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Monthly spatial occurrence of phytoplankton and zooplankton in River Ogun, Abeokuta, Ogun State, Southwest Nigeria

Dimowo, Benjamin Onozeyi

Department of Aquaculture and Fisheries Management, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria.

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The aim of this study was to investigate the monthly spatial occurrence of phytoplankton and zooplankton in River Ogun, Abeokuta, Southwest Nigeria. This was carried out for seven months between December, 2011 and June, 2012 in 4 stations. A total of 41 species of phytoplankton and 16 zooplankton species from 5 classes respectively were recorded. Zooplankton was dominated by Cladocera throughout the study period while phytoplankton was dominated by blue green algae (Cyanophyta or Cyanobacteria). The dominance of Cyanophyta in this river is similar to findings by Sekadende and co-workers, Ogato, Deng and co-worker, and Shakila and co-worker. The dominance of Cladocera in this river is similar to findings by Ude and co-workers, and Ogbuagu and co-worker.

Key words: Monthly, spatial, occurrence, phytoplankton, zooplankton, River Ogun.

INTRODUCTION

The study of plankton (phytoplankton and zooplankton) is very important because they serve as a base upon which the aquatic ecosystem is supported. Phytoplankton (singular, phytoplankter) are primary producers while zooplankton (singular, zooplankter) are secondary producers. Phytoplankton serve as food to zooplankton which in turn serve as food to almost all larval forms (either meroplanktononic or holoplanktonic in nature) in natural surface water. Many Scientists including Abohweyere, 1990; Adakole et al., 2008; Adeogun et al., 2005; Adejuwon and Adelakun, 2012; Adesalu and Nwankwo, 2008; Agbaire and Obi, 2009; Ajuonu, et al., (2011); Atobatele and Ugwumba, 2008; Ayeni et al., 2011; Balarabe, 2001; Bwala et al., 2010; Chia et al., 2011; Chinedu et al., 2011; Davies and Ansa, 2010; Erondu and Chindah, 1991; Essien-Ibok et al., 2010; Ezekiel et al., 2011; Ezeribe et al., 2012; Fafioye et al., 2005; Ibrahim, 2009; Imoobe and Egborge, 1997; Ladipo et al., 2011; Mood, 2004; Muhibbu-din et al., 2011; Mustapha and Omotosho, 2005; Nkwoji et al., 2010; Offem et al., (2011); Ogbuagu and Ayoade, 2012; Onuoha and Vyverman, 2010; Onyema, 2007; Oso and Fagbuaro, 2008; Ovie, 1995; Ude et al., 2011; etc have worked on the various aspects of ecosystem studies of rivers, reservoirs, lakes, creeks and estuaries in Nigeria. However, not much work has been carried out on the plankton composition and distribution of River Ogun. This study is therefore aimed at investigating the monthly spatial occurrence of phytoplankton and zooplankton in River Ogun so as to contribute to the existing knowledge

E-mail: benjamindimowo@yahoo.com.

STATIONS	
A	IBEREKODO
B	AGO IKA
C	ENU GADA
D	OFF PEPSI BUSTOP

Figure 1. Map of River Ogun showing the sampling stations. Source: Google Maps, 2012.

on plankton ecology and distribution.

MATERIALS AND METHODS

Study area

Ogun State is a state in South-western Nigeria. It borders Lagos State to the South, Oyo and Osun states to the North, Ondo State to the east and the republic of Benin to the west. Abeokuta is the capital and largest city in the state (NBS, 2012).

