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Mayflies (Order Ephemeroptera) Distribution as Indicators of the Water Quality Status of a Stretch of Ovia River (Iguoriakhi), Edo State, Southern Nigeria

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Abstract:
The distribution of Ephemeroptera (Mayflies) community in a stretch of Ovia River (Iguoriakhi), Edo State, Nigeria, was investigated at four designated stations over a period of 8-months. Eight taxa belonging to four families; Baetidae (5), Adenophlebiidae (1), leptophlebiidae (1), and Siphlonuridae (1) were encountered in the study. The most dominant taxa were adenophlebiidae and baetidae contributing 22.2% and 77.78% in station 1, 24.07% and 75.93% in station 2, 50.96% and 49.04% in station 3 and 36.97% and 63.03% in station 4.Aposteriori test for multiple comparison showed that the density of ephemeroptera at station 4 was significantly higher (P<0.01) than those at stations 1, 2, and 3, which were not significantly different from each other. The diversity indices showed that taxa richness, Shannon diversity and evenness were moderately impacted at station 2. The aquatic macrophyte -rich stations 1, 3 and 4 were non-impacted compared to station 2. This study showed that mayflies (Ephemeropterans) are good indicators for freshwater quality monitoring.

Keywords: *Mayfly, Ephemeroptera, Diversity, Ovia River, water quality, Biomonitoring*

1. Introduction

Aquatic ecosystems are sometimes disturbed by several physical and chemical stressors that significantly have cascading effects on biodiversity. Water quality is a global environmental issue which is having increasing consideration in Nigeria among other nations of the world. Aquatic macrobenthic fauna is an inexpensive means of monitoring aquatic perturbations due to the fact that aquatic insects are use as biomarker due to their abundance or absence (Abowei and Sikoki, 2005). The study of benthic fauna of freshwater is the subject of so much research because of their paramount in the food chain and as bio-indicators of pollution and productivity in aquatic ecosystem (Ogbeibu and Victor, 1989). Ephemeroptera larvae are a group of macrobenthic invertebrates that are capable of exhibiting low tolerance to low level of dissolved oxygen, and they have been used in the bio-assessment and monitoring of freshwater bodies worldwide because of their relatively abundance in a wide variety of substrates and their increasing chance of detecting pollution impacts (Ogbeibu and Victor, 1989). Further, this order is the abundant and recognizable freshwater insect especially in riffles, runs and marginal vegetation and it forms an important component of fish diets (Rosenberg and Resh, 1993).

The Ovia River at Iguoriakhi, Edo State, Nigeria, is a major river that flows through the whole of Iguoriakhi community which serves as the main drainage system in the community. As a result, the river is subjected to effluent discharge from various sources which in turn are likely to bring about changes in the community structure of the fauna. The dearth of data on the knowledge of Ephemeroptera especially as a tool for biomonitoring in Nigeria forms the need for this investigation. The aim of this study is to investigate the composition and diversity of Ephemeroptera species in Ovia River, Iguoriakhi, Nigeria with a view to using them as a biomonitoring and indicator index of the water quality and integrity.

1.1. Study Area

The study was carried out within a stretch of Ovia River (Iguoriakhi), which took it source from the Akpata hills in Ekiti State, Nigeria. Iguoriakhi is located about 23.9km from Benin City, off Lagos-Benin Express Road (Lat. $06^0$23'42.76" – $06^0$27'10.15"N; Long $005^0$25'55.0"- $005^0$29'36.20"E), within the tropical rainforest belt of Nigeria. This region has two distinct regions: wet and dry season, which starts from April to October and November to March respectively. The vegetation is predominantly shrubs and trees.

Four sampling stations were selected: 1 and 2 (upstream) and 3 and 4 was designated downstream, each station was about 0.5km apart. Station 1 is located upstream about 1km from a bridge across the river. The station is partially shaded by trees forming a canopy over it. The substratum is a mixture of sandy and decaying organic materials at the bank of the river. Anthropogenic activity is solely fishing. Station 2 is about 0.5km downstream of station 1. The substratum is composed of mud with decaying organic materials at the bank of the river. Human activities include bathing, laundry, dredging, Lumbering and fishing.

