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Iloba Kate Isioma
Animal and Environmental Biology, Delta State University, Abraka. Delta State, Nigeria

Edeghagba O Stephany
Animal and Environmental Biology, Delta State University, Abraka. Delta State, Nigeria

Correspondence
Iloba Kate Isioma
Animal and Environmental Biology, Delta State University, Abraka. Delta State, Nigeria

The algae of a tropical floodplain in the Niger Delta, Nigeria

Iloba Kate Isioma and Edeghagba O Stephany

Abstract
The evaluation and documentation of physical and chemical limnology and algae of floodplains is paramount in fisheries development in Nigeria. The algae community of the Aghalopke floodplain was studied weekly between April and May, 2015. The water quality variables varied significantly at all sites ($p<0.05$) except carbon dioxide ($p = 0.2110$) and will favour fisheries development, with the good acidity- alkalinity neutralizing interactions structuring the floodplain. The phytoplankton community structured by 33 species of six genera and four taxa; Bacillariophyta (6), Chlorophyta (7), Cyanophyta (3) and Euglenophyta (17). The organic loving - euglenoids dominated over 80% of the algae community while less than 20% were apportioned between Bacillariophyta (6.8 %), chlorophyta (7.6 %) and cyanophyta (0.4%). Dissolved oxygen ($r= 0.7374$; $p=0.0149$) and total dissolved solids ($r= 6514$; $p=0.0413$) only correlated significantly with the euglenophytes ($p\leq 0.005$). The diversity indices (0.40 – 0.828) confirmed the poor quality status of the floodplain and the Palmer pollution index identified the floodplain as organically polluted.

Keywords: water quality, diversity indices, palmer pollution index, aghalopke floodplain, niger delta

1. Introduction

Floodplains bewildering array of organisms explain their extensive exploit for fisheries worldwide [1, 2, 3]. Aghalopke flood plains are interspersed with canal- connected ponds used for intensive fish farming by the community for both commercial and domestic purposes [4]. Influxes of flood into the ponds come with enormous nutrients, organic loads from the river system, and outputs of soil excavation, deforestation and slumping of the pond walls during the rains [5, 6]. These events impose challenges on the water quality, environment and its biota, apparently affecting the health of the water system [7, 8]. These challenges are primarily detected by algae due to their position in the aquatic food web [9]. One of the resultant effects is either over dominance or paucity of some algae species, to signature the prevailing water status [8, 10]. The use of algae as an indicator tool in assessing water type, fish yield and biological production and pollution has received world approval as no two water bodies have uniform algal composition and characterization [11, 18, 12]. The composition and diversity of this important biological group of organisms have been reported to change over time and space, depending on the prevailing environmental conditions [13, 14]. The influence of phytoplankton on water quality due to their position at the base of the food chain in an open water system have been reported by several workers [15, 11, 14]. However, little is known about the algae of Aghalopke floodplain used for fish farming, agricultural pasture and domestic uses. Successful management, exploitation and conservation of its productive potentials involve effective evaluation of its algal status on which ecosystems anchor [3]. It is also important to assess its water quality status for future development and predictions of ecological models and at the moment, its suitability for domestic uses by the community. This study therefore examined the algae composition and abundance of this floodplain to ascertain its ecological status.

2. Materials and Methods

2(a). Study Area

The Adagbarassa flood plain at Aghalokpe, Okpe Local Government area, in the Niger region of Delta State, Nigeria, lies between latitude 5°46'46" N of the equator and longitude 5°51'53" E of the Greenish meridian (Fig. 1) and is one of the productive freshwater floodplains in the low lying rain forest plain of the Niger Delta. This unexploited plain with great fishery potentials is inundated by

