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Preliminary study on the diversity of Insects species in Nnamdi Azikiwe university stream

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Abstract
The study was conducted to assess the insect communities of a stream in Nnamdi Azikiwe University, Awka (Unizik stream) using the indices of species diversity and abundance of aquatic insects. Sampling of the aquatic insects was conducted weekly from May through June 2013. Shannon-Weiner diversity index, Margalef index, Shannon's equitability index, Simpson's dominance index and Menhinick diversity index were used to assess species richness and diversity. A total of 177 individuals were recorded which comprise of 7 orders and 12 families; dominated by order Diptera (40.1%) and Hemiptera (22%). The results from the study showed that percentage composition was highest at station 1(49.7%) followed by station 3(31.1%) while lowest at station 2(19.2%). Shannon wiener diversity index shows that the stream has a relatively diverse and well distributed aquatic insect community.

Keywords: preliminary, diversity, insects, stream

1. Introduction
The economic importance of aquatic insects cannot be over emphasized. They are of great importance to water bodies where they are found and they constitute food for fishes and other aquatic animals and vectors of disease pathogens to humans and other animals (Latimore, 2012; Popoola and Otalekor, 2011; Budin *et al*., 2007) [17, 21, 6] but most importantly, they serve as bioindicators of water quality as they have different tolerance levels (Latimore, 2012; Da Rocha *et al*, 2010) [17, 7]. Aquatic insects are group of arthropods that live or spend part of their life cycle in water bodies (Popoola and Otalekor, 2011) [21]. Aquatic insects are sessile and show little migration. If migration occurs, these are often responses to disturbances caused by pesticides input or increased sedimentation. Individual taxa demonstrate a complete range of pollution sensitivity, thus is valuable indicators of both general and specific types of disturbances. They are easy to sample and taxonomic identification is almost easy to family level and usually relatively easy to genus level (Subramanian and Sivaramakrishnan, 2007; Moeykens, 2002) [23, 18]. However, a complete study of insect species and diversity in different ecoregions of Nigeria is yet to be undertaken.
Diversity can be defined as the number of different items and their relative frequency. For biological diversity, it encompasses different ecosystems, species, genes and their relative abundance (Aslam, 2009) [3]. One characteristic attribute to multi-species populations is diversity; the commonest misconception is that species richness and diversity are synonymous. Although related, they are distinct. Species richness is the total numbers of species present in a given area or sample whereas diversity takes into account how individuals are distributed amongst those species, i.e., the species frequency distribution. In fact, it turns out that nearly all quantitative measures of diversity are some combination of two components, species richness and evenness, where evenness describes how equally individuals are distributed amongst the species (Aslam, 2009; Singh, 2012; Kerkhoff, 2010) [3, 22, 16].
Studies on the diversity of Nigerian aquatic macro fauna including aquatic insects have been reported in few literatures (Popoola and Otalekor, 2011; Edema *et al.*, 2002; Ibemenuga and Inyang, 2006) [21, 9, 13] and no study has been done on the diversity of aquatic insects in the major water body in Nnamdi Azikiwe University (Unizik stream). Thus, this study becomes imperative to assess the diversity and richness of the insects' species found around the stream.

2. Materials and Methods
Description of Study Area
The study area is a lotic freshwater body that flows within the Nnamdi Azikiwe University premises, Awka. Awka is the capital of Anambra State located in the lowland rain forest zone of Southern Nigeria. Awka is located between latitude 5˚ and 6˚25′ and longitude 7˚E and 8˚E. It lies at an altitude approximately between 46m - 48m above sea level. The stream empties its content into the Amansea River at Amansea village in Awka North L.G.A. of Anambra State (Obiakor, 2010) [19]. Three sampling stations were selected to represent different environments and ecological variation within the stream; Station 1 was located close to the Unizik old gate, adjacent to the Unizik block industry, Station 2 was located close to the laboratory complex at the Science village, Station 3 was located close to the old Law Faculty (now the Unizik high school).

