COMPOSITION OF PHYTOPLANKTON COMMUNITIES IN IKPUKULU-AMA CREEK, NIGER DELTA

[*]Okoseimiema I. J, Vincent-Akpu I. F,Onyeagbodor P. and Oriakpono E.O.
Department of Animal and Environmental Biology, University of Port Harcourt, Nigeria

Abstract
The study was conducted to evaluate the phytoplankton structure, abundance, distribution and diversity in three sampling stations from Ikpukulu-ama creek, an important fishing creek in Niger Delta. Standard methods were deployed in the collection and analysis of phytoplankton; Identification was done using relevant literatures and enumerationof cell as cells/ml. A total of 987 phytoplankton individuals belonging to 5 families, 28 genera and 34 species were recorded. Spatially, 27.96% of organisms were observed at Station 1, 14.99% observed at Station 2 and 57.04% at Station 3. Percentage composition of the phytoplankton was 93.38% of *Bacillariophycaea*, 3.51% of *Rhodophycaea* and 2.66 % of *Cyanophycaea*. Species richness and diversity was evenly distributed across the stations in the following order station3<station1<station 2 and was more dominated in Station 3. Species dominance and evenness were less than 1 indicating that the composition of the creek is low which might be attributed to the anthropogenic activities within the area.

Keywords: Diversity, phytoplankton, abundance, dominance

1. Introduction

The imbalance in the population of planktons due natural or man-made phenomenon could cause damage to the dependent fishery resources.Whatever factor influencing plankton production directly affects the plankton feeders e.g. commercial fishes (Robin, 2009). The health of the coastal environment is dependent on the plankton colony (Jayasiri and Priyadarshani, 2007).

In the marine and estuarine habitats, the main food producers arethe phytoplanktons,while zooplanktons are secondary producersthat feedon non-living organic matter, bacteria and phytoplankton (Ayodele and Adeniyi, 2005).

Phytoplanktonperforms a significant ecological role in aquatic ecosystem and has been used as indicators of water qualityREFERENCE,this is possible because some species flourish in highly organic and/or chemical wastes while others are very sensitive. Thus the composition of phytoplankton may be useful in assessing water quality.

Since Zoo- and phytoplankton are the main food sources for marine and brackish mammals, fishes and birds (Percy, 1993,Nilssen*et al.,* 1995), their abundance will indirectlydetermine the food source in the water

ndthey have the ability of extracting bio-concentrated heavy metals in the cellular tissues. Hence, plankton (Phytoplankton and Zooplankton) may possibly add to the transfer of metals to high trophic levels and is sometimes recommended for baseline studies in marine ecosystem (AMAP, 1995). Marine zooplankton makes up a main constituent of the total biomass in the marine environment, and as such plays a major role in the biogeochemical cycle of heavy metals in the sea (Schulz-Bald, 1992), especially particle- reactive metal in the water column (Fisher *et al.*, 1991; Lee and Fisher, 1994; Stewart *et al.*, 2005). The diversity of a community depends on the species richness and species evenness.

Despite the important role played by phytoplantons, information on the diversity of phytoplankton species of Ikpukulu-ama creek has not been documented before this investigation. Thus, the aim of this study is to assess the phytoplankton community structure of Ikpukulu-ama Creek and to give baseline ecological information on the phytoplankton status.

2. Materials and method

Study Area

The Ikpukulu-ama creek is a tidal creek in the Niger Delta regionwhichis a tributary of the Bonny River that flows into the Atlantic Ocean.It is an important fishing creek for thefishing settlement at Borikiri in Port Harcourt City Local Government Area of Rivers State, nigeria. Its salinities varies from 5 ppt to 35ppt. Despite the creeks' important to the fishing communities, some factories such as NLNG Dock, Almarine base, Federal Fishing Terminal, Dredging Company and John Holt. are located within this area.These companies are involved in oil and gas production and servicing, marine technology, and transportation and other anthropogenic activities.

