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A survey on the status of arthropods of medical importance in Okorombokho, Nigeria

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Abstract
A survey on the occurrence of arthropods of medical importance in Okorombokho, Nigeria was carried out, from December 2016 to May 2017. Both aquatic and terrestrial habitats were surveyed. A scoop net was used for the collection of aquatic specimens, while a sweep net and various traps (pit fall, light and sticky traps) were used for terrestrial investigations. A total of 1094 arthropods were collected, of which 308 were of medical importance. These were *Callinectes amnicola*, ixodid ticks (12.01%) and some insect vectors. Insect vectors collected included *Periplaneta americana* (4.22%, Blattodea) and dipterans of the families Psychodidae (40.26%), Ceratopogonidae (22.10%), Muscidae (16.23%) and Culicidae (4.87%). Results obtained from t-test revealed that the seasonal variation in abundance of the medically important arthropods was significant. Shannon Wiener's diversity index (H′) revealed that the terrestrial habit was more diverse (3.22) than the aquatic habitat (1.32). It is therefore pertinent to draw up a program targeted at the control of these vectors.

Keywords: Survey, arthropods, medical importance, okorombokho

1. Introduction

Arthropods are invertebrate fauna that abound in every conceivable environment. They are characterized mainly by the possession of jointed appendages. Over 1.5million species of arthropods have been described [1]. Arthropod-borne infectious diseases are still a scourge and cause a significant fraction of the global infectious disease burden. More than one million deaths from vector-borne diseases are recorded every year. These diseases include malaria, dengue, leishmaniasis, yellow fever, encephalitis, lymphatic filariasis, onchocerciasis, etc. [2]. These disease burdens contribute immensely to the misery and hardship suffered by affected persons in endemic areas [2]. In the tropics and sub-tropics where these diseases are prevalent there is profound restriction of socio-economic status and development.

It is difficult to implement control measures of arthropod vectors without some knowledge of their diversity and abundance. The early detection of vectors of public health importance in an area is essential to the prevention of disease – outbreaks; which in turn will enhance the quality of health and livelihood of people in such an area. Besides, the health of a people is really the foundation upon which their happiness and wealth depend.

Nigeria is a country that is rich in biodiversity (flora and fauna). An experience of many mangrove coastal areas is invasion by *Nypa fruticans*, otherwise known as nipa palm. It is a mono-species that grows in soft mud, usually where the water is calm and requires regular inflow of fresh water and nutritious silt [3]. Nipa can be found inland, as far as the tide can deposit the palm's floating seeds. It can also tolerate infrequent inundation, so long as the soil does not dry out for too long [4].

When a single species of an invasive plant such as *N. fruticans* dominates and the flora of the area becomes more homogenous, vegetation structure and microclimate conditions are simplified, such that a diversity of arthropods can find appropriate habitat conditions [5]. It has been reported that *N. fruticans* provides numerous microhabitats for some species of arthropods to hide and so escape predators [6]. Nipa palm has also been reported to serve as a breeding site and nursery for *Aedes* mosquitoes, whose females are vectors of yellow fever, dengue and encephalitis [7]. Thus, the invasion of *Nypa fruticans* may enhance arthropod species abundance and diversity and some of these arthropod species may be of public health importance, owing to their potentials as vectors/transmitters of disease-causing organisms.

Some scientific investigations have been carried out in study area on Nipa palm on the intertidal epibenthic macrofauna of the area (East of the Imo River Estuary) [6] and studies on the invasive palm (*Nypa fruticans* Wurmb) and avian diversity at Okorombokho wetlands, Nigeria [8]. However, there is a paucity of scientific information on the arthropod fauna of the study area and no report on the medically important arthropods of the area.

The objective of this study was to ascertain/determine the abundance of arthropods of medical importance in Okorombokho, a nipa invaded wetland of Eastern Obolo, Nigeria.

2. Materials and Methods

2.1 Survey area

The study area, Okorombokho is a coastal community in Eastern Obolo Local Government Area of Akwa Ibom State, Nigeria (Fig. 1). It is located between latitudes 04°32.19′ and 04°32.16′ North and longitudes 7°44.10′ and 7°45.05′ East. Its shoreline stretches between the estuaries of the Imo and Qua Iboe rivers, covering a distance of about 84km [9]. Okorombokho community has a population that is less than 56,000 and the community dwellers have diverse socio-economic activities such as artisanal fishing, logging and boat transportation.

