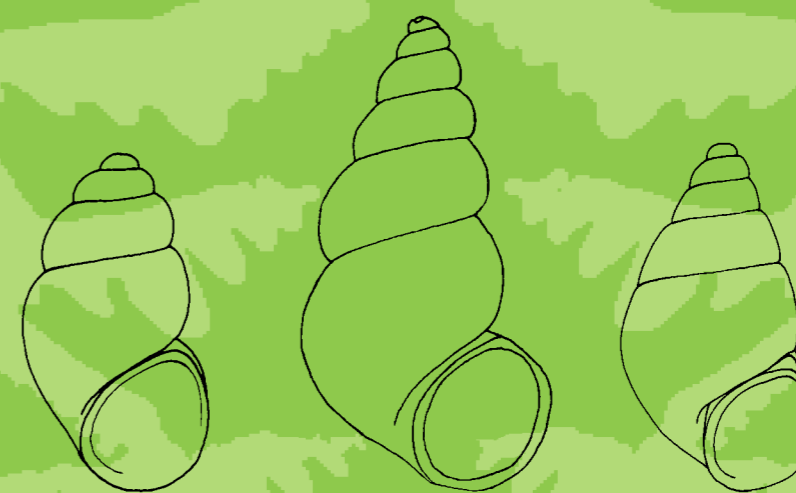


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A Morphostatic Radiation
of Freshwater Gastropods in Southeastern Australia

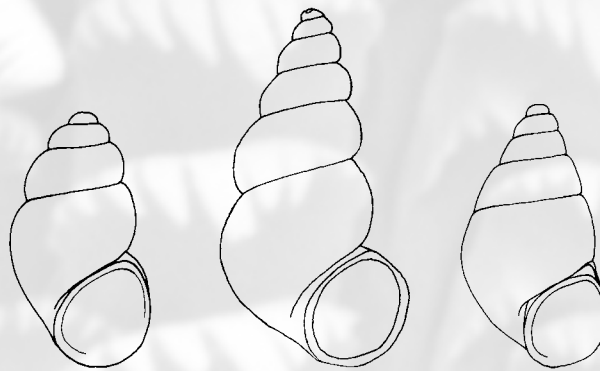
by

Stephanie A. Clark,
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Revision of the Snail Genus *Austropyrgus* (Gastropoda: Hydrobiidae): A Morphostatic Radiation of Freshwater Gastropods in Southeastern Australia

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ABSTRACT. The species that comprise a morphostatic radiation in southeastern Australia of the hydrobiid genus *Austropyrgus* Cotton are described using shell, opercular, anatomical and radular characters, and the genus is redefined. The previously described taxa have been included under several generic names, including *Fluvidona* (now a separate genus), *Rivisessor*, *Pupiphryx* and *Angrobia*, which are now treated as synonyms of *Austropyrgus*. Seventy-four species are described from southeastern Australia, fifty-seven of them new. These are grouped into six informal morphological groups to aid identification. Two recently described outlying species, *A. bunyaensis* from Mt Bunya, southern Queensland and *A. centralia* from Dalhousie Springs, northern South Australia, are not included in this revision. Members of the genus are typically found in streams, although a few species live in springs, rivers or lakes. A large number of the species have restricted distributions and several are known only from single locations. In southern New South Wales, Victoria and South Australia *Austropyrgus* is the dominant native freshwater hydrobiid genus whereas in Tasmania it is often sympatric with the native freshwater hydrobiid genera *Beddomeia* and/or *Phrantela*.

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Introduction

In both numbers of individuals and species, members of the Hydrobiidae form the dominant component of the Australian freshwater molluscan fauna with over 140 described taxa (Smith, 1992; Ponder, 1992; Ponder *et al.*, 1993, 1994, 1995, 1996, 1999; Miller *et al.*, 1999). The genus *Austropyrgus*, as recognized in this paper, is distributed throughout southeastern Australia including Tasmania, with two outliers: *A. centralia* (Ponder *et al.*, 1996) from Dalhousie Springs, northern South Australia and *A. bunyaensis* Miller *et al.*, 1999 from Mt Bunya, southern Queensland, which are not treated further. The group is found in virtually all freshwater habitats from high mountain streams to isolated springs in the arid zone. Nearly all mainland taxa are found in coastal drainages, with only four (*A. abercrombiensis*, *A. cooma*, *A. angasi* and *A. daylesfordensis*) known to occur in the eastern part of the Murray River drainage and two from the Flinders Ranges (*A. halletensis* and *A. flindersensis*).

A large number of the taxa recognized below, many of them new, have restricted ranges with several only known from a single locality. This implies that most of the species within the genus have poor dispersal abilities (Ponder & Colgan, 2002) and/or little opportunity for passive dispersal by agents such as birds or fish. In addition their egg capsules do not resist desiccation for long periods of time.

With 76 recognized species *Austropyrgus* is the largest genus of Australian freshwater molluscs and is the most widespread of the Australian freshwater hydrobiid genera. The next largest freshwater molluscan genus is the Tasmanian hydrobiid genus *Beddomeia*, with 47 species (Ponder *et al.*, 1993) and several additional undescribed taxa (SAC and WFP pers. obs.). However, species of *Beddomeia* exhibit a much wider range of variation in shell morphology than that found in *Austropyrgus*, the latter being a truly “morphostatic” radiation (i.e. a radiation with little niche differentiation and consequently low morphological and anatomical differentiation—Davis, 1994). In such a situation the recognition of discrete species will always be contentious when based on morphology alone. However, we can be much more confident of the recognition of species when these are in sympatry—as is often the case in Tasmania and western Victoria. Allopatric taxa are much more difficult

to determine. The morphological separation of the allopatric taxa described in this paper is generally difficult because the morphological (shell, opercular, radular and anatomical) differences separating many of the species are small and frequently subtle. However, electrophoretic work, both published (Ponder *et al.*, 1994) and unpublished (Clark, 1997; SAC, pers. obs.), lends considerable support to recognizing at least the level of speciation that we describe here.

Ponder *et al.* (1994) investigated a small radiation of *Austropyrgus* (treated as *Fluvidona* in that study) distributed across Wilsons Promontory, eastern Victoria. This study examined 75 populations that fell into two morphologically distinct species (“morphospecies”) within the Promontory, and also described two outlying taxa from nearby. Within the Promontory three genetically distinct groups were found within a single morphospecies, *A. turbatus* (these genetic taxa were referred to as MPI 3, 4 and 5). Because they were indistinguishable morphologically from *A. turbatus* (MPI 5 form) they were not formally named. The study also showed that there was considerable genetic structure within the Wilsons Promontory populations of the genetically distinguishable *Austropyrgus* species even though the area is well watered with numerous streams. Most of this variation is related to the geographic proximity of populations within each drainage (see also Ponder & Colgan, 2002) reflecting the very low dispersal ability of these animals.

A range of aquatic invertebrates can be used as indicator species of water quality, biodiversity and habitat disturbance, with molluscs and particularly hydrobiids being well suited for these purposes. They are typically abundant, do not require specialized collecting equipment, can be collected throughout the year and can be identified to species. Hydrobiids also make excellent subjects for study of processes such as speciation, hybridization and evolutionary processes at different spatial scales (e.g., Ponder *et al.*, 1994).

No detailed studies on the biology of these animals have been undertaken to date. However, casual observation suggests that at least some species of *Austropyrgus* may breed throughout much of the year (due to the presence of egg capsules and juveniles of various sizes at different times of the year) and because their reproductive systems usually appear to be mature irrespective of the season.

In the present study we describe 74 species using external and internal morphology to distinguish the taxa found in southeastern Australia. However, clearly additional studies will be required, particularly using molecular techniques, to define species and to resolve taxonomic relationships within this interesting group.

We do not provide a key to the taxa because identification of these animals using a standard printed key is extremely difficult and would require the incorporation of characters that would necessitate very detailed examination of anatomy and the radula. However, all the taxa are included in an interactive key to all Australian freshwater molluscs that will be available electronically by 2004.

Materials and methods

Collection. Material for this project was largely collected either by hand picking specimens from the surface of the substratum, such as stones or wood, or by using a hand sieve to sweep the surface layers of the bottom and the vegetation. The samples were then fixed in 5–10% formalin buffered with sodium bicarbonate and after sorting stored in 5% buffered seawater formalin. Where sufficient material was available a subsample from each lot was dried.

Distribution. Specimen details and localities were databased and maps were produced using MapInfo Professional Version 4.0.

Morphometrics and meristics. The methods employed are described in Ponder *et al.* (1989) using a digitising pad linked to a computer. The shells were laid aperture side up with the plane of the aperture horizontal. Only “adult” (i.e. specimens that have reached terminal growth) were measured.

Statistics. For most taxa, 20 specimens were measured and sexed in addition to the primary types. Discriminant function analyses were carried out with SYSTAT 8 (Wilkinson, 1998) using shell, aperture and whorl measurements, convexity ratio (see Ponder *et al.*, 1989) and whorl counts, as well as opercular length, smear length and the number of opercular pegs.

Anatomy. Subsamples of the specimens used for morphometrics were dissected in a small black watch glass using an Orient SM1 stereomicroscope with a camera lucida. Fine watchmakers forceps were used, with the animal immersed in a mixture of Bouin’s fixative and tap water. Up to six individuals (three of each sex) were dissected. Scoring was done according to characters similar to those employed by Ponder *et al.* (1993) and are grouped into the following categories; pigmentation of the animal, pallial cavity, visceral coil, and male and female reproductive systems and are listed in the Appendix. Stomach characters were scored but, because they were rather uniform, were not used in the descriptions. The stomachs of a few species are illustrated in Fig. 6 for comparison with other genus-group taxa.

Scanning electron microscopy. Shells, opercula and radulae were mounted on aluminium stubs, coated in gold and then examined with a Cambridge Instruments S120 scanning electron microscope (SEM). Shells and protoconchs were cleaned before mounting with a 25%

hypochlorite bleach solution and brushing with a fine paintbrush to remove any adherent material. Radulae were prepared by placing the head in a strong solution of sodium hydroxide typically overnight to allow the tissue to dissolve. The radulae were then removed and rinsed in distilled water, before being mounted on small pieces of coverslip glass and finally onto the stub. Operculae were carefully removed from the foot and gently cleaned with a fine paintbrush in water before being mounted.

Descriptions. The descriptions were generated using DELTA (Dallwitz *et al.*, 1993). The list of characters and their states, which were used to produce the descriptions, are given in the Appendix.

Taxonomic method. In this study we have used the following approach to determine species limits. Initially the material was sorted into morphospecies using shell morphology (size and shape). These morphospecies were then grouped according to geography and any geographic anomalies were re-examined and, if necessary, reassigned. At this point a single population was then chosen from each morphospecies and examined in detail (shell measurements, anatomy etc.). This population was then assumed to be representative of the populations grouped under each morphospecies. The data from each of these “representative” lots were then compared and differences noted. In a few cases no notable differences were found and these morphospecies were united. Where justifiable differences (see below) were found these populations were assigned to the available names and those remaining were treated as new species-group taxa and allocated names.

Although this approach does not differ significantly from normal taxonomic practice, we acknowledge that the non-type material listed for each taxon is, in some cases, likely to contain additional genetically distinct taxa assuming that the situation observed at Wilsons Promontory (Ponder *et al.*, 1994) is in any way typical.

Layout of paper. This paper describes a large number of species and to facilitate its use we have subdivided them into six informal groups containing morphologically similar taxa. In addition, the order of the species within these groups is arranged according to the State in which they are found, in the following order: New South Wales, eastern Victoria, western Victoria, South Australia and Tasmania. They are generally arranged in geographic order within each State. The illustrations largely follow this order as well, with geographically neighbouring taxa typically illustrated together. The diagnoses are combinations of characters that differentiate the taxa, although the individual characters making up a diagnosis will not usually be unique to that taxon. Each character combination, however, is unique for that taxon.

The bulk of the material listed below is held in the collections of the Australian Museum and these lots are identified by the prefix “C”. Material from all other museums is prefixed by its abbreviation as listed below. All shell measurements are in millimetres, except for TW, which is a count.

Summary data. Tables of summary statistics and the results of comparisons between taxa are available from the authors.

Abbreviations

The following institutional abbreviations are used throughout the text:

NHML	Natural History Museum, London, England
MV	Museum of Victoria, Melbourne, Victoria
NHMW	Naturhistorisches Museum, Wien, Austria
QVM	Queen Victoria Museum, Launceston, Tasmania
SAMA	South Australian Museum, Adelaide, South Australia
TMH	Tasmanian Museum, Hobart, Tasmania
WAM	Western Australian Museum, Perth, Western Australia

Shell and opercular measurements and counts. AH, aperture height; SH, shell height; SW, shell width; TW, number of teleoconch whorls.

Anatomical labels. ag, albumen gland; bc, bursa copulatrix; cg, capsule gland; co, coiled oviduct; ir, indentation from rectum; po, genital opening; ppw, posterior pallial wall; rc, seminal receptacle; vc, ventral channel.

Taxonomy

Family Hydrobiidae Troschel, 1857

Subfamily Tateinae Thiele, 1925

Genus *Austropyrgus* Cotton, 1942

Austropyrgus Cotton, 1942: 125. Type species. *Paludina nigra* Quoy & Gaimard, 1834, by original designation.

Rivissor Iredale, 1943: 200. Type species. *Hydrobia gunnii* Frauenfeld, 1863, by original designation.

Pupiphryx Iredale, 1943: 201. Type species. *Bithynia dyeriana* Petterd, 1879, by original designation.

Angrobia Iredale, 1943: 204. Type species. *Hydrobia angasi* Smith, 1882, by original designation.

Rivissor–Cotton, 1943: 144 (misspelling of *Rivissor* Iredale, 1943).

Diagnosis. Shell more than 1 mm and less than 5 mm, conical, elongate conical or pupiform, with evenly convex (one species with angulation) to flattened whorls, smooth. Operculum flat, paucispiral, yellowish, with white smear and 1–6 (typically 3–4) pegs on inner surface. Radula with 3–5 (typically 4) basal cusps on central teeth. Penis simple and tapering and prostate gland closed and more-or-less kidney-shaped with pallial vas deferens emerging from middle of ventral side. Coiled oviduct ranging from simple inverted U-shape to having several bends, loops or twists; pallial oviduct with terminal to subterminal opening.

Description. *Shell.* Shell small to medium-sized for family (up to 4.8 mm), spire very elongate to squat, outline straight to convex, aperture not disjunct to separated from the last whorl. Teleoconch of 2.0–6.2 flattened to convex whorls, last whorl and base evenly convex to strongly angled. Inner lip of aperture firmly adhering to parietal wall to distinctly separated from parietal wall, outer lip weakly thickened to heavily thickened but lacking varix, with or without weak reflection, straight (weakly sinuous in one species). Translucent to opaque; white to yellow-brown; thin periostracum may impart darker colour. Protoconch about 1.5 whorls; sculptured with irregular, close set pits (see Figs. 13, 26). *Operculum.* Operculum ovate, thin, flat, yellowish, paucispiral, with eccentric nucleus and with 1–7 (typically 3–4) large distinct pegs. *Radula.* Typical of subfamily. Central teeth: with 3–8 lateral cusps, median cusp narrow to broad, sharply to bluntly pointed, from about 3 to less than twice as long as adjacent cusps; 2–4 (typically 4) pairs of basal cusps. Basal tongue U-shaped, sometimes protruding past the lower ends of the

lateral edges. Lateral teeth: with 3–8 cusps on either side of median cusp; median cusp sharply to bluntly pointed, up to twice as long as adjacent cusps. Basal projection of lateral teeth U-shaped to pointed, accessory denticles absent. Inner marginal teeth with 11–35 cusps, ratio of cutting edge to shaft about 1/3 to about 1/2, outer marginal teeth with 18–46 cusps, ratio of cutting edge to shaft about 1/4 to about 1/3. *Head-foot.* Typical of subfamily in main features. Cephalic tentacles long and slender, slightly tapering, with longitudinal ciliated bands only; unpigmented or with poorly developed dorsal median stripe; snout unpigmented or pigmented, usually only along midline if present; eyes pigmented; remainder of external parts of animal with pigmentation absent to well developed; pigment grey or black. Columellar muscle small to large. *Non-genital anatomy.* Typical of subfamily. Ctenidium with 9–28 filaments. Osphradium elongately oval to short oval, near posterior end to about middle of ctenidium. Hypobranchial gland thick to very inconspicuous (apparently absent in dissection) and may or not cover rectum when visible. Rectum simple or prominently arched; faecal pellets orientated longitudinally or obliquely / transversely; anus near to distant from mantle edge. Renal organ (as mainly seen from renal gland) behind pallial cavity or up to about 1/2 in pallial roof; renal gland circular to oval with long axis longitudinal; thin to very thick. Pericardium behind pallial cavity or extending more than 1/2 its length into pallial roof; ctenidium overlapping anterior end by one filament to being separated by a short efferent branchial blood vessel. Stomach (Fig. 6) with small to large caecum. *Male reproductive system.* Very similar to other members of subfamily. Testis of 0.6–1.8 whorls. Seminal vesicle tightly to inconspicuously coiled. Prostate gland about 1/3 to almost entirely within pallial roof, kidney-shaped (rarely elongate-pyriform), broadly-oval to highly compressed in cross section. Pallial vas deferens emerges from middle of ventral surface, flush with surface of body to raised; straight to coiled. Penis attached at right side of head to near centrally; distal end long to short, tapering. *Female reproductive system.* Similar to other members of subfamily. Ovary simple to lobulate, about 0.5–2.0 whorls. Coiled oviduct not surrounded by obvious connective tissue, with initial inverted U orientated dorsoventrally to longitudinally backwards; initial loop long to short; proximal part an inverted U-shape or this modified with two or more bends, loops or twists; distal to seminal receptacle oviduct straight or with one or two bends. Coiled oviduct and bursal duct join at or behind posterior pallial wall. Bursa copulatrix elongately oval to ovoid, with bursal duct arising from middle of anterior edge of bursa. Bursal duct short, parallel sided or tapering, usually straight (not specified in descriptions), rarely bent or twisted. Oviduct joining bursal duct ventrally or from right or left side. Seminal receptacle ovoid to narrow sac shaped; distal end pointed (rarely) to rounded (typical); duct short to long; lies alongside anterior to posterior edge of bursa copulatrix. Albumen gland lies behind to more than 1/2 in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, broadly-oval to elongately-oval in cross section, with three distinct to indistinct glandular zones. Rectum sometimes indents albumen and/or capsule gland. Ventral channel indistinct to distinct, with indistinct muscular vestibule to large, obvious muscular vestibule. Genital opening small to long and lies terminally or anterior to capsule gland. *Egg capsules.* Hemispherical, smooth, horny, with single egg. Usually attached to sand grains, wood, leaves, etc. Limited field observations suggest that at least some species (e.g., *A. grampianensis* and *A. cooma*) may lay eggs throughout the year.

Distribution and habitat. The genus is distributed throughout southeastern Australia, with outliers in the Bunya Mountains, southern Queensland (Miller *et al.*, 1999) and Dalhousie Springs (Ponder *et al.*, 1996), northern South Australia (Fig. 1). Members of the genus can be found on all substrates but are most often found amongst leaves, weeds and roots and on and under stones and wood. A few taxa crawl on sediment in the open, such as those from various small springs in Victoria and Tasmania.

Remarks. *Austropyrgus* is closely related to *Posticobia* Iredale, 1943, which can be distinguished by its generally triangularly shaped shell and, often, by the presence of a keel on the periphery of the last whorl. In addition, the two genera are genetically distinguishable (Clark, 1997). *Posticobia* is only known from the mainland and Norfolk Island and has not been recorded from Tasmania. *Fluvidona* Iredale, 1937 is also very similar to *Austropyrgus* and was

used as the generic name for this group by Smith (1992) and Ponder *et al.* (1994), the latter authors providing a generic diagnosis largely based on the *Austropyrgus* taxa they examined from Wilsons Promontory. Miller *et al.* (1999) recognized *Austropyrgus* and *Fluvidona* as separate genera and listed diagnostic characters for both.

The genus-group names included in the synonymy are all based on species treated in this revision. They show no apomorphic differences that set them apart from other members of the genus.

The species included in this genus are morphologically very uniform. A discriminant analysis of all the taxa included in this revision, using shell characters and some opercular characters (see Methods) successfully classified only 57% of individuals.

Given the large number of taxa, we have divided the species into six informal groups to aid species determination.

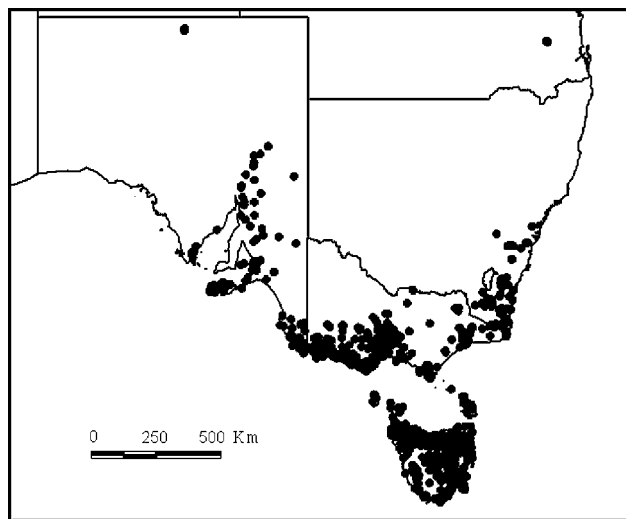


Fig. 1. Distribution of *Austropyrgus* in Australia.

Group 1. *Austropyrgus cooma* group

Small to medium sized shells, generally pupiform to conical, last whorl and base evenly convex. Coiled oviduct typically an inverted U-shape.

The following characters are common to the Group: Spire of average length, except for *A. mersus* and *A. conicus* where it can also be squat. Aperture slightly disjunct, except for *A. avius* where it is sometimes not disjunct. Inner marginal teeth with ratio of cutting edge to shaft about $\frac{1}{3}$ and about $\frac{1}{4}$ for outer marginal teeth. Osphradium elongately oval, between posterior end and middle of ctenidium. Faecal pellets orientated longitudinally in rectum. Renal gland orientated with long axis longitudinally. Pallial vas deferens flush with the surface. Penis with distal end long and tapering. Seminal receptacle with a rounded end.

The shell features of this group are rather uniform but a discriminant analysis (using shell and a subset of opercular data) of the taxa in this group successfully classified 76% of the individuals.

Mainland taxa

Austropyrgus cooma (Iredale, 1943)

Figs. 2A, 3A, 4A, 5A, 6A, 7A,B, 8A

Pupiphryx cooma Iredale, 1943: 202.

Pupiphryx cooma.—Cotton, 1943: 144; Iredale, 1944: 114, fig. 4.

Fluvidona cooma.—Smith, 1992: 46.

Austropyrgus cooma.—Ponder *et al.*, 2000.

Type material. Lectotype C.100581 (here designated Fig. 4A), paralectotypes C.51747 (20+).

Type locality. Cooma, New South Wales.

Material dissected and figured. C.173966, C.343681 (figured specimens), trib. of Jinny Brothers Ck at Myalla Rd, 23.3 km S of Cooma, New South Wales, 36°26.65'S 149°07.03'E, in sedges along edges, 4 November 1990.

Other material examined. New South Wales: Cooma, C.51701, MV F.54450, F.17876, F.54442, SAMA D.19072; trib of Cooma Ck, at on Myalla Rd, 10 km S of Cooma, C.173971; trib of Cooma Ck, at Myalla Rd, 13 km S of Cooma, C.173967; trib of Cooma Ck, at Myalla Rd, 13.7 km S of Cooma, C.173969; Spring Ck, near Rock Flat, 1 km SSW along track off Snowy Mountains Hwy, S of Cooma, C.173973; trib of Jinny Brothers Ck, at Myalla Rd, 23.6 km S of Cooma, C.173976; trib of Jinny Brothers Ck, at Myalla Rd, 24 km S of Cooma, C.173974; Jinny Brothers Ck, at Myalla Rd, 25 km S of Cooma, C.173972; trib of Bobundara Ck, at Myalla Rd, 28.3 km S of Cooma, C.173970; Bobundara Ck at Myalla Rd, 29 km S of Cooma, C.173968.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small to medium in size, with convex whorls, central radular teeth with 5 lateral cusps, pallial vas deferens strongly undulating at the prostate gland.

Description. *Shell* (Figs. 2A, 3A, 4A). Shell 1.63–2.71 mm in length, 0.95–1.62 mm in width; outline convex; aperture 0.69–1.08 mm in height, 0.69–0.95 mm in width. Body whorl 1.34–1.70 mm in height. Teleoconch of 3.00–3.80 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum.* Operculum 0.61–0.87 mm in length, 0.41–0.58 mm in width, with 1–4 pegs. *Radula* (Fig. 5A). Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about 2 to less than twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 25–27 cusps, outer marginal teeth with 30–33 cusps. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe or with well to poorly developed pigmented dorsal central stripe; remainder of external parts of animal with well-developed pigmentation to unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 13–16 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch; anus intermediate in position. Renal gland about $\frac{1}{4}$ – $\frac{1}{3}$ in pallial roof; thin to intermediate in thickness. Pericardium about $\frac{1}{3}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system* (Fig. 7A,B). Testis of 1.00–1.25 whorls. Seminal vesicle tightly coiled over stomach; inconspicuously to conspicuously coiled on digestive gland and conspicuously coiled on testis behind stomach. Prostate gland about $\frac{1}{2}$ – $\frac{2}{3}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens strongly undulating at prostate, straight to slightly undulating between prostate and penis; straight or strongly undulating at base of penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 8A). Ovary simple, about 1.1–1.2 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; straight to with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind

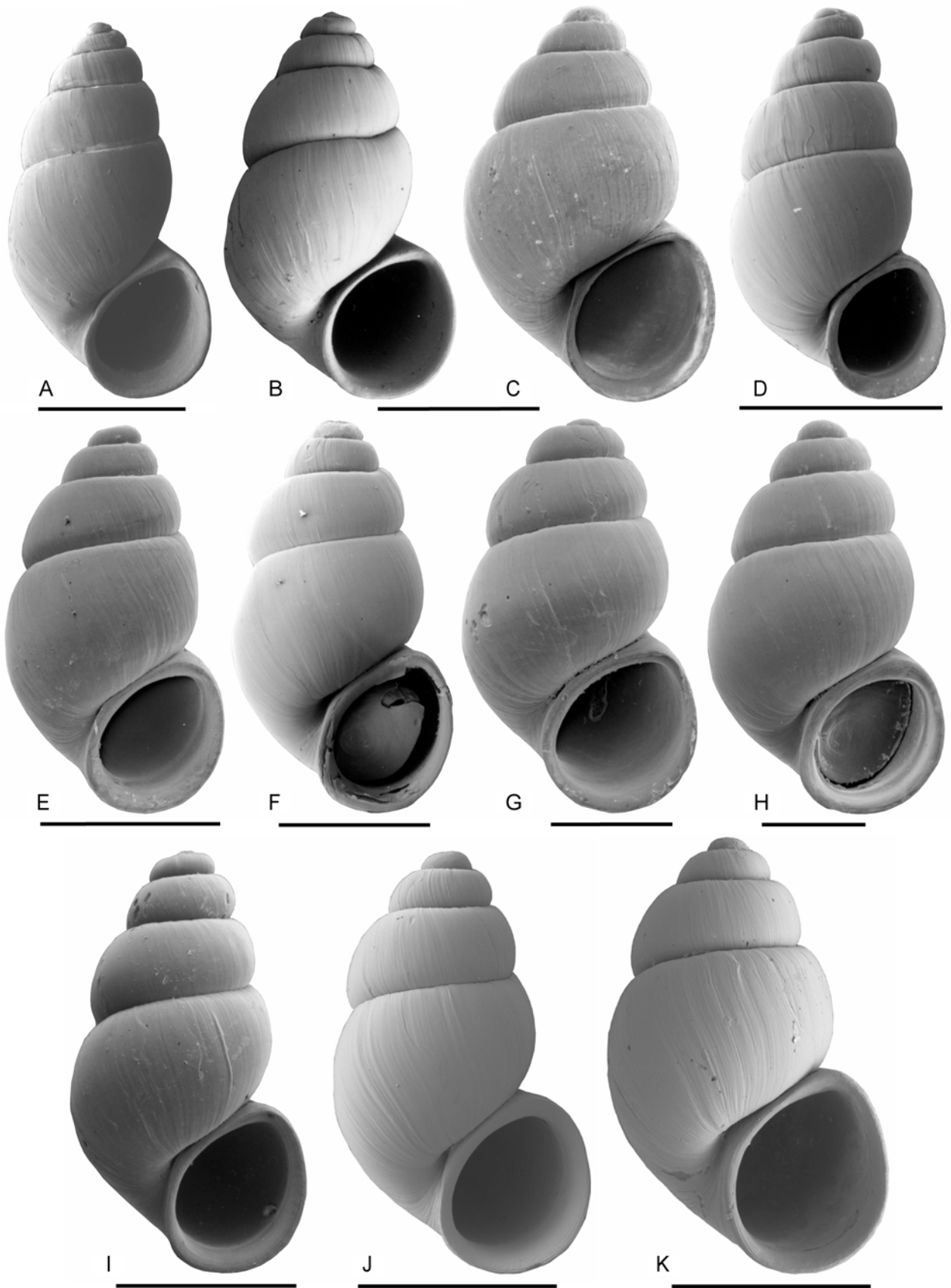


Fig. 2. Shells of species of *Austropyrgus*: A, *A. cooma*, C.343681; B, *A. monaroensis*, holotype, C.173983; C, *A. viridarium*, holotype, C.173986; D, *A. lippus*, holotype, C.334058; E, *A. avius*, holotype, C.343112; F, *A. bullerensis*, holotype, C.343003; G, *A. grampianensis*, C.334601; H, *A. daylesfordensis*, holotype, C.343021; I, *A. otwayensis*, holotype, C.343023; J, *A. macedonensis*, holotype, C.343033; K, *A. colensis*, holotype, C.343036. Scales A–F, I–K 1 mm; G, H 0.5 mm.

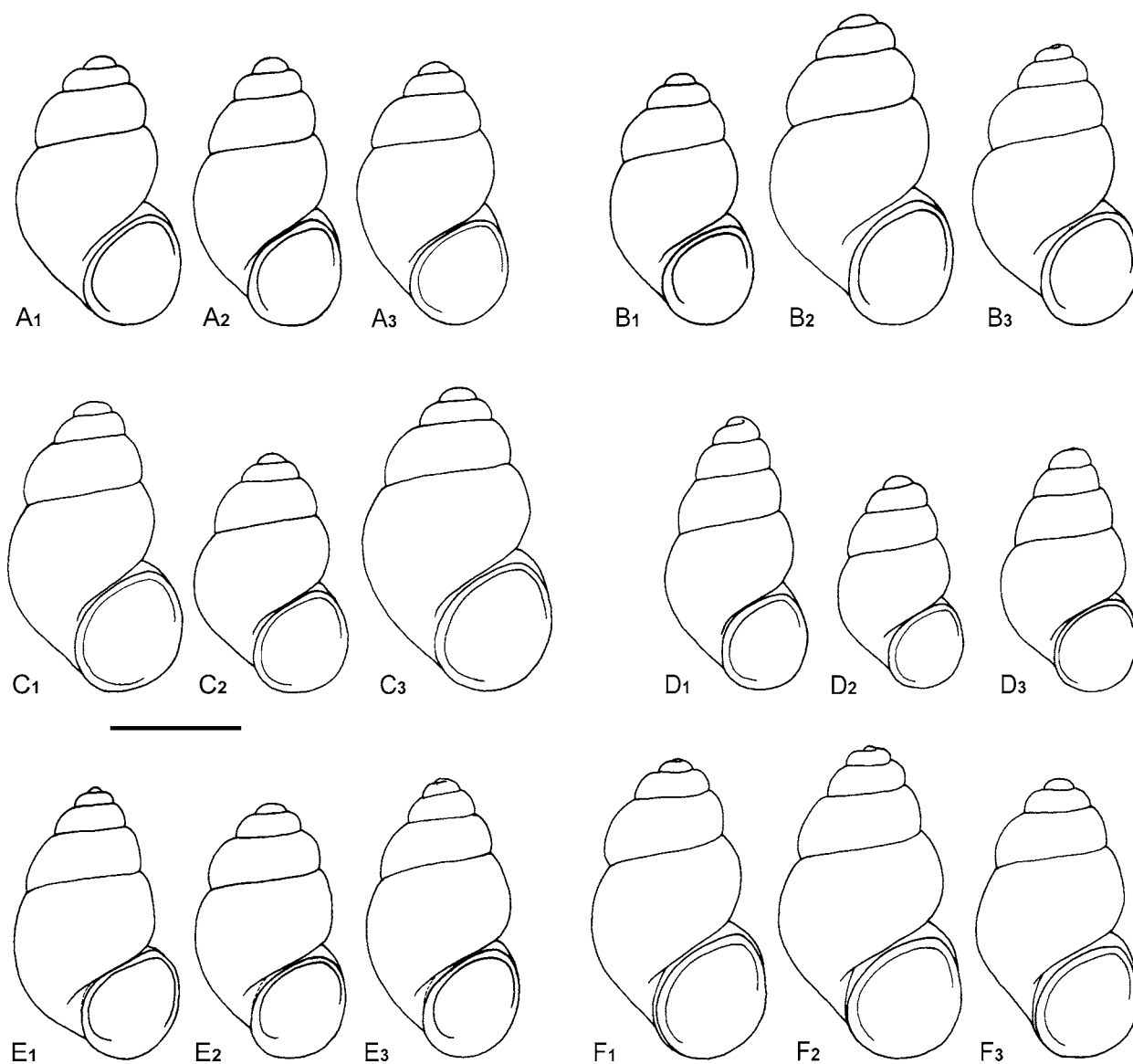


Fig. 3. Shells of species of *Austropyrgus*: A, *A. cooma*, C.343681; B, *A. monaroensis*, paratypes, C.307583; C, *A. viridarium*, paratypes, C.342945; D, *A. lippus*, paratypes, C.174322; E, *A. avius*, paratypes, C.307590; F, *A. bullerensis*, paratypes, C.173721. Scale 1 mm.

pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum indenting albumen gland and overlapping capsule gland. $\frac{1}{4}$ or less of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with indistinct muscular vestibule. Genital opening small, terminal.

shell dimensions:	SH	SW	AH	TW
lectotype	2.71	1.62	1.17	3.90
paralectotypes (10)	1.63–2.49	0.95–1.47	0.69–1.08	3.00–3.80
figured SEM specimen	1.94	1.14	0.79	3.50

Iredale's original measurements were given as 2.5 mm by 1.5 mm.

Distribution and habitat. This species is known from a number of small streams and springs found south of Cooma, southern New South Wales (Fig. 9). It is typically found on weeds, leaves, roots and stones and can be locally abundant.

Remarks. This species is most similar to *A. monaroensis* in shell shape, which occurs just to the west, around Jindabyne, southern New South Wales. It differs from that species in the shell being narrower and in some anatomical characters (see descriptions). *Austropyrgus cooma* is also similar in shell shape to several other members of Group 1 occurring in the same general geographic area including *A. avius*, *A. viridarium* and *A. bullerensis*. *Austropyrgus avius* differs in having a flatter outline to the last whorl of the

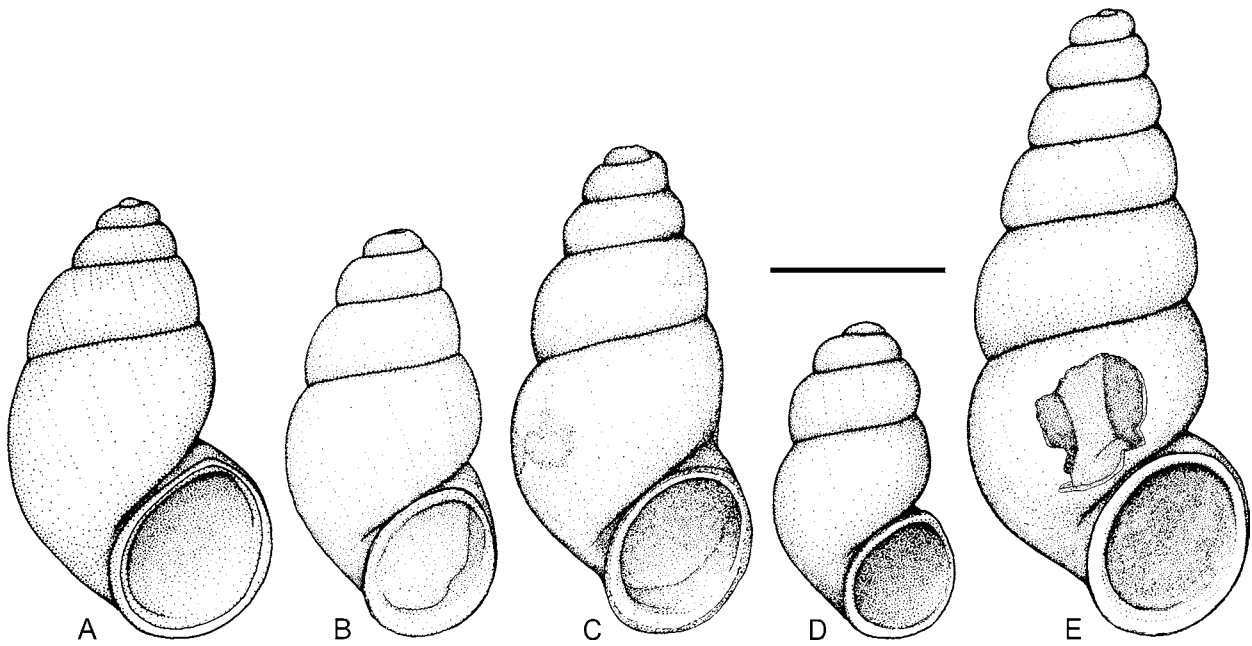


Fig. 4. A, *Pupiphyryx cooma* Iredale, 1943, lectotype, C.100581; B, *Potamopyrgus smithii* Petterd, 1889, lectotype, C.27793; C, *Amnicola petterdiana* Brazier, 1875, lectotype, C.100615; D, *Bithynia dyeriana* Petterd, 1879, lectotype, C.27800; E, *Potamopyrgus elongatus* May, 1921, holotype, TMH E.472/781. Scale 1 mm.

shell, *A. bullerensis* differs in having a slightly larger shell and somewhat less convex whorls and *A. viridarium* differs in having a broader shell.

Austropyrgus cooma is geographically isolated from the other species. Preliminary allozyme data on several New South Wales and some Victorian members of Group 1 support the species decisions made here (Clark, 1997; SAC, personal observations). Other similar taxa include *A. grampianensis*, *A. daylesfordensis*, *A. otwayensis*, *A. macedonensis*, *A. colensis*, *A. nanus*, *A. smithii*, *A. pisinnus*, *A. parvus*, and *A. conicus*. Species such as *A. turbatus* have superficially similar populations that can be separated by their straight spire outline. Three species in Group 3 (*A. niger*, *A. dyerianus* and *A. tebus*) have slightly convex spire outlines but have the initial part of the coiled oviduct composed of multiple coils rather than an inverted U-shape.

Austropyrgus cooma was rather poorly discriminated in the discriminant analysis. Other species for which individuals of *A. cooma* were misclassified included *A. colensis* (4), *A. avius* (3), *A. macedonensis* (2), *A. glenelgensis* (2) and *A. tebus* (2) (overall 38% correct, with only 15 of the 39 individuals of *A. cooma* measured being correctly classified). Even when the analysis was restricted to just the members of Group 1, only 51% of individuals were correctly classified with others being attributed to *A. avius* (4), *A. colensis* (4), *A. macedonensis* (3), *A. smithii* (3), *A. monaroensis* (2), *A. grampianensis* (1), *A. daylesfordensis* (1) and *A. otwayensis* (1).

***Austropyrgus monaroensis* n.sp.**

Figs. 2B, 3B, 8B

Austropyrgus Monaro species—Ponder *et al.*, 2000.

Type material. Holotype C.173983, figured paratypes C.307583 (3), paratypes C.173984 (20+).

Type locality. Wambrook Ck at Snowy Mountains Hwy, 17 km SW. of Cooma, New South Wales, 36°12.65'S 148°57.00'E, under willows amongst roots and leaves, 1 November 1980.

Other material examined. **New South Wales:** Gorrudee Rivulet at Snowy Mountains Hwy, 5.5 km NW of Adaminaby, C.173985; Wambrook Ck at Snowy Mountains Hwy, 17 km SW of Cooma, C.302413; Rushes Ck on Cooma Rd, N of Jindabyne, C.174045, C.173977, C.173975.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small to medium in size, broad, with convex whorls; basal projection of lateral teeth U-shaped and pallial vas deferens straight or slightly undulating at prostate gland.

Description. *Shell* (Figs. 2B, 3B). Shell 2.11–2.60 mm in height, 1.18–1.56 mm in width; outline convex; aperture 0.77–1.02 mm in height, 0.80–0.94 mm in width. Body whorl 1.43–1.82 mm in height. Teleoconch of 3.00–3.80 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque (intermediate). *Holotype dimensions:* SH, 2.46 mm; SW, 1.49 mm; AH, 1.02 mm; TW, 3.60 whorls. *Operculum.* Operculum 0.73–0.96 mm in length, 0.49–0.66 mm in width, with 1–3 pegs. *Radula.* Central teeth: with 4–6 lateral cusps, median cusp narrow to medium width, sharply to bluntly pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth U-shaped. Inner marginal teeth with 17–25 cusps, outer marginal teeth with 24–32 cusps. *Head-foot.* Cephalic tentacles with pigment well developed with unpigmented median dorsal stripe or pigmented dorsal central stripe only; snout, head and neck with pigment well developed; foot and opercular lobe pigmentation well to poorly developed; pallial roof and visceral coil with pigment well developed to mottled. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 13–16 filaments. Hypobranchial gland thick; covers rectum. Rectum without arch to with slight arch; anus intermediate in position. Renal gland about ¼–½ in pallial roof; intermediate in thickness. Pericardium up to ½ in pallial roof; ctenidium abutting anterior end to separated by short efferent branchial blood vessel. *Male reproductive system.* Testis of 1 whorl.

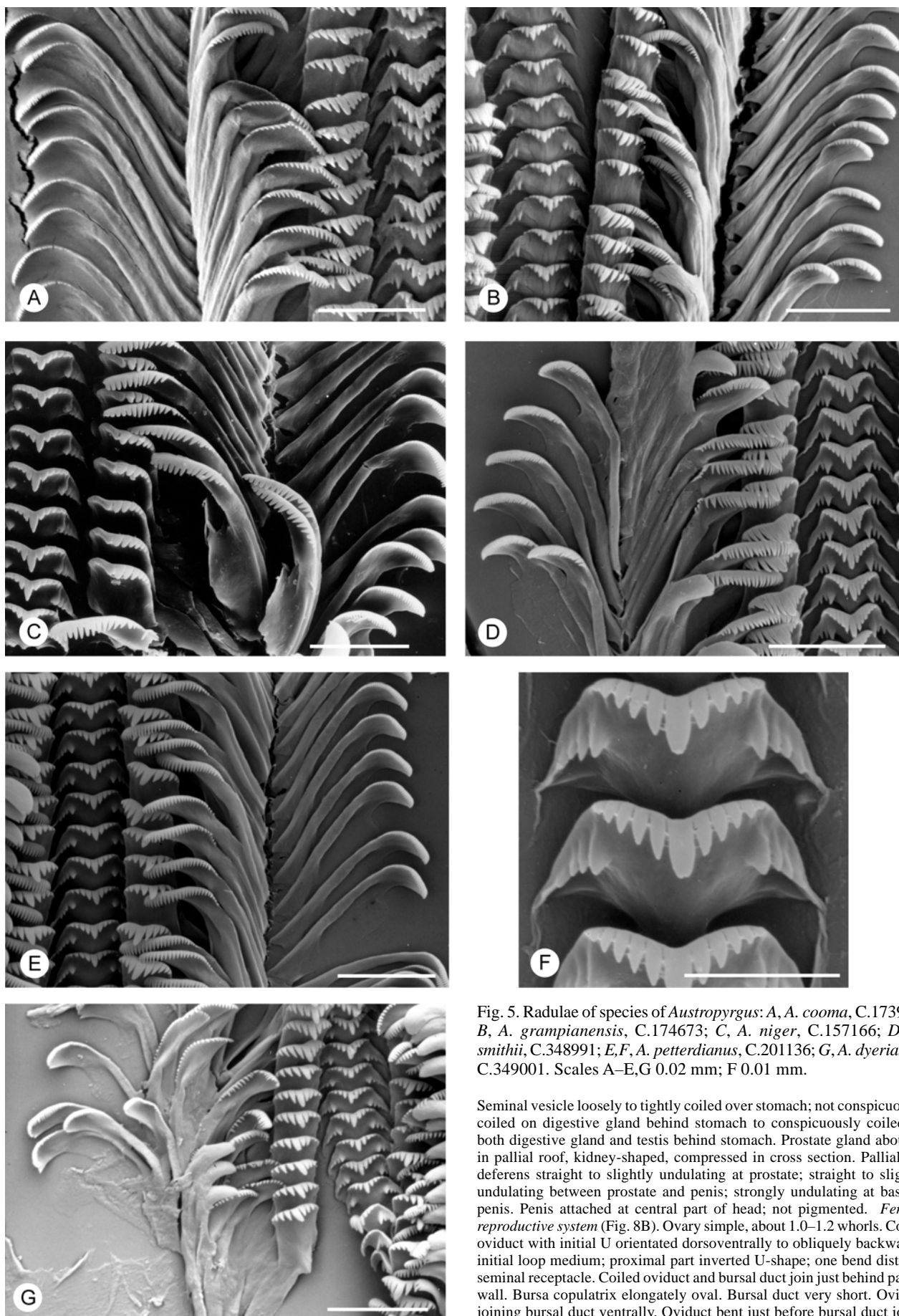


Fig. 5. Radulae of species of *Austropyrgus*: A, *A. cooma*, C.173966; B, *A. grampianensis*, C.174673; C, *A. niger*, C.157166; D, *A. smithii*, C.348991; E, F, *A. petterdianus*, C.201136; G, *A. dyerianus*, C.349001. Scales A–E, G 0.02 mm; F 0.01 mm.

Seminal vesicle loosely to tightly coiled over stomach; not conspicuously coiled on digestive gland behind stomach to conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{2}{3}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight to slightly undulating at prostate; straight to slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 8B). Ovary simple, about 1.0–1.2 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins.

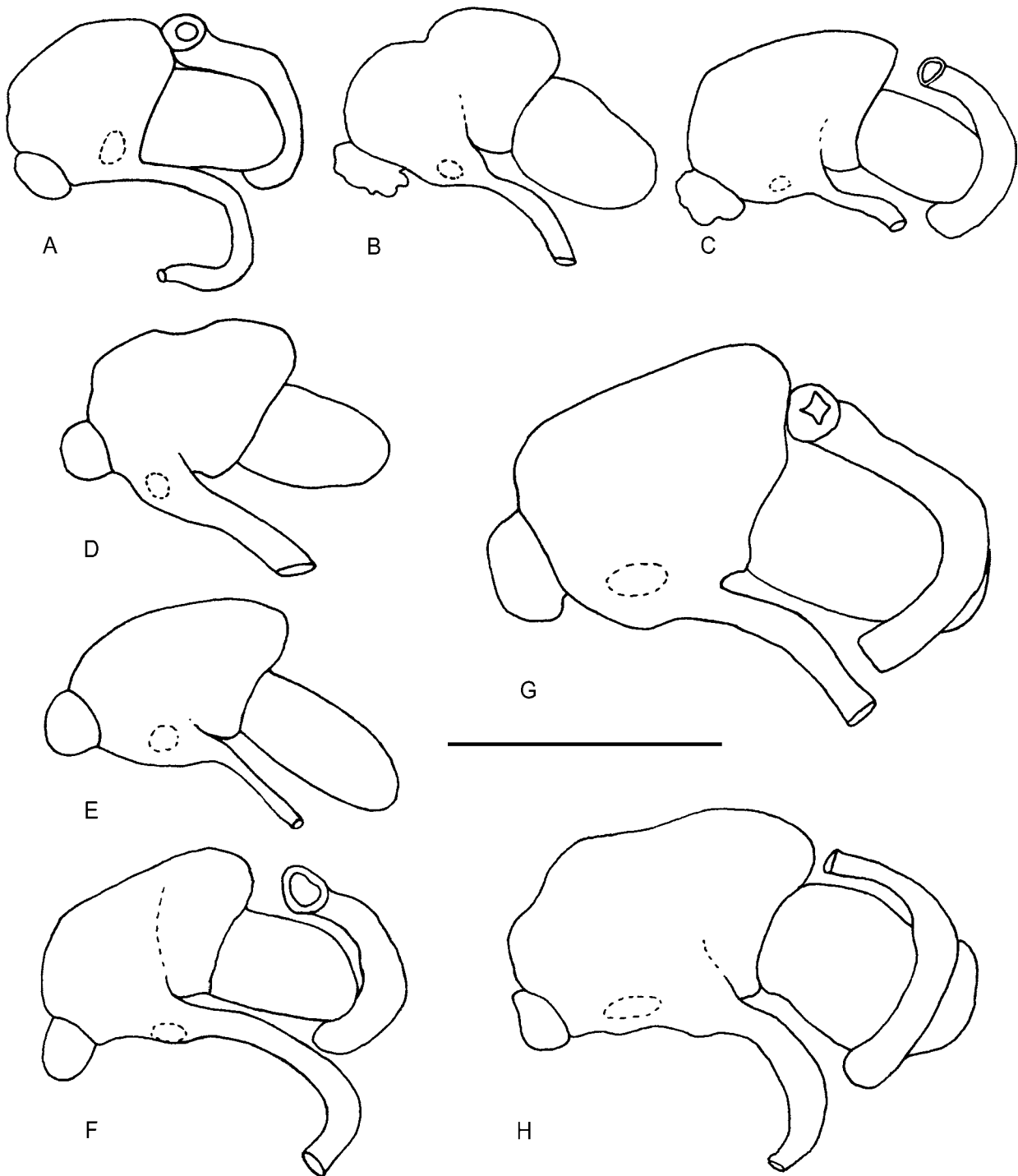


Fig. 6. Stomachs of species of *Austropyrgus*: A, *A. cooma*; B, *A. petterdianus*; C, *A. niger*; D, *A. dyerianus*; E, *A. sparsus*; F, *A. elongatus*; G, *A. angasi*; H, *A. gunnii*. Scale 0.5 mm.

Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, duct short. Rectum indenting albumen gland and overlapping capsule gland. Albumen gland about half behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule to moderate sized muscular vestibule. Genital opening small, terminal.

Distribution and habitat. This species has been found in a number of small streams around Jindabyne and to the SW of Cooma, southern New South Wales (Fig. 9). It is typically found on weeds, leaves and roots and can be locally abundant.

Remarks. This species is most similar in shell shape to *A. cooma* (see remarks under *A. cooma*), but is slightly larger. Other similar taxa found nearby geographically include *A. avius*, *A. viridarium* and *A. bullerensis* but these taxa differ in several morphological and anatomical characters (see descriptions).

Austropyrgus monaroensis is also geographically isolated from other species of *Austropyrgus*. Preliminary allozyme data on several New South Wales and some Victorian members of Group 1 support the species decisions made here (Clark, 1997; SAC, personal observations).

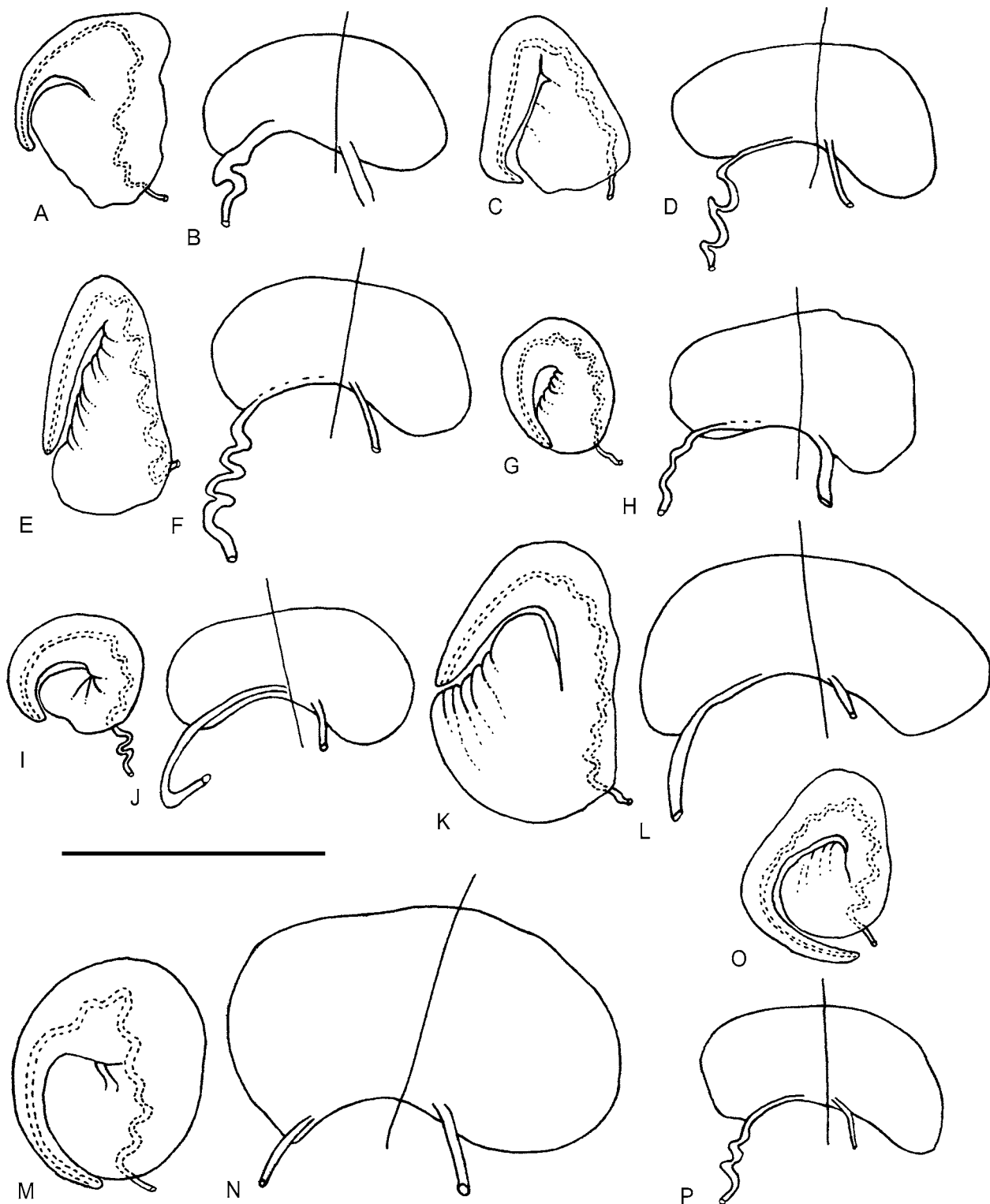


Fig. 7. Male genitalia of species of *Austropyrgus*. *Austropyrgus cooma*: A, penis; B, prostate gland. *Austropyrgus petterdianus*: C, penis; D, prostate gland. *Austropyrgus niger*: E, penis; F, prostate gland. *Austropyrgus dyerianus*: G, penis; H, prostate gland. *Austropyrgus sparsus*: I, penis; J, prostate gland. *Austropyrgus gunnii*: K, penis; L, prostate gland. *Austropyrgus angasi*: M, penis; N, prostate gland. *Austropyrgus elongatus*: O, penis; P, prostate gland. Scale 0.5 mm.

Other similar taxa include *A. daylesfordensis*, *A. macedonensis*, *A. colensis*, *A. otwayensis*, *A. grampianensis*, *A. smithii*, *A. conicus*, *A. nanus*, *A. pisinnus* and *A. parvus* (see descriptions).

In the discriminant analysis the only specimens of *A. monaroensis* misclassified by more than one individual were

three to *A. glenelgensis* (Group 3) (overall 65% correct). When the analysis was restricted to Group 1, 75% were correctly classified with five individuals being misclassified as *A. cooma* (3) and *A. viridarium* (2).

Etymology. Named after the region in which it is found.

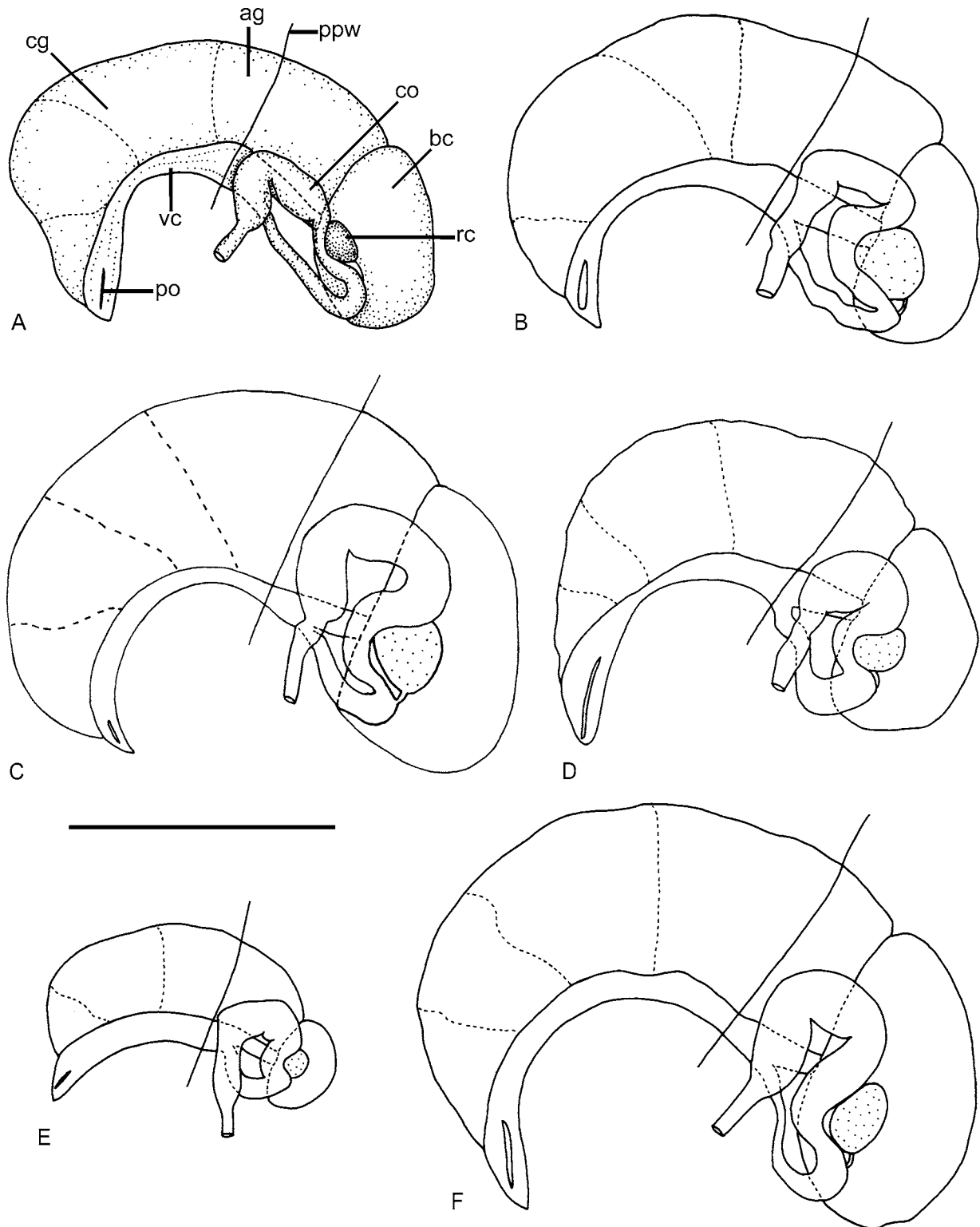


Fig. 8. Female genitalia of species of *Austropyrgus*: A, *A. cooma*, C.173966; B, *A. monaroensis*, C.173984; C, *A. viridarium*, C.173987; D, *A. avius*, C.174043; E, *A. lippus*, C.334057; F, *A. bullerensis*, C.334059. Scale 0.5 mm, see p. 5 for abbreviations.

***Austropyrgus viridarium* n.sp.**

Figs. 2C, 3C, 8C, 10A

Austropyrgus Tallaganda species—Ponder *et al.*, 2000.

Type material. Holotype C.173986, figured paratypes C.342945 (3); paratypes C.173987 (8).

Type locality. Small trib. of Bombay Ck, Tallaganda State Forest (TSF), S of Braidwood, New South Wales, 35°28.40'S 149°37.90'E, on dead leaves, 16 January 1981.

Other material examined. New South Wales: trib of Elrington Ck, 2.3 km NE of Lowden Forest Park, TSF, C.174048; trib of Lowden Ck, 0.3 km N of junction of Forest and Lowden Forest Park Rds, 0.5 km NE of Lowden Park, TSF, C.173991; Lowden Ck at Lowden Forest Park, TSF, C.174038; trib of Bourkes Ck at Lowden Forest Rd, TSF, C.173992;

trib of Bourkes Ck at Lowden Forest Rd, TSF, C.173989; trib of Round Mountain Ck at Crow Valley Creek Rd, TSF, C.173993; trib of Little Crow Valley Ck at Crow Valley Creek Rd, TSF, C.174049; Coxes Gully, trib of Harolds Cross Ck, 10 km S of Rossi, C.174040; Bourkes Ck at Northern Rd, 12.5 km SE of Rossi, C.173996; trib of Bush Paddock Ck at Crow Valley Creek Rd, near Round Mountain, C.174041; Bush Paddock Ck at Jerrabattgulla Rd, S of Braidwood, C.173988; Jerrabattgulla Ck at Jerrabattgulla Rd, S of Braidwood, C.173994; trib of Jerrabattgulla Ck at Jerrabattgulla Rd, S of Braidwood, C.200916; trib of Big Badja R at Gundillion-Courtegan Rd, 1.5 km N of Badja Mill Rd, C.174039; trib of Peppers Ck, 2.4 km from Big Badja, C.173995; ditch on side of road, 250 m S of Badja R crossing at Badja Rd, Boggy Plain, 30 km ENE of Cooma, C.174042; trib of Rutherford Ck at Snowy Mountains Hwy, 1.2 km SE of Pipers Lookout, 13.8 km W of Bemboka, C.173990.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with slightly convex whorls and straight spire outline; pallial vas deferens slightly undulating at prostate gland.

Description. *Shell* (Figs. 2C, 3C). Shell 1.83–2.46 mm in height, 1.18–1.55 in width; outline convex; aperture 0.76–1.05 mm in height, 0.73–0.95 mm in width. Body whorl 1.35–1.77 mm in height. Teleoconch of 3.00–3.60 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, opaque. *Holotype dimensions*: SH, 2.46 mm; SW, 1.55 mm; AH, 1.05 mm; TW, 3.25 whorls. *Operculum* (Fig. 10A). Operculum 0.70–0.90 mm in height, 0.50–0.65 mm in width, with 2–4 pegs. *Radula*. Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 17–26 cusps, outer marginal teeth with 26–31 cusps. *Head-foot*. Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 14–18 filaments. Hypobranchial gland thick to very reduced to apparently absent; covering or partially covering rectum when visible. Rectum without arch; anus intermediate in position. Renal gland about $\frac{1}{4}$ – $\frac{1}{3}$ in pallial roof; thin to intermediate in thickness. Pericardium about $\frac{1}{3}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system*. Testis of 1.0–1.2 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped to elongate pyriform, compressed in cross section. Pallial vas deferens flush with surface; slightly undulating at prostate; slightly to strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 8C). Ovary simple to lobulate, ovary about 1.0–1.1 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop long to medium; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct short to medium length. Rectum overlapping to indenting albumen gland and overlapping capsule gland. $\frac{1}{4}$ or less of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with moderate sized muscular vestibule. Genital opening small and terminal.

Distribution and habitat. This species is currently known from a number of small streams in the Tallaganda Range, S of Braidwood, New South Wales (Fig. 9). It is typically found among weeds, leaves and roots and can be locally very common.

Remarks. This species is most similar in shell shape to *A. colensis*, from which it differs in a number of characters including shell colour (yellow brown compared with white to pale yellow in *A. colensis*) and in some anatomical characters (see descriptions). Other similar taxa include *A.*

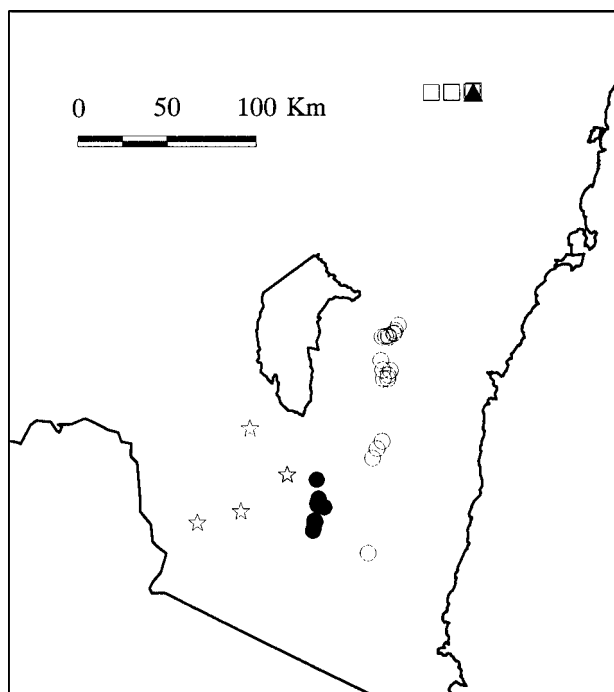


Fig. 9. Distribution of *Austropyrgus monaroensis* ☆, *A. cooma* ●, *A. viridarium* ○, *A. avius* ▲ and *A. lippus* □.

cooma, *A. monaroensis*, *A. avius*, *A. bullerensis*, *A. daylesfordensis*, *A. macedonensis*, *A. grampianensis*, *A. otwayensis*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis *A. viridarium* was not well discriminated, although no species was wrongly classified by more than one individual (overall 35% correct). When the analysis was restricted to Group 1, 60% were correctly classified with specimens being misclassified as *A. parvus* (2), *A. cooma* (1), *A. monaroensis* (1), *A. otwayensis* (1), *A. macedonensis* (1), *A. colensis* (1), and *A. conicus* (1).

Etymology. *Viridarium* Latin: plantation of trees, pleasure garden—alludes to the type locality and to several of the other populations considered to belong to this species which were found within the Tallaganda State Forest.

Austropyrgus lippus n.sp.

Figs. 2D, 3D, 8E

Austropyrgus Wombeyan spring species—Ponder *et al.*, 2000.

Type material. Holotype C.334058, figured paratypes C.174322 (3), paratypes C.334057 (2).

Type locality. Very small spring, below ladder to pumphouse on Mares Forest Ck, Wombeyan Caves, New South Wales, 34°18.87'S 149°57.35'E, in moss, roots and leaves, 27 December 1993.

Other material examined. New South Wales: Wombeyan Caves area: small spring on Gap Ck, below Wombeyan Quarry, C.201678; Mares Forest Ck, C.201681; Mares Forest Ck Cave, C.174662; Grants Cave, C.174679; very small spring below pumphouse on Mares Forest Ck, C.201658.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with

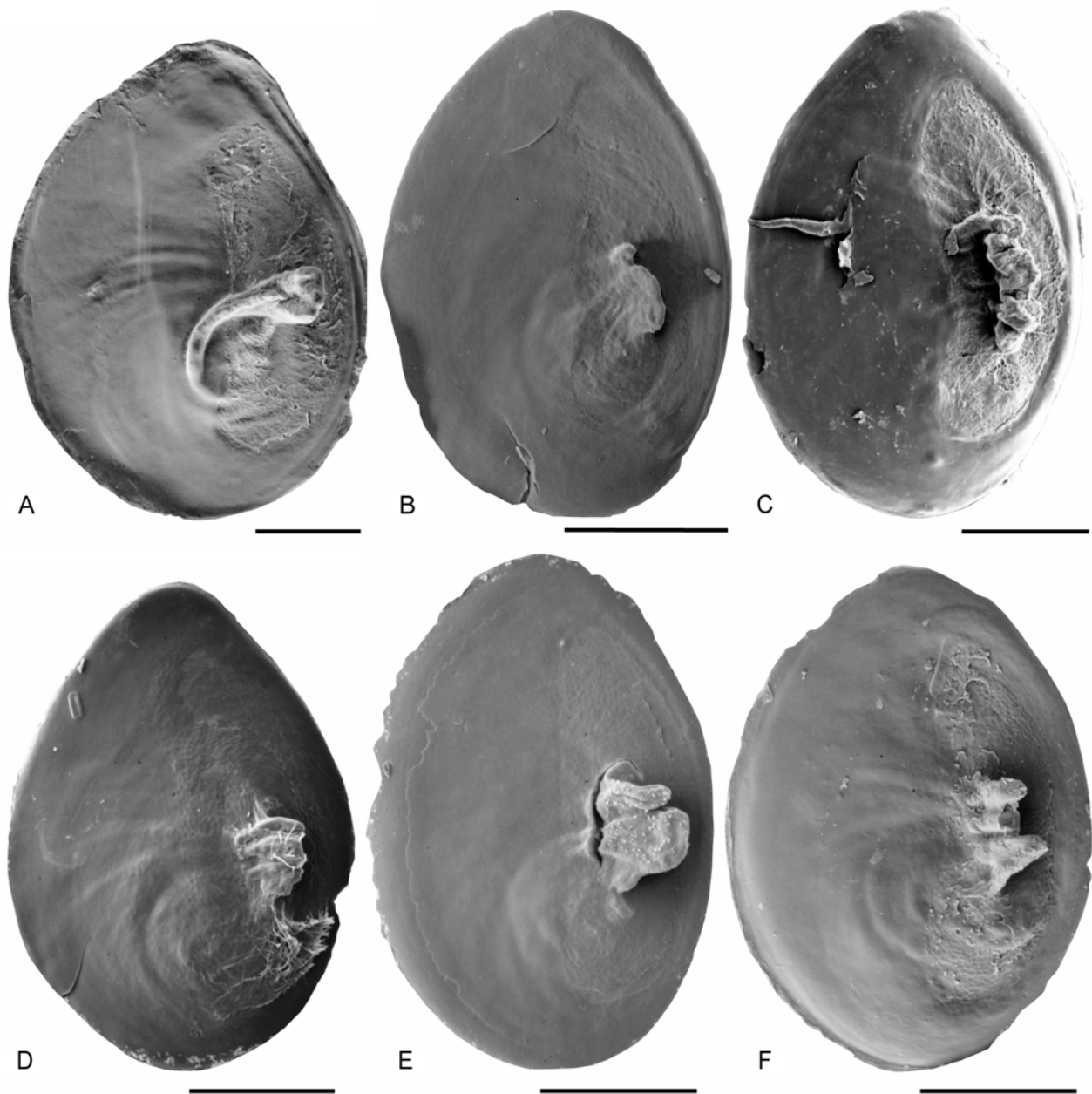


Fig. 10. Opercula of species of *Austropyrgus*: A, *A. viridarium*, C.173987; B, *A. grampianensis*, C.174673; C, *A. niger*, C.157166; D, *A. smithii*, C.348991; E, *A. petterdianus*, C.201136; F, *A. dyerianus*, C.349001. Scales all 0.2 mm.

straight spire outline and slightly convex whorls; pallial vas deferens straight at prostate, strongly undulating at base of penis, bursa copulatrix ovoid.

