International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2015; 2 (3): 48-51
Received: 30-03-2015
Accepted: 19-04-2015

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Pattern of soil arthropods diversity in Itu local government area of Akwa Ibom state, Nigeria

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Abstract
This study was conducted to assess the pattern of arthropods diversity in contrasting habitats in Itu Local Government Area of Akwa Ibom state, Nigeria. Soil arthropods were collected from September to November 2012 in cultivated and fallowed farmland using pitfall trap. A total of 290 individuals of soil arthropods belonging to eight (8) orders; Hymenoptera, Isoptera, Araneae, Diptera, Diplopoda, Coleoptera, Orthoptera, Lepidoptera and Isoptera, were encountered during the study. The order Hymenoptera accounted for the most abundant in the cultivated farmland (59%) and fallowed farmland (48%), while Lepidopterans were the least in the cultivated farmland (1.93%) and fallowed farmland (2.15%). The fallowed farmland recorded the highest diversity (Shannon's Wiener index) value of 2.06 and richness index (R) value of 2.37 as compared to the cultivated farmland that recorded 1.80 for diversity index and 1.9 for richness index. This was probably due to availability of vegetation canopy which provided different niches to the arthropods in the fallowed land. Therefore, sustainable farming practices should be adopted so as to ameliorate the impact of agricultural practices on arthropods and other soil organisms, and to restore the integrity of the soil ecosystem.

Keywords: Arthropods, diversity, pitfall, farmland.

Introduction
The soil consists of various forms of life in an endless series of interlinked caves (Williams, 2000) [14]. It is a natural body comprising of solids, liquids and gases that occur on the land surface and which has the ability to support rooted plant (Coleman, 2000) [4]. Soil organisms are important components of the soil food chain as decomposer and without these organisms, nature would have no way of recycling organic materials on its own (Trombetti and Williams, 1999) [13]. Arthropods are the most diverse group of animals on earth and they forms part of the major functional component of the soil food web, such as; soil accumulation of organic matter, soil structure and nutrient cycling as well as encouraging plant root development (Behan-Pelletier, 2000; Basset *et. al*., 2003; Gardi and Jeffery, 2009).
Vegetation structure usually provides the habitat template for assemblage of soil arthropods in multi-trophic communities by offering shelter, food resources, oviposition micro-sites and refuge against predators (Seymour and Dean, 1999; Mazia *et al*., 2006) [9]. Also, the abundance and diversity of soil micro arthropods are influenced by the availability of organic matter, substrate quality, concentrations of macro and micro nutrients, age and diversity of the rehabilitating habitat (Loranger *et al*, 2000) [8]. This study investigates the abundance and diversity pattern of soil arthropods in Itu Local Government Area.

2. Materials and Methods
2.1 Study Area
The study area lies on latitude $5^{0}10^{1}$N and longitude 7^{0} 59^{1} ^{0}E (Fig. 1). It is characterized with rainy season and dry season lasting from late March to early November and late November to early March respectively. The vegetation in the area is predominantly the low land rainforest formation with an annual mean temperature of 31^{0}C. People living in the community practices subsistent farming such as cassava plantation, water leaf plantation, yam and much more. The vegetation included a great variety of grasses, herbs, shrubs and trees.

