

# *Lenwebbia* Stanisic, 1990 revisited with the description of a new species, *Lenwebbia jimthompsoni* sp. nov. from the Einasleigh Uplands Bioregion, north-eastern Queensland (Gastropoda: Eupulmonata: Charopidae)

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**Keywords:**

shell morphology | protoconch sculpture | incomplete secondary ureter | new species | higher relationships | biogeography.

## **ABSTRACT**

A new species of pinwheel snail, *Lenwebbia jimthompsoni* sp. nov., is described from Bakers Blue Mountain, Einasleigh Uplands, north-eastern Queensland. The species belongs to a genus of Charopidae whose members have an incomplete secondary ureter and conchological features that set them apart from typical Australian charopids. Higher relationships of these charopids as part of Punctoidea are considered in light of recent molecular studies with the possibility of future subfamilial recognition. The biogeographic significance of this species as part of a genus with representatives in geographically distant eastern Queensland rainforests is discussed.

*Lenwebbia* Stanisic, 1990 was introduced as a monotypic genus for a south-eastern Queensland species, *L. protoscrobiculata* Stanisic, 1990. Subsequently, two additional species (*L. paluma* Stanisic, 1993 from the Paluma Range in the southern Wet Tropics and *L. marissae* Holcroft & Stanisic, 2018 from mid-eastern Queensland rainforests) were described. This study introduces an additional species in the *Lenwebbia* lineage from the Einasleigh Uplands Bioregion in north-eastern Queensland. *Lenwebbia jimthompsoni* sp. nov. is described from the rainforested upper slopes of Bakers Blue Mountain, which is an isolated peak north-north-west of the Hann Tableland. The malleate protoconch sculpture and the incomplete secondary ureter combine to unite these species as distinct from other eastern Australian charopid genera. *Lenwebbia* forms part of a select group of charopid genera with an incomplete secondary ureter. The significance of this anatomical novelty is discussed in relation to their unusual lifestyles that contrast with those of the majority of litter-dwelling Australian charopids. Their phylogenetic position in Punctoidea is the subject of continuing debate and here we examine available evidence for giving these genera formal higher level taxonomic recognition. *Lenwebbia* has a geographically disjunct range from south-east to north-east Queensland, which is discussed in relation to continental climate change since the mid to late Miocene.

## MATERIALS AND METHODS

Material used in this study is held in the spirit (SC) and dry mollusc collections (RC) of the Queensland Museum (QMMO). Measurements of shell height, diameter, umbilical width and whorl numbers were made using a Wild M5 stereomicroscope with a calibrated eyepiece. Whorl counts were made to the nearest 0.125 whorl. High-resolution images of shells (260–600MB) were taken with a Visionary Digital BK-Plus lab system camera setup in the Queensland Museum's Digital Imaging Unit (QMDIU). Shell sculpture was investigated and photographed using a TM-1000 Tabletop Scanning Electron Microscope (SEM) located in the Queensland Museum.

**Abbreviations:** D/U, diameter/umbilical width ratio; H/D, height/diameter ratio; MEQ, mid-east

Queensland; Mtn, Mountain; NEQ, north-east Queensland; QMDIU, Queensland Museum Digital Imaging Unit; Qld, Queensland; QM, Queensland Museum; RC, dry mollusc reference collection; SC, mollusc spirit collection; SEM, scanning electron microscopy; SEQ, south-east Queensland.

## SYSTEMATICS

### Infraorder EUPULMONATA

#### Superfamily PUNCTOIDEA

#### Family CHAROPIDAE

#### *Lenwebbia* Stanisic, 1990

*Lenwebbia* Stanisic, 1990: p. 52; Stanisic, 1993: p. 21; Stanisic et al. 2010: p. 256

Type species: *Lenwebbia protoscrobiculata* Stanisic, 1990 — original designation.

**Diagnosis:** Shell tiny (diameter 3.5–4.0 mm), brown to yellowish-brown, depressedly turbinate with a moderately elevated, domed spire; whorls rounded, sutures impressed. Protoconch sculpture malleate with scattered dimples; umbilicus extremely narrow, U-shaped. Secondary ureter incomplete.

