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Post Flood Impact on the Diversity, Abundance and Distribution of Phytoplankton in River-Nun, at Amassoma, Niger Delta, Nigeria

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Abstract

Global warming and Climate change have resulted in perennial floods in the Niger Delta. As floods recede, they do so with land-based pollutants which affect aquatic biota. Phytoplanktons are greatly affected by pollutants resulting in the reduction and distortion of their diversity, distribution and abundance. Hence this study was undertaken to gauge the damage of flooding on phytoplankton and the ecosystem. Four (4) sampling were identified and phytoplankton samples collected in triplicates using plastic containers and fixed with 4% formalin. Identification of samples were done in the Laboratory of the Niger Delta University using standard identification keys. Result showed the presence of twenty seven (27) species of phytoplankton which are *Coscinodiscus stellaris, Synedra sp., Melorisn sp., Pseudo-nitzrchia pungers, Thalassion erna nitzsthioides, Tabellaria sp., Tabellaria fenestrata, Epithemia sp., Pseudo-nitzrchiea australis,* and *Melorisa undulata Microcystis aeruginosa, Calochrix sp. Draparnaldia sp., Closteriopsis longissima, Cladophora crispate, Mougeotia sp., Closterium juncidum, Microspora sp., Closterium gracile, Cladophora glomorata, Zygnema sp., Trachelomonas sp., Trachelomonas tamboweica, Euglena sp., Lamanea sp. Tribonema sp., Vanchoria sp.* from six divisions (Cyanophyta, Bacillariophyta, Chlorophyta. Euglenophyta, Rhodophyta, and Xanthophyta.). Data analysis reveal that Shannon diversity index was highest in Station 3 (2.34) followed by Station 1 (2.16), and Station 4 (2.04) and lastly Station 2 (0.64). Simpson's Index was lowest in Station 3 (0.07), followed by Stations 2 (0.54), Stations 1 (0.12) and lastly Station 4 (0.16). There were major changes and variations occurring in phytoplankton communities in the different stations. This indicate that flooding has a marked negative influence on phytoplankton dynamics as all the measured parameters show spatial variations.

Keywords: Flood, Phytoplankton, Abundance, Diversity, Distribution, River-Nun, Amassoma

1. Introduction

Phytoplankton play a very important role in nature as their importance to man and every other life form on the planet is unparalleled. Some of their roles and importance can be seen in; marine ecosystems, their effect on global temperature, oxygen production and as indicators of environmental change. The duties carried out by phytoplankton in the aquatic ecosystem are similar to those carried out by green plants in the sustenance of land animals. They make themselves into a source of food for everyone else.

However, phytoplankton numbers are changing as reported in several literature (Boyce *et al*, 2010; Schiermeier, 2010; Mackas, 2011; McQuatters-Gollop *et al*, 2011; Boyce *et al*, 2014) [2, 9, 6, 3]. These changes may be in response to the change in climate due to anthropogenic activities of pollution and contamination of aquatic bodies. Phytoplankton concentrations in surface waters were estimated to have decreased by about 40% since 1950, at a rate of around 1% per year, possibly in response to ocean warming (Boyce *et al*, 2010; Schiermeier, 2010) [2, 9].

In Nigeria, the recent perennial flooding of our towns and cities have further compounded the problem as receding waters carry toxins from land thus polluting the rivers and resulting in more phytoplankton deficit and modifying the ecosystem. Pollution of the River Nun is very evident in the Amassoma axis where the study is carried out\ following the recent floods that inundated the entire town. Therefore, this post flood impact study is conducted to gauge the effect on phytoplankton and by implication the to assess the ecosystem stability.

2. Materials and Methods

2.1 Study Area

The study area is River Nun, along Amassoma axis which receives its source of water from the River Niger. The area of

study lies between longitude 6º 6' 56.35" E to 6º 6' 49.05". E and latitude 4º 58' 11.4" N to 4º 58' 11.15" N in Amassoma community in Southern-Ijaw Local Government Area of Bayelsa State, Nigeria.

