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WET SEASON SPATIAL OCCURRENCE OF PHYTOPLANKTON AND ZOOPLANKTON IN LAGOS LAGOON, NIGERIA.

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ABSTRACT
Investigation into the spatial occurrence of wet season phytoplankton and zooplankton in Lagos lagoon, Nigeria was carried out in October, 2008 in 12 stations. A total of 36 species of phytoplankton from 21 genera, 20 zooplankton species from 17 genera and 10 juvenile forms were recorded for the study. The results showed that freshwater conditions within the lagoon were due to high freshwater inflow from adjoining waterways and reduced tidal incursion from the sea. The wet season spectrum of the lagoon was dominated by diatoms for the phytoplankton and copepods for the zooplankton. The presence and array of juvenile forms in the wet season suggest that the lagoon remain a sanctuary, nursery and breeding grounds for aquatic species Crustaceans dominated the spectrum of the juvenile forms.

***Keywords*:** Plankton, Physico-chemical characteristics, lagoon, juvenile forms, Lagos.

INTRODUCTION

An intricate network of creeks, rivers and lagoons exist in south-western Nigeria which eventually connects to the sea via the Lagos harbour (Onyema, 2007). Lagoons in this region are connected and run parallel to the Gulf of Guinea coastline over a distance of 237 km (Hill & Webb, 1958). The Lagos lagoon is open and tidal. The lagoon, with a surface area of 208 km^2 and an average depth of 1.5m is a shallow micro-tidal environment (FAO, 1969). Salinity regime in the lagoon is seasonal with high salinities reported from December to April and low salinities observed between May and November. Various ecologists (Hill & Webb, 1958; Olaniyan, 1975; Nwankwo, 1986) have attributed salinity gradients within the lagoon to two main factors; influx of floodwater from rivers and creeks surrounding wetlands and tidal seawater inflow through the Lagos harbour.

Investigations of anthropogenic wastes and environmental modifications in the Lagos lagoon have revealed increased levels of pollution stress (Ajao,1996, Onyema *et al*., 2003, 2007; Edokpayi & Nkwoji, 2007). According to Nwankwo (2004), an important ecological ramification of increasing population pressure, poor sewerage system, industrialization and poor waste management in Nigerian's coastal area is that pollutants freely find their way unabated into our coastal waters through drains, canals, rivers, creeks and lagoons that act as conduits. Apart from enriching the water with high amounts of biodegradable matter, these discharges introduces nutrients, toxic and other land based substances that may consequently signal epidemiological problems and an increase in human induced stressors which impairs aquatic biodiversity (Nwankwo & Akinsoji, 1988).

Information dealing with the plankton species of the Lagos lagoon and its environs is quite scanty. Existing reports include Olaniyan (1969) on the plankton of the lagoons of South-Western Nigeria and Akpata *et al.,* (1993) on the effects of organic pollution on plankton and benthic population of parts of the Lagos lagoon. More recent studies include Onyema *et al.,* (2003, 2007) at point sources of pollution, Nwankwo *et al*., (2008) on the Kuramo lagoon, Emmanuel & Onyema (2007) on a tidal creek (Abule-elude creek) and Onyema &Ojo (2008) on the lower Ogun river (Agboyi creek). The aim of this work is to investigate the spatial occurrence of phytoplankton and zooplankton in the wet season in relation to environmental characteristics.

MATERIALS AND METHODS

The Study Area: The Lagos lagoon (Fig. 1) located in Lagos State, Nigeria and is one of the nine lagoons in South-western Nigeria (Webb, 1958a; Nwankwo, 2004b; Onyema, 2008a). The lagoon is an open, shallow and tidal lagoon, with a surface area of 208km^2 (FAO, 1969) and an average depth of less than two meters. It provides the only opening to the sea for the nine lagoons of South Western Nigeria. Owing to the dynamics of river inflow and seawater incursion, the Lagos lagoon experiences brackish condition that is more discernable in the dry season. In the wet season, the increased river inflow creates freshwater and low brackish conditions in various parts of the lagoon. The harmattan, a short season of dry, dusty North-East Trade winds are experienced sometimes between November and January in the region reducing visibility and lowering temperatures (Onyema *et al.*, 2003).

