Science World Journal Vol 14(No 2) 2019
www.scienceworldjournal.org
ISSN 1597-6343
Published by Faculty of Science, Kaduna State University

Full Length Research Article

INSECT SPECIES DIVERSITY AND ABUNDANCE IN KADUNA STATE UNIVERSITY MAIN CAMPUS, KADUNA, NIGERIA

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ABSTRACT
Insects are one of the most prevalent features of our environment, the insect lives are inextricably intertwined with human. Three sites were chosen for the study to reflect different land uses and covers. Line transects were used to survey the three site, the hand sweep net and pit fall trap method were used to trap flying and crawling insects respectively. A total of 1908 insects from 8 orders, 24 Families and 48 species were collected from the three habitats. The most dominant order was Odonata with a relative abundance of (22.92%) followed by Lepidoptera and Hymenoptera (20.83%) and the least was Neuroptera and Hemiptera (2.08%). Species diversity, evenness and richness varied from habitat to habitat. Using one-way Anova the result showed, that there was significant difference in species composition across the habitat types at 0.05%. This can be clearly understood from the perspective that both BG and BFH are highly plant and seedlings based and it is believed that plants co-evolve with their insect herbivores. This study therefore, reveals the diversity and abundance of insects' species in Kaduna State University and the need for sustainable actions to conserve beneficial species.

Keywords: Abundance, diversity, species; insects, environment Shanon index (H')

INTRODUCTION

Insect are one of the most prevalent features of our environment, the lives of insects are inextricably intertwined with human. Although some of us are fascinated by them, others see insects as a hindrance of human activities only. Either way, it is usually insect numbers, not simply the presence of a solitary individual that attracts our attention. We often asked why they can be so abundant in one area and not in another or why they are numerous in one year and not the next year. They are highly sensitive to changes in climatic factors such as rainfall, temperatures, wind, humidity and altitudes (Khaliq *et al.,* 2014; and Alarape *et al.,* 2015), as these affect their population dynamics, distribution, abundance, intensity and feeding behavior (Ayres *et al.,* 2009). Insect play a vital role in our environment such as aiding in the production of fruits, seeds, vegetables, and flowers, Improve physical condition of soil and promote fertility by burrowing, devouring bodies of dead animals and plants and also act as bio-indicator of fresh water bodies, some of the insects also provide us with honey, silk and other commercial value products; they serve as food for bird and fish (Chima *et al.,* 2013). However, they are also disease vectors to many other organisms, including humans (Schowalter *et al.,* 2011).

Emma-Okafor *et al.* (2010) reported that large scale plantation establishment of cash crops as well as indiscriminate bush burning and overgrazing has led to habitat destruction with consequent impact on insect species, and the disappearance of insects could lead to the extinction of other animals that feed on them. The rapid increase in human population, has led to the concomitant increase in the anthropogenic activities leading to rise in habitat modification (Wardle, 2002). The change in habitat composition and seasonal variations affects population of insect (Ayres *et al.,* 2009). It is critical to understand the factors shaping the abundance and diversity of insects, which provide a range of supporting ecosystem functions in urban ecosystems (Thompson and McLachlan, 2007), support other, insectivorous taxa, such as birds and bats (Scanlon and Petit, 2008), and constitute sensitive indicators of changes in management practices and habitat characteristics impacting overall biodiversity (Clarke *et al.,* 2008).

The Kaduna State University main campus is a developing University with so much anthropogenic activities such as cutting down of trees so as to construct lecture theaters could have an adverse effect on the insect fauna. Habitat loss poses the greatest threat to the long term survival of species on earth. Saunders *et al.* (1991) reported that, decreases in species richness, in density and in species abundance and alteration of interspecific interactions are some possible biotic effect of habitat loss and fragmentation recognized as the major causes of the current biodiversity crisis. However, changes in land use like intensification of agriculture, habitat fragmentation and invasion of alien species have led to the decline of species such as butterflies (Dover *et al.,* 1990; Thomson, 2001), bees (Calabuig, 2000; Cane and Tepedino, 2001), and bumblebees (Kwak and Bergman, 1996). Anthropogenic activities on the Campus could have an adverse effect on the insect fauna hence, the need to identify and explore the effect of spatial differences on insect species diversity and abundance the area.

MATERIALS AND METHODS

Study Area

Kaduna is located within the Guinea Savannah to Sudan Savannah zone between latitudes 10˚31'02" N, and longitudes 7˚27'05" E. Kaduna State University Main Campus is located within Kaduna metropolis in Kaduna North Local Government Area, Kaduna.

