

# Towards a Systematic Revision of the Eastern Australian Land Snail *Austrochloritis* Pilsbry, 1891 (Eupulmonata, Camaenidae): Re-description of its Type Species, *A. porteri* (Cox, 1866)

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**ABSTRACT.** *Helix porteri* Cox, 1866 is the type species of *Austrochloritis* Pilsbry, 1891, a speciose genus of camaenid land snail with a known range in eastern Australia stretching from Wilson’s Promontory in Victoria to southeastern Queensland. This species was first described based on material from two locations in New South Wales, “Upper Clarence River at Guy Faux Station” and “Upper Richmond River, at Cowlong”. These two locations are about 230 km apart from each other while all type material is considered to be lost. Comparative morpho-anatomy of specimens collected in the proximity of both type localities shows that the original concept of *Helix porteri* is based on two distinct species. Here we designate a neotype for this species from the Upper Richmond River area and provide a detailed redescription in order to remove any ambiguity about the identity of *Austrochloritis porteri*. Material from the vicinity of the second site mentioned in the original description of *H. porteri*, Guy Fawkes Station, is identified as *Austrochloritis specularis* Shea & Griffiths, 2010. We describe key diagnostic features distinguishing both species.

## Introduction

*Austrochloritis* Pilsbry, 1891 is probably the most speciose land snail genus in eastern Australia comprising 34 currently accepted species (Stanisic *et al.*, 2010). These species are overall similar externally, having rather small, depressed and hairy shells of dull brown colour. Given their rather inconspicuous appearance, *Austrochloritis* species have historically not received the same attention of taxonomists that other land snail groups with more distinct looking shells may have enjoyed. Yet, the systematic concept of *Austrochloritis* has changed significantly since its original description. Still, the currently preferred classification introduced by Stanisic *et al.* (2010) is not without difficulties, which arise from the subjectivity and inconsistencies of 150

years of changing taxonomic treatments and the prevailing lack of critical anatomical and molecular phylogenetic data, which is essential to achieve a more objective systematic classification. *Austrochloritis* was described as a subgenus in *Chloritis* Beck, 1837, for the type species *Helix porteri* Cox, 1866, and has subsequently become a catch-all for uniform brownish bristle snails from eastern Australia and even New Guinea (e.g., Pilsbry, 1891: 262–265; Gude, 1906; Iredale, 1938; Zilch, 1966). Iredale (1933) argued that the presence of periostracal setae alone was not a sufficient character to unify all Australian “chloritids” under one genus name, let alone the New Guinean species, and successively allocated Australian species into several genera based on assessments of additional shell characters, such as protoconch sculpture, the elevation of the shell spire, and the size and shape of the

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shell. Iredale (1938) elevated *Austrochloritis* to full genus rank and recognized fourteen species as its members, whose combined distribution spanned the Australian east coast from Cape York to northern New South Wales. Subsequently, Iredale (1943) added three more species-group taxa with his usual casual flare. Anatomical data has been published on very few species so far, often associated with uncertain species identifications. Hedley (1890) first figured the jaw, radula and genitalia of what he considered to be *Helix porteri* from Upper Nerang Creek near Brisbane, Queensland (28°12'S 153°14'E). Pilsbry (1894) also published a drawing of the reproductive anatomy of this species without specifying the origin of the examined material. Much later, Solem (1979) presented a detailed description of the reproductive anatomy of what he identified as *Austrochloritis disjuncta* from the Barrington Tops and *A. victoriae* from Wilson's Promontory in Victoria. Based on his observations of a largely consistent reproductive anatomy in both species, Solem (1979) concluded that *Chloritobadistes* Iredale, 1933, which he considered to be *nomen nudum* for the lack of a diagnosis in the original description, was identical with *Austrochloritis*. In a molecular phylogeny of the eastern Australian Camaenidae, Hugall & Stanisc (2011) found *Austrochloritis* as delineated before 2010 to be polyphyletic. Anticipating this result, Stanisc *et al.* (2010) described several new genera, such as *Aetholitis* Stanisc, 2010 and *Trachygenia* Stanisc, 2010, to accommodate species that are phylogenetically clearly distinct from the type species *A. porteri*. However, the re-alignment of the genus boundaries has been proposed in spite of rather poor knowledge of the type species *A. porteri*. No type material is known to exist that might aid its correct identification while two distinct localities are given as type locality in the original description that are about 230 km apart from each other. According to the current systematic treatment by Stanisc *et al.* (2010), most *Austrochloritis* species are narrow-range endemics and based on the average size of species ranges in this genus it is unlikely that the two localities mentioned in the original description harbour the same species. It is therefore probable that the original description of *Helix porteri* was based on material representing more than a single species. In order to remove prevailing ambiguity about the identity of *Austrochloritis porteri*, we here designate a neotype and re-describe its morpho-anatomy as a first step towards a systematic revision of the entire genus.

## Materials and methods

This study is based on examination of relevant material housed in the collections of the Australian Museum in Sydney (AM) and the Queensland Museum in Brisbane (QM), including historic and newly collected material, both wet and dry.

A Leica MZ8 stereo microscope with a drawing apparatus was used to examine the reproductive anatomy of ethanol preserved samples by means of anatomical dissection. Bodies were removed from shells prior to dissection and shells were photographed. Shell height (H) and diameter (D) were measured with callipers accurate to 0.5 mm. We also counted the number of whorls (N) as shown by Köhler (2011). Selected shells were cleaned by gently brushing in warm soapy water, dried, mounted on carbon specimen tabs, and coated with gold for electron scanning microscopy.

## Abbreviations used

*Repositories*: AM, Australian Museum, Sydney; NHMUK, Natural History Museum, London (UK); NMV, National Museum of Victoria, Melbourne; QM, Queensland Museum, Brisbane; SMF, Naturmuseum Senckenberg, Frankfurt (Germany); ZMB, Museum für Naturkunde, Berlin (Germany). *Shell measurements*: D, diameter; H, height. *Geography*: Ck, creek; Hwy, highway; Mt, Mount; NP, National Park; nr, near; Rd, road; SF, State Forest.

## Systematics

### Gastropoda

### Stylommatophora

### Family Camaenidae Pilsbry, 1895

Genus *Austrochloritis* Pilsbry, 1891 (type species: *Helix porteri* Cox, 1866, by original designation).

