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The Relationship between Aquatic Macrophytes and Water Quality in New Calabar River Niger Delta Nigeria

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ABSTRACT

Survey of the macrophytes abundance in the New Calabar River in Rivers State, Nigeria was conducted to quantify the relationship between the aquatic macrophytes and the water quality. The studies were conducted between December, 2013 to May 2014.The correlation analysis indicated that pH and Chemical Oxygen Demand (COD) showed negative correlation to all the macrophytesLudwigiadecurrens and Diplasiumsammatti. Dissolved Oxygen (DO) and salinity showed positive correlation to all macrophytes except Cyperusdifformis and Ludwigiadecurrens, Aspilliaafricana.Temperarture showed positive correlation except Cyperus,difformisR.corymbosa,c.iria,T.latifolia and L.decurrens while Biological Oxygen Demand (BOD) was positively correlated to all macrophytes and significant at(P<0.1)

Keywords: *Macrophytes, water quality, aquatic environment, abundance, New Calabar River*

INTRODUCTION

The term "aquatic macrophyte" refers to large visible plants having at least their vegetative parts growing permanently or periodically in aquatic habitats/ environment. They are group of large macroscopic photosynthetic organism usually growing with their roots in soil or water (Jones *et al*. 2012).Macrophytes are important components of the aquatic ecosystem because they enhance the physical structure of habitats and biological complexity which increases biodiversity within the littoral zones (Esteves, 1998, Wetzel, 2001, Pelicice*et al*. 2008). In addition both live and dead materials (detritus) from aquatic macrophyte may serve as food resources for aquatic and terrestrial organisms (Lopes *et al*. 2007). The study of aquatic macrophyte is an essential component of understanding a water body due to its important ecological role and its ability to characterize the water quality (Gharzan*et al*. 2006). Aquatic macrophytes can be efficient indicators of water quality and their presence may enhance water quality due to their ability to absorb excess load of nutrients (Petre, 1990).

Macrophytes play a significant role in the hydro ecosystem by providing breeding substrate for organisms including fish, aquatic insects and zooplankton and many of them serve as food for fishes (Ratusshnyale, 2008). However in most rivers and lakes the excessive growth of macrophytes may provoke some negative effects (Bini*et al*., 2005) and it develops in to explosively large population only when the environment is altered among the least understood and least studied components of urban streams and rivers biota are aquatic macrophytes. This is rather unfortunate since changes in macrophytes communities may be especially indicative of major categories of urban stress. As such the health and structure of macrophytes communities are likely to be important determinants of water quality (Gregg and Rose, 1982; Suren 2000; Balanson*et al* 2005)

In order to improve water quality by integrated management practices a more profound understanding and quantification of the interactions between the macrophytes and the aquatic system is indispensable. This necessitates the study to be carried out. The study therefore focuses on the effects of aquatic macrophytes on the water quality of the New Calabar River.

Materials and Methods

Study Area

The study area is a section of the New Calabar River as shown in Figure1. The New Calabar River lies between longitude 006º53 53086'E and latitude 04º53' 19.020'N in Choba, Rivers State, Nigeria. The entire river course is situated between longitude 7º60'E and latitude 5º45'N in the coastal area of the Niger Delta and empties into the Atlantic Ocean. The New Calabar River region has an annual rainfall between 2000-3000mm (Abowei 2000). The New Calabar River is among the important water resources in the Niger Delta region of Southern Nigeria; it is in the vicinity of the rapidly expanding oil city of Port Harcourt in Rivers State, Southern Nigeria. Most communities within this area are directly dependent on the river for their agricultural, recreational, and sometimes, domestic water supplies.

