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Systematics of the landsnail genus *Gyrocochlea* and relatives (Mollusca: Charopidae)

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Abstract

This study reviews the charopid snails of *Gyrocochlea s.l.* This genus has been used as a convenient ‘catch-all’ for those species characterised by chiefly biconcave brown shells that have a strong radially-ribbed teleoconch. The genus currently comprises 34 species but could include many more undescribed species that reside in museum collections using this broad conchological definition. The study aims to establish a framework for defining natural monophyletic groups within the genus and its relatives based on both morphological and molecular data. In doing so, a number of new genera and species that must be characterised to circumscribe this new definition are also described. The study utilises qualitative and quantitative conchological data, scanning electron microscopy—primarily of the shell protoconch, anatomical studies of the male reproductive system and DNA sequences of cytochrome *c* oxidase subunit I and the internal transcribed spacer 2 region of the ribosomal RNA cistrons.

This study reaffirms *Gyrocochlea s.s.* (type species: *Helix vinitincta* Cox, 1868) as a geographically restricted genus comprising only a handful of species occurring in the Border Ranges of NSW and Qld following Stanisic (1990) but with the additional exclusion of *Gyrocochlea curtisiana* (Hedley, 1912) which will require re-assignment to a new genus. *Gyrocochlea vinitincta* (Cox) is re-examined and new anatomical details presented. Eight new genera comprising *Cumberlandica n. gen.*, *Planorbacochlea n. gen.*, *Barringtonica n. gen.*, *Comboynea n. gen.*, *Cancellocochlea n. gen.*, *Dictyoropa n. gen.*, *Richmondaropa n. gen.* and *Macphersonia n. gen.* are diagnosed to accommodate species ranging from mid-eastern to north-eastern NSW. Seventeen new species are described comprising *Cumberlandica wilsoniana n. sp.*, *Cu. wombeyanensis n. sp.*, *P. dandahra n. sp.*, *P. manningensis n. sp.*, *P. nambucca n. sp.*, *P. watagan n. sp.*, *P. graemei n. sp.*, *P. reticulata n. sp.*, *P. yessabahensis n. sp.*, *P. parriwiensis n. sp.*, *Barringtonica polblue n. sp.*, *B. montana n. sp.*, *Comboynea boorganna n. sp.*, *Co. mountaineer n. sp.*, *Co. winghamensis n. sp.*, *Cancellocochlea coolongolook n. sp.* and *Ca. heatherae n. sp.* *Gyrocochlea impressa* Hedley, 1924, *G. planorbis* Hedley, 1924, *G. conferta* Hedley, 1924, *G. prava* Hedley, 1924, *G. eurythma* Hedley, 1924, *G. conjuncta* (Iredale, 1941), *G. ponderi* Stanisic, 2010, *G. hawkesburyana* Stanisic, 2010 and *G. canalis* Stanisic, 2010 are variously reassigned to the new genera. Neotypes are erected for *Gyrocochlea impressa* Hedley, 1924 (holotype crushed) and *Roblinella conjuncta* Iredale, 1941 (holotype presumed lost). Lectotypes are designated for *Gyrocochlea conferta* Hedley, 1924 and *Gyrocochlea eurythma* Hedley, 1924. The anatomy of the Sydney Basin *Diphyoropa saturni* (Cox, 1864) is figured for the first time and comparisons made between the shell morphology of this species and the general *Gyrocochlea* shell form. A number of species from other genera are also investigated using molecular techniques to provide a broader view of the east coast charopid radiation. The biogeographical implications of generic ranges and the conservation status of species are discussed.

Key words: Charopidae, *Gyrocochlea*, new genera, new species, systematics, biogeography

Introduction

Charopid land snails are widely distributed through most major landmasses of the Southern Hemisphere. They are found in New Zealand (Climo 1981; Barker 2005; Marshall and Barker 2008), Australia (Hedley 1892, 1912, 1924; Gabriel 1930; Iredale 1937; Kershaw 1955, 1956; Stanisic 1987, 1990, 1993a, 1993b; Smith 1992; Hyman and Stanisic 2005; Stanisic *et al.* 2010), South America (Simone 2006) and South Africa (Emberton *et al.* 1997, Herbert and Kilburn 2004). They are also found on most islands and archipelagos of the south and west Pacific Ocean (Preston 1913; Iredale 1944, 1945; Solem 1983). In the Northern Hemisphere, the family as currently understood is found in northern South America (Hausdorf 2005), Central America (Correa-Sandoval 1999; Pérez and López 2003) and western U.S.A. (Branson 1975).

The family is known to be highly diverse in Australia although a great many of the recognised species remain undescribed (Hyman and Stanisic 2005). Most Australian charopids inhabit the east coast margins of the continent, where rainforest persists, often in small refugial patches. Here, any areas of suitable habitat are usually occupied by the family (Stanisic 1990; Smith 1992). The snails are predominantly litter dwellers and generally, areas of high litter occurrence, such as rainforest, have large numbers of species. High species diversity is observed in the temperate rainforests of south-eastern Australia (including Tasmania), the subtropical rainforests of central eastern Australia, the dry rainforests (vine thickets) of sub-coastal southern Queensland; and the montane rainforests of the high mountains of the Wet Tropics in north-eastern Queensland (Stanisic 1987, 1993a, 1993b; Stanisic *et al.* 1994). A significant number of species also occur in wet sclerophyll forests (Stanisic unpublished data). There are also a number of described and undescribed species occurring in the south-west of Western Australia (Iredale 1939; Solem 1983; Stanisic personal observation).