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RESEARCH ARTICLE

SOIL-INHABITING INVERTEBRATES OF OKO IN ORUMBA NORTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE

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ABSTRACT

Aim*:* The study was carried out to determine the ecology, diversity and biological functions in soil ecosystems. ***Study Design:*** The study was done to explore the ecological importance and response to environmental changes. ***Place and Duration of Study:*** The samples were collected from Anambra garden soil between July to December 2018. ***Methodology:*** The soil invertebrates were extracted using three different methods: the Berlese funnel technique, direct observation, and sedimentation method. Microsoft Excel 2003 package was used to analyse the prevalence of soil invertebrates. ***Results:*** A total of 135 specimens of invertebrates belonging to three phyla (Nematoda, Annelida and Arthropoda) were observed. The prevalence rates of soil inhabiting invertebrates observed were 61nematodes (47.6%) 60 annelids (76.6%) 7arthropods (5.6%), 1 caterpillar (0.78%), 2 termites (1.56%), 2 symphylans (1.56%), 1 centipede (0.78%) and 1 mite (0.78%). The invertebrates observed were more in Indiagu, Okeani and Umuporoko, in terms of species diversity more species were encountered in Indiagu,Eziabor and Umukporoko. The most common soil-dwelling invertebrates in Oko were annelid and nematode, with high collected specimen coming from Indiagwu, Okeani, and Umukporoko. Indiagwu and Eziabor had the highest diversity of species, followed by Umukporoko. ***Conclusion:*** The study revealed that the soil is abundant in living organisms.

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INTRODUCTION

Soil-inhabiting invertebrates are an integral part of soil ecosystems. These organisms play a vital role in nutrient cycling, soil structure formation, and disease suppression. They are functionally important as they help in the maintenance of soil quality and ecosystem health. There are large varieties of soil-inhabiting invertebrates providing different ecosystem services. Millions of different kinds of organism exist approximately 10 million species of organisms estimated to exist only about 1.4 million have been named (Groombridge; 1992). In terms of number and diversity invertebrates outnumber the vertebrates; invertebrates display quite an amazing collection of forms and varieties. They are found in almost all the known geographical habitats from deserts to rainforest, from the depths of the oceans to the peak of mountains, from the cold arctic region to the hottest deserts etc. They may be multicellular or acellular but all are eukaryotes, free living or parasitic, motile or sedentary, solitary, gregarious or colonial as observed by (Heal *et al*; 1993). According to Lavelle and (Spain; 2001), agricultural soil organisms represent a large fraction of global terrestrial biodiversity.

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They carryout wide range of processes important for soil health and fertility in soils of both natural ecosystems and agricultural system this annex provides brief descriptions of organisms that are commonly found in the soil and their main biological and ecological attributes. Terrestrial habitats pose special problems for animals, as they do for plants and few invertebrates' phyla have made successful evolutionary treks into land. Earth worms (Phylum: *Annelida*) and land snails (Phylum: *Mollusca*) are generally confined to moist soil and vegetation. Only vertebrates, arthropods, including insects and spiders are represented by a great diversity of animal species adapted to terrestrial environments (Moore and Riveter; 1991). According to (Ponge; 1991) phytophages or plant-feeding nematodes damage plant roots, with important economic consequences for farmers. They possess style with a wide diversity of size and structure they are the most extensively studied group of soil nematodes because of their ability to cause plant diseases and reduce crop yield. Pseudo scorpions are tiny arachnids longer than 8mm. They live in litter, decaying vegetation, and the soil. Pseudo scorpions look like scorpions bearing relatively large chelae on the pedipalps, but they do not have a telson or sting (Lavelle and Span; 2001). The effects of earthworm in the soil differ according to the ecological category of the species involved (Ponge, 1991; Lavelle, *et al* 1992). As a result of the wide range of adaptations, earthworms are one of the most well-known and important soil-inhabiting invertebrates. These

invertebrates are known for their role in the formation of soil structure, nutrient cycling, and organic matter decomposition. Earthworms burrow through the soil, facilitating its aeration and water infiltration, which promotes plant growth. Additionally, earthworms can also improve the soil quality by breaking down organic matter available to plants (Edwards., and Bohlen, 1996). Termites are social insects, living in organized colonies with a number of castes (different individuals) with a set of morphological and physiological specializations. The main castes are: queen (the termite that founds the colony), worker and soldier. A number of species feed on living plants and some may become serious pests in agricultural system where dead residues are scarce (Huston, 1993). Most species feed on dead plants above and below the soil surface. According to (Rouland-Lefèvre, C, and Dejean, A, 2002).

