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# Diatoms and Dinoflagellates of an Estuarine Creek in Lagos.

I.C. Onyema*, D.I. Nwankwo and T. Oduleye *Department of Marine Sciences,*
*University of Lagos, Akoka-Yaba, Lagos,*
*Nigeria.*

**ABSTRACT**

*The diatoms and dinoflagellates phytoplankton of an estuarine creek in Lagos was investigated at two stations between July and December, 2004. A total of 37 species centric diatom (18 species) pennate diatoms (12 species) and 7 species of dinoflagellates were recorded. Values of species diversity (1 - 14), abundance (10 - 800 individuals), species richness (0 - 2.40) and Shannon and Weiner index (0 - 2.8f) were higher in the wet period (July - October) than the dry season (November - December). These bio-indices were higher in station A than Bfor most of the study period. Almost all the diatoms and dinoflagellates recorded for this investigation have been reported by earlier workers for the Lagos lagoon, associated tidal creeks and offshore Lagos. The source of recruitment of the lagoonal dinoflagellates is probably the adjacent sea as most reported species were warm water oceanic forms.*

**Keywords: diatoms, dinoflagellates, plankton, hydrology, salinity.**

## INTRODUCTION

In Nigeria there are few studies on the diatoms and dinoflagellates of marine and coastal aquatic ecosystems. Some of these studies are Olaniyan (1957), Nwankwo (1990a), Nwankwo and Kasumu-Iginla (1997), Nwankwo (1991) and Nwankwo (1997). Other works such as Chindah and Pudo (1991), Nwankwo (1986, 1996), Chindah (1998), Kadiri (1999), Onyema *et al. (2003,* 2007), Onyema (2007, 2008) have investigated phytoplankton assemblages and pointed out the dominance of diatoms.

Diatoms and dinoflagellates are important components of the photosynthetic organisms that form the base of the aquatic food chain (Davis, 1955; Sverdrop *et al.,* 2003). According to Nwankwo (1990b) dinoflagellates are second in importance only to the diatoms as basic food producers in the plankton of marine waters. Unlike diatoms most dinoflagellate species are planktonic and live in salt water, although there are many freshwater species. Under favourable conditions both diatoms and dinoflagellates may form blooms that may result in deleterious consequences to other biosystems. For instance Nwankwo *et al.* (2003) have already reported 3 diatoms and 4 dinoflagellate species as noxious algae for the coastal waters of south-western Nigeria with reported harmful effects in the region.

*^Corresponding author. E-mail: iconyeama@yahoo.com.au*

Existing records on the algal flora of south-western Nigeria creeks are quite limited. The available reports are on the periphytic and epiphytic algae of the Ogbe creek (Nwankwo and Akinsoji 1988; Nwankwo and Amuda, 1993) the epipelic algae of the Ijora creek (Onyema, 2007; Onyema and Nwankwo, 2006) and the plankton of the Abule-Agege creek (Emmanuel and Onyema, 2007). There is a dearth of literature on any aspect of the ecology of the Five Cowrie creek. The aim of this study was to investigate the composition and distribution of diatoms and dinoflagellates species within the Five Cowrie creek. This information may have scientific and economic implications.

## MATERIALS AND METHODS

### Study Site

The Five Cowrie creek is one of the numerous adjoining creeks to the Lagos lagoon. It is connected to the lagoon at two ends and the Kuramo creek that drains the Kuramo lagoon. The Five Cowrie creek is flanked at both sides by highly industrialized and densely populated urban setting. The creek separates Lagos island and Ikoyi from Victoria Island. It is connected to Lagos lagoon at the Lagos habour and at the extreme of the eastern part of Ikoyi at Moba. The creek has an approximate length of 7km and stretches from about Latitude 6° 26' N, Longitude 3° 24' E to Latitude 6° 26' N, Longitude 3° 27' E, The creeks banks at many points are continually