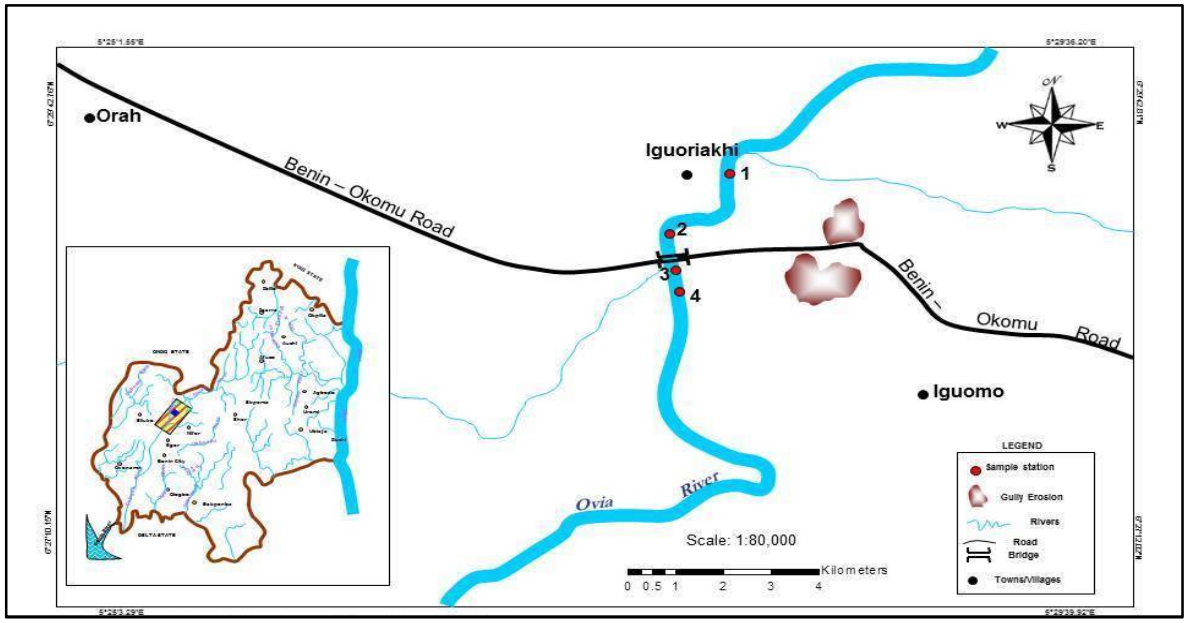

Figure 1: Map of the study area showing location of Ovia River and the sampling stations, with map of Edo State, Nigeria

Station 3 is about 1.5km downstream of station 1. The average depth of the river at this station is 1.45±0.62m. The current velocity of flow is 0.71m/s. The major activity here is fishing and farming at the bank of the river. It is characterized by floating macropytes such as the *Eichhornia crassipes and Salvinia* sp. and the bank is made up of grass mats and few palm trees. Station 4 is located about 2km downstream of station 1 (latitude 6˚ 28’ 44.9’’N and longitude 5˚ 27’ 43.5’’E). The flow rate is minimal at this station, with mean flowing velocity of 0.62m/s. The average depth at this station is about 1.46±0.48m. The dominant terrestrial vegetation here includes *Elaeis guineensis* and grass vegetation. The activities witnessed here include, fishing only. The substratum composes of decaying plant materials with little organic matter and with clay.

2. Materials and Methods

Ephemeropterans were sampled in the four study stations monthly between 0730h and 1100h on each sampling day. The sampling period spanned from June 2014 to February, 2015.

Emphemeropterans were sampled using the kick sampling technique (Hynes, 1970; Peterson & Fernando, 1970; Ogbeibu & Victor 1989) and dusting of *Echhornia crassipes*. The substratum in a known area of 0.25m^2 in each station was vigorously disturbed by kicking for a few minutes. The dislodged organisms in the course of the disturbance were sampled with a hand net made of a cone shaped 100µm mesh size, with a mouth diameter of 20cm and a detachable handle by placing it opposite the flow direction of the river. The dislodged organisms were then washed into the net. Samples collected were sieved with a set of Tyler sieves of mesh sizes 2mm, 1mm, 150um and 100um respectively. The contents retained in the sieves were washed into polypropylene bottle and preserved in 10% formalin. Macrobenthic invertebrates were sorted under a binocular microscope (American Optical Corporation model 570), while identification, counting and drawing were done using an Olympus Vanox Research Microscope Model 230485 (Mag. 50-500x). Identification of specimens of macrobenthic invertebrates was carried out using manuals listed in Ogbeibu and Victor 1989.

2.1. Data Analysis

Analysis and Characterizing the community structure and fauna similarities were according to Ogbeibu and Egborge, (1995). The single Factor Analysis of Variance (ANOVA) and Duncan Multiple Range (DMR) test were used to test for significant difference in the abundance of fauna among stations and to identify site(s) of significant difference respectively. All statistical procedures for test of significance, diversity and similarity indices were adopted from Ogbeibu, (2005), as well as SPSS 20.0 computer package.