Aquatic Insects Sampling and Identification
The sampling period spanned from May through June, 2013 for a period of 8 weeks. Samplings were carried out between 8.00am- 12.00pm. Insect samples were collected weekly from each sampling points. At each sampling station, adult insects were collected from water surface using a dip-net with a mesh size of 200mm. Adult insects and their nymph were also collected from the vegetations around the stream using a sweep net with a mesh size of 250mm. The sweep net was passed over the area for at least two minutes. The contents collected were put in a sorting bucket and the net was properly checked for insects clinging to the mesh. Insects collected were preserved

in 70% ethanol in specimen bottles labeled to show sample station, description and collection date. Sediments were collected and emptied into labeled polythene bags and taken to laboratory for washing. The washed samples were sieved separately through a sieve with mesh size of 0.5mm to eliminate the excess sediments. Organisms contained were sorted from the detritus and preserved in 10% formalin solution. Subsequently, the collected benthic macro-fauna were identified with the aid of a compound microscope, and preserved in separate 2cmx4cm vials containing 10% formalin solution for keeps in the laboratory. Aquatic arthropods taxonomic keys (Hickman *et al.*, 2008; Kentucky, 2013; Hadley, 2013; Kellogg and Kellogg, 1994; Edelstein, 1993; Abowei and Ukoroije, 2012) [12, 15, 11, 14, 8, 1] were used to identify the collected specimens to family level.

Data Collection and Statistical analysis

Total number of species for each sampled station was calc and Margalef's Diversity Index (D) was used to determine species richness. The family and species abundance and diversity was calculated for each sampling data and for the overall samplings using Shannon-wiener's diversity index (H). Shannon's equitability (*E*) was used to measure the evenness of the community. Menhinick diversity Index, Simpson's dominance index and Importance value index were also calculated.

3. Results

From the three stations, twelve (12) taxa were identified from a total of 177 individuals collected during the sampling periods presented in Table 4. The highest percentage composition of insect's was recorded at station1 (49.7%) followed by station 2(19.2%) while lowest at station3 (31.1%). The highest family encountered in the three sampling stations were the Chironomidae and the lowest were the Hydrophilidae. The importance value index of the aquatic insects' species at the three sampling stations shown in Tables 1, 2 and 3 indicates that Chironomidae had the highest importance value index at the three stations, with Hydrophilidae having the lowest at stations 1 and 3 and Perlidae having the lowest at station 2. The overall insect composition, abundance, and distribution from the sampled points were summarized in Table 4. Diversity, taxa richness and dominance indices of various insects collected during period of sampling are shown in Table 5.

Table 1: The Species Dominance of Aquatic Insects in Unizik Stream at Old Gate (Sampling Station 1)

Families	Total	Count in Quadrants	Density Per 6sq meter	Frequency	Rel. Density	Rel. Freq.	*IVI
Gyrinidae	7	3	1.17	37.5	7.95	8.57	16.52
Hydrophilidae	2	1	0.33	12.5	2.27	2.86	5.13
Chironomidae	30	6	5.00	75	34.08	17.14	51.23
Lestidae	3	2	0.50	25	3.41	5.71	9.12
Gerridae	15	5	2.50	62.5	17.04	14.29	31.33
Veliidae	6	3	1.00	37.5	6.82	8.57	15.39
Beatiscidae	7	3	1.17	37.5	7.95	8.57	16.52
Culicidae	2	3	0.33	37.5	2.27	8.57	10.84
Perlidae	3	3	0.5	37.5	3.41	8.57	11.98
Elmidae	4	3	0.67	37.5	4.54	8.57	13.12
Libellulidae	5	2	0.83	25	5.68	5.71	11.39
Tabanidae	4	1	0.67	12.5	4.54	2.86	7.40
Total	88		14.67	437.5			

*IVI = Importance Value Index

Table 2: Species Dominance of Aquatic Insects in Unizik Stream at Science Village (Sampling Station 2)

