Iranian Journal of Animal Biosystematics (IJAB)
Vol.7, No.2, 89-97, 2011
ISSN: 1735-434X

The Earthworm Fauna of Tehran Province, Iran: an Ecological Characterization

Mirmonsef, H., Malek, M.*, Latif, R.

School of Biology and Center of Excellence in Phylogeny of living organisms, College of Science, University of Tehran, Tehran, Iran

In this study, the earthworms of Tehran Province were investigated. Specimens were collected from wet soil in 48 stations during 2011 and 2012. During the course of the study, eight earthworm species were identified, including: *Aporrectodea caliginosa* (Savigny, 1826), *Ap. rosea* (Savigny, 1826), *Dendrobaena veneta* (Rosa, 1886), *Dendrodrilus rubidus* (Savigny, 1826), *Eisenia fetida* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826), *Octolasion lacteum* (Örley, 1881), *Perelia kaznakovi* (Michaelsen, 1910). All of them were common in this area except *Perelia kaznakovi* and *Dendrobaena veneta*.

Key words: Earthworms, Lumbricidae, Ecology, Tehran Province, Iran

INTRODUCTION

Earthworms are perhaps the most important members of soil macroinvertebrates fauna, aiding the maintenance of soil structural development while Aristotle called them the "intestines of the earth." In spite of the vast increase in scientific literature on earthworms in recent years, much remains to be learn of earthworm taxonomy. In Iran, like in many other regions around the world, taxonomy-related researches are inadequate. Taxonomic studies on Iranian earthworms were started by Omrani (1973), afterwards more studies have been done by the researchers in the North (Latif et al., 2009; Ezzatpanah et al., 2010), North West (Zirak Mobaraki, 2010) and South West (Farhadi, 2011) regions of Iran. The present study aimed to obtain a better knowledge of the Iranian earthworms.

MATERIAL AND METHODS

Specimens were collected from Tehran Province. The climate in the region is arid to semi-arid with hot summers. Earthworms were collected from 48 locations (Fig.1) including litter mould, under logs and stones, inside of rotting logs and within decaying plants and other wet soils from 2011 to 2012. Two methods were applied for the earthworm sampling, (i) sifting through soil samples by hand, (ii) application of 0.6% formalin solution (25 ml of 40% formalin in 4.6 literes of water to 0.4 m^2 of soil according to Edwards and Bohlen (1996)). Earthworms were transferred to the laboratory and washed to remove soil. The adult specimens were anaesthetized and killed in 15% and 75% ethanol, respectively. After one day, samples were placed in 4% formalin and examined by stereomicroscope. The identification of adult earthworms conducted mainly based on the position and shape of clitellum, setae, and internal organs such as nephridial bladders, according to Csuzdi and Zicsi (2003).

