

EARTHWORMS (OLIGOCHAETA: LUMBRICIDAE,  
CRIODRILIDAE AND ACANTHODRILIDAE)  
OF HATAY PROVINCE, TURKEY, WITH DESCRIPTION  
OF THREE NEW LUMBRICIDS

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The earthworm fauna of Turkey has recently been summarized by CSUZDI and on the whole 66 lumbricid species were reported. Three new species: *Dendrobaena mahunkai*, *Dendrobaena omodeoi* and *Perelia hatayica* spp. n. from the newly collected earthworm material in the Hatay Province, Turkey, are described. Altogether, 20 species were recorded (families Lumbricidae, Criodrilidae, and Acanthodrilidae); 12 to 15 species are autochthonous to the region and five to eight species are introduced. The earthworm fauna of Hatay shows more similarity with that of the Levant than with that of Anatolia, indicating that the area around the Bay of Iskenderun is part of the Levant zoogeographic province rather than of the Anatolian one. The new earthworm data indicate that neither the river Orontes nor the Amanus Mountains form the northern border of the Levant province as proposed earlier by POR, but the Taurus Mts should be regarded as a geographic barrier.

Key words: Oligochaeta, Lumbricidae, earthworms, *Dendrobaena*, *Perelia*, new species, Turkey, Levant

## INTRODUCTION

Earthworm research in Turkey goes back to ROSA, who reported the first earthworm species *Allolobophora syriaca* ROSA, 1893 from Samsun, North Anatolia. Sporadic reports have since been presented (ROSA 1905, POP 1943, OMODEO 1952, 1955, ZICSI 1973, 1981, 1985), which are based on materials collected as by-products of other investigations. The only other large-scale and expedient investigation has been carried out by Italian zoologists in the late 1980s and summarized by OMODEO and ROTA in two consecutive papers (1989, 1991). This systematic earthworm sampling resulted in the description of a new genus and several new species. However, collection activities focused only on the northern part of the country and thus vast territories have yet to be investigated. This is also true for

the area surrounding the Bay of Iskenderun (officially the Hatay Province, Turkey) localized south of the Taurus Mts where the border between the Anatolian and the Levantine zoogeographic provinces (KOSSWIG 1955) is found. Our collection efforts were therefore aimed at: (i) contributing to the earthworm zoogeography, fauna, and taxonomy of this previously scarcely known region, (ii) contributing to the border delineation between the Levantine and Anatolian zoogeographic provinces because some authors (*e.g.*, POR 1975) claimed, without providing supporting evidence, that the border between both provinces could be formed also by the river Orontes and by the Amanus Mts. In such a scenario, the area around of the Bay of Iskenderun should belong to the Anatolian zoogeographic province, and (iii) contributing to the information on the origin of autochthonous earthworm fauna of Cyprus as proposed by PAVLÍČEK and CSUZDI (2006).

## MATERIALS AND METHODS

Earthworms were collected by the diluted formalin method (RAW 1959), and by digging and hand-sorting. The combination of both methods provides a more complete sampling of species because the formalin method alone is not efficient in collecting species living in mineral soil layers or in a horizontal system of burrows. The animals were killed in 75% ethanol, preserved in 4% formol and after several days transferred to 75% ethanol.

For histological study, several postclitellar segments were embedded in paraffin, 10 µm wide microscopic cross-sections were sliced using a Microm Rotary-microtome, and stained with hematoxylin and eosin (KRUTSAY 1980).

Setal arrangements are also presented graphically according to the pie diagram proposed by MORENO *et al.* (2007).

All material is deposited in the Oligochaeta collection of the Hungarian Natural History Museum, Budapest (Z/ and AF/ catalogue numbers in material sections).

Full descriptions, synonymies, and world distributions of the introduced or “cosmopolitan” species are to be found in BLAKEMORE (2002) and are therefore not discussed here.

## SYSTEMATICS

### Family Lumbricidae RAFINESQUE-SCHMALTZ, 1815

#### *Aporrectodea caliginosa* (SAVIGNY, 1826)

*Aporrectodea caliginosa*: MİSİRLİOĞLU, 2002: 18, MİSİRLİOĞLU, 2004: 3, CSUZDI & PAVLÍČEK 2005: 88, CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 4.,

*Allolobophora caliginosa* subsp. *trapezoides*: OMODEO 1952: 9.

*Allolobophora caliginosa* f. *trapezoides*: OMODEO 1955: 2.

*Allolobophora caliginosa*: ZICSI 1973: 229.

*Nicodrilus caliginosus trapezoides*: OMODEO & ROTA 1989: 181.

*Nicodrilus caliginosus* complex: OMODEO & ROTA 1991: 176.

*Aporrectodea trapezoides*: MİSİRLİOĞLU, 2004: 2.

