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A Checklist of Phytoplankton Species of the Iyagbe Lagoon, Lagos

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Abstract: The phytoplankton diversity of the Iyagbe lagoon, Lagos was investigated from October, 2004 to September, 2006. Seven main algal groups were recorded namely: Bacillariophyta, Cyanophyta, Chlorophyta, Euglenophyta, Pyrrhophyta, Chrysophyta and Rhodophyta. A total of 129 species belonging to 64 genera were observed. Diatoms formed the most abundant group making up 90 species from 39 genera. This was followed by the cyanobacteria with 19 species from nine genera, the green algae with 10 species from eight genera, the euglenoids with four species from three genera, the dinoflagellates with three species from two genera, the chrysophytes with two species from two genera and the red algae represented by one species. Comparatively, a higher number of species was recorded in the dry than in the wet season. 18 species of diatoms, nine species of cyanobacteria, four species of euglenoids and green algae each, one species of dinoflagellates, red algae and chrysophytes each, are first reports for south-western Nigeria with regard to existing checklists in the region.

Key words: Lagoon, checklist, algae, phytoplankton, diatoms, cyanobacteria, Iyagbe lagoon

INTRODUCTION

Checklists of phytoplankton species in Nigeria have been documented by different workers even from the last century (Mills, 1932; Fox, 1957; Holden and Green, 1960; Imevbore, 1965; Egborge, 1973; Nwadiaro and Ezefili, 1986). More recently, a checklist of algae in the plankton from the Bonny River have received attention from Chinda and Pudo (1991) while Kadiri (1999) presented a list of phytoplankton species in some coastal waters of Nigeria and Opute (1991) presented a similar list for the phytoplankton of Warri/Forcados estuary.

In the last 50 years or so, there has been increasing interest in phytoplankton studies of the Lagos lagoon complex (Nwankwo *et al*., 2003a). Nwankwo (1988) compiled a list of 195 species of planktonic algae for the Lagos lagoon. Furthermore, Nwankwo *et al*. (2003a, b) published an additional list of 126 taxa to the already existing checklist for the Lagos lagoon (Nwankwo, 1988) after 15 years of additional investigations in the Lagos lagoon. A first list of chrysophytes has also be documented by Wujek *et al*. (2004) for the Epe lagoon. In a pioneering report of phytoplankton species in off shore waters of Nigeria, Nwankwo and Onyema (2004) published a list of 63 species from off shore Lagos.

Presently, there is no published work on the phytoplankton of the Iyagbe lagoon. These species form the primary foundation of this environment hence their dire importance to trophic relationship in the lagoon. The aim of this study was to investigate the phytoplankton community of the Iyagbe lagoon and provide a systematic list that will therefore be useful in measuring our knowledge of the lagoon phytoplankton in the region and Nigeria.

MATERIALS AND METHODS

Study Site

The Iyagbe lagoon (Fig. 1) is located in Lagos state, Nigeria and is one of the nine lagoons in South-western Nigeria (Webb, 1958; Nwankwo, 2004b). It is located between Latitude 6° 23'N and Longitude 3° 06' E. It is mainly made up of the Porto-Novo and Badagry creeks. The Iyagbe lagoon is centered about the town of Iyagbe (Webb, 1958). Twelve stations were chosen for sampling within the lagoon. The lagoon is shallow at some point especially in the Badagry creek arm and is open all year round via the Lagos harbour to the sea (Hill and Webb, 1958; Sandison, 1966; Sandison and Hill, 1966). Like all parts of South-western Nigeria, the Iyagbe lagoon is exposed to two distinct seasons namely the wet (May-October) and the dry (November-April) (Nwankwo, 2004b). The harmmattan, a short season of dry, dusty North-East Trade winds is experienced sometimes between November and January in the region reducing visibility and lowering temperatures. Dense rain forest zone vegetation preceded by littoral mangrove assemblages is the common macrofloral assemblages especially in areas with reduced anthropogenic influence.

Collection of Phytoplankton Samples

Phytoplankton sample was collected on each occasion and station with a 55 μm mesh size standard plankton net towed from a motorized boat for 5 min at low speed (<4 knots). The net was hauled in and the sample transferred into a 250 mL well labeled plastic container with screw cap. Each sample was preserved with 4% unbuffered formalin and stored in the laboratory. After 48 h and prior to microscope analysis, samples were concentrated to 10 mL (Nwankwo, 1984).