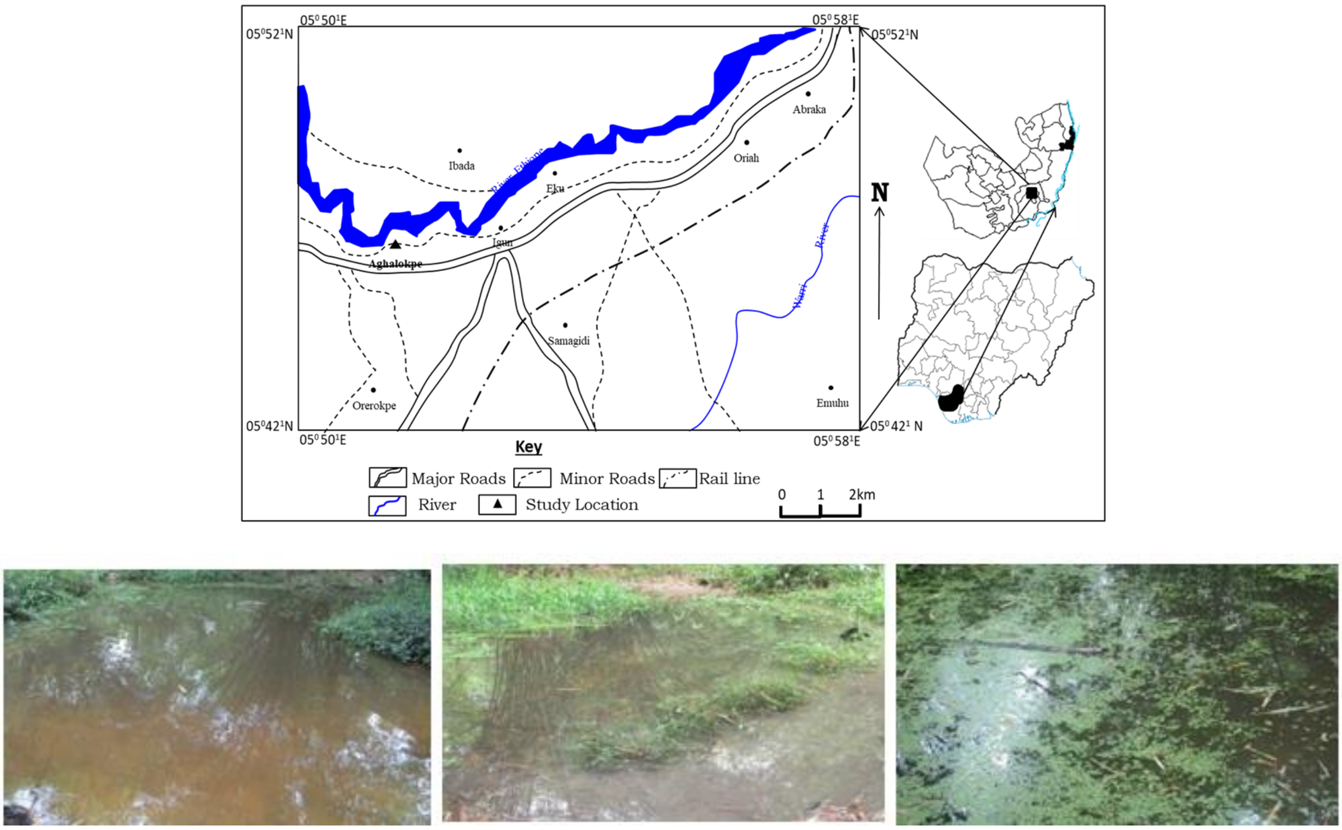


Fig 1: Location of adabgarasa, aghalopke and plates of the sampling sites (***Source***: Google Map)

Drainage, local rainfall and overspill from River Ethiope. The substratum consists mainly of sand and is vegetated in the non-tidal zone and mainly muddy sediments in the tidal area. The riparian vegetations include *Bambosa-Bambosa*, palm tree (palmist rouge), grass, fern plant (*Dicksonia antaritica*) and various emergent macrophyte.

2(b). Sampling Sites

Three earthen fish ponds were randomly selected and sampled (Fig.1) Station 2 receives water from Station 1 Station 3 is about 0.05km away from station 2 where it receives water from except during flood. Three stations were used for the study. Station 1 is the widest and deepest, covered with extensive riparian vegetation which were mainly *Bambossa spinosa*, fern (*Dryopteri dilatata*), water lettuce (*Pistia stratiote*), and rubber trees and with lots of fishing activities. Station 2 receives water from Station 1. It is surrounded by sparsed/ scanty Bambossa spinosa, exposing the water to sunlight. Its sparse vegetation exposed the water surface to direct sunlight. Fish farming is prominent here, other activities include bathing, laundry, pasturing while Station 3 which is about 0.05km apart from station 2, is open and very shallow with extensive floating macrophytes. It primarily receives water from station 2. *Bambossa spinosa* was predominant among the riparian vegetation. The station with extensive floating macrophytes had no human attraction (Fig. 1).

2(c). Data collection

At each station, sub surface water and plankton samples were collected weekly from April and May, 2015, between 10:50 am to 1: 00 pm. Water samples were stored and preserved in 1000ml plastic container/ in Ice chest and plankton samples in 250ml plastic bottles with 4% formalin. Plankton sedimentation was by Utermohl technique. Species were counted under x 10 and x40 magnification of Nikron microscope and identified with reference to standard taxonomic guides [16]. The study sites were inundated during the rains by the second sampling, with devastating skin infections experienced, such as painful, reddish, hard swollen limbs of the researchers. These symptoms were alleviated only after two weeks.

2 (d). Environmental variables

The environmental variables were surveyed with the established routines explained in APHA [17]. Air and water temperatures were read in –situ with mercury- in -glass thermometer graduated in 0.1°C, conductivity by the auto conductivity analyzer (model DDB/303A), total dissolved solid values were read with TDS meter (model 579312), Turbidity by turbidimeter, pH by pH meter.

Dissolved oxygen values obtained Modified Winkler's method was used for Dissolved oxygen. Titrimetric method was used for Alkalinity and Acidity [17]. Phosphorus, potassium, carbon dioxide were determined using spectrophotometer (AJ/1CO_3) with 000, 111, 222 wavelengths respectively.

2(e). Statistical analysis

Obtained data relative to environmental variables were subjected to relevant descriptive statistics to detect useful changes or variations in these factors during the study period. One- way Analysis of variance (ANOVA) was used to detect significant variations in environmental and biological factors within and between stations. The maximum impacts of environmental variables in structuring the algal population were evaluated by Principal component Analysis (PCA) with significant eigen factor of ≥ 1.0 and Pearson correlation at $P \leq 0.05$. The statistical analysis were executed by the means of Past Paleontological Statistical Software Package (Hammer *et al.*) [18].

2(f). Diversity indices/ Palmer Pollution Index

Three biological indices were employed to evaluate the ecological status and trophic nature of the study site. The palmer index based on the presence of pollution loving algae was further used to ascertain the water quality and the organic status of the floodplain [18]. The Palmer's Pollution Index expression is interpreted as follows:

Palmer's Pollution Index (P. P.I.) < 15 = Very light organic pollution

P.P.I between 15 and 20 = Organic Pollution

P.P.I > 20 = Organic Pollution

3. Results

This study recorded weekly environmental variations between and among all variables at all stations. The physiochemical variables at the three stations are summarized in Table 1. Carbon dioxide was the most variable during this study (CV>200%) while pH was least (CV<1.0%). We recorded a total of 33 algae belonging to four taxa namely; Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta with species listed in Table 2. Euglenophyta was the most dominant at all stations and contributed over 80% (85.2%) of the total phytoplankton abundance, followed by Chlorophyta (7.6%), Bacillariophyta 6.8% and Cyanophyta (0.4%) (Table 2 and Fig.2). The algae composition and abundance varied spatially and temporally during this study as presented in Table 2 and Fig. 2. Stations 1 and 3 had equal number of organisms (27 each) but with unequal species composition and density. Station 1 had 446 and station 3; 263. The relative representation of Euglena, Trachelomonas, Lepocincl Phacus, Strombomonas, Closterium and Diatoma, species differed by stations (Table 2). Of the taxon euglenophyta, the genus *Euglena* was most abundant with seven (7) species.

