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The Gondwanan relict oribatid genus *Crotonia* (Acari: Oribatida: Crotoniidae) from rainforests in Queensland and Northern New South Wales: new species show a mixed pattern of short-range and long-range endemism

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Abstract

Twelve new species of *Crotonia* are described from rainforests in Queensland and Northern New South Wales, Australia. *Crotonia sterigma* **sp. nov.** belongs to a new species group, Borbora, to which *C. borbora* Luxton, 1987, redescribed here, and for which a lectotype is designated, is re-assigned from the Capistrata group. Six species belong to the Capistrata group (*C. brisbanensis* **sp. nov.**, *C. maculata* **sp. nov.**, *C. monteithi* **sp. nov.**, *C. daviesae* **sp. nov.**, *C. weiri* **sp. nov.**, and *C. yeatesi* **sp. nov**.). Previously-known Australian members of the Capistrata group, *C. ardala* Luxton, 1987 and *C. capistrata* Luxton, 1987, are redescribed and lectotypes are designated. Four species, *C. cameroni* **sp. nov**., *C. queenslandiae* **sp. nov.,** *C. eungella* **sp. nov.** and *C. seemani* **sp. nov**., belong to the Cophinaria species-group and one, *C. raveni* **sp. nov**. is morphologically so different from other *Crotonia* spp. that it is also assigned to a new species-group. This brings the number of species of *Crotonia* recorded from Australia to 27, almost half of the global fauna. Most

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species show localised distribution in rainforest remnants, characteristic of short-range endemics with apparently low dispersal capabilities, are subject to constraints of body water balance and thus confined to wet habitats. They can be divided into those associated with a northern region (ca. 16–18°S) centred around the Wet Tropics from Cape Tribulation to the Walter Hill Range (*C. ardala*, *C. borbora*, *C. capistrata*, *C. monteithi*), a central region (ca. 20–18°S) from Mount Dryander to Byfield (*C. cameroni*, *C. eungella*, *C. seemani*) and a southern region (ca. 26-28°S) from the Conondale Range to Whian Whian (*C. brisbanensis*, *C. daviesae*, *C. queenslandiae*, *C. raveni*, *C. weiri*, and *C. yeatesi*). Other species are long-range endemics. *Crotonia maculata* **sp. nov.** is found throughout all three regions and *C. sterigma* **sp. nov.** is found in both the central and southern regions. Several species show a series of characters that are considered to function in aiding the accumulation and retention of mineral soil and organic debris adhering to the cerotegument. These characters include the elongation of the caudal apophyses, expansion or elongation of the notogastral shield, retention of the elongated, flagelliform nymphal form of the notogastral setae and retention of nymphal exuviae in the caudal region. The layer of detritus covering the cerotegument was dissected off the cuticle of adult female and tritonymphal *C. raveni* **sp. nov.** and was found to constitute more than the mean wet weight of the mites. The acquisition by the mites of the detrital layer after each moult is considered to function as a general anti-predator system and in the reduction of body water loss.

Key words: mite, taxonomy, oribatid, morphology, systematics, biogeography, Australia, cerotegument, predators, water balance

Introduction

Crotonia Thorell, 1876 is a Gondwanan genus of 68 species (including those described herein) of very large oribatid mites (median length 1200 µm, range 700–1725), typically with a well-developed cerotegument covered in debris, and with variously-developed caudal apophyses. All species are sexual, with some secondary sexual characteristics other than smaller body size of the males (Colloff & Cameron, 2009). Some 71% of species-diversity is found in the Australasian region, 13% from the Neotropics and 9% from the Afrotropical region, with a mix of harmonic Gondwanan and disjunct trans-Pacific vicariant distribution patterns, with evidence of oceanic dispersal events (Wallwork, 1977; Colloff, 2009b; Colloff, 2010).

About three quarters of species for which habitat data has been recorded are found in corticolous and saxicolous moss and litter in wet forests, with a tendency towards occurrence at higher altitudes with decreasing latitude. *Nothofagus* rainforest is a common macrohabitat of temperate species (Hammer, 1966; Balogh & Csiszár, 1963; Luxton, 1982; Łochyńska, 2008a; Colloff, 2009a; Colloff & Perdomo, 2009). Other species, notably from New Zealand (Luxton, 1982) and South Africa (Colloff, 1990) are found in shrubland or open woodland, in litter and soils and on plants. Two species from sub-Antarctic islands are associated with tussock grassland macrohabitats (Wallwork, 1966; Colloff, 2009b).

Crotonia may have re-evolved sexuality from thelytokous parthenogenetic ancestors (Domes *et al*., 2007, but cf. also Goldberg & Igić, 2008 for an alternative scenario). In a phylogenetic analysis Colloff & Cameron (2009) placed the Gondwanan sexual clade of *Crotonia*, *Austronothrus* and *Holonothrus* within the subfamily Crotoniinae; the parthenogenetic, Holarctic genus *Camisia* within the Camisiinae as the sister clade of the Crotoniinae, and the parthenogenetic genera *Heminothrus*, *Platynothrus* and *Paracamisia* within the subfamily Heminothrinae, the sister clade of Crotoniinae + Camisiinae. These authors placed these three subfamilies in the Camisiidae Oudemans, 1900. In fact, the oldest available family-group name is not Camisiidae but Crotoniidae Thorell, 1876.

The assumption that *Crotonia* spp. are arboreal and that this is linked to re-evolution of sexuality (Maraun *et al*., 2009; Heethoff *et al*., 2009) is not entirely supported by the ecological evidence (Colloff & Cameron, 2009). In terms of arboreal habitat, *Crotonia* spp. can be considered to be associated with mosses and other epiphytes on tree trunks in wet forests, but they appear not to be major components of the canopy acarofauna. Corticolous epiphytes may often be part of a habitat continuum from saxicolous and terricolous mosses on the forest floor (Colloff, 2009a). *Crotonia* spp. are occasionally present in samples from canopy knockdown samples (as exemplified by *C. queenslandiae* **sp. nov.** herein), but they have not been reported from leaves and stems in quantitative studies of oribatid canopy taxa (Walter *et al*., 1994; Walter, 1995).

Colloff (2009b) proposed six species-groups of *Crotonia*, of which three occur in Australia: Capistrata, Cophinaria and Lanceolata. Colloff & Perdomo (2009) found morphologically homogeneous groups of