SHORT COMMUNICATION

Abundance, Distribution and Diversity of Terrestrial Insects in University of Ibadan, Ibadan, Western Nigeria

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ABSTRACT: This study was conducted to assess the status of terrestrial insects' population in three selected sites (the Botanical Garden, Awba Dam area and the Practical Year Training Programme farmland all on University of Ibadan campus). The study was carried out from February to July, 2012. Insect samples were collected from the study sites using sweep net, pitfall trap and handpicking methods. Insects collected were identified at the Insect Museum in the Department of Crop Protection and Environmental Biology, University of Ibadan, using Standard Key and Comparative Morphology. A total of 1,524 individuals, belonging to nine orders were recorded during the study. The order Hymenoptera was observed as the most abundant while order Lepidoptera was the most diverse. Margalef's and Shannon's indices of species richness and diversity analysis showed that the Awba Dam site had the highest species richness and diversity, with Margalef's and Shannon's indices values of 4.96 and 4.36 respectively. Pearson correlation coefficient showed no significant relationship between insect abundance and temperature, relative humidity or solar radiation. But there was a significant relationship between insect abundance and months ($r=0.890$) at $p>0.05$ level.

Keywords: Terrestrial Insects, Abundance, Distribution, Diversity, University of Ibadan

INTRODUCTION

Insects are the most diverse and abundant of all groups of arthropods. Borror and Delong (1970) reported insects as the dominant group of animals on earth to date. They noted that insects by far exceed all other terrestrial animals in numbers, and they occur practically everywhere. The diversity of insects in the humid tropics has amazed biologists such as Bates, Wallace and the other 19th century explorer naturalists (since the days of Bates, Godfray *et al.*, 1997). Only small fractions (certainly fewer than 20%) of tropical insects have been described by entomologists.

All the while, habitats are contracting and being destroyed at historically incomparable

rate (Godfray *et al.* 1997). Several studies have provided pieces of evidence showing that tropical insects undergo seasonal changes in abundance at least in those parts of the tropics where wet and dry seasons alternate (Davis, 1945). Denlinger (1980) pointed out that seasonality is a "conspicuous feature in the life history of many organisms". According to Owen (1972), in the humid tropics of West Africa, adults of many species of terrestrial insects occur in all the months of the year, but with seasonal peaks of abundance that are associated with the alternation of wet and dry seasons. In an area where there are well-defined seasons, the onset of the rains often results in an enormous increase in the numbers of species that have occurred at low frequencies, throughout the dry season (Aydagnhum, 2007). The study determined the

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abundance, distribution and diversity of terrestrial insect species found on the University of Ibadan Campus, Oyo State, Nigeria.

MATERIALS AND METHODS

Description of Study Area

The study was conducted at the University of Ibadan, Oyo State, Nigeria. Geographically, the University of Ibadan is situated in the South Western part of Nigeria (7°8'9"N, 5°15'7"E) (Figure 1). Ibadan is characterized by both rainy and dry seasons, with rainy and dry seasons lasting from April to October, and November to March respectively (Akoroda, 2008). The three sites used within the study location include the Botanical Garden (A), the Awba Dam area (B) and the Practical Year Training Programme (PYTP) Farmland (C). Site A (the Botanical Garden), was founded in 1948 during the establishment of the University primarily for teaching and research in Botany. It also serves for collection, raising and preservation of different plant species. The garden occupies about 40 hectares of land area. Currently, the garden houses a lot of plant diversity with about 80-100 plant families represented. The botanical garden is mapped out into different sections, including the nursery and ornamental sections, rose garden, conserved area and others. The Awba Dam is a small man-made lake with a surface area of 6 hectares and a length of 700m (Omotosho, 1981). It was constructed in April 1964, to develop the university's internal water supply system and compliment the very limited amount supplied from Oyo State. The dam also store water for domestic consumption, laboratory use, aquaculture and to facilitate hydrobiology and ecology research projects. It is surrounded by modified tropical rainforest vegetation and as such, is rich in insect fauna. The Practical Year Training Programme (PYTP) was established in 1976 to enable the fourth year students of the Faculty of Agriculture

acquire practical farming skills. The PYTP Farmland occupies about 2.5 hectares and crops such as maize, vegetables and cowpeas.