In the Lagos lagoon, there is a direct relation between the seasonal bimodal rainfall pattern, the environmental gradient and the biotal gradient. South-western Nigeria is endowed with an intricate network of rivers, creeks and lagoons, which serve as conduits transferring highly nutrified waters from hinterland to coastal areas. Flood waters associated with rainfall are known to enrich the coastal environment, dilutes its ionic concentration and break down existing environmental gradients (Olaniyan, 1969; Nwankwo, 1996). Conversely in the dry season, freshwater inflow is greatly reduced and seawater enters the lagoon through the harbour giving rise to marine conditions near the harbour and brackish water extending far inland (Hill & Webb, 1958; Nwankwo, 1996; Onyema *et al.,* 2003). Hence, areas located in close proximity to the harbour experience greater marine influence than places further inland.

Collection and Analysis of Water Samples: Surface water samples were collected with a 1dm^3 water sampler and stored in 1litre water bottles and analysed in the laboratory for pH, conductivity, salinity and turbidity using a multi-meter water checker (Horiba U-12). Separate water samples were collected in 250ml dissolved oxygen bottles at each station for dissolved oxygen estimation using iodometric Winkler's method. Air and surface water temperature were measured *in situ* using mercury-in-glass thermometers. Alkalinity of the water samples was determined by titrating dilute HCl against 50 ml of the water sample using methyl orange as an indicator.

Collection and Analysis of Plankton Samples: Plankton sample was collected on each occasion with a 55 µm mesh size standard plankton net held against the current of the ebbing tide for 10mins. The net was then hauled in and the sample transferred to a 250 ml well labelled plastic container with screw cap and preserved with 4% unbuffered formalin and stored in the laboratory prior to microscopic analysis in the laboratory.

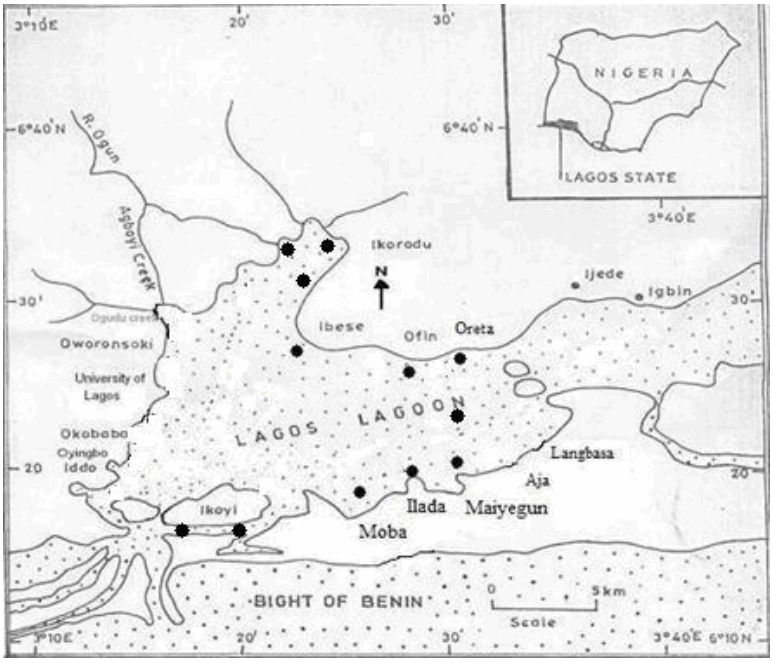

FIG 1. MAP OF LAGOS LAGOON SHOWING THE SAMPLING STATIONS

Ten ml of the concentrated sample was investigated for plankton analyses, at different magnifications (50X, 100X and 400X) using a Wild II Binocular Microscope with calibrated eye piece and the average recorded. A suitable plankton sample mount was then created. The drop count microscope analysis method described by Onyema (2007) was used to estimate the plankton flora and fauna. Since each sample drop from the dropper accounts to 0.1ml, the results on abundance / occurrence were multiplied accordingly to give the values as numbers of organisms per ml which is the standard unit of measurement. Organisms were observed for phytoplankton (cells, filaments, colonies) and zooplankton species (adults and juvenile stages alike). Final data were presented as number of organisms (cells, filaments, colonies and whole organism) per ml. Appropriate texts were used to aid identification of the species encountered (Wimpenny, 1966; Olaniyan, 1975; Vanlandingham, 1982; Nwankwo, 1990, 1995, 2004; Siver, 2003; Rosowski, 2003; Barnes *et al.,* 1993 and Waife & Frid, 2001).

