Original Research Article

Distribution, Abundance and Diversity of Phytoplankton in Onah Lake, Asaba, Delta State, Nigeria

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Abstract

Phytoplankton composition, abundance and distribution could be used to evaluate the health of aquatic habitats. Phytoplankton was harvested from surface water of Onah Lake between February and May 2018. Fifty-eight (58) phytoplankton individuals were identified from the stations, accounting for four classes and ten genus. Stations "C" had (21) individuals followed by stations "A" with (20) individuals, while stations "B" recorded the least (17) number of individuals. The dominant phytoplankton flora was *Closterium* sp accounting for (13) individuals, while *Stigeodium* sp accounted for the least (1) number. Temporal distribution and composition of phytoplankton showed that the highest (19) number was encountered in February, followed by March (17) while May had the least (10) number. Biological diversity indices show that the water body was poor in phytoplankton species. Regular checks in the assessment of phytoplankton of water bodies are recommended, as it will enable hydrologist ascertain any increase or decrease in phytoplankton that could result in pollution or improve water quality over time.

Keywords: Distribution, Abundance, Diversity, Phytoplankton, Onah Lake

Introduction

Phytoplankton have been widely used as indicators of water quality (Sharma and Bhardwaj, 2011) because they respond quickly to environmental changes. There are few phytoplankton associated with noxious blooms, and, because of their short life span, sometimes create odours as well as toxic conditions at death.

Phytoplankton constitute the most important component of the food chain in all water bodies. Secondary and tertiary consumers including fish depend directly or indirectly on them for food. The knowledge of the phytoplankton community of any water body is therefore important for better understanding of the fish community. (Davies, 2010).

Phytoplankton are responsible for 50% of all photosynthetic activities on earth. Their cumulative energy fixation in primary productivity could better be understood on the basis of the vast majority of oceanic and fresh water food webs. Phytoplankton have been divided into two broad divisions, namely phototrophic bacteria: (which consist of purple and green sulphur bacteria) and algae (which consist of *euglenophyta, chryphyta, phaecophyta, rhodophyta, pyrrophyta, and cyanophyta)*. Phytoplankton are important in pollution monitoring (Davies, 2010), little wonders their distribution, abundance, and diversity have been used to assess the biological integrity of the water body (Ezekiel *et al*., 2011). Some species of phytoplankton are associated with high eutrophic level while others show high sensitivity to chemical and or organic waste.

Cynanophyta bacteria, commonly known as blue-green algae (produce geom., a bio-toxin that endangers the life of fishes, particularly bottom dwellers. There is an existing direct link between water quality and phytoplankton abundance, showing that the availability of nutrients influences their abundance. Phytoplankton convert light energy to chemical energy through primary production which makes them relevant in the food web. Based on their distribution the water quality of the environment can be assessed (Kharti, 2014). The present study provides a checklist of phytoplankton in Onah Lake, Asaba, Delta State, Nigeria.

Materials and Methods

The map of Onah Lake, already described in Olele (2009), is presented in Figure 1. Phytoplankton were collected between 7.00 and 9.00am from sample stations A, B and C in the lake for four months (February to May, 2018) with the aid of a standard plankton net. The net was suspended below the water surface and towed over a considerable distance, before collecting the water sample in 5cl bottle, in each station. The samples were conveyed to Animal Care Laboratory in Igbusor Road, Asaba, Delta State. At the laboratory, the water sample was centrifuged and the supernatant discarded. With the help of a dropper, 0.01ml of the centrifuged water sample was dropped on a cleaned microscope slide, and covered with a cover slip. Slide content was examined under a Leltz-Wetzlar Binocular Microscope, and the isolated plankton identified with keys (Janse van Vuuren *et al*., 2006; Bellinger and Sigee, 2010). Identified phytoplankton were photographed while still under the microscope with the aid of Mini VID digital camera UCMOS05100KPA (51.MP/25 APTINA CMOS SENSOR). Percentages of the plankton enumerated were computed. Species diversity indices were used to obtain estimations of phytoplankton abundance, richness and evenness.

