Species Composition and Relative Abundance of Insects in Niger Delta University and its Host Amassoma Community in Bayelsa State, Nigeria

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Abstract
The composition and relative abundance of insects inhabiting the ecosystems of the Niger Delta University and host Amassoma community were studied from May 15 – October 15, 2020. Five (5) methods used to collect samples from four sites included sweep nets, aerial nets, pitfall traps, light traps and direct collection by hand. Out of a total of 7,225 individual species of insects collected, 7220 were identified into 8 orders, 24 families and 32 species. The most abundant insects the Anopheles species (Dipteria: Culicidae) constituted 58.74%; Dorylus species (Diptera: Formicidae) constituted 26.12%. There were low numbers of six (6) species of insects which included Libellula pulchella (Odonata: libullidae); Danaus plexippus (Lepidoptera: Nymphalidae); Spodoptera exampta (Lepidoptera: Noctuidae) and Colgmia sp. (Diptera: psychodoidae) ranged between 1.24%-1.68% in abundance. Among the remaining twenty-six (26) families which had a lower number of species, the least were the Hypenas cabra (Erebidae), Labidomera clivicollis (Chrysomelidae) and Coccinnella sp. (Cocccinelidae) which had negligible populations that ranged between 0.043 – 0.05%. Five insects which had an abundance of 0.076% were not identified. This study confirmed the rich composition of insect species in the environs of Niger Delta University and its host community.

Keywords: *Composition, Abundance, Insects, Species, Ecosystem*

Introduction

Insects inhabit almost all types of ecosystems and constitute over 75% of the biodiversity of animals (Samways, 1995; Gibson et al., 2004). Insects are of high importance for the sustainable management of the environment. Many species of insects are used as environmental indicators, for instance, the *Chironomid* species enables scientists to detect the ecological implication of human and natural activities (Mehmet et al., 2002). On the other hand, insects are natural resources that are utilized as food by humans and animals which impacts the economy of different nations of the world (Emosairue, 2007). For instance, bees are of great economic importance because they pollinate crops and produce honey (Berenbaum et al., 2006). They also serve as food for birds, fish and other predators (Samways, 1995). We also obtain silk and other raw materials for industrial processes from insects. Termites also perform valuable services as soil engineers and explorers of mineral resources. They are also used as agents of biological control of pests of economic and agricultural products. Insects play very significant roles in nutrient cycling by degrading leaf litter, wood and dung. However, some

insects are harmful and become pests of crops and stored products, while some insects transmit diseases to humans and other animals (Triplehorn & Johnson, 2005). Since the establishment of the Niger Delta University (NDU) at Amassoma in 2000 till date, there had been no studies on the biodiversity of insects which form an important component of the natural ecology. In contemporary times, studies have shown that there is systematic bioaccumulation of toxic pollutants in the edible larvae of African Palm weevil (*Rhynchophorus phoenicis*) arising from consistent gas flares, crude oil spills from vandalized pipelines and indiscriminate illegal refining of crude oil by the unemployed youths in Bayelsa State and the entire Niger Delta of Southern Nigeria (Thomas et al., 2022). Even though insects are the most dominant of the biodiversity of the forests, they are the least studied in Nigeria *(*Cardoso et al., 2011; Zou et al., 2012; Kehinde et al., 2014). Therefore, the objective of this study was to investigate the composition of different species of insects in the Niger Delta University and Amassoma Community in the Southern Ijaw Local Government Area of Bayelsa State, Nigeria. The information obtained from this study will form a baseline for students and researchers who wish to evaluate the impact of environmental pollution on the species richness of insects in the Niger Delta University and the host (Amassoma) community in Bayelsa State of Nigeria

Materials and Methods

The study was conducted in the area shown in the map (Fig. 1)

