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The Phytoplankton Community Structure of a Tropical River in Niger Delta, Nigeria

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Abstract
The phytoplankton community structure in Mbo Rver, Akwa ibom State was studied for a period of one year (December 2009-November 2010) using standard analytical methods. The aim was to study the algal structure as reference point for the sustainable management of the river in view of the proposed development plans for the river basin. The result showed that station 1 had the highest value of species richness making up 42.16% with 43 species. Station II recorded 30 species making up to 29.41% and Station III contributed to 28.43% of the sample with 29 species. A total of 102 species of phytoplankton in general and five taxonomic groups were collected. Of this total, the diatoms had the highest number of species (45 species), followed by chlorophyceae with 25 species. The highest diversity of 3.23 was recorded in Station I in march and the lowest of 2.96 in February also in Station 1.
Keywords: Phytoplankton, community structure, Mbo River

Introduction
The knowledge of the nature and behaviour of water bodies (the structure and function of aquatic ecosystems) is fundamental to getting answer to greatly pondered questions relating to ecology, water resources and water quality.
Rivers provide a wide range of ecosystem goods and services to the society. Many of these services, fisheries in particular, depend upon the biodiversity and ecological integrity (Arthington, *et al,* 2004). The quality of the aquatic systems can be expressed as the composition and state of the biological life present in the water, the physical state of the water, chemical composition of the water, and the descriptions of aquatic organisms, including their density biomass and diversity.

MATERIAL AND METHODS
STUDY AREA: THE MBO RIVER
The Mbo River (Fig.1) is one of the major rivers in Akwa Ibom State, Nigeria, It is a near coastal river located within the Cross River Basin and drains into the Cross River Estuary at Ibaka in the Bight of Bonny,
For this survey, three sampling stations within the stretch of the river were recognized (Fig.1) Station *111* (Ukontenge creek) is located about 1500m upstream of the Mbo Bridge.
Mbo River is an important hydrographic feature draining two local government areas and plays a major role in the fisheries resources of the state, transportation and nutrient load of the estuary.
PLANKTON SAMPLING
Water samples (1,000ml) were collected from approximately 20cm below the water surface mid-stream at each sample site in new, clean 100ml polyethene sample bottles, clearly and permanently labeled. The sample was fixed with approximately 5ml of 4% formaldehyde solution and taken to the laboratory for analysis. The sample bottles for plankton were allowed to stand for 48 hours before decanting the supernatant leaving an aliquot of known volume. The concentrated samples were homogenized before 1ml of sub-sample from the original stock collected with sample pipette (Onuoha, 2009). The pipette content was transferred unto a Sedgewick – Rafter counting chamber for species enumeration at a microscope magnification of 400_x using the synopsis of Mills (1932), Durand and Leveque (1980), Screenivas and Dulthie (1993), Newell and Newell (1977), Egborge (1973), APHA (2005); Onuoha (2009).
Qualitative estimation of plankton was made using a 30cm square mouthed 70mm mesh bolting silk net (Griffin) and collections were made in triplicate. Plankton samples for qualitative analysis were obtained by placing the net below the water surface (20cm) and the net towed for 5 minutes until a sufficient quantity of plankton was collected.
For quantitative estimation of plankton, 50cm^3 of surface water was filtered through the plankton net, Khan *et al.*,(1983); Khan and Ejike (1984). One percent (1%) Lugol's iodine solution was added to the plankton sample to fix the phytoplankton component (Akpan *et al.,* 1994). Samples were fixed immediately for zooplankton with 4% hexamine buffered formalin to preserve the organisms. Sample was then concentrated by centrifuging and adjusting to 10ml. All organisms were identified and enumerated using a light compound microscope. The biotic community will be analysed using diversity and similarity indices adopted from Ludwig and Reynolds, 1988.

COMMUNITY ASSESSMENT

Shannon – Wiener index of diversity was expressed as:

$H_s = \sum Ni/N \log_e Ni/N$ (Shannon and Weaver, 1963)

Where:

Hs = Shannon – Wiener index

N= total number of individuals in the sample

Ni = the number of individuals in species I in the sample

RESULTS

DIVERSITY (SHANNON-WEINNER INDEX)

A total of 102 species of phytoplankton in general and five taxonomic groups were collected (Table 1). Of this total, the diatoms had the highest number of species (45 species), followed by chlorophyceae with 25 species. The highest diversity (Fig. 2) of 3.23 was recorded in Station I in March and the lowest of 2.96 in February also in Station I.

Station I was noted to have higher phytoplankton diversity both in the dry and wet seasons than the other two stations. Station II had slightly higher diversity in the wet season than Station III while the reverse was the case in the dry season.