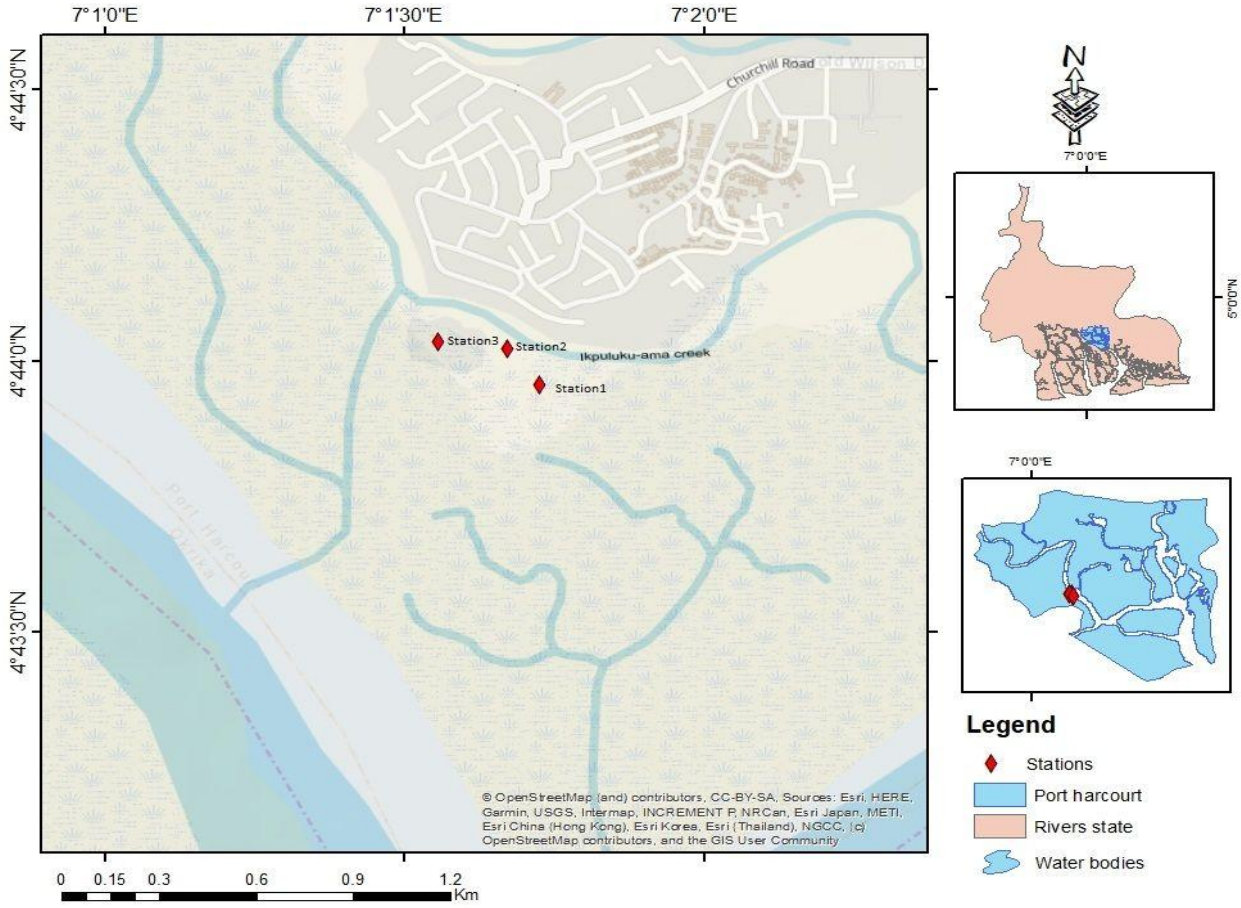

Fig. 1.0Map of the study Area

Three sampling stations were located along the creek. The vegetation of Ikpukulu-ama creek are sparse, full of dead roots of mangrove trees (*Rhizophoraracemosa*, *Avenniciaafricana*) with few pockets of Nipa palms (*Nypafruticans*) trees found in some stations.

Collection of Plankton Samples

Phytoplankton samples were collected with the help of a plankton net (mesh size: 20 μm) through vertical hauls from the upper layer of 10 cm. Filtered plankton samples were kept in sampling bottles and immediately fixed with 10% formalin..

