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Effect of Water Quality Indices on Phytoplankton of a Sluggish Tidal Creek in Lagos, Nigeria

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Abstract: The phytoplankton of a tidal creek in Lagos was investigated for six months (September 1998-February 1999).The physico-chemical environment was essentially neutral (pH 7.00-7.30), relatively more transparent (>0.23 m), expressed higher conductivity (>0.10 mS cm^{-1}), higher chloride values (>23.48 mg L^{-1}), lower nitrate content (<0.70 mg L^{-1}), lower sulphate values (<0.45 mg L^{-1}) and phosphate values (<0.12 mg L^{-1}) in the dry months. In the wet months, September to November 1998, conductivity (<0.16 mS cm^{-1}), transparency (<0.80 m), salinity (<0.04%), dissolved oxygen (<24.00 mg L^{-1}), chloride (<24.21 mg L^{-1}) and phosphate (< 0.21 mg L^{-1}) were recorded. The phytoplankton was dominated by diatoms (48 pennate forms and 23 centric forms).The other algal groups comprised six blue- green algae and six green algae. Species richness (d) was high in stations nearer the Lagos lagoon for the six sampling periods. Shannon-Weaver index (H^1) was lowest in November 1998 and highest in October 1998 and February 1999 while evenness of species J was low (<0.71) throughout the period. Higher phytoplankton biomass was recorded in the dry months than wet months.

Key words: Physico-chemical parameters, tidal creek, seasons, algae, depth

INTRODUCTION

The coastal waters of South-Western Nigeria include a system of lagoons which receive a number of large rivers and creeks draining more than 64,000 km^2 of country (Hill and Webb, 1958). The lagoon system open to the sea through the Lagos harbour. Owing to the seasonal distribution of rainfall, the lagoon system experiences seasonal flooding which introduces a lot of detritus, nutrients and dilutes the water considerably (Nwankwo, 1993). There are numerous creeks associated with the Nigerian coastal environment. They are of two types, the tidal freshwater creeks which are surrounded partly by mangrove swamps and partly by freshwater swamps while the non-tidal creeks are surrounded by freshwater and are infested by aquatic macrophytes all year round.

Abule-Eledu creek forms part of the many sluggish tidal creeks that drain into the Lagos lagoon. It harbors many aquatic macrophytes which at certain times of the year completely cover the water surface and affects navigation of canoe. Records on the flora of Nigeria creeks are limited. Of all the different creeks that emptied into the Lagos lagoon, only Ogbe creek has more records and these include Edwards and Ekundayo (1981) who analysed the successional species and biomass of mangroves around Ogbe creek, Mbamarah (1986) investigated the biota associated with the roots of *Pistia stratiotes* in Ogbe creek, while Nwankwo and Akinsoji (1988b) highlighted the presence of some euglenoid species with high pollution value in *Pistia stratiotes* L. in Ogbe creek, Nwankwo and Amuda (1993) investigated the periphytic diatoms on three floating aquatic macrophytes also in Ogbe creek. Nwankwo and Akinsoji (1988a) reported the tolerance to salinity and survivorship of *Eicchornia crassipes* (Mart) Solms. growing in Orile creek Lagos while recently Onyema and Nwankwo (2006) investigated the epipelic assemblage in Ijora creek, Lagos. In the Niger delta, Okpuruka (1986) studied the tidal and semi lunar variations in the surface phytoplankton of a mangrove creek in the Niger delta, Nwadiaro (1990) studied a hydrobiological survey of the Chanomi creek in the lower Niger delta where he observed that 80% of the total taxa were diatoms while Chindah *et al.* (1993) investigated Elechi creek. Chindah (1998) investigated the effects of industrial activities on the periphyton communities of upper New Calabar River while Chindah and Nduaguibe (2003) reported the effects of tank farm wastewater on the water quality and periphyton of lower Bonny River in Niger delta and more recently, Adesalu and Nwankwo (2005) recorded 36

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phytoplankton taxa in the study of Olero creek in the Niger delta. There are no previous biological investigation of Abule-Eledu creek hence this study was determined to correlate any changes in the water chemistry with changes in the phytoplankton algal community for possible biological monitoring of Abule-Eledu environments.

