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EFFECT OF PHYSICO-CHEMICAL CHARACTERISTICS OF WATER OF RIVER OGUN ON THE DISTRIBUTION AND ABUNDANCE OF AQUATIC INSECTS

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ABSTRACT

This study was carried out to determine the abundance, composition, distribution of aquatic insects and physico – chemical factors of Ogun River. The aquatic insects were collected using sweep and pond net (0.5mm) from two study sites during February and middle April, 2012. The water samples and insects were collected once in a week. Insects were sampled using standard entomological methods, while water samples was analysed using standard Winkler's titrimetric and APHA methods to determine the chemical properties. Water analyses were conducted in the laboratory of Ogun State Water Corporation, Abeokuta, Ogun State. While insects identifications were done in the laboratory in the Entomology Laboratory of the College of Natural Sciences, Federal University of Agriculture, Abeokuta, Nigeria. Results show that five orders and thirteen families were found with the highest number of aquatic insects from the order Odonata. The most abundant family were Coenagriidae and Libellulidae respectively. Physico – chemical values, water temperature, pH, Dissolved Oxygen (DO), Conductivity and Nutrient were measured. Only conductivity had the greater value among the water quality parameters.

Keywords: Aquatic, Survey, Parameter, Habitat, Pollution

INTRODUCTION

Aquatic insects live entire part of their life-cycle in close association with water bodies (Pennak, 1978). As a group, they are divided into two based on stages of their life cycle, as either hemimetabolous or holometabolous. They are of great importance to the aquatic ecosystem due to the services they provide such as providing the needed food resources for fishes and animals (Foil, 1998; Chae *et al*., 2000). Also, aquatic insects serve as good indicators of water qualities since they have various environmental disturbances tolerant levels (Arimoro *et al*, 2008).

Studies of aquatic insects in freshwaters have frequently examined the species habitat relationship with regard to the habitat water quality. Some insect species are known to have particular requirements with regard to nutrients, water quality, substrate components and the structure of vegetation. Once defined, the presence of a particular species in a habitat would imply that the given determinants are within the tolerance limits of the

species. Thus, the species is considered to belong to the habitat.

Aquatic habitats are known to accommodate a great number of the earth's arthropod. Insects utilize the aquatic ecosystem in various ways, but sometimes, only at certain stage of their life cycle (Pennak 1978). Some aquatic insects are particularly very sensitive to pollution, while others can live and proliferate in disturbed and extremely polluted waters (Merritt and Cummins, 1996). Anthropogenic activities of humans encourage discharge of untreated animal waste, from sewage and septic tanks, runoff from Agricultural lands and laundering into rivers. This water bodies have been greatly polluted and these affects their quality and health status. In particular, thephysico-chemical properties of water such astemperature, Dissolved Oxygen, alkalinity, phosphates, nitrates and metal concentration levels are affected. Variations in these properties greatly influence the distribution patterns of aquatic insects in the water.

OBJECTIVES OF THE STUDY

The main objective of the study is to survey the aquatic insects on Ogun River and the effect of the physic-chemical properties on the aquatic insect. The study will also: compare the physic-chemical parameters of the aquatic insect sampling areas; ascertain the effect of human pollution on the river.

METHODOLOGY

The study area

The study was carried out on Ogun river located along Lafenwa and Akomoje, Abeokuta, Ogun State, Nigeria, for 18 months, April, 2011 – September, 2012. Ogun River stretches from Igaran Hill east of Shaki in the North-western part of Oyo State of Nigeria (Latitude 07^0 40'N and Longitude 03^0 35'N) and flow Southwards through Abeokuta in Ogun State, finally with its channel outlet into Lagos Lagoon (Latitude 06^0 30'N and Longitude 03^0 20'N) (Ogun-Oshun River Basin Development Authority, 1980).

Aquatic insects sampling and identification

At each sampled zone; insects, both the adult and the nymph, were collected from littoral point and pelagic point using a sweep net of 12cm diameter and pond net with 0.05mm mesh. The sweep net was passed over the area for at least two minutes. The contents collected were 315 samples and put in a sorting bucket and the net was properly checked for insects clinging to the mesh. Other several insects' were handpicked from specific micro habitats. The pond net was put on the bottom against the river current then the area in front of the net was disturbed by the foot. All samples of insect collected were later preserved in 7% formalin in jars labelled according to sample point, description and collection date. All samples collected were taken to the Entomology laboratory at College of Natural Sciences, Federal University of Agriculture, Abeokuta, Nigeria for identification. The identification was done by using a taxonomical key from order to the species level. The numbers of individuals in each family were counted.