In the laboratory, Samples for the extraction of plankton comprised of a uniform volume of 100ml using distilled water. Following a thorough agitation and homogenization, 1 ml sub-samples were taken using a Stempel Pipette and transferred to a graded 1 ml counting chamber for observation under a binocular microscope with magnification of 40x. The organisms were simultaneously identified using the specialized literature for each taxonomic group (key) and enumerated.

Statistical Analysis

i) **Diversity were determine usingii) Shannon-weiner diversity index (H); while the richness and evenness were calculated usingmargalefspecies richness index(d);**and iii) Evenness index (E) respectively. The equations are as follows:Margalef species richness index(d);

$$d = \frac{S-1}{\ln(N)}$$

(Margalef) where,

S = Total number of species

N = Total number of individuals

In = The natural or Naperian logarithm (log)

ii) Shannon-weiner diversity index (H);

$$H=\frac{N log N - \sum_{i=1}^{S} fi log fi}{N}$$

(Shannon-weiner) Where,

H = Species diversity

fi = No. of individuals of the ith species

N = Total no. of the individuals in the collection and

Σ = Sum

iii) Evenness index (E)

$$E=\frac{H}{Hmax} = \frac{H}{\log S}$$

(Evenness index)

Where, S = Total number of species

H = Species diversity

iv) Simpson's dominance index (C)

$$C=\Sigma(\frac{ni}{N})^2$$

3. Results

PHYTOPLANKTON IN THE CREEK

The phytoplankton recorded during the study are presented in Table 1. A total of Two-hundred and seventy-six (276) cells/ml for station 1, One hundred and forty-eight (148) cells/ml for station 2 and Five hundred and sixty-three (563) cells/ml for station 3 belonging to three (3) families were recorded in Ikpukulu-ama creek. The family *Bacillariophyceae*was represented by 252 cells/ml for station 1, 130 cells/ml for station 2, 452 cells/ml for station 3. This was followed *Cyanophyceae* consisting of 25 cells/ml for station 1 and no individual for station 2 and 3, while *Rhodophyceae*consists of 10 cells/ml for station 1, 8 cells/ml for station 2 and 15 for station 3. Unidentified taxa had 14 cells/ml in station 1, 10 cells/ml in station 2 and 23 cells/ml for station 3. Shannon-weiner diversity and Margalef decreased according to the following pattern:Station 3 > Station 1 > Station 2. Evenness across the stations decreased from Station 3.>.Station 2 > Station1. Simpson's dominance of the species across the stations showed Station 3> Station 1 > Station 2respectively.Percentage composition revealed Bacilliophyceae had 89%, Cyanophyceae and Rhodophyceae- 3% while the unidentified had 5% as seen in Fig.2.0.

TABLE 1. PHYTOPLANKTON SPECIES OF IKPUKULU-AMA CREEK

TAXANOMIC GROUPS	STATION 1 cells/ml	STATION 2 cells/ml	STATION 3 cells/ml
Bacillariophyceae			
Climacospheniamoniligera	*	*	8
Coscinodiscusmorphotype	5	3	15
Coscinodiscus spp.	8	2	13
Cosmoneis sp.	2	5	13
Cycotellaspp	23	10	25
Craticula sp.	5	3	18
Diatoma sp.	6	5	15
Diploneisvagabuda	3	*	12
Entomoneis sp.	5	4	20
Grammatophora marina	6	2	15
Gyrosigmaballicum	4	*	8
Gyrosigmabutylium	10	5	13
Gyrosigma spp.	9	8	24
Licmophora sp.	*	*	10
Mastogoliaexilis	8	5	15
Mastogoliaparadoxa	3	2	14
Navicula spp.	19	12	28
Nitzchiaspectabilis	10	8	15
Nitzchianitzcloidea	12	9	18
Oestrupiazanardiniana	13	5	25
Phaeodactylumtricornutum	*	*	3
Placoneis sp.	2	*	5
Cosmoneis sp.	3	1	8
Pleurosigma spp.	15	5	10
Pseudonitzchia spp.	18	7	45
Rhabdonemapunctatum	15	5	25