Collection of Insect Samples

Insect samples were collected fortnightly from the sampling sites, within a sampling period of six months. The standard methods employed in the collection of insect were those outlined by Youdeowei (1977) and include the use of sweep net, pitfall trap and hand picking methods. Killing jar was prepared with chloroform-soaked cotton wool for charging, with a laid plain paper on top of the wool. The Killing jar was used in killing collected insects before preservation in insect box.

Processing of Insects Collected

After the death of the insects, they were preserved by pinning. This was done by placing the insects on a mounting stage and entomological pins were pushed vertically through the thorax of the insect specimens after which, they were left to dry. Insects collected were identified at the Insect Museum of the Department of Crop Protection and Environmental Biology and the Museum of the Department of Zoology, University of Ibadan, using Standard Key and Comparative Morphology. The identified insect specimens were labelled using a stiff white paper mounted in an insect box. Information such as the insect species, date of collection, place of collection and the name of the collector, were included on the label (Oldroyd, 1958).

Environmental Parameters Reading

The environmental parameters taken include temperature, solar radiation and relative humidity (r.h). The daily temperature at the time of insect collection was measured using a thermometer, while data on solar radiation and relative humidity were obtained from the Geographic Information System (G.I.S) Unit of the Department of Geography, University of Ibadan.

Figure 1: Map of University of Ibadan with sampling sites

Data analysis

Margalef's index was used to determine the species richness for each sampling site. Evenness index was used to determine the distribution of insect species within the sampling sites. The relative abundance and diversity of insects from each sampling site were computed using Shannon's diversity index (H). Pearson correlation coefficient was used to evaluate the relationship between insect abundance per month and average temperature, relative humidity and solar radiation.

RESULTS

Abundance, Distribution and Diversity of insects

The relative abundance, distribution and diversity of insects caught during the period of study are presented in Table 1. Nine identified orders were recorded with a total population of 1,524 individuals. The Botanical Garden had 35 taxa, comprising 709 individuals; Awba Dam site had 31 taxa, consisting of 531 individuals, while the PYTP Farmland had 23 taxa, made up of 284 individuals (Table 1).

Order Hymenoptera, conspicuously represented by the genus *Componotus*, had 74% relative abundance in Awba Dam area, 73.61% in the Botanical Garden and 71.13% in PYTP Farmland. The Hymenopterans were evenly distributed in the sampled points. Order Lepidoptera, were also relatively well distributed in the sampled sites, with 12.68% relative abundance in the Botanical Garden, followed by PYTP Farmland (7.39%) and lastly Awba Dam site (3.75%). Similarly, order Odonata, solely represented by the family Libellulidae, had 16.90% relative abundance in PYTP Farmland, 7.70% in Awba Dam area and 2.96% in the Botanical Garden (Table 1).

Order Diptera, represented by only two species *Chrysomya* sp. and *Sarcophaga* sp. had 4.23% relative abundance in PYTP Farmland, 0.94% in Awba Dam site and 0.28%

in the Botanical Garden. Order Orthoptera, was only recorded in the Botanical Garden and Awba Dam site, with 2.11% and 1.88% relative abundance respectively. In the same way, order Hemiptera, was only recorded in Awba Dam site and in the Botanical Garden, with 10.73% and 3.52% relative abundance respectively. Similarly, the Coleopterans were only found in Awba Dam area and in the PYTP Farmland (Table 1).

Order Dictyoptera, represented by only one species *Mantis* sp. was found in the Botanical Garden and in PYTP Farmland. The order Neuroptera, represented by a single species *Hagenomyia tristis*, occurred only in the Botanical Garden (Table 1).

Monthly Prevalence of Insects

The number of insects collected per month from each of the three sampled points is shown in Figure 2. The highest number of insects was recorded in June at the Botanical Garden, while the least was obtained in February. For Awba Dam site, the highest number was obtained in July while the least was also in February. For PYTP Farmland, the highest number of insects was recorded in the month of July, while the least was in February.