Geography of the River

River Ogun (Figure 1) is one of the main rivers in the southwestern part of Nigeria with a total area of 22.4 km^2 and a fairly large flow of about 393 m^{3}sec G1 during the wet season (Oketola et al., 2006). It has coordinates of 3°28''E and 8°41''N from its source in Oyo state to 3°25''E and 6°35''N in Lagos where it enters the Lagos lagoon (Ayoade et al., 2004). There are two seasons in Ogun river basin. The dry season starts from November and ends in March while the wet season starts from April and ends in October. Mean annual rainfall ranges from 900 mm in the north to 2000 mm towards the south. The estimates of total annual potential evapotranspiration have been put between 1600 and 1900 mm (Bhattacharya and Bolaji, 2010). The water is used for agriculture, transportation, human consumption, various industrial activities and domestic purposes (Ayoade et al., 2004; Oketola et al., 2006). It also serves as a raw water supply to the Ogun state water corporation which treats it before dispensing it to the public. Along its course, it constantly receives effluents from breweries, slaughterhouses, dyeing industries, tanneries and domestic wastewater before finally discharging to Lagos lagoon (Ayoade et al., 2004; Oketola et al., 2006). A 100 km^2 area around River Ogun

has an approximate population of 3637013 (0.03637 persons per square meter) and an average elevation of 336 meters above the sea (Travel Journals, 2012).

Experimentation

Water samples for physico-chemical and plankton analyses were collected monthly for seven consecutive months (December 2011 to June 2012) at the four sampling stations. Plankton samples were collected using 55 µm mesh size standard plankton net by trawling horizontally and filling into air tight 120 ml well labeled plastic bottles. It was ensured that fixation and preservation of the samples with 4% formalin was done within 5 min of collection. The fixed samples were then taken to the laboratory for further analysis. In the laboratory, the samples were identified under the microscope using suitable keys such as Edmondson (1959) etc. Abundance was reported as number of cells or individuals per drop. pH, air temperature (°C), water temperature (°C), conductivity (µs/cm) and total dissolved solids (mg/L) were conducted *in-situ* with the use of HANNA Combo pH and EC multi meter Hi 98129 and Mercury-in-glass thermometer. Dissolved oxygen (mg/L), nitrate (mg/L), phosphate (mg/L), alkalinity (mg/l) and hardness (mg/L) were determined *ex-situ* using standard methods for examination of water (APHA, 1998).

Plankton community structure analysis

Three indices were used for Plankton Community Structure Analysis. These include:

1. Species diversity (Shannon and Weaver, (1949) and Simpson, (1949)
2. Species equitability or evenness (Pielou 1966)
3. Species richness (Margalef (1951) and Menhimick (1964)

Shannon and Weaver diversity index (1948): The Shannon and Weaver diversity index (Hs) is given by:

$$Hs = \frac{N \text{ Log } N - \Sigma Pi \text{ Log } Pi}{N}$$

Where: Hs = Shannon and Weaver diversity Index; N = Total number of individuals in S species.
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.

Simpsons dominance index (Ogbeibu, 1949): It is given by:

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

Where: C = Simpsons dominance index; n_i = Total number of organisms of a particular species;
N = Total number of organisms of all species; Pielou species equitability or evenness index (1966): It is given by:

$$j = \frac{Hs}{Log_2 S}$$

Where: j = Equitability index; Hs = Shannon Weaver's index, and S = Number of species in a population.

Margalef Species Richness Index (d) (1951): 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, and N = Total number of individuals in S species.
Menhinick's Index: it is given by:

$$D = \frac{S}{(N)\ ½}$$

Where: D = Menhinick's Index; S = Number of species in a population, and N = Total number of individuals in S species.

RESULTS

The result of the physico-chemical parameters is shown in Table 1 while results of phytoplankton and zooplankton composition are shown in Tables 2 and 3. A total of 41 genera of phytoplankton from 5 classes and 16 zooplankton genera from 5 classes were recorded during the studies. The percentage distribution of phytoplankton and zooplankton classes at all the stations are shown in Figures 2, 3, 4, 5, 6, 7, 8 and 9. Generally, Cyanophyta and Cladocera which are phytoplankton and zooplankton classes were dominant throughout the study period.