**Remarks:** The combination of malleate protoconch sculpture and the incomplete secondary ureter uniquely assign the new species to *Lenwebbia*. The characteristic protoconch sculpture also differentiates this genus from other Australian charopid genera that have an incomplete secondary ureter (Stanisic 1990).

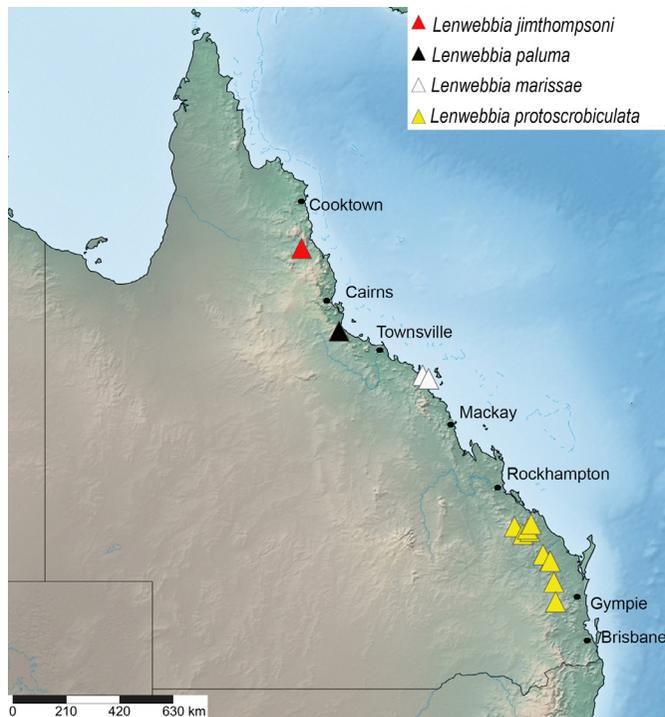
#### *Lenwebbia jimthompsoni* sp. nov.

(Figs 1–5)

**Etymology:** Named for Dr Jim Thompson PSM, Chief Executive Officer of the Queensland Museum through the years 2017–2025.

**Preferred common name:** Jim Thompson's Pinwheel Snail.

**Comparative remarks:** Conchologically, *L. jimthompsoni* sp. nov. closely resembles its congeners. Features of shell size, shape and overall sculpture (particularly the malleate protoconch) are comparable to *L. protoscrobiculata*, *L. marissae* and *L. paluma*. However, differences in coiling pattern (umbilical width) and teleoconch microsculpture



**Figure 1.** Map showing distribution of *Lenwebbia jimthompsoni* sp. nov. and related species.

combined with geography identify each of the species. *Lenwebbia jimthompsoni* sp. nov. differs from the geographically proximate *L. paluma* by having a larger umbilicus, looser coiling (mean diameter 0.51 mm vs 0.38 mm, mean D/U 8.48 vs 13.3, N = 12 vs 3 respectively) and teleoconch sculpture characterised by more prominent and regular microradial threads. Compared with *L. protoscribiculata*, *L. jimthompsoni* sp. nov. has a smaller umbilicus and tighter coiling (mean diameter 0.51 mm vs 0.75 mm, mean D/U 8.48 vs 5.85, N = 12 vs 10 respectively), and teleoconch sculpture characterised by more prominent spiral grooves.

**Material examined:** *Holotype*: QMMO87868, RC, Bakers Blue Mountain, 17 km SW of Mt Molloy, NEQ (16°43'21" S, 145°10'32" E), rainforest, under litter on large granite boulders, coll. J. Stanisic, G. Ingram, L. Little, 15.vii.1997.