Euglena acus was more dominant in Station1 and 3, while it was absent in Station 2. This was followed by *Euglena oxyuris* with twenty (20) species in Stations 1 and 3 but absent in Station 2. Another dominant genus was *Trachelomonas* with 3 species including *Trachelomonas grandis*. The Genera *Lepocinclis* and *Phacus* species had two (2) followed by *Eutreptia* and *Strombomonas* with single species each. Phylum Chlorophyta was dominated with the genus *Clostridium* having 4 species with *Clostridium monoliform* most dominant in all Stations. Other genus had single species each across the Stations.

The phylum Bacillariophyta was dominated by *Diatoma* with two species while the *Coscinodiscus* sp. had the highest dominance in terms of individual species.

Cyanophyta was dominated by the genus *Oscillatoria* which was spatially distributed across the three Stations. A reduction in algal biomass (temporally) was evident in our last three weeks with Chlorophytes measuring up and even dominating in stations 2 and 3.

The various ecological indices revealed low algae diversity in the floodplain (Table 3). Simpson's and Shannon indices varied between 0- 0.74 and 0- 1.75 respectively. The euglenoids had the maximum ecological indices.

Station 1 for all taxa except for the euglenophytes (0.30) as against 0.28 in station 2 and 0.26 in station 3. Station 1 (0.4-0.69) also recorded the lowest evenness as against the other two stations; station 2(0.45- 0.75), station (0.41 -0.828) (Table 3).

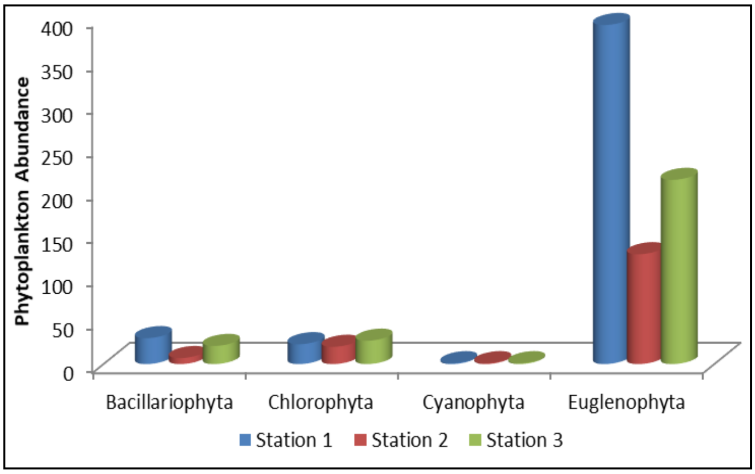
Principal component analysis identified major six components in stations 1, 2 and seven (7) in station 3 responsible for variations of phytoplankton in these stations. The scree plot test detected a similar trend in factors regulating phytoplankton structure (abundance) and environmental variables interactions in this study (Fig. 4). The tri-plot diagram showed a similar phytoplankton community structure along the different stations (Fig. 3)

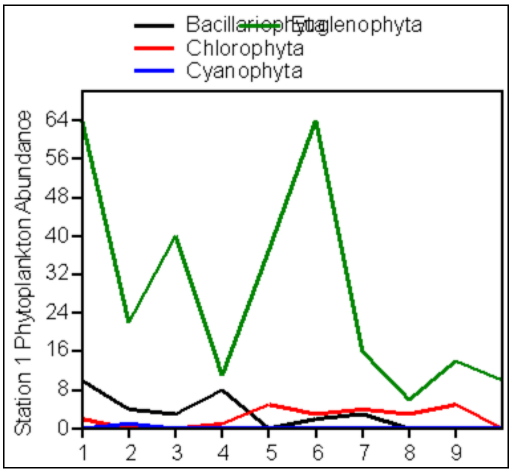
Table 1: The descriptive statistics of the water quality parameters in Aghalopke floodplain for April – May, 2015