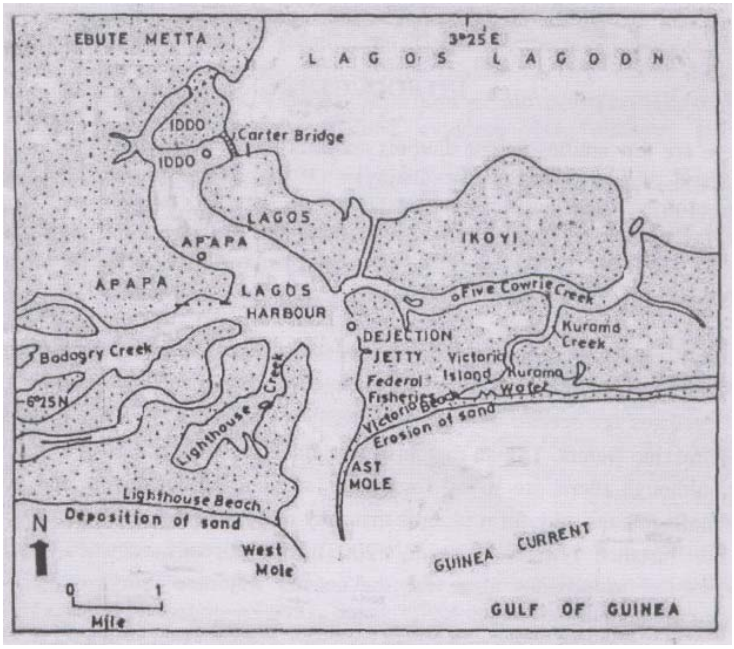


**Fig. 1: Part of the Lagos lagoon showing the Five Cowrie creek.**

subjected to high levels of topographical modification in response to the conflict of land use and the dire need of it. At high tide, water enters into the creek through the Lagos habour end, whereas at low tide water is drained from the eastern part of the Lagos lagoon through the creek to the habour enroute to the sea. The creek experiences semi-diurnal tidal influence from the harbour and freshwater discharges from the adjoining urban areas and the lagoon. According to Hill and Webb (1958) tidal flow in the Five Cowrie creek is the fastest anywhere in the Lagos lagoon system. The region during the course of a year experiences two seasons, the wet season (May - October) with a short dry break usually in August, and the dry season (November -April).

Waste discharges from the Lagos island, Ikoyi and Victoria island find their way unabated into the creek. Floating garbage/debris and oil base discharges especially from commercial boat operators are very frequent sights within the creek. Habour and port related activities and their associated waste input also impact the creek. The region is exposed to high level human and vehicular (motor cars, boat and ship) traffic.

Collection of Samples

Samples were collected for six months (July - December 2004) using a 55um mesh size standard plankton net tied unto a motorized boat and towed at low speed (< 4 Knots) and at two stations (stations A and B) each time for 5 minutes. The filtrate from the plankton net after collection was transferred into 200ml properly labeled plastic containers with screw cap and preserved in 4% unbuffered formalin.

Biological Analysis

In the laboratory one drop, five different times for each sample was investigated at different magnifications (X100 and X400) using a Wild Mil binocular microscope with a calibrated eye piece. The microtransect drop count method described by Lackey (1938) was employed. Since each drop is O.lml and two drops were used for each sample mount, results on abundance were multiplied by 5 to give me values as numbers of organisms per ml. Appropriate texts were used to aid identification (Smith 1950; Davis, 1955; Hendey, 1958, 1964; Newell and Newell, 1966; Wimpenny, 1966; Patrick and Reimer, 1966, 1975; Whitford and Schmacher, 1973; Nwankwo, 1990a, 2004a; Bettrons and Castrejon, 1999).

Community Structure Analysis

The following diversity indices were used for biological data analysis.

Species Richness Index (d)

The Species richness index (d) according to Margalef (1951). The equation below was applied and results was recorded to two decimal places.

$$d = S - l \ \ln N$$

where d = Species richness index, S = Number of species in a population and N = Total number of individuals in S species.