MATERIALS AND METHODS

Description of study site: The Abule-Eledu creek (Fig. 1) is one of the numerous creeks that emptied into the Lagos lagoon. It is tidal with a depth which decreases inland. It is located in the wet tropics where alternations of the dry and wet seasons are phenomenal. During the wet seasons, nutrients are brought down into the lagoon by flood from adjacent freshwater bodies such as rivers, creeks and creeklets. The region is characterized by fringing macrophytes vegetation which is mostly mangrove and freshwater types. The mangrove species are dominated by few genera *Rhizophora* (Red mangrove), *Acrosticum* and *Paspalum*. A number floating macrophytes find their way through the numerous adjoining creeklets in to the lagoon at low tide. These macrophytes include, *Eicchornia crassipes* (Mart) Solms.; *Pistia stratoites*, *Lemna paucicostata*, *Vossia cuspidata* and associated with these plants are periphytic organisms such as algae and mollusks. Artisanal fishing is the mainstay of communities that live around the creek. Six different stations were created inland due to accessibility.

Field studies

Sampling stations: The sampling stations were shown in Table 1. These stations were chosen to reflect differences in physico-chemical and biological characteristics which exist in the same body of water.

Table 1: Location of sampling stations in the study site

Location	Names	Average depth (m)
A	Back of University of Lagos Guest House	0.49
B	Back of University of Lagos Power House	2.04
C	Back of New Halls 1	0.99
D	Back of New Halls 11	0.87
E	Side view of New Halls	0.46
F	Back of University of Lagos Mosque and Chapel	0.34

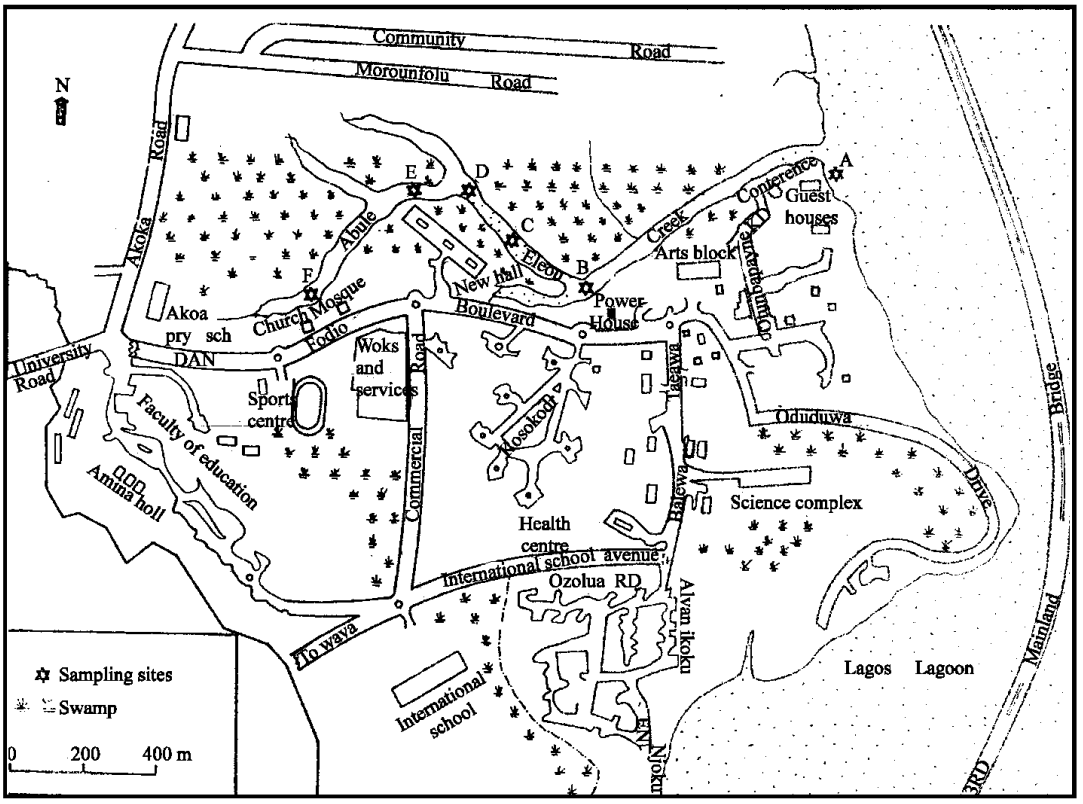

Fig. 1: Map showing part of Lagos lagoon and Abule-Eledu creek with sampling sites

Collection of samples: Water samples were collected 0.5 m below the surface from six different stations created along the Abule-Eledu creek for a period of six months (September 1998- February 1999). All water samples for physico-chemical analysis were stored in one liter properly labeled plastic containers with screw caps and fixed with white and black ampoules for proper dissolved oxygen estimation. Biological samples were obtained by filtering at each station, 330l of water through 55 μm mesh size standard plankton net because of the shallowness of the creek. Each filtrate from each station was transferred into 250 mL plastic container and preserved in 4% unbuffered formalin. All specimens were transferred to the laboratory and stored in the refrigerator (+<5°C) for further analysis.