Physicochemical parameters

Water temperature ranged between 26°C (Station A in December, 2011) and 39.3°C (Station C in May, 2012). Dissolved oxygen ranged between 1.2 mg/l (Stations B and C in January, 2012) and 9 mg/l (Station A in May, 2012). Conductivity ranged between 76 µs/cm (Station A in February, 2012) and 276 µs/cm (Station B in June, 2012). TDS was between the values of 38 ppm (Station A in February, 2012) and 138 ppm (Station B in June, 2012). Transparency values ranged between 20 cm (Station A in June 2012) and 102.5 cm (Station A in March, 2012). Alkalinity concentrations ranged between 1 mg $CaCO_3$/L (Station A in December, 2011) and 18 mg $CaCO_3$/L (Stations A, B and C in April, 2012). Hardness concentrations also ranged between 32 mg $CaCO_3$/L (Station A in March, 2012) and 244 mg $CaCO_3$/L (Station A in April, 2012). Furthermore, Hydrogen ion concentration (pH) values ranged between 7.19 (Station B in January, 2012) and 9.46 (Station A in December, 2011). Nitrates concentration also ranged between 0.36 mg/L (Station C in December, 2011) and 135.61mg/L (Station A in June, 2012). Phosphate concentrations ranged from 0.01 mg/L (Station A in February, 2012) and

Table 1. Physicochemical parameters of the water samples.

Date	December, 2011				January, 2012				February, 2012				March, 2012			
Station	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Water temperature (°C)	26	27	27	28	28.3	30.5	30.4	30.9	29.5	30.1	31.1	30.6	29.9	29.9	30.1	30
DO (mg/L)	3.25	2.6	3.15	2.45	3.5	1.2	1.2	5.2	5.5	3.2	1.9	2.7	5.5	2.5	4.1	4.8
Conductivity (µcm)	163	184	180	195	89	147	137	152	76	111	103	106	78	118	95	105
TDS (ppm)	82	93	90	98	43	74	67	75	38	54	50	53	42	58	47	52
Transparency (cm)	77	85	54	75	90	80	60	50	85	57.5	77.5	50.75	102.5	35	65	45
Alkalinity	1	6	7	6	3.5	5	4	5	3	6	4	6	6	4	6	4
Hardness	52	56	52	60	32	54	46	50	34	70	44	42	32	48	54	194
pH	9.46	9.03	8.87	9.23	8.34	7.19	7.39	8.32	8.92	7.48	7.62	7.8	7.91	7.33	7.61	7.96
Nitrate	1	0.45	0.36	0.54	4.9	1.72	0.91	1.27	1.63	5.08	2.18	1.45	43.9	60.49	66.34	61.46
Phosphate	0.14	0.06	0.09	0.09	0.19	0.09	0.05	0.13	0.01	0.067	0.015	0.011	0.43	0.708	0.637	0.843
Air temperature (°C)	29	24	24	28	34	35	36	36	30	31	32	34	30	31	31	32

	April, 2012				May, 2012				June, 2012			
	A	B	C	D	A	B	C	D	A	B	C	D
Water temperature (°C)	30.6	32.6	32.6	32.6	28.6	29.2	39.3	29.71	26.8	27	27.1	26.6
DO (mg/l)	7.5	5.8	6.3	6.6	9	6.7	7.2	8	7.8	3.1	7.1	8.5
Conductivity (µcm)	94	133	123	128	109	148	136	134.11	132	276	143	160
TDS (ppm)	47	66	61	64	54	78	67	66.96	66	138	71	80
Transparency (cm)	82.5	55	47.5	60	60	30	50	30	20	25	27.5	25
Alkalinity	18	18	18	17	3	7	4	7	5	6	5	6
Hardness	244	76	50	50	42	58	62	62	44	104	54	66
pH	8.96	7.65	7.9	8.16	8.39	7.9	8.02	8.23	8.58	8.6	8.91	8.8
Nitrate	16.59	41.95	28.29	17.56	44.88	32.2	31.22	65.37	135.61	92.68	109.27	116.1
Phosphate	0.179	0.332	0.108	0.143	0.081	0.09	0.161	0.108	0.43	0.35	0.323	0.368
Air Temperature (°C)	33	34	35	31	30	32	31	31	29	27	29	27

0.843 mg/L (Station D in March, 2012). Finally, air temperature ranged between 24°C (Stations B and C in December, 2011) and 36°C (Stations C and D in January, 2012)

