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Abundance, distribution and species diversity of phytoplankton in Ikere-Gorge, Iseyin, Oyo State, Nigeria

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ABSTRACT

Phytoplankton is a good bio-indicator for evaluation of healthy condition of freshwater ecosystem. The distribution, abundance and species diversity of phytoplankton of Ikere-gorge are determined in this study. Monthly phytoplankton samples were collected with a standard plankton net within the hours of 11:00 am – 02:00 pm between January 2017 and December 2018. Phytoplankton species identification was done with the aid of Celestron LCD digital microscope II and appropriate identification keys. Fifty-five genera of phytoplankton belonging to 9 families were identified. Chlorophyceae family dominated with 23 species of phytoplankton. It was also observed that *Microcystis spp* was the most dominant species across all the sampling sites. The gamma diversity (γ) of phytoplankton species was 55. Beta diversity was 0.08. Species richness of each sampling sites were Site A (52), Site B (47), Site C (54) and Site D (50). Sites A and C have the same value of Dominance D and Simpson index (0.02 and 0.98 respectively), while sites B and D also have the same values of Dominance D and Simpson index (0.03 and 0.97) respectively. Shannon Weiner index varied slightly among the sites. The presence of some members of Cyanophyceae family like *Microcystis spp*., *Oscillatoria spp* and *Gloeotrichia spp*. suggests that Ikere-gorge is polluted. This calls for proper management action to sustain healthy functioning of Ikere-gorge.

Keywords: Diversity, phytoplankton, species, genera, ecosystem

INTRODUCTION

Phytoplankton is among the most diverse aquatic organisms. Their productivity, emergence and existence are being regulated by biotic and abiotic factors more especially solar radiation, water conditions especially phosphate, nitrate and temperature. They are evenly distributed across the water column with respect to their sizes. Phytoplankton is the collection of photosynthetic micro-organisms adapted to live partly or continuously in open water (Reynolds, 2006). They are also known as algae, widely distributed in aquatic ecosystems such as lakes, rivers, reservoirs.

Phytoplankton are micro-organisms with size varies between <2 μm and >200 μm. They are mainly visible under a light microscope, although some can be visible with naked eyes. Example of such phytoplankton is large globular colonies of blue-green algae such as *Microcystis* (Bellinger and Sigee, 2010). They are the foundational species in aquatic environment being the primary producers in the aquatic

ecosystems. They are at the base of aquatic food web and supply energy to other aquatic living organisms. They indirectly transfer energy to other terrestrial living organisms that depend on aquatic resources for the survival of their parts or whole lives. Therefore, phytoplankton is central to normal functioning of aquatic ecosystem (Ekwu and Sikoki, 2006).

Phytoplankton can be used as bio-indicators of aquatic ecosystem. Their abundance and species composition can be used to describe the health status of any freshwater ecosystem. Some phytoplankton species in freshwater ecosystem can become nuisance organisms forming dense blooms, having adverse effects on human activities by clogging water courses and impairing recreational activities. They can also be toxic and become harmful to higher order consumers, such as humans, but not necessarily to the vectors of the toxin, such as oysters or fish (Bellinger and Sigee, 2010; Suthers and Rissik 2009). However, some phytoplanktons have direct benefits to humans. Certain species of phytoplankton have medicinal and cosmetic benefits while some are used as delicacies or dietary supplement. The Aztecs of Mexico and the people around Lake Chad cultivate and harvest *Spirulina* as a dietary supplement and process into *Spirulina* tablet available in health food shops (Bellinger and Sigee, 2010).

The study of phytoplankton species composition, diversity, biomass, abundance and distribution is an integral part of sustainable management of the aquatic ecosystem. Phytoplankton play important role in fish production and they are good indicators of environmental conditions (Odulate *et al*. 2017; Ekwu and Sikoki, 2006). Bellinger and Sigee, (2010) identified 10 major divisions (phyla) of freshwater phytoplankton to include blue-green algae (*Cyanophyta*); green algae (*Chlorophyta*); euglenoids (*Euglenophya*); yellow-green algae (*Xanthophyta*); dinoflagellates (*Dinophyta*); cryptomonads (*Cryptophyta*); chrysophytes (*Chrysophyta*); diatom (*Bacillariophyta*); red algae (*Rhodophyta*) and brown algae (*Phaeophyta*). Reynolds (2006) reported 15 major divisions of phytoplankton although these are for both freshwater and marine ecosystems. However, *Chlorophyta* and *Bacillariophyta* are the most diverse divisions among the 10 major divisions of phytoplankton as listed above (Odulate *et al*. 2017; Akinyemi and Adesalu, 2015; Çelekli, *et al*. 2014; Gast *et al*. 2014; Ogbuagu and Ayoade. 2012; Kadiri, 2006; Ekwu and Sikoki, 2006). Some scholars such as Kehinde and Ayoade (2012); Akinyemi and Adesalu (2015) had earlier worked on the phytoplankton species composition of Ikere-gorge. But, this study aims to evaluate seasonal variation of abundance, distribution and species diversity as a means of monitoring the health status of Ikere-gorge.