*Corresponding Author: mmalek@khayam.ut.ac.ir

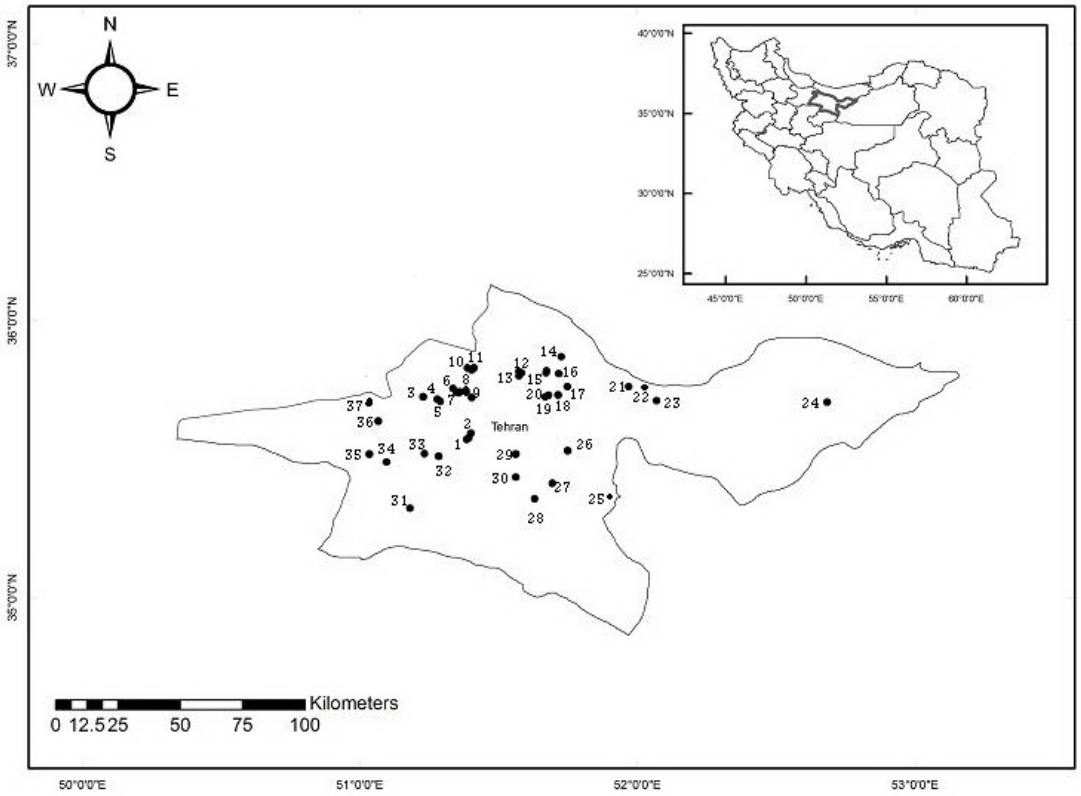

FIGURE 1. Sampling sites of earthworms in Tehran Province. 1-11: Tehran; 12-20: Lavasanat; 21-23: Damavand; 24: Firouzkouh; 25- 26: Pakdasht; 27- 28; Waramin; 29-33: Rey; 34-37: Robat-Karim.

RESULTS

In the present study, eight species earthworm belonging to seven genera were identified, namely, *Aporrectodea caliginosa* (Savigny, 1826), *Ap. rosea* (Savigny, 1826), *Dendrobaena veneta* (Rosa, 1886), *Dendrodrilus rubidus* (Savigny, 1826), *Eisenia fetida* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826), *Octolasion lacteum* (Örley, 1881), *Perelia kaznakovi* (Michaelsen, 1910). *Perelia kaznakovi* and *Dendrobaena veneta* were rare and found in only one and three stations respectively. A list of species and habitats, they were found in, is summarized in Table 1.

List of species

***Aporrectodea caliginosa caliginosa* (Savigny, 1826)**

For complete synonymy, see Csuzdi and Zicsi 2003: 75.

Ecology: endogeic

Observations: Clitellum and tubercula respectively extend on segments 27- 34, 31-33. Tubercula bipartite, pigmentation absent, colour whitish-grey. Some of them have extended prostomium into a proboscis, 100-180 segments (Fig. 2).

Collecting sites: Ghale- no Haj Mousa (N 35º 34' 37.4"; E 51º 23' 28.5"), Lavasan (N 35º 48' 52"; E 51º 40' 13.8"), Pardisan Park (N 35º 44' 24.3"; E 51º 21' 22.7"), Vavan Qom road (N 35º 30' 35"; E 51º 16' 55"), Vavan Town (N 35º 31' 11" ; E 51º 13' 53"), Lavasan (N 35º 48' 38.5"; E 51º 34' 48.1"), Bagher Shahr (N 35º 31' 46.6"; E 51º 44' 50.9"), Abbali-Mobarakabad (N 35º 48' 33 "; E 52º 1' 49").

