MAPPING OF PHYTOPLANKTON COMPOSITION AND ABUNDANCE IN TAGWAI DAM RESERVOIR NIGER STATE, NIGERIA

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ABSTRACT

The mapping of phytoplankton composition and abundance of Tagwai reservoir were assessed with the aid of computer-assisted interpretation of Quick Bird Satellite imagery (Geographical Information System) over a period of six months (February-July 2016). Four sampling stations were selected based on provincial activities around the lake and the co-ordinate points of each identified sampling station were taking using Global Positioning System (GIS). Plankton net was used to take plankton samples from the water surface monthly, preserved using with 5% formalin and taken to the laboratory for analysis. A total of fifteen species from four taxonomic group were identified in which chlorophyceae was the most abundant which ranged from 20.00±14.14 (station III) to 106.00±61.89 (station II) There was a significant difference (P<0.05) in the mean variation of chlorophyceae observed in all stations followed by Baccillariophyceae, with the mean range of 68.57±65.94 (station II) to 12.00±4.47 (station III), and Cyanophyceae that ranges from 40.00±28.28 (station III) to 70.00±28.28 (station II) The difference was not significant (P>0.05) in the mean variation of Baccillariophyceae and Cyanophyceae distributions in all the stations.While the lowest was Desmidiaceae. The high relative abundance of Chlorophyceae is an indication that the reservoir will support fish production.

KEYWORDS: GIS, Phytoplankton, GPS, Mapping, Quick Bird Satellite imagery

INTRODUCTION

For a water body to be productive and generate high yield, the primary producers (phytoplanktons) of the water must be assessed because they are the main source of food directly or indirectly to the fish population and all the aquatic organisms as they form part of the aquatic ecosystem food web for their optimum performance. Phytoplanktons are essential component of the aquatic food chain (Janjua, et al., 2008). Phytoplanktons do not only influence the food chain but are also of economic value and biological significance to man (Araoye and Owolabi, 2005). Water quality share a mutual relationship with Phytoplankton as the later strongly influence water quality through carbon dioxide uptake and oxygen production. Changes in the water quality can also lead to change in the phytoplankton' distribution and abundance. The importance of phytoplankton and its structure as a means of determining the productivity of the Tagwai dam reservoir, as well as the well-being of the organisms of the water body calls for the Mapping of the phytoplankton in Tagwai dam reservoir using GIS which is a computerized mapping system that enables the user to spatially illustrate and interactively visualize statistical information about an area on a map was used because it has many advantages in that it provides the user an instantaneous visualization of the distribution of phytoplankton in the dam reservoir in which the study was channelled on.

METHODOLOGY

The study Area

The study was carried out for the period of six months (February to July 2016) and located on Tagwai dam reservoir in Chachanga Local Government area in southwest zone of Minna which is at the east of Tungan Goro about 10km, southeast of Mobil market and northeast of Paiko. It is an earthen dam constructed in the year 1978 by the Kano state water resources engineering construction agency (NSWB, 1991). The dam lies on the latitude 90 33' 35'' to 90 36' 07'' N and longitude 60 39' 20'' to 60 39' 58'' E. The dam is under the care of Niger State water board and serves as primary reservoir for Minna town water supply and a source of livelihood to riverine communities around it.

Sources of Data Acquisitions

Various methods and materials were used ranging from plankton net, plankton bottle, electronic microscope, centrifuge model 800, monograph for phytoplankton identification, DO bottle for dissolve oxygen and B.O.D, GPSMAP 76 garmin product for coordinates measurement, secchi disc for transparency, fish finder 400C for depth and temperature measurement, pH meter for Potential Hydrogen Concentration, Chloride, Nitrate and Phosphate Determination were measured according to APHA (1995) standard procedures using Hach spectrophotometer model and GIS techniques to acquire the data for study. The data were obtained from two main sources which are primary data and secondary data. Primary data was data from measurement results of chemical-physical parameter of the water which was performed in situ or ex situ whose outcomes were
analyses at the wet and dry laboratory of FUT, Minna, Niger State, Nigeria While the secondary data was data related to the location map and mapping of the phytoplankton, mapping was done with the aid of computer-assisted interpretation of Quick Bird Satellite imagery, Topographic map and research data from various report.