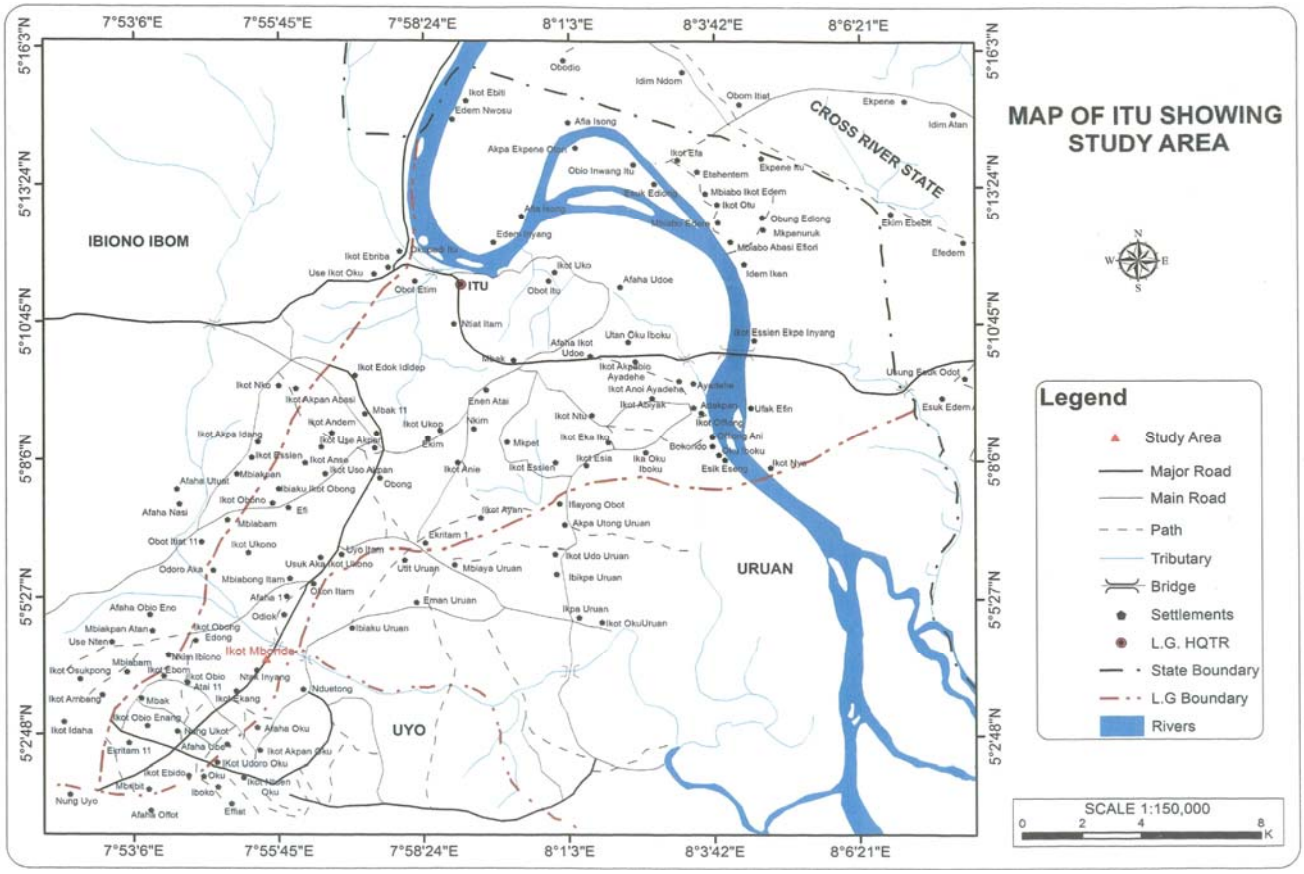

Fig 1: Showing Map of Study Area

2.2 Collection of samples

The study area is an expanse of land measuring 2500m^2 (50 x 50m) for cultivated land and 4900m^2 (70m x70m) for fallowed land. Pitfall traps consisting of plastic container measuring 17cm in length and 14.5cm in diameter, funnel and formalin of about 4% were used in the collection of the soil arthropods. The containers were placed in a hole of about 17cm; dug at different sampling points of the study area, such that the aperture of the containers could level with the soil surface in order to enhance easy passage of arthropods into the container. After about 48 hours, the content were emptied into a container and reset. The arthropods collected were transported to the Zoology Laboratory, University of Uyo for sorting, counting and identification. The arthropods were identified using appropriate guide book of Pennak (1978) and Borror and White (1970). Shannon-wiener diversity index (H) and Evenness (E) were determined using PAST3 software.

3. Results

A total of 290 individual arthropods for both cultivated (186) and fallowed (104) plot were encountered. In the cultivated plot, Hymenoptera accounted for 56.99% followed by Orthoptera (22.58%), and the least was Lepidoptera (2.15%) of the percentage abundance. Among the 186 species collected for the cultivated plot *Aenictus* sp. (Army ant), was the most abundant with 74 species followed by *Gryllotalpa* sp. (mole cricket) with 30 species, *Pachycondyla* sp. with 19 species, *Menemerus* sp. (Ground spiders) with 15 species, *solenopsis* sp. (fire ant) and *Pterostichus* sp (ground beetle) both with 13 species each (Table 1).

In fallowed plot, the order Hymenoptera, followed by Orthoptera were the most abundant accounting for 48.08% and 17.31% respectively and the least was Lepidoptera (1.92%) of the percentage abundance. Out of the 106 species collected from the fallowed plot, *Pachycondyla* sp. and *Aenictus* sp. (army ant) were the most abundant with 25 species respectively, followed by *Pterostichus* sp. (ground beetle) with 13 species, *Gryllotalpa* sp. (mole cricket) and *Menemerus* sp. (ground spider) with 10 species respectively. *Omocestus* sp. (short-honed grasshopper) and *Musca domestica* (house fly) both recorded 6 species each, while *Zonocerus variegatus* with 2 species. (Table 2)

The species richness (R), Evenness (e) and Shannon's index (H^1) were 1.91, 0.78 and 1.8 respectively for cultivated plot, while for the fallowed plot they were 2.37, 0.86 and 2.06 respectively (Table 3 and Table 4).

