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EFFECT OF ANTHROPOGENIC ACTIVITIES ON THE PHYTOPLANKTON COMMUNITY OF ABA RIVER, ABA, ABIA STATE

+1**Edoghotu, A.J., &** 2**Nworu, E.F.**
1-2Department of Biology, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, NIGERIA

+**Corresponding author(email)**: azibodi.edoghotu@iaue.edu.ng

Abstract

In four (4) months, the effect of anthropogenic activities on the phytoplankton community structure and abundance of the Aba River was investigated. Temperature was 26.751.26^{o}C– 27.751.26^{o}C, pH 6.70.58 – 6.90.89, salinity 0.110.08‰ – 0.190.18‰, turbidity 0.490.32NTU– 1.351.33NTU, nitrate 0.280.11mg/l –0.590.30mg/l and phosphate 0.050.01mg/l– 0.090.06mg/l. Ten species belonging to three phytoplankton groups were discovered through their biological characteristics. Cyanobacteria was the most common family, accounting for 1226 cells per liter, or 49 percent of total phytoplankton, followed by Chlorophyceae (894 cells per liter, or 35.7 percent), and Xanthophyceae (381 cells per liter, or 15.2 percent). The highest levels of phytoplankton family recorded in all of the months studied were the Cyanobacteria. Stations 1,2, and 3 located few meters from an abattoir and receives effluent from nearby industries, bore the highest phytoplankton population relative to other stations. During September, the Shannon-Weiner index/station/month was 0.983 in station 5. In July, the minimum per station/month was 0.421, which was also recorded at station 5. The Megalef richness index was between 1.70 to 2.25. While the evenness index (E) varied between 0.441 to 0.983. As a result, it was established that anthropogenic activities and nutrient input into the water body altered the phytoplankton community of the Aba River's species composition, distribution, and abundance.

Keywords: Effect, Anthropogenic, Activities, Phytoplankton, Community, Aba River

Introduction

Phytoplankton abundance in a water body fluctuates with light and nutrition availability vertically, horizontally, and seasonally. The phytoplankton population plays a critical role in primary production in the aquatic food chain and carbon cycle, producing oxygen that helps to maintain ecological equilibrium in bodies of water. Increased aquatic system pollution, on the other hand, can be detected not only by the water body's physicochemical data, but also by indicator organisms like phytoplankton (Manduet al., 2015). Water, unlike most other liquids, is a life-supporting substance. Lakes, streams, rivers, springs, oceans, and ponds are all sources of water for life (Akagha et al. 2016). Pollution makes water unfit for the survival of organisms and other human uses. When toxins are dumped into bodies of water, pollution occurs. directly or indirectly into it without first undergoing proper treatment to eliminate any potentially dangerous chemicals (Ajayi & Adeleye, 1997). Individual species, populations, and biological groups, including humans, are negatively affected. More than 14,000 people die every day as a result of pollution (WHO, 2007). Water contamination is caused by a variety of sources. Human, animal, and agricultural activities are all included. Nature has an important part in the provision of contaminants in many forms in water bodies. Water becomes less valuable to humans, animals, and agriculture as it becomes contaminated. Such water may not even be valuable to the construction industry in some cases (Maartin et al.,1998). As a result, water quality refers to the physical, chemical, and biological qualities of the water (Adeleye, 2000). It is a measurement of water quality in respect to the needs of one or more biotic species, as well as human need and purpose (Babich & Stoczky, 1985). In most circumstance, contaminants alter the physical, chemical, and biological properties of the environment. They are directly or indirectly introduced into it without first removing the harmful elements that change the taste and odour of the water. They are a nuisance in the ecosystem and alter the aesthetic value of the system, with other consequences such as plant nutrient loss. Such contaminants that course pollution in water include synthetic organic compounds, petroleum, radioactive materials, heat, inorganic chemicals, mineral input, heavy metals and addition of toxic materials like Mercury, Arsenic, Lead, Cadmium, and Copper. These substances also bioaccumulation in both surface water and sediments organisms (Aremu et al., 2007; Ajayi & Adeleye, 1997).