*Austrochloritis* Pilsbry, 1891 (in Pilsbry, 1890–1891): 262–263; Pilsbry, 1894 (in Pilsbry, 1893–1895): 121–122, pl. 28, figs 1–2; Gude, 1906: 114–115; Iredale, 1938: 93–95, 1943: 64–65; Solem, 1979: 120–125, Smith, 1992: 116–118; Stanisc *et al.*, 2010: 378–392, 535–537, Stanisc *et al.* 2018: 258, 557.

### Taxonomic history

Originally described as infrageneric taxon in *Chloritis*, *Austrochloritis* was elevated to full genus rank by Iredale (1938). Next to the type species, *A. porteri* (Cox, 1866), Pilsbry's (1891) original definition of *Austrochloritis* included several eastern Australian species, such as *Helix spinei* Cox, 1868 (now *Mussonena spinei*), *H. mansueta* Reeve, 1854 (now *Moretonistes mansueta*), *H. blackalli* Brazier, 1875 (now *Gloreugenia blackalli*), *H. buxtoni* Brazier, 1880 (now *Patrubella buxtoni*), *H. brevipila* Pfeiffer, 1849 (now *Austrochloritis brevipila*), *H. aridorum* Cox, 1866 (now *Neveritis aridorum*) as well as two species from New Guinea (refer to Stanisc *et al.*, 2010 for the currently accepted taxonomy of eastern Australian Camaenidae). Subsequently, Gude (1906), Iredale (1938, 1943) and Stanisc *et al.* (2010) described additional species. Iredale (1938) and Stanisc *et al.* (2010) also transferred several species to other genera. Solem (1979) misidentified a then undescribed species of *Austrochloritis* as *Chloritobadistes victoriae* (Cox, 1868) and, based on this misidentification, considered *Chloritobadistes* Iredale, 1933 as a synonym of *Austrochloritis*. Rectifying this mistake, Stanisc *et al.* (2010, 2018) removed *Chloritobadistes* from the synonymy of *Austrochloritis* and described the mistaken and up till then unnamed species as *A. beecheyi* Shea & Griffiths, 2018. According to the latest taxonomic treatment of Stanisc *et al.* (2010, 2018), the genus comprises 34 currently accepted species. We agree with the Stanisc *et al.* (2010) treatment of *Chloritobadistes* as an available name in accordance with Art. 13.3 of the Code (ICZN 1999), because the original description of Iredale (1933: 49, 58) contains, although a very brief, diagnosis ("In shell features it agrees with the shells of "*Badistes*" = *Meridolum* ante, but bears hairs. It has a smooth apex...") as well as a type species designation.

## Diagnosis

*Shell.* Small to large in size ( $D = 14\text{--}24$  mm), subdiscoidal, subglobose, turbinate or trochoidal with almost flat to moderately elevated spire ( $H = 4\text{--}15$  mm), whorls rounded, shouldered, subangulate or keeled, sutures moderately to strongly impressed; umbilicus from moderately open to partially closed, with V-shaped profile; protoconch sculpture of dense to scattered pustulose radial ridges; teleoconch sculpture smooth or with regular radial corrugations and overlying low rounded pustules that support periostracal setae, interstitial microsculpture of fine wavy periostracal ridgelets; lip unreflected to strongly reflected, usually with a distinct sulcus and associated swelling behind; body whorl slightly to strongly descending below whorl plane; lip white to dark reddish brown; colour pale yellow-brown to dark red-brown, with or without a single narrow spiral colour band at mid-whorl, rarely with umbilical colour patch.

*External anatomy.* Animal dark grey or black to orange-brown; retractable head wart near inner bases of ocular tentacles present, varying in size.

*Reproductive anatomy.* Penis with or without a penial sheath, internally with vergic papilla that may have a very elongated to short conical or blunt tip, open laterally and apically, or have one lobe fastened to the penis wall and another free lobe; inner penial wall supporting irregular longitudinal interlocking ridges and pustulations of various lengths; penial retractor muscle inserting near mid-epiphallus; epiphallus rather long with or without very short to rather long finger-like caecum; vas deferens entering head of epiphallus through simple pore; vagina with prominent longitudinal anastomosing pilasters, usually thickened around entrance decreasing in prominence apically; bursa copulatrix moderately long (equal to length of oviduct) to very long (longer than oviduct), with multi-folded or looped shaft (twice as long as oviduct, or longer), with oval shaped head, aligned against terminal end of spermoviduct; free oviduct short; hermaphroditic duct inserting into head of talon.

## Comparative remarks

*Austrochloritis* is distinguished from other eastern Australian camaenids by the combination of pale to dark brown discoidal to turbinate to trochoidal shell with pustulose radial wrinkles on protoconch, closely spaced curved to straight to strap-like pointed periostracal setae on teleoconch and typical reproductive characters, such as a rather long bursa copulatrix with multi-folded or looped shaft and oval shaped head, aligned against terminal end of spermoviduct, a long epiphallus, usually with caecum, and a free vergic papilla of the penis.

## Distribution

From SE Victoria (Wilson's Promontory and Mt Donna Buang) to SE Queensland (Mt Tamborine). Mainly coastal and sub-coastal, but ranging as far west as Warrumbungle Range in central New South Wales; from near sea level to altitudes of up to c. 1,700 m in the Snowy Mountains.

## *Austrochloritis porteri* (Cox, 1866)

*Helix porteri* Cox, 1866: 373 [publ. 5 Sep]; Hedley, 1890: 249–250, pl. 15.

*Chloritis (Austrochloritis) porteri*.—Pilsbry, 1891 (in 1890–1891): 263, pl. 58, figs 23–24; Pilsbry, 1894 (in 1893–95): 121, pl. 28, figs 1–4; Zilch, 1966: 299.

*Austrochloritis porteri*.—Iredale, 1938: 94; Stanisic *et al.* 2010: 390.

## Material examined

*Type material.* Neotype, herein designated, AM C.24556 from New South Wales, Upper Richmond River, Booyong, Pearce's Ck, 28°45'00"S 153°26'53"E (leg. 1906) (Fig. 1A).

