

# INSECTA MUNDI

A Journal of World Insect Systematics

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0083

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Paradoxosomatidae (Polydesmida) in the Middle East; first records of  
the Diplopoda from Saudi Arabia

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Date of Issue: July 24, 2009

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*Insecta Mundi* 0083: 1-6

**Published in 2009 by**

Center for Systematic Entomology, Inc.

P. O. Box 141874

Gainesville, FL 32614-1874 U. S. A.

<http://www.centerforsystematicentomology.org/>

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Printed Copy    ISSN 0749-6737

On-Line        ISSN 1942-1354

CD-ROM        ISSN 1942-1362

## The milliped families Spirostreptidae (Spirostreptida) and Paradoxosomatidae (Polydesmida) in the Middle East; first records of the Diplopoda from Saudi Arabia

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**Abstract.** The class Diplopoda, represented by the families Spirostreptidae (Spirostreptida) and Paradoxosomatidae (Polydesmida), is recorded from Saudi Arabia for the first time. *Archispirostreptus transmarinus* Hoffman, 1965 (Spirostreptidae) inhabits the Jabal Al-Hijaz Mountains in the southwest, and the Paradoxosomatidae, represented by an unidentifiable, indigenous female, occurs in a “wadi” in the center of the country. Other Middle Eastern familial records are documented, and occurrences in the Arabian Peninsula are mapped. Males, necessary to identify the paradoxosomatid, may be encountered if samplings are timed to coincide with seasonal rains.

### Introduction

Species of the arthropod class Diplopoda are major detritivores in forest ecosystems throughout the Temperate and Tropical zones of the world. Some species can survive and even thrive in arid environments, primarily by occurring in forested summits of desert mountains or in litter near water sources like transient springs and permanent oases. Rarely are millipeds found in sandy or gravelly biotopes or in ones lacking shade, moisture, or plant litter.

Because of the aridity and expanse across the desertine Arabian Peninsula, few milliped species and low taxonomic diversity are anticipated in Saudi Arabia. However, scattered oases, “wadis” or valleys, and the Jabal Al-Hijaz Mountains, which extend along the Red Sea for around 1,080 km (675 mi.) from Jeddah into southwestern Yemen, could provide habitat for indigenous millipeds in this environmentally harsh country. Apparently, however, no one has ever sampled there as to my knowledge no published Saudi records exist, either of native or introduced species. Until 2009, I had not seen a preserved Saudi milliped sample in a North American or European repository.

While perusing holdings at the Florida State Collection of Arthropods (FSCA), Gainesville, USA, in March, I discovered three Saudi milliped samples, one with a female Paradoxosomatidae (order Polydesmida) and two with representatives of the Spirostreptidae (Spirostreptida). The paradoxosomatid was taken in a “wadi” northwest of Ar Riyad (= Riyadh), and while even the tribe is uncertain, it is an indigenous form and not a “tramp” species introduced by man. The spirostreptids, comprising five specimens with one adult male, occupy the Jabal Al-Hijaz Mountains in southwestern Saudi Arabia. Herein, I report these samples, which constitute the first milliped records from Saudi Arabia, and summarize familial representations in the Arabian Peninsula and the Middle East south of Turkey. The Spirostreptidae (sensu Hoffman 1980 and Shelley 2003) are absent from both Turkey and Iran; Turkish paradoxosomatids are reviewed by Jeekel (1968), Hoffman and Lohmander (1968), and Enghoff (2006), and Iranian representatives are listed by Enghoff and Moravvej (2005). I thank G. B. Edwards and C. Whitehill, for access to the FSCA collection and loan of the Saudi samples, and R. L. Hoffman, for access to material at the Virginia Museum of Natural History (VMNH), Martinsville, USA. Dr. Hoffman provided a presubmission review of the manuscript, and he and C. A. W. Jeekel advised on identities. Sergei Golovatch also provided beneficial review commentary, and Jonathan Raine prepared the base maps. C. W. Mills III characterized the environments in which he collected the specimens.