***Aporrectodea caliginosa trapezoides* (Dugès, 1828)**

For complete synonymy, see Csuzdi and Zicsi 2003: 92

Ecology: endogeic
Observations: Clitellum and tubercula respectively on segments 27-34, 31-33. Tubercule tripartite, dorsal surface light to dark brown, 100-180 segments (Fig. 3).
Collecting sites: Pardisan Park (N 35º 44' 24.3" ;E 51º 21' 22.7"), Hakim Highway (N 35º 44' 36.4";E 51º 22' 57.1"), Shahre Ziba (N 35º 44' 24.4" ;E 51º 21' 22.7"), Hemat Highway (N 35º 44.9' 35"; E 51º 20.4' 95"), West of Hemat Highway (N 35º 44.9' 78"; E 51º 20.5' 03"), Vavan Town (N 35º 31' 11" ; E 51º 13' 53"), Lavasan (N 35º 48' 38.5"; E 51º 34' 48.1"), West Salehabad (N 35º 35' 33 "; E 51º 23' 55"), Gharchak (N 35º 26' 02.6"; E 51º 33' 37.6").

***Aporrectodea rosea* (Savigny, 1826)**
For complete synonymy, see Csuzdi and Zicsi 2003: 92.
Ecology: endogeic
Observations: Clitellum on segment 26-31, tubercles on segments 29-31. Dorsal pores are readily visible, especially on the clitellum, 100-150 segments (Fig. 4).
Collecting sites: Pardisan Park (N 35º 44' 24.3"; E 51º 21' 22.7"), Hakim Highway (N 35º 44' 36.4"; E 51º 22' 57.1"), Shahre Ziba (N 35º 44' 24.4"; E 51º 21' 22.7"), Hemat Highway (N 35º 44.9' 35"; E 51º 20.4' 95"), West of Hemat Highway (N 35º 44.9' 78"; E 51º 20.5' 03"), Vavan Town (N 35º 31' 11"; E 51º 13' 53"), Lavasan (N 35º 48' 38.5"; E 51º 34' 48.1"), West Salehabad (N 35º 35' 33"; E 51º 23' 55"), Gharchak (N 35º 26' 02.6";E 51º 33' 37.6").

***Dendrobaena veneta* (Rosa, 1886)**
For complete synonymy, see Csuzdi and Zicsi 2003:127, for complete synonym list.
Ecology: epigeic
Observations: Clitellum on segment 27-33, tubercles on segment 30-31, pigmentation often transversely striped, 55-150 segments (Fig. 5).
Collecting sites: Golabdareh (N 35° 49' 45";E 51° 23' 11"), Fasham-Zaygan (N 36° 39' 71"; E 51.5° 14' 56"), Fasham-Garmabdar (N 35° 45' 58"; E 51° 31' 58").

***Dendrodrilus rubidus* (Savigny, 1826)**
For complete synonymy, see Csuzdi and Zicsi 2003:132.
Ecology: epigeic
Observations: Clitellum extends on segments 27-31, tubercles on 29-30, red-violet, 50-100 segments (Fig. 6).
Collecting sites: Touchal (N 35º 49' 18"; E 51º 24' 05").