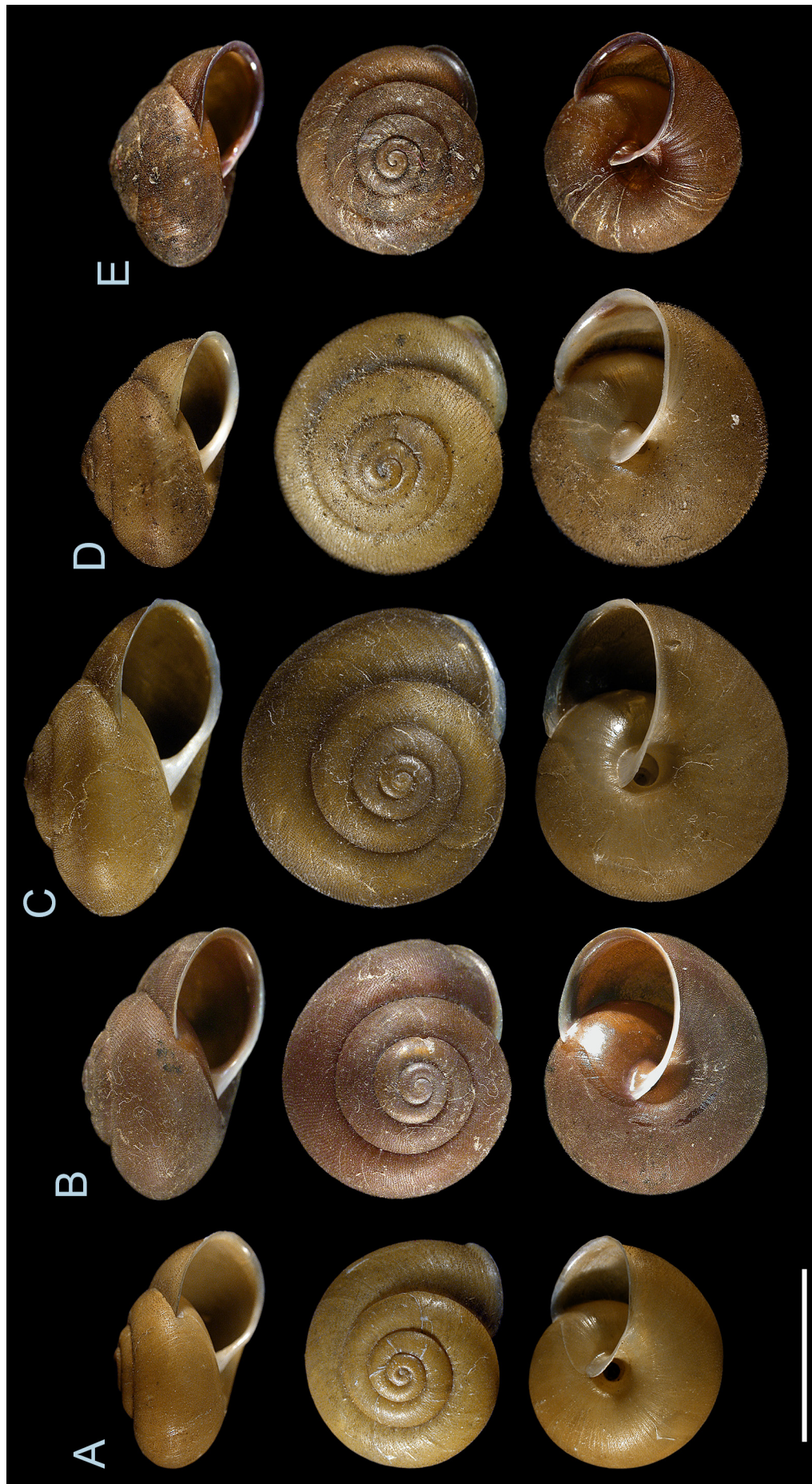
*Non-type material.* NEW SOUTH WALES: Upper Richmond River, Booyong, Pearce's Ck, 28°45'00"S 153°26'53"E (AM C.557014); Upper Richmond River, 28°30'30"S 152°59'E (AM C.334934–35); Wilson River, tributary of Richmond River, Booyong, 28°44'53"S 153°26'53"E (AM C.112291); Richmond River (AM C.33390, AM C.339397, AM C.334941, AM C.334943–45); 25 km NE of Kyogle, Wiangarie SF, off Forest Rd, 28°23'23"S 153°6'24"E (AM C.339394, AM C.339744); Whian Whian SF, Red Scrub Flora Reserve, 28°38'12"S 153°19'48"E (AM C.339391, AM C.339745); Whian Whian SF, Terania Ck, Mackays Rd, 28°35'S 153°19'E (AM C.339395–96, AM C.339743); E of Mullumbimby, Huonbrook, upper Coopers Ck, 28°33'S 153°21'E (AM C.334959); Mt Warning, track to summit, 50–100m from carpark, 28°23'55"S 153°16'59"E (AM C.463198, AM C.463214); Mt Warning, 28°24'S 153°16'11"E (AM C.136825); banks of the Richmond River at Casino, 28°52'S 153°03'E (AM C.137773); SE of Lismore, near Alstonville, Victoria Park, 28°54'S 153°24'30"E (AM C.363835); Byron Bay, 28°39'S 153°37'E (AM C.31218, AM C.339398); E of Lismore, Wollongbar, 28°49'S 153°24'E (AM C.334946); SW of Murwillumbah, Byangum, 28°21'30"S 153°21'37"E (AM C.334948, C.334950); Tweed River, 28°18'S 153°27'E (AM C.55539). QUEENSLAND: Lamington NP, Binna Burra, Bellbird Circuit, 28°12'S 153°11'E (AM C.363837, AM C.444258, AM C.363842–43, AM C.512604); Lamington NP, Binna Burra Guest House, 28°11'46"S 153°11'20"E (AM C.363837, AM C.363842–43, AM C.444258); Lamington NP, O'Reilly's Camp Ground, 28°13'54"S 153°08'01"E (AM C.129249); Numinbah Valley Rd, 1 km S of Natural Arch, 28°14'21"S 153°14'17"E (AM C.474737); NW of Murwillumbah, nr Springbrook, 28°14'07"S 153°16'38"E (AM C.444266); Currumbin Valley, 28°08'S 153°29'E (AM C.444267); Currumbin, 4 miles W of coast, 28°8'S 153°25'19"E (AM C.363858); Collins Gap, Mt Lindsay Hwy, 28°20'S 152°42'E (AM C.444259); Natural Bridge NP, 28°13'S 153°14'E (AM C.129279).