Material examined: Z/14892 two ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/14895 five ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/14897 two ex. Turkey, Iskenderun, Karaağaç, bank of irrigation canal, grassy and brushwood area, leg. C. A. TURKMEN, 13 May 2005. Z/15082 two ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLÍČEK, 16 April 2006. Z/15094 ten ex. Turkey, Hatay Province, near the road between Reyhanlı to Kırıkhan, near Karahöyük (6 km N from Reyhanlı), 36°28'58"N, 36°14'20"E, bank of a small stream inside an agricultural plain, leg. T. PAVLÍČEK, 12 April 2006. Z/15101 one ex. Turkey, Hatay Province, near the road from Akbez to Islahiye, 36°52'N, 36°33'E, limestone and alluvial sediments, leg. T. PAVLÍČEK, 16 April 2006.

Remarks: All the specimens belong to the “*trapezoides*” morph of this highly variable parthenogenetic species.

#### *Aporrectodea jassyensis* (MICHAELSEN, 1901)

*Allolobophora jassyensis*: ZICSI 1973: 229, OMODEO & ROTA 1989: 182.

*Aporrectodea jassyensis*: MİSİRLİOĞLU, 2002: 18, CSUZDI & PAVLÍČEK 2005: 89.

*Aporrectodea jassyensis jassyensis*: CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 6.

Material examined: Z/15072 two ex. Turkey, Hatay Province, near the right bank of the Orontes River, about two km below the St. Simeon Monastery, 36°06'N, 36°02'E, partly limestone hills with small orchards and garrigue, leg. T. PAVLÍČEK, 13 April 2006. Z/15076 eight ex. Turkey, Hatay Province, near the road Harbiye to Yayladağı, 36°05'N, 36°07'E, small wadi covered by Mediterranean garrigue with oak, *Pistacia palaestina*, *Arbutus* etc., leg. T. PAVLÍČEK, 14 April 2006. Z/15097 one ex. Turkey, Hatay Province, near the road between Belen and Antakya, 36°28'58"N, 36°14'20"E, mountain limestone region covered by Mediterranean garrigue with small *Quercus*, *Asphodelus*, *Euphorbia*, *Crataegus*, *Azalea*, *Pine* etc., leg. T. PAVLÍČEK, 11 April 2006. Z/15103 nine ex. Turkey, Hatay Province, above Narlica, 5 km NE from Hatay, 36°13'42"N, 36°12'40"E, mountain region covered by macquis with *Poterium spinosum*, *Asphodelus*, *Euphorbia*, and planted pines, leg. T. PAVLÍČEK, 12 April 2006.

#### *Aporrectodea rosea* (SAVIGNY, 1826)

*Allolobophora (Notogama) rosea*: ROSA 1905: 5.

*Allolobophora rosea* f. *typica*: POP 1943: 15.

*Eisenia rosea* f. *acystis*: OMODEO 1952: 9.

*Allolobophora rosea* f. *balcanica*: OMODEO 1955: 2.

*Allolobophora rosea*: OMODEO 1956: 334, ZICSI 1973: 229, OMODEO & ROTA 1991: 177.

*Aporrectodea rosea*: MISIRLIOĞLU 2002: 1, CSUZDI & PAVLÍČEK 2005: 89, CSUZDI, ZICSI & MISIRLIOĞLU 2006: 6.

Material examined: Z/15081 four ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLÍČEK, 16 April 2006. Z/15092 one ex. Turkey, Hatay Province, mountains above Belen, 36°30'N, 36°11'E, pine forest, leg. T. PAVLÍČEK, 17 April 2006. Z/15093 five ex. Turkey, Hatay Province, near the road between Reyhanlı to Kırıkhan, near Karahöyük (6 km N from Reyhanlı), 36°28'58''N, 36°14'20''E, bank of a small stream inside an agriculture plain, leg. T. PAVLÍČEK, 12 April 2006.

### *Dendrobaena byblica byblica* (ROSA, 1893)

*Dendrobaena byblica*: ZICSI 1973: 220, OMODEO & ROTA 1989: 185.

*Dendrobaena byblica byblica*: CSUZDI, ZICSI & MISIRLIOĞLU 2006: 8.

Material examined: Z/15085 two ex. Turkey, Hatay Province, left bank of the Orontes River, near Karşıyaka, 36°05'N, 36°03'E, mud sediments covered by *Tamariscus* and reed, leg. T. PAVLÍČEK, 14 April 2006. Z/15089 11 ex. Turkey, Hatay Province, near the road from Hamam to Kırıkhan, 36°30'N, 36°29'E, small lake surrounded by a stone steppe, leg. T. PAVLÍČEK, 17 April 2006.

### *Dendrobaena orientalis* ČERNOSVITOV, 1940

*Dendrobaena semitica*: OMODEO 1952: 13.

*Dendrobaena orientalis*: CSUZDI, ZICSI & MISIRLIOĞLU 2006: 11.

Material examined: Z/15071 six ex. Turkey, Hatay Province, near the right bank of the Orontes River, about two km below the St. Simeon Monastery, 36°06'N, 36°02'E, partly limestone hills with small orchards and garrigue, leg. T. PAVLÍČEK, 13 April 2006.