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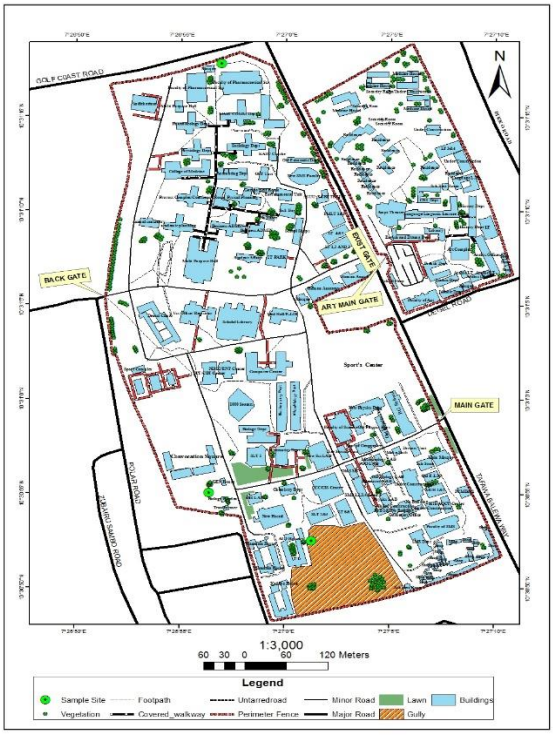

Figure 1: Kaduna State University showing the study sites. Source: Google open street map, 2018

Sample Collection

The study area was stratified into four sampling points. Insect species were assessed quantitatively across the sampling area: point A (Botanical garden), point B (Behind Females' Hostel), and point C (Faculty of Pharmaceutical Science), with handheld sweep net and pitfall trap as outlined by (Nandini *et al.,* 2012). A 0.23 km line transects was established at every site and attempts were made to catch every insect seen.

The sweeps net was used during the morning hours from 7am to 10am and evening from 4 pm to 6pm three times in a week along the predetermined transect.

A total of 9 pitfall traps used to collect ground dwelling insects were set up from 9.00 am until 7.00 pm. Each pitfall trap consisted of a single 100 ml capacity plastic container buried and the top was flushed with the ground surface and was half-filled with water, formalin (10%), and 2cm of dishwashing soap to prevent escape by captured insects. The insects collected were killed using chloroform and temporarily kept in a collecting jar (killing jar) and later taken to the laboratory for pinning and identification. Specimens that cannot be pinned were pickled in tubes containing 70% ethanol fluid preservative. Pre-identification into morphs Species was done as described by Triplehorn and Johnson (2005), and then taken to Institute for Agricultural Research (IAR) Ahmadu Bello University Zaria for identification.

Data Analysis

Data generated were analyzed using descriptive statistics, One-Way ANOVA to determine the different Order, Family Species diversities and distribution among the sampled insects.

RESULT

Table 1 show the diversity and abundance of insect species recovered in the selected habitats. A total of 1908 insect samples were recorded having 48 species belonging to 24 families and 8 orders during the experimental period from August to September, 2018. The largest number of insect species (1058) was recovered from Behind Females' Hostel (BFH) and the least (119) were recovered from Faculty of Pharmaceutical Sciences (FPS). *Apis mellifera* Linn. had the highest abundance (149) followed by *Eurema hecabe* L. (107) and *Papilio demoleus* Linn.(81), the least abundant (rare) insect species included *Crocothemis divisa* Baumann (5).

Table 2 showed the frequency distribution of insect species encountered according to order. The dominant order was Odonata 11(22.92%), followed by Lepidoptera and Hymenoptera 10(20.83%) each and the least was Neuroptera and Hemiptera with 1(2.08%) each respectively.

The result in (Table 3) reveals that the BFH had the highest value for species diversity and Equitability (H'= 3.46), (J = 0.973), followed by BG for species diversity and Equitability (H'= 3.3), (J = 0.973), however FPS had the lowest species diversity (H=1.72) but highest in species evenness (e^ H/S'= 0.933).

The similarity index of species across habitat type in Table 4 showed high similarity for insect species composition between Botanical garden (BG) and Faculty of Pharmaceutical Science (FPS) 0.34 and the low value between Botanical Garden (BG) and Behind Females' Hostel (BFH) 0.06.

The result of One-way ANOVA revealed indicates that there was significant difference in species composition/richness across habitat at $p<0.05$.