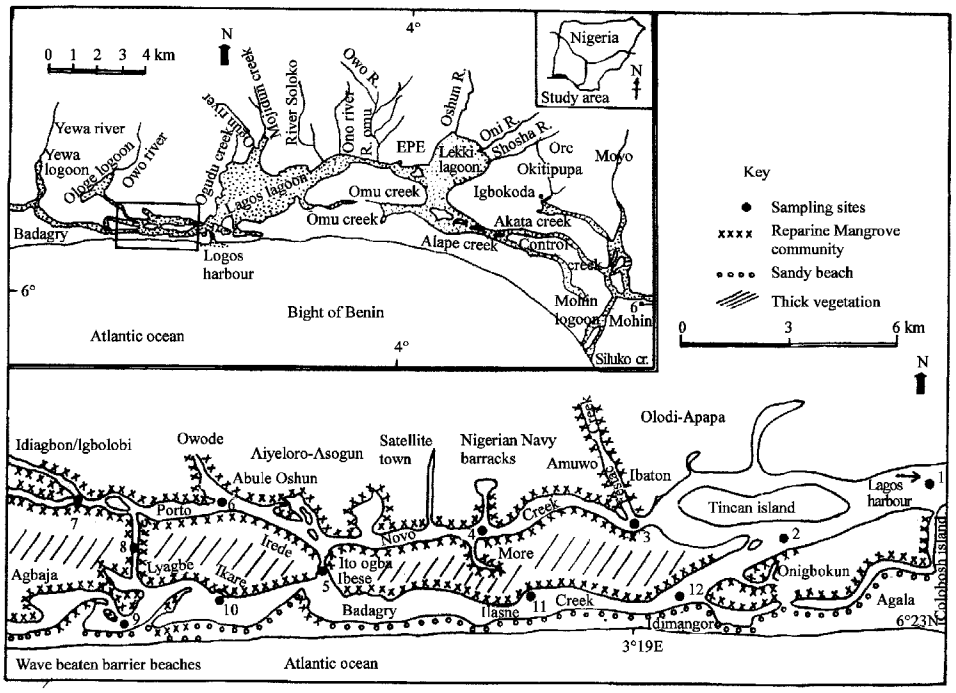

Fig. 1: Parts of lyagbe lagoon, Porto-Novo and badagry creeks showing sampling sites

Biological Analysis

In the Laboratory, one drop of the concentrated sample, five different times for each sample was investigated at different magnifications (X100 and X400) using a Wild M11 binocular microscope with a calibrated eye piece. The microtransect drop count method described by Lackey (1938) and employed by Nwankwo (1984) was used. Since each drop is 0.1 mL and two drops were used for each sample mount, results on abundance were multiplied by 5 to give the values as numbers of organisms per mL. Appropriate texts were used to aid identification (Smith, 1950; Hendey, 1958, 1964; Desikachary, 1959; Wimpenny, 1966; Patrick and Reimer, 1966, 1975; Whitford and Schmacher, 1973; Vanlandingham, 1982; Nwankwo, 1984, 1990, 2004a; Bettrons and Castrejon, 1999; Siver, 2003; Rosowski, 2003).

RESULTS

The Phytoplankton Flora of the Iyagbe Lagoon

Seven major algal groups were represented in the micro-flora of sampled areas of the Iyagbe lagoon. These were the Bacillariophyceae, Cyanophyceae, Euglenophyceae, Chlorophyceae, Dinophyceae, Chrysophyceae and Rhodophyceae. A total of 129 species from 64 genera were recorded. Diatoms were the most abundant group making up 90 species from 39 genera. The cyanobacteria recorded 19 species from nine genera, green algae with 10 species from eight genera, euglenoids with four species from three genera, dinoflagellates with three species from two genera, the chrysophytes with two species from two genera and the red algae represented by a sole species. Table 1 shows a checklist of Iyagbe lagoon phytoplankton species and their classification. Species that are first reports for South-western Nigeria with regard to existing checklists (Nwankwo, 1988; Nwankwo *et al*., 2003a, b; Nwankwo and Onyema, 2004; Wujek *et al*., 2004) are preceeded by an asterick on the list (Table 1).