Stations Parameters		Air Temp.	Water Temp.	D.O	Alkalinity	Acidity	TDS	Conductivity	pH	Turbidity	Phosphorus	CO_2	Potassium
Units		^{0}C	^{0}C	mg/L	mg/L	mg/L	mg/L	μs/cm	mg/L	mg/L	mg/L	mg/L	mg/L
Station 1	Mean	28.7	27.5	1.13	38	315.6	14.9	31.85	5.58	12.7	0.07	4.21	15.4
	SD	2.99	1.84	0.74	6.34	181.1	1.20	2.68	9.49E-03	3.47	0.05	9.90	17.4
	C.V.	10.4	6.69	65.8*	41.7*	57.4*	8.0	8.4	0.17	27.3	72.6*	235.1*	113.2*
	Min	10.5	22.5	0.3	4.0	128	13.0	27.5	5.57	7.0	-0.03	-5.4	-21.5
	Max	31.0	29.0	2.6	24.0	658	16.0	37.5	5.60	18.0	0.11	22.3	38.5
	T	30.3	47.2	4.81	7.58	5.51	39.36	37.63	1862	11.59	4.18	1.34	2.79
	T;Prob	0.0000*	0.0000*	0.0010*	0.0000*	0.0004*	0.0000*	0.0000*	0.0000*	0.0000*	0.0024*	0.2116	0.0024*
Station 2	Mean	29.2	27.6	1.02	12.2	282.6	17.6	36.31	5.59	33.2	0.07	16.68	22.4
	SD	2.92	1.93	0.78	4.37	80.3	2.99	5.56	3.16E-03	13.37	0.04	56.7	7.00
	C.V.	10.0	7.0	76.5*	35.8	28.4	17.0	15.3	0.06	40.3*	60.3*	339.8*	31.2
	Min	21.5	22.5	0.05	2.0	224.0	14.0	29.8	5.59	11.0	0.01	-5.04	9.9
	Max	32.0	29.0	2.3	18.0	478.0	25.0	50.1	5.60	55.0	0.18	177.6	32.6
	T-Test	31.6	45.3	4.13	8.84	11.13	18.6	20.7	5591	7.85	5.25	0.93	10.1
	T; Prob	0.0000*	0.0000*	0.0026*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0005*	0.3763	0.0000*
Station 3	Mean	29.1	28.2	1.16	11.8	260.0	17.0	35.13	5.59	14.3	0.09	1.52	21.62
	SD	3.15	2.08	0.75	5.12	67.5	1.25	0.79	0.00	1.82	0.03	2.42	2.23
	C.V.	10.8	7.4	65.1*	43.4*	26	7.3	7.1	0.00	40.2*	117.1*	504.8*	33.2
	Min	20.5	22.5	0.05	2.0	170	15.0	31.6	5.59	6.0	8.0E-03	-4.39	12.8
	Max	32.0	30.0	2.50	18.0	400	19.0	38.9	5.59	25.0	0.34	18.64	33.9
	T-Test	29.2	42.8	4.86	7.29	12.2	43.1	44.45	-	7.86	2.70	0.63	9.54
	T;Prob	0.0000*	0.0000*	0.0009*	0.0000*	0.0000*	0.0000*	0.0000*	-	0.0000*	0.0244*	0.5466	0.0000*
F-Value		0.07	1.10	0.09	1.21	0.54	5.06	3.62	1.30	17.4	0.09	0.58	0.25
F-Probabilty		0.9733	0.3485	0.9146	0.3131	0.5915	0.0136*	0.0405*	0.2890	0.0000*	0.9130	0.5653	0.7800

Table 2: Characteristic species, distribution, abundance, and percentage composition (bold) of phytoplankton in each Station.

Group	Species	Station 1	Station 2	Station 3
Bacillariophyta (6)	*Achnanthes exilis*	4(13.3)	-	-
	Coscinodiscus sp (Ehrenberg)	16(53.3)	1(14.3)	12(57.14)
	Cyclotella sp	2(6.7)	-	2(9.52)
	Diatoma sp	3(10.0)	-	-
	Diatoma vulgaris (Bory)	2(6.7)	-	-
	Navicula sp	3(10.0)	6(85.7)	7(33.33)
	Total	30(6.73)	7(4.52)	21(8.02)
Chlorophyta (7)	*Closterium acerosum* (Ehrenberg)	2(8.7)	6(30)	3(11.11)
	Closterium lincatum (Ehrenberg)	-	-	3(11.11)
	Closterium monoliferum (Bory)	15(65.22)	11(55)	17(63)
	Closterium parvulum (Navgar)	3(13.04)	-	2(7.4)
	Dilabifilum printzii (Vischer)	1(4.35)	1(5)	1(3.70)
	Haematococcus sp (J. Von Flotow 1844)	1(4.35)	1(5)	-
	Hydrodictyon sp (A.W. Roth 1791)	1(4.35)	1(5)	1(3.70)
	Total	23(5.16)	20(12.9)	27(10.31)
Cyanophyta (3)	*Oscillatoria sp*	1(100)	-	-
	Oscillatoria proboscidea	-	1(100)	-
	Oscillatoria bornetora (Kuzal)	-	-	1(100)
	Total	1(0.22)	1(0.65)	1(0.38)
Euglenophyta (17)	*Euglena acetissima* (Lemm)	-	-	1(0.47)
	Euglena acus (Ehrenberg)	196(50)	60(47.20)	98(46)
	Euglena hyaline (Klebs)	-	-	1(0.47)
	Euglena mangenotii	2(0.51)	1(0.8)	1(0.47)
	Euglena oxyuris (Schmarda)	20(5.1)	20(15.7)	30(14.08)
	Euglena sp	2(0.51)	-	-
	Euglena tripteris (Klebs)	1(0.26)	1(0.8)	1(0.47)
	Eutreptia viridis (Perty)	4(1.02)	-	3(1.41)
	Lepocinclis dextrose (Thom)	17(4.34)	5(3.9)	7(3.29)
	Lepocinclis playfairiana (Deflandre 1932)	8(2.04)	2(1.6)	2(0.94)
	Phacus curvicauda (Swir)	5(1.28)	2(1.6)	6(2.82)
	Phacus longicauda (Swir)	32(8.16)	8(6.3)	21(9.86)
	Strombomonas australis (Defandre)	82(20.92)	17(13.4)	19(8.92)
	Trachelomonas grandis	23(5.87)	9(7.1)	22(10.33)
	Trachelomonas nadsoni	-	1(0.8)	-
	Trachelomonas sp	-	1(0.8)	-
	Trachelomonas volvocina (Ehrenberg)	-		1(0.47)
	Total	392(87.9)	127(81.94)	213(81.3)
	Grand Total	446	155	262