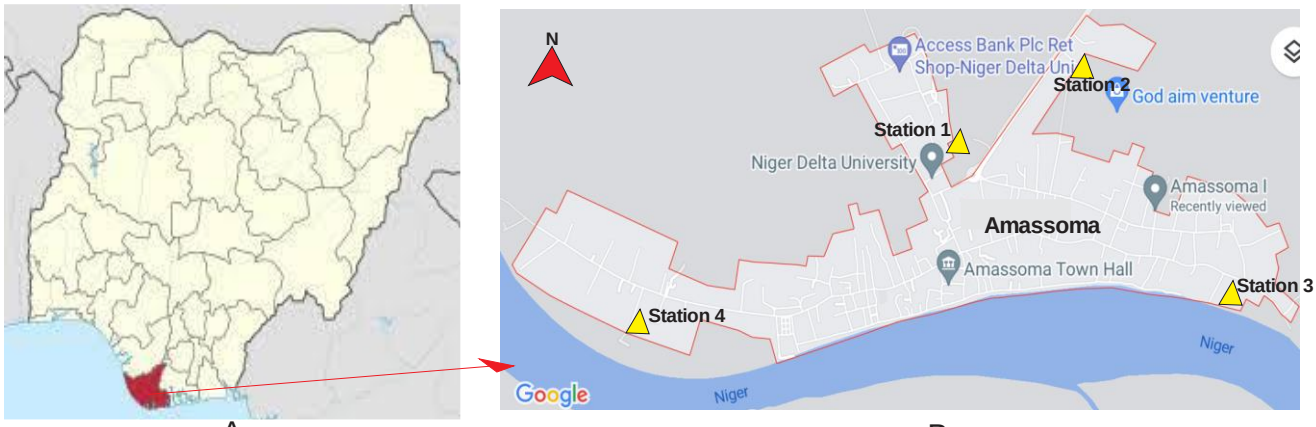

Figure 1**A:** Map of Nigeria showing Bayelsa State. **B.**GoogleMap of Niger Delta University and Environs of Amassoma Community in Bayelsa State, Nigeria

Description of sampling stations:

Four (4) sampling points were established for the collection of insects. Sampling point 1 was behind the biology laboratory in the permanent site of Niger Delta University, Wilberforce Island, Nigeria, which had GPS coordinates of longitude $N4^{0}58^{1}42.006$ and latitude $E6^{0}06^{1}19.6236$". This area had thick vegetation of tall trees, palm trees, plantain and cassava plantations and different species of grasses. The second sampling point was taken at Ogbopina-Ama along the expressway which had longitude $N4^{0}58^{1}42.006$" and latitude $E6^{0}06^{1}19.6236$" as coordinates. This area also had a dense wetland forest with few tall trees and grasses because it was an old refuse dump site. The third sampling station was taken at Ebitimikondei Pele

which was close to the bank of the river, with coordinates of longitude N4^{0}58^{1}01.1676" and latitude E6^{0}07^{1}23.4228". This area had dense vegetation of trees, plantain and cassava farms, paw-paws and grass fields. The fourth sampling station was taken at the College of Health Sciences of Niger Delta with longitude N4^{0}58^{1}07.368" and latitude E6^{0}05^{1}07.386" as its coordinates. This area also comprised of dense tropical vegetation with few trees, palm trees, paw-paws, plantain and tall shrubs and grasses

Sample Collection Procedures

In this study, four (4) sampling methods used in collecting insects included sweep nets, light traps, pitfall traps and direct hand picking. In each of the sampling points, a light trap which consisted of a white cloth which was suspended in front of a bright light was put between 7-9 pm and kept till 7 am of the next morning, so that the insects that were attracted by the light and fell on the white cloth were carefully wrapped and put into a killing jar. The aerial net was swung through the air to collect flying insects such as houseflies, butterflies, dragonflies, grasshoppers and others. Once an insect was caught, the end of the net was quickly flipped over to prevent the insects from escaping. The sweep net was used similarly to the aerial net, except that it was used to collect insects from grasses, leaves and stems of flowering parts of crops and plants without damaging the crops. The insects caught in the net were put into killing bottles which contained alcohol. The pitfall traps were used to collect ground-dwelling insects such as ground beetles, cockroaches, spiders, ants, termites and others which crawl on the ground. The pitfall trap which consisted of a sizeable plastic container with a killing agent and preservatives such as ethyl alcohol and formalin was buried on the ground at specific points such that insects crawl into it and died. The number of insects was counted within 24 hours. The samples were collected daily from May 2020 – October 2020. They were sorted into different orders and preserved in 70% alcohol in plastic containers and labelled for identification using taxonomic keys (Medler, 1980) at the University of Port Harcourt, while some specimens were sent to the University of Ibadan.