**Spirostreptida: Spirostreptidae:  
Triaenostreptinae**

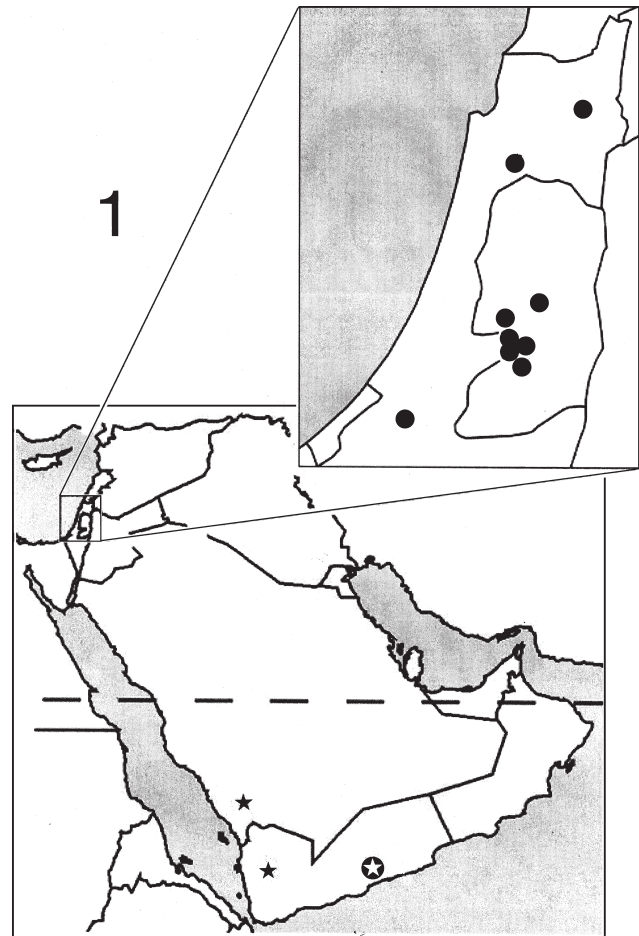
***Archispirostreptus transmarinus* Hoffman,  
1965**

Proposed by Hoffman (1965) for two males and a female from San'a (= Sanaa), Yemen, *A. transmarinus* is also known from Obal-Der el Oetsch and Sanaa-El Geraas (exact locations unknown) in this country (Attems 1914, Krabbe 1982). It is the second Yemeni spirostreptid, the other being *A. arabs* (Pocock, 1895), from an unspecified site in the Hadramawt (= Hadramaut) region. *Archispirostreptus* Silvestri, 1895, extends across Africa to Senegal in the west and Mozambique in the south, and traverses the Red Sea into the southwestern Arabian Peninsula (Hoffman 1965, 1980; Krabbe 1982; Jeekel 1985; Hamer 1998). The Saudi locality is in the Jabal Al-Hijaz Mountains of Asir Emirate, the coolest and wettest region of Saudi Arabia with the highest mountains in the country, which is located some 360 km (225 mi) north-northwest of San'a and around 88 km (55 mi) north of the Yemeni border. The millipeds were discovered beneath stones in a dwarf Juniper/grassy habitat at the edge of a steep escarpment; the site was moist with condensate from fog sweeping up the escarpment face from the Red Sea Coast. The male conforms to Hoffman's description, the only differences being a longer and more prominent lateral telocoxal lobe and a shorter field of ramose telopodal spines. The specimens were too brittle and tightly coiled to be straightened for measurements, but the following ring counts, which include the epiproct, were obtained:

- M - 65 rings, epiproct legless.
- F - 58 rings, epiproct + 4 rings legless.
- F - 59 rings, epiproct legless.
- F - 63 rings, epiproct legless.
- F - 64 rings, epiproct + 1 ring legless.