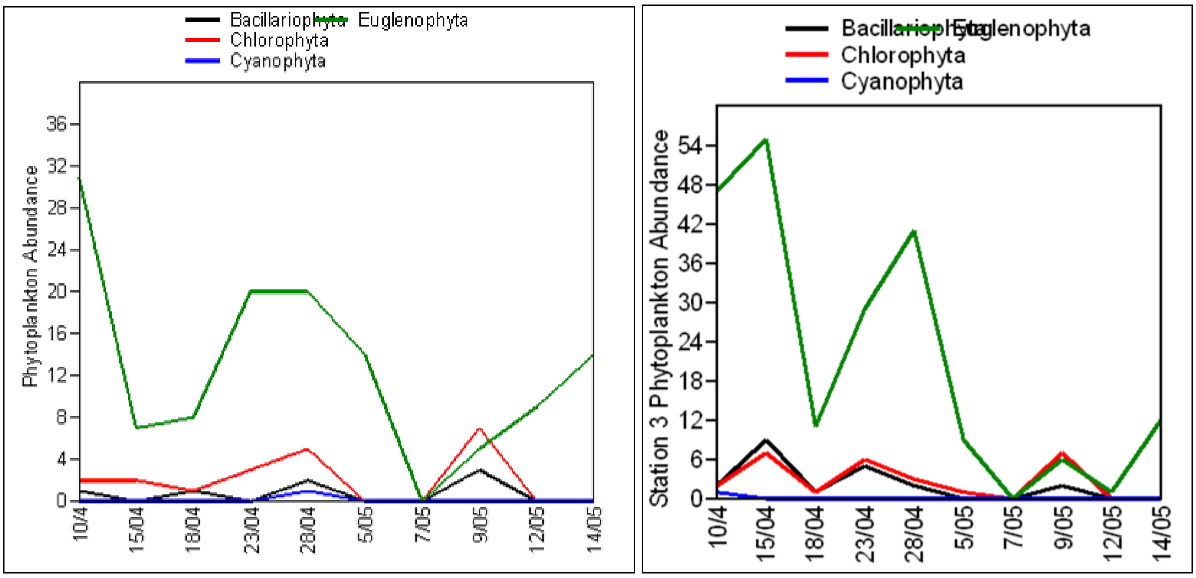


Fig 2: Phytoplankton abundance and temporal and spatial variations of phytoplankton at the different stations during the study period.

Table 3: Diversity profile of algae divisions in Aghalopke flood plain

TAXA	Diversity Indices	Station 1	Station 2	Station 3	F- value	P- value
Bacillariophyta	Taxa_S	6	2	3	1.84	0.1780
	Individuals	30	7	21		
	Simpson_1-D	0.6689	0.2449	0.5533		
	Shannon_H	1.426	0.4101	0.9099		
	Evenness_e^H/S	0.6933	0.7535	0.828		
Chlorophyta	Taxa_S	6	5	6	0.24	0.8064
	Individuals	23	20	27		
	Simpson_1-D	0.5444	0.6	0.5706		
	Shannon_H	1.166	1.139	1.216		
	Evenness_e^H/S	0.5348	0.625	0.5625		
Cyanophyta	Taxa_S	1	1	1	0.00	1.0000
	Individuals	1	1	1		
	Simpson_1-D	0	0	0		
	Shannon_H	0	0	0		
	Evenness_e^H/S	1	1	1		
Euglenophyta	Taxa_S	12	12	14	1.89	1707
	Individuals	392	127	213		
	Simpson_1-D	0.6909	0.7228	0.7379		
	Shannon_H	1.584	1.687	1.754		
	Evenness_e^H/S	0.406	0.4502	0.4128		

4. Discussion

The descriptive analysis of the water quality parameters in our study revealed that the floodplain was highly dynamic (CV≥ 40%; SD) with significant weekly variations within (except carbon dioxide and among (total dissolved solids, conductivity and turbidity) the stations (p≤ 0.05). The oligoionic status of the river system despite rapidity in change is further confirmed. The study established diurnal changes in this floodplain as common with canopied rivers. As expected a strong linear relationship was observed between air and water temperature, a predictable temperature pattern or trend in most tropical waters [20, 21, 22]. The no significant association between them in station 3 is the resultant effects of density macrophytes cover in this station. The versatility effects of water temperature on water properties/activities is also demonstrated in this study, evident from its positive or negative significant correlations with air temperature, alkalinity, conductivity phosphate and carbon dioxide (Table 5) [23].

The within permissible limits of most water variables are the impacts of the good neutralizing (alkalinity- acidity interactions) capacity demonstrated in this study [22]. This confers a high sensitivity to the floodplain, buffering the acid/ base – inputs/ fallouts from rain-flood, tree leaves, fish ponds, cattle and the atmosphere. This study hypothesized that this (acidity – alkalinity) interaction underlines all isolated principal components directly or indirectly in structuring this floodplain ecosystem. Apparently, the environmental variables interact to produce the characteristic algal composition of the Aghalopke floodplain.

The low number of species and density of most algal species in this study is associated with the oligotrophic nature the river [24]. The algal structure of this flood plain was quite different from those recorded in other floodplains in the Niger delta plains, dominated primarily by diatoms known for unpolluted water bodies [25].

The present study recorded Euglenophyta as the dominant species in composition and abundance, contrary to the reports of Bacillariophyta by most researchers in the Niger Delta. These include the works of [26, 27, 28, 29, 30, 31, 32, 33, 34,35, 36] in the Niger Delta, which were insignificant in the present study. However, similar records were given by [37] in River Ogun, Abeokuta, Ogun State, Southwest Nigeria.