Water Samples Collection and Analysis

Water samples were collected weekly from each sampled points with 2-litre plastic containers washed with nitric acid to remove any form of contaminants. The sampling period spanned from middle February through April (2 months). Sampling was usually carried out between the hours of 6.00am and 9.00am. The water samples collected were then taken to the laboratory and analyzed

immediately to ensure that the physical and chemical properties of the water were maintained. Water velocity was determined at each sampled point using a fisherman's floater on the water and time it took to travel 20m distance was recorded using a stopwatch. The average of four determinations was recorded in m/s.

The water temperature was determined using hand mercury thermometer, pH using a pH meter, conductivity and total dissolved solid using a conductivity/TDs meter, turbidity using a spectrophotometer by the absorptomeric method, water alkalinity by phenolphthalein methyl orange indicator method.

Data analysis: At each sampling point the total number of insect species collected were counted and recorded. The family and species abundance and diversity was calculated for each sampling data and for the overall samplings. Analysis of variance (ANOVA) was use to calculate the means of physico-chemical parameters of the two sampling stations. Pie chart was used to show the composition of the Orders of aquatic insect by calculating the percentage composition of insect orders while the mean of the physico-chemical values was used to draw the bar chart which was used to compare the physico-chemical parameters between Akomoje and Lafenwa.

RESULTS

The result shows the identification of insect from the two sampling points. Different species of insect were identified from the order to the species level (Table 1). The total number of individual insect and family were also recorded and the overall total of the two sampling sites were showed in Table 2. Table 3 shows the mean variation of the eight (8) water samples collected from each sampling station.

Some of the insect species identified from the two sampling points shows the variation, distribution and abundance of each point. Species such as *Balanogasterjunceus* thirteen (13) species from Lafenwa and eleven(11) species in Akomoje were recorded while some of the Odonatas were not found in Akomoje, only single species were found there, which is *Pheonirridipennis* due to the unpolluted of the river in that area. At Lafenwa higher number of the order Odonata were found, such as *Trithemisarteriosa, Ummelongistima,Urothemisassignata* and *Pseudagrionwhellani* which might be due to the human activities such as dumping of refuse and sewages. Higher numbers of the insects that live by the river were recorded at Lafenwa, Cheilomenessp*, Cryptocephalusgladiatorius, Muscadomestica.* From the Belostomatidae family, *Hydrocyriuscolumbiae* had higher number at Lafenwa than Akomoje which is the most benthic insect found during the period of study. The total number of insect from each order with individual species are Coleoptera 46, Diptera 37, Odonata 118, Hymenoptera 68 and Hemiptera 46

Table 1: Classification of Identified Insects

ORDER	FAMILY	GENUS	SPECIES
Hymenoptera	Vespidae	Balanogaster	junceus
Odonata	Libellulidae	Trithemis	arteriosa
Odonata	Agriidae	Umme	longistima
Hymenoptera	Anthophoridae	Xylocopa	spp
Odonata	Agriidae	Pheon	iridipennis
Hymenoptera	Vespidae	Balanogaster	spp
Coleoptera	Coccinellidae	Cheilomenes	spp
Odonata	Coenagriidae	Urothemis	assignata
Diptera	Syrphidae	Eristalimus	megacephilus
Hemiptera	Pentatomidae	Aspavia	armigera
Hymenoptera	Apidae	Apis	mellifera
Hemiptera	Pyrrhocoridae	Dysdercus	superstitiosus
Diptera	Muscidae	Musca	Domestica
Coleoptera	Coccinellidae	Cheilomenes	Vicina
Odonata	Coenagriidae	Pseudagrion	Whellani
Coleoptera	Chrysomelidae	Cryptocephalus	Gladiatorius
Coleoptera	Coccinellidae	Epilachna	Assimilis
Hemiptera	Redurridae	Rhynocoris	Spp
Hemiptera	Belostomatidae	Hydrocyrius	Columbiae
Hemiptera	Belostomatidae	Limnogeton	Spp
Hemiptera	Belostomatidae	Hydrocyrius	Spp

Table 2: The overall composition and distribution of aquatic insects encountered during sampling at the two sampling sites of Ogun River

	Akomoje	Lafenwa	Total
Coleoptera			
Coccinellidae	16	17	33
Chrysomelidae	11	2	13
Diptera (Larvae)			
Syrphidae	13	-	13
Muscidae	3	21	24
Odonata(Adult and Nymph)			
Libellulidae	17	31	48
Agriidae	-	7	7
Coenagriidae	18	45	63
Hymenoptera			
Vespidae	11	20	31
Anthophoridae	-	7	7
Apidae	10	20	30
Hemiptera			
Pyrrhocoridae	-	4	4
Belostomatidae	9	7	16
Pentatomidae	24	2	26
Total	132	183	315

Table 3: Mean variation and F-values of the physico-chemical parameters measured at the Two Sampling points along Ogun River.

