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Research Paper

A Review of Phytoplankton Abundance and Its Effects On The Ogane- Aji River In Anyigba, Kogi State

Abhinav Kumar

Abstract
Water, after air, is the most essential natural resources on earth for life survival. Human life depends to a large extent on water due to its array of activities; chief among these is its use for drinking, food preparation as well as for sanitation purpose. This study was conducted to review the phytoplankton abundance and its effects on Ogane-Aji River, Anyigba, Kogi State. Ten water samples were collected from the river and analyzed for its phytoplankton abundance and effects on the river using standard analytical procedures for some various physico-chemical parameters. A total of 40 phytoplankton species were identified of which, class Chlorophyceae had the highest number with 16, Bacillariophyceae 11, Cyanophyceae, 10 and Euglenophyceae, 3 and. Among all the members, Chlorophyceae were dominant with a total distribution of 40%. In contrast, Euglenophyceae, has the least abundance of 7.5%. The result obtained for the physico-chemical parameters in mean at weekly intervals reveals that; for temperature, week 1 recorded the lowest temperature of 27.5°C while, week 4 with 30°C, as the highest. The mean average after four weeks was 28.8 °C. For pH, week 4 average of 6.56 was the lowest acidic level recorded. In contrast, week 1 value of 5.04 was the highest acidic level recorded while; the mean average of 5.80 for the four weeks' intervals indicates slight acidity. For dissolved oxygen (DO), week 3 recorded the lowest value of: 2.9 mg/L. In contrast, week 2 recorded the highest value, 5.7 mg/L with a mean average of 4.2 mg/L across four weeks. For transparency, lowest value was recorded in week 4 with 0.81m while highest value was recorded in week 1: 0.93m with a mean average of 0.86m across the four weeks. The result reveals that the river is moderately polluted. Also, Chlorophyceae dominance indicates that this group may thrive more in polluted waters hence, they are more suited to the habitat. In contrast, Euglenophyceae, with the least abundance of 7.5%, shows these groups are more sensitive to pollution.

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I. INTRODUCTION

Water, after air, is the most essential natural resources on earth for survival of life (Islam and Azam, 2015). Human life depends to a large extent on water, it is used for an array of activities; chief among these is its use for drinking, food preparation as well as for sanitation purpose. The growing demand for adequate quality water resources create an urgent need to link research with improved water management, enhanced monitoring, assessment and forecasting of water resources' and the sanitation issue with much emphasis on the roles of stakeholders. (Sulaiman, 2021). Reservoirs provide much of drinking water supplied to a community, and plankton can greatly influence the water quality of these reservoirs. Uncontrolled growth of certain species of phytoplankton can increase toxicity levels in the water (Watson, 2004; Waya and Mwambungu, 2004). Similarly, it has also been observed that cholera outbreaks are rampant after plankton blooms and can be spread through zooplankton that supports the growth of vibro cholera, the infectious agent of cholera, and can aid in its spread through unfiltered or poorly filtered drinking water (Hug *et al.* 1996). Phytoplanktons are microscopic organisms that form the base of the aquatic food chain. They act as energy transducers and convert the solar energy into chemical energy of food. These organisms are important biological indicator of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes. (Cloern and others, 2014). They are sensitive to the slightest environmental disturbances. Due to this sensitivity, Long-term monitoring has been enabled to determine the annual phytoplankton succession and facilitates the recognition of aberrant phenomena and their progression in the phytoplankton community (Fleming and Kaitala 2006, Klais *et al*., 2011, Majaneva *et al*., 2012, Olli *et al*., 2013). Analyzing the abundance level will further give clearer view on the chemistry of the phytoplankton and why they survive in the river and whether they pollute the river or not.

The Ogane-Aji River serves as a source of water for both domestic and agricultural purposes. Other anthropogenic activities prevalent are swimming, bathing, collection of alluvial soil for constructions etc. Due to these activities and other activities, there is need to assess the diversity of phytoplankton to determine its effect on the water quality. This research will better enhance proper identification of various types of phytoplankton present in Ogane-Aji river and their abundance. Hence, this study was carried out to review the phytoplankton abundance and its effects on Ogane-Aji River in Anyigba, Kogi State, with the view of identifying, assessing the diversity and abundance and determining the effect of phytoplankton on the water body of Ogane-Aji River.

II. METHODOLOGY

Sample source

Samples for this research were collected from Ogane-Aji River, Anyigba, Dekina Local Government Area, of Kogi State.