Contrary to reports of Bacillariophyta by most researchers in the Niger Delta, present study recorded Euglenophyta as the dominant species in composition and abundance. Nwadiaro and Ezekiel [26]; Kadiri, [27]; Abowei *et al* [28]; Onyema, [29]; Davies *et al* [30]; Ezekiel et al. [31]; Abowei *et al*., 2012 [32]; Ansa *et al*., 2015 [33]; Obianefo *et al*., [34], Ojelade *et al*., 2016 [35] and Onwuteaka and Choko, 2017 [36], of the Niger Delta had reported significant values for the Bacillariophyta, making it at deviant with the report of present study. Whereas Nwadiaro and Ezekiel, 1986 [26] reported a 67 species abundance for desmids and blue green algae; showing it to occure more commonly in the freshwater upstream zone, Ezekiel *et al*., 2011 [31] reported a 45 species

composition and abundance of Bacillariophyta in Sombreiro River of the Niger Delta for five (5) taxonomic groups; Bacillariophyta (41.9%), Chlorophyta (32.6%) Cyanophyta (18.6%), Chrysophyta (2.3%) and Xanophyta (4.7%). In any case, their report proved a contrary outcome to those observed in the current study. However, similar records were given by Dimowo (37) in River Ogun, Abeokuta, Ogun State, Southwest Nigeria.

The PCA results and screed graphs revealed similarity in species composition and abundance, and pattern of response to environmental variables among stations. The influential environmental factors were isolated along the positive axes, and denoted favourable environmental conditions, particularly for the euglenoids. These variables (air and water temperatures, conductivity, dissolved oxygen, carbon dioxide, and phosphate) were identified as primary drivers regulating the abundance distribution of algae [38].

number of the significant Eigen quantification observed to be equal or greater than 1(≥ 6), compared with studied variables, revealed significant contributions water quality properties in structuring the algal composition and water quality status of the floodplain.

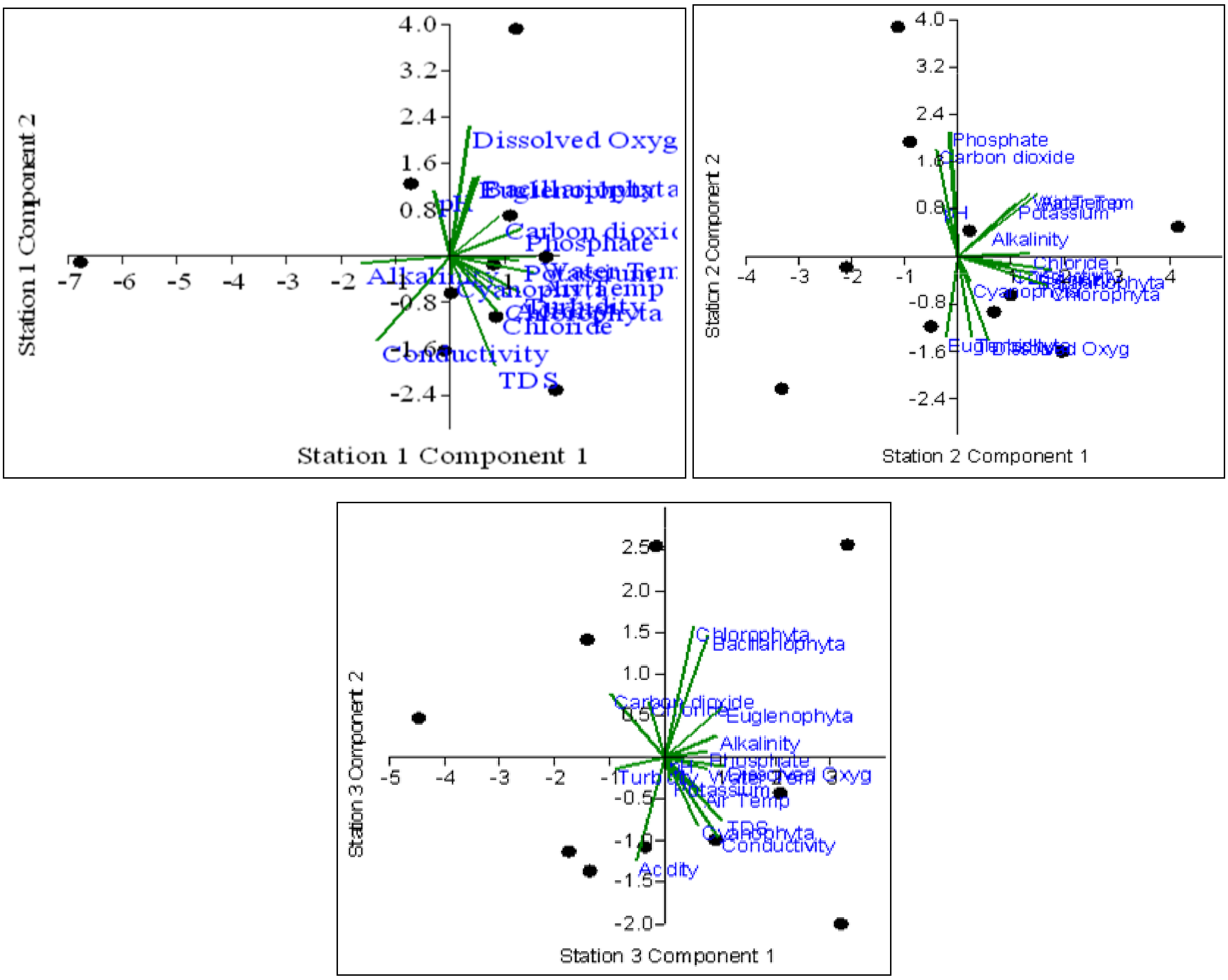


Fig 3: Tri-plots diagram of the first and second ordinate axes at the different stations

