Zootaxa 3768 (3): 201–252
www.mapress.com/zootaxa/
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Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3768.3.1
http://zoobank.org/urn:lsid:zoobank.org:pub:AE4CFE9E-2AB6-4099-8F50-C49310808060

Twenty seven new species of *Orthocentrus* (Hymenoptera: Ichneumonidae; Orthocentrinae) with a key to the Neotropical species of the genus

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Accepted by J. T. Jennings: 23 Dec. 2013; published: 26 Feb. 2014

Abstract

We describe 27 new species of parasitoid wasps of the genus *Orthocentrus* (Ichneumonidae: Orthocentrinae) from the Neotropical region, where previously only one species of the genus (*O. insularis* Ashmead) was known, and provide a key to all described *Orthocentrus* species of the region. Based on previous studies and additional material that we have seen from the region, describing these species is only an initial attempt to document the Neotropical orthocentrine fauna.

Key words: Amazonia, Central America, koinobiont, parasitoid wasp, Project LLAMA, tropical rainforest, taxonomy

Introduction

Small-bodied parasitoid wasps comprise one group of organisms whose tropical fauna remains remarkably understudied (Smith *et al.* 2008, Santos & Quicke 2011, Arias-Penna 2012, Veijalainen *et al.* 2012, 2013). In a recent paper, Veijalainen *et al.* (2012) reported a minimum of 177 undescribed species of Orthocentrinae—a cosmopolitan subfamily of small-bodied parasitoid wasps in the large family Ichneumonidae—from the forests of Ecuadorean Amazonia and Central America. The number was 3.7 times and 12.6 times the described 38 tropical and 14 Neotropical orthocentrine species, respectively (Yu *et al.* 2012).

Orthocentrines are koinobiont endoparasitoids (see Askew & Shaw 1986) of bibionomorph Diptera, which typically develop in fungal fruiting bodies, although species of *Megastylus* are parasitoids of predatory larvae of Keroplatidae (e.g. Mansbridge 1933, Wahl 1996). As pointed out by Broad (2010), Orthocentrinae species and genera are in need of modern revisions and potential reclassification. Problems in adequately defining orthocentrine genera, which are often virtually cosmopolitan, arise from the lack of information about morphological diversity in tropical species, and the fact that most generic definitions are based on temperate material (Townes 1971). The *Orthocentrus* genus-group is a rather well-defined assemblage within the Orthocentrinae (Wahl & Gauld 1998), recognisable by the face and clypeus forming a single, curved surface, and by the long antennal scape. Within the *Orthocentrus* genus-group, seven genera are currently recognised, although some of these are doubtfully monophyletic (Broad 2010).

Orthocentrus can be defined by the reduced mandibles, which hardly meet medially when closed and have reduced dentition. Additionally, the lower edge of the clypeus is usually convex (sometimes truncate though) and the hind wing nervellus (Cu+cu-a) is often inclivous, rather than reclivous, as in other *Orthocentrus*-group genera. The ovipositor is always short in *Orthocentrus*. However, wing venation, sculpture, presence or absence of notauli and various other characters that tend to be fairly uniform in other genera, all vary considerably within *Orthocentrus* and there must be considerable doubt as to whether this is really a monophyletic genus.

Very little is known about the biology of *Orthocentrus* species, other than reported rearings from *Sciophila* (Mycetophilidae) (Kolarov & Bechev 1995, Šedivý & Ševčik 2003), but not from isolated hosts. Like other orthocentrines, *Orthocentrus* species are presumed to be koinobiont endoparasitoids, and their emergence from the host pupa supports this. No cocoon is spun. The generally robust habitus of *Orthocentrus* species suggests that they force their way out of (or into) the substrate. Most species of the ichneumonid subfamily Metopiinae have similarly convex faces and robust bodies, which seem in this case to be adaptations towards forcing their way through webbings and tunnels of host Lepidoptera. We still have much to learn about even the basic aspects of *Orthocentrus* biology.