Community Structure Analysis:

Species Richness Index (d): The Species richness index (d) was used to evaluate the community structure.

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

Where:
d = Species richness index
S = Number of species in a population
N = Total number of individuals in S species.

Shannon and Wiener diversity index (Hs) (Ogbeibu, 2005). The Shannon and Wiener diversity index (Hs)

$$Hs = \frac{N \log N - \Sigma Pi \log Pi}{N}$$

Where
Hs = Shannon and Wiener diversity Index
i = Counts denoting the ith species ranging from 1 – n
Pi = Proportion that the ith species represents in terms of numbers of individuals with respect to the total number of individuals in the sampling space as whole.

Species Equitability or Evenness index (j) (Ogbeibu, 2005)**.** The Species Equitability or Evenness index (j)

$$J = \frac{Hs}{\log_2 S}$$

Where
J = Equitability index
Hs = Shannon and Weiner index
S = Number of species in a population

Simpsons dominance index (C) (Ogbeibu, 2005).

$$C = \sum \left(\frac{n_i}{N} \right)^2$$

Where
n = the total number of organisms of a particular species
N = the total number of organisms of all species

RESULTS

The result of the physico-chemical parameters is shown in Table 1 while results of the phytoplankton, zooplankton and juvenile forms are presented in Tables 2a, 3a and 4a respectively with their community composition parameters (Table 2b, 4b and 4b). A total of 36 species of phytoplankton from 21 genera and 20 zooplankton species from 17 genera were recorded during the studies. Generally, stations within the Five Cowries creek recorded known brackish water species than species found in other parts of the lagoon. Furthermore the staition at Oreta recorded no zooplankton species for the study. A total of 10 juvenile forms were also recorded for the study.

TABLE 1. PHYSICO-CHEMICAL PARAMETERS OF THE WATER SAMPLES

	Queen's Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichmtex	Ikorodu port	Majidun
Air Temp. (^{O}C)	28	27.2	26	28	30	30	30	30	30.5	30	30	31
H_2OTemp. (^{O}C)	29	29	28	28	28.9	29	29	29	29.5	28	28	28
pH	9.1	8.9	9.0	9.1	8.9	8.8	9.2	8.9	9.0	9.0	8.8	9.1
Conductivity ($mScm^{-1}$)	0.84	1.0	0.64	0.67	0.61	0.12	0.19	0.3	0.24	0.54	0.18	0.61
Turbidity (NTU)	78	366	126	108	208	226	86	386	248	256	346	276
Salinity ($^{o}/_{oo}$)	0	0	0	0	0	0	0	0	0	0	0	0
D.O (mgl^{-1})	11.2	13.6	18.4	15.6	12.0	11.2	12.4	12.4	12.8	9.2	8.0	5.2
Alkalinity	8.0	8.0	6.0	8.0	10.0	8.0	8.0	8.0	8.0	8.0	12.0	8.0

Phytoplankton community structure: The species composition of the phytoplankton is presented in Table 2a.

For the twelve stations studied, diversity (S) ranged between 5 species (Park view and Oreta) and 26 species (Nichemtex). Abundance of individuals per ml (N) of the samples was between 85 individuals per ml (Itedo) and 895 individuals per ml (Majidun). Whereas Log of Species diversity (Log S) ranged between 0.70 (Park view) and 1.04 (Ofin), Log of phytoplankton abundance (Log N) were between 1.93 (Itedo) and 2.95 (Majidun). Furthermore, the values for Shannon-Wiener Index (Hs) were between 0.48 (Park view) and 1.10 (Nichemtex). Menhinick Index (D) on the other hand ranged between 0.48 (Park view) and 1.09 (Nichemtex). Margalef Index (d) values also ranged between 0.82 (Oreta) and 3.68 (Majidun). Equitability Index (j) index values were between 0.57 (Ikorodu port) and 0.93 (Queens Drive). Simpson's Dominance Index (C) also ranged between 0.09 (Nichemtex) and 0.43 (Oreta). (Table2b).