Menhinick's Index (D) (Ogbeibu, 2005).

$$D = S$$

S = Number of species in a population and N = Total number of individuals in S species.

Shannon and Weiner diversity index (Hs)
Shannon and Weiner (1963) diversity index (Hs) was determined by the equation:

$$Hs = I\ Pi\ In\ Pi$$

where Hs = Diversity Index, I = Counts denoting the ith species ranging from 1 - n and 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.

Coefficient of Similarity (S) f
This is the measure of the degree of similarity between species in two nabitats. This index was obtained using the equation (Ogbeibu, 2005).

$$S = \_\_2C\ A + B$$

where S = Index of similarity between two samples, A= Number of species in sample A, B= Number of species in sample B and C= Number of species common to both samples.

## RESULTS

Table 1 shows the composition and abundance (cells per ml) of diatoms and dinoflagellates of the Five cowrie creek from July to December, 2004. Bio-indices of the occurrence of these species are also included.

A total of 37 species were recorded from this study. The diatoms were represented by 30 species with the centric forms (18 species) better represented in terms of taxa than the pennate forms (12 species). *Chaetoceros* (5 species), *Biddulphia* (4 species) and *Thalassionema* (3 species) were the most represented genera. Species of *Biddulphia* were more frequently represented in terms of occurrence. The centric forms occurred throughout the study while the pennate forms showed higher representation during rainy season than the dry season. The dinoflagellates were represented by 7 species with the genus *Ceratium* making up 6 species.

Values of species diversity (1 - 15), abundance (10 - 800 individuals), species richness (0 - 2.40) and Shannon and Weiner (0 - 2.80) indices were higher in the wet season (July - October) than the dry season (November - December). These bio-indices were comparatively higher in station A than B for most of the study period.

Similarity index followed a similar trend as the other biotic indices with regard to temporal variations. Values for this index (0 - 0.56) were higher in the wet seasons (July - Oct) than the

dry season (November - December). Hence the stations were more similar in terms of species composition in the wet season.

*Table 1: Composition and abundance of phytoplankton (cells per ml) from the five Cowrie creek between July and December 2004.*

| | JUL | | AUG | | SEPT | | OCT | | NOV | | DEC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAXA | A | B | A | B | A | B | A | B | A | B | A | B |
| DIVISION: BACILLARIOPHYTA | | | | | | | | | | | | |
| CLASS: BACILLARIOPHYCEAE | | | | | | | | | | | | |
| ORDER I: CENTRALES | | | | | | | | | | | | |
| *Bacteriastrum hyalinum* Castracane | | | 10 | 10 | | | | | | | | |
| *Biddulphia aurita* Lyngbye | | | | | 40 | | 20 | 10 | | | | |
| *Biddulphia biddulphiana* Sra Bayer | | | 10 | | 20 | 10 | | | | . | | 10 |
| *Biddulphia regia* Schultze | | | | | | 20 | | | | 20 | | |
| *Biddulphia sinensis* Greville | | | | 10 | 60 | 30 | 10 | | 30 | | 10 | |
| *Campylodiscus sp* | 10 | | | | | | | | | | | |
| *Coscinodiscus radiatus* Ehrenberg | 20 | | 10 | | | 20 | | | | | | 20 |
| *Chaetoceros atlanticum* Cleve | | | 160 | 60 | | 10 | | | | | | |
| *Chaetoceros constriction* Gran | | | | 10 | | | | | | | | |
| *Chaetoceros decipens* Cleve | | | 90 | 40 | 20 | | | | | | | |
| *Chaetoceros lorenzianum* Grunnow | | | | 10 | | | | | | | | |
| *Chaetoceros radicans* Schutt | | | | | | | | | | 20 | | |
| *Cyclotella meneghiniana* Kutzing | | | | | 30 | | | | | | | |
| *Guinardia flaccida* Castracane | | | | | | 10 | | | | | | |
| *Melosiramoniliformis(O.FM)Agardh* | 100 | 20 | | | | 40 | | | | | 30 | |
| *Melosira numuloides* (Dillw) Agardh | 50 | 10 | | | | | | | 10 | | | |
| *Podosira stelliger* Bailey | 20 | 10 | | | | | | | | | | |
| *Rhizosolenia styliformis* Brightw | 10 | | 10 | 10 | | | | | | | | |
| ORDER II: PENNALES | | | | | | | | | | | | |
| *Gyrosigma balticum* Ehrenberg | 10 | | | | | | | | | | | |
| *Licmophora lyngbeyei* Kutzing | 60 | | | | | | | | | | | |
| *Licmophora sp* | 70 | | 10 | | | | | | | | | |
| *Navicula expansa* Haglestoin | 80 | | | | | | | | | | | |
| *Navicula causpidata* Kutzing | 50 | | | | | | | | | | | |
| *Nitzschia sigmoidea* Nitzsch | 10 | | | | | | | | | | | |
| *Pinnularia sp* | 10 | | | | | | | | | | | |
| *Synedra crystallina* Kutzing | 110 | | 40 | 30 | | | | | | | | |
| *Synedraulna* Nitzsch | 30 | | 60 | 10 | | | | | | | | |
| *Thalassionemafrauenfeldii* Grunow | 80 | 50 | | | | | | 10 | | | | |
| *Thalassionema longissima* Grunow | 90 | 40 | | | | | | | | | | |