Description. *Shell* (Figs. 2D, 3D). Shell 1.72–2.28 mm in height, 0.93–1.27 mm in width; outline straight; aperture 0.62–0.88 mm in height, 0.58–0.77 mm in width. Body whorl 1.13–1.54 mm in height. Teleoconch of 3.00–4.00 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow, translucent. *Holotype dimensions*: SH, 2.11 mm; SW, 1.24 mm; AH, 0.80 mm; TW, 3.75 whorls. *Operculum*. Operculum 0.55–0.76 mm in height, 0.43–0.52 mm in width, with 2–4 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4 lateral cusps, median cusp of medium width, sharply pointed; about twice as long as adjacent cusps to less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 19–23 cusps, outer marginal teeth with 25–26 cusps. *Head-foot*. Cephalic tentacles and snout

with pigment absent to well developed; remainder of animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 14–17 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum with slight arch to with short S-shape; anus intermediate in position. Renal gland about $\frac{1}{2}$ in pallial roof; thin or very thick. Pericardium more than $\frac{1}{2}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system*. Testis of 0.5–1.0 whorls. Seminal vesicle inconspicuously to loosely coiled over stomach; inconspicuously to conspicuously coiled on digestive gland and testis behind stomach. Prostate gland about $\frac{2}{3}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, straight between prostate and penis strongly undulating at base of penis. Penis attached slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 8E). Ovary lobulate, about 0.5–1.2 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix ovoid. Bursa copulatrix ovoid, with bursal duct arising from ventral $\frac{1}{2}$ of bursa. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall to at posterior edge of bursa copulatrix, pyriform to narrow sac shaped, duct

short. Rectum overlapping albumen gland and separate from capsule gland. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; terminal to overlapping anterior end of capsule gland.

Distribution and habitat. This species has been found in a few small to very small seeps and springs around Wombeyan Caves, central New South Wales (Fig. 9). It is typically found amongst weeds, leaves and roots in the springs and amongst leaves and mud just inside some of the caves of the Wombeyan Caves system.

Remarks. This species is among the smallest members of the genus and the only *Austropyrgus* on the mainland that has been found in limestone caves. It is most similar to *A. pisinnus* from Tasmania from which it differs in having a straighter spire outline and in several anatomical characters (see descriptions). *Austropyrgus avius* is found nearby but is much larger with a more broadly conical shell. Another much larger species, *A. wombeyanensis*, is found in the streams around Wombeyan Caves but has not yet been found living in sympatry with *A. lippus*. This species is unique in the genus in most specimens having an elongate seminal receptacle.

In the discriminant analysis some specimens of *A. lippus* were misclassified by more than one individual as *A. dyerianus* (4) and *A. smithii* (2) (overall 64% correct). When the analysis was restricted to Group 1, 79% were correctly classified, with six specimens being attributed to *A. cooma* (2), *A. avius* (2) and *A. grampianensis* (2).

Etymology. *Lippus* Latin: blear-eyed, dim-sighted, nearly blind—alludes to the fact that this species can be found just inside some of the caves of the Wombeyan Caves system.

Austropyrgus avius n.sp.

Figs. 2E, 3E, 8D

Austropyrgus Wombeyan Caves Road species—Ponder *et al.*, 2000.

Type material. Holotype C.343112, figured paratypes C.307590 (3), paratypes C.174043 (20+), C.174323 (20+).

Type locality. Small creek crossing Wombeyan Caves Rd., 2 km E of Goodmans Ford Bridge, New South Wales, 34°18.85'S 150°5.52'E, on weeds and in leaf litter, in seepage, 24 October 1992.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell with straight to weakly-convex spire outline and slightly convex whorls; central teeth with 3 pairs of basal cusps; seminal vesicle slightly undulating over stomach; rectum indents albumen gland.

Description. *Shell* (Figs. 2E, 3E). Shell 1.82–2.92 mm in height, 1.05–1.32 mm in width; outline straight to weakly-convex; aperture 0.71–0.92 mm in height, 0.69–0.88 mm in width. Body whorl 1.33–1.63 mm in height. Teleoconch of 2.75–3.75 slightly convex whorls. Inner lip of aperture firmly adhering to narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow, translucent. *Holotype dimensions*: SH, 2.08 mm; SW, 1.18 mm; AH,

0.80 mm; TW, 3.40 whorls. *Operculum.* Operculum 0.43–0.84 mm in height, 0.38–0.61 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 18–20 cusps, outer marginal teeth with 20–25 cusps. *Head-foot.* Cephalic tentacles with pigmented dorsal central stripe; snout with pigmentation well developed around edges or along midline; foot, opercular lobe, pallial roof and visceral coil with pigmentation well developed to absent; head and neck with pigmentation well developed or on sides of neck only. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 12–16 filaments. Hypobranchial gland thick; covers rectum. Rectum with slight arch to prominent arch; anus intermediate in position. Renal gland about ¼–½ in pallial roof; intermediate in thickness. Pericardium about ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 0.75–1.00 whorls. Seminal vesicle slightly undulating over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ⅓ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, straight to slightly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis attached slightly or well to right side of head; not pigmented. *Female reproductive system* (Fig. 8D). Ovary simple to lobulate, ovary about 0.75–1.00 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; straight to with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct ventrally or from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, duct short. Rectum indenting albumen gland and separate from to overlapping capsule gland. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from a single small stream on the road to Wombeyan Caves, S of Mittagong, New South Wales (Fig. 9). It is found in leaf litter in the small seeps and flowing parts of the stream.

Remarks. This species is described from an isolated population that is currently the most northern member of Group 1 known. *Austropyrgus avius* is very similar in shell characters to *A. cooma*, *A. monaroensis*, and *A. viridarium* from New South Wales and *A. bullerensis*, *A. colensis*, *A. daylesfordensis*, *A. macedonensis*, *A. otwayensis* and *A. grampianensis* from Victoria. *Austropyrgus smithii*, *A. nanus*, *A. parvus* and *A. pisinnus* from Tasmania are also similar. Species such as *A. turbatus* and *A. gippslandicus* are superficially similar and can be separated by their straight spire outline. Three species in Group 3 (*A. niger*, *A. dyerianus* and *A. tebus*) have slightly convex spire outlines but have the initial part of the coiled oviduct composed of multiple coils rather than an inverted U-shape.

Discrimination of this taxon was poor, although in the discriminant analysis no specimens of *A. avius* were wrongly classified by more than one individual with the exception of two being included with *A. gippslandicus* and *A. niger* (both in Group 3) (overall 35% correct). When the analysis was restricted to Group 1, 60% were correctly classified with several specimens being misclassified as follows: *A. lippus* (1), *A. bullerensis* (1), *A. grampianensis* (2), *A. daylesfordensis* (3) and *A. colensis* (1).

Etymology. *Avius* Latin: out of the way, unfrequented, remote, solitary—alluding to the isolated nature of the only known location for this species.

Austropyrgus bullerensis n.sp.

Figs. 2F, 3F, 8F

Type material. Holotype C.343003, figured paratypes C.173721 (3+), paratypes C.334059 (20+), MV.F.82285 (3).

Type locality. Trib. of Delatite R. at Mt Buller Rd, Victoria, 37°06.65'S 146°23.33'E, on leaves and roots of tree ferns, 8 December 1988.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell with straight to weakly-convex spire outline and slightly convex whorls; rectum of short S-shape; distal and medial penis pigmented; oviduct bent just before bursal duct joins and coiled oviduct and bursal duct join just in front of posterior pallial wall.

Description. *Shell* (Figs. 2F, 3F). Shell 2.22–2.54 mm in height, 1.26–1.49 mm in width; outline straight to weakly-convex; aperture 0.90–1.04 mm in height, 0.77–0.99 mm in width. Body whorl 1.55–1.76 mm in height. Teleoconch of 3.00–3.65 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour white to very pale yellow, opaque. *Holotype dimensions:* SH, 2.54 mm; SW, 1.49 mm; AH, 0.99 mm; TW, 3.55 whorls. *Operculum.* Operculum 0.80–0.92 mm in height, 0.55–0.64 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed; about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 19–23 cusps, outer marginal teeth with 27–31 cusps. *Head-foot.* Cephalic tentacles with dorsal central stripe; snout with pigmentation around edges; foot and opercular lobe pigmentation poorly developed to unpigmented; head and neck with well-developed pigmentation; pallial roof with mottled to poorly developed pigmentation; visceral coil mottled. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 15–17 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum with short S-shape; anus intermediate in position. Renal gland does not extend into to about ¼ into pallial roof; intermediate in thickness. Pericardium about ½–½ in pallial roof; ctenidium abutting anterior end to separated by short efferent branchial blood vessel. *Male reproductive system.* Testis of 1.5 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ⅓ in pallial roof, kidney-shaped, broadly-oval in cross section. Pallial vas deferens straight to strongly undulating at prostate, straight between prostate and penis, slightly to strongly undulating at base of penis. Penis attached slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 8F). Ovary lobulate, about 1–2 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop long; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just in front of posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided or with bend pointing downwards. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, duct of medium length. Rectum separate from albumen and capsule glands. About ½ or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct to moderate sized muscular vestibule. Genital opening of small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from a single small stream near the base of Mt Buller, eastern Victoria (Fig. 11). It is found amongst fern roots, leaves and weeds.

Remarks. No other species of *Austropyrgus* are known from a radius of at least 80 km around the Mt Buller area of central Victoria. The nearest members of Group 1 are *A. macedonensis* from Mt. Macedon area, central Victoria,

about 150 km to the west and *A. cooma* from the Cooma area, southern New South Wales, about 250 km to the east. *Austropyrgus bullerensis* is currently the only member of Group 1 to be found in eastern Victoria and it is highly likely that additional populations and taxa will be found with future fieldwork within the region, which is rather poorly collected. The most similar species in Victoria are *A. daylesfordensis*, *A. macedonensis*, *A. grampianensis*, *A. colensis* and *A. otwayensis*. Other similar taxa include *A. cooma*, *A. monaroensis*, *A. avius*, *A. viridarium*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. bullerensis* were wrongly classified by more than one individual with the exception of two each being attributed to *A. foris* and *A. exiguus* (overall 70% correct). When the analysis was restricted to Group 1, 95% were correctly classified with only one specimen being misclassified as *A. monaroensis*.

Etymology. Named after Mount Buller, Victoria as the type locality is near the base of the mountain.

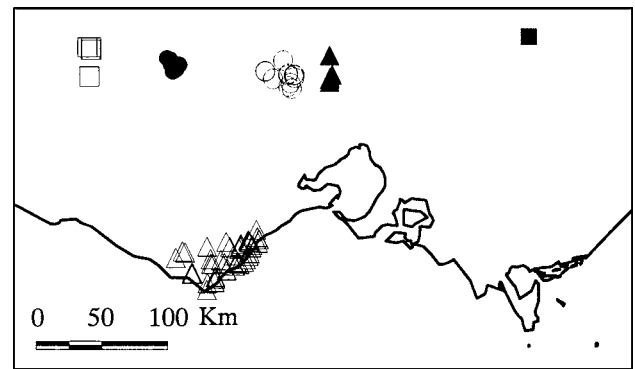


Fig. 11. Distribution of *Austropyrgus bullerensis* ■, *A. grampianensis* □, *A. daylesfordensis* ○, *A. otwayensis* △, *A. macedonensis* ▲ and *A. colensis* ●.

Austropyrgus grampianensis (Gabriel, 1939)

Figs. 2G, 5B, 10B, 12A, 13A, 14A

Bythinella grampianensis Gabriel, 1939: 106.

Austropyrgus grampianensis.—Cotton, 1942: 126.

Pupiphryx grampianensis.—Iredale, 1943: 202; Smith & Kershaw, 1979: 46, text figure; Smith, 1978: 239.

Fluvidona grampianensis.—Smith, 1992: 46.

Type material. Holotype MV.F.598, paratype F.30584.

Type locality. Near Silverband Falls, Grampians, Victoria.

Material dissected and figured. C.174673, C.334601 (figured specimens), trib. of Dairy Ck, Grampians, Victoria, 37°11'S 142°30.033'E, 2 February 1984.

Other material examined. **Victoria:** Dairy Ck, 200m above Silverband Falls, C.174714; Dairy Ck, below Silverband Falls, C.174672, C.302381, MV.F.54756; Jimmy Ck, C.203991.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex spire outline and convex whorls; aperture slightly disjunct; seminal receptacle at anterior edge of bursa copulatrix and its duct long.

Description. *Shell* (Figs. 2G, 12A, 13A). Shell 1.62–2.10 mm in height, 0.94–1.23 mm in width; outline convex; aperture 0.64–0.82 mm in height, 0.62–0.81 mm in width. Body whorl 1.24–1.54 mm in height. Teleoconch of 2.80–3.40 slightly convex to convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow, opaque. *SEM specimen:* SH, 1.96 mm; SW, 1.23 mm; AH, 0.82 mm; TW, 3.05 whorls. Holotype measurements as given by Gabriel (1939) were 2 mm by 1 mm. *Operculum* (Fig. 10B). Operculum 0.60–0.75 mm in height, 0.40–0.52 mm in width, with 2–5 pegs. *Radula* (Fig. 5B). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–28 cusps, outer marginal teeth with 31–35 cusps. *Head-foot.* Animal unpigmented. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 12–14 filaments. Hypobranchial gland moderately developed to very reduced to apparently absent; not covering to covering rectum when visible. Rectum with short S-shape to with prominent arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin. Pericardium about ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 0.5–0.6 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, straight to slightly undulating between prostate and penis, straight to slightly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 14A). Ovary about 0.8–1.0 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop long; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape, duct long. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from two small creeks in The Grampians, western Victoria (Fig. 11). It typically occurs on leaves, weeds, roots and stones.

Remarks. This species is the most westerly member of Group 1 currently known. It is smaller and narrower than *A. colensis*, the nearest member of Group 1 (from Mt Cole, Victoria, about 60 km to the east). It is only known from the type locality and a small creek a little further south in The Grampians. This species is smaller than the other Victorian species included in Group 1. Other species with a similar shaped shell are *A. macedonensis*, *A. daylesfordensis*, *A. otwayensis*, *A. monaroensis*, *A. cooma*, *A. aviis*, *A. bullerensis*, *A. viridarium*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. grampianensis* were misclassified by more than one individual except for two attributed to *A. dyerianus* (overall 60% correct). When the analysis was restricted to Group 1, 85% were correctly classified with three specimens being misclassified as *A. daylesfordensis* (1) and *A. smithii* (2).

Austropyrgus daylesfordensis n.sp.

Figs. 2H, 12C, 14B

Type material. Holotype C.343021, figured paratypes C.334617 (2), paratypes C.300697 (10), C.302427 (20+), MV F.82286 (3).

Type locality. “Trentham Falls”, Coliban R., near Trentham, Victoria, 37°22.32'S 144°19.43'E, under rocks, 60–80m upstream of falls, 11 April 1988.

Other material examined. Victoria: Kangaroo Ck, C.200777; c. 50 m before Brandy Hot Spring, 800 m from Deep Spring, SW of Daylesford, C.300768; small spring near Deep Spring, C.300770; Sebastapol Creek at Loddon River Rd, NW of Trentham, C.300769; trib of Loddon R, 1.3 km along rd to Lyonville Mineral Springs, Wombat SF, E of Daylesford, C.302499; Coliban R at Enders Bridge, N of Trentham, C.174716; Trentham, MV F.82314; Sailors Creek Falls, near Daylesford, C.204040; Blue Mountain Stud, Newbury, MV F.54754; Lerderberg R, 100 m W of road at Blackwood, C.174718; Lerderberg R, 4 km WNW of Blackwood, C.204048; Lerderberg R, 3.8 km WNW of Blackwood, C.204039.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex whorls; prostate gland compressed in cross section; seminal receptacle on middle of inner wall of bursa copulatrix; rectum indents albumen gland; female genital opening terminal.

Description. *Shell* (Figs. 2H, 12C). Shell 2.01–2.41 mm in height, 1.18–1.53 mm in width; outline convex; aperture 0.73–0.98 mm in height, 0.73–0.90 mm in width. Body whorl 1.37–1.74 mm in height. Teleoconch of 3.00–3.50 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.00 mm; SW, 1.22 mm; AH, 0.73 mm; TW, 3.25 whorls. *Operculum.* Operculum 0.67–0.87 mm in height, 0.50–0.59 mm in width, with 3–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–28 cusps, outer marginal teeth with 30–34 cusps. *Head-foot.* Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–19 filaments. Hypobranchial gland thick; covering to partially covering rectum. Rectum with slight arch to with short S-shape; anus intermediate in position. Renal gland about ½ in pallial roof; thin to intermediate in thickness. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1.2–1.5 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, highly compressed in cross section. Pallial vas deferens straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 14B). Ovary simple, about 0.5–1.1 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct of medium length. Rectum indenting albumen gland and overlapping capsule gland. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval to elongately-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small, terminal.

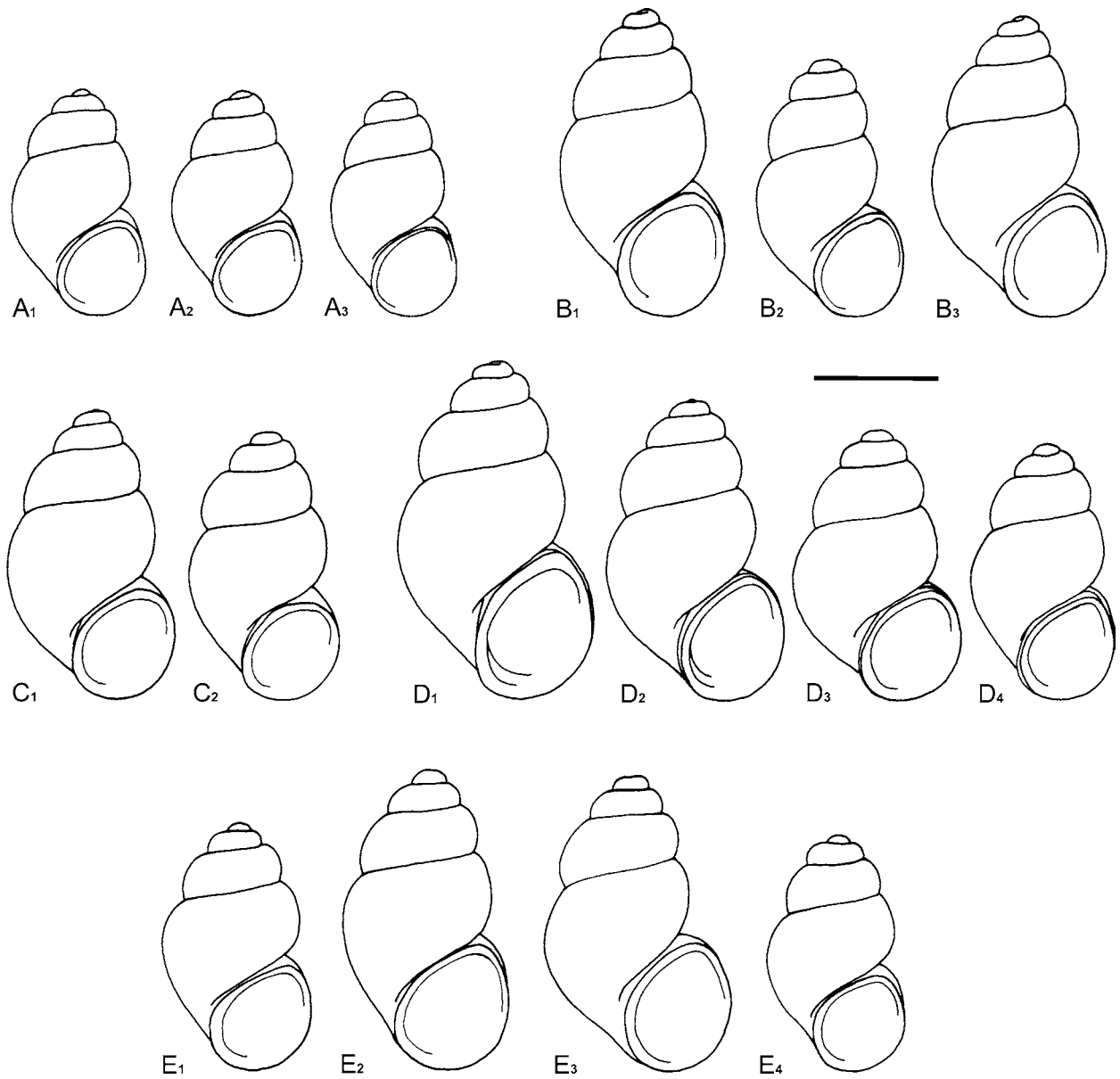


Fig. 12. Shells of species of *Austropyrgus*: A, *A. grampianensis*, C.334601; B, *A. macedonensis*, paratypes, C.346057; C, *A. daylesfordensis*, paratypes, C.334617; D, *A. otwayensis*, paratypes, C.345276; E, *A. colensis*, paratypes, C.343034. Scale 1 mm.

Distribution and habitat. This species is found in a number of the small streams and rivers around the Daylesford area of central Victoria (Fig. 11). It is typically found on weeds, leaves, roots and stones and can be locally very abundant.

Remarks. This species is most similar to *A. macedonensis* from which it differs in its straight spire outline (convex in *A. macedonensis*). It is also similar to *A. avius*, *A. otwayensis* and *A. grampianensis*. Other similar taxa include *A. cooma*, *A. monaroensis*, *A. bullerensis*, *A. colensis*, *A. viridarium*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. daylesfordensis* were misclassified by more than one individual except for two attributed to *A. bungoniensis* (overall 80% correct). When the analysis was restricted to Group 1, 75% were correctly classified with single individuals being misclassified as *A. cooma*, *A. monaroensis*, *A. avius*, *A. bullerensis* and *A. macedonensis*.

Etymology. Named after the area the type locality is situated.

Austropyrgus otwayensis n.sp.

Figs. 2I, 12D, 14C

Type material. Holotype C.343023, figured paratypes C.345276 (4), paratypes C.300706 (20+), MV F.82283 (3).

Type locality. Erskine R, 80 m above Erskine Falls, Otway Range, W. of Lorne, Victoria, 38°30.55'S 143°54.78'E, in weeds and on bark, 17 April 1988.

Other material examined. Victoria: Painkalac Ck, C.317580, C.317579, C.317578, C.317581, C.317577; Erskine R, 1 km above bridge, MV F.54821; C.300709, Big Hill Ck at Great Ocean Rd; Erskine Falls, C.200791, C.201002, MV F.54637, F.54665, F.54667; Straw Falls, below Erskine Falls, C.204026; Barwon R, West Branch, MV F.54776; stream 500 m along track from Blanket Leaf Picnic Area, C.200792; first large trib crossing track about 1.5 km from Blanket Leaf Picnic Area, C.204043, C.200793; Stony Ck at Great Ocean Rd, C.200772; 2.3 km from Erskine Rd turnoff (Todds Corner), C.200794; Lynn Ck at track crossing and locked gateway, near Lorne, C.300759; trib N of main gully, 0.4 km SW of Cowley Track, 5.8 km SW of Erskine Rd intersection, C.200795;

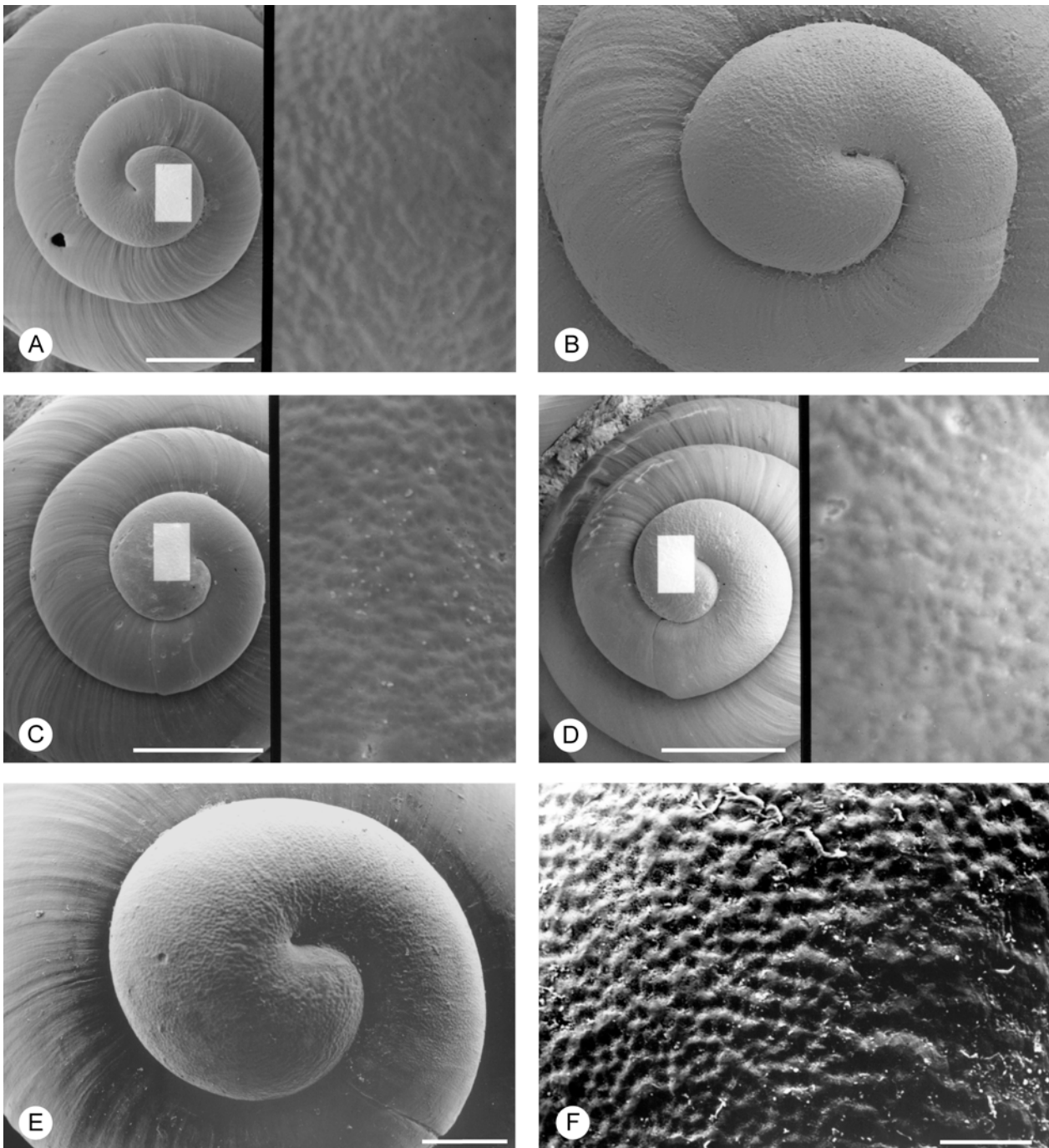


Fig. 13. Protoconchs of species of *Austropyrgus*: A, *A. grampianensis*, C.174673; B, *A. nanus*, C.201026; C, *A. smithii*, C.348991; D, *A. petterdianus*, C.201136; E, F, *A. niger*, C.157166. Scales A, C, D, 0.2 mm; B, 0.01 mm; E, 0.1 mm; F, 0.02 mm.

Lardners Ck, near Gellibrand, C.204044; Lake Elizabeth, near Mount Sabine, MV F.54674, F.54675, F.54676, F.54677, F.54678, F.54679, F.54680, F.54681, F.54682; 0.9 km SW of Cowley track intersection with Benwerrin-Mt Sabine Rds, C.200796; Sheoak Ck, Lorne Forest Park, C.300760; Turtons Ck, MV F.54655, F.54659; Upper Gellibrand River Falls, MV F.54642; Sandy Ck at Gellibrand River Rd, SW of Carlisle River, C.204046; Jamieson R c. 300 m from the sea, 1.5 km SW of Mount Defiance Lookout, C.300708; 1.4 km SW from Kennett Rd, 2.3 km NE from Grey River Rd, C.200797; Boggaley Ck, S of Lorne, MV F.82274, C.300765; Gellibrand River, 19 km from Simpson Creek, C.200926; Wye River, 300 m up from beach, C.200770; Beech Forest, MV F.54615; small trib of Olangolah Ck, 7.7 km W of Haines Junction along Turtons Track, C.200799; Monash Gully, 60–70 m from sea, C.300763; Grey River at Grey Rd near Kennett River, MV F.54614; Aire R, C.204013, C.204045; Grey R at bridge, 100 m upstream from sea, C.200776; headwaters of

Skenes Ck, C.300761; Carisbrook Ck, below falls, MV F.82275; Carisbrook Falls, MV F.54778; Mariners Lookout, Apollo Bay, C.200783, MV F.54755; small trib of Burramonga Ck, 1.1 km SW of Apollo Bay Rd, C.200798; Ford R West Branch, C.200773; Johanna R, 0.5 km from coast, C.300764; Ford R West Branch, Aire Settlement Rd, S of Lavers Hill, C.302490; Johanna R, trib of Chapple Ck South Branch at rd, near Lavers Hill, C.300766, C.300767; Elliott R at Elliot Rd, Elliott, C.300707; Elliot R, 100 yards from mouth, MV F.54758; Geary R on Elliot Rd Bridge, C.200778; Parker R at Lighthouse, south track, N of Cape Otway, C.300762; Parker R at Blanket Cay Rd, edge of NP, C.200774.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small to medium in size, spire outline straight to weakly-convex; aperture

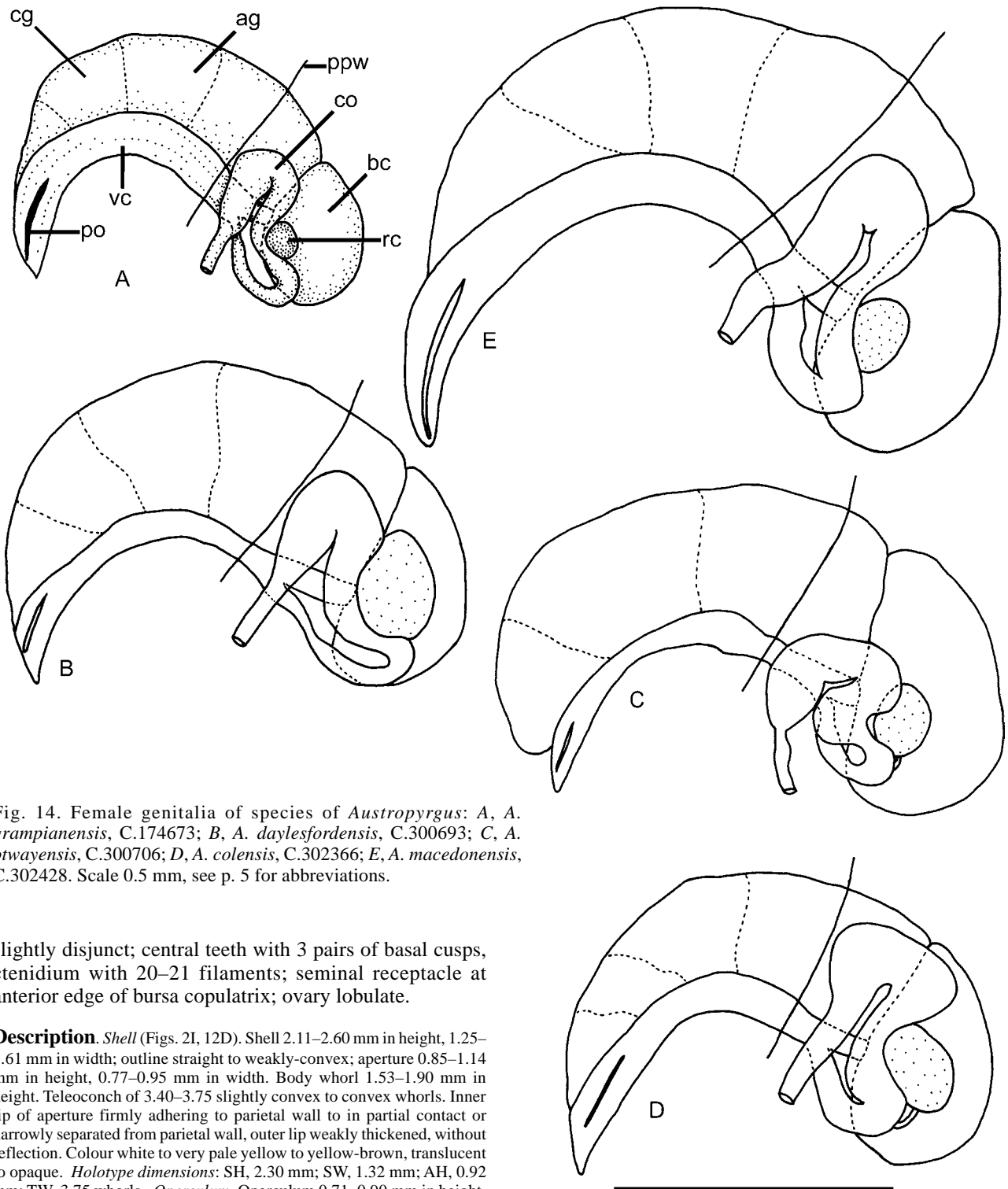


Fig. 14. Female genitalia of species of *Austropyrgus*: A, *A. grampianensis*, C.174673; B, *A. daylesfordensis*, C.300693; C, *A. otwayensis*, C.300706; D, *A. colensis*, C.302366; E, *A. macedonensis*, C.302428. Scale 0.5 mm, see p. 5 for abbreviations.

slightly disjunct; central teeth with 3 pairs of basal cusps, ctenidium with 20–21 filaments; seminal receptacle at anterior edge of bursa copulatrix; ovary lobulate.

Description. *Shell* (Figs. 2I, 12D). Shell 2.11–2.60 mm in height, 1.25–1.61 mm in width; outline straight to weakly-convex; aperture 0.85–1.14 mm in height, 0.77–0.95 mm in width. Body whorl 1.53–1.90 mm in height. Teleoconch of 3.40–3.75 slightly convex to convex whorls. Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow to yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 2.30 mm; SW, 1.32 mm; AH, 0.92 mm; TW, 3.75 whorls. *Operculum*. Operculum 0.71–0.90 mm in height, 0.51–0.66 mm in height, with 3–4 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–28 cusps, outer marginal teeth with 28–32 cusps. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout with pigment around edges; foot pigmentation poorly developed; opercular lobe with pigmentation poorly developed to unpigmented; pigmentation of head and neck well to poorly developed; pallial roof and visceral coil unpigmented. Columellar muscle of moderate size to large. *Non-genital anatomy*. Ctenidium with 20–21 filaments. Hypobranchial gland thick to moderately developed; covers rectum.

Rectum without arch to with slight arch; anus intermediate in position. Renal gland about $\frac{1}{2}$ in pallial roof; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system*. Testis of 1.3–1.5 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens slightly to strongly undulating at prostate; strongly undulating or longitudinally S-shaped between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 14C). Ovary lobulate, about 1.3–1.5 whorls. Coiled oviduct with initial U orientated

obliquely backwards; initial loop long to medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct to distinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the small streams and rivers of the Otway Ranges, Victoria (Fig. 11). It is typically found on weeds, leaves, roots and stones and can be locally abundant.

Remarks. This species is most similar in shell shape to *A. macedonensis*, *A. daylesfordensis*, *A. grampianensis* and *A. colensis* but differs from these taxa in several anatomical characters (see descriptions). Other similar taxa include *A. cooma*, *A. monaroensis*, *A. avius*, *A. bullerensis*, *A. viridarium*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. otwayensis* were misclassified by more than one individual except for two attributed to *A. avius* (overall 65% correct). When the analysis was restricted to Group 1, 80% were correctly classified with four specimens being misclassified as *A. bullerensis* (2), *A. avius* (1) and *A. macedonensis* (1).

Etymology. Named after the type locality.

Austropyrgus macedonensis n.sp.

Figs. 2J, 12B, 14E

Type material. Holotype C.343033, figured paratypes C.346057 (3), paratypes C.302428 (20+), MV F.82339 (3).

Type locality. 1st trib. of Bolinda Ck at Kerrie-Hesket Rd, 1 km N of Kerrie, E of Mount Macedon, Victoria, 37°22.22'S 144°39.40'E, in roots and leaves, 20 February 1994.

Other material examined. Victoria: trib of Dry Ck, trib of Deep Ck, Cobaw SF, NW of Lancefield, C.302559; small trib of Riddle Ck, corner of Cherokee-Kerrie Rd, Cherokee, E of Mount Macedon C.302491; Barringo Ck, C.203981; Barringo, near Mount Macedon, MV F.54742.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex spire outline and convex whorls; aperture slightly disjunct; pericardium about ½ in pallial roof; prostate gland broadly-oval in cross section.

Description. *Shell* (Figs. 2J, 12B). Shell 1.97–2.44 mm in height, 1.16–1.45 mm in width; outline convex; aperture 0.80–1.01 mm in height, 0.76–0.93 mm in width. Body whorl 1.42–1.68 mm in height. Teleoconch of 3.00–3.75 convex whorls. Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 2.04 mm; SW, 1.27 mm; AH, 0.85 mm; TW, 3.25 whorls. *Operculum*. Operculum 0.59–0.87 mm in height, 0.42–0.61 mm in width, with 2–5 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 25–28 cusps, outer marginal teeth with 32–35 cusps. *Head-foot*. Cephalic tentacles, snout and foot with pigmentation well developed; opercular lobe with pigmentation

poorly developed; head and neck, pallial roof and visceral coil unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 16–18 filaments. Hypobranchial gland thick; covers rectum. Rectum with slight arch to prominent arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin to intermediate in thickness. Pericardium about ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system*. Testis of 1.0–1.5 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, broadly-oval in cross section. Pallial vas deferens flush with surface, straight to strongly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 14E). Ovary lobulate, about 1.0–1.9 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, duct of medium length. Rectum indenting albumen gland and overlapping capsule gland. About ½ of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in a few small streams around Mt Macedon, central Victoria (Fig. 11). It is typically found on leaves, roots and stones and can be locally common.

Remarks. This species is most similar to *A. daylesfordensis* and is also similar to *A. otwayensis*, *A. grampianensis* (which is smaller) and *A. avius*. Although there are no significant ($P < 0.001$) differences in the measurement data between *A. macedonensis* and *A. daylesfordensis*, the two species can be distinguished by their spire outline, which is convex in the former and straight in the latter and several anatomical characters (see descriptions). *Austropyrgus macedonensis* can be distinguished from *A. colensis* by its narrower shell, which has a weakly thickened outer lip (more heavily thickened in *A. colensis*) and there are some anatomical differences (see descriptions). Other similar taxa include *A. cooma*, *A. monaroensis*, *A. bullerensis*, *A. viridarium*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. macedonensis* were misclassified by more than one individual other than four attributed to *A. colensis* (2) and *A. niger* (2) (overall 55%). When the analysis was restricted to Group 1, only 55% were correctly classified with the a number of specimens being misclassified as follows: *A. cooma* (2), *A. avius* (2), *A. colensis* (2), *A. viridarium* (1), *A. grampianensis* (1) and *A. otwayensis* (1).

Etymology. Named after the type locality.

Austropyrgus colensis n.sp.

Figs. 2K, 12E, 14D

Type material. Holotype C.343036, figured paratypes C.343034 (4), paratypes C.302366 (3).

Type locality. Trib. of Mt Cole Ck at Victoria Mills Scenic Forest, Mt Cole SF (MCSF), Victoria, 37°16.02'S 143°13.63'E, small boggy pond, just above main pond, 15 February 1994.

Other material examined. **Victoria:** Victoria Mill Picnic Area, Mt Buangor, MCSF, MV F.54812, F.54813, F.82288; trib of Mt Cole Ck, MCSF, C.302371; Mt Buangor Forest, MCSF, MV F.54810; trib of Fiery Ck, MCSF, C.200931; McLeods Ck on Wallaby Caves track, MCSF, MV F.54784; Ben Nevis, MCSF, MV F.54807; Waterfalls Reserve, Mt Cole, MV F.54452; trib of Fiery Ck at road to Warrak, c. 8 km NW of Raglan, C.302375.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small to medium in size, broad, with convex spire outline and convex whorls, heavily thickened outer lip; pallial vas deferens straight at prostate gland; ovary lobulate.

Description. *Shell* (Figs. 2K, 12E). Shell 1.82–2.58 mm in height, 1.13–1.63 mm in width; outline convex; aperture 0.79–1.12 mm in height, 0.75–1.02 mm in width. Body whorl 1.37–1.94 mm in height. Teleoconch of 2.85–3.50 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour white to very pale yellow, opaque. *Holotype dimensions:* SH, 2.16 mm; SW, 1.31 mm; AH, 0.99 mm; TW, 3.05 whorls. *Operculum.* Operculum 0.69–0.99 mm in height, 0.51–0.71 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–27 cusps, outer marginal teeth with 31–34 cusps. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout, foot, opercular lobe, head, neck, pallial roof and visceral coil with well-developed pigmentation. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–18 filaments. Hypobranchial gland moderately developed to very reduced or apparently absent; covers rectum when visible. Rectum with slight arch or with short S-shape; anus intermediate in position. Renal gland about ½ in pallial roof; thin to intermediate in thickness. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1.00–1.25 whorls. Seminal vesicle loosely to tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 14D). Ovary lobulate, about 1.10–1.25 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop long; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in a few small streams on Mt Cole, western Victoria (Fig. 11). It is typically found on weeds, leaves, roots and stones and can be locally very abundant.

Remarks. This species is most similar to *A. viridarium* and is also similar to the other Victorian members of Group 1 (*A. daylesfordensis*, *A. macedonensis*, *A. grampianensis*, *A. bullerensis* and *A. otwayensis*) in its broad shell with strongly convex whorls. Other similar taxa include *A. cooma*, *A. monaroensis*, *A. avius*, *A. smithii*, *A. nanus*, *A. parvus*, *A. conicus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. colensis* were misclassified by more than one individual except for

seven attributed to *A. parvus* (3), *A. macedonensis* (2) and *A. smithii* (2) (overall 55% correct). When the analysis was restricted to Group 1, 70% were correctly classified the remainder being misclassified as *A. viridarium* (2), *A. parvus* (2), *A. macedonensis* (1), and *A. smithii* (1).

Etymology. Named after the type locality.

Tasmanian taxa

Austropyrgus nanus n.sp.

Figs. 13B, 15G, 16G, 17G

Type material. Holotype C.343051, figured paratypes C.307591 (3), C.392384 (3), paratypes C.201026 (20+), C.201027 (20+), C.201035 (20+), C.201036 (20+), C.201038 (20+), C.348990 (20+), TMH E.23420 (3), QVM 9:17049 (3).

Type locality. Natural thermal spring, S of dam and pool, Hastings Thermal Springs, W. of Hastings, Tasmania, 43°24.97'S 146°52.25'E, roots and moss, 10 January 1982.

Other material examined. **Tasmania:** Hastings Caves, MV F.54709; downstream of natural thermal spring, 10m upstream of Hot Springs Ck junction, Hastings Cave, W Hastings, C.201037.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex spire outline; outer lip weakly thickened and without reflection; bursa copulatrix ovoid; capsule gland with anterior end tapering and compressed-oval in cross section.

Description. *Shell* (Figs. 13B, 15G, 16G). Shell 1.15–1.87 mm in height, 0.65–1.05 mm in width; outline convex; aperture 0.46–0.70 mm in height, 0.48–0.71 mm in width. Body whorl 0.91–1.42 mm in height. Teleoconch of 2.40–3.00 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 1.44 mm; SW, 0.78 mm; AH, 0.57 mm; TW, 2.75 whorls. *Operculum.* Operculum 0.43–0.65 mm in height, 0.30–0.48 mm in width, with 1–2 pegs. *Radula.* Central teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed; about 2 to less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 21–28 cusps, outer marginal teeth with 30–33 cusps. *Head-foot.* Cephalic tentacles pigmented (with unpigmented median dorsal stripe) to unpigmented; rest of animal with pigment absent to well developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 12–17 filaments. Hypobranchial gland very reduced to apparently absent; partly covering rectum when visible. Rectum with slight arch to prominent arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 0.4–0.5 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate; straight to slightly undulating between prostate and penis; slightly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 17G). Ovary lobulate, about 0.5–0.75 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix ovoid. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at

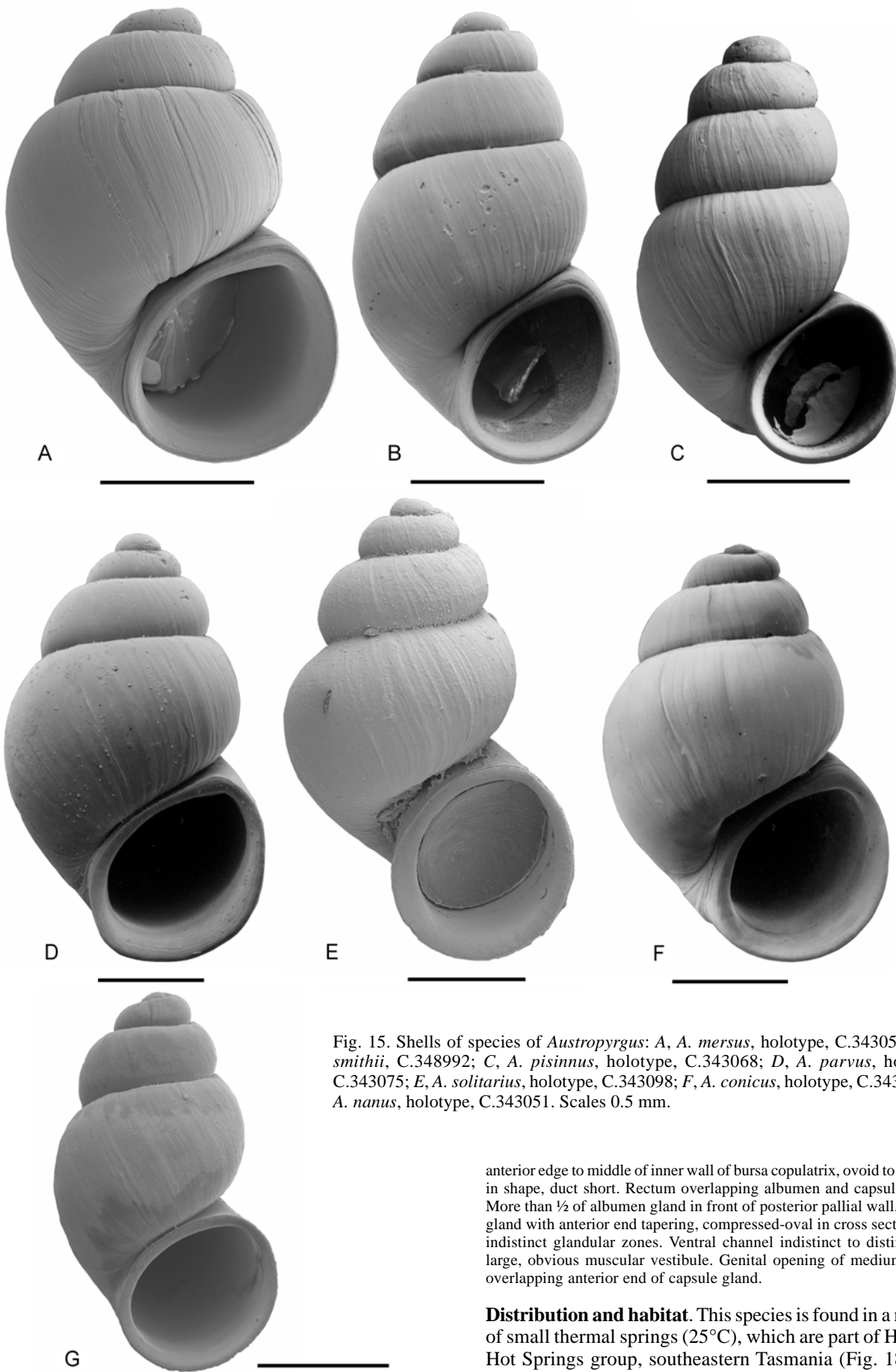


Fig. 15. Shells of species of *Austropyrgus*: A, *A. mersus*, holotype, C.343052; B, *A. smithii*, C.348992; C, *A. pisinnus*, holotype, C.343068; D, *A. parvus*, holotype, C.343075; E, *A. solitarius*, holotype, C.343098; F, *A. conicus*, holotype, C.343100; G, *A. nanus*, holotype, C.343051. Scales 0.5 mm.

anterior edge to middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than 1/2 of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with large, obvious muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in a number of small thermal springs (25°C), which are part of Hastings Hot Springs group, southeastern Tasmania (Fig. 18). It is extremely abundant throughout the very small area of the

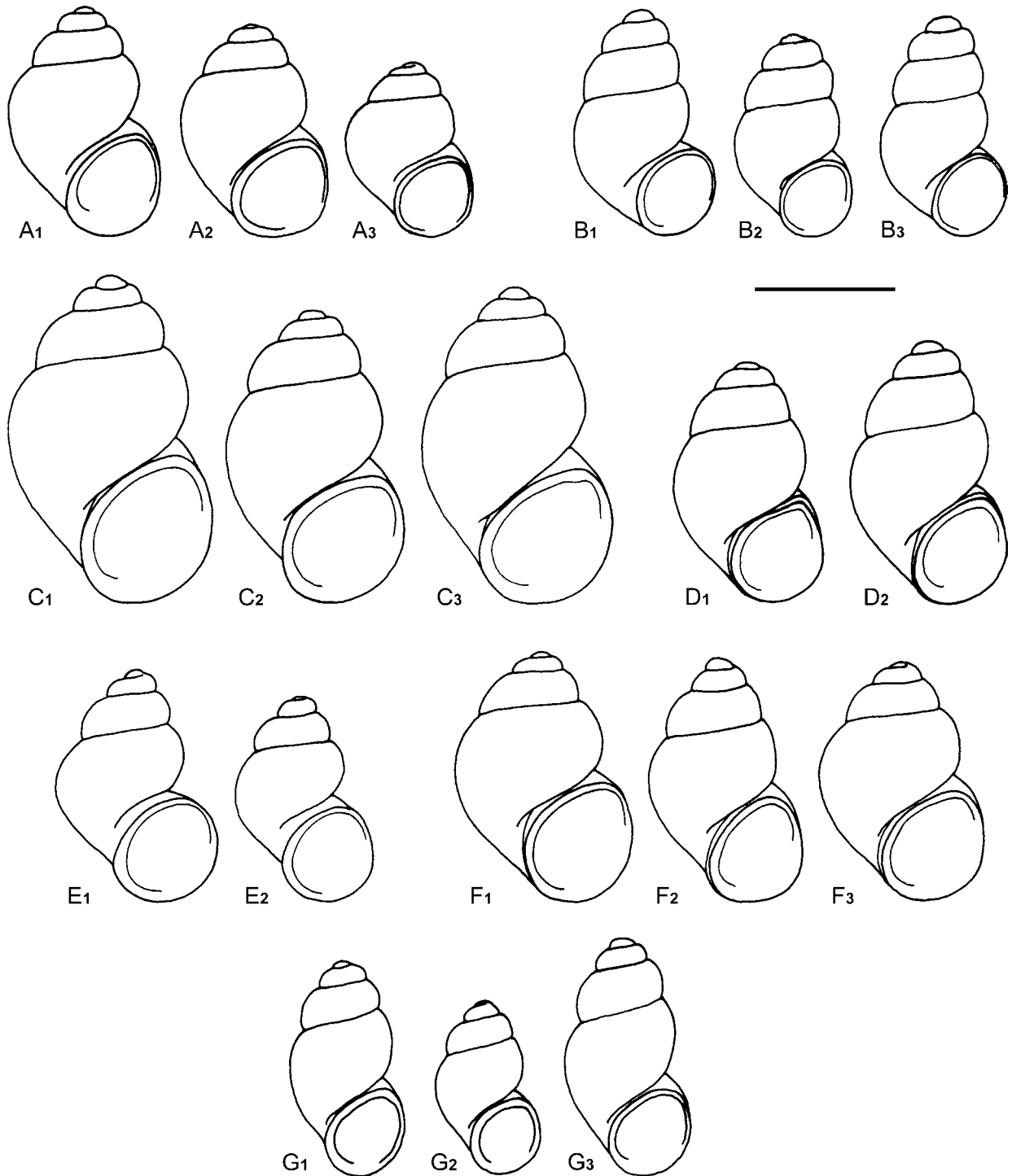


Fig. 16. Shells of species of *Austropyrgus*: A, *A. mersus*, paratypes, C.307574; B, *A. pisinnus*, paratypes, C.343070; C, *A. parvus*, paratypes, C.343076; D, *A. smithii*, C.348992; E, *A. solitarius*, paratypes, C.343099; F, *A. conicus*, paratypes, C.343101; G, *A. nanus*, paratypes, C.307591. Scale 1 mm.

springs and is found crawling on all substrates. This species and *A. solitarius* are the only two hydrobiids to be found in this habitat in Tasmania. However, *A. niger* can be found in the significantly cooler (14°C) creek into which the springs discharge.

Remarks. This species is the smallest member of the genus and among the few that exhibit obvious sexual dimorphism in shell size, with the females significantly larger than the males ($P < 0.001$). It can be distinguished from all other

Tasmanian members of Group 1 by its small, narrow shell. Other similar (but larger) taxa include *A. cooma*, *A. monaroensis*, *A. avius*, *A. bullerensis*, *A. daylesfordensis*, *A. macedonensis*, *A. grampianensis*, *A. colensis*, *A. viridarium*, *A. otwayensis*, *A. smithii*, *A. nanus*, *A. parvus* and *A. pisinnus*.

In the discriminant analysis all specimens of *A. nanus* were correctly classified.

Etymology. *Nanus* Latin: dwarf—referring to its small size.

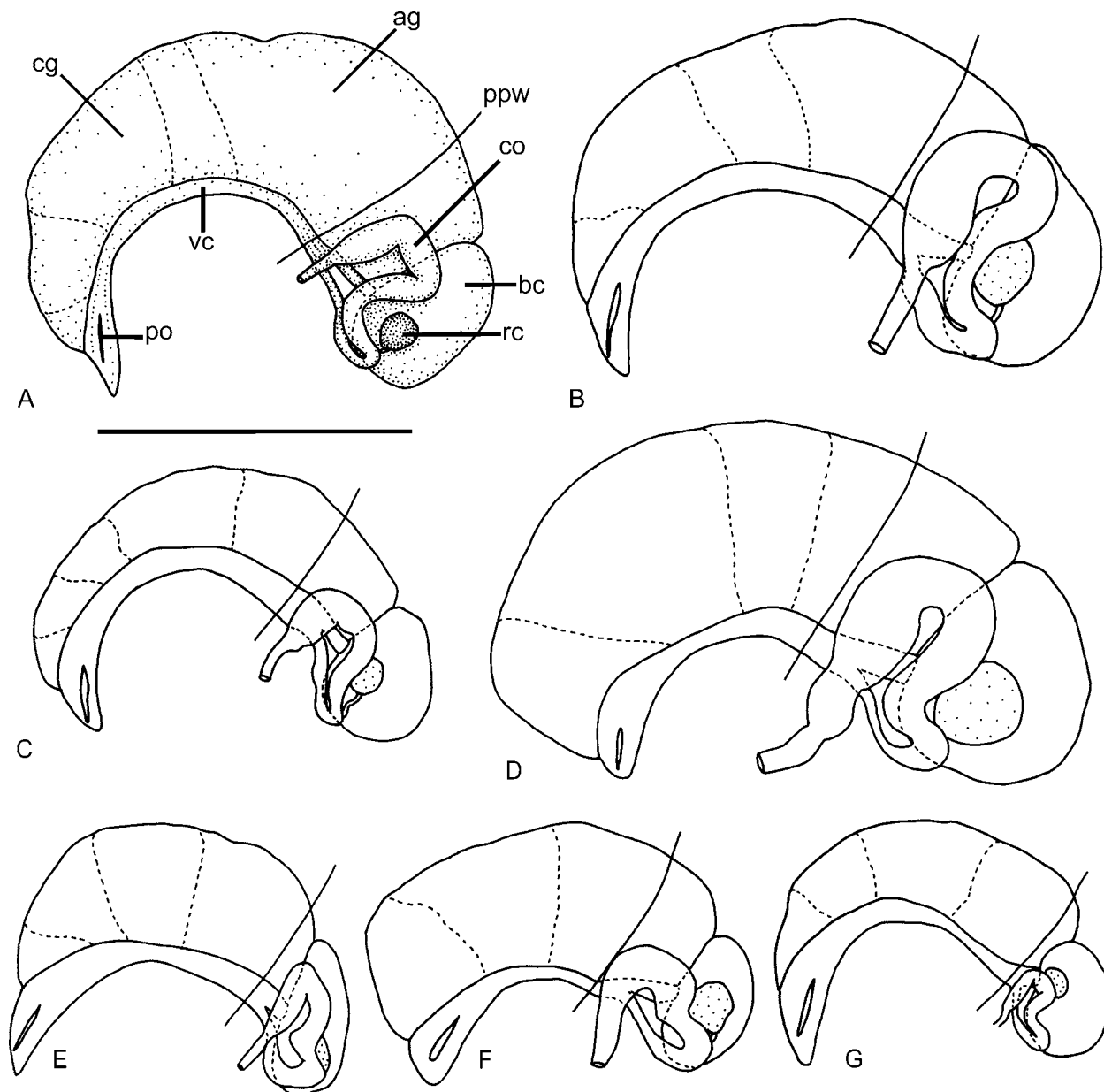


Fig. 17. Female genitalia of species of *Austropyrgus*: A, *A. smithii*, C.348991; B, *A. conicus*, C.201371; C, *A. pisinnus*, C.201288; D, *A. parvus*, C.201349; E, *A. solitarius*, C.201280; F, *A. mersus*, paratypes, C.201028; G, *A. nanus*, C.201026. Scale 0.5 mm, see p. 5 for abbreviations.

Austropyrgus mersus n.sp.

Figs. 15A, 16A, 17F

Type material. Holotype C.343052, figured paratypes C.307574 (3), paratypes C.201028 (20+), TMH E.23421 (3), QVM 9:17050 (3).

Type locality. Dip Falls, Dip R., Arthur River area, above falls, Tasmania, 41°02.20'S 145°22.70'E, 10 February 1989.

Other material examined. Tasmania: Dip Falls, C.169010, MV F.60407; Dip R, below falls, MV F.60409; Blizzards Ck at Youngs Rd, S of Irishtown, C.201570; Chester Ck, trib of Arthur R, C.201030.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small; broad, with convex spire outline; pallial vas deferens with overlying loops/coils at prostate gland and straight at base of penis; pigmentation on penis absent or on medial section only.

Description. *Shell* (Figs. 15A, 16A). Shell 1.27–1.78 mm in height, 0.89–1.16 mm in width; outline convex; aperture 0.54–0.78 mm in height, 0.61–0.74 mm in width. Body whorl 0.98–1.36 mm in height. Teleoconch of 2.25–3.00 slightly convex to convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 1.44 mm; SW, 1.03 mm; AH, 0.68 mm; TW, 2.45 whorls. *Operculum*. Operculum 0.50–0.73 mm in height, 0.37–0.50 mm in width, with 1–4 pegs. *Radula*. Central teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 2–3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp of medium width cusps, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 25–30 cusps, outer marginal teeth with 29–34 cusps. *Head-foot*. Cephalic tentacles pigmented to unpigmented, with unpigmented median dorsal stripe; snout with pigment well developed to around edges; foot pigmentation well to poorly developed; opercular lobe with pigmentation poorly developed; pigmentation of head and neck well developed or on sides of neck only; pallial roof and visceral coil with pigment well developed to absent. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 15–18 filaments. Hypobranchial gland moderately developed; covers rectum. Rectum with

slight arch to with short S-shape; anus intermediate in position. Renal gland about $\frac{1}{2}$ in pallial roof; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 0.6–0.7 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens with overlying loops/coils at prostate, slightly undulating between prostate and penis, straight at base of penis. Penis attached well to right side of head; pigmentation absent or on medial section only. *Female reproductive system* (Fig. 17F). Ovary lobulate, about 0.6–0.7 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix ovoid. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at posterior edge of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with moderate sized to large, obvious muscular vestibule. Genital opening of medium length; terminal to overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in a few small streams and rivers mainly around the Dip Falls area of northwest Tasmania (Fig. 18). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species can be found in sympatry with up to three species of *Austropyrgus* (*A. conicus*, *A. rectoides* and *A. lochi*) throughout its currently recognized range. It can be distinguished from the other Tasmanian members of Group 1 by its small size and broad, squat shell that has a convex outline. The only similar Tasmanian species is *A. conicus* which is larger.

In the discriminant analysis no specimens of *A. mersus* were wrongly classified by more than one individual. When the analysis was restricted to Group 1, 85% were correctly classified, with three specimens being attributed to *A. grampianensis*, *A. solitarius* and *A. conicus*.

Etymology. *Mersus* Latin: dip, plunge—alludes to type locality.

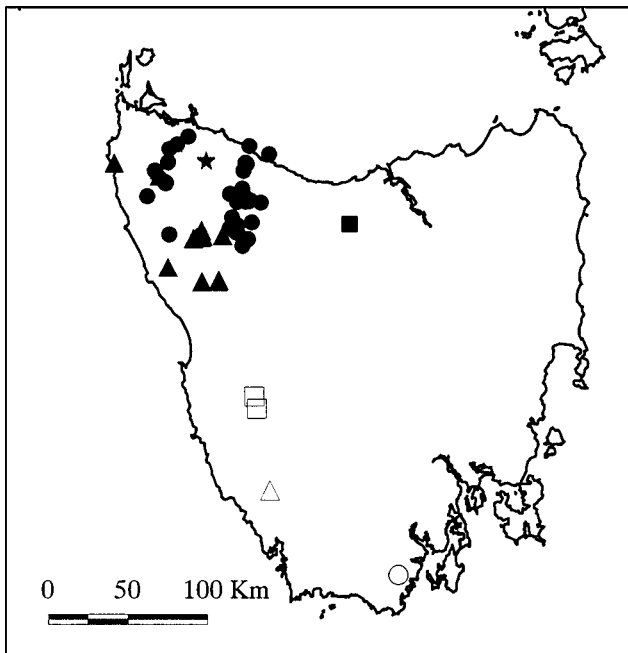


Fig. 18. Distribution of *Austropyrgus conicus* ●, *A. solitarius* ■, *A. parvus* □, *A. pisinnus* △, *A. smithii* ▲, *A. mersus* ★ and *A. nanus* ○.

Austropyrgus smithii (Petterd, 1889)

Figs. 4B, 5D, 10D, 13C, 15B, 16D, 17A

Potamopyrgus smithii Petterd, 1889: 72, pl. 1, fig. 10.

Bithynella smithii.—Johnston, 1891: 138.

Potamopyrgus smithii.—May, 1921a: 72, pl. 11, fig. 27; May, 1921b: 56; May, 1923: 54–55, pl. 25, fig. 28.

Austropyrgus smithii.—Cotton, 1942: 126.

Pupiphryx smithii.—May, 1958: 29, pl. 25, fig. 28; Iredale, 1943: 201.

Fluvidona smithii.—Smith, 1992: 47.

Type material. Lectotype. C.27793 (here designated, Fig. 4B), paralectotypes C.399105 (9), QVM 9:180 (15), SAMA D.16370 (6).

Type locality. Heazlewood River, Tasmania.

Material dissected and figured. C.348991, C.348992 (figured specimens), Thirteen Mile Ck, trib. of Heazlewood R. at Heazlewood Rd, Tasmania, 41°28.423'S 145°20.315'E, in weed and on stones, 9 February 1995.

Other material examined. Tasmania: Thirteen Mile Ck, C.201094, C.201095, C.201097, C.201099, C.203771; Thirteen Mile Ck, 800 m E of Mt Cleveland Rd at Corinna Rd, C.203775, C.201098; small trib of Thirteen Mile Ck, 800 m E of Mt Cleveland Rd at Corinna Rd, C.203750; trib of Heazlewood R at Mt Cleveland Rd, C.201096, C.201593; Ritchie Ck, 1 km along track Corinna Rd, C.201536; Roaring Mag Ck at junction with Heazlewood R near Corinna Rd, C.201296; Corinna, MV F.54722; Tributary Ck at Pieman Rd, 14.1 km from Murchison Hwy, C.201093; trib of Huskisson R at Pieman Rd, 14.5 km from Murchison Hwy, C.203764; creek at Pieman Rd, 1.9 km W of Wilson R, 28.0 km from Murchison Hwy, C.201295; Arthur R, C.204016, NHML 20001329.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex spire outline and slightly convex whorls; pallial vas deferens straight at prostate gland; penis base pigmented; anterior end of capsule gland tapering.

Description. *Shell* (Figs. 4B, 13C, 15B, 16D). Shell 1.72–2.15 mm in height, 0.96–1.24 mm in width; outline convex; aperture 0.68–0.89 mm in height, 0.64–0.78 mm in width. Body whorl 1.26–1.48 mm in height. Teleoconch of 2.90–4.15 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum* (Fig. 10D). Operculum 0.54–0.75 mm in height, 0.41–0.56 mm in width, with 1–3 pegs. *Radula* (Fig. 5D). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps to less than twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 26–28 cusps, outer marginal teeth with 28–33 cusps. *Head-foot.* Cephalic tentacles, snout, foot, opercular lobe, head and neck with well-developed pigmentation; pallial roof and visceral coil unpigmented. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 14–16 filaments. Hypobranchial gland thick to moderately developed; partly covering to covering rectum. Rectum with slight arch to with short S-shape; anus intermediate in position. Renal gland about $\frac{1}{2}$ in pallial roof; thin. Pericardium more than $\frac{1}{2}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, slightly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis attached well to right side of head; pigmented on basal section only. *Female reproductive system* (Fig. 17A). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part an inverted U-shape or with one bend, loop or twist; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind

pallial wall. Bursa copulatrix elongately oval to ovoid. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid in shape, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	1.86	1.12	0.77	4.00
paralectotypes				
C.399105	1.85–2.06	1.01–1.15	0.68–0.82	3.65–4.15
SAMA D.16370	1.85–2.15	1.04–1.18	0.73–0.77	3.85–4.05
QVM 9:180	1.75–2.09	0.96–1.19	0.67–0.77	3.70–4.00
figured SEM specimen	1.87	1.12	0.75	3.25

Petterd's original measurements were given as 2 mm by 1 mm.

Distribution and habitat. This species is found in a number of the small streams and rivers of northwest Tasmania (Fig. 18). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species can be found in sympatry with at least two species of *Austropyrgus* (*A. nanoacuminatus* and *A. conicus*) throughout its currently recognized range. It is most similar to *A. conicus* from which it differs mainly in its narrower shell and a few anatomical and morphometric characters (see descriptions). These two taxa are separated at present but may prove to be variants of the same taxon or represent multiple taxa. Other similar Tasmanian species include *A. nanus*, *A. parvus* and *A. pisinnus* whereas other similar mainland species include *A. cooma*, *A. monaroensis*, *A. avius*, *A. viridarium*, *A. bullerensis*, *A. daylesfordensis*, *A. macedonensis*, *A. colensis*, *A. otwayensis* and *A. grampianensis*.

In the discriminant analysis no specimens of *A. smithii* were wrongly classified by more than one individual. When the analysis was restricted to Group 1, 85% were correctly classified, with three specimens being misclassified as *A. cooma*, *A. grampianensis*, and *A. macedonensis*.

Austropyrgus pisinnus n.sp.

Figs. 15C, 16B, 17C

Type material. Holotype C.343068, figured paratypes C.343070 (3), paratypes C.201288 (20+), TMH E.23422 (3), QVM 9:17051 (3).

Type locality. Trib. of Dismal Ck, trib. of Hardwood R., Tasmania, 42°55.88'S 145°52.43'E, on weed and other substrates, 18 February 1989.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with straight spire outline and convex whorls; ctenidium abutting anterior end or separated by short efferent branchial blood vessel; penis pigmented on the medial section only; capsule gland with indistinct glandular zones.

Description. *Shell* (Figs. 15C, 16B). Shell 1.30–1.69 mm in height, 0.82–1.02 mm in width; outline straight; aperture 0.48–0.63 mm in height, 0.44–0.60 mm in width. Body whorl 0.85–1.14 mm in height. Teleoconch of 2.80–3.40 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 1.59 mm; SW, 1.02 mm; AH, 0.62 mm; TW, 3.25 whorls. *Operculum.* Operculum 0.39–0.57 mm in height, 0.27–0.45 mm in width, with 1–4 pegs. *Radula.* Central teeth: with 6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 29–32 cusps, outer marginal teeth with 30–32 cusps. *Head-foot.* Animal with well-developed pigmentation. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 14–16 filaments. Hypobranchial gland moderately developed to very reduced or apparently absent; covers rectum when visible. Rectum without arch to with slight arch; anus near the mantle edge. Renal gland about ½ in pallial roof; thin. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end to separated by short efferent branchial blood vessel. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens slightly undulating at prostate, slightly to strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 17C). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix. Seminal receptacle pyriform, duct of medium length. Rectum overlapping to indenting albumen gland and overlapping capsule gland. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently only known from the type locality in southwest Tasmania (Fig. 18). It is typically found on weeds, leaves, roots and stones and can be common.

Remarks. This species is not found together with any other species of *Austropyrgus*. However, *A. salvus* is found nearby and can be distinguished from *A. pisinnus* by its larger, broader shell. *Austropyrgus pisinnus* can be distinguished from all other Tasmanian members of Group 1 by its small shell, which has a distinctive conical shape. *Austropyrgus pisinnus* also resembles *A. lippus* from New South Wales but can be separated from this taxon by its more pupiform shape and much more elongate capsule gland.

In the discriminant analysis all specimens of *A. pisinnus* were correctly classified.

Etymology. *Pisinnus* Latin: small, little—refers to the small size of this species.

Austropyrgus parvus n.sp.

Figs. 15D, 16C, 17D

Type material. Holotype C.343075, figured paratypes C.343076 (3), paratypes C.201349 (20+), C.201336 (20+), TMH E.23423 (3), QVM 9:17052 (3).

Type locality. W. side of Newlands Cascades, Franklin R., opposite downstream end of rock shelter, Tasmania, 42°23.65'S 145°45.00'E, c. 100 m down from “splits” in small trickle, 22 January 1992.

Other material examined. Tasmania: Jane R at junction with Franklin R, C.201353.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with convex spire outline and convex whorls; pallial vas deferens slightly undulating at prostate gland; penis pigmented medially and distally; albumen gland about ¼–½ in front of the posterior pallial wall.

Description. *Shell* (Figs. 15D, 16C). Shell 1.92–2.58 mm in height, 1.21–1.63 mm in width; outline convex; aperture 0.84–1.15 mm in height, 0.83–1.05 mm in width. Body whorl 1.48–1.86 mm in height. Teleoconch of 2.75–3.70 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.20 mm; SW, 1.42 mm; AH, 0.95 mm; TW, 3.20 whorls. *Operculum.* Operculum 0.84–1.07 mm in height, 0.58–0.73 mm in width, with 1–5 pegs. *Radula.* Central teeth: with 5–7 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–27 cusps, outer marginal teeth with 25–32 cusps. *Head-foot.* Cephalic tentacles with pigment well developed, with unpigmented median dorsal stripe; snout unpigmented; remainder of animal with well-developed pigmentation. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 16–18 filaments. Hypobranchial gland moderately developed to very reduced to apparently absent; covers rectum when visible. Rectum without arch to with slight arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin to intermediate in thickness. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens slightly undulating at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 17D). Ovary lobulate, about 0.8–1.0 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long to medium; proximal part inverted U-shape or with one bend, loop or twist; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge or on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. ¼ or less to about ½ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently only known from two locations a short distance apart along the lower Franklin River, southwest Tasmania (Fig. 18). It is typically found on leaves, roots and stones and can be locally common.

Remarks. This species is sympatric with *A. salvus* from which it can be separated by its smaller, narrower shell. *Austropyrgus parvus* is more similar to members of Group 1 from the mainland than it is to the other Tasmanian members of Group 1. This species is significantly larger than all other species in Group 1 and its convex spire outline distinguishes it from all other taxa of similar size. Other

similar taxa include *A. cooma*, *A. monaroensis*, *A. avius*, *A. viridarium*, *A. bullerensis*, *A. daylesfordensis*, *A. macedonensis*, *A. colensis*, *A. otwayensis*, *A. grampianensis*, *A. smithii*, *A. nanus* and *A. pisinnus*.