## Nomenclatural and taxonomic remarks

The original type material could not be traced in the AM, nor in the QM, NMV, ZMB, SMF, NHMUK, and is considered lost. Cox's types have generally been deposited in the collection of the Australian Museum. Indeed, other historic shell material collected by both Porter and Macgillivray in northern NSW in or before 1866 is still extant in this collection. Repeated efforts by various persons (Alan Solem, John Stanisic, ourselves) to find type material at the AM or other institutions have been unsuccessful. No types are known or suspected to be kept in other museums. Zilch (1966) did not report any types to be held by the SMF.

The original description was based on material collected by two different collectors at two separate sites: "Upper Clarence River at Guy Faux Station (Porter)" and "Upper Richmond River, at Cowlong [...] (Macgillivray)". Using contemporary georeferenced materials, we have located these two sites with reasonable precision. The first site is Guy Fawkes Station, N of Ebor and W of Point Lookout within the uppermost Clarence River catchment (c. 30°21'00"S 152°22'12"E). The second is NE of Lismore, S of Booyong (c. 28°46'12"S 153°25'12"E) (Fig. 2). Both locations are about 230 km apart from each other. Since the type material was collected in 1866, the original forest cover that existed at this time has largely been destroyed through clearing for agriculture. However, we





**Figure 1.** Shells (front, top, and umbilical view). (A–C) *Austrochloritis porteri* AM C.24556 (NSW, Upper Richmond River); (A) AM C.575455 (NSW, Mt Warning); (C) AM C.512605 (Queensland, Lamington NP). (D–E) *Austrochloritis specularis*: (D) AM C.575464 (NSW, Point Lookout); (E) AM C.575456 (NSW, Cathedral Rock NP). Scale bar = 10 mm.

have examined material from as close to these two locations as possible and found that the *Austrochloritis* species found near one (Guy Fawkes) is not identical with that found near the other site (Cowlong) even though they are both similar in external appearance. It is not impossible to identify *A. porteri* among these two species based on the diagnosis given in the original description. In order to remove the uncertain identity of *Helix porteri* Cox, 1866, to stabilize this taxonomic name and to fix the type locality, we here designate a neotype in accordance with Art. 75 of The Code (ICZN, 1999) and provide an updated diagnosis.

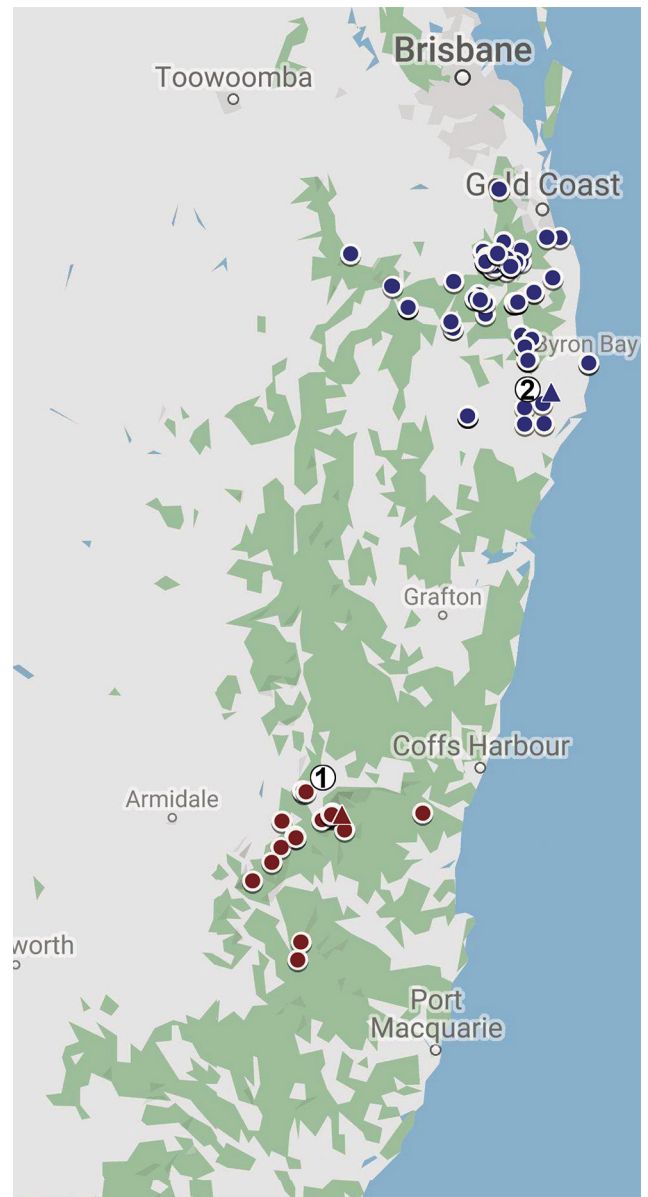
Hedley (1890) and Pilsbry (1894) published descriptions and figures of the digestive and reproductive anatomy and attributed these to *A. porteri*. Hedley's (1890) material originated from near Brisbane, which is not very close to any of the two original locations. The whereabouts of Pilsbry's (1894) material have remained uncertain. Stanisci *et al.* (2010) reported the species to be distributed from SE of Lismore (Victoria Park, NSW) to W of Gold Coast (Springbrook, Qld). This distribution incorporates the second site mentioned in the original description (Cowlong), but not the first. By contrast, the species occurring at the first site, Guy Fawkes Station, has subsequently been described as *A. specularis* Shea & Griffiths, 2010 (see below). To conserve the subsequent use of these two species names, we chose the neotype to come from close to site 2 (Cowlong).

### Description

**Shell** (Fig. 1A–C, Fig. 3). Large (D=14–24 (average 17.8) mm, H=10–15 (average 12) mm; for n = 34 lots), sub-globose to turbate in shape with a low to moderately raised spire, with on average 4.25 rounded to sub-angulate whorl that increase in diameter, sutures moderately impressed; protoconch sculpture of scattered pustules and rugose pustulose radial ridges; teleoconch sculpture of low irregular growth lines with microsculpture of small crowded pustules, periostracal sculpture of crowded short curved setae, microsculpture of wavy periostracal ridgelets; end of last whorl descending below whorl plane; aperture moderately tilted from axis of coiling, with moderately thickened and reflected white outer lip with sulcus behind, columella slope about 45°; umbilicus narrow and partially covered by reflected columella, V-shaped in profile; shell colour from pale reddish brown to dark reddish brown, with or without a narrow reddish brown spiral colour band at whorl periphery.

**General anatomy.** A retractable head wart is present at the inner bases of the ocular tentacles. Animal head-foot dark grey.