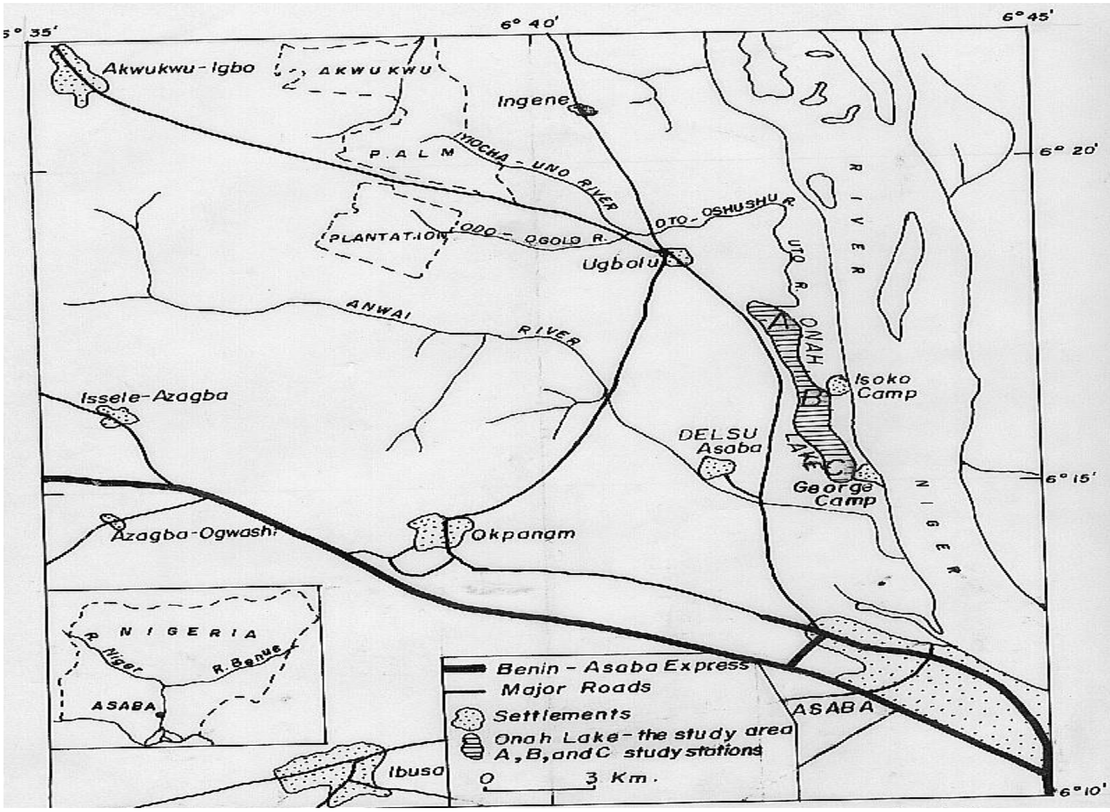

Figure 1: Map of Onah Lake showing water sampling stations A, B and C.

Results

Abundance, composition and distribution of phytoplankton in Onah Lake

Data on the abundance, composition and distribution of phytoplankton in Onah Lake (Table 1) show that fifty eight (58) individuals belonging to four (4) classes and nine (9) species were identified. Station "C" had a total of twenty one (21) phytoplankton individuals, followed by station "A" with twenty (20) while station "B" recorded the least number (17). The phytoplankton flora were dominated by *Closterium* sp having a total of thirteen (13) individuals, accounting for (22.41%) while *Stigeodium* sp had the least (1) accounting for (1.72%). Photographs and scientific names of phytoplankton identified are presented in Figure 2.

Monthly abundance, composition and distribution of phytoplankton from Onah Lake

Monthly composition of phytoplankton is presented in Table 2. The table shows that the highest composition (19) of phytoplankton was obtained in February while May had the least (10).

Table 1: Spatial distribution of phytoplankton from Onah Lake

	Class	Genus	Stations A	Stations B	Stations C	Total Composition	Percentage composition
1	Cyanophyta	*Mycrocystis* sp	4	2	6	12	20.69%
2	Chrypsophyta	*Oscillatoria* sp	5	5	2	12	20.69%
3	Bacillariophyta	*Navicula* sp	1	2	2	5	8.62%
4	Chlorophyta	*Closterium*	5	3	5	13	22.41%
		Cosmarium sp	2	2	3	7	12.07%
		Spirogyra sp	0	1	1	2	3.45%
		Staurastrum sp	2	0	2	4	6.90%
		Stigeodium sp	0	1	0	1	1.72%
		Volvox sp	1	1	0	2	3.45%
	Total		**20**	**17**	**21**	**58**	**100%**