Data Analysis

All data collected were process and tabulated using Microsoft excel of 2010.The tabulated data were subjected to statistical analysis. Mean difference of parameters was compare using two-way ANOVA at $P<0.05$ to see the variations due to months and stations. While One-way ANOVA was used to see the station variation of phytoplankton.

RESULTS AND DISCUSSION

The result of Table 2 shows Phytoplankton community identified in Tagwai dam reservoir was characterized by four families which are Chlorophyceae represent by Coscinodiscus sp., Lingulodinium polyedra sp., Pediastrum sp., Microspore sp., Gonatozygon sp. and Spirogyra sp. Baccillariophyceae was represented by Rhizosolentia sp., Pseudo-nitzchia australis sp., Proboscia alata sp. Fragillariopsis sp. Cyanophyceae was represented by Coelosphaerium sp. and Anabaena spirodes sp. while Desmidiaceae was represented by Closterium sp.

The result (Table 3) depicts that the mean value of Chlorophyceae recorded which range from 20.00±14.14 (station III) to 106.00±61.89 (station II) There was a significant difference ($P<0.05$) in mean variation of Chlorophyceae observed in all stations. For Bacillariophyceae the mean range was from 68.57±65.94 (station II) to 12.00±4.47 (station III), while that of Cyanophyceae it ranges from 40.00±28.28 (station III) to 70.00±28.28 (station II) There was no significant difference ($P>0.05$) in the mean variation of Bacillariophyceae and Cyanophyceae distributions in all the stations.

The result which was display on the GIS map (Figure 3.). showed that high concentration of the three phytoplanktons (chlorophyceae, baccillariophyceae and Cyanophyceae) were in station II, moderately concentrated in station I and IV and low concentration in III. This high occurrence and relative abundance of phytoplankton in station II (site with vegetation) may be due to the farming activities in that region (eutrophication) and the plant nutrient washed into the dam reservoir via runoff which aid in growth of phytoplankton in the station and the low occurrence in station III (open water) may also be due to lack of nutrient that promote the growth of phytoplankton. The GIS querry map result shows that Demidiaceae was present only in station 1 and absent in other (Figure 4and Table 3).

The species attribute data

The result Figure 5 indicates that dam reservoir was dominated by Chlorophyceae followed by Bacillariophyceae then Cyanophyceae with Demidiaceae been the least representative in the dam. The presence of this phytoplankton in the reservoir indicates that the water is productive. The observation of more Chlorophyta than Bacillariophyta agrees to the trend in tropical water bodies (Akomeah et al., 2010). This result was also inclined with the work, Abdullahi and Indabawa (2005), on the phytoplankton content of Nguru Lake, Kolo et al (2010), on plankton communities of Tagwai Dam, Omondi et al (2016) on assessment of primary productivity of Kuinet Dam, Ahmed (2015) on determination of physic-chemical parameters and plankton composition in Wawan-Rafi Lake. Though the result disagrees with the result of Mustapha (2009) on limnological and assemblages of Oyun Reservoir in which the Bacillariophyceae was the dominant phytoplankton group in the reservoir.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study identified four groups of phytoplankton which include the Chlorophyceae, Bacillariophyceae, Cyanophyceae and Demidiaceae in Tagwai dam reservoir. It also identified Tagwai dam reservoir as a water body with potentials to support fish life due to the presence and abundance of the Chlorophyceae group of phytoplankton.

Recommendation.

There is need for periodic and continuous analysis of the composition and distribution of phytoplankton in Tagwai dam reservoirs. This will serve as an

indicator of its productivity status as well as provide data needed for its effective management.