FIGURE 2. *Aporrectodea caliginosa caliginosa.*

FIGURE 3. *Aporrectodea caliginosa trapezoides.*

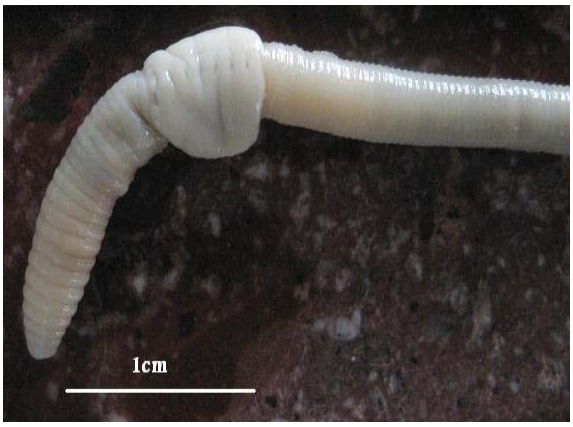

FIGURE 4. *Aporrectodea rosea.*

FIGURE 5. *Dendrobaena veneta.*

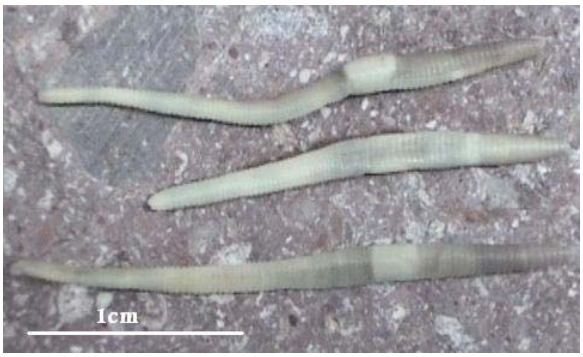

FIGURE 6. *Dendrodrilus rubidus.*

FIGURE 7. *Eisenia fetida.*

***Eisenia fetida* (Savigny, 1826)**
For complete synonymy, see Csuzdi and Zicsi 2003: 143.
Ecology: epigeic
Observations: Clitellum on segment 27-33, tubercles on segments 30-31, dorsal surface brown-red, and pigmentation often absent from furrows, 60-110 segments (Fig. 7).
Collecting sites: Waramin (N 35º 31.3' 4.1"; E 51º 33' 37.6"), Eram Park (N 35º 42' 28.2"; E 51º 17' 21.3") , Robat- Karim (N 35º 29' 20" ; E 51º 05' 38"). Ahar (N 35.9 º 34' 16"; E 051.5º 23' 01"), Fasham-Laloun (N 36.0° 39' 71"; E 51.5° 14' 56"), Oshan (N 35.8 º 94' 71"; E 051.5º 25' 78"), Damavand- Chenar (N 35° 42' 35"; E 52° 04' 04"), Tange Vashi (N 35° 52' 9.4"; E 52° 43' 28"), 5 km Boumehen (N 35° 43' 49"; E 31° 40' 42"), Roudehen (N 35° 43' 29"; E 51° 40' 3"), Jajrood (N 35° 45' 39"; E 51° 44' 43").

***Eiseniella tetraedra* (Savigny, 1826)**
For complete synonymy, see Csuzdi and Zicsi 2003: 153.
Ecology: epigeic

Observations: Clitellum on segments 23-26, tubercles on segments 24-25. Small or medium body size, large setae and post clitellar region with a couple of setae at each corner and dorsal side, 60-100 segments (Fig. 8)**.**
Collecting sites: Abali (N 35º 45' 38 "; E 51º 58' 01"),Touchal (N 35 º 49' 31"; E 51 º 23' 58"), Golabdareh (N 35° 49' 45"; E 51° 23' 11"), Fasham-Laloun (N 36.0° 39' 71"; E 51.5° 14' 56"), 5 km Boumehen (N 35° 43' 49"; E 31° 40' 42"), Roudehen (N 35.0° 43' 29"; E 51° 40' 3"), Jajrood (N 35° 45' 39"; E 51° 44' 43"), Latiyan (N 35.0° 48' 26"; E 51° 42' 53").

***Octolasion lacteum* (Örley, 1881)**
For complete synonymy, see Csuzdi and Zicsi 2003: 197.
Ecology: endogeic
Observations: Clitellum on segments 30-35, tubercles on segments 31-34, male pore is obvious and extends across furrow 14/15 and 15/16, 60-200 segments (Fig. 9).
Collecting sites: Pardisan Park (N 35º 44' 24.3"; E 51º 21' 22.7"), Azadi (N 35º 42' 56"; E 51º 16' 35.9"), Chitgar park (N 35º 43' 30.7"; E 51º 13' 32.3"), Tehran-Karaj Exp.way (N 35º 42' 56"; E 51º 16' 35.9").