### *Dendrobaena pentheri* (ROSA, 1905)

*Allolobophora (Notogama) pentheri* ROSA, 1905: 6.

*Dendrobaena pentheri*: ZICSI 1973: 223, OMODEO & ROTA 1989: 195, MISIRLIOĞLU 2004: 2, CSUZDI, ZICSI & MISIRLIOĞLU 2006: 12.

Material examined: Z/15074 one ex. Turkey, Hatay Province, near the road Harbiye to Yayladağı, 36°05'N, 36°07'E, small wadi covered by Mediterranean garrigue with oak, *Pistacia palaestina*, *Arbutus* etc., leg. T. PAVLÍČEK 14 April 2006. Z/15106 one ex. Turkey, Hatay Province, above Narlica, 5 km NE from Hatay, 36°13'42''N, 36°12'40''E, mountain region covered by macquis with *Poterium spinosum*, *Asphodelus*, *Euphorbia*, and planted pines, leg. T. PAVLÍČEK, 12 April 2006.

*Dendrobaena semitica* (ROSA, 1893)

*Dendrobaena semitica*: CSUZDI, ZICSI & MISIRLIOĞLU, 2006: 15.

Material examined: Z/15065 three ex. Turkey, Hatay Province, near the road Antakya to Samandağ, about five km from Samandağ, 36°08'N, 36°01'E, near a river, deep soil sediments, surrounded by citrus orchards, leg. T. PAVLÍČEK, 13 April 2006. Z/15070 eight ex. Turkey, Hatay Province, near the right bank of the Orontes River, about two km below the St. Simeon Monastery, 36°06'N, 36°02'E, partly limestone hills with small orchards and garrigue, leg. T. PAVLÍČEK, 13 April 2006. Z/15075 seven ex. Turkey, Hatay Province, near the road Harbiye to Yayladağı, 36°05'N, 36°07'E, small wadi covered by Mediterranean garrigue with oak, *Pistacia palaestina*, *Arbutus* etc., leg. T. PAVLÍČEK 14 April 2006. Z/15104 one ex. Turkey, Hatay Province, above Narlica, 5 km NE from Hatay, 36°13'42''N, 36°12'40''E, mountain region covered by macquis with *Poterium spinosum*, *Asphodelus*, *Euphorbia*, and planted pines, leg. T. PAVLÍČEK, 12 April 2006.

***Dendrobaena mahunkai* sp. n.**

(Figs 1, 2, 5, 6, 9)

Holotype: Z/15238 Turkey, Hatay Province, near the road between Belen and Antakya, 36°28'58''N, 36°14'20''E, mountain limestone region covered by Mediterranean garrigue with small *Quercus*, *Asphodelus*, *Euphorbia*, *Crataegus*, *Azalea*, *Pine* etc., leg. T. PAVLÍČEK, 11 April 2006. Paratypes: Z/15098 two ex. Locality same as that of the Holotype.

*Etymology*. The new species is dedicated to Prof. Dr. SÁNDOR MAHUNKA (Budapest) on his seventieth birthday.

*Diagnosis*. Length: 38–50 mm, diameter: 4–5 mm, setae distant. Pigmentation red-violet. Clitellum on ½ 25–33, tubercles lacking. Male pore on 15 large. Septa 7/8–9/10 thickened. Three pairs of vesicles in 9, 11, 12; spermathecae lacking. Calciferous glands with diverticula in 11, 12. Nephridial bladders “octaedra” type.

*Description*. Holotype: length 50 mm, diameter just after the clitellum 5 mm. Number of segments 118. Paratypes: 38–46 mm long and 4–5 mm wide. Number of segments 89–108. Colour red-violet, paler on ventral side. Prostomium tanylobous, first dorsal pore at the intersegmental furrow 5/6 (Figs 1–2). Setae distant, setal formula at segment *xl*: aa:ab:bc:cd:dd = 2.44:1.11:2.22:1:4.4 (Fig. 6). Male pores large on the segment *xv* covering also the neighboring segments. Nephridial pores irregularly alternated between setal line *b-d*. Clitellum on segments *xxv* (*xxvi*)–*xxxiii*. Tubercula pubertatis and genital papillae lacking.

*Internal characteristics*: Septa 6/7, 10/11–11/12 slightly, 7/8–9/10 strongly thickened. Free testes and funnels paired in segments *x–xi*. Seminal vesicles present in segments *ix*, *xi* and *xii*. Spermathecae lacking. Calciferous diverticula present in segments *xi*, *xii*. Hearts appeared in segments *vi–xi*, extraoesophageal vessel lacking. Nephridial bladders is of “octaedra” type (Fig. 5). Crop

in segments *xv-xvi*, and gizzard in segments *xvii-xviii*. Typhosolis large, bi-lobed. Longitudinal muscle layer is of pinnate type (Fig. 9).