**Reproductive anatomy** (Fig. 4). Penis cylindrical, no penial sheath, inner penial wall with corrugated interlocking longitudinal pilasters, distally giving rise to longitudinal rows of interlocking pilasters; epiphallus cylindrical, about 1.5 to 2 times as long as penis, distal end with well-developed epiphallic flagellum, broad at base, epiphallus tapering to very narrow toward apex, opening into penial lumen through a conical longitudinally grooved (Victoria Park and Binna Burra; Figs 4 D,F) to pustulose (Mt Warning; Fig. 4 E), free verge, opening laterally; penial retractor attached to mid-epiphallus; vas deferens entering head of epiphallus through single pore just below base of epiphallic flagellum; vas deferens quite broad at its junction with apex of epiphallus but later tapering to a narrow tubule; vagina cylindrical, twice as long as penis, inner wall with prominent longitudinal



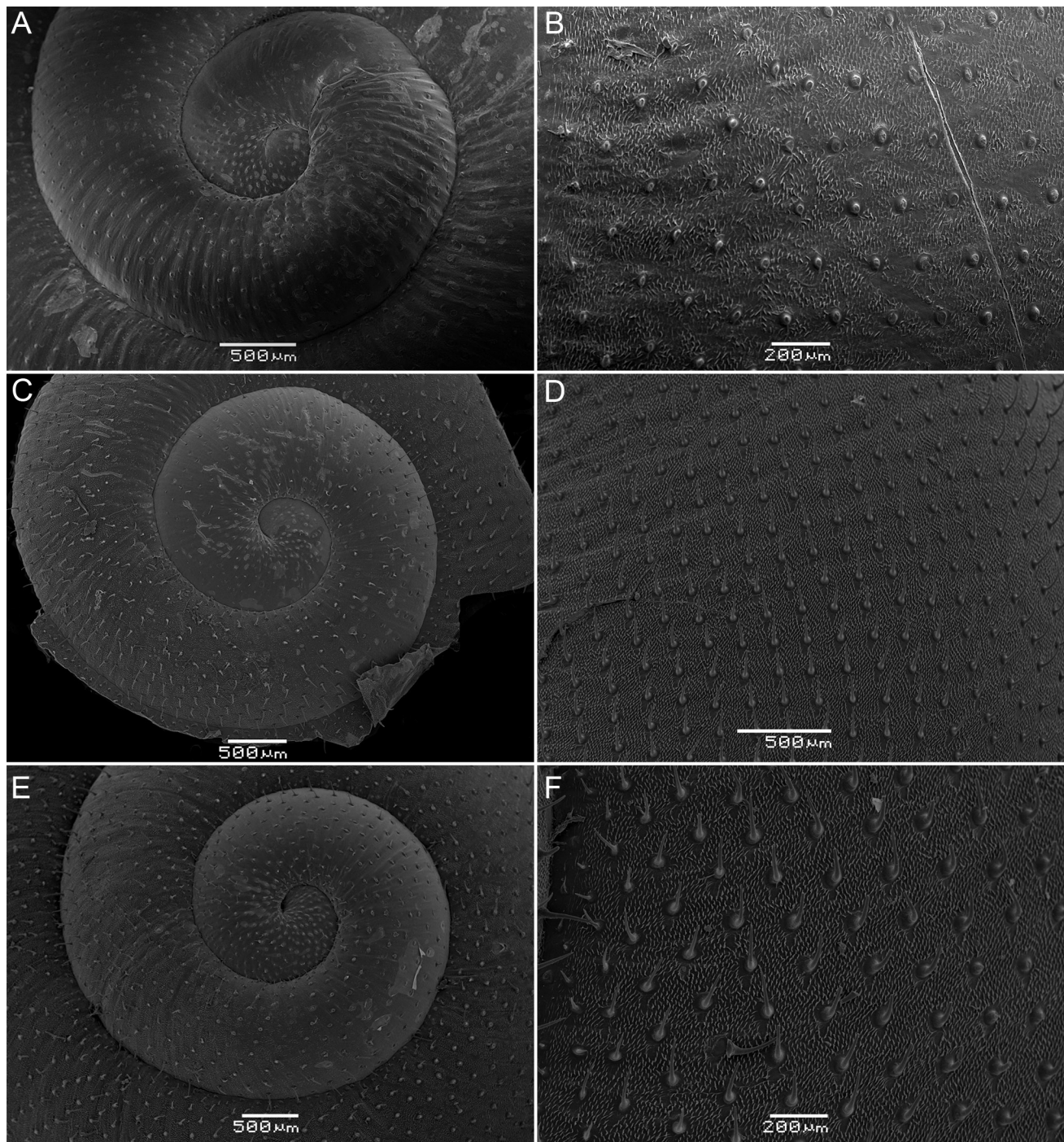
**Figure 2.** Occurrence records of *Austrochloritis porteri* (blue dots) and *A. specularis* (red dots) from the malacological collection of the AM. Legend: blue triangle—type locality of *A. porteri* based on neotype AM C.24556, red triangle—type location of *A. specularis*, original type locality of *Helix porteri*: 1—Guy Fawkes Station near Ebor; 2—Cowlong. Source of base map: Google Maps.

anastomising pilasters usually thickened around vaginal entrance; free oviduct very short; bursa copulatrix long and broad, particularly at its base, folded or kinked several times, about as long as spermoviduct (Victoria Park and Binna Burra; Figs 4A,C) to 1.5 times longer (Mt Warning; Fig. 4B), with inflated bulb-like head, aligning with base of albumen gland; hermaphroditic duct inserting into head of talon.