In the discriminant analysis no specimens of *A. parvus* were wrongly classified by more than one individual except for two as *A. tumidus* (overall 75% correct). When the analysis was restricted to Group 1, 90% were correctly classified, with two individuals being misclassified as *A. colensis*.

Etymology. *Parvus* Latin: little refers to the small size of this species.

Austropyrgus solitarius n.sp.

Figs. 15E, 16E, 17E

Type material. Holotype C.343098, figured paratypes C.343099 (3), paratypes C.201280 (20+), TMH E.23424 (3), QVM 9:17053 (3).

Type locality. Kimberley Warm Springs, Tasmania, 41°24.00'S 146°29.65'E, on weed, 21 February 1989.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with slightly convex to straight spire outline, convex whorls, inner lip of aperture distinctly separated from parietal wall and outer lip with reflection.

Description. *Shell* (Figs. 15E, 16E). Shell 1.43–1.88 mm in height, 0.96–1.25 mm in width; outline straight to slightly convex; aperture 0.60–0.80 mm in height, 0.62–0.81 mm in width. Body whorl 0.81–1.33 mm in height. Teleoconch of 2.55–3.10 convex whorls. Inner lip of aperture distinctly separated from parietal wall, outer lip weakly thickened, with reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 1.88 mm; SW, 1.19 mm; AH, 0.80 mm; TW, 3.00 whorls. *Operculum.* Operculum 0.53–0.72 mm in height, 0.36–0.57 mm in width, with 2–4 pegs. *Radula.* Central teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed; less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 26–29 cusps, outer marginal teeth with 28–31 cusps. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout with pigmentation well developed to around edges; foot and opercular lobe with poorly developed pigmentation; head and neck with well to poorly developed pigmentation; pallial roof and visceral coil with well-developed to mottled pigmentation. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 12–15 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin to intermediate in thickness. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 0.9–1.0 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 17E). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; straight or with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior

pallial wall. Capsule gland with anterior end blunt, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with large, obvious muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from a single thermal spring (25°C) from central northern Tasmania (Fig. 18) and is the only hydrobiid present. This species like *A. nanus* are the only two species of the genus to be recorded from this habitat in Tasmania.

Remarks. This species has a distinctive expanding-conical shell that, with its reflected outer lip and small size, makes it separable from other members of the genus.

In the discriminant analysis no specimens of *A. solitarius* were misclassified by more than one individual except three as *A. mersus* and two as *A. pusillus* (overall 60% correct). When the analysis was restricted to Group 1, 65% were correctly classified, with some individuals being misclassified as *A. grampianensis* (2), *A. colensis* (1), *A. mersus* (4) and *A. conicus* (1).

Etymology. *Solitarius* Latin: alone—known only from a single location.

Austropyrgus conicus n.sp.

Figs. 15F, 16F, 17B

Type material. Holotype C.343100, figured paratypes C.343101 (3), paratypes C.201371 (20+), TMH E.23425 (3), QVM 9:17054 (3).

Type locality. Chester Ck, trib. of Arthur R., Tasmania, 41°05.72'S 144°58.92'E, under leaves, stones, wood on sides of creek, 10 February 1989.

Other material examined. Tasmania: Deep Ck at South Rd, 1.9 km S of South Forest, C.204106; Allen Ck at Youngs Rd, C.204100; Murdering Gully, Table Cape, C.201533; Blizzards Ck at Lileah–Spinks Hill Rd, C.204102; 6 km N of Waldheim, C.378707; Roger River West, MV F.88883, F.88884; Big Ck at Tram Rd, 0.5 km NW of junction with Cleveland Rd, C.201281; trib of Big Ck, C.201355; Arthur R, C.169007; Blackfish Ck at Lowries Rd, WSW of Somerset, C.201320; Julius R, C.168993; Julius R at Sumac Rd, C.201621, C.201584; small stream on road between Rapid River and Julius River, C.204113; Sumac Rivulet on road to Julius River Forest Reserve and Kanunnah Bridge, C.204053; trib of Inglis R at Murchison Hwy, C.201319; Hellyer R, just off Blackwell Rd, C.201577; Douglas Brook at Oonah Rd, C.201106; Frankland R at Balfour, C.201379; trib of Cam R, at Oonah Rd, C.201317; St Josephs R, trib of Cam R, at Talunah Rd, C.201321; Hellyer R, C.201576; Cam R, SAMA D19080; East Cam R at Lockwood Creek Rd, C.201316; Hellyer R at Hellyer Gorge, C.201287, C.201318; Wollastonite Ck at Upper Natone Rd, C.201601; trib of Leven R, on road to Gunns Plain Cave, C.203797; Wandle R at Murchison Hwy, N of Waratah, C.201323; Sheppard Ck, trib of Wey R, N of Guildford, C.320077, C.201609; Wandle R, trib of Arthur R, W of Guildford, C.320080, C.201612; Deep Gully Ck, trib of Arthur R, at Murchison Hwy, C.201322; Fossey R at Murchison Hwy, between White and Micklethwaite Marshes, C.201619; trib of Fossey R, E off Murchison Hwy, near picnic grounds upstream of Micklethwaite Marsh, C.201538; Donaldson R at road, C.203962; Hellyer R, S of Guildford, C.320079, C.201615; Hatfield R at Murchison Hwy, C.201442; Tasmania, C.42121.

Diagnosis. Differs from other members of Group 1 in the following combination of characters: shell small, with straight to weakly-convex spire outline, convex whorls; central teeth with 2 pairs of basal cusps; pallial vas deferens strongly undulating at prostate gland; penis not pigmented.

Description. *Shell* (Figs. 15F, 16F). Shell 1.62–1.97 mm in height, 1.08–1.37 mm in width; outline straight to weakly-convex; aperture 0.72–0.94 mm in height, 0.72–0.86 mm in width. Body whorl 1.27–1.56 mm in height. Teleoconch of 2.55–3.75 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 1.89 mm; SW, 1.37 mm; AH, 0.86 mm; TW, 3.75 whorls. *Operculum.* Operculum 0.61–0.77 mm in height, 0.43–0.57 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 6–8 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 2 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed; about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–30 cusps, outer marginal teeth with 32–35 cusps. *Head-foot.* Cephalic tentacles with dorsal central pigmented stripe; snout with pigmentation well developed to around edges; foot, head and neck with well to poorly developed pigmentation, poorly developed on opercular lobe; pallial roof and visceral coil with pigmentation poorly developed to unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 12–16 filaments. Hypobranchial gland thick to moderately developed; partly covering rectum. Rectum without arch to with slight arch; anus intermediate in position. Renal gland about ½ in pallial roof; thin. Pericardium more than ½ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1.0–1.1 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens strongly undulating at prostate, slightly to strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 17B). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the streams and rivers of northwest corner of Tasmania (Fig. 18). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species can be found in sympatry with up to seven species of *Austropyrgus* (*A. lochi*, *A. juliae*, *A. stevensmithi*, *A. smithii*, *A. mersus*, *A. rectoides* and *A. procerus*) throughout its currently recognized range, although in any one locality the number of taxa is no more than three. The shell of this species is most similar to *A. smithii* from which it differs in being larger and broader. It is also similar to *A. mersus* in shape but is smaller. *Austropyrgus conicus* is similar in shell shape to *A. pusillus*, *A. tumidus*, *A. exiguus* and *A. salvus* which have been allocated to Group 3. These taxa all differ in having a coiled renal oviduct.

In the discriminant analysis no specimens of *A. conicus* were wrongly classified by more than one individual (overall 80% correct). When the analysis was restricted to Group 1, 90% were correctly classified, with only two being misclassified as *A. grampianensis*.

Etymology. *Conicus* Latin: conical shape—refers to the general shell shape of this species.

Group 2. *Austropyrgus petterdianus* group

Small sized shells with elongate to very elongate spires with straight to very slightly convex outlines, whorls flattened to moderately convex. Coiled oviduct an inverted U-shape.

The following characters are common for Group 2: Shell aperture slightly disjunct, last whorl and base evenly convex. Outer lip without reflection. Colour of shell yellow-brown and translucent. Median cusp of central teeth of medium width and sharply pointed. Median cusp of lateral teeth of medium width and sharply pointed. Basal projection of lateral teeth bluntly pointed. Ratio of cutting edge to shaft about $\frac{1}{3}$ for inner marginal teeth. Ratio of cutting edge to shaft about $\frac{1}{4}$ for outer marginal teeth. Osphradium elongately oval, between posterior end and middle of ctenidium. Faecal pellets orientated longitudinally in rectum; anus intermediate in position. Renal gland about $\frac{1}{2}$ in pallial roof, oval. Pericardium more than $\frac{1}{2}$ in pallial roof. Seminal vesicle conspicuously coiled on both digestive gland and testis behind the stomach. Prostate gland oval, compressed in cross section. Pallial vas deferens flush with surface, strongly undulating at base of penis. Distal end of penis long and tapering. Ovary lobulate, coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle with rounded end and short duct. Rectum overlapping albumen and capsule glands. Genital opening overlapping anterior end of capsule gland.

This small group of Tasmanian taxa have more elongate shells than the members of Group 1. The discriminant analysis of the taxa included in this group correctly classified 92% of the specimens.

Austropyrgus petterdianus (Brazier, 1875)

Figs. 4C, 5E,F, 6B, 7C,D, 10E, 13D, 19A, 20A, 21A

Amnicola petterdiana Brazier, 1875: 19.

Bithynia petterdiana.—Petterd, 1879: 85.

Amnicola petterdiana.—Tate & Brazier, 1881: 563.

Austropyrgus petterdiana.—Cotton, 1942: 126; Cotton, 1943: 144.

Potamopyrgus petterdiana.—Iredale, 1943: 200.

Fluvidona petterdiana.—Smith, 1992: 47.

Type material. Lectotype (here chosen, Fig. 4C) C.100615, paralectotypes C.399106 (2).

Type locality. Scottsdale, Tasmania.

Material dissected and figured. C.201136, C.348993 (figured specimens), tributary of Brid R., off Upper Bird Rd, Tasmania, 41°15.683'S 147°27.633'E, in tree-fern roots, 8 February, 1987.

Other material examined. **Tasmania:** Tasmania, C.27799; Brid R at Duncraggen Rd, C.201133; trib of Arnon R at Kamona Valley Rd, 200m from Forester Rd turnoff, C.201131; Hurst Ck, 2.5 km W of Scottsdale, C.305262, C.201134, C.201579; trib of Brid R at Golcondo Rd, Blumont, C.201128; Hurst Ck at Oakdene Rd, C.201156; small stream, near Denison R, Turners Marsh, C.203820; trib of Weld R, near Weldborough, C.201140; McKenzie Rivulet at North Rd, S of Scottsdale, C.203809, C.201272; Brid R at Tasman Hwy, C.201414, C.201581, QVM 9:7599; Brid R at Upper Brid Rd, 2.9 km from junction with Tasman Hwy, C.201132; trib of St Patricks R at Tasman Hwy, C.201142; Wilsons Ck at Tasman Hwy, C.201212; trib of St Patricks R at junction of Weavers Creek Rd and Tasman Hwy, C.201149, C.201599, C.203971; first creek

crossing of Weavers Creek Rd, Nunamara, C.201146; small stream at Weavers Creek Rd, 2 km E of Tasman Hwy, C.201147; small stream at Weavers Creek Rd, C.201145, C.201420; trib of St Patricks R, near Weavers Ck Rd, C.201137; trib of St. Patricks R, near Weavers Creek Rd, Nunamara, C.201151; trib of St Patricks R at rd, 1 km off Tasman Hwy, SSE of Nunamara, C.201130.

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell small, with elongate spire and convex whorls; pallial vas deferens slightly undulating at prostate gland; penis unpigmented; ventral channel indistinct with moderate sized muscular vestibule.

Description. *Shell* (Figs. 4C, 13D, 19A, 20A). Shell 1.86–2.54 mm in height, 0.99–1.26 mm in width; spire elongate, with straight to weakly-convex outline; aperture 0.65–0.88 mm in height, 0.61–0.82 mm in width. Body whorl 1.26–1.63 mm in height. Teleoconch of 3.10–4.40 slightly convex to convex whorls. Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip weakly thickened. *Operculum* (Fig. 10E). Operculum 0.61–0.85 mm in height, 0.41–0.58 mm in width, with 2–5 pegs. *Radula* (Fig. 5E,F). Central teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, less than twice as long as adjacent cusps. Inner marginal teeth with 22–28 cusps, outer marginal teeth with 30–35 cusps. *Head-foot.* Animal unpigmented. Columellar muscle large. *Non-genital anatomy.* Ctenidium with 17–20 filaments. Hypobranchial gland very reduced (appears to be absent) to moderately developed; covers rectum when visible. Rectum without arch to with slight arch. Renal gland thin to intermediate in thickness. Ctenidium abutting anterior end of pericardium or separated from it by efferent branchial blood vessel. *Male reproductive system* (Fig. 7C,D). Testis of 1 whorl. Seminal vesicle slightly undulated over stomach. Prostate gland about $\frac{1}{2}$ in pallial roof. Pallial vas deferens slightly undulating at prostate, slightly undulating between prostate and penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 21A). Ovary about 1.0–1.5 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Bursal duct parallel sided, or with bend pointing upwards. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval to elongately-oval in cross section, with distinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small.

shell dimensions:	SH	SW	AH	TW
lectotype	2.54	1.22	0.79	4.40
paralectotype	2.38	1.25	0.85	4.00
figured SEM specimen C.348993	3.05	1.80	1.16	4.15

Brazier's original measurements were given as 1.5 lines (= 3.7 mm) by 0.75 lines (= 1.1 mm).

Distribution and habitat. This species is known from a number of small streams around Scottsdale, northeast Tasmania (Fig. 22). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is among the few that exhibit sexual dimorphism in shell height (SH), with females being significantly taller than males ($P < 0.001$) and shell width (SW) with females being narrower than males ($P < 0.001$). It is unusual that females are narrower than males; typically they are broader. This species is occasionally found in sympatry with *A. tebus* from which it can be distinguished by its small narrow shell and elongated spire. Similar species from Group 2 are *A. nanoacuminatus*, *A. stevensmithi*, *A. privus* and *A. lochi*. It is most similar to *A. juliae* from which

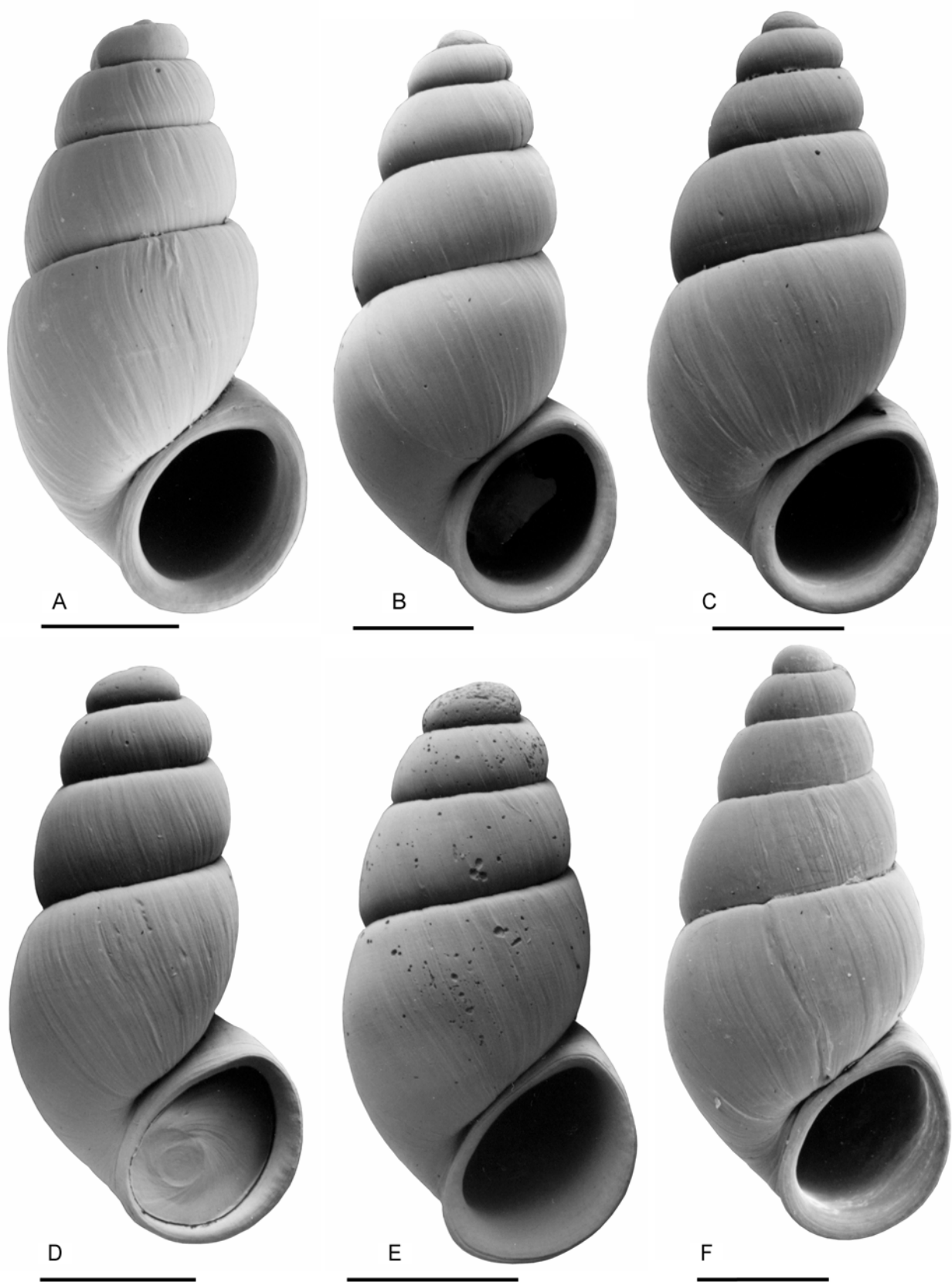


Fig. 19. Shells of species of *Austropyrgus*: A, *A. petterdianus*, C.348993; B, *A. juliae*, holotype, C.343092; C, *A. nanoacuminatus*, holotype, C.348994; D, *A. stevensmithi*, holotype, C.343096; E, *A. privus*, holotype, C.343102; F, *A. lochi*, holotype, C.343826. Scales 0.5 mm.

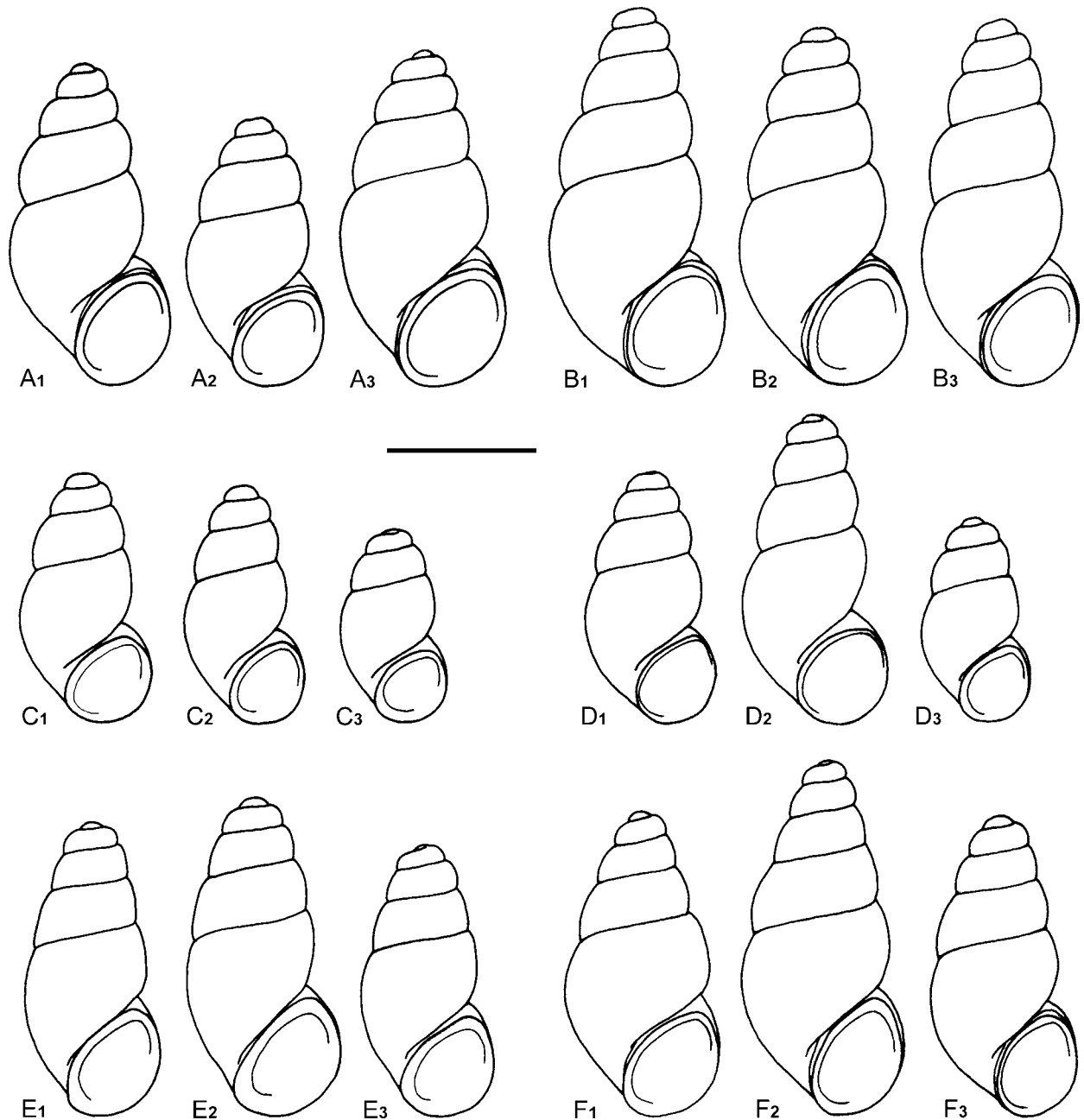


Fig. 20. Shells of species of *Austropyrgus*: A, *A. petterdianus*, C.348993; B, *A. juliae*, paratypes, C.343093; C, *A. nanoacuminatus*, paratypes, C.348995; D, *A. stevensmithi*, paratypes, C.343097; E, *A. privus*, paratypes, C.343103; F, *A. lochi*, paratypes, C.349000. Scale 1 mm.

it differs in its smaller size and the oviduct has a large extra loop. It differs from *A. nanoacuminatus* in being markedly smaller, whereas *A. stevensmithi* is also smaller and more elongate. *Austropyrgus privus* is similar in size but has flatter whorls and a straighter inner lip and *A. lochi* tends to be larger, with an elongately conical shell and straight spire outline. The shell of *A. petterdianus* also superficially resembles a few species from Group 1 but has a less convex spire and more whorls.

In the discriminant analysis no specimens of *A. petterdianus* were misclassified by more than one individual except for four attributed to *A. lippus* (2) and *A. nanoacuminatus* (2) (overall 60% correct). When the analysis was restricted to Group 2, all were correctly classified.

Austropyrgus juliae n.sp.

Figs. 19B, 20B, 21B

Type material. Holotype C.343092, figured paratypes C.343093 (3), paratypes C.201258 (20+), C.201585 (5), TMH E.23434 (3), QVM 9:17055 (3).

Type locality. Trib. of West Gawler R., 3 km E of Preston, Tasmania, 41°17.20'S 146°5.83'E, roots, moss, liverworts and leaves, 5 February 1989.

Other material examined. Tasmania: Blizzards Ck at Youngs Rd, S of Irishtown, in seeping gully, C.201427; Table Cape, C.201364; Calder R at Zigzag Rd, C.201220; Sulphur Ck, SAMA D19081; trib of Inglis R at Murchison Hwy, C.201356; trib of Little Claytons Rivulet, C.201270; trib of Little Claytons Rivulet off Thompson Rd, S of Ulverstone, C.203800; Hellyer R, 2.3 km upstream from Blackwell Rd

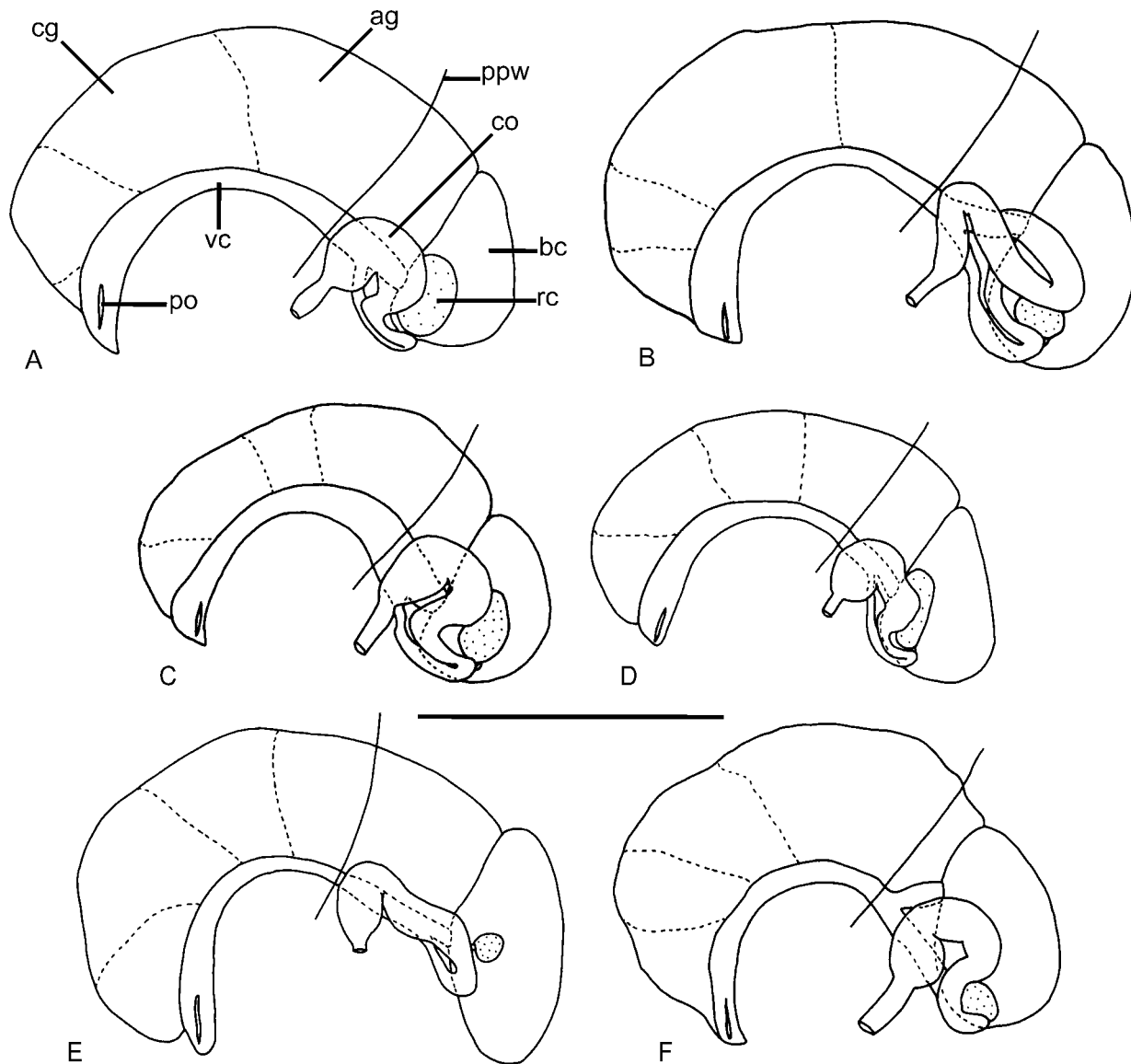


Fig. 21. Female genitalia of species of *Austropyrgus*: A, *A. petterdianus*, C.201136; B, *A. juliae*, C.201258; C, *A. nanoacuminatus*, C.343032; D, *A. stevensmithi*, C.201278; E, *A. privus*, C.201366; F, *A. lochi*, C.203801. Scale 0.5 mm, see p. 5 for abbreviations.

along track, C.201587; Douglas Brook at Oonah Rd, C.201257; Companion R, TMH E.5909; East Cam R at Lockwood Creek Rd, C.201440, C.203811; Hellyer R at Hellyer Gorge, Murchison Hwy, C.201578; top end of Viking Ck, trib of Wilmot R, C.201361; trib of Lockwood Ck, near end of Lockwood Creek Rd, C.368994, C.201413; Lowana Ck at South Riana Rd, C.201367; trib of Emu R just S of Kara Rd crossing, C.204015; trib of Leven R at Raymond Rd, 2.9 km E of Gunns Plains, C.201421, C.201422; Upper Preston Falls, C.201605; Heathcote Ck at Castra Rd, Upper Castra, C.203969, C.201365; Buttons Rivulet at South Preston Rd, C.201362; Nietta Ck, S of Ulverstone, C.201358; Nietta Ck above junction with Castra Rivulet, S of Ulverstone, C.201357; Castra Rivulet at South Nietta Rd, 2 km SE of Nietta, QVM 9:7605; creek at Cradle Mountain Rd, 5 km S of Wilmot, C.201359; trib of Minnow R, 3 km E of Kenzies Hill, C.201261, C.201234; Hellyer R, S of Guildford, C.201616.

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell narrow, with very elongated spire and straight to weakly-convex spire outline and flattened to slightly convex whorls. Pallial vas deferens straight at prostate gland; only medial section of penis pigmented; coiled oviduct with initial bends orientated dorsoventrally.

Description. *Shell* (Figs. 19B, 20B). Shell 2.18–3.23 mm in height, 1.00–1.33 mm in width; spire very elongate with straight to weakly convex outline; aperture 0.70–1.01 mm in height, 0.62–0.79 mm in width. Body whorl 1.31–1.84 mm in height. Teleoconch of 3.75–5.00 flattened to slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened. *Holotype dimensions*: SH, 2.30 mm; SW, 1.12 mm; AH, 0.79 mm; TW, 4.00 whorls. *Operculum*. Operculum 0.57–0.86 mm in height, 0.39–0.59 mm in width, with 1–4 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps. Inner marginal teeth with 22–25 cusps, outer marginal teeth with 28–35 cusps. *Head-foot*. Cephalic tentacles with dorsal pigmented central stripe; snout with pigment well developed around edges; foot, opercular lobe, head and neck and pallial roof with pigment poorly developed; visceral coil mottled. Columellar muscle large. *Non-genital anatomy*. Ctenidium with 17–20 filaments. Hypobranchial gland thick to moderately developed; partially covering to covering rectum. Rectum without arch to with slight arch. Renal gland thin. Ctenidium separated from pericardium by short efferent vessel. *Male reproductive system*. Testis of 1.25–1.50 whorls. Seminal vesicle slightly undulated over stomach. Prostate gland about ½ in pallial roof. Pallial vas deferens straight at prostate, slightly to strongly undulating between prostate and penis. Penis

attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 21B). Ovary about 1.25 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part inverted U-shape or with two or more bends, loops or twists; straight distal to seminal receptacle. Bursal duct parallel sided. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small.

Distribution and habitat. This species is known from a number of small streams of central northern Tasmania (Fig. 22). It is typically found on leaves, roots and stones and can be locally very common.

Remarks. This species can be found in sympatry with three other species of *Austropyrgus* (*A. lochi*, *A. conicus* and *A. procerus*) throughout its currently recognized range and from which it can be distinguished by its narrow, elongate spire and rounded whorls. It differs from the other members of Group 2 (*A. petterdianus*, *A. nanoacuminatus*, *A. stevensmithi*, *A. privus* and *A. lochi*) in having a large additional loop on the oviduct. It is most similar to *A. petterdianus* in shell characters and is contrasted with that species above.

In the discriminant analysis only two specimens of *A. juliae* were misclassified as *A. lochi* (overall 90% correct). When the analysis was restricted to Group 1, 90% were correctly classified, again with two individuals misidentified as *A. lochi*.

Etymology. Named after Julie Ponder, in recognition of her unpaid assistance in the field on many occasions.

Austropyrgus nanoacuminatus n.sp.

Figs. 19C, 20C, 21C

Type material. Holotype C.348994, figured paratypes C.348995 (3), paratypes C.203770 (20+), C.343032 (20+), TMH E.23435 (3), QVM 9:17056 (3).

Type locality. Thirteen Mile Ck at Heazlewood Rd, Mt Cleveland, Tasmania, 41°28.42'S 145°20.32'E, in weeds and on rocks, 9 February 1995.

Other material examined. **Tasmania:** Thirteen Mile Ck at Mt Cleveland Rd and Corinna Rd junction, C.201297, C.201290, C.201300; trib of Heazlewood R at Mt Cleveland Rd, C.201332, C.204038; Thirteen Mile Ck, 800m E of Mt Cleveland Rd off Corinna Rd, C.203782; Wandle R at Murchison Hwy, N of Waratah, C.201423; Hellyer R, S of Guildford, C.320078; Bowry Ck, trib of Savage R side rd off Corinna Rd, C.201283, C.201293; Tributary Ck at Pieman Rd, 14.1 km from Murchison Hwy, C.201298; seepage beside Pieman Rd, 27.2 km from Murchison Hwy, C.201517; trib of Huskisson R at Pieman Rd, 14.5 km from Murchison Hwy, N of Roseberry, C.203763; creek at Pieman Rd, 28 km from Murchison Hwy, 1.9 km W of Wilson R, C.201275; trib of Crotty R at Franklin River Rd, E of Mt Darwin, S of Queenstown, C.203761.

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell small, with elongated spire and straight to weakly convex spire outline; ctenidium with short efferent branchial blood vessel separating it from pericardium; prostate gland about ⅓ in pallial roof; pallial vas deferens strongly undulating at prostate gland; penis pigmented distally and medially; oviduct with one bend distal to seminal receptacle.

Description. *Shell* (Figs. 19C, 20C). Shell 1.83–2.26 mm in height, 0.86–1.13 mm in width; spire elongate with straight to weakly-convex outline; aperture 0.60–0.76 mm in height, 0.54–0.68 mm in width. Body whorl 1.15–1.42 mm in height. Teleoconch of 3.45–4.10 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened. *Holotype dimensions:* SH, 2.26 mm; SW, 1.12 mm; AH, 0.76 mm; TW, 4.10 whorls. *Operculum.* Operculum 0.54–0.69 mm in height, 0.39–0.49 mm in width, with 1–3 pegs. *Radula.* Central teeth: with 5–7 lateral cusps, median cusp about 2 to less than twice as long as adjacent cusps; 2–3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 20–30 cusps, outer marginal teeth with 24–31 cusps. *Head-foot.* Cephalic tentacles with pigment well developed with unpigmented median dorsal stripe; snout with pigment well developed to around edges; foot, opercular lobe, pigment on head and neck well to poorly developed; pallial roof with pigment well developed to mottled; visceral coil densely pigmented, mostly black or dark grey to mottled. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–18 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland thin. Ctenidium separated from pericardium by short efferent vessel. *Male reproductive system.* Testis of 1.5 whorls. Seminal vesicle slightly undulated over stomach. Prostate gland about ⅓ in pallial roof. Pallial vas deferens straight to strongly undulating at prostate, slightly to strongly undulating between prostate and penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 21C). Ovary about 0.50–0.75 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Bursal duct parallel sided. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, pyriform in shape. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening small.

Distribution and habitat. This species is known from a number of small streams all of which are tributaries of the Arthur River, northwestern Tasmania (Fig. 22). It is typically found on weeds, leaves, roots and stones and can be locally very common. However, the species has been found at several scattered localities and further work may reveal the presence of additional taxa.

Remarks. This species can be found in sympatry with three other species of *Austropyrgus* (*A. lochi*, *A. conicus* and *A. smithii*) throughout its currently recognized range and from which it can be distinguished by its small size, narrow elongate spire and slightly rounded whorls. It is most similar to *A. stevensmithi* from which it differs by its shell usually being slightly smaller in size and narrower (although not significant at $P < 0.001$) as well as in some anatomical characters (see descriptions). *Austropyrgus nanoacuminatus* can be distinguished from the other members of Group 2 by its small size and more convex whorls. This species also appears to show some sexual dimorphism with the females typically taller than the males ($P < 0.001$). The shell of *A. nanoacuminatus* also resembles *A. nanus* from Group 1 but can be distinguished by *A. nanus* having fewer whorls and being slightly broader.

In the discriminant analysis only one individual of *A. nanoacuminatus* was misclassified as *A. petterdianus* (overall 95% correct). When the analysis was restricted to Group 2, 85% were correctly classified, with single individuals misclassified as *A. stevensmithi*, *A. privus* and *A. lochi*.

Etymology. *Nanus* Latin: a dwarf, *Acuminatus* Latin: pointed—alludes to this species small size and narrow elongated shell.

Austropyrgus stevensmithi n.sp.

Figs. 19D, 20D, 21D

Type material. Holotype C.343096, figured paratypes C.343097 (3), paratypes C.201278 (20+), TMH E.23436 (3), QVM 9:17057 (3).

Type locality. Creek, 14.7 km SW. of Rapid River, Tasmania, 41°22.15'S 145°14.43'E, under and on rocks, gravel, seep and moss, 12 February 1989.

Other material examined. Tasmania: Blizzards Ck at Youngs Rd, S of Irishtown, C.201574; Birthday Ck, at Scotchtown Rd, C.201530, C.204090; trib of Duck R at Trowutta Rd, just S of Roger River, C.203783; trib of Williamsons Ck at Trowutta Rd, c. 1 km S of Roger River, C.201419; Sumac Rivulet at rd to Julius River Forest Reserve and Kanunnah Bridge, C.204050; St Josephs R, at Talunah Rd, C.201521; trib of Rapid R at Pipeline Rd, 21.7 km S of Holden Rd, C.201019; trib of Little Donaldson R at Pipeline Rd, 15.4 km SW of Rapid River, C.201330; creek at Pipeline Rd, 16.4 km SW of Rapid River, C.201331.

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell small, with elongated spire and straight to weakly convex spire outline; ctenidium abutting anterior end of the pericardium; prostatic gland about ½ in pallial roof; pallial vas deferens S-shaped at prostate.

Description. *Shell* (Figs. 19D, 20D). Shell 1.36–2.14 mm in height, 0.74–1.06 mm in width; spire very elongate; aperture 0.45–0.71 mm in height, 0.50–0.67 mm in width. Body whorl 0.97–1.40 mm in height. Teleoconch of 2.55–4.00 slightly convex whorls with straight to weakly-convex outline. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened. *Holotype dimensions:* SH, 1.73 mm; SW, 0.84 mm; AH, 0.60 mm; TW, 3.50 whorls. *Operculum.* Operculum 0.49–0.74 mm in height, 0.31–0.48 mm in width, with 2–3 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 17–27 cusps, outer marginal teeth with 27–30 cusps. *Head-foot.* Cephalic tentacles pigmented (sometimes only basal part) with unpigmented median dorsal stripe, or unpigmented; snout with pigmentation well developed to poorly developed around edges; foot, opercular lobe, pallial roof and visceral coil with pigmentation poorly developed to unpigmented; head and neck with pigmentation poorly developed to developed on sides of neck only. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–19 filaments. Hypobranchial gland moderately developed; partially covering to covering rectum. Rectum without arch to with slight arch. Renal gland thin. Ctenidium abutting anterior end of pericardium. *Male reproductive system.* Testis of 0.75–0.90 whorls. Seminal vesicle slightly undulated over stomach. Prostatic gland about ½ in pallial roof. Pallial vas deferens longitudinally S-shaped at prostate, slightly undulating between prostate and penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 21D). Ovary about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop short; proximal part inverted U-shape; one bend distal to seminal receptacle. Bursal duct parallel sided. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape. About ½ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct to distinct, with indistinct muscular vestibule. Genital opening small.

Distribution and habitat. This species is known from several small streams from northwest Tasmania (Fig. 22). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species can be found in sympatry with three other species of *Austropyrgus* (*A. conicus*, *A. rectoides* and

A. procerus) throughout its currently recognized range and from which it can be distinguished by its small, narrow shell with an elongate spire and slightly rounded whorls. It is most similar to *A. nanoacuminatus* from which differs in a number of characters (see remarks under that species), the other members of Group 2 being larger. This species also appears to show some sexual dimorphism with females typically taller than males ($P < 0.001$). *Austropyrgus stevensmithi* has been found at several scattered localities and further work may show that the populations attributed to this taxon represent more than one species.

In the discriminant analysis only one individual of *A. nanus* was misclassified as *A. stevensmithi* (overall 95% correct). When the analysis was restricted to Group 2, all individuals were correctly classified.

Etymology. Named after Dr Steven Smith, of the Tasmanian National Parks and Wildlife Service, in recognition of his contributions to the understanding and conservation of Tasmanian invertebrates.

Austropyrgus privus n.sp.

Figs. 19E, 20E, 21E

Type material. Holotype C.343102, figured paratypes C.343103 (3), paratypes C.201366 TMH E.23437 (2), QVM 9:17058 (2).

Type locality. Keddies Ck at Dial Rd, S of Penguin, Tasmania, 41°10.22'S 146°3.35'E, on leaf litter and moss, 6 February 1989.

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell small, with very elongated spire and straight to weakly-convex spire outline, inner lip firmly adhering to the parietal wall, outer lip heavily thickened; pallial vas deferens strongly undulating at prostate gland; penis attached centrally on head.

Description. *Shell* (Figs. 19E, 20E). Shell 1.69–2.28 mm in height, 0.82–1.11 mm in width; spire very elongate with straight to weakly-convex outline; aperture 0.62–0.84 mm in height, 0.58–0.69 mm in width. Body whorl 1.13–1.40 mm in height. Teleoconch of 3.50–4.25 flattened to slightly convex whorls. Inner lip of aperture firmly adhering to parietal wall, outer lip heavily thickened. *Holotype dimensions:* SH, 2.03 mm; SW, 0.94 mm; AH, 0.76 mm; TW, 4.05 whorls. *Operculum.* Operculum 0.55–0.69 mm in height, 0.29–0.41 mm in width, with 2–4 pegs. *Radula.* Central teeth: with 5 lateral cusps, median cusp about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps. Inner marginal teeth with 23–24 cusps, outer marginal teeth with 31–32 cusps. *Head-foot.* Animal unpigmented. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 15–16 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland thin. Ctenidium separated from pericardium by short efferent vessel. *Male reproductive system.* Testis of 0.75 whorls. Seminal vesicle slightly undulated over stomach. Prostatic gland about ½ in pallial roof. Pallial vas deferens strongly undulating at prostate, strongly undulating between prostate and penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 21E). Ovary about 0.75 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part with flattened inverted U-shape; one bend distal to seminal receptacle. Bursal duct parallel sided. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small.

Distribution and habitat. This species is currently only known from a small stream south of Penguin, in northern Tasmania (Fig. 22). It was found on leaves and in moss.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus* and can be distinguished from the other members of Group 2 by its small, narrow shell, oblique aperture (due to the rather straight inner lip), the latter feature giving it a distinctive shape, and flattened whorls.

In the discriminant analysis no specimens of *A. privus* were misclassified by more than one individual (overall 85% correct). When the analysis was restricted to Group 1, 90% were correctly classified, with only two individuals misclassified as *A. nanoacuminatus*.

Etymology. *Privus* Latin: alone, single—referring to the fact that this species has only been found on a single occasion, even though it has been searched for since.

Austropyrgus lochi n.sp.

Figs. 19F, 20F, 21F

Type material. Holotype C.343826, figured paratypes C.349000 (3), paratypes C.201236 (20+), C.203801 (20+), C.370296 (4), TMH E.23438 (3), QVM 9:17059 (3).

Type locality. Small trib. of Little Claytons Rivulet, off Thompson Rd, S of Ulverstone, Tasmania, 41°13.22'S 146°12.06'E, 7 February 1995.

Other material examined. **Tasmania:** Tasmania, C.42122; Blizzards Ck at Youngs Rd, S of Irishtown, C.201218, C.201428; trib of Dip R at Pipeline Rd, C.201221; Table Cape, C.201363; Murdering Gully, C.201253; bottom of Main Ck, SE side of Table Cape, C.201224; small creek, SE of Table Cape, C.201219; streams at Table Cape Lighthouse, C.201217; creek between dams, above cliff, SE side of Table Cape, C.201226; Sisters Ck at Myalla, C.201543; small trib of Alarm R at Newhaven Rd, C.201230; Dip Falls, Arthur R, C.169011, C.201105; Roger River West, MV F.88885, F.88886; Big Ck, along Tram Rd, 0.5 km NW junction with Cleveland Rd, C.201424; trib of Big Ck, C.201216, C.201425; Sulphur Ck, W of Penguin, C.201222, C.201233; stream at road between Rapid River and Julius River, C.204115; Sumac Rivulet at rd to Julius River Forest Reserve and Kanunnah Bridge, C.204052; Adams Ck, trib of Blythe R, C.201251; trib of Forth R, on W side, 2.5 km S of Forth, C.201263; Hellyer R, just off Blackwell Rd, C.201249; Don R at Eugenana, C.201237; Companion R, TMH E.5909; trib of Cam R at Oonah Rd, C.201252; Emu Bay, C.201225; Melrose Ck at Palooona Rd, C.201243; St Josephs R at Talunah Rd, C.201254; bottom of Guide River Falls, MV F.54605; Hellyer R, C.201103; Cam River, SAMA D19082; trib of Cam R at Lockwood Creek Rd, C.201264, C.201227; trib of Forth R at Palooona Rd, C.201524; Hellyer R at Hellyer Gorge, C.201241, C.201255; trib of Lockwood Ck, near end of Lockwood Creek Rd, C.201231; Lowana Ck at South Riana Rd, C.201531; trib of Emu R just S of Kara Rd crossing, C.201229; Wollastonite Ck at Upper Natone Rd, C.201269; trib of Leven R at Raymond Rd, 2.9 km E of Gunns Plains, C.201266, C.201267, C.201232, C.201239; trib of Leven R at Raymond Rd, 3 km E of Gunns Plains, C.201260; trib of Leven R, 2.5 km E of Gunns Plain, C.165989; Upper Preston Falls, C.203810, C.201242; Marine Ck at Dallys Rd near Dulverton, C.201443; Marine Ck, NE of Railton, C.201244; Heathcote Ck at Castra Rd, Upper Castra, C.201248; Wilmot R, upstream and below, Spellmans Bridge, C.201100, C.203818; Castra Rivulet, S of Upper Castra, C.201223, C.201360; Castra Rivulet at Nietta Rd, 2 km SE of Nietta, C.201247; Notley Fern Gorge, NW of Launceston, C.201181; trib of Redwater Ck at Native Plains Rd, 1.5 km E of Railton, C.201265; Sheppard Ck, N of Guildford, C.201610; Wandle R at Murchison Hwy, N of Waratah, C.201279; Wandle R, W of Guildford, C.201613; Deep Gully Ck at Murchison Hwy, C.201294; trib of Dasher R, NNE of Mt Roland, C.201262, C.201246; trib of Minnow R at Lower Beulah Rd,

C.201235; trib of Dasher R at Claude Rd, C.201259; Lynds Ck at Liena and Gowroe Rd, C.201240; Marakoopa Ck at Mayberry, C.203805; trib of Quamby Brook at Bogan Rd, SE of Deloraine, C.201139; trib of Quamby Brook at Bogan Rd, 1.3 km SW of rd junction to Golden Valley, C.201138; creek at St Peters Pass, Oatlands, TMH E.5914, E.5913 (possibly an erroneous location as it is much further south than any other population currently included under *A. lochi* or it represents another unknown species which has not been recollected).

Diagnosis. Differs from other members of Group 2 in the following combination of characters: shell small, with elongated spire, straight spire outline and flattened to slightly convex whorls; anterior end of ctenidium abutting pericardium; pallial vas deferens strongly undulating at prostate gland.

Description. *Shell* (Figs. 19F, 20F). Shell 1.82–2.44 mm in height, 0.93–1.16 mm in width; spire elongate with straight outline; aperture 0.67–0.86 mm in height, 0.57–0.73 mm in width. Body whorl 1.20–1.52 mm in height. Teleoconch of 3.75–4.55 flattened to slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened. *Holotype dimensions:* SH, 2.21 mm; SW, 1.06 mm; AH, 0.71 mm; TW, 4.00 whorls. *Operculum.* Operculum 0.56–0.71 mm in height, 0.39–0.49 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 22–25 cusps, outer marginal teeth with 29–31 cusps. *Head-foot.* Cephalic tentacles unpigmented or with dorsal central stripe only; snout with pigment poorly developed around edges; foot and opercular lobe unpigmented; pigmentation of head and neck on sides of neck only; pallial roof and visceral coil weakly pigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–20 filaments. Hypobranchial gland very reduced (appears to be absent) to moderately developed; partly covering to covering rectum when visible. Rectum with slight arch to with short S-shape. Renal gland thin. Ctenidium abutting anterior end of pericardium. *Male reproductive system.* Testis of 1.00–1.25 whorls. Seminal vesicle loosely coiled over stomach. Prostate gland about ½ in pallial roof. Pallial vas deferens strongly undulating at prostate, strongly undulating between prostate and penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 21F). Ovary about 1.0–1.1 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part inverted U-shape; straight or with one bend distal to seminal receptacle. Bursal duct parallel sided. Seminal receptacle at anterior edge of bursa copulatrix, pyriform to narrow sac shaped. About ½ to more than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small to medium length.

Distribution and habitat. This species is found in small streams across the mid western part of the north coast to the mid north coast of Tasmania (Fig. 22). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species can be found in sympatry with six other species of *Austropyrgus* (*A. juliae*, *A. ronkershawi*, *A. procerus*, *A. mersus*, *A. conicus* and *A. rectoides*) throughout its currently recognized range, with up to three in any one location. Its shell can be distinguished by its tall, narrow spire and straight outline. It is often found with *A. juliae*, from which it differs in its slightly broader, more conical shell with more flattened whorls. Other similar species (the other members of Group 2) are *A. petterdianus* and *A. privus*, these being differentiated from *A. lochi* under those taxa.

The material that we have included within *A. lochi* shows some variation in shell shape and size and it may, with further work (e.g., allozyme electrophoresis) be shown to be made up of more than one taxon.

In the discriminant analysis only two individuals of *A. lochi* were misclassified as *A. privus* (overall 90% correct). When the analysis was restricted to Group 2, 85% were correctly classified, with three specimens misclassified as *A. privus* (2) and *A. nanoacuminatus* (1).

Etymology. Named after Ian Loch of the Australian Museum in recognition of his considerable contribution to Australian malacology.

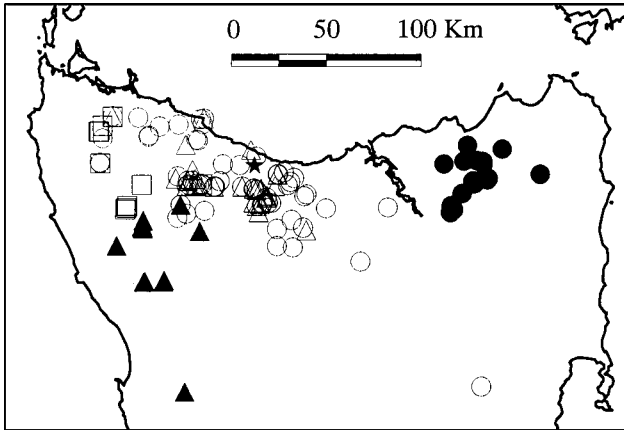


Fig. 22. Distribution of *Austropyrgus lochi* ○, *A. privus* ★, *A. stevensmithi* □, *A. nanoacuminatus* ▲, *A. juliae* ▽ and *A. petterdianus* ●.

Group 3. *Austropyrgus sparsus* group

Small to medium sized shells, conical, with convex to slightly convex whorls. Coiled oviduct inverted U-shape or with two or more bends, loops or twists.

The following characters are common to Group 4: Aperture slightly disjunct, except for *A. aslini* and *A. flindersensis* where it is sometimes not disjunct. Median cusp of lateral tooth of medium length and sharply pointed. Osphradium elongately oval; faecal pellets orientated longitudinally except for *A. niger* which are orientated transversely. Anus intermediate in position except for *A. nepeanensis*, *A. gippslandicus*, *A. turbatus* and *A. gordonensis* where it is located near the mantle edge and *A. dekeyzeri* where it is located intermediate to distant from the mantle edge. Ctenidium abutting anterior end of pericardium except for *A. turbatus* and *A. diemensis* where it can also be overlapping by one filament and *A. ronkershawi* and *A. salvus* where it can also be separated by a short efferent branchial blood vessel. Distal end of penis long and tapering.

This large group of conical taxa comprises 37 taxa or 50% of the southeastern Australian species of *Austropyrgus*. Most of the taxa included here have very uniform shell features but a discriminant analysis on the members of this group using shell characters and a subset of opercular characters successfully classified 63% of individuals.

Southern New South Wales taxa

Austropyrgus sparsus (Iredale, 1944)

Figs. 6E, 7I,J, 23B, 24C, 25A, 26A, 27A, 28A, 29A

Potamopyrgus sparsus Iredale, 1944: 114, fig. 4.

Fluvidona sparsus.—Smith, 1992: 47.

Austropyrgus sparsus.—Ponder *et al.*, 2000.

Type material. Holotype C.100614 (Fig. 25A), paratypes C.109316 (19), C.109317 (1).

Type locality. Braidwood, New South Wales.

Material dissected and figured. C.302420, C.307587 (figured specimens), Monkitee Ck at rd to Goulburn, Braidwood, New South Wales, 35°26.48'S 149°47.98'E, in weeds and roots, 23 February, 1994.

Other material examined. New South Wales: Reedy Ck at Bettowynd Fire Trail, Bendoura Range, C.173978; Araluen Ck at camping ground near Araluen, C.201672; Reedy Ck, Marble Arch, Deua NP, C.173980; School House Ck, Gundillion, S of Braidwood, C.173982; School House Ck at Krawarree Rd, S of Braidwood, C.173979, C.173981.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with convex whorls, inner lip distinctly separated from parietal wall and outer lip with slight reflection; osphradium near middle of ctenidium.

Description. *Shell* (Figs. 23B, 24C, 25A, 26A). Shell 2.16–2.76 mm in height, 1.24–1.72 mm in width; spire of average length, outline straight; aperture 0.80–1.02 mm in height, 0.73–0.99 mm in width. Body whorl 1.51–1.93 mm in height. Teleoconch of 3.00–3.75 convex whorls, last whorl and base evenly convex. Inner lip of aperture distinctly separated from parietal wall, outer lip weakly thickened, with very slight reflection. Colour white to very pale yellow, translucent. *Operculum* (Fig. 27A). Operculum 0.74–0.95 mm in height, 0.52–0.75 mm in width, with 2–5 pegs. *Radula* (Fig. 28A). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 25–28 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 30–34 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe or pigmented dorsal central stripe only; snout, head, neck and foot with well-developed pigmentation; opercular lobe with poorly developed pigmentation; pallial roof and visceral coil with well-developed to mottled pigmentation. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 19–21 filaments. Osphradium located near middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; covers rectum when visible. Rectum without arch to with slight arch. Renal gland about 1/3–1/2 in pallial roof; oval; thin to intermediate in thickness. Pericardium about 1/2 in pallial roof. *Male reproductive system* (Fig. 7I,J). Testis of 1.00–1.10 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at central part of head to slightly to right; pigmented on all areas except base. *Female reproductive system* (Fig. 29A). Ovary lobulate, about 0.70–0.75 whorls. Coiled oviduct with initial U orientated dorsoventrally to longitudinally backwards; initial loop long; proximal part with one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct of medium length. Rectum

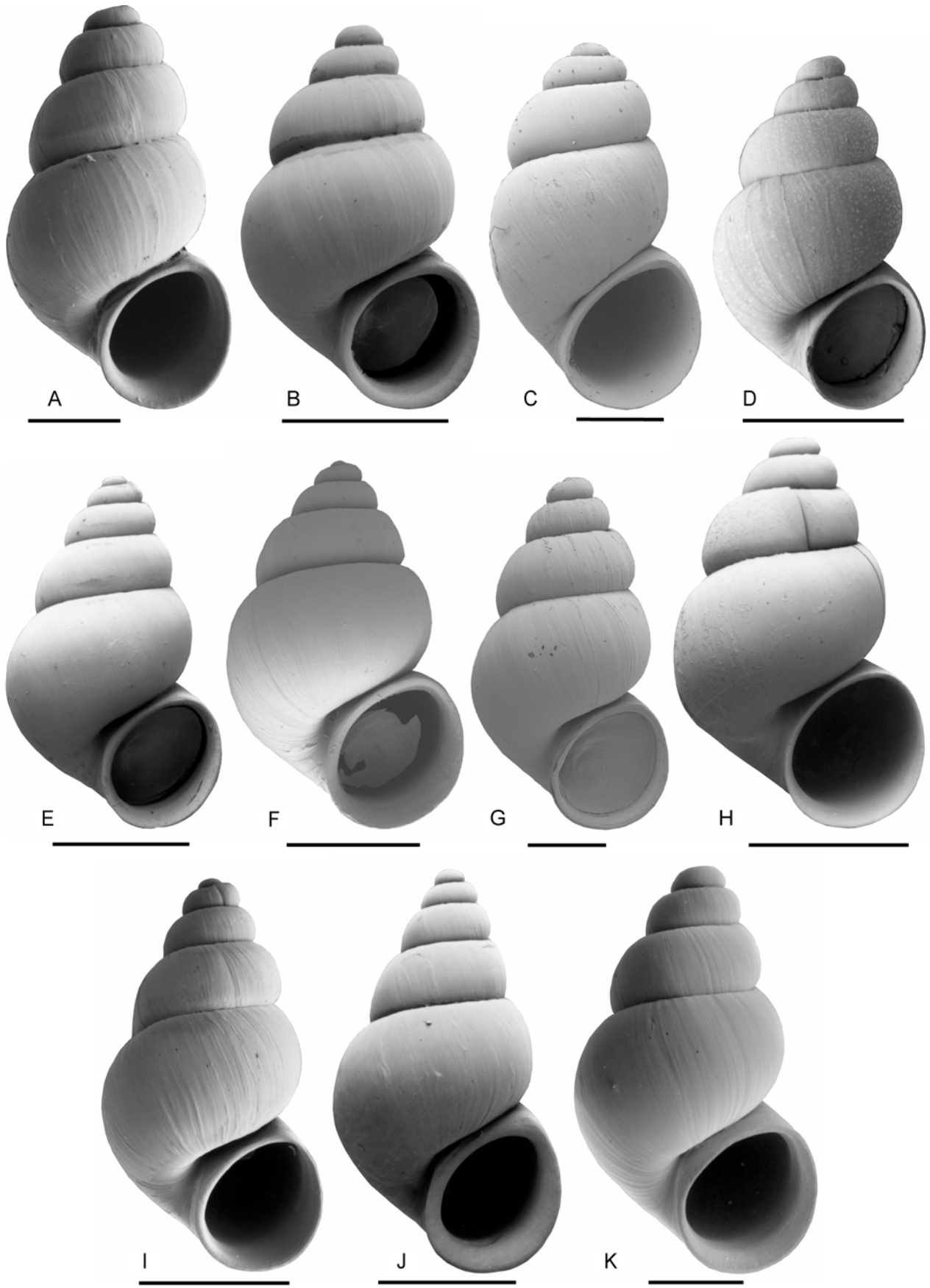


Fig. 23. Shells of species of *Austropyrgus*: A, *A. bungoniensis*, holotype, C.173964; B, *A. sparsus*, C.302420; C, *A. synoria*, holotype, C.173997; D, *A. tathraensis*, holotype, C.174008; E, *A. dekeyzeri*, holotype, C.343001; F, *A. wombeyanensis*, holotype, C.348556; G, *A. nepeanensis*, holotype, C.343011; H, *A. abercrombiensis*, holotype, C.343012; I, *A. buchanensis*, holotype, C.343005; J, *A. macaulayi*, holotype, C.334102; K, *A. ora*, holotype, C.343008. Scales B,D–F,H–J 1 mm; A,C,G,K, 0.5 mm.

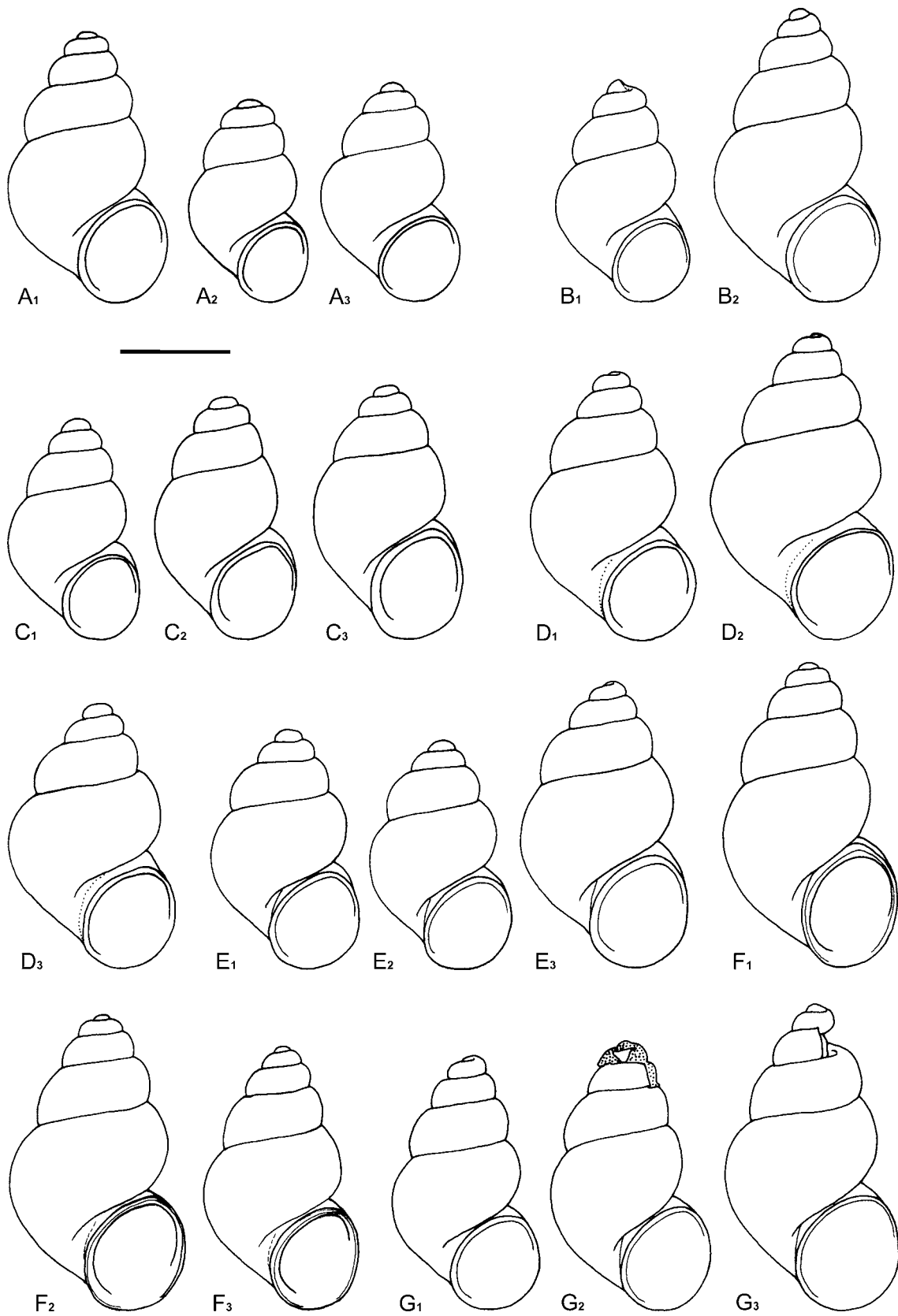


Fig. 24. Shells of species of *Austropyrgus*: A, *A. bungoniensis*, paratypes, C.307595; B, *A. synoria*, paratypes, C.307578; C, *A. sparsus*, C.307587; D, *A. nepeanensis*, paratypes, C.343010; E, *A. wombeyanensis*, paratypes, C.343753; F, *A. tathraensis*, paratypes, C.307588; G, *A. abercrombiensis*, paratypes, C.334100. Scale 1 mm.

overlapping albumen and capsule glands. About ½ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
holotype	2.36	1.48	0.88	3.35
paratypes	2.17–2.49	1.31–1.56	0.81–0.98	3.25–3.65
figured SEM specimen	2.22	1.36	0.86	3.05

Iredale's original measurements were given as 2.75×1.75 mm.

Distribution and habitat. This species is known from a number of small streams around the Braidwood area of southern New South Wales (Fig. 30). It can be very abundant and is typically found on leaves, weeds and stones.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is similar to all other species of Group 3 in New South Wales and eastern Victoria except for *A. synoria*. It differs from *A. tathraensis*, *A. abercrombiensis* and *A. dekeyzeri* in not possessing a reflected outer lip. It can be separated from *A. buchanensis* in the shell having more convex whorls and from *A. abercrombiensis* in the shell being broader. Other similar taxa include *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. nitidus*, *A. gordonensis*, *A. gunnii*, *A. colludens*, *A. tebus* and *A. simsonianus* and can be distinguished by morphological and anatomical characters (see descriptions).

In the discriminant analysis specimens of *A. sparsus* were misclassified by more than one individual as *A. dekeyzeri* (3), *A. daylesfordensis* (3), *A. turbatus* (2) and *A. wombeyanensis* (2) (overall 43% correct). When the analysis was restricted to Group 3, 43% were correctly classified, with the following misclassified as *A. turbatus* (4), *A. gippslandicus* (1), *A. bungoniensis* (1), *A. wombeyanensis* (1), *A. ora* (1), *A. niger* (1) and *A. gordonensis* (1).

Austropyrgus bungoniensis n.sp.

Figs. 23A, 24A, 29B

Austropyrgus Bungonia species—Ponder *et al.*, 2000.

Type material. Holotype C.173964, figured paratypes C.307595 (3), paratypes C.173965 (20+).

Type locality. Spring flowing into Bungonia Ck, on Red Track below the "Efflux", bottom of Bungonia Gorge, New South Wales, 34°47.82'S 150°0.93'E, in weed, 29 January 1993.

Other material examined. New South Wales: trib of Bungonia Ck, at bottom of "red track", C.320200, C.320202; small springs, downstream of main spring at cave B68, C.308934, C.308947, C.308948; main spring at B68, C.308940; Bungonia Ck, 40m upstream from Red Track exit, C.308946.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium size, with straight spire outline; pallial vas deferens straight at prostate gland; penis attached at central part of head; oviduct joins bursal duct ventrally; rectum separate from both albumen and capsule glands.

Description. *Shell* (Figs. 23A, 24A). Shell 1.79–2.58 mm in height, 1.05–1.51 mm in width; spire of average length, outline straight; aperture 0.70–0.96 mm in height, 0.70–0.88 mm in width. Body whorl 1.28–1.78 mm in height. Teleoconch of 3.00–3.80 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, with very slight reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.20 mm; SW, 1.30 mm; AH, 0.83 mm; TW, 3.30 whorls. *Operculum.* Operculum 0.67–0.96 mm in height, 0.45–0.68 mm in width, with 2–6 pegs. *Radula.* Central teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp less than 2 times to about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 18–25 cusps, ratio of cutting edge to shaft about ½, outer marginal teeth with 25–29 cusps, ratio of cutting edge to shaft about ¼. *Head-foot.* Cephalic tentacles pigmented with a colourless median dorsal stripe or only with poorly developed pigmented dorsal central stripe; snout pigmentation well developed to just around edges; foot, head and neck with well to poorly developed pigmentation; opercular lobe with pigmentation well developed to unpigmented; pallial roof with well-developed to mottled pigmentation; visceral coil densely pigmented. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 14–17 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to thick; covers rectum when visible. Rectum without arch to with slight arch. Renal gland about ¼ in pallial roof; oval; thin. Pericardium about ½ in pallial roof. *Male reproductive system.* Testis of 0.9–1.1 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface; straight at prostate; slightly undulating between prostate and penis; slightly undulating at base of penis. Penis attached at central part of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 29B). Ovary lobulate, about 0.75–1.00 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop medium to high; proximal part with one bend, loop or twist; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided or widest at junction with distal coiled oviduct. Oviduct joining bursal duct ventrally. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum separate from albumen and capsule glands. ¼ or less of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland to terminal.

Distribution and habitat. This species is currently only known from the small streams and springs flowing from the Bungonia Gorge Caves, southern New South Wales (Fig. 30). However, unlike the Wombeyan Cave system no hydrobiids have as yet been detected living in the caves. This species is typically found on leaves, weeds and stones and is very abundant.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. Other New South Wales and Victorian species with similar shells are *A. sparsus*, *A. wombeyanensis*, *A. nepeanensis*, *A. tathraensis*, *A. abercrombiensis*, *A. buchanensis*, *A. ora*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus* and *A. dekeyzeri*. It differs from *A. tathraensis* in its smaller, narrower shell, which has a taller spire and the outer lip has a reflection (lacking in *A. tathraensis*) and from *A. nepeanensis* in its slightly less rounded whorls and outer lip with a reflection (without in *A. nepeanensis*). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis* and *A. halletensis* and can be distinguished by morphological and anatomical characters (see descriptions).

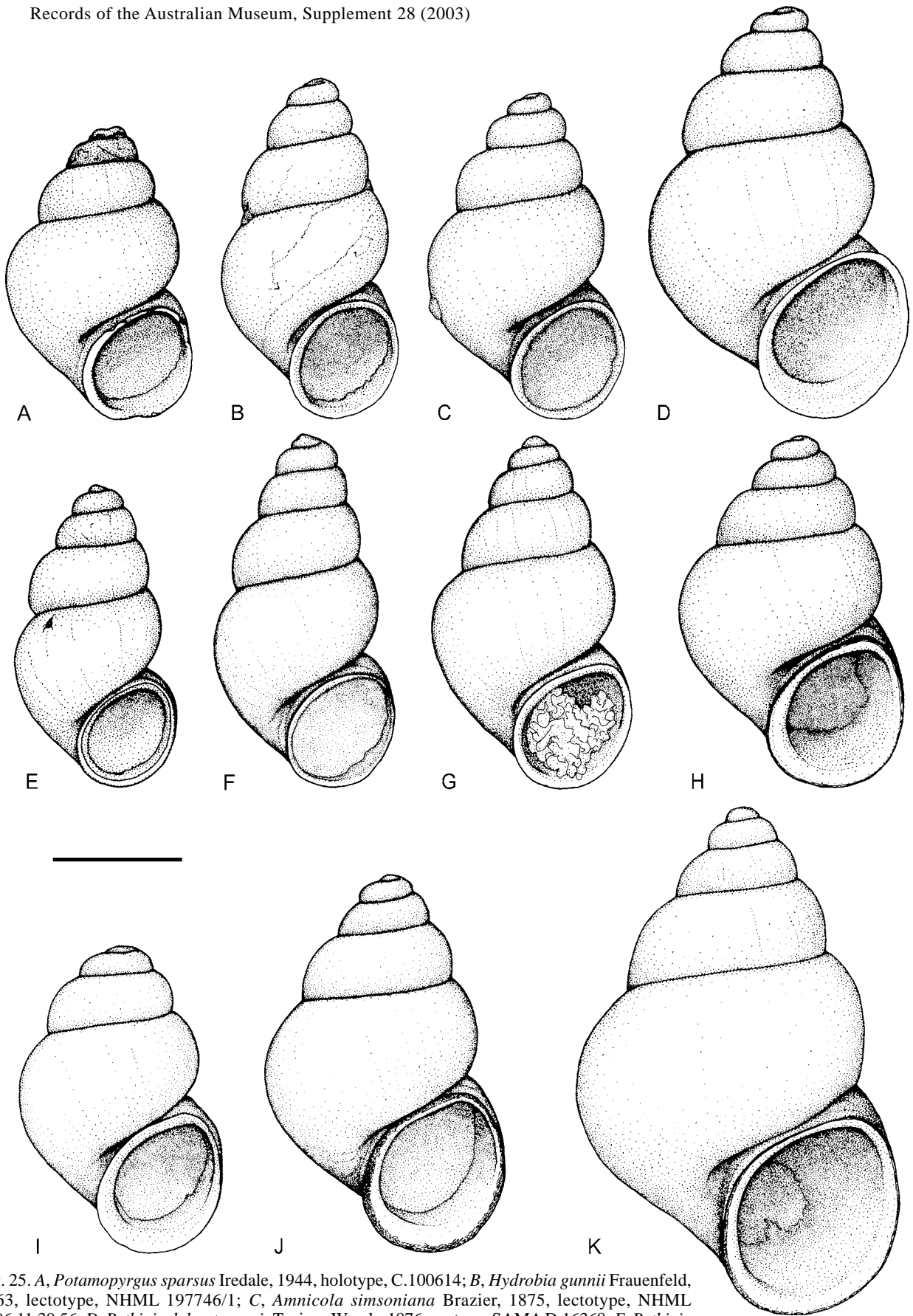


Fig. 25. A, *Potamopyrgus sparsus* Iredale, 1944, holotype, C.100614; B, *Hydrobia gunnii* Frauenfeld, 1863, lectotype, NHML 197746/1; C, *Amnicola simsoniana* Brazier, 1875, lectotype, NHML 1896.11.30.56; D, *Bythinia dulvertonensis* Tenison Woods, 1876, syntype, SAMA D.16368; E, *Bythinia dunrobinensis* Tenison Woods, 1876, paratype, SAMA D.15769; F, *Bythinia pontvillensis* Tenison Woods, 1876, syntype, TMH E.475/7816; G, *Bithynella nitida* Johnston, 1879, lectotype, TMH Z.198; H, *Amnicola diemense* Frauenfeld, 1863, lectotype, NHML 197745/1; I, *Potamopyrgus brownii* Petterd, 1889, syntype, C.27794; J, *Potamopyrgus woodsii* Petterd, 1889, syntype, C.27792; K, *Hydrobia angasi* Smith, 1882 lectotype, NHML 1973003/1. Scale 1 mm.