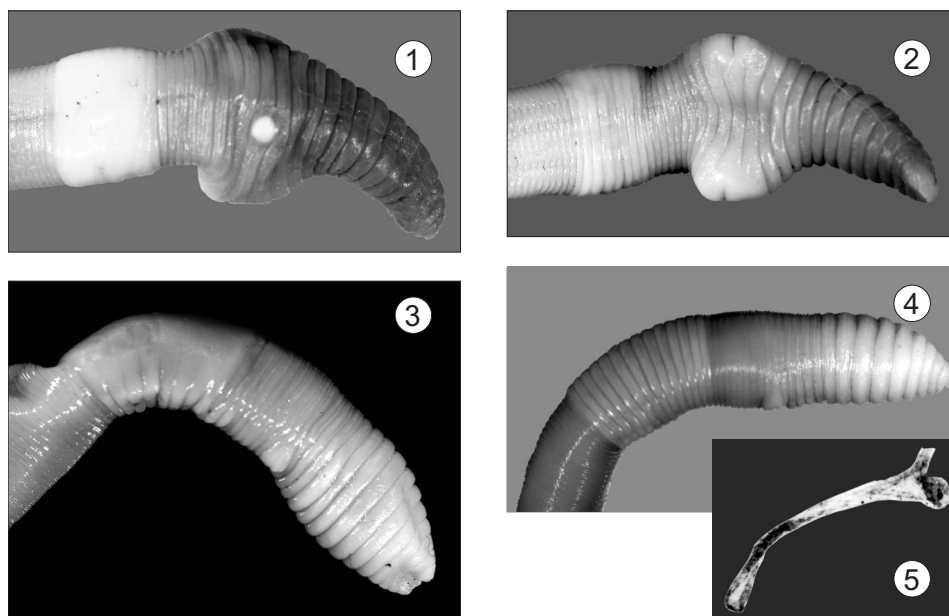
Remarks. The new species seems to be close to the Levantine *D. samarigera* (ROSA, 1893) and *D. hauseri* ZICSI, 1973 but differs from both in the position of the clitellum. These three species form a homogenous group characterized by a tanylobous head, dark purple-red pigmentation, lack of tubercles and spermathecae.

***Dendrobaena omodeoi* sp. n.**  
(Figs 3, 7, 10)

Holotype: Z/15240 Turkey, Hatay Province, near the road between Belen and Antakya, 36° 28'58''N, 36°14'20''E, mountain limestone region covered by Mediterranean garrigue with small *Quercus*, *Asphodelus*, *Euphorbia*, *Crataegus*, *Azalea*, *Pine* etc., leg. T. PAVLÍČEK, 11 April 2006.

Paratypes: Z/15095 12 ex. Locality same as that of the Holotype.

*Etymology.* The new species is dedicated to Prof. Dr. PIETRO OMODEO (Siena), the pioneer of earthworm research in Turkey, prominent taxonomist, and evolutionary biologist.



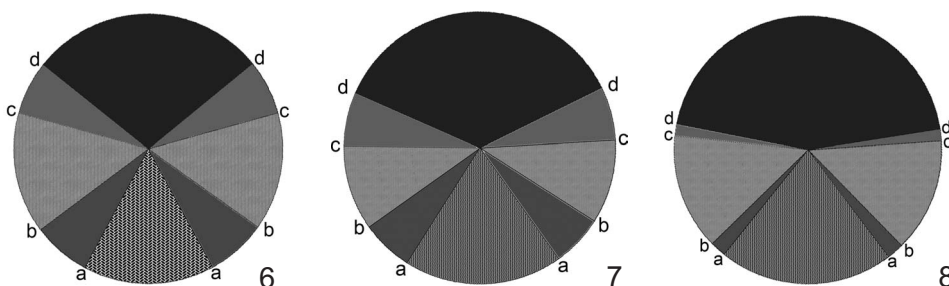
**Figs 1–5.** *Dendrobaena mahunkai* sp. n.: 1 = dorsal view of the anterior part of the body, 2 = ventral view of the anterior part of the body; 3 = *D. omodeoi* sp. n., dorso-lateral view of the anterior part of the body; 4 = *Perelia hatayica* sp. n., dorso-lateral view of the anterior part of the body; 5 = *Dendrobaena mahunkai* sp. n., nephridial bladder from the postclitellar region

**Diagnosis.** Length: 52–70 mm, diameter: 5–6.5 mm, setae widely paired. Pigmentation lacking. Clitellum on 26–33, tubercles on 30–31. Male pore on 15 large. Septa 6/7–9/10 slightly thickened. Two pairs of vesicles in 11, 12 and two pairs of spermathecae in 9/10, 10/11 open in setal line *d*. Calciferous glands without well detached diverticula in 1/2 10–11. Nephridial bladders are sausage-shaped.