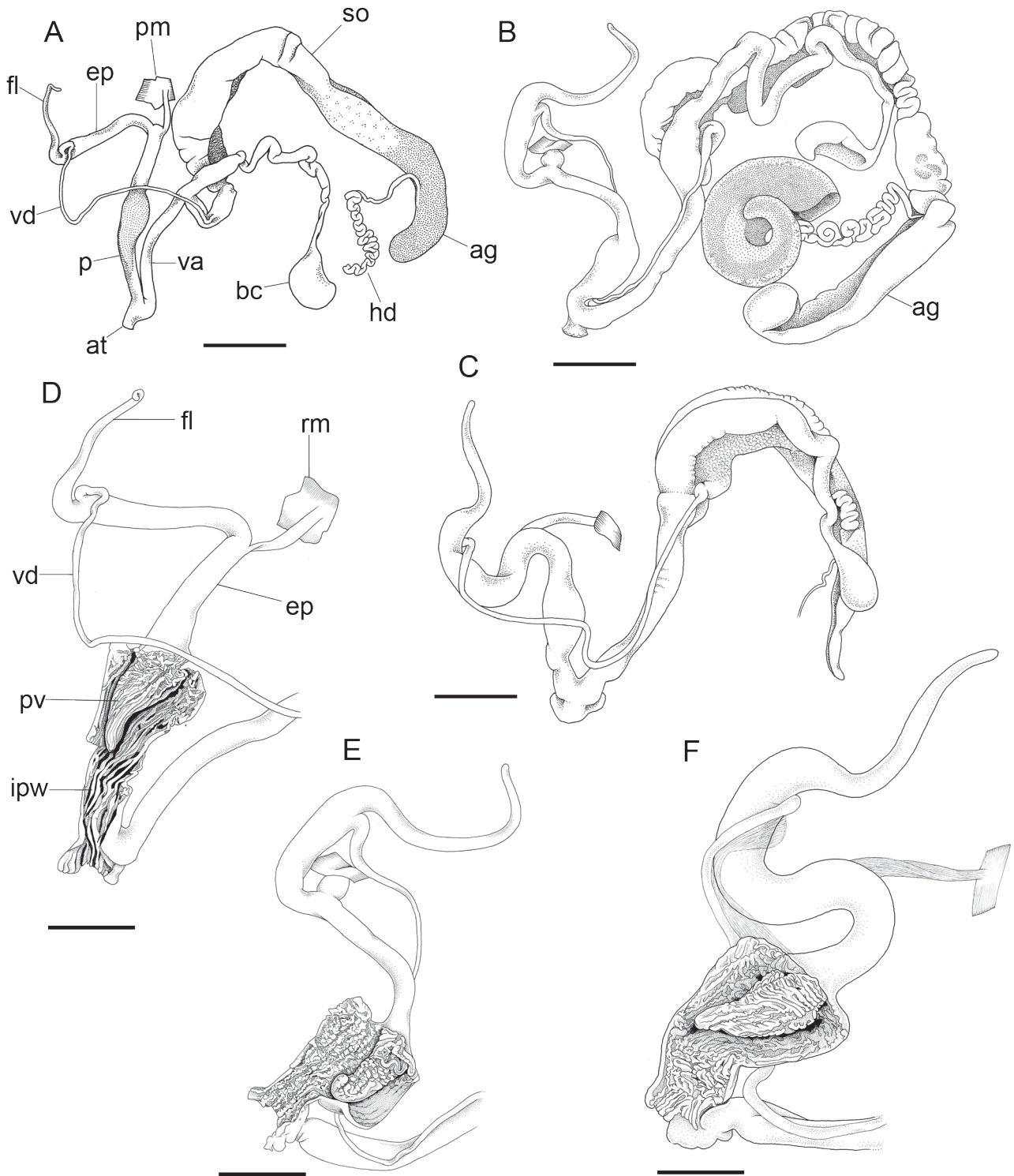
### Distribution and ecology

Lives in subtropical rainforests from the Richmond River valley of NE NSW north to the upper Nerang Creek valley of SE Qld. Mainly found at altitudes of up to 900 m on basaltic bedrock; found under logs, rocks and inside sheaths of fallen palm leaves (Fig. 2).





**Figure 3.** Scanning electron micrographs of shells of *Austrochloritis porteri* showing protoconch (left) and detail of teleoconch sculpture (right). (A, B) AM C.557014 (topotype, Upper Richmond River); (C, D) AM C.575262 (NSW, Mt Warning); (E, F) AM C.444258 (Queensland, Lamington NP). Scale bars = 0.2 or 0.5 mm.



**Figure 4.** Reproductive anatomy of *Austrochloritis porteri*. (A–C) Drawings showing the entire reproductive system: (A) AM C.363835 (NSW, Upper Richmond River); (B) AM C.575455 (NSW, Mt Warning); (C) AM C.512605 (Queensland, Lamington NP). Scale bars = 5 mm. (D–F) Details of penial anatomy: (D) AM C.363835 (NSW, Upper Richmond River); (E) AM C.575455 (NSW, Mt Warning); (F) AM C.512605 (Queensland, Lamington NP). Scale bars = 3 mm. Abbreviations: *ag*—albumen gland; *at*—atrium; *bc*—bursa copulatrix; *ep*—epiphallus; *fl*—epiphallic flagellum; *hd*—hermaphroditic duct; *ipw*—inner penial wall; *p*—penis; *pm*—penial retractor; *pv*—penial verge; *va*—vagina; *vd*—vas deferens.



*Austrochloritis specularis*  
Shea & Griffiths, 2010

*Austrochloritis specularis* Shea & Griffiths, 2010 (in Stanisic *et al.* 2010): 384, 536.

**Material examined**

*Type material.* Holotype QM MO27314 (from NE New South Wales, New England NP, Point Lookout region, 31°22'50"S 152°15'25"E [leg. D. & N. Potter, 8 Mar 1990, under logs]). Paratypes AM C.378010 (Gladstone SF, Reids Ck Rd at Moodys Ck crossing, 3.3 km from Kalang Rd, 30°28'52"S 152°50'21"E), AM C.339822 (Forest Way, 14.5 km SW Pt Lookout Rd, 30°34'23"S 152°14'24"E), AM C.339819 (Styx River, ca. 79 km E Armidale, nr Pt Lookout, 30°30'36"S 152°22'E).