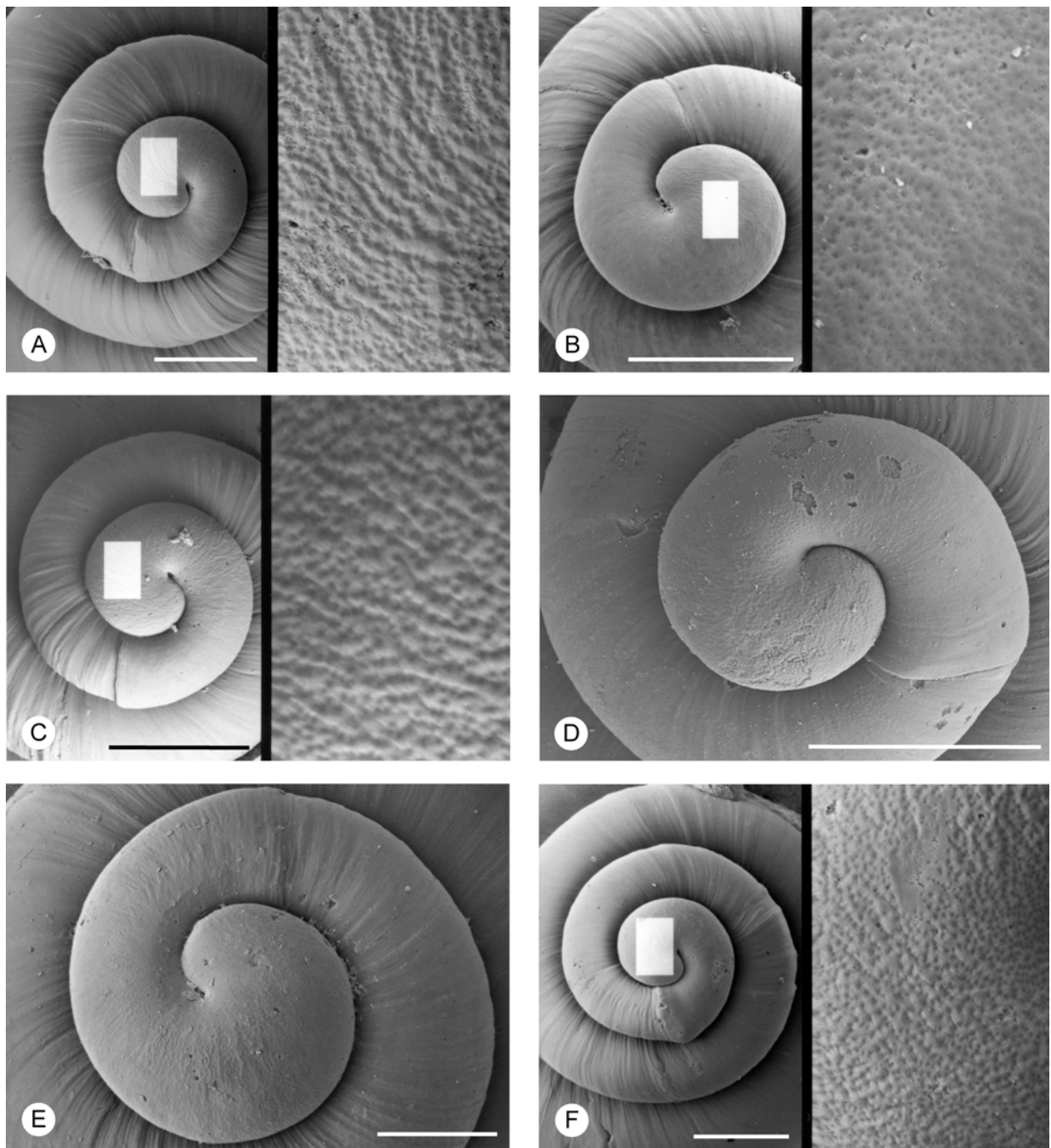


Fig. 26. Protoconchs of species of *Austropyrgus*: A, *A. sparsus*, C.302420; B, *A. macaulayi*, C.174674; C, *A. simsonianus*, C.204041; D, *A. macropus*, SAMA D.19086; E, *A. angasi*, C.166887; F, *A. diemensis*, C.201203. Scales A–D,F 0.2 mm; E 0.1 mm.

The shells are frequently covered to varying degrees by a hard calcareous deposit that in its extreme can more than double the size of the specimen.

In the discriminant analysis no specimens of *A. bungoniensis* were misclassified by more than one individual except for two attributed to *A. abercrombiensis* (overall 60% correct). When the analysis was restricted to Group 3, 60% were correctly classified, with the following misclassified as *A. dyerianus* (3), *A. gippslandicus* (1), *A. tathraensis* (1), *A. dekeyzeri* (1), *A. exiguus* (1) and *A. nitidus* (1).

Etymology. Named after the type locality.

Austropyrgus synoria n.sp.

Figs. 23C, 24B, 29C

Austropyrgus Eden species—Ponder *et al.*, 2000.

Type material. Holotype C.173997, figured paratypes C.307578 (3), paratypes C.173998 (20+).

Type locality. Trib. of Myrtle Ck at road to Candelo, New South Wales, 36°52.90'S 149°41.13'E, on algae, 21 February 1983.

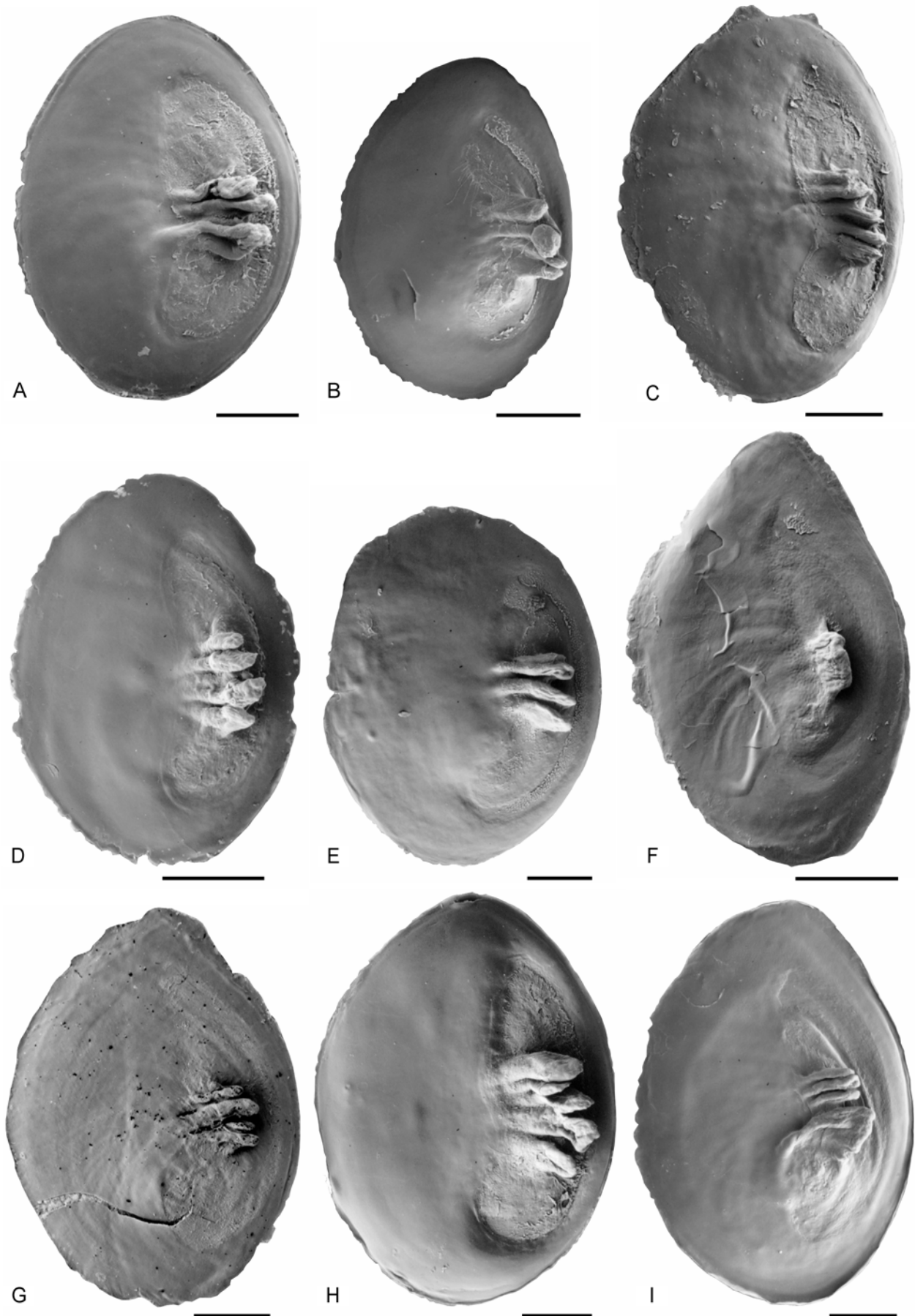


Fig. 27. Opercula of species of *Austropyrgus*: A, *A. sparsus*, C.302420; B, *A. tathraensis*, C.174009; C, *A. buchanensis*, C.302530; D, *A. simsonianus*, C.204041; E, *A. pagodoides*, C.201020; F, *A. tateiformis*, C.201033; G, *A. angasi*, C.166887; H, *A. rectoides*, C.201055; I, *A. diemensis*, C.201203. Scales all 0.2 mm.

Other material examined. **New South Wales:** trib of Yankees Ck at Yankees Gap Rd, N side of Yankees Gap, C.173999; trib of Rutherford Ck at Snowy Mountains Hwy, SE of Piper Lookout, C.174004, C.174044; trib of Tantawangalo Ck at Postmans Track, C.174003; Solomons Ck at fire trail through Glen Bog SF, C.174001.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell subpupiform, with straight to convex spire outline, outer lip heavily thickened; prostate gland oval to elongate pyriform, pallial vas deferens slightly undulating at prostate gland; penis attached to central part of head.

Description. *Shell* (Figs. 23C, 24B). Shell 1.91–2.68 mm in height, 1.13–1.66 mm in width; spire of average length, outline straight to convex; aperture 1.74–1.06 mm in height, 0.72–0.98 mm in width. Body whorl 1.40–1.85 mm in height. Teleoconch of 3.00–3.85 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.11 mm; SW, 1.21 mm; AH, 0.86 mm; TW, 3.25 whorls. *Operculum.* Operculum 0.75–0.96 mm in height, 0.51–0.70 mm in width, with 2–4 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 17–22 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 26–33 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles with pigment absent, or pigmented dorsal central stripe only; snout with pigment well developed to around edges; foot, opercular lobe, head and neck pigmentation poorly developed to absent; pallial roof and visceral coil with pigment mottled to absent. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 14–18 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to thick; covers rectum when visible. Rectum without arch or with short S-shape. Renal gland about $\frac{1}{4}$ – $\frac{1}{3}$ in pallial roof; oval; thin to very thick. Pericardium about $\frac{1}{3}$ in pallial roof. *Male reproductive system.* Testis of 0.9–1.0 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{2}{3}$ in pallial roof, kidney-shaped to elongate pyriform, compressed in cross section. Pallial vas deferens flush with surface; slightly undulating at prostate; slightly undulating between prostate and penis; slightly undulating at base of penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 29C). Ovary simple, about 0.6–1.1 whorls. Coiled oviduct with initial U orientated dorsoventrally to longitudinally backwards; initial loop long to medium; proximal part inverted U-shape to two or more bends, loops or twists; straight to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct ventrally or from right side. Oviduct bent just before bursal duct joins to straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, end rounded, duct short to medium length. Rectum indenting albumen gland, and overlapping capsule gland to indenting capsule gland. $\frac{1}{4}$ or less of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones to with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams around the Candelo region of southern New South Wales (Fig. 30). It is typically found on weeds, leaves, roots and stones and can be common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. This species can be distinguished from the other New South Wales members of Group 3 by its subpupiform shell usually with a weakly convex to convex spire outline and heavily thickened outer

lip. *Austropyrgus synoria* can be differentiated from other members of Group 3 by several shell and anatomical characters (see descriptions).

In the discriminant analysis no specimens of *A. synoria* were wrongly classified by more than one individual (overall 65% correct). When the analysis was restricted to Group 3, 60% were correctly classified, with the following misclassified as *A. abercrombiensis* (3), *A. gippslandicus* (1), *A. bungoniensis* (1), *A. tathraensis* (1), *A. fonscultus* (1) and *A. niger* (1).

Etymology. *Synoria* Greek: borderland—referring to the distribution of the species, which is found in southern New South Wales near the Victorian border.

Austropyrgus tathraensis n.sp.

Figs. 23D, 24F, 27B, 29D

Austropyrgus Tathra-Bega species—Ponder *et al.*, 2000.

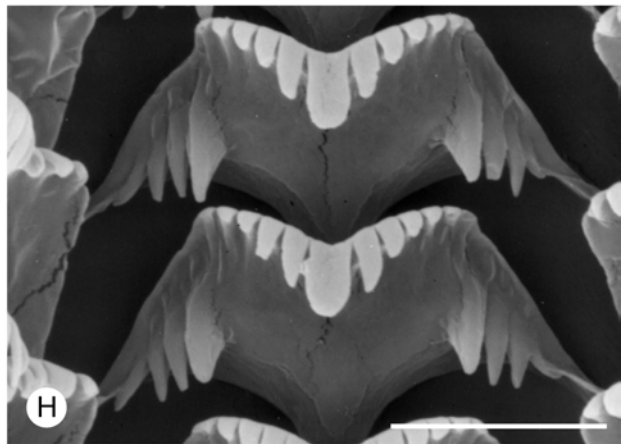
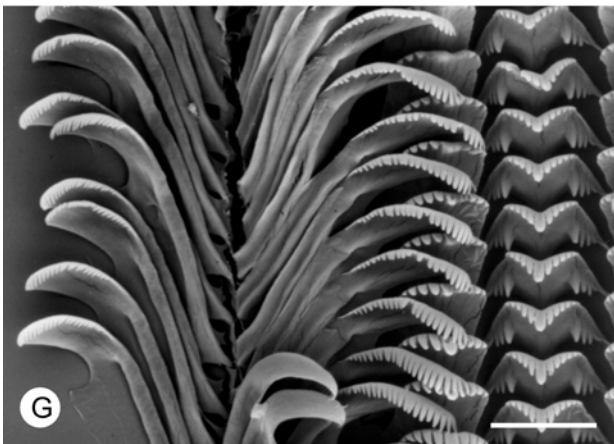
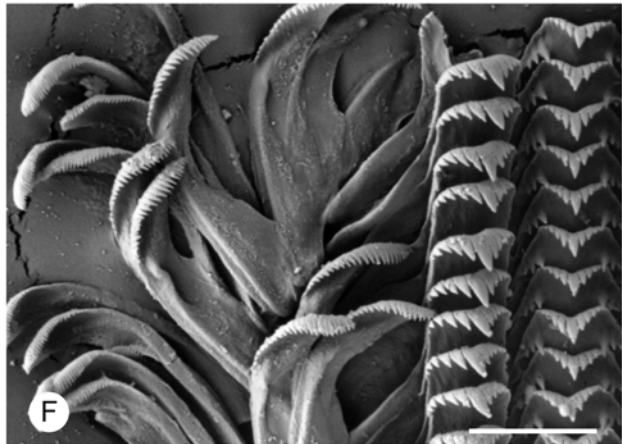
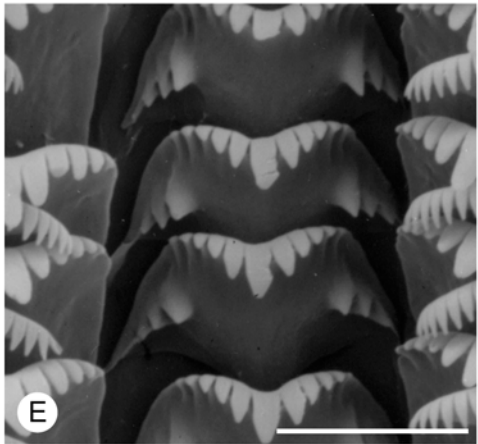
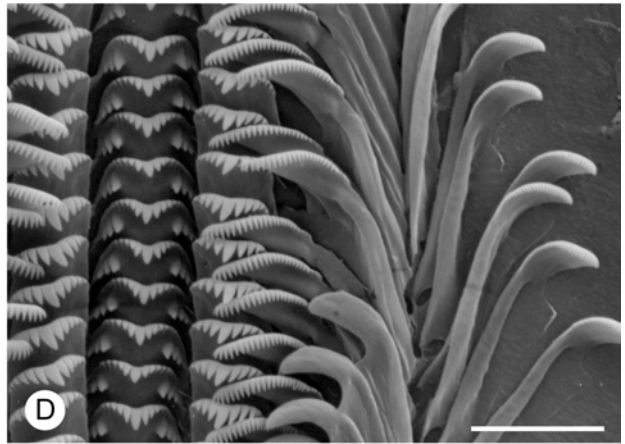
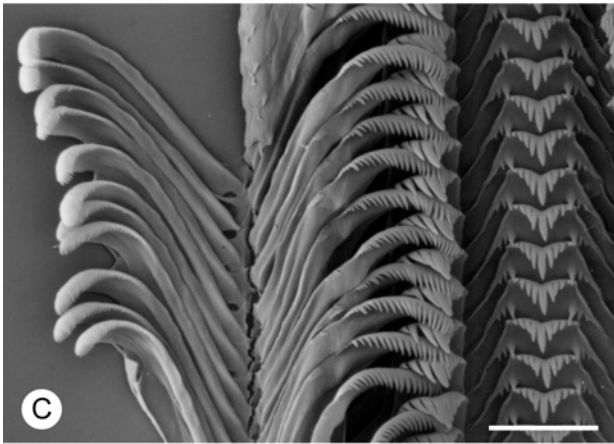
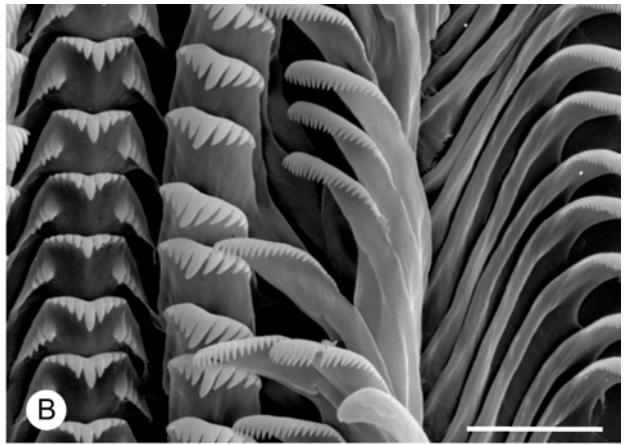
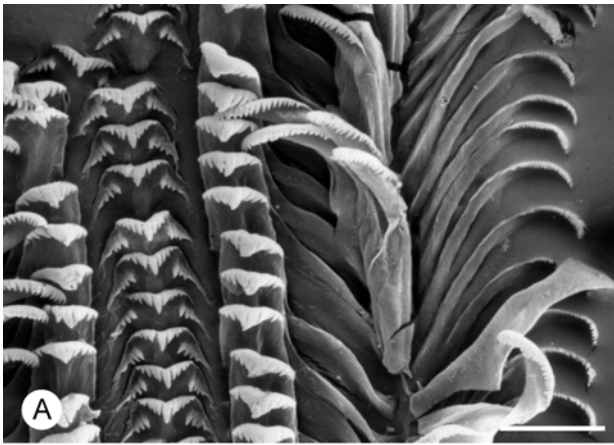
Type material. Holotype C.174008, figured paratypes 307588 (3), paratypes C.174009 (20+), C.302468 (20+).

Type locality. Trib. of Wapengo Ck at Tathra-Bermagui Rd, N of Tathra, New South Wales, 36°35.98'S 149°49.98'E, amongst sedge, in pools of small stream, 27 February 1983.

Other material examined. **New South Wales:** trib of Racecourse Ck, S of Moruya, C.174015; Deep Ck at Lower Cadgee–Nerrigundah Rd, C.174010; Punkally Ck at Mount Dromedary Rd, Bodalla SF, SW of Narooma, C.201004; Pollacks Flat Ck at Yankees Gap Rd, Yankees Flat, C.174014; Nunnock R at Snowy Mountains Hwy, 35 km SE of Nimmitabel, MV F.54437; creek at Wents Rd, 0.25 km off Snowy Mountains Hwy, C.174013; Wallagarough R at Princes Hwy, MV F.54439.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline; prostate gland about $\frac{1}{2}$ in pallial cavity; pallial vas deferens straight at prostate gland and between prostate and penis; proximal part of coiled oviduct with more than two bends, loops or twists; seminal receptacle ovoid.

Description. *Shell* (Figs. 23D, 24F). Shell 2.05–2.82 mm in height, 1.17–1.70 mm in width; spire of average length, outline straight; aperture 0.75–1.01 mm in height, 0.70–0.94 mm in width. Body whorl 1.42–1.86 mm in height. Teleoconch of 3.25–4.10 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.14 mm; SW, 1.35 mm; AH, 0.88 mm; TW, 3.50 whorls. *Operculum* (Fig. 27B). Operculum 0.73–1.04 mm in height, 0.51–0.73 mm in width, with 3–5 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 18–23 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 25–29 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles pigmented (with unpigmented median dorsal stripe) to unpigmented; snout unpigmented; rest of animal with pigmentation well developed to absent. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 17–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland



very reduced (appears to be absent) to moderately developed; not covering to partly covering rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{4}$ – $\frac{1}{3}$ in pallial roof; oval; intermediate in thickness. Pericardium about $\frac{1}{3}$ in pallial roof. *Male reproductive system.* Testis of 0.75–1.25 whorls. Seminal vesicle tightly coiled over stomach to loosely coiled over stomach; not conspicuously coiled on digestive gland behind stomach to conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, straight between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only or on all areas except base or on basal section only. *Female reproductive system* (Fig. 29D). Ovary simple to lobulate, ovary about 0.90–1.25 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part with two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct bent to straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, end rounded, duct of medium length. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small coastal streams and rivers around the Tathra region of southern New South Wales (Fig. 30). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is most similar to *A. sparsus* (see remarks under *A. sparsus*), *A. wombeyanensis*, *A. buechanensis* and *A. abercrombiensis*. It differs from *A. wombeyanensis* by its slightly narrower shell, outer marginal teeth with 25–29 cusps (22–23 cusps in *A. wombeyanensis*). It differs from *A. buechanensis* by its slightly broader shell and some anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidlerii*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. buechanensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. tathraensis* were misclassified by more than one individual except for three attributed to *A. bungoniensis* (overall 65% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following misclassified as *A. bungoniensis* (3), *A. buechanensis* (2), *A. dekeyzeri* (2), *A. sparsus* (1) and *A. simsonianus* (1).

Etymology. Named after the town of Tathra (New South Wales) near the type locality.

Austropyrgus wombeyanensis n.sp.

Figs. 23F, 24E, 29E

Austropyrgus Wombeyan creek species—Ponder *et al.*, 2000.

Type material. Holotype C.348556, figured paratypes C.343753 (3), paratypes C.201665 (20+).

Type locality. Mares Forest Ck, below Wombeyan Quarry, Wombeyan Caves, New South Wales, 34°18.36'S 149°59.50'E, 12 March 1994.

Other material examined. New South Wales: main spring, Little Wombeyan Ck, C.201686; spring flowing into Mares Forest Ck, below Wombeyan Quarry, C.370346, C.378420; very small spring flowing into Mares Forest Ck, below pumphouse, C.201659.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with convex whorls, central teeth with 4 lateral cusps and 4 pairs of basal cusps, osphradium located near middle of ctenidium, pericardium about $\frac{1}{2}$ or more in pallial roof.

Description. *Shell* (Figs. 23F, 24E). Shell 2.14–2.85 mm in height, 1.31–1.72 mm in width; spire of average length to squat, outline straight to weakly-convex; aperture 0.85–1.18 mm in height, 0.80–1.02 mm in width. Body whorl 1.53–1.89 mm in height. Teleoconch of 3.25–3.75 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.85 mm; SW, 1.72 mm; AH, 1.18 mm; TW, 3.70 whorls. *Operculum.* Operculum 0.77–1.03 mm in height, 0.61–0.78 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 4 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 18–20 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 22–23 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe or dorsal central pigmented stripe only; snout, head, neck, pallial roof and visceral coil with well-developed pigment; foot with well to poorly developed pigmentation; opercular lobe with poorly developed pigmentation; pallial roof with well-developed pigmentation. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 17–20 filaments. Osphradium located near middle of ctenidium. Hypobranchial gland appears to be absent to moderately developed to thick; covers rectum when visible. Rectum without arch to with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium about $\frac{1}{2}$ or more in pallial roof. *Male reproductive system.* Testis of 0.5–0.8 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, broadly-oval in cross section to compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 29E). Ovary lobulate, about 0.65–0.75 whorls. Coiled oviduct with initial U orientated

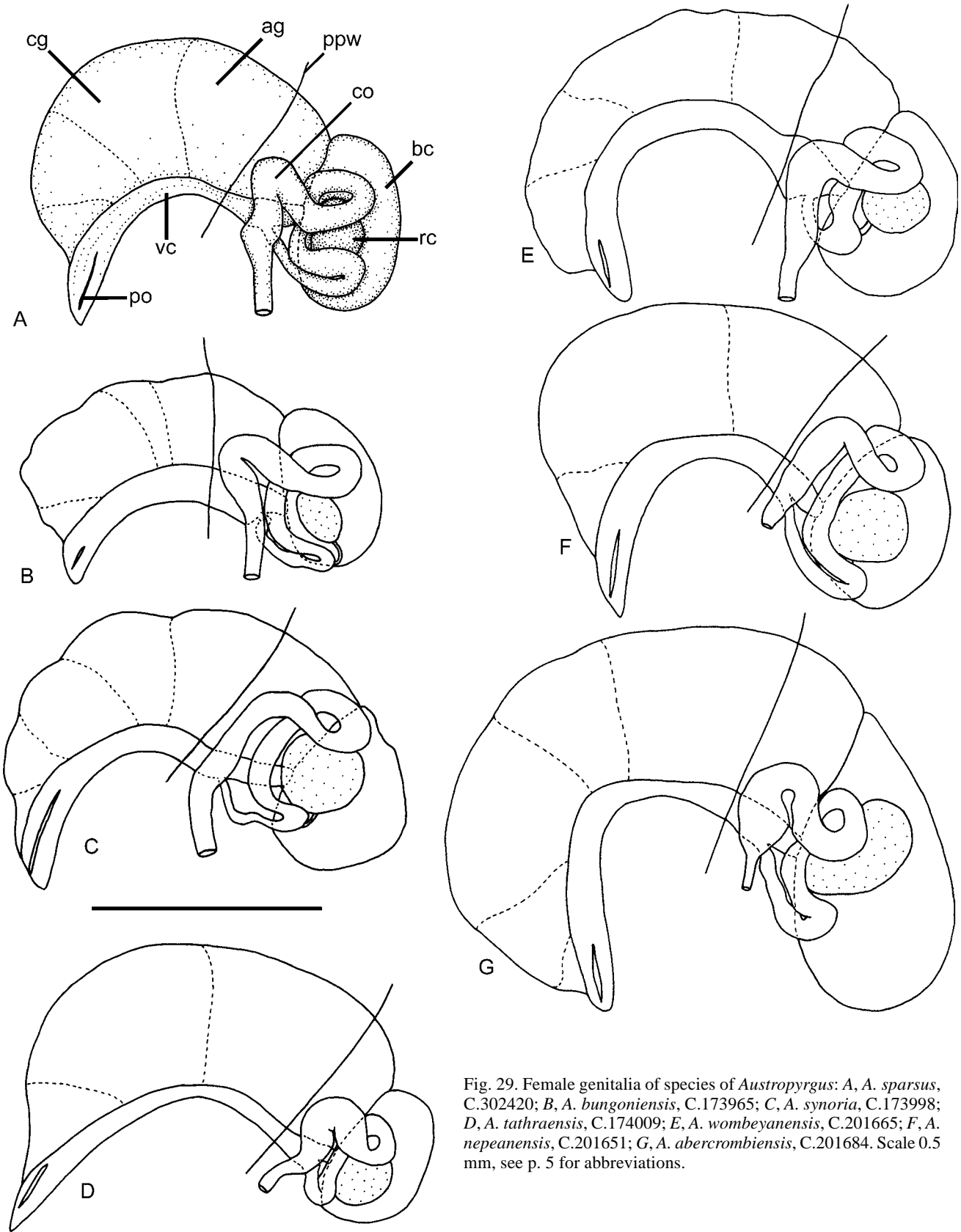


Fig. 29. Female genitalia of species of *Austropyrgus*: A, *A. sparsus*, C.302420; B, *A. bungoniensis*, C.173965; C, *A. synoria*, C.173998; D, *A. tathraensis*, C.174009; E, *A. wombeyanensis*, C.201665; F, *A. nepeanensis*, C.201651; G, *A. abercrombiensis*, C.201684. Scale 0.5 mm, see p. 5 for abbreviations.

obliquely backwards to longitudinally backwards; initial loop medium; proximal part with two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct of medium length. Rectum indenting

albumen gland and overlapping capsule gland. About 1/2 or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a few small springs and streams around Wombeyan Caves, New South Wales (Fig. 30). It has not been found in sympatry with *A. lippus*, which also occurs at the caves. It is typically found on weeds, leaves and roots and can be common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It however, can be found very close to small springs where *A. lippus* occurs and from which it can be distinguished by its larger size, broader shape and more rounded whorls. It is most similar to *A. sparsus* (see remarks under *A. sparsus*), *A. tathraensis* (see remarks under *A. tathraensis*), *A. buechanensis* and *A. abercrombiensis*. It differs from *A. buechanensis* in some anatomical characters (see descriptions) and from *A. abercrombiensis* in its slightly narrower shell and radular and anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidlereri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buechanensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. wombeyanensis* were misclassified by more than one individual (overall 75% correct). When the analysis was restricted to Group 3, 75% were correctly classified, with the following misclassified as *A. gippslandicus* (1), *A. bungoniensis* (1), *A. sparsus* (1), *A. dekeyzeri* (1) and *A. macaulayi* (1).

Etymology. Named after the type locality.

Austropyrgus nepeanensis n.sp.

Figs. 23G, 24D, 28B, 29F

Austropyrgus Nepean River species—Ponder *et al.*, 2000.

Type material. Holotype C.343011, figured paratypes C.343010 (3), paratypes C.201651 (20+).

Type locality. Stonequarry Ck, about 50m upstream from the Nepean R, at Maldon, S of Picton, New South Wales, 34°12.34'S 150°37.83'E, in leaves etc., 3 October 1994.

Other material examined. New South Wales: Cattai Ck at Neich Rd, Maraylya, C.320465; Nepean R, Douglas Park Causeway, Douglas Park, C.201689, C.309199; Nepean R, Maldon Weir, Maldon, C.309193, C.309188; Nattai R, at The Crags, N of Mittagong, C.204153.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, narrow, with straight spire outline and convex whorls; central teeth with 5 lateral cusps and 4 pairs of basal cusps; anus near mantle edge; pericardium more than ½ in pallial roof.

Description. *Shell* (Figs. 23G, 24D). Shell 1.84–2.42 mm in height, 1.19–1.48 mm in width; spire of average length, outline straight; aperture 0.70–0.94 mm in height, 0.68–0.86 mm in width. Body whorl 1.36–1.67 mm in height. Teleoconch of 3.00–3.75 convex whorls, last whorl and

base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 2.18 mm; SW, 1.21 mm; AH, 0.78 mm; TW, 3.50 whorls. *Operculum*. Operculum 0.70–0.91 mm in height, 0.53–0.65 mm in width, with 2–5 pegs. *Radula* (Fig. 28B). Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 24–26 cusps, ratio of cutting edge to shaft about ¼, outer marginal teeth with 23–27 cusps, ratio of cutting edge to shaft about ¼. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout, head, neck, foot and visceral coil pigmentation well developed; opercular lobe with pigmentation poorly to well developed. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 18–21 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick; covers rectum. Rectum without arch with slight arch. Renal gland about ½ in pallial roof; oval; thin to intermediate in thickness. Pericardium more than ½ in pallial roof. *Male reproductive system*. Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, slightly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 29F). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part with 1–2 or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from a few small streams flowing into the Nepean River, western Sydney, New South Wales (Fig. 30). It is typically found on leaves and roots and can be common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus* and, surprisingly, has only recently been found despite the collecting effort that has occurred in the Sydney area over the last century. It is most similar to *A. bungoniensis* and *A. dekeyzeri*. It differs from *A. bungoniensis* in its narrower shell, smaller aperture and a few anatomical characters (see descriptions). It differs from *A. dekeyzeri* in its narrower shell and a few anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidlereri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buechanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. nepeanensis* were misclassified by more than one individual other than four attributed to *A. tathraensis* (2) and *A. wombeyanensis* (2) (overall 65% correct). When the analysis was restricted to Group 3, 60% were correctly classified, with the following misclassified as *A. tathraensis* (2), *A. wombeyanensis* (2), *A. bungoniensis* (1), *A. ora* (1) and *A. simsonianus* (2).

Etymology. Named after the type locality.

Austropyrgus abercrombiensis n.sp.

Figs. 23H, 24G, 28C, 29G

Austropyrgus Abercrombie species—Ponder *et al.*, 2000.**Type material.** Holotype C.343012, figured paratypes C.334100 (3), paratypes C.203823 (20+), C.201684 (20+).**Type locality.** Efflux Cave, Abercrombie Caves, S of Blayney, New South Wales, 33°52.57'S 149°20.76'E, on tree roots, plant litter and silt, twilight and dark zones, 13 June 1995.**Diagnosis.** Differs from other members of Group 3 in the following combination of characters: shell small to medium in size and broad; central teeth with 3 pairs of basal cusps; seminal vesicle slightly undulating over stomach; penis pigmented on medial section only.

Description. *Shell* (Figs. 23H, 24G). Shell 2.13–3.07 mm in height, 1.30–1.83 mm in width; spire of average length, outline straight; aperture 0.83–1.08 mm in height, 0.79–1.01 mm in width. Body whorl 1.47–2.01 mm in height. Teleoconch of 3.10–4.00 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.50 mm; SW, 1.58 mm; AH, 0.97 mm; TW, 3.10 whorls. *Operculum.* Operculum 0.78–1.07 mm in height, 0.58–0.79 mm in width, with 1–4 pegs. *Radula* (Fig. 28C). Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–24 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 27–33 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles unpigmented or pigmented on basal portion only; snout unpigmented or weakly pigmented around edges; head, neck, foot and opercular lobe pigmentation poorly developed to unpigmented; pallial roof and visceral coil with pigmentation well developed to unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 17–21 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; covers rectum when visible. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; oval; thin. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system.* Testis of 1.00–1.25 whorls. Seminal vesicle slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface; slightly undulating at prostate; slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 29G). Ovary lobulate, about 1.00–1.25 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge or on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, oval in cross section to compressed-oval in cross section with indistinct to distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule to moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known only from a small stream flowing from the Efflux Cave, Abercrombie Caves, central New South Wales (Fig. 30). However, unlike the Wombeyan Caves system no hydrobiids have as yet been detected living in the caves.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is among the few species of *Austropyrgus* found in the drainage system of the Murray River. It is most similar to *A. sparsus* (see remarks under *A. sparsus*), *A. wombeyanensis* (see remarks under *A. wombeyanensis*), *A. tathraensis* (see remarks under *A. tathraensis*) and *A. buchanensis*. It differs from *A. buchanensis* in its broader shell with more convex whorls and a few anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidlereri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. tathraensis*, *A. buchanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. abercrombiensis* were wrongly classified by more than one individual (overall 70% correct). When the analysis was restricted to Group 3, 70% were correctly classified, with the following misclassified as *A. ora* (1), *A. tebus* (1), *A. macropus* (1), *A. zeidlereri* (1), *A. flindersensis* (1) and *A. halletensis* (1).

Etymology. Named after the type locality.

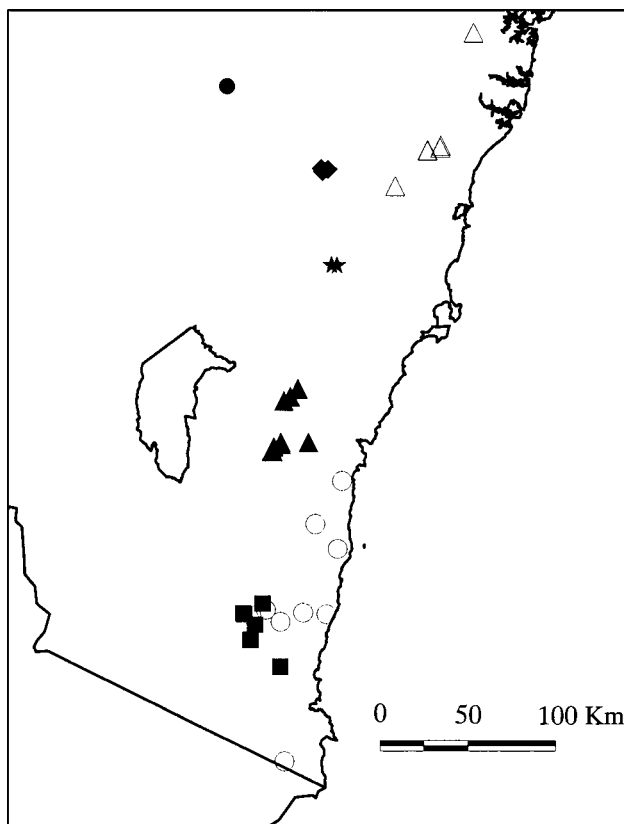


Fig. 30. Distribution of *Austropyrgus abercrombiensis* ●, *A. nepeanensis* △, *A. wombeyanensis* ◆, *A. tathraensis* ○, *A. synoria* ■, *A. bungoniensis* ★ and *A. sparsus* ▲.

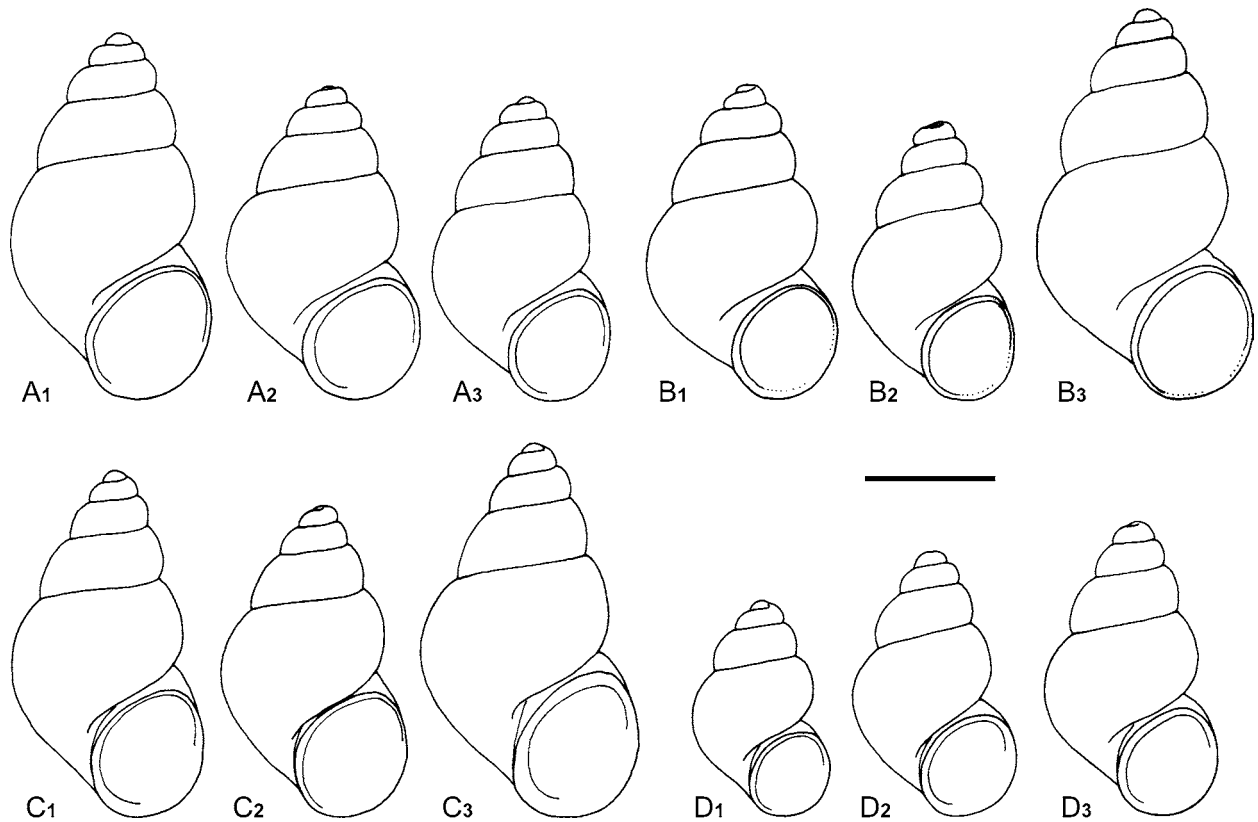


Fig. 31. Shells of species of *Austropyrgus*: A, *A. dekeyzeri*, paratypes, C.342593; B, *A. buchanensis*, paratypes, C.307586; C, *A. macaulayi*, paratypes, C.334101; D, *A. ora*, paratypes, C.334103. Scale 1 mm.

Eastern Victorian taxa

Austropyrgus dekeyzeri n.sp.

Figs. 23E, 31A, 32A

Type material. Holotype C.343001, figured paratypes C.342593 (3), paratypes C.174080 (20+).

Type locality. Trib. of Tambo R at Omeo Hwy, N of Jews Pinch, 21.1 km S of Ensay South, Victoria, 37°31.98'S 147°49.98'E, in weeds and roots, 6 February 1990.

Other material examined. Victoria: Dart R, ¼ mi upstream of bridge, on Cravensville Track, MV F.54453; Mitta Mitta R, 1 km upstream from dam site, New Dartmouth, C.174082, MV F.54794; Eustace Gap Ck, at and 1–2 km upstream of Mitta Mitta R, MV F.54792, F.82282, F.54790; Eight Mile Ck, 0.4–6 km upstream from Mitta Mitta R, Dartmouth, MV F.54791, F.54757, F.54752, F.54746, F.54793, F.54795; Swifts Ck, 3.5 km E of Swifts Creek, C.173722; Swifts Ck, 300 yards downstream from camping area, C.174306, MV F.82281; Tambo R, 8.2 km S of Swifts Creek, C.173723; Murrindal R at Falls Creek Rd, MV F.54461; Tambo R at Ensay, MV F.54466; Tambo R at Omeo Hwy, N of Bruthen, MV F.54467; Glenaladale NP, MV F.54462; Woolshed Ck, Mitchell River NP, C.174307; Tambo R at Bruthen, MV F.54465, F.54463, F.54468.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size; renal gland does not extend into pallial cavity; pallial vas deferens strongly undulating between prostate gland and penis; coiled oviduct and bursal duct join just in front of posterior pallial wall.

Description. *Shell* (Figs. 23E, 31A). Shell 1.83–2.70 mm in height, 1.11–1.65 mm in width; spire of average length, outline straight, aperture 0.70–1.07 mm in height, 0.65–0.97 mm in width. Body whorl 1.28–1.89 mm in height. Teleoconch of 3.25–4.15 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly

separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 2.65 mm; SW, 1.56 mm; AH, 0.99 mm; TW, 3.60 whorls. *Operculum*. Operculum 0.67–0.99 mm in height, 0.48–0.69 mm in width, with 3–5 pegs. *Radula*. Central teeth: with 4–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about 2 to less than twice as long as adjacent cusps. Basal projection of lateral teeth pointed. Inner marginal teeth with 21–25 cusps, ratio of cutting edge to shaft about ½, outer marginal teeth with 25–29 cusps, ratio of cutting edge to shaft about ¼. *Head-foot*. Cephalic tentacles with pigmented dorsal central stripe; snout, head and neck with well-developed pigmentation; foot and visceral coil pigmentation well to poorly developed; opercular lobe with pigmentation poorly developed to absent; pallial roof with pigmentation mottled to poorly developed. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 12–21 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; not over rectum to covering rectum. Rectum with slight arch. Renal gland does not extend in pallial roof; oval; intermediate in thickness. Pericardium about ⅓ in pallial roof. *Male reproductive system*. Testis of 1.25 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½–⅔ in pallial roof, kidney-shaped, compressed to highly compressed in cross section. Pallial vas deferens flush with surface; straight to strongly undulating at prostate, strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 32A). Ovary simple, about 1.5 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop long; proximal part inverted U-shape to two or more bends, loops or twists; one to two bends distal to seminal receptacle. Coiled oviduct and bursal duct join just in front of posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided or very short. Oviduct joining bursal duct ventrally or from left side. Oviduct bent or straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short to medium length. Rectum separate from albumen and capsule glands. About ½ to more than ½ of albumen gland in front of

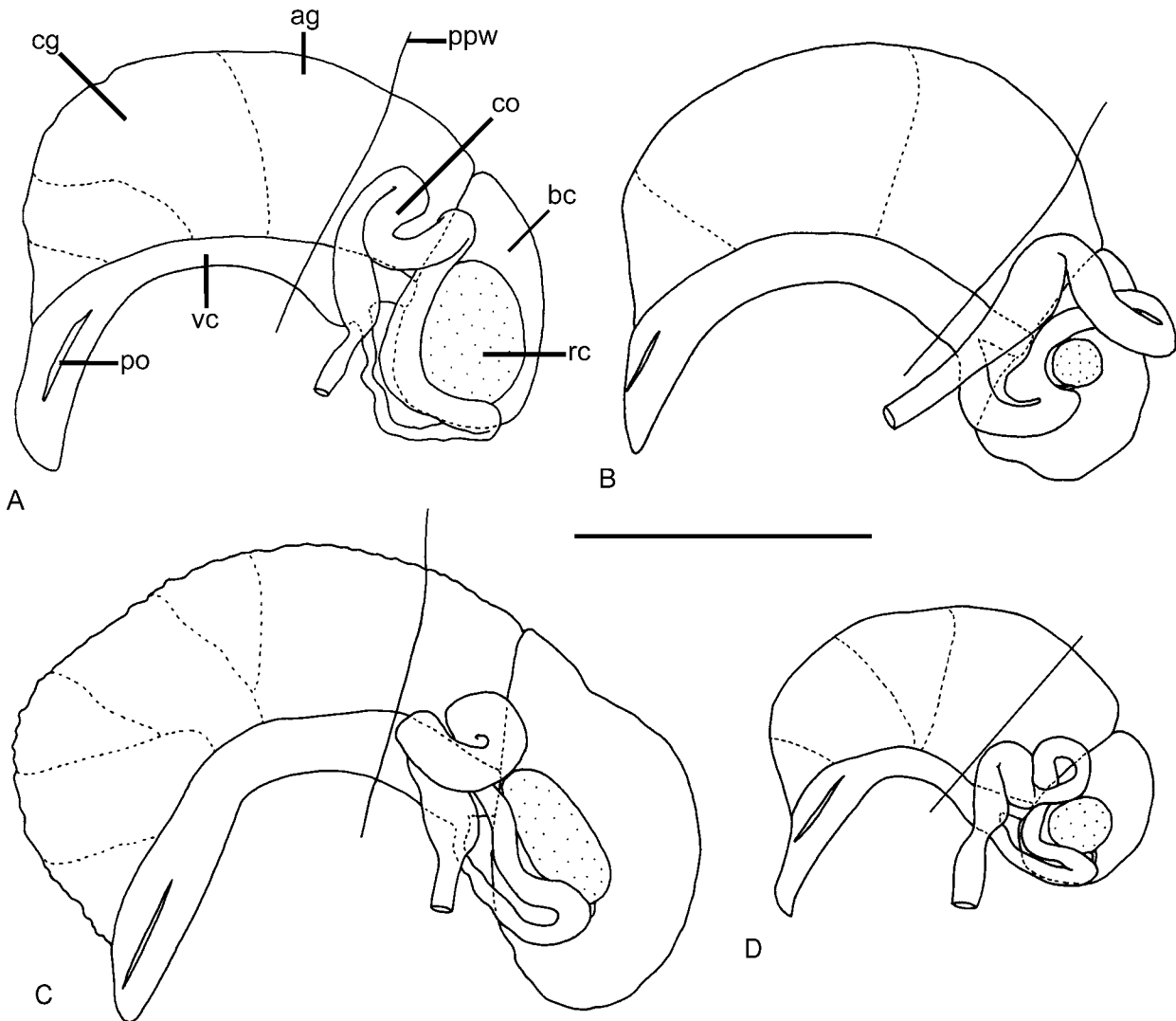


Fig. 32. Female genitalia of species of *Austropyrgus*: A, *A. dekeyzeri*, C.174080; B, *A. buchanensis*, C.302530; C, *A. macaulayi*, C.174674; D, *A. ora*, C.302460. Scale 0.5 mm, see p. 5 for abbreviations.

posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; anterior to overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams and rivers of central eastern Victoria (Fig. 33). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is most similar to *A. sparsus* (see remarks under *A. sparsus*), *A. turbatus*, *A. buchanensis* and *A. ora*. It differs from *A. turbatus* in its broader shell, is generally larger and slightly narrower than *A. buchanensis* and is larger and broader than *A. ora* and in some anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. gippslandicus*, *A. abercrombiansis*, *A. tathraensis*, *A. nepeanensis*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. dekeyzeri* were misclassified by more than one individual except for the following *A. nepeanensis* (2) and *A. vulgaris* (2) (overall

50% correct). When the analysis was restricted to Group 3, 60% were correctly classified, with the following misclassified as *A. wombeyanensis* (2), *A. nepeanensis* (2), *A. gippslandicus* (1), *A. tathraensis* (1), *A. macaulayi* (1) and *A. dyerianus* (1).

Etymology. Named after Roger de Keyzer who has assisted with fieldwork for this and other projects related to Australian freshwater molluscs throughout southeastern Australia.

Austropyrgus buchanensis n.sp.

Figs. 23I, 27C, 31B, 32B

Type material. Holotype C.343005, figured paratypes C.307586 (3), paratypes C.302530 (20+), MV F.82340 (3).

Type locality. Fairy Ck, first crossing after kiosk, Buchan Caves, Victoria, 37°29.93'S 148°9.57'E, in roots, 22 February 1994.

Other material examined. New South Wales: Chapel Ck, N of Dalgety, MV F.54440; Genoa R at Cann-Bombala Rd, MV F.54438; creek at Imlay Rd, 1.7 km E of Nungatta Rd, C.174002; trib of Little Bog Ck at Old Mill Rd, C.174000; Nungatta Ck at Eden Rd, 18 km E of Cann Valley

Hwy, MV F.54441. **Victoria:** Craigie Bog Ck at Bendoc Rd, C.174007; Butchers Ck at road, N of Butchers Creek, C.302421; Craigneish Ck, N of Butchers Ridge, C.302502; trib of Butchers Ck, Butchers Ridge, 22.5 mi N of Buchan-Jindabyne Rd, C.174081; Goanna Ck at Bonang Hwy, C.174006; A.E. Lind Memorial Pool, Buchan Caves, C.173720; Fairy Ck, Buchan Caves, MV F.82310; Tonghi Ck, 5 mi W of Cann River, C.174005, MV F.82309; Boggy Ck at Buchan Rd, C.201685; Boggy Ck at Princes Hwy, Nowa Nowa, MV F.54443.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with convex whorls; osphradium near posterior end of ctenidium; rectum with short S-shape; pericardium about $\frac{1}{2}$ in pallial roof; prostate gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; pallial vas deferens straight at prostate; penis pigmented on medial section only; coiled oviduct and bursal duct join at posterior pallial wall.

Description. *Shell* (Figs. 23I, 31B). Shell 2.19–2.72 mm in height, 1.34–1.69 mm in width; spire of average length, outline straight, aperture 0.80–1.00 mm in height, 0.74–0.95 mm in width. Body whorl 1.52–1.88 mm in height. Teleoconch of 3.10–3.80 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.50 mm; SW, 1.42 mm; AH, 0.88 mm; TW, 3.75 whorls. *Operculum* (Fig. 27C). Operculum 0.78–0.97 mm in height, 0.55–0.71 mm in width, with 3–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 19–23 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 27–30 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles unpigmented or with dorsal central stripe only; snout, head, neck, foot, pallial roof and visceral coil unpigmented to well developed; opercular lobe with pigmentation absent to poorly developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 18–22 filaments. Osphradium located near posterior end of ctenidium. Hypobranchial gland thick; covers rectum. Rectum with short S-shape. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium about $\frac{1}{2}$ in pallial roof. *Male reproductive system.* Testis of 0.60–0.75 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis attached well to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 32B). Ovary lobulate, about 1–2 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; initial loop proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right or left side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams and rivers of eastern Victoria and southern New South Wales (Fig. 33). It can be locally abundant and typically occurs on weeds, leaves, roots and stones.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is similar to *A. sparsus* (see remarks under *A. sparsus*), *A. wombeyanensis* (see remarks under *A. wombeyanensis*), *A. tathraensis* (see

remarks under *A. tathraensis*), *A. dekeyzeri* (see remarks under *A. dekeyzeri*) and *A. ora*. It differs from *A. ora* in its larger, broader shell and some anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. nepeanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. buchanaensis* were misclassified by more than one individual except those attributed to *A. sparsus* (2), *A. dekeyzeri* (2) and *A. tathraensis* (3) (overall 50% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following misclassified as *A. sparsus* (2), *A. tathraensis* (2), *A. dekeyzeri* (2), *A. bungoniensis* (1), *A. wombeyanensis* (1) and *A. gordonensis* (1).

Etymology. Named after the type locality.

Austropyrgus gippslandicus
(Ponder, Colgan, Clark, Miller & Terzis, 1994)

Figs. 34A, 35A

Fluvidona gippslandica Ponder *et al.*, 1994: 634–638, fig. 42A.

Type material. Holotype C.172757. Paratypes C.174023 (20+), C.174020 (20+), MV F.65712.

Type locality. Franklin R. at South Gippsland Hwy, E of Foster, Victoria, 38°40.4'S 146°17.783'E, in willow roots along edges, 11 January 1992.

Other material examined. **Victoria:** Franklin R, C.204011; Deep Ck at Boolarra-Foster Rd, C.174021; Franklin R at South Gippsland Hwy, C.300689; Deep Ck at South Gippsland Hwy, C.174022.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, with convex whorls; prostate gland about $\frac{1}{2}$ – $\frac{2}{3}$ in pallial roof; pallial vas deferens raised above surface, with overlying loops/coils at prostate gland; coiled oviduct and bursal join just behind pallial wall.

Description. *Shell* (Figs. 34A, 35A). Shell 1.76–2.45 mm in height, 1.07–1.38 mm in width; spire of average length, outline straight; aperture 0.72–0.94 mm in height, 0.65–0.86 mm in width. Body whorl 1.26–1.71 mm in height. Teleoconch of 2.85–3.75 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum.* Operculum 0.65–0.90 mm in height, with 1–4 pegs. *Radula.* Central teeth: with 5 lateral cusps, median cusp narrow, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, protruding well past lateral edge. Lateral teeth: with 4–5 lateral cusps; median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 19–25 cusps, ratio of cutting edge to shaft about $\frac{1}{2}$, outer marginal teeth with 23–30 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout, head and neck with pigment well developed; foot, opercular lobe, pallial roof and visceral coil pigmentation well to poorly developed. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 14–17 filaments, apices on right. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum without arch with short S-shape. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; oval; intermediate in thickness. Pericardium about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ – $\frac{2}{3}$ in pallial roof, kidney-shaped, broadly-oval in

cross section. Pallial vas deferens raised; with overlying loops/coils at prostate; slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system.* Ovary simple, about 1 whorl. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part inverted U-shape to with two or more bends, loops or twists; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins. Seminal receptacle at anterior edge of to overlapping anterior edge of bursa copulatrix, pyriform in shape, end pointed, duct short. Rectum separate from albumen gland and overlapping capsule gland. $\frac{1}{4}$ or less to about $\frac{1}{3}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval in cross section, with distinct glandular zones. Ventral channel anterior muscular vestibule, with moderate sized muscular vestibule. Genital opening small; anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
holotype	2.19	1.29	0.82	3.40
paratypes	1.76–2.45	1.07–1.38	0.72–0.94	2.85–3.75

Distribution and habitat. This species is currently only known from a few small tributaries of the Franklin River, north of Wilsons Promontory, eastern Victoria (Fig. 33). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is similar to *A. turbatus* and differs from it by its small size, convex outline, more rounded whorls and some anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidlereri*, *A. flindersensis*, *A. halletensis*, *A. ora*, *A. dekeyzeri*, *A. macaulayi*, *A. abercrombiensis*, *A. tathraensis*, *A. buchanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. gippslandicus* were misclassified by more than one individual except for two assigned to *A. turbatus* (overall 55% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following misclassified as *A. halletensis* (2), *A. dyerianus* (2), *A. turbatus* (1), *A. bungoniensis* (1), *A. dekeyzeri* (1), *A. tebus* (1) and *A. niger* (1).

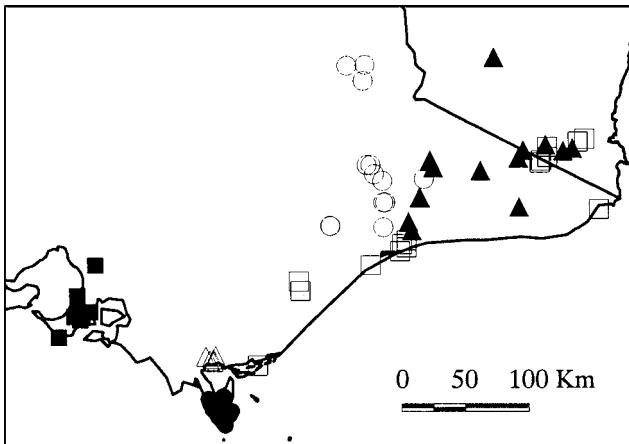


Fig. 33. Distribution of *Austropyrgus ora* □, *A. macaulayi* ■, *A. turbatus* ●, *A. gippslandicus* △, *A. buchanensis* ▲ and *A. dekeyzeri* ○.

Austropyrgus turbatus
(Ponder, Colgan, Clark, Miller & Terzis, 1994)

Figs. 34D, 35B

Fluvidona turbata Ponder *et al.*, 1994: 643–644, figs. 42D–F.

Type material. Holotype C.172760, paratypes C.174025 (20+), MV F.65715.

Type locality. Squeaky Beach Ck about 60m above road, Wilsons Promontory, Victoria, 39°0.70'S 146°18.35'E, on leaves, 13 February 1990.

Other material examined. **Victoria:** Found in numerous streams throughout Wilsons Promontory, Victoria, see Ponder *et al.*, 1994 for a full list of the known populations of *A. turbatus*.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline and convex whorls; pallial vas deferens with several coils at prostate gland.

Description. *Shell* (Figs. 34D, 35B). Shell 1.61–3.51 mm in height, 0.96–1.98 mm in width; spire elongate to average length, outline straight; aperture 0.65–1.33 mm in height, 0.62–1.20 mm in width. Body whorl 1.21–2.38 mm in height. Teleoconch of 2.60–4.40 convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent.

shell dimensions:	SH	SW	AH	TW
holotype	2.98	1.61	1.16	3.75
paratypes	2.38–3.02	1.32–1.59	0.91–1.15	3.40–3.80

Operculum. Operculum 0.60–1.17 mm in height, with 3–5 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp narrow, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, protruding well past lateral edge. Lateral teeth: with 3–6 lateral cusps; median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 15–26 cusps, ratio of cutting edge to shaft about $\frac{1}{2}$, outer marginal teeth with 27–36 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$. *Head-foot.* Cephalic tentacles with pigment poorly to well developed, with unpigmented median dorsal stripe; snout with pigment well developed; foot pigmentation absent; opercular lobe, pallial roof and visceral coil with pigmentation poorly developed to unpigmented; pigmentation of head and neck well developed to poorly developed. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 19–21 filaments, apices on right to with central apices. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum with slight arch to with short S-shape. Renal gland about $\frac{1}{3}$ in pallial roof; oval; intermediate in thickness. Pericardium about $\frac{1}{3}$ in pallial roof. *Male reproductive system.* Testis of 1.4–1.7 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ – $\frac{2}{3}$ within pallial roof (note Ponder *et al.*, 1994 erroneously give it as $\frac{2}{3}$ – $\frac{1}{10}$ within the pallial roof), kidney-shaped, broadly-oval in cross section. Pallial vas deferens flush with surface; with several coils at prostate and between prostate and penis; straight at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system.* Ovary simple, about 1.0–1.2 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; straight to with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct bent just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum separate from albumen gland and overlapping capsule gland. About $\frac{1}{3}$ to about $\frac{1}{2}$ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval in cross section, with distinct

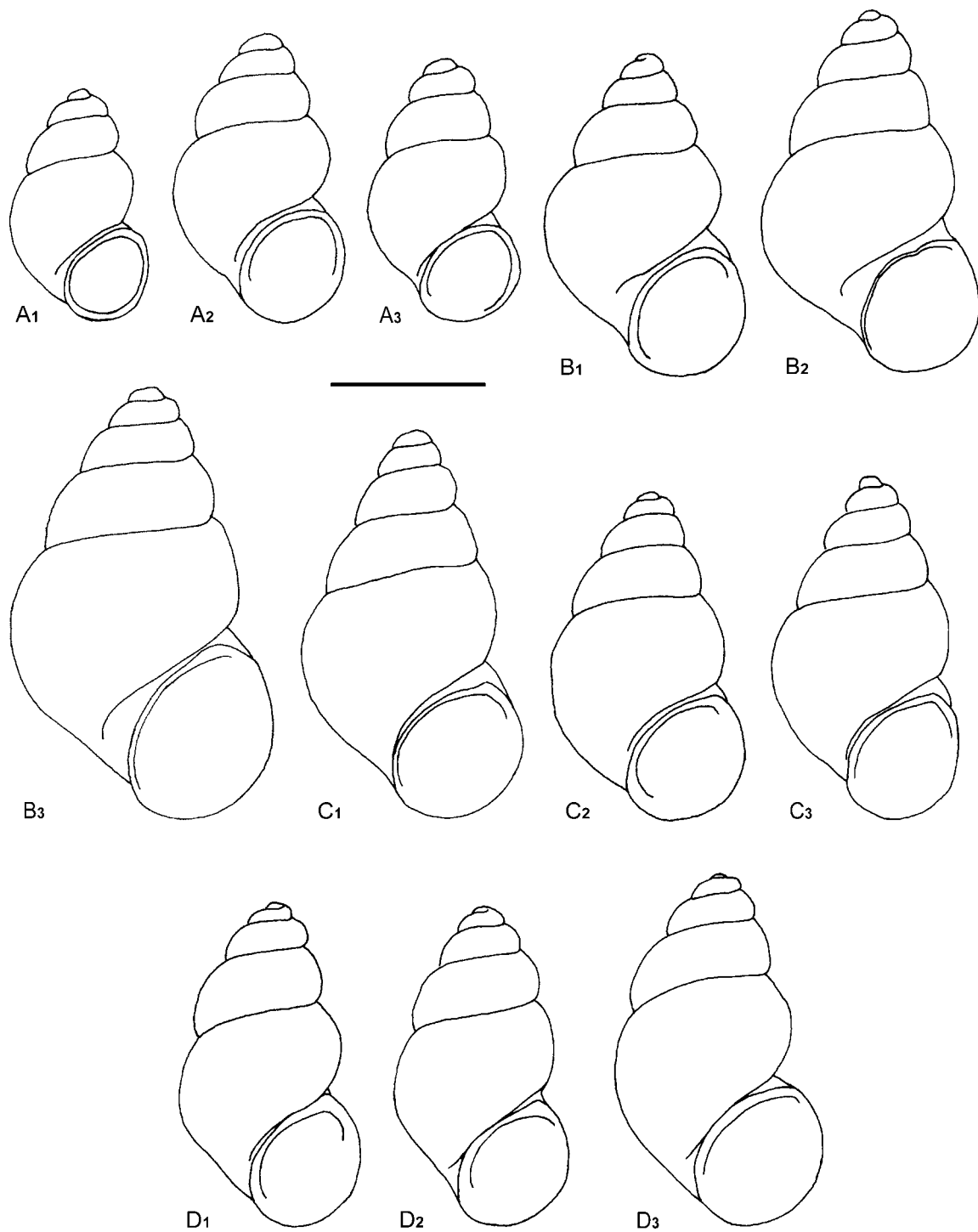


Fig. 34. Shells of species of *Austropyrgus*: A, *A. gippslandicus*, paratypes, C.174023; B, *A. foris*, paratypes, C.174024, C, *A. rectus*, paratypes, C.174026; D, *A. turbatus*, paratypes, C.174025. Scale 1 mm.

glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is restricted to the small streams and rivers of Wilsons Promontory, eastern Victoria (Fig. 33). It is typically found on weeds, leaves, roots, sand and gravel and can be extremely abundant.

Remarks. This species can be found in sympatry with *A. rectus* from which it can be distinguished by its rounded whorls and generally smaller size. Within Wilsons Promontory is the only known occurrence of sympatry of species of *Austropyrgus* on the mainland east of Melbourne, Victoria. The shell of *A. turbatus* is similar to *A. dekeyzeri* (see remarks under *A. dekeyzeri*), *A. gippslandicus* (see

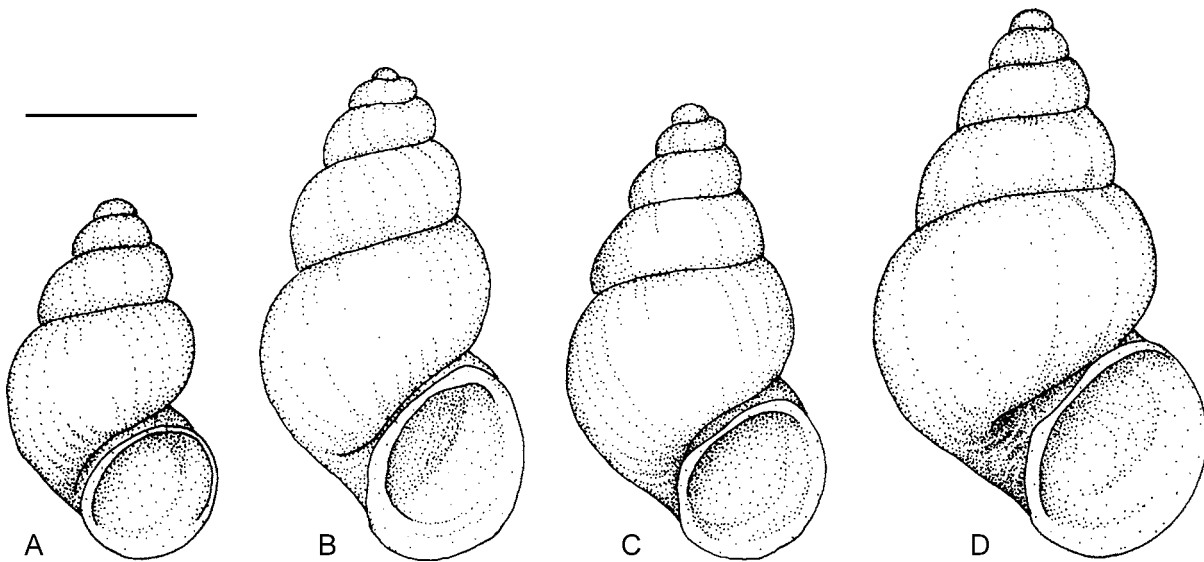


Fig. 35. A, *Fluvidona gippslandica* Ponder *et al.*, 1994, holotype, C.172757; B, *Fluvidona turbata* Ponder *et al.*, 1994, holotype, C.172760. C, *Fluvidona recta* Ponder *et al.*, 1994, holotype, C.172759; D, *Fluvidona foris* Ponder *et al.*, 1994, holotype, C.172758; Scale 1 mm.

remarks under *A. gippslandicus*), *A. macaulayi* and *A. ora*. Its shell differs from *A. macaulayi* by its more rounded whorls and weakly thickened outer lip (heavily thickened in *A. macaulayi*). These taxa also differ in some anatomical characters (see descriptions). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. ora*, *A. abercrombiensis*, *A. tathraensis*, *A. buchaniensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

Ponder *et al.* (1994) found that *A. turbatus* consisted of three genetically distinct species, their conclusions being based largely on the coexistence in sympatry of genetically distinct morphs in various parts of Wilsons Promontory. However, they did not formally name the three genetic distinguishable taxa because they lacked clear morphological differences.

We included all the measured populations of this taxon (see Ponder *et al.*, 1994) in the discriminant analysis, a total of 564 specimens. Consequently there was considerable overlap with the material attributed to this taxon, which, as noted above, actually includes three genetically distinct species. Numerous individuals from the various populations that were assigned to *A. turbatus* were misclassified—those misclassified more than 10 individuals included *A. bullerensis* (101), *A. avius* (65), *A. macaulayi* (37), *A. otwayensis* (34), *A. niger* (32), *A. halletensis* (31), *A. gippslandicus* (30), *A. foris* (27), *A. rectus* (22), *A. dyerianus* (20), *A. petterdianus* (18), *A. bungoniensis* (15), *A. grampianensis* (15), *A. daylesfordensis* (15) and *A. synoria* (12). Overall 40% of the specimens were correctly assigned to *A. turbatus*. When only the type population of *A. turbatus* was included in the overall analysis, 90% of the specimens were correctly identified (one specimen attributed to *A. rectus* and one to *A. avius*).