130 100 50 20 10

**JUL**

*Thalassionema nitzschiodes* Grunow

DIVISION: PYRRHOPHYTA CLASS: DINOPHYCEAE *Ceratiumfusus* Ehrenberg *Ceratium lineatum* Ehrenberg *Ceratium*

20 10

20

*macroceros* Ehrenberg *Ceratium massilense* Gourret *Ceratium trichoceros* Ehrenberg *Ceratium vultur* Cleve *Dinophysis caudata* Kent

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Species Abundance | 14 630 | 3 40 | 17 | 15 | 7 | 8 | 2 30 | 1 10 | 3 90 | 3 50 | 3 60 | 3 40 |
| Species Margalef s Species Richness | 2.02 0.56 | 0.54 | 800 | 430 | 190 | 150 | 0.29 | 0 | 0.44 | 0.51 | 0.49 | 0.54 |
| (D) | | 047 | 2.40 | 2.31 | 1.41 | 1.40 | 017 | 03? | 037 | 0.42 | 039 | 0.47 |
| | | | 060 | 073 | 051 | 065 | | | | | | |
| Shannon And Weiner (Hs) Similarity | 2.80 0.35 | 1.60 | 1.09 | 1.03 | 1.21 | 0.82 | 0.28 | 0 | 0.37 | 0.46 | 0.39 | 0.45 |
| Index (S) | | | 0.56 | | 0.27 | | 0.33 | | 0 | | 0.17 | |

## DISCUSSION

A good number of the diatoms and dinoflagellates recorded for this investigation have been reported by earlier workers for the Lagos lagoon and associated tidal creeks (Nwankwo, 1988, 1996, 1998; Onyema and Nwankwo, 2006; Nwankwo and Onyema 2003). Like for the Lagos lagoon it is possible that tidal seawater incursion and flood water inputs are important sources of recruitment for diatoms and dinoflgellates species in the Five Cowerie creek (Onyema, 2007). Common diatom taxa for the Lagos lagoon also encountered in his study include *Biddulphia aurita, Biddulphia regia, Biddulphia sinensis, Coscinodiscus radiatus, Cyclotella meneghiniana, Melosira moniliformis, Melosira numuloides, Gyrosigma balticum, Nitzschia sigmoidea, Synedra crystallina* and *Synedra ulna* (Nwankwo, 1988, 1996).