Statistical Analysis

The sample size (N) was the total of all individual species collected in the study.

N= (n_1+n_2+n_3+n_4+-------- +n_i), where 1, 2, 3, 4-------- and i are index numbers of individual species collected. The relative abundance of each species was calculated as the percentage of several individual species relative to the total number of individual species of insects collected in the study:

Relative Abundance $= \frac{n \times 100\%}{\Sigma(n1+n2+n3+n4+--------+ni)}$ or $\frac{n}{N} \times \frac{100\%}{1}$

where: N= Total number of individual insects collected in this study
n= Number of the individuals of a particular species that was counted

Results

Species Composition and Relative Abundance of various Insect groups:

The results (Table 1) showed that, out of a total of 7,225 insects collected, 7,220 insects were identified under eight orders, 24 families and 32 species, while 5 insects were not identified.

Of the 7,220 identified insects, 61.13% (4,736 insects) were Diptera (flies), while Hymenoptera constituted 27.63% (1,809 wasps and ants); Lepidoptera were 4.41% (279 butterflies and moths); Orthoptera were 2.53% (177 locust and grasshoppers); odonata were 2.32% (147 dragonflies and damsel flies); Hemiptera were 0.47% (31 bugs); Coleoptera were 0.37% (26 beetles and weevils) and blattoidea were 0.32% (21 cockroaches).

The order Diptera was the largest group of insects with 61.31% of flies which were identified under five families: Culicidae were 58.74% individuals with 3,846 anopheles mosquitoes; psychodoidae were 1.23% with 81 individual species of *Clogmia spp; Muscidae* (*Musca domestica*) were 0.67%, while Chrysopidae (*Chrysoperla carnea*) was 0.21%. The order Hymenoptera was the second largest group of insects which constituted 27.63% with *Dorylus* sp having 26.12%, belonging to the family Formicidae. The others were the Apidae which were the honey bees (*Apis mellifera)* constituted 0.47%, *Camponotus* spp were 0.51%; *Monomerium pharaoni*c 0.35% and *Formica ligniperda* was 0.183%. The order Lepidoptera which constituted 4.76% was dominated by 1.57% of *Spodoptera exampta* belonging to the family Noctuidae. It was followed by nymphalidae which constituted 1.66% with *Danaus plexippus* as the common species; Geometridae were 0.412% with *Lemographa* species; nolidae were 0.17% with *Nola cucullatela* species. There was a single species of *Hyphenas cabra* which belongs to the family erebidae(0.015%), while there were 12 individual species of *Caenurgina erechtea.* The family Pieridae had 34 individuals of *Pieris rapae* was 0.52%. The order orthoptera which constituted 2.53% was classified into three families, Acrididae 0.52% represented by *Schistocerca americana* (0.58%), *Melanoplus* spp (0.595%), and *Dendeotetti squercus* (0.519%). The family Gryllidae was 0.50% with *gryllus bimaculata* and *Acheta domestica* as common species found in the environment. The family Gryllotalpidae was 0.34% with *Gryllotalpa brachyptera* as the common species collected in the ecosystem.

The order Odonata constituted 2.32% of the insects under two families: the *caenagrionidae* which constituted 0.56% was identified as *Ischnura elegans,* while the Libellulidae which constituted 1.68% was identified as *Libellule pulchella.* The order hemiptera was the sixth group of insects which constituted 0.47% was identified as *Nezera viridula* which belongs to the family pentatomidae. The order Coleoptera was the seventh group which constituted 0.37% of the total insect population was classified into four families: carobidae was 0.20% with *Brachinus spp* as the common species. The Tenebrionidae were 0.09% with *Aphitabius sp* as the common species. The Coccinellidae were 0.05% with *Coccinella sp,* while the Chrysomelidae constituted 0.03% with *Labidomera clivicollis* as the common species. The order blattoidea which constituted 0.32% had the cockroach (*Periplaneta americana*) as the typical species found in the study area.