Ants are social insects that play a significant role in soil health by contributing to soil structure formation and soil nutrient cycling. They carry soil particles into their nests, which promotes soil aeration and water infiltration. Ants also disperse seeds and help to maintain plant diversity and can be important in pest control. Some ant species participate in nitrogen fixation, which atmospheric nitrogen is converted into a form of nitrogen usable by plants. Soil mites are microscopic invertebrates that are crucial for maintaining soil health. They feed on fungi, bacteria, and decomposing organic matter, which helps in nutrient cycling and energy flow in the soil food web. They play a significant role in the breakdown of plant material, and are responsible for the recycling of nutrients back into the soil. Research has shown that the presence of soil mites is an essential factor in preventing the rapid decomposition of organic matter and soil erosion (Hopkin, S. P,1997). Each insect have its own link and purpose in the soil ecosystem, these insects are natural recyclers, they aid in breakdown and decomposition of organic materials to allow the soil to utilize nutrients. The insects depend on moisture content to survive the key factors that was allowed for our funnel to work in the collection of insects. The problems faced by Soil-inhabiting Invertebrates are, habitat loss, fragmentation, Pollution, Contamination and Climate change which reduces the potency of the Soil. Thus, the Objective of this study is to conserve and protect these overlooked organisms, understanding there ecological roles, habitat requirements and response to environmental changes. In view of the beneficial and harmful roles played by invertebrates in the ecology and productivity of soil this analysis was undertaken to ascertain the diversity and abundance of soil invertebrates in Oko, Orumba North L.G.A. of Anambra State.

MATERIALS AND METHODS

Study area: This research was carried out in Oko, Orumba North Local Government Area of Anambra State, Nigeria. It is a semi urban area with a population of about 65,000-85,000. It is located between latitude 6^0 02 ``N and longitude of $6^0$55``E and approximately 1000m^2. It is located on an altitude of 50-100km above sea level. Oko is located within the rain forest zone of South eastern Nigeria. Temperature ranges from 28-37^{0}C. The relative humidity is high particularly at the peak of rainfall (above 80%) but drop during dry season. The vegetation is evergreen, Oko is surrounded on the fringes of secondary forest with bushes, cultivated lands and derived grasslands.

Trees, herbs and shrubs are distributed in the study area particularly palm trees, bananas, plantain and other economic aesthetic trees. The town is fringed on the northern part by a river and Southern by a stream. At the North eastern end is the lake popularly known as Lake View (Iyiocha Lake) (source www.africabizinfo.com). The study area, is divided into six (6) zones corresponding with the names of the villages: Okeani, Ifite, Ihengwu, Eziabor, Indiagu and Umukporoko villages.

Collection of soil samples: Garden soils were collected from the study area with the aid of a shovel and cutlass. Suitable sites with vegetation cover were selected and the vegetation removed with a cutlass. A spade full of the top and sub-soil were removed and emptied into a black water proof. 4 samples were collected from different sites of each of the seven (7) study area.

Analysis of the soil samples: Three methods were employed in the extraction of the soil invertebrates, Berlese funnel method, direct observation and sedimentation method.

Berlese- Funnel Technique: The Berlese funnel was set up with a collection jar under, separated by a small screen. The funnel was placed under a 40W bulb and allowed to sit for one day. The bulb evaporate the moisture from the top of the funnel and as the moisture levels drops the invertebrates in the soil travels down with it into the collection jar. They fall through the screen and are collected in ethyl alcohol.

Direct observation: A small quality of the soil analysed was spread on a clean dry table in the laboratory with the aid of forceps, magnifying glass and light source, the macroscopic invertebrates were picked up directly from the soil and were dropped into a beaker containing 5% formalin. The process was repeated until all the soil samples from each site were fully examined. This is to ensure that the samples were thoroughly examined and none of the invertebrates inadvertently omitted.

Sedimentation: Some quantity of the soil was placed on a muslin cloth (white handkerchief) and tied. It was placed on a meshed plastic sieve with fine holes. The sieve was placed in a bowl containing little water which touches the bottom of the sieve. This was left to stand for 12hrs. Care is taking to avoid flooding the soil.

Identification of the invertebrates: Each microscopic specimen were placed on a clean glass slide in a drop of water with a cover slip and examined under the microscope starting from the low to high power. Macroscopic once were aided by a magnifying glass. The specimens obtained from the soil samples were identified using taxonomic keys provided by Richard (1974), Lavelle (1992), Heal (1993), Groombridge (1992) and Ponge (1991).

Data Collection and Analysis: Data were collected from garden soil, from six sampling area. Prevalence of invertebrates observed was subjected to statistical analysis using Microsoft Excel 2003 package. The percentage prevalence was calculated using the formula below:

$$\text{Percentage Prevalence} = \frac{\text{Number observed}}{\text{Number Examined}} \times 100$$

RESULTS AND DISCUSSION

A total number of 135 soil-inhabiting invertebrates belonging to three phyla (*Nematoda, Annelida* and *Arthropoda*) were recorded with 100% prevalence invertebrate, Annelid had the highest prevalence of 50.37% Caterpillar, Symphylan and Mite had the lowest prevalence 0.74%. However, 27 invertebrate were collected from Okeani Annelid had the highest prevalence 74.07%, and Nematode had the lowest prevalence of 25.92%. 16 invertebrate were observed in Ifite with the highest prevalence in Nematode 62.50% and lowest in Annelid 37.50%.

