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Preliminary Investigation into the Periphyton Community of a Tidal Creek, Bonny River, Rivers State, Nigeria

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Abstract- In this report the periphyton community of a tidal creek in Bonny River was investigated, study site was demarcated to five stations where samples were collected for six (6) months. Laboratory analysis was based on standard methods and involved identification and enumeration of periphytic organisms. The periphytic community of the study area was composed of 83 species belonging to six classes and 61 genera. The most dominant class was Bacillariophyta represented by 32 species, followed by Chlorophyta with 18 species, Cyanophyta with 17 species, Pyrrophyta 7species, and Euglenophyta and Xanthophyta with 5 and 4 species respectively. The order of total class abundance contrasted with that of species richness, following in decreasing order – Bacillariophyta, Cyanophyta, Euglenophyta, Pyrrophyta, Chlorophyta and Xanthophyta. The increasing presence of Cyanophyta and Euglenaphyta in all stations suggests that study area is under stress which may have been caused by petroleum hydrocarbon.

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Preliminary Investigation into the Periphyton Community of a Tidal Creek, Bonny River, Rivers State, Nigeria

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Abstract- In this report the periphyton community of a tidal creek in Bonny River was investigated, study site was demarcated to five stations where samples were collected for six (6) months. Laboratory analysis was based on standard methods and involved identification and enumeration of periphytic organisms. The periphytic community of the study area was composed of 83 species belonging to six classes and 61 genera. The most dominant class was Bacillariophyta represented by 32 species, followed by Chlorophyta with 18 species, Cyanophyta with 17 species, Pyrrophyta 7species, and Euglenophyta and Xanthophyta with 5 and 4 species respectively. The order of total class abundance contrasted with that of species richness, following in decreasing order – Bacillariophyta, Cyanophyta, Euglenophyta, Pyrrophyta, Chlorophyta and Xanthophyta. The increasing presence of Cyanophyta and Euglenaphyta in all stations suggests that study area is under stress which may have been caused by petroleum hydrocarbon.

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I. Introduction

Periphytons are a complex mixture of algae, cyanobacteria, heterotrophic microbes and detritus that are attached to submerged surfaces such as rocks, macrophytes etc. in most aquatic ecosystem (Ekhator, 2010). Periphytons are the dominant producers and sources of autochthonous organic matter in most standing water, since most lakes and reservoirs are predominantly small and shallow (Wetzel, 1996), similarly, when current velocity is appreciable nearly all primary production is from periphyton as phytoplankton are unstable and not abundant. Gaiser, (2008) observed that periphytons are a crucial and fundamental part of the food web, as the primary food source for small consumers such as fish and invertebrates. Through the physicochemical interactions with the biotic and abiotic environment, periphyton affects many biotic communities and ecosystem features such as nutrient circling, dissolved oxygen concentration and soil/sediment quality through photosynthesis to sustain much of the aquatic life in its surrounding (Gaiser, 2008; Vadeboncoeur and Steinman, 2002). According to Lowe and Pan(1996) periphyton contributes significantly to the biodiversity of these ecosystems.

Periphytons serve as an important food source for invertebrates, tadpoles, and some fishes (Finlay, *et. al*., 2002), and can absorb contaminants removing them from the water column and limiting their movement through the environment (Wikipedia, 2012). Periphyton due to their sedentary nature, species composition, community structure, succession and biomass are sensitive to changes in water quality and are often used as bio-indicators of ecological conditions and change in response to human and natural disturbance (Cascaller *et. al.*, 2003) and in classification of water ways (DeNicola, Eyto, Wemaere and Irvine, 2004). Their responses to pollutants or water quality changes according to Cairns, (2003), can be measured in a variety of scales or levels viz, physiologically, population, community etc levels. Their fast response to changes in the environment, naturally high species richness and their high level of tolerance/ sensitivity makes them ideal bio-monitors (Wikipedia, 2012).

Periphytons have a very high rate of reproduction, and in ideal conditions (sufficient supply of light and nutrients) their population can explode into blooms which can contribute to oxygen depletion, fish kills and aesthetic problems that can interfere with recreational use (DeNicola, et. al., 2004; Siva and John, 2002).

Despite its ecological significance, periphytic algae has received less attention from Hydrobiologists than planktons (phytoplankton and zooplankton), and in the study area there is no report on the periphytic community in the past. This study is therefore aimed at providing information to fill this gap.

II. Materials and Methods

a) *Description of the study area*

The study area – Kua-Kinabere creek, in Ogoni land is a mangrove wetland, an estuary of the Bonny River serving as transportation channel or route and is notorious for oil activities including illegal oil bunkering and or refining.