2.2 Sample Stations

Four (4) sampling stations were selected for the purposes of this study based on the peculiarities of the land-based activities adjacent to the River. The description and coordinates of the stations are provided in the table below:

Table 1: Description of Sample Stations (River-nun Amassoma Axises)

Station	Location	Activity	Coordinate	Altitude (m)
1	Ebenikiri waterside	Boats & Dredgers	$4^0$58'11.4"N & $6^0$6'56.35E	2
2	Ogboebiama waterside	Cassava Processing	$4^0$58'35"N & $06^0$6'52.2 E	2
3	Ogbopina waterside	Fishing and Dredging	$4^0$58'11.22"N & $6^0$6'51.07" E	3
4	Goin-Ama waterside	Fishing & Farming	$4^0$58'11.15"N & $6^0$6'49.05" E	3

2.3 Phytoplankton Sample Collection

Phytoplankton samples were collected in each sampling stations using labeled one litre wide mouthed plastic containers dipped about 6cm into the water. The collected samples were immediately fixed with 4% formalin and stored in a cool box before being transported to the laboratory for analysis. In the laboratory, sample were allowed to stand for a day before the supernatant was carefully pipette off until a 50ml concentrated sample was achieved.

2.4 Counting and Analysis

Plankton samples were allowed to settle by gravity for 24 hours before decanting carefully the supernatant to achieve 50 ml volume. From the stock sample, 1 ml sub-sample was taken with the help of a Pasteur pipette and transferred into a Sedgwick Rafter counting chamber. It was allowed to settle for approximately 2-15minutes to allow the plankton to settle into a single layer to make counting easier. A DC-2 camera with USB cord was attached to a computer and the camera to the eye piece of light microscope. After that, the screen of the microscope was maximized and exposure adjusted. Identification guides of Edmonson (1959) [4], Pennak (1978) [7], Botes (2003) [1] and Phyllis *et al.*, (1970) [8] were used for phytoplankton identification.

2.5 Statistical Analysis (Data Analysis)

Data were analyzed for diversity indices such as Shinon-weiner, Simpson's index & evenness. Analysis of variance (ANOVA) was employed to determine degree of variability or relatedness of the various classes of phytoplankton across the study stations. SPPSS ® software was used in the analysis.

3. Result

3.1 Phytoplankton

The result of the phytoplankton identification and enumeration are captured in Tables 2 and 3 below.

Table 2: Check list of Phytoplankton in River-nun at Amassoma

S. No	Taxa	1	2	3	4
	Bacillariophyta				
1	*Coscinodiscus stellaris*	+	-	-	-
2	*Synedra sp*	+	-	+	-
3	*Melorisn sp*	+	-	-	-
4	*Pseudo-nitzrchia pungers*	+	-	+	-
5	*Thalassion erna nitzsthioides*	-	-	+	-
6	*Tabellaria sp*	-	-	+	-
7	*Tabellaria fenestrate*	-	-	+	-
8	*Epithemia sp*	-	-	+	-
9	*Pseudo-nitzrchiea australis*	-	-	+	-
10	*Melorisa undulata*	-	-	+	-
	Cyanophyta				
11	*Microcystis aeruginosa*	++	-	-	-
12	*Calochrix sp*	-	-	-	+
	Chlorophyta				
13	*Draparnaldia sp*	++	-	-	-
14	*Closteriopsis longissimi*	-	-	+	-
15	*Cladophora crispate*	-	-	+	-
16	*Mougeotia sp*	-	-	++	++
17	*Closterium juncidum*	-	-	+	-
18	*Microspora sp*	-	-	-	+
19	*Closterium gracile*	-	-	-	++++
20	*Cladophora glomorata*	-	-	-	+
21	*Zygnema sp*	-	-	-	+
	Euglenophyta				
22	*Trachelomonas sp*	+	-	-	-
23	*Trachelomonas tamboweica*	-	+	-	-
24	*Euglena sp*	-	++	-	-
	Rhodophyta				
25	*Lamanea sp*	++	-	+	++
	Xanthophyta				
26	*Tribonema sp*	-	-	-	+
27	*Vanchoria sp*	++	-	+	+