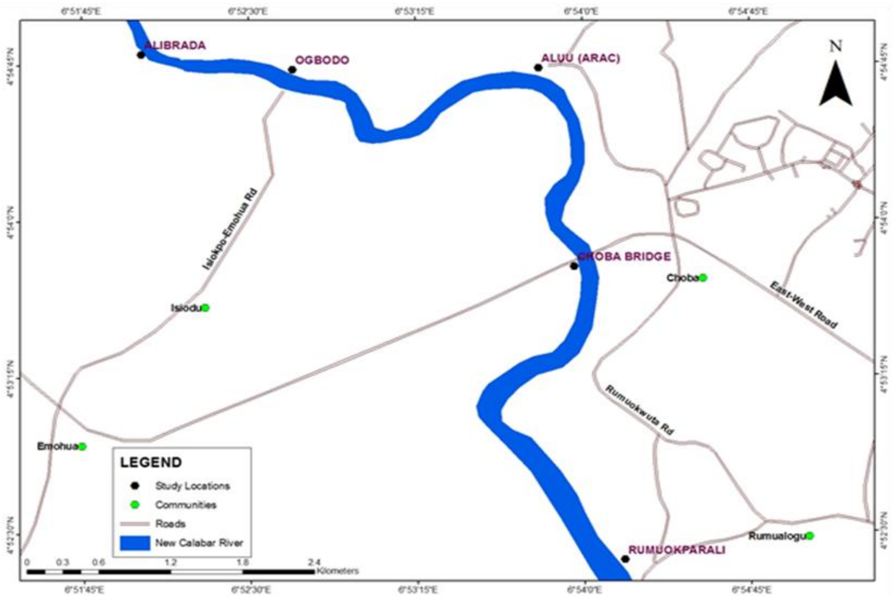

Figure1. *Map of the study area showing the different sampling Stations of the New Calabar River*

Sampling Procedure

A total of five different stations which includes: Rumuokparali, Choba bridge, Aluu (Arac Center), Ogbodo (Isiokpo), Elibrada (Emuoha) and were established.The sampling was done twice in a month from December 2013 to May 2014 which covers a period of six months (three months of dry season and three months of wet season).

Macrophytes Collection And Analysis

Aquatic Macrophytes found along the edge of the river were easily collected in Stations 1 to 5 while the ones in the middle of the river were collected with a boat using a 1m by 1m square quadrant. The samples were collected at a depth of 15cm. After collection, samples were washed then tagged for easy identification and further analysis following Akobundu and Agyakwa (1987).

Surface Water Collection for Pysico Chemical Parameters

At each of the Stations a set of water samples were collected in a pre-cleaned 50cl poly propylene container and transported to the laboratory for further analysis. The physico-chemical parameters that were analyzed are: pH, Temperature measured in °C, Salinity measured in mg/l, Chemical Oxygen Demand measured in mg/l, Biological Oxygen Demand measured in mg/l and Dissolved Oxygen measured in mg/l.

The Dissolved Oxygen (DO) in the water samples were determined by Winkler's method (APHA 1992), Biological Oxygen Demand and Chemical Oxygen Demand (COD) was determined using dilution method (APHA 1992), temperature and Hydrogen ion concentration (pH) was measured using a pH meter (Model HI 9812, Hannah Products, Portugal), Salinity was also determined by dilution method.

Statistical Analysis

Analysis of Variance (ANOVA) was done by computer software. It was used to ascertain significant variations of parameters within different sites of the New Calabar River. Pearson's Correlation coefficient (r) was used to identify the relationship between season and

Stations and physico-chemical parameters of the New Calabar River. Probability was set at ($P < 0.05$) and ($P<0.01$)

RESULTS

A total of 12 macrophytes species were recorded during the study. The mean values of macrophytes of the sampling stations of the New Calabar River shown in Table 1 indicated that *Diplaziumsammatti* had the highest mean value recorded in Station 3 69.00 and the lowest mean value of 25.82 in Station 5. *Ludwigiadecurrens* recorded the highest mean value of 44.22 in Station 1 and the least 13.00 in Station 3. *Eichhorniacrassipes* had a mean value of 53.01 in Station 1 alone. *Triumfettacordifolia* had the highest value of 15.00 in station 4 with the least value of 15.00 in Station 3.*Aspilliaafricanum* recorded the highest value 67.59 in Station 2 and Station 5 recorded the lowest value of 57.20. *Cyperusiria* specie recorded highest value 79.67 in Station 1 and lowest 19.00 in Station 5.*Aneilemabeniniense* had a value range of 68.33 in Station 1 and 47.00 in Station 3. *Rhynchosporacorymbosa* had 100.86 as the highest in Station 4 and 49.57 in Station 1 as the lowest. *Sacciolepsisafricana* recorded the highest in Station 1 with value of 79.00 and Station 5 recorded the lowest value 24.00. *Nymhea lotus* had values of 53.89 in Station 2 as the highest and 17.50 in Station 5 as the lowest. *Cyperusdifformis* had the highest mean value of 90.883 for Station 2 and lowest for Station 4 43.47.The mean values for the season in the macrophytes of the New Calabar Rivers as shown in Table 3 revealed that across the two seasons both dry and wet, all species increased from dry season to wet season.