In the presence of nutrients such as phosphorus, nitrogen, iron, manganese, molybdenum, and zinc, phytoplankton transform incident radiant energy from the sun to chemical energy. Their abundance, diversity, and distribution reflect the physico-chemical characteristics of the aquatic ecosystem in general, as well as the nutrient status of the ecosystem in particular (Anene, 2003). Phytoplankton is the foundation of aquatic food webs, providing nutritious foundation for zooplankton and, as a result, other invertebrates, shellfish, and finfish (Emmanuel & Onyema, 2007). Because plankton is the principal producer, the productivity of any aquatic body is dictated by the amount of plankton present (Davies et al., 2009). Phytoplankton According to Townsend et

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al., (2000), plankton ecosystems serve as the foundation for the food chain that sustains both artisanal and commercial fishing. Phytoplankton population, according to Davies et al., (2009), are substantial producers of organic carbon in big rivers, a source of food for planktonic consumers, and the dominant oxygen source in low-gradient rivers. Furthermore, phytoplankton plays a critical function in pollution bio-monitoring (Davies et al., 2009). The ecological integrity of water bodies is determined by the distribution, quantity, species diversity, and species composition of phytoplankton. Due to the dynamic nature of aquatic ecosystems, both composition and distribution shift from place to place and on a regular basis (FAO, 2006). These characteristics of distinct phytoplankton species can occasionally aid scientists in distinguishing one water body from another (Davies et al.,2009).

Materials and Methods

The Aba River, which runs from Longitude 7°19' to 7°23'E and Latitude 5°05' to 5°10'N, goes through the commercial Aba city's industrial structure. It's a tributary of the Imo River in Nigeria's south. Its source is in the Ngwa heartland's Okpu-Umobo. The river runs north-south until it reaches Cross Rivers State where it discharges into the Atlantic Ocean (Nwankwoala et al.,2017). The river is a freshwater stream typical of Nigeria's tropical rain forest. Because it is economically significant, its water is used for a variety of human activities such as vehicle washing, fishing, and abbatoir. People who live in the upstream area use the river to get water for drinking and other domestic needs (Ubalua et al., 2007). Within the Aba metropolis, five sampling stations were set along the River banks and mid-stream in regions with anthropogenic activities. Five stations were chosen based on their accessibility and sample collection ease. The samples were collected in polypropylene containers that were clearly labeled. These containers were carefully cleaned with strong Nitric acid and rinsed with distilled water several times. For four months, samples were taken once a month (i.e., July to October) in 5 stations.

Physicochemical Parameters

Water chemistry analysis was performed on surface water samples taken in each station using plastic cans. Water samples were taken using sampling bottles to determine salinity, pH, and dissolved oxygen (DO). Water samples for dissolved oxygen were obtained using narrow necked 250ml DO bottles that were washed and dipped into the water until an acceptable volume was collected; no bubbles in the bottles were allowed during the collection of the water samples for dissolved oxygen. They were immediately fixed with 2ml of each of the produced Winkler 1 and 2 reagents, and the reagent bottles were promptly closed to ensure that no air was trapped inside. BOD_5 was collected in the same bottle at the same time and was not fixed, but rather covered and brought to the lab for incubation and analysis. The laboratory procedures used in this investigation were based on those recommended by the American Public Health Association, pH was measured in the lab with a pH meter (pH meter, Jenway model No.2010). The ascorbic acid method was used to assess phosphorus (PO_4), whereas nitrate was with alpha 419methods, also known as the brucine method.