Table 1: Composition of insect orders, families and species and their relative abundance in Niger Delta University and Amassoma Community

S/N	Orders	Families	Species	Number counted	% Abundance
1.	Diptera	culicidae	*Anopheles spp*	3,846	58.74
		psychodoidae	*Clogmia spp*	813	1.324
		muscidae	*Musca domestica*	44	0.67
		tabanidae	*Hybomitra micans*	18	0.28
		chrysopidae	*Chrysoperla carnea*	15	0.21
			Sub-total	**4,736**	**61.134**
2.	Hymenoptera	formicidae	*Dorylus sp*	1,710	26.12
		apidae	*Apis mellifera*	31	0.47
			Camponotus spp	33	0.504
			Monomerium pharaonis	23	0.35
			Formica ligniperda	12	0.18
			Sub-total	**1,809**	**27.631**
3.	Lepidoptera	noctuidae	*Spodoptera exempta*	103	1.57
		nymphalidae	*Danaus plexippus*	100	1.66
			Lemizenitis archippus	17	0.21
		erebidae	*Hypenas cabra*	1	0.015
		nolidae	*Nola cucullatela*	12	0.18
		geometridae	*Lomographa sp*		0.18
			Caenurgina erechtea	12	0.18
		pieridae	*Pieris rapae*	34	0.52
			Sub-total	**279**	4.41
4.	Orthoptera	acrididae	*Dendeotettis squercus*	34	0.52
		gryllidae	*Gryllus bimuculatus*	22	0.34
		gryllotalpidae	*Grylotalpa brachyptera*	22	0.34
			Acheta domestica	22	0.17
			Schitocerca americana	38	0.58
			Melanoplus spp	39	0.60
			Sub-total	**177**	**2.53**
5.	Odonata	caenagrinoidae	*Ischura elegaus*	31	0.56
		libellulidae	*Labella pulchella*	110	1.68
		ni	*Un-identified*	5	0.08
			Sub-total	**146**	**2.32**
6.	Hemiptera	pentatomidae	*Nezara viridula*	31	0.47
			Sub-total	**31**	**0.47**
7.	Coleoptera	carobidae	*Brachinus spp.*	15	0.20
		tenebrionidae	*Aphitabius sp*	6	0.09
		coccinellidae	*Coccinella sp*	3	0.05
		chrysomelidae	*Labidomera clivicollis*	2	0.03
			Sub-total	**26**	**0.37**
8.	Blattoidea	blattodae	*Periplaneta americana*	21	0.32
			Sub-total	**21**	**0.32**
	Total			**7,225**	**99.185**

Ranking of the Relative Abundance of Insect Species

The results (Table 2) showed that *Anopheles* species (Diptera: Culicidae) were the most abundant insects with 58.74% (3.846 individuals); *Dorylus* sp was the second most abundant with 26.12% (1,710 individuals). Four insects which were sparingly found in the study were *Libellula pulchella* (Odonta: Libullulidae); with 1.68% (110 individuals) *Danaus plexippus* (Lepidoptera: nymphalidae) with 1.66% (109 individuals); *Spodoptera exampta* (Lepidoptera: Noctuidae) with 1.57% (103 individuals) and *Clogmia sp* (Diptera: psychodoidae) with 1.24% (81 individuals). The next group comprised fourteen (14) insect species which were within close range of 0.31% - 0.67% and comprised of 39 – 44 individuals, namely: *Musca domestica,*