Sample collection

A total of 10 water samples (1L each) were collected in the month of October from 10 locations of River Ogane-Aji, Anyigba, Dekina Local Government Area of Kogi State. The samples are denoted as S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10 respectively with their sampling points for easy identification. The water samples were collected in sterilized containers with caps as per APHA method (2008). They were thoroughly cleaned by rinsing with deionized water followed by repeated rinsing with sample water to avoid contamination in the bottle. The water samples were filtered using Millipore membrane filters (Omnipore TM, Ireland) composed of mixed cellulose with 0.45 μm pores and then stored in polystyrene bottles and kept at 4^{o}C.

Samples identification

Phytoplankton identification was carried out in Plant Science and Biotechnology laboratory, Kogi State University. Water samples were decanted (supernatant) and the concentrated part (residue) was placed on glass slide and stained with leishman's stain then covered with a cover slip at an angle of 45 degrees after which it was viewed under the binocular (light) microscope which was connected to a desktop computer set and a digital camera for the micro graphical pictures of the phytoplankton. After the micro graphical pictures were taken, identification of the various species of phytoplankton found was carried out.

DETERMINATION OF TEMPERATURE

Water temperature was determined using mercuric glass thermometer (range of 0°-36°C) which was calibrated at the 0.2°. The thermometer was immersed directly into the water for 5 minutes until a steady temperature was obtained

DETERMINATION OF TRANSPARENCY

Transparency was determined using secchi disk as in Stirling (1985) with four grandaunts of alternative black and white on the upper surface and a long rope at the centre. Measurement was achieved by lowering the disc into the water, the point of disappearance and re-appearance was noted and the distance was measured in a graduated rope and the results were recorded in centimeter.

DETERMINATION OF pH

Values we're determined by colorimetric method using the lovibond comparator, with bromothymol blue as indicator. Ten millimeters of each water samples were taken into each of the two glass tubes contained in the comparator.

Ten drops of the indicator were added into the water samples contained in one of the tubes and thoroughly mixed. The indicator colour disc was then inserted in the comparator to compare with colour in the tube containing the indicator and the water sample, the corresponding pH value was then read and recorded.

DETERMINATION OF DISSOLVED OXYGEN (DO)

Dissolved oxygen concentration of the sampling area was determined using H19146 microprocessor dissolved oxygen meter. The DO concentration of the sampling area were determined by dipping the meter tip a few centimeters on the water surface and stirred for one minute and the reading was taken when meter reading was stable.

STATISTICAL ANALYSIS

All data were analyzed using descriptive statistics on Statistical Package for Social Sciences (SPSS) Version 20.

III. RESULTS AND DISCUSSION

Table 1: List of Identified phytoplankton and its Abundance in Ogane-Aji River.

Species Class	Species Family	No of Identified Species	Abundance	Sampling point wise identified species									
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Chlorophyceae	Chlorellaceae	3	++	√	×	×	√	×	×	×	×	√	√
	Occystaceae	1	+	√	×	×	×	×	√	×	×	×	×

	Codiaceae	1	+	√	×	×	×	×	×	×	×	√	×
	Scenedesmusace ae	2	++	×	√	×	×	√	√	×	×	√	×
	Chaetophroracea e	2	++	√	×	√	×	×	×	√	×	√	√
	Zygnemataceae	2	++	×	√	×	√	×	√	×	×	×	×
	Desmidiaceae	3	++	√	×	×	√	×	√	×	√	√	×
	Cladophoraceae	1	+	×	√	×	×	×	×	×	×	√	×
	Hydrodictyaceae	1	+	×	×	×	×	×	×	×	×	√	×
Cyanophyceae	Nostaceae	2	++	×	√	×	√	×	√	×	×	×	√
	Oscillatoraceae	3	++	√	√	×	√	√	×	√	×	√	√
	Rivulariaceae	1	+	√	×	√	×	×	×	×	×	×	×
	Microcystaceae	1	+	√	×	×	×	×	×	×	×	√	×
	Spirulinaceae	1	+	×	×	×	√	×	×	×	×	√	×
	Chromulinaceae	1	+	×	×	×	√	×	√	×	×	×	×
	Fucaceae	1	++	√	×	×	×	×	×	√	×	×	√
Euglenophyceae	Euglenaceae	3	++	√	√	×	√	×	×	√	√	×	√
Bacillariophycea	Melosiraceae	3	++	√	×	×	√	√	×	√	√	×	×
	Flagilariaceae	3	++	√	×	√	√	×	√	√	×	×	√
	Dinobryaceae	1	+	√	×	×	×	×	√	×	×	×	√
	Vaucheriaceae	1	+	×	×	×	√	√	×	×	×	√	×
	Cocconeidaceae	1	+	×	×	×	√	×	√	×	×	×	×
	Diatomaceae	2	+	×	√	×	×	√	×	×	√	×	√