Rhizosolenia spp.	*	*	10
Skeletonema sp.	15	8	12
Synedra spp.	18	11	28
Surirellafastuosa	12	5	25
Trigoniumarcticum	3	*	5
Cynanophycaea			
Lyngbyaagardh	*	*	25
Rhodophycaea			
Prorocentrium sp.	10	8	15
Unidentified	14	10	23
Total Number of Individuals	**276**	**148**	**563**
Shannon index	**3.18**	**3.09**	**3.40**
Pielou index of evenness	**0.83**	**0.87**	**0.88**
Margalef	**4.98**	**4.80**	**5.21**
Simpson's dominance	**0.953**	**0.949**	**0.963**

Key * means absence of an organism

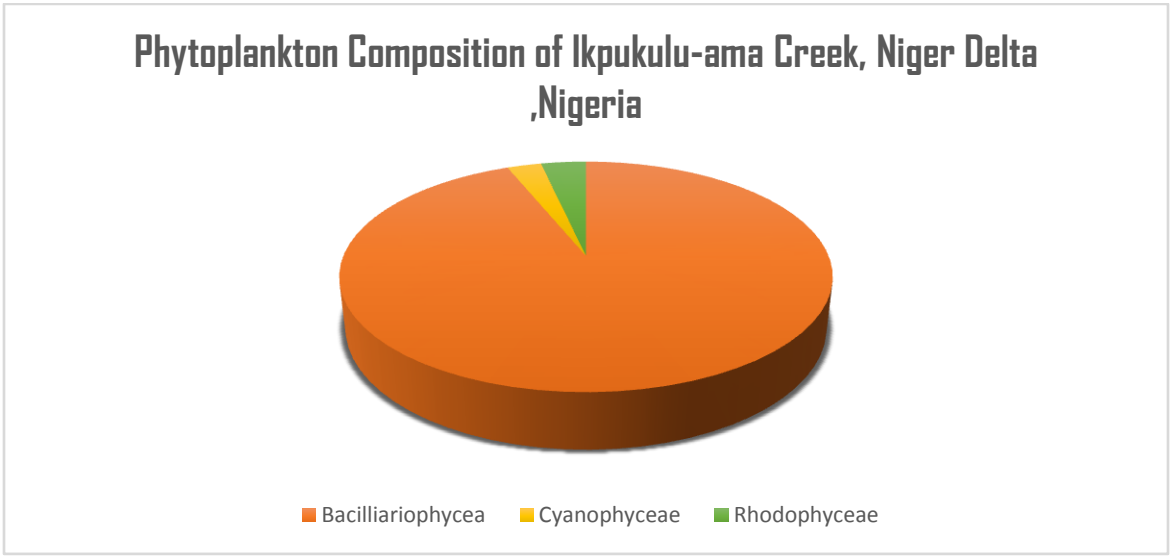

Fig. 2.0 Percentage composition of phytoplankton in Ikpukulu-ama creek

4. Discussion

PHYTOPLANKTON SPECIES

A total of 987phytoplankton individuals belonging to 5 families, 28 Genera and 34 species were recorded;with 27.96%of the organisms observed at Station 1, 14.99%(Station 2) and 57.04%(Station 3). Percentage composition of the phytoplankton showed *Bacilliariophyceae* 93.38%, followed by *Rhodophyceae*3.51% and *Cyanophyceae* 2.66%. In terms of phytoplankton species identified, it is observed that the *Bacilliarophyceae* were predominant in the Ikpukulu-Amacreek with27 species in 20 genera. This conforms to most reports from some Niger Delta rivers. Yakubu*et al*., (2000) recorded 17 species from River Nun. Yakubu*et al*., (2000) also observed 20 and 34 species from Orashi and Nkisa Rivers respectively, while Erondu and Chinda (1991) reported 27 species from New Calabar River. Ogamba*et al*., (2004) recorded 143 species in Elechi creek. Davies *et al*., (2009) also reported 169 species in Elechi Creek and Emmanuel and Onyema (2007) also recorded 82 species in Lagos Lagoon. Similarly, Ekeh and Skikoki (2004), Ekwu and Sikoki (2006), observed the predominance of Bacilliarophyceae in the Cross river estuary. Furthermore, Edogbolu and Aleleye-Wokoma (2007) recorded 198 species from Ntawogba Creek, Port Harcourt.