Physico-chemical analysis: Surface water temperature was measured in the field using a mercury thermometer accurate to 0.1°C, pH was determined using the Phillips pH meter model (Pw950), conductivity was measured using the HANNA instrument, a wide range conductivity meter. Depth was estimated using a pre-calibrated pole. Transparency was determined using a 20 cm diameter Secchi disc. Salinity was estimated using silver nitrate chromate titration method as described by Barnes (1980). Dissolved oxygen was determined using a Griffin oxygen meter (Model 40). Chloride ion was estimated using Mercury trioxo-nitrate v method. Calometric methods using a lovibond Nesslerier were used for the determination of phosphate- phosphorus and nitrate-nitrogen content while gravimetric method was adopted for sulphate content determination. Federal Meteorological Department, Oshodi, Lagos, Nigeria kindly supplied the rainfall distributive pattern for the study area.

Biological analysis: In the laboratory, the samples were allowed to settle for 24 h and the supernatant decanted until a concentrate of 10 mL achieved. Five drops of each concentrated samples were observed using a Wild MII binocular microscope with calibrated eye piece. Laekey (1938) microtransect drop count method was used. Several keys and illustrations were consulted to confirm identification (Hendey, 1958, 1964; Hustedt, 1930; Subramanyan, 1946; Patrick and Reimer, 1966, 1975; Patrick, 1976; Nwankwo, 1984, 1990; Navaro, 1981).

Community structure analysis: Three indices were used to obtain the estimate of species diversity (H^1), species richness (d) and species evenness (J).

- Shannon and Weaver (1963) diversity index value was obtained using the following equation:

$$H^1 = -\sum_{I=1} pi \log_2 pi$$

Where:
H^1 = Shannon and Weaver diversity index
pi = Proportion of sample made up by the ith species
S = Total No. of species

- Species richness (d) was obtained using the equation

$$d = \frac{S-1}{\log_e N}$$

Where:
d = Margalef's diversity index (1970)
S = No. of species
N = No. of individuals

- Species equitability was determined by using the expression of Pielou (1966).

$$J = H^1 / \text{In } S$$

Where:
H^1 = Shannon and Weaver index
J = Equitability
S = Total No. of species

Coefficient of similarity: Coefficient of similarity (s) between two samples Odum (1971) was also estimated using this equation:

$$S = \frac{2C}{A+B}$$

Where:
A = No. of species in sample A
B = No. of species in sample B
C = No. of species common to both samples

RESULTS

Physical and chemical analysis: Monthly variation in surface water temperature was relatively high in all the sampling period. The lowest surface water temperature (27°C) was recorded in September and October 1998 while the highest 30.2°C was recorded in December 1998. Transparency values ranged between 0.08 and 0.80 m for the study stations and high values were recorded throughout the sampling period except in December where 0.08 m was recorded at the back of Mosque and Chapel

(station F) may be due to the shallowness of the station. Average depth values ranged from 0.34 m at the back of Mosque and Chapel (station F) to 2.04 m at back of University of Lagos Power House (station B).

In October 1998, highest rainfall value was recorded (236 mm) while December 1998 and January 1999 recorded the lowest values (≤16.7 mm). The water sample was essentially neutral varied from 7.00 to 7.30. The conductivity values were low through out the sampling period with the lowest 0.0010 mS cm^{-1} being recorded in February at back of New Halls 11 (station D). The conductivity values varied in the dry month, February (1999) between 0.0120 mS cm^{-1} at side view of New Halls (station E) and 0.0010 mS cm^{-1} at back of New Halls 11 (station D). Low surface water salinity values were recorded throughout the period of six months, the lowest value 0.01% was recorded in January (1999) at back of New Halls 11, (station D). In wet month October (1998), the salinity values varied between 0.02 and 0.04% at back of University of Lagos Guest House and back of New Halls 1 (stations A and C), respectively.