**Description.** Holotype: length 70 mm, diameter just after the clitellum 6.5 mm. Number of segments 145. Paratypes: 52–65 mm long and 5–6 mm wide. Number of segments 134–140. Colour white, pigmentation lacking. Prostomium epilobous 2/3 open (Fig. 3). First dorsal pore at the intersegmental furrow 5/6. Setae widely paired, setal formula at segment *xl*: aa:ab:bc:cd:dd = 3:1:1.6:1:5.8 (Fig. 7). Male pores large on the segment *xv* intruding also to the neighboring segments. Nephridial pores irregularly alternated between setal line *b-d*. Clitellum on segments *xxvi-xxxiii*, tubercula pubertatis on *xxx-xxxi*. Genital papillae on segments 11 *abc*, 26–28, 33 *ab*. Genital setae of *xi* 1.10–1.25 mm long, spear-shaped with 0.80–0.85 mm long longitudinal grooves

**Internal characteristics:** Septa 6/7–9/10 slightly thickened. Testes enclosed in perioesophageal testis sac in segments *x-xi*. Two pairs of seminal vesicles present in segments *xi* and *xii*. Spermathecae in 9/10, 10/11 open in setal line *d*. Calciferous glands without well detached diverticula in segments *x, xi*. Hearts appear in segments *vi-xi*, with a pair of extraoesophageal vessel in *xii*. Nephridial bladders are sausage-shaped. Crop in segments *xv-xvi*, and gizzard in segments *xvii-xviii*. Typhosolis large, bi-lobed. Longitudinal muscle layer is of transitory type (Fig. 10).

**Remarks.** The new species, due to the structure of the calciferous glands, nephridial bladders and the circulatory system, show similarity with the “*veneta*” species group and seems to be close to the Levantine *D. kervillei* (MICHAELSEN, 1910) an unpigmented species as well. But *D. omodeoi* sp. n. differs from it first of all in the opening of the spermathecae and in the structure of the musculature, which is true fasciculate in *D. kervillei* (Fig. 11) – as in other members of the “*veneta*” group –, but shows transitory characters in the new species. Furthermore, *D. omodeoi* differs from *D. kervillei* in the position of the clitellum (*xxvi-xxxiii* vs. *xxv-xxxiv*) and tubercles (*xxx-xxxi* vs. *xxx-1/2xxxii*).



**Figs 6–8.** Setal arrangements: 6 = *Dendrobaena mahunkai* sp. n., 7 = *D. omodeoi* sp. n., 8 = *Perelia hatayica* sp. n.



*Dendrobaena veneta veneta* (ROSA, 1886)

*Allolobophora* (*Notogama*) *veneta succinta* ROSA, 1905: 5.

*Dendrobaena veneta* var. *concolor*: POP 1943: 22.

*Dendrobaena veneta* var. *zebra*: POP 1943: 22.

*Eisenia veneta* typica: OMODEO 1952: 6.

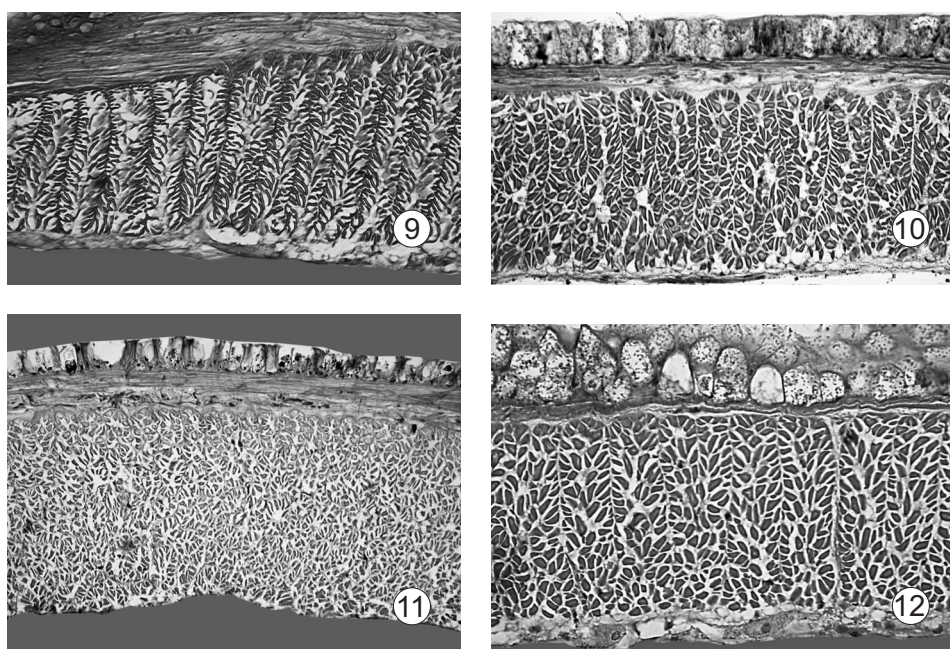
*Eisenia veneta kervillei*: OMODEO 1952: 7.

*Dendrobaena veneta* typica: OMODEO 1955: 7.

*Dendrobaena veneta*: ZICSI 1973: 225. OMODEO & ROTA 1989: 187, OMODEO & ROTA 1991: 179, MİSİRLİOĞLU 2002: 18, MİSİRLİOĞLU 2004: 2.

