# The Morphological Identification and Biodiversity of Earthworms in Babylon Province-Iraq

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**KEYWORDS**

Earthworms , Morphological Identification, Distribution, Biodiversity indices

**ABSTRACT**

The present study is passing through the city of Babylon–Iraq during the period from Autumn 2023 to Spring 2024. Three stations representing various habitats were chosen for sampling. Our study involve the morphological identification of Earthworms and confirm the identification of nine species (Aporrectodea tuberculata, Aporrectodea rosea, Aporrectodea caliginosa, Amynthas grasilis, Dendrobaena platyura, Hormogaster redii, Lumbricus terrestris, Lumbricus rubellus and Polytoreutus finni). As well as measured some physiochemical parameters such as soil temperature ranged between (17.3-25.83C°), pH (5.66-7.06), Electrical conductivity (420-787.67µs/cm), Total Dissolved Solids (333.66-683.66 mg/L), Moisture content (5.22-9.24 %) and soil texture were Sandy clay in all stations. In order to get insight into the overall ecosystem health, various biodiversity indices were utilized such as Shannon-Wainer Index ranged between (1.26-2.75) and Simpson Index (0.15-0.59) to evaluate the basic Earthworms community structure, species distribution, and interactions. The study also demonstrates a significant relationship between species distribution and the environmental factors.

## 1. Introduction

Because it sustains a variety of ecosystem processes, activities and services, soil biodiversity is essential to human survival (Blouin et al.,2013). Biodiversity is categorized into two main types: above-ground biodiversity and below-ground biodiversity (soil biodiversity), these two types of biodiversity interact with each other in a mutually influential manner (Wardle et al.,2004). The richness and diversity of earthworm species have consistently been found to be more pronounced in undisturbed land than in disturbed land, with the likelihood of further increases in populations under favorable soil conditions (Schmidt et al.,2003; Frazao et al.,2017).

Earthworms are considered as the most important invertebrates for their beneficial role as soil biomanipulator and decomposer (Aira et al.,2007). They are considered environmental engineers due to their significant contribution in the preservation of soil structure and composition (Singh et al.,2016). They also significantly alter the physical, chemical, and biological properties of the soil, which has an effect on the dynamics of soil nutrients. They have a positive impact on soil by creating the drilosphere layer, which increases soil porosity as well as modifying soil structure and its properties (Blouin et al.,2013; Singh et al.,2018). It also alters the soil porosity by controlling the rate of decomposition of organic matter and the release of nutrients (De Wandeler et al.,2016). This beneficial effect of earthworms is crucial for plant development and yield. Because of their significance, several species of earthworms are used in soil management and fertilization. Therefore, the vermicomposting process, which yields vermicompost, is an effective way to recycle organic waste (Ansari and Ismail,2012). Many studies indicating that earthworm such Lumbricus rubillus can convert the biodegradable wastes into useful compost such as (Sethuraman and Kavitha,2013)

Many factors affecting the distribution of earthworm like temperature, pH, organic matter, moisture and soil texture (Moreno and Mischis,2004). Nonetheless, these factors can not only have a direct effect on earthworms, but they also often change soil characteristics such as moisture content, temperature, pH, and texture (Ruiz Sinoga and Diaz,2010) which then affect earthworm communities (Tiunov et al.,2006; Nieminen et al.,2011).

With approximately 6500 recognized species worldwide, earthworms are thought to be the most common members of the phylum Annelida, class Clitellata, and order Oligochaeta. Small setae are present in each body segment of this segmented worms, with the exception of the first and last ones