Bacillariophyceae

The occurrence of diatoms were more in the dry season than in the wet season. The bacillariophyceae were the predominant group at all stations for the duration of the study in terms of phytoplankton species diversity. Ninety diatom species were recorded with the pennate forms being more diverse than the centric forms throughout the lagoon. *Actinoptychus splendens*, *Aulacoseira granulata* var. *augustissima*, *Aulocoseira granulata* var. *angustissima* f. *curvata*, *Aulacoseira granulata* var. *augustissima* f. *spiralis*, *Coscinodiscus centralis*, *Coscinodiscus eccentricus*, *Coscinodiscus lineatus*, *Coscinodiscus marginatus*, *Coscinodiscus radiatus*, *Skeletonema coastatum*, *Odontella regia* and *Odontella sinensis* were the more abundant and frequently occurring centric species recorded. More frequently occurring pennate diatoms included *Bacillaria paxillifer*, *Parabelius delognei*, *Synedra crystallina*, *Synedra ulna*, *Thalassionema fraunfeldii*, *Thalassionema longissima* and *Thalassionema nitzschioides*. Rarely occurring diatoms included *Amphipora alata*, *Aulocoseira granulata*, *Asterionella jopanica*, *Cyclotella menighiniana*, *Cyclotella striata*, *Fragillaria construens*, *Fragillaria oceanica*, *Grammatophora marina*, *Melosira nummuloides*, *Melosira moniliformis*, *Nitzschia closterium*, *Rhizosolenia alata*, *Paralia sulcata*, *Pleurosigma angulatum*, *Trachyreis ergadensis* and *Terpsinoe musica*.

Chlorophyceae

A total of ten species were recorded for the green algae. *Akistrodesmus* sp., *Cladophora glomerata*, *Gonatozygon monotaenium*, *Gonotozygon* sp., *Microspora flocca*, *Straurastrum paradoxum* var. *cingulum*, *Pediastrum simplex*, *Spirogyra africana*, *Scenedesmus obliquus* and *Scenedesmus quadriqauda* were species recorded.

Table 1: A checklist of phytoplankton species of the Iyagbe lagoon

Division-Bacillariophyta
Class-Bacillariophyceae
Order 1-Centrales
Actinoptychus splendens Ehrenberg
Amphiprora alata Ehrenberg
Aulacoseira granulata Ehrenberg (Ralfs)
Aulacoseira granulata var. *angstissima* Muller
Aulacoseira granulata var. *angstissima* f. *spiralis* Muller
Aulacoseira granulata var. *curvata* Simon
Aulacoseira islandica (O.F. Muller) Simonson
Aulacoseira moniliformis Agardh
Aulacoseira nummuloides Agardh
**Aulacoseira varians* Agardh
Campylodiscus clypeus (Ehr.) Kutzing
Chaetoceros atlanticum Cleve
Chaetoceros convolutus Castracane
Chaetoceros decipens Cleve
Odontella aurita (Lyngbe) Brebisson
**Odontella biddulphiana* Bayer
Odontella laevis Ehrenberg
Odontella mobilensis Bailey
Odontella regia (Schultze) Ostenfeld
Odontella sinensis Greville
Coscinodiscus centralis Ehrenberg
Coscinodiscus eccentrius Ehrenberg
Coscinodiscus jonesianus (Greville) Ostenfeld
Coscinodiscus gigas Ehrenberg
Coscinodiscus lineatus Ehrenberg
Coscinodiscus marginatus Ehrenberg
Coscinodiscus oculus-iridis Ehrenberg
Coscinodiscus radiatus Ehrenberg
Coscinodiscus sub-bulliens Jorg
Cyclotella menighiniana Kutzing
Cyclotella striata (Kutzing) Grunow
Ditylum brightwelli (T. West) Grunow
**Eucampia zodiacus* Ehrenberg
Hemidiscus cuneiformis Wallich
Leptocylindricus danicus Cleve
Paralia sulcata Ehrenberg
Podosira sp.
Rhizosolenia alata Brightwell
Rhizosolenia styliformis Brightwell
Skeletonema coastasum Cleve
Terpsinoe musica (Ehr) Hustedt
Thalasiosira subtilis (Ostenfeld) Gran
Triceratium favus Ehrenberg
Order 2-Pennales
**Achnanthes longipes* Agardh
Amphora ovalis Kutzing
Bacillaria paxillifer (O.F. Muller) Hendey
Cymbella affinis Kutzing
**Diatoma elongatum* (Lyngb.) Agardh
Diatoma hyalinum Kutzing
Eunotia monodon Ehrenberg
Eunotia glacialis Mesiter
Fragillaria construens Ehrenberg
Fragillaria islandica Grunner
**Fragillaria oceanica* Cleve
**Gomphonema parvulum* Grunner
Gyrosigma balticum (Ehr.) Rabenhorst
Gyrosigma spenceri W. Smith
**Gyrosigma hippocampus* Ehrenberg