MATERIALS AND METHODS

The study Site

The study was carried out in Ikere-gorge. It is a 565 million cubic meters (mcm) multipurpose dam located at Ikere village, about 28km, North East of Iseyin in Oyo State. Ikere-gorge is located between longitude 8°10' and 8° 20'N and latitude 3° 40' and 3° 50'E (Figure 1). There are 12 fishing villages in Ikere-gorge from which four fishing villages were selected using stratified random selection method. The fishing villages were divided into four strata for easy access based on their geographical location and proximity to each other. The selected fishing villages were used as sampling sites. They are Site A – Irawote (N8º 13 ' 51.689; E3º 42 ' 42.468), Site B – Agatu (N8º 09 ' 51.426; E3º 45 ' 00. 000); Site C – Spillway (N8º 11 ' 37.290; E3º 43 ' 45.168), and Site D – Asamu (N8º 14 ' 03.294; E 3º 46 ' 56.028) fishing villages.

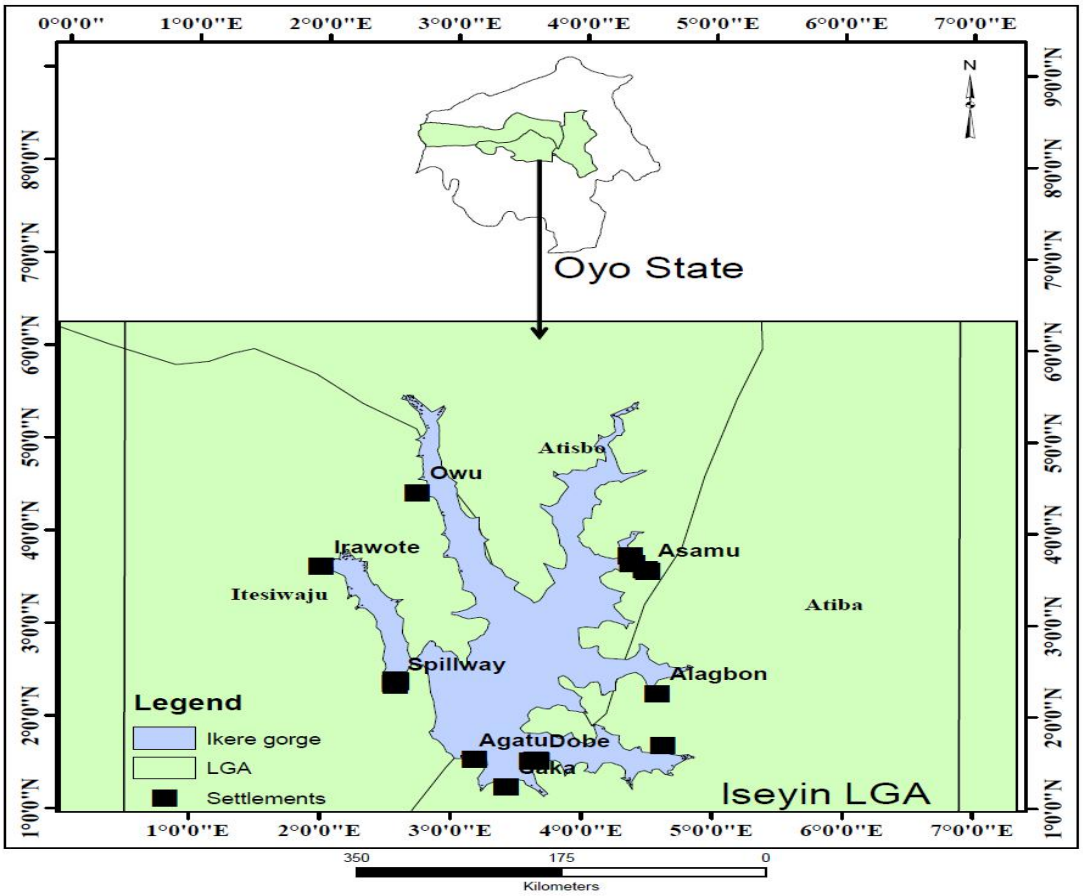

Fig.1. Map of Ikere-gorge (showing some fishing villages), Iseyin, Oyo State, Nigeria

Phytoplankton sampling

Monthly phytoplankton samples were collected within the hours of 11:00 am – 02:00 pm between January 2017 and December 2018. The plankton net with 25 cm diameter and 50 µm mesh size was used to collect phytoplankton samples; since the sizes of most microplankton like protozoa, rotifers etcetera are within the 20 – 200 µm (Shiel, 1995). The plankton net was trawled horizontally in the water column at a distance of 100 m. The concentrated samples of phytoplankton collected were poured into 50 ml plastic bottles and were preserved with 4% formalin. The samples were labelled, recorded accordingly and brought to the laboratory of Biotechnology centre, Forestry Research Institute of Nigeria (FRIN), Ibadan for further analysis.