Table 1: Insects species diversity and abundance within Kaduna State University Main Campus, Kaduna

Insect order	Family	S/N	Species	Points		
				BG	BFH	FPSG
Odonata	Libellulidae	1	*Palpopleura Lucia* Dry. 32	0	0	
		2	*Orthetrum icteroneas* Ris.	9	0	0
		3	*Orthetrum icteromelas* Ris.	32	0	0
		4	*Trithemis kalula* Kirby. 35	0	0	
		5	*Trithemis annutaa* P de B.	39	0	0
		6	*Pantala Sp.*	31	21	8
		7	*Tholymis tillarga* Fab.	0	30	0
		8	*Crocothemis divisa* Baumann.0	5	0	
		9	*Hemistigma albipuncta* Ramb.0	24	0	
		10	*Trithemis pruinata* Karsch.	28	43	0
	Platycnemidae					
		11	*Metecnemis robusta* Selys.	0	40	0
Lepidoptera						
	Papilionidae					
		12	*Papilio demoleus* Linn. 26	35	20	
	Pieridae					
		13	*Dixeia arbona* Geyer.	16	36	16
		14	*Eurema hecabe* L.	21	67	19
		15	*Nepharonina* Sp.	21	33	0
		16	*Appias sp.*	7	31	0
	Acraeidae					
		17	*Acraea eponina* Cr.	38	38	0
		18	*Acraea eponia* Cr.	21	9	25
	Danaidae					
		19	*Amauris niavius* Linn.	28	0	0
	Nymphalidae					
		20	*Precis chorimene* Guer-men	20	34	0
		21	*Precis orithyan* Linn.	0	39	0
Hymenoptera						
	Apidae					
		22	*Apis mellifera* Linn.	52	66	31
		23	*Anthophora spp.*	29	29	0
		24	*Anthopora bipartite* Sm. 0	25	0	
		25	*Thyreus sp.*	0	25	0
	Ichneumonidae					
		26	*Osprynchotus sp*	0	26	0
	Vespidae					
		27	*Belongaster spp.*	20	0	0
		28	*Synagris sp*	33	5	0
		29	*Polistes sp*	0	32	0

Insect Order	Family	S/N	Species	Point		
				BG	BFH	FPSG
	Mutillidae					
		30	*Trogaspidia spp.*	0	30	0
	Scolidae					
		31	*Campsomeris sp*	41	0	0
Diptera						
	Stratomyiidae					
		32	*Acrodesmia illucens Linn.*	0	28	0
	Sarcophagidae					
		33	*Sarcophaga inzi* Curran. 9	16	0	
		34	*Wohlfahrtia sp.* 13	0	0	
	Tachinidae					
		35	*Peleteria rustica Karsch* 8	0	0	
	Calliporidae					
		36	*Crysomyia chloropyga* Wied.	9	20	0
	Syrphidae					
		37	*Lathyrophthalmus sp.*	17	0	0
	Ephydridae					
		38	*Karema sp.*	24	0	0
Coleoptera						
	Chysomelidae					
		39	*Aspidomorpha Quinquefasciata* Fab.	0	35	0
		40	*Gynandrophthalma sp*	0	36	0
		41	*Mesoplatys cincta* Oliv 26	31	0	
	Coccinellidae					
		42	*Epilachna chrysomelina* F.	0	27	0
		43	*Cheilomenes sulphurea* Oliv.	0	10	0
	Lagriidae					
		44	*Lagria villosa* F. 0	30	0	
Heteroptera						
	Pentatomidae					
		45	*Halydicoris sp.* 0	29	0	
		46	*Dorycoris sp.*	23	0	0
Neuroptera						
	Ascalaphidae					
		47	*Helicomitvus testivus Rambur.* 0	37	0	
Hemiptera						
	Coreidae					
		48	*Anoplocnemis curvipes* Fab.	23	36	0
			Total=	731	1058	119

Key: BG =Botanical Garden, BFH = Behind Females' Hostel and FPSG = Faculty of Pharmaceutical Sciences

Table 2: Frequency distribution of insect species encountered in selected locations within Kaduna State University Main Campus, Kaduna

S/N	Order	Number of species (%)	Individuals (%)
1.	Odanata	11(22.92)	377(19.75)
2.	Lepidoptera	10(20.83)	600(31.45)
3.	Hymenoptera	10(20.83)	444(23.27)
4.	Diptera	07(14.58)	144(07.55)
5.	Coleoptera	06(12.50)	195(10.22)
6.	Heteroptera	02(04.17)	052(02.73)
7.	Neuroptera	01(02.08)	037(01.93)
8.	Hemiptera	01(02.08)	059(03.09)
	Total	48(100.00)	1908(100.00)

Table 3: Diversity indices of insect species recovered from selected location within Kaduna State University Main Campus, Kaduna

