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Research Article

Earthworm Species Identified in the Region of Tebessa (Eastern Algeria)

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Abstract

Objective: The aim of this study was the identification of earthworm species collected from the geographic regions of Tebessa in Eastern Algeria. **Materials and Methods:** Samples collected from different regions of Tebessa were fixed in 4% formalin solution and observed under a binocular microscope for identification based on external morphological study. **Results:** From 1707 samples gathered, 438 adult samples were recognizable and identified. Four species were recognized which belonged to Lumbricidae family: *Aporrectodea caliginosa*, *Eisenia fetida*, *Aporrectodea rosea* and *Aporrectodea longa*. **Conclusion:** This study showed that the dominant species in Tebessa belonged to *Aporrectodea caliginosa* and *Aporrectodea longa* was first time recorded in Algeria.

Key words: Lumbricidae, earthworms, identification, biodiversity, morphology, Tebessa, semiarid land

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Soil fauna, which is usually divided according to the size of the organisms that comprise three distinct groups: Micro, meso and macro fauna, covering many taxa, including hundreds or even thousands of species¹⁻³. To quantify the role of earthworms in ecosystems, a precise and accurate estimation of their diversity, abundance and biomass is needed⁴.

However, the knowledge of wildlife worm terrestrial land in Algeria is still incomplete and insufficient^{5,6}. Studies about this group of soil fauna in Algeria are focused on the ecological and biogeographic characteristics, particularly in Algiers area, the Kabylie and the whole of Maghreb where it was inventoried 33 species. Three new species were added (*Octodrilus maghrebinus*, *Octodrilus kabylianus* and *Eisenia xylophila*) to science from 83 localities spread over Tunisia, Algeria and Morocco⁷. Recently, some studies are realized in Eastern of Algeria in Constantine and Annaba⁸⁻¹⁰.

The objective of this study was the identification of different species of the current earthworms in various regions of Tebessa, including pastures, field agriculture and wadi to utilize them in improvement of earth fertility,

transformation of garbage to compost, management and preservation of forest resources, feeding of fish and poultry, fishing industry and even in treatment of human diseases, for future researches and use them in the related centers.

MATERIALS AND METHODS

Study regions: This study was conducted during the period 2014 to 2016. Studied areas were different regions of Tebessa. Tebessa is part of the high plains of Constantine. It is located in the extreme North-east of Algeria. The climate in the region is semi-arid with hot summers. Earthworms were collected from five sites (Fig. 1):

- **Site of Elma Labiod:** It is an agriculture field located in Elma Labiod 32 km in South of Tebessa province
- **Site of Elmerdja plain:** A pasture located in Tebessa 4.5 km in East of Tebessa province
- **Site of Chabrou:** A pasture located in Boulhef 6 km in North of Tebessa province
- **Site of Ain Zarroug:** Wadi located in Tebessa 10 km in West of Tebessa province
- **Site of El Hammamet:** A pasture located in El Hammamet 20 km in West of Tebessa province