In the laboratory, phytoplankton species identification was done with the aid of Celestron LCD digital microscope II at 100x to 400x magnification and appropriate keys such as: Neehdam and Neehdam (1962); Belcher and Swale, (1978); Findlay and Kling (1979); Huynh and NSerediak (2006); Taylor *et al*. (2007); Janse van Vuuren *et al*. (2006); Suthers and Rissik, (2009). The identified image of phytoplankton were taken, recorded and saved for further analysis. Lackey drop count method (Lackey, 1938) was adopted to count phytoplankton cells and 28 drops of the concentrated sample is equivalent to 1ml.

Relative Abundance

It is the proportion contribution of individual aquatic species to the total population in the sample. It was computed with the formula:

RA = Si / N * 100 ……(1)

Where:

RA – Relative Abundance
Si – Population of individual species
N – Total population of species

Statistical analysis

The data obtained were subjected to descriptive statistics analysis using SPSS (Version 20.0) software to determine the abundance of phytoplankton species. Phytoplankton species diversity was determined by different diversity indices using Palaeontological Statistics (PAST) and R statistical package (Hammer *et al.* 2001; Odulate *et al*. 2017).

RESULTS

This study identified phytoplankton taxa to species level. Fifty-five (55) genera of phytoplankton belonging to 9 families were reported in Ikere-gorge between January 2017 and December 2018 (Table 1). This shows that 23 species of phytoplankton belonging to Chlorophyceae family, constituting 42% of total phytoplankton abundance, followed by Bacillariaophyceae 15 species with 27% contribution, Cyanophyceae (Cyanobacteria) 7 species with 13% contribution, Chrysophyceae 3 species with 5% contribution, Desmidiaceae 2 species with 3% contribution, Xanthophyceaae 2 species with 4% contribution, while other families are represented with 1 species each (Figure 2).

Table 2 shows spatial distribution and relative abundance of phytoplankton in Ikere-gorge. Site C has the highest species richness (54), followed by site A (52), site D (50) and site B (47). It was also observed that in site A, *Microcystis spp* (3,724) was the most dominant species. This is followed by *Chroococcus spp* (2,800), *Aulacoseira spp* (2,744) and *Gonatozygon spp* (2,744). The most abundant species in site B were *Microcystis spp* (6,067), *Volvox spp* (3,612), *Gloeotrichia spp* (3,192), *Oocystis spp* (3,136) and *Oscillatoria spp* (2,968). The predominant species in site C are *Microcystis spp* (5,908), *Gloeotrichia spp* (3,472), *Calothrix spp* (3,360), *Oscillatoria spp* (3,024) and *Gonatozygon spp* (2,856). The predominant species in site D were *Microcystis spp* (6,356), *Gloeotrichia spp* (3,136), *Calothrix spp* (3,108), *Aulacoseira spp* (3,024) and *Synedra spp* (2,716). The least abundance species in site A was *Melosira* spp (728), in site B was *Vauchena sp* (616), in site C was *Frustulia spp* (756) and in site D *Tetraedron sp* (728).

However, it was observed that *Microcystis spp*. is the dominant species across the sites with percentage relative abundant 6.68%. It is followed by *Gloeotrichia spp* (3.78%), *Calothrix spp* (3.34%), *Aulacoseira spp* (3.28%), *Oscillatoria spp* (3.26%), *Volvox spp* (3.21%), *Gonatozygon spp* (3.15%) and *Synedra spp* (3.02%). Other phytoplankton species contributions were lower than 3%. However, *Ochroomonas spp, Aphanocapsa spp, Bacillaria spp, Gomphonesis spp, Tetraedron spp* and *Rhopalodia spp* contributed less than 1% to phytoplankton composition of Ikere-gorge.

It is observed that site C recorded the highest abundance (93,828; 28.42%) of phytoplankton, followed by site B (80,976; 24.53%), site A (77,728; 23.54%) and site D (77,616; 23.51%). There is higher abundance production of phytoplankton (62.8%) in the rainy season than in the dry season with 37.2% phytoplankton abundance (Figure 3). It was observed that the month of July recorded the highest abundance of phytoplankton (10.08%), followed by the month of August (9.90%), June (9.14%), September (9.04%) and November (9.01%). The least phytoplankton abundance was recorded in the month of January (6.34%) as shown in Figure 4.