Variables	BG	BFH	FPS
Number of species	30	35	6
Individuals	731	1058	119
Dominance_D	0.039	0.033	0.188
Shannon_(H)	3.3	3.46	1.72
Species Evenness_e^ H/S	0.904	0.907	0.933
Equitability_(J)	0.970	0.973	0.961
Fisher_alpha (α)	6.299	6.957	1.332
Simpson_1-D	0.960	0.966	0.812

Table 4: Similarity index of insect species composition across the selected locations within Kaduna State University, Main Campus, Kaduna

Pairing Sampling Point	Similarity index value
Botanical Garden vs Behind Females' Hostel	0.0576
Botanical Garden vs Faculty of Pharmaceutical Sciences	0.3416
Faculty Pharmaceutical Sciences vs Behind Females' Hostel	0.0697

DISCUSSSION

A total of 1908 insect samples were collected out of which 48 species with 24 families were identified belonging to 8 Orders in selected habitats at the Kaduna State University Main Campus ; Behind Females' Hostel had the highest species diversity and abundance. The rich number of species found in the ecosystem could be mainly because of the availability of different tree species (ornamental plants/seedlings) and vegetation cover with a forest-like nature area, against Botanical garden (BG) and Faculty of Pharmaceutical Sciences Garden (FPSG).

The result where; Odonata were the most dominant Order with 11(22.92%) followed by Order Lepidoptera and Hymenoptera with 10(20.83%) each respectively (Table 2).This is in contrast with the work of Yager *et al.*(2018); who reported Hemiptera and Hymenoptera as the dominant insect Order in Federal University of Agriculture, Makurdi Forestry Nursery, Benue State, Nigeria while Adeduntan and Olusola (2013) recorded Orthoptera as the most dominated insect Order in different forest vegetation types in Ondo State. These differences can be attributed to the variation in environmental conditions, season of insect collection and the presence of susceptible hosts within the study area. This is substantiated by the view of Khaliq *et al.* (2014) who reported that both abiotic (temperature, humidity, light) and biotic (host, vegetative biodiversity, crowding and diets) significantly influence the insects and their population dynamics. Order Lepidoptera and Order Hymenoptera had the highest number of individual species which disagrees with the findings of Okrikata and Yusuf (2016) in Wukari, Taraba State and Yager *et al.* (2018) in Federal University of Agriculture, Makurdi Forestry Nursery, which reported that the Order Coleoptera and Order Hemiptera were the most dominant individual species respectively. The reason for this disparity might be attributed to differences in study location and other environmental factors as reported by Alarapa *et al.* (2015) that the abundance of individual of a species at any given point on a temporal scale was again dependent on abiotic and biotic environmental factors.

The species of Lepidoptera captured were typical of West African taxa and this is in line with Nwosu and Iwu (2011) who reported to have captured same families of Lepidoptera such as Pieridae, Nymphalidae, and Papilionidae. More so, the present study revealed that Hymenoptera (Apidae) was the dominated Order in term of individual species. This could be as a result of presence of several plant, ornamental and seedlings species and also because of the fact that the Botanical Garden (BG) and Behind Females' Hostel (BFH) is a protected area with forest canopy. This agrees with the findings of Nwosu and Iwu (2011) who observed more species of butterfly in protected area of Okwu Ogbaku forest reserve of Imo State. The high number of butterfly recorded is an indication that they are attracted by plant species in the area.

The result of diversity indices across habitats showed that Behind Females' Hostel habitat had the higher value of insect species diversity (H'= 3.46), (J = 0.973), and was more in species richness put together. This implies that the availability of different plants influences the diversity and abundance of insect species. This agrees with findings of Gaston (1991); and Cheng *et al.* (2007) whose reports substantiated that plants and insects interact by way of mutualism and phytophagy. In an earlier study by the authors Alarape *et al.* (2015) revealed that the structural complexity of habitat and diversity of vegetation forms have been shown to correlate with animal and insect species diversity.

The BG and BFH habitats were more similar in species composition. However, there was significant difference in species composition/richness across habitat types which can be clearly understood from the perspective that both BG and BFH are highly plant and seedlings based and it is believed that plants co-evolve with their insect herbivores as opined by Tscharntke and Brand (2007). This can also be attributed to the continuous availability of resources in the habitat and so the environment is conducive for breeding. This finding agrees with the results of Samways (2007), Adeduntan and Olusola (2013) who reported that insects are present where there is a favorable condition for their survival.

Conclusion

In conclusion, the present survey has shown that Kaduna State University Main Campus is rich in insect biodiversity. It has also documented probably for the very first time, the insect fauna in the area by providing a check list of insect and underlines the diversity and composition of insect's species. This information will assist all stakeholders to optimize the beneficial insects, while managing noxious species.

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