The Pearson correlation between the macrophytes and the physico-chemical parameters of the study area which indicates that pH shows a negative correlation to all the macrophytes except L.decurrens. Temperature shows a positive correlation to C.difformis, Rhynchosporacorymbosa, Cyperusiria, Triumfettacordifolia and Ludwigiadecurrens while the other macrophytes were negatively correlated. Dissolve oxygen showed a negative correlation to C.difformis and but correlated positively to all other macrophytes. Salinity also was positively correlated to all the macrophytes except Ludwigiadecurrens and As pilliaafricana which had a negative correlation. The chemical oxygen demand (COD) was negatively correlated to all the macrophytes except *D.sammatti* while Biological oxygen demand (BOD) was also positively correlated to all the macrophytes.

DISCUSSION

The interplay between macrophytes and water quality variables represent a fundamental characteristic of river systems, which has important for river flow and ecological functioning (Xiao *et al*, 2010).Although the growth and spread of macrophytes in aquatic environment is a natural phenomenon, in recent years,there has been increasing concern about aquatic macrophyte and the water quality as a result of human activities ,such as agriculture, forestry operations, construction activities and urbanization programs (Collins and Walling,2007, Wang et al,2009)The relationship revealed that as pH reduces during wet season the level of macrophytes abundance increases, also dissolved oxygen Showed a positive correlation to all the macrophytes except C.difformis. This agrees with Uedeme-Naa, *et al* (2011) .Dissolved oxygen decreases across the season macrophyte abundance increases. Salinity increases across the season, therefore the macrophytes abundance in the river was slightly in a way influence by salinity. This is not in total agreement with observation of Okayi and Abe (2001) who stated that macrophytes distribution and abundance in some reservoir in Makurdi Nigeria is not in any way influenced by salinity.As temperature increases fewer species increases and are abundant while the decrease, declined macrophytes abundance in the study area. Chemical oxygen demand shows a negative correlation with all the macrophytes while Biological oxygen shows a positive correlation with all the macrophyte, this implies that as BOD increases as a result of dead organic matters in the river supports the growth of macrophytes, therefore pH, Dissolved oxygen and Chemical oxygen demand affects and influence the distribution and abundance of macrophytes in the New Calabar River.

CONCLUSION

The changes in the macrophytes in relation to the physico chemical parameters of the New Calabar River due to the industrial and human activities are very common. cause of these changes is important for appropriate management decisions and when macrophytes of the river is properly checked helps as substrate ground, feeds and habitat for aquatic animals, therefore there is need to monitor the water quality and growth of the river at regular intervals. The pysico-chemical parameters of the river were found to be related to aquatic macrophytes either positively or negatively.

Table1. *Mean value for macrophytes in the different Stations*

SPECIES	**1**	**2**	**3**	**4**	**5**	**SEM**
Cyperusdifformis	48.40^{b}	90.83^{a}	63.00^{ab}	43.47^{b}	73.93^{ab}	5.332
Nymphea lotus	50.50	58.89			17.50	4.06
Sacciolepsisafricana	79.00	65.38	56.25		24.00	5.633
Rhynchosporacorymbosa	49.57^{b}	76.00^{ab}	71.89^{ab}	100.85^{a}	66.61^{b}	4.693
Aneilemabeniniense	68.33	49.59	47.00	65.67	53.00	4.482
Cyperusiria	79.67^{a}	67.22^{a}	55.94^{a}	73.88a	19.00^{b}	4.442
Platostomaafricanum		67.59			57.20	5.529
Aspilliaafricana	50.29	61.75	22.22	19.00	59.20	5.529
Triumfettacordifolia		36.31	15.00	37.09	31.67	3.576
Eichhorniacrassipes	53.10					
Ludwigiadecurrens	44.21	32.14	13.00		24.83	3.668
Diplaziumsammatti	33.83		69.00	34.40	25.82	4.316

