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Composition and Abundance of Phytoplankton of Adiabo River in Calabar River system, Southeast, Nigeria

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ABSTRACT

Studies on the Composition and Abundance of phytoplankton assemblages in the Adiabo River were carried out for six (6) months. Twenty litres (20L) of Adiabo River water samples were collected in each month throughout the study period at high tide. Phytoplankton sample were collected by filtration using bolting preserved in formalin. Phytoplankton analysis was carried out using numerical counts with compound microscope and identification. A total of Forty two (42) species of phytoplankton belonging to six (6) families were identified. Chlorophyceae (Green algae) and Bacillariophyceae (Diatom) were the most abundant phytoplankton family, followed by Cyanophyceae (Blue-green algae), Cryptophyceae and Euglenophyceae (Green flagellates), of the total phytoplankton abundance respectively. Chlorophyceae and Bacillariophyceae showed progressive and abundance across all months while Cyanophyceae, Cryptophyceae and Euglenophyceae however, showed no spatial bias. Chlorophyceae was also the most dominant family, while Bacillariophyceae was observed to be subdominant groups. Similarity of species occurrence was generally observed across all months. This study indicates high productivity of phytoplankton, also the presence of certain Cyanophyceae taxa indicates environmental degradation in Adiabo River.

Keywords: Phytoplankton, Composition, Abundance, Adiabo River, Calabar.

INTRODUCTION

The Calabar River system has been described as one of the richest inland fisheries resources in Nigeria, contributing one of the highest quotas of fish production [1] and that 90% of Nigeria's total marine/brackish water output comes from this system. The phytoplankton of an aquatic ecosystem is central to its normal functioning. While they constitute the starting point of energy transfer, they are highly sensitive to allochthonously imposed changes in the environment [2, 3]. Thus the species composition, biomass, relative abundance, spatial and temporal distribution of these aquatic biota are an expression of the environmental health or biological integrity of a particular water body [4] had earlier reported that this estuary is Nigeria's richest source of shrimp fishery, producing the world's best quality shrimps. However, although this estuary has been noted for rich aquatic biodiversity [4, 5], little documented information exists by way of baseline data on algal communities, which are essential tools in assessment of the biological integrity of the area. This study is based on the assumption that both biological and physical factors in an aquatic ecosystem which influence the diversity, distribution and richness of aquatic organisms. This, in the long run influences the productive capacity of the system and hence the species inhabiting it [6]. Phytoplankton organisms being one the primary food source for most aquatic species feed on and derive the necessary nutrients from the habitat water for normal physiological functions [7]. Studies have been conducted on species composition and abundance of chaethognatha in the Cross River Estuary Nigeria [8]. [9] Reported on the distribution of meso-zooplankton along salinity gradient of Calabar Rivers, no studies have however been reported in the abundance and species composition of phytoplankton in Adiabo River. It is therefore important to assess their distribution, abundance and species composition in the population structure of the phytoplankton organism. The present study is

therefore designed to investigate the abundance and species composition of the phytoplankton community in Adiabo River which is part of Calabar River system, Nigeria.