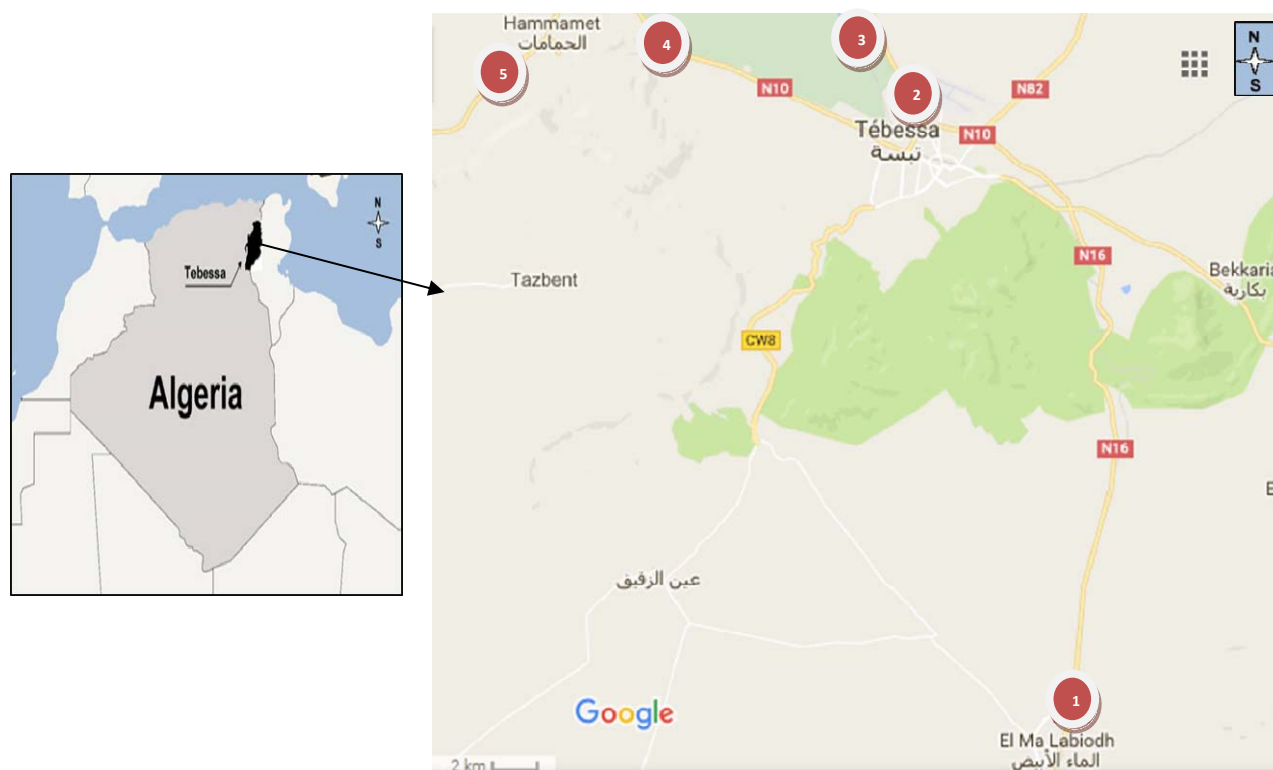


Fig. 1: Map of Tebessa showing the location of collecting sites

Table 1: Collecting sites and different species

Sampling sites	Dates	Lambert details	Type of soil	Species (number of individuals)
Elmerdja				
Pasture	19/01/2015	35°24 53.9" N	Sandy loam	<i>Aporrectodea caliginosa</i> (111)
	09/02/2015	08°07 57.2" E		<i>Aporrectodea rosea</i> (07)
	03/03/2015			
	20/04/2015			
Ain Zarroug				
Wadi	09/02/2015	35°26 59.9" N	Loam silty clay	<i>Aporrectodea caliginosa</i> (25)
	05/03/2015	08°01 19.2" E		<i>Aporrectodea longa</i> (21)
	20/04/2015			<i>Aporrectodea rosea</i> (11)
El Hammamet				
Pasture	15/01/2016	35°27 52.9" N	Loam	<i>Eisenia foetida</i> (70)
	12/02/2016	07°54 54.6" E		<i>Aporrectodea caliginosa</i> (16)
	15/03/2016			<i>Aporrectodea rosea</i> (08)
	16/04/2016			<i>Aporrectodea longa</i> (01)
Elma Labiod				
Agriculture field	23/01/2016	35°10 39.6" N	Sandy loam	<i>Eisenia foetida</i> (13)
	13/02/2016	08°10 48" E		<i>Aporrectodea caliginosa</i> (83)
	15/03/2016			<i>Aporrectodea rosea</i> (24)
	22/04/2016			<i>Aporrectodea longa</i> (01)
Chabrou				
Pasture	12/12/2014	35°26 49.8" N	Clay loam	<i>Aporrectodea caliginosa</i> (18)
	15/01/2015	08°05 30.9" E		<i>Aporrectodea rosea</i> (29)
	01/02/2015			
	16/03/2015			
	10/04/2015			

Characteristics of different sampling sites, dates of sampling and species found in each site are summarized in Table 1.

Sampling of animals: Hand sorting method was used to extract soil animals. This method is most commonly used for earthworm sampling. It leads to high soil disturbance, very labor intensive, but more importantly works in all soil types¹¹. In this method the soil was dig in to a depth of about 30 cm and the search for earthworms was done with the hand¹². Soil samples at 30 cm depth were realized in each site for physico-chemical analysis. Four replicates were realized in each site as it was described by Clapperton¹³.

Identification and description of earthworms: In the laboratory, earthworms were studied morphologically, in the living state (before fixation) noting the length of the body, the coat color, the color gradient and the emission of mucus. Earthworms were then fixed by placing them in the 4% formalin and then observed under a binocular microscope for identification based on external morphological study¹⁴. Finally, species and genus of each sample were identified with use of recorded characteristics according to Sims and Gerard¹⁵ and Bouche¹². Sims and Gerard¹⁵ nomination for the different species was adopted.