***Perelia kaznakovi* (Michaelsen, 1910**)
For complete synonymy, see Csuzdi and Pavlíček 2005: 79.
Ecology: endogeic
Observations: Clitellum extends on segments 27-35, tubercles on 32-34, large species, and pigmentation absent, 100- 150 segments (Fig. 10).
Collecting sites: Bagher Shahr (N 35º 31' 46.6"; E 51º 44' 50.9").

FIGURE 8. *Eiseniella tetraedra.*

FIGURE 9. *Octolasion lacteum.*

FIGURE 10. *Perelia kaznakovi.*

TABLE 1. Earthworm taxa recorded from Tehran Province and their habitats.

Species	Grassland	Anthropogeni	Planted trees	Semi(aquatic)	Cultivations	Park forest	mountain
Ap. caliginosa caliginosa	+	+	+	-	+	-	+
Ap. caliginosa trapezoides	-	-	-	-	+	+	-
Ap. rosea	+	+	-	-	+	-	+
Dd. rubidus	+	-	+	-	-	-	+
D. veneta	+	-	-	-	-	-	+
E. fetida	-	+	+	+	-	-	+
Eis. tetraedra	-	-	+	+	-	-	+
O. lacteum	+	+	+	-	+	+	-
P. kaznakovi	-	-	+	-	-	-	-

DISCUSSION

This report details eight species of earthworms belonging to seven genera of Lumbricidae. This region has six peregrine species, which are common all over this province, and two native species. The most abundant earthworms were *Ap. caliginosa* and *Ap. rosea*, mostly cohabited.

Ap. caliginosa is represented by two forms: diploid and parthenogenetic polyploid populations. According to Edwards and Bohlen (1996), the high level of heterozygosity resulting from the association of parthenogenesis and polyploidy, provides resistance to the environmental stress. In the present study, external characters in both candidates, *Ap. caliginosa caliginosa* and *Ap. caliginosa trapezoides,* were approximately the same. *Ap. caliginosa caliginosa* comprises large individuals living in damp environments with a darker pigmentation at the head area, while *Ap. caliginosa trapezoid*es bears a dark pigmentation throughout its body with a darker segments near clitellum and is found only in meadows and arid pastures. *Ap. caliginosa* has not only two different forms but an interesting case of morphological variation in this species is the colour and shape of tubercula and the shape of prostomium in some specimens. Some researchers, such as Pérez-Losada et al. (2009) and Pérez On-

teniente and Rodríguez Babío (2002) have considered them as different species based on molecular studies. Bouché (1972) believed that *Ap. caliginosa* and *Ap. trapezoides* inhabit different ecological groups, the former living in horizontal burrows (endogeic) and the latter living in vertical burrows (anecic). This ecological niche differentiation was also observed in the field by authors of the current study. Fernández et al. (2010) studied life cycle of *Ap. trapezoides* and concluded that it could be an intermediate epianecic ecological group, because of having some similar features as epigeic species, such as higher number of laid cocoons than anecic species. They were introduced by human and their successful tolerance to high temperature and drought could be due to their ability to reabsorb water from urine. Experimentally, this feature was documented in *Ap. caliginosa* (El-Duweini and Ghabbour, 1965; Ghabbour, 1999).

Ap. rosea also occurs in every type of soil, in soil under bushes and in banks of water courses and it is well adapted to agriculture, which is confirmed by Piearce (1978) who showed that *Ap. rosea* normally consumes well-degraded amorphous plant material by analysing gut contents of lumbricid earthworms. In most stations, *Ap. caliginosa* and *Ap. rosea* were present in the same habitats. It seems that their ecological requirements are very similar to each other as it is shown in the study by Omodeo and Martinucci (1987).

The semiaquatic *Eiseniella tetraedra* common throughout this region, was found along water courses. It is also represented by parthenogenetic polyploid individuals, according to Csuzdi and Zicsi (2003). Two different populations of this species were found, one inhabiting absolutely along water courses and the other one inhabiting wet leaf litter. They differed in terms of size and colour, although both were the same species.