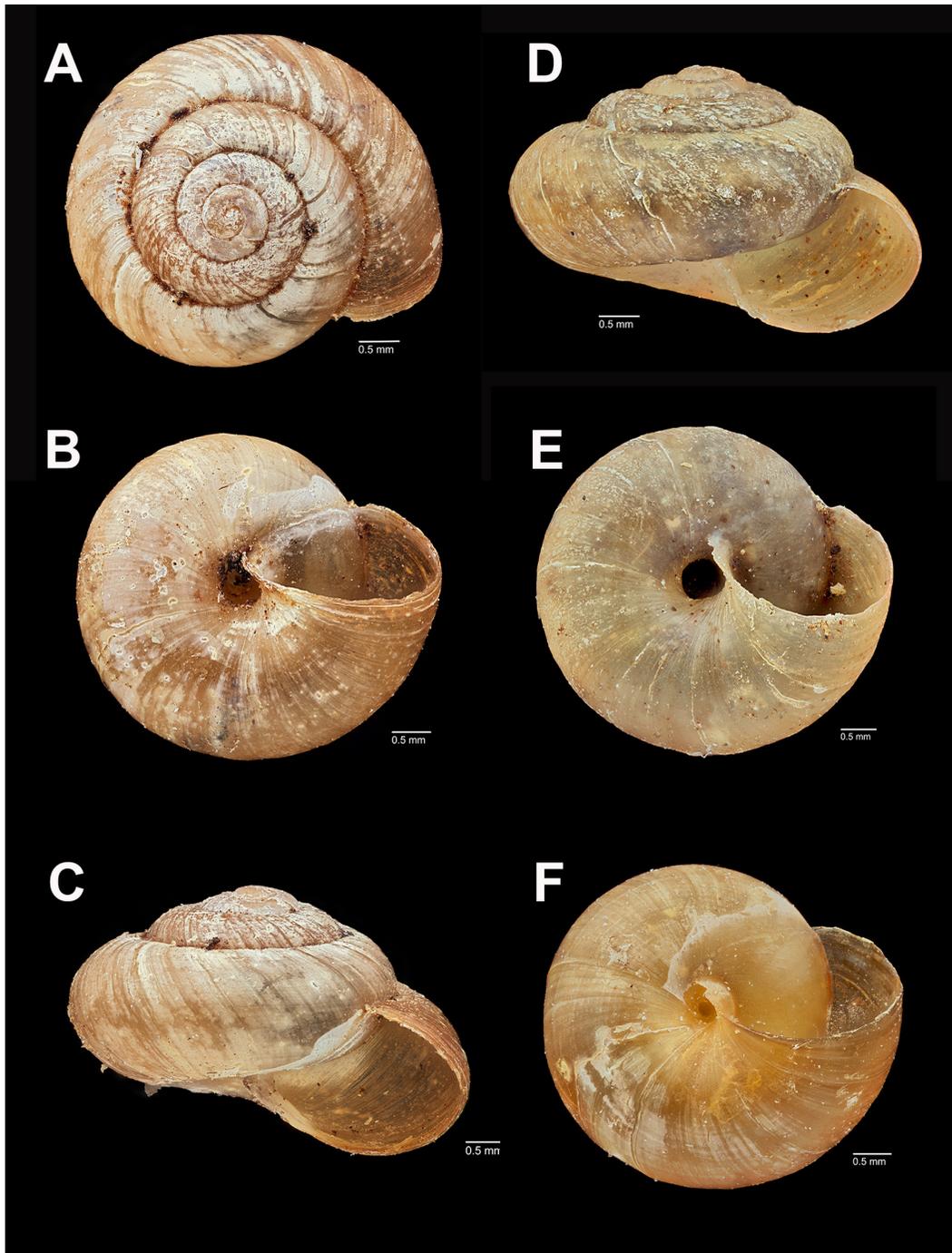
*Paratypes*: QMMO73860, 2SC/8RC; QMMO57381, 10RC; same data as holotype.