Insect Species	Total	Count in Quadrants	Density Per 6sq meter	Frequency	Rel. Density	Rel. Freq	IVI
Gyrinidae	2	3	0.33	37.5	5.13	11.11	16.24
Hydrophilidae	1	2	0.17	25	2.56	7.41	9.97
Chironomidae	10	4	1.66	50	29.33	14.81	44.14
Lestidae	1	2	0.17	25	2.56	7.41	9.97
Gerridae	4	1	0.67	12.5	10.26	3.70	13.96
Veliidae	2	3	0.33	37.5	5.13	11.11	16.24
Beatiscidae	2	3	0.33	37.5	5.13	11.11	16.24
Culicidae	4	2	0.67	25	10.26	7.41	17.66
Perlidae	1	1	0.17	12.5	2.56	3.70	6.27
Elmidae	2	3	0.33	37.5	5.13	11.11	16.24
Libellulidae	2	2	0.33	25	5.13	7.41	12.54
Tabanidae	3	1	0.50	12.5	7.69	3.70	11.40
Total	34		5.66	337.5			

Table 3: Species Dominance of Aquatic Insects in Unizik Stream at Old Law Faculty (Sampling Station 3)

Insect families	Total	Count in Quadrants	Density Per 6sq meter	Frequency	Rel. Density	Rel. Freq	IVI
Gyrinidae	5	3	0.83	37.5	9.09	16.56	25.64
Hydrophilidae	1	1	0.17	12.5	1.82	5.52	7.34
Chironomidae	12	4	2.00	50.0	21.81	22.08	43.88

Lestidae	2	1	0.33	12.5	3.64	5.52	9.15
Gerridae	10	4	1.67	50.0	18.18	22.08	40.25
Veliidae	2	1	0.33	12.5	3.64	5.52	9.15
Beatiscidae	3	1	0.50	12.5	5.45	5.52	10.97
Culicidae	4	1	0.67	12.5	7.27	5.52	12.79
Perlidae	3	2	0.50	25	5.45	11.04	16.49
Elmidae	5	1	0.83	12.5	9.09	5.52	14.61
Libellulidae	6	1	1.00	12.5	10.91	5.52	16.42
Tabanidae	2	1	0.33	12.5	3.64	5.52	9.15
Total	55		9.17	262.5			

Table 4: The Overall Diversity and Distribution of aquatic Insect Encountered during Sampling of Unizik Stream

Individual insects from					
Aquatic Insects		**Station 1**	**Station 2**	**Station 3**	**Total**
Coloeptera	Gyrinidae (whirlgig beetle)	7	2	5	14
	Hydrophilidae (water scavenger beetle)	2	1	1	4
	Elmidae (riffle beetle)	4	2	5	11
Diptera	Chironomidae (bloodworms)	30	10	12	52
	Culicidae (mosquito larva)	2	4	4	10
	Tabanidae (horsefly larva)	4	3	2	9
Odonata	Lestidae (spread-winged damselfly)	3	1	2	6
	Libellulidae (skimmer-dragonfly)	5	2	6	13
Hemiptera	Gerridae (pond skater)	15	4	10	29
	Veliidae (riffle bugs)	6	2	2	10
Ephemoroptera	Beatiscidae (armoured mayfly larva)	7	2	3	12
Plecoptera	Perlidae (stonefly)	3	1	3	7
	Total	88	34	55	177
	% Composition	49.7%	19.2%	31.1%	100%

Table 5: Diversity and Other Indices of Aquatic Insects in the Sampling Station of Unizik Stream

Sampling stations			
Indices	**1**	**2**	**3**
No. of Taxa	12	12	12
No. of individuals	88	34	55
Simpson's dominance index (D)	0.1633	0.1152	0.1083
Menhinick diversity Index (d)	1.279	2.058	1.618
Margalef's index	2.46	3.01	2.74
Shannon weiner index (H)	2.10	2.22	2.26
Shannon weiner equitability *(E)*	0.8453	0.8943	0.9103

4. Discussion

From the result of the study, the number of taxa (12) recorded was low in contrast to the number of taxa (43) recorded by Ibemenuga and Inyang, (2006) [13] in other streams with similar bio-geographical zones. This could be as a result of unfavourable conditions within the stream. Ibemenuga and Inyang, (2006) [13] reported good water quality and food supply as factors that influences the survival, growth and abundance of the macro invertebrates fauna in a stream.