Table 1: Continued

**Gyrosigma littorale* (W. Sm) Griffith and Henfrey
Gyrosigma scalproides (Rabh) Cleve
Gyrosigma wansbeckii (Grunow) Cleve
Hantzschia amphioxys (Her) Rbenhorst
Navicula bicapitata Ehrenberg
Navicula cryptocephala (Kutz) Hustedt
**Navicula cuspidata* Kutzing
**Navicula ergadensis* Ralfs
Navicula mutica Kutzing
**Navicula rhynchocephala* Kutzing
Nitzschia closterium Wm. Smith
Nitzschia obtusa Wm Smith
Nitzschia palea (Kutzing) Wm smith
Nitzschia sigmoidea (Witesch) W. Smith
Nitzschia sigma Grunow
Parabelius delognei E.J. Cox
**Pleurosigma aestuarii* Brebisson
Pleurosigma angulatum (Quekett) Wm Smith
Pleurosigma elongatum Wm Smith
Pinnularia major (Kutzing) Rabenh
**Pinnularia gibba* Ehrenberg
Surirella ovata Kutzing
**Surirella splendida* Wm. Smith
**Surirella striatula* Turpin
Synedra ulna (Nitzsch) Ehrenberg
**Synedra ulna* var. *biceps* Ehrenberg
Synedra crystallina (Ag) Kutzing
Synedra sp.
Thalasiothrix fraunfeldii Cleve and Grunow
Thalasionema longissima Cleve and Grunow
Thalassionema nitzschioides Cleve and Grunow
**Thalaiossira gravida* Ehrenberg
Division-Cyanophyta
Class-Cyanophyceae
Order 1-Chroococcales
**Chroococcus turgidus* (Kutz.) Lemm
Microcystis aureginosa Kutzing
Microcystis flos-aquae Kirchner
Merismopedia gluca (Ehr.) Nageli
Order 2-Hormogonales
**Anabaena constricta* Geitler
Anabaena spiroides Klebahn
**Anabaena torulosa* Lagerheim
Lynbgya limnetica Lemm
Lynbgya martensiana Meneghini
**Oscillatoria borneti* Zukal
**Oscillatoria chalybea* Gomont
**Oscillatoria curviceps* C.A. Agardh
**Oscillatoria formosa* Bory
Oscillatoria limnosa Agardh
Oscillatoria tenius Agardh
**Oscillatoria sancta* Sancta
**Scytonema crustaceum* C.A. Agardh
Spirulina platensis Geitler
Trichodesmium thiebautii Gomont
Division-Euglenopohyta
Class-Euglenophyceae
Order-Euglenales
**Euglena acus* Ehrenberg
**Phacus curvicauda* Swirenko
**Phacus acuminatus* Stokes
**Trachelomonas hispida* (Perry) Stein