TABLE 2a. SPATIAL VARIATION IN THE PHYTOPLANKTON COMPOSITION AND ABUNDANCE IN SOME PARTS OF THE LAGOS LAGOON.

Stations	Queen's Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
PHYTOPLANKTON TAXA												
DIVISION – BACILLARIOPHYTA												
CLASS – BACILLARIOPHYCEAE												
ORDER I – CENTRALES												
Actinoptychus splendens Ehrenberg	20	25	-	5	-	5	-	10	5	5	15	30
Aulacoseira granulata Ehrenberg (Ralfs)	10	20	70	35	50	20	80	75	55	20	75	105
Aulacoseira granulata var. *angustissima* Muller	-	-	5	10	-	5	10	15	25	20	415	450
Aulacoseira granulata var. *curvata* Simon	-	-	-	-	-	10	5	15	5	5	5	15
Aulacoseira sp.												
Coscinodiscus eccentrius Ehrenberg	35	-	25	5	5	-	-	-	-	-	-	-
Coscinodiscus radiatus Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-
Cyclotella menighiniana Kutzing	-	-	-	-	5	-	-	-	5		36	5
Cyclotella striata (Kutzing) Grunow	-	-	-	-	-	-	-	5	-	-	-	
Terpsinoe musica (Ehr) Hustedt	-	-	-	-	-	-	-	-	-	-	-	10
Order II – PENNALES												
Gyrosigma balticum (Ehr.) Rabenhorst	15	10	25	5	-	10	-	-	-	-	-	-
Gyrosigma balticum (Ehr.) Rabenhorst												
Navicula mutica Kutzing												15
Pinnularia major (Kutzing) Rabenh	-	-	-	-	-	-	-	5	-	15	-	5
Pleurosigma angulatum (Quekett) Wm Smith	25	50	10	-	5	-	-	-	-	-	-	-
Surirella splendida Wm. Smith	-	-	-	-	-		-	-	-	5	-	5
Synedra crystallina (Ag) Kutzing	5		5	15	5	-	-	5	15	10	45	15
Synedra sp.	-	-	-	-	-	-	-	-	-	-	-	10
Synedra ulna (Nitzsch) Ehrenberg	-	-	-	-	-	10	-	-	5	-	5	15

TABLE 2a. CONT. SPATIAL VARIATION IN THE PHYTOPLANKTON COMPOSITION AND ABUNDANCE IN SOME PARTS OF THE LAGOS LAGOON.

	Queen's Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikd. port	Majidun
DIVISION – CYANOPHYTA												
CLASS – CYANOPHYCEAE												
ORDER I – CHROOCOCCALES												
Microcystis flos-aquae Kirchner	-	-	-	-	-	5	-	15	-	-	20	45
Microcystis flos-aquae Kirchner	-	-	-	-	-	-	-	-	-	-	-	5
Order II – HORMOGONALES												
Oscillatoria chalybea Gomont	-	-	-	-	-	-	-	-	5	25	-	-
Oscillatoria curviceps C.A. Agardh	-	-	-	-	-	-	-	-	-	15	15	15
Oscillatoria limnosa Agardh	15	5	5	-	10	-	5	-	-	5	5	5
Oscillatoria tenius Agardh	-	-	-	-	-	5	-	-	15	-	5	-
Spirulina platensis Geitler	-	-	-	-	-	-	-	-	-	-	-	15
DIVISION – CHLOROPHYTA												
CLASS – CHLOROPHYCEAE												
ORDER I – ULOTHRICALES												
Spirogyra africana Fritsch Cruda	-	-	-	-	-	-	-	5	-	5	-	25
Spirogyra sp.	-	-	-	-	-	-	-	-	-	-	-	5
ORDER II - ZYGNEMATALES												
Closterium ehrenbergii Meneghini	-	-	-	-	-	-	-	-	5	35	25	30
Closterium moniliferum (Bory.) Ehrenb.	-	-	-	-	-	-	-	-		5		5
Gonatozygon sp.				25	5	55	35	50		10		25
ORDER III – CLADOPHORALES												
Cladophora glomerata (L) Kutzing	-	-	-	-	-	-	-	-	-	5	-	25
DIVISION – EUGLENOPHYTA												
CLASS – EUGLENOPHYCEAE												
ORDER – EUGLENALES												
Euglena acus Ehrenberg	-	-	-	-	-	-	-	-	-	30	-	5
Phacus acuminatus Stokes	-	-	-	-	-	-	-	5	-	-	-	5
Phacus curvicauda Swirenko	-	-	-	-	-	-	-	-	-	-	-	
Trachelomonas hispida (Perry) Stein	-	-	-	-	-	-	-	-	-	-	5	5
Total species diversity (S)	**7**	**5**	**7**	**7**	**7**	**9**	**5**	**11**	**10**	**16**	**13**	**26**
Total phytoplankton abundance (N)	**125**	**110**	**145**	**100**	**85**	**125**	**135**	**205**	**140**	**215**	**671**	**895**