Statistical analysis: The morphological characteristics were compared by an analysis of variance (ANOVA) using the statistical program Minitab (version 17). When the differences were significant in the ANOVA analysis, a Tukey test was used to pinpoint which species were different from others. The biodiversity of different sites was estimated with Shannon Weaver index which was calculated as following Eq. 1:

$$H' = -\sum_{i=1}^R p_i \ln p_i \quad (1)$$

where, p_i is the proportion of individuals found in species i and R is the number of species found.

RESULTS AND DISCUSSION

About 438 samples (25,66%) collected from all sites were adult worms from 1707 gathered samples which were related to 80 spots within three seasons, from 2014 to 2016. Of the recorded 4 lumbricid species (Table 2), *Aporrectodea caliginosa* (collected from all sites) represented the dominant species and *Aporrectodea longa* was described for the first time in Algeria.

The morphological features are of great value in the identification of earthworm species. The cutaneous color, position and number of segments per clitellum and tubercula

pubertatis and form of earthworm were key characteristics to identify earthworms. For example, *Eisenia foetida* commonly known as tiger worm has specific color appearing as dark segmental bands separated by lighter inter segmental bands¹⁶. As it was reported by Ismail¹⁷, in *L. mauritii* 14-17 segments form the clitellum and in *M. posthuma* it is formed by 14-16 segments while in *P. excavatus* it is formed by 13-17 segments.

In the other hand, the length, diameter and number of segments were important factors for identification of earthworms. There were meaningful relations statistically (Tukey test, $p = 0.000$) between each of these variables within species. The most average of these characteristics belonged to *A. longa* and almost the least average related to these variables belonged to *E. foetida* and *A. rosea*. These results agreed those of Ansari and Saywack¹⁸ who found that body length was diagnostic feature and proved that *Eisenia foetida* ranged from 35-130 mm, while the local species in Guyana fell into the range of 111-300 mm.

In contrast, setae shape, number and position of segments per spermathecal pores were the same in different species.

Family Lumbricidae

Genus *Aporrectodea* (Orley, 1885)

***Aporrectodea caliginosa* (Savigny 1826):** This species was collected from all studied sites (Fig. 2). It is a parthenogenetic earthworm of Palaearctic region but almost worldwide distribution. Although typically a Holarctic species, it has been introduced worldwide due to the spread of European agricultural practices and widespread use of this earthworm as fishing bait¹⁹, thus it is considered a peregrine species (Michaelsen)²⁰. Smith²¹, Stephenson²² and Omodeo²³ characterized it as the most commonly found earthworm. So, this species represents 57.76% of the total found species in studied sites, 55.77% in pastures, 68.59% in agriculture field

and 43.86% in wadi. The findings were agreed with those of Jansch *et al.*²⁴ who found that this species was most frequently appearing in 148 sites of a total of 294 sites. Finally, in Algeria this species has been reported in all studies^{5,7,8,10}.

***Aporrectodea rosea* (Savigny 1826):** This species was collected in all studied sites (Fig. 3). It is quite common in the whole Palearctic region. As it was reported by El-Okki *et al.*⁹ that two *Aporrectodea* species (*Aporrectodea rosea* and *Aporrectodea trapezoides*) were the most widely distributed in the Kebir-Rhumel basin. It was found in this study that the two species (*Aporrectodea rosea* and *Aporrectodea caliginosa*) were the most widely distributed in Tebessa, occurring in 75.8% of all studied sites. It seems that their ecological requirements are very similar to each other as it was shown



Fig. 2: *Aporrectodea caliginosa*

Table 2: Comparison between characteristics of species of earthworms of the family Lumbricidae

Characters	<i>Aporrectodea caliginosa</i>	<i>Aporrectodea rosea</i>	<i>Aporrectodea longa</i>	<i>Eisenia foetida</i>
Length (mm)	40-200 ^a	35-130 ^b	170-220 ^c	40-120 ^b
Diameter (mm)	3-6 ^a	3-5 ^b	6-7 ^c	3-5 ^d
No of segments	111-194 ^a	52-162 ^b	95-167 ^c	54-118 ^d
Color	Brown cutaneous pigmentation	Light pink	Brown pigment anteriorly and dorsally	Purplish red pigmentation cutaneous
Form	Cylindrical flattened at the caudal level	Cylindrical flattened at clitellien level	Sub-trapezoidal flattened at the clitellien and caudal level	Cylindrical with light caudal flattening
Prostomium	Epilobic	Epilobic	Epilobic	Epilobic
Clitellum	27-34	25 (26)-33	27-35	26-32
Tubercula pubertatis	31-33	29-31	31-34	28-30
Setae	Geminated	Geminated	Geminated	Geminated
Spermathecal pores	9-10-11	9-10-11	9-10-11	9-10-11

Different letters indicate significant differences between different species for each character, $p < 0.05$ (ANOVA with Tukey's post-hoc test)



Fig. 3: *Aporrectodea rosea*



Fig. 4: *Aporrectodea longa*

in the study by Omodeo and Martinucci⁷ and it has been described in Algeria by Baha⁵, Bazri *et al.*⁸ and El-Okki *et al.*⁹.