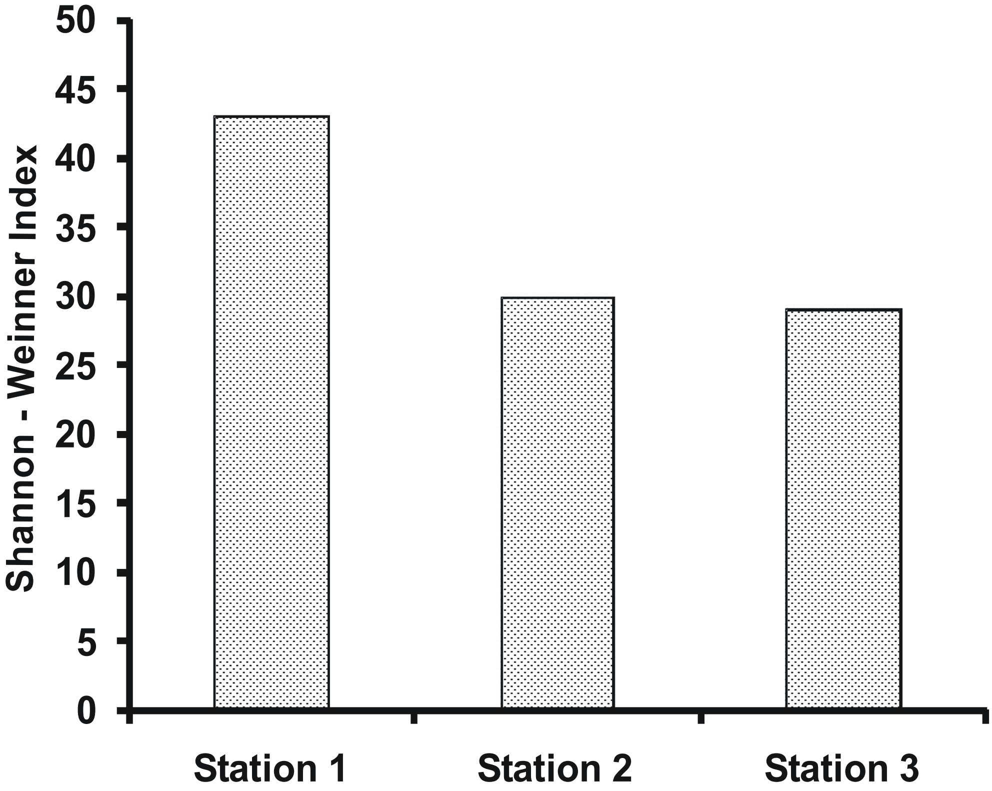

Fig 1: Shannon-weinner Index of phytoplanktons in the three sampling stations in Mbo river.

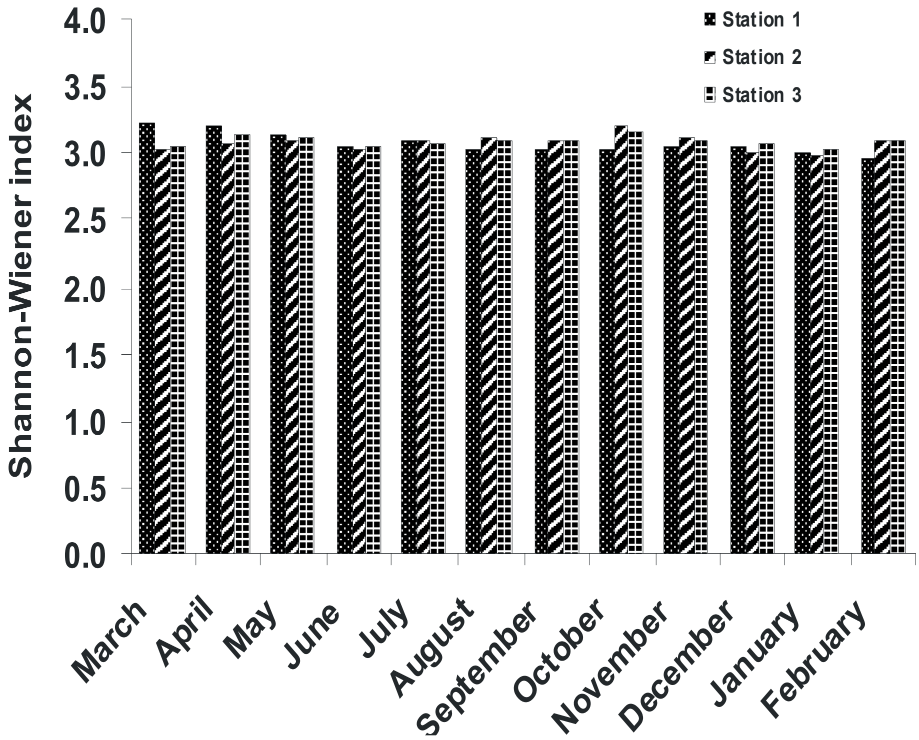

Fig. 2: Temporal variation in the Shannon-wiener index of the phytoplankton of Mbo River

Temporally phytoplankton showed higher diversity value (3.60) in the dry season (Fig. 4) in Station I than in the wet season (3.56). On the other hand, Station II had a higher diversity value in the wet season (3.15) than in the dry season (3.13). Station III on its own recorded approximately same diversity value in both seasons.