Species Richness and Diversity of Insects in the Sampled Sites

The overall species richness and diversity of insects collected in the sampled sites are summarized in Table 2. Awba Dam area had the highest species richness with Margalef's index value of 4.96, followed by the Botanical Garden (2.36) and lastly the PYTP Farmland (2.14). Shannon's index (H) value, was also highest in Awba Dam area with the value of 4.36, followed by PYTP Farmland (2.36) and lastly, Botanical Garden (2.05). Evenness's index was similarly highest in Awba Dam area with the value of 5.62, followed by 4.13 and 3.15 for Botanical Garden and PYTP Farmland respectively.

Table 1: Relative Abundance and Distribution of Insects from the three Sampled Sites

INSECTS ORDERS COLLECTED AND SPECIES	SAMPLED SITES					
	A		B		C	
	BOTANICAL GARDEN		AWBA DAM AREA		PYTP FARMLAND	
	Number of individuals	% Relative Abundance	Number of individuals	% Relative Abundance	Number of individuals	% Relative Abundance
HYMENOPTERA						
<i>Componotus maculatus</i>	463	65.30	200	37.66	0	0.00
<i>Componotus</i> sp.	52	7.33	179	33.71	181	63.73
<i>Dorylus nigricans</i>	1	0.14	0	0.00	0	0.00
<i>Sceliphronis pirifex</i>	0	0.00	0	0.00	8	2.82
<i>Apis mellifera</i>	1	0.14	10	1.88	1	0.35
<i>Xylocopa olivacea</i>	0	0.00	1	0.19	0	0.00
<i>Neolaparus</i> sp.	2	0.28	0	0.00	3	1.06
<i>Synagris calida</i>	0	0.00	0	0.00	1	0.35
<i>Belonogaster junceus</i>	3	0.42	3	0.56	8	2.82
LEPIDOPTERA						
<i>Cataphlia florella</i>	48	6.77	2	0.38	0	0.00
<i>Belenois calypso</i>	2	0.28	4	0.75	6	2.11
<i>Eurema hecaba</i>	1	0.14	0	0.00	0	0.00
<i>Appia sepaphia</i>	0	0.00	0	0.00	2	0.70
<i>Panlymna salcippus</i>	4	0.56	2	0.38	2	0.70
<i>Amauris hyalites</i>	2	0.28	0	0.00	3	1.06
<i>Papilio demodecus</i>	3	0.42	1	0.19	0	0.00
<i>Graphiumpolicines</i>	1	0.14	0	0.00	0	0.00
<i>Precis oenone</i>	6	0.85	4	0.75	3	1.06
<i>Precis octavia</i>	8	1.13	0	0.00	0	0.00
<i>Precis dabijs</i>	2	0.28	0	0.00	0	0.00
<i>Euryphura chalcis</i>	6	0.85	0	0.00	0	0.00
<i>Hypolimnas dubius</i>	1	0.14	0	0.00	1	0.35
<i>Bebearia cutteri</i>	1	0.14	0	0.00	0	0.00
<i>Heptis morose</i>	0	0.00	1	0.19	0	0.00
<i>Aterica galena</i>	0	0.00	1	0.19	0	0.00
<i>Euphaedroceres</i>	1	0.14	0	0.00	0	0.00
<i>Acraeaeponina</i>	3	0.42	4	0.75	4	1.41
<i>Heraclia geryon</i>	0	0.00	1	0.19	0	0.00
<i>Amauris niavius</i>	1	0.14	0	0.00	0	0.00
ODONATA						
<i>Palpopleura</i> sp.	6	0.85	9	1.69	13	4.58
<i>Brachythemis locustis</i>	0	0.00	3	0.56	7	2.46
<i>Parazyxama flavicans</i>	0	0.00	5	0.94	0	0.00
<i>Palpopleura lucio</i>	11	1.55	5	0.94	8	2.82
<i>Pantala flavesceus</i>	3	0.42	16	3.01	3	1.06
<i>Metacnemis robusta</i>	0	0.00	0	0.00	1	0.35
<i>Orthetrum brachiale</i>	1	0.14	3	0.56	16	5.63
ORTHOPTERA						
<i>Locusta migratoria</i>	1	0.14	0	0.00	0	0.00
<i>Scapsipedus marginatus</i>	0	0.00	7	1.32	0	0.00
<i>Zonocerus variegatus</i>	14	1.97	3	0.56	0	0.00