When the discriminant analysis was repeated (with all the populations) using only the taxa included in Group 3, 60% of the individuals were correctly classified. Those wrongly classified (more than 10) were assigned to *A.*

dyerianus (54), *A. macaulayi* (50), *A. niger* (47), *A. gippslandicus* (42), *A. halletensis* (35), *A. synoria* (24), *A. bungoniensis* (21), *A. exiguus* (16), *A. wombeyanensis* (14), *A. tebus* (13) and *A. gunnii* (11). A discriminant analysis on just the 57 populations included above in *A. turbatus* provided an average of 41% successful discrimination (ranging from 5–80%).

Austropyrgus macaulayi n.sp.

Figs. 23J, 26B, 31C, 32C

Type material. Holotype C.334102, figured paratypes C.334101 (3), paratypes C.174674 (20+), C.200999 (20+).

Type locality. Dunns Ck at Bittern-Dromana Rd, Red Hill, S of Frankston, Victoria, 38°20.90'S 145°02.50'E, on roots and leaves etc., 27 June 1993.

Other material examined. Victoria: Frankston, MV F.54434, F.54431, F.54634; Rowans Gully, Frankston, MV F.54423, F.54432; Manmangur Ck, Sunnyside Beach, Mornington, C.174677, C.201000; Warringine Ck at Frankston Rd, Hastings, C.174692, C.318242; Merricks Ck, Hauns Ck Reserve, Balnarring, MV F.54457; Merricks Ck at Stanley Rd, W of Balnarring, C.174686; Burrabong Ck on Cape Schanck–Bushranger Bay Walking Track, C.200920.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline, outer lip heavily thickened; renal gland about ¼ in pallial roof, circular; coiled oviduct with initial U orientated longitudinally backwards.

Description. *Shell* (Figs. 23J, 26B, 31C). Shell 2.16–3.37 mm in height, 1.32–2.07 mm in width; spire elongate to average length, outline straight; aperture 0.82–1.35 mm in height, 0.79–1.12 mm in width. Body whorl 1.55–2.29 mm in height. Teleoconch of 3.45–4.30 slightly convex to

Austropyrgus ora n.sp.

Figs. 23K, 31D, 32D

Type material. Holotype C.343008, figured paratypes C.334103 (3), paratypes C.302460 (20+), MV F.82341 (3).

Type locality. Small trib. of Stony Ck, Toorloo Arm, just to the W. of bridge, Victoria, 37°48.22'S 148°02.67'E, in leaves etc., 21 February 1994.

Other material examined. **New South Wales:** Camping Ground Ck at Pericoe Rd, C.174011; Pericoe Ck at Pericoe, C.174012; Bondi Ck at Imlay Rd, C.174016; Hopping Joe Ck at Cann Valley Hwy, C.174017. **Victoria:** E branch of Cann R at Cann Valley Hwy, C.174018; Winnot Ck at Cann Valley Hwy, C.174019; Thurra R at Drummer Creek Rainforest, E of Cann River, C.201407; Toorloo Arm, Princes Hwy, MV F.54464; Bunga Ck at Lake Tyers Rd, MV F.54451; Bunga Ck at Old Bunga Rd, just N of Lake Bunga, C.302506; warm pond No. 1, Lakes Entrance, MV F.54455; Lakes Entrance, MV F.54429; Gippsland Lakes, MV F.54478; Sale?, MV F.54618; Longford, MV F.54428, F.54425.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, narrow, with convex whorls; bursal duct very short; seminal receptacle duct of medium length; albumen gland about 1/2 in front of the posterior pallial wall; ovary lobulate; coiled oviduct with initial U orientated dorsoventrally.

Description. *Shell* (Figs. 23K, 31D). Shell 1.79–2.36 mm in height, 1.08–1.44 mm in width; spire of average length, outline straight, aperture 0.66–0.90 mm in height, 0.62–0.84 mm in width. Body whorl 1.26–1.60 mm in height. Teleoconch of 3.10–3.75 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 2.11 mm; SW, 1.28 mm; AH, 0.78 mm; TW, 3.50 whorls. *Operculum.* Operculum 0.64–0.91 mm in height, 0.42–0.65 mm in width, with 2–4 peg. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–25 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 30–33 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout unpigmented; foot well to poorly pigmented; opercular lobe poorly pigmented; pigmentation of head, neck, pallial roof and visceral coil well developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 15–17 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to thick; covers rectum when visible. Rectum with slight arch to with short S-shape. Renal gland about 1/3 in pallial roof; oval; thin. Pericardium about 1/3–1/2 in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, straight between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 32D). Ovary lobulate, about 0.5–0.9 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop long; proximal part with two or more bends, loops or twists; straight or one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct ventrally or from right side. Oviduct bent just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct of medium length. Rectum overlapping albumen and capsule glands. About 1/2 of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.98 mm; SW, 1.76 mm; AH, 1.20 mm; TW, 4.10 whorls. *Operculum.* Operculum 0.80–1.12 mm in height, 0.59–0.78 mm in width, with 3–5 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 3–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–22 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 25–30 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout, head, neck and pallial roof with pigment well developed; foot, opercular lobe and visceral coil with pigmentation well to poorly developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 18–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland appears to be absent to thick; covers rectum when visible. Rectum with slight arch or with short S-shape. Renal gland about 1/4 in pallial roof; circular; intermediate in thickness. Pericardium about 1/3 in pallial roof. *Male reproductive system.* Testis of 1.0–1.5 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2–3/3 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, straight to slightly undulating between prostate and penis; slightly to strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 32C). Ovary simple, about 1.00–1.25 whorls. Coiled oviduct with initial U orientated longitudinally backwards; initial loop long; proximal part with two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct of medium length. Rectum separate from albumen and capsule glands. More than 1/2 of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening of medium length to long; anterior to capsule gland.

Distribution and habitat. This species is found in the small streams on the eastern side of Port Phillip Bay, Victoria (Fig. 33). It is typically found on weeds, leaves, roots and wood and can be locally abundant.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. However, it is commonly found with the introduced hydrobiid *Potamopyrgus antipodarum* from which it differs in a number of characters including its smaller size, thickened aperture and pegs on the inner side of the operculum. It is similar to *A. turbatus* (see remarks under *A. turbatus*) and differs from *A. dekeyzeri* in its broader shell. Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. ora*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buchanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. macaulayi* were misclassified by more than one individual except for four attributed to *A. dekeyzeri* (2) and *A. foris* (2) (overall 70% correct). When the analysis was restricted to Group 3, 75% were correctly classified, with the following misclassified as *A. turbatus* (2), *A. dekeyzeri* (2) and *A. niger* (1).

Etymology. Named after Geoff Macaulay who has assisted us with numerous collections of freshwater molluscs from various parts of Victoria.

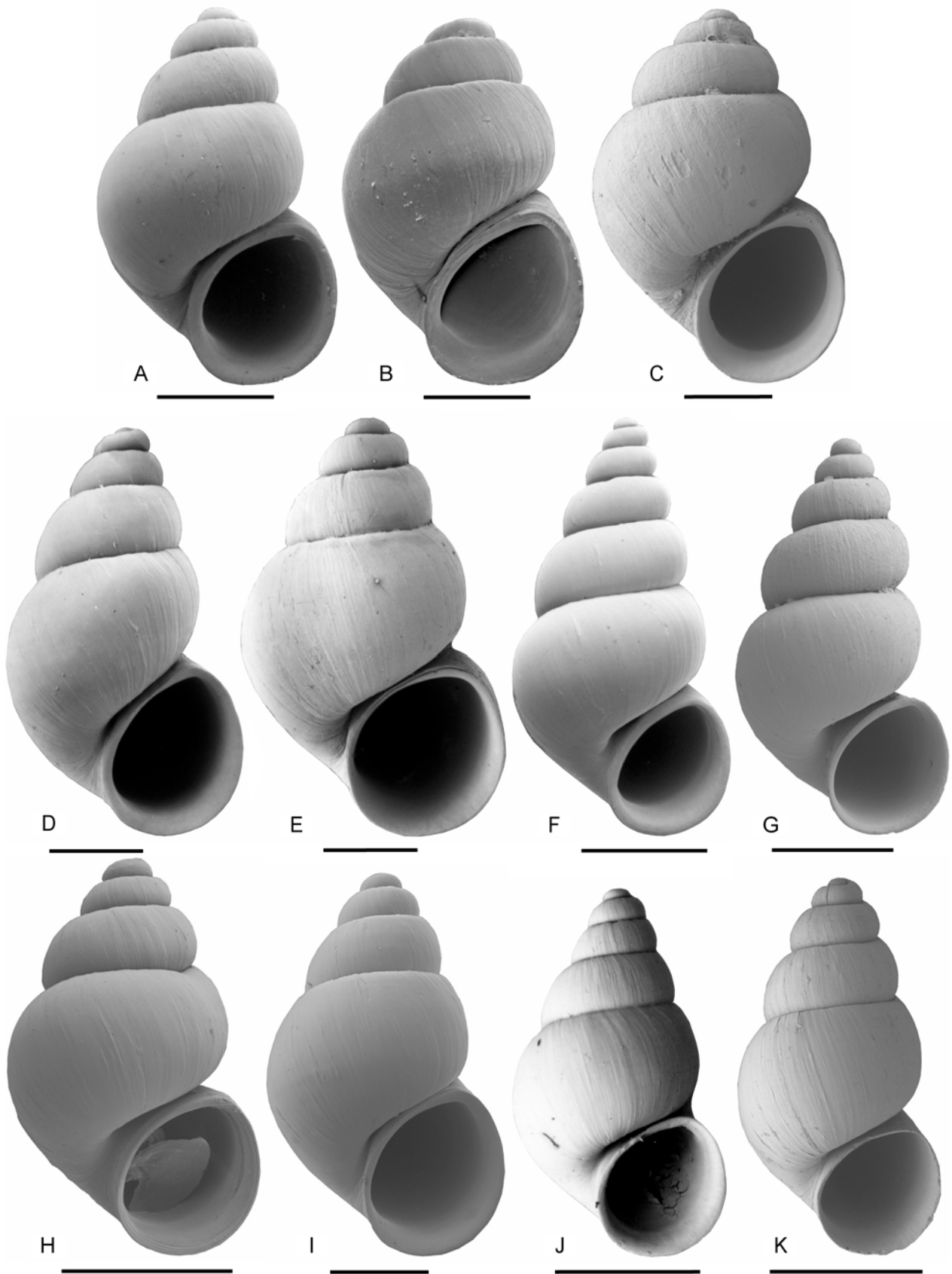


Fig. 36. Shells of species of *Austropyrgus*: A, *A. pusillus*, holotype, C.334602; B, *A. exiguus*, holotype, C.343019; C, *A. tumidus*, holotype, C.343025; D, *A. spectus*, holotype, C.343020; E, *A. glenelgensis*, holotype, C.348919; F, *A. aslini*, holotype, C.343819; G, *A. zeidleri*, holotype, C.343049; H, *A. macropus*, holotype, SAMA D.19085; I, *A. fonscultus*, holotype, C.343048; J, *A. flindersensis*, holotype, C.343050; K, *A. halletensis*, holotype, C.348920. Scales A–E, I 0.5 mm; F–H, J, K 1 mm.

Distribution and habitat. This species is found in the small coastal streams and rivers of eastern Victoria and southern most New South Wales (Fig. 33). It is typically found on leaves, weeds, roots and stones and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is similar to *A. dekeyzeri* (see remarks under *A. dekeyzeri*), *A. buechanensis* (see remarks under *A. buechanensis*) and *A. turbatus* (see remarks under *A. turbatus*). Other similar taxa include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. gippslandicus*, *A. abercrombiansis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. ora* were wrongly classified by more than one individual except for two attributed to *A. gippslandicus* (overall 53% correct). When the analysis was restricted to Group 3, 53% were correctly classified, with the following misclassified as *A. gippslandicus* (2), *A. bungoniensis* (1), *A. nepeanensis* (1), *A. spectus* (1), *A. glenelgensis* (1), *A. flindersensis* (1), *A. dyerianus* (1) and *A. tebus* (1).

Etymology. *Ora* Latin: extremity, edge, margin, coast—refers to the coastal distribution of this species.

Western Victorian taxa

Austropyrgus pusillus n.sp.

Figs. 36A, 37A, 38B

Type material. Holotype C.334602, figured paratypes C.307582 (3), paratypes C.300691 (20+), C.300701 (20+), C.300702 (20+), MV F.82342 (3).

Type locality. Small trib. of Glenelg R., at Dartmoor, Victoria, 37°54.60'S 141°19.93'E, on stones etc., 18 May 1984.

Other material examined. **Victoria:** creek at Princes Hwy, between Mt Gambier and Heywood, SAMA D19073; Moleside Ck, Lower Glenelg NP, MV F.54661; Skipworth Springs, E side of Eaglehawk bend, Lower Glenelg NP, C.302543; Moleside Ck off Kentbruck Rd, 8.9 km N of Nelson-Portland Rd, C.203826, C.203866; Little Moleside Ck, MV F.54613; MacPhails Ck, Kentbruck, MV F.54653.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, with straight to weakly-convex spire outline and convex whorls; ctenidium with 9–12 filaments; prostate gland about 2/3 in pallial roof; ovary simple.

Description. *Shell* (Figs. 36A, 37A). Shell 1.09–1.59 mm in height, 0.79–1.14 mm in width; spire of average length to squat, outline straight to weakly-convex, aperture 0.51–0.76 mm in height, 0.48–0.68 mm in width. Body whorl 0.89–1.20 mm in height. Teleoconch of 2.00–3.10 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions:* SH, 1.59 mm; SW, 1.01 mm; AH, 0.71 mm; TW, 3.10 whorls. *Operculum.* Operculum 0.44–0.58 mm in height, 0.32–0.45 mm in width, with 1–4 pegs. *Radula.* Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps,

median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 21–26 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 25–37 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 9–12 filaments. Oosphradium located between posterior end and middle of ctenidium. Hypobranchial gland appears to be absent to moderately developed, not covering rectum. Rectum with slight arch to with prominent arch. Renal gland about 1/3 in pallial roof; oval; thin. Pericardium about 1/2 in pallial roof. *Male reproductive system.* Testis of 0.5 whorls. Seminal vesicle loosely coiled over stomach to slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 2/3 in pallial roof, kidney-shaped, highly compressed in cross section. Pallial vas deferens flush with surface, slightly undulating at prostate, straight between prostate and penis, slightly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 38B). Ovary simple, about 0.5–0.9 whorls. Coiled oviduct with initial U orientated dorsoventrally to longitudinally backwards; initial loop long; proximal part with two or more bends, loops or twists; straight distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short to medium length. Rectum overlapping albumen gland and separate from capsule gland. More than 1/2 of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval to compressed-oval in cross section, with indistinct glandular zones. Ventral channel distinct, with moderate sized to large, obvious muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small springs and streams which flow into the lower part of the Glenelg River, western Victoria (Fig. 39). It is typically found crawling on all substrates and is very abundant.

Remarks. This species has been found in sympatry with four other species of *Austropyrgus* (*A. exiguus*, *A. glenelgensis*, *A. tumidus* and *A. latus*) throughout its currently recognized range. It differs from *A. exiguus* in its very small, squat shell and weakly thickened outer lip (heavily thickened in *A. exiguus*), from *A. glenelgensis* in its much smaller shell with a squatter spire, from *A. tumidus* in its much smaller, narrower shell and from *A. latus* in its much smaller shell with convex whorls. The only other taxon with a similar shell is *A. salvus* from Tasmania, which is larger in size.

In the discriminant analysis no specimens of *A. pusillus* were misclassified by more than one individual except for two attributed to *A. mersus* (overall 80% correct). When the analysis was restricted to Group 3, 90% were correctly classified, with only the following misclassified as *A. gippslandicus* (1) and *A. glenelgensis* (1).

Etymology. *Pusillus* Latin: very little—refers to the very small size of this species.

Austropyrgus exiguus n.sp.

Figs. 36B, 37F, 38A

Type material. Holotype C.343019, figured paratypes C.334613 (3), paratypes C.300692 (20+), MV F.82343 (3).

Type locality. Small trib. of Glenelg R., at Dartmoor, Victoria, 37°54.60'S 141°19.93'E, on stones, 18 May 1984.

Other material examined. **Victoria:** Cawker Ck at Glenelg Hwy, SW of Casterton, C.302390, C.302391; Glenelg R at Dartmoor, C.300703, C.300704, MV F.54669; creek at Princes Hwy, between Mt Gambier and

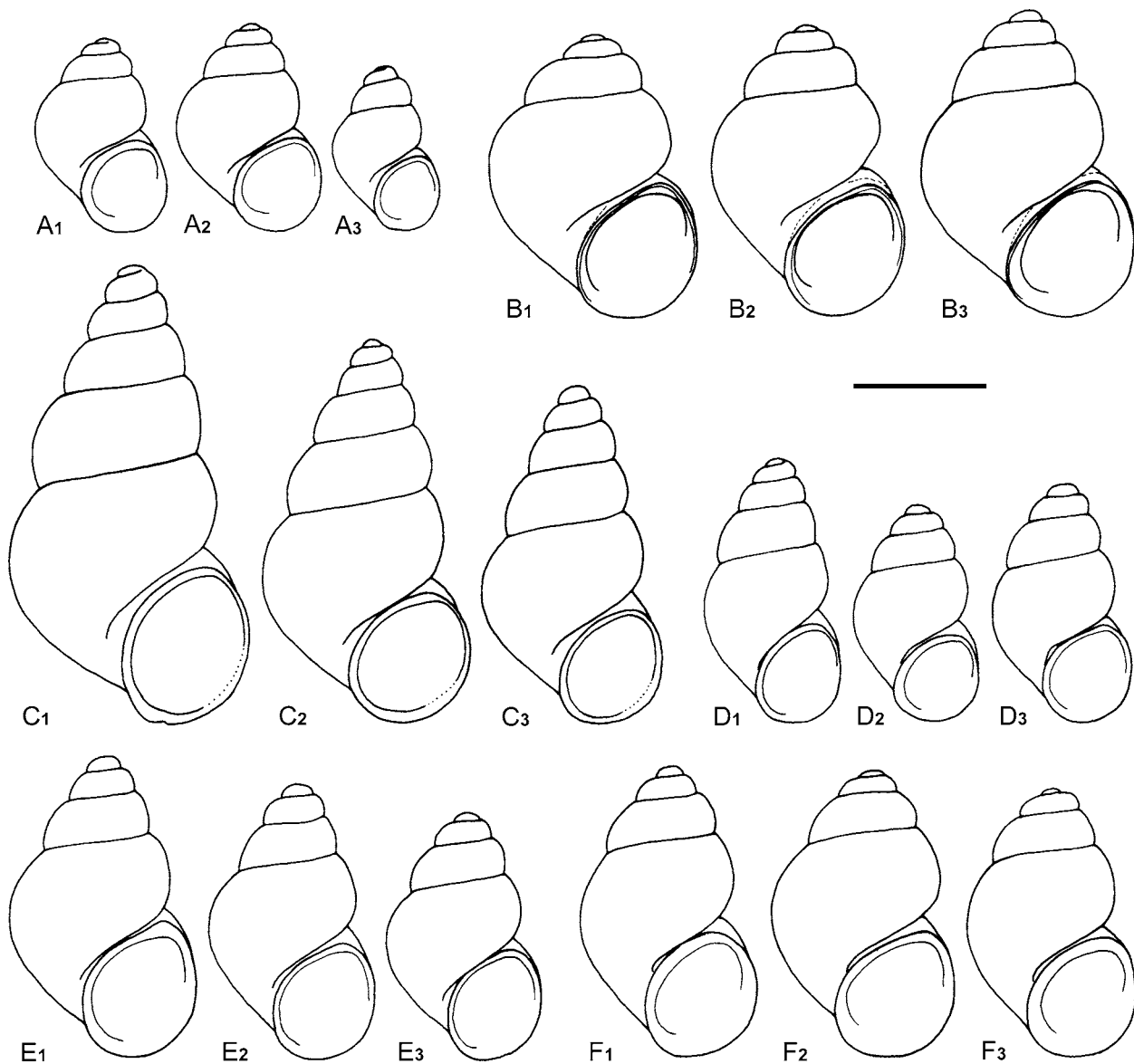


Fig. 37. Shells of species of *Austropyrgus*: A, *A. pusillus*, paratypes, C.307582; B, *A. tumidus*, paratypes, C.307592; C, *A. aslini*, paratypes, C.307584; D, *A. spectus*, paratypes, C.334616; E, *A. glenelgensis*, paratypes, C.345629; F, *A. exiguus*, paratypes, C.334613. Scale 1 mm.

Heywood, SAMA D19074; Spring Ck at Princes Hwy between Heywood and Dartmoor, C.300705; Moleside Ck, Moleside Creek Picnic Area, Lower Glenelg NP, C.302462; MacPhails Ck, Kentbruck, MV F.54653, F.54656.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, with straight to weakly-convex spire outline, slightly convex to convex whorls, and outer lip heavily thickened; central teeth with 2 pairs of basal cusps; basal projection of lateral teeth U-shaped; inner marginal teeth with 11–14 cusps, outer marginal teeth with 18–24 cusps; seminal vesicle not conspicuously coiled on digestive gland behind stomach.

Description. *Shell* (Figs. 36B, 37F). Shell 1.78–2.28 mm in height, 1.15–1.45 mm in width; spire of average length, outline convex; aperture 0.77–1.04 mm in height, 0.72–0.88 mm in width. Body whorl 1.41–1.73 mm in height. Teleoconch of 2.50–3.10 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent. *Holotype*

dimensions: SH, 1.81 mm; SW, 1.17 mm; AH, 0.83 mm; TW, 2.75 whorls. *Operculum*. Operculum 0.59–0.88 mm in height, 0.45–0.59 mm in width, with 1–5 pegs. *Radula*. Central teeth: with 3–4 lateral cusps, median cusp of medium width to broad, sharply to bluntly pointed, about 2 to 3 times longer than adjacent cusps; 2 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 3–4 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth U-shaped. Inner marginal teeth with 11–14 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 18–24 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles unpigmented or with poorly developed dorsal central stripe; snout with pigment absent or poorly developed around edges; foot, opercular lobe and pallial roof unpigmented; pigmentation of head and neck developed on sides of neck only or absent; visceral coil mottled. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 13–16 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; partly covering rectum when visible. Rectum without arch to with prominent arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium about $\frac{1}{2}$ or more in pallial roof. *Male reproductive system*. Testis of 1 whorl. Seminal vesicle slightly undulated over to not conspicuously coiled over stomach; not conspicuously coiled on digestive gland behind stomach.

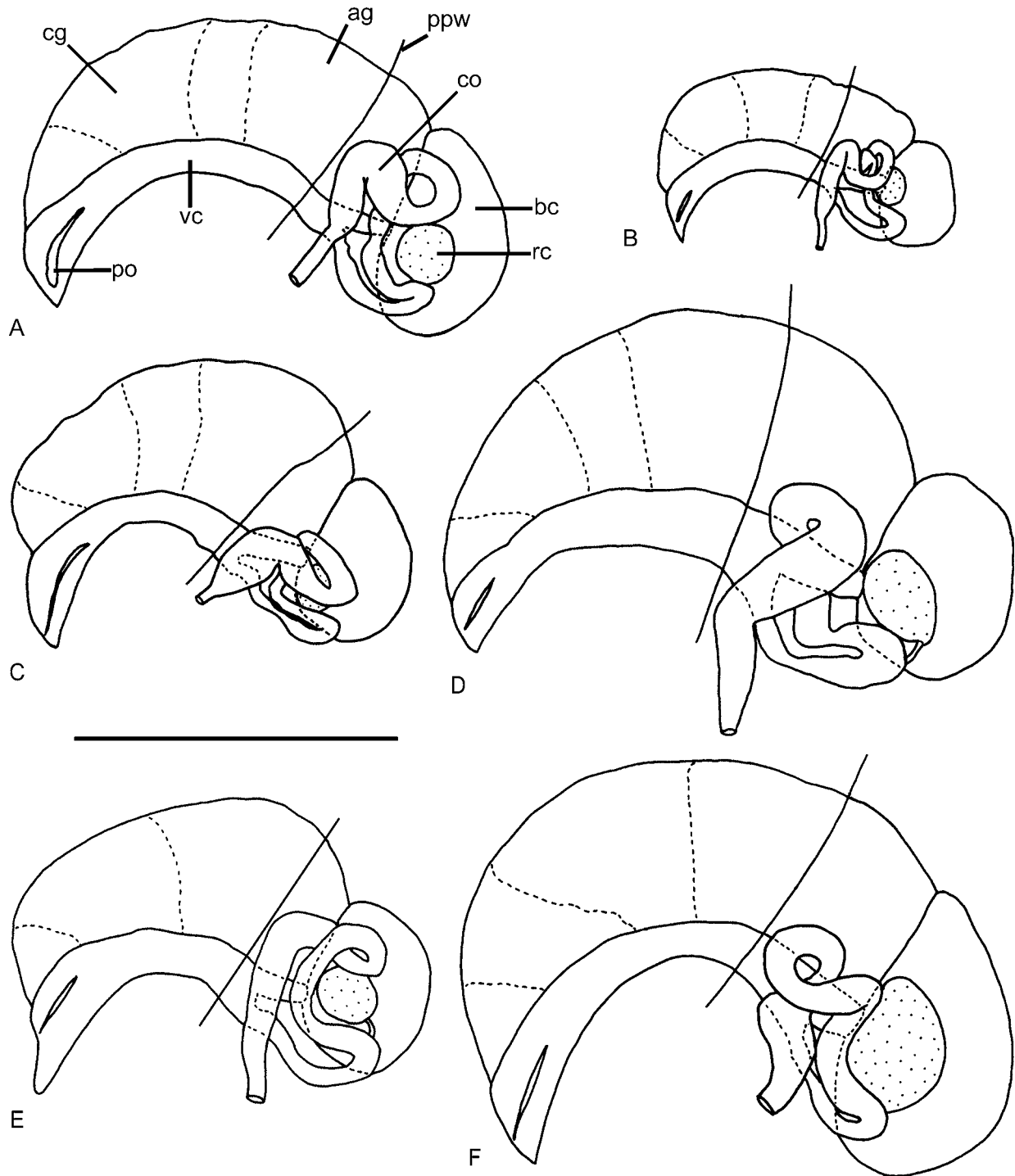


Fig. 38. Female genitalia of species of *Austropyrgus*: A, *A. exiguus*, C.300692; B, *A. pusillus*, C.300691; C, *A. spectus*, C.302369; D, *A. tumidus*, C.302793; E, *A. glenelgensis*, C.302794; F, *A. aslini*, C.300699. Scale 0.5 mm, see p. 5 for abbreviations.

Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface; straight at prostate; straight between prostate and penis; slightly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 38A). Ovary lobulate, about 0.7–1.2 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop long; proximal part inverted U-shape or with two or more bends, loops or twists; straight or one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall

of bursa copulatrix, ovoid to pyriform in shape, end pointed to end rounded, duct short to medium length. Rectum indenting albumen gland and overlapping capsule gland. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small springs and streams which flow into the

lower part of the Glenelg River, western Victoria (Fig. 39). It is typically found crawling on all substrates and can be very abundant.

Remarks. This species can be found in sympatry with three other species of *Austropyrgus* [*A. pusillus* (see remarks under *A. pusillus*), *A. glenelgensis* and *A. latus*] throughout its currently recognized range. It differs from *A. glenelgensis* and *A. latus* in its much smaller size.

In the discriminant analysis no specimens of *A. exiguus* were misclassified by more than one individual other than four attributed to *A. synoria* (2) and *A. conicus* (2) (overall 70% correct). When the analysis was restricted to Group 3, 85% were correctly classified, with the only misclassifications being three individuals assigned to *A. synoria*.

Etymology. *Exiguus* Latin: little—refers to the small size of this species.

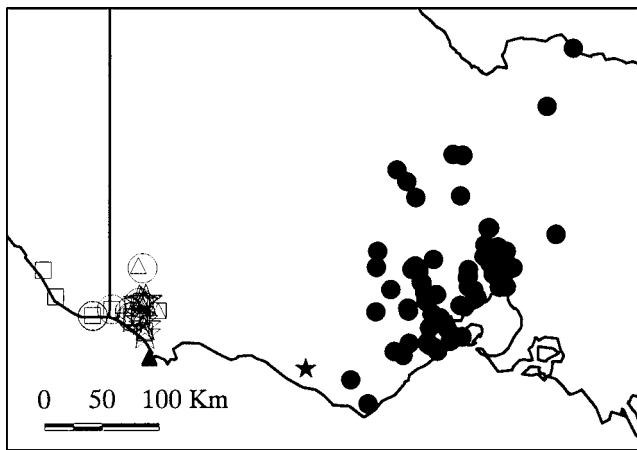


Fig. 39. Distribution of *Austropyrgus angasi* ●, *A. aslini* ★, *A. glenelgensis* □, *A. tumidus* ○, *A. spectus* ▲, *A. exiguus* △ and *A. pusillus* ☆.

Austropyrgus spectus n.sp.

Figs. 36D, 37D, 38C

Type material. Holotype C.343020, figured paratypes C.334616 (3), paratypes C.302369 (20+), C.302396 (20+), C.302370 (20+), C.302378 (20+), MV F.82344 (3).

Type locality. Small springs at The Watering Place, 2 km from car park, Cape Duquesne, Victoria, 38°21.93'S 141°22.00'E, on rocks and amongst mosses and sedges, 16 February 1994.

Additional paratype material. Victoria: 4 Posts Spring, between petrified forest and blowhole, Cape Duquesne, C.302392 (20+).

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, with straight to weakly-convex spire outline, slightly convex to convex whorls, columellar muscle small and coiled oviduct with initial U orientated longitudinally backwards.

Description. *Shell* (Figs. 36D, 37D). Shell 1.50–2.03 mm in height, 0.88–1.22 mm in width; spire elongate to average length, outline straight to weakly-convex, aperture 0.58–0.84 mm in height, 0.54–0.74 mm in width. Body whorl 1.10–1.42 mm in height. Teleoconch of 3.00–3.75 slightly convex to convex whorls, last whorl and base evenly convex.

Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 2.03 mm; SW, 1.22 mm; AH, 0.84 mm; TW, 3.55 whorls. *Operculum*. Operculum 0.55–0.72 mm in height, 0.40–0.51 mm in width, with 1–5 pegs. *Radula*. Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–23 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 28–31 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Cephalic tentacles unpigmented or dorsal central stripe only; snout with pigment well developed to just around edges; foot and opercular lobe with pigmentation well to poorly developed; pigmentation of head, neck, pallial roof and visceral coil well developed. Columellar muscle small. *Non-genital anatomy*. Ctenidium with 15–16 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum with slight arch to with short S-shape. Renal gland about 1/2 in pallial roof; oval; thin. Pericardium more than 1/2 in pallial roof. *Male reproductive system*. Testis of 0.75 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate, straight to slightly undulating between prostate and penis; slightly to strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 38C). Ovary lobulate, about 0.9–1.0 whorls. Coiled oviduct with initial U orientated longitudinally backwards; initial loop medium; proximal part inverted U-shape or with one bend, loop or twist; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than 1/2 of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a few quite small springs, all in close proximity to one another, which are located within a few meters of the Southern Ocean at Cape Duquesne, south of Portland, western Victoria (Fig. 39). It is found crawling on all substrates present within the springs and is very abundant. The springs themselves are very small, only a few centimetres deep at the most and only a few meters long before they enter the sea. These springs were used for almost a century by the local farmers as a source of drinking water for their stock. As the water from the springs becomes brackish by mixing with seawater, the estuarine hydrobiid *Ascorhis tasmanicus* (Martens, 1858) can be found living with *A. spectus*.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It can be distinguished from the other western Victorian members of Group 3 by its small, narrow, conical shell, which has a moderately tall spire. The only other species with a closely similar shell is *A. fonscultus* from southeastern South Australia but the shell of that species is more conical in shape.

In the discriminant analysis no specimens of *A. spectus* were misclassified by more than one individual (overall 90% correct). When the analysis was restricted to Group 3, 90% were correctly classified, with only two individuals misclassified as *A. dyerianus*.

Etymology. *Spectus* Latin: behold, look—refers to the spectacular ocean view from the type locality.

***Austropyrgus tumidus* n.sp.**

Figs. 36C, 37B, 38D

Type material. Holotype C.343025, figured paratypes C.307592 (3), paratypes C.302793 (20+), MV F.82345 (3).

Type locality. Spring at Post and Rail North Camp, 5.4 km E of Battersleys Camp, Lower Glenelg NP, Victoria, 38°03.40'S 141°12.03'E, amongst leaves, roots etc., 18 February 1994.

Other material examined. **Victoria:** Glenelg R, MV F.54627; creek E of Princess Margaret Rose Cave, MV F.54612; Glenelg R, forestry camp at Eaglehawk Bend, Lower Glenelg NP, MV F.54660; Skipworth Springs, E side of Eaglehawk Bend, Lower Glenelg NP, C.302547. **South Australia:** Eight Mile Ck, at rd, near Danger Point, E of Port MacDonnell, C.302549; Hitchcocks Drain, E of Port MacDonnell, MV F.54694.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, broad, with squat spire and straight to weakly-convex spire outline and convex whorls, inner lip of aperture narrowly to distinctly separated from parietal wall; inner marginal teeth with 17–19 cusps; more than ½ of pericardium in pallial roof; about ½ of prostate gland in pallial roof; rectum separate from capsule gland.

Description. *Shell* (Figs. 36C, 37B). Shell 2.06–2.42 mm in height, 1.40–1.61 mm in width; spire of average length to squat, outline straight to weakly-convex, aperture 0.89–1.07 mm in height, 0.85–1.01 mm in width. Body whorl 1.60–1.85 mm in height. Teleoconch of 2.85–3.50 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.11 mm; SW, 1.52 mm; AH, 0.96 mm; TW, 2.75 whorls. *Operculum.* Operculum 0.88–1.02 mm in height, 0.63–0.70 mm in width, with 3–5 pegs. *Radula.* Central teeth: with 4 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 17–19 cusps, ratio of cutting edge to shaft about ¼, outer marginal teeth with 26–28 cusps, ratio of cutting edge to shaft about ¼. *Head-foot.* Cephalic tentacles unpigmented; snout with well-developed pigmentation to poorly developed around edges; foot, opercular lobe, pallial roof and visceral coil with well to poorly developed pigmentation; head and neck with pigmentation well developed or on sides of neck only. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–18 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; covers rectum when visible. Rectum with slight arch to with short S-shape. Renal gland about ½–⅔ in pallial roof; oval; thin to intermediate in thickness. Pericardium more than ½ in pallial roof. *Male reproductive system.* Testis of 0.75–1.00 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to strongly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only to all areas except base. *Female reproductive system* (Fig. 38D). Ovary lobulate, about 0.75–1.00 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape or with one bend, loop or twist; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen gland and separate from capsule gland. About ⅓ to about ½ of albumen gland behind posterior pallial wall.

Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a few small springs and streams flowing into the lower part of the Glenelg River, western Victoria (Fig. 39). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is found in sympatry with two other species of *Austropyrgus* (*A. pusillus* and *A. glenelgensis*) throughout its currently recognized range. The shell of this species differs from *A. pusillus* in its much larger and broader shell and from *A. glenelgensis* in its smaller, squatter shell. It is also similar in shell shape to *A. exiguus* but is larger and broader.

This species as currently recognized shows some variation in shell shape and it is possible that additional work will reveal it to be composed of more than one taxon.

In the discriminant analysis no specimens of *A. tumidus* were misclassified by more than one individual (overall 80% correct). When the analysis was restricted to Group 3, all individuals were correctly classified.

Etymology. *Tumidus* Latin: swollen—refers to the inflated shape of this species.

***Austropyrgus glenelgensis* n.sp.**

Figs. 36E, 37E, 38E, 40C, 41D, 42C

Type material. Holotype C.348919, figured paratypes C.345629 (3), paratypes C.302794 (20+), MV F.82346 (3).

Type locality. Spring at Post and Rail North Camp, Lower Glenelg NP, 5.4 km E of Battersleys Camp, Victoria, 38°03.40'S 141°12.03'E, amongst leaves, roots etc., 18 February 1994.

Other material examined. **South Australia:** Lake Bonney, Corys Landing, MV F.54698; Eight Mile Ck at road, near Danger Point, C.302550. **Victoria:** Skipworth Springs, lower Glenelg NP, C.302544; Spring at Post and Rail North Camp, Lower Glenelg NP, C.302792; Moleside Ck, off Kentbruck Rd, C.305063, C.302419; Moleside Ck, Nelson-Winnap Rd, Lower Glenelg NP, C.302463, MV F.2402, F.54639; Glenelg R at junction of Moleside Ck, Lower Glenelg NP, MV F.82284, F.82312; creek, E of Princess Margaret Rose Cave, lower Glenelg NP, MV F.54657; Johnstone Ck on Portland-Nelson Rd, C.200804, C.343029; Crawford R on Dartmoor-Hamilton Rd, C.300820; Glenelg R on Princes Hwy, Dartmoor, C.300698; Spring Ck on Princes Hwy between Heywood and Dartmoor C.300819.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline and slightly convex whorls; penis pigmented on medial section only; coiled oviduct with initial U orientated longitudinally backwards.

Description. *Shell* (Figs. 36E, 37E, 40C, 41D). Shell 1.93–2.64 mm in height, 1.22–1.62 mm in width; spire of average length; aperture 0.76–1.14 mm in height, 0.73–0.94 mm in width. Body whorl 1.48–1.87 mm in height. Teleoconch of 2.75–3.75 slightly to strongly convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.64 mm; SW, 1.62 mm; AH, 1.14 mm; TW, 2.75 whorls. *Operculum.* Operculum 0.73–0.92 mm in height, 0.55–0.68 mm in width, with 2–6

pegs. *Radula*. Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps, 3 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–24 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 29–33 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles with poorly developed dorsal central stripe; snout with pigmentation developed around edges; foot and opercular lobe pigmentation poorly developed to unpigmented; pigmentation of head and neck poorly developed or on sides of neck only; pallial roof and visceral coil mottled to poorly pigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 17–19 filaments. Osphradium between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; partly covering to covering rectum. Rectum with slight arch to with short S-shape. Renal gland about $\frac{1}{2}$ in pallial roof; oval, thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.00–1.25 whorls. Seminal vesicle conspicuously coiled on both the digestive gland and testis behind the stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface; slightly undulating to strongly undulating at prostate; strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 38E, 42C). Ovary simple, about 1.2–1.4 whorls. Coiled oviduct with initial U orientated longitudinally backwards; initial loop long; proximal part inverted U-shape; straight to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short to medium length. Rectum overlapping to indenting albumen gland and overlapping capsule gland. About $\frac{1}{2}$ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section with indistinct glandular zones. Ventral channel indistinct to distinct, with moderate sized muscular vestibule. Genital opening small to medium length; terminal.

Distribution and habitat. This species is known from a number of small streams flowing into the lower part of the Glenelg River, western Victoria and southeastern South Australia (Fig. 39). It is typically found on weeds, leaves, roots and stones and can be very common.

Remarks. This rather variable species is sympatric with up to three species of *Austropyrgus* (*A. latus*, *A. tumidus* and *A. exiguus*) throughout its currently recognized range. Its shell is smaller and has more rounded whorls than that of *A. latus* and is larger and broader than that of *A. exiguus*. Other similar taxa include *A. spectus*, *A. fonscultus*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. macaulayi*, *A. ora*, *A. buchanensis*, *A. gippslandicus*, *A. dekeyzeri*, *A. turbatus*, *A. synoria* and *A. tathraensis*.

In the discriminant analysis several specimens of *A. glenelgensis* (2 populations, total of 40 specimens) were misclassified by more than one individual to several Group 1 taxa as follows: *A. macedonensis* (3), *A. cooma* (3), *A. otwayensis* (3) and *A. conicus* (2) as well as *A. synoria* (2) from Group 3 (overall 30% correct). When the analysis was restricted to Group 3, 60% were correctly classified, with the following misclassified as *A. sparsus* (3), *A. synoria* (3), *A. niger* (2), *A. macaulayi* (2), *A. fonscultus* (2), *A. turbatus* (1), *A. dekeyzeri* (1), *A. exiguus* (1) and *A. spectus* (1).

Etymology. Named after the river system to which all the small streams and springs the species has been found in flow into.

Austropyrgus aslini n.sp.

Figs. 36F, 37C, 38F

Type material. Holotype C.343819, figured paratypes C.307584 (3), paratypes C.300699 (20+), MV F.88887 (3).

Type locality. Curdies R., at Nullawarre-Timboon Rd, Victoria, 38°27.48'S 142°56.43'E, on water weed, under rocks, 22 April 1988.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline, slightly convex whorls and elongate spire; ctenidium with 21–23 filaments; coiled oviduct and bursal duct join at the posterior pallial wall.

Description. *Shell* (Figs. 36F, 37C). Shell 2.47–3.35 mm in height, 1.35–1.87 mm in width; spire elongate, outline straight; aperture 0.86–1.20 mm in height, 0.80–1.06 mm in width. Body whorl 1.53–2.04 mm in height. Teleoconch of 3.80–4.75 slightly convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 3.35 mm; SW, 1.79 mm; AH, 1.11 mm; TW, 4.75 whorls. *Operculum*. Operculum 0.81–1.12 mm in height, 0.54–0.74 mm in width, with 2–6 pegs. *Radula*. Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–28 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 27–38 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe to poorly developed central pigmented dorsal stripe or unpigmented; snout unpigmented or with pigmentation developed around edges; foot pigmentation poorly developed to unpigmented; opercular lobe, pallial roof and visceral coil unpigmented; head and neck with pigmentation developed on sides of neck only. Columellar muscle of moderate size to large. *Non-genital anatomy*. Ctenidium with 21–23 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.25–1.40 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating to strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 38F). Ovary lobulate, about 1.2–1.4 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop long to medium; proximal part inverted U-shape to two or more bends, loops or twists; straight distal to seminal receptacle to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct very short, or widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval to elongately-oval in cross section with indistinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening of medium length to long; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently only known from the type locality in western Victoria (Fig. 39). It is typically found on weeds, leaves and stones and is common.

Remarks. This species is found in sympatry with only one species of *Austropyrgus* (*A. goliathus*), from which it can be distinguished by its smaller, narrower shell with an elongated spire and convex whorls. It differs from the other western Victorian members of Group 3 in its medium sized, conical shell with a tall spire.

In the discriminant analysis no specimens of *A. aslini* were misclassified by more than one individual (overall 75% correct). When the analysis was restricted to Group 3, 75% were correctly classified, with the following misclassified as *A. flindersensis* (2), *A. gordonensis* (1), *A. ronkershawi* (1) and *A. tebus* (1).

Etymology. Named after Fred Aslin, who collected this species (and many others) and for his overall contribution with regards to his collecting efforts of non-marine Australian molluscs.

Austropyrgus angasi (Smith, 1882)

Figs. 6G, 7M,N, 25K, 26E, 27G, 28F, 40F, 41E, 42A

Hydrobia angasi Smith, 1882: 271.

Angrobia angasi.—Iredale, 1943: 204; Smith & Kershaw, 1979: 48–49, text figure.

Fluvidona angasi.—Smith, 1992: 46.

Type material. Lectotype (here chosen) NHML 1973003/1 (Fig. 25K), paralectotype NMHL 1973003/2.

Type locality. Campaspe (as Campasely) River, Victoria.

Material dissected and figured. C.166887, C.346056 (figured specimens), Axe Ck at McIvor Hwy, 12.5 km E of Bendigo, Victoria, 36°45'43"S 144°25'56"E, on leaves, roots and wood, 6 July 1991.

Other material examined. **Victoria:** Cobram, MV F.54435; MV F.54809, Campaspe R at bridge, Axedale, C.200771; Campaspe R, MV F.82298; Tullaroop Ck at bridge on Eddington-Baringhup Rd, C.200769; Loddon R, below bridge at Baringhup, MV F.54815; Campaspe R at Kyneton-Heathcote Rd, C.166840, C.200800; Loddon R at Newstead, C.300808; Deep Ck at Dalys Bridge, 4 km E of Romsey, C.302537; Deep Ck, S of Springfield, C.201003; Deep Ck, upstream, Springfield, Hess, MV F.82294; Horseshoe Bend, Bream Ck, MV F.54822; Jacksons Ck, 1 km S of Clarkefield, C.174719; Maribyrnong R, MV F.5631; Burrumbete Ck, C.204005; Merri Ck, MV F.54630, F.54664, F.54651, F.54629, F.82297; Jacksons Ck, Sunbury, MV F.82313, F.82292; Ballan Sewage Farm, MV F.54808; Merri Ck at Summerhill Rd, MV F.54773, F.54771, F.54768, F.54770, F.54767, F.54772, F.54769; Thompsons Ck on Ghanepore Rd, near Geelong, MV F.54744; Deep Ck (Maribyrnong R), Bulla, Hess, MV F.82311, F.82291, C.200780; Moorabool R, C.204000, C.203982, C.204008; Lal Lal Falls, MV F.54624, F.54663, F.54623, F.54645; Woody Yaloak Ck at bridge, Tannery Rd, C.300789; Darebin Ck, MV F.7590; Blind Ck, Melton, MV F.54804; Moorabool R at bridge, Bungal, MV F.54814; Saltwater Ck, Keilor, C.201650; Merri Ck, Coburg, MV F.54647; Werribee R, downstream of Toolern Ck, Hess, MV F.82293; Toolern Ck, near Werribee R, MV F.54753; Werribee R, above Toolern Ck, MV F.54745; Toolern Ck, C.203983; Moorabool R, Elaine turn-off at Morrisons, MV F.54800, F.54816; Melbourne, C.201648; Cobble-dick Ford, Werribee R, MV F.54811; Yarraville, MV F.54610; Kruc-A-Ruc Ck near bridge, C.300805; Werribee R, MV F.54617, C.203994; island in swamp, Meredith, C.300816; Moorabool R, Meredith, MV F.54625, C.300814, C.300815, C.300817, WAM 813-80; Steiglitz Ck, MV F.54817; Anakie Gorge, MV F.54787; Werribee R, at bridge, Corio Bay, C.300812; Coghills, Moorabool R, MV F.7529; Little R, C.204009; Little R, 6 km from mouth, E of Geelong, MV F.54803; Leigh R, MV F.5416; Shelford, MV F.54649, F.54635; Woody Yaloak Ck, MV F.54819, West Moorabool, C.203996; Barwon R at Gauge Stn, 200 m upstream of Pollocksford Bridge, C.300807; Geelong slate quarry, MV F.20423; Geelong, MV F.54643; Lake Connemara, MV F.54671, F.54632, SAMA D19083;

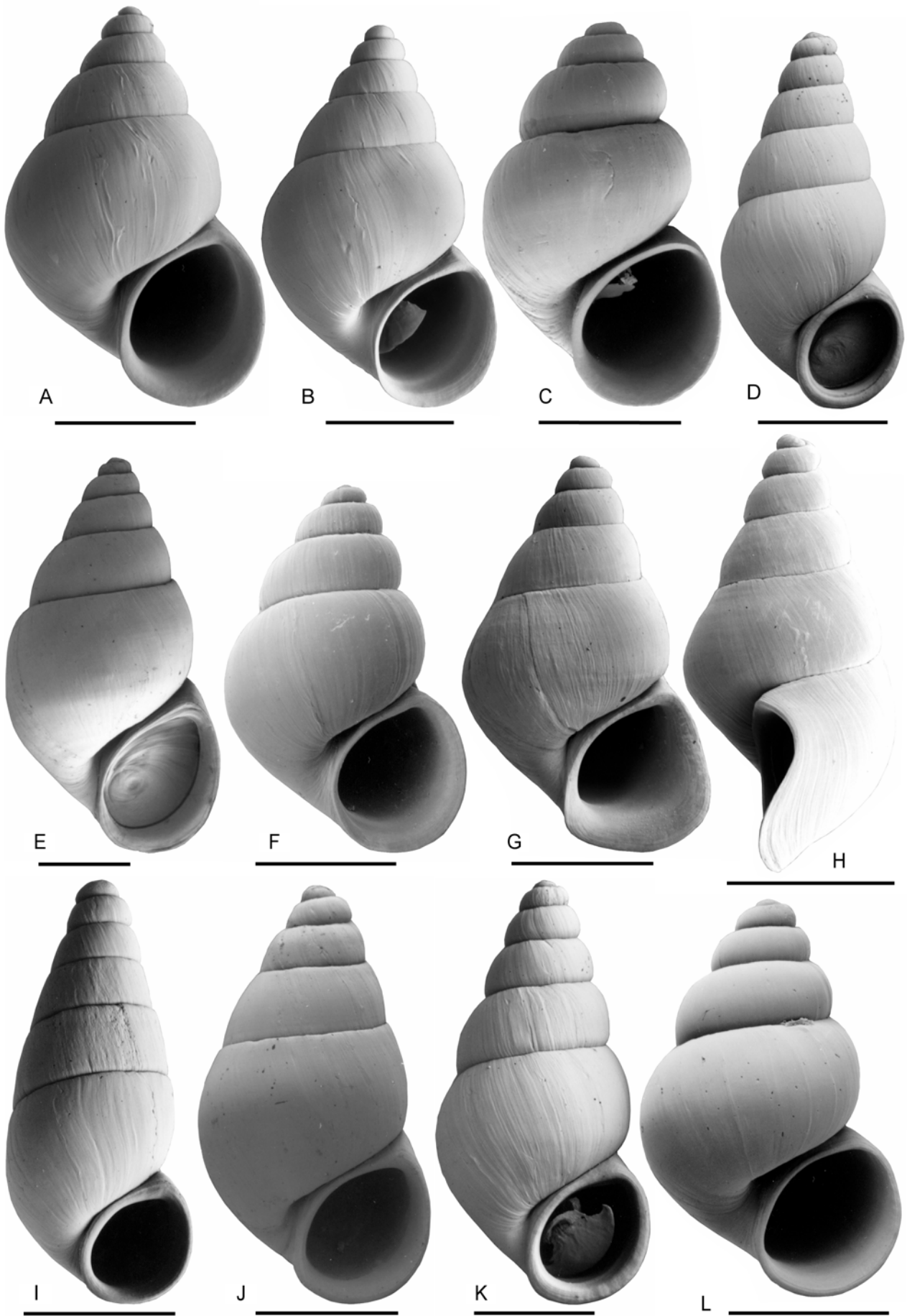
Thompsons Ck on Tennis Courts Rd, Pettavel, MV F.54459; Connemara Gully, Port Campbell, MV F.54648; unnamed creek at bridge, 1.5 km S of Moriac, C.300813; Top Break, Barwon R, MV F.20426; Thompson Ck at road bridge, 2.5 km S of Moriac, C.300809; Thompsons Ck, 20 km NW of Torquay, MV F.82301; Merrigig Ck, near Pettavel Rd, WNW of Torquay, C.300803; Spring Ck, Bellbrae near Torquay, MV F.82289, C.300804, C.300806; Barwon R, C.203999; Karngun Bridges, on Winchelsea-Deans Marsh Rd, MV F.54766; Carlisle River, C.200921; Cape Otway Forest, MV F.54621.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium size, with squat spire and straight spire outline and convex whorls; penis with pigmentation absent or on all areas except base; coiled oviduct with proximal part inverted U-shaped.

Description. *Shell* (Figs. 25K, 26E, 40F, 41E). Shell 2.07–3.76 mm in height, 1.32–2.36 mm in width; spire of average length to squat, aperture 0.81–1.56 mm in height, 0.77–1.32 mm in width. Body whorl 1.43–2.54 mm in height. Teleoconch of 3.00–4.65 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Operculum* (Fig. 27G). Operculum 0.73–1.32 mm in height, 0.56–0.99 mm in width, with 2–6 pegs. *Radula* (Fig. 28F). Central teeth: with 3–4 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps, 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 17–20 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 26–29 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout with well-developed pigmentation; head, neck and foot with well to poorly developed pigmentation; opercular lobe, pallial roof and visceral coil weakly pigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 19–23 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about 1/3–1/2 in pallial roof; oval, thin to intermediate in thickness. Pericardium about 1/2 in pallial roof. *Male reproductive system* (Fig. 7M,N). Testis of 1.0–1.2 whorls. Seminal vesicle conspicuously coiled on both the digestive gland and testis behind the stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface; straight at prostate; slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on all areas except base. *Female reproductive system* (Fig. 42A). Ovary lobulate, about 1.1 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct of medium length. Rectum overlapping albumen and capsule glands. About 1/2 of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section with indistinct to distinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	3.66	2.23	1.44	4.25
paralectotype	3.41	2.08	1.38	4.65
figured SEM specimen	2.84	1.86	1.19	3.65

Distribution and habitat. This is a widespread species found in central Victoria (Fig. 39) and is not found in sympatry with any other species of *Austropyrgus*. It is typically found on weeds, leaves, roots and stones and can be locally abundant.



Remarks. *Austropyrgus angasi* is the type species of *Angrobia* Iredale, 1943. This species has not been found in sympatry with any other species of *Austropyrgus*. However, it does exhibit variation in shell shape and size across its currently recognized range and it may prove to consist of more than one taxon. It is most similar to *A. foris* and *A. macaulayi*. It differs from *A. foris* in its broad, squat shell and in having a simple inverted U-shaped renal oviduct (coiled in *A. foris*). *Austropyrgus angasi* differs from other Victorian members of Group 3 by several shell and anatomical characters (see descriptions for comparisons). *Austropyrgus angasi* also resembles *A. diemensis* and differs in having a complexly coiled renal oviduct.

In the discriminant analysis (two populations, 42 individuals) several specimens of *A. angasi* were wrongly classified by more than one individual as follows: *A. diemensis* (7), *A. foris* (5), *A. exiguus* (2) and *A. latus* (2) (overall 43% correct). When the analysis was restricted to Group 3, only 48% were correctly classified, with the following misclassified as *A. diemensis* (7), *A. dekeyzeri* (3), *A. macaulayi* (2), *A. exiguus* (2), *A. macropus* (2), *A. turbatus* (1), *A. bungoniensis* (1), *A. tathraensis* (1), *A. wombeyanensis* (1), *A. colludens* (1) and *A. zeidlereri* (1).

South Australian taxa

Austropyrgus fonscultus n.sp.

Figs. 36I, 43A, 44B

Type material. Holotype C.343048, figured paratypes C.307596 (3), paratypes C.300785 (20+), C.200952 (20+), C.200951 (20+), C.200954 (3), SAMA D19075 (3).

Type locality. Small springs on property of B.S. Milstead, N of Umpherstone Bay, South Australia, 38°0.48'S 140°37.75'E, small spring 0.3–0.8m inside hole, in tangled roots, 20 May 1984.

Other material examined. South Australia: SE end of Bool Lagoon, C.200953; Lake Battye, near Robe, C.200961; The Springs, E side of Lake Eliza, SE of Robe, C.201644; stream NW of Millicent, SAMA FWA 3765; Blue Lake, N wall, E of pontoon, Mt Gambier, SAMA D19076, SAMA D19077; Simpsons Hole (L24), large cenote (divers call it 1080), SAMA FWA 3762; Devils Punchbowl or Blackhole (L47), a cenote, SW of Mt Gambier SAMA D19078; Ewen Ponds and Eight Mile Creek, S of Mt Gambier SAMA D19079, C.201643.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, with slightly convex whorls and straight spire outline, inner lip of aperture firmly adhering to parietal wall; seminal vesicle slightly undulating over stomach; ¼ or less to about ½ of the albumen gland in front of posterior pallial wall.

Description. *Shell* (Figs. 36I, 43A). Shell 1.51–2.20 mm in height, 0.99–1.40 mm in width; spire of average length, outline straight; aperture 0.62–0.95 mm in height, 0.58–0.83 mm in width. Body whorl 1.11–1.58 mm in height. Teleoconch of 2.75–3.65 slightly convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal

wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow to yellow-brown, translucent. *Holotype dimensions:* SH, 1.89 mm; SW, 1.15 mm; AH, 0.79 mm; TW, 3.25 whorls. *Operculum.* Operculum 0.57–0.83 mm in height, 0.46–0.65 mm in width, with 1–3 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 26–31 cusps, ratio of cutting edge to shaft about ¼, outer marginal teeth with 26–31 cusps, ratio of cutting edge to shaft about ¼. *Head-foot.* Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 16–21 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; partly covering rectum when visible. Rectum without arch to with slight arch. Renal gland about ½ in pallial roof; oval; thin. Pericardium more than ½ in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 44B). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part with one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind to well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. ¼ or less to about ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the small streams and large springs associated with the limestone sinkholes distributed in southeastern corner of South Australia (Fig. 45). It is typically found on leaves, weeds and on the sediment and can be locally abundant.

Remarks. This species has been found in sympatry with one species of *Austropyrgus* (*A. latus*) throughout its currently recognized range. It is distinguished from *A. latus* by its much smaller size and convex whorls. This species is the smallest of the species of *Austropyrgus* found in South Australia and can also be distinguished from the other South Australian members of Group 3 by its slightly rounded whorls. It is similar to *A. spectus*, from which it differs by its broader, more conical shell and shorter spire.

In the discriminant analysis no specimens of *A. fonscultus* were misclassified by more than one individual (overall 75% correct). When the analysis was restricted to Group 3, 80% were correctly classified, with the following misclassified as *A. glenelgensis* (2), *A. pusillus* (1) and *A. dyerianus* (1).

Etymology. *Fons* Latin: spring; *cultus* Latin: abide, dwell, inhabit—refers to this species being found predominantly in springs.

Fig. 40. Shells of species of *Austropyrgus*: A, *A. vulgaris*, holotype, C.343024; B, *A. latus*, holotype, C.343824; C, *A. glenelgensis*, C.343029; D, *A. procerus*, holotype, C.343061; E, *A. goliathus*, holotype, C.343031; F, *A. angasi*, C.346056; G, *A. sinuatus*, holotype, C.343038; H, *A. sinuatus*, lateral view of aperture of holotype; I, *A. tateiformis*, holotype, C.343053; J, *A. rectoides*, holotype, C.343055; K, *A. praecipitis*, holotype, C.343057; L, *A. diemensis*, C.348998. Scales all 1 mm.

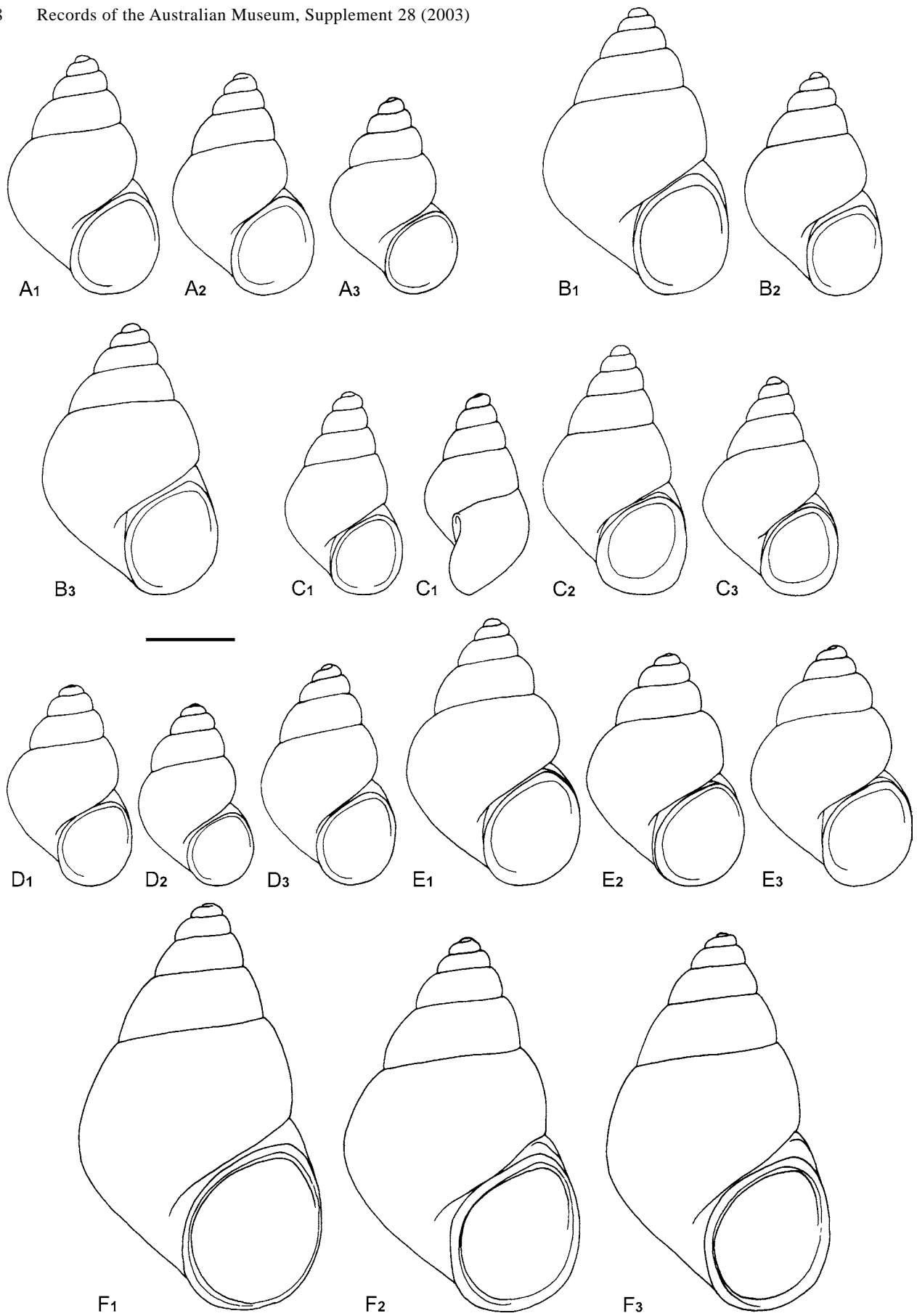


Fig. 41. Shells of species of *Austropyrgus*: A, *A. vulgaris*, paratypes, C.307585; B, *A. latus*, paratypes, C.300796; C, *A. sinuatus*, paratypes, C.343037; D, *A. glenelgensis*, C.345628; E, *A. angasi*, C.346056; F, *A. goliathus*, paratypes, C.307594. Scale 1 mm.

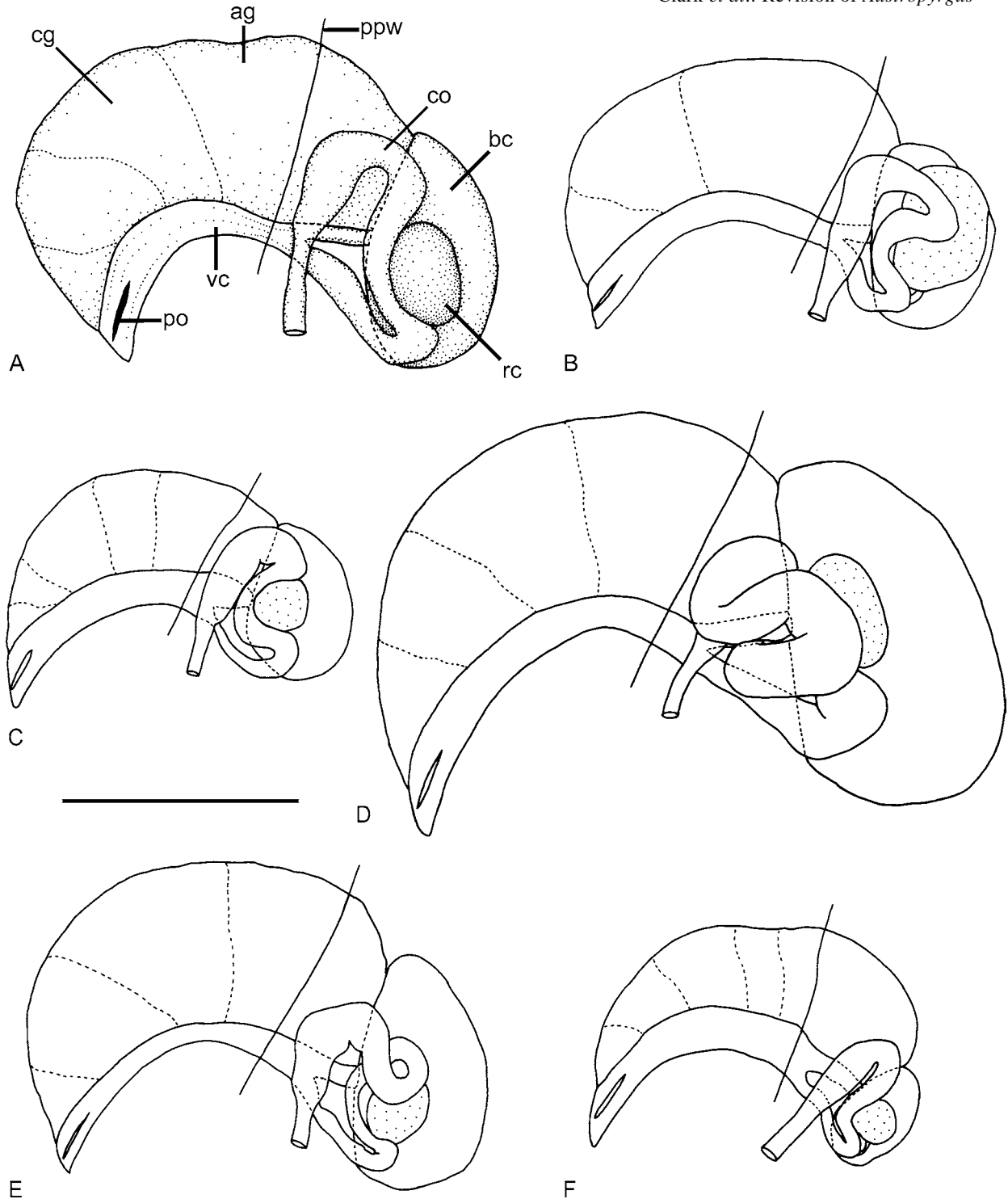


Fig. 42. Female genitalia of species of *Austropyrgus*: A, *A. angasi*, C.166887; B, *A. vulgaris*, C.302424; C, *A. glenelgensis*, C.300818; D, *A. goliathus*, C.300700; E, *A. latus*, C.300695; F, *A. sinuatus*, C.302425. Scale 0.5 mm, see p. 5 for abbreviations.

***Austropyrgus macropus* n.sp.**

Figs. 26D, 36H, 43B, 44A

Type material. Holotype SAMA D.19085, figured paratypes SAMA D.19084 (3), paratypes SAMA D.19086, D.19087, C.202143.

Type locality. Eleanor River at road, 5 km SSW of Parndana, Kangaroo Island, South Australia, 35°56.00'S 137°15.00'E, April 1981.

Other material examined. South Australia: Port Pirie, SAMA D.19088; Crystal Brook, SAMA D.19089; Broughton R, Koolunga, SAMA D.19090; Franklin Harbour, Wongaraleednie, SAMA D.19091; trib of Light R, Undalya, SAMA D.19092; Wakefield R, 10 mi from Riverton, SAMA D.19093; Waterfall Ck, near Wadella Falls, 10 km NW of Tumby Bay, SAMA D.19094; Gawler Pond, on Tod R, N of Port Lincoln, SAMA D.19095; Tod R at Lincoln Hwy, C.201646, SAMA D.19096; Stinky Ck at Lincoln Hwy, SAMA D.19097; Port Lincoln, C.200970; roadside creek, Foreston via Gumeracha, C.201630, SAMA D.19098, D.19099, MV F.54686; Torrens R, Adelaide, SAMA D.19100, MV F.54633; Prospect, SAMA D.19101; Payneham, SAMA D.19102; Long Gully, National Park, Adelaide, C.42299; Adelaide, SAMA D.19103;

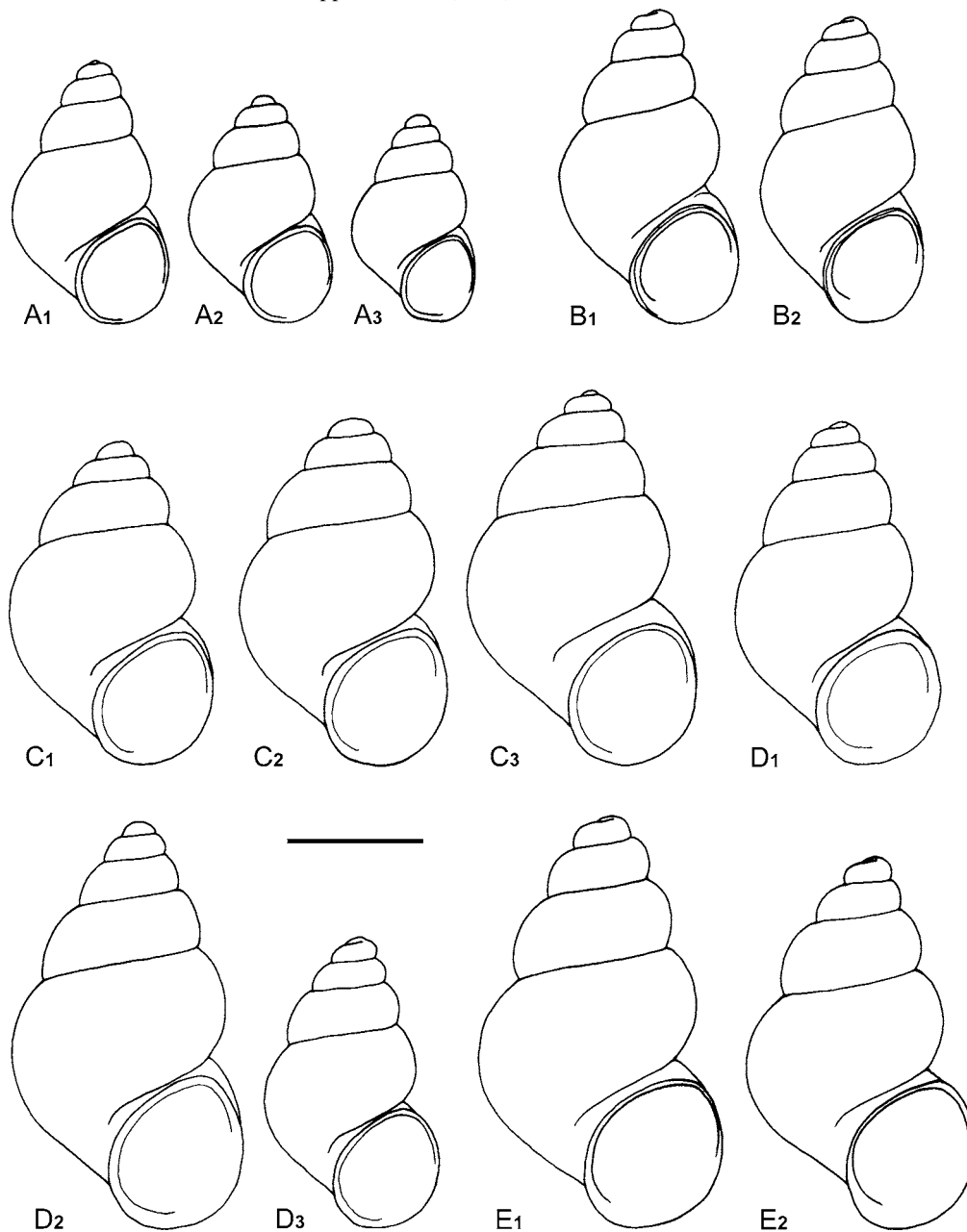


Fig. 43. Shells of species of *Austropyrgus*: A, *A. fonscultus*, paratypes, C.307596; B, *A. macropus*, paratypes, SAMA D.19084; C, *A. halletensis*, paratypes, C.307593; D, *A. flindersensis*, paratypes, C.307575; E, *A. zeidleri*, paratypes, SAMA D.19155. Scale 1 mm.