Phytoplankton community structure

For the 4 stations studied in Table 2, diversity (S) ranged between 2 (Station B in December, 2011 and Station A in February, 2012) and 12 (Stations A and D in June, 2012). Abundance of cells per drop (N) of the samples was between 3 individuals per drop (Station A in February, 2012) and 37 individuals per drop (Stations A and D in June, 2012). Furthermore, the values for Shannon-Weaver Index (Hs) ranged between 0.24 (Station A in March, 2012) and 1.22 (Stations A and D in June, 2012). Menhinick Index (D) on the other hand ranged between 0.58 (Station B in December, 2011) and 2.46 (Station B in February, 2012). Margalef Index (d) values also ranged between 0.4 (Station B in December, 2011) and 3.34 (Station B in February). Pielou Equitability Index (j) values were between 0.15 (Station A in March, 2012) and 1.03 (Station B in December, 2011). Simpson's Dominance Index (C) also ranged between 0.09 (Station D in June, 2012) and 0.56 (Station A in February, 2012).

Zooplankton community structure

For the 4 stations studied in Table 3, diversity (S) ranged between 2 (Stations A and D in January, 2012; Station A in March, 2012 and Station A in April, 2012) and 8 (Station A in December, 2011). Abundance of individuals per drop (N) of the samples was between 5 individuals per drop (Station D in January, 2012; Station A in March, 2012 and Station A in May, 2012) and 29 individuals per drop (Stations C in December, 2011). Furthermore, the values for Shannon-Weaver Index (Hs) ranged between 0.5 (Station B in February, 2012) and 1.26 (Station C in December, 2011). Menhinick Index (D) on the other hand ranged between 0.82 (Station A in January, 2012) and 1.89 (Station A in December, 2011). Margalef Index (d) values also ranged between 0.56 (Station A in January, 2012) and 2.42 (Station A in December, 2011). Pielou Equitability Index (j) values were between 0.24 (Station D in March, 2012 and Station C in May, 2012) and 0.68 (Station A in January, 2012). Simpson's Dominance Index (C) also ranged between 0.16 (Station A in December, 2011) and 0.68 (Station D in January, 2012).

Table 2. Monthly spatial variation in the phytoplankton composition and abundance (number of cells per drop) in some parts of River Ogun.

Date	Dec, 2011				Jan, 2012				Feb, 2012				March, 2012				April, 2012				May, 2012				June, 2012			
Station	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Euglenophyta																												
Phacus	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euglena	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
Menoidium	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta																												
Gonatoxygon	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Ankistrodesmus	0	7	0	1	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	0	1	2	2	3	4	3
Closterium	0	0	7	1	0	3	0	0	0	0	0	2	0	1	0	0	0	0	0	2	0	0	2	0	1	0	0	0
Ulothrix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Spirotaenia	0	0	0	2	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Penium	0	0	0	1	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
Pleurotaenium	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Protococcus	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0
Spirogyra	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Zygnema	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	2	4
Mougeotia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Netrium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Tetraspora	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Closteriopsis	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	1	0	0
Chrysophyta																												
Pinnularia	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitzchia	1	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	2	3	0	5	4	10	3	2	3
Navicula	0	0	0	0	0	0	0	0	1	2	1	3	0	3	3	2	0	0	0	0	0	0	2	0	2	0	1	2
Ophiocytium	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	1	0
Eunotia	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Chrysophyta																												
Cyclotella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0
Oscillatoria	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0	0	0	2	2	1	0	2	0	0	0	0	0	0
Synedra	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	2	0	0	0	0
Tabellaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	4	0	0
Chlorogibba	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monallantus	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gloeochloris	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Gomphonema	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fragillaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	4	2	0	0
Diatoma	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyrrophyta																												
Peridinium	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Chilomonas	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Cyanophyta																												
Phormidium	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	2
Spirulina	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Table 2. Contd

