Zootaxa 3753 (6): 549–572
www.mapress.com/zootaxa/

Article

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

http://dx.doi.org/10.11646/zootaxa.3753.6.3
http://zoobank.org/urn:lsid:zoobank.org:pub:8DF3EFAA-F8CC-4D4C-A830-D07D76C2D1C0

New species and records of the earthworm genus *Ramiellona* (Annelida, Oligochaeta, Acanthodrilidae) from southern Mexico and Guatemala

CARLOS FRAGOSO* & PATRICIA ROJAS
Laboratorio de Invertebrados del Suelo. Red de Biodiversidad y Sistemática. Instituto de Ecología A. C. Carretera Antigua a Coatepec No. 351. Col. El Haya. Xalapa, Veracruz. C.P. 91070 MEXICO
E-mail: carlos.fragoso@inecol.mx; patricia.rojas@inecol.mx*

Abstract

Three new species from the Mexican states of Tabasco and Chiapas are added to the acanthodrilid earthworm genus *Ramiellona*, *R. microscolecina* **sp. nov.**, *R. tojolabala* **sp. nov.** and *R. teapaensis* **sp. nov.** They belong to a group of species with penial setae and last pair of hearts in segment 12. All are holandric and the spermathecae have either a flat circular diverticle in a segment anterior to that of the ampulla (*R. microscolecina* **sp. nov.** and *R. tojolabala* **sp. nov.**) or two ovoidal and sessile diverticles on opposite sides in the same segment of the ampulla (*R. teapaensis* **sp. nov.**). *Ramiellona americana* (Gates) is re-described from a single specimen from central Guatemala, and the diagnosis of *Ramiellona lasiura* (Graff) from El Salvador is emended after reinvestigating a paratype specimen from the Senckenberg Naturmuseum Frankfurt. On the basis of several individuals from different populations of the Mexican states of Chiapas and Tabasco, the morphological variation of *Ramiellona strigosa setosa* Righi is described and its relationship with the Guatemalan *Ramiellona strigosa strigosa* Gates and *Ramiellona eiseni* (Michaelsen) is discussed. Finally, the position of *Ramiellona* within Acanthodrilidae and its relation to genera of the doubtful Octochaetidae is discussed.

Key words: Acanthodrilidae, Octochaetidae, Tabasco, Chiapas, meronephridia

Resumen

Se describen tres nuevas especies del género acanthodrilido *Ramiellona* (*Ramiellona microscolecina* **sp. nov.**, *Ramiellona tojolabala* **sp. nov.** and *Ramiellona teapaensis* **sp. nov.**) colectadas en los estados de Tabasco y Chiapas, México. Los nuevos taxa pertenecen al grupo de especies con quetas peneales y con el último par de corazones en el segmento 12. Las tres nuevas especies son holándricas y con el divertículo de las espermatecas en forma de disco aplanado en el segmento anterior a donde se encuentra el ámpula (*R. microscolecina* **sp. nov.** y *R. tojolabala* **sp. nov.**) o con dos divertículos opuestos, ovoidales, sésiles y en el mismo segmento del ámpula (*R. teapaensis* **sp. nov.**). Se presenta también la re-descripción de *Ramiellona americana* (Gates) con base en un individuo colectado en la parte central de Guatemala así como la corrección de algunos caracteres de *Ramiellona lasiura* (Graff) a partir de la revisión de un paratipo depositado en el Museo Senckenberg de Historia Natural de Frankfurt. Con base en el estudio de numerosos ejemplares provenientes de varias localidades de los estados mexicanos de Chiapas y Tabasco, se presenta la variación morfológica de la subespecie *Ramiellona strigosa setosa* Righi y su relación con las especies guatemaltecas *Ramiellona strigosa strigosa* Gates y *Ramiellona eiseni* (Michaelsen). Por último, se discute la ubicación de *Ramiellona* en Acanthodrilinae y su relación con los controversiales octochaetidos.