Naturally, Okorombokho is a mangrove swamp ecosystem, but this natural ecosystem has experienced serious perturbation due to nipa palm invasion. As part of the tropics, this area experiences two seasons, the dry and the wet seasons. This community is serviced by a general hospital at Okoroete (Headquarters of Eastern Obolo Local Government Area).

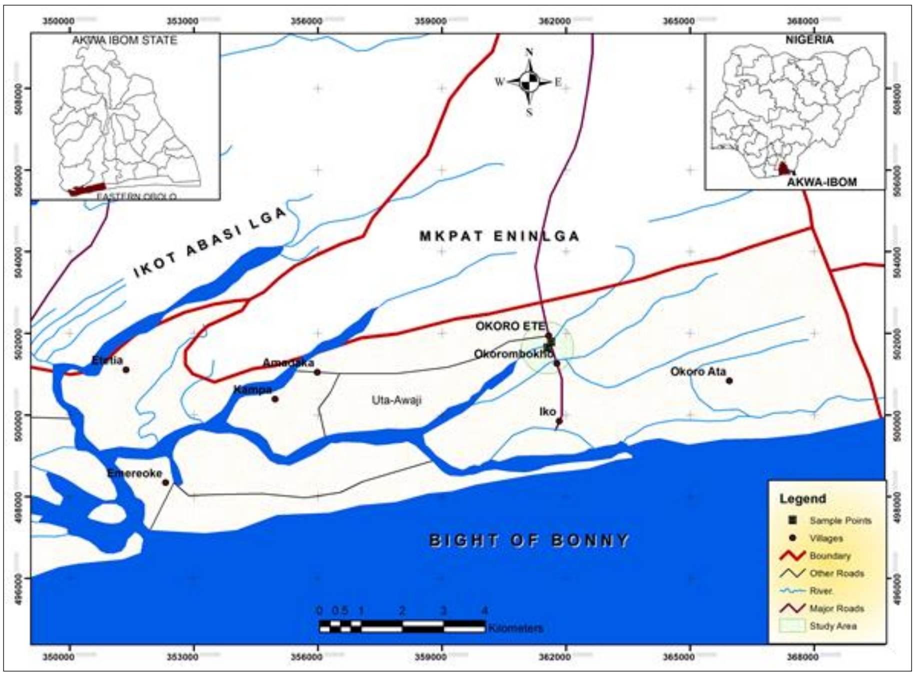

Fig 1: A map of Eastern Obolo showing the study area (Okorombokho). Inset: Map of Nigeria showing the position of Akwa Ibom state and map of Akwa Ibom State showing the position of Eastern Obolo

2.2 Arthropod specimens collection and preservation

Collection of arthropods commenced in December, 2016 and was concluded in May, 2017. December, January and February were relatively dry months while March, April and May were rainy months.

Arthropods were collected from both the aquatic and terrestrial habitats of the study area. In each of these habitats, two designated points were surveyed. Aquatic arthropods were collected from two locations in the habitat (estuaries). For the terrestrial investigations, the location sampled were vegetation close to mangrove and vegetation close to nipa dominated area.

Aquatic surveys were carried out using hydrobiological scoop nets. Sampling from the free aquatic area (water surface) was done using a hydrobiological net (80mm in diameter). Sampling for benthic arthropod species was done using a standard hydrobiological dip net with about 23 meshes per cm. At each aquatic sampling site, the shore was searched by eye and decaying plant materials and other objects found were examined, using a hand lens. The same was done for objects/materials found in water. Specimens collected from the same sampling site were placed together in the same collecting tube, containing 70% alcohol. Each sample was accompanied with a locality label indicating site and date of collection.

For terrestrial surveys a sweep net (45 x 75cm), light, pit fall and sticky traps were used. Sticky traps which were used mainly for the collection of nocturnal species, were made of parchment paper (34 x 22cm), and wooden support. Each sticky trap was coated on both surfaces with engine oil [10]. These traps were set at about 17.00hours and collected next day, at about 07.00hours. Trapped arthropods were removed from sticky traps using a small brush that was first of all moistened. The arthropods were washed in 1% saline solution and rinsed in water [11]. Wandering crustaceans were collected by the handpicking method. Arachnids were collected using the pit fall trap and manual handpicking using protective gloves [12, 13].