Keys: + = Few; ++ = Common; √ = Present; S= Sample site and × = Absent

The phytoplankton identified from water samples collected from Ogane-AJI River includes; *Chlorella vulgaris, Chlorella rotunda, Chlorella sp., Chladophora glomerata, Oocystics negeli, Codium duthiae, Cosmarium botrytis, Zygnema sp., Hydrodictyon sp., Chaetophora sp., Nostoc sp., Nostoc carneum, Oscillatoria sp., Oscillatoria limosa, Oscillatoria brevis, Microcystics sp. ,Chromulina sp., Spirulina sp., Euglena viridis, Euglena gracilis, Euglena sp., Melosira lineata, Melosira vulgaris., Dinobryon sp., Diatoma vulgaris, Diatoma sp., Cocconeis sp., Fragilaria sp., Vaucheria sp., Scenedesmus sp.* among others.

In total, 40 species of phytoplankton were identified from the collected water samples from the study area. Among them, members of the Chlorophyceae were found to be most abundant with a total number of 16 species where Desmidiaceae and Chlorellaceae were more abundant than others. Class Euglenophyceae has the least abundance with only 3 Members from the family Euglenaceae.

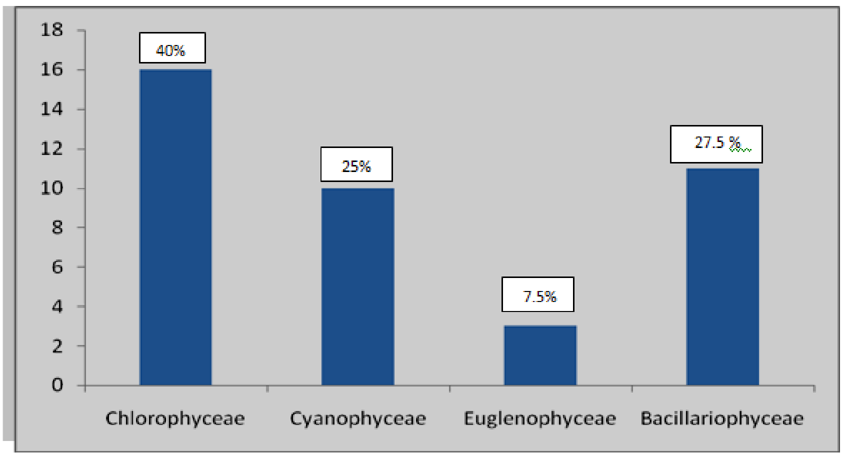

Fig.1: Phytoplankton Total Distribution in Ogane-Aji River

Table 2: Mean variation in the physiochemical parameters of Ogane-Aji River, Anyigba

Weeks	Temperature (◦ C)	pH	Dissolved Oxygen (mg/l)	Transparency (M)
Week 1	27.5	5.04	5.7	0.93
Week 2	28	5.32	5.3	0.86
Week 3	29.8	6.22	2.9	0.83
Week 4	30	6.56	3.0	0.81

The mean values of the physiochemical parameter of Ogane-Aji River, Anyigba is shown in table 2 below. Temperature range during the period of study was between 27°C to 30°C while pH ranges from 5.0 to 6.56, dissolved oxygen was between 3.0 to 5.04 mg/L and transparency 0.81 to 0.93 respectively.

Effect of phytoplankton on Ogane-Aji River

Phytoplankton community composition directly affects the nutrition, growth, reproduction and survival of different organisms (Hällfors and Uusitalo 2013) as well as the biogeochemical cycles of the Baltic Sea (Tamelander *et al.*, 2008). However, phytoplankton contributes to more than 90 percent of total marine primary production. In the group of cyanobacteria, some genera such as Trichodesmium, Nostoc and Richelia, are able to fix nitrogen from the atmosphere, thereby increasing sources of nutrients (Lyimo and Hamis 2008, Poulton and others, 2009). Under increased nutrient concentration, other genera from among the dinoflagellages such as Dinophysis can form blooms that could be harmful (harmful algal blooms – HABs or red tides) or be a nuisance to other aquatic organisms like fish and shellfish, the environment, as well as humans, and could cause serious economic losses in aquaculture, fisheries and tourism-based activities (Babin and others, 2008). In the Baltic Sea, eutrophication has resulted in increase in summer phytoplankton abundance and biomass as productivity increases in areas where algal blooms occur (Carstensen and Heiskanen 2007, Fleming-Lehtinen *et al.*, 2008, Jaanus *et al.*, 2011) as well as more frequent and intense blooms (Finni *et al.*, 2001, Carstensen *et al.*, 2007).