Zooplankton Community Structure: For the zooplankton, the Phylum - Crustacea was the dominant phyla recorded for the study. Among the copepods which were the most important group in terms of diversity and abundance, 3 sub-orders namely Calanoida represented by 5 species (*Acartia clausii* , *Acartia discaudata, Acartia tonsa* and *Paracalanus parvus* and *Pseudocalanus elongatus*), Cyclopoida represented by 5 species **(***Corycaeus anglicus, Cyclopina longicornis, Cyclops strenus, Cyclops* sp. and *Oithona plumifera***)** and Harpaticoida represented by 1 species - *Enterpina acutifrons. With regard to the* Subclass: Branchiopoda (Cladocerans) they were represented by 4 species namely *Bosmina* sp., *Diaphanosoma excisum, Diaphnia* sp. and *Penilia avirostris.* For the Phylum – Chaetognatha (arrow worms), *Sagitta enflata* was the sole species recorded. For the Phylum Rotifera (rotifers) 4 species were recorded viz. *Brachionus plicatilis, Keratella* sp., *Lecane bulla* and *Tetrasiphon hydrocoral* (Table 3a).

For the twelve stations studied, diversity (S) ranged between 0 species (Nichemtex) and 9 species (Queens Drive, Moba, Ikorodu port and Majidun). Abundance of individuals per ml (N) of the samples was between 0 individuals per ml (Nichemtex) and 120 individuals per ml (Queens Drive). Whereas Log of Species diversity (Log S) ranged between 0 (Itedo, Oreta and Nichemtex) and 0.95 (Queens Drive, Moba, Ikorodu port and Majidun). Log of phytoplankton abundance (Log N) were between 0 (Nichemtex) and 2.08 (Queens Drive). Furthermore, the values for Shannon-Wiener Index (Hs) were between 0 (Itedo and Nichemtex) and 0.93 (Ikorodu port). Menhinick Index (D) on the other hand ranged between 0 (Nichemtex) and 1.12 (Ikorodu port). Margalef Index (d) values also ranged between 0 (Itedo, Ofin, Oreta and Nichemtex) and 1.95 (Moba). Equitability Index (j) index values were between 0 (Itedo, Oreta, Ofin and Nichemtex) and 1.0 (Ikate). Simpson's Dominance Index (C) also ranged between 0 (Nichemtex) and 1.00 (Itedo, Oreta and Ofin). (Table 3b).

TABLE 2b. SPATIAL VARIATION IN PHYTOPLANKTON COMMUNITY COMPOSITION PARAMETERS IN SOME PARTS OF THE LAGOS LAGOON.