2.3 Identification of arthropod specimens

Arthropods collected from the study area were placed in specimen bottles containing 70% ethanol. Each specimen bottle had a label with the following information: date, place and time of collection. Specimens were thereafter taken to the Malaria Vector Research Laboratory and Insectary (supported by USAID, Center for Disease Control and Prevention, Vector Link, FMOH – NMEP), hosted by the Department of Animal and Environmental Biology, University of Uyo, Nigeria. Identification of specimen was done in this laboratory.

All specimens collected were reviewed using a hand lens. However, tiny specimens were viewed under a light microscope. Their morphological features were noted. With the aid of morphological and pictorial keys they were grouped into classes, others and families, based on their morphological features. Some arthropods were identified to their generic and specific levels. Identification of some vector species was also done by direct comparison (of morphological features) with preserved specimens in the Insectary of the Department of Animal and Environmental Biology, University of Uyo. An insect taxonomist in the Department of Crop Science, Faculty of Agriculture, University of Uyo, assisted in identification of specimens.

Taxonomic and pictorial keys that were used for identification [14, 15, 16, 17, 18]. Since arthropods of medical importance do not exist in isolation, all arthropods found in the designated areas of both the aquatic and terrestrial habitats of the study area were collected. Arthropods which are known to transmit pathogens and or parasites and cause biting nuisance were categorized as medically important arthropods according to Service [19].

2.4 Data analysis

Data obtained from this survey were subjected to t-test and Shannon-Wiener's diversity index (H') analysis. The t-test was used to determine seasonal variations in arthropods and also compare the abundance of arthropods of medical importance collected in both dry and rainy months. Using Shannon-Wiener's diversity index (H'), comparison of diversity of arthropods in the aquatic and terrestrial habitats was made.

3. Results

A total of 1094 arthropods were collected within the period of survey. They were members of the classes: crustacea, arachnida and insecta (Table 1). The class insecta had the highest number of arthropods followed by the class crustacea. Arachnids were the least in number. Insects collected were members of the orders diptera (33.64%), orthoptera (13.07%), lepidoptera (6.12%), blattodea (1.19%), odonata (1.10%) and demaptera (1.01%). Other groups of insects collected were hymenoptera (7.13%), hemiptera (6.58%) and 6.40% of coleoptera (Table 1).

In the terrestrial habitat sampled, some alien arthropod species (insects) were collected. These alien species were *Trialeurodes vaporariorum*, commonly referred to as "white flies", of the family aleyrodidae and order hemiptera. These species were found in the nipa invaded environment of the study area. Through personal communication the natives of Okorombokho confirmed that they were indeed new species which came with the invasion of nipa palm.

Arachnids were the fewest arthropods collected and they were members of the orders Araneae (5.39%) and Acari (3.38%).

All crustaceans collected were members of the order decapoda (15.00%). They were the only class of arthropods collected from aquatic surveys (Table 2). Aquatic insects such as mayflies (ephemeroptera), stoneflies (plecoptera), caddisflies (trichoptera) and dipteran larvae were not found in the aquatic habitat of the study area.

Out of the 1094 arthropods collected 308 (28.15%) were of medical importance (Table 3). Crustaceans of medical importance collected from the study area were edible/blue crabs (0.32%) of the species *Callinectes amnicola* (order: decapoda). In the class arachnida, medically important specimens collected were members of the family ixodidae (12.01%).

Medically important insects collected from the study area were in the order blattodea (4.22%) and the order diptera. In the order diptera, the families of medical importance were psychodidae (40.26%), ceratopogonidae (22.10%), muscidae (16.23%) and culicidae (4.87%).

Data generated form this study was subjected to statistical analysis. Inter-season variation in arthropod density was not significant as revealed by t-test; because the t-tabulated (2.13) was greater than t-calculated (1.98). However, for the medically important arthropods the result obtained revealed that there was significant difference in density in the two seasons, as t-tabulated (2.13) was less than t-calculated (3.99), at 95% (0.05) level of significance.