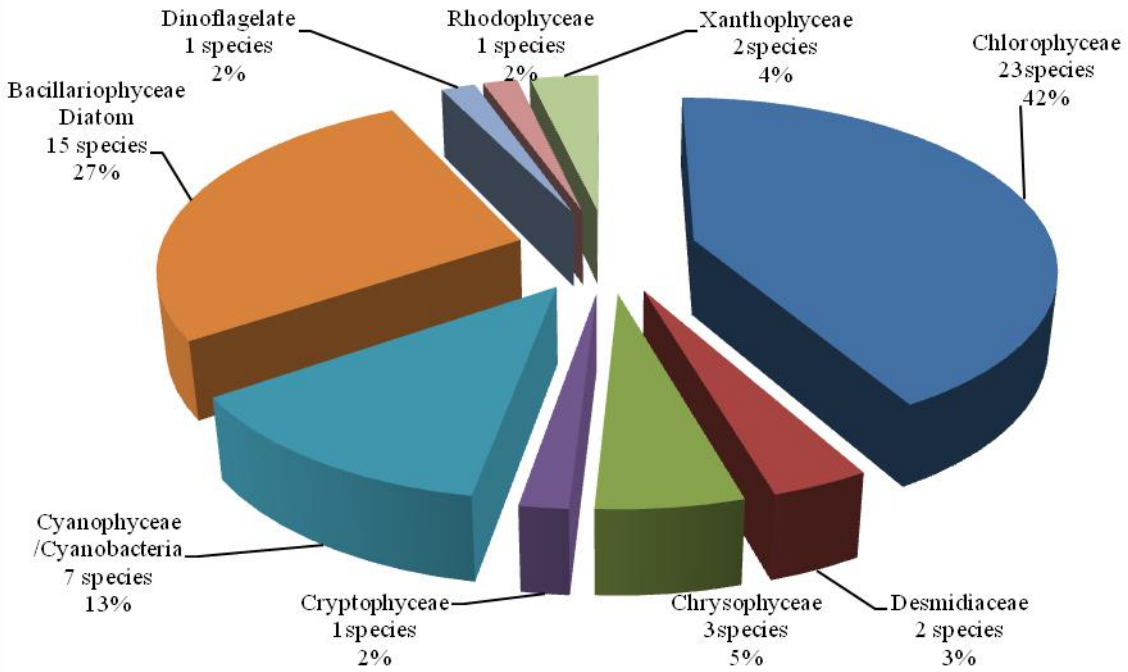

Fig. 2. Percentage contribution of phytoplankton species by families in Ikere-gorge

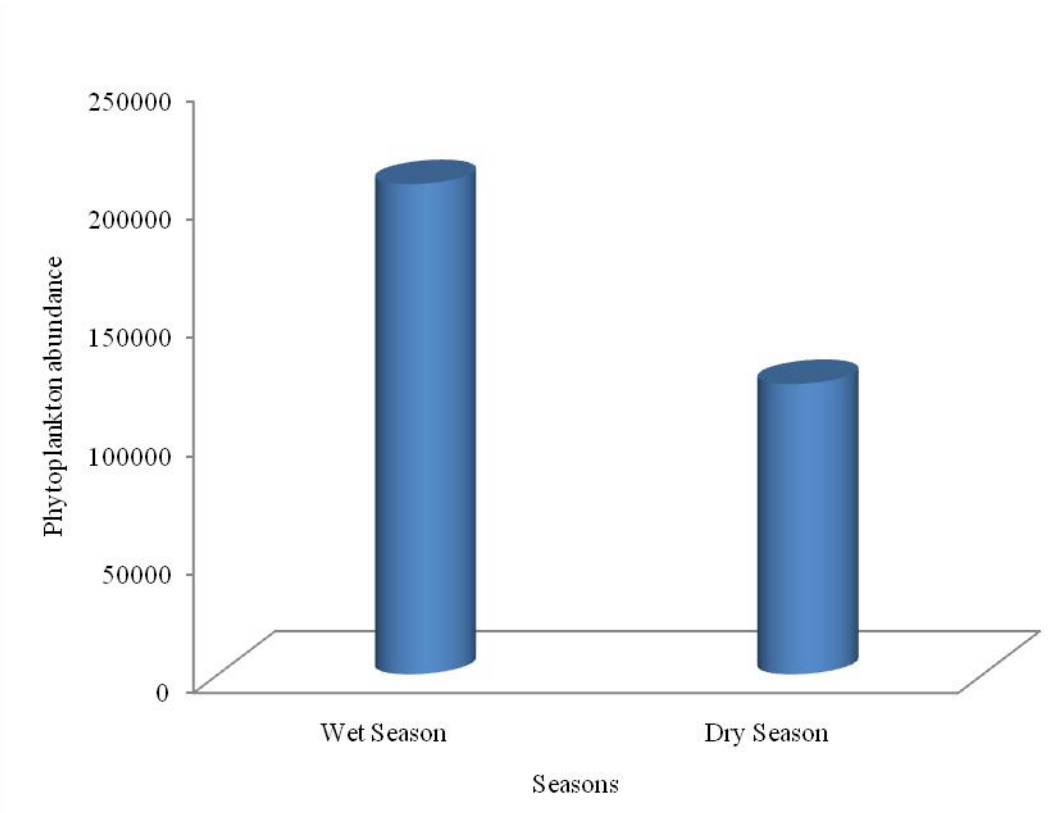

Fig. 3. Seasonal variation of phytoplankton abundance in Ikere-gorge, Iseyin, Oyo State.