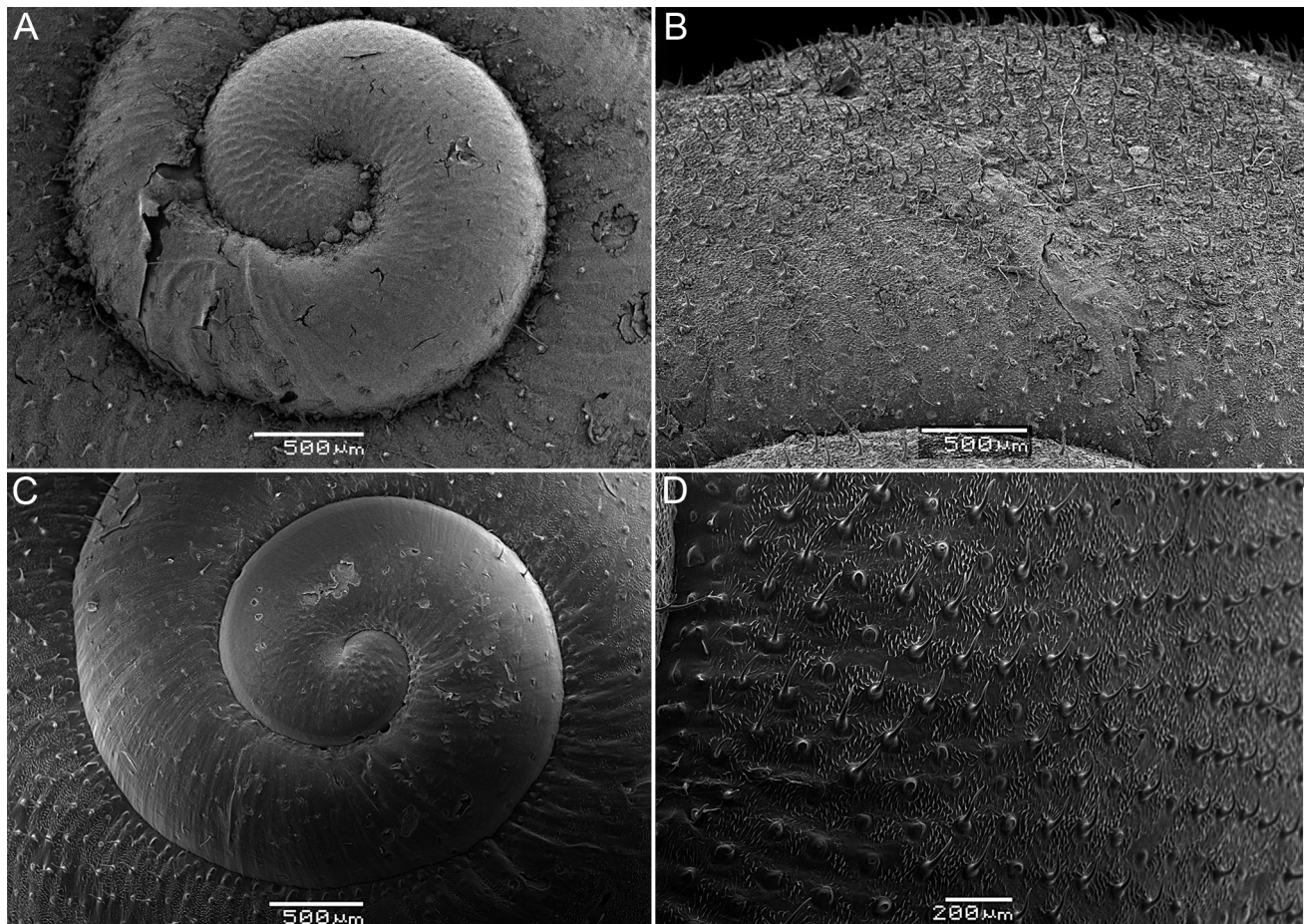
*Non-type material.* NEW SOUTH WALES: New England NP, Point Lookout, 30°29'23"S 152°24'28"E (AM C.108470); Point Lookout, Platypus Valley Lookout track, 30°29'20"S 152°24'35"E (AM C.575464); New England NP, near Point Lookout, 30°29'36"S 152°24'23"E (AM C.108368); Oakes SF, Robinsons Knob Trail, nr Spring Ck, 30°33'S 152°28'23"E (AM C.337911); E of Armidale, W of Ebor, 6.6 km NW of Guy Fawkes intersection, Sandy Ck, 500m W of sand pit turnoff, 30°23'48"S 152°17'30"E (AM C.108452); E of Armidale, 750 m S of Lightning Knob, 30°30'55"S 152°10'44"E (AM C.108381); Cathedral Rock NP, northern boundary, 1 km W of Sandy Creek crossing, W of Ebor, Ebor-Guyra Rd, 30°23'35"S 152°16'33"E (AM C.575456); E of Armidale, E of Jeogla, 800m N of Forest Way on Jacks Fire Rd, 30°34'51"S 152°14'46"E (AM C.108365); Waterfall Way, 1 km S of junction with Guyra Road, W of Ebor, 30°26'31"S 152°18'58"E (AM C.561044); Oxley Wild Rivers NP, Youdales, 31°4'19"S 152°15'17"E (AM C.506320); Styx SF, Raspberry Rd, Halls Peak Rd crossing, 30°45'18"S 152°2'35"E (AM C.506286); 63 km ESE of Armidale, N of Raspberry Mt, 800m down Raspberry Rd, 30°37'17"S 152°10'30"E (AM C.339820); 63 km ESE Armidale, 15.2 km down Raspberry Rd, 30°40'47"S 152°08'E (AM C.339821).

**Description**

*Shell* (Fig 1D–E, Fig. 5). Medium sized ( $D=12\text{--}16.5$  (average 14.3) mm,  $H=8.5\text{--}12$  (average 10.0) mm, for  $n=18$  lots), turbate in shape with moderately raised spire, with on average 4.25 rounded whorls that weakly increase in diameter, sutures moderately impressed, protoconch sculpture of scattered pustules and rugose pustulose radial ridges, teleoconch sculpture of irregular growth lines with microsculpture of crowded pustules, periostracal sculpture of crowded curved setae, microsculpture of wavy periostracal ridgelets; end of last whorl descending below whorl plane, aperture moderately tilted from axis of coiling, with moderately thickened and reflected white to dark red-brown outer lip, columella slope about 45°; umbilicus narrow, partially covered by reflected columella, V-shaped in profile; shell colour from pale yellowish brown to dark reddish brown, with or without a narrow reddish brown spiral band around the whorl periphery.