Parameter	No. of samples	Akomoje	Lafenwa	F-Value
Temperature ^{0}C	8	30.39±0.99	27.59±2.55	8.38
		(29.30-32.20)	(24.20-29.90)	
Velocity(ms^{-1})	8	0.24±0.25	0.25±0.26	0.07
		(0.001-0.63)	(0.02-0.52)	
Dissolved	8	5.78±0.33	5,45±1.42	0.41
Oxygen(mg/L)		(4.34-6.29)	(4.19-7.96)	
Conductivity	8	83.00±39.03	152.64±58.10	7.75
		(2.82-142.60)	(97.20-285.00)	
Turbidity	8	10.58±6.01	7.31±3.81	1.67
		(3.27-21.80)	(4.41-14.40)	
Acidity (mg/L)	8	0.83±1.65	0.10±0.00	1.54
		(0.10-4.80)	(0.10-0.10)	
Magnesium(ppm)	8	12.38±5.32	13.88±2.90	0.49
		(2.00-19.00)	(10.00-19.00)	
Chloride(ppm)	8	18.38±3.20	20.38±3.74	1.32
		(14.00-23.00)	(16.00-26.00)	
Iron (ppm)	8	0.39±0.45	0.15±0.10	2.29
		(0.10-1.20)	(0.05-0.30)	
Nitrate(mg/L)	8	15.52±9.48	1.11±0.92	18.30

***Aquatic insect sampling and identification**:*

The analysis was based on two (2) sampling sites namely, Akomoje and Lafenwa along Ogun River. The overall insect abundance and distribution from the sampled points were summarized in Table 2. Table 1 shows the result of the insect identified from the Order to species level. Thirteen (13) taxa were identified from a total of 315 individuals collected during the sampling period. The percentage composition of insect collected from the points were recorded, Akomoje and Lafenwa, 41.9 and 58.1% respectively.

The most abundant family was Coenagriidae (Odonata), followed by Libellulidae (Odonata), Coccinellidae (Coleoptera), Vespidae (Hymenoptera) and Apidae (Hymenoptera) at 20.0, 15.2, 10.5, and 9.8% respectively (Table 2). The most abundant individuals was Odonata (118 Individual) and the least wasDiptera (37 Individual) (Table 2). The highest number of aquatic insects was found at the second sampling sites (Lafenwa) which might be as a result of human impact (Anthropogenic) such as sewage, livestock and agriculture. On the other hand, the lowest number was found from the first sampling site (Akomoje) because of the vegetation, gravel and sand extracting from the river. Pie chart below (Figure 1), shows the result of the composition of insect order.

Physico-chemical parameters of water sample:

The result of the physico-chemical parameters of Ogun River is presented in Table 3. The spatial trend in the pattern of each physical, chemical and heavy metal characteristics was similar in some cases and not similar in other ones along the river. Velocity, pH, DO, Acidity, Magnesium and Iron were not significantly different during the period of study, while Temperature, Conductivity, Chloride and Nitrate were significantly different during the study.

Insect Orders percentage composition

Coleoptera=14.6%
Diptera=11.7%
Odonata=37.5%
Hymenoptera=21.6%
Hemiptera=14.6%

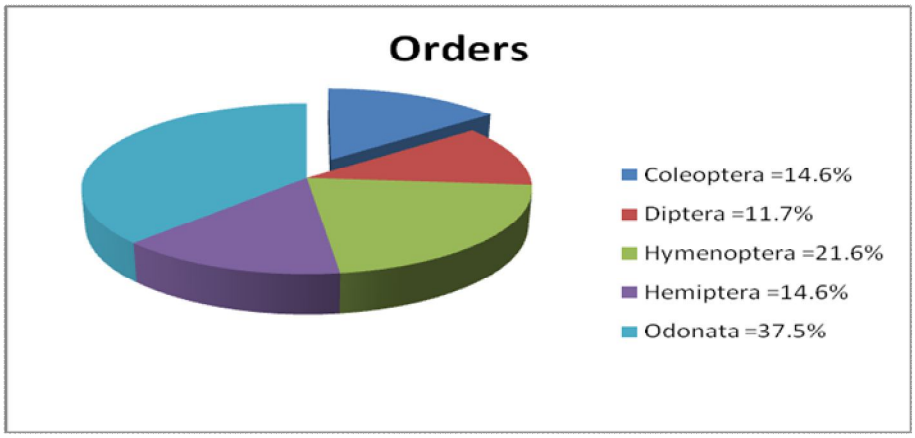

Figure 1: Composition pie chart of insect orders

DISCUSSION

For water temperature, the results showed that the lowest temperature (27.6^{0}C) was recorded at Lafenwa while the highest was recorded at Akomoje (30.4^{0}C)(Figure 2). The difference in water temperature may depend on the climate and the environment near the River as well as sampling time, wind, water mixing and the amount of sunlight. Water temperature affects the number of aquatic insects, since each species require a specific range of water temperature to live in, because of their different respiratory rate and metabolism. During the study, where there is high temperature, the number of insect reduces, while at low temperature more insects were found. Some species like *Cryptocephalus sp., Epilachna sp.* And *Eristalimusmegacephilus* insects were abundant with increase in temperature because they prefer cooler water for their feeding rate, metabolism and reproduction.