- Absent + Present

Table 3: Phytoplankton diversity and abundance in River-nun Amassoma

S. No	Taxa	1	2	3	4
	Bacillariophyta				
1	*Coscinodiscus stellaris*	1	0	0	0
2	*Synedra sp*	1	0	1	0
3	*Melorisn sp*	1	0	0	0
4	*Pseudo-Nitzrchia pungers*	1	0	1	0
5	*Thalassion Erna nitzsthioides*	0	0	1	0
6	*Tabellaria sp*	0	0	1	0
7	*Tabellaria fenestrate*	0	0	1	0
8	*Epithemia sp*	0	0	1	0
9	*Pseudo-Nitzrchiea australis*	0	0	1	0
10	*Melorisa undulata*	0	0	1	0
	Cyanophyta				
11	*Microcystis aeruginosa*	2	0	0	0
12	*Calochrix sp*	0	0	0	1
	Chlorophyta				
13	*Draparnaldia sp*	2	0	0	0
14	*Closteriopsis longissimi*	0	0	1	0
15	*Cladophora crispate*	0	0	1	0
16	*Mougeotia sp*	0	0	2	2
17	*Closterium juncidum*	0	0	1	0
18	*Microspora sp*	0	0	0	1
19	*Closterium gracile*	0	0	0	4
20	*Cladophora glomorata*	0	0	0	1
21	*Zygnema sp*	0	0	0	1
	Euglenophyta				
22	*Trachelomonas sp*	1	0	0	0
23	*Trachelomonas tamboweica*	0	1	0	0
24	*Euglena sp*	0	2	0	0

	Rhodophyta				
25	*Lamanea sp*	2	0	1	2
	Xanthophyta				
26	*Tribonema sp*	0	0	0	1
27	*Vanchoria sp*	2	0	1	1