**Locality: Saudi Arabia, Asir Em.,** Khamis Mushayt, Jabal Al-Hijaz Mts., 2,050 m (6,724 ft), F, 20 February 1997, and M, 3F, 12 June 1997, C.W. Mills III. **New Country Record for the Species, Genus, Family, Order, and Class.**

Figure 1 depicts occurrences of *Archispirostreptus* and the Spirostreptidae in the Arabian Peninsula and Middle East. A second species, for which *A. syriacus* (Saussure, 1859) is the oldest name, occurs some 1,984 km (1,240 mi) to the northwest in central and northern Israel and the West Bank (Hoffman 1965, 1980; Krabbe 1982; Jeekel 1985). Despite holding 68 years of taxonomic priority, Krabbe (1982) considered *syriacus* a junior synonym of *A. tumuliporus judaicus* (Attems, 1926), but following Bercovitz and Warburg (1985) and Tabacaru (1995), I recognize this much older name at the species level. Published literature reports of *A. syriacus* are cited below followed by a new one; here and in the Paradoxosomatini account, modern geopolitical terminology is employed with older names in parentheses. As nearly as I can deter-



**Figure 1.** Distributions of *Archispirostreptus*, Spirostreptidae, and Spirostreptida in the Arabian Peninsula and Middle East. Dots, *A. syriacus*, Stars, *A. transmarinus*; Star in Dot, *A. arabs*.

mine, *A. syriacus* is known only from Israel (around the Sea of Galilee, Jerusalem and vicinity, and the northern extremity of the Negev Desert) and the West Bank; north to south, its known distribution extends for only 304 km (190 mi).

**SYRIA.** Syria in general (Attems 1914), but I know of no published records from this country in the modern sense.

**ISRAEL.** Jerusalem (Mar Saba, Jehosaphat Valley), Teverya [= Tiberias], Megiddo, Moshav Brosh (= Brosh) (Attems 1926, Krabbe 1982, Bercovitz and Warburg 1985).

**WEST BANK.** Bayt Lahm (= Bethlehem), Saffa [a small village west of Ramallah], Wadi Ali (entrance to the Judean Hills) (Attems 1914, 1926; Krabbe 1982).

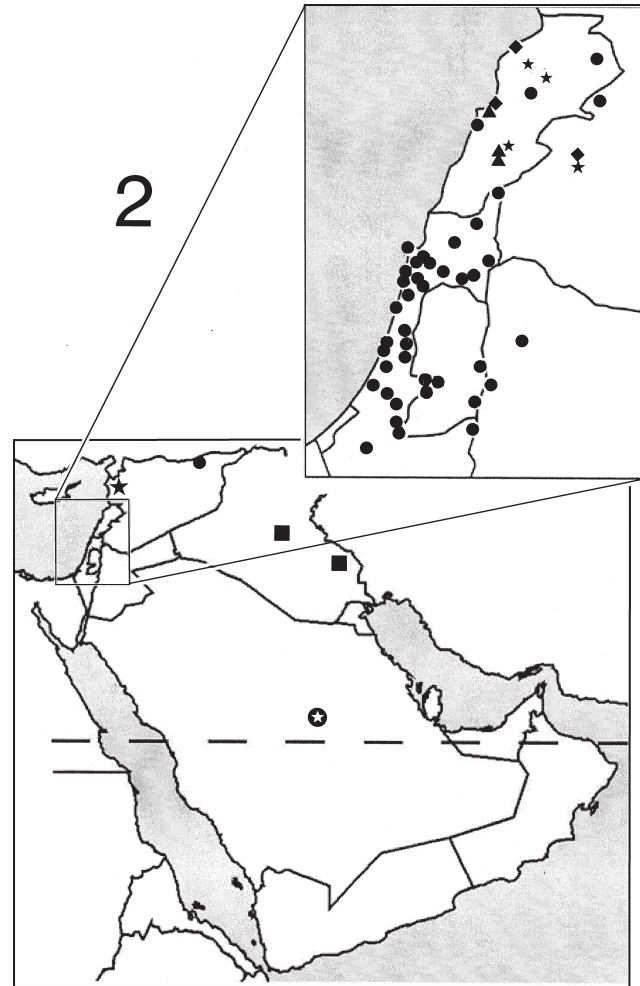
**New Record. Israel,** Jerusalem, old Hebrew cemetery on Mt. of Olives, 3M, 3F, March 1965, I. Brown (VMNH).