MATERIALS AND METHODS

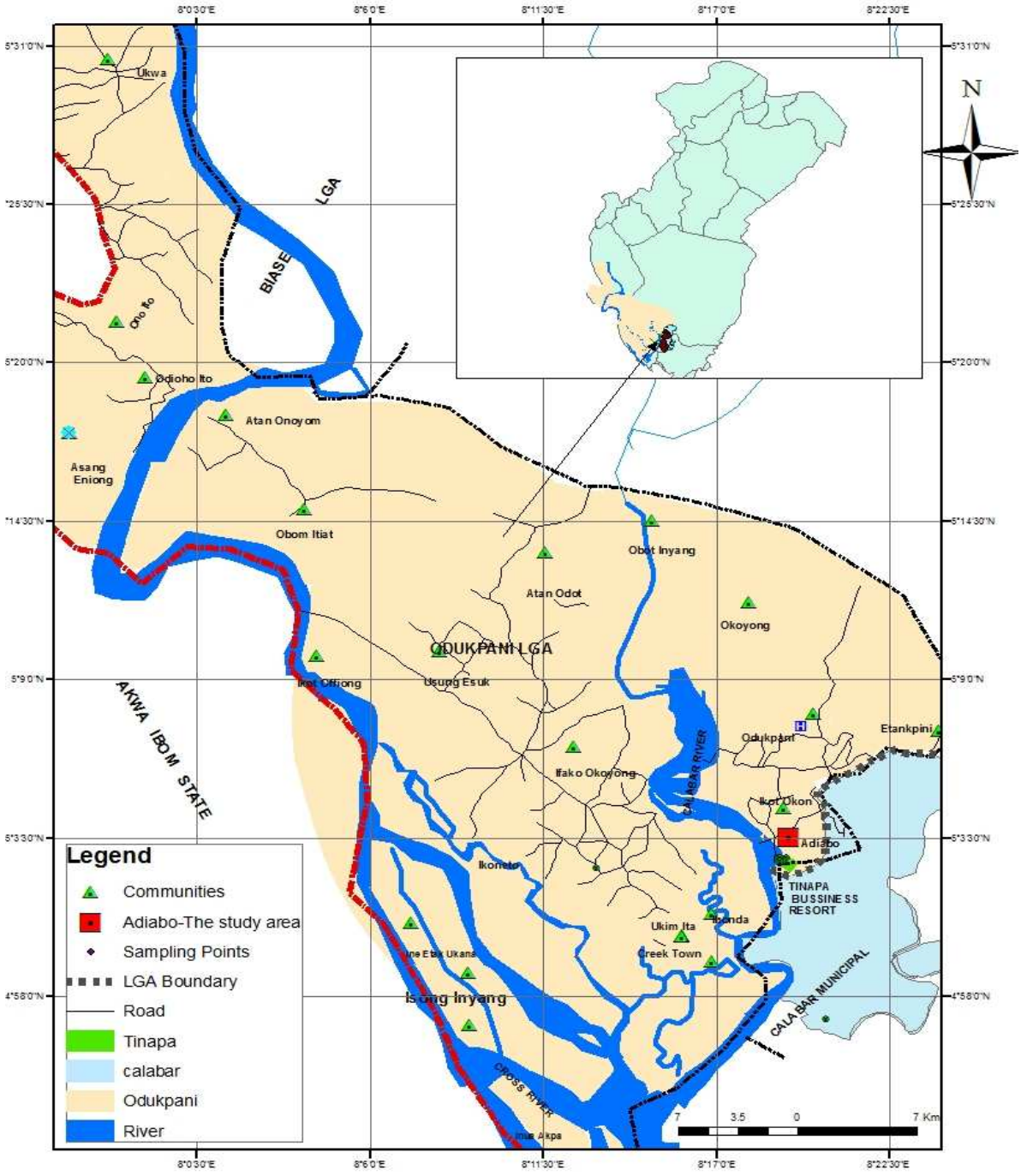

Figure 1: Map of Odukpani Local Government Area showing the Study Area (Adiabo River).

Description of Study Area

Adiabo River is located on latitude 05^0 3.365^0N and longitude 008^0 18.379^0E along the Calabar River, Nigeria. It takes its origin from urban hill. Both the Great Kwa and Calabar Rivers are the tributaries of the Cross River Estuary and are parts of the Cross River System [10]. Adiabo jetty is a tidal River and is characterized by a long wet season from April to October and a dry season from November to March. Mean annual rainfall is about 200mm [11]. A short period of drought occurs in the wet season around August/September which is called the August drought. There is usually a cold, dry and dusty period between December and January referred to as the harmattan season.

Sampling procedure

Water samples were collected bi-monthly for six month from March, 2011 to August, 2011, at the surface of the water by filtering 20 litres of habitat water through bolting silk plankton net of 55µm mesh size, and stored in 500ml plastic sample bottles. Samples are preserved in 4% formalin following the method recommended by [12]. Samples were collected at high tide during the dry and wet season months. The phytoplankton samples were analyzed in the Marine Biology Laboratory in the Institute of Oceanography, University of Calabar, Nigeria by use of light microscope of (x40) objective following [13]. Lugol's iodine solution was used for staining the samples to enhance proper discernment of the phytoplankton species based on morphological features, as individual species normally takes up the stain, thereby exposing the organelles for proper identification [14]. Identification of phytoplankton species was carried using standard identification schemes and manuals of [15, 7]. The numerical abundance of each of the phytoplankton species under each group was determined by adding the respective number contributed by each species in the group per month of sampling following [16, 17].