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Table 1: Description of the Sampling point

Sampling point	Location	Description	Longitudes X	Latitudes Y
1	Landing site	Landing site for fishers and where domestic activities take place	09°34.321″	06°39.159″
2	Site with vegetation	The site is very close to the reservoir where farming activities were carried out	09°34.558″	06°39.377″
3	open water	The middle part of the reservoir where all tributaries empty their water.	09°34.178″	06°39.600″
4	Dam site	This site is close to the dam outlet.	09°33.991″	06°39.419″

Source: Researcher compilation 2016

Table 2: Phytoplankton species identified across the Stations

Taxa	Station I	Station II	Station III	Station IV
Chlorophyceae				
Coscinodiscus sp	+	++	–	–
Lingulodinium polyedra sp	+	+	+	+
Pediastrum sp	–	+	–	–
Microspora sp	+	+	–	+
Gonatozygon sp	++	+	+	+
Spirogyra sp	++	++	–	+
Baccillariophyceae				
Rhizosolentia sp	+	+	–	–
Nitzchia sp	++	+++	+	+
Proboscia sp	–	++	–	+
Fragillariopsis sp	+	+	–	+
Navicula sp	+	+	–	+
Thalassirora sp	++	+	–	–
Cyanophyceae				
Coelosphaerium	+	++	+	+
Anabaena sp	+	++	–	++
Desmidiaceae				
Closterium sp	++	–	–	–

- = absent, + = sparse, ++ = abundant and +++ = dominant

Table. 3: Station Variation of Phytoplankton distribution

Species	Station I	Station II	Station III	Station IV
Chlorophyceae	74.00±31.30^{ab}	106.00±61.89^{b}	20.00±14.14^{a}	68.00±34.21^{ab}
Bacillariophyceae	55.71±44.29^{a}	68.57±65.94^{a}	12.00±4.47^{a}	48.57±37.16^{a}
Cyanophyceae	50.00±28.28^{a}	70.00±28.28^{a}	40.00±28.28^{a}	60.00±28.28^{a}
Desmidiaceae	90.00^{a}			