**Diagnosis:** Shell tiny with low domed spire; whorls rounded with impressed sutures. Protoconch

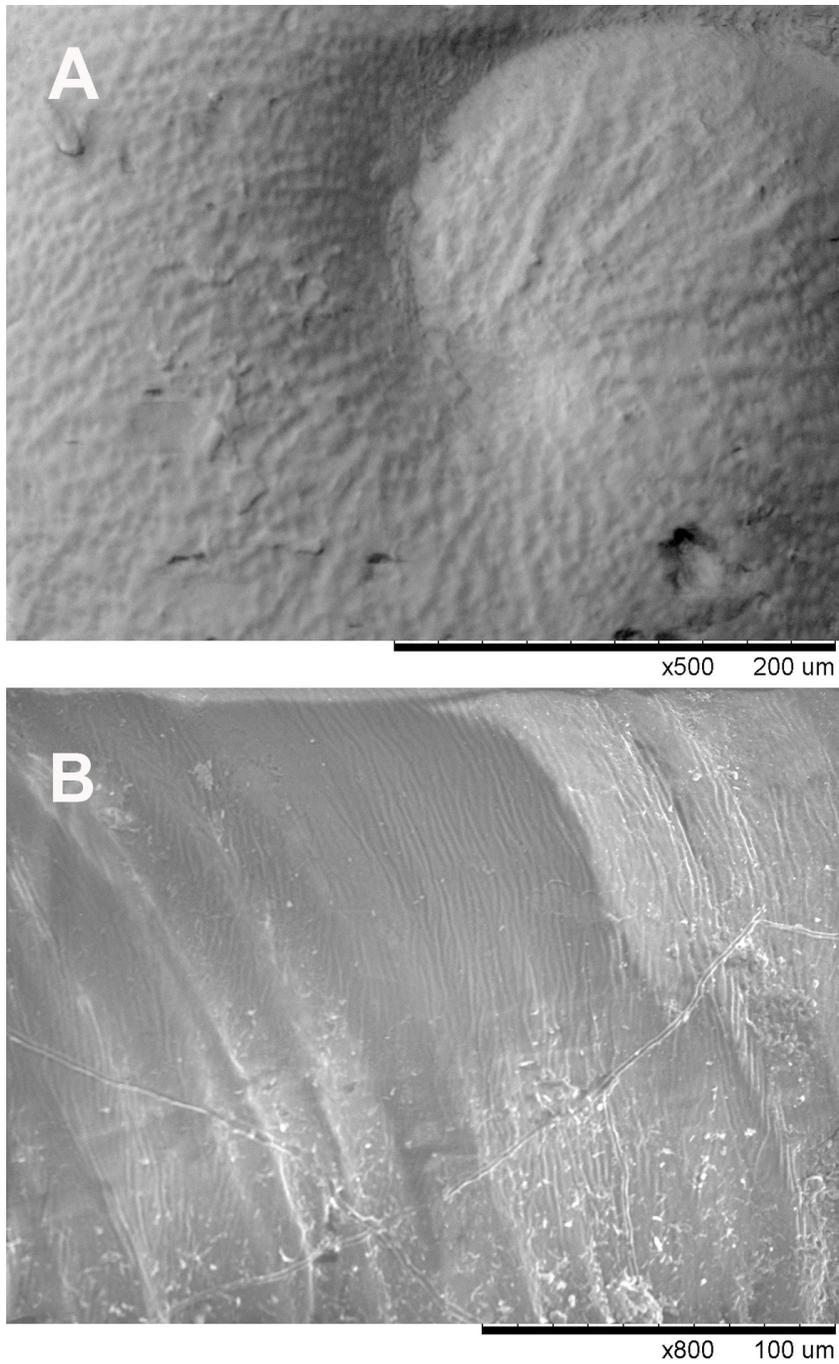
sculpture malleate with scattered dimples; umbilicus extremely narrow. Secondary ureter incomplete.

**Description:** *Shell*: Tiny, yellowish-brown, depressedly turbinate with a low domed spire; whorls 4.0–4.375 (mean 4.25), evenly coiled and rounded at the periphery, last rapidly descending, sutures impressed. Diameter of shell 3.77–4.67 mm (mean 4.25 mm), height 2.26–3.11 mm (mean 2.82 mm), H/D 0.62–0.72 (mean 0.66). Protoconch of 1.5 whorls, diameter approx. 940 µm, microsculpture malleate with scattered dimples and irregular sinuate ridgelets; teleoconch with curved radial ridges and crowded interstitial microradial threads, broad spiral grooves on the latter whorls. Aperture ovately lunate, lip simple. Umbilicus extremely narrow, U-shaped, diameter 0.41–0.66 mm (mean 0.51 mm), D/U 6.71–10.59 (mean 8.48). Based on 12 measured specimens (QMMO87868 [1], QMMO73860 [7], QMMO57381 [4]).