Ecological parameter such as Simpson's index (D) was used in the calculation of species dominance and relative abundance was also determined using the appropriate formular below.

Determination of species dominance, D

Species dominance of phytoplankton during the study period was determined using the formula cited by [18].

$$D = \frac{\sum_{i=1}^{s} ni(ni - ni)}{N\,(N-1)} \qquad \text{..... (1)}$$

Where;

n = the number of individual of either phytoplankton

N = Total number of all individuals of either phytoplankton identified.

Determination of relative abundance

These were determined using the formular:

$$\%Ra = \frac{n\,(100)}{N} \qquad \text{.....(2)}$$

[17]

Where;

n = the total number of the phytoplankton species under consideration

N = the total number of all species in the phytoplankton group.

RESULTS

A total of forty-two taxa of phytoplankton belonging to six families were encountered in Adiabo River Calabar, Nigeria during the study period. These included the Bacillariophyceae *(Fragilaria species, Diatoma species, Diatomella species, Hydrosera species, Leptocylindricus demiun, Melosira granulate, Actinelia species, Denticule thermalis, Rhizosolenia species, Tetracyclus species and Gyrosigma species*. Among the Chlorophyceae were *Ulothrix species, Spirogyra varians, Trochisea species, Tetradon regulare, Straurastrum roluta, Tetradesmus species, Chlamyolomonas species, Chlorella vulgaris, Closfemirium species, Oocystis lascutris, Pedinomonas species, Sphaerocystis species, Eudoma species and Volvox species*. In the Euglenophyceae family were *Euglena rubra, Euglena acus, Calacium species, Euglenopsis species, Lepocyncils ovum, Phacus pleuroneites, Trachelomonas species and Trachelmonas volvocina.* Among the chrysophyceae were also identified the following phytoplankton species: *phaethamnion species, Dinorbryon species* and *Chrysapis species* while among the Eyanophyceae were *Microcystis aeruginosa, Oscillatoria rubiscus* and *Anabaena spiroids* and among the cryptophyceae were *Gyptomonas splendid* and *Tetragoridium species*. In March, a total of 69 Bacillariophyceae

was recorded. This constituted 25.56% often total phytoplankton community in the river system during the study period. 109 (40.37%) of Chlorophyceae were encountered in the same month (March) with 42 (15.55%) of Euglenophyceae, 14 (15.1%) of chrysophyceae, 23(8.52%) of Cyanophyceae and 13(4.81%) of cryptophyceae (table 1). In April, 67 (29.13%) each of Bacillariophyceae and Chlorophyceae were recorded, 54(23.48%) of Euglenophyceae, 18(7.83%) of Chrysophyceae, 10(4.3%) of Cyanophyceae and 14 (9.60%) of Chrysophyceae, 11(5.56%) of Cyanophyceae and 14(7.07%) of Cryptophyceae. In June, 60 (31.58%) of Bacillariophyceae, 39 (20.52%) of Euglenophyceae, 8 (4.21%) of Chrysophyceae, 11 (5.79%) of Cyanophyceae and 6 (3.16%) of Cryptophyceae (Table 1). In July, 38 (27.94%) of Bacillariophyceae were recorded with 47 (34.56%) of Chlorophyceae, 29 (21.32) of Euglenophyceae, 9 (6.62%) of Chrysophyceae, 7 (5.15%) of Cyanophyceae and 6(4.41%) of Cryptophyceae, while in August, 65 (24.62%) of Bacillariophyceae were recorded with 110 (41.67%) of Chlorophyceae, 33(12.50%) of Euglenophyceae, 18 (6.82%) of Chrysophyceae, 26 (9.85%) of Cyanophyceae and 12 (4.54%) of Cryptophyceae (Table 1). In all, 365 (27.64%) Bacillariophyceae, 462 (35.87%) of Chlorophyceae, 23 (17.93%) of Euglenophyceae, 86 (6.68%) of Chrysophyceae, 88 (6.83%) of Cyanophyceae and 65 (5.05%) of Cryptophyceae were recorded during the study (Table 1). The monthly indices of the phytoplankton are shown in Table 2. The dominance index of the Bacillariophyceae ranged between 0.01 – 0.04, with a range of 0.007 – 0.03 for Chlorophyceae, 0.01-0.06 for Euglenophyceae, 0.02-0.04 for Chrysophyceae, 0.01 – 0.07 for Cyanophyceae and between 0.0-0.02 for Cryptophyceae.