The sites recorded high dissolved oxygen (≤ 16.40 mg L^{-1}), the lowest value (5.20 mg L^{-1}), was recorded in January 1999 at back of New Halls 11 (station D) while the highest value (16.4 mg L^{-1}) was recorded in October 1998. The chloride content value ranged between 4.00 mg L^{-1} at back of University of Lagos Power House and back of New Halls 11 (stations B and D) and 24.21 mg L^{-1} at side view of New Halls (station E) in September 1998. The phosphate-phosphorus value was at its peak in December 1998, its value ranged between 0.02 mg L^{-1} in October at back of University of Lagos Power House (station D) and 0.21 mg L^{-1} in December at side view of New Halls (station E). Nitrate-nitrogen values were low throughout the sampling period. It ranged between 0.01 mg L^{-1} in October at back of University of Lagos Guest House (station A) and 0.07 mg L^{-1} in September at side view of New Halls (station E). As in nitrate-nitrogen content, sulphate values were also low throughout, the lowest value 0.01 mg L^{-1} being recorded in November 1998 and February 1999 (Table 2).

Table 2: Water chemistry indices of Abule-Eledu Creek, Lagos, Nigeria

Parameters	Months	Station A	Station B	Station C	Station D	Station E	Station F
Transparency (m)	Sept.1998	0.80	0.67	0.70	0.70	0.63	0.50
	Oct.1998	0.38	0.42	0.42	0.50	0.42	0.50
	Nov.1998	0.31	0.62	0.50	0.42	0.27	0.11
	Dec.1998	0.38	0.50	0.50	0.57	0.15	0.08
	Jan.1999	0.30	0.49	0.49	0.49	0.36	0.23
	Feb.1999	0.34	0.65	0.65	0.80	0.46	0.30
Conductivity (mS cm^{-1})	Sept.1998	0.14	0.16	0.16	0.16	0.17	0.16
	Oct.1998	0.01	0.01	0.01	0.01	0.01	0.01
	Nov.1998	0.01	0.01	0.01	0.01	0.01	0.01
	Dec.1998	0.01	0.01	0.01	0.01	0.01	0.01
	Jan.1999	0.01	0.01	0.01	0.01	0.01	0.01
	Feb.1999	0.01	0.01	0.01	0.01	0.01	0.01
pH	Sept.1998	7.00	7.10	7.30	7.20	7.10	7.30
	Oct.1998	7.10	7.00	7.20	7.20	7.10	7.00
	Nov.1998	7.10	7.00	7.00	7.00	7.10	7.00
	Dec.1998	7.10	7.10	7.00	7.00	7.20	7.20
	Jan.1999	7.00	7.00	7.10	7.10	7.00	7.00
	Feb.1999	7.00	7.10	7.10	7.00	7.00	7.10
Phosphate-phosphorus (mg L^{-1})	Sept.1998	0.06	0.03	0.04	0.07	0.10	0.04
	Oct.1998	0.06	0.04	0.05	0.02	0.12	0.06
	Nov.1998	0.06	0.02	0.07	0.03	0.02	0.08
	Dec.1998	0.07	0.04	0.06	0.03	0.21	0.07
	Jan.1999	0.02	0.03	0.06	0.02	0.02	0.06
	Feb.1999	0.07	0.04	0.04	0.06.	0.12	0.32
Sulphate (mg L^{-1})	Sept.1998	0.34	0.39	0.39	0.40	0.42	0.40
	Oct.1998	nd	nd	nd	nd	nd	nd
	Nov.1998	0.01	0.02	0.07	0.02	0.03	0.02
	Dec.1998	0.25	0.14	0.07	0.13	0.25	0.07
	Jan.1999	0.01	0.02	0.06	0.02	0.04	0.02
	Feb.1999	0.01	0.10	0.11	0.25	0.37	0.45
Nitrate-nitrogen (mg L^{-1})	Sept.1998	0.64	0.52	0.67	0.46	0.70	0.47
	Oct.1998	0.01	0.21	0.01	0.02	0.22	0.30
	Nov.1998	0.07	0.01	0.06	0.02	0.12	0.07
	Dec.1998	0.01	0.11	0.01	0.02	0.24	0.21
	Jan.1999	0.05	0.03	0.06	0.02	0.02	0.05
	Feb.1999	0.01	0.11	0.12	0.02	0.01	0.03
Salinity (mg L^{-1})	Sept.1998	*	*	*	*	*	*