Results obtained from Shannon-Weiner's diversity index (H') indicated that the terrestrial habitat was more diverse (3.22) than the aquatic habitat (1.32).

Table 1: Composition and Abundance of Arthropod Taxonomic Groups in the Study Area

Taxonomic Group	December	January	February	March	April	May	Total	Percentage (%)
Crustacea								
Decapoda	29	34	13	18	37	33	164	15.00
Arachnida								
Acari	9	5	6	4	7	6	37	3.38
Araneae	12	8	16	3	9	11	59	5.39
Insecta								
Blattodea	2	-	-	7	4	-	13	1.19
Odonata	5	-	5	-	1	1	12	1.10
Dermaptera	-	2	-	5	-	4	11	1.01
Orthopera	20	21	22	29	19	32	143	13.07
Hymenoptera	15	13	11	6	16	17	78	7.13
Lepidoptera	16	3	8	14	12	14	67	6.12
Diptera	48	36	45	71	89	79	368	33.64
Hemiptera	18	18	1	14	-	21	72	6.58
Coleoptera	13	10	17	-	17	13	70	6.40
Total	187	150	144	171	211	231	1094	100

$P \leq 0.05$ ($n_1 + n_2 - 2$) degree of freedom = 4, t-tab 2.13 > t-cal 1.98

***Source*:** Field Study, 2017

Table 2: Arthropods collected from the aquatic habitat of the study area

	Taxonomic Group	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total	%
CLASS	CRUSTACEA								
Order	Decapoda								
Species:	*Palaemon hastatus*	7	18	3	-	23	16	67	40.85
" :	*Scylla sp.*	16	5	5	-	12	5	43	26.22
" :	*Menippe nodiferous*	6	-	-	11	-	1	18	10.98
" :	*Callinectes amnicola*	-	-	-	-	1	-	1	0.61
" :	*Uca tangeri*	-	11	5	7	1	11	35	21.34
	Total	29	34	13	18	37	33	164	100

Source: Field data (2017)

Table 3: Frequency of occurrence of medically important arthropod orders and families in the study area

Class	Order	Family	Species	Dec	Jan	Feb	Mar	Apr	May	Total	%
Crustacea	Decapoda	Portunidae	*Callinectes amnicola*	-	-	-	-	-	1	1	0.32
Arachnida	Acari	Ixodidae	*Ixodes sp.*	9	5	6	4	7	6	37	12.01
Insecta	Blattodea	Blattidae	*Periplaneta americana*	2	-	-	7	4	-	13	4.22
	Diptera	Psychodidae	*Phlebotomus sp.*	10	15	23	18	31	27	124	40.26
		Ceratopogonidae	*Culicoides sp.*	-	-	-	16	23	29	68	22.08
		Muscidae	*Musca domestica*	17	4	-	11	17	1	50	16.23
		Culicidae	*Culex quinquefaciatus*	-	-	4	3	5	-	12	3.90
			Aedes aegypti	-	-	2	-	1	-	3	0.97
Total				38	24	31	58	87	64	308	100

$P \leq 0.05$ ($n_1 + n_2 - 2$) degree of freedom = 4, t-tab 2.13 > t-cal 3.99

Source: Field Study, 2017

4. Discussion

Okorombokho, a nipa invaded area of Eastern Obolo, Nigeria, consists of diverse taxonomic groups of arthropods, as revealed by the results obtained from this research. Of the 163 crustaceans collected from the aquatic habitat the species *Callinectes amnicola* (edible crabs), otherwise referred to as blue crabs are of medical importance [20]. Their study revealed the heavy parasite (protozoan) load in the skeletal muscles of the blue crab. They added that the diseases of blue crabs vary from one location to the other and may be dependent on the prevailing environmental conditions. A research on the parasites of *Callinectes amnicola* in the Cross River estuary, Nigeria showed that this species harboured certain protozoans *(Trichodina)* and nematodes. *C. amnicola* is a delicacy and a rich source of protein in Okorombokho [21]. It is consumed by the young as well as the elderly. Some even consume it raw or partially cooked. Since this species has the potential of transmitting disease, it could constitute a health risk to the community dwellers, if consumers are not enlightened on the need to properly cook them before consumption.