3. Results and Discussions

Mayfly larva are common and occur everywhere in bodies of water, from fresh to brackish water, still toofast water flows, and clean to relatively organically polluted water. Aquatic mayflies were sampled to establish their salinity, pollution and trace elements tolerance based on their occurrence in a certain environment from fresh water and brackish water habitats throughout the study

locations. They can be seen by naked eyes and show different forms with variety of morphological features. Typically, they are describing not only the water quality but also reflect their habitat conditions.

A total of 951 individuals which belonged to 10 generic taxa and 6 families were recorded. All the taxa were represented in all studied stations. The most dominated taxa were *Adenophlebiodes* sp., *Cloeon simplex*, and *Centroptilum* sp. They each recorded their highest abundance at stations 3, 2, and 1 respectively. *A posteriori* test for multiple comparison showed that the density of ephemeroptera at station 4 was significantly higher ($P<0.01$) than those at stations 1, 2, and 3, which were not significantly different from each other (Table 1).

3.1. Checklist of Ephemeroptera Fauna

Phylum	Arthropoda	
Class	Insecta	
Subclass	Pterygota	
Order	Emphemeroptera	
Family	Baetidae	
	Pseudocloeon sp.	Klapalek
	Baetis bicaudatus	Leach
	Cloeon simplex.	
	Cloeon cylindroculum	Kimmins
	Centroptilum sp.	Eaton
Family:	Adenophlebiodes	
	Adenophlebiodes sp.	Ulmer
Family:	Siphlonuridae	
	Siphlonura sp	Needham
Family:	Leptophlebiidae	
	Leptoplebia sp	
Family:	Dicercomyzidae	
	Dicercomyzon sp	Demoulin
Family:	Caenidae	
	Caenis sp.	

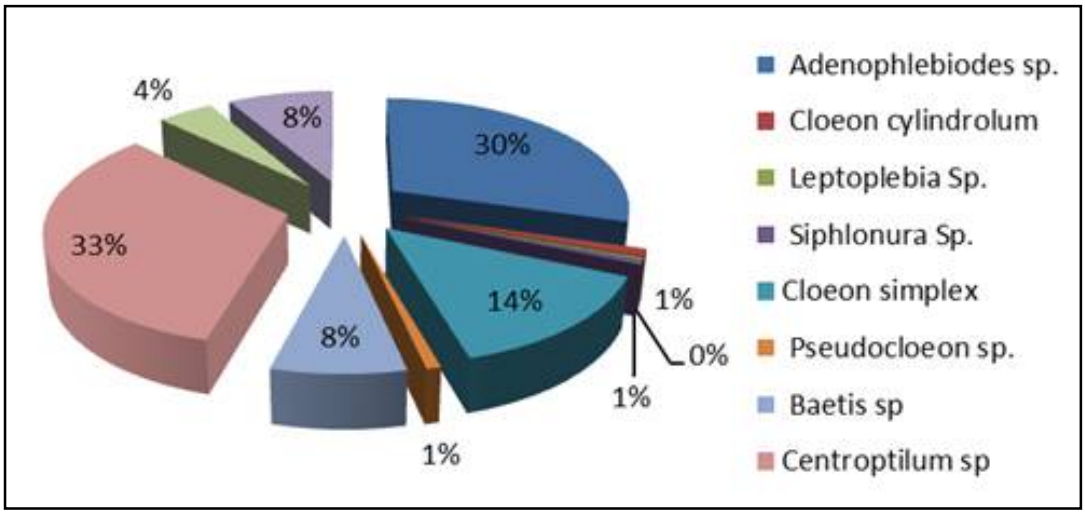

Figure 2: Relative (%) composition of different species of Emphemeroptera of Ovia River