**Polydesmida: Paradoxosomatidae:  
Paradoxosomatinae: ?Paradoxosomatini**

Classifying a female Middle Eastern paradoxosomatid essentially amounts to guess work, but the Saudi individual likely belongs to the Paradoxosomatini, which is represented in the northern Arabian Peninsula by *Lohmanderodesmus* Schubart, 1934, and *Tetrarthrosoma* Verhoeff, 1898 (Jeekel 1968, Hoffman and Lohmander 1968, Tabacaru 1995, Enghoff 2006). Another possibility is Xanthodesmini, as the general body form conforms to known individuals of *Streptogonopus* Attems, 1914, occurring to the east, in India, Pakistan, and beyond, and to the west, in Eritrea and Ethiopia (Hoffman 1980; Golovatch 2000, 2009). As the latter tribe has never been recorded from the Middle East, Paradoxosomatini is more likely, and I assume such for this contribution. I present below localities of regional paradoxosomatines the most dominant being *T. syriacus*, the only Israeli paradoxosomatid, along with data for the Saudi specimen, which occurs some 736 km (460 mi) south-southwest of *T. persicum* (Humbert and Saussure, 1869) at Al Amarah, Iraq, the most proximate tribal locality. GMIS denotes localities on the Global Myriapod Information System website ([http://www.gbif2.mwn.de/GloMyrIS/GloMyrIS\\_locraw\\_1.php?val\\_TaxID=2038718](http://www.gbif2.mwn.de/GloMyrIS/GloMyrIS_locraw_1.php?val_TaxID=2038718)), and locatable records are depicted in Fig. 2.

*Lohmanderodesmus galeatus* Schubart, 1934

**LEBANON.** Lebanon in general (Enghoff 2006). Jabal, Taj (= Jage), Tannourine el Faouqa (Hoffman and Lohmander 1968).



**Figure 2.** Occurrences of Paradoxosomatidae in the Arabian Peninsula and the Middle East south of Turkey. Dots, *Tetrarthrosoma syriacus*; Squares, *T. persicum*; Diamonds, *T. horticola*; Triangles, *T. asproengaeum*; Stars, *Lohmanderodesmus galeatus*; Star in Dot, unidentified Saudi Arabian female. Some symbols denote more than one closely proximate locality; the dashed line represents the Tropic of Cancer.



*Tetrarthrosoma asproengaeum* Hoffman and Lohmander, 1968

LEBANON. Lebanon in general (Enghoff 2006). Dekouane, Bkasin (= Bkassine), Tannourine el Faouqa (Hoffman and Lohmander 1968).

*Tetrarthrosoma broelemanni* (Verhoeff, 1940)

IRAQ. Iraq in general (Enghoff and Moravvej 2005). No specific Iraqi localities are known.

*Tetrarthrosoma horticola* (Attems, 1911)

LEBANON. Lebanon in general (Enghoff 2006). 10 km (6.3 mi) NE Beyrouth (= Beirut), Grotte de Ghita; 6 km (3.8 mi) S Trablous (= Tripoli), Grotte Dahr el Ain (Hoffman and Lohmander 1968).

SYRIA. Syria in general (Enghoff 2006). Damascus (Attems 1911, 1926, 1937; Hoffman and Lohmander 1968).

*Tetrarthrosoma persicum* (Humbert and Saussure, 1869)

IRAQ. Baghdad; Al Amarah (= Amara) (Humbert and Saussure 1869; Attems 1898, 1937; Brolemann 1921).

*Tetrarthrosoma syriacum* (Humbert and Saussure, 1869)

IRAQ. Iraq in general (Tabacaru 1995).