Phytoplankton community composition and abundances can be used as early indicators of ecosystem health. Phytoplankton play major roles in estuarine ecosystem processes, such as eutrophication, nutrient cycling, water quality, and food web dynamics (US EPA 2005). They are sensitive to the slightest environmental disturbances. Due to this sensitivity, changes in the phytoplankton community can serve as an early warning sign for declines in estuarine ecosystem health. Additionally, in order to determine phytoplankton community responses to anthropogenic and natural environmental disturbances such as hurricanes, droughts, nutrient runoff, and pollution, diagnostic photopigments (chlorophylls and carotenoids) unique to specific phytoplankton genera, are monitored. However, initial presence of invasive and toxic phytoplankton species such as HABs, can be detected in their early colonization stages (Bortone, 2005).

A total of 40 species of phytoplankton were identified from the water samples collected from Ogane-Aji River. Among them, class Chlorophyceae (40%) recorded the highest number (16) cutting across 9 families; the class Bacillariophyceae (27.5%) was represented with a total number of (11) species comprising of 7 families. Cyanophyceae (25%) recorded a total species number of (10) which also cut across 7 families and class Euglenophyceae (7.5%) recorded the least number of phytoplankton species identified (3) in the family Euglenaceae. Similar diversity and abundance have been reported by Islam and Huda (2016) in their assessment of phytoplankton diversity and abundance in Shitalakya River. The class Chlorophyceae showed the highest abundance and appears to be quite adapted to Ogane-Aji River as their suitable habitat. However, this do not conform with the result of Islam and Huda (2016) in their assessment of water pollution by industrial effluent and phytoplankton diversity of Shitalakya River, Bangladesh where class Bacillariophyceae recorded 45% of the total abundance while, Chlorophyceae has the least abundance (14%).

The temperature of the river ranged between 27.5 $^{\circ}$ C (minimum) to 30 $^{\circ}$ C (maximum). The increasing level of water temperature accelerates chemical reactions, reduces solubility of gases, amplifies taste and odour and increases metabolic activities of organisms (Usharani *et al.,* 2010).

The pH range is (5.04) to (6.56) with a mean average of 5.8. Nigerian rivers acidity has been noted by multiple researchers (Ogbonna 2010; Anyanwu 2012; Imoobe and Koye 2011). WHO (2011) stated that low pH levels can enhance corrosive characteristics resulting in contamination of drinking water and adverse effect on its taste and appearance.

Dissolved oxygen of the ranged from 3.0 mg/L to 5.7 mg/L with a mean average of 4.2 mg/L. The DO represent the most important parameter for water quality assessment as it reflects the physical and biological processes prevailing in water and water bodies (Kumar and Puri, 2012).

Photosynthesis and growth (Sathyendranath *et al.*, 1989).

The transparency of the river ranged from 0.81m to 0.93m with a mean average of 0.86m. Transparency plays a huge role in understanding water ecology differences and biogeochemical processes such as phytoplankton

IV. CONCLUSION

Results from the study suggest that Ogane-Aji River is moderately polluted and showed trend of increasing eutrophication. The study reveals that class chlorophyceae was found to be the most abundant followed by class Bacillariophyceae, Cyanophyceae and Euglenophyceae. Also, Chlorophyceae dominance in abundance indicates that this group thrives more in the water body while Euglenophyceae with the lowest abundance, indicate that are not suited to the environment. The physiochemical parameters of the Ogane-Aji River were optimal for aquatic organisms and anthropogenic activities such as agriculture, laundry and bathing makes the water polluted.

V. RECOMMENDATION

The following recommendations are made from this study

- Identification of organisms that produces toxins i.e phytoplankton should be carried out other rivers to determine its safety for consumption.
- Growth and multiplication of phytoplankton should be encouraged as they are responsible for creating an oxygen-rich environment despite some are harmful as they produce toxic chemicals.

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