Table 2: Continued

Parameters	Months	Station A	Station B	Station C	Station D	Station E	Station F
	OCT.1998	0.02	0.02	0.04	0.03	0.02	0.04
	NOV.1998	0.02	0.02	0.04	0.01	0.03	0.03
	DEC.1998	0.02	0.01	0.01	0.02	0.02	0.02
	JAN.1999	0.02	0.04	0.03	0.01	0.02	0.04
	FEB.1999	0.02	0.02	0.03	0.03	0.02	0.04
Chloride (mg L^{-1})	SEPT.1998	20.07	22.58	22.74	23.35	24.21	23.48
	OCT.1998	12.01	8.01	12.01	16.00	8.01	20.00
	NOV.1998	8.01	12.00	20.02	4.00	16.02	16.02
	DEC.1998	10.40	4.00	7.02	9.60	11.00	12.00
	JAN.1999	8.50	20.00	15.10	6.02	9.10	20.00
	FEB.1999	14.00	10.20	13.50	15.80	10.30	20.00
Dissolved oxygen (mg L^{-1})	SEPT.1998	*	*	*	*	*	*
	OCT.1998	18.40	16.40	20.40	16.80	19.20	24.00
	NOV.1998	10.60	8.60	9.80	8.40	11.00	8.60
	DEC.1998	18.10	15.07	19.05	16.30	18.40	20.00
	JAN.1999	11.00	9.01	10.10	5.20	10.00	7.50
	FEB.1999	17.20	16.60	19.40	15.20	19.90	23.90
Water temperature (°C)	SEPT.1998	27.00	27.00	27.00	27.20	27.00	27.30
	OCT.1998	27.00	27.00	27.20	27.30	27.30	27.00
	NOV.1998	29.00	30.00	30.00	30.00	30.10	30.10
	DEC.1998	28.00	30.00	29.00	30.00	30.00	30.20
	JAN.1999	30.00	29.00	29.00	29.00	29.30	30.00
	FEB.1999	28.20	28.00	28.30	28.00	28.00	28.00

nd = Not detected; * = Sample not tested

Biological analysis: Four major classes were recorded in this study, Bacillariophyceae (Diatoms), Cyanophyceae, Chlorophyceae and Euglenophyceae. The phytoplankton community was dominated by diatoms. Out of the 83 phytoplankton taxa identified, 71 species from 24 genera were diatoms. The blue green algae made up six species. Among the blue green, five genera *Anabaena*, *Gleocapsa*, *Oscillatoria*, *Phormidium* and *Spirulina* were represented. The green algal forms comprised three genera *Cosmarium*, *Genicularia* and *Netrium* (Zygnematales). The euglenoids were represented by two genera *Trachelomonas* and *Spirogyra*. Although the diatoms were more abundant the bottom dwelling forms (Pennales) made up 48 species while the truly planktonic forms (centrales) made up 23 species. The most abundant pennate diatoms encountered were *Diatoma tenue, Diatonella* sp., *Frustulia vulgaris*, *Nitzschia gracilis*, *Navicula mutica* and *Tabellaria fenestrata* during the dry season while the two most abundant species encountered in the wet season were *Amphora ovalis* and *Pinnularia* sp. The true planktonic diatoms recorded, *Cyclotella striata*, *Podosira tenebro* and *Thallasiossira condensata* as their dominant representative during the study period. *Microspora* sp., was the only abundant green algae recorded while occasional species included. *Genicularia* and Cosmarium while Oedogoniales recorded *Bulbochaete gigantea* as the only representative of the order. Euglenoids was ably represented by *Trachelomonas hispida* which only appeared in September 1998.The blue green algae recorded high value in terms of number in November with *Anabaena* sp., recorded the highest value. *Oscillatoria agardii* and *O. margaritifera* were important members of this group (Table 3). In general, higher phytoplankton biomass was recorded in the dry months than wet months.