Prior to commencement of sampling, a reconnaissance visit was paid to the study area during which five (5) sampling stations were identified. Two

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replicate samples were collected from each station for six (6) months (March to August). The geographical location of the various sampling stations obtained with a hand-held Global Positioning System (G.P.S) instrument (GARMIN EXTREX) are, (STN 1) N 04040.017', E 007014.081'; (STN 2) N 04040.506' E 007013.577' (STN 3)N 04040.699' E 007014.800' (STN 4) N 04041.184' E 007014.199' and (STN 5) N 04041.169' E 007014.256'.

b) Field Methods

Periphyton samples were collected at low tide in each of the five sampling stationsin triplicates by randomly throwing a 2cm by 2cm quadrant on the surface of aquatic macrophytes or any other object and carefully scrapping off the quadrant area with a scalpel, which was then emptied into a properly labeled. To each of the container was then added a few drops of eosin solution to stain the tissues of the organisms and make them visible during microscopic analysis in the laboratory. The samples were then preserved in 10% formalin solution with few drops of eosin before transporting to the laboratory in an ice-chest cooler for identification and enumeration.

c) Laboratory Methods

In the laboratory samples were allowed to stand for a minimum of 24 hours before decanting the supernatant. The supernatant was removed carefully until a 50ml concentrated sample was achieved. The concentrated sample was then properly shaken and 1ml sub-sample was collected from it and transferred into a Sedgewick Rafter counting chamber using a stampel pipette. Identification and enumeration was carried out under a binocular compound microscope with magnification of 40 x 400. Three replicates of the sub-samples were analyzed. For each sample, each solitary cell was counted as one unit in a cell by cell basis. The result was then expressed in number of organisms per ml of sample.

Identification and characterization of the periphytic algae species was based on the descriptive keys and illustrations ofMaosen, (1978) and Durand and Leveque (1980).

III. Results and Discussion

The periphyton community in the study area was represented by 83 species, spread across 6 classes and 61 genera. Bacillariophyta had the highest number of species -32, followed by Chlorophyta with 18 species, Cyanophyta was represented by 17 species, Pyrrophyta, Euglenophyta and Xanthophyta, had 7, 5and 4 species respectively, as shown in Table 1. However, the total abundance of the periphytic community showed that the diatoms Bacillariophyta were the most dominant class accounting for 39.72% of the population, followed by the class Cyanophyta with 23.39%. The next is class Euglenophyta with 12.34%, Pyrrophyta with 10.93%, Chlorophyta with 8.35% while at the rear with 5.27% is class Xanthophyta, see figure 1. The most occurring species isthe diatom *Stauroneisacuta* with 5100 individuals followed by *Ophiocytium capitatum* of class Xanthophyta with 3200 individuals, following next with a population of 2700 is *Peridinium bipes* of class Pyrrophyta. However, the total abundance in decreasing order of dominance is Bacillariophya>Cyanophyta>Euglenophyta>Pyrrophyta >Chlorophyta>Xanthophyta.

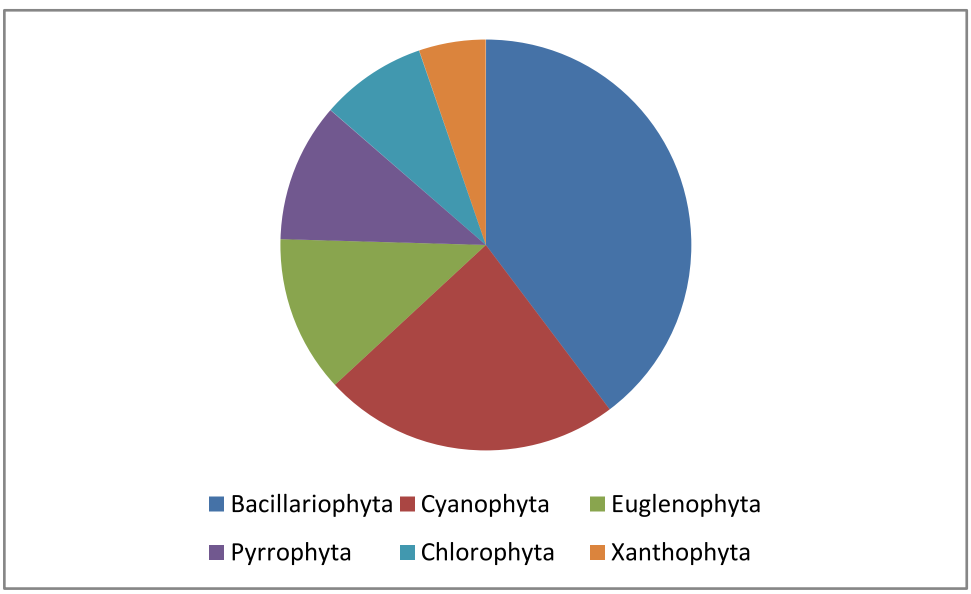

Figure 1: Periphyton Class Total Abundance in the study area

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Table 1: Checklist of Periphytic algae in the study area