Table 4: Principal Component Analysis based on the phytoplankton at the different stations

PC	Station 1		Station 2		Station 3	
	EV	VAR %	EV	VAR %	EV	VAR %
1	6.34567	37.3	4.50549	26.5	5.91801	34.9
2	3.00599	17.7	3.2714	19.2	2.73268	16.1
3	2.09527	12.3	2.85178	16.8	2.55729	15.1
4	1.66548	9.8	1.77223	10.4	1.73164	10.2
5	1.62727	9.6	1.50423	8.8	1.37184	8.1
6	1.05433	6.2	1.47655	8.7	1.00068	5.9
Cum.%		92.9		90.5		90.3

PC=Principal Component; STN = Station; EV = Eigenvalue; VAR= Variance

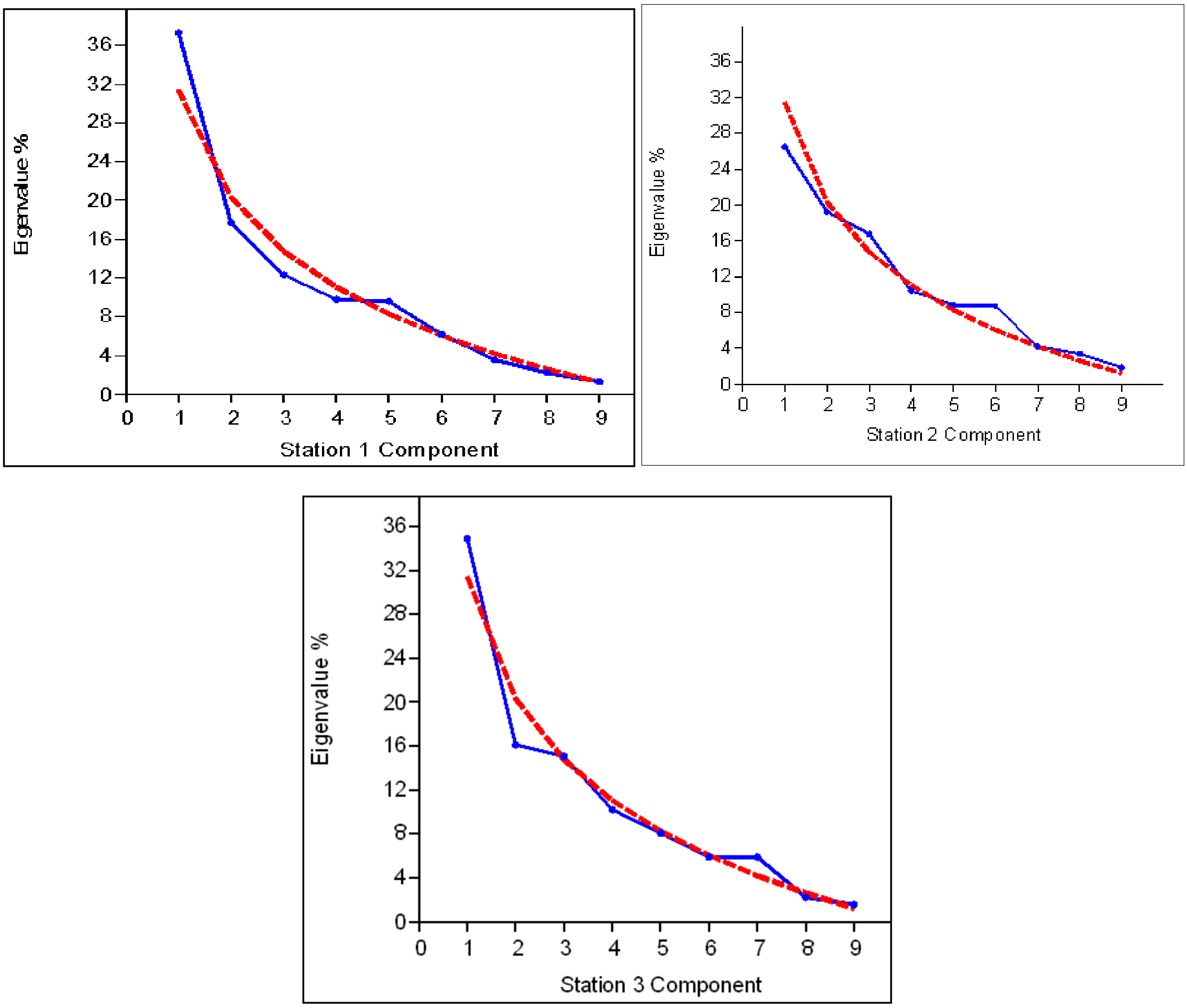


Fig 4: Eigenvalue plots for scree test criterion for the different stations

Table 5: Significant associations between water quality variables and phytoplanktonic groups at the three stations

	Station 1					Station 2				Station 3					
	Acidity	Air Temperature	Alkalinity	Conductivity	Phosphate	Acidity	Carbon dioxide	Air Temperature	Conductivity	Acidity	Air Temperature	Carbon dioxide	Conductivity	Dissolved Oxygen	Euglenophyta
CO2 rp	0.6988 0.0245										-0.7114 0.0211				
Potassium		0.6496 0.0420													
Phosphate			0.7091 0.0217				0.8682 0.0015								
TDS			0.6325 0.0497						0.9945 0.0000			-0.7054 0.0227	0.9766 0.0000		**0.6514 0.0413**
Water T		0.9479 0.0000	0.6380 0.0472	-0.6461 0.0436	0.6425 0.0452			0.9267 0.0000				-0.7985 0.0056			
Dissolved Oxygen				-0.6323 0.0498									0.6696 0.0342		
Bacilariophyta						0.6345 0.0488				-0.6673 0.0350					
Chlorophyta						0.8255 0.0033				-0.6382 0.0471					
Alkalinity											0.6560 0.0394				
Conductivity												-0.7198 0.0189			
Euglenophyta														0.7374 0.0149	