The presence of *Chaetoceros, Biddulphia, Thalassionema* and *Rhlzosolenla* species probably point to their source of recruitment. These taxa are known marine forms in the zone (Nwankwo and Onyema, 2003). According to Nwankwo (1986), salinity and floodwater conditions are known to regulate the algal composition and abundance in the Lagos lagoon. A similar situation likely exists for the Five Cowrie creek. It is important to note that *Aulacoseira granulata* and its verities common for most of the phycological studies in the region (Nwankwo, 1988, 1996; Onyema, 2007; Onyema *et al.,* 2003, 2007) was absent in the creek plankton. Nwankwo (1988) has already associated these species to primarily fresh water conditions associated with the wet

season and much reduced salinities. According to Nwankwo and Akinsoji (1989) diatoms are known to dominate the plankton algae of the Lagos lagoon.

Nwankwo (1997) is of the view that with regard to the Lagos lagoon there is an increase in the dinoflagellate cell numbers during periods of high salinity and low nutrient levels and suggests a possible relationship. Nwankwo (1990b) also suggested that the source of recruitment of the lagoonal dinoflagellates (Lagos lagoon) in the adjacent sea since most of the reported species were warm water oceanic forms.

For instance according to Nwankwo (1990b), more dinoflagellates were found in the marine neritic and high brackish water zone of the Lagos lagoon and the number of species decreased in the stations further inland. Species such as *Ceratium macroceros, C. massilense* and *C. tripos* were the most wide spread species in the lagoon. *Dinophysis caudatta* recorded for this study has been recorded by Nwankwo (1990b). According to Nwankwo (1990b) it could be inferred that the source of recruitment of the lagoonal dinoflagellates is the adjacent sea since most reported species were warm water oceanic forms. Among the dinoflagellates, the genus *Ceratium* formed a good number of the recorded species (6 taxa). Nwankwo (1988) recoreded 8 species of *Ceratium* which also dominated the dinoflagellates in that study. Similarly, Nwankwo (1990b) also tecoKkd IS tax&o€ C«ra?ium fonsag ^ -significant part of the total dinoflagellates (28 taxa). The dinoflagellate species recorded for this study have been previously recored for the region (Nwankwo, 1988, 1991, 1997, Nwankwo 2004, Nwankwo *et al .,* 2003, Onyema *et al* .,2003, 2007). Futher to this, the entire community of dinoflagellates recorded by Nwankwo and Onyema (2003) were all of the genus - *Ceratium.* Common dinoflagellate forms include *Ceratium fusus, Ceratium macroceros* and *Dinophysis caudata.*

The relatively higher species richness recorded at station A as compared to that of station B throughout the sampling period could be due to the mixture of different communities adjoining at the former. It is possible that values for similarity index were higher in the wet than dry season because of the sourcing, dislodging and floodwater mixings associated with the rains. This was particularly evident in station A in July and August. The dry season probably with increasing salinity created environmental gradients. According to Onyema *et al.* (2003) the diluting and enriching effects of floodwaters, inflow of seawater and the existence of environmental gradients govern the distribution of Lagos lagoon biota.

Nwankwo (2004b) and Nwankwo and Akinsoji (1989) are of the view that during the rains vertical and horizontal gradients created especially hi the dry season are broken down with the coming of the rains. Similar controlling factors may be responsible for higher values for all the bio-indices used in the wet than dry season. Onyema and Nwankwo (2006) reported that for the epipelic community of the Ijora creek, the rain drops and the scouring effect of flood waters may be key limiting factors to the development of the endemic epipelic communities. Hence the distribution of diatoms and dinoflagellates species could be said to be largely seasonal in the Five Cowrie creek.

From this study, it maybe possible to denote that observed presence or absence of diatom or dinofagellate species may not indicate any particular type of pollution or zone of contamination

but may be as a result of the changing physical environment. For instance according to Onyema ef *al.,* (2003) increasing tidal influence occasioned by dry conditions is known to elevate salinity and create conditions suitable for the survival of marine species in the Lagos lagoon.

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