*N.B: *Superscripts of the same alphabet are not significantly different (P<0.05)*

***Superscripts of different alphabets are significantly different (P<0.05)*

Table2. *Mean values for macrophytes comparing Season*

	SEASON		
Species	**Dry**	**Wet**	**SEM**
Cyperus difformis	37.48	99.45	5.33
Nymphea lotus	40.30	57.43	4.06
Sacciolepsisafricana	28.44	90.55	5.63
Rhynchosporacorymbosa	41.81	96.97	4.69
Aneilemabeniniense	30.50	67.15	4.48
Cyperusiria	39.08	87.65	4.44
Platostomaafricanum	42.62	83.36	5.53
Aspilliaafricana	26.75	72.79	5.24
Triumfettacordifolia	23.82	49.57	3.58
Eichhorniacrassipes	37.22	85.88	6.78
Ludwigia decurrens	26.33	49.55	3.67
Diplazium sammatti	23.79	45.17	2.97

Table3. *Correlation matrix of water parameters and macrophytes between month and Station*

Month Loc pH Temp. DO Sal COD BOD
C.difformisN.lotusS.africanaR.corymbosaA.benienseC.iriaP.africanumA.africanaT.coedifoliaE.crassipesL.decurrensD.sammatti

Month	.878**	1						
Location	.000	.000	1					
Ph	-.712**	-.772**	.351**	1				
Temperature	-.331**	-.330**	-.205	.282**	1			
DO	.232*	.360**	-.758**	-.443**	.223*	1		
Salinity	.486**	.424**	-.660**	-.673**	-.209*	.644**	1	
COD	-.076	-.203	-.584**	-.170	.576**	.425**	.350**	1

BOD		.390**	.451**	-.611**	-.483**	.039	.770**	.664**	.303**	1		
C.difformis		.732**	.685**	.198	-.567**	-.433**	-.110	.101	-.332**	.000	1	
N.lotus		.433*	.482*	-.180	-.419*	-.447*	.023	.740**	-.254	.430*	.634**	1
S.africana	.878**	.796**	.164	-.614**	-.146	.282	.386*	-.255	.601**	.844**	.785**	1
R.corymbosa		.734**	.781**	-.351**	-.782**	-.381**	.474**	.511**	-.133	.579**	.793**	
	.643**	.834**	1									
A.beniniense		.716**	.848**	-.056	-.565**	-.080	.413*	.217	-.167	.571**	.488**	
	.751**	.676**	.749**	1								
C.iria		.780**	.762**	-.060	-.758**	-.641**	.281*	.523**	-.085	.439**	.546**	
	.749**	.703**	.877**	.733**	1							
P.africanum		.722**	.783**	-.178	-.794**	-.334	.341	.820**	-.195	.552**	.838**	
	.675**	.802**	.796**	.766**	.905**	1						
A.africana	.713**	.612**	.283	-.499**	-.309	.019	-.031	-.175	.414**	.825**	.684**	
	.747**	.704**	.593*	.789**	.823**							
T.coedifolia		.654**	.623**	-.042	-.532**	-.513**	.104	.425*	-.070	.202	.557**	.559*
	.645**	.576**	.586*	.608**	.744**	.602**	1					
E.crassipes		.896**	.871**	.a	-.838**	-.111	.612**	.789**	-.226	.500*	.637	.969
	.364	.934**	.845	-.034	.a	.795*	.a					
L.decurrens		.580**	.584**	.423*	-.114	.050	.351	-.049	-.058	.137	.388	.074
	.422	.184	.400	.220	.462	.386	.833*	.528	1			
D.sammatti		.570**	.647**	-.248	-.602**	-.081	.248	.516**	.120	.330*	.334	.969
	.527	.431*	-.445	.287	.481	-.147	.375	.198	.687	1		

*N.B: ** Significant at 0.01 alpha level (2- tailed), * Significant at 0.05 alpha level (2- tailed), 'a' cannot be computed because at least one of the variables is constant.*

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