Burnside Ck, C.200967; Gulf St. Vincent, SAMA D.19104; Glenelg Beach, Adelaide, C.200968; Mt Lofty, SAMA D.19105; Myponga R at Hindmarsh Valley Rd, Myponga, C.204067; Noarlunga Meadows, SAMA D.19106; Meadows Ck at road to Koppio, near Balmoral, SAMA D.19107; creek, about 3 km S of Normanville, C.200965; Point McLeay, Lake Alexandrina, SAMA D.19108; Lake Battye, near Robe, C.204027, C.204028; Robe, SAMA D.19130; Kangaroo Island—Gum Ck, near Stokes Bay, SAMA D.19109; King George Ck at rd, SAMA D.19110; Cygnet R, near Telephone Exchange, SAMAD.19111; Cygnet R, near Longwater Hole, SAMA D.19116; Upper Cygnet R, SAMA D.19120; near mouth of Middle R, near lagoon, SAMA D.19112; De Molle R at rd, SAMA D.19113; De Molle R, 8 km N of Shackle Rd, junction with Playford Hwy, SAMAD.19114, D.19115; Ravine des Casoars, at Playford Hwy, SAMA D.19117, D.19118; Raining Creek, SAMA D.19119; Stunsail Boom R, SAMA D.19121; North West R, ENE of Grainger Lagoon, SAMA D.19122; Breakneck R, near road crossing, Flinders Chase, SAMA D.19123; Rocky R, 3 km W of Ranger Station, SAMA D.19124, D.19125, D.19128; Rocky River, near mouth, Flinders Chase, SAMAD.19127; Camp Creek Flat River at rd, near Vivonne Bay, SAMAD.19126; South West R at rd, Kangaroo Island, SAMAD.19129.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with convex whorls, outer lip heavily thickened and without reflection; penis pigmented on basal section only; anterior end of capsule gland blunt.

Description. *Shell* (Figs. 26D, 36H, 43B). Shell 2.30–3.05 mm in height, 1.41–1.94 mm in width; spire of average length, outline straight; aperture 0.95–1.21 mm in height, 0.88–1.06 mm in width. Body whorl 1.79–2.14 mm in height. Teleoconch of 3.25–3.90 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 2.30 mm; SW, 1.41 mm; AH, 0.95 mm; TW, 3.50 whorls. *Operculum*. Operculum 0.87–1.10 mm in height, 0.67–0.83 mm in width, with 3–6 pegs. *Radula*. Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal

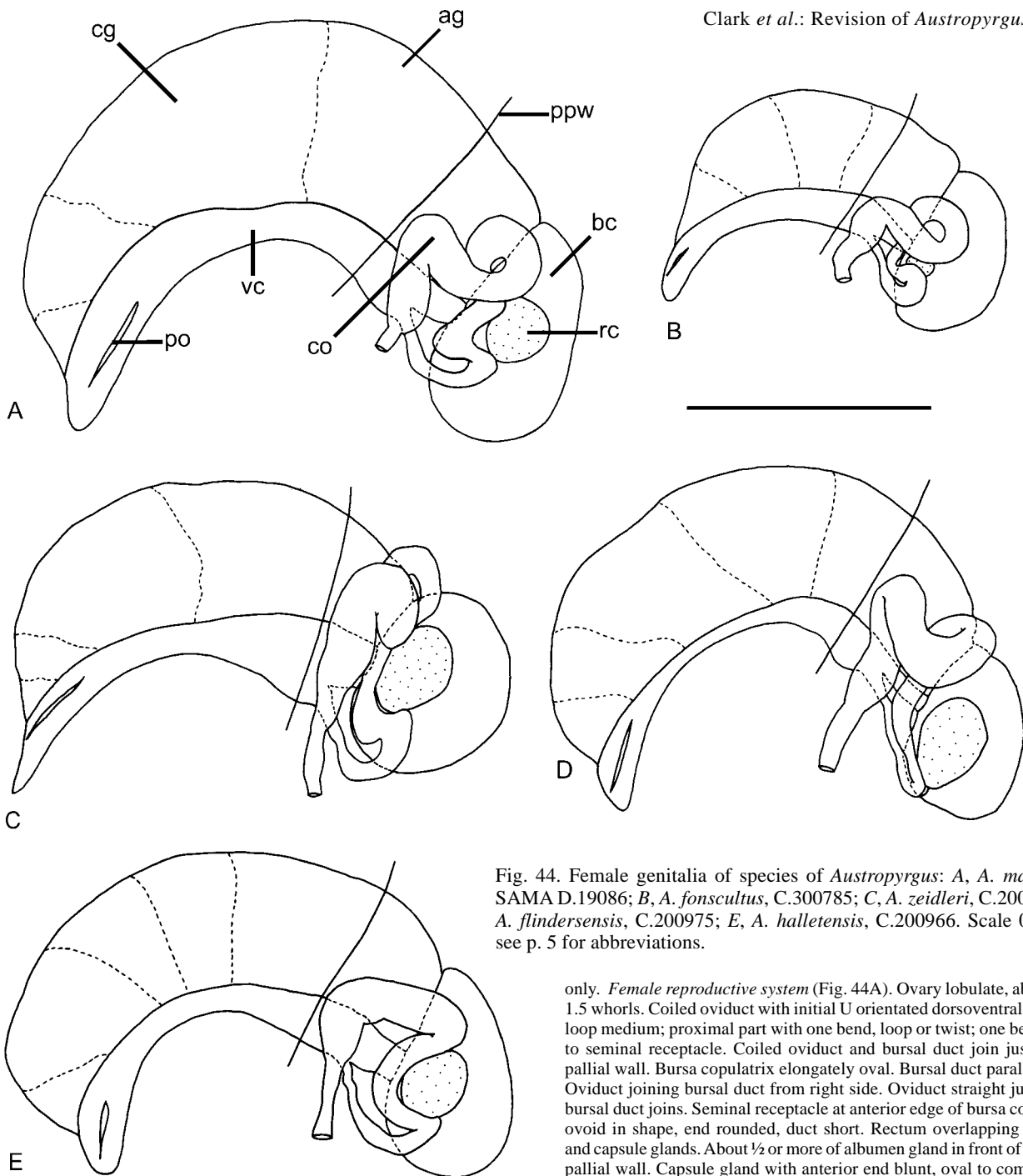


Fig. 44. Female genitalia of species of *Austropyrgus*: A, *A. macropus*, SAMA D.19086; B, *A. fonscultus*, C.300785; C, *A. zeidleri*, C.200956; D, *A. flindersensis*, C.200975; E, *A. halletensis*, C.200966. Scale 0.5 mm, see p. 5 for abbreviations.

tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 21–26 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 28–31 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout, foot, opercular lobe, head and neck and pallial roof with pigmentation well developed; visceral coil mottled. Columellar muscle small. *Non-genital anatomy*. Ctenidium with 19–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with short S-shape. Renal gland about $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.0–1.1 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface. straight at prostate. slightly undulating between prostate and penis. strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on basal section

only. *Female reproductive system* (Fig. 44A). Ovary lobulate, about 1.3–1.5 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part with one bend, loop or twist; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About $\frac{1}{2}$ or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, oval to compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the small streams and rivers of Kangaroo Island and the coastal streams of the mainland around the Eyre and York Peninsulas and the Adelaide area of South Australia (Fig. 45). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*, although it is occasionally found together with *Posticobia brazieri* (Smith, 1882). *Austropyrgus macropus* exhibits some variation in shell size and shape throughout its currently recognized range and further work may show that it is composed of more than one taxon. Its shell can be distinguished from all other South Australian members of Group 4 by its generally medium

size, narrow shape and slightly convex whorls. Other taxa with similar shells include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. zeidleri*, *A. flindersensis*, *A. halletensis*, *A. ora*, *A. dekeyzeri*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buechanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. macropus* were misclassified by more than one individual (overall 85% correct). When the analysis was restricted to Group 3, 85% were correctly classified, with the following misclassified as *A. macaulayi* (1), *A. wombeyanensis* (1) and *A. flindersensis* (1).

Etymology. *Macropus*, the generic name for the kangaroo, refers to Kangaroo Island the type locality.

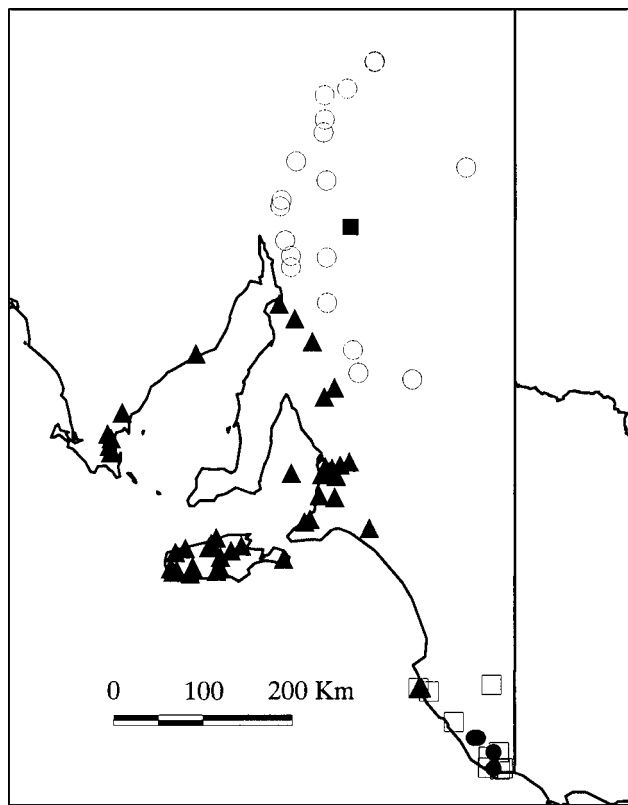


Fig. 45. Distribution of *Austropyrgus halletensis* ■, *A. flindersensis* ○, *A. zeidleri* ●, *A. macropus* ▲ and *A. fonscultus* □.

Austropyrgus zeidleri n.sp.

Figs. 36G, 43E, 44C

Type material. Holotype SAMA D.19131, figured paratypes D.19155 (2), paratypes C.200956 (20+) SAMA D.19132 (20+).

Type locality. Benara Sinkhole, (L32), 6 km WSW of Mt Gambier, South Australia, 37°50.98'S 140°41.98'E, 5 m, "mop trap" from not quite total darkness, 31 Aug 1986–24 Sept 1987.

Other material examined. South Australia: Iddlebidy Cave, sinkhole in Tantanoola Forest c. 8 km SE of Tantanoola, SAMA D.19133, D.19134; Fossil Cave, sinkhole on S side of Princes Hwy, c. 3 km SE of Tantanoola Caves, SAMA D.19135, D.19136, D.19137, D.19138; 3 km NW of Tantanoola Caves at Princes Hwy, C.200955; Hancock's Cave (5L 66) near Allendale East, SAMA D.19139.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, very thin, sutures incised, whorls convex, inner lip distinctly separated from parietal wall and outer lip with reflection; bursal duct widest at junction with distal coiled oviduct.

Description. *Shell* (Figs. 36G, 43E). Shell 2.09–3.60 mm in height, 1.41–1.97 mm in width; spire elongate to average length, outline straight; aperture 0.81–1.25 mm in height, 0.78–1.13 mm in width. Body whorl 1.50–2.26 mm in height. Teleoconch of 3.05–4.55 strongly convex whorls, last whorl and base evenly convex. Inner lip of aperture distinctly separated from parietal wall, outer lip weakly thickened, with reflection. Colour white to very pale yellow, translucent to opaque. *Holotype dimensions*: SH, 3.31 mm; SW, 1.72 mm; AH, 1.16 mm; TW, 4.00 whorls. *Operculum*. Operculum 0.75–1.24 mm in height, 0.57–0.92 mm in width, with 2–5 pegs. *Radula*. Central teeth: with 5 lateral cusps, median cusp of medium width, sharply pointed, less than twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 24–26 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 30–34 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Animal unpigmented. Columellar muscle small. *Non-genital anatomy*. Ctenidium with 20–24 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced to appears to be absent; partly covering rectum when visible. Rectum with slight arch to with short S-shape. Renal gland about 1/2 in pallial roof; oval; thin to intermediate in thickness. Pericardium more than 1/2 in pallial roof. *Male reproductive system*. Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 44C). Ovary lobulate, about 0.75–1.00 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; one to two bends distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/2 or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is restricted to a few small springs and sinkholes found around the Mt Gambier region of southeastern South Australia (Fig. 45). It is typically found on weeds and leaves and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It differs from the other South Australian members of Group 3 in its very thin shell with strongly convex whorls with deeply incised sutures and the inner lip of the aperture being distinctly separated from the parietal wall. This species shows some variation in shell size and shape throughout its currently recognized range, and with further work, additional taxa may be recognized.

The very thin shell of this species is atypical for the genus. Other taxa with similar shells include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. ora*, *A. dekeyzeri*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buechanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. zeidleri* were misclassified by more than one individual except for two assigned to *A. abercrombiensis* (overall 75% correct). When the analysis was restricted to Group 3, 75% were correctly classified, with the following misclassified as *A. abercrombiensis* (2), *A. aslini* (1), *A. flindersensis* (1) and *A. gunnii* (1).

Etymology. Named after Wolfgang Zeidler who has greatly assisted with the collection of hydrobiid material for this and other projects.

Austropyrgus flindersensis n.sp.

Figs. 36J, 43D, 44D

Type material. Holotype C.343050, figured paratypes C.307575 (3), paratypes C.200975 (20+), SAMA D.19140 (3).

Type locality. Moro Springs in Moro Gorge, Flinders Ranges, South Australia, 30°41.50'S 139°12.57'E, small spring above pools, in weed, 11 May 1981.

Other material examined. South Australia: Moro Spring, Big Moro Gorge, 14 km W of Wertaloona HS, SAMA D.19141, D.19142; Woodendinna Spring, 7 km SW of Narrina HS, SAMA D.19143; second spring, 11 km NW of Blinman, SAMA D.19144; Aroona Spring, near ruins, Aroona Valley, SAMA D.19145; Bunyeroo Ck at road, Bunyeroo Valley, SAMA D.19146; Hookina Ck, at road to Cotabena, 30 km NW of Hawker, SAMA D.19147; Nooltana Ck, 12 km NW of Hawker, SAMA D.19148; creek at Willow Waters, 15 km E of Hawker, SAMA D.19149; Buckaringa Gorge, SAMA D.19150; Warren Gorge, SAMA D.19151; Mimbadoggie Creek at Wilmington-Quorn road on E slope of Mount Bruce, C.200969; Spring Ck, 8 km S of Wilmington, SAMA D.19152; spring at Orroroo town water supply, C.200964; Mambray Ck, Mt Remarkable NP, SAMA D.19153; creek at Jamestown Weir, C.201017; Willow Ck, W slope of Mt Plantagenet on road to "Willow Waters" and "Worumba", C.200972; Burra Gorge, 20 km SSE of Burra, C.201018; trib of Burra Ck at Morgan Rd, c. 2 km E of Burra, C.200963.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with slightly convex to convex whorls and outer lip with slight reflection; coiled oviduct and bursal duct join well behind posterior pallial wall; female genital opening of medium length.

Description. *Shell* (Figs. 36J, 43D). Shell 2.34–3.12 mm in height, 1.37–1.82 mm in width; spire of average length, outline straight; aperture 0.84–1.13 mm in height, 0.83–1.06 mm in width. Body whorl 1.57–2.07 mm in height. Teleoconch of 3.40–4.50 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal wall in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, with very slight reflection. Colour white to very pale yellow, translucent. *Holotype dimensions:* SH, 2.65 mm; SW, 1.49 mm; AH, 1.00 mm; TW, 3.60 whorls. *Operculum.* Operculum 0.81–1.09 mm in height, 0.60–0.77 mm in width, with 2–4 pegs. *Radula.* Central teeth: with 4 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral

teeth: with 4–5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 19–21 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 23–25 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Animal unpigmented. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 20–24 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced to appears to be absent; partly covering rectum when visible. Rectum without arch to with slight arch. Renal gland about 1/2 in pallial roof; oval; thin. Pericardium more than 1/2 in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach to slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 44D). Ovary lobulate, about 1.0–1.1 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; straight or with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle overlapping anterior edge to at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/3 to about 1/2 of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct to moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the streams and springs of the northern and central parts of the Flinders Ranges, South Australia (Fig. 45). It is typically found associated with the roots of reeds and other water plants growing in and along the edges of the streams and springs and can be locally common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. However, it shows some variation in shell size and shape over its currently recognized range and additional taxa may eventually be recognized, particularly as several populations are known from isolated, widely separated springs. It is also quite likely that additional populations will be found, as suitable habitats are small and not readily located. It is most similar to *A. halletensis* from which it differs in the shell having the outer lip with a reflection (absent in *A. halletensis*), as well as in some anatomical characters (see descriptions). It differs from *A. macropus* in its generally larger, broader shell with the outer lip weakly thickened (thickened in *A. macropus*) and reflected (simple in *A. macropus*). Other taxa with similar shells include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. zeidleri*, *A. ora*, *A. dekeyzeri*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buechanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. flindersensis* were misclassified by more than one individual except for three assigned to *A. abercrombiensis* (overall 55% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following misclassified as *A. abercrombiensis* (3), *A. synoria* (1), *A. zeidleri* (1), *A. nitidus* (1), *A. gordonensis* (1) and *A. colludens* (1).

Etymology. Named after the Flinders Ranges, which encompasses the currently known range of the species.

Austropyrgus halletensis n.sp.

Figs. 36K, 43C, 44E

Type material. Holotype C.348920, figured paratypes C.307593 (2), paratypes C.200966 (20+), SAMA D.19154 (3).

Type locality. Small creek 0.5 km E of Hallet, on Burra-Peterborough Road, South Australia, 32°24.08'S 138°54.17'E, in small gully, 7 May 1981.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with convex whorls, inner lip of aperture narrowly to distinctly separated from parietal wall, outer lip without reflection; more than ½ of albumen gland in front of posterior pallial wall; female genital opening small.

Description. *Shell* (Figs. 36K, 43C). Shell 2.07–2.83 mm in height, 1.17–1.55 mm in width; spire elongate to average length, outline straight; aperture 0.80–1.01 mm in height, 0.72–0.92 mm in width. Body whorl 1.53–1.93 mm in height. Teleoconch of 3.00–3.85 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour white to very pale yellow, translucent. *Holotype dimensions:* SH, 2.23 mm; SW, 1.27 mm; AH, 0.85 mm; TW, 3.40 whorls. *Operculum.* Operculum 0.80–0.97 mm in height, 0.53–0.73 mm in width, with 2–6 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–30 cusps, ratio of cutting edge to shaft about ½, outer marginal teeth with 24–31 cusps, ratio of cutting edge to shaft about ¼. *Head-foot.* Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 20–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to appears to be absent; partly covering rectum to covers rectum when visible. Rectum without arch to with slight arch. Renal gland about ½ in pallial roof; oval; thin. Pericardium more than ½ in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate; slightly to strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 44E). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently only known from the type locality in the central portion of the Flinders Ranges, South Australia (Fig. 45). It is typically found on weeds, leaves, roots and stones and can be common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*. It is most similar to *A. flindersensis* (see remarks under *A. flindersensis*).

This species is currently known from only a single population, although it is possible that some of the populations currently included within *A. flindersensis* may be transferable to *A. halletensis*, and with further work, additional populations may be found. Other taxa with similar shells include *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. ora*, *A. dekeyzeri*, *A. macaulayi*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. buchanensis*, *A. nepeanensis*, *A. sparsus*, *A. wombeyanensis* and *A. bungoniensis*.

In the discriminant analysis some specimens of *A. halletensis* were misclassified by more than one individual as *A. gippslandicus* (2), *A. bungoniensis* (2) and *A. ora* (2) (overall 40% correct). When the analysis was restricted to Group 3, 50% were correctly classified, with the following misclassified as *A. bungoniensis* (2), *A. ora* (2), *A. turbatus* (1), *A. gippslandicus* (1), *A. sparsus* (1), *A. buchanensis* (1), *A. wombeyanensis* (1) and *A. simsonianus* (1).

Etymology. Named after the type locality.

Tasmanian taxa*Austropyrgus pagodoides* n.sp.

Figs. 27E, 46A,B, 47A, 48H

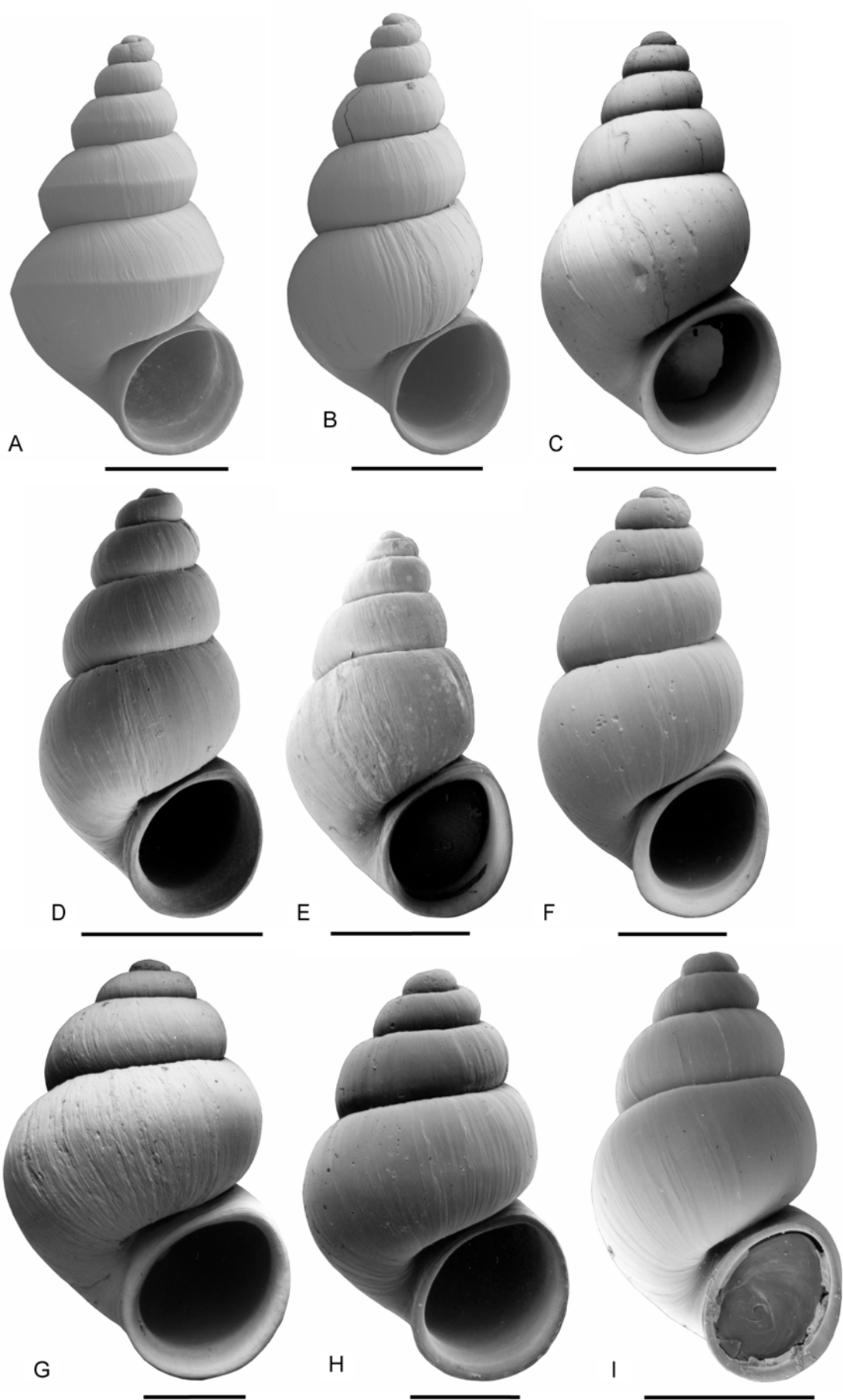
Type material. Holotype C.343818, figured paratypes C.392383 (3), paratypes C.201020 (20+), C.201021 C.201025 (20+), MV F.54717 (20+), F.54718 (20+), F.54739 F.54740 (1), TMH E.23426 (3), QVM 9:17060(3).

Type locality. Lake Sorell, Tasmania, 42°4.94'S 147°13.23'E, 27 January 1981.

Other material examined. *Tasmania:* small creek, 14 km W of Interlaken, MV F.54733; canal between Lake Sorell and Lake Crescent at Interlaken, C.203768, C.201548, MV F.82351; Lake Crescent, MV F.54741.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell medium in size, with last whorl and base either evenly convex (females) or strongly angled to keeled (males); seminal receptacle at anterior edge of bursa copulatrix; coiled oviduct and bursal duct join just behind pallial wall.

Fig. 46. Shells of species of *Austropyrgus*: A, *A. pagodoides*, holotype, C.343818; B, *A. pagodoides*, paratype, C.201020; C, *A. nitidus*, C.343059; D, *A. gordonensis*, holotype, C.343063; E, *A. gunnii*, C.201271; F, *A. ronkershawi*, holotype, C.343065; G, *A. salvus*, holotype, C.343094; H, *A. colludens*, holotype, C.348996; I, *A. simsonianus*, C.204041. Scales A–E, I 1 mm; F–H 0.5 mm.



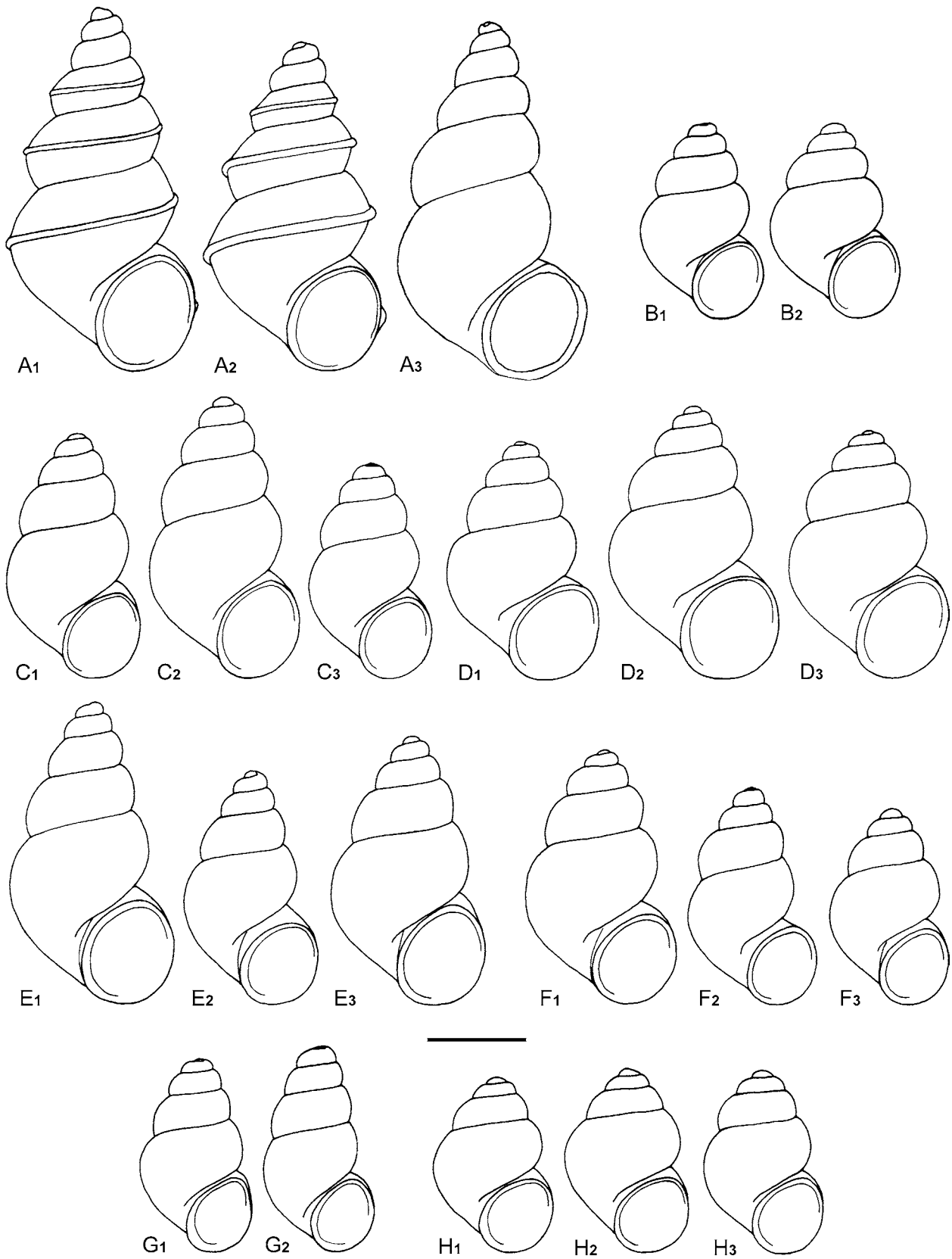


Fig. 47. Shells of species of *Austropyrgus*: A, *A. pagodoides* paratypes, C.392383; B, *A. colludens*, paratypes, C.348997; C, *A. gordonensis*, paratypes, C.343064; D, *A. gunnii*, C.201271; E, *A. nitidus*, C.343059; F, *A. simsonianus*, C.348999; G, *A. ronkershawi*, paratypes, C.343066; H, *A. salvus*, paratypes, C.343095. Scale 1 mm.

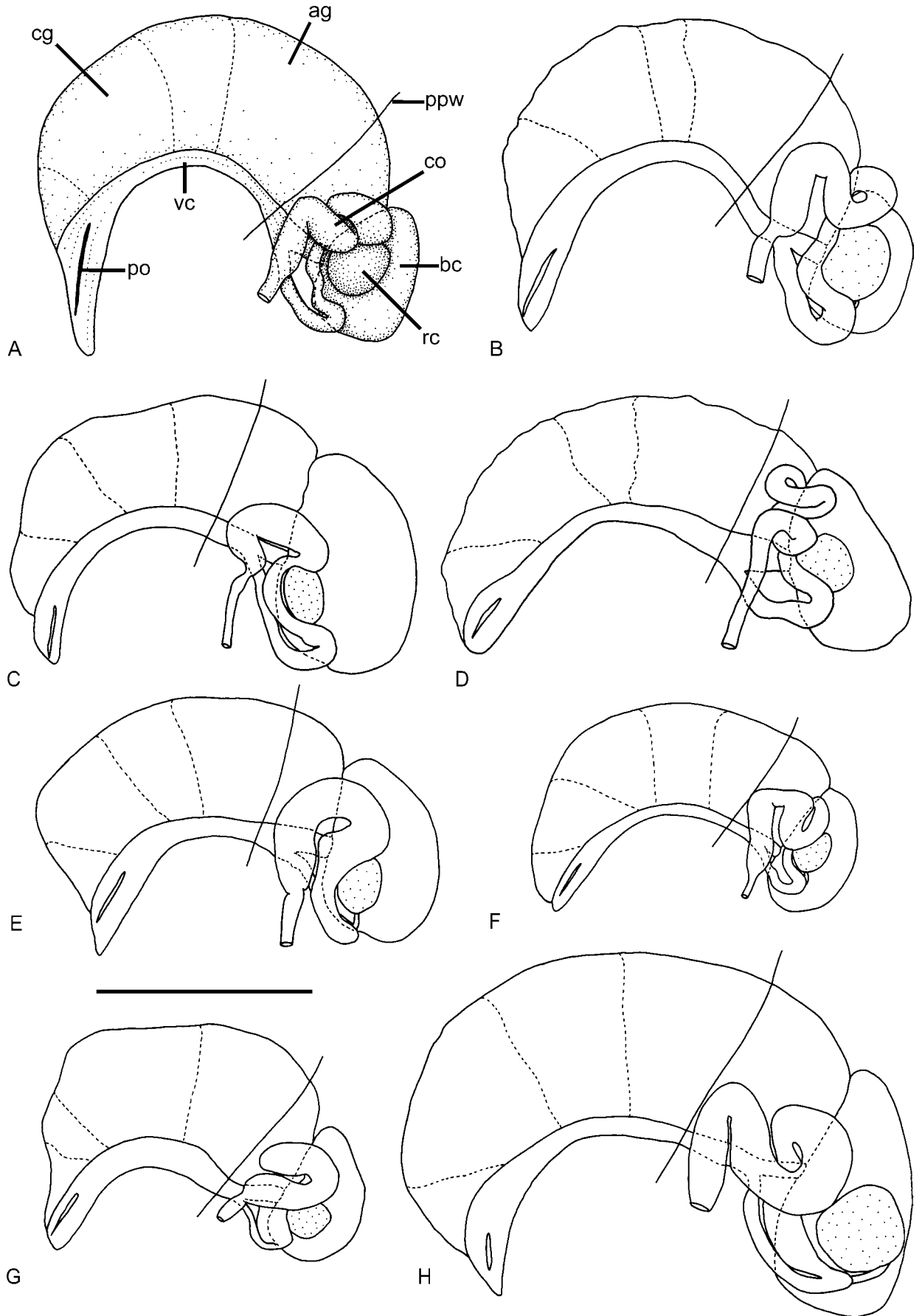


Fig. 48. Female genitalia of species of *Austropyrgus*: A, *A. simsonianus*, C.204041; B, *A. nitidus*, C.201513; C, *A. gordonensis*, C.201380; D, *A. gunnii*, C.201271; E, *A. ronkershawi*, C.201286; F, *A. salvus*, C.201277; G, *A. colludens*, C.343028; H, *A. pagodoides*, C.201020. Scale 0.5 mm, see p. 5 for abbreviations.

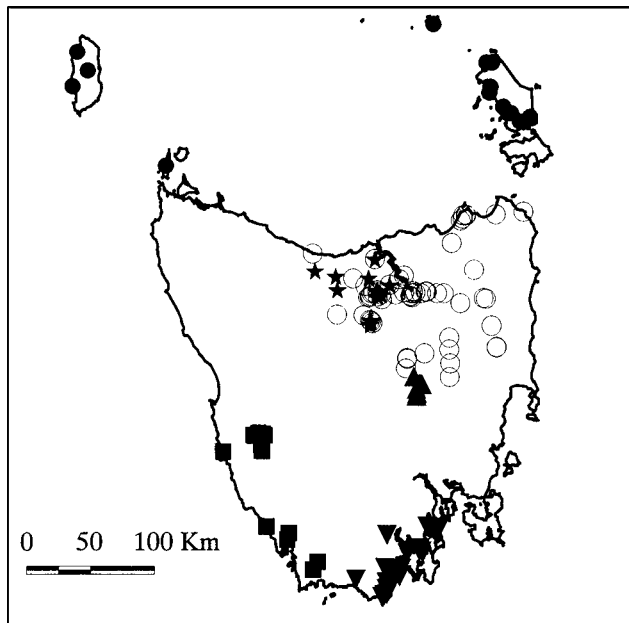


Fig. 49. Distribution of *Austropyrgus ronkershawi* ★, *A. gunnii* ○, *A. gordonensis* ■, *A. nitidus* ●, *A. niger* ▼ and *A. pagodoides* ▲.

Description. *Shell* (Figs. 46A,B, 47A). Shell 2.98–3.73 mm in height, 1.67–2.08 mm in width; spire elongate to average length, outline straight; aperture 0.98–1.16 mm in height, 0.90–1.15 mm in width. Body whorl 1.79–2.19 mm in height. Teleoconch of 4.50–5.00 convex whorls, last whorl and base either evenly convex (females) or strongly angled (males). Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour pale yellow to yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 3.37 mm; SW, 1.88 mm; AH, 1.13 mm; TW, 4.65 whorls. *Operculum* (Fig. 27E). Operculum 0.90–1.27 mm in height, 0.73–0.87 mm in width, with 2–7 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 24–27 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 29–32 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Animal unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 20–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to very reduced to appears to be absent; partly covering to covering rectum when visible. Rectum without arch or with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; oval; thin. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate; slightly to strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 48H). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part with one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is restricted to Lake Sorell, central Tasmania (Fig. 49). It is typically found on weeds, leaves, roots and stones and can be locally common.

Remarks. This species is among the more unusual members of the genus and indeed of the Australian hydrobiid fauna, in that there is marked sexual dimorphism, with the males possessing a prominent keel on the whorls whereas the females lack the keel. It can be distinguished from all other Tasmanian members of Group 3 by its large size, convex whorls and the presence of a keel (in males) roughly along the centre of the whorl. This species is not found in sympatry with any other species of *Austropyrgus*.

In the discriminant analysis all specimens of *A. pagodoides* were correctly classified.

Etymology. Named after the distinctive shape of the male shell which is reminiscent of Japanese and Chinese temples.

Austropyrgus niger (Quoy & Gaimard, 1834)

Figs. 5C, 6C, 7E,F, 10C, 13E,F, 50A, 51A, 52A

Paludina nigra Quoy & Gaimard, 1834: 174, pl. 58, figs. 9–12.

Hydrobia nigra.—Frauenfeld, 1864: 629.

Paludina nigra.—Ponder, 1988: 284–285, figs. 6–7.

Fluvidona nigra.—Smith, 1992: 47.

Type material. Neotype, C.153149; figured paraneotypes, C.153150, C.157166.

Original type locality. Small stream flowing into the D'Entrecasteaux Channel, Tasmania.

Neotype locality and material dissected and figured. C.157166, Bacons Ck, WSW. of Gordon, D'Entrecasteaux Channel, Tasmania, 43°16.70'S 147°11.50'E, 5 February 1987.

Other material examined. Tasmania: Tasmania, C.36976; stream flowing into Oyster Cove, C.201044; Graveyard Ck, Bruny I., C.201327; Richardsons Ck, Bruny I., C.201046; McCrackens Ck, Bruny I., C.201276; Kirkby Ck, Bruny I., C.201052; Mountain Ck at Channel Hwy, 18 km SE of Cygnet, C.201598; Kubes Ck at Esperance Coast Rd, Roaring Bay, C.201047; Hot Springs Ck at North Lune Rd, W of Southport, C.203827; stream on the S side of Lady Bay, Lady Bay Rd, C.201554; Thermal Springs, Hastings, C.378708; stream flowing into Sisters Bay at Lady Bay Rd, C.201048; Tea Tree Ck, Lune R, C.201045; Southport, C.201429; North Limestone Ck at first major track crossing, C.201041; D'Entrecasteaux R at South Cape Rd, C.201050; Recherche Bay, C.168999; trib of Catamaran Ck at track off South Cape Rd, C.201550; D'Entrecasteaux Watering Place, Rocky Bay, C.201315; Heathers Ck, Recherche Bay, C.201313; small swampy trib of Cackle Ck, South East Cape, C.201314; creek flowing into E side of South Cape Bay, C.201446, C.201040.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, conical, with straight to weakly convex spire outline; faecal pellets orientated obliquely or transversely; pallial vas deferens strongly undulating at prostate gland; anterior end of capsule gland blunt.

Description. *Shell* (Figs. 50A, 51A, 13E,F). Shell 2.16–2.83 mm in height, 1.23–1.61 mm in width; spire elongate to average length, outline straight to weakly convex; aperture 0.82–1.06 mm in height, 0.78–0.95 mm in width. Body whorl 1.46–1.87 mm in height. Teleoconch of 3.35–4.10 slightly convex to convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall. Outer lip weakly thickened, without reflection. Shell colour yellow-

brown and translucent. *Operculum* (Fig. 10C). Operculum 0.78–0.95 mm in height, 0.51–0.67 mm in width, with 3–6 pegs. *Radula* (Fig. 5C). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps, 3–4 pairs of basal cusps. Basal tongue of the central teeth U-shaped, just protruding past lateral edge. Lateral teeth with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Ratio of cutting edge to shaft about $\frac{1}{3}$ for inner marginal teeth. Ratio of cutting edge to shaft about $\frac{1}{4}$ for outer marginal teeth. Inner marginal teeth with 22–24 cusps, outer marginal teeth with 27–35 cusps. *Head-foot*. Cephalic tentacles with pigment absent or with poorly developed dorsal central stripe; snout with pigment absent or around edges, absent on foot and opercular lobe; pigmentation of head and neck on sides of neck only or absent; pallial roof and visceral with pigment poorly developed to absent. Columellar muscle small to moderate size. *Non-genital anatomy*. Ctenidium with 16–19 filaments. Osphradium between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; partly covering rectum to covering rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof, oval, thin. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system* (Fig. 7E,F). Testis of 1 whorl. Seminal vesicle conspicuously coiled on both digestive gland and testis behind stomach. Seminal vesicle loosely coiled over stomach to slightly undulated over stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, strongly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of the head, not pigmented. *Female reproductive system* (Fig. 52A). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part with 1–2 or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from the right side. Seminal receptacle overlapping anterior edge to at anterior edge of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About $\frac{1}{2}$ of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening small, overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
neotype	2.51	1.50	1.01	3.6
range	2.09–2.83	1.24–1.50	0.83–1.02	3.35–4.10
figured SEM specimen	2.67	1.61	1.01	3.40

Distribution and habitat. This species is found in the small streams along the D'Entrecasteaux Channel, southeastern Tasmania (Fig. 49). It is typically found on leaves, roots and stones and can be very common.

Remarks. This species is the type species of the genus and the first hydrobiid to be named from Australia. However, since its original description it has been consistently misidentified and for many years was believed to represent an Australian endemic species of the New Zealand genus *Potamopyrgus*. Ponder (1988) however, showed that *A. niger* was an endemic Tasmanian hydrobiid and that it was not a member of the genus *Potamopyrgus* and selected a neotype. To add to the confusion the introduced *Potamopyrgus antipodarum* and *A. niger* are frequently found together and can sometimes be difficult to separate without careful examination. *Austropyrgus niger*, like other species of *Austropyrgus*, can be separated by the more rounded and thickened aperture, the presence of pegs on the inner side of the operculum, typically smaller adult size and in lacking brooded embryos which are nearly always present in the parthenogenic *Potamopyrgus*.

Austropyrgus niger currently has the most southerly distribution of any known member of the genus. It is

geographically and morphologically similar to *A. dyerianus* but is often larger and broader. It also differs in several measurements and a few anatomical characters (see descriptions), notably the number of ctenidial filaments. It also resembles *A. tebus* in having a slightly convex spire outline but can be separated by a number of anatomical differences (see descriptions). Other somewhat similar taxa in Group 3 have straight spire outlines.

In the discriminant analysis no specimens of *A. niger* were misclassified by more than one individual (overall 60% correct). When the analysis was restricted to Group 3, 75% were correctly classified, with the following misclassified as *A. macaulayi* (2), *A. wombeyanensis* (1), *A. glenelgensis* (1), *A. nitidus* (1) and *A. gordonensis* (1).

Austropyrgus nitidus (Johnston, 1879)

Figs. 25G, 46C, 47E, 48B

Bithynella [sic] *nitida* Johnston, 1879: 25.

Bithynella nitida.—Tate & Brazier, 1881: 564; Johnston, 1889: 86, figs. 8–10?; Johnston, 1891: 138.

Type material. Lectotype (here chosen, Fig. 25G) TMH Z.198, paralectotypes (same number) and SAMA D.19212.

Type locality. Thunder and Lightning Bay, Cape Barren Island, Bass Strait, Tasmania (Quaternary fossil deposit).

Material dissected and figured. C.201513, C.343059 and C.343060 (figured specimens), Bootjack Ck, NW of Lady Barron, Flinders Island, Tasmania, 40°12'S 148°10'E, on submerged grass, in cleared flats, 14 June 1992.

Other material examined. **Tasmania:** Deal I.—East Cove, MV F.54735; Garden Cove Stream, MV F.54734, F.54732; Flinders I.—Edens Ck, C.204032, C.204059; Marshall Bay, MV F.54711; Hays Ck, N of Emita, C.203821; Pats R, 200m up from bridge, near airstrip, C.204120, C.307371, C.307368; Nalinga Ck, SE of Whitemark, C.307379; Chew Tobacco Ck, SE of Whitemark, C.307383; Pot Boil Ck at Logan Lagoon, C.204035; Holloways lime pit, NE of Vinegar Hill, QVM ex 40005(D); King I.—Camp Ck, Currie Harbour, MV F.54606; Yellow Rock Lagoon, C.306094; King I., SAMA TD.11945; Hunter I., MV F.88888.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, with straight spire outline and convex whorls; seminal vesicle tightly coiled over stomach; pallial vas deferens straight at prostate gland; coiled oviduct and bursal duct join well behind posterior pallial wall.

Description. *Shell* (Figs. 25G, 46C, 47E). Shell 2.29–3.25 mm in height, 1.34–1.92 mm in width; spire elongate to average length, outline straight; aperture 0.86–1.22 mm in height, 0.80–1.09 mm in width. Body whorl 1.63–2.24 mm in height. Teleoconch of 3.50–4.50 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum*. Operculum 0.81–1.08 mm in height, 0.62–0.85 mm in width, with 3–5 pegs. *Radula*. Central teeth: with 4–5 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 3–5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 21–24 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 27–31 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe, or dorsal pigmented central stripe only; rest of animal with well-developed pigment. Columellar muscle of moderate size. *Non-*

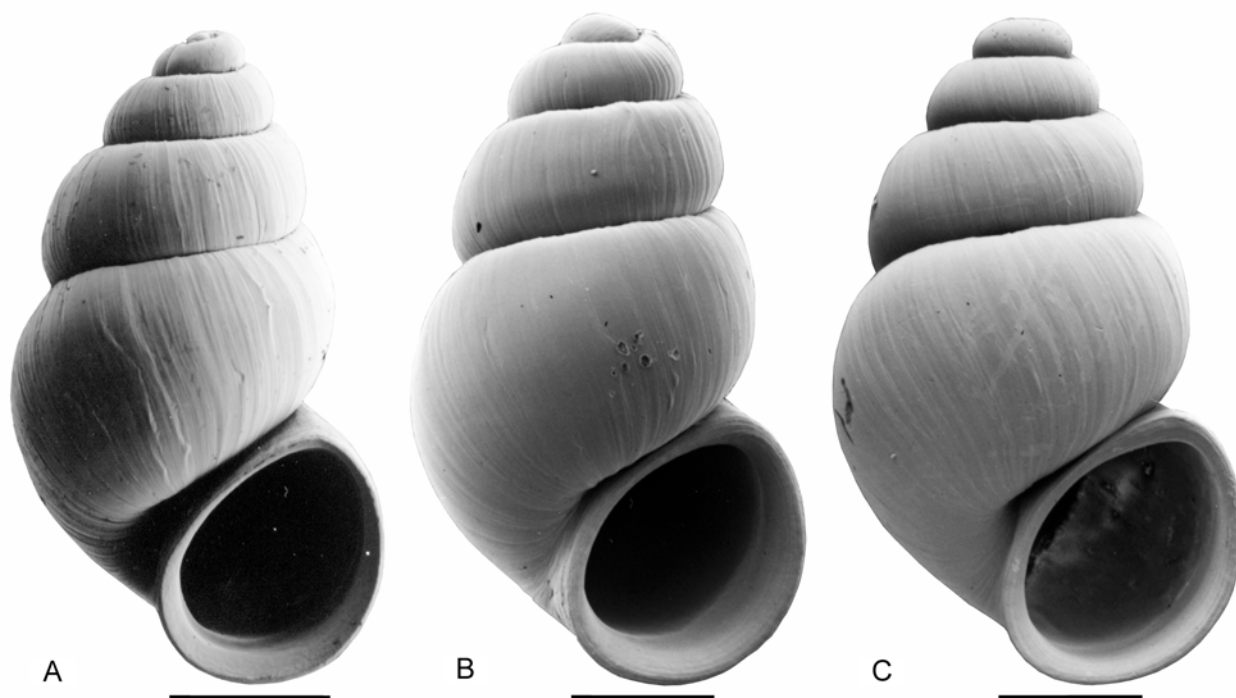


Fig. 50. Shells of species of *Austropyrgus*: A, *A. niger*, paraneotype, C.153150; B, *A. dyerianus*, C.349001; C, *A. tebus* holotype C.343104. Scales 0.5 mm.

genital anatomy. Ctenidium with 20–24 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; partly covering to covering rectum when visible. Rectum without arch to with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; oval; intermediate in thickness. Pericardium about $\frac{1}{2}$ or more in pallial roof. *Male reproductive system.* Testis of 1.0–1.3 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 48B). Ovary lobulate, about 1.00–1.25 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop long to medium; proximal part inverted U-shape to one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix ovoid. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle overlapping anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	3.00	1.77	1.09	3.75
figured SEM specimen	3.05	1.80	1.16	4.15

Distribution and habitat. This species is found in the small streams and rivers of Flinders and King Islands and some of the other smaller islands of Bass Strait (Fig. 49). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species was originally described from Quaternary fossil material collected from Cape Barren Island, just to the south of Flinders Island. The fossil type

material is very similar to extant populations on Flinders Island and given this similarity in shell characters, we somewhat tentatively regard the fossil and Recent populations on the Bass Strait Islands as being conspecific. However, the species as currently recognized, exhibits variation in shell size and shape throughout its range and it is possible that additional taxa may eventually be recognized. It is also possible that some of the populations that we have included within this species may prove to be related to some Tasmanian taxa (e.g., *A. simsonianus* and *A. gunnii*) and others to Victorian taxa, especially *A. turbatus* from Wilsons Promontory, Victoria. This is especially so for a population from Deal Island (which is not far from Wilsons Promontory), which looks very similar to *A. turbatus* but until further evidence is available it is here tentatively referred to *A. nitidus*.

We do not recognize any other species of *Austropyrgus* living on the Bass Strait Islands. Of the Tasmanian taxa, it is most similar to *A. gunnii* and *A. simsonianus* in shell shape. It differs from *A. gunnii* in its generally smaller, narrower shell with slightly less rounded whorls and from *A. simsonianus* in its often larger shell with less rounded whorls. There are also some anatomical differences (see descriptions). These two taxa, in particular, require further work to determine their relationships and status. Other species with similar shells include *A. gordonensis*, *A. colludens*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. ora*, *A. dekeyzeri*, *A. gippslandicus*, *A. abercrombiensis*, *A. tathraensis*, *A. abercrombiensis*, *A. wombeyanensis*, *A. buchanensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. nitidus* were misclassified by more than one individual except for two attributed to *A. halletensis* and *A. simsonianus* (overall 50% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following

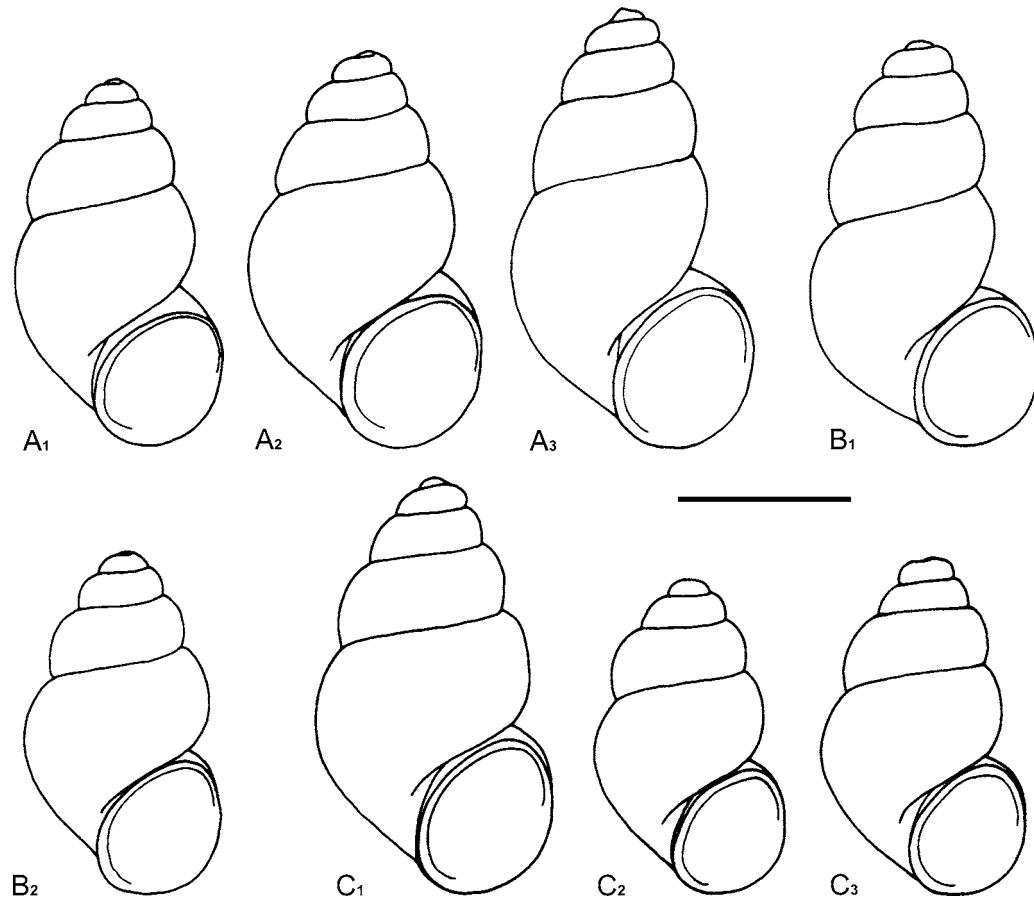


Fig. 51. Shells of species of *Austropyrgus*: A, *A. niger*, paraneotypes C.157166; B, *A. dyerianus*, C.349001; C, *A. tebus* paratypes C.343105. Scale 1 mm.

misclassified as *A. bungoniensis* (1), *A. buchanensis* (1), *A. macaulayi* (1), *A. flindersensis* (1), *A. halletensis* (2), *A. gordonensis* (1) and *A. simsonianus* (1).

***Austropyrgus gordonensis* n.sp.**

Figs. 46D, 47C, 48C

Type material. Holotype C.343063, figured paratypes C.363505 (3), C.343064 paratypes C.201380 (20+), C.201344 (20+), C.201152 (20+), C.201384 (20+), C.201501 (6), TMH E.23427 (3), QVM 9:17061 (3).

Type locality. Trib. of Gordon R, on W. side, slightly upstream of Snag Point, Tasmania, 42°31.62'S 145°40.00'E, on leaves and wood, 15 February 1989.

Other material examined. Tasmania: trickle, Spence R, C.201154; major trib of Eagle Ck, 1 km along track, C.201392; Eagle Ck at Gordon R, C.201387, C.201350, C.201386, C.201337; trib of Eagle Ck, 300 m from Old Hut site, C.201390; Eagle Ck, 1st major creek crossing along track, C.201391; trib of Gordon R, between Horseshoe Bend and Expectation Reach, C.201396; N bank of Gordon R, C.201389; Pine Landing, Boom Camp, Gordon R, C.201512, C.201388; Little Eagle Ck, E side of Limekiln Reach, C.201498; Gordon R just below Camerons Flat, C.201499; c. 2 km upstream of Champ Cliff, E side of Gordon R, C.201394; Gordon R at Butler I., C.201381, C.201382; trib of Gordon R, N of Snag Point, C.201385, C.201383; Hibbs Lagoon Ck, C.201519, C.201399; Mulcahy R, 500 m from sea, C.201157; island in river, 1.5 km downstream of Davey Gorge, C.201398; Davey R, bay NE of Settlement Point, C.201401; Moulters Inlet, Bathurst Harbour, C.201150, C.201153; Melaleuca Lagoon, near Moth Ck, S of Bathurst Harbour, C.201400.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, spire elongate to of average length and spire outline straight, anus near mantle edge; pallial vas deferens strongly undulating from prostate gland to penis; penis with pigmentation absent or on medial section only.

Description. *Shell* (Figs. 46D, 47C). Shell 1.95–3.03 mm in height, 1.19–1.61 mm in width; spire elongate to average length, outline straight; aperture 0.74–1.05 mm in height, 0.74–0.94 mm in width. Body whorl 1.40–1.89 mm in height. Teleoconch of 3.15–4.25 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 2.34 mm; SW, 1.23 mm; AH, 0.83 mm; TW, 3.55 whorls. *Operculum*. Operculum 0.73–0.94 mm in height, 0.48–0.74 mm in width, with 2–4 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–30 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 32–37 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Cephalic tentacles unpigmented or with pigmented dorsal central stripe; snout with pigment absent to well developed or just around edges; head, neck, foot and opercular lobe pigmentation poorly developed to absent; pallial roof with pigment mottled to absent; visceral coil mottled. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 17–20 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland very reduced (appears to be absent) to moderately developed; covers rectum when visible. Rectum without arch to with slight arch. Renal gland about 1/2 in pallial roof; oval; thin. Pericardium more than 1/2 in pallial roof. *Male reproductive system*. Testis of 0.75–

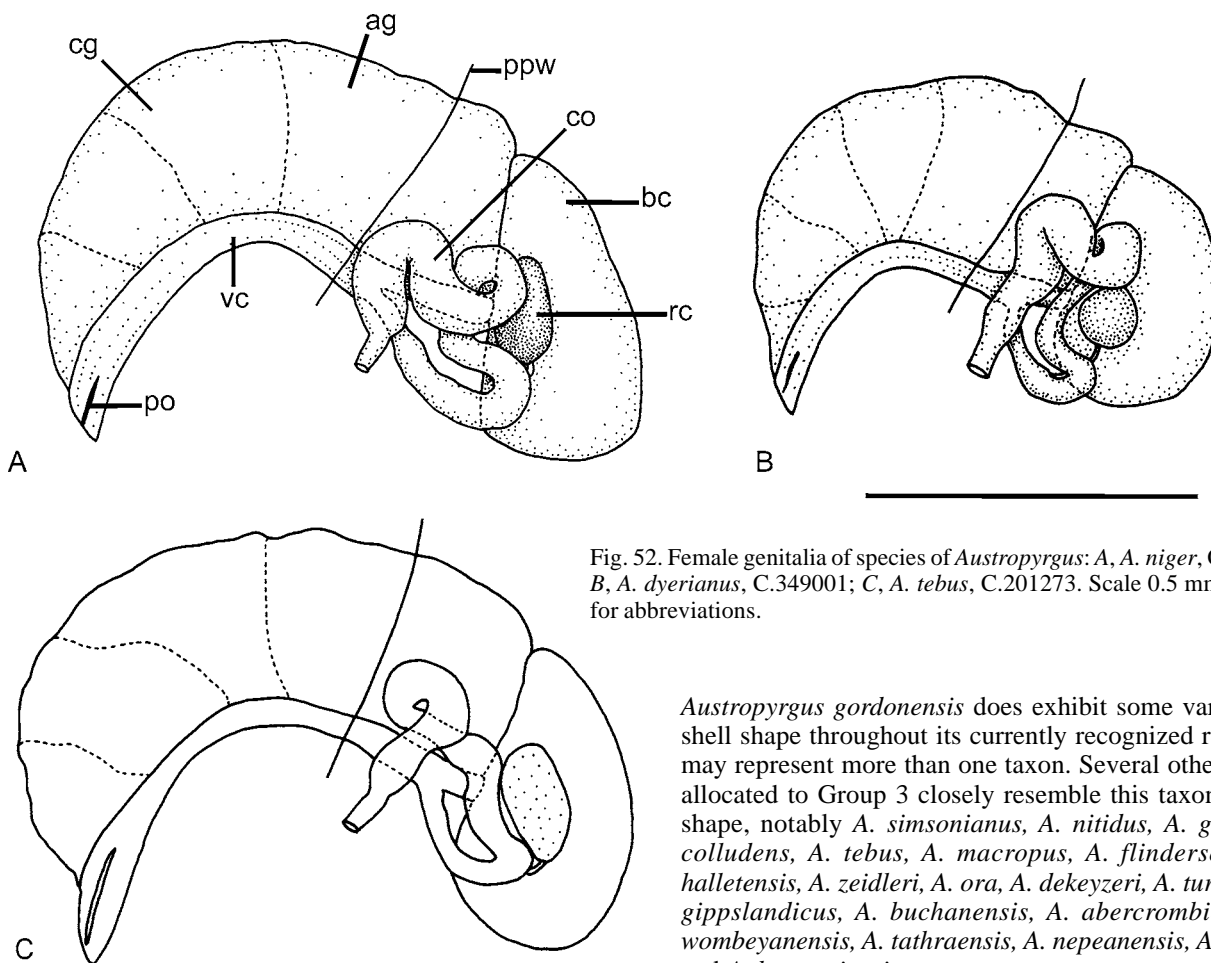


Fig. 52. Female genitalia of species of *Austropyrgus*: A, *A. niger*, C.157166; B, *A. dyerianus*, C.349001; C, *A. tebus*, C.201273. Scale 0.5 mm, see p. 5 for abbreviations.

1.00 whorls. Seminal vesicle tightly coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, strongly undulating from prostate to base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 48C). Ovary lobulate, about 0.75–1.00 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop long to medium; proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping to indenting albumen gland and overlapping capsule gland. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval to elongately-oval in cross section, with indistinct to distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams and rivers in southwestern Tasmania. Most of the known localities occur along the Gordon River and some of its tributaries below its junction with the Franklin River (Fig. 49). It is typically found on weeds, leaves, roots and stones and can be very common.

Remarks. *Austropyrgus gordonensis* can be distinguished from *A. salvus*, which is found living with it in the upper Gordon and Franklin Rivers, in its larger, narrower shell.

Austropyrgus gordonensis does exhibit some variation in shell shape throughout its currently recognized range and may represent more than one taxon. Several other species allocated to Group 3 closely resemble this taxon in shell shape, notably *A. simsonianus*, *A. nitidus*, *A. gunnii*, *A. colludens*, *A. tebus*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. zeidleri*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. buchannensis*, *A. abercrombiensis*, *A. wombeyanensis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis many specimens of *A. gordonensis* were misclassified, but mostly by only one individual. Two individuals were assigned to *A. zeidleri* and four to *A. petterdianus* (overall only 21% correct). When the analysis was restricted to Group 3, 42% were correctly classified, with the following misclassified as *A. aslini* (3), *A. zeidleri* (2), *A. turbatus* (1), *A. bungoniensis* (1), *A. abercrombiensis* (1), *A. glenelgensis* (1) and *A. nitidus* (1).

Etymology. Named after the region where it is found.

Austropyrgus gunnii (Frauenfeld, 1863)

Figs. 6H, 7K,L, 25B, 46E, 47D, 48D

Hydrobia gunnii Frauenfeld, 1863: 1025.

Hydrobia gunnii.—Frauenfeld, 1864: 612; Frauenfeld, 1865: 526; pl. 8 (two figures); Tate & Brazier, 1881: 564; Tate, 1882: 32; Petterd, 1889: 79–80; Johnston, 1891: 138.

Littoridina gunnii.—Hedley, 1913: 283–284, pl. 17, fig. 51.

Potamopyrgus gunnii.—May, 1921a: 71; May, 1921b: 55; May, 1923: 54–55, pl. 25, fig. 29.

Rivissessor gunnii.—Iredale, 1943: 201; May, 1958: 29, pl. 25, fig. 29; Smith & Kershaw, 1979: 48, text figure.

Fluvidona gunnii.—Smith, 1992: 46.

Type material. Lectotype (here chosen Fig. 25B) NHML 197746/1, paralectotypes NHML 197746/2–9 (8), NHMW TYPEN/R35.

Type locality. Tasmania—here restricted to South Esk River, Cataract Gorge, Launceston, Tasmania.

Material dissected and figured. C.201271, Ben Lomond Rivulet, 0.5 km W of junction of Kingston and Nile Rds, Tasmania, 41°45'S 147°29.1'E, 2 February 1987.

Other material examined. Tasmania: C.27797, C.201418, Tasmania; C.201049, C.204135, Cape Naturaliste Lagoon No. 1; C.204138, C.204145, C.204136, C.204144, C.204152, C.202704, C.202707, C.202710, C.202718, C.202719, Bowlers Lagoon; C.202250, Tower Lagoon; C.202248, C.202717, C.204149, C.204137, C.204151, C.204147, C.204142, C.202702, C.202703, C.202711, C.202716, MV F.53180, Little Waterhouse Lagoon; C.204150, C.204134, C.204141, C.204139, C.204143, C.202699, C.202701, C.202714, C.202715, C.202705, C.202712, MV F.53206, F.53207, Big Waterhouse Lagoon; C.204140, C.204146, C.202698, C.202708, C.202709, MV F.53208, F.53175, Blackmans Lagoon; MV F.53199, Big Punchbowl Lagoon, near Freycinet; C.203752, Tuckers Ck at Barnbogle Rd, N of Scottsdale; C.201547, Andersons Ck at Tattersalls Rd, W of Beaconsfield; C.201214, Symons Ck at East Tamar Hwy, 10.3 km N of Launceston; C.201127, Carries Brook, E of Maurice Rd, 2.5 km S of Ringarooma; C.201228, Rubicon R; C.201541, Dallys Ck at "Charnwood" on West Tamar Hwy; C.201179, Notley Fern Gorge, NW of Launceston; C.201608, trib of Parrot Ck, trib of Rubicon R; C.201431, Black Sugarloaf Ck at Bensemanns Rd, W of Birralee; C.201167, White Flats Ck at Bensemanns Rd; SAMA D.19156, NHML 20001330, Launceston; C.201172, C.201126, C.201173, C.201412, MV F.54719, First Basin, Cataract Gorge, South Esk R; Launceston; C.202484, C.201163, C.201170, Distillery Ck at Tasman Hwy; C.201187, Brushy Rivulet at Bensemanns Rd; C.201180, White Flats Ck on SW side of Black Sugarloaf Ridge; C.201178, trib of Hunters Ck at Ecclestone Rd, W of Launceston; C.201190, Brushy Rivulet at Bryans Rd, WSW of Birralee; C.201159, South Esk R, Cataract Gorge, between First and Second Basin, Launceston; Tasmanian Inland Fisheries, Weavers Creek; Musselboro Creek; C.201113, QVM 9:7611, Distillery Ck at St Leonards, C.201169, C.201188, C.201161, Black Sugarloaf Ck at Birralee Rd, S of Glengarry; C.201285, trib of Pipers Lagoon Ck, 1.3 km NE of junction with Ecclestone Bridgenorth Rds; C.201186, trib of Bryans Ck, trib of Brushy Rivulet at Bryans Rd; NHML 93.3.3.294.6, South Esk R, Clynevale; C.201160, C.201165, South Esk R, 50m above Duck Reach; C.201452, Black Ck at Bensemanns Rd; C.201184, trib of Bryans Ck at junction of River and Porters Rds; C.201189, Reedy Marsh at Larcombes Rd, c. 9 km N Deloraine; NHML 93.3.2.297.9, South Esk R, Emerecreek; C.201158, trib of South Esk R, 6.4 km W of Mathinna; C.201193, Brooks Ck at Upper Esk Rd, 4.5 km W of Mathinna; C.201185, Brushy Rivulet, trib of Meander R at Birralee Rd; C.201141, trib of Pig Run Ck; C.201580, Wet Ck, c. 100m from cave, Mole Creek Caves, S of Devonport; C.201183, trib of Meander R at Lake Hwy; C.201620, Quamby Brook, near Golden Valley; C.201129, trib of Quamby Brook at Bogan Rd, 1.3 km SW of road junction to Golden Valley; C.201606, trib of Quamby Brook at Bogan Rd, 3 km SE of Golden Valley; MV F.54673, South Esk R at Tullochgorum; C.201271, Ben Lomond Rivulet, 0.5 km W of junction of Kingston and Nile Rds; C.204018, C.201417, St Pauls R at Merrywood Rd, c. 5 km E of Royal George; C.7470, South Esk R near Cleveland; C.201174, C.201200, Isis R, trib of Macquarie R at Cressy-Ross Rd; C.201175, QVM 9:7598, Isis R at Isis; C.201594, Sugarloaf Ck, trib of Lake R at Lake River Rd; C.201164, Musk Ck at Lake River Rd; C.201202, Elizabeth R at Campbell Town; C.201528, C.201603, Lake R at Lake River Rd; C.201171, MV F.54725, Macquarie R at Ross.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, spire outline straight, with convex whorls; central teeth with 6–7 lateral cusps; lateral teeth with 6–8 cusps; inner marginal teeth with 32–35 cusps; pallial vas deferens straight or slightly undulating at prostate gland and with several coils or S-shape bends between prostate gland and penis; anterior end of capsule gland blunt.

Description. *Shell* (Figs. 25B, 46E, 47D). Shell 2.10–2.96 mm in height, 1.28–2.02 mm in width; spire of average length, outline straight; aperture 0.81–1.18 mm in height, 0.78–1.17 mm in width. Body whorl 1.47–2.00 mm in height. Teleoconch of 3.30–4.20 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Operculum.*

Operculum 0.58–1.00 mm in height, 0.35–0.74 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 6–7 lateral cusps, median cusp of medium width, sharply pointed, less than twice as long as adjacent cusps; 4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 7–8 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 32–35 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 31–36 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout with pigmentation well developed to poorly developed around edges; foot and opercular lobe pigmentation poorly developed to unpigmented; pigmentation of head and neck poorly developed to sides of neck only; pallial roof with mottled to poorly developed pigmentation; visceral coil mottled. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 20–25 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland moderately developed to thick; partly covering to covering rectum. Rectum without arch to with slight arch. Renal gland about 1/2 in pallial roof; oval; thin to intermediate in thickness. Pericardium more than 1/2 in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland (Fig. 7L) about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate; longitudinally S-shaped to several coils between prostate and penis; slightly to strongly undulating or longitudinally S-shaped at base of penis. Penis (Fig. 7K) attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 48D). Ovary lobulate, about 1.0–1.1 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop medium; proximal part with one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/2 of albumen gland behind posterior pallial wall. Capsule gland with anterior end blunt, broadly-oval to compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small to of medium length; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	2.43	1.28	0.83	4.20
paralectotypes				
NHML 197746/2–9	2.19–2.85	1.28–1.60	0.83–1.13	3.80–4.15
NHML	2.27–2.52	1.37–1.50	0.81–0.98	3.65–4.00
figured SEM specimen	2.96	1.68	1.17	3.95

Frauenfeld's original measurements were given as 3 × 1.5 mm.

Distribution and habitat. This species is found throughout the drainage of the South Esk River, northern Tasmania (Fig. 49). It is typically found on weeds, leaves, roots and stones and can be very abundant.

Remarks. The type material of this species is identical to specimens from the South Esk River, Launceston and we formally restrict the type locality to this general location. The material on which the anatomical description is based is from the Ben Lomond Rivulet, a tributary of the South Esk River because prior to examining the types we were unable to recognize *A. gunnii*. On examination of the type material of both *A. gunnii* and *A. diemensis* later in the study it was found that they were most similar to the populations of *Austropyrgus* present in the South Esk River at Launceston. Specimens of *A. gunnii* were dissected from the South Esk River, the likely type locality, and were found to be very similar, with no observable differences in the main features of the female and male reproductive systems

and the mantle cavity. The only difference was that the South Esk specimens dissected were unpigmented but this was possibly a preservation artefact due to them having been collected over a decade previously.

This species is found in sympatry with two species of *Austropyrgus* (*A. diemensis* and *A. ronkershawi*) throughout its currently recognized range. It is distinguished from *A. diemensis* by its smaller, narrower shell and it differs from *A. ronkershawi* in its broader shell with a shorter spire and more rounded whorls. *Austropyrgus gunnii* is similar to *A. nitidus* (see remarks under *A. nitidus*), *A. colludens* and *A. simsonianus*. It differs from *A. colludens* by its generally smaller and narrower shell and some radular and anatomical characters (see descriptions). It differs from *A. simsonianus* in the inner lip of the shell aperture being in partial contact or narrowly separated from the parietal wall (distinctly separated in *A. simsonianus*) and several radular and anatomical characters (see descriptions). *Austropyrgus gunnii* shows much variation in shell size and shape over its currently recognized range and may represent more than one taxon. *Austropyrgus gunnii* is generally similar in shell shape and size to *A. gordonensis*, *A. tebus*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. zeidlereri*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippislandicus*, *A. buchanensis*, *A. abercrombiensis*, *A. wombeyanensis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis involving two populations (40 specimens), no specimens of *A. gunnii* were misclassified by more than one individual except for those misclassified as *A. colludens* (8), *A. salvus* (4), *A. tathraensis* (2), *A. nepeanensis* (2) and *A. tebus* (2) (overall 50% correct). When the analysis was restricted to Group 3, 48% were correctly classified, with the following misclassified as *A. colludens* (10), *A. salvus* (4), *A. nepeanensis* (2), *A. tathraensis* (1), *A. zeidlereri* (1), *A. flindersensis* (1) and *A. tebus* (2).

Austropyrgus ronkershawi n.sp.

Figs. 46F, 47G, 48E

Type material. Holotype C.343065, figured paratypes C.343066 (5), paratypes C.201286 (20+), TMH E.23428 (3), QVM 9:17062 (3).