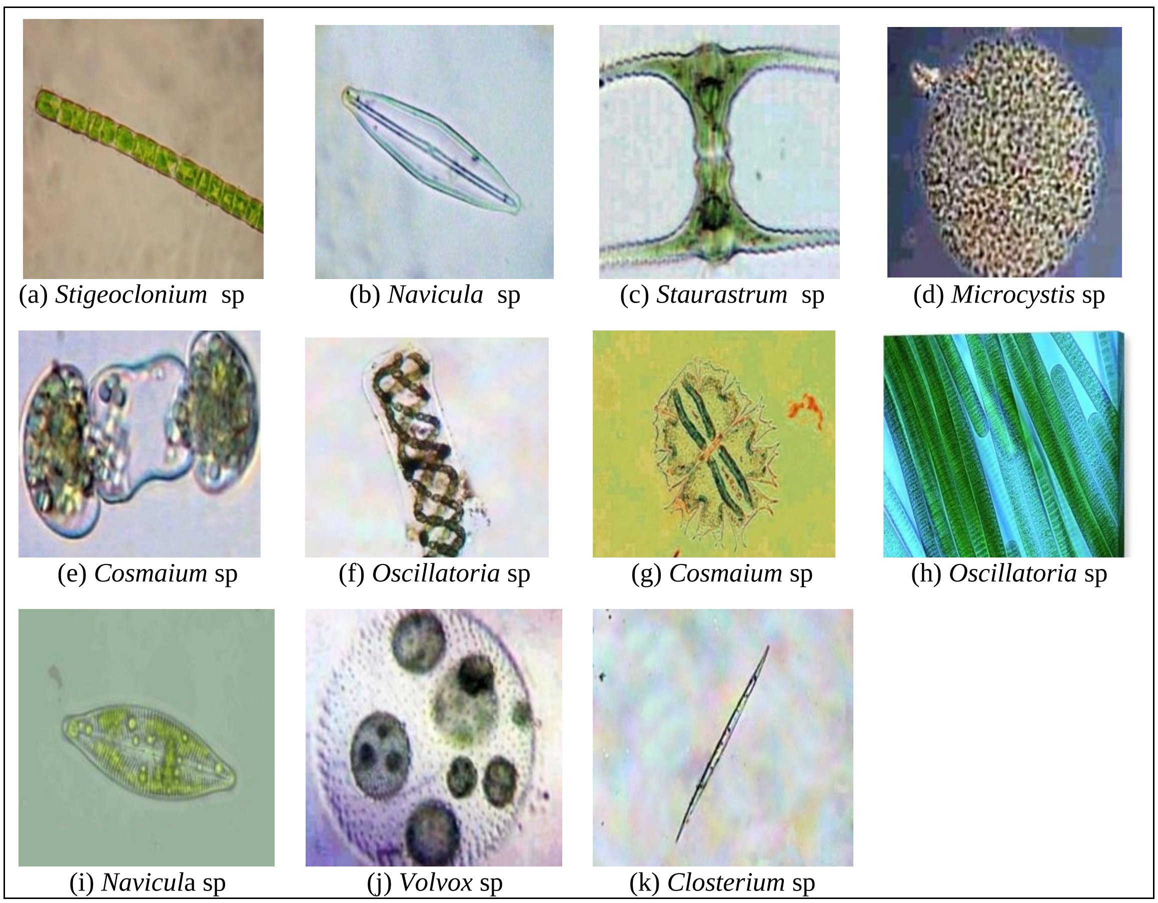

Figure 2: Photographs (a – k) of phytoplankton identified from Onah Lake.

Table 2: Temporal distribution of phytoplankton from Onah Lake

Genus	February	March	April	May	Total
Mycrocystis sp	0	0	1	1	2
Oscillatoria sp	4	4	3	2	13
Dinobryon sp	2	2	2	0	6
Navicula sp	1	1	1	1	4
Cosmarium sp	5	3	1	2	11
Spirogyra sp	2	5	1	2	10
Staurastrum sp	1	1	0	1	3
Stigeodium sp	1	1	1	0	3
Volvo sp	3	0	2	1	6
Total	**19**	**17**	**12**	**10**	**58**

Phytoplankton diversity indices across stations in Onah Lake

Diversity index of phytoplankton is presented in Table 3. Margalef index shows that station C was the most diverse (2.76) while the least diverse station was A (2.41). Shannon Weiner index of species abundance shows that station B recorded the highest abundance (2.82) while station C accounted for the least abundance (2.11). Species richness was highest at station B with a value of (0.87) while station C recorded the least species richness, with a value of (0.53).