HEMIPTERA

<i>Probergrothius sexpunctatus</i>	4	0.56	15	2.82	0	0.00
Reduviidae nymph	1	0.14	0	0.00	0	0.00
<i>Dieuches</i> sp	1	0.14	1	0.19	0	0.00
Lygaeidae	19	2.68	40	7.53	0	0.00
<i>Rhynocoris bicolor</i>	0	0.00	1	0.19	0	0.00

COLEOPTERA

<i>Chrysolagria cuprina</i>	0	0.00	1	0.19	0	0.00
<i>Aulacophora transversa</i>	0	0.00	0	0.00	1	0.35
<i>Melyris abdominalis</i>	0	0.00	2	0.38	0	0.00
<i>Melambia striata</i>	0	0.00	1	0.19	0	0.00
<i>Oides ferruginea</i>	0	0.00	1	0.19	0	0.00

DIPTERA

<i>Chrysomya</i> sp	2	0.28	5	0.94	9	3.17
<i>Sarcophaga</i> sp	0	0.00	0	0.00	3	1.06

DICTYOPTERA

<i>Mantis</i> sp	1	0.14	0	0.00	1	0.35

NEUROPTERA

<i>Hagenomyia tristis</i>	33	4.65	0	0.00	0	0.00

TOTAL

	709		531		284	

Figure 2: Number of insects collected per month from the three sampled sites

Pearson correlation coefficient between the average monthly temperature, relative humidity, solar radiation and the total number of insects collected per month, is summarized in table 3. There was significant correlation (0.890)

Table 2: Species richness, diversity and other indices of insects in the three sampled sites, University of Ibadan, Ibadan

Indices	Botanical Garden	Awba Dam	PYTP Farmland
No. of taxa	35	31	23
No of individuals	709	531	284
Margalef's index	2.36	4.96	2.14
Shannon's Index	2.05	4.36	2.14
Evenness's index	4.13	5.62	3.15

between months and the total number of insects recorded ($p > 0.05$). The total number of insects collected also increase. In addition, there was partial correlation (0.374) between the total number of insects collected per month and the average solar radiation, while average temperature and relative humidity did not have significant correlation with total number of insects collected per month.

Table 3: Summary of Pearson Correlation coefficient (r) between insect abundance and some environmental parameters

		Month	AVERAGE TEMP.(0 C)	AVE. REL. HUMIDITY (%)	AVE. SOLAR RADIATION (MJ/M2)	TOTAL NUMBER OF INSECTS COLLECTED
Month	Pearson Correlation	1	-0.497	-0.783	0.540	0.890*
	Sig. (2-tailed)		0.316	0.065	0.269	0.018
	N	6	6	6	6	6
AVERAGE TEMP.(0°C)	Pearson Correlation	-0.497	1	0.216	-0.626	-0.066
	Sig. (2-tailed)	0.316		0.681	0.183	0.901
	N	6	6	6	6	6
AVE. REL. HUMIDITY (%)	Pearson Correlation	-0.783	0.216	1	-0.010	-0.768
	Sig. (2-tailed)	0.065	0.681		0.984	0.075
	N	6	6	6	6	6
AVE. SOLAR RADIATION (MJ/M2)	Pearson Correlation	0.540	-0.626	-0.010	1	0.374
	Sig. (2-tailed)	0.269	0.183	0.984		0.465
	N	6	6	6	6	6
TOTAL NUMBER OF INSECTS COLLECTED	Pearson Correlation	0.890*	-0.066	-0.768	0.374	1
	Sig. (2-tailed)	0.018	0.901	0.075	0.465	
	N	6	6	6	6	6

*Correlation is significant at the 0.05 level (2- tailed).

DISCUSSION

The Botanical Garden, Awba Dam and the PYTP Farmland of the University of Ibadan have the potential to support insect diversity considering the outcome of this study. According to Hunter (2002), insects dwell within complex ecosystems and interact with other taxonomic groups and the abiotic environment. It was observed that the PYTP Farmland that was exposed to direct sunlight was drier and warmer and had less number of insects than the Awba Dam Area and the Botanical Garden. Food availability for the insects could result in the presence of certain insects. The relative proportions of insect species as indicated by the results, suggested that the various insect communities resident in the study sites potentially respond differently to the heterogeneity of its environment (Kareiva, 1994; Dauber *et al.*, 2003).