(Csuzdi,2012; Lalthanzara et al.,2018). In Iraq, the morphological identification of earthworms has historically received little attention, with only a limited number of studies conducted on Iraqi earthworms until recent years when interest in this group began to increase. Al-Khafaji (2006) conducted the first identification study on earthworms in Iraq, recording five species over four locations in Baghdad. Another work, Ahmed et al.,(2015) identified the species Aporrectodea rosea in different locations south Baghdad. Recently, Othman,(2020) detected six species belong to three genera of two families in Kurdistan-Iraq. The primary method for identifying adult earthworms based on their morphological features includes assessing features such as body color, prostomium type, setae arrangement, genital tumescence, clitellum position and form, tubercle pubertal, and male pore characteristics. Therefore, these traits play a crucial role in distinguishing between different earthworm species (Ahmed et al.,2015; Othman and Ahmad,2020). The majority of external characteristics, however, are only visible in mature animals and are frequently insufficient to distinguish between species (Chang et al.,2016). Therefore, to fully identify a species, the number, location, and form of its internal organs have been considered (Mirmonsef et al.,2011).

## 2. Methodology

Three stations in Babylon province were selected. All the stations categorized as an agricultural area (Figure 1). The first station (Albu Alwan village) represented the northern part of the province (32°35'47.43"N,44°23'4.45"E). The core of the governorate is represented by the second station (Al-Bu Nafi village) (32°31'1.93"N,44°33'3.70"E). The third station (Al-Mu'aymira district) represented the south of the governorate (32°22'3.16"N ,44°42'36.04"E).

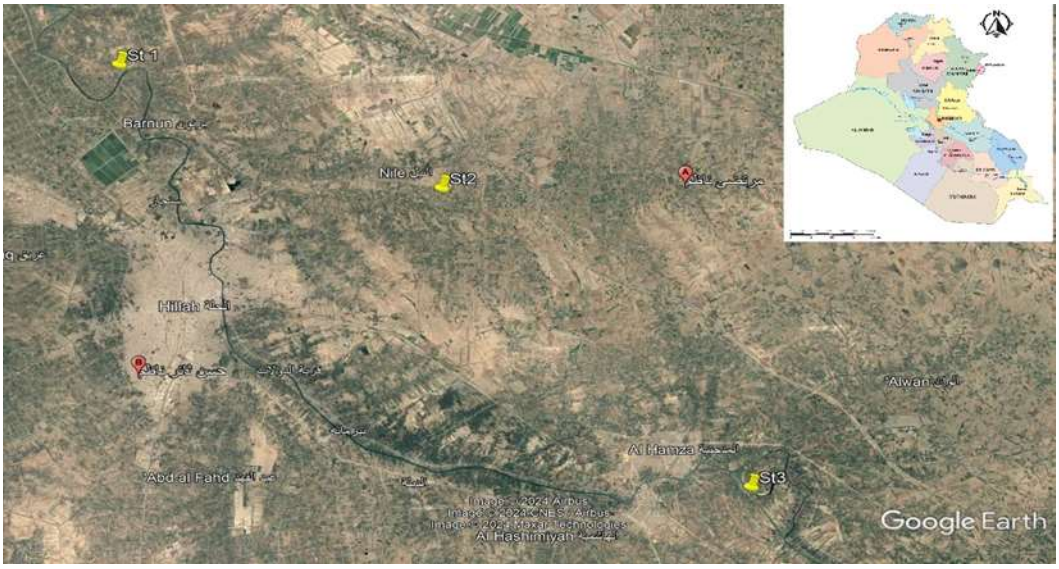


Figure (1): Satellite image show the study stations

### Collection of Samples

Earthworms with the soil containing them were collected seasonally during the period from Autumn 2023 to Spring 2024. Three replicates for each sample were taken. The samples were collected by digging the soil with a depth of 5-25 cm with a shovel (Farhadi et al.,2013) and placed in polyethylene containers with a length (40 cm) and width (30 cm ), then samples were brought to the laboratories of Biology department /Faculty of science at University of Babylon for soil analysis and worm diagnosis. Leaf litters and manure added frequently for each container and the moisture was kept between 70% to 80% by rushing water daily. However, each container was covered by textile net to avoid worm escaping.

### Ecological Measurement:

1- Soil temperature: were measured directly in the station using thermometer grading from 0 –100 ºC (Kamp England).

2- Electrical Conductivity (EC), potential of Hydrogen (pH), Total Dissolved Solid (TDS): EC (µs/cm), pH, TDS (mg/L) were measured using multi-parameters type HANNA, model Romania, after the calibration each parameter.