Table 3: Diversity indices of phytoplankton across stations in Onah Lake

	Stations		
Diversity index	A	B	C
Margalef index of species diversity	2.41	2.50	2.76
Shannon Weiner index of species abundance	2.48	2.82	2.11
Evenness index of species richness	0.71	0.87	0.53

Discussion

The present study showed that a total of (58) fifty eight individuals comprising of four (4) classes and nine (9) genuses were identified. This result was in contrast with a total of ten (10) species earlier reported in the same water body (Olele, 2009). Adeyemi *et al.*, (2008) reported 1,302 species of phytoplankton consisting of four (4) classes viz: *Chlorophyta*, *Baccillariophyta*, *Cryptophyta* and *Euglenophyta* from Gbedikere Lake, Bassa, Kogi State Nigeria. *Chlorophyta* had the highest percentage dominance of (77.74%), *Bacillariophyta* accounted for (18.81%) while *Cryptophyta*, and *Euglenophyta* accounted for (3%) each. Adesalu (2010) recorded 55 species of phytoplankton belonging to four (4) classes namely *Bacillariophyta*, *Cryptophyta*, *Euglenophyta* and *Cyanophyta* from Kainji Lake. Offem *et al*., (2011) recorded thirty four (34) species of phytoplankton belonging to four families in Ikwori Lake. Abubakar and Yakasai (2013) indentified twenty five (25) species of phytoplankton consisting of four classes viz: *Chlorophyta, Cyanophyta*, *Bacillariophyta* and *Dinophyta* in Ngulu Lake, Enugu State, Nigeria. Variation in these reports could be attributed to differences in locality, prevailing weather conditions, time of the day, method of sampling (Mahar, 2003) and fluctuations in water parameters (Abubakar, 2009). Ezra and Nwankwo (2001) observed that a change in phytoplankton population in Gubi Lake was not only influenced by physico-chemical parameters, but was also due to alteration in the level of nutrients as well as changes in predator/grazing populations (Ghosh *et al*., 2012).

Among the identified phytoplankton species *Closterium* accounted for the highest dominance with a percentage composition of (22.41%) in line with those of Olele (2009). Ewebiyi *et al*., (2015) opined that most dominant chlorophyta reported in water bodies were *Closterium*. The dominance of *Closterium* species in Onah Lake indicates that the ecosystem is low in nutrients, slightly acidic and dystrotrophic (Bellinger and Sigee, 2010). The highest density of phytoplankton species was observed in station C. This could be attributed to a conducive environmental condition for their growth (Rajagopal *et al*., 2010). Carvalho *et al.* (2010) was of the view that high density of phytoplankton could be associated with favorable environmental condition, and also, lesser activities of grazers and predators (Ghosh *et al*., 2012). Some phytoplankton species were absent in some sampling stations at different months. This may be attributed to sensitive species disappearing as the water became degraded/polluted while the tolerant species that could survive pollution stress remained (Ghosh *et al*., 2012).

A change in phytoplankton structure and biomass greatly affects the aquatic ecosystem functions including shift in nutrient cycles and or food web (Pearly and Peierls, 2008). Uneven distribution of phytoplankton was observed across sampling stations. Ewebiyi *et al*. (2015) was of the opinion that the distribution of phytoplankton within aquatic ecosystems was directly correlated with water quality. Consequently the whole community structure of phytoplankton forms the base of any aquatic food chain and organic production in an ecosystem.

Diversity indices in phytoplankton studies are used in the assessment of pollution. Shannon-Weiner diversity index greater than 4 was reported for clean water, a value of 3-4 was reported for a mildly polluted water, whereas a water body with values less than 2 was a heavily polluted water body (Shekhar *et al.* 2008). Since the diversity indices of the present study ranged from 0.53 – 2.82, it indicates that Onah Lake is heavily polluted. However, values of Shannon – Weiner index above 0.48 – 1.10 was reported by Nkwoji *et al.* (2010). It could be concluded that Onah Lake is poor in phytoplankton composition because its biological diversity indices were less than 2, a water body affected with pollution. The phytoplankton species were unevenly distribution at the stations. Regular check of phytoplankton is therefore recommended to enable hydro-biologist ascertain changes in phytoplankton composition, distribution and abundance over time.

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