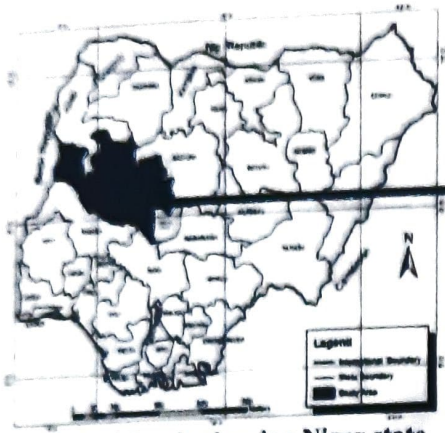

Figure 1a: Nigeria showing Niger state

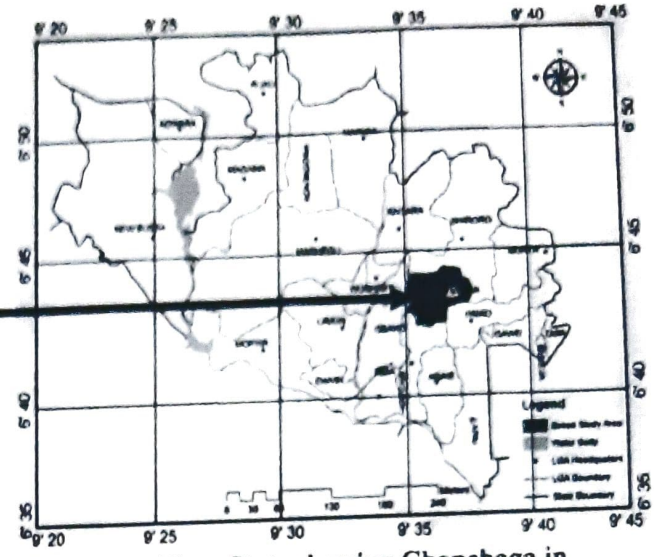

Figure 1b: Niger State showing Chanchaga in Bosso Local Government Area

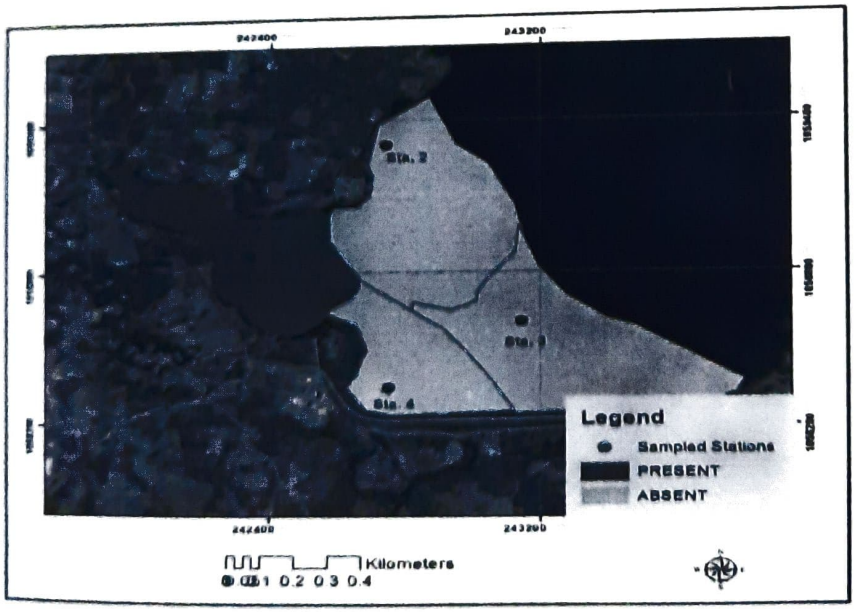

Figure 4: GIS Map of Tagwai Dam Reservoir Indicating the distribution of Desmidiaceae

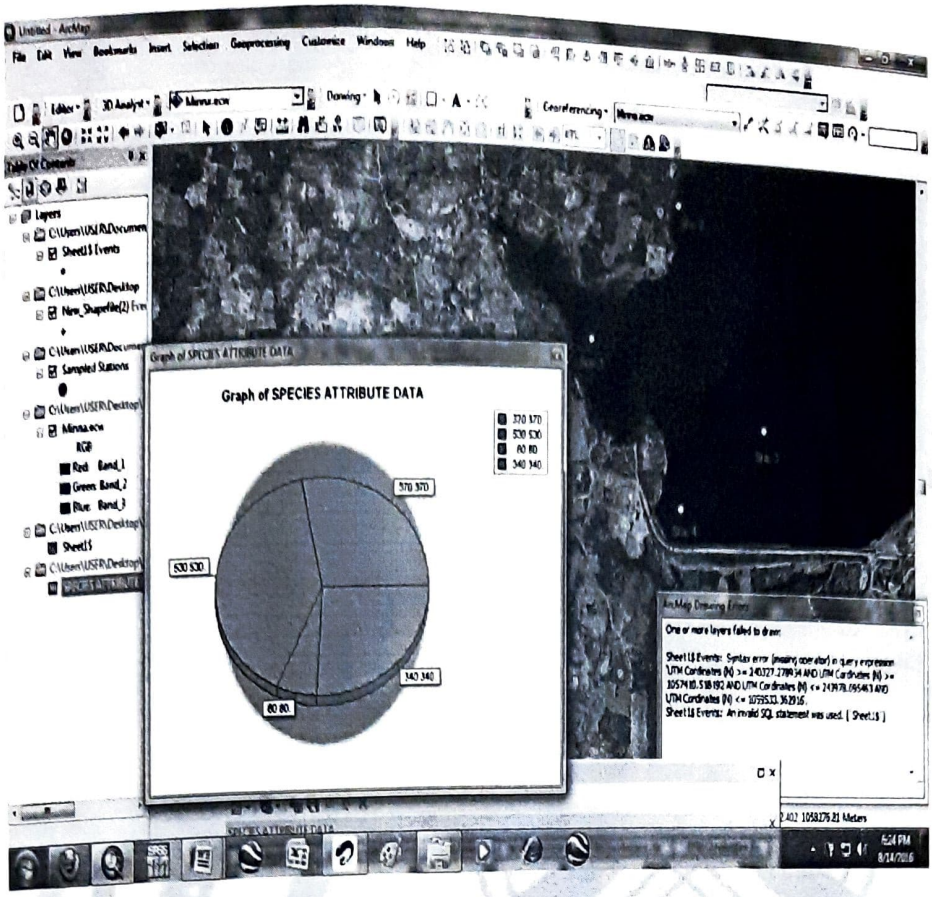

Figure 5: Database map of the study Area showing the phytoplankton attributes

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