Community structure: Phytoplankton diversity and abundance was higher in the dry than the wet months. In September, back of University of Lagos Power House and side view of New Halls (stations B and E) had the highest species richness. In November and December 1998 many more stations except, the back of University of Lagos Guest House (station A, $d<2.11$) were all rich in species ($d \geq 3.02$). Highest species richness ($d = 5.24$) was recorded in December at side view of New Halls (station E). Species richness was high in January 1999; it ranged between 1.92 at side view of New Halls (station E) and 4.30 at back of New Halls 11 (station D). The Shannon- Weaver (H^1) diversity index was highest (>2.72) in November 1998 at side view of New Halls and the back of Mosque and Chapel (station E and F). Throughout the sampling period, the Shannon-Weaver (H^1) diversity were higher (>0.65). Species evenness (J) showed greater values in October and November 1998 than in January and February. The period of high species richness corresponded with the period of lower evenness (Fig. 2). Equitability (j) was relatively higher during the wet season indicating a reduction in the degree of dominance at this period. Seasonal variation in Shannon-Weaver information (H^1) and equitability j in this creek follow each other closely with the lowest values of these two found in November 1998, back of New Halls 1 (station C) (Fig. 2).

Table 3: Phytoplankton composition of most abundant taxa on six sampling occasions at Abule-Eledu Creek (mg L^{-1})

	Station A						Station B						Station C					
Diatoms (Baccilariophyceae)	S	O	N	D	J	F	S	O	N	D	J	F	S	O	N	D	J	F
Order: Pennales																		
Amphora ovalis (Kutzing) Kutzing	-	16	-	36	-	-	-	10	-	-	-	-	-	-	4	-	-	-
Cymbella affinis Kutzing	-	-	-	-	-	2	2	-	-	-	-	-	2	6	-	-	-	-
Diatoma tenuc Agardh	-	-	-	-	2	-	-	-	-	-	8	12	-	-	-	-	-	10
Diatonella sp.	-	-	-	-	-	-	-	-	-	-	-	76	-	-	-	-	-	36
Diploneis ovalis (Hilse) Cleve.	2	-	2	-	2	2	2	-	-	10	-	-	2	2	-	-	-	-
Gomphonema micropus EHR	-	-	-	-	-	-	-	-	-	12	-	-	-	-	2	2	2	-
Navicula mutica Kutzing	-	-	-	-	2	2	6	-	2	-	-	6	-	-	6	-	-	-
Nitzschia closterium W. sm	2	-	-	-	-	2	-	-	-	-	-	2	2	-	2	-	-	10
N. gracilis Hantzsch.	-	20	-	-	2	-	10	-	-	-	-	-	-	-	-	-	-	-
Pinnularia sp. I	2	30	10	2	-	2	8	8	2	-	-	-	-	6	-	4	-	-
Pinnularia sp. II	-	2	-	2	-	6	2	4	-	6	-	-	-	2	4	-	-	-
Tabellaria fenestrata (Lyngb) Kutzing	-	-	-	-	2	2	2	-	-	4	-	2	-	6	-	-	-	-
T. floculosa (Roth)Kutzing	-	-	-	-	-	-	-	-	-	-	-	6	-	-	2	-	2	-
Order: Centrales																		
Coscinodiscus maginatus (Ehr)	-	-	-	-	-	6	-	-	-	-	2	2	-	-	-	-	4	-
Cyclotella striata (Kutz) Grunow	-	4	-	4	-	-	-	-	6	8	-	4	-	-	-	2	-	-
Podosira tenebro Leuduger Fort.	-	4	4	4	-	-	-	8	4	4	2	10	-	-	6	6	4	36
Thallasiossira condeusata				2	20	6			4	4	4					4	58	
Green Algae (Chlorophyceae)																		
Order: Zygnematales																		
Microspora sp.	-	-	-	-	-	30	10	-	-	-	36	58	-	-	-	-	-	24
Netrium digitus	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	6	-	-
order: Euglenales																		
Trachelomonas hispida (Perty) Stein.	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
Order:Oedogoniales																		
Bulbochaete gigantea	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-
Blue-green algae(Cyanobacteria)																		
Order:Hormogonales																		
Anabaena sp.	20	-	10	14	-	-	10	30	8	4	-	-	6	4	86	8	-	8
Oscillatoria agardii Gomont	-	-	4	4	2	-	-	8	2	14	-	4	-	2	4	8	-	-
O. margaritifera Kutzing (Gomont)	-	-	-	-	-	4	-	4	-	18	-	-	-	4	-	-	-	-'