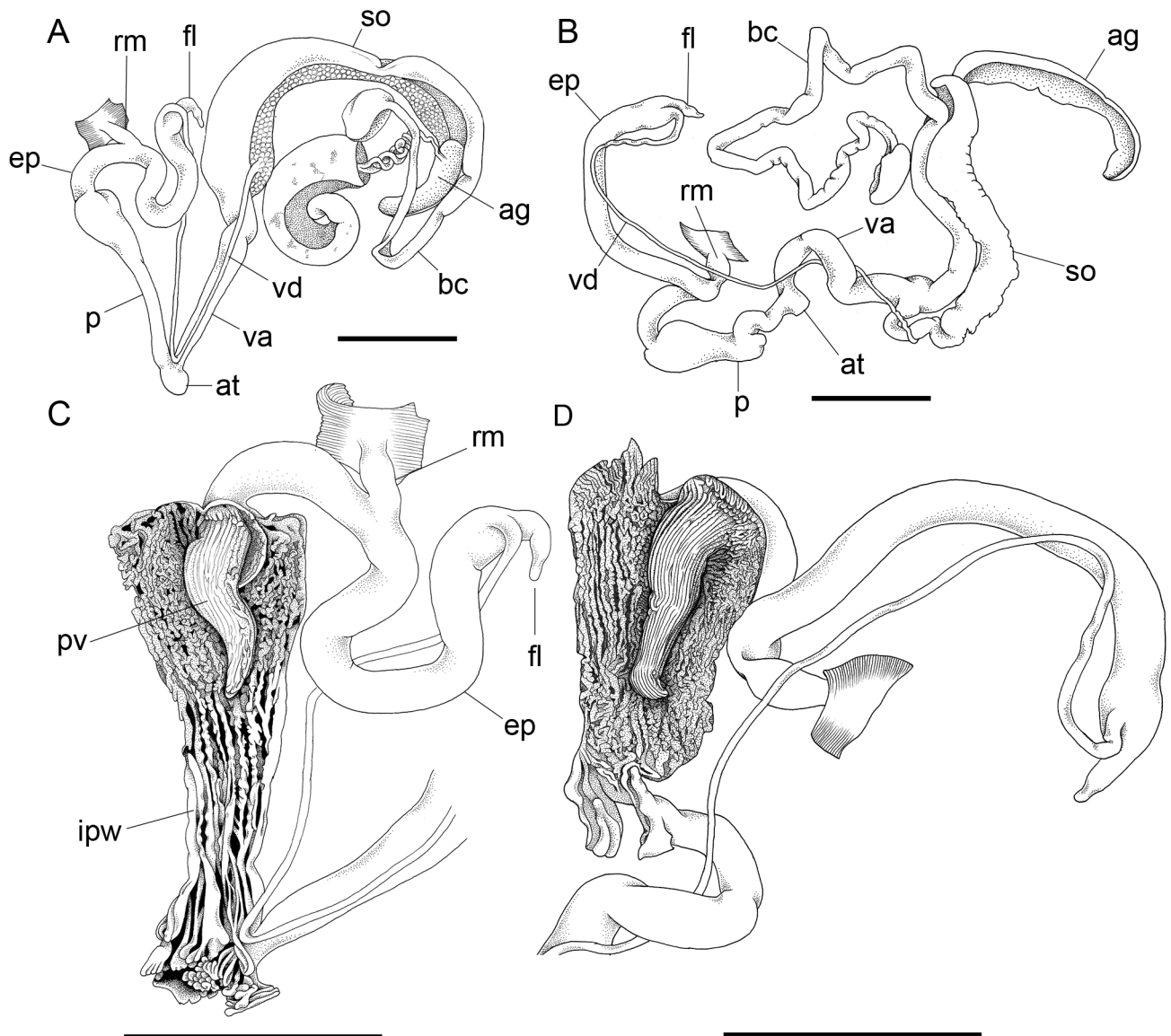
*External anatomy.* Animal head-foot dark grey-brown; with retractable head at inner bases of ocular tentacles.

*Reproductive anatomy* (Fig. 6). Penis cylindrical, about as long as vagina, no penial sheath, inner penial wall with corrugated interlocking short longitudinal pilasters, distally giving rise to longitudinal rows of elongate strap-like pilasters; epiphallus cylindrical, about 3 times as long as penis, distal part with short epiphallic flagellum, epiphallus opening into penial lumen through narrow, pointed and finger-like, longitudinally grooved, penial verge, about half as long as penis, opening laterally; penial retractor attached



**Figure 5.** Scanning electron micrographs of shells of *Austrochloritis specularis* showing protoconch (left) and detail of teleoconch sculpture (right): (A–B) AM C.343464 (NSW, Ebor–Guyra Rd); (C–D) AM C.575456 (NSW, Ebor–Guyra Rd). Scale bars = 0.2 or 0.5 mm.





**Figure 6.** Reproductive anatomy of *Austrochloritis specularis*. (A–B) Drawings showing the entire reproductive system: (A) AM C.575464 (NSW, Point Lookout); (B) AM C.575456 (NSW, Ebor–Guyra Rd). (D–F) Details of penial anatomy: (C) AM C.575464 (NSW, Point Lookout); (D) AM C.575456 (NSW, Ebor–Guyra Rd). Scale bars = 5 mm. Abbreviations: ag—albumen gland; at—atrium; bc—bursa copulatrix; ep—epiphallus; fl—epiphallic flagellum; hd—hermaphroditic duct; ipw—inner penial wall; p—penis; pm—penial retractor; pv—penial verge; va—vagina; vd—vas deferens.

to proximal third of epiphallus; vas deferens entering head of epiphallus through a single pore just below base of epiphallic flagellum; vagina cylindrical, as long as penis, inner wall with very prominent longitudinal anastomosing pilasters, usually thickened around vaginal entrance; free oviduct short; bursa copulatrix long and thin and looped or folded several times, twice as long or more than oviduct length, with inflated bulb-like head, aligning with base of albumen gland; hermaphroditic duct inserting into head of talon.

### Comparative remarks

Both species cannot be confidently distinguished by their shell, which is on average smaller in *A. specularis*, but exhibits very similar characteristics otherwise. However, both species differ in some reproductive characters, such as length of the bursa copulatrix relative to length of spermoviduct (longer in *A. specularis*), relative length of

penis (about equal to vagina in *A. porteri*, but longer in *A. specularis*), length of epiphallus relative to penis (longer in *A. porteri*), position of the penial retractor muscle (at proximal third of epiphallus in *A. porteri*, mid-epiphallus in *A. specularis*), and relative length of the penial verge (half as long as penis in *A. porteri*), and the length of the epiphallic flagellum (much longer in *A. porteri*).

### Distribution and ecology

Lives in dry to moist sclerophyll forests on the eastern edge of the New England Plateau and escarpment from Gladstone State Forest in the east to the upper Guy Fawkes River drainage north of Ebor and Point Lookout areas in the north to Youdales, Oxley Wild Rivers NP in the south (Fig. 2). Mainly found at altitudes over 900 meters on granitic or basaltic bedrock. Generally found under logs, rocks and shed bark around base of trees.

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