ISRAEL. Israel in general (Tabacaru 1995, Enghoff 2006). Ramleh, Jerusalem, Kouloniyyeh (Porat 1893). Hefa (= Haifa) (Hoffman and Lohmander 1968, Tabacaru 1995). Yafo (= Jaffa) (Verhoeff 1920, Moritz and Fischer 1978). Rehovot (= Rehoboth) (Verhoeff 1923, Tabacaru 1995). Davir (= Davira) (Golovatch and Wytwer 2009). Mt. Carmel and vicinity, Mt. Gilboa, base of Mt. Hermon, Adolam Nature Reserve, Allone Abba, Allonim, Basmat Tivon, Beit Gurvin, Beit Nir, Bet Oren, Elyakim, Galil, Giveat Ela near Timrat, Giveat Yeshaiahu, Kfar Haruv, Lahav, between Lehavim Junction and Tel Shoket, Mader near Akko, Muhraqa, Nir Banim, Ramot Avishur, Samaria Foothills, Sansan near Mata, Shiqmona, Shores, Tel-Aviv University Campus, Tel Junction, Tivon, West Milek, and Zharya (GMIS).

JORDAN. Jordan in general (Enghoff 2006). Totes Meer [Dead Sea], Amman (= Hammam Zara) (Schubart 1934).

LEBANON. Lebanon in general (Tabacaru 1995, Enghoff 2006). Khalde (around 12 km [7.5 mi] S Beyrouth (= Beirut)), Zabbugha (= Zabboud) (Hoffman and Lohmander 1968, Enghoff 2006).

SYRIA. Syria in general (Humbert and Saussure 1869; Attems 1898, 1937; Verhoeff 1914, 1920; Tabacaru 1995; Enghoff 2006). Damascus (Attems 1926, Hoffman and Lohmander 1968). Tell Halaf (Schubart 1934). Oasis de Damascus, Ataïbé, Anti-Laban, and Doummar (near Damascus); Qasioun (Attems 1898, 1926).

WEST BANK. Dead Sea vicinity (Schubart 1934, Hoffman and Lohmander 1968, Tabacaru 1995). Ein Prat SW Ariha (= Jericho) (GMIS).

?Paradoxosomatini, genus and species unknown

SAUDI ARABIA, *Ar Riyad Em.*, Wadi Huraymala, 100 km (67.2 mi) NW Ar Riyad (N25°, 7', 29"; E46°, 6', 53"), 770 m (2,526 ft), subadult F, 17 March 1988, C. W. Mills III, Y. N. Aldryhim, A. S. Al-Dawood. **New Country Record for the Family, Order, and Class.**

According to Wikipedia (<http://en.wikipedia.org/wiki/Wadi>), “wadi” is an Arabic term for a valley or dry riverbed that contains water only during heavy rains. “Wadi Huraymala” is a densely vegetated agricultural area in central Saudi Arabia just north of the Tropic of Cancer that is surrounded by the Tuwayq Mountains and receives substantial run off water during the rainy season (<http://plantdiversityofsaudiarabia.info/Biodiversity-Saudi-Arabia/Vegetation/Huraimala.htm>). The paradoxosomatid was collected around the crowns of understory plants beneath an *Acacia arabica* tree, the understory consisting of scattered *Rhazya stricta* and *Lycium shawii*. It is difficult to envision collection of only one individual if dozens or hundreds were present, so this female would seem to have been alone. In the Namib Desert of southwestern Africa, *Cnemodesmus riparius* Shelley and Crawford, 1996 (Polydesmida: Paradoxosomatidae: Cnemodesmini) appears, and in substantial numbers, only after rare floods of the otherwise dry Kuiseb River; when the moisture disappears, so do the millipeds (Shelley

and Crawford 1996). The Saudi collectors probably were not deliberately searching for millipedes, so the situation in Wadi Huraymala may be similar to that in Namibia; perhaps that individual was the only one available because the habitat was too dry at the end of the seasonal rains, which last from January-March in this region of Saudi Arabia. If future collecting efforts are timed to coincide with rains, more individuals may be available including the males necessary to identify the species. Ephemeral abundance and surface activity, as demonstrated by *C. riparius*, would be an advantageous life history pattern throughout desert regions of Africa, the Middle East, and Asia, and timing samplings to coincide with infrequent rains is advisable.

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**Received May 13, 2009; Accepted June 2, 2009.**