Table 1: Continued

Division-Chlorophyta
Class-Chlorophyceae
Order 1-Ulothricales
**Microspora flocca* (Vaucher) Thuret
Spirogyra africana Fritsch Cruda
Order 2-Cladophorales
Cladophora glomerata (L.) Kutzing
Order 3-Chlorococcales
Akistrodesmus sp.
Scenedesmus obliquus (Turp.) Kutzing
Scenedesmus quadriquada (Turp.) de Brebisson
Ordee 4- Zygnematales
**Closterium ehrenbergii* Meneghini
**Gonatozygon monotaenium* De Bary
Gonatozygon sp.
**Staurastrum paradoxum* var. *cingulum*W. and G.S. West
Division-Dinophyta
Class-Dinophyceae
Order- Peridinales
Ceratium macroceros (Ehr.) Cleve
Ceratium tripos (O.F.M.) Nitzsch
**Peridinium africana* Kofoid
Division Rhodophyta
Class Rhodophyta
Order-Bangiales
**Batrachospermum* sp.
Division-Chrysophyta
Order-Chrysophyceae
**Chrysotepphanosphaera globulifera* Scherffel
Synura uvella Ehrenberg

*: Species that are first reports to South-western Nigeria with regard to existing checklists

Dinophyceae

The dinoflagellates recorded only three species namely *Ceratium macroceros*, *Ceratium tripos* and *Peridinium africana*.

Euglenophyceae

The euglenoids were represented by *Euglena acus, Phacus acuminatus*, *Phacus curvicauda* and *Trachelomonas hispida.*

Chrysophyceae

The chrysophytes recorded two species namely *Chrysoteppanoshaera globulifera* and *Synura uvella.*

Rhodophyceae

The red algae recorded a sole species namely *Batrachospermum* sp.

DISCUSSION

In the Iyagbe lagoon phytoplankton diversity was higher in the dry than the wet season and diatoms were the more important group among the phytoplankton categories recorded. Nwankwo (1988) have already reported that phytoplankton production in the Lagos lagoon was high and principally dominated by diatoms. Similar dominance of diatoms among phytoplankton assemblages have been reported by other ecologists in the coastal waters of Nigeria (Imevbore, 1965; Kadiri, 1999; Nwankwo, 1988, 1998a, b; Nwankwo and Onyema, 2004; Onyema and Nwankwo, 2006). Similarly,

Onyema *et al*. (2003, 2007) reported diatoms dominating the phytoplankton spectrum of the Lagos lagoon. In the Iyagbe lagoon pennate diatoms (50 taxa) were more in number than the centric diatoms (43 taxa) attributed the numerous pennate forms recorded to the effect of tidal mixing that probably scours up the phytobenthic forms into the plankton of the Lagos lagoon. The flushing of planktonic algal forms towards the sea during the rains by flood waters, could also account for the reduced phytoplankton diversity in the wet season. Similarly, reduced phytoplankton diversity in the wet season may be linked to the low water clarity which reduces the amount of light available to the planktonic algal component for photosynthesis. Onyema and Nwankwo (2006) have also reported similar inferences for the Ijora creek phytoplankton regime.

Whereas diatoms were prominent in both seasons (dry and wet), the euglenoids, green algae, cyanobacteria and chrysophytes were more important in terms of diversity in the wet season and were recorded in the more inland stations of the lagoon. Conversely, the dinoflagellates were recorded only in the dry season and only in stations close to the Lagos habour. A good number of the species encountered for this study have been recorded before now in marine situations in the region (Nwankwo, 1988, 1998a, b; Kadiri, 1999; Onyema *et al*., 2003, 2007; Nwankwo and Onyema, 2004).

Notable encountered genera for the study were *Coscinodiscus* (9 taxa), *Odontella* (6 taxa), *Aulacoseira* (5 taxa) (centric diatoms), *Navicula* (6 taxa) and *Nitzschia* (5 taxa) (pennate diatoms). These taxa have been reported as prominent in other studies (Nwankwo, 1988, 1998b; Kadiri, 1999; Onyema *et al*., 2003, 2007; Nwankwo and Onyema, 2004).

In the Iyagbe lagoon, there existed environmental gradients from the habour to areas in the lagoon further inland and the phytoplankton assemblages and distribution reflected these trends. The exact trend of environmental characteristics and trends were not known for the lagoon till now.

At least 14 phytoplankton species within the lagoon were reported to be potentially harmful/toxic bloom species. Nwankwo *et al*. (2003b) have already reported on the toxins/potential danger and reported harmful effects of some of these species in south-western Nigeria and especially for the Lagos lagoon. There is need for other extensive ecological studies to be carried out in the Iyagbe lagoon.

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