Chironomids occurred more at Station 1 and 3 which have muddy bottom, this supports the findings of Edema *et al.*, (2002) [9] who reported that Chironomids require a substratum with high organic matter content as well as preferring muddy bottom to sandy bottom. However, Station 2 had less insects present due to the stony substratum and this is in agreement with the report of Ogbogu and Akinya (2007) [20] that stones usually had little or no insects. According to the studies carried out by Ibemenuga and Inyang, (2006) [13], the distribution of animals among available habitat is generally mediated by water velocity, immediate substratum of occupation, food availability, predation intensity and tolerance of the physico-chemical conditions of the system.

Aquatic coleopterans are widely distributed in streams and ponds with organic detritus as observed in station 1 and 3. This supports the findings of Elliott, (2008) [10] who also reported that high flow velocity resulting from sudden or severe spates (rainfall) can have detrimental effect on the coleopterans as observed at Station 2. Binckley and Resetarits, (2005) [5] stated that more beetles are usually found in fishless streams and ponds because predation by fishes can influence the abundance and species richness of beetles.

In terms of relative abundance, Dipteran species were the most dominant fauna. Similar reports were given from previous studies (Popoola and Otalekor, 2011; Ibemenuga and Inyang 2006) [21, 13]. The dominance of dipterans in a system may be attributed to their morphological and physiological adaptation to various habitats, availability of food and sustained reproduction (Apperson *et al.*, 2006) [2].

Hemipteran species were the second widely distributed insects around the stream; Berchi *et al.*,(2011) [4] points out that

difference in pH and dissolved oxygen have no detectable effect on the occurrence of hemipteran species but physical condition of the habitat (size, depth of stream and temperature) tends to affect their distribution. They further stated that aquatic Hemipterans tend to be more distributed in habitats of standing or slow moving water as observed in Station 1 and 3. In general, the distribution of individuals throughout the stream tends to be relatively low which could be as a result of the season (rainy) the study was carried out. Supatra and Sanchai, (2012) reported that individuals were very relatively low during the rainy season than during the dry season; as a result of substrate disturbance by floods.

In terms of importance of value index, Chironomidae had the highest dominance at Station 1 (51.23) followed by Hydrophilidae having the least (5.13); Station 2 was also dominated by Chironomidae (44.14) followed by Perlidae having the least (6.27); Station 3 also had Hydrophilidae as the least dominating species (7.34) with Chironomidae dominating the station (43.88) as shown in Tables 1, 2 and 3.

Insects communities found within stations 1, 2 and 3 had a Shannon Weiner index of 2.10, 2.22 and 2.26 respectively and this represent a relatively diverse and well distributed community. This agrees with the findings of Kerkhoff, (2010) [16] who reported that typical values are generally between 1.5 and 3.5 and rarely greater than 4. Shannon's equitability (E_H) measures the evenness of a community and values of 0.85, 0.89 and 0.91 were obtained from each station respectively as shown in Table 5.

The stations 1, 2, and 3 had a Simpson's dominance index of 0.1633, 0.1152 and 0.1083 respectively. Station 2 had the highest Margalef index of 3.01; Station 3 had a value of 2.74 and station 1 had the least value of 2.46. The Mehuinick's index followed the same trend with Station 2 which had the highest value of 2.058; Station 3 with a value of 1.618 and station 1 had the least value of 1.279.

The diversity of insect species in the study stations was found to be low which could be attributed to the season of the study. During rainy season, high flow velocity tends to be major characteristics of streams and consequently reduces insect abundance. Further researches on insect diversity should be carried out during the dry season.

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