Palabras clave: Acanthodrilidae, Octochaetidae, Tabasco, Chiapas, meronefridios

Introduction

The genus *Ramiellona* was erected by Michaelsen (1935) to include *Ramiellona stadelmanni* Michaelsen, a meroic species from Honduras with acanthodrilin male terminalia, tubular prostates, one gizzard and with internal calciferous lamellae. Some years later Gates (1962), in the seminal paper of this genus, described three species from Guatemala (*Ramiellona guatemalana* Gates*, Ramiellona balantina* Gates and *Ramiellona strigosa* Gates) and

Accepted by R. Schmelz: 27 Nov. 2013; published: 10 Jan. 2014

Jamieson (2001) and Jamieson *et al.* (2002), in the first molecular analysis of the family Megascolecidae, reassigned the "acanthodrilin dichogastrins" *Dichogaster* and *Neodiplotrema* to Acanthodrilinae, and the "megascolecin dichogastrins" to Megascolecinae *s.l.* but no formal assignation was made of the other dichogastrins of Jamieson (1971), in which was included *Ramiellona*.

Results of a comprehensive molecular phylogenetic analysis of earthworms (James & Davidson 2012) support the polyphyletic nature of the octochaetids, but due to lack of sampling the authors had to leave open the question where to place several genera from North America, Central America and the Caribbean —including *Ramiellona*— that comply with the diagnosis of octochaetids. They suggest to include in Diplocardinae (Eisen 1900) the multigiceriate and holoic or meroic genera from USA, Mexico and the Caribbean (*Diplocardia, Protozapotecia, Trigaster, Zapotecia, Zapatadrilus*), excepting the genera *Dichogaster* and *Eutrigaster* which are currently placed in the resurrected Benhamiinae (Csuzdi 1996, 2010). In the case of *Ramiellona*, the only neotropical monogiceriate meroic genus that is not in Benhamiinae, we consider unlikely that it is closely related to the octochaetids of the Australian region, which include *Octochaetus* Beddard, the genus that gave the name of the family. It remains to figure out the relationships of *Ramiellona* with several octochaetid genera from India, and whether the genus is more closely related to the holoic acanthodrilids of Mexico and Central America (e.g. *Diplotrema, Kaxdrilus, Lavellodrilus*) than to the meroic multigiceriate acanthodrilids in the same region (Mexican *Zapatadrilus* and other Caribbean related genera). One hypothesis would be that *Ramiellona* belongs to a Neotropical lineage that acquired the meronephric condition independently of other lineages with similar nephridia from other regions of the world. Another possibility would be that *Ramiellona* is indeed phylogenetically linked to some Indian (*e.g. Bahlia, Calebiella, Ramiella*; Julka 1988) and New Zealand genera (*e.g. Deinodrilus, Hoplochaetina*; Lee 1959) with similar lamellae and extramural dorsal calciferous glands, and which differ much from the discrete ventral pockets of lamellae in the Mexican and Central American acanthodrilid genera (*e.g. Balanteodrilus* and *Kaxdrilus*). However, the separation of ancient Mexico from Gondwana more than 160 Ma ago (end of Jurassic), when India was still joined to Gondwana, does not favour this scenario.

Finally, it seems that the diversification of *Ramiellona* has occurred mainly in the mountains of Guatemala, El Salvador and the southern Mexican state of Chiapas, where volcanic activity has been constant since the early Oligocene, ca. 32 Ma ago (Alvarado *et al.* 2007). How much of the isolation and differentiation between species and populations has been due to the orographic changes occurred during the formation of these mountain systems, is something that should be investigated in the next years. Another way in which speciation in this genus could have occurred is observed in the morphologically closely related species pair *R. strigosa setosa* and *R. microscolecina* **sp. nov.** (Fragoso 1993), where the coupling between morphological differentiation (acanthodrilin *vs.* microscolecin male genitalia) and the different habitat (forest soils *vs*. riparian soils) suggests some kind of ecological speciation.

Obtaining fresh tissue from species of this genus, in order to perform molecular analysis, will be necessary to generate robust phylogenies. Only then it will be possible to test biogeograpical hypothesis, calculate the degree of relatedness between species and find support for the kind of speciation mechanisms operating in *Ramiellona*.

Acknowledgments

To Antonio Angeles Varela for his help in the elaboration of maps and figures, and the preparation and selection of the scanning electrone microscope samples of penial setae; to Tiburcio Laez for obtaining the electron microscope figures; to Pedro Reyes for providing the material from Guatemala; to P. Lavelle and Sheila Uribe for donating some of the material collected in the tropical rain forests of Chiapas and Tabasco. We also want to thank Dr. J. Römbke for his kindness in facilitating the types for revision, deposited at the Senckenberg Naturmuseum Frankfurt. Finally we acknowledge comments of two anonymous referees that greatly improved the manuscript.

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