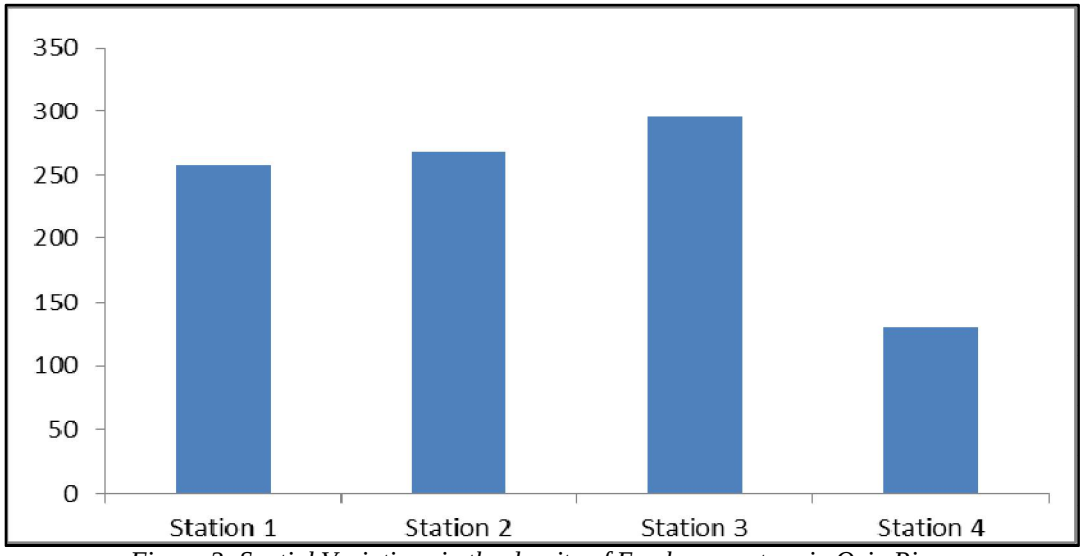

Figure 3: Spatial Variations in the density of Emphemeroptera in Ovia River

		Station 1	Station 2	Station 3	Station 4	Chi-Square	p-Value
Dominant	Ephemeroptera	257 [a]	268 [a]	296 [a]	130 [b]	68.51	p<0.01
Subdominant	Diptera	23 [a]	13 [b]	21 [a]	21 [a]	16.69	p<0.01
Rare	Rare Taxa	20 [b]	18 [b]	47 [a]	21 [b]	21.32	p<0.01
Total		300 [a]	299 [a]	364 [a]	172 [b]	68.46	p<0.01

Table 1: Summary of Taxa Composition and Test of Significant Difference

Ephemeropterans appeared at all stations; the density was most and least felt at stations 3 and 4 respectively. The ephemeropterans encountered in this study have earlier been recorded by Ogbeibu and Victor (1989), Ogbeibu and Oribhabor, (2002) at Ikpoba River, Edokpayi and Ekikhalo (2001) at Ibiekuma River, Omoigberale and Ogbeibu (2010) at Osse River. The qualitative presence of Ephemeroptera in almost all the water bodies in Edo State as being spectacular has being acknowledged (Olomukoro and Ezemonye 2006). Contrary to the documentations by Ogbeibu and Oribhabor (2002) and Omoigberale and Ogbeibu (2010) which recognised *Baetis tricaudatus* and *Baetis bicaudatus* respectively as most dominant ephemeropterans at the various study rivers, *Adenophlebiodes* sp.was recorded as the most dominant ephemeropterans in this study. *Cloeon simplex* and *Centroptilum* sp. which are current loving were encountered visually at all the stations. Significant correlation was recorded between members of the family Baetidae and Caenidae with total hydrocarbon content of the sediment. The dominance of Mayfly species in freshwater ecosystem has been acknowledged. This significance as indicators of trophic status of freshwater ecosystem has been perturbed (Olomukoro and Ezemonye, 2006). Mayflies are good indicators of environmental condition of freshwater ecosystem (Olomokoro, 1996). They tend to live mostly in unpolluted and unperturbed freshwater bodies where they contribute greatly in secondary production. However, the present of trace amount of organic pollutants in the aquatic systems can increase the number and production of certain species, while others are exterminated (Williams and Feltmate, 1992). Mayflies are mainly dominance in fast-flowing, cool and clean streams and rivers rich in dissolved oxygen content.

The Ephemeropterans recorded were those commonly found in tropical African freshwater ecosystems. The total number of taxa from this study was high compared to records from various surveys on freshwater ecosystems in Nigeria (Olomukoro and Ezemonye, 2006; Olomukoro and Azubuike, 2009) but was lower compared to the results recorded by Omoigberale and Ogbeibu, 2010 and Ogbeibu and Anagboso, 2005. Edema *et al.*, 2004 recorded similar dominance of Ephemeroptera in Ossiomo River which documented good water quality of the river.

Several studies have showed that mayflies in freshwater ecosystem in southern Nigeria cannot tolerate heavily polluted water. They might either be choked by pollution freshwater or migrate away for safety. The absence of mayfly insects from such environment indicates poor water quality.

One key strategy that needs to be explored among others for effective water quality management is the enacting of adequate controls and implementation of procedures to prevent contamination and perturbation of aquatic environment. Control of various untreated wastewaters inflow into the rivers should be adequately enforced.

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