The population of phytoplankton is influenced by water temperature, velocity of current, availability of nutrient and light penetration into the water. The dominance of *Bacillariophyceae*in this study is a usual occurrence. Many phytoplankton studies have recorded the dominance of *Bacillariophyceae*in rivers and creeks of the Niger Delta and Nigeria. Such reports include Yakubu*et al*., (2000), Ogamba*et al*., (2004), Emmanuel and Onyema (2007), Aboweie*t al*., (2008), Zabbey*et al*., (2008), Davies *et al*. (2009), Nkwoji*et al*., (2010) and Margalef (1963) had reported that species that have the highest self-sustaining natural mechanisms of natural increase usually becomes dominant. *Pseudonitzchia, Gyrosigma, Cyclotella*and *Navicula*species were the most predominant across the stations. This can be attributed to stirring of the water column by the fast moving currents, (Onuoha, 2006).

Species composition changes significantly over time at a particular spatial location in response to temporal variation in local nutrient concentrations and herbivore levels (Hillebrand, 2002). The species richness and diversity showed that the phytoplankton were evenly distributed across all stations- Station 3< Station 1< Station 2, with Simpson's dominance value becoming highest at

Station 3.High species diversity values usually indicate diverse and well-balanced communities, while low values indicate stress or impact (Bode et al.,2002). The poor abundance and diversity of the phytoplankton in Station 2 may also be attributed to the regular discharge of industrial effluent into the creeks which is capable of deteriorating the water quality. This corresponds with the findings of Anaero-Nweke (2013) who stated that phytoplankton distribution and abundance among the sampling stations in Ekerekana area were very poor with a total of 40 taxa represented by three families. Low evenness values suggest low habitat quality across stations. Station 2 on the Ikpukulu-ama creek appears to be most impacted with reduced diversity indices which could be due to impact of effluent discharge into the creek. These findings also agree with Mbaneme (2013) that various pollutants released into the Okrika creek affected the littoral zone, the shallow waters along the shore where rooted vegetation grow, and the limnetic zone, the open water that sunlight penetrates where phytoplankton (algae) live. The high tidal velocity in waters and rapid flushing time in relatively open waters can also suppress the accumulation of phytoplankton biomass (Lee ., 2006).

Generally, Dominance Index (C) and Evenness Index (E) were low (less than 1) for the phytoplankton species of the creek. Therefore, with regards to the species diversity, the phytoplankton composition of Ikpukulu-Ama creek can be termed low. This can be as a result of climate change effects and incessant oil bunkering activities within the area. The study therefore suggest adequate bio-monitoring of the creek because of its peculiarity and significance generally in the lifecycle of many aquatic organisms.

REFERENCES

AMAP (1995). Guidelines for the AMAP: Assessment Arctic monitoring and assessment program. Oslo, report 95: 1

Anaero-Nweke, G. N. (2013).Impact of oil refinery effluent on the water quality: case study of Ekerekana creek in Nigeria. A Thesis Submitted to the Department of EnvironmentalScience of theKwame Nkrumah University of Science andTechnology,Ghana.

Ayodele H.A and Adeniyi I.F (2005). The zooplankton fauna of six impoundments of River Osun, southwest Nigeria. Zoologist; 4: 49-67.

Bode, R.W., M.A. Novete, L.E. Abele, D.L. Heitzman and A.J. Smith: Quality assurance work plan for biological stream monitoring in New York State, Department of environmental Conservation, Albany, New York (2002).

Davies, O.A., J.F.N. Abowei and C.C. Tawari, (2009). Phytoplankton community of Elechi Creek, Niger Delta, Nigeria - A nutrient polluted tropical creek. *American Journal of Applied Sciences*. 6(6): 1143-1152.

