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Molecular approach to identify sibling species of the *Ceriodaphnia cornuta* complex (Cladocera: Daphniidae) from Australia with notes on the continental endemism of this group

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Abstract

Taxonomy of the genus *Ceriodaphnia* Dana, 1853 (Cladocera: Daphniidae) has been uncertain for a long time, the species richness was often underestimated due to (1) a morphological similarity among the species and (2) their great morphological inter- and intra- populational variability. Support for this conclusion comes from the first analysis of three molecular markers for Australian representatives of this genus, two mitochondrial (COI and 16s) and one nuclear (28s) genes. Sequence analysis indicates the existence of three sibling Australian species belonging to the complex. Further work is required to establish species boundaries and investigate potential morphological diagnoses. Comparison of COI sequences with all other published sequences from the genus *Ceriodaphnia* revealed no common clades among continents pointing to the regional endemism within this group, which could suggest its Mesozoic differentiation.

Key words: Cladocera, Daphniidae, *Ceriodaphnia cornuta*, COI, Australia, barcoding

Introduction

The taxonomy of the genus *Ceriodaphnia* Dana, 1853 (Cladocera: Daphniidae) is confusing. The genus currently comprises 12 valid species worldwide, but also includes 21 *species inquirenda*, and 24 species which look like junior synonymous of previously described taxa (Kotov 2013). There is limited morphological and genetic evidence to support this proliferation of names.

Of the six species of *Ceriodaphnia* recorded from Australia to date, only *Ceriodaphnia cornuta* Sars, 1885, was formally described from Australia (Sars 1885). Subsequent investigators demonstrated that it is a very common taxon on this continent (Henry 1922; Smirnov & Timms 1983; Shiel & Dickson 1995; Smirnov 1995). *D. cornuta*-like morphotypes are also widely distributed across the globe in the tropics and subtropics (Sars 1901, 1916; Jenkin 1934; Frey 1982; Elías-Gutiérrez *et al.* 2006) including some isolated archipelagos (Schabetsberger *et al.*, 2009). Some other taxa from this group, *C. rigaudi* Richard, 1894 and *C. cornigera* Xiezhi, 1977, were described from Asia (Richard 1894; Xiezhi 1977). The taxonomy of *C.* cf. *cornuta* has long been uncertain; the species richness is often underestimated due to: (1) a high inter- and intra-population variability and (2) morphological similarity between cryptic species (Berner 1985). Apparently, the *C. cornuta* group consists of several cryptic species with no morphological diagnostic traits identified to date (Berner 1985, 1987; Elmoor-Loureiro 1998), although it does not mean that such differences are absent at all.

It is well known that genetic analysis in taxonomic studies has added a new understanding to species differentiation and speciation patterns within taxonomic groups. Elías-Gutiérrez *et al.* (2008) first applied a molecular approach (the COI barcoding) to the analysis of diversity of the *cornuta*-like taxa in Mexico and Guatemala and found three taxa morphologically similar to *C. rigaudi*, plus a related fourth species. Before the current study, no genetic analysis had been performed on members of the *Ceriodaphnia* genus from Australia. The aim of this study was to use DNA markers, two mitochondrial (COI and 16s) and one nuclear (28s) genes, to investigate the diversity of Australian members of the *Ceriodaphnia cornuta* cryptic species complex.

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