Bio-indices	Queens Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
Total species diversity (S)	**7**	**5**	**7**	**7**	**7**	**9**	**5**	**11**	**10**	**16**	**13**	**26**
Total phytoplankton abundance (N)	125	110	145	100	85	125	135	205	140	215	671	895
Log of Species diversity (Log S)	0.85	0.70	0.85	0.85	0.85	0.95	0.70	1.04	1.00	1.20	1.11	1.41
Log of phytoplankton abundance (Log N)	2.10	2.04	2.16	2.00	1.93	2.10	2.13	2.31	2.15	2.33	2.83	2.95
Shannon-Wiener Index (Hs)	0.79	0.59	0.65	0.73	0.61	0.77	0.48	0.82	0.81	1.10	0.63	0.90
Menhinick Index (D)	0.63	0.48	0.58	0.70	0.76	0.80	0.43	0.77	0.85	1.09	0.50	0.87
Margalef Index (d)	1.24	0.85	1.21	1.30	1.35	1.66	0.82	1.88	1.82	2.79	1.84	3.68
Equitability Index (j)	0.93	0.85	0.77	0.86	0.72	0.81	0.68	0.79	0.81	0.91	0.57	0.64
Simpson's Dominance Index (C)	0.18	0.30	0.30	0.23	0.38	0.24	0.43	0.21	0.22	0.09	0.41	0.28

TABLE 3a. SPATIAL VARIATION IN THE ZOOPLANKTON COMPOSITION AND ABUNDANCE IN SOME PARTS OF THE LAGOS LAGOON.

Stations	Queens Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
ZOOPLANKTON TAXA												
PHYLUM-CRUSTACEA												
CLASS – COPEPODA												
SUB-ORDER I: CALANOIDA	25	10	15	5	-	5	-	-	10	-	-	-
Acartia clausii Giesbrecht	15	-	5	-	-	-	-	-	-	-	-	-
Acartia discaudata Giesbrecht	-	-	-	-	-	-	-	-	-	-	-	-
Acartia tonsa Giesbrecht	-	10	5	-	-	-	-	-	-	-	-	-
Paracalanus parvus (Claus)	5	5	10	-	-	15	-	10	5	-	10	-
Pseudocalanus elongatus (Boeck)	10	5	5	-	-	-	-	-	-	-	-	-
ORDER II - CYCLOPOIDA												
Corycaeus anglicus Lubbock	10	5	-	5	5	-	-	-	-	-	-	-
Cyclopina longicornis Boeck	5	-	-	-	-	-		-	-	-	-	-
Cyclops strenus Fisher	-	-	-	-	-	-	5	-	5	-	10	25
Cyclops sp.	-	-	-	-	-	-		-	-	-	5	5
Oithona plumifera Baird	15	5	5	-	-	-		-	-	-	-	-
SUB-ORDER III: HARPATICOIDA												
Enterpina acutifrons Dana	-	5	5	-	-	-	-	-	-	-	-	-
SUBCLASS: BRANCHIOPODA												
ORDER : CLADOCERA												
SUB-ORDER: EUCLADOCERA												
Bosmina sp.	-	-	-	-	-	-	-	-	5	-	5	5
Diaphanosoma excisum (Sar.)	-	-	-	-	-	-	-	-	-	-	5	15
Diaphnia sp.	-	-	-	-	-	-	-	-	-	-	5	10
Penilia avirostris Dana	25	15	5	-	-	-	-	-	-	-	-	-
PHYLUM – CHAETOGNATHA												
ORDER – APHARAGMORPHA												
Sagitta enflata Vogt	10	-	5	-	-	-	-	-	-	-	-	-
PHYLUM: ROTIFERS												
CLASS: MONOGONOTA												
ORDER: PLOIMA												
Brachionus plicatilis Muller	-	-	-	-	-	-	-	-	5	-	10	15
Keratella sp.	-	-	-	-	-	-	-	-		-		20
Lecane bulla Gosse	-	-	-	-	-	5	-	-	5	-	10	15
Tetrasiphon hydrocoral Ehrenberg	-	-	-	-	-		-	-	5	-	5	5
Total species diversity (S)	9	8	9	2	1	3	1	1	7	0	9	9
Total zooplankton abundance (N)	120	60	60	10	5	25	5	10	40	0	65	115

TABLE 3b. SPATIAL VARIATION IN ZOOPLANKTON COMMUNITY COMPOSITION PARAMETERS IN SOME PARTS OF THE LAGOS LAGOON.