Biological Samples

Phytoplankton was collected with 1 liter plastic cans. For laboratory investigations, the collected samples in the can were preserved in 10% formalin. After carefully mixing the plankton samples, a drop of 5ml was utilized to charge a counting chamber. After charging the chamber, it was thoroughly examined under the microscope for plankton identification and counting. Families and species were identified using a counting chamber (type Neubauerhemacytometer) with four 1mm squares gridesat each corner, which were subsequently subdivided into 25 smaller squares.

Results and Discussion

Figures 1–8 show the results of this study's parameters, whereas plates 1–4 show the results of phytoplankton. During the study period, water temperatures were quite consistent between locations. The mean temperatures measured varied from 26.75±1.26°C to 27.75±1.71°C, which is similar to Wokoma (2016). Elechi Creek had a somewhat different range of 27°C–32°C observed by Ogamba et al., (2004); 26.1°C–32.8°C in the lower Bonny River by Chindah and Braide, (2004); and 25°C–32°C in the Lagos Lagoon by Ajao and Fagade, (2002). Temperature difference between stations could be caused by the accumulation of nutrients from industrial, agricultural, and other anthropogenic sources. During the study period, however, changes in water temperature in the Aba River had no substantial impact on the abundance of plankton. Regardless of the high temperatures, there were months of low plankton abundance. The abundance of phytoplankton was lower at station 5, where the mean temperature was 27.75±1.71°C, compared to stations 1 and 2, where the mean temperatures were 26.75±1.26°C and 27.10±6.63°C, respectively. Station 3, which had the same mean temperature as station 5 (27.75±1.26°C), showed a greater class abundance of>60%. This was due to the presence of additional nutrient input. Temperature has an undeniable impact on aquatic organisms, particularly in terms of food production. Temperature determines maximum phytoplankton growth, according to a number of studies. In certain stations.

However, the relationship between temperature and phytoplankton quantity could not be firmly confirmed. Plankton distribution is often determined by the amount of light reaching them as well as the illumination of the sea surface, which varies with time and conditions. The ability of light to penetrate a water body is thus determined by the transparency of the water. Turbidity is a

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measurement of a water body's cloudiness, haziness, or disorderliness. The turbidity ranged from 0.49±0.32NTU to 1.35±1.33NTU in this study, which is lower than the 67.35NTU–76.81NTU reported by Osunkiyesi (2004) on the Ogun River. It's also below the WHO, (2010) recommended guideline of 50 NTU. In some months, high turbidity among stations could be the result of car washing activities, which transferred particles from drainage systems into the river.

Station 3 had the highest mean turbidity value of 1.35±1.33NTU, followed by station 4 with 1.28±1.12NTU, which could explain the lower phytoplankton count in these stations. The pH ranged from 6.7±0.58 to 6.9±0.89 in this study, which is higher than 5.58±0.27- 6.72±0.27 on the Orashi River in South-South by Wokoma (2016) and 5.39– 7.06 on the Aba River by Nkwocha et al., 2017) and was ideal for biological productivity, which peaks at a pH higher than 7, but lower than 8.5 of Abowei (2010). Because most marine species, including shrimps, cannot survive large temperature fluctuations, the limited pH range was expected and is generally more conducive to aquatic life. Water with a pH of 6.5 to 9.0 is thought to be excellent for fish development. The pH value of 6.7±0.58 – 6.9±0.89 obtained in this study also fall within the WHO (2010) 6.5–9.5 range and NESREA (2011) 6.5–8.5 range for drinking water, aquatic life, and recreational activities. The pH values found in this study indicate that the study sites are fresh water, while the Delta region of the River Niger has been reported to be acidic, with pH range of 5.5–7.0. (Chindah, 2003). Salinity levels ranged from 0.11±0.008‰ to 0.19±0.18‰. The increase in volume of water during the height of rainfall causes the values to decline in September and October.

These organisms require nitrogen in the form of nitrate, a nutrient required for plant growth. In River Lavun, values varied from 0.28±0.11mg/l to 0.59±0.30mg/l, close to Abdulmalik et al (2018) of 0.22mg/l – 0.30mg/l, and were below WHO, (2011) of 5.0mg/l. The result also differed from Umunnakwe, et al., (2013) and Ibekwe, et al., (2006) in the Aba River, with 35.2mg/l - 159.8mg/l and 0.69-4.68mg/l respectively.