3- Soil Moisture: A 50 gram of composite soil sample was used to measure the moisture content, and it was dried at 105°C for 24 hours. We measured the dry weight of the sample till it showed a constant weight. The weight loss corresponds to the amount of water in the soil sample. The percentage of moisture content of each sample was calculated using the formula according to (Joel and Amajuoyi,2009).

4- Soil Texture: Utilize a simple jar test to determine the relative amounts of sand, silt, and clay present in the soil to evaluating its texture. Following the calculation of percentages, the soil textural triangle can be employed to classify the soil type (USDA,2017).

**Biodiversity Indices**

1 – Diversity index (Shannon Wainer): Biodiversity of worms was studied using the formula of diversity index, which denoted by (Magurran,2011)

2 - Index of Dominance (Simpson index): An indicator of dominance is utilized to measure the extent to which one or several species hold a significant presence within a community. This indicator calculates the importance of each species within the context of the entire community (Magurran,2011).

3 - Relative abundance (%): The Relative abundance was calculate according to (Salahi et al.,2017)

**Morphological Identification of Earthworm :**

For the morphological identification of earthworm species depends on the external features; numerous available identification keys were used (Bouché,1972; James,2000; Csuzdi & Zicsi,2003; Blakemore,2009).

## 3. Result and Discussion

Nine species of earthworm were identified (*Aporrectodea tuberculata*, *Aporrectodea rosea*, *Aporrectodea caliginosa*, *Amynthas grasilis*, *Dendrobaena platyura*, *Hormogaster redii*, *Lumbricus terrestris, Lumbricus rubellus* and *Polytoreutus finni*). Regarding their distribution through the study stations and period, *Aporrectodea tuberculata*, *Aporrectodea caliginosa, Dendrobaena platyura and Lumbricus rubellus* were the most abundant species and the highest density (37.1%) recorded by *Lumbricus rubellus* in station two during spring (Figures 2-4) and this come agree with (Klok *et al*.,2007). As can be seen, it turned out that the decline in the density of earthworm coincided with the rise in temperatures during the hottest season of the year and decline in moisture content, and this agrees with some studies (Lavelle and Spain,2001; Al-Khafagi *et al*.,2013; Jaweir & Al-Seria,2015; Javidkar *et al*.,2020). Because the soil temperature varied throughout the study period from 17.3 Cº in station two in spring to 25.83 Cº in station two in the autumn (Figure 5). The statistical analysis revealed significant differences across all seasons for soil temperature rates when comparing it during the study period. Changes in temperature reflected the general attitude of the geographical location (Tiwari *et al*.,2004 ; Manickam *et al*.,2014). As well as the current study recorded low moisture content ranged between 5.22 - 9.24 % **(**Figure 6**)** and this negatively affects on earthworm population (Hendrix and Edwards,2004).

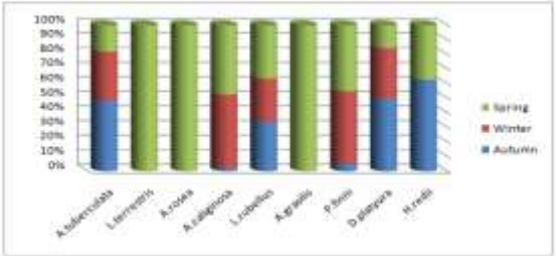


Figure (2): Seasonally changes of earthworm density at station one during the study period

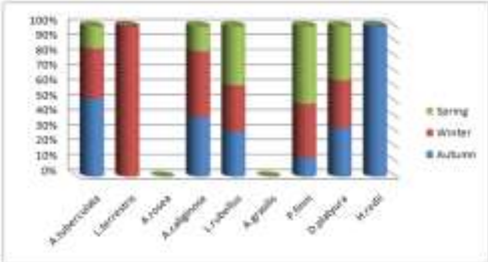


Figure (3): Seasonally changes of earthworm density at station two during the study period