Anabaena	0	0	0	0	1	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	1	0	
Aphanocapsa	0	0	0	14	10	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	3	0	2	3	1	2	3	0
Merismopedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	2	1	2	0
Coelosphaerium	0	0	0	0	2	0	0	10	0	3	5	3	0	4	1	0	0	0	0	0	7	0	4	0	3	4	4	0
Polycystis	0	0	0	0	0	0	0	0	0	1	1	5	0	0	4	2	2	1	3	4	2	2	2	1	0	5	4	0
N	7	12	25	20	15	18	14	17	3	20	14	14	4	11	9	12	10	11	12	15	29	14	24	15	37	28	24	**37**
S	4	2	6	6	5	8	9	5	2	11	7	5	3	5	4	5	4	7	6	9	11	6	11	8	12	11	10	12
Hs	0.50	1.03	1.21	1.07	0.94	0.85	0.53	1.02	0.28	0.73	0.72	0.90	0.24	0.72	0.69	0.79	0.76	0.50	0.69	0.60	1.07	0.81	0.90	0.69	1.22	1.04	0.96	1.22
D	1.51	0.58	1.20	1.34	1.29	1.89	2.41	1.21	1.15	2.46	1.87	1.34	1.50	1.51	1.33	1.44	1.26	2.11	1.73	2.32	2.04	1.60	2.25	2.07	1.97	2.08	2.04	1.97
d	1.54	0.40	1.55	1.67	1.48	2.42	3.03	1.41	0.91	3.34	2.27	1.52	1.44	1.67	1.37	1.61	1.30	2.50	2.01	2.95	2.97	1.89	3.15	2.58	3.05	3.00	2.83	3.05
J	0.25	1.03	0.47	0.41	0.41	0.28	0.17	0.44	0.28	0.21	0.26	0.39	0.15	0.31	0.34	0.34	0.38	0.18	0.27	0.19	0.31	0.31	0.26	0.23	0.34	0.30	0.29	0.34
C	0.31	0.51	0.20	0.51	0.48	0.17	0.12	0.40	0.56	0.12	0.21	0.24	0.38	0.26	0.33	0.26	0.34	0.21	0.19	0.15	0.13	0.26	0.12	0.16	0.13	0.11	0.13	0.09

Table 3. Monthly spatial variation in the zooplankton composition and abundance (number of individuals per drop) in some parts of River Ogun.

Date	**Dec, 2011**				**Jan, 2012**				**Feb, 2012**				**March, 2012**				**April, 2012**				**May, 2012**				**June, 2012**			
Site	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Rotifera																												
Platyias	2	0	4	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cupelopagis	4	3	0	1		3	4	1	1	1	0	2	0	0	0	1	0	0	0	1	0	2	0	0	3	0	4	2
Keratella	4	5	10	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudinella	1	0	2	4	0	0	0	0	0	0	0	0	0	1	0	2	0	1	0	1	0	0	0	0	0	0	0	0
Protozoa																												
Amoeba	1	2	0	2	0	0	0	0	4	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Oikomonas	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0
Paramecium	0	0	0	1	2	4	0	4	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0
Blepharisma	3	0	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda																												
Diaptomus	0	2	3	0	0	2	0	0	1	0	1	3	0	0	0	0	0	4	0	5	0	0	0	0	0	0	0	0
Canthocamptus	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladocera																												
Polyphemus	0	0	3	7	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	4	0	0	1	5	4	3	2	1
Ceriodaphnia	2	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scapholeberis	1	0	0	0	0	0	0	0	0	1	0	1	0	4	0	4	0	0	0	0	2		5	3	5	4	1	4
Bosmina	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	5	2	0	0	3	2	1	5	0	4	6	7
Eurycerus	0	0	0	0	0	0	0	0	0	4	4	0	3	0	4	1	1	0	4	0	0	0	1	0	3	2	1	2
Ostracoda																												
Cypridiopsis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	4	0	2	1
N	18	12	29	16	6	15	9	5	8	7	6	6	5	7	6	9	7	10	9	13	5	8	9	13	19	13	16	17
S	8	4	7	6	2	5	3	2	4	4	3	3	2	3	3	5	3	5	3	6	2	3	5	3	5	4	6	6