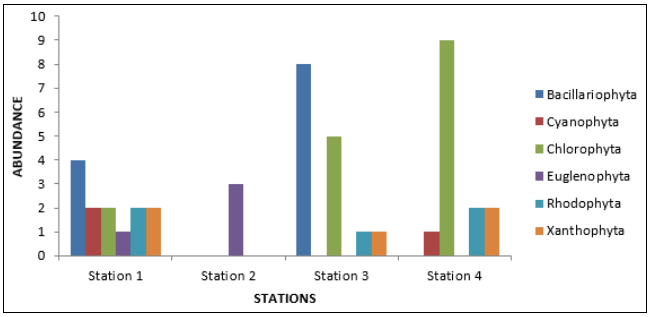

Fig 1: Phytoplankton abundance in River-nun Amassoma axises

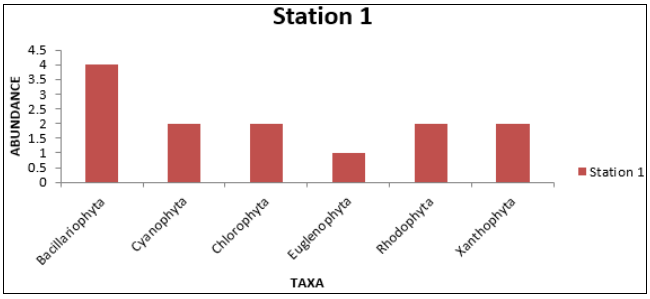

Fig 2: Phytoplankton abundance in Station 1 at River-nun Amassoma axises

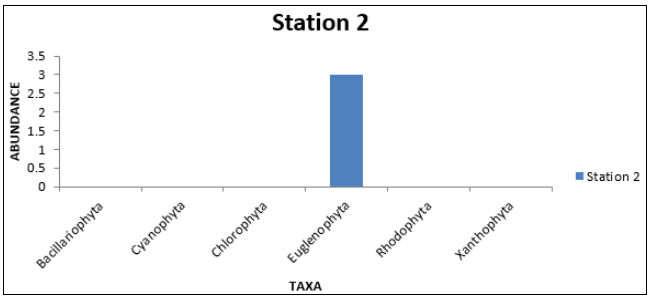

Fig 3: Phytoplankton abundance in Station 2 at River-nun Amassoma axises

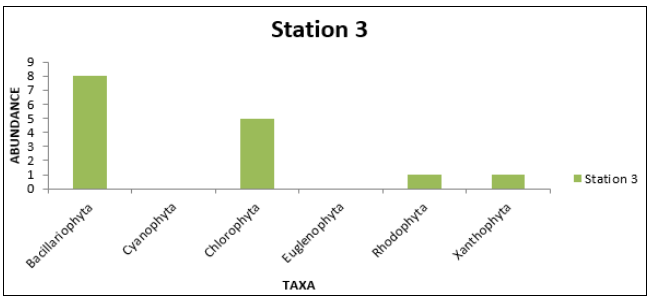

Fig 4: Phytoplankton abundance in Station 3 at River-nun Amassoma axises

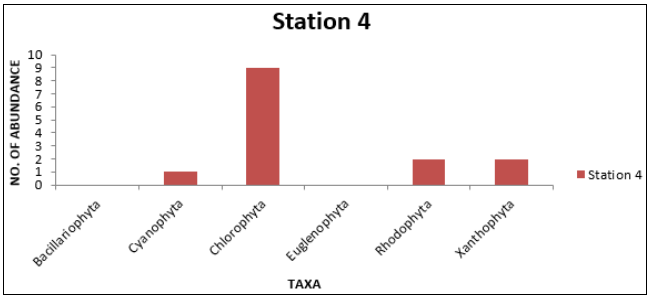

Fig 5: Phytoplankton abundance in Station 4 at River-nun Amassoma axises

3.2 Phytoplankton Taxa Richness and Diversity Indices

The results for taxa richness and the diversity indices of the Nun River at Amassoma axis were calculated and presented in Table 4 below.

Table 4: Taxa richness and Diversity Indices of River-nun at Amassoma Axises

S. No	Taxa/Diversity Indices	Station 1	Station 2	Station 3	Station 4
1	Bacillariophyta	4	0	8	0
2	Cyanophyta	2	0	0	1
3	Chlorophyta	2	0	5	9
4	Euglenophyta	1	3	0	0
5	Rhodophyta	2	0	1	2
6	Xanthophyta	2	0	1	2
7	Shannon Diversity	2.16	0.64	2.34	2.04
8	Evenness	0.98	0.92	0.89	0.92
9	Simpson's Index	0.12	0.54	0.07	0.16