Edogbolu, A.J. and I.P. Aleleye-Wokoma, (2007). Seasonal Variations in Phytoplankton Composition and Physicochemical Properties of Ntawoba Creek, Port Harcourt, Nigeria.*International Journal of Natural and AppliedSciences*. 3(3): 344-348

Ekeh, I.B and Sikoki, F.D (2004). Diversity and Spatial Distribution of Phytoplankton in New Calabar River, Nigeria. *Liv. Sys. Sus. Dev.* 1(3): 25-31.

Ekwu, A.O and Sikoki, F.D (2006). Phytoplankton Diversity in the Cross River Estuary of Nigeria *J. Appl. Sci. Environ. Mgt.* 10 (1) 89. – 95

Emmanuel, B.E. and I.C. Onyema, (2007). The plankton and fishes of a tropical creek in South Western Nigeria. *Turkish Journal of Fisheries and Aquatic Science,* 7: 105-113.

Erondu, E.S. and A.C. Chinda, (1991). Variations in the physicochemical features and phytoplankton of new Calabar River at Aluu, Rivers State, Nigeria. Nigerian Institute of Oceanography and Marine Research, Technical Paper No. 75: 3-18.

Fisher, N.S., Nolan, C.V., and Fowler, S.W., (1991). Assimilation of metals in marine copepods and its biogeochemical implications. Marine Ecology Progressive Series.71, 37-43.

Jayasiri H.B and W.N. C Priyadarshani (2007). Hydrobiological aspects of Palk Bay and Palk Strait area PART (II): Diversity and abundance of marine plankton and benthos at selected locations in the Gulf of Mannar and Palk Bay, SriLanka. *Journal of Natural and Aquatic Resource Research Development Agency*. 38: 45-59.

Lee B.G. and Fisher N.S. (1994). Effects of sinking zooplankton grazing on the release of elements from planktonic debris, *Marine Ecology Progress Series*. 110, 271.

Lee, J.H.W., Harrison, P.,J., Kuang, C.P. and Yin, K.D. (2006). Eutrophication dynamics in Hong Kong coastal waters: physical and biological interactions. In:Wolanski, E. (Ed.).The environment inAsian Pacific Harbors.Netherlands, Springer, pp, 187-206.

Mbaneme, F.C.N., OkolI, C.G. and Ekweghi, C. (2013).The impact of refinery effluent in the physiochemical regime of Ekerekana creek in Okirika mainland, Rivers state,Nigeria. *American Journal of Environment, Energy and PowerResearch* 1(10): 255-271.

Nilssen, K.T.; Hug, T.; Petelov, V.; Stasenkov, V.A. and Timoshenko, Y.K. (1995).Food habits of harp seals (*Phocagroemlanlamdica*) during location and moltin March- May in the southern Barents Sea and White sea. *ICES Journal of Marine Sciences*. 52: 33- 41

Ogamba, E.N., A.C. Chinda, I.K.E Ekweozor and J.N. Onwuteaka, (2004). Water quality and phytoplankton distribution in Elechi Creek Complex of the Niger Delta. *Journal of Nigerian Environmental Society*, 1(2): 121-130.

Percy, J.A. (1993). Reproduction and growth of the Arctic hyperiid amphipod .*Themistolibellula*. Mandt. Polar Biology 13: 131 -139

Robin.R. S (2009); Distribution of zooplankton from Arabian Sea, along southern Kerala. *Current research Journal of Biological Sciences*, 1 (3); 155-159.

Schulz-Bald, M. (1992). Baseline study on Cd, Cu, and Pb concentration in Atlantic concentration in Atlantic Neuston organism. *Marine Biology*, 112; 211 –222

Stewart, G.M., Fowler, S.W, Teyssie J.I., Cotret O., Cochran, J.K., and Fisher, N.S., (2005). Contrasting transfer of polonium-210 and lead-210 across three trophic levels in marine plankton. *Marine Ecology Progress Series*.290.27-33.

Yakubu, A.F., F.D. Sikoki, J.F.N. Abowei and S.A. Hart, (2000). A comparative study of phytoplankton communities of some Rivers, Creeks and burrow pits in the Niger Delta. Area. *Journal of Applied Science and Environmental Management* 4(2): 41-46.