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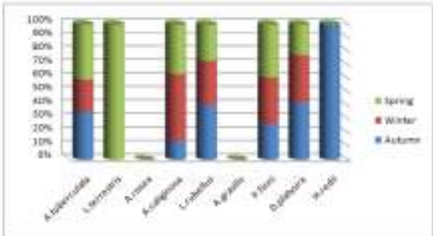


Figure (4): Seasonally changes of earthworm density at station three during the study period

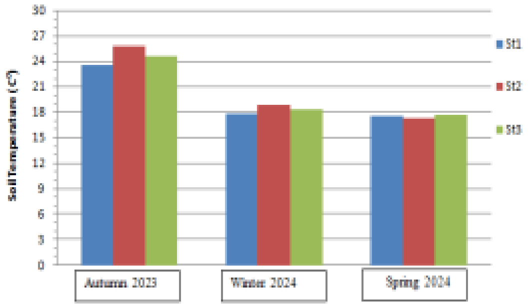


Figure (5): Seasonally changes of Soil Temperature at the stations during the study period

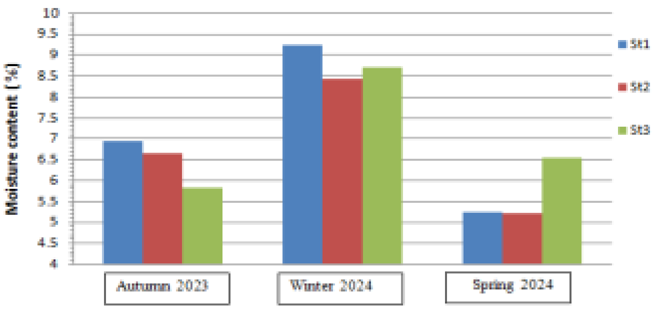


Figure (6): Seasonally changes of moisture content at the stations during the study period

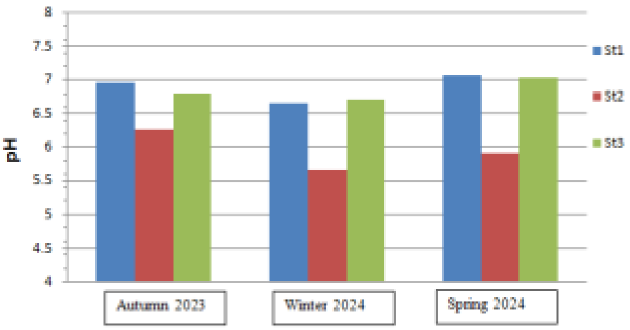


Figure (7): Seasonally changes of pH at the stations during the study period

alue of pH was (5.66) in station two during the winter while the highest was (7.06) in station one during the spring (Figure 7). When comparing pH values during the study period and between the stations, statistical analysis showed there is no significant seasonal changes for pH values. The current study observed a narrow pH range which is linked to the buffering capacity of carbonic acid and bicarbonate which are resistant to pH changes (Wetzel,2001). The findings comes agree with (Sankar and Patnaik,2018) who showed that earthworm generally have narrow range in pH. While some of them may tolerate acidic or alkaline soils, most of them show a tendency for neutral soil. The pH values reported in this study are within the range that is favorable to earthworms habitat.

Electrical conductivity is usually relates to dissolved salts, hence there is a strong correlation between EC and TDS. In this study, E.C and TDS values varied from the lowest of 420 µs/cm in station one during winter to the highest of 787.67 µs/cm in station one during spring, as well as TDS ranged between the lowest of 333.66 mg/l in station three during winter to the highest of 683.66 mg/l in station three during spring (Figures 8-9). Significant seasonal fluctuations were noticed. It is known, the increased of EC and TDS were recorded in the dry season probably as a result of high temperature, less solubility and high degradation of organic substances. This agree with many studies around the world such as (Muhammad and Ali,2013; Dhanasekaran *et al*.,2017 and Dastgeer *et al*.,2020).