***Aporrectodea longa* (Ude, 1885):** This species occurs with the weakest proportion (5,25%) in three sites: Elma Labiod, Ain Zarroug and El Hammamet (Fig. 4). It is a peregrine species with Atlantic origin²⁵. It is widespread in Northern temperate regions (Palearctic, North America), introduced into South America, Africa, Asia, Australia and New Zealand^{25,26}. This species is newly recorded in Algeria. The same results were found by Baker *et al.*²⁷ in Australia where deep-burrowing, surface-feeding (anecic) species are rare. Also, Jansch *et al.*²⁴ noticed that this species was least frequently found (appearing in 24 sites of a total of 294 sites). This situation contrasts with that in similar pastures elsewhere in the world where anecic species can constitute large proportions of the earthworm fauna and contribute significantly to soil structure and fertility²⁸.

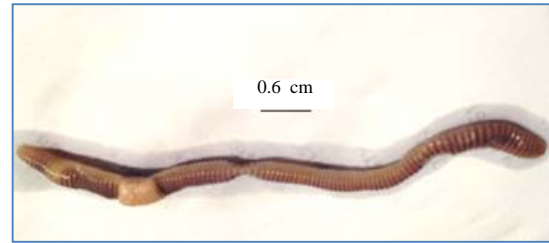


Fig. 5: *Eisenia foetida*

Table 3: Shannon Weaver's index (H') values in different studied sites of Tebessa

Sites	Shannon Weaver's index (bit)
Elmerdja	0.25
El Hammamet	0.84
Chabrou	0.99
Elma Labiod	1.30
Ain Zarroug	1.51

Genus *Eisenia* (Michaelsen, 1900; sensu Omodeo, 1956):

***Eisenia foetida* (Savigny, 1826):** It is cosmopolitan species-complex of the European origin. It belongs to the epigeic earthworms group²⁹. This ecological category lives on or near the soil surface, typically in the litter layers of forest soils or organic rich materials (such as compost) and does not burrow^{30,31}. Also, it is a ubiquitous species with a worldwide distribution³². This species (Fig. 5) was collected from two locations: Elma Labiod and El Hammamet. It has been reported in Algeria by lot of studies^{9,10}.

Table 3 shows the diversity index of earthworms in Tebessa where the factors were the type of soil, climates, the available organic resources, land use pattern and disturbance that influence the diversity of earthworm communities³³.

It is known that lowest Shannon Weaver's diversity index value means lowest diversity where a dominant species is present³⁴ and it was found that Elmerdja site, characterized with a sandy loam soil, has the lowest value. Obviously, this site contains two species where *Aporrectodea caliginosa* is largely dominant.

On the other hand, highest index value means highest diversity with equal partition of abundance of different species³⁴, while it was seen in Ain Zarroug site which has a loam silty clay soil. These findings agreed with Makin *et al.*³⁵ in Bangladesh where the clay loamy soil appeared to carry higher earthworm species in total populations than the sandy loamy appeared to carry lower earthworm species. Jansch *et al.*²⁴ found that the number of earthworm species at four common Dutch site categories (arable land, cattle or dairy farms on clay soils and sandy

soils)³⁶ were similar to those at German sites with the same land use and soil texture: low numbers (about three) at arable sites on sandy soils but high (about nine) at cattle or dairy farms on clay.

CONCLUSION

Four species named *Aporrectodea caliginosa*, *Eisenia fetida*, *Aporrectodea rosea* and *Aporrectodea longa* were recognized in the field of study. This study showed that the dominant species in Tebessa belonged to *Aporrectodea caliginosa*. These species were obtained from all regions of Tebessa, included: Pastures, field agriculture and wadis. *Aporrectodea longa* is new record for the country. Elmerdja site represented the lowest earthworm diversity, while the site of Ain Zarroug had the highest value. Importance of earthworms is ever-increasing now a days, thus suggesting that scientific centers of country should increase studies about these animals and effort to prepare atlas books of earthworms.

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