New Zealand's giant springtails (Collembola: Holacanthella): now available in purple.

Frank Ashwood[1] and Frans Janssens[2]

[1] University of Canterbury, Christchurch, New Zealand
Email: francis.ashwood@canterbury.ac.nz

[2] Evolutionary Ecology, Department of Biology, University of Antwerp, Antwerp, Belgium.

Introduction

New Zealand has a proportionately high number of endemic invertebrates (Taylor-Smith et al. 2020), of which the 'giant' Collembola of the genus *Holacanthella* Börner, 1906 are a particularly impressive yet understudied group (Stevens et al. 2007). Members of this genus represent the largest springtail species on Earth, and are among the most visibly striking – possessing brightly coloured dorsal digitations in a range of yellow, red, orange and white pigmentation (Salmon 1942). Species of *Holacanthella* are known to have restricted spatial distributions and display significant within-species variation in colour and digitation development (Stevens et al. 2007). Here, we present the first known observation of purple digitation colouring in *Holacanthella*, and discuss the finding in context of known morphological variation and taxonomic uncertainties in this genus.

Observation details

On 30th June 2024 at approximately 10:00 am NZST, **FA** discovered three *Holacanthella* springtails on the underside of decaying wood in regenerating native podocarp forest beside the Fyffe Palmer Track, Kaikōura, South Island (Lat/Long: -42.331759, 173.638106). On initial inspection of the specimens in habitat, it appeared that all three were lacking in any of the usual vibrant yellow or red/orange dorsal digitation pigmentation, appearing generally dark blue to the naked eye. Upon closer investigation using professional macrophotography equipment (Nikon D850 DSLR camera, with Laowa 100mm f/2.8 2:1 ultra macro lens and

KX-800 twin macro flash unit), it became clear that most of the digitations covering the dorsal surface of the springtails were in fact a purple colour. This was the case for all three springtails encountered (two adults of approx. 6 mm length, and one juvenile approx. 4 mm in length) (Fig. 1). All specimens were extensively documented using macrophotography and released.

Description

The specimens possessed a dense covering of two different lengths of apically rounded dorsal digitations: the longer ones purple and shorter ones yellow/orange, with a row of lighter/white digitations on either side of the dorsal midline of each segment, running the full length of the animal (Fig. 2). No well-developed digitations were present on the antennae, although a small, raised patch of pigmentation featured on antennal segments II and III in the adults. Based on the morphological features visible from the photographs taken (with the exception of the purple digitation colour), the species are at present considered a loose match for *Holacanthella brevispinosa* using the identification key of Stevens et al. (2007). However, this identification requires confirmation through proper investigation of a collected specimen (none were collected at the time due to lack of permit for invertebrate sampling on NZ Department of Conservation land).

Image analysis

Validation of the colour of the specimens from images was carried out by **FJ** using image processing software to reduce the number of RGB colours to its minimum (1 bit channel posterisation). This confirmed the small dorsal spines were yellow or red, and the larger lateral spines were purple, and in some cases white with purple/blue edges. The antennal colour remained equal to the dorsum colour (blue/purple).

Figure 1. In habitat photographs of an adult *Holacanthella* sp. with longer purple and shorter yellow/red dorsal digitations (top), a juvenile *Holacanthella* sp. with similar dorsal digitations (middle), and an adult viewed from above, showing arrangement of purple and white dorsal digitations (bottom). Image © Frank Ashwood

Figure 2. In-habitat photographs of an adult *Holacanthella* sp. viewed from the rear, showing arrangement of purple and white posterior dorsal digitations (top), and the same image following posterisation, showing purple and white colour distribution in the larger digitations (bottom). Image © Frank Ashwood

Discussion

In a national review of the distribution of the five described species of *Holacanthella*, Stevens et al (2007) revealed restricted species distributions and significant within-species variation in colour and digitation development. Following the identification key of Stevens et al (2007), our specimens most closely resemble *H. brevispinosa*, albeit with notable differences in digitation colour, the possession of two distinct digitation lengths and the apparent lack of a tooth on the internal crest of the claws. Two different *H. brevispinosa* morphs have been reported for South Island, with different dorsal digitation sizes and arrangements, as well as significant location-specific colour variation in the species *Holacanthella paucispinosa* (Stevens et al. 2007). Based on the degree of variation observed, the possibility of cryptic species complexes within these two described species was suggested. As such, the specimens reported in this manuscript may represent a cryptic species or, perhaps more likely, a local variant of an already described species. A third possibility is that they may represent a random aberration within an isolated number of specimens, whereby localised environmental conditions (e.g., temperature during embryonic development) have caused unusual morphological developments (Cassagnau 1955; Hopkin 1997; Bonfanti et al. 2023).

This finding highlights our continued paucity of knowledge regarding *Holacanthella* taxonomy, species distributions and ecology. As saproxylic invertebrates of native forest, they are involved in essential organic matter decomposition processes, and highly vulnerable to forest management or land use changes which remove their specialist habitat - native deadwood - from the forest floor. Given their vulnerability to localised species extinctions, these endemic animals should be considered of great national conservation importance, but to date no Collembola species feature on the New Zealand Threat Classification System (NZTCS) (DOC 2024). *Holacanthella* spp. remain under-studied and poorly understood members of New Zealand's endemic invertebrate fauna, desperately in need of greater taxonomic and spatial distribution research to support their conservation.

Next steps

Follow-up work is needed to confirm the species identity of the observed specimens, and determine whether this observation represents a new species, a local variant or simply an isolated aberration of a few specimens. Suggested next steps are to revisit the site to survey the extent of the population and obtain permits to collect specimens for morphological and molecular study, to enable accurate species identification.

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