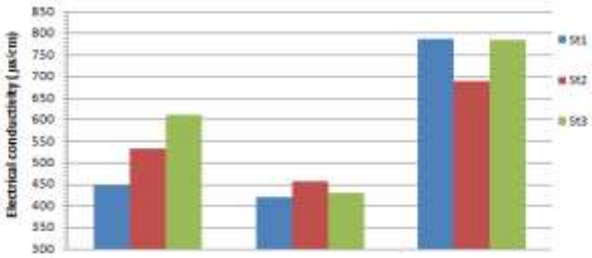

Figure (8): Seasonally changes of electrical conductivity at the stations during the study period

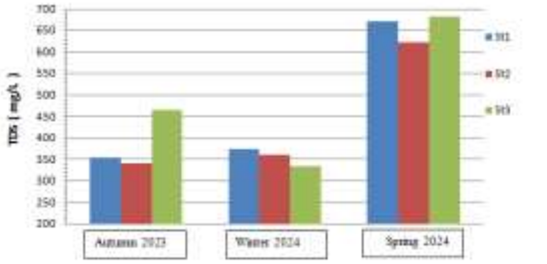

Figure (9): Seasonally changes of TDS at the stations during the study period

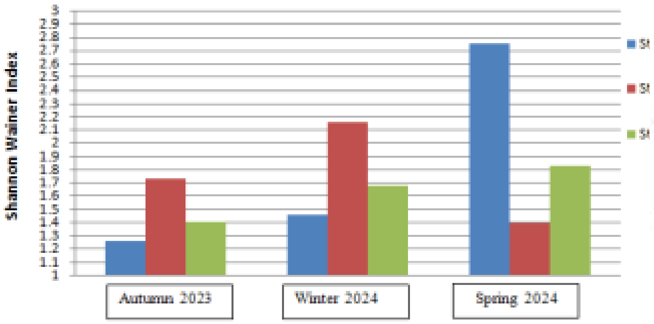

Figure (10): Seasonally changes of Shannon Wainer Index at the stations during the study period

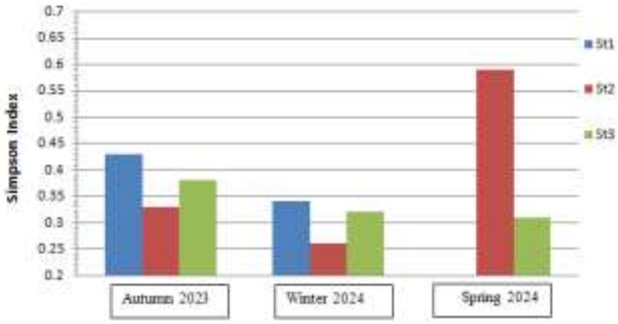

Figure (11): Seasonally changes of Simpson Index at the stations during the study period

According to Shannon-Wiener index, The present study indicated that the first station recorded the highest value (2.75) in the spring and the lowest value (1.26) in the autumn respectively (Figure 10). While the index of dominance (Simpson index) shows high value (0.59) in station two and low value (0.15) in station one during spring (Figure 11). The results of the study suggest that the communities are well-developed and in equilibrium due to the presence of a diverse array of species sharing dominance. A lack of diversity, typically indicated by values nearing zero, is indicative of stress conditions within the communities (Dash,2003). Diverse alterations in land use patterns have had a direct impact on the diversity and distribution of earthworm populations in varying geographic areas (Bhadauria *et al*., 2000; Lalthanzara *et al*.,2011). Diversity of epigeic species like in agricultural field was low may be due to physical disturbance of the soil during plowing and intensive use of insecticide and pesticide (Jouquet *et al*.,2010). and this come agree with (Sudha *et al*.,2008).

## 4. Conclusion and future scope

According to the values of the biodiversity indices, we found that the species richness of earthworms was low and that their biodiversity varied throughout the year. Regarding the recorded species, most species have low density as a results of environmental stress due to changes in its chemical and physical characteristics, leading to pollution. We recommend to carry out a thorough investigation of all agricultural areas in order to identify the species of earthworms present and examine their ability to withstand unfavorable environmental factors.

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