*Dendrobaena veneta veneta*: CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 15.

Material examined: Z/14891 six ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/14894 four ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/15067 four ex. Turkey, Hatay Province, near the road from Antakya to Samandağ, about five km from Samandağ, 36°08'N, 36°01'E, close to river, deep soil sediments, surrounded by citrus orchards, leg. T. PAVLÍČEK, 13 April 2006. Z/15084 one ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLÍČEK, 16 April 2006. Z/15088 one ex. Turkey, Hatay Province, close to road from Hamam to Kırıkhan, 36°30'N, 36°29'E, small lake surrounded by a stone steppe, leg. T. PAVLÍČEK, 17 April 2006. Z/15091 four ex. Turkey, Hatay Province, mountains



**Figs 9–12.** Musculature: 9 = *Dendrobaena mahunkai* sp. n., 10 = *D. omodeoi* sp. n., 11 = *D. kervillei* (MICHAELSEN, 1910), 12 = *Perelia hatayica* sp. n.



above Belen, 36°30'N, 36°11'E, pine forest, leg. T. PAVLIČEK, 17 April 2006. Z/15100 two ex. Turkey, Hatay Province, close to the road Akbez to Islahiye, 36°52'N, 36°33'E, limestone and alluvial sediments, leg. T. PAVLIČEK, 16 April 2006. Z/15102 12 ex. Turkey, Hatay Province, near the road Akbez-Kilis, about five km from Akbez, 36°52'N, 36°36'E, small springs and grass vegetation, leg. T. PAVLIČEK, 16 April 2006. Z/15105 one ex. Turkey, Hatay Province, above Narlica, 5 km NE from Hatay, 36°13'42''N, 36°12'40''E, mountain region covered by macquis with *Poterium spinosum*, *Asphodelus*, *Euphorbia*, and planted pines, leg. T. PAVLIČEK, 12, April 2006.

*Eiseniella neapolitana* (ÖRLEY, 1885)

*Eiseniella neapolitana* f. *ninnii*: OMODEO 1952: 5.

*Eiseniella tetraedra neapolitana*: CSUZDI & PAVLIČEK 2005: 91.

*Eiseniella neapolitana*: CSUZDI, ZICSI & MISIRLIOĞLU 2006: 19.

Material examined: Z/15080 one ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLIČEK, 16 April 2006.

*Eiseniella tetraedra* (SAVIGNY, 1826)

*Eiseniella tetraedra*: ROSA 1905: 5, OMODEO 1956: 335, OMODEO & ROTA 1989: 178, MISIRLIOĞLU, 2002: 18, CSUZDI, ZICSI & MISIRLIOĞLU 2006: 19.

*Eiseniella tetraedra typica*: OMODEO 1952: 3, OMODEO 1955: 4.

*Eiseniella tetraedra hercynia*: OMODEO 1952: 4, MISIRLIOĞLU, 2002: 19.

*Eiseniella tetraedra tetraedra*: OMODEO & ROTA 1991: 173.

*Eiseniella tetraedra eutypica*: OMODEO & ROTA 1991: 173.

Material examined: Z/15079 one ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, river bank with *Platanus* trees, leg. T. PAVLIČEK, 16 April 2006.

Remarks. In our opinion the subspecies and forms of this species so far described are all invalid and represent different parthenogenetic morphs of the peregrine *Eiseniella tetraedra*.

*Healyella syriaca* (ROSA, 1893)

*Allolobophora syriaca* ROSA, 1893: 461.

*Eophila atheca* f. *kosswigi* OMODEO, 1952: 10.

*Dendrobaena syriaca*: ZICSI 1973: 218.

*Healyella syriaca*: OMODEO & ROTA 1989: 173, OMODEO & ROTA 1991: 173, CSUZDI, ZICSI & MISIRLIOĞLU 2006: 22.

*Healyella syriaca* var.: OMODEO & ROTA 1989: 174.

*Healyella kosswigi*: OMODEO & ROTA 1989: 174.

Material examined: Z/15068 three ex, Z/15069 two ex. Turkey, Hatay Province, near the road from Antakya to Samandağ, about five km from Samandağ, 36°08'N, 36°01'E, close to a river, deep soil sediments, surrounded by citrus orchards, leg. T. PAVLÍČEK, 13 April 2006. Z/15073 one ex. Turkey, Hatay Province, near the right bank of the Orontes River, about two km below the St. Simeon Monastery, 36°06'N, 36°02'E, partly limestone hills with small orchards and garrigue, leg. T. PAVLÍČEK, 13 April 2006. Z/15077 one ex. Turkey, Hatay Province, near the road Harbiye to Yayladağı, 36°05'N, 36°07'E, small wadi covered by Mediterranean garrigue with oak, *Pistacia palaestina*, *Arbutus* etc., leg. T. PAVLÍČEK 14 April 2006.