Veijalainen *et al.* (2012) found *Orthocentrus* to be the best-represented genus in their Neotropical study areas in terms of number of morphospecies. Here, we describe 27 new Neotropical species of *Orthocentrus*, many of which were discovered in the course of Veijalainen *et al.*'s (2012) study. Although this is not a comprehensive revision of Neotropical *Orthocentrus* this study serves two main purposes: (1) the species discovered by Veijalainen *et al.* (2012) are formally described, proving that 'unknown biodiversity' can fairly rapidly be transformed into named biodiversity; (2) we propose several species-groups for the Neotropical fauna and illustrate some of the extensive morphological diversity within *Orthocentrus*. This study is a significant contribution to our knowledge of *Orthocentrus*, given that only one species, *O. insularis* Ashmead (Fig. 5 F), has previously been described from the Neotropics, from the Caribbean island of St. Vincent (Yu *et al.* 2012). Indeed, prior to this work there were only 49 described species of *Orthocentrus* in the world (disregarding dubious names and fossil taxa). The fact that these Neotropical species are new was confirmed by comparing the material to the type series of *O.*

Material examined. Holotype female: 'Costa Rica, Sn José Pv, 20 km S, Empalme, Cerro de la Muerte, 2800 m, III–VI.90, Gauld' (BMNH).

Paratypes: 1 ♀ as holotype; 2 ♀ and 1 ♂ as holotype but II–III.90 (all BMNH); 1 ♀ as holotype but VII–IX.90, 1 ♀ Costa Rica, San José Pv., Cerro de la Muerte, Quercus forest, 2700 m, II.89, Gauld & Mitchell (USNM); 2 ♀ Costa Rica, 2800 m, San José Pv, 20 km S Empalme, XI.88–I.89, I. Gauld (ZMUT).

Discussion

We have provided the descriptions of 27 new species of *Orthocentrus* yet many more species of the genus still await description. Having focused on Neotropical material, we have noticed that for a large portion of the sampled material, it is difficult to find morphological characteristics that would allow their separation to reliable species. In such cases, it is advisable to incorporate extensive genetic data; the DNA barcoding, COI mtDNA gene can provide useful data for clustering individuals into species (see Veijalainen *et al.* 2012).

Our results are similar to those found by Arias-Penna *et al.* (2012). Previously only three Neotropical species of *Trichacis* Foerster (Hymenoptera: Platygastroidea: Platygastridae) were known, and they described 24 species more. The species of this genus are also koinobiont endoparasitoids of dipteran larvae (however, on gall midges, Cecidomyiidae, the larvae of which typically feed on plant tissues, causing galls, whereas fungus gnats feed on fungi). Together, the results imply that the tropical fauna of koinobiont endoparasitoid wasps—a group of parasitoids that has been particularly interesting in the debate on the suggested anomalous diversity gradient of parasitoids (e.g., Santos & Quicke 2011, Veijalainen *et al.* 2013)—is inadequately investigated and requires much more taxonomic attention in the future. Given that parasitoid wasps comprise a large proportion of organisms, and are intimately dependent on their hosts' population dynamics, understanding diversity patterns of a group of parasitoids will also be a major step forward in elucidating drivers of speciation in the tropics.

Acknowledgements

We are grateful for Dr. Terry L. Erwin (USNM; Smithonian Institution), M.Sc. Isrrael Gómez (ZMUT) and Dr. John T. Longino (LLAMA Project, NSF grant DEB-0640015) for providing material for this study, and Kari Kaunisto (University of Turku) for assisting with the imaging of the specimens. The extensive collections of Costa Rican Hymenoptera in BMNH have been built up over the years mainly through the huge efforts of the late Ian Gauld and John Noyes. This research received support from the SYNTHESYS Project http://www.synthesys.info/ which is financed by European Community Research Infrastructure Action under the FP7 "Capacities" Program. Jenny and Antti Wihuri Foundation provided financial support for A. Veijalainen. The Peruvian Amazonian material was mainly collected with financial support to I.E. Sääksjärvi from the Ministry of Education (Finland), Kone Foundation (Finland) and the Entomological Society of Finland. The Ministry of Agriculture (Peru) provided the collecting and export permits for the Peruvian samples.

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