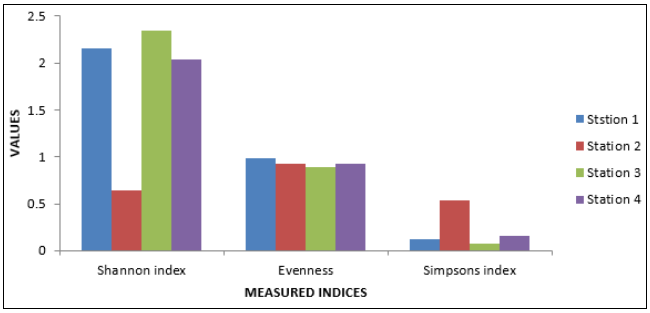

Fig 6: Diversity indices in River-nun Amassoma axises

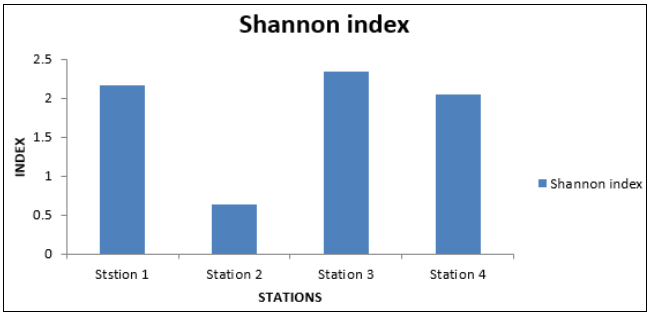

Fig 7: Shannon index in River-nun Amassoma axises

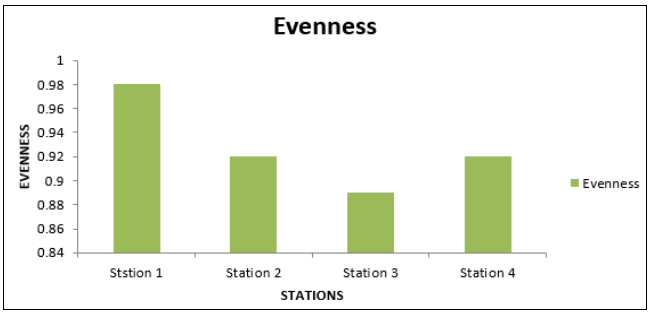

Fig 8: Evenness index in River-nun Amassoma axises

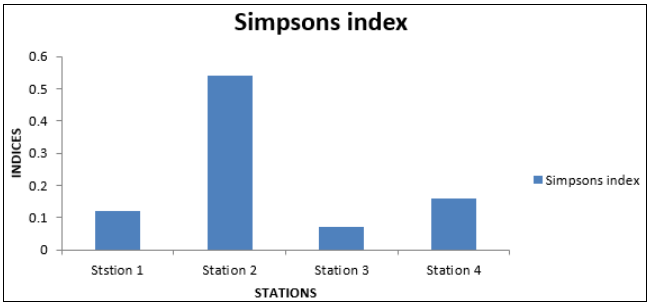

Fig 9: Simpson's index in River-nun Amassoma axises

3.3 Discussion

The biodiversity of phytoplankton in River Nun along the Amassoma axises showed the presence of twenty seven (27) species of phytoplankton including *Coscinodiscus stellaris, Synedra sp., Melorisn sp., Pseudo-nitzrchia pungers, Thalassion erna nitzsthioides, Tabellaria sp., Tabellaria fenestrata, Epithemia sp., Pseudo-nitzrchiea australis,* and *Melorisa undulata* from the division Bacillariophyta, *Microcystis aeruginosa, Calochrix sp.* from the division Cyanophyta, *Draparnaldia sp., Closteriopsis longissima, Cladophora crispate, Mougeotia sp., Closterium juncidum, Microspora sp., Closterium gracile, Cladophora glomorata, Zygnema sp.* from the division Chlorophyta, *Trachelomonas sp., Trachelomonas tamboweica, Euglena sp.* from the division Euglenophyta, *Lamanea sp.* from Rhodophyta, and *Tribonema sp., Vanchoria sp.* from Xanthophyta.

Species abundance shows station 3 to be very diverse with the presence of fourteen (14) species of phytoplankton. This could be as a result of low anthropogenic activities (Only boats used for dredging and fishing were seen in that station) suggesting that the dredging activities had little or no terminal effect on the phytoplankton species, while station two (where the major cassava mill is located had the lowest diversity with only one division of phytoplankton (Euglenophyta) surviving in that station. This could be as a result of other species of phytoplankton not been able to survive in that area due to the harmful effluents and waste deposited in that region.

Shannon diversity index was highest in Station 3 (2.34) followed by Station 1 (2.16), and Station 4 (2.04) and lastly Station 2 (0.64). Simpson's Index was lowest in Station 3 (0.07), followed by Stations 2 (0.54), Stations 1 (0.12) and lastly Station 4 (0.16). The above findings indicate that land use activities greatly determined phytoplankton dynamics in the river. It can be reasonably suggested that the receding flood water may have carried along with it toxins and pollutants which are site specific and therefore affected plankton in the sampled sites. The dynamics of phytoplankton is of grave importance to the entire ecosystem and sustenance of life on earth.

4. References

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