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

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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), *A. rosea* (Savigny, 1826), *Dendrobaena veneta* (Rosa, 1886), *Dendrodrilus rubidus* (Savigny, 1826), *Eisenia fetida* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826), *Octolasion lacteum* (Orley, 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 learnt 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 liters of water to 0.4 m² 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).
RESULTS
In the present study, eight species earthworm belonging to seven genera were identified, namely, *Aporrectodea caliginosa* (Savigny, 1826), *A. rosea* (Savigny, 1826), *Dendrobaena veneta* (Rosa, 1886), *Dendrodrilus rubidus* (Savigny, 1826), *Eisenia fetida* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826), *Octolasion lacteum* (Orley, 1881), *Perelis kaznakovi* (Michaelsen, 1910). *Perelis 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 34' 28.5''), Pardisan Park (N 35º 44' 24.3''; E 51º 21' 22.7''), Vavan Qom road (N 35º 48' 38.5''; E 51º 16' 55''), Bagher Shahr (N 35º 31' 11''; 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 35° 44' 24.3"; E 51° 21' 22.7"), Hakim Highway (N 35° 44' 36.4"; E 51° 22' 57.1"), Shahre Ziba (N 35° 44' 24.4"; E 51° 21' 22.7"), Hemat Highway (N 35° 44.9' 35"; E 51° 20.4' 95"), West of Hemat Highway (N 35° 44.9' 78"; E 51° 20.5' 03"), Vavan Town (N 35° 31' 11"; E 51° 13' 53"), Lavasan (N 35° 48' 38.5"; E 51° 34' 48.1"), West Salehabad (N 35° 35' 33"; E 51° 23' 55"), Gharchak (N 35° 26' 02.6"; E 51° 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 35° 44' 24.3"; E 51° 21' 22.7"), Hakim Highway (N 35° 44' 36.4"; E 51° 22' 57.1"), Shahre Ziba (N 35° 44' 24.4"; E 51° 21' 22.7"), Hemat Highway (N 35° 44.9' 35"; E 51° 20.4' 95"), West of Hemat Highway (N 35° 44.9' 78"; E 51° 20.5' 03"), Vavan Town (N 35° 31' 11"; E 51° 13' 53"), Lavasan (N 35° 48' 38.5"; E 51° 34' 48.1"), West Salehabad (N 35° 35' 33"; E 51° 23' 55"), Gharchak (N 35° 26' 02.6"; E 51° 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 35° 49' 18"; E 51° 24' 05").
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° 34' 16''; E 051.5° 23' 01''), Fasham-Laloun (N 36.0° 39' 71''; E 51.5° 14' 56''), Oshan (N 35.8° 94' 71''; E 051.5° 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 clittellar 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 35º 49' 31''; E 51º 23' 58''), Golabdareh (N 35º 49' 45''; E 51º 23' 11''), Fasham-Laloun (N 36.0º 39' 71''; E 51.5º 14' 56''), 5 km Boumehen (N 35º 43' 49''; E 31º 40' 42''), Roudehen (N 35.0º 43' 29''; E 51º 40' 3''), Jajrood (N 35º 45' 39''; E 51º 44' 43''), Latiyan (N 35.0º 48' 26''; E 51º 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.*
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 trapezoides* 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 (aneic). 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 Plearce (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 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.
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