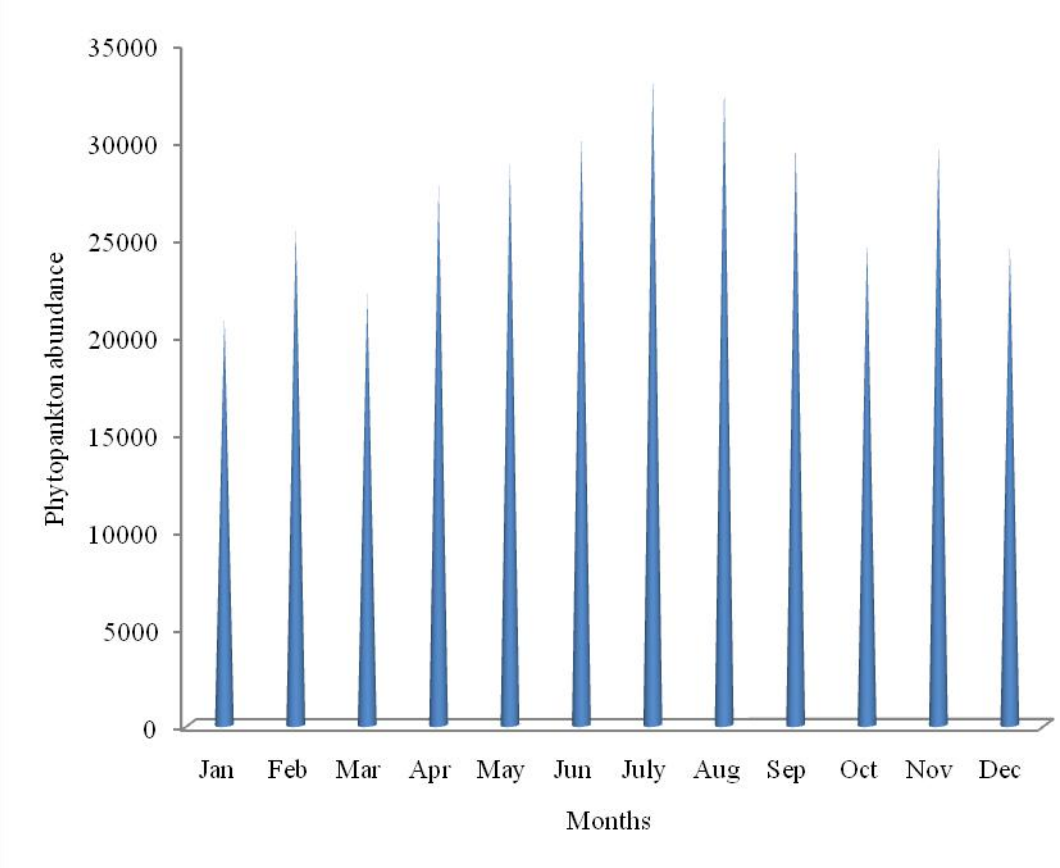

Fig. 4. Monthly variation of phytoplankton abundance in Ikere-gorge, Iseyin, Oyo State, Nigeria

Table 1: Checklist of species composition of phytoplankton of Ikere-gorge, Iseyin, Oyo State, Nigeria

Taxa	Species
Chlorophyceae	
	Ankistrodesmus spp.
	Bulbochaete spp
	Characium spp
	Chlamydomonas spp
	Closterium spp.
	Crucigenia spp
	Drapanaldia spp
	Germirella spp
	Heamatococcus spp
	Hydrodictyon spp
	Microspora spp
	Mougeotia spp
	Navicula spp
	Oedogonium spp
	Oocystis spp
	Palmodictyon spp

	Pleodorina spp
	Pleurotaenium spp
	Spirogyra spp
	Stigeoclonium spp
	Tetraedron spp
	Ulothrix spp
	Volvox spp
Desmidiaceae	
	Gonatozygon spp
	Mesotaenium spp
Chrysophyceae	
	Chromulina spp
	Dinobryon spp
	Ochroomonas spp
Cryptophyceae	
	Cryptomonas spp
Cyanophyceae /Cyanobacteria	
	Merismopedia spp
	Aphanocapsa spp
	Calothrix spp
	Chroococcus spp
	Gloeotrichia spp
	Microcystis spp
	Oscillatoria spp
Bacillariophyceae Diatom	
	Aulacoseira spp
	Bacillaria spp
	Cocconeis spp
	Cyclotella spp
	Diatoma spp
	Encyonema spp
	Fragillaria spp
	Frustulia spp
	Gomphonesis spp
	Melosira spp
	Nitzchia spp
	Pinularia spp
	Rhopalodia spp
	Surirella spp
	Synedra spp
Dinoflagelate	
	Dinophysis spp
Rhodophyceae	