Table 1: Species Composition and Relative Abundance of Phytoplankton in Adiabo River, Southeast Nigeria (March- August, 2011)

S/n	Phytoplankton Family	March		April		May		June		July		August	
		Numerical abundance	% Ra	Numerical abundance	% Ra	Numerical abundance	% Ra	Numerical abundance	% Ra	Numerical abundance	% Ra	Numerical abundance	% Ra
1.	**Bacillariophyceae**	69	25.56	67	29.13	57	28.79	60	31.58	38	27.94	65	24.62
2.	**Chlorophyceae**	109	40.37	67	29.13	63	31.81	66	34.74	47	34.56	110	41.67
3.	**Euglenophyceae**	42	15.55	54	23.48	34	17.17	39	20.52	29	21.32	33	12.50
4.	**Chrysophyceae**	14	5.19	18	7.83	19	9.60	8	4.21	9	6.62	18	6.82
5.	**Cyanophyceae**	23	8.52	10	4.35	11	5.56	11	5.79	7	5.15	26	9.85
6.	**Cryptophyceae**	13	4.81	14	6.08	14	7.07	6	3.16	6	4.41	12	4.54
	Total abundance	**270**	**100**	**230**	**100**	**198**	**100**	**190**	**100**	**136**	**100**	**264**	**100**

Table 2: Dominance indices of phytoplankton in Adiabo River Nigeria during the study Period (March-August, 2011).

S/n	Phytoplankton families	Simpson's Dominance Index, D					
		March	April	May	June	July	August
1.	Bacillariophyceae	0.02	0.02	0.02	0.02	0.04	0.01
2.	Chlorophyceae	0.003	0.03	0.007	0.03	0.03	0.01
3.	Euglenophyceae	0.02	0.01	0.04	0.04	0.05	0.06
4.	Chrysophyceae	0.03	0.02	0.02	0.04	0.03	0.02
5.	Cyanophyceae	0.01	0.07	0.02	0.05	0.05	0.01
6.	Cryptophyceae	0.0	0.0	0.01	0.0	0.0	0.02

DISCUSSION

From the result of the study more Chlorophyceae than any other family of phytoplankton were observed. This is in agreement with the report of [19] who studied the seasonal variation in the diversity and species richness of phytoplankton in a tropical eutrophic reservoir in Brazil was observed. Comparatively, the phytoplankton composition of the Adiabo River is in consistent to that of the Ikpoba reservoir, Edo State, Nigeria [20], Opi Lake in Anambra State, Nigeria [21] and River Okhuehe in Uhunmwode local government Area of Edo State [22]. From this study it was observed that Chlorophyceae was the dominant follow by Bacillariophyceae, Cyanophyceae, Chrysophyceae, Cryptophyceae, and Euglenophyceae and this was in consistent with the observation of [8].