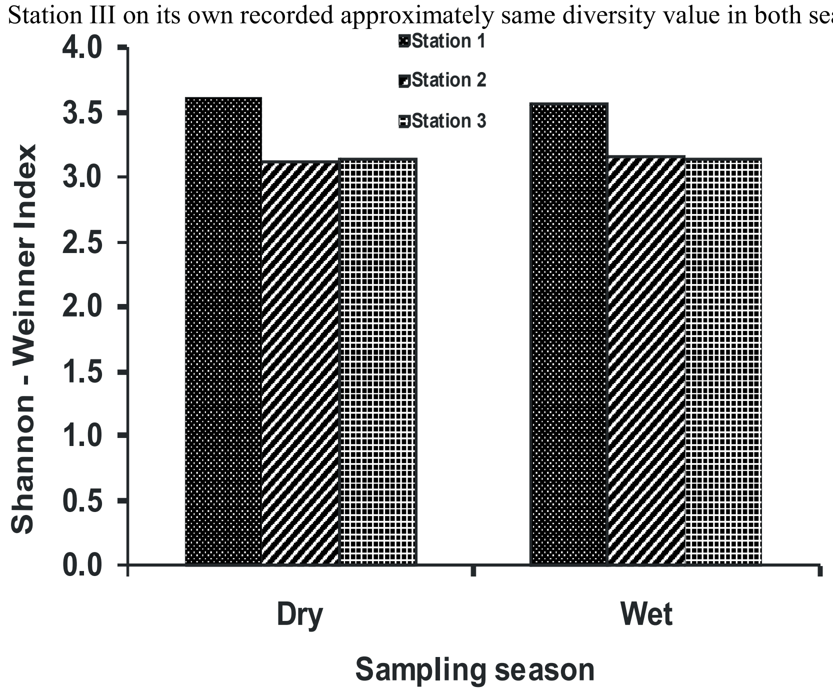

Fig. 3: Seasonal variation in Shannon-Wiener index of phytoplankton composition

Species Richness

Bacillariophyceae recorded a total of 20 species in Station I, 13 species in Station II and 12 species in Station III (Fig. 5). Dinophyceae had its highest number of species richness in Station I and recorded three species each in stations II and III. Station I also recorded the highest number of species in terms of chlorophyceae with 9 species while stations II and III had 8 species each. Cyanobacteria and Xanthophyceae recorded five and one species respectively in each of the stations. Bacillariophyceae, therefore, had the highest species richness in all the stations during the sampling period, recording 45 species making it a total of 44.12% of the species richness. Chlorophyceae concentration contributed to 24.51% of the total phytoplankton recorded with 25 species. Cyanobacteria followed with 15 species contributing to 14.71% of the species richness. Dinophyceae with 14 species, made up a total of 18.71% and Xanthophyceae with a total of 3 species contributed 2.94% of the total phytoplankton species richness observed.