	Lemanea spp
Xanthophyceae	
	Tribonema spp
	Vauchena spp

Table 2: Spatial distribution and relative abundance of phytoplankton in Ikere- gorge, Iseyin, Oyo State, Nigeria

Phytoplankton Species	SITE A (Number/ml)	SITE B (number/ml)	SITE C (Number/ml)	SITE D (Number/ml)	Mean	%RA
Microcystis spp	3724 (16.88)	6076 (27.54)	5908 (26.78)	6356 (28.81)	5516	6.68
Gloeotrichia spp	2688 (21.52)	3192 (25.56)	3472 (27.80)	3136 (25.11)	3122	3.78
Calothrix spp	2408 (21.29)	2436 (21.53)	3360 (29.70)	3108 (27.48)	2828	3.43
Aulacoseira spp	2744 (25.32)	2296 (21.19)	2772 (25.58)	3024 (27.91)	2709	3.28
Oscillatoria spp	2464 (22.92)	2968 (27.60)	3024 (28.13)	2296 (21.35)	2688	3.26
Volvox spp	1988 (18.78)	3612 (34.13)	2688 (25.40)	2296 (21.69)	2646	3.21
Gonatozygon spp	2744 (26.42)	2660 (25.61)	2856 (27.49)	2128 (20.49)	2597	3.15
Synedra spp	2464 (24.72)	2436 (24.44)	2352 (23.60)	2716 (27.25)	2492	3.02
Spirogyra spp	1652 (17.46)	2548 (26.92)	2800 (29.59)	2464 (26.04)	2366	2.87
Chroococcus spp	2800 (30.96)	2632 (29.10)	2520 (27.86)	1092 (12.07)	2261	2.74
Oocystis spp	2044 (22.74)	3136 (34.89)	2716 (30.22)	1092 (12.15)	2247	2.72
Pleodorina spp	1204 (15.25)	2604 (32.98)	1652 (20.92)	2436 (30.85)	1974	2.39
Drapanaldia spp	1904 (31.34)	1512 (24.88)	1484 (24.42)	1176 (19.35)	1519	1.84
Chlamydomonas spp	1260 (21.13)	1596 (26.76)	1820 (30.52)	1288 (21.60)	1491	1.81
Oedogonium spp	1176 (1981)	1988 (33.49)	1624 (27.36)	1148 (19.34)	1484	1.80
Dinophysis sp	1484 (26.77)	1204 (21.72)	1624 (29.29)	1232 (22.22)	1386	1.68
Crucigenia spp	0 (0.00)	1820 (32.99)	2268 (41.12)	1428 (25.89)	1379	1.67
Stigeoclonium spp	1232 (22.80)	1456 (26.94)	1708 (31.61)	1008 (18.65)	1351	1.64
Cyclotella spp	1204 (22.63)	1260 (23.68)	1540 (28.95)	1316 (24.74)	1330	1.61
Hydrodictyon spp	1064 (20.11)	1596 (30.16)	1316 (24.87)	1316 (24.87)	1323	1.60
Mougeotia spp	840 (15.96)	1176 (22.34)	1932 (36.70)	1316 (25.00)	1316	1.59
Heamatococcus spp	1204 (23.24)	1232 (23.78)	1512 (29.19)	1232 (23.78)	1295	1.57
Mesotaenium spp	1316 (25.41)	1092 (21.08)	1372 (26.49)	1400 (27.03)	1295	1.57
Merismopedia spp	1316 (25.68)	952 (18.58)	1512 (29.51)	1344 (26.23)	1281	1.55
Fragillaria spp	1204 (23.63)	1288 (25.27)	1120 (21.98)	1484 (29.12)	1274	1.54
Chromulina spp	1092 (21.67)	1596 (31.67)	1512 (30.00)	840 (16.67)	1260	1.53
Closterium spp.	1624 (32.58)	1680 (33.71)	1680 (33.71)	0 (0.00)	1246	1.51
Dinobryon spp	896 (18.08)	1512 (30.51)	1428 (28.81)	1120 (22.60)	1239	1.50
Cocconeis spp	1204 (24.57)	1008 (20.57)	1120 (22.86)	1568 (32.00)	1225	1.48
Surirella spp	1596 (32.95)	952 (16.65)	1204 (24.86)	1092 (22.54)	1211	1.47
Melosira spp	728 (15.12)	1484 (30.81)	1316 (27.33)	1288 (26.74)	1204	1.46
Microspora spp	1176 (24.56)	1204 (25.15)	1428 (29.82)	980 (20.47)	1197	1.45
Encyonema spp	1288 (27.06)	1008 (21.18)	840 (17.65)	1624 (34.12)	1190	1.44