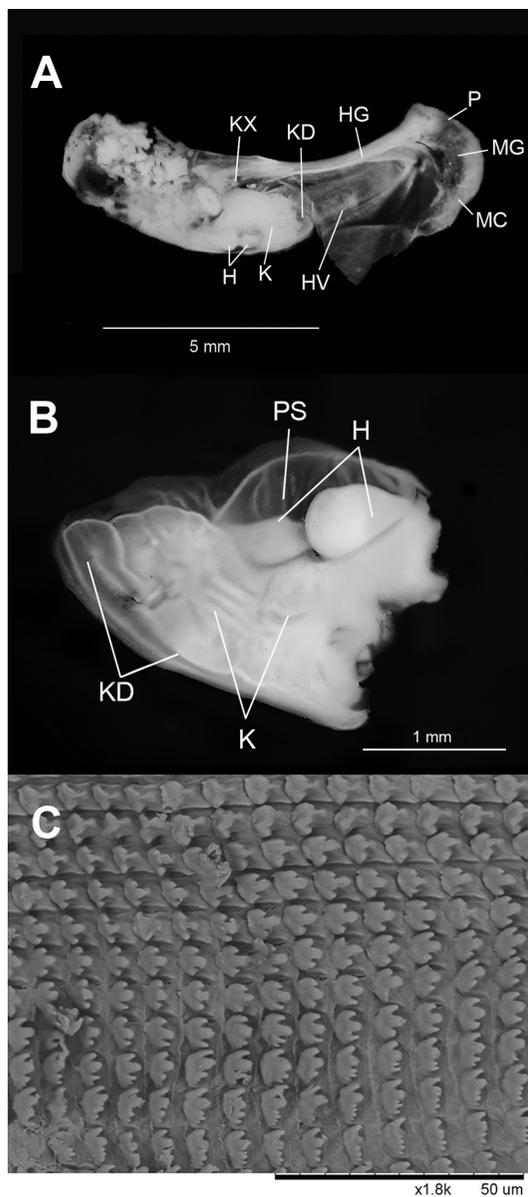
*Anatomy*: Pallial cavity with well-developed mantle collar and prominent mantle gland incorporating pneumostome. Kidney unilobed with a well-developed pericardial lobe.



**Figure 2.** Shells of *Lenwebbia* species. **A–C.** *Lenwebbia jimthompsoni* sp. nov., holotype, QMMO87868, Bakers Blue Mtn, NEQ; **D–E.** *L. protoscrobiculata* Stanisic, 1990, holotype, QMMO17048, Kalpowar State Forest, SEQ; **F.** *L. paluma* Stanisic, 1993, holotype, QMMO43311, Mt Spec National Park., NEQ. Scale lines as marked.



**Figure 3.** Shell sculpture of *L. jimthompsoni* sp. nov., paratype, QMM073860, Bakers Blue Mtn, NEQ. **A.** Protoconch (x500); **B.** Teleoconch whorl three (x800).



**Figure 4.** A–C. Pallial cavity and radula details of *L. jimthompsoni* sp. nov., paratypes, QMMO73860. **A.** Pallial cavity; **B.** Kidney-ureter-heart complex; **C.** Radula (x1800). Scale lines as marked.

**Key:** KX, ureteric pore; KD, ureter; HG, hindgut; P, pneumostome; MG, mantle gland; MC, mantle collar; HV, hindvein; K, kidney; H, heart; PS, pericardial sac; KD, ureter.

Ureter originating from apex of the kidney, reflexing and continuing rearwards along the outer edge of the kidney to the base where it again reflexes to give rise to a tiny incomplete secondary ureter; ureteric pore situated in the angle between the base of the kidney and hindgut. Heart two chambered within pericardial sac. Hindvein without unusual features. Genitalia of preserved specimens immature and not figured.

Radula comprising tricuspid central and lateral teeth with a long and lanceolate mesocone, ectocone and endocone considerably shorter; marginal teeth multicuspid with endocone and ectocone spilt into several minor cusps; basal plates squarish. Based on several dissected specimens (QMMO73860).