Table 3. Contd

Hs	0.85	0.88	1.26	0.91	0.68	0.94	0.80	0.58	0.60	0.50	0.54	0.54	0.58	0.64	0.54	0.57	0.64	0.65	0.80	0.75	0.58	0.72	0.57	1.00	1.09	0.93	0.91	0.96
D	1.89	1.15	1.30	1.50	0.82	1.29	1.00	0.89	1.41	1.51	1.22	1.22	0.89	1.13	1.22	1.67	1.13	1.58	1.00	1.66	0.89	1.06	1.67	0.83	1.15	1.11	1.50	1.46
d	2.42	1.21	1.78	1.80	0.56	1.48	0.91	0.62	1.44	1.54	1.12	1.12	0.62	1.03	1.12	1.82	1.03	1.74	0.91	1.95	0.62	0.96	1.82	0.78	1.36	1.17	1.80	1.76
J	0.28	0.44	0.45	0.35	0.68	0.41	0.50	0.58	0.30	0.25	0.34	0.34	0.58	0.40	0.34	0.24	0.40	0.28	0.50	0.29	0.58	0.46	0.24	0.63	0.47	0.46	0.35	0.37
C	0.16	0.29	0.19	0.28	0.56	0.22	0.41	0.68	0.34	0.39	0.50	0.39	0.52	0.43	0.50	0.28	0.55	0.26	0.36	0.27	0.52	0.38	0.36	0.35	0.21	0.27	0.24	0.26

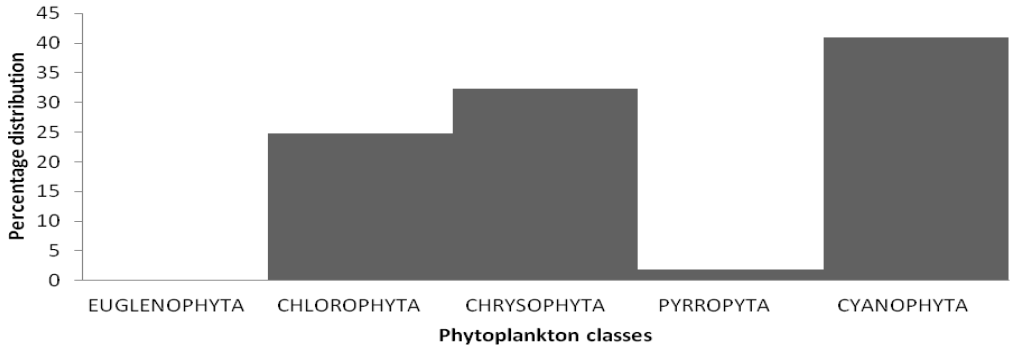

Figure 2. Percentage distribution of phytoplankton classes in station A.

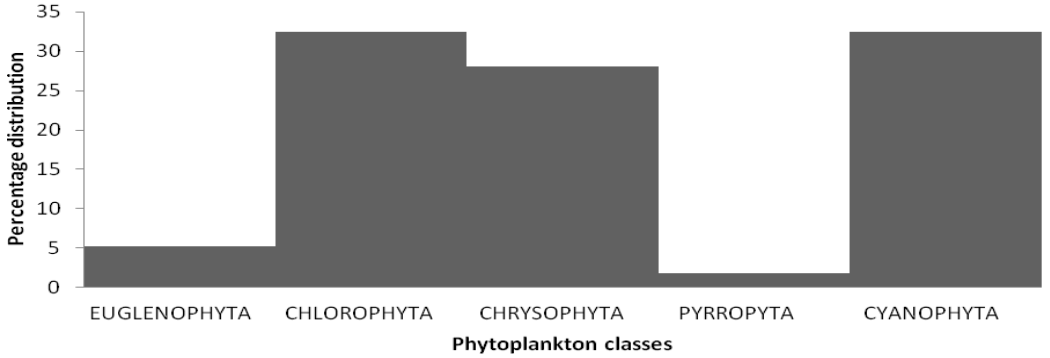

Figure 3. Percentage distribution of phytoplankton classes in station B.