Schistocera americana, Ischnura elegans, Pieris rapae, Dendeotettis squercus, Apis mellifera, Nezera viridula, Lamographa sp., Monomerium pharaonis, Gryllus bimaculatus, Gryllotalpa brachyptera, Periplaneta americana, Camponotus spp and M*elanoplus spp.* The fifth group comprised seven different insect species which also had close relative abundance values ranging from 0.17% - 0.28% (11- 18 individuals): *Hybomitra micans, Chyrysoperla carnea, Limenitis archippus, Formica ligniperda, Nola cucullatella, Caenurgina erechtea and Acheta domestica.* The sixth group was made up of five insect species which had the lowest numbers collected and varied from 0.015-0.09% with 1-6 individuals: *Brachinus spp.; Alphitabius sp; Coccinella sp; Labidomera clivicollis and Hypenas cabra.* Five insects were Not Identified (NI)

Table 2*:* Ranking of relative abundance of insect species in Niger Delta University and host Amassoma community in Bayelsa State

Orders	Families	Species	Numbers counted	(%) Abundance	Ranking
Diptera	culicidae	*Anopheles spp.*	3,846	58.74	1st
Hymenoptera	formicidae	*Dorylus sp.*	1710	26.12	2nd
Odonata	libellulidae	*Libellula pulchella*	110	1.680	
Lepidotera	nymphalidae	*Danaus plexippus*	109	1.664	3rd group
Lepidotera	noctuidae	*Spodoptera exampta*	103	1.573	
Diptera	psychodoidae	*Clogmia sp.*	81	1.237	
Diptera	muscidae	*Musca domestica*	44	0.672	
Orthoptera		*Schistocerca americana*	38	0.580	
Odonata	caenagrionidae	*Ischnura elegans*	37	0.565	
Lepidoptera	pieridae	*Pieris rapae*	34	0.519	
Orthoptera	acrididae	*Dendrotettis quercus*	34	0.519	
Hymenoptera	apidae	*Apis mellifera*	31	0.473	
Hemiptera	pentatomidae	*Nezara viridula*	31	0.473	4th group
Lepidoptera	geometridae	*Lomographa sp.*	27	0.412	
Hymenoptera		*Monomerium pharaonis*	23	0.351	
Orthoptera	gryllidae	*Gryllus bimaculatu*	22	0.336	
Orthoptera	gryllotalpidae	*Gryllotalpa brachyptera*	22	0.336	
Blattoidea	blattidae	*Periplaneta americana*	21	0.321	
Hymenoptera		*Camponotus spp.*	33	0.321	
Orthoptera		*Melanoplus spp*	39	0.305	
Diptera	tabanoidae	*Hybomitra micans*	18	0.275	
Diptera	chrysopidae	*Chrysoperla carnea*	15	0.229	
Lepidoptera		*Limenitis archippus*	17	0.210	
Hymenoptera		*Formica ligniperda*	12	0.183	5th group
Lepidoptera	nolidae	*Nola cucullatella*	12	0.183	
Lepidoptera		*Caenurgina erechtea*	12	0.183	
Orthoptera		*Acheta domestica*	11	0.168	
Coleopteran	tenebrionoidae	*Alphitabius sp.*	6	0.092	
Coleoptera	carobidae	*Brachinus spp*	5	0.076	
Not identified	*not known*	*Not Known*	5	0.076	
Coleptera	coccinellidea	*Coccinella sp.*	3	0.046	6th group
Coleptera	chrysomelidae	*Labidomera clivicollis*	2	0.031	
Lepidoptera	erebidae	*Hypenas cabra*	1	0.015	
	Total		**7,225**	**99.185**	

Discussion

The findings of this study revealed that the *Anopheles* mosquitoes were the most abundant insects which constituted 58.74% with 3,846 individuals of the total 7,225 insects collected. This means that humans and some domestic animals living in the Amassoma community and the University were at high risk of endemic malaria disease transmitted by the female anopheles