Dendrobaena veneta was common in wood litter and under stones, but not everywhere, suggesting that it has been introduced in connection with anthropogenic activities.

Eisenia fetida was collected in leaf litter, rotten logs, and under cow dungs. In some stations *E. fetida* and *D. veneta* were found in similar habitats.

Octolasion lacteum particularly common in damp stations was very common in Park Forest and become rare toward arid stations. Most of its populations constitute of polyploid individuals, although diploid lineages were found in Switzerland and British Isles according to Briones et al. (2009).

Perelia kaznakovi comprises of large individuals which live in soil under bushes. They also occurred in forest soils. *Eis. tetraedra*, *O. lacteum* and *D. veneta* were the most common species at the stations at the northern part of province**.** These species were previously recorded from North of Central Elburz Mountains (Latif et al., 2010). This subject probably demonstrates the faunal exchange between two regions. *P. kaznakovi* and *Dd. rubidus* were collected only from one station, the former from the south of Province and latter from the North of Province.

Four species which had been reported before by Omrani et al. (1973): *Dendrobaena byblica* (Rosa, 1893), *Pheretima indica* (=*Amynthas corticis*) (Horst, 1883), *Aporrectodea jassyensis* (Michaelsen, 1891), *Eisenia parva* (=*Allolobophoridella eiseni*) (Levinsen, 1884), from one or two stations in Tehran Province, were not found in present study. It is possible that they are not widespread or their abundance has undergone anthropogenic activities. *Eis. tetraedra* was reported from this Province in current study for the first time.

Drawing a conclusion about geographical distribution of Iranian earthworms is very difficult because there is not sufficient information about it, so more samplings are required. Limited data is available to evaluate the similarities between Tehran Province and the other regions. The comparison of earthworm species between this region and available information regarding the north and west of Iran has indicated smaller number of native species exist in this region. Among eight recorded species in this region, some were very abundant, to the point that at many sites they formed the bulk of the collection, e.g., *Ap. caliginosa* and some were collected from only one station e.g., *P. kaznakovi.* However, the presented data provides a pilot information to discover the origin of earthworm fauna of this region.

ACKNOWLEDGMENTS
We would like to thank the research Affairs of the University of Tehran and The National Science Foundation of Iran for financial support. Thanks are extended to Mr. Kazemi for his help with sampling.

LITERATURE CITED

Briones, M.J., Posada, P.M., 2009. Are the sexual, somatic and genetic characters enough to solve nomenclatural problems in lumbricid taxonomy? *Soil Biology & Biochemistry* 41, 2257–2271.

Bouché, M. B., 1972. Institut National de la Recherche Agronomique, Articles de Zoologie-Écologie animale. *Lombriciens de France. Écologie et Sysématique* (Numéro hors-série) pp. 671.

Csuzdi, Cs., Zicsi, A., 2003. Earthworms of Hungary. *Pedozoologica Hungarica* 1, 272.

Csuzdi, Cs., Pavlíček, T., 2005. Earthworms from Israel. II. Remarks on the Genus *Perlia* Easton, 1983 with description of a new Genus and two new species. *Acta Zoologica Academiae Scientiarum Hungaricae* 51, 75–96.

Dugés, A., 1828. Recherchesur la circulation, la respiration, et la reproduction des Annélidessétigéresabranches. *Annales des Sciences Naturelles Paris* 15, 284-336.

Edwards, C.A., Bohlen, P.J., 1996. Biology and Ecology of Earthworms, third ed. Chapman and Hall, London.

Edwards, C.A., 2004. *Earthworm Ecology*. Boca Raton (FL): St.Lucie Press.

El-Duweini, A.K., Ghabbour, S.I., 1995. Temperature relations of three Egyptian Oligochaeta species, *Oikos* 16, 9-15.

Ezzatpanah, S., Latif, R., Malek, M., and Salehi, H., 2010. Earthworm fauna of the western Mazandaran province, Iran. *Zoology in the Middle East Supplement* 2, 67-73.