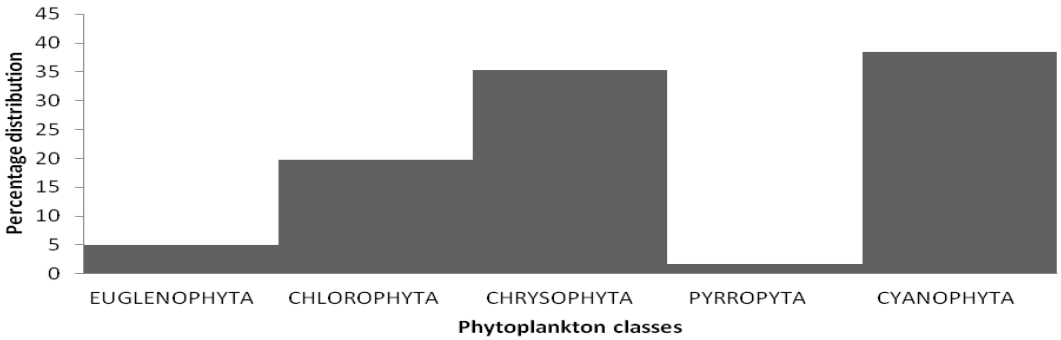

Figure 4. Percentage distribution of phytoplankton classes in station C.

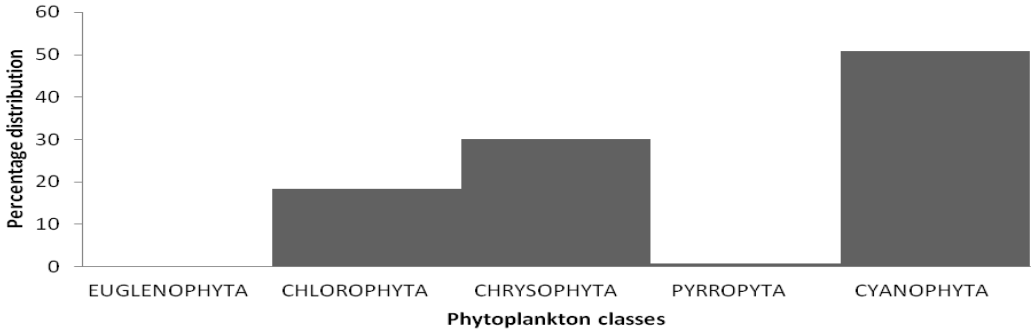

Figure 5. Percentage distribution of phytoplankton classes in station D.

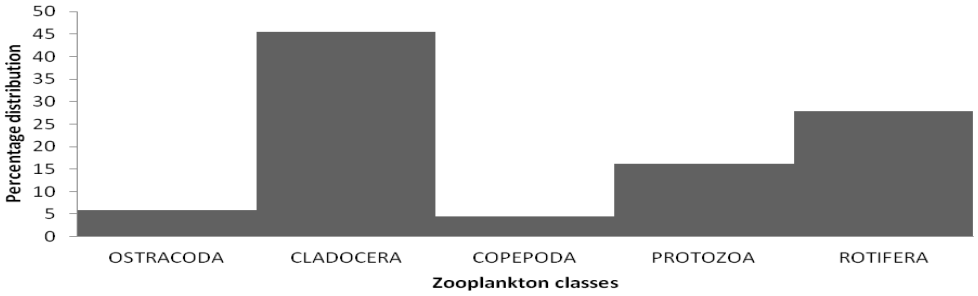

Figure 6. Percentage distribution of zooplankton classes in station A.

DISCUSSION

For the 4 Stations, water temperature was lowest in Station A in December, 2011 and was highest in Station C in May, 2012. It was observed that for the first four months of this study, the dissolved oxygen values were very critically low, that is, less than 5 mg/l. This could have been caused by pollution due to anthropogenic activities carried out around the water resource. Jaji et al. (2007) reported that pollution of Ogun river water along its course is evidenced by the high concentrations of pollution indicators, nutrients and trace metals above the acceptable limit.

In the frequency distribution of phytoplankton classes, Cyanophyta was predominant in all the stations excluding station B where there was a tie between Cyanophyta and Chlorophyta. The dominance of Cyanophyta in this river is similar to findings by Sekadende et al. (2004), Ogato (2007), Deng et al. (2007), and Shakila and Natarajan (2012).