**Distribution and habitat:** Known from the upper slopes of Bakers Blue Mountain, north-eastern Queensland; collected under accumulated litter on large boulders in notophyll vine forest with emergent *Araucaria*.

**Remarks:** *Lenwebbia jimthompsoni* sp. nov. is uniquely distinguished from other sympatric charopids by a combination of turbinate shape, reduced teleoconch sculpture and malleate protoconch sculpture. Anatomically, a major diagnostic feature is an incomplete secondary ureter, which *L. jimthompsoni* shares with *L. protoscrobiculata* and *L. paluma*. This character has yet to be identified in *L. marissae* from MEQ, for which only shells were available for study (Holcroft & Stanisic 2018). The genitalia of *L. protoscrobiculata* and *L. paluma* indicate that there have also been character shifts in the penial morphology in these two geographically distant species (Stanisic 1990, 1993).

Although the species was collected under accumulated litter on boulders it is more than likely, based on the habitat preference of its congeners, that the species will be found under the bark of dead trees and fallen logs. The specialised microhabitat of the *Lenwebbia* group of species makes their detection difficult and subject to focused searching. General land snail surveys do not commonly source out exfoliating bark on fallen logs and dead trees. This suggests that the new species may be found in other refugial locations, especially in the montane regions of the Wet Tropics.

## DISCUSSION

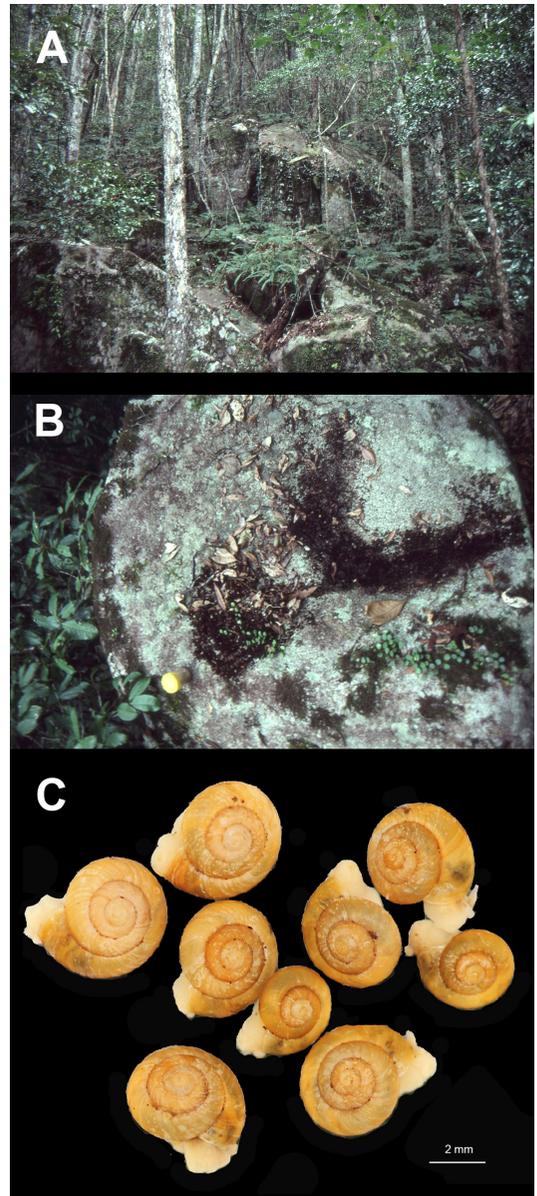
The discovery of *L. jimthompsoni* sp. nov. on Bakers Blue Mountain further extends the northern distribution of *Lenwebbia* from the southern Wet Tropics (Paluma) into the Einasleigh Uplands Bioregion in far north-eastern Queensland. The southern-most species, *L. protoscrobiculata*, inhabits the drier subtropical araucarian microphyll vine forests of the uplands between Gympie and Monto, SEQ, while the mid-eastern Queensland species, *L. marissae*, has been recorded from the araucarian vine forests of the Conway Range and Mount Dryander, MEQ. The northern species, comprising *L. paluma* and the newly described *L. jimthompsoni* sp. nov., survive in the structurally similar forest of montane refugia in the Wet Tropics and Einasleigh Uplands Bioregions.