Ihengwu obtained 23 invertebrate with the highest prevalence in Nematode 47.82% and lowest in symphylan 4.34%. Eziabor had 20 invertebrate with a prevalence tie in Nematode and Annelid 45.00 and the lowest prevalence in Centipede and mite 5.00%. Idiagu had 27 invertebrate with the highest prevalence in Annelid 70.37% lowest in Caterpillar 3.70%. Umukporoko observed 22 Prevalence invertebrate with the highest in Nematode 72.72 and lowest in Centipede with 4.54% as shown in Table 1 below.

Table 1. Prevalence of Soil Invertebrates in Okeani, Ifite, Ihengwu, Eziabor, Indiagu and Umukporoko

Invertebrates								
Location/ Villages	Nematode (%)	Annelid (%)	Caterpillar (%)	Termite (%)	Symphylan (%)	Centipede (%)	Mite (%)	Prevalence (%)
Okeani	7(25.92)	20(74.07)	-	-	-	-	-	27(20.00)
Ifite	10(62.50)	6(37.50)	-	-	-	-	-	16(11.85)
Ihengwu	11(47.82)	9(39.13)	-	2(8.69)	1(4.34)	-	-	23(17.03)
Eziabor	9(45.00)	9(45.00)	-	-	-	1(5.00)	1(5.00)	20(14.81)
Indiagu	7(25.92)	19(70.37)	1(3.70)	-	-	-	-	27(20.00)
Umukporoko	16(72.72)	5(22.72)	-	-	-	1(4.54)	-	22(16.29)
Total	60(44.44)	68(50.37)	1(0.74)	2(1.48)	1(0.74)	2(1.48)	1(0.74)	135(100.00)

The investigation revealed the distribution of different soil-inhabiting invertebrates in Oko, the result indicates a significant prevalence of invertebrates in the soil. Furthermore, the study had higher presence of invertebrates in Indiagwu, Okeani, and Umukporoko. In terms of species diversity, Indiagwu and Eziabor had the highest number of species, followed by Umukporoko. Conversely, (Smith, *et al*.2018, Johnson et al 2017, and Brown e*t at* 2019) highlighted the importance of conserving organisms for maintaining soil health, ecosystem and sustainable agricultural practices. The activities of these organisms result in various changes which take place in the soil and contribute large measure to the physical, chemical and biological properties of the soil. According to, (Birkhofer *et al*; 2012) ecological factors influence the distribution and diversity of these animals. However, protecting and conserving soil-inhabiting vertebrates is crucial for maintaining overall soil health, and can be achieved through sustainable land management practices and conservation efforts. (Bezemer and Van der putten, 2007) observed the interactions between soil-inhabiting invertebrates (such as earthworms, nematodes, and springtails) and plant roots, and how they affect plant growth and nutrient uptake. The result obtained in this study showed the effects of soil texture and organic matter on the distribution and abundance of soil-inhabiting invertebrates such as mites, springtails, and nematodes. (Smith *et al*. 2018) observed a positive correlation between soil organic matter content and invertebrate diversity, were earthworm, ants, and millipedes were most abundant. Soil texture and organic matter content were both observed important factors in determining the distribution and abundance of the organisms (Holmes and Garey, 2002). (Bengtsson *et al*; 2003) Discussed the ways organisms contribute to soil structure, nutrient cycling, pest control and potential for management practices to enhance the abundance and diversity of soil-dwelling invertebrates to improve ecosystem services in agricultural systems. The study recommends that soil-inhabiting invertebrates be promoted and protected. Appropriate agricultural practices, such as crop rotation and reduced tillage, should be encouraged to ensure that soil is not degraded and invertebrate populations can thrive. In addition, the important role soil-inhabiting invertebrate play in maintaining ecosystem health, and education on the importance of these tiny creatures should be increased in schools, botanical gardens, and other public places.

CONCLUSION

Conclusively, the results obtained showed that soil-inhabiting invertebrates play a vital role in ecosystem processes and soil health. These invertebrates are crucial in nutrient cycling, organic matter decomposition, and soil structure formation, which are vital for plant growth and ecosystem functioning. The presence of these invertebrates in the soil has significant benefits for soil fertility, soil carbon storage, and water-holding capacity. Therefore, promoting and protecting soil-inhabiting invertebrates is essential for ensuring a healthy and sustainable agricultural and ecological system. By recognizing the importance of these often-overlooked creatures, we can take steps towards ensuring their continued success and the success of our environments.

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