In the frequency distribution of zooplankton classes, Cladocera was predominant in all the stations. This is shown in Figures 6, 7, 8 and 9. The dominance of Cladocera in this river is similar to findings by Ude et al.

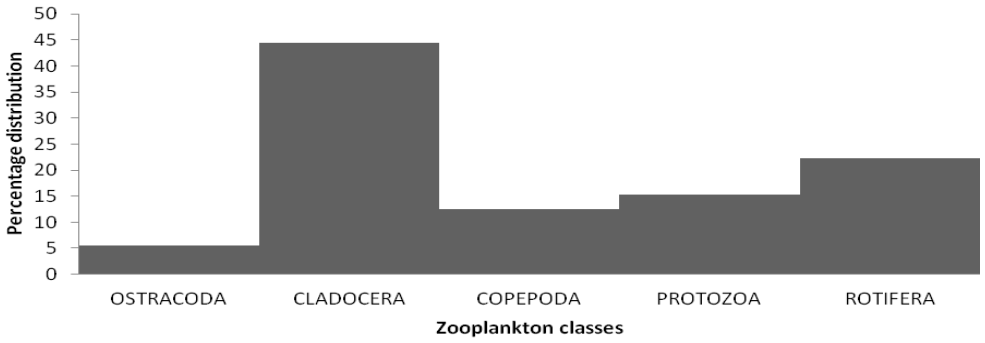

Figure 7. Percentage distribution of zooplankton classes in station B.

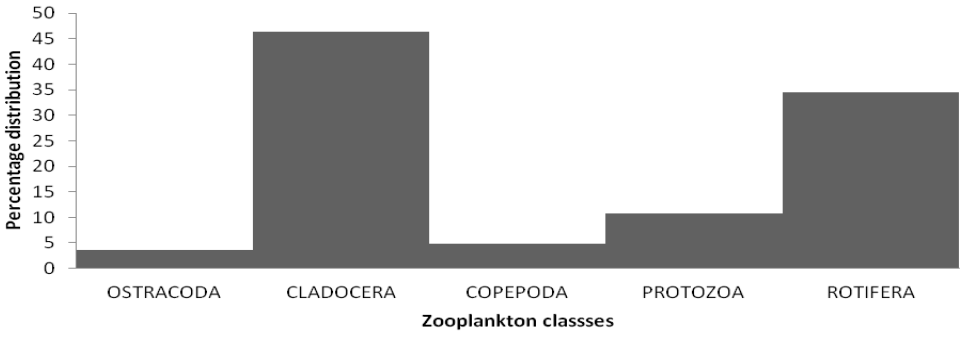

Figure 8. Percentage distribution of zooplankton classes in station C.

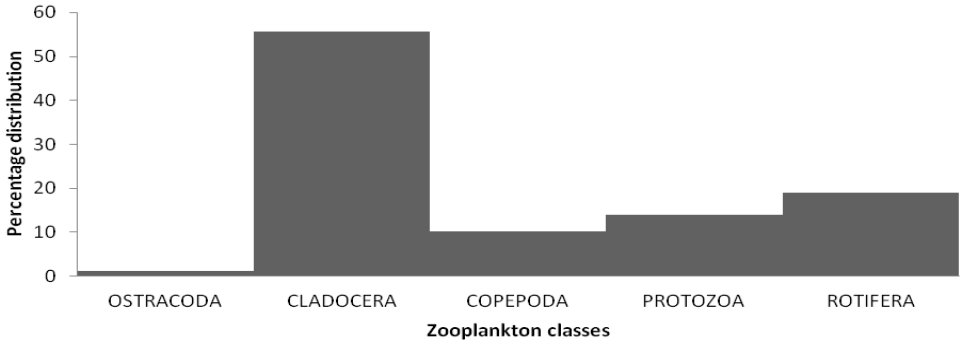

Figure 9. Percentage distribution of zooplankton classes in station D.

(2011) and Ogbuagu and Ayoade (2012).

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