Table 6: Palmer species Pollution Index in Aghalopke floodplain

Group	Species	Station 1	Station 2	Station 3
Bacillariophyta	*Achnanthes exilis*	+	-	-
	Coscinodiscus sp (Ehrenberg)	+	+	+
	Cyclotella sp	+1	-	+1
	Diatom sp	+1	-	-
	Navicula sp	+3	+3	+3
Chlorophyta	*Closterium*	+1	+1	+1
	Dilabifilum	+	+	+
	Haematococcus sp	+	+	+
	Hydrodictyon	+	+	+
Cyanophyta	*Oscillatoria sp*	+4	+ 4	+4
Euglenophyta	*Euglena*	+5	+5	+5
	Eutreptia	+	-	+
	Lepocinclis dextrose (Thom)	+	+	+
	Phacus	+2	+2	+2
	Trachelomonas grandis	+	+	+
Total		17	15	16

The study reveals the dynamism of algae in Aghalopke floodplain and their correlation with some environmental variables as affirmed by the PCA output (Fig 3). The propensity of low dissolved oxygen on the dominating algae eugleniods is noted and positive.

The euglenoids were the eminent and diverse algae in the floodplain both in number and composition. The eminence of this organically loving group of algae in this system elicits a stable organically contaminated water body [39, 12]. The organic load from the various anthropogenic activities in the study area such as agriculture, pond preparation and cattle pasture are culpable and which saliently contributed to the enormous fish production in the study area (Self-observation). The high significant association between conductivity and TDS (organic load) in stations 2 and 3 (r= 0.9945; p= 0.0000) indicates influence of organic loads on conductivity.

The propitious existence of Euglenophytes as bio-sensors of organically polluted and poor /low oxygen waters as in this study have been reported by several researchers [12] depicting the execrable nature of study area for domestic use. The lower dissolved oxygen level observed in station 3, may have resulted in its positive significant correlation with Euglenophyta (r = 0.7374; p = 0.0149). The mono-dominance of euglenophyceae all through this study signatures the presence of extreme environments conducive for their growth [40]. The euglenoid status in this study also demonstrated that the floodplain is a lentic storage system when compared with its river system [41], favouring their proliferation. However, their stability was disrupted during the heavy inundation (42) which may have been responsible for the non-statistical difference between the different taxonomic groups. However, the homogenous effects of the flood did not erode the stations' species diversity (F: 22.0; p= 0.0003) within the period of research.

The study noted the paucity of clean water loving desmids (Chlorophyceae; order: Desmidiaceae; Closterium) despites the favourable acidic and poor oxygen loving conditions prevalent in the system. These species (desmids) with marked acidic and poorly aerated water preference absenteeism, as well as visible organic load (self- observation), infers a contaminated environment. Antagonistic against these factors was the extensive vegetation in the study area, to hinder the euplankton- existence and the colonization of the desmids (Closterium), although the dynamism of the environment could be flood associated which could be another factor regulating their (desmids) existence/ abundance and which could also factor the low abundance of the euglenoids at the tail end of research [7]. Next to the chlorophyta was the bacillariophyta dominated by Diatoma, Coscinodiscus sp., the only diatoms sustained in the present studied stations, they could have been resilient to the unfavourable physicochemical parameters [43]. Effects of alkalinity on diatoms and desmids abundance appeared to be unpredictable or indiscernible and/or their abundances were driven by different drivers as alkalinity tested statistically positive with Bacilariophyta r = 0.6345, p= 0.0488; chlorophyta, r= 0.8255, p= 0.0033 and with Bacilariophyta r = - 0.6673, p= 0.0350; chlorophyta, r = - 0.6382, p= 0.0471 in stations 2 and 3 respectively.

Worthy of note were the hazardous public health signs; painful, itching, reddish, hard and swollen limbs experienced during our sampling, which were vital verification of the contamination of this water body, particularly during the floods. The cyanophytes were undoubtedly anticipated as the common causal agents since they have been extensively reported to produce toxins capable of inducing skin inflammations or irritations [40], but were however exonerated by their trivial nature in the system, traceable to the nutrient level and slight acidity of the study area [45, 40, 15]. The insignificant number of cyanophytes in the system has further elucidated the source of contaminant as sewage/organic and its obnoxious effects on their survival and has further confirmed the euglenoids as the causal agents behind the skin reactions since they form over 80% of the algal population. The euglenophytes pollution indicator attribute is further confirmed by this research. This is revealed by the Palmer's Pollution Index (PPI) results (15-17), which is interpreted as organic pollution, an identified axis of water quality compromise in this system.

The low water quality status is responsible for the low phytoplankton diversity indices noted in this research. Currently, euglenoid's toxicity has been reported by several authors [44]. Thus, this water, when used for drinking and other domestic activity may be of serious health implications.

5. Conclusion

In the present study, the biological techniques showcased dominance of organically loving-euglenoids, low diversity indices, positive organic P.P.I. test, demonstrating that Aghalokpe floodplain is organically polluted. However, the study observed that some variables were within aquaculture allowable standards and with the buffering acid/ base capacity demonstrated, the tendency of restoring the flood plain is very high, with little management. We therefore recommend periodical monitoring of this floodplain for consumption suitability and aquaculture usage. Despite the evidence of some favourable water parameters for aquaculture, health education programmes should be introduced, to instruct users of the danger of drinking or coming in contact with this seemly contaminated water without proper treatment.

6. References

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