	Queens Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
Total species diversity (S)	**9**	**8**	**9**	**2**	**1**	**3**	**1**	**1**	**7**	**0**	**9**	**9**
Total zooplankton abundance (N)	120	60	60	10	5	25	5	10	40	0	65	115
Log of Species diversity (Log S)	0.95	0.90	0.95	0.30	0	0.48	0	0	0.85	0	0.95	0.95
Log of zooplankton abundance (Log N)	2.08	1.78	1.78	1.00	0.70	1.40	0.70	1.00	1.60	0	1.81	2.06
Shannon-Wiener Index (Hs)	0.89	0.86	0.91	0.30	0	0.41	0.00	0.00	0.83	0	0.93	0.89
Menhinick Index (D)	0.82	1.03	1.16	0.63	0.45	0.60	0.45	0.32	1.11	0	1.12	0.84
Margalef Index (d)	1.67	1.71	1.95	0.43	0	0.62	0	0	1.63	0	1.92	1.69
Equitability Index (j)	0.94	0.95	0.95	1.00	0	0.86	0	0	0.98	0	0.97	0.93
Simpson's Dominance Index (C)	0.14	0.15	0.14	0.50	1.00	0.44	1.00	1.00	0.16	0	0.12	0.14

TABLE 4a. SPATIAL VARIATION IN THE JUVENILE STAGES COMPOSITION AND ABUNDANCE IN SOME PARTS OF THE LAGOS LAGOON.

JUVENILE STAGES	Queens Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
PHYLUM : ARTHROPODA												
CLASS : CRUSTACEA												
Barnacle nauplii larva	15	35	20	15	5	-	15	5	5	-	10	15
Copepod eggs	10	10		5	-	5	-	-	-	-	-	-
Copepods nauplii larva	25	15	10	5	-	-	5	10	15	5	10	15
Megalop larva	-	5	-	-	-	10	-	-	5	-	-	-
Zoea larva of crab	15	10	5	5	10	5	5	-	10	-	5	15
PHYLUM: CHORDATA												
Fish eggs	10	5	-	-	5	-	-	-	-	-	-	-
Fish larva	-	-	5	-	-	5	-	5	-	-	-	-
PHYLUM: MOLLUSCA												
Gastropod larva	-	-	-	10	-	15	5	10	5	-	-	-
Bivalve larva	10	5	-	-	-	15		5	5	-	-	-
PHYLUM: ANNELIDA												
Annelid larva	-	5	5	-	-	-	-	-	-	-	-	-
Forms of juvenile stages	6	8	5	5	3	6	4	5	6	1	3	3
Juvenile stage abundance	85	90	45	40	20	55	30	35	45	5	25	45

TABLE 4b. SPATIAL VARIATION IN THE JUVENILE STAGES COMMUNITY COMPOSITION PARAMETERS IN SOME PARTS OF THE LAGOS LAGOON.

	Queens Drive	Park view	Moba	Ikate	Itedo	Mid lagoon	Oreta	Ofin	Ibese	Nichemtex	Ikorodu port	Majidun
Total species diversity (S)	6	8	5	5	3	6	4	5	6	1	3	3
Total phytoplankton abundance (N)	85	90	45	40	20	55	30	35	45	5	25	45
Log of Species diversity (Log S)	0.78	0.90	0.70	0.70	0.48	0.78	0.60	0.70	0.78	0	0.48	0.48
Log of phytoplankton abundance (Log N)	1.93	1.95	1.65	1.60	1.30	1.74	1.48	1.54	1.65	0.70	1.40	1.65
Shannon-Wiener Index (Hs)	0.75	0.78	0.62	0.65	0.45	0.73	0.54	0.67	0.73	0	0.46	0.48
Menhinick Index (D)	0.65	0.84	0.75	0.79	0.67	0.81	0.73	0.85	0.89	0.45	0.60	0.45
Margalef Index (d)	1.13	1.56	1.05	1.08	0.67	1.25	0.88	1.13	1.31	0	0.62	0.53
Equitability Index (j)	0.96	0.86	0.89	0.93	0.95	0.93	0.90	0.96	0.94	0	0.96	1.00
Simpson's Dominance Index (C)	0.19	0.22	0.28	0.25	0.38	0.21	0.33	0.22	0.21	1.00	0.36	0.33