Table 1: Percentage Abundance of Soil Arthropod species for Cultivated Land

Order	Species	N	%
Araneae	*Menemerus* sp.	15	8.06
Hymenoptera	*Pachycondyla* sp.	19	10.21
	Solenopsis sp.	13	7.00
	Aenictus sp.	74	39.78
	Total	56.99	
Orthoptera	*Gryllotalpa* sp.	30	16.13
	Chorthippus sp.	5	2.69
	Omocestus sp.	7	3.76
	Total	22.63	
Lepidoptera	*Papilio* sp.	4	2.15
Diplopoda	*Narceus americanus*	6	3.23
Coleoptera	*Pterostichus* sp	13	6.99
Total		186	

Table 2: Percentage Abundance of Soil Arthropod Species for fallowed land

Order	Species	N	%
Araneae	*Menemerus* sp.	10	9.62
Coleoptera	*Pterostichus* sp.	13	12.5
Diptera	*Musca domestica*	6	5.77
Hymenoptera	*Pachycondyla* sp.	25	24.03
	Aenictus sp.	25	24.03
	Total	48.06	
Orthoptera	*Zonocerus Variegatus*	2	1.92
	Omocestus sp.	6	5.77
	Gryllotalpa sp.	10	9.62
	Total	17.31	
Lepidoptera	*Papilio* sp.	1	0.96
	Phereoeca sp.	1	0.96
	Total	1.92	
Isoptera	*Cryptotermes* sp.	5	4.81
Total		104	

Table 3: Diversity values of Soil arthropod assemblages for cultivated land

	Total species	Orthoptera	Araneae	Lepidoptera	Diplopoda	Hymenoptera	Coleoptera
Shannon-Wiener Index (H^1)	1.8	0.79	0	0	0	0.81	0
Evenness (E)	0.78	0.72	0	0	0	0.74	0
Richness	1.91	0.80	0.37	0.72	0.56	0.64	0.39

Table 4: Diversity values of Soil arthropod Assemblages for fallowed Land

	Total species	Araneae	Coleoptera	Diptera	Hymenoptera	Orthoptera	Lepidoptera	Isoptera
Shannon-Wiener Index (H^1)	2.06	0	0	0	0.7	0.93	0.7	0
Evenness (E)	0.86	0	0	0	1.01	0.85	1.01	0
Richness (R)	2.37	0.43	0.39	0.56	0.51	1.04	2.89	0.62

4. Discussion

In this study, different species of arthropods belonging to different taxa were encountered in both cultivated farmland and fallowed land. More soil arthropods were encountered in the cultivated plot than the fallowed plot. This could be attributed to the fact that the thick vegetation in the fallowed plot may have impeded arthropods movement and provided more diverse food. Hymenoptera dominated the taxa, while Lepidoptera accounted for the least occurrence for both cultivated and fallowed plot. The presence of other taxa namely: Coleoptera, Orthoptera, Isoptera, Araneae, Diptera and Diplopoda in the study plots could be attributed to the moisture content and food availability in the study area. This observation is similar to that made by IIoba and Ekrakene (2009) [7] that increase in soil moisture lead to increase in soil fauna. The dominant of Hymenoptera in this study is similar to observation made by Powell (2009) [11] that Hymenoptera were found on sampled plots either foraging, prospecting for nectar, mate, and even oviposition site.

Aenictus sp. accounted for 39.8% in the cultivated plot while *Pachycondyla sp.* and *Aenictus sp.* both accounted for 24% respectively. This is similar with report made by Hilldobler and Wilson (1990) [6] that ants account for an estimated 30% of terrestrial biomass. The high diversity value and richness index of soil arthropods species in the fallowed plot could be attributed to availability of vegetative canopy which provides different microhabitats and niches to the soil arthropods while partially open vegetation exposes the soil arthropods to avoidable predators and harsh weather conditions, hence the low diversity value and richness index in the cultivated plot.

4.1 Conclusion

The study area in Ikot Mbonde supports a wide range of diverse and functionally important groups of arthropods. Thus, sustainable farming practices should be adopted so as to ameliorate the impact of agricultural practices on soil arthropods and organisms, and restore the integrity of the soil ecosystem.

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