The order Hymenoptera was the most abundant, while members of the order Lepidoptera were the most diverse. Within the Hymenopterans, the genus *Comptonotus* of the family Formicidae had the highest number. The high concentration of Hymenopterans may be due to food availability and habitat suitability. This observation can be explained by the findings of Ross (1965), who reported that food was one of the most important factors influencing the abundance and distribution of insects. Insects are found to be more abundant where food is available.

The hymenopterans were dominated by ant species which formed the bulk of the insect biomass. Studies by various workers (Leston, 1973; Room, 1971, 1975) point to the fact that in general, ants tend to dominate the abundance and species richness of the arthropod fauna of many tropical ecosystems.

Badejo (1982) highlighted that the high level

of social organization among the Hymenopterans, was the basis for their aggregated number. The great diversity of the Lepidopterans may be due to habitat suitability. This finding is consistent with the report of Gullan and Cranston (2004) that Lepidopterans inhabit all terrestrial habitats ranging from desert to rainforest, from lowland grassland to mountain plateaus but almost always associated with higher plants.

The results also showed that Awba Dam area of the University of Ibadan, had the highest species richness and diversity, with Margalef and Shannon's indices values of 4.96 and 4.36, respectively. This may be due to the presence of the water body in the site, as some insects generally breed around water. This finding was in accordance with the report of Sera (2001), where it was reported that insects growth and development are often governed by temperature and moisture content of the area under consideration. The presence of the water body also modify the temperature and relative humidity of the area, thereby making the site to be more conducive for insect fauna, as insects generally prefer humid environment to dry one. The more humid the soil, the nearer are insects to the surface (Little, 1957). Another reason why the Awba Dam recorded the highest abundance and diversity of insect species might be due to the higher tree species found in the area. This observation can be supported by the findings of Adeduntan *et al.* (2007), where it was reported that the higher the tree species diversity in an area, the higher the insect species diversity. Trees play a vital role in modifying the environment, as they prevent the high intensity of sun rays from reaching the soil, thereby making the temperature and the humidity of the soil more convenient for insect habitation.

The lowest numbers of insects were recorded in the months of February and March, which falls into the dry season during which there was usually shortage of green grasses and food, coupled with high temperature. It was known that only a few number of insects were found during the dry season, due to the fact that the period promotes inactivity in insects. With increasing moisture as it began to rain (from

April onward) and temperatures becoming optimal ($15^{\circ}\text{C} - 30^{\circ}\text{C}$), a good food base of inorganic nutrients, microbial growth is sure to increase which probably led to the increased insects abundance during the period. It was therefore, not surprising that the bulk of the insects encountered in this study, were recorded during the rainy season.

Pearson correlation coefficient (r) showed a significant relationship between months and the total number of insects obtained. This might be due to the influence of rainfall, as the amount of rainfall increases from February to July. This observation corroborates the findings of Tanka and Tanka (1982), where it was reported that there was a positive relationship between arthropod abundance and rainfall. Temperature and relative humidity showed no significant correlation with the number of insects obtained in the study.

The University of Ibadan (located in the South Western part of Nigeria), has rainforest ecosystem characteristics. Hence, it is rich in insect species and diversity. Although, this study did not cover the dry and wet seasons fully, one can infer from the result obtained in this study that insects were more in abundance during the wet season than in the dry season covered by this study. This was because there were enough plant materials and water, which serve as food and breeding grounds for insects during the wet season. It was also very clear from this study that members of the order Hymenoptera, particularly of the family Formicidae, were the most abundant group of terrestrial insects in the University of Ibadan. This finding might be due to habitat suitability which favours their occurrence.

Further studies in this area of research should explore all the possible methods of collecting insects beyond the methods already used. Also, the period of study should be extended to at least 18 months to properly cover the wet and dry seasons. Furthermore, aquatic insects should also be considered in future studies, so as to have a more comprehensive report of the abundance, distribution and diversity of insects in the University of Ibadan, Ibadan, Nigeria.

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