Type locality. Black Sugarloaf Ck at Bensemans Rd, W. of Birrallee, Tasmania, 41°24.78'S 146°47.50'E, on and under rocks, 24 January 1987.

Other material examined. Tasmania: Andersons Ck at Tattersalls Rd, W of Beaconsfield, C.201256; top end of Viking Ck, trib of Wilmot R, C.201586; Marine Ck at Dalyls Rd, near Dulverton, C.201532; Franklin Rivulet, C.201250; Notley Fern Gorge, NW of Launceston, C.201432, C.202526, MV F.54736; trib of Dasher R at Beulah Rd, SE of Sheffield, C.201238; Dasher R at Beulah Rd, SE of Sheffield, C.201268; White Flats Ck at Bensemans Rd, C.201182; trib of White Flats Ck at Bensemans Rd, C.203791; White Flats Ck, on SW side of Black Sugarloaf Ridge, C.201526; Black Sugarloaf Ck at Birrallee Rd, S of Glengarry, C.201177, C.201445; Black Sugarloaf Ck at Bensemans Rd, C.201453; Quamby Brook, near Golden Valley, C.201135; trib of Quamby Brook at Bogan Rd, C.201430; creek near Stella Glen at Liffey Hwy, C.201527.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, spire elongate to average length, outline

straight and whorls convex; pallial vas deferens S-shaped at prostate gland.

Description. *Shell* (Figs. 46F, 47G). Shell 2.03–2.89 mm in height, 1.09–1.64 mm in width; spire elongate to average length, outline straight; aperture 0.71–1.12 mm in height, 0.62–0.89 mm in width. Body whorl 1.30–1.81 mm in height. Teleoconch of 3.75–4.50 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, opaque. *Holotype dimensions:* SH, 2.03 mm; SW, 1.17 mm; AH, 0.77 mm; TW, 3.75 whorls. *Operculum.* Operculum 0.64–0.95 mm in height, 0.44–0.67 mm in width, with 2–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–26 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 29–35 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Animal unpigmented. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 20–24 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about 1/2 in pallial roof; oval; thin. Pericardium more than 1/2 in pallial roof. *Male reproductive system.* Testis of 1.25–1.75 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, longitudinally S-shaped at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 48E). Ovary lobulate, about 1.25–1.40 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/2 or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, broadly-oval to compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams and rivers of central northern Tasmania (Fig. 49). It is typically found on weeds, leaves, roots and stones and can be common.

Remarks. This species is found in sympatry with at least three other species of *Austropyrgus* (*A. gunnii*, *A. lochi* and *A. diemensis*) throughout its currently recognized range. It differs from *A. gunnii* in its smaller, narrower shell with less rounded whorls. It differs from *A. lochi* in its larger, broader shell with a shorter spire. It differs from *A. diemensis* in its narrower shell with less rounded whorls. It can be distinguished from other Tasmanian members of Group 3 by its narrow shell and elongated spire. *Austropyrgus ronkershawi* also superficially resembles the much larger *A. procerus* (Group 4).

In the discriminant analysis no specimens of *A. ronkershawi* were misclassified by more than one individual (overall 85% correct). When the analysis was restricted to Group 3, 90% were correctly classified, with the following misclassified as *A. dyerianus* (1) and *A. colludens* (1).

Etymology. Named in honour of the late Ron Kershaw, to acknowledge his considerable contribution to the study of Tasmanian molluscs and his assistance with both collecting specimens and his hospitality to the authors particularly WFP.

Austropyrgus dyerianus (Petterd, 1879)

Figs. 4D, 5G, 6D, 7G,H, 10F, 50B, 51B, 52B

Bithynia dyeriana Petterd, 1879: 86 (Long Bay Creek, Tasmania).*Bithynia dyeriana*.—Tate & Brazier, 1881: 563.*Bithynella dyeriana*.—Johnston, 1891: 138.*Potamopyrgus dyeriana*.—May, 1921a: 71, pl. 10, fig. 18; May, 1921b: 55; May, 1923: 54–55, pl. 25, fig. 27.*Pupiphryx dyeriana*.—Iredale, 1943: 201; May, 1958: 29, pl. 25, fig. 27.*Fluvidona dyeriana*.—Smith, 1992: 46.**Type material.** Lectotype (here chosen Fig. 4D) C.27800, paralectotypes, C.424274 (3), QVM 9:181 (3), SAMA D.16367 (2).**Type locality.** Stream flowing into Long Bay, Tasman Peninsula, Tasmania.**Material dissected and figured.** C.349001 (figured specimens), Long Bay Ck at Coronation Rd, Tasman Peninsula, Tasmania, 43°06.203'S 147°52.608, in weeds and roots and on stones, 11 May 1995.**Other material examined.** Tasmania: Sounds Ck, near Murdunna, C.201329; Flinders Ck, C.168996; Long Bay Ck at Coronation Rd, N of Port Arthur, C.201325; small creek flowing into Long Bay, near Stingaree Bay, N of Port Arthur, C.203808; Long Bay, C.42120, C.201556, NHML 20001331; Walkers Ck, Canoe Bay, Fortescue Bay, C.201039; trib into Fortescue Lagoon, C.201328.**Diagnosis.** Differs from other members of Group 3 in the following combination of characters: shell small, spire outline straight, whorls convex; pigmentation present on only medial section of penis; seminal receptacle at anterior edge of bursa copulatrix; anterior end of capsule gland tapering.**Description.** *Shell* (Figs. 4D, 50B, 51B). Shell 1.57–2.92 mm in height, 0.91–1.68 mm in width; spire of average length, outline straight; aperture 0.57–1.04 mm in height, 0.60–0.89 mm in width. Body whorl 1.18–1.65 mm in height. Teleoconch of 3.00–4.40 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall. Outer lip weakly thickened, without reflection. Shell colour yellow-brown and translucent. *Operculum* (Fig. 10F). Operculum 0.56–0.80 mm in height, 0.41–0.57 mm in width, with 2–4 pegs. *Radula* (Fig. 5G). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps, 3 pairs of basal cusps. Basal tongue of the central teeth U-shaped, just protruding past lateral edge. Lateral teeth with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Ratio of cutting edge to shaft about 1/3 for inner marginal teeth. Ratio of cutting edge to shaft about 1/4 for outer marginal teeth. Inner marginal teeth with 23–26 cusps, outer marginal teeth with 30–35 cusps. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe or dorsal pigmented central stripe only; snout with pigmentation well developed or only around edges; foot, opercular lobe, visceral coil and mantle roof with well to poorly developed pigmentation; pigmentation of head and neck well developed to sides of neck only. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 14–16 filaments. Osphradium between posterior end and middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about 1/2 in pallial roof, oval, thin. Pericardium more than 1/2 in pallial roof. *Male reproductive system* (Fig. 7G,H). Testis of 1 whorl. Seminal vesicle conspicuously coiled on both digestive gland and testis behind stomach. Seminal vesicle loosely coiled over stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, slightly to strongly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of the head, pigmented on medial section only. *Female reproductive system* (Fig. 52B). Ovary

lobulate, about 0.75–0.90 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape or with one bend, loop or twist; straight to with one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from the right side. Seminal receptacle at anterior edge of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/2 or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small, overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	1.61	0.93	0.61	3.50
paralectotypes				
C.424274	1.81–1.94	1.02–1.14	0.66–0.73	3.55–3.75
SAMA D.16367	1.80	1.08	0.64	3.60
	2.37	1.41	1.04	3.65
QVM 9:181	1.88	1.02	0.68	3.60
	1.73	0.96	0.59	3.55
figured SEM specimen	1.66	0.99	0.68	3.05

No type measurements are given by Petterd (1879).

Distribution and habitat. This species is currently known from a few small streams on the Tasman Peninsula, southeastern Tasmania (Fig. 53). It is typically found on leaves, roots and stones and can be locally common.**Remarks.** *Austropyrgus dyerianus* is the type species of *Pupiphryx* Iredale, 1943, a synonym of *Austropyrgus*. This species is not found in sympatry with any other species of *Austropyrgus*. It can be distinguished, along with *A. niger* and *A. tebus*, from other similar Group 3 taxa in having a slightly convex spire outline. *Austropyrgus dyerianus* can be usually be distinguished from these two taxa by its generally smaller and narrower shell. There are relatively few important differences between this taxon and *A. niger* and they may well prove to be sister taxa or of subspecific status.

There is some doubt about the type locality because Tenison Woods had a marine collecting site called Long Bay that was apparently in the upper part of D'Entrecasteaux Channel. However, the type material appears very similar to material collected in small streams flowing into Long Bay on the Tasman Peninsula and it is this material that the above description is based on.

In the discriminant analysis no specimens of *A. dyerianus* were misclassified by more than one individual (overall 67% correct). When the analysis was restricted to Group 3, 93% were correctly classified, with only one specimen misclassified as *A. spectus*.*Austropyrgus salvus* n.sp.

Figs. 46G, 47H, 48F

Type material. Holotype C.343094, figured paratypes C.343095 (3), paratypes C.201277 (20+), TMH E.23439 (3), QVM 9:17063 (3).**Type locality.** Franklin R., opposite island downstream of Kutikina Cave, SW Tasmania, 42°31.50'S 145°45.78'E, on liverworts, algae and lichens on rock platform, 23 March 1988.

Other material examined. Tasmania: C.201518, Trib of Little Henty R at Zeehan Rd; C.201342, Andrew R near Shingle Bar; C.201500, Andrew R, Cave #1; C.201338, Franklin R, outside Proina Cave; C.201340, rapids below Proina Cave campsite; C.201341, rapids below Royal Box Hill Cave; C.201402, Little Fall, below Royal Box Cave; C.201351, Franklin R, Proina Cave, stream emerging from cave; C.201354, Acheron R; MV F.54728, Franklin R; C.201335, Franklin R, between Jane junction and Aerial Cableway; C.201393, Franklin R at Eagle Creek track; C.201352, Franklin R, 2 km S of Flat I., S of Jane R; C.201343, C.201333, first rapids below Kutikina Cave; C.201347, between Double Fall and Big Fall, Franklin R; C.201339, C.201334, rapids above Galleon Bluff; C.201345, Big Fall, Franklin R; MV F.53203, Pyramid I. at junction of Gordon and Franklin R; C.201395, Gordon R at Big Eddy; MV F.53204, Gordon R above junction with Franklin R; MV F.53178, near Gordon R; MV F.53190, right bank of Gordon R, in riffle zone, above Sprent R; MV F.60396, Denison R W of island and below Maxwell R junction; MV F.54737, Gordon R, 0.5 km above Smith R; MV F.53187, Olga R, 100 m upstream from junction with Gordon R; MV F.53183, F.53172, F.53169, F.53170, Gordon R; MV F.54730, junction of Maxwell-Denison R; C.166837, MV F.54729, Gordon R, 400 m above Denison R junction; MV F.53184, Gordon R, 300 m upstream from junction with Denison R; MV F.53191, F.53194, F.53195, Olga R above junction with Gordon R; MV F.53176, The Splits, Gordon R; C.201346, trib of Olga R; C.201348, Sandfly Ck at Scotts Peak Rd.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small, squat, spire outline straight, with convex whorls; pallial vas deferens slightly undulating at prostate gland; penis with no pigmentation to medial section only; bursa copulatrix ovoid in shape.

Description. Shell (Figs. 46G, 47H). Shell 1.77–2.18 mm in height, 1.21–1.48 mm in width; spire of average length to squat, outline straight; aperture 0.69–0.91 mm in height, 0.73–0.90 mm in width. Body whorl 1.36–1.59 mm in height. Teleoconch of 2.90–3.45 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.09 mm; SW, 1.45 mm; AH, 0.91 mm; TW, 3.25 whorls. *Operculum.* Operculum 0.49–0.62 mm in height, 0.36–0.51 mm in width, with 1–4 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–25 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 28–35 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout with pigmentation well developed to just around edges; foot and opercular lobe with poorly developed pigmentation; head, neck, pallial roof and visceral coil pigmentation well to poorly developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 15–18 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum with slight arch to with short S-shape. Renal gland about 1/2 in pallial roof; oval; thin to intermediate in thickness. Pericardium more than 1/2 in pallial roof. *Male reproductive system.* Testis of 1 whorl. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, slightly undulating at prostate, strongly undulating between prostate and penis, slightly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 48F). Ovary lobulate, about 0.50–0.75 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix ovoid. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. About 1/2 or more of albumen gland in front of posterior pallial wall. Capsule gland with anterior end

tapering to blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening small; terminal to overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from the lower parts of the Franklin River and the upper parts of the Gordon River, southwestern Tasmania (Fig. 53). It is typically found on weeds, leaves, roots, and stones and can be locally abundant.

Remarks. This species is found in sympatry with one other species of *Austropyrgus* (*A. parvus*) within its currently recognized range. It differs from *A. parvus* in its larger, broader shell with more rounded whorls. *Austropyrgus gordonensis* is found in the lower Gordon River but to date has not been found in sympatry with *A. salvus* (see remarks under *A. gordonensis*). This species is distinguished from the other Tasmanian members of Group 3 by its small, squat shell. Two taxa from Victoria with similar shaped shells are *A. pusillus* and *A. tumidus*, the latter being larger and the former smaller.

In the discriminant analysis all specimens were correctly classified.

Etymology. *Salva* Latin: preserved, unhurt—referring the preservation of the world heritage area which contains this species and a great many other species endemic to southwestern Tasmania.

Austropyrgus colludens n.sp.

Figs. 46H, 47B, 48G

Type material. Holotype C.348996, figured paratypes C.348997 (2), paratypes C.343028 (20+), TMH E.23440 (3), QVM 9:17064 (3).

Type locality. Apsley R., at Lilla Villa bridge, SW of Bicheno, Tasmania, 41°53.84'S 148°15.31'E, on and under stones, 13 February 1995.

Other material examined. Tasmania: C.201155, Steels Ck at South Ansons Rd, above bridge; C.201546, The Bottleneck, Ansons R at Ansons Bay Rd; MV F.54720, Scamander R, Upper Scamander; Last R at Ansons Bay Rd, C.201444; Forester R at Ansons Bay Rd, C.201542; Bolpeys Ck at Scamander Rd, C.201590, C.201591; creek on SE top of Elephant Pass on Highway 3, C.201148; trib of Apsley R at Rosedale Rd, Douglas-Apsley NP, C.203979; Apsley R at Rosedale Rd, on road to Douglas-Apsley NP, C.203960; Apsley R at Tasman Hwy, C.201544, TMH E.9955; Apsley R at Coles Bay Rd, near Bicheno, C.201558; stream at Friendly Beaches, Issacs Pt, S of Bicheno, C.201560; Swan R at Melrose, C.203790; Swan R, 10 km from Old Coach Rd on forestry rd, C.201534; Meredith R at Tasman Hwy, C.201562, C.201441; Mitchelmores Ck at Swanston Rd, C.201537; Prosser R, at Tasman Hwy, c. 4.2 km W of Orford, C.201301; Maria I., lagoon near ruins, C.374342.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small; spire outline straight, whorls convex, outer lip with slight reflection; seminal vesicle slightly undulating over stomach; pallial vas deferens strongly undulating or longitudinally S-shaped between prostate gland and penis.

Description. Shell (Figs. 46H, 47B). Shell 2.03–2.77 mm in height, 1.31–1.64 mm in width; spire of average length, outline straight; aperture 0.80–1.02 mm in height, 0.75–0.90 mm in width. Body whorl 1.44–1.75 mm in height. Teleoconch of 3.35–4.25 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall,

outer lip weakly thickened, with very slight reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 1.94 mm; SW, 1.33 mm; AH, 0.84 mm; TW, 3.25 whorls. *Operculum*. Operculum 0.74–0.98 mm in height, 0.54–0.66 mm in width, with 2–5 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, less than twice as long as adjacent cusps; 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 24–27 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 25–30 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe; rest of animal with well-developed pigmentation. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 20–22 filaments. Osphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; oval; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.4–1.5 whorls. Seminal vesicle slightly undulated over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, broadly-oval to compressed in cross section. Pallial vas deferens flush with surface, slightly to strongly undulating at prostate, strongly undulating or longitudinally S-shaped between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system* (Fig. 48G). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally, or longitudinally backwards; initial loop long to medium; proximal part with one or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval to compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of the small coastal streams and rivers of eastern Tasmania (Fig. 53). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species has been found in sympatry only with *A. elongatus*, and at a single location. It is distinguished by its much smaller shell with a shorter spire. This species does show some variation throughout its currently recognized range and it may, with additional work, be found to represent more than one taxon. It may also be confused with *A. gunnii* found in the South Esk River drainage just to the west and from which it differs in its much smaller, slightly narrower shell. It is also similar to several other Group 3 taxa including *A. simsonianus*, *A. gordonensis*, *A. nitidus*, *A. tebus*, *A. macropus*, *A. zeidleri*, *A. ora*, *A. buechanensis*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. wombeyanensis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. colludens* were wrongly classified by more than one individual except for two misclassified as *A. abercrombiensis* (overall 85% correct). When the analysis was restricted to Group 3, 85% were correctly classified, with the following misclassified as *A. abercrombiensis* (2) and *A. glenelgensis* (1).

Etymology. *Collusus*, *colludo* Latin: play together, cooperate with a secret understanding—referring to the fact that this species is known to occur in sympatry with *A. elongatus* at a single location.

Austropyrgus diemensis (Frauenfeld, 1863)

Figs. 25H–J, 26F, 27I, 28G,H, 40L, 54E, 55A

- Amnicola diemense* Frauenfeld, 1863: 1028.
Amnicola diemense.—Frauenfeld, 1864: 599; Frauenfeld, 1865: 529, pl. 10 (two figures); Tate & Brazier, 1881: 563; Tate, 1882: 32; Petterd, 1889: 80–81; Johnston, 1891: 138.
Potamopyrgus woodsii.—Petterd, 1889: 71–72, pl. 1, fig. 12, pl. 4, fig. 3.
Potamopyrgus brownii Petterd, 1889: 72–73, pl. 3, fig. 14.
Bithynella woodsii.—Johnston, 1891: 138.
Bithynella brownii.—Johnston, 1891: 138.
Littoridina diemensis.—Hedley, 1913: 284, pl. 17, fig. 52.
Potamopyrgus brownii.—May, 1921a: 71, pl. 10, fig. 17; May, 1921b: 55; May, 1923: 56–57, pl. 24, fig. 1.
Rivissor brownii.—Iredale, 1943: 201; May, 1958: 30, pl. 26, fig. 1.
Fluvidona diemense.—Smith, 1992: 46.
Fluvidona woodsii.—Smith, 1992: 47.

Type material. Lectotype (here chosen Fig. 25H) NHML 197745/1, paralectotypes NHML 197745/2–16 (15), NHMW TYPEN/R37.

Type locality. Tasmania—here restricted to South Esk River, Cataract Gorge, Launceston, Tasmania.

Type material of synonyms. *Potamopyrgus woodsii*, syntypes C.27792 (13), South Esk River, Tasmania (Fig. 25J); *Potamopyrgus brownii*, syntypes C.27794 (4), QVM 9:111 (2), QVM 9:112 (3), SAMA D.15767 (5), St Pauls River, Tasmania (Fig. 25I).

Material dissected and figured. C.201203, C.348998 (figured specimens), South Esk R., in gorge between First and Second Basin, Launceston, Tasmania, 41°25.967'S 147°07.95'E, on rocks and stones, 8 February 1987.

Other material examined. **Tasmania:** C.36975, C.201206, C.201120, Tasmania; C.2305, C.201207, C.202486, North Tasmania; C.201596, unnamed stream, 6.8 km NW of bridge over 14 Mile Ck on East Tamar Hwy; QVM 9:7641, 14 Mile Ck, East Tamar; C.201592, Williams Ck at East Tamar Hwy, NW of Launceston; C.201595, Panatana Rivulet at Ford Rd, S of Port Sorell; C.201520, Brown Ck, 2.3 km from Bakers Beach Rd; C.169001, Wilmot R at Alma Reserve; C.201201, Forth R at Alma bridge; C.201600, St Patricks R at Tasman Hwy, 27 km NE of Launceston; C.201123, Wilsons Ck at Tasman Hwy; NHML 93.3.2.300.2, St Patricks R, St Marys; C.201604, MV F.54710, St Patricks R; C.201109, St Patricks R at Pecks Hill Rd; C.201168, Barnards Ck at Tamar Hwy, NW of Launceston; MV F.54727, Barnards Ck; C.201192, trib of Redwater Ck, at Native Plains Rd, 1.5 km E of Railton; C.201125, St. Patricks R, above weir, 0.5 km S of Nunamara; C.201111, Carters Ck at Hogans Rd, 1 km N of Scamander R; C.201588, Dasher R at Beulah Rd, SE of Sheffield; C.201116, MV F.54603, SAMA D.19157, NHML 20001332, Launceston; C.201607, C.201119, C.201195, MV F.54719, TMH E.1899/15609, First Basin, Cataract Gorge, South Esk R, Launceston; C.27792, C.166059, C.202494, NHML 20001333, South Esk R, C.201205, Meander R; SAMA D.19158, QVM 9:7537, North Esk River; C.201176, trib of South Esk R, Cataract Gorge, QVM 9:7612, trib of South Esk R, First Basin, Cataract Gorge; C.204025, C.201115, South Esk R, 50 m above Duck Reach; C.201198, South Esk R, c. 1.2 km below Trevallyn Dam, TMH E.3051, Lobster Ck; C.201166, Pig Run Ck at Ragged Jack Rd; C.201117, North Esk R at Blessington Rd, 1.2 km W of Musselboro Rd, E of Launceston; C.201204, Meander R, near Westbury; C.201144, trib of Durham Ck, at Hasslemere Rd, W of main creek, TMH E.9937, trib of South Esk R, side channel, 1.9 mi to Nile; MV F.54714, Mole Ck, W of Launceston; C.201582, Break O'Day R at road, 7 mi from Fingal; C.203824, South Esk R, 500 m upstream in Storys Ck; C.201110, C.201124, Nile R at Nile; C.201112, MV F.54672, Tullochgorum, South Esk R; C.201122, Ben Lomond Rivulet, 0.5 km W of junction of Kingston and Nile Rds; C.201108, QVM 9:7646, Ben Lomond Rivulet, trib of South

Esk R, at Mile-Conara Rd; C.201107, Lake R, trib of Macquarie R, at Ross-Cressy Rd, Macquarie Settlement; C.204017, St Pauls R at Merrywood Rd; C.201114, St Pauls R at Merrywood Rd, c. 5 km E of Royal George; C.201589, St Pauls R, at Royal George Rd between Avoca and Royal George; C.201118, C.169004, C.169005, St Pauls R, at Royal George; C.201411, South Esk R, near Cleveland; C.201121, Swan R, above Hardings Falls; C.201162, Dabool Rivulet, trib of Lake R, at Lake River Rd, QVM 9:7623, 9: 7618, C.201191, C.201199, C.201522, Lake R at Lake River Rd; MV F.54708, Macquarie R, S of Esk R, TMH E.9934, Lake R, between Arthurs and Woods Lakes, TMH E.9954, Lagoon of Islands; C.378712, Tyenna R near National Park.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell medium in size, broad, squat, with straight spire outline and convex whorls; pallial vas deferens strongly undulating at base of penis, penis unpigmented; seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix.

Description. *Shell* (Figs. 40L, 54E, 25H–J, 26F). Shell 1.86–3.46 mm in height, 1.32–2.53 mm in width; spire of average length to squat, aperture 0.91–1.60 mm in height, 1.06–1.31 mm in width. Body whorl 1.96–2.37 mm in height. Teleoconch of 3.25–3.75 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent.

shell dimensions:	SH	SW	AH	TW
lectotype	2.54	1.65	1.03	4.0
paralectotypes				
NHML 197745/2–16	1.90–2.90	1.32–1.99	0.80–1.21	3.40–4.15
paralectotypes NHMW	2.35–2.71	1.56–1.90	1.03–1.20	3.65–3.95
<i>P. woodsii</i> syntypes				
C.27792 figured syntype	2.73	1.81	1.15	4.15
range	2.62–3.17	1.78–2.11	1.11–1.33	3.85–4.55
QVM 9:7536 range	2.49–3.46	1.76–2.38	1.10–1.59	3.75–5.00
QVM 9:7535 range	2.60–3.25	1.70–2.53	1.07–1.60	3.70–4.40
C.27794 figured syntype	2.67	1.61	1.01	3.40
range	1.86–2.49	1.46–1.86	0.91–1.21	3.40–3.60

Frauenfeld's original measurements were given as 2.7×1.9 mm.

Operculum (Fig. 27I). Operculum 1.05–1.27 mm in height, 0.71–0.89 mm in width, with 2–4 pegs. **Radula** (Fig. 28G,H). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed and about twice as long as adjacent cusps, 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 22–26 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 24–28 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. **Head-foot.** Animal unpigmented. Columellar muscle of moderate size. **Non-genital anatomy.** Ctenidium with 20–24 filaments. Osphradium between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof, oval; intermediate in thickness to very thick. Pericardium more than $\frac{1}{2}$ in pallial roof. **Male reproductive system.** Testis of 1.25–1.30 whorls. Seminal vesicle conspicuously coiled on both the digestive gland and testis behind the stomach. Prostate gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate; slightly to strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. **Female reproductive system** (Fig. 55A). Ovary lobulate, about 1.0–1.1 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to two or more bends, loops or twists; straight to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided and straight. Oviduct joining bursal duct

from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum separated from overlapping albumen gland and separated from or indenting capsule gland. About $\frac{1}{2}$ of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering to blunt, compressed-oval to elongately-oval in cross section, with indistinct to distinct glandular zones. Ventral channel indistinct to distinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This is a very widespread species found mainly in the drainage of the South Esk River, northeastern Tasmania (Fig. 53). It is typically found on weeds, leaves, roots and stones and can be locally abundant.

Remarks. The type material of this species can be very closely matched with specimens from the South Esk River at Launceston as well as other locations in this river system. This species is sympatric with *A. gunnii* throughout most of its currently recognized distribution and from which it can be distinguished by its larger, broader shell and squat spire. *Austropyrgus diemensis* shows much variation in shell size and shape over its currently recognized range and may represent more than one taxon. This species resembles *A. foris* from Group 4 and *A. angasi* from Victoria, but differs in the renal oviduct being a simple inverted U-shape in *A. angasi* and a single coil in *A. foris*, that of *A. diemensis* being complexly coiled.

In the discriminant analysis no specimens of *A. diemensis* were wrongly classified.

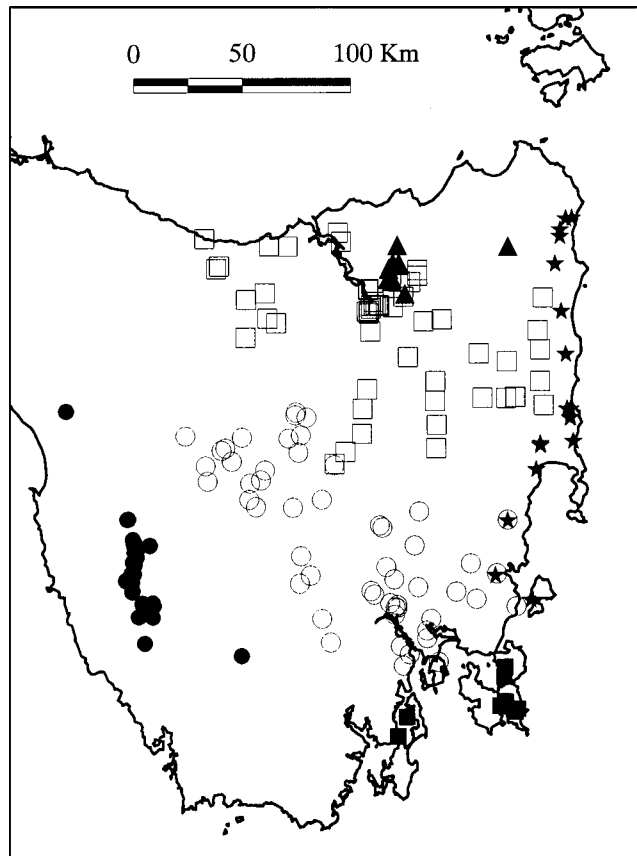


Fig. 53. Distribution of *Austropyrgus simsonianus* ○, *A. tebus* ▲, *A. diemensis* □, *A. colludens* ★, *A. salvus* ● and *A. dyerianus* ■.

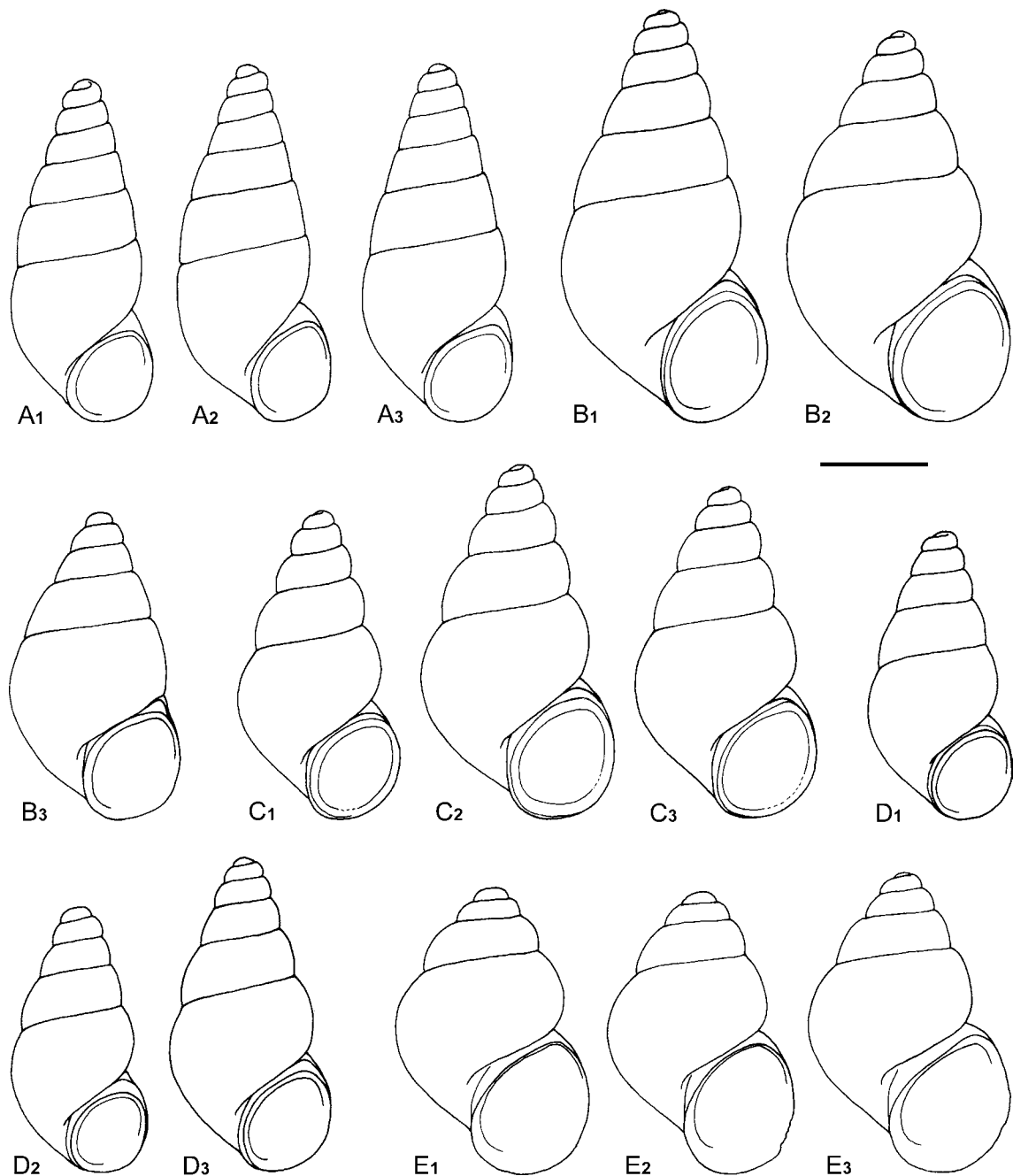


Fig. 54. Shells of species of *Austropyrgus*: A, *A. tateiformis*, paratypes, C.343054; B, *A. rectoides*, paratypes, C.343056; C, *A. praecipitis*, paratypes, C.343058; D, *A. procerus*, paratypes, C.343062; E, *A. diemensis*, C.348998. Scale 1 mm.

***Austropyrgus tebus* n.sp.**

Figs. 50C, 51C, 52C

Type material. Holotype C.343104, figured paratypes C.343105 (3), paratypes C.201273 (20+), TMH E.23429 (3), QVM 9:17065 (3).

Type locality. Trib. of Pipers R. on W. slopes of Eagle Hawk Tier, Mt Arthur, Tasmania, 41°19.77'S 147°14.13'E, on and under rocks, weed and leaves, 20 February 1989.

Other material examined. Tasmania: McGowans Ck, NW side of Mt Arthur, C.201213; trib of Second R at Doaks Rd, 6.4 km E of Lilydale, C.201143; trib of Second R at Doaks Rd, 6 km E of Lilydale, C.201602; trib of Second R at Doaks Rd, 7.5 km E of Lilydale, C.201210; trib of Third R at Lilydale Rd, near junction with Whites Mill Rd, C.201208; Denison R at Golcondo Rd, C.201535; Weldborough Pass, C.168994; trib of Pipers R, on SW slopes of Mt Arthur, C.201215; Butchers Ck, trib of Pipers R, on SW side of Mt Arthur, C.201211; creek at junction of Weavers Ck Rd and Tasman Hwy, C.201209.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium

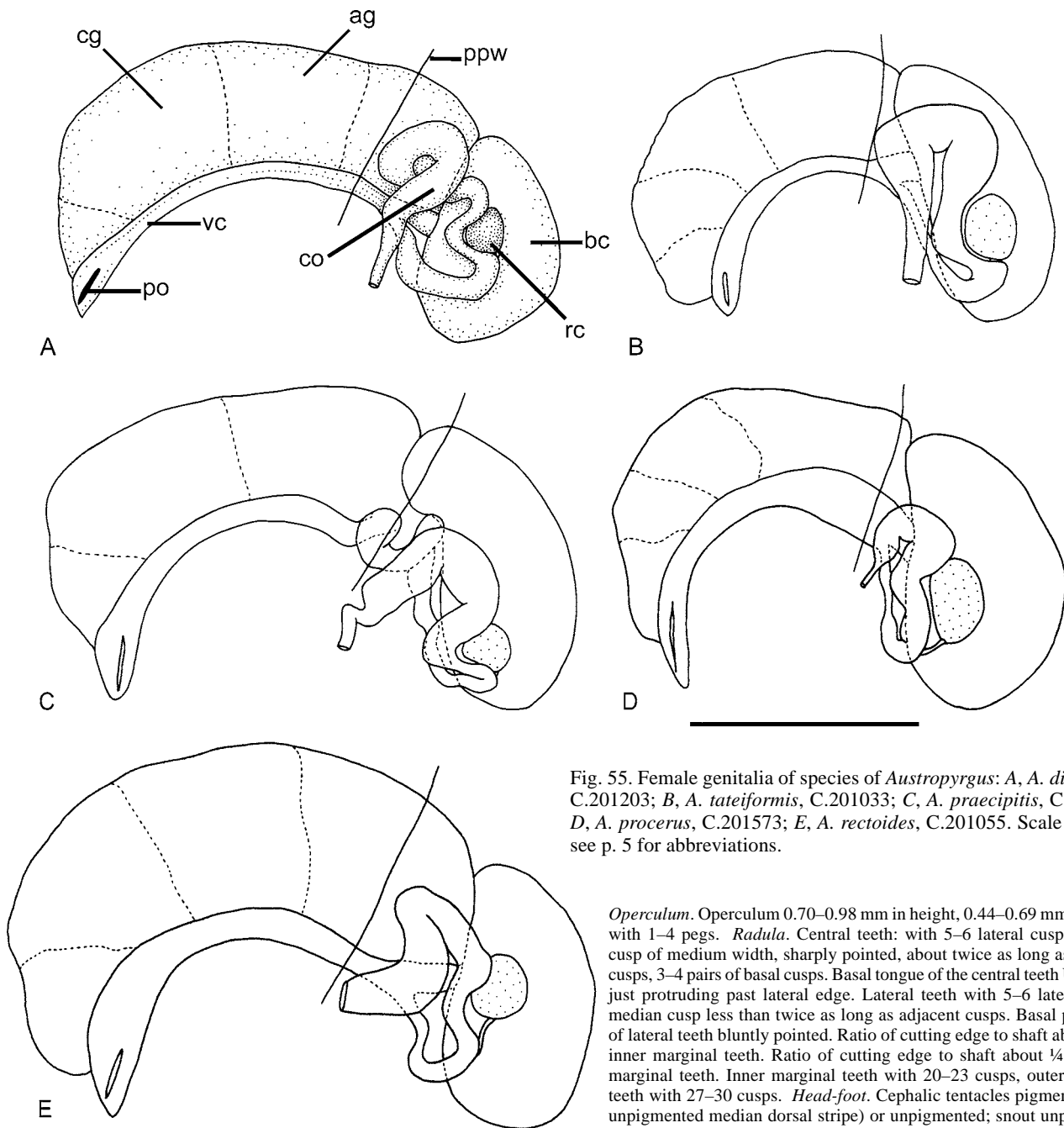


Fig. 55. Female genitalia of species of *Austropyrgus*: A, *A. diemensis*, C.201203; B, *A. tateiformis*, C.201033; C, *A. praecipitis*, C.201086; D, *A. procerus*, C.201573; E, *A. rectoides*, C.201055. Scale 0.5 mm, see p. 5 for abbreviations.

in size, with straight to weakly convex spire outline and convex whorls; pallial vas deferens slightly undulating at prostate gland; proximal part of coiled oviduct with two or more bends, loops or twists; seminal receptacle at middle of inner wall of bursa copulatrix.

Description. *Shell* (Figs. 50C, 51C). Shell 1.87–2.77 mm in height, 1.11–1.55 mm in width; spire of average length, outline straight to weakly convex; aperture 0.73–1.05 mm in height, 0.69–0.92 mm in width. Body whorl 1.29–1.79. Teleoconch of 3.25–3.80 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall. Outer lip weakly thickened, without reflection. Shell colour yellow-brown and translucent. *Holotype dimensions*: SH, 2.25 mm; SW, 1.32 mm; AH, 0.90 mm; TW, 3.55 whorls.

Operculum. Operculum 0.70–0.98 mm in height, 0.44–0.69 mm in width, with 1–4 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, about twice as long as adjacent cusps, 3–4 pairs of basal cusps. Basal tongue of the central teeth U-shaped, just protruding past lateral edge. Lateral teeth with 5–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Ratio of cutting edge to shaft about $\frac{1}{3}$ for inner marginal teeth. Ratio of cutting edge to shaft about $\frac{1}{4}$ for outer marginal teeth. Inner marginal teeth with 20–23 cusps, outer marginal teeth with 27–30 cusps. *Head-foot*. Cephalic tentacles pigmented (with unpigmented median dorsal stripe) or unpigmented; snout unpigmented to pigmentation well developed around edges; foot, pallial roof and visceral coil pigmentation poorly developed or unpigmented; opercular lobe unpigmented; head and neck with pigmentation developed on sides of neck only or unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 16–20 filaments. Osphradium between posterior end and middle of ctenidium. Hypobranchial gland thick; covers rectum. Rectum without arch or with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof, oval, thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.5 whorls. Seminal vesicle conspicuously coiled on both digestive gland and testis behind stomach. Seminal vesicle loosely coiled over stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, slightly undulating at prostate, slightly to strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached slightly to right side of the head; not pigmented. *Female reproductive system* (Fig. 52C). Ovary lobulate, about 1.25–1.40 whorls. Coiled oviduct with initial U orientated dorsoventrally, or longitudinally backwards; initial loop medium; proximal part with two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct parallel sided. Oviduct joining bursal duct from the right side. Seminal receptacle on middle of

inner wall of bursa copulatrix, pyriform to narrow sac shaped, end rounded, duct short. Rectum overlapping albumen and capsule glands. About ½ of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct to distinct, with indistinct muscular vestibule. Genital opening small, overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams around the Lilydale area of northern Tasmania (Fig. 53). It is typically found on leaves, roots and stones and can be common.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus*, although two other species of *Austropyrgus* (*A. gunnii* and *A. diemensis*) are found nearby. Its shell is smaller and narrower than that of *A. gunnii* and is much smaller and narrower than that of *A. diemensis*. *Austropyrgus tebus* is generally similar in shell shape to *A. gordonensis*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. zeidleri*, *A. ora*, *A. dekeyzeri*, *A. turbatus*, *A. gippslandicus*, *A. buchanensis*, *A. abercrombiensis*, *A. wombeyanensis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. tebus* were misclassified by more than one individual (overall 65% correct). When the analysis was restricted to Group 3, 65% were correctly classified, with the following misclassified as *A. gippslandicus* (1), *A. dekeyzeri* (1), *A. nepeanensis* (1), *A. fonscultus* (1), *A. flindersensis* (1), *A. gordonensis* (1) and *A. colludens* (1).

Etymology. *Teba* Latin: hill—alludes to the distribution of the species being restricted to the Mount Arthur area.

Austropyrgus simsonianus (Brazier, 1875)

Figs. 25C–F, 26C, 27D, 28D,E, 46I, 47F, 48A

Ammicola simsoniana Brazier, 1875: 19; Tate & Brazier, 1881: 563.
Bythinia pontvillensis Tenison Woods, 1876: 76.
Bythinia dunrobinensis Tenison Woods, 1876: 77; Petterd, 1879: 86; Tate & Brazier, 1881: 563; Johnston, 1889: 85.
Bythinia dulvertonensis Tenison Woods, 1876: 77; Petterd, 1879: 85; Tate & Brazier, 1881: 563; Johnston, 1889: 85.
Bithynella dulvertonensis.—Johnston, 1879: 28; Tenison Woods, 1879: 71; Johnston, 1891: 138.
Bithynella dunrobinensis.—Johnston, 1879: 28; Tenison Woods, 1879: 71; Johnston, 1891: 138.
Bithynella simsoniana.—Tenison Woods, 1879: 71; Johnston, 1891: 138.
Bithynia simsoniana.—Petterd, 1879: 85.
Pupiphryx dunrobinensis.—Iredale, 1943: 202; Smith & Kershaw, 1979: 47 (in part), text figure.
Fluvidona dulvertonensis.—Smith, 1992: 46.
Fluvidona dunrobinensis.—Smith, 1992: 46.
Fluvidona pontvillensis.—Smith, 1992: 47.
Fluvidona simsoniana.—Smith, 1992: 47.

Type material. Lectotype (here chosen, Fig. 25C) NHML 1896.11.30.56, paralectotypes NHML 1896.11.30.57–61 (5).

Type locality. Brighton, Hobart, Tasmania.

Type material of synonyms. *Bythinia pontvillensis*, syntypes TMH E.475/7816 (38), SAMA D.15771 (2), Jordan River, near Brighton, Tasmania (Fig. 25F); *Bythinia dunrobinensis*, holotype TMH E.473/7814 (lost), paratypes SAMA D.15769 (3), QVM 9:182 Ouse near Dunrobin,

Tasmania (Fig. 25E); *Bythinia dulvertonensis*, syntypes TMH E.489/7830 (lost), SAMA D.16368 (1); Lake Dulverton, Tasmania (Fig. 25D).

Material dissected and figured. C.204041, C.348999 (figured specimens), Jordan R. at Tea Tree Rd, Polonia Bridge, Brighton, Tasmania, 42°42.268'S 147°15.896'E, in leaves and roots, 11 February 1995.

Other material examined. Tasmania: trib of Iris R at Cradle Mountain Rd, C.201597; trib of Split Rock Ck at Lake Hwy, C.201304; Split Rock Ck at Lake Hwy, C.201311; Great Lake, MV F.54608; Miena, Great Lake, C.201291, C.201284; Johnsons Lagoon, SW of Great Pine Tier, C.201308; Johnsons Lagoon, Tas IFC; Ouse R, near Marlborough Hwy, C.201292; Lake Ina, Tas IFC, Tas IFC; unnamed lake between Lakes Ina and Travellers Rest, C.201312; Ouse R at Dunrobin, QVM 9:182; Clarence R at Clarence Lagoon, C.201299, C.201302; Lagoon of Islands, TMH E.9953, E.16457; S end of Lake St Clair, Cradle Mountain-Lake St Clair NP, C.203812; Cynthia Bay, Lake St. Clair, C.201415; Lake St Clair, QVM 9:7613; Serpentine Rivulet, near pumphouse, C.201557; Nive R, Bronte Park, C.201196, C.201194; Coates Ck at Lyell Hwy, C.201197; Brown Marsh Ck above Clarence R junction, C.201307; Ouse R, W of Miena, C.42117, MV F.54738; Nive Marsh Rivulet at Lyell Hwy, C.201309; Dee R, C.201306, Lake Dulverton, TMH E.489/7830; billabong on Jordan R, near Apsley, C.201042; S edge of Lake Tiberias, near Lake House, C.201324; Ouse R at Apex Park, Ouse, C.203766; creek, 0.8 mi S of Kempton, TMH E.9962; Kempton, MV F.54716; trib of Prosser R, MV F.54604; Jones R near Ellendale, C.201305; Quoin Rivulet, C.169000, C.169002; Montos Ck at Ellendale Rd, C.201054; Native Hut Rivulet, MV F.54723; Bushy Plains Rivulet at Tasman Hwy, C.201289; creek near Hollow Tree, C.201043, C.201409, C.318251; trib of Mitchelmores Ck, Buckland Military Training Area, C.201326; Bluff R, Buckland Military Training Area, C.203788; Maclaines Ck, Buckland Military Training Area, C.201545; Cockle Ck, C.168997; Jordan R at Apsley-Jericho Rd, Bothwell-Green Ponds, C.201539; Jordan R at Ford Rd, Pontville, C.203769; Jordan R, Brighton, TMH E.475/7816, NHML 93.3.2.275–93, NHML 1896, SAMA D.19159; ditch off Styx R, on rd to Strathgordon, C.201303; Coal R, Richmond, C.203813, C.201310, MV F.54607, NHML 20001334; Plenty R, C.201439; Picket Hill Ck, SW Hobart, C.201053; Manning Ave, Sandy Bay, C.201559, C.348530; Sandford, MV F.82278, SAMA D.19160; Browns R near Hobart, C.201540, MV F.53127, F.54724.

Diagnosis. Differs from other members of Group 3 in the following combination of characters: shell small to medium in size, spire outline straight, whorls convex, outer lip simple, inner lip distinctly separated from parietal wall; pallial vas deferens straight at prostate gland; penis pigmented on medial section only; oviduct straight distal to seminal receptacle.

Description. *Shell* (Figs. 25C–F, 26C, 46I, 47F). Shell 2.22–2.89 mm in height, 1.30–1.80 mm in width; spire of moderate length to squat, outline straight; aperture 0.76–1.01 mm in height, 0.74–1.01 mm in width. Body whorl 1.52–2.00 mm in height. Teleoconch of 3.50–4.35 convex whorls, last whorl and base evenly convex. Inner lip of aperture distinctly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum* (Fig. 27D). Operculum 0.74–1.02 mm in height, 0.56–0.77 mm in width, with 2–5 pegs. *Radula* (Fig. 28D,E). Central teeth: with 5–6 lateral cusps, median cusp of medium width, sharply pointed, less than twice as long as adjacent cusps; 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 21–28 cusps, ratio of cutting edge to shaft about ⅓, outer marginal teeth with 26–30 cusps, ratio of cutting edge to shaft about ¼. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe or pigmented dorsal central stripe only; snout, head and neck with well-developed pigmentation; foot and opercular lobe with well to poorly developed pigmentation; pallial roof and visceral coil with well-developed to mottled pigment. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 19–23 filaments. Oosphradium located between posterior end and middle of ctenidium. Hypobranchial gland thick; covers rectum.

Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; oval; intermediate in thickness to very thick. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system.* Testis of 1.1–1.2 whorls. Seminal vesicle loosely coiled over stomach; conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 48A). Ovary lobulate, about 1 whorl. Coiled oviduct with initial U orientated obliquely backwards; initial loop medium; proximal part with two or more bends, loops or twists; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle overlapping anterior edge to at anterior edge of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct to distinct, with large, obvious muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

shell dimensions:	SH	SW	AH	TW
lectotype	2.30	1.28	0.81	3.60
paralectotypes NHML 1896.11.30.57–61				
range	2.41–2.82	1.22–1.42	0.84–0.91	3.55–4.15
<i>B. pontvillensis</i> syntypes TMH E.475/7816				
figured syntype	2.52	1.29	0.80	4.25
range	2.21–3.21	1.23–1.74	0.79–1.17	3.80–4.70
<i>B. pontvillensis</i> syntypes SAMA D.15771				
range	2.34–3.01	1.32–1.57	0.82–1.02	3.85–5.00
<i>B. dulvertonensis</i> syntype SAMA D.16368				
range	2.98	1.89	1.19	4.60
<i>B. dunrobinensis</i> syntypes SAMA D.15769				
figured syntype	2.61	1.41	0.88	4.35
range	2.52–2.28	1.38–1.24	0.88–0.77	4.40–4.25
figured SEM specimen	2.50	1.43	0.93	3.50

Brazier's original measurements were given as 1.5 lines (= 3.7 mm) \times 0.75 lines (= 1.1 mm)

Distribution and habitat. This species has an extensive range throughout the drainage of the Derwent River, Tasmania (Fig. 53). It is typically found on weeds, leaves, roots, stones and other substrates and can very abundant.

Remarks. This species is not found in sympatry with any other species of *Austropyrgus* throughout its currently recognized range. It is similar to *A. gunnii* (see remarks under *A. gunnii*) and *A. nitidus* (see remarks under *A. nitidus*). The type material for both *Bythinia pontvillensis* and *Amnicola simsonianiana* originated from the same area, the Jordan River, Brighton, which is a tributary of the Derwent River. The type locality for *Bythinia dunrobinensis* is on the Ouse River which is also a large tributary of the Derwent River. The type locality for *Bythinia dulvertonensis* is Lake Dulverton, which also ultimately drains into the Derwent River. However, this lake frequently dries out and two attempts to collect hydrobiids have failed; in January, 1987 the lake was completely full, whereas in February, 1995, the lake was completely dry. It is reasonable to assume that the populations previously found in the lake are transient and that populations may or may not be present within the lake, depending on how long the lake holds water and the likelihood of successful dispersal events from nearby areas with extant populations of *Austropyrgus*. It is also possible that other nearby taxa could be introduced to the lake in the future.

This species exhibits a range of variation in shell size and shape with the type material of the synonyms (Fig. 25C–F) exhibiting much of the variation seen in the species, and it is possible that with further work additional taxa will be recognized. It is similar to *A. gunnii* from which it differs in its smaller, narrower shell with the inner lip of the aperture being distinctly separated from the parietal wall. Other species with similar shells include *A. gordonensis*, *A. nitidus*, *A. colludens*, *A. tebus*, *A. macropus*, *A. flindersensis*, *A. halletensis*, *A. glenelgensis*, *A. zeidlereri*, *A. ora*, *A. dekeyzeri*, *A. b Buchananensis*, *A. turbatus*, *A. gippslandicus*, *A. abercrombiensis*, *A. wombeyanensis*, *A. tathraensis*, *A. nepeanensis*, *A. sparsus* and *A. bungoniensis*.

In the discriminant analysis no specimens of *A. simsonianus* were misclassified by more than one individual except for the following misclassified as *A. nepeanensis* (2) and *A. b Buchananensis* (2) (overall 50% correct). When the analysis was restricted to Group 3, 55% were correctly classified, with the following misclassified as *A. nepeanensis* (2), *A. sparsus* (1), *A. tathraensis* (1), *A. b Buchananensis* (1), *A. wombeyanensis* (1), *A. ora* (1), *A. abercrombiensis* (1) and *A. nitidus* (1).

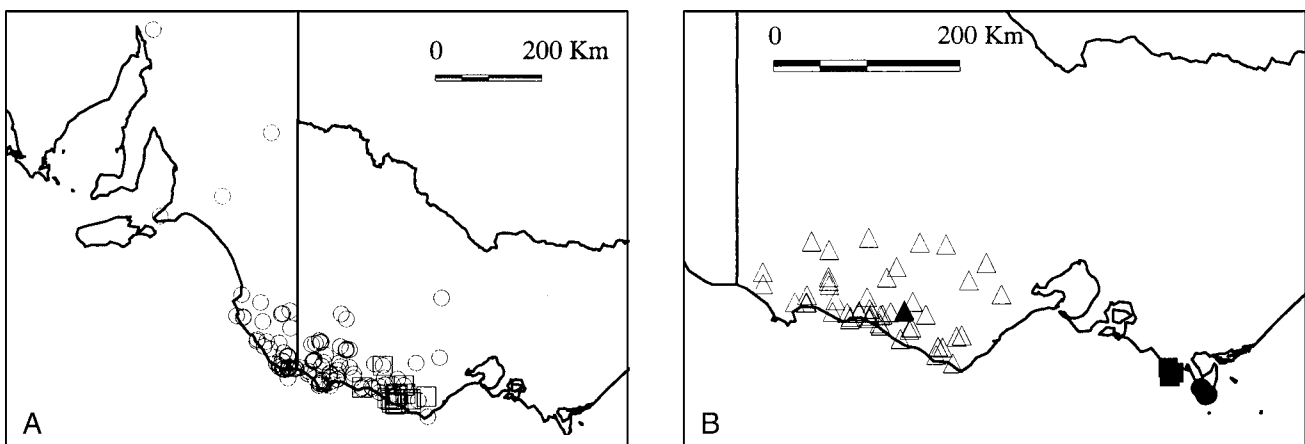


Fig. 56. Distribution of *Austropyrgus goliathus* □, *A. latus* ○, *A. sinuatus* ▲, *A. vulgaris* △, *A. foris* ■ and *A. rectus* ●.

Group 4. *Austropyrgus rectus* group

Small to medium sized shells, narrow to broad, with spires of average length to very elongate, with straight outline and typically flattened to slightly convex whorls. Coiled oviduct with one or more bends, loops or twists.

The following characters are common to Group 4: Aperture slightly disjunct. Median cusp of the central teeth sharply pointed and about twice as long as adjacent cusps. Shape of median cusp of the lateral teeth medium and sharply pointed. Faecal pellets orientated longitudinally except for *A. rectoides* which are orientated transversely. Anus intermediate in position except for *A. rectus* and *A. foris* where it is located near the mantle edge and *A. tateiformis* where it is intermediate in position to near mantle edge. Renal gland oval. Ctenidium abutting anterior end of pericardium except for *A. foris* where it can also be overlapping anterior end by one filament and *A. tateiformis* which has a short efferent branchial blood vessel to posterior end of ctenidium. Seminal vesicle conspicuously coiled on both the digestive gland and testis behind the stomach. Distal end of penis long and tapering and bursa copulatrix elongately oval.

A discriminant analysis involving the species assigned to this group had an overall discrimination of 89%

Victorian taxa

Austropyrgus rectus

(Ponder, Colgan, Clark, Miller & Terzis, 1994)

Figs. 34C, 35C

Fluvidona recta Ponder *et al.*, 1994: 640–643, fig. 42C.

Type material. Holotype C.172759, paratypes C.174026 (20+), MV F.65714.

Type locality. Squeaky Beach Ck, about 60m above road, Wilsons Promontory, Victoria, 39°0.70'S 146°18.35'E, on leaves, 13 February 1990.

Other material examined. **Victoria:** Whisky Ck, C.174028, C.174029, C.174032, C.174033, C.174034, C.174036, C.174037, C.202457, C.202458, C.202573; Squeaky Beach Ck at road, C.174030; Growler Ck at bridge, C.174031, C.202460; Frasers Ck, near mouth, C.174027, C.174035.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell medium in size, with slightly convex whorls; pallial vas deferens with several coils at prostate gland; female genital opening of medium length.

Description. *Shell* (Figs. 34C, 35C). Shell 1.93–3.66 mm in height, 1.09–2.02 mm in width; spire of average length; aperture slightly disjunct, 0.69–1.41 mm in height, 0.67–1.16 mm in width. Body whorl 1.31–2.39 mm in height. Teleoconch of 3.75–4.30 slightly convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum.* Operculum 0.66–1.27 mm in height, with 2–5 pegs. *Radula.* Central teeth: with 4–6 lateral cusps, median cusp narrow; 4 pairs of basal cusps. Basal tongue U-shaped, protruding well past lateral edge. Lateral teeth: with 4–6 lateral

cusps; median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 21–33 cusps, ratio of cutting edge to shaft about ½, outer marginal teeth with 31–39 cusps, ratio of cutting edge to shaft about ½. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe or pigmented dorsal central stripe; snout with pigment well developed around edges; foot and opercular lobe pigmentation poorly developed to absent; pigmentation of head and neck poorly developed or sides of neck only; pallial roof and visceral coil with pigment mottled to absent. Columellar muscle small to moderate size. *Non-genital anatomy.* Ctenidium with 19–21 filaments. Osphradium elongately oval to short oval, between posterior end and middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum without arch to with short S-shape. Renal gland about ½–½ in pallial roof; intermediate in thickness. Pericardium behind the posterior pallial cavity to about ½ in pallial roof. *Male reproductive system.* Testis of 1.4–1.8 whorls. Prostate gland about ½–½ in pallial roof, kidney-shaped, broadly-oval in cross section. Pallial vas deferens flush with surface; with several coils at prostate; with several coils between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base. *Female reproductive system.* Ovary simple, about 1.1–1.5 whorls. Coiled oviduct with initial U orientated dorsoventrally; initial loop long; proximal part inverted U-shape to two or more bends, loops or twists; one to two bends distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct bent just before bursal duct joins. Seminal receptacle at anterior edge of to overlapping anterior edge of bursa copulatrix, pyriform in shape, end rounded, duct short. Rectum separate from albumen gland and overlapping capsule gland. About ½ to more than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening of medium length; terminal.

shell dimensions:	SH	SW	AH	TW
holotype	2.76	1.54	0.95	4.30
paratypes	2.50–3.07	1.35–1.73	0.93–1.17	3.75–4.25

Distribution and habitat. This species is only known from a few small coastal streams on Wilsons Promontory, Victoria (Fig. 56B). It is typically found on weeds, roots and leaves and can be very abundant.

Remarks. This species is found in sympatry with *A. turbatus* from which its shell differs in its very slightly convex (almost flattened) whorls (convex in *A. turbatus*), tapering anterior end of the capsule gland (blunt in *A. turbatus*) and terminal female genital opening (overlapping anterior end of capsule gland in *A. turbatus*). Its shell is similar to that of *A. goliathus* but is much smaller and narrower. *Austropyrgus latus* is broader and *A. rectoides* is generally larger. This latter species appears to be the sister taxon for *A. rectus* but differs in having more cusps on the outer marginal teeth and in having more ctenidial filaments.

In the discriminant analysis, which included all 130 measured individuals comprising 11 populations, several specimens of *A. rectus* were misclassified by more than 3 individuals as the following *A. petterdianus* (11), *A. rectoides* (6), *A. macaulayi* (4), *A. nitidus* (4) and *A. gordonensis* (4) (overall 54% correct). When only the type population of *A. rectus* was included in the overall analysis, 75% of the specimens were correctly identified and none were misclassified by more than one individual. When the analysis was restricted to Group 4, and all populations included, 88% were correctly classified, with the following misclassified as *A. rectoides* (6), *A. foris* (4), *A. vulgaris* (1), *A. praecipitis* (2) and *A. procerus* (2).

Austropyrgus foris

(Ponder, Colgan, Clark, Miller & Terzis, 1994)

Figs. 34B, 35D

Fluvidona foris Ponder *et al.*, 1994: 638–640, fig. 42B.**Type material.** Holotype C.172758, paratypes C.174024 (20+), MV F.65713.**Type locality.** 10 Mile Ck at Cape Liptrap, near Waratah Bay, Victoria, 38°49.12'S 145°55.02'E, 16 February 1990.**Other material examined.** Victoria: Port Albert, MV F.54422; Bear Ck, Waratah Bay, C.334063; Cape Liptrap, MV F.54449, F.54436.**Diagnosis.** Differs from other members of Group 4 in the following combination of characters: shell small to medium in size, with convex whorls; lateral teeth with 3 cusps; with ¼ or less of albumen gland in front of posterior pallial wall; oviduct joins bursal duct ventrally; female genital opening long.**Description.** *Shell* (Figs. 34B, 35D). Shell 2.38–3.33 mm in height, 1.42–1.92 mm in width; spire of average length; aperture slightly disjunct, 0.98–1.32 mm in height, 0.86–1.09 mm in width. Body whorl 1.70–2.19 mm in height. Teleoconch of 3.30–4.25 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour yellow-brown, translucent. *Operculum.* Operculum 0.90–1.14 mm in height, with 3–6 pegs. *Radula.* Central teeth: with 5 lateral cusps, median cusp narrow, 4 pairs of basal cusps. Basal tongue U-shaped, protruding well past lateral edge. Lateral teeth: with 3–4 lateral cusps; median cusp less than twice as long as adjacent cusps. Inner marginal teeth with 17–21 cusps, ratio of cutting edge to shaft about ½, outer marginal teeth with 21–29 cusps, ratio of cutting edge to shaft about ⅓. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; rest of animal with pigmentation well developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 20–22 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum with slight arch to with short S-shape. Renal gland about ¼–½ in pallial roof; intermediate in thickness. Pericardium about ⅓–½ in pallial roof. *Male reproductive system.* Testis of 1.30–1.75 whorls. Prostate gland about ½ in pallial roof, kidney shaped, broadly-oval in cross section. Pallial vas deferens flush with surface; straight at prostate; slightly undulating between prostate and penis; strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system.* Ovary about 1.2–1.3 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; straight distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Coiled oviduct and bursal duct join just behind pallial wall. Bursal duct widest at junction with distal coiled oviduct. Oviduct joining bursal duct ventrally. Oviduct bent just before bursal duct joins. Seminal receptacle overlapping anterior edge of bursa copulatrix, pyriform in shape, end pointed, duct short. Rectum separate from albumen gland and overlapping capsule gland. ¼ or less of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, broadly-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening long; terminal.

shell dimensions:	SH	SW	AH	TW
holotype	3.33	1.92	1.27	4.25
paratypes	2.38–3.26	1.42–1.90	0.98–1.32	3.30–4.25

Distribution and habitat. This species is only known from the type locality, a small stream at Cape Liptrap, near Waratah Bay, eastern Victoria (Fig. 56B, p. 92) where it is found on weeds, roots and leaves.**Remarks.** This species is not found in sympatry with any other species of *Austropyrgus*. It is most similar to *A. angasi*, *A. vulgaris* and *A. macaulayi*. It differs from *A. vulgaris* in its broader shell and the oviduct joins the bursal duct ventrally (joins on right in *A. vulgaris*). It differs from *A. angasi* by the coiled oviduct having a single coil (inverted U-shaped oviduct in *A. angasi*). *Austropyrgus foris* also resembles a few taxa in Group 3, notably *A. diemensis*, but can be separated from this taxon by its taller spire and more convex whorls.In the discriminant analysis no specimens of *A. foris* were misclassified by more than one individual except for two as *A. macaulayi* (overall 75% correct). When the analysis was restricted to Group 4, 95% were correctly classified, with one specimen misclassified as *A. vulgaris*.*Austropyrgus vulgaris* n.sp.

Figs. 40A, 41A, 42B

Type material. Holotype C.343024, figured paratypes C.307585 (3), paratypes C.302424 (20+), MV F.88941 (2).**Type locality.** Mt Emu Ck, just below weir, at Ayrford Rd, S of Terang, Victoria, 38°18.42'S 142°52.77'E, in weed and roots, on and under rocks, 19 February 1994.**Other material examined.** Victoria: Nine Mile Ck, 23 mi E of Hamilton, MV F.54782; Springfield, Wannon, MV F.54751; Fiery Ck, C.204003; Mt Emu Ck, C.204010, C.204004; Hamilton, MV F.54774; Spring Ck, c. 4 km NE of Wurrook, C.200950; Hopkins R; MV F.54763, 6 km N of Macarthur, C.203990, C.203986; Hopkins R, Hexham, C.300694; Woody Yaloak Ck, Cressy, C.200923; Macarthur, MV F.2406; 3 mi N of Little R, MV F.54611; 6 mi S of Macarthur, MV F.2407; Barwon R, C.203984; Darlot Ck, just S of Ettric, C.302416; Spring Ck at Woolsthorpe Rd, C.300788, C.300810; Shaw R, Orford, MV F.2416; Mt Emu Ck, 2 mi E of Terang, C.300781, MV F.54780; Surrey R, Woolwash, Heathmere, Portland, MV F.54658; Fitzroy R at Princes Hwy, C.302483; Darlot Ck at Princes Hwy, C.300795, C.302422; Lake Cartcarrong, Winslow, MV F.54760; Koroit, MV F.54650, F.54668, F.82280; Shaw R at Princes Hwy, SAMA D.19161; Merri R, Woodford, MV F.54759; Mt Emu Ck at Princes Hwy, Panmure, C.300791; North West Crater, Tower Hill, C.200789; Curdies R, C.174678, C.204001; Curdies R, 2 km W of Timboon, MV F.54765; Hopkins Falls, MV F.5413; Moyne R at Princes Hwy, C.203988, SAMA D.19162; Merri R, 2 mi N of Warrnambool, MV F.54628; Merri R at Wollaston Rd, C.203793; Merri R, Warrnambool, MV F.54631; Port Fairy, C.6867, C.200801, MV F.54636; Lake Gilliar, MV F.54761; Cudgee Ck, between Terang and Warrnambool, MV F.88889; Gellibrand R, Gellibrand, C.203989, C.201842, C.203995, C.204014, MV F.54799, F.54820; small creek at road, 3 km S of Nirranda East, C.300825; Gellibrand R at Lavers Hill-Cobden Rd, MV F.82279; Gellibrand R, 19 km from Simpson Creek, C.200925; Chapple Ck, South Branch at Gauge Station, C.300792; Ford R at Great Ocean Rd, C.200775.**Diagnosis.** Differs from other members of Group 4 in the following combination of characters: shell small to medium in size, with straight spire outline and convex whorls; central teeth with 3 pairs of basal cusps; penis attached well to right side of head; bursal duct parallel sided.**Description.** *Shell* (Figs. 40A, 41A). Shell 2.30–3.06 mm in height, 1.45–1.93 mm in width; spire of average length, aperture 0.86–1.24 mm in height, 0.85–1.13 mm in width. Body whorl 1.59–2.12 mm in height. Teleoconch of 3.70–4.50 convex whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip weakly thickened, without reflection. Colour

yellow-brown, translucent. *Holotype dimensions*: SH, 2.86 mm; SW, 1.85 mm; AH, 1.23 mm; TW, 3.75 whorls. *Operculum*. Operculum 0.83–1.22 mm in height, 0.56–0.85 mm in width, with 2–6 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–29 cusps, ratio of cutting edge to shaft about 1/3, outer marginal teeth with 36–41 cusps, ratio of cutting edge to shaft about 1/4. *Head-foot*. Cephalic tentacles unpigmented; snout with pigmentation well developed to around edges; foot, pallial roof and visceral coil pigmentation poorly developed to absent; opercular lobe with poorly developed pigmentation; head and neck pigmentation developed on sides of neck only to absent. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 20–22 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about 1/3 in pallial roof; thin to intermediate in thickness. Pericardium about 1/2 in pallial roof. *Male reproductive system*. Testis of 1.0–1.5 whorls. Prostate gland about 1/2 in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight or strongly undulating at prostate, strongly undulating between prostate and penis; strongly undulating at base of penis. Penis attached well to right side of head; with pigmentation absent or on all areas except base. *Female reproductive system* (Fig. 42B). Ovary lobulate, about 1.00–1.25 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape to two or more bends, loops or twists; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursal duct parallel sided and straight. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct of medium length. Rectum overlapping albumen and capsule glands. More than 1/2 of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with moderate sized muscular vestibule. Genital opening small, terminal.

Distribution and habitat. This species is widespread throughout the small streams and rivers of western Victoria (Fig. 56B, p. 92). It is typically found on weeds, leaves, roots and stones and can be locally abundant.

Remarks. This species is found in sympatry with four species of *Austropyrgus* (*A. latus*, *A. goliathus*, *A. eumekes* and *A. sinuatus*) throughout its currently recognized range. Its shell can be separated from *A. latus* and *A. goliathus* by its smaller size and slightly more rounded whorls, from that of *A. eumekes* by its much shorter spire and broader shape and from *A. sinuatus* by its lack of a curved outer lip. Because it shows some variation in shell size and shape throughout its currently recognized range, further work may show it to be comprised of more than one taxon. *Austropyrgus vulgaris* also superficially resembles a few taxa from Group 3 but can be separated from most of these taxa by its weakly convex whorls. *Austropyrgus fonscultus* is similar in shape but is much smaller.

In the discriminant analysis only one specimen of *A. vulgaris* was misclassified as *A. rectoides* (overall 95% correct). When the analysis was restricted to Group 4, 89% being correctly classified with the following misclassified as *A. latus* (1) and *A. vulgaris* (1).

Etymology. *Vulgaris* Latin: common, commonplace—refers to the widespread distribution and abundance of this species.

Austropyrgus latus n.sp.

Figs. 40B, 41B, 42E

Type material. Holotype C.343824, figured paratypes C.300796 (3), paratypes C.300695 (20+), MV F.82347 (3).

Type locality. Surrey R. at Princes Hwy, S of Heywood, Victoria, 38°11.88'S 141°36.78'E, 18 May 1984.