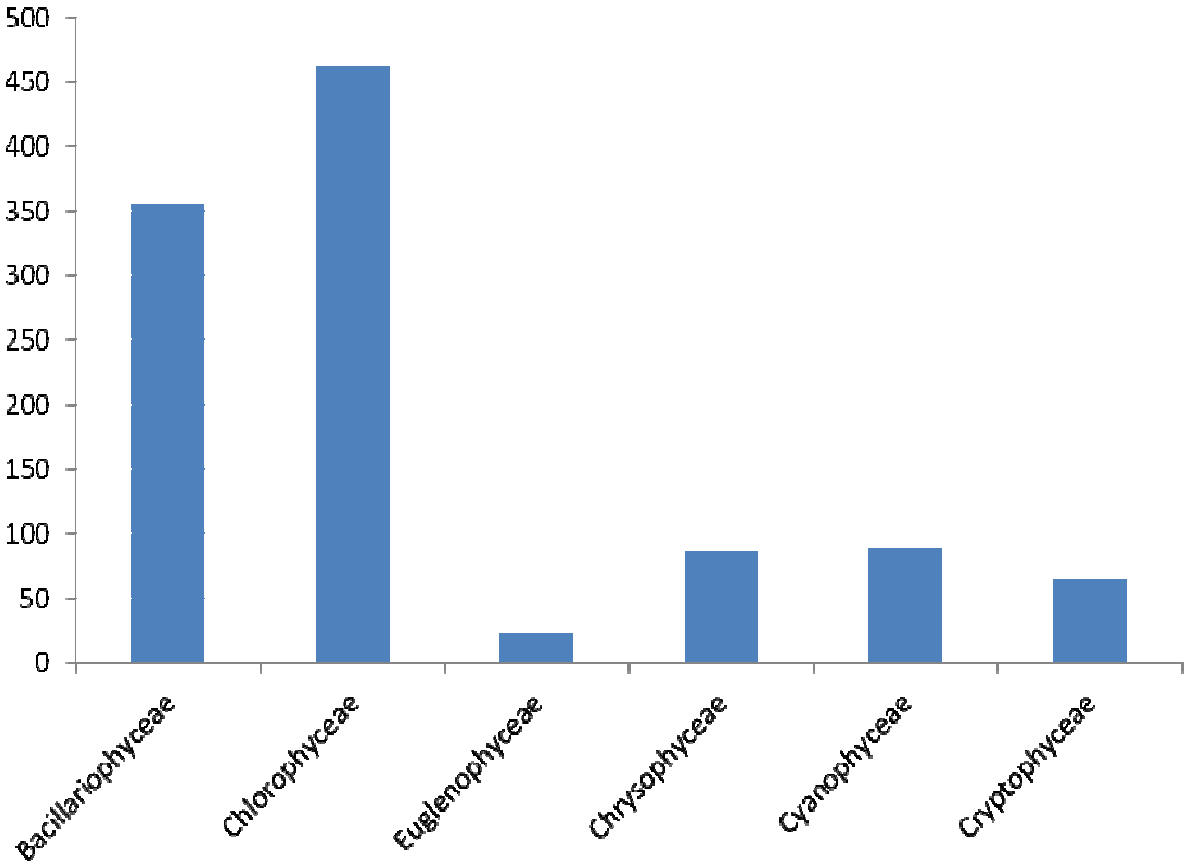

Figure 2: Abundance of the major phytoplankton families in the Adiabo River, Calabar, Nigeria.

The occurrence of Euglenophyceae in the month of April in Adiabo is as a result of oscillation at the Eutrophic and Oligotrophic condition. Usually in an aquatic system where there is no heavy nutrient inputs possibly from run-off or human inputs, Bacillariophyceae are usually the dominant phytoplankton group, but when nutrient levels is high such that eutrophication occurs. The Chlorophyceae will surprise the Bacillariophyceae to become the most abundant group, [19, 23]. This might have been the case in Adiabo River, during the period of this study such that Chlorophyceae become the most abundantly distributed. The ecological parameter considered in this study was species dominance index. There was no significant variation in this parameter in relation to the phytoplanktons community during the period of study. For the phytoplanktons species dominance ranged between 0.01-0.06, this could be as a result of ecological condition arising from important factor governing the abundance and distribution of the phytoplankton communities. Such factor is food availability. The Adiabo River is however, characterized by strong tidal currents and river discharge, so the system does not suffer from poor flushing. Also, Eutrophication does not occur in the river system [11, 24].

CONCLUSION

The population of phytoplankton was generally higher in the river system during the study period. Phytoplankton contributed a total of 1288 individuals (68.37%) to the community. This leads to the conclusion that the Adiabo River is highly rich in taxa and dominance of phytoplankton in both rainy and dry season and these could also shows that productivity is high in Adiabo River.

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