	Station D						Station E						Station F					
Diatoms (Baccilariophyceae)	S	O	N	D	J	F	S	O	N	D	J	F	S	O	N	D	J	F
Order: Pennales																		
Amphora ovalis (Kutzing) Kutzing	-	-	-	6	2	-	-	-	-	-	-	-	-	-	-	-	2	-
Cymbella affinis Kutzing	-	-	2	-	-	-	-	6	2	-	2	-	-	2	4	-	2	10
Diatoma tenuc Agardh	-	-	-	2	-	-	-	-	-	2	2	-	-	-	-	40	2	60
Diatonella sp.	-	-	-	-	2	20	-	-	-	-	-	36	-	-	-	-	2	22
Diploneis ovalis (Hilse) Cleve.	2	2	2	2	-	-	2	2	-	4	-	-	-	-	6	16	4	-
Gomphonema micropus EHR	-	12	4	2	-	-	6	4	2	-	2	-	-	6	-	2	-	10
Navicula mutica Kutzing	-	-	-	-	2	-	-	-	2	-	-	-	-	-	2	6	-	30
Nitzschia closterium W. sm	-	-	-	-	2	2	-	-	2	-	-	4	2	-	-	-	2	6
N. gracilis Hantzsch.	-	6	-	-	2	2	-	-	-	4	-	-	-	-	12	2	6	80
Pinnularia sp. I	4	-	-	-	-	-	4	-	4	-	-	-	4	2	4	6	-	18
Pinnularia sp. II	-	-	2	2	-	2	-	-	4	-	-	-	-	-	-	6	-	6
Tabellaria fenestrata (Lyngb) Kutzing	-	8	4	-	2	6	-	8	6	2	-	-	-	4	6	12	12	30
T. floculosa (Roth)Kutzing	-	6	2	4	-	4	-	-	-	2	-	-	-	-	2	-	-	-
Order: Centrales																		
Coscinodiscus maginatus (Ehr)	-	-	4	4	2	6	4	-	-	6	-	-	-	-	-	-	-	-
Cyclotella striata (Kutz) Grunow	-	-	6	14	-	-	-	6	2	10	4	-	-	-	4	38	14	4
Podosira tenebro Leuduger Fort.	-	4	-	36	6	18	-	16	-	14	18	12	-	4	-	8	8	28
Thallasiossira condeusata					6					4	4						4	
Green Algae (Chlorophyceae)																		
Order: Zygnematales																		
Microspora sp.	-	-	-	-	8	10	-	-	-	-	-	8	-	-	-	-	-	4
Netrium digitus	-	2	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	6
order: Euglenales																		
Trachelomonas hispida (Perty) Stein.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Order:Oedogoniales																		
Bulbochaete gigantea	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Blue-green algae(Cyanobacteria)																		
Order:Hormogonales																		
Anabaena sp.	10	22	4	4	4	-	6	-	2	24	2	-	-	-	8	8	8	2
Oscillatoria agardii Gomont	-	2	16	2	-	-	-	4	6	2	4	-	-	-	4	4	-	-
O. margaritifera Kutzing (Gomont)	-	-	4	2	-	-	-	10	-	2	-	-	-	4	-	4	-	-

S = September, O = October; N = November; D = December; J = January; F = February

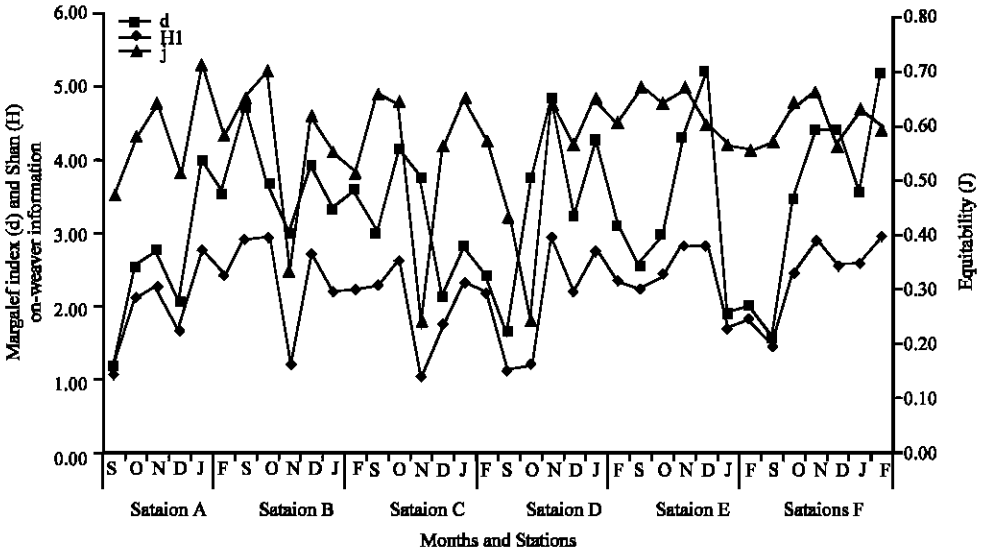

Fig. 2: Monthly variations in Margalef' (d) value equitability (j) and Shannon-weaver information (H^1) at Abule-Eledu creek throughout the sampling period