Farhadi, Z., 2011. Earthworm taxonomy of Kohgiluyeh and Boyer-Ahmad Province and study of intraspecific genetic variation of some populations of *Eiseniella tetraedra*. Unpublished Msc. Thesis, University of Tehran.

Fernández, R., Novo, M., Gutiérrez, M., Almodóvar, A., Díaz Cosín, D., 2010. Life cycleandreproductive-traitsoftheearthworm *Aporrectodea trapezoides* (Duges, 1828) in laboratory cultures. Pedobiologia 53 (2010) 295–299.

Ghabbour, S.I., 1999. Physiological diversity of water balance in some African Oligochaeta. *Cario University African Research & Studies Review* 21, 1-30.

Horst, R., 1883. New species of the genus *Megascolex* Templeton (*Perichaeta Schmarda*) in the collections of the Leyden Museum. 5, 182-196.

Latif, R., Ezzatpanah, S., Malek, M., Parsa, H., 2009. Earthworms of the Central Elburz Mountains, Iran. *Iranian Journal of Animal Biosistematics* 5, 1-15.

Levinsen, G.M.R., 1884. Systematisk-geografisk oversigt over de nordiske Annulata, Gephyrea, Chaetognathi og Balanoglossi. – *Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn*, 45, 241.

Michaelsen, W., 1891. Oligochaeten des Naturhistorischhen Museums in Humburg. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten* 8, 1- 42.

Michaelsen, W., 1910. Oligochäten von verschiedenen Gebieten. – *Mitteilungen aus dem Naturhistorischen Museum in Hamburg* 27, 47-169.

Omrani, G.A., 1973. Bodenozoologische Untersuchungenüber Regenwürmer im Zentral- und Nordiran. Inaugural Dissertation.Institut für Bodenkunde und Bodenerhaltung und Tropeninstitut der Justus Liebig-Universität Giessen.

Omodeo, P., Martinucci, G., 1987. Earthworms of Maghreb. *Selected Symposia and Monographs U.Z.I.,2, Mucchi, Modena,* pp. 235-250.

Omodeo, P., Rota, E., Baha, M., 2003.The magadril fauna (Annelida: Oligochaeta) of Maghreb: a biogeographical and ecological characterization. *Pedobiologia* 47, 458-465.

Örley, L., 1881. A magyarországi Oligochaetákfaunája. I. Terricolae. *Mathematikaiés Természettudományi Közlemények* 16, 562-611.

Pérez Onteniente, A., Rodríguez Babío, C., 2002. Three new species of earthworm (Annelida: Oligochaeta: Lumbricidae), from the Valencian Community, Spain. – *Journal of Natural History* 36, 515-530.

Pérez -Losada, M., Ricoy, M., Marashall, J.C., Domenguez, J., 2009. Phylogenetic assessment of the earthworm *Aporrectodea caliginosa* species complex (Oligochaeta: Lumbricidae) based on mitochondrial and nuclear DNA sequences. *Molecular Phylogenetics and Evolution* 52, 293–302.

Piearce, T.G., 1978. Gut contents of some Lumbricid earthworms. Pedobiologia, 18: 153-157.

Rosa, D., 1886. Note sui lombrici del Veneto. – *Atti del Reale Istituto Veneto di Scienze* 4, 673-687.

Rosa, D., 1893. Viaggi del Dr. E. FESTA in Palestina nel Libano regioni vicine- *Bollettino del Museo regionale di Scienze Naturali Torino* 8, 1-14.

Savigny, J.C., 1826. In G. Cuvier: Analyse des Travaux de l'Academieroyale des Sciences, pendantl'année 1821, partiephysique. – *Mémoires de l'Académie des Sciences de l'Institut de France Paris* 5, 176-184.

Zirak Mobaraki, F., 2010. A study in the earthworm of Ardebil and Azarbyjan provinces and molecular taxonomy of *Dendrobaena byblica* (Rosa, 1893) species complex. Unpublished Msc. Thesis, University of Tehran.