Water Velocity of the two sampling sites during the study was 0.2 and 0.3m/s^{-1}, which shows that the flowing rate of the river at Lafenwa was a bit faster than that of Akomoje..

For the pH value,the value of pH of the water sampled from each sampling site were not much different. Interestingly, normal value of the pH were found, with the lowest at 6.8 in Akomoje while the one from Lafenwa is higher 7.6, the standard range of surface water quality is 5 to 9, which implies that the pH value of the two sampling sites is normal for the River.

Dissolved oxygen, the normal DO level in running water ranges from 4.6-8.6mg/L. The DO value from the two sampled points was found normal for the River which helps in distribution and abundance of aquatic insects. Dissolved oxygen (DO), concentration of Ogun River was inversely related to change in temperature. This observation agreed with Arimoro and Ikomi (2008) findings. Who reported that increase in water temperature brings about decrease in DO. This may be due to respiration and other processes such as breakdown of organic matters. Species diversity was higher in Lafenwa where there is low dissolve oxygen of 5.5mg/L.

Conductivity of the sampling sites was significantly different. The higher value of conductivity was 152.6μs/cm in Lafenwa and the lowest value (83μs/cm) was measured in Akomoje. The Conductivity was caused by the high rate of soil erosion and that many ions were dissolved in the River. The dry season had less water volume thus the ions-concentration might be higher. Moreover, the Conductivity was affected by the impacts of human activities such as agriculture, for example the raising of livestock and the discharge of Urban wastewater.

Nitrate; higher value of Nitrate was recorded in Akomoje indicating, significant input of organic discharges in this area, which also play an important role in the distribution and abundance of some insects.

Akomoje had a higher Turbidity than the other, with the value of 10.6 NTU. The underlying reason for the high turbidity was soil erosion, as well as the landscape morphology and their diversity. The magnesium from the sampling sites shows that there is no much significant different during the study period.

The value of Chloride was high in Lafenwa, which may be due to anthropogenics, such as sewage, pollution and release

of ions which affect the distribution of aquatic insect of the sampling sites. In comparing the sampling sites, there is difference in the Chloride values while the concentration of ions was higher in Akomoje than Lafenwa, 0.4 and 0.2mg/L respectively, but in comparing the two to the normal standard, water quality was low. Relating the aquatic insect species abundance of both sites, Lafenwa which was the polluted area had higher aquatic insect species than Akomoje which is the unpolluted area.

Human activities might change the normal development of these fragile ecosystem, especially at Lafenwa side of Ogun River. The poorer water quality at Lafenwa could be attributed to several man-induced activities, such as sedimentation, sewage, nutrients runoff and agricultural pesticides. It shows that the variation of the aquatic insect assemblage is moulded by their different levels of sensitivity of pollution, together with many other abiotic factors in the River.

Therefore the water physic-chemical data, together with the presence/absence of aquatic insect of the studied area are combination of natural and anthropogenic influence.

CONCLUSION

In conclusion, water quality plays a vital role in the distribution, abundance anddiversity of aquatic insects. The high abundance and distribution of pollution tolerant orders of aquatic insects in Lafenwa indicates the relative pollution of the River.

Five orders and 13 families of aquatic insects were found, with the highest number of aquatic insects is from the order Odonata.

The most abundant individual is Pseudagrionwhellani and Urothemisassignata respectively from Lafenwa. While the least was Pyrrhocoridae (Hemiptera).

For physico-chemical parameters, only Conductivity value in Lafenwa had the highest value (152μs/cm), compared to other physico-chemical parameters which was due to high level of soil erosion and dissolve of many ions into the River. Species of aquatic insects were much in Lafenwa, the polluted area compared to the unpolluted area (Akomoje) which may be as a result of less human impact in that area.

RECOMMENDATIONS

Adequate measures should be put in place by the Law enforcement agencies to restrict human from polluting the River by pouring sewage, agricultural waste and other forms of pollution into the River. More researches should be carried out on the River, the aquatic insects and the physico-chemical parameters.

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