The shells of *Lenwebbia* species display remarkable similarity in features considering their long-term geographic isolation from each other. Conchological features that separate the species are only minor shifts in coiling pattern and teleoconch sculpture. The fact that *Lenwebbia* spp. display a fidelity to drier araucarian rainforests and specialised microhabitat throughout their fragmented range is considered a likely contributing factor in maintaining a stable shell form through time.

### Significance of the incomplete secondary ureter

Stanisic (1987) first drew attention to the incomplete secondary ureter of eastern Australian charopid genera when introducing *Oreokera* Stanisic, 1987 from the Wet Tropics Bioregion. A further five genera (*Setomedea* Iredale, 1941, *Ngairea* Stanisic, 1990, *Mussonula* Iredale, 1937, *Lenwebbia* Stanisic, 1990 and *Hedleyoconcha* Pilsbry, 1893) were shown to possess the same unusual ureter configuration. This appears as an incomplete secondary ureter located in the angle between the base of the kidney and the hindgut. In the vast majority of Australian charopids, the secondary ureter follows the hindgut to the edge of the pneumostome. This enables waste products to be excreted through the pneumostome directly to the outside.

An incomplete secondary ureter implies that the excretory products exit onto the roof of the pallial cavity. Water must then be used to flush out these



**Figure 5.** A. *L. jimthompsoni* sp. nov. habitat: rainforest, upper slopes Bakers Blue Mtn, NEQ. B. *L. jimthompsoni* sp. nov. microhabitat: accumulated litter on granite boulder; C. Original lot of *L. jimthompsoni* sp. nov. preserved specimens, paratypes, QMMO73860. Scale line as marked.

products. Solem (1974) suggested that a complete secondary ureter was a necessary preadaptation to the evolution of slugs from shelled ancestors and concluded that the secondary ureter's primary function is water reabsorption (Solem 1976, p. 85).

Species with an incomplete secondary ureter may therefore be more at risk from desiccation and display a preference for moister secluded microhabitats. Yet apart from *Setomedea* species, which prefer to live in moist rotting logs, they are found in mainly arboreal (*Hedleyoconcha*) and semi-arboreal situations (*Oreokera*, *Ngairia*, *Lenwebbia* and probably *Mussonula*) that are less moisture secure (Stanisic 1987, 1990). Clearly long-term environmental adaptation combined with physiological acclimatisation has enabled this microhabitat specialisation to overcome moisture insecurity.

### Higher relationships

Charopids with an incomplete secondary ureter are the subject of debate regarding their phylogenetic position within Punctoidea. Stanisic (1990) noted that as well as the anatomical novelty of an incomplete secondary ureter, there are conchological features that set these species apart from typical Australian charopids displaying discoidal shells with spiral, radial or cancellate protoconch sculpture. As a group, they are considered highly differentiated and collectively possess shell features such as incised spiral lines, broad spiral grooves, periostacal setae, elevated spires and punctate apical sculpture that are not seen in other eastern Australian charopids.

A cladistic Phylogenetic Analysis Using Parsimony (PAUP) analysis undertaken by Stanisic (1990) used 75 characters (42 anatomical, 33 conchological) and isolated *Mussonula*, *Hedleyoconcha*, *Ngairia* and *Lenwebbia* among 18 genera of eastern Australian rainforest charopids. The one exception was *Setomedea*, which was aligned with the moist forest dweller *Elsothera*, largely based on shared conchological features.

Shea et al. (2012) provided the first molecular evidence for this group of snails to be given separate taxonomic recognition. Using the cytochrome c oxidase subunit 1 (CO1) sequence, their results showed that *Hedleyoconcha*, *Ngairia* and *Setomedea* formed a 'very distinct' clade linked to a much larger group of typical charopids with the *Gyrocochlea*-grade shell configuration (discoidal, large umbilicus, prominent teleoconch sculpture and spiral, radial or cancellate protoconch sculpture).