as vectors. The high population of anopheles (culicid) mosquitoes found in the study area had a direct relationship with a high rate of malaria infection among the human populace of Amassoma Community and the students plus staff of the university agreed with earlier studies (Amawulu et al., 2014) which reported that Southern-Ijaw local government (which encompasses the host Amassoma community and Niger Delta University) was rated as a "mesoendemic" ecological zone having moderate prevalent rate for malaria infection in Bayelsa State, Nigeria. Similarly, Ikeh et al. (2021) reported that 5,161 adult species of mosquitoes were identified into four genera, namely *Aedes*, *Culex*, *Anopheles*, and *Toxorhynchites* in Nnewi community in Anambra state, Nigeria. This confirms that mosquitoes are usually the most abundant in tropical forests, especially in the humid freshwater ecosystem of Amassoma in Bayelsa State which usually has high annual rainfall (Coetzee *et al*, 2000). The results also showed that *Dorylus* (order Hymenoptera family Formicidae) were the second most abundant insect found in the study because it constituted 26.12% which was equivalent to 1,710 individuals of the insect population. The high number of *Dorylus* species in this study agreed with an earlier report of Chima et. al. *(*2013) who stated that *Dorylus* species constituted the dominant population of about 70% of insects collected in some farmlands at the University of Port Harcourt campus. The *Libellula pulchella* which is a species of dragonfly (order Odonata: family libellulidae) was the third most abundant insect because it made up 1.68% with 110 individuals, It was closely followed by two species of Lepidoptera known as *Danaus plexippus* (nymphalidae) and *Spodopetera exempta* (Noctuidae*)* with 109 individuals and 1.57% having 103 individuals, respectively. Furthermore, *Clogmia* spp which were Diptera (family psychodoidae) constituted 1.24% of 81 individuals collected in this study.

In addition, Kemabonta et al.*(*2018) also reported that 1002 dragonflies were collected and identified into 20 species, 15 genera and two families (libellulidae and aesnidae) sampled from a fish pond and farm land in parts of Lagos metropolis which shared great similarities with that of Bayelsa State, especially in high annual rainfall and swampy aquatic habitats. The variation observed in the abundance was attributed to the peculiarities in the environmental characteristics of the locations (Dijkstra et al., 2014). The low population of insects observed in the remaining genera of insects was a normal trend in insect populations in Southern Nigeria been attributed to the effect of environmental pollution and the sustained development of infrastructure in the Niger Delta University, coupled with habitat disturbance by the agrarian activities of the Ijaw people who depend on subsistence farming as a source of food and economic survival (Umeozor, 1996; Edward and Ugwumba, 2011; Adakole and Annume, 2003). However, four insects which had the lowest relative abundance of 0.031%- 0.09% included the *Aphitabius sp*., *Brachinus sp*., *Coccinella sp* and *Labidomera clivicolis* as well as *Hypenas cabra* (Lepidoptera) with a single individual having the least relative abundance of 0.015%. This was of great concern because these low numbers could be signals that these insect species could be "endangered" due to adverse effects of chemical pollution from the crude oil exploration activities that had continued since 1968 till date in Bayelsa State. There is a need for further investigation to ascertain the factors responsible for the low numbers and suggest appropriate conservation methods to preserve these insects (Kehinde et al., 2014; Groombridge, 1992). Finally, five species of insects were not identified, while some species were not identified at the family levels in this study due to the dearth of taxonomists which had been a major constraint against insect conservation. Therefore, 20% of insect species only are

catalogued in Nigeria (Medler, 1988), while many insects are yet to be identified (Kehinde et al., 2014). To buttress this fact, Chima et al. (2013) reported seventeen (17) unidentified species of insects at the University of Port Harcourt, Nigeria.

Conclusion

The findings of this preliminary study revealed that the Niger Delta University and the surrounding ecosystems of the host Amassoma community had rich biodiversity of insects The *Anopheles spp*. (Diptera: Culicidae) were the dominant species because they had the highest relative abundance of 58.74%, while *Dorylus spp*, had 26.12%. There were low populations of insects in 6 orders: lepideptera (4:41%), orthoptera (2.53%), Odonata (2.31%), Hemiptera (0.47%), Coleoptera (0.37%) and blattoidea (0.32%). The steady decline in numbers could be an indication of the possible existence of threat factors that are affecting their survival and could lead to the extinction of some insects. Therefore, there is a need for further studies to ascertain the causes of the consistent reduction in insect populations and recommend appropriate conservation practices to save the loss of insect species from the environment.

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