Ulothrix spp	1120 (23.67)	1708 (36.09)	1148 (24.26)	756 (15.98)	1183	1.43
Characium spp	924 (19.64)	1176 (25.00)	1484 (31.55)	1120 (23.81)	1176	1.42
Navicula spp	840 (17.96)	1288 (27.54)	1344 (28.74)	1204 (25.75)	1169	1.42
Nitzchia spp	1288 (27.71)	1120 (24.10)	1036 (22.29)	1204 (25.90)	1162	1.41
Lemanea spp	1540 (33.13)	1008 (21.69)	1036 (22.29)	1064 (22.89)	1162	1.41
Tribonema sp	1036 (22.56)	1120 (24.39)	1120 (24.39)	1316 (28.66)	1148	1.39
Frustulia spp	1512 (33.13)	1120 (24.54)	756 (16.56)	1176 (25.77)	1141	1.38
Vauchena sp	1176 (26.75)	616 (14.01)	1372 (31.21)	1232 (28.03)	1099	1.33
Pleurotaenium spp	1456 (34.67)	1428 (34.00)	1316 (31.33)	0 (0.00)	1050	1.27
Pinularia spp	1092 (26.35)	784 (18.92)	1260 (30.41)	1008 (24.32)	1036	1.26
Palmodictyon spp	1092 (26.71)	0 (0.00)	1512 (36.99)	1484 (36.30)	1022	1.24
Germirella spp	1120 (27.97)	0 (0.00)	1680 (41.96)	1204 (30.07)	1001	1.21
Cryptomonas spp	784 (19.72)	1092 (27.46)	1064 (26.76)	1036 (26.06)	994	1.20
Ankistrodesmus spp.	756 (19.29)	840 (21.43)	1344 (34.29)	980 (25.00)	980	1.19
Diatoma spp	1288 (33.58)	896 (23.36)	812 (21.17)	840 (21.90)	959	1.16
Bulbochaete spp	1120 (31.50)	0(0.00)	1288 (36.22)	1148 (32.28)	889	1.08
Ochroomonas spp	1792 (55.65)	0 (0.00)	1428 (44.35)	0 (0.00)	805	0.98
Aphanocapsa spp	1484 (48.18)	0 (0.00)	1596 (51.82)	0 (0.00)	770	0.93
Bacillaria spp	1512 (50.47)	0 (0.00)	1484 (49.53)	0(0.00)	749	0.91
Gomphonesis spp	0 (0.00)	1568 (52.34)	0 (0.00)	1428 (47.66)	749	0.91
Tetraedron spp	1064 (36.89)	0 (0.00)	1092 (37.86)	728 (25.24)	721	0.87
Rhopalodia spp	0 (0.00)	0 (0.00)	1176 (46.67)	1344 (53.33)	630	0.76
Total	77728	80976	93828	77616		82537

*Percentage relative abundance in parenthesis

The analysis of diversity indices of the identified phytoplankton species composition of Ikere-gorge is presented in Table 3. It is observed that the number of individual phytoplankton collected from each sampling sites are Site A (77,728); Site B (80,976); Site C (93,828), Site D (77,616) and for the whole dam is 330,148. The species richness of Ikere-gorge was 55. . The species richness of each sampling sites were Site A (52), Site B (47), Site C (54) and Site D (50). Other components of diversity are reported with their values for each site. Sites A and C have the same value of Dominance D and Simpson index to be 0.02 and 0.98 respectively, while sites B and D also have the same values of Dominance D and Simpson index to be 0.03 and 0.97 respectively. Shannon Weiner index varies slightly among the sites. Shannon Weiner index for Site A is 3.87, Site B is 3.72, Site C is 3.89 and Site D is 3.79. Evenness index for site A is 0.92, site B is 0.88, site C is 0.91 and site D is 0.88.

Table 3: Diversity indices of phytoplankton of Ikere-gorge, Iseyin, Oyo State, Nigeria

Diversity Variable	Site A	Site B	Site C	Site D	Ikere
Individuals	77728	80976	93828	77616	330148
Taxa_S	52	47	54	50	55
Dominance_D	0.02	0.03	0.02	0.03	0.02
Simpson_1-D	0.98	0.97	0.98	0.97	0.98
Shannon_H	3.87	3.72	3.89	3.79	3.89
Evenness_e^H/S	0.92	0.88	0.91	0.88	0.89

