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

CSUZDI, C.S.1, PAVLÍČEK, T.2 and MISIRLIOĞLU, M.3

1Systematic Zoology Research Group of the Hungarian Academy of Sciences and Hungarian Natural History Museum, H-1088 Budapest, Baross u. 13, Hungary
E-mail: csuzdi@mail.zoo.nhmus.hu
2Institute of Evolution, University of Haifa, Mt. Carmel, Haifa 31905, Israel
3Eskişehir Osmangazi Üniversitesi Fen-Edebiyat Fakültesi Biyoloji Bölümü 26480 Eskişehir, Turkey

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)


Acta zool. hung. 53, 2007


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

Aporrectodea jassyensis (MICHAELSEN, 1901)


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.

Acta zool. hung. 53, 2007


Dendrobaena byblica byblica (ROSA, 1893)


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


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)


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.

Acta zool. hung. 53, 2007
Dendrobaena semitica (ROSA, 1893)


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 Yayladaği, 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.


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 x:\(x_l\): a\(a\):b\(b\):c\(c\):d\(d\) = 2.44:1.11:2.22:1:4.4 (Fig. 6). Male pores large on the segment x\(x\) covering also the neighboring segments. Nephridial pores irregularly alternated between setal line b\(b\)-d. Clitellum on segments x\(x\) (xx\(x\))–x\(x\)iii. 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–x\(x\). Seminal vesicles present in segments x\(ix\), x\(xi\) and x\(x\)ii. Spermathecae lacking. Calciferous diverticula present in segments x\(ix\), x\(xii\). Hearts appeared in segments vi–x\(i\), 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.


**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 xi: 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–xxiii, 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 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 extraesophageal 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–xxiii vs. xxv–xxiv) and tubercles (xxx–xxiv vs. xxx–½xxii).

![Figs 6–8. Setal arrangements: 6 = Dendrobaena mahunkai sp. n., 7 = D. omodeoi sp. n., 8 = Perelia hatayica sp. n.](image-url)
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.


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. PAVLÍČEK, 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. PAVLÍČEK, 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. PAVLÍČEK, 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. PAVLÍČEK, 12, April 2006.

**Eiseniella neapolitana** (ÖRLEY, 1885)

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

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. PAVLÍČEK, 16 April 2006.

**Eiseniella tetraedra** (SAVIGNY, 1826)


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. PAVLÍČEK, 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)

*Alolobophora syriaca* ROSA, 1893: 461.
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)


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)


Octodrilus transpadanus (ROSA, 1884)


Perelia galileana CSUZDI et PAVLÍČEK, 2005

Perelia galileana CSUZDI & PAVLÍČEK, 2005: 81.


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. Cli
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 ½ 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–xxviii. Genital papillae variable usually in the region x–xiii ab and xxxviii–xxxiii ab. Genital setae of xi 0.600–625 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 periesophageal 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 sigmoid 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


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)


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*, *Aporrectodea rosea*, *Eiseniella tetraedra*, *Octodrilus transpadianus* 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.

Acknowledgements – We would like to thank the Hungarian Scientific Research Fund (OTKA no. 42745) for a research grant to the first author. We are grateful to Mrs ROBIN PERMUT (University Haifa) and to MS PATRICIA CARDET for comments on the manuscript.
REFERENCES


Acta zool. hung. 53, 2007


Revised version received June 6, 2007, accepted September 2, 2007, published November 30, 2007

*Acta zool. hung. 53, 2007*