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A new genus and species of Discozerconidae (Acari: Mesostigmata) from carabid beetles (Coleoptera: Carabidae) in New Zealand

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Abstract

Berzercon ferdinandi **gen. nov., sp. nov.** (Acari: Mesostigmata: Discozerconidae) is described from carabid beetles in New Zealand. As in all Discozerconidae, *Berzercon* has large ventrally-directed opisthogastric suckers. However it is distinctive in its long marginal setae, tripartite gnathotectum, fused palp tibia and tarsus, the female's large dome-shaped genital shield and the male's highly modified hypostomal seta *h1*. This new species also represents the first Heterozerconina from an insect host.

Key words: Heterozerconina, Sejida, taxonomy, species relationships, leg chaetotaxy

Introduction

Mites in the cohort Heterozerconina (Acari: Mesostigmata) are remarkable for their large opisthogastric suckers that allow them to adhere to their smooth, cylindrical hosts: centipedes (Discozerconidae) or millipedes, snakes and worm-lizards (Heterozerconidae). Only adult mites have suckers and associate with hosts. Their diet is unknown, although blood was found in the gut of *Amheterozercon amphisbaenae* (Flechtmann & Johnston), suggesting that parasitism occurs in species associated with reptiles (Flechtmann & Johnston 1990). Immature life stages are described only for *Narceoheterozercon ohioensis* Gerdeman & Klompen 2003 and an undescribed Brazilian species (Krantz & de Moraes 2011). The immature stages are free-living and *N. ohioensis* is predacious (Gerdeman *et al*. 2000; Gerdeman & Garcia 2009 (2010); Krantz & de Moraes 2011). The cohort-level relationships are unresolved. Johnston in Norton *et al*. (1993) suggested a sister-group relationship with the Trigynaspida, but Klompen (2000) and Lekveishvili & Klompen (2004) presented DNA evidence showing that the Heterozerconina are highly modified members of the cohort Sejina. Although these data are the best available evidence for classifying the Heterozerconina, Lindquist *et al*. (2009) continued to treat the group as its own separate cohort pending further evidence regarding the placement of these two enigmatic families. This treatment is followed here. The Heterozerconidae is a small family of 20 described species (Fain 1989; Klompen *et al*. 2013). The most remarkable synapomorphy of the family is the independent evolution of podospermy and a secondary sperm access system. Podospermy is best known in the Parasitina and Dermanyssina and, in both groups, involves the modification of the moveable digit for sperm transfer. Podospermy probably also occurs in some Antennophorina (e.g., Diplogyniidae), where males have modified cheliceral excrescences on the moveable digit, presumably to assist in transfer of the spermatophore (e.g., Seeman 2012). In contrast, male Heterozerconidae have a coiled spermatodactyl, but on the fixed digit of the chelicera (Di Palma *et al*. 2008). Female Heterozerconidae also possess a unique secondary sperm access system (Gerdeman *et al*. 2000).

The Discozerconidae comprises just three species: the type species, *Discozercon mirabilis* Berlese, collected from *Scolopendra subspinipes* Leach in Java (Berlese 1910); *Discozercon derricki* Domrow from scolopendrid centipedes in Australia (Domrow 1956); and *Discomegistus pectinatus* Trägårdh from *Scolopendra gigantea* L. in Trinidad (Trägårdh 1911). Unlike the Heterozerconidae, male discozerconids lack a coiled spermatodactyl, although *Discomegistus* does have a sexually dimorphic fixed digit (Trägårdh 1911), perhaps representing a precursor to the heterozerconid spermatodactyl. Female *Dz. derricki* lack a secondary sperm access system (pers. obs.), but whether this system is present in *Dz. mirabilis* and *Dm. pectinatus* is unknown.

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A noteworthy feature of *B. ferdinandi* is the presence of a keel on the gnathotectum, typically present only in the trigynaspid cohort Antennophorina. The keeled gnathotectum is expressed strongly in some antennophorine superfamilies (e.g., Megisthanoidea, Celaenopsoidea) but weakly in others and is sometimes absent (e.g., most Parantennulidae) (Kim 2004). The keel of *B. ferdinandi* is weak, visible as a long thin line, as seen in Fedrizzioidea, Aenictequoidea, Antennophoroidea and some Paramegistidae.

The presence of a keel may represent convergence, as a similar keel-like structure occurs in *Pyriphis* (Ologamasidae) (pers. obs.). However, a trigynaspid-heterozerconine sister-group relationship was suggested by Norton *et al*. (1993). Within the Trigynaspida, members of the Paramegistidae are associated with millipedes, lizards and snakes (e.g. Kim & Klompen 2002; Klompen & Austin 2007; Baker & Seeman 2008) and share at least a strikingly superficial resemblance. Many paramegistids are discoid, have smooth dorsal shields with numerous marginal setae, and extensive ventral shields, but these are probably independent adaptations to living on similar hosts. More curious are similarities between the chelicerae of the Paramegistidae and Heterozerconidae (and *Discomegistus*): both have a moveable digit with a fine row of cilia-like teeth and two interdigital membranes (one truly interdigital, the other on the fixed digit). Again, this probably reflects convergence in feeding habits on the same host taxon, but the likelihood of this being so is harder to dismiss due to the complex morphology of the chelicerae.

The modified hypostomal setae *h1* of *B. ferdinandi* are also found in some sejid and trigynaspid taxa. In the Sejida setae *h1* are often small and scale-like (e.g., Fig. 12.7D in Lindquist *et al*. 2009) but are not sexually dimorphic and bear little resemblance to the strong thick *h1* setae of *B. ferdinandi*. In the Trigynaspida, *Promegistus* (Parantennuloidea: Promegistidae) have strikingly modified setae *h1*, being large and membranous in both sexes (pers. obs.), and many *Ophiomegistus* (Paramegistidae) and Antennophoridae have *h1* much stronger than other hypostomal setae (e.g., Goff 1980; Wisniewski & Hirschmann 1992). Sexual dimorphism occurs in the hypostome and hypostomal setae of some Trigynaspida, most spectacularly in the Celaenopsidae, Euzerconidae, Schizogyniidae and Megacelaenopsidae (e.g., Kinn 1970; Funk 1974, 1980; Rosario 1988), but also less impressively in the Fedrizziidae (Seeman 2007). However these taxa are unlikely sister-groups of the Heterozerconina, being within well-established superfamilies (Celaenopsoidea and Fedrizzioidea, respectively). Instead, these partly illustrate the diversity of independently derived modifications found in male trigynaspid mites, presumably for transferring the spermatophore to the female's genital opening. Other examples are the Asternoseiidae (modified sternal setae, see Karg & Schorlemmer 2011, erroneously placed in Fedrizziidae), Saltiseiidae (modified gnathotecta; Walter 2000), Antennophoridae and Diplogyniidae (modified chelicerae; e.g., Wisniewski & Hirschmann 1992; Seeman 2012), and Fedrizziidae and Klinckowstroemiidae (modified presternal shields; e.g., Rosario 1988; Seeman 2007). Therefore, although the modified hypostomal setae of *B. ferdinandi* might provide a link with either the Sejida or Trigynaspida, the sexual dimorphism observed in these setae is likely to have evolved independently.

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