DISCUSSION

Phytoplankton constitute the primary producers in aquatic ecosystem. They are at the base of food web. They are among the most diverse aquatic organisms. Their productivity, emergent and existence are being regulated by biotic and abiotic factors more especially solar radiation, water conditions especially phosphate, nitrate and temperature. They are evenly distributed across the water column with respect to their sizes. This study identified 55 phytoplankton genera belonging to 9 families in Ikere-gorge. This is greater than 41 genera of phytoplankton belonging to 5 taxonomic groups recorded by Dimowo (2013) from Ogun River. Ogbuagu and Ayoade, (2012) recorded 43 genera of phytoplankton from Imo River in Etche. Abdul *et al*. (2015) recorded 42 phytoplankton genera belonging to 6 taxa in Ogun State costal estuary, Nigeria. Gast *et al*. (2014) identified 71 taxa distributed in 6 classes in the Mundaú reservoir, semi-arid northeastern Brazil. Phytoplankton population is therefore correlated to productivity of an aquatic ecosystem (Narasimha, 2013). In addition, Peltomaa *et al*. (2017) reported that phytoplankton provide many essential biomolecules such as, sterols, fatty acids (FAs), and amino acids (AAs) to consumers, which cannot synthesize them adequately.

Chlorophyceae is mostly found in freshwater ecosystem with few (about 10%) found in marine and brackish ecosystem. This study observed that the family of Chlorophyceae dominated with 23 species constituting 42% of total phytoplankton abundance. This result is in agreement with the earlier reports of Akinyemi and Adesalu (2015) and Kehinde and Ayoade (2012) that the phytoplankton abundance of Ikere-gorge is dominated by the *Chlorophyta*. Odulate *et al*. (2017) reported that Chlorophyceae (52%) with 28 genera was the most dominant family in the composition of the phytoplankton community in Lekan Aare Lake, Abeokuta, Nigeria. Ewebiyi *et al*. (2015) also reported that the Chlorophyta had the highest number of species in some water bodies in Kaduna Metropolis, Nigeria. Gast *et al*. (2014) reported that the Chlorophyceae Class was the richest species throughout their study in the Mundaú reservoir, semi-arid northeastern Brazil. Çelekli, *et al*. (2014) observed that the most dominant group was Chlorophyta (21 taxa) in a shallow artificial pond in Gaziantep, Turkey. The dominance of Chlorophyceae (green alage) in freshwater has been recently noticed for production of algae-based biofuels. This is seen as one of the best current alternative source of renewable energy. It is reported that algae can also be a source of other fuels, such as bioethanol, biohydrogen, and biogas (Scranton *et al*. 2015).

But in contrast to this, Dimowo (2013) observed that phytoplankton species composition was dominated by Chrysophyta with 15 species consisting of 36.6% in Ogun

River; although this is followed by *Chlorophyta* with 14 consisting of 34.1%. Ogbuagu and Ayoade, (2012) reported that the dominant phytoplankton was the Bacillariophyceae (53.25%) in a freshwater body in Etche, Nigeria. Kadiri (2006) observed that the bulk of the flora comprised diatoms (Bacillariophyta) in the Western Niger Delta, Nigeria. Ekwu and Sikoki (2006) reported that Bacillariophyceae (Diatom) was the most abundant phytoplankton family, in the Cross River Estuary of Nigeria.

Dominance and excessive growth of some phytoplankton species such as Oscillatoria *spp*, *Microcystis spp, Gloeotrichia spp, Closterium spp., Navicula spp., Frustulia spp., Melosira spp* as observed in this study is an indication of increase nutrients and pollution in Ikere-gorge (Abdul *et al*. 2015; Anago *et al*. 2013). Moreover *Microcystis spp*., *Oscillatoria spp* and *Gloeotrichia spp*. are among phytoplankton identified by WHO (2003) as most common toxic cyanobacteria in freshwater. Their health impairments through drinking-water as well as accidental swallowing or aspiration of scum material are seen through such symptoms as abdominal pain, nausea, vomiting, diarrhoea, sore throat, dry cough, headache, blistering of the mouth, atypical pneumonia, and elevated liver enzymes in the serum, as well as hay fever symptoms, dizziness, fatigue, and skin and eye irritations; these symptoms are likely to have diverse causes, with several classes of toxin and genera of cyanobacteria involved. Therefore, anthropogenic activities that are fuelling the abundance of these phytoplankton species should be put under control for the safety and proper functioning of Ikere-gorge.

CONCLUSION

Phytoplankton are the foundation organisms of food web in aquatic ecosystem. Their importance cannot be over emphasised as primary producer and biological indicator in aquatic ecosystem. This study identified 55 genera of phytoplankton belonging to 9 families in Ikere-gorge. The dominant genera and family are *Microcystis spp*., and Chlorophyceae respectively. The presence and abundance of Oscillatoria *spp*, *Microcystis spp, Gloeotrichia spp, Closterium spp., Navicula spp., Frustulia spp., Melosira spp* as observed in this study is an indication of increased nutrients, pollution and toxin in Ikere-gorge. Therefore, management of Ikere-gorge needs to be improved to reduce pollution and nutrient load.

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