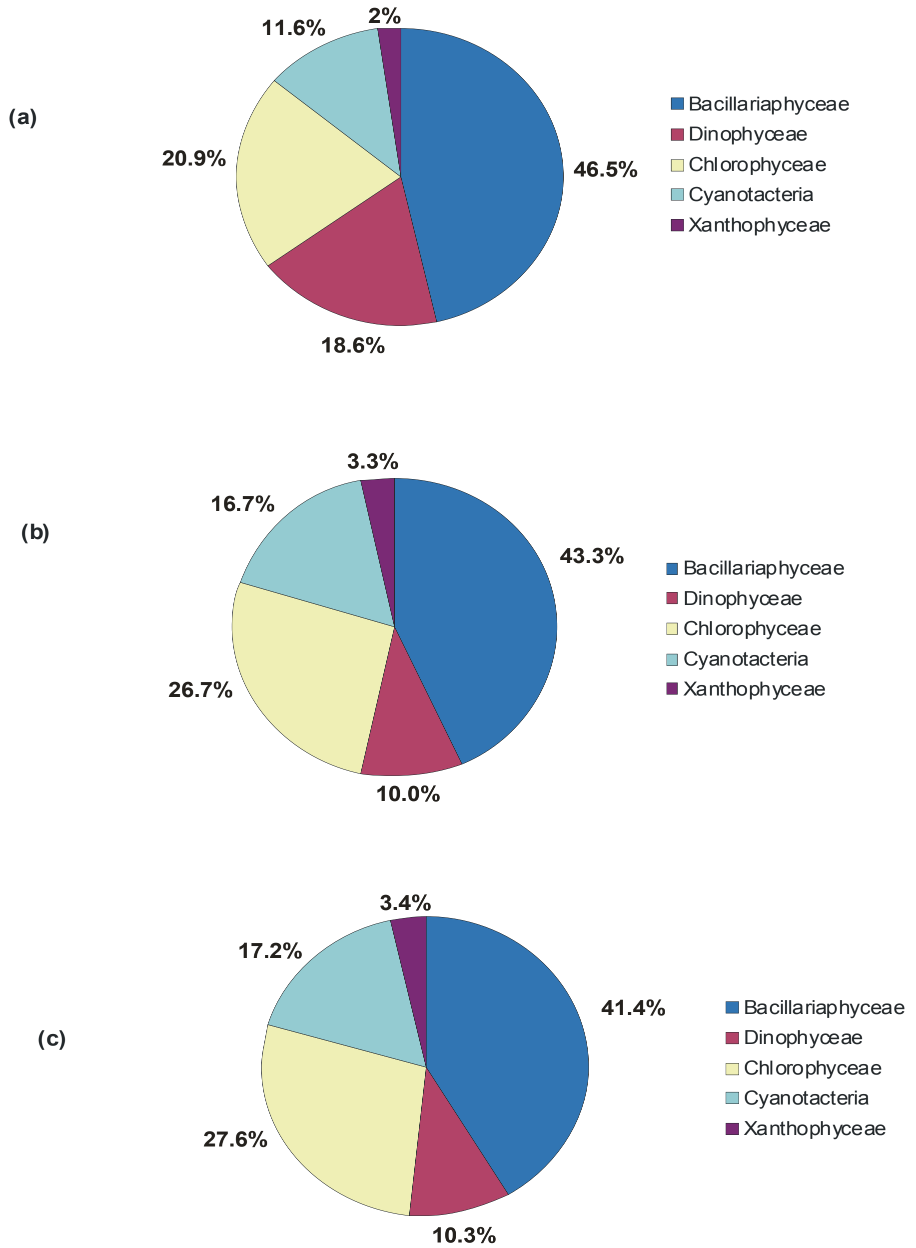

Fig. 4: Species Richness of Phytoplanktons in the three sampling stations in Mbo River (Station I=a, Station II=b Station III=c)

Spatially, Station I had the highest value of species richness making up 42.16% with 43 species (Fig. 5). Station II recorded 30 species making up 29.41% and Station III contributed to 28.43% of the sample with 29 species.
In this study, the 102 species recorded may be associated with the limited reach of the area covered in addition to the relative poor species richness of tropical coastal waters (Obire, 2004). Diatomic domination of the phytoplankton community has been reportedin other similar ecological areas (Chindah and Pudo, 1991; Erondu and Chindah, 1991 Chindah and Braide 2004). The dominance of the phytoplankton community by diatoms in the study sites confirms the statement that diatoms are predominant in natural lotic water bodies in the tropics (Chindah and Braide, 2004, Ibiebele *et al,* 1984). Increase in abundance of phytoplankton in the rains may be attributed to the mixing of the water during periods of heavy rainfall that would have resulted in recycling of nutrients and may have boosted the growth and subsequent abundance of algae more during the rains (Ugwumba and Ugwumba, 1993).
The increased phytoplankton diversity for this study was more than the values recorded for studies within the Niger Delta. This indicates that these phytoplankton support commercial fisheries that are noted as major economic value of this river. This might be attributed to the high nutrients values (phosphate, nitrate and sulphate) observed during the study. Mbo River as stated earlier, receives large quantities of raw human faeces from its surroundings. These wastes increase the nutrients status of this river. Phosphorous increases phytoplankton growth. The higher increase in species diversity in Station I during the dry season may be due to the stable conditions including increased transparency, flow characteristics and marine situation during this season that could have encouraged the development of a richer plankton community. Onyema, (2007) and Onyema *et al.,* 2003 reported similar observations for Lagos Lagoon. The generally high species diversity recorded in this study was impressive. This could mean that there is no excessive nutrient input, which normally causes decline in species diversity (Wetzel, 2001). It is a measure of availability of various ecological niches to be occupied by various species of organisms within an ecosystem (Yakubu, 2004).

Conclusion/Recommendation

The assessment of community and ecosystem stability using overall diversity showed Station I as the most complex and stable station. The overall diversity may be the product of all spatial and temporal changes affecting the community (Ogbeibu and Oribhabor, 2001). The structure of the phytoplankton community is a good method of assessing the quality and stability of an aquatic ecosystem at various scales. Therefore, more research should be encouraged in this seemingly simple but significant bioassessment method.

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