Remarks. *H. syriaca* is a Levantin–Anatolian species; the present specimens are completely identical with those occurring in Israel.

### *Helodrilus patriarchalis* (ROSA, 1893)

*Helodrilus oculatus* OMODEO & ROTA 1989: 18, OMODEO & ROTA 1991: 177.

*Helodrilus patriarchalis*: CSUZDI & PAVLÍČEK 2005: 92, CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 22.

Material examined: Z/14896 six ex. Turkey, Iskenderun, Karaağaç, bank of irrigation canal, grassy and brushwood area, leg. C. A. TURKMEN, 13 May 2005. Z/15086 five ex. Turkey, Hatay Province, left bank of the Orontes River, near of Karşıyaka, 36°05'N, 36°03'E, mud sediments covered by *Tamariscus* and reed, leg. T. PAVLÍČEK, 14 April 2006.

Remarks. OMODEO and ROTA (1989, 1991) recorded the occurrence of the western European species *Helodrilus oculatus* HOFFMEISTER, 1845 in Turkey. Based on the clitellar and tubercular data CSUZDI *et al.* (2006) regarded these specimens as *H. patriarchalis*. The present record of *H. patriarchalis* in southern Turkey corroborates this view.

### *Murchieona minuscula* (ROSA, 1896)

*Allolobophora minuscula*: OMODEO & ROTA 1991: 176.

*Murchieona minuscula*: CSUZDI & PAVLÍČEK 2002: 108, CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 23.

Material examined: Z/15078 three ex. Turkey, Hatay Province, near the road Harbiye to Yayladağı, 36°05'N, 36°07'E, small wadi covered by Mediterranean garrigue with oak, *Pistacia palaestina*, *Arbutus*, etc., leg. T. PAVLÍČEK, 14 April 2006.

*Octodrilus transpadanus* (ROSA, 1884)

*Octolasion* (*Octodrilus*) *transpadanum*: ZICSI 1973: 226.

*Octodrilus transpadanus*: OMODEO & ROTA 1989: 183, OMODEO & ROTA 1991: 1, MİSİRLİOĞLU 2002: 18, CSUZDI, ZICSI & MİSİRLİOĞLU 2006: 24.

Material examined: Z/14890 two ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/14893 six ex. Turkey, Iskenderun, Sakarya quarter, orange grove, grassy area, leg. C. A. TURKMEN, 13 May 2005. Z/14898 five ex. Turkey, Iskenderun, Karaağaç, bank of irrigation canal, grassy and brushwood area, leg. C. A. TURKMEN, 13 May 2005. Z/15066 two ex. Turkey, Hatay Province, near the road from Antakya to Samandağ, about five km from Samandağ, 36°08'N, 36°01'E, near a river, deep soil sediments, surrounded by citrus orchards, leg. T. PAVLÍČEK, 13 April 2006. Z/15083 two ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLÍČEK, 16 April 2006.

*Perelia galileana* CSUZDI et PAVLÍČEK, 2005

*Perelia galileana* CSUZDI & PAVLÍČEK, 2005: 81.

Material examined: Z/15090 two ex. Turkey, Hatay Province, mountains above Belen, 36°30'N, 36°11'E, pine forest, leg. T. PAVLÍČEK, 17 April 2006.

***Perelia hatayica* sp. n.**

(Figs 4, 8, 12)

Holotype: Z/15239 Turkey, Hatay Province, near the road Akbez to Islahiye, 36°52'N, 36°33'E, limestone and alluvial sediments, leg. T. PAVLÍČEK, 16 April 2006.

Paratypes: Z/15099 eight ex. Turkey, Hatay Province, near the road Akbez to Islahiye, 36°52'N, 36°33'E, limestone and alluvial sediments, leg. T. PAVLÍČEK, 16 April 2006.

*Etymology.* The name of this species refers to the Hatay Province, Turkey, from where it was originally found.

*Diagnosis.* Length: 45–56 mm, diameter: 4–5 mm, setae closely paired. Clitellum on ½25, 25–½39, 39. Tubercles on 34–38. Male pore on 15. Septa 6/7–8/9 thickened. Two pairs of vesicles in 11, 12; two pairs of spermathecae in 9/10, 10/11 open in setal line cd. Calciferous glands with lateral diverticula in 10. Nephridial bladders sigmoid-type, with cephalad bent ental part and an ectal vesiculum.

*Description.* Holotype: length 54 mm, diameter just after the clitellum 5 mm. Number of segments 160. Paratypes: 45–56 mm long and 4–5 mm wide. Number of segments 169–177. Colour pale, pigmentation lacking. Prostomium epilobous  $\frac{1}{2}$  closed (Fig. 4). First dorsal pore at the intersegmental furrow 5/6. Setae strictly paired. Setal formula at segment *xl*: aa:ab:bc:cd:dd = 16.5:1.5:11:1:35 (Fig. 8). Two pairs of spermathecal pores present in furrows 9/10 and 10/11 in the setal line *cd*. Male pores ventral just above setae *b*, on the segment *xv* confined to its own segment. Nephridial pores irregularly alternated between setal line *b-d*. Clitellum on segments *xxiv*, *xxv*–*xxxix*. Tubercula pubertatis on segments *xxxiv*–*xxxviii*. Genital papillae variable usually in the region *x–xiii ab* and *xxix–xxxiii ab*. Genital setae of *xi* 0.600–0.625 mm long, spear-shaped with 0.350–0.375 mm long longitudinal grooves.