BACILLARIOPHYTA	*Achnantheshungarica*	*Aphanothececlathrata*
Melosiralistans	*Pinnulariabraunii*	*Oscilatorialacustris*
M. varians		*Spirulinasubtilssima*
M. distans	CHLOROPHYTA	*Raphidiopsiscurvata*
M. pusilla	*Closteriumdianae*	*Anabaenopsisraciborskii*
Cyclotellameneghiniana	*C. intermidium*	*Coelosphaeriumdubium*
C. comta	*C. moniliferum*	*Gomphosphaerialacustris*
C. operculata	*Carteriamultifilis*	*Gloeocapsaturgida*
Synedra ulna	*C. globosa*	*Gloeotrichiaechinulata*
S. vaucheriae	*Volvoxaureus*	
Cymatopleurasolea	*Gloeotaeniumloitlesbergerianum*	EUGLENOPHYTA
C.elliptica	*Asterococcuslimneticus*	*Euglena sanguinea*
Naviculacuspidata	*Schroederiasetigera*	*E. oxyuris*
N. radiosa	*Ankistrodesmusfalcatus*	*E. variabilis*
N. gracilis	*Radiococcusnimbatus*	*Trachelomonasdubia*
Stauroneisanceps	*Gonatozygonaculeatum*	*T. volvocina*
S. acuta	*Gymnozygamoniliformis*	*T. armata*
Gyrosigmaattenuatum	*Cosmariumgranatum*	*Colaciumcyclopicola*
Nitzschiadenticula	*Tetrallanthoslagerheimii*	
Surirellatenera	*Actidesmiumhookeri*	PYRROPHYTA
S. elegans	*Eudorinaelegans*	*Glenodiniumcinctum*
Cymbellahauckii	*Golenkiniaradiata*	*G. quadridens*
Epithemia zebra		*Gonyostonum semen*
Rhopalodiagibba	CYANOPHYTA	*Peridiniumbipes*
Flagilariacapucina	*Anabaena flos-aquae*	*Chiliomonasparamaecium*
Cocconeishustedtii	*Affinis*	
Cymatopleurasolea	*hassalii*	XANTHOPHYTA
Tabellariafenestrata	*Phormidiumvalderiae*	*Ophiocytiumcapitatum*
Pinnulariaappendiculata	*P. mucicola*	*O. cochleare*
Asterionellaformosa	*Microcystisaeriginosa*	*Tribonemaviride*
Stephanodiscushantzschii	*M. pulverea*	*Gloeobotryslimneticus*
	Nostocplanctonicum	

The 83 species of periphyton observed in this investigation is lower than the 149 and169 species gotten by Carrick and Steinman, (2001) and Chindah, (2004), respectively and even much lower than the 457 species recorded by Algarte, Siqueira, Murakami and Rodrigues (2009) in the Upper Parana River floodplain, but is comparable to the 77 species reported by Chindah, (1998) in the Upper Reaches of the New Calabar River and the 75 species recorded by Wokoma, Umesi and Edoghotu, (2010) in the Elechi Creek. It is however higher than the 30 species recorded by Onyema*et. al*.,(2010) in the shoreline of Lagosas well as the 54, 32 and 22 species reported by Wood, Kuluajek, Winton and Phillips (2011) in Rotoiti, Tikitapu and Okareka Lakes respectively. Several factors may account for the observed variation of periphyton species richness, such as differences in substrates from which periphyton was gotten, variations in nutrient concentration, habitat differences in water quality as well as changing conditions in some physicochemical parameters such as pH, Conductivity and Salinity gradient, (Chindah, 2004). The dominance of the periphytic algal community by the diatoms (Bacillariophyta) is a common feature in most Niger Delta water bodies. There was however a clear departure from this trend in the report of Algarte*et. al.,* (2009) where Zygnemaphyceae was observed as the most dominant class, followed by class Bacillariophyceae. Generally, the pattern of species richness in this study in decreasing order is (Bacillariophyta>Chlorophyta>Cyanophyta>Euglenophyta>Pyrrophyta>Xanthophyta) at variance with the trend reported by Chinda *et. al.* (2006) – (Bacillariophyta>Chlorophyta>Euglenophyta>Cyanophyta) and Wood *et. al.,* (2011) – Bacillariophyta>Cyanophyta>Chlorophyta>Euglenophyta>Xanthophyta = Chrysophyta.

The few species observed and even the low abundance of periphyton in this present investigation could be associated to the low nutrient content of the river. However, the order of specie dominance and community structure were slightly different.

The order of total abundance observed in this study showed Bacillariophyta as the most dominant class followed by Cyanophyta and Euglenophyta as the second and third most dominant classes. The high number of Cyanophyta and Euglenophyta above Chlorophyta (with more species) indicates that the prevalent environmental conditions are favourable to them more than the others. This suggests that the study sites are contaminated with petroleum related wastes which may have enhanced their growth relative to the other classes. This is corroborated by the earlier reports of Wokoma et al., (2012) Chindah et. al., (2006) and Chindah, (1998) who concluded that cyanophyta thrives in oil contaminated environment.

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