Species of arthropods in the class arachnida (Orders acari and araneae) were collected. In this class, members of the family ixodidae (acari) which were also collected are of medical importance. Their medical importance has been discussed extensively [19, 22, 23, 24]. Medically important insects encountered in the study area were of the orders blattodea and diptera. In the order blattodea only the species *Periplaneta americana* were collected. These species are known to transmit pathogens mechanically because of their filthy habits. It is reported that the parasites transmitted by *P. americana* were *Ascaris lumbricoides* (Causative agent of ascariasis), *Trichuris trichiura* (Agent of trichuriasis), hookworms, *Entamoeba coli* and *Entamoeba histolytica* (Responsible for amoebiasis) and *Balantidium coli* etc [25]. Data obtained from their study thus revealed the potentials of cockroaches as mechanical transmitters of cysts and ova of parasites.

Of the dipterans obtained from the survey only members of psychodidae, ceratopogonidae, muscidae and culicidae families are of medical importance, because of their potentials as vectors of disease-causing organisms. Phlebotomine sandflies of the family psychodidae, genus *Phlebotomus,* collected in good number from the terrestrial habitats of the study area are known vectors of the parasite *Leishmania* spp, which are the causative agents of leishmaniasis. Their occurrence in some parts of Southern Bauchi State, Nigeria and their role in the transmission of cutaneous leishmaniasis in the area. The presence of phlebotomine sandflies in Turkey is associated with the outbreak of leishmaniasis and symptoms ranging from fever, skin lesions, headache, gastro-intestinal disturbances including diarrhea [26].

Biting midges (Ceratopogonidae), of the genus *Culicoides* which were collected from the study area are known vectors of filarial parasites [19]. In addition to the transmission of filarial parasites, biting midges constitute a serious biting nuisance. They are very small, but what they lack in size they can make up for in numbers.

Muscina stabulans and *Musca domestica* (Muscidae) also found in the study area are capable of either mechanical or biological transmission of human pathogens and parasites. The relative abundance of synanthropic flies with associated parasites and pathogens in Minna metropolis, Niger State, Nigeria has been investigated and showed that synanthropic flies in the family muscidae pose a serious health risk to the inhabitants of their study area and commented on the need for their control [27].

Culex quinquefasciatus and *Aedes aegypti* (Culicidae) which were collected from the terrestrial habitats are known vectors of lymphatic filariasis and yellow fever respectively [19]. Worthy of note is the fact that no species of *Anopheles* (responsible for the transmission of the malaria parasite) was collected throughout the period of study. This could be attributed to the absence of suitable breeding site/habitat for this species.

The t-test result which revealed that there was significant difference in the density of the medically important arthropods in the two seasons, corroborates the report of Arong *et al.* [22] who commented on the seasonal variation in the abundance and distribution of some medically important arthropods in Plateau State, Nigeria.

The aforementioned medically important arthropod species are not new in the area, but the alien species *Trialeurodes vaporariorum* (white flies) of the order hemiptera, family aleyrodidae, though not of medical importance are associated with *Nypa* invasion in the environment. They were collected from Nipa palm and feed on sucrose from the palm.

The absence of arthropods such as mayflies (ephemeroptera), stoneflies (plecoptera) and some caddisflies (trichoptera), which are commonly found in other aquatic habitats implies that the water quality of the aquatic habitat is poor. These group of arthropods are known to be sensitive/intolerant to pollution [28, 29].

5. Conclusion

Okorombokho, like every other part of the biosphere, provides habitats for diverse organisms, arthropods inclusive. The early detection of organisms with potentials for the transmission of pathogens/parasites is essential to the prevention and control of vector-borne disease outbreaks in an area. The invasion of *Nypa fruticans* in Okorombokho has resulted in the introduction of *T. vaporariorum*. The species is not of public health concern since it is neither known to transmit pathogens and parasites nor cause biting nuisance. However, some medically important arthropods have been identified in the study area. It is recommended that a program targeted at controlling these vectors be drawn up. Such program can prevent vector-borne disease outbreak and thus enhance the quality of health and life in the community.

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