Juvenile Forms: With regard to juvenile stages the Phylum Arthropoda was represented by barnacle nauplii, copepod eggs, copepods nauplii, megalop larvae and zoea larvae of crab. For the Phylum Chordata, fish eggs and fish larvae were represented. For the Phylum Mollusca, Gastropod and bivalve larvae were represented and with regard to the Phylum Annelida, annelid larvae were represented. The crustacean juvenile forms were the more important form in terms of diversity and occurrence. Barnacle nauplii were the most frequent occurring form of the lot (Table 4a). Juvenile forms community composition parameters for the twelve stations studied are shown in Table 4b

DISCUSSION

The highest air temperature (30.5^{o}C) and water temperature (29.5^{o}C) were recorded at Ibese sampling station. Surface water temperature values were high (28^{o}C - 29.5^{o}C) in all the sampling stations. Majidun had the lowest dissolved oxygen values (5.2mg/l) when compared with other stations. This value is just a little above the minimum WHO standard of 5mg/l required for water quality assessment. The water samples were very turbid in all the stations. The period of sampling was a rainy season and particulate matters brought into the lagoon by surface run-off and flood must have caused high turbidity. Zero salinity value was recorded for all the stations and this implies a freshwater condition. This is indicative of the period of sampling, a typical rainy season.

According to Nwankwo (1996) the dynamic interplay between freshwater inflow and tidal seawater incursion determine the Lagos lagoon environment from year to year. For instance In the wet season according to Onyema *et al*., (2003), there is increased river inflow which creates freshwater and low brackish water conditions in various parts of the lagoon. For the present study, salinity levels were low at all the stations samples. This is likely due to freshwater inflow and reduced tidal incursion (Hill & Webb, 1958). Onyema (2007) observed a direct relation between the seasonal bimodal rainfall pattern, the environmental and biotal gradient in the Lagos lagoon.

With regards to the plankton spectrum the diatoms were clearly the dominant phytoplankton form where as the copepods particularly the calanoid forms were the more important forms for the zooplankton. Onyema *et al*., (2003) observed that whereas diatoms dominate the phytoplankton population, copepods were prominent members of the zooplankton population of the Lagos lagoon. Nwankwo (1996) had earlier reported high diatom production in the Lagos lagoon and attributed the numerous pennate forms to the tidal induced mixing of the phytobenthic forms and the plankton.

The juvenile forms encounter in the study were also ecologically important. The Lagos lagoon has been described by authors as a nursery ground for an array of aquatic biota. For this study for instance a total of 10 juvenile stages were recorded. This is more than the numbers recorded by Akpata *et al*., 1993, Onyema *et al*., (2003, 2007) and Onyema & Ojo (2008). This may reflect that the Lagos lagoon even in the wet season still serves as a nursery and breeding ground for juveniles as evident by the presence of an array of juvenile stages. Owing to the distributive rainfall pattern in southwestern Nigeria there exists four ecologically important periods in our coastal waters (Nwankwo, 2004). These are the dry months (Jan –March/ April) when high salinity is experienced in the coastal waters and lagoons; April/May, when the salinity drops drastically causing a stress condition and a resultant loss of biodiversity arising from the death of marine biota that invade the coastal water in the dry high salinity months. At this time (April/May) only opportunistic forms such as *Gomphosphaeria aponina, Amphora coffeaformis* abound. There are the wet months (June – Nov.) when the coastal lagoons are fresh and December when the salinity rises sharply, excluding freshwater forms. This may explain why there was few brackish water or estuarine species recorded. Additionally a significant number of the species recorded in this study were freshwater species. For instance *Aulacoseira granulate, Aulacoseira granulata* var. angustissima, *Aulacoseira granulata* var. curvata, *Microcystis flos-aquae, Microcystis aureginosa, Spirogyra Africana, Closterium ehrenbergii, Gonatozygon* sp. and *Euglena acus* among others have been reported by a number of authors (Kadiri, 1999, Nwankwo, 1988, Onyema, 2008) as fresh water species. Few authors are of the view that the most productive period in the coastal waters of south western Nigeria occurs after the second rainfall period (October or November) and that plankton diversity in the Lagos lagoon increases towards the harbour.

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