*Internal characteristics.* Septa 6/7–8/9 thickened. Testes and funnels paired in segments *x–xi*; in *x* enclosed in perioesophageal testis sacs. Seminal vesicles present in segments *xi* and *xii*. Spermathecae in segments *ix*, *x* with external openings in the setal line *cd*. Calciferous diverticula present in segments *x* with lamellae extending into *xi*. Paired hearts appeared in segments *vi–xi*, with a pair of small extraesophageal vessel in *xii*. Nephridial bladders sigmoide with cephalad bent ental limb and an ectal vesicle. Crop in segments *xv–xvi*, and gizzard in segments *xvii–xviii*. Typhosolis large, tri-lobed. Longitudinal muscle layer is of fasciculate type with strong radial walls (Fig. 12).

*Remarks.* The new species seems to closely resemble *P. bouchei* (PEREL, 1977) described from Kazakhstan, but differs from it in the position of the clitellum and tubercles, as well as in the opening of the first dorsal pore.

#### Family Criodrilidae VEJDOVSKY, 1884

##### *Criodrilus lacuum* HOFFMEISTER, 1845

*Criodrilus lacuum*: ČERNOSVITOV 1940: 440, OMODEO 1952: 3, PAVLÍČEK, CSUZDI & NEVO 2003: 457.

Material examined: Z/15087 one ex. Turkey, Hatay Province, left bank of the Orontes River, near Karşıyaka, 36°05'N, 36°03'E, mud sediments covered by *Tamariscus* and reed, leg. T. PAVLÍČEK, 14 April 2006.

#### Family Acanthodrilidae CLAUS, 1880

##### *Microscolex phosphoreus* (DUGÈS, 1837)

*Microscolex phosphoreus*: ČERNOSVITOV 1940: 440, OMODEO 1952: 2, PAVLÍČEK, CSUZDI & NEVO 2003: 457.

Material examined: AF/5199 one ex. Turkey, Hatay Province, mountain valley near Akbez, 36°51'N, 36°30'E, riverbank with *Platanus* trees, leg. T. PAVLÍČEK, 16 April 2006.

## DISCUSSION

Altogether, 20 species of earthworms are recorded from the Hatay Province, Turkey; 12 species are autochthonous (60%) (*Dendrobaena byblica*, *D. orientalis*, *D. pentheri*, *D. semitica*, *D. omodeoi*, *D. mahunkai*, *Eiseniella neapolitana*, *Healyella syriaca*, *Helodrilus patriarchalis*, *Murchieona minuscula*, *Perelia galileana*, *P. hatayica*). The position of *Aporrectodea jassyensis*, *D. veneta veneta* and *Criodrilus lacuum* is doubtful (15%). Five species (25%) are introduced (*Aporrectodea caliginosa*, *Ap. rosea*, *Eiseniella tetraedra*, *Octodrilus transpadanus* and *Microscolex phosphoreus*).

Our present data indicate that neither the river Orontes nor the Amanus Mountains form the northern border of the Levant zoogeographical province as proposed earlier by POR (1975). The earthworm fauna of Hatay shows more similarity with those of the Levant than with those of Anatolia, indicating that the Bay of Iskenderun is biogeographically part of the Levant. We, therefore, redefine here the Levant as a stretch of land about 150 km wide, wedged between the Mediterranean Sea and the Syrio-Arabian deserts, stretching from the Taurus Mountains in the north to the Isthmus of Suez in the south.

Based on our previous survey (PAVLÍČEK & CSUZDI 2006, PAVLÍČEK *et al.* 2007), we concluded that the fauna from the Anatolian and Levantine zoogeographic provinces are also present in Cyprus. In the same papers we expressed our opinion: the colonization of Cyprus by autochthonous earthworms could have taken place only during the Messinian Salinity Crisis Period (MSCP) along the now submerged ridges from which the most southern ones are the Hecataneus and Latakia ridges. These ridges could have connected the island with the region of Latakia (Syria). Whereas the most northern connection, the Misis ridge, could have been within the Bay of Iskenderun in Turkey and Northeastern Cyprus. In other words, the ridges could have facilitated the migration of earthworms from the northern part of the Levantine coast to the island during the MSCP and helped them to bypass thick layers of the salty sediments and the salty lakes covering the deep bottom of the dried up Mediterranean Sea that are impenetrable to earthworms. If our scenario is correct, one would expect to find the remnants of the earthworm fauna that colonized Cyprus in Syria and also around the Bay of Iskenderun. The new material elaborated here seems to corroborate this scenario.

\*

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