Other material examined. South Australia: Mimbaddogge Ck, on Wilmington-Quorn road on E slope of Mount Bruce, C.200934; Barmera? shores of Lake Bonney, SAMA D.19163; Murray R, near ferry, Tailem Bend, MV F.54689; Yattagolanga R, Main South Rd, near Normanville, C.204061; Kingston, SAMA D.19164, D.19165; Jackywhite drain, 2.8 km N of Avenue, SAMA D.19166; Mosquito Ck, near Struan, SAMA D.19167, D.19168; SE end of Bool Lagoon, C.200959; drain at SW end of Bool Lagoon, just below weir, C.201649; Lake Fox, near Robe, SAMA D.19169; The Springs, E side of Lake Eliza, SE of Robe, MV F.54695, C.200957; Eastern Diversion Drain at Furner Rd, C.200960; Penola, SAMA D.19170, D.19171; Lake Frome Drain, 3.2 km upstream from bridge at S end, SAMA D.19172; creek flowing into Lake George, N of Beachport, C.200958; Millicent, SAMA D.19173; Lake Leake, c. 14 km SW of Kalangadoo, SAMA D.19174; Corys Landing, Lake Bonney, MV F.54698; drain at road intersection between Lake Bonney and Tantanoola, MV F.54693; Tartwaup limestone quarry, C.374392; cenote L14, Ela Elap (spring), SSW of Mt Gambier, SAMA D.19184, FWA 3764–3765; Dingley Dell, Mount Gambier, SAMA D.19175; Valley Lake, SAMA D.19176, C.200942, MV F.54684; Bones Pond, near Mount Gambier, C.200945; Blue Lake, C.201634, MV F.54697, F.25303, SAMA D.19177, D.19178, D.19179, D.19180, D.19181, D.19182; “The Sisters Sinkhole”, 10 km along The Sisters Rd, c. 20 km SW of Mt Gambier, SAMA D.19183; stream running from swamp, Nene Valley, NW of Port MacDonnell, MV F.54700; spring at head of creek, SW of Mt Gambier, C.200936; springs on property of B.S. Milstead, N of Umpherstone Bay, C.200939, C.200935, C.200937, C.200940; Ewens Ponds and Eight Mile Ck, C.200941, C.200933, C.200943, C.201632; C.305259, C.200944, C.201639, C.201642, SAMA D.19185; SAMA D.19186, SAMA D.19187, MV F.54687, MV F.54683; Umpherstone Bay, C.200938; Deep Ck at coast road, 12 km E of Port MacDonnell, C.200948; Eight Mile Ck at rd, near Danger Point, C.302551; Piccaninnie Ponds, C.200947, C.200946, SAMA D.19188, D.19189, D.19190, D.19191; Crescent Pond, 3 mi W of Piccaninnie Ponds, SAMA D.19196; Port MacDonnell, SAMA D.19192, D.19193, D.19194, D.19195; Eight Mile Ck near Riddoch Bay, MV F.54692; Drain near Riddoch Bay, Port MacDonnell, MV F.54699; Hitchcocks Drain, E of Port MacDonnell, MV F.54694; Clark Park, Port MacDonnell, MV F.54696; creek on corner of Compton St, Port MacDonnell, C.302525; MacDonnell Bay, Port MacDonnell, SAMA D.19197. **Victoria:** Tullaroop Ck, at Eddington-Baringhup Rd, MV F.54685; Glenelg R, C.204002, C.204007; Glenelg R at Casterton, C.302397; Wannon R at Sandford, C.302368; Glenelg R at old Myaring Bridge, S of Casterton, C.302514, C.200852; Wannon R, C.203997, C.203987; Cawker Ck at Glenelg Hwy, C.302389; Grange Burn Ck, Hamilton, MV F.54647, F.7533, F.54662; Muddy Ck, Hamilton, SAMA D.19198; Muddy Ck, near junction with Grange Burn Ck, Hamilton, C.300801; Stokes R just of Hamilton Rd, 13 km NE of Dartmoor, C.200782; Spring Ck c. 4 km NE of Wurrock, C.300696; Glenelg R at Princes Hwy, Dartmoor, C.300793, C.302494, C.300799, MV F.54669, F.82272, F.54798; trib of Glenelg R at Dartmoor-Digby Rd, C.305056; Crawford R at rd, E of Greenwald East, C.300800; 12 km W of Byaduk, MV F.54764; Browns Waterholes, Lismore, C.200929; Muston Ck, Caramut, between Mortlake and Hamilton, MV F.82273; Hopkins R at Hexham, C.300782, C.302475; Spring Ck at Princes Hwy between Heywood and Dartmoor, C.300794; upper part of Darlot Creek, Condah Swamp, C.302518; Eumeralla R at Princes Hwy, E of Portland, C.300797; Eumeralla Ck, Macarthur, MV F.54789, F.54749; Nelson, MV F.54786; Whittlebury Ck, Whittlebury Swamp, NNE of Ettrick, C.302464; drain below Cave Hill, Heywood, MV F.54609; Lake Bongbong, (= Lake Monebyong) 22 km SE of Nelson, MV F.54806, F.54783, F.54779, SAMA D.19199, D.19200; Dunmore Swamp, MV F.7761; Fitzroy R at Princes Hwy, Heywood, C.300802, MV F.54640, SAMA D.19201; Darlton Ck, C.204012; Surrey R at Princes Hwy, c. 7 km S of Heywood, SAMA D.19202; Swan Lake, off road to Nelson, c. 30 km NW of Portland, MV F.88890; Hopkins R at Framlingham C.300787; Shaw R, Orford, MV F.54785; Mt Emu Ck at Princes Hwy, 15 km W of Camperdown, SAMA

D.19203; Fitzroy R at Princes Hwy, C.302482, SAMA D.19205; Darlot Ck at Princes Hwy, SAMA D.19204; second creek along Mt Richmond NP Rd, off Nelson Rd, C.302404, MV F.54748, F.54748, F.54747; Gorae West (on property of T. Phillips), MV F.54622; Surry R, C.203992; Bridgewater Lakes, C.302384, MV F.54805, F.54781, F.54796, F.6870, F.54750; Mt Emu Ck, just below weir, at Ayrford Rd, S of Terang, C.200949; Mt Emu Ck below bridge, Princes Hwy, Panmure, C.200803; Curdies R, 6 km S of Cobden, SAMA D.19206; Portland, MV F.54654; Hopkins Falls, MV F.5413; trib of Merri R near Dennington, MV F.54646; Moyne R at Princes Hwy, just E of Port Fairy, C.300784; Merri R, near small wharf, E side of river, off Princes Hwy, Warrnambool, C.300811; Merri R, at Walsh Rd, near Warrnambool, MV F.54802; Port Fairy, C.4392, MV F.9975, F.54620; Cudgee Ck, between Terang and Warrnambool, MV F.88891; Curdies R, C.203985; Power Ck, 800 m SSE of Timboon, C.300790; Carlisle R at Carlisle, C.201403; Blanket Bay Ck, 150 m up from the sea, C.300786.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell broad, with straight spire outline and flattened whorls; pallial vas deferens strongly undulating at base of penis; penis unpigmented; female genital opening of medium length and overlapping anterior end of capsule gland.

Description. *Shell* (Figs. 40B, 41B). Shell 2.25–3.34 mm in height, 1.47–2.21 mm in width; spire of average length; aperture slightly disjunct, 0.83–1.40 mm in height, 0.79–1.22 mm in width. Body whorl 1.61–2.45 mm in height. Teleoconch of 3.25–4.25 flattened whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 2.98 mm; SW, 1.90 mm; AH, 1.12 mm; TW, 4.00 whorls. *Operculum.* Operculum 0.79–1.21 mm in height, 0.59–0.93 mm in width, with 2–6 pegs. *Radula.* Central teeth: with 4–5 lateral cusps, median cusp of medium width, 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 20–25 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 24–31 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles pigmented with a poorly developed dorsal central stripe; snout with pigment well developed around edges; foot, opercular lobe and pallial roof unpigmented; pigmentation of head and neck developed on sides of neck only; visceral coil weakly pigmented to unpigmented. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 22–24 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland very reduced to appears to be absent; not covering to partly covering rectum when visible. Rectum without arch to with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; thin to intermediate in thickness. Pericardium about $\frac{1}{2}$ or more in pallial roof. *Male reproductive system.* Testis of 1 whorl. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight at prostate, straight between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented; distal end long and tapering. *Female reproductive system* (Fig. 42E). Ovary lobulate, about 1.20–1.75 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part with 1–2 or more bends, loops or twists; straight to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursal duct very short or widest at junction with distal coiled oviduct. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, pyriform in shape, end rounded, duct short to medium length. Rectum overlapping albumen and capsule glands. About $\frac{1}{2}$ of albumen gland behind posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct to distinct, with moderate sized muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is widespread throughout the streams and rivers of southeastern South Australia and western Victoria (Fig. 56A, p. 92). It is typically found on weeds, leaves, roots and stones and can be locally abundant.

Remarks. This species occurs in sympatry, in its currently recognized range, with at least nine other species of *Austropyrgus* (*A. vulgaris*, *A. goliathus*, *A. sinuatus*, *A. eumekes*, *A. glenelgensis*, *A. pusillus*, *A. exiguus*, *A. tumidus* and *A. fonscultus*), with up to three species at any one site. Its shell is similar to that of *A. goliathus* but differs in its much smaller size. It differs from all other species in the area in its generally larger, broader shell with straight-sided whorls. *Austropyrgus latus* also resembles a few taxa, especially *A. diemensis*, from Group 3 but can be separated from these taxa by its larger size and flattened whorls.

In the discriminant analysis no specimens of *A. latus* were misclassified by more than one individual except for the following: *A. macaulayi* (3), *A. foris* (2), *A. tathraensis* (2), *A. vulgaris* (2) and *A. simsonianus* (2) (overall 65% correct). When the analysis was restricted to Group 4, 85% were correctly classified, with the following misclassified as *A. vulgaris* (5) and *A. foris* (1).

Etymology. *Latus* Latin: broad, wide—refers to the broad shape of this species.

Austropyrgus goliathus n.sp.

Figs. 40E, 41F, 42D

Type material. Holotype C.343031, figured paratypes C.307594 (3), paratypes C.300700 (20+), MV F.82348 (3).

Type locality. Spring Ck, NE of Curdies Inlet, Victoria, 38°32.25'S 142°55.25'E, in weeds in open area, 22 April 1988.

Other material examined. **Victoria:** Hopkins R at Hexham, SAMA D.19207; Cobden, MV F.7510; Curdies R near Cobden, MV F.82270; Moyne R at Princes Hwy, Port Fairy, C.200802; Scotts Ck, between Port Campbell and Cobden, C.204006, SAMA D.19208; Curdies R at Nullawarre-Timboon Rd, C.300826; Power Ck, 800 m SSE of Timboon, C.300824; Love Ck on road to Gellibrand, 17 km S of Colac, SAMA D.19209; Spring Ck, between Warrnambool and Port Campbell, C.300830, C.300831; Kennedys Ck at Lavers Hill-Cobden Rd, S of Simpson, C.300829, MV F.82271; Kennedys Ck, SE of Simpson, C.200927, C.300828; small creek at road, 3 km S of Nirranda East, C.300821; Wallaby Ck at road, off Great Ocean Rd, near Peterborough, C.300822; Loch Ard Gorge, Port Campbell NP, C.201661, MV F.54788; London Bridge, Port Campbell NP, C.302489, C.300827; 4 km N of Port Campbell, C.300823.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell of medium size (up to 4.7 mm), broad, with flattened whorls, last whorl and base subangled; basal projection of lateral teeth U-shaped, ovary simple, rectum indenting albumen gland.

Description. *Shell* (Figs. 40E, 41F). Shell 3.73–4.74 mm in height, 2.24–2.83 mm in width; spire of average length, aperture 1.52–2.15 mm in height, 1.31–1.71 mm in width. Body whorl 2.73–3.32 mm in height. Teleoconch of 3.50–4.75 flattened whorls, last whorl and base subangled. Inner lip of aperture firmly adhering to parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions:* SH, 4.36 mm; SW, 2.47 mm; AH, 1.77 mm; TW, 4.70 whorls. *Operculum.* Operculum 1.30–1.79 mm in height, 0.94–1.28 mm in width, with 4–7 pegs. *Radula.* Central teeth: with 4 lateral cusps, median cusp of medium width, 3–4 pairs of basal cusps. Basal tongue U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp about twice as long as adjacent cusps. Basal

projection of lateral teeth U-shaped. Inner marginal teeth with 16–22 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 22–33 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout, head and neck with pigment well developed; foot and opercular lobe pigmentation poorly developed; pallial roof and visceral coil with pigment mottled to poorly developed. Columellar muscle of moderate size to large. *Non-genital anatomy*. Ctenidium with 25–28 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; very thick. Pericardium about $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.4–1.7 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, highly compressed in cross section. Pallial vas deferens raised, slightly to strongly undulating at prostate, slightly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 42D). Ovary simple, about 1.00–1.75 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop long; proximal part inverted U-shape to two or more bends, loops or twists; straight to one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, end rounded, duct short to medium length. Rectum indenting albumen gland and overlapping capsule gland. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering to blunt, compressed-oval to elongately-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is found in the small coastal streams and rivers of central western Victoria (Fig. 56A, p. 92). It is typically found on weeds, leaves, roots and stones and can be locally very common.

Remarks. This species is the largest member of the genus and the second largest of all known Australian hydrobiids (the largest being *Phrantela richardsoni* Ponder & Clark, 1993 from southwest Tasmania). It is found in sympatry with three other species of *Austropyrgus* (*A. latus*, *A. aslini* and *A. vulgaris*) throughout its currently recognized range. It differs from all three species in its much larger shell, and from *A. aslini* and *A. vulgaris* in having straight-sided rather than rounded whorls.

In the discriminant analysis all specimens of *A. goliathus* were correctly classified.

Etymology. *Goliath* Hebrew: giant—alludes to the large size of this species which is the largest in the genus.

Austropyrgus sinuatus n.sp.

Figs. 40G,H, 41C, 42F

Type material. Holotype C.343038, figured paratypes C.343037 (3), paratypes C.302425 (20+), MV F.82349 (3).

Type locality. Mt Emu Ck at Ayrford Rd, just below weir, S of Terang, Victoria, 38°18.42'S 142°52.77'E, on weeds, roots and on and under rocks, 19 February 1994.

Other material examined. Victoria: Gauge Station loon east of bridge over Mt Emu Ck, C.201406.

Diagnosis. Distinguished from other members of genus in shell having a sinuous outer lip.

Description. *Shell* (Figs. 40G,H, 41C). Shell 2.24–2.86 mm in height, 1.38–1.74 mm in width; spire elongate to average length; aperture slightly disjunct, 0.88–1.20 mm in height, 0.85–1.04 mm in width. Body whorl 1.54–1.93 mm in height. Teleoconch of 3.75–4.50 slightly convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, sinuous, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 2.75 mm; SW, 1.66 mm; AH, 1.20 mm; TW, 4.05 whorls. *Operculum*. Operculum 0.74–0.91 mm in height, 0.51–0.70 mm in width, with 2–5 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 5–6 lateral cusps, median cusp about twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–26 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 26–32 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented or unpigmented, with unpigmented median dorsal stripe; snout with pigment well developed to just around edges; foot with well to poorly developed pigmentation; opercular lobe with poorly developed pigmentation; head, neck, pallial roof and visceral coil unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 18–21 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum with slight arch to with short S-shape. Renal gland about $\frac{1}{2}$ in pallial roof; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 0.9–1.0 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, strongly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on medial section only. *Female reproductive system* (Fig. 42F). Ovary lobulate, about 0.75 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursal duct very short. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening of medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently known from a single location on the Mt Emu Creek, south of Terang, western Victoria (Fig. 56B, p. 92). It is typically found on leaves, roots and stones and is very common.

Remarks. This species is found in sympatry with *A. vulgaris* and *A. latus*, from which it can be readily distinguished from these taxa and other members of the genus by its shell having a very distinctive curved outer lip (Fig. 40H). This character has not been observed in any other Australian hydrobiid to date. Although further field work in western Victoria may reveal additional populations, it nevertheless probably has a restricted distribution as the general area has been reasonably well sampled.

In the discriminant analysis only one specimen of *A. sinuatus* was misclassified as *A. dekeyzeri* (overall 95% correct). When the analysis was restricted to Group 4, 95% were correctly classified, with one specimen misclassified as *A. vulgaris*.

Etymology. *Sinuatus* Latin: bend, curve—refers to the curved outer lip of this species.

Tasmanian taxa

Austropyrgus tateiformis n.sp.

Figs. 27F, 40I, 54A, 55B

Type material. Holotype C.343053, figured paratypes C.343054 (3), paratypes C.201033 (20+), TMH E.23430 (3), QVM 9:17066 (3).

Type locality. Trib. of Blackwater Rivulet at Blackwater Rd, Tasmania, 41°11.20'S 144°56.85'E, on leaves, wood and mud, 11 February 1989.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell narrow, with very elongate spire; ctenidium with short efferent branchial blood vessel joining pericardium; pallial vas deferens with overlying loops/coils at prostate; penis unpigmented.

Description. *Shell* (Figs. 40I, 54A). Shell 2.79–3.66 mm in height, 1.20–1.55 mm in width; spire very elongate; aperture 0.79–1.01 mm in height, 0.68–0.89 mm in width. Body whorl 1.53–1.83 mm in height. Teleoconch of 5.20–6.20 flattened whorls, last whorl and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour white to very pale yellow, translucent to opaque. *Holotype dimensions:* SH, 2.79 mm; SW, 1.20 mm; AH, 0.79 mm; TW, 5.25 whorls. *Operculum* (Fig. 27F). Operculum 0.70–0.87 mm in height, 0.37–0.60 mm in width, with 1–4 pegs. *Radula.* Central teeth: with 6 lateral cusps, median cusp of medium width, 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6–7 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–25 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 37–38 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; snout, foot, opercular lobe, head and neck with well-developed pigmentation; pallial roof weakly pigmented. Columellar muscle of moderate size to large. *Non-genital anatomy.* Ctenidium with 19–24 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; intermediate in thickness. Pericardium about $\frac{1}{2}$ or more in pallial roof. *Male reproductive system.* Testis of 1.5–1.6 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, with overlying loops/coils at prostate, slightly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; not pigmented. *Female reproductive system* (Fig. 55B). Ovary about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally; initial loop medium; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join at posterior pallial wall. Bursal duct wider at bursal end. Oviduct joining bursal duct ventrally. Oviduct bent to straight just before bursal duct joins. Seminal receptacle at anterior edge of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum indenting albumen gland and overlapping capsule gland. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with indistinct glandular zones. Ventral channel indistinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is currently only known from a single locality in northwestern Tasmania (Fig. 57). It is typically found on leaves, roots and stones and is common.

Remarks. This species is found in sympatry with *A. conicus* and *A. smithii*, from which it can be distinguished by its larger, taller (narrower) shell with straight-sided whorls. Two other members of Group 4, *A. procerus* and *A. rectoides*,

are found nearby. *Austropyrgus tateiformis* can be distinguished from both these species by its narrower shell and *A. procerus* is smaller. Although further work in the area where this species was found may reveal additional populations, it is likely to remain a species with a restricted range as the general area has been reasonably well sampled. This species is not similar to any other species assigned to the other groups.

In the discriminant analysis four specimens of *A. tateiformis* were misclassified as *A. eumekes* (3) and *A. elongatus* (1) (overall 80% correct). When the analysis was restricted to Group 4, 100% were correctly classified.

Etymology. Named for its distinctive shape—very reminiscent of the southern Australian estuarine hydrobiid genus *Tatea*.

Austropyrgus rectoides n.sp.

Figs. 27H, 40J, 54B, 55E

Type material. Holotype C.343055, figured paratypes C.343056 (3), paratypes C.201055 (20+), TMH E.23431 (6), QVM 9:17067 (6).

Type locality. Trib. of Fixters Ck at N end of Brittons Swamp, Tasmania, 40°54.78'S 144°57.85'E, under and on wood, roots and leaves, 11 February 1989.

Other material examined. Tasmania: Mt Cameron, Circular Head, MV F.54721; Montagu R, C.168995; Welcome R, C.204112; Smithton, MV F.82276; Mella Ck at Mella Rd, Mowbray Swamp, Mella, C.201568; Duck R at Bass Hwy, C.346746; Deep Ck on Bass Hwy, C.201564, C.204084; trib of Deep Ck, C.204064, C.346731, C.201514; Deep Ck at South Rd, 1.9 km S of South Forest, C.204107, C.201566; Pulbeena "Swamp", C.204089, C.201804, C.201808; Geales Ck on side track off NW side of Bass Hwy, C.201567, C.346757, C.204093; Greys Ck at Dunns Rd, C.201056; Christmas Hills, C.168992; Farnhams Ck at Bass Hwy, 1.5 km W of Christmas Hills, C.201069; Fixters Ck, 2 km on Riseborough Rd, NW of Brittons Swamp, C.201072, C.201059; Copper Ck at Trowutta Rd, C.201565, C.204087, C.346741; Fixters Ck near Brittons Swamp, C.201076; Blizzards Ck at Youngs Rd, S of Irishtown, C.201563, C.370345; trib of Doctors Ck at Arthur River Rd, Marawah, C.201078; between drains and Plains Ck, Brittons Swamp, C.201081, C.201569; Mella Springs, near Smithton, C.201061, C.201062, C.201065, C.201066; Murdering Gully, Table Cape, C.371591; Welcome R at Linnanes Rd, C.201060; Cassidys Ck near Boat Harbour, C.201082; trib of Flowerdale R at Bass Hwy, Sisters Creek, C.201083; Blizzards Ck at Lileah–Spinks Hill Rd, C.346737; Mowbray Swamp, MV F.82277; Birthday Ck at Scotchtown Rd, C.201057; trib of Mill Ck, C.201071, C.201073; Swards Ck at Arthur River Rd, C.201074; creek at Salmon Rd, 0.2 km N of Lerunna Rd, C.201075; trib of Salmon R at junction of Salmon and Lerunna Rds, C.201067; Roger River West, MV F.88894; Salmon R at Salmon Rd, C.201077, C.201376; trib of Arthur R, S side of Kanunnah Bridge, C.201377; Julius R at Sumac Rd, C.201068, C.201085, C.201378, C.201583; small stream at road between Rapid River and Julius River, C.346751; Rebecca Lagoon, N of Temma, TMH E.9960; creek at Blackwater Rd, 10 km S of Kanunnah Bridge, C.201372; Templars Ck at Temma Rd, C.201523; trib of Blythe R at South Riana Rd, C.201245; Wilsons Ck, C.168998; S of Trial Harbour, TMH E.8975; North coast, MV F.53131.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell of medium size, broad, with flattened whorls; penis not pigmented; pallial vas deferens straight or slightly undulating at prostate gland.

Description. *Shell* (Figs. 40J, 54B). Shell 2.84–3.88 mm in height, 1.51–2.13 mm in width; spire of average length; aperture 0.95–1.29 mm in height, 0.89–1.24 mm in width. Body whorl 1.92–2.45 mm in height. Teleoconch of 4.00–5.50 flattened to slightly convex whorls, last whorl

and base evenly convex. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour white to very pale yellow, opaque. *Holotype dimensions*: SH, 2.97 mm; SW, 1.67 mm; AH, 1.12 mm; TW, 3.75 whorls. *Operculum* (Fig. 27H). Operculum 0.92–1.24 mm in height, 0.63–0.91 mm in width, with 3–6 pegs. *Radula*. Central teeth: with 6 lateral cusps, median cusp of medium width, 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 28–34 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 40–46 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented (with unpigmented median dorsal stripe) or unpigmented, snout unpigmented or pigmented around edges; foot, opercular lobe, pallial roof and visceral coil unpigmented; head and neck pigmentation poorly developed to unpigmented. Columellar muscle of moderate size. *Non-genital anatomy*. Ctenidium with 24–28 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; thin to intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.0–1.3 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, straight to slightly undulating at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at central part of head; not pigmented. *Female reproductive system* (Fig. 55E). Ovary lobulate, about 1.0–1.5 whorls. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium; proximal part inverted U-shape to one bend, loop or twist; one to two bends distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursal duct parallel sided and straight. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen and capsule glands. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel indistinct to distinct, with indistinct to moderate sized muscular vestibule. Genital opening small to medium length; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small coastal streams and rivers of northern and western Tasmania, including Hunter Island (Fig. 57). There are a few lots of material that we tentatively consider to be this species found south of the main focus of distribution and it is possible that these populations could represent undescribed taxa or that the species is much more widespread than is currently recognized. It is typically found on leaves, roots, wood and stones and can be very common.

A few lots (E of King I., C.204156; N of Three Hummock I., Hunter Group, Bass Strait, C.204157, C.201058, C.201063; E of Grassy, King I., C.204155; Hunter I., MV F.88893) are known from the western Bass Strait, mainly from shells from sediment samples, which may be Holocene or Pleistocene fossils. These are locations are not shown in Fig. 57.

Remarks. This species is found in sympatry with five other species of *Austropyrgus* (*A. conicus*, *A. procerus*, *A. juliae*, *A. lochi* and *A. mersus*) throughout its currently recognized range, with up to three in any one location. It can be separated from all these species by its larger, broader shell, and in addition, from *A. mersus*, by its straight-sided whorls. It differs from *A. procerus* in its larger size and broader shape. However, it does exhibit some variation in both shell size and shape, and with further work it may be shown to consist of more than one taxon. *Austropyrgus rectoides* does not closely resemble any taxa from other groups.

In the discriminant analysis most specimens of *A.*

rectoides were poorly discriminated, with 60% wrongly classified. Those misidentified by more than one individual were *A. praecipitis* (4), *A. rectus* (2) and *A. nitidus* (2) (overall 40% correct). When the analysis was restricted to Group 4, 55% were correctly classified, with the following misclassified as *A. rectus* (3), *A. latus* (2), *A. praecipitis* (2), *A. vulgaris* (1) and *A. procerus* (1).

Etymology. Named for its distinctive shape—reminiscent of *A. rectus* from Wilsons Promontory, Victoria.

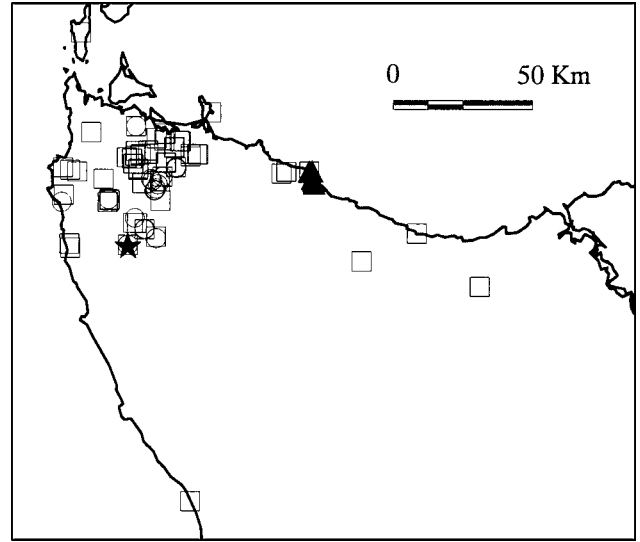


Fig. 57. Distribution of *Austropyrgus procerus* ○, *A. praecipitis* ▲, *A. rectoides* □ and *A. tateiformis* ★.

Austropyrgus praecipitis n.sp.

Figs. 40K, 54C, 55C

Type material. Holotype C.343057, figured paratypes C.343058 (3), paratypes C.201086 (20+), C.201087 (20+), C.201426 (20+), TMH E.23432 (3), QVM 9:17068 (3).

Type locality. Streams at Table Cape Lighthouse, Tasmania, 40°58.53'S 145°43.50'E, on and under rocks and leaves, 8 February 1989.

Other material examined. Tasmania: swamp on Table Cape, C.201090; Murdering Gully, C.201089; bottom of main creek, SE side of Table Cape, C.371602; Fossil Bluff, c. 0.3 km NW of car park, C.201064; Guttridge Gardens, Wynyard, C.204075.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell medium in size, spire elongate to average length, whorls slightly convex; pallial vas deferens S-shaped at prostate gland; bursal duct with twist.

Description. *Shell* (Figs. 40K, 54C). Shell 2.92–3.58 mm in height, 1.56–1.86 mm in width; spire elongate to average length; aperture 0.93–1.21 mm in height, 0.91–1.12 mm in width. Body whorl 1.82–2.18 mm in height. Teleoconch of 4.45–5.00 slightly convex whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent to opaque. *Holotype dimensions*: SH, 3.58 mm; SW, 1.80 mm; AH, 1.14 mm; TW, 4.55 whorls. *Operculum*. Operculum 0.88–1.08 mm in height, 0.65–0.77 mm in width, with 3–7 pegs. *Radula*. Central teeth: with 6 lateral cusps, median cusp of medium width, 4 pairs of

basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 23–27 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 38–40 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout with pigment well developed around edges; head, neck, foot and opercular lobe pigmentation well to poorly developed; pallial roof and visceral coil with pigment well developed to mottled. Columellar muscle of moderate size to large. *Non-genital anatomy*. Ctenidium with 23–26 filaments. Osphradium elongately oval, between posterior end and middle of ctenidium. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; intermediate in thickness. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.4–1.5 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed in cross section. Pallial vas deferens flush with surface, longitudinally S-shaped at prostate, slightly to strongly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis attached at slightly to right side of head; pigmented on all areas except base to all over. *Female reproductive system* (Fig. 55C). Ovary lobulate, about 1.0–1.1 whorls. Coiled oviduct with initial U orientated obliquely backwards to longitudinally backwards; initial loop medium; proximal part inverted U-shape; one to two bends distal to seminal receptacle. Coiled oviduct and bursal duct join well behind posterior pallial wall. Bursal duct with twist. Oviduct joining bursal duct ventrally. Oviduct straight just before bursal duct joins. Seminal receptacle on middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, end rounded, duct short. Rectum overlapping albumen gland and separate from to overlapping capsule gland. More than $\frac{1}{2}$ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end blunt, compressed-oval in cross section, with distinct glandular zones. Ventral channel distinct, with moderate sized muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a few small streams within the vicinity of Table Cape, central northern Tasmania (Fig. 57). It is typically found on weeds, leaves, roots and stones and can be common.

Remarks. This species is sympatric with *A. lochi*, from which it can be distinguished by its much larger, broader shell and slightly more convex whorls. It differs from the other members of Group 4 found in Tasmania in its larger shell which has a more elongate spire and slightly convex whorls. Overall, the shell of *A. praecipitis* does not closely resemble any other taxa.

In the discriminant analysis specimens of *A. praecipitis* were well discriminated, with only three individuals misidentified as *A. praecipitis* (2) and *A. procerus* (1) (overall 84% correct). When the analysis was restricted to Group 4, 84% were correctly classified, with the same misclassifications.

Etymology. *Praecipitium* Latin: a steep place, cliff—alludes to the type locality.

Austropyrgus procerus n.sp.

Figs. 40D, 54D, 55D

Type material. Holotype C.343061, figured paratypes C.343062 (3), paratypes C.201573 (20+), C.371718 (5), TMH E.23433 (6), QVM 9:17069 (6).

Type locality. Blizzards Ck at Youngs Rd, S of Irishtown, in seeping gully, Tasmania, 40°56.55'S 145°08.98'E, on wood, leaves and stones, 9 February 1989.

Other material examined. Tasmania: Montagu R, C.169003; Allen Ck at Youngs Rd, C.204101; Blizzards Ck at Lileah-Spinks Hill Rd, C.204103; Duck R at Poilinna Rd, W of Edith Creek, C.201080; Birthday Ck at Scotchtown Rd, C.201368, C.201070, C.201369, C.201034, C.201370, C.201029; trib of Duck R, 3 km S of Edith Creek, C.203804; Duck R at Trowutta Rd and Brodies Rd junction, S of Smithton, C.201079, C.201375; trib of Duck R at Trowutta Rd, just S of Roger River, C.203784; Duck R, MV F.88892; trib of Williamsons Ck at Trowutta Rd, 1 km S of Roger River, C.201032, Arthur R, C.169006, C.169008, C.204029, TMH E.9923; mouth of Arthur R at Arthur River Rd, C.201551; creek 2.35 km from junction with Leensons Rd along Sumac Rd, C.201374; small stream S of Arthur River near Kanunnah Bridge, C.201084; Keppel Ck, 5.3 km SE of Kanunnah Bridge, C.201373; Julius R at Sumac Rd, C.201104, C.201092, C.371650, C.371679, C.201575; Sumac Rivulet at rd to Kanunnah Bridge, C.204051; creek at Blackwater Rd, 10 km S of Kanunnah Bridge, C.201091.

Diagnosis. Differs from other members of Group 4 in the following combination of characters: shell narrow, with elongated spire; large columellar muscle; osphradium near middle of ctenidium; pallial vas deferens strongly undulating or longitudinally S-shaped at prostate.

Description. *Shell* (Figs. 40D, 54D). Shell 2.60–3.28 mm in height, 1.28–1.67 mm in width; spire elongate; aperture 0.81–1.12 mm in height, 0.75–0.95 mm in width. Body whorl 1.52–1.99 mm in height. Teleoconch of 4.40–5.00 flattened whorls, last whorl and base evenly convex. Inner lip of aperture firmly adhering to parietal wall to in partial contact or narrowly separated from parietal wall, outer lip heavily thickened, without reflection. Colour yellow-brown, translucent. *Holotype dimensions*: SH, 2.95 mm; SW, 1.48 mm; AH, 1.02 mm; TW, 4.75 whorls. *Operculum*. Operculum 0.76–0.97 mm in height, 0.54–0.69 mm in width, with 2–5 pegs. *Radula*. Central teeth: with 5–6 lateral cusps, median cusp of medium width, 3–4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 4–5 lateral cusps, median cusp less than twice as long as adjacent cusps. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with 24–28 cusps, ratio of cutting edge to shaft about $\frac{1}{3}$, outer marginal teeth with 32–36 cusps, ratio of cutting edge to shaft about $\frac{1}{4}$. *Head-foot*. Cephalic tentacles pigmented with unpigmented median dorsal stripe; snout with pigment well developed to just around edges; head, neck and foot pigmentation well to poorly developed; opercular lobe with poorly developed pigmentation; pallial roof and visceral coil with pigment mottled to poorly developed. Columellar muscle large. *Non-genital anatomy*. Ctenidium with 22–26 filaments. Osphradium elongately oval; near middle of ctenidium. Hypobranchial gland moderately developed; covers rectum. Rectum without arch to with slight arch. Renal gland about $\frac{1}{2}$ in pallial roof; thin. Pericardium more than $\frac{1}{2}$ in pallial roof. *Male reproductive system*. Testis of 1.4–1.5 whorls. Prostate gland about $\frac{1}{2}$ in pallial roof, kidney-shaped, compressed to highly compressed in cross section. Pallial vas deferens flush with surface, strongly undulating or longitudinally S-shaped at prostate, strongly undulating between prostate and penis, strongly undulating at base of penis. Penis attached at slightly to right side of head; with pigmentation absent or on medial section only. *Female reproductive system* (Fig. 55D). Ovary lobulate, about 1.0–1.5 whorls. Coiled oviduct with initial U orientated dorsoventrally to longitudinally backwards; initial loop short; proximal part inverted U-shape; one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursal duct parallel sided and straight or with twist. Oviduct joining bursal duct from right side. Oviduct straight just before bursal duct joins. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix. Seminal receptacle pyriform, end rounded, duct short.

Rectum overlapping albumen and capsule glands. More than ½ of albumen gland in front of posterior pallial wall. Capsule gland with anterior end tapering, compressed-oval to elongately-oval in cross section, with distinct glandular zones. Ventral channel distinct, with indistinct muscular vestibule. Genital opening small; overlapping anterior end of capsule gland.

Distribution and habitat. This species is known from a number of small streams and rivers of northwestern Tasmania (Fig. 57). It is typically found on leaves, roots, wood and stones and can be locally very common.

Remarks. Throughout its currently recognized range this species is found in sympatry with one of four other species of *Austropyrgus* (*A. rectoides*, *A. conicus*, *A. lochi* and *A. stevensmithi*). It can be distinguished from *A. lochi*, *A. stevensmithi* and *A. conicus* by its larger, broader shell that has straight-sided whorls, and from *A. rectoides* by its smaller, narrower shell. The only other similar species in Group 4 is *A. tateiformis* from which it can be distinguished by its shorter spire, smaller number of whorls and broader shape. In addition the ctenidium abuts the pericardium, whereas in *A. tateiformis* the ctenidium is separated from the pericardium by a short efferent branchial blood vessel.

In the discriminant analysis all specimens of *A. procerus* were correctly identified.

Etymology. *Procera* Latin: tall, slender, long—refers to the elongate spire of this species.

Group 5. *Austropyrgus elongatus* group

Medium sized shells, with very elongate spires, straight outline and convex whorls. Coiled oviduct with one or more bends, loops or twists.

The following characters are common to members of Group 6: Translation of shell with aperture slightly disjunct, last whorl and base evenly convex. Outer lip weakly thickened. Colour yellow-brown. Median cusp of central teeth of medium width, sharply pointed and about twice as long as adjacent cusps. Median cusp of lateral teeth of medium width and sharply pointed. Basal projection of lateral teeth bluntly pointed. Inner marginal teeth with ratio of cutting edge to shaft about ⅓ and about ¼ for outer marginal teeth. Osphradium elongately oval, between posterior end and middle of ctenidium. Anus intermediate in position. Renal gland oval. Seminal vesicle conspicuously coiled on both digestive gland and testis behind stomach. Prostate gland about ½ in pallial roof, oval in shape and compressed in cross section. Pallial vas deferens flush with surface. Penis attached slightly to right side of head, distal end long and tapering. Ovary lobulate. Oviduct joins bursal duct from right side, oviduct straight just before bursal duct joins. Seminal receptacle with rounded end. More than ½ of albumen gland in front of posterior pallial wall. Anterior end of capsule gland blunt, capsule gland with indistinct glandular zones; female genital opening overlaps anterior end of capsule gland.

In a discriminant analysis restricted just to the two taxa in this group, all were correctly classified.

Austropyrgus elongatus (May, 1921)

Figs. 4E, 6F, 7O,P, 58B, 59B, 60A, 61A

Potamopyrgus elongatus May, 1921a: 72, pl. 11, fig. 21.

Potamopyrgus elongatus.—May, 1921b: 55; May, 1923: 54–55, pl. 25, fig. 30.

Pupiphryx elongatus.—Iredale, 1943: 202; May, 1958: 29, pl. 25, fig. 30.

Fluvidona elongatus.—Smith, 1992: 46.

Type material. Holotype TMH E.472/781 (Fig. 4E), paratypes SAMA D15770 (7), MV F.30454 (1).

Type locality. Apsley River, near Bicheno, Tasmania.

Material dissected and figured. C.392382 (figured specimens), Apsley River at Lilla Villa Bridge, Tasman Hwy, SW. of Bicheno, Tasmania, 41°53.837'S 148°15.313'E, on and under stones, 13 February 1995.

Other material examined. Tasmania: Apsley R at Tasman Hwy, C.201031, TMH E.9955; Apsley R at Coles Bay Rd, near Bicheno, C.201561.

Diagnosis. Differs from the other member of Group 5 in the following combination of characters: shell medium in size, spire very elongated, more convex whorls; 4 pairs of basal cusps on central teeth; ctenidium with short efferent branchial blood vessel connecting it to pericardium.

Description. *Shell* (Figs. 4E, 58B, 59B, 60A). Shell 2.25–3.42 mm in height, 1.19–1.54 mm in width; aperture 0.68–1.09 mm in height, 0.72–0.91 mm in width. Body whorl 1.41–1.77 mm in height. Teleoconch of 4.25–6.15 convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall, outer lip with very slight reflection. Shell translucent. *Operculum.* Operculum 0.70–0.79 mm in length, 0.46–0.62 mm in width, with 1–5 pegs. *Radula.* Central teeth: with 5–6 lateral cusps, 4 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges. Lateral teeth: with 6 lateral cusps, less than twice as long as adjacent cusps. Inner marginal teeth with 27–29 cusps, outer marginal teeth with 32–34 cusps. *Head-foot.* Cephalic tentacles pigmented, with unpigmented median dorsal stripe; rest of animal with pigmentation well developed. Columellar muscle of moderate size. *Non-genital anatomy.* Ctenidium with 21–26 filaments. Hypobranchial gland thick to moderately developed; covers rectum. Rectum without arch to with slight arch; faecal pellets orientated obliquely or transversely. Renal gland about ⅓ in pallial roof; thin to intermediate in thickness. Pericardium about ½ or more in pallial roof; ctenidium with short efferent branchial blood vessel to posterior end of ctenidium. *Male reproductive system* (Fig. 7O,P). Testis of 0.9–1.0 whorls. Seminal vesicle slightly undulated over stomach. Pallial vas deferens slightly undulating at prostate; strongly undulating between prostate and penis; strongly undulating at base of penis. Penis pigmented on all areas except base. *Female reproductive system* (Fig. 61A). Ovary about 1 whorl. Coiled oviduct with initial U orientated dorsoventrally to obliquely backwards; initial loop medium to short; proximal part with 1–2 or more bends, loops or twists, one bend distal to seminal receptacle. Coiled oviduct and bursal duct join just behind pallial wall. Bursa copulatrix elongately oval. Bursal duct very short. Seminal receptacle at anterior edge to middle of inner wall of bursa copulatrix, ovoid to pyriform in shape, duct short. Rectum overlapping to indenting albumen gland and overlapping capsule gland. Capsule gland broadly-oval in cross section. Ventral channel indistinct, with indistinct muscular vestibule. Genital opening small.

shell dimensions:	SH	SW	AH	TW
holotype	3.21	1.46	0.89	6.15
paratypes SAMA D.15770	2.25–3.08	1.19–1.41	0.68–0.84	5.70–5.90
figured SEM specimen	3.08	1.30	0.86	5.25

May's original measurements were given as 3 mm by 1 mm.

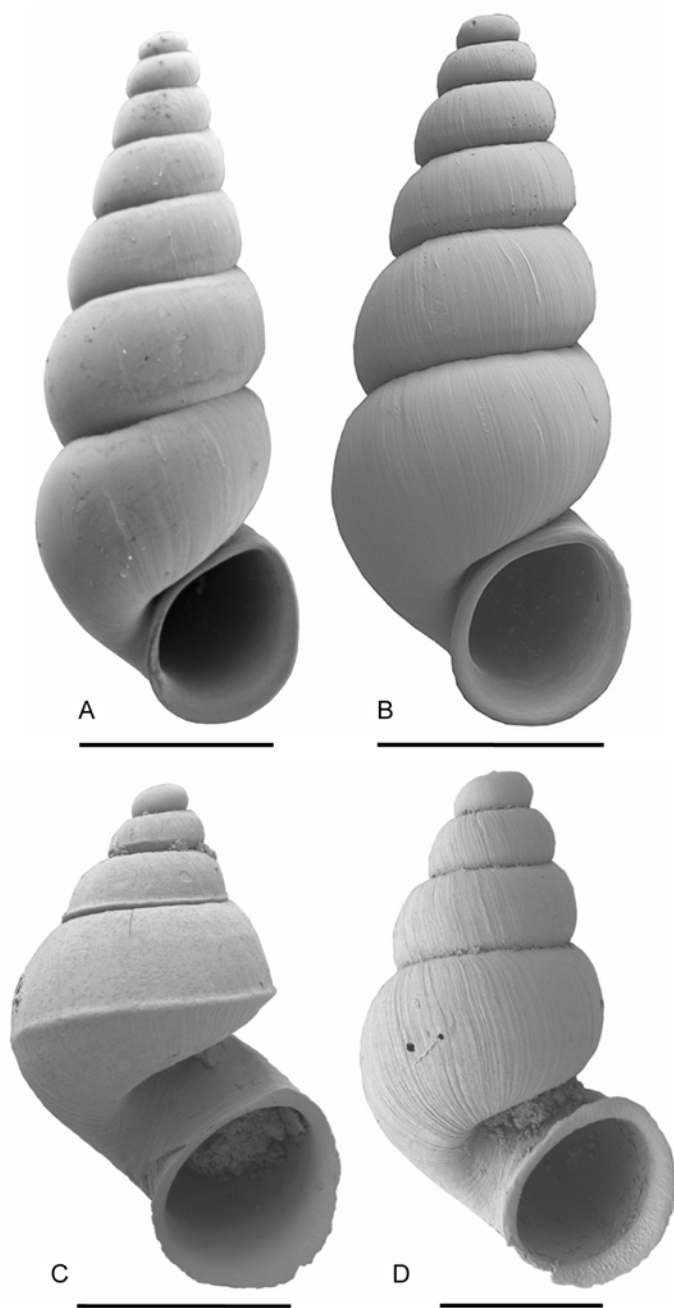


Fig. 58. A, *Austropyrgus eumekes*, holotype, C.334594; B, *A. elongatus*, C.392382; C, ?*Austropyrgus* sp., C.343046; D, *A. vastus*, holotype, C.343047. Scales A–C 1 mm; D 0.5 mm.

Distribution and habitat. This species is currently only known from a single location on the Aspley River, south of Bicheno, eastern Tasmania (Fig. 62). It is typically found on weeds, leaves, roots and stones and can be very common.

Remarks. This species is found in sympatry with *A. colludens* from which it is distinguished by its more elongated spire. *Austropyrgus elongatus* is similar to *A. eumekes* from western Victoria, from which it differs in a number of characters: shell broader, with more convex whorls, radula with 4 pairs of basal cusps on the central teeth (3 in *A. eumekes*) and the ctenidium has a short efferent branchial blood vessel separating it from the pericardium (abutting in *A. eumekes*) and the rectum overlaps the capsule gland (separate in *A. eumekes*). To date no other similar taxa have been located in the intervening area and, although further work in the area may reveal additional populations of this species, it is likely to remain with a restricted range.

In the discriminant analysis involving all taxa, all specimens were correctly identified.

Austropyrgus eumekes n.sp.

Figs. 58A, 59A, 61B

Type material. Holotype C.334594, figured paratypes C.307577 (3), paratypes C.174664 (20+), MV F.82350 (3).

Type locality. Darlot Ck at Princes Hwy, E of Portland, Victoria, 38°13.27'S 141°46.12'E, in deep, weedy stream, 5 March 1977.

Other material examined. Victoria: Darlot Ck at Princes Hwy, C.302423, SAMA D.19210; Darlot Ck just S of Ettrick, C.302415.

Diagnosis. Differs from the other member of Group 5 in the following combination of characters: shell narrower; whorls slightly convex; central radular teeth with 3 pairs of basal cusps; ctenidium abuts pericardium.

Description. *Shell* (Figs. 58A, 59A). Shell 2.72–3.60 mm in height, 1.10–1.42 mm in width; aperture 0.70–0.92 mm in height, 0.62–0.85 mm in width. Body whorl 1.31–1.75 mm in height. Teleoconch of 5.20–6.10 slightly convex whorls. Inner lip of aperture in partial contact or narrowly separated from parietal wall to distinctly separated from parietal wall, outer lip without reflection. Shell translucent to opaque. *Holotype dimensions:* SH, 3.20 mm; SW, 1.22 mm; AH, 0.79 mm; TW, 6.10 whorls. *Operculum.* Operculum 0.61–0.79 mm in height, 0.44–0.53 mm in width, with 1–4 pegs. *Radula.* Central teeth: with 3–5 lateral cusps, 3 pairs of basal cusps. Basal tongue U-shaped, just protruding past ends of lateral edges to U-shaped, not protruding past ends of lateral edges. Lateral teeth: with 4–6 lateral cusps, about twice as long as adjacent cusps. Inner marginal teeth with 16–27 cusps, outer marginal teeth with 31–38 cusps. *Head-foot.* Animal unpigmented. Columellar muscle small. *Non-genital anatomy.* Ctenidium with 19–22 filaments. Hypobranchial gland appears to be absent to thick; not covering rectum when visible. Rectum without arch to with slight arch; faecal pellets orientated longitudinally. Renal gland about $\frac{1}{4}$ – $\frac{1}{3}$ in pallial roof; thin to intermediate in thickness. Pericardium about $\frac{1}{3}$ – $\frac{1}{2}$ in pallial roof; ctenidium abutting anterior end. *Male reproductive system.* Testis of 1.0–1.5 whorls. Seminal vesicle tightly coiled over stomach. Pallial vas deferens straight to strongly undulating at prostate, straight to slightly undulating between prostate and penis, slightly to strongly undulating at base of penis. Penis not pigmented. *Female reproductive system* (Fig. 61B). Ovary about 1.1–1.5 whorls. Coiled oviduct with initial U orientated obliquely backwards; initial loop long; proximal part with two or more bends, loops or twists; one to two bends distal to seminal receptacle. Coiled oviduct and bursal

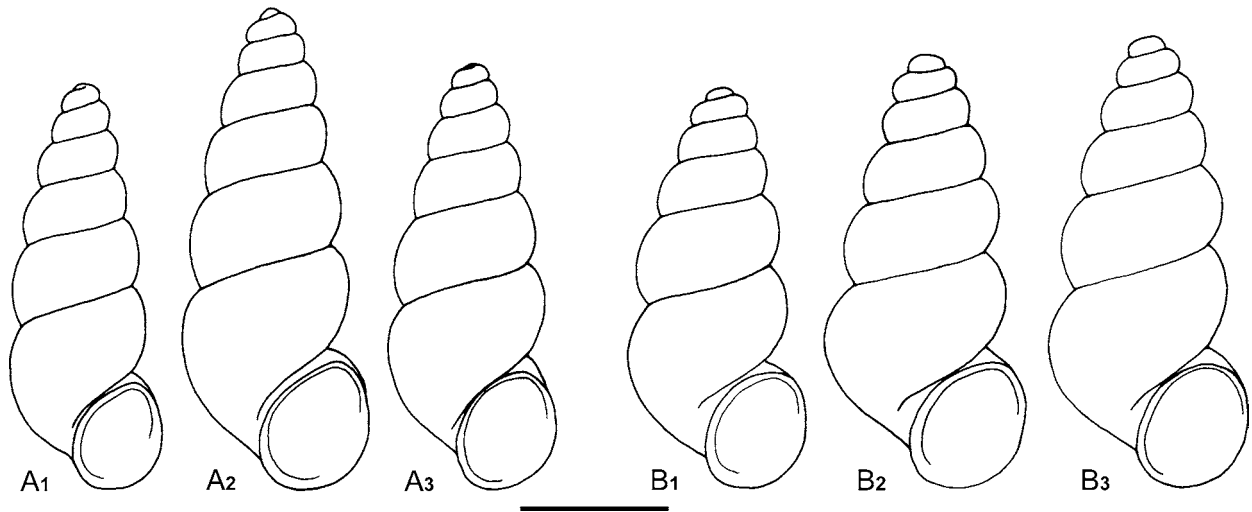


Fig. 59. Shells of species of *Austropyrgus*: A, *A. eumekes*, paratypes, C.307577; B, *A. elongatus*, C.392382. Scale 1 mm.

duct join at posterior pallial wall. Bursa copulatrix elongately oval to ovoid. Bursal duct very short or parallel sided and straight. Seminal receptacle overlapping anterior edge of bursa copulatrix to at anterior edge of bursa copulatrix, pyriform in shape, duct short to medium length. Rectum indenting albumen gland and separated from capsule gland. Capsule gland broadly-oval to compressed-oval in cross section. Ventral channel distinct, with moderate sized to large, obvious muscular vestibule. Genital opening small to medium length.

Distribution and habitat. This species is currently known only from the only two locations along Darlot Creek, western Victoria (Fig. 62). It is typically found on weeds, leaves, roots and stones and can be extremely abundant.

Remarks. This species is found in sympatry with *A. latus* and *A. vulgaris*. Its shell is separable from both these species in having a much more elongated spire (i.e. narrower shape), and more rounded whorls. Although further work in the area may reveal additional populations of this species, collecting in the area to date suggests that its overall range will not increase markedly. It is similar to *A. elongatus* (see remarks under *A. elongatus*).

In the discriminant analysis involving all taxa, all specimens were correctly identified except for one as *A. tateiformis*.

Etymology. *Eumekes* Greek: of good length, tall—refers to the elongated spire of this species.

Group 6. Sinkhole Group

This group consists of two small to medium sized taxa that have the last whorl of the shell widely separated from the parietal wall.

Austropyrgus vastus n.sp.

Figs. 58D, 60B, 63B

Type material. Holotype C.343047, figured paratypes C.307589 (3), paratypes C.200979 (20+), SAMAD.19211 (3).

Type locality. One Tree Sinkhole (= Wurwurlooloo 5L7), near Mt Gambier, South Australia, 37°49.98'S 140°46.98'E, cave, 47m deep, in fine silt/mud, 9 February 1988.

Diagnosis. Differs from all species of *Austropyrgus* in having rounded periphery of last whorl and last whorl separated.

Description. *Shell* (Figs. 58D, 63B, 60B). Shell 1.44–1.76 mm in height, 0.87–1.08 mm in width; spire elongate to average length, outline straight, last ½ whorl disjunct, aperture 0.51–0.66 mm in height, 0.51–0.58 mm in width. Body whorl 1.00–1.26 mm in height. Teleoconch of 3.05–3.50 convex whorls, last whorl and base evenly convex. Inner lip of aperture widely separated from parietal wall, outer lip weakly thickened, with reflection. Colour white to very pale yellow, opaque (true colour

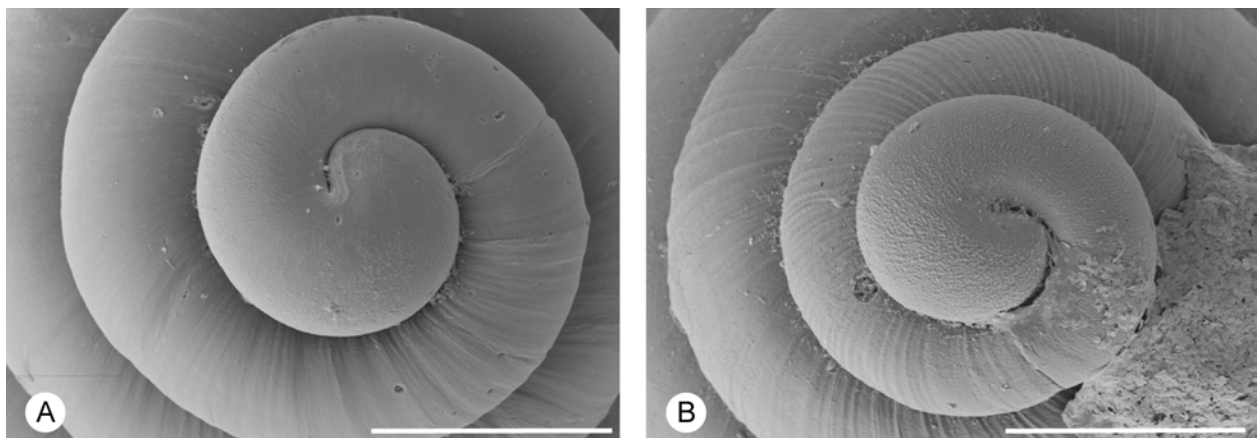


Fig. 60. Protoconchs of species of *Austropyrgus*: A, *A. elongatus*, C.392382; B, *A. vastus*, C.200979. Scales 0.2 mm.

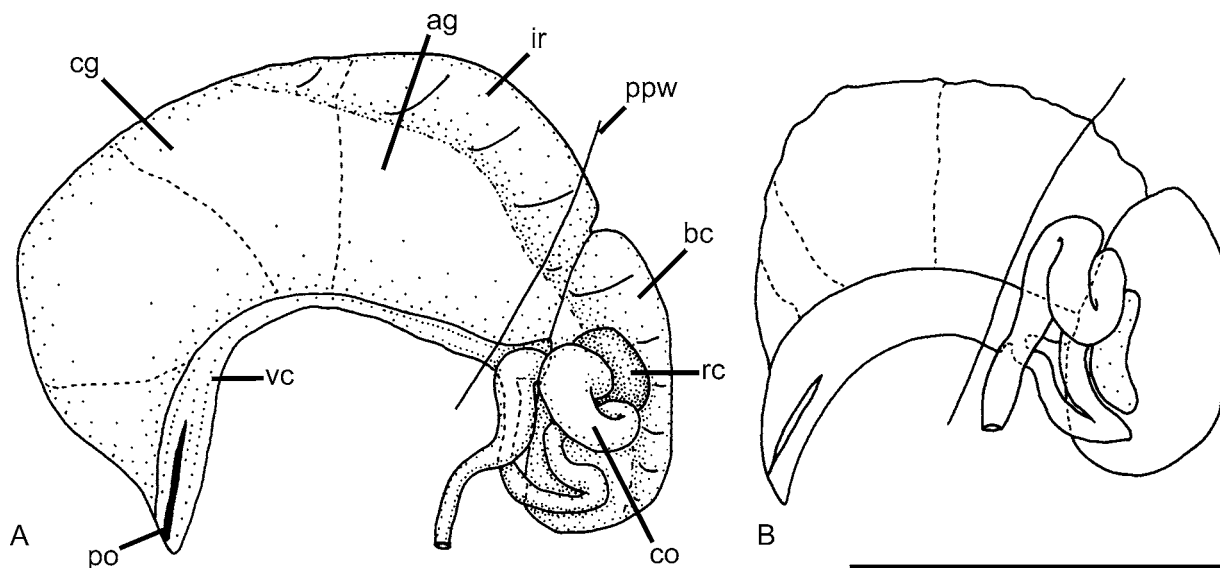


Fig. 61. Female genitalia of species of *Austropyrgus*: A, *A. elongatus*, C.392382; B, *A. eumekes*, C.174664. Scale 0.5 mm, see p. 5 for abbreviations.

probably translucent in life, however available material long dead). *Holotype dimensions*: SH, 1.52 mm; SW, 0.94 mm; AH, 0.56 mm; TW, 3.25 whorls. Operculum, radula and anatomy unknown.

Distribution and habitat. This species is currently only known from a sinkhole near Mt Gambier, southeastern South Australia (Fig. 62), from empty shells.

Remarks. This species was found together with the unnamed species of *?Austropyrgus* sp. described below, which is also only known from empty shells. *Austropyrgus vastus* is somewhat tentatively placed in the genus *Austropyrgus* pending the examination of anatomical material. It is named because of its very distinctive shape, which matches no other within the genus. It is probable that with further work in the area additional populations will be found.

Etymology. *Vastus* Latin: empty, desolate—refers to the fact that only empty shells have been found for this species.

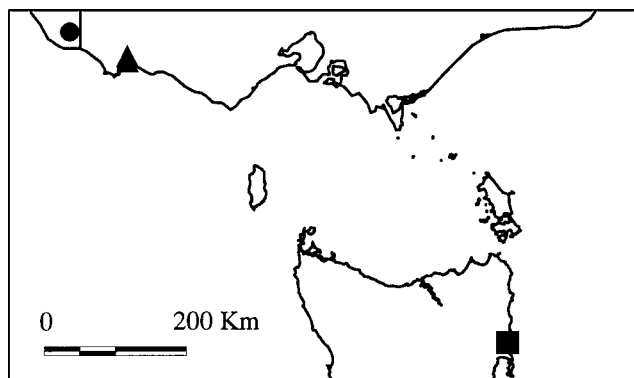


Fig. 62. Distribution of *Austropyrgus vastus* ●, *A. eumekes* ▲ and *A. elongatus* ■.

?Austropyrgus sp.

Figs. 58C, 63A

Material examined. South Australia: C.343046, C.307580 (figured specimens); C.200977, C.200976, One Tree Sinkhole (= Wurwurlooloo 5L7), near Mt Gambier, South Australia, 37°49.983'S 140°46.983'E, cave, 47m deep, in fine silt/mud., 9 February 1988.

Diagnosis. Differs from all species of *Austropyrgus* in having keeled periphery of last whorl and last whorl separated.

Description. *Shell* (Figs. 58C, 63A). Shell 2.19–2.63 mm in height, 1.38–1.71 mm in width; spire of average length, outline straight; last ½ whorl disjunct, aperture 0.87–1.11 mm in height, 0.85–1.04 mm in width. Body whorl 1.68–1.93 mm in height. Teleoconch of 3.25–4.00 flattened whorls, last whorl and base strongly angled [keeled similar to *Posticobia brazieri*]. Inner lip of aperture widely separated from parietal wall, outer lip weakly thickened, with reflection. Colour white to very pale yellow, opaque (true colour probably translucent in life, however available material long dead). SEM specimen dimensions: SH, 2.23 mm; SW, 1.48 mm; AH, 0.93 mm; TW, 3.25 whorls. Operculum, radula and anatomy unknown.

Distribution and habitat. This species is currently only known from a sinkhole near Mt Gambier, southeastern South Australia, from empty shells.

Remarks. This species was found together with *A. vastus*, which is also only known from empty shells. It has been placed tentatively in *Austropyrgus* but has not been named despite its very distinctive shape because it is possible that it may be an ecophenotype of *Posticobia brazieri*, known to occur in a few localities in South Australia, mainly in the southeast (Clark, 1997). In the absence of anatomical material (to date no living populations have been located) we prefer to leave this taxon unnamed.

This taxon is found in a sinkhole near Mt Gambier, southeastern South Australia. The only other species from this location also has the last whorl separated from the body of the shell. This character very rarely occurs in species of Australian hydrobiids, with the exception of two species found in the springs of the Great Artesian Basin of Queensland, *Jardinella isolata* and *J. corrugata* (Ponder & Clark, 1990).

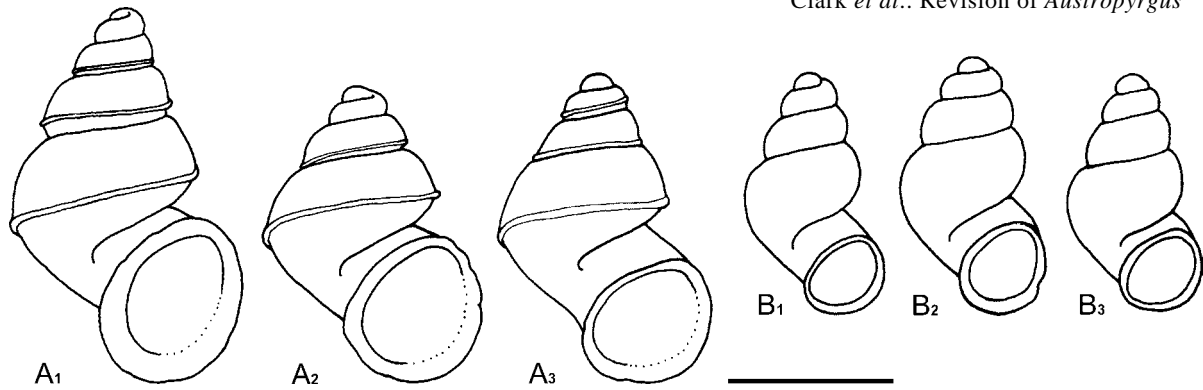


Fig. 63. Shells of species of *Austropyrgus*: A, ?*Austropyrgus* sp., C.307580; B, *A. vastus*, paratypes C.307589. Scale 1 mm.

Discussion

As with the *Beddomeia* group (Ponder *et al.*, 1993), Tasmania has the highest diversity of *Austropyrgus*, with 30 species distributed among five of the six recognized informal species groups. All of the members of Group 2 (*A. petterdianus* Group) are endemic to Tasmania. In western and northern Tasmania, species of *Austropyrgus* are often found in sympatry, as well as occurring with species of *Beddomeia*, *Phrantela* and the introduced hydrobiid *Potamopyrgus antipodarum*. In coastal localities, the brackish-water species *Ascorhis tasmanicus* is sometimes found with *Austropyrgus*. The next most diverse region for *Austropyrgus* is the southwestern corner of Victoria and the southeastern corner of South Australia, with 14 currently recognized taxa. Here again it is common for two to four species of *Austropyrgus* to be found in sympatry and species can co-occur with *Ascorhis tasmanicus* and *Potamopyrgus antipodarum*. The diversity decreases east of the Otway Ranges and into southern and central New South Wales where only a single species of *Austropyrgus* frequents any one site. An exception is Wilsons Promontory, Victoria, where *A. turbatus* and *A. rectus* occur in sympatry in a few locations (Ponder *et al.*, 1994).

Typically, when species of *Austropyrgus* occur in sympatry, they can be readily separated (e.g., *A. elongatus* occurs with *A. colludens* and *A. pusillus* with *A. tumidus*). However, between localities, the differences are often more subtle and it is this apparent lack of morphological distinctiveness within *Austropyrgus*, that makes it very likely that additional allopatric taxa are yet to be recognized. In their study of *Austropyrgus* from Wilsons Promontory, Ponder *et al.* (1994) found that in some populations there existed non-interbreeding genetically distinct but morphologically indistinguishable species (also see introduction). Genetic variation was high among populations of the same genetically defined cryptic species—even in those populations found in the same stream or in different tributaries of the same catchment. Although this genetic differentiation was accompanied by some morphological variation, patterns in anatomy and shell morphology could not be correlated with either geographic distribution or genetic similarity. If this pattern is typical for *Austropyrgus* in other areas, the number of genetically distinguishable taxa is likely to be higher than those distinguished morphologically. Work is in progress to test species concepts in southern New South Wales and in western Victoria using molecular data. These and similar studies will undoubtedly refine the species taxonomy proposed herein.

From central New South Wales north to central Queensland, *Austropyrgus* appears to be replaced by the closely related hydrobiid *Posticobia brazieri* and, in a few places, the highly restricted species of *Fluvidona* (Miller *et al.*, 1999). Elsewhere on the mainland *Austropyrgus* is sympatric with *Posticobia brazieri* in a few scattered localities in South Australia (Clark, 1997). Throughout most of the range of the genus (although not in all localities) it can be found in sympatry with *Potamopyrgus antipodarum* (Ponder, 1988), especially where the habitat has been degraded. What impact, if any, *Potamopyrgus* may be having on the population dynamics of *Austropyrgus* is unknown, but it is apparent from field observations that in disturbed situations the introduced taxon is much more abundant and may even be replacing *Austropyrgus* in some locations.

In southern New South Wales and eastern Victoria there appear to be some morphological and anatomical patterns that can be roughly correlated with altitude. Here the highland species are pupiform in shape and females have a simple inverted U-shaped coiled oviduct (*A. cooma* Group). Lowland species are conical in shape and females have a more complexly looped coiled oviduct (part of the *A. sparsus* Group). West of Melbourne this pattern breaks down in the lowlands, but the highland pupiform pattern is maintained west to the Grampians.

Many species of hydrobiids from “ordinary” forested habitats where permanent springs or streams occur have restricted distributions, this being particularly true for species in the *Beddomeia* group (Ponder *et al.*, 1993). Only 38 (51%) of the species of the southeastern *Austropyrgus* radiation have very restricted ranges (< 10 km²), compared with 60 (94%) in the *Beddomeia* group. This difference may in part be explained by the greater morphological (shell and anatomical) diversity in the latter group making species distinction easier and in part to different habits in the two groups (Ponder & Colgan, 2002). Many species of the *Beddomeia* group are uncommon and live under stones, wood etc., some being very cryptic. In contrast, many *Austropyrgus* species are abundant and often crawl on the surface of leaves, weed, rocks etc. thus providing more opportunities for chance dispersal by birds, floods etc.

The majority of the taxa reviewed above have restricted to highly restricted distributions and this means that many of them are of conservation concern. Currently, Tasmania is the only Australian state that lists any species of hydrobiid on its threatened species lists. The primary conservation management strategy to maintain the genetic and morphological diversity of the group is to prevent the degradation and or removal of the native riparian zone. In

addition to minimise or prevent runoff and siltation from forestry, mining, agriculture and urban areas.

The limited genetic data available for *Austropyrgus* suggest that there is a relatively large amount of genetic differentiation between populations even at very short distances. One likely model of speciation is that this group, with poor dispersal abilities, occasionally successfully colonizes new or recently vacated habitat niches within its preferred environmental tolerances and, because of low levels of gene flow, genetic changes occur through adaptation or genetic drift.

The phylogenetic relationships of the species of *Austropyrgus*, and hence their phylogeography, remain unknown. Cladistic analyses was undertaken using PAUP* (Swofford, 1998) and a modified version of the data provided herein. Although *Austropyrgus* was shown to be monophyletic in most of the analyses, the resolution within the genus was very poor with topologies very poorly supported. For this reason, these results are not presented here. Given the small morphological differences between taxa and considerable homoplasy in most morphological characters, the resolution of phylogenetic relationships within the genus must await the availability of molecular data.

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Appendix: Non-shell characters used in the descriptions

Operculum

- 1 Number of pegs.
- 2 Proportion of opercular length occupied by pegs.

Radula

- 3 Number of lateral cusps on central teeth.
- 4 Number of pairs of basal cusps on central teeth.
- 5 Number of cusps on inner side of marginal teeth.
- 6 Number of cusps on inner marginal teeth.
- 7 Number of cusps on outer marginal teeth.

Head foot

- 8 Pigmentation of cephalic tentacles: 1, absent; 2, poorly developed and uniform; 3, well developed and uniform; 4, pigmented, with unpigmented median dorsal stripe; 5, pigment on basal portion only; 6, pigmented dorsal central stripe only; 7, poorly-developed dorsal central stripe.
- 9 Pigmentation of snout: 1, absent; 2, poorly developed and uniform; 3, well developed and uniform; 4, laterally only, well developed; 5, laterally only, poorly developed; 6, pigmented only along midline.
- 10 Pigmentation of foot: 1, well developed; 2, poorly developed; 3, absent.
- 11 Pigmentation of opercular lobe: 1, well developed; 2, poorly developed; 3, absent.
- 12 Pigmentation of head and neck: 1, well developed; 2, poorly developed; 3, developed on sides of neck only; 4, absent.
- 13 Pigmentation of pallial roof: 1, well developed; 2, mottled; 3, poorly developed; 4, absent.
- 14 Pigmentation of visceral coil: 1, densely pigmented, mostly black or dark grey; 2, mottled—some areas darkly pigmented; 3, weakly pigmented; 4, absent.

Pallial cavity

- 15 Ctenidium—number of filaments.
- 16 Osphradium—position relative to gill: 1, near posterior end of ctenidium; 2, between posterior end and middle of ctenidium; 3, near middle of ctenidium.
- 17 Hypobranchial gland—development: 1, thick and conspicuous; 2, moderately developed; 3, very reduced to absent.
- 18 Hypobranchial gland—relative to rectum: 1, not on rectum; 2, partly covering rectum; 3, covers rectum.
- 19 Rectum shape: 1, without arch; 2, with slight arch; 3, with short S-shape; 4, with prominent arch.
- 20 Renal organ—proportion in pallial cavity: 1, behind pallial cavity; 2, c. $\frac{1}{4}$ (or less) in pallial cavity; 3, c. $\frac{1}{3}$ (or less) in pallial cavity; 4, c. $\frac{1}{2}$ (or less) in pallial cavity.
- 21 Pericardium—proportion in mantle roof: 1, up to $\frac{1}{3}$ in pallial roof; 2, about $\frac{1}{2}$ in pallial roof; 3, more than $\frac{1}{2}$ in pallial roof.
- 22 Pericardium—relationship with ctenidium: 1, ctenidium overlapping anterior end by one filament; 2, ctenidium abutting anterior end; 3, ctenidium with short efferent branchial vessel to posterior end of ctenidium.

Male genital system

- 23 Testis—number of whorls.
- 24 Pallial vas deferens—coiling at prostate gland: 1, straight; 2, slightly undulating; 3, strongly undulating; 4, with overlying loops/coils; 5, longitudinally S-shaped; 6, with several coils.
- 25 Pallial vas deferens coiling between prostate and penis: 1, straight; 2, slightly undulating; 3, strongly undulating; 4, longitudinally S-shaped; 5, with several coils.
- 26 Pallial vas deferens—coiling at base of penis: 1, straight; 2, slightly undulating; 3, strongly undulating.
- 27 Penis—pigmentation: 1, absent; 2, on medial section only; 3, on all areas except base; 4, all over; 5, on basal section only.

Female genital system

- 28 Ovary—number of whorls.
- 29 Coiled oviduct—shape of proximal part: 1, inverted U-shape; 2, flattened inverted U-shape; 3, one bend, loop or twist; 4, two or more bends, loops or twists.
- 30 Oviduct distal to seminal receptacle: 1, straight; 2, one bend; 3, two bends.
- 31 Coiled oviduct and bursal duct—point of connection: 1, at posterior pallial wall; 2, just in front of posterior pallial wall; 3, just behind pallial wall; 4, well behind posterior pallial wall.
- 32 Bursa copulatrix—shape: 1, pyriform to triangular; 2, ovoid.
- 33 Bursal duct—shape: 1, parallel sided and straight; 2, wider at bursal end; 3, very short; 4, with bend pointing downwards; 5, with bend pointing upwards; 6, wider at junction with distal coiled oviduct; 7, with a twist.
- 34 Point of joining of bursal duct to oviduct: 1, ventral; 2, on right side; 3, on left side.
- 35 Seminal receptacle—position relative to bursa: 1, overlapping anterior edge of bursa copulatrix; 2, at anterior edge of bursa copulatrix; 3, on middle of inner wall of bursa copulatrix; 4, at posterior edge of bursa copulatrix.
- 36 Seminal receptacle duct—length: 1, short; 2, medium; 3, long.
- 37 Albumen gland relative to rectum: 1, separate from albumen gland; 2, overlapping albumen gland; 3, indenting albumen gland.
- 38 Capsule gland relative to rectum: 1, separate from capsule gland; 2, overlapping capsule gland; 3, indenting capsule gland.
- 39 Albumen gland—proportion in pallial cavity: 1, $\frac{1}{4}$ or less of albumen gland in front of posterior pallial wall; 2, about $\frac{1}{3}$ of albumen gland in front of posterior pallial wall; 3, about $\frac{1}{2}$ of albumen gland behind posterior pallial wall; 4, more than half of albumen gland in front of posterior pallial wall.
- 40 Capsule gland—shape of anterior end: 1, tapering; 2, blunt; 3, rounded.
- 41 Vestibule size: 1, indistinct; 2, moderate-sized; 3, large, obvious.
- 42 Genital opening—shape: 1, small; 2, of medium length; 3, long.
- 43 Genital opening—position: 1, anterior to capsule gland; 2, overlapping anterior end of capsule gland; 3, terminal.

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