Table 4: Coefficient of similarity between different stations of Abule Eledu Creek

Stations	Sept.1998	Oct.1998	Nov.1998	Dec.1998	Jan.1999	Feb.1999
A : B	0.21	0.380	0.58	0.39	0.32	0.41
A : C	0.38	0.190	0.39	0.53	0.30	0.39
A : D	0.55	0. 260	0.22	0.46	0.18	0.42
A : E	0.40	0.220	0.19	0.33	0.26	0.21
A : F	0.55	0.370	0.30	0.35	0.31	0.35
B : C	0.35	0.490	0.56	0.40	0.43	0.51
B : D	0.10	0.220	0.28	0.43	0.40	0.50
B : E	0.30	0.300	0.32	0.47	0.33	0.39
B : F	0.14	0.420	0.30	0.36	0.18	0.37
C : D	0.35	0.330	0.36	0.48	0.26	0.55
C : E	0.38	0.380	0.49	0.46	0.20	0.58
C : F	0.24	0.500	0.29	0.36	0.14	0.38
D : E	0.63	0.380	0.47	0.62	0.22	0.48
D : F	0.17	0.250	0.44	0.45	0.44	0.38
E : F	0.13	0.360	0.55	0.48	0.48	0.42

Coefficient of similarity: Apart from few occasions, similarities between various stations in Abule-Eledu creek were low. It was only in September that similarities were above 0.50. There was evidence that similarity increased in February (0.583) from a low value of 0.20 in December. Similarities were generally increased in February except for few stations (Table 4).

DISCUSSION

The physical and chemical changes observed in the creek may have been a reflection of the seasons. The lower temperature values recorded in the wet months is in agreement with what Olaniyan (1957), Hill and Webb (1958) and Nwankwo (1984) observed for the Lagos lagoon. Dilution of the creek water during the wet months, the degree of dilution and flushing depended on the amount of rainfall in the catchments area and the attendant effects of flood waters. According to Webb (1960), in the tropics, rainfall is more important than temperature in determining environments. Rainfall possibly initiated floods which increased suspended and dissolved solids, diluted the water thereby lowering salinity and conductivity and broke down any stratification. Flooding caused changes in the volume of water and the dilution of nutrients. Similar effects of dilution have been highlighted by Thomas (1966) and Biswas (1968) in some water bodies in Ghana. Imevbore (1968) associated low phytoplankton production at Eleyele reservoir Ibadan with unfavourable flood effects and Adeniji (1978) reported variations of phytoplankton production in Kainji Lake, Nigeria with flood condition. Similar observation was made by Nwankwo (1984) who associated the lesser concentrations of phytoplankton biomass in the wet months to higher rainfall and subsequent increased flood water. According to Karlman

(1982) transparency regulates primary production in a accordance with flood conditions. Similarly, Nwankwo (1991) reported that turbidity and dilution by freshwater were the major factors limiting growth of periphytic algae on fish fences in the Lagos lagoon. The dominance of diatoms in the sampling areas conforms with observation made by Nwadiaro (1990) in the Chanomi creek system of the Niger delta, Chindah and Pudo (1991) in Bonny River, Erondu and Chindah (1991) in the New Calabar River and Nwankwo (1986,1991) in the lagoons of south western Nigeria. The dominance of pennate forms over centric suggest the introduction of bottom dwelling forms into planton either through the Artisanal fishing or as a result of shallow depth.

Generally, low diversity values were observed in the sampling sites probably suggesting the effects of stress condition in the environment. According to Patrick (1976) diatom community affected by toxic pollution typically has a low diversity and a low number of species. However, in this creek stress condition may have been imposed by the drying up of some parts at the peak of the dry months for instance, the depth of water in station F reduced drastically between December and February. Moreover the pennate forms dominated at this period in station F. The degree of similarity increased in wet months possibly because of the influence of flood water and the introduction of species from creeklets. The results of this investigation suggest that the abundance of the phytoplankton depends on the depth of the water.

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