The proposed inclusion of some Australian charopid genera (*Scelidoropa* Hyman & Stanisic, 2005, *Diemenoropa* Bonham, 2018) within the Australian endemic slug family Cystopeltidae by Salvador et al. (2020) initiated discussion regarding the monophyly of the Australian Charopidae and how to position the Australian group of species with incomplete secondary ureters. An investigation of the phylogenetic relationships of Australian species within Charopidae using a 28S rRNA D1 dataset, a concatenated CO1 and 28S rRNA D1 dataset and inferred CO1 amino acid sequence by Colgan & Stanisic (2023) found that *Hedleyoconcha*, *Ngairia* and *Setomedea* clustered as a relatively basal group within Charopidae in all analyses.

Hyman & Köhler (2025, in press) suggested that this group of species could be closely related to the east Australian endemic slugs of Cystopeltidae. However, while their molecular analyses assign *Hedleyoconcha* and *Ngairia* to Cystopeltidae, the critical anatomical evidence for shelled snails aligning with Cystopeltidae is not present.

Though the phylogenetic position of Australian species with incomplete secondary ureters within Punctoidea is still a work in progress, all current circumstantial evidence points to some form of sub-familial recognition within Charopidae in the future given their unusual anatomical and conchological features.

### Biogeography

Located in the Einasleigh Uplands Bioregion, Bakers Blue Mountain is one of thirteen biogeographic units recognised as islands of vertebrate endemism in the Wet Tropics by Nix (1991). Utilising bioclimatic modelling chiefly based on radiation, temperature, moisture and rainfall, these units were identified as major source areas of endemic species of vertebrates. However, these unit-defining parameters are also critical to the survival of land snails. Peaks on the mountain reach 1075 m, 1096 m and 1124 m, which are higher than those of the Hann Tableland and therefore predicted to be suitable for a greater range of endemic fauna. Rainforest covers less than 1000 ha above an elevation of 900 m.

Rainforest in eastern Australia experienced a major retreat when plant genera such as *Eucalyptus*

gained ascendancy and occupied the drier areas vacated by rainforest vegetation (Galloway & Kemp 1981). Major north-south disjunctions evident in today's eastern Australian biota probably date from this epoch. The establishment of the Fitzroy and Burdekin dry corridors fragmented populations of formerly widespread mesic communities (Nix 1991). Land snails would have suffered considerable range attrition during the drying of the late Tertiary and Quaternary because of their extreme moisture sensitivity and low vagility. In the Wet Tropics Bioregion, temperate and subtropical communities were isolated in upland refugia, and despite multiple Holocene 'wet phases' (Kershaw & Nix 1988), did not re-emerge because of potent bioclimatic barriers operating at lower elevations (Nix 1991).

*Lenwebbia* is a significant faunal element of these environmentally cornered communities and its altitudinal restriction in the north is inextricably linked to the reduction of rainforest communities that began in the mid to late Miocene. The drying events of the Pliocene, and their more radical effects in the Pleistocene (Galloway & Kemp 1981) most likely caused the initial fragmentation of *Lenwebbia*. Climatic changes in the past 100,000 years that caused major vegetation changes in eastern Australia (Kershaw 1981) would have strengthened these disparities and isolated species into upland refugia.

In many respects, the large, geographically disjunct range of *Lenwebbia* is comparable to other charopids with an incomplete secondary ureter, such as species assigned to *Setomedea* Iredale, 1941 and *Hedleyoconcha* Pilsbry, 1893. These genera also exhibit extensive north-south disjunct ranges. The inference is that these genera are very old rainforest lineages, whose former wide ranges have been fragmented because of rainforest regression caused by a long-term, ongoing continental climatic shift that favoured xeric vegetation.

*Lenwebbia jimthompsoni* sp. nov. augments the significance of Bakers Blue Mountain as an important refugium for land snails. Previously highlighted by the tiny and unusual endemic pupinid *Alpinipupina griffithsi* Stanisic, 2010, the locality has also been shown to contain the geographically restricted camaenid *Monteithosites helicostracum* Stanisic,

1993 and the helicarionid semi-slug, *Hymanarion hanniana* Stanisic, 2010, two species also present on the nearby Hann Tableland. Several undescribed charopids from Bakers Blue Mountain are currently the focus of a separate study of Einasleigh Uplands pinwheel snails by the authors, which will add to this significant altitudinally restricted inventory of endemic land snails.

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