The phosphorus concentrations ranged from 0.05±0.01mg/l to 0.09±0.06mg/l. This is similar to Eli's 0.05mg/l, but lower than Wokoma, (2017) of 0.26±0.19mg/l -0.52±0.20mg/l and Anthony et al., (2018) 0.69±0.01mg/l -1.02±0.01mg/l.For survival and maintenance, phytoplankton and other aquatic creatures require well-oxygenated water. Deoxygenated water causes aquatic species to suffocate. The dissolved oxygen readings obtained in varied from 10.17±4.42mg/l to 15.431±0.72mg/l, which is consistent with the NESREA, (2011) standard DO value of 6.00. It differs from Wokoma (2016) on the Orashi River and Abdulmalik et al., (2018) on the River Lavun, which found 4.5±0.84mg/l – 5.1±0.57mg/l and 6.0mg/l – 8.0mg/l, respectively. Many aquatic creatures cannot survive if DO levels fall below 4 mg/l according to Zhang (2007). Even though there were low DO records in several sites during the study period, the average concentration of dissolved oxygen was sufficient to support aquatic organisms.

The Biochemical Oxygen Demand (BOD) levels varied between 3.82±2.63 and 6.53±3.98 mg/l. Amah-Jerry et al., (2017) found 1.1-6.1 mg/l on the Aba River, and Abdulmalik et al., (2018) found 4.00mg/l - 6.00mg/l on the Lavun River. Sewage and other biodegradable waste from abattoirs and other sources, which use oxygen during breakdown of organic matter, were blamed for high BOD values at some of the stations.

This study found 2,501 cells per liter of phytoplankton from 10 different species belonging to three different groups. The number of species was low in comparison to the 117 species on the Nhu Y River and the 221 species recorded by Akoma (2008) on the Imo River. Cynobacteria were the most abundant (1,226 cells/l), accounting for 49.0% of the total phytoplankton. Chlorophyceae (894cells/l, or 35.7 percent) and Xanthophyceae (381cells/l, or 15.2 percent) came in second and third, respectively. Cyanobacteria >Chlorophyceae>Xanthophyceae was the order of abundance.

The high phytoplankton abundance observed in stations 1 and 2was attributed to nutrients availability due effluent from nearby soap factories, breweries and abattoir around these stations. The high phytoplankton abundance observed in station2 may have also influenced the high dissolved oxygen of the stations. Stations 4 and 5 showed high abundance of phytoplankton and was attributed to increased temperature in those stations and light intensity. However, high turbidity as observed in some stations could be a factor of low abundance in those stations. Turbidity in stations 1,2 and 3 were low. This could be the reason for the relative high abundance of phytoplankton in those stations since light penetration will be more. Megalef richness index in this study varied within 1.7 and 2.25. Station 5 had the highest value of 2.25 in October, while station 1 had the lowest reading of 1.7 in July. Shannon–Weiner diversity indices ranged from 0.421 to 0.983, which differed from Ogamba et al., (2004) and Chindah et al., (2004) in Elechi Creek. It was greater in September with a value of 0.98 in station 5 and lower in July with a value of 0.42 in the same station. The effect of pollution on aquatic ecosystems is frequently revealed via species diversity indices. Most of the species were found in all of the locations, indicating that they were evenly dispersed. This shows that pollution has little impact on the study region at the moment. Within the study period, evenness indices ranged from 0.44 to 0.98 among stations, with station 5 having the highest in September (0.98) and the lowest in July (0.44).

Conclusion

As a result, it was found that fluctuations in phytoplankton family and species abundance, distribution, and diversity were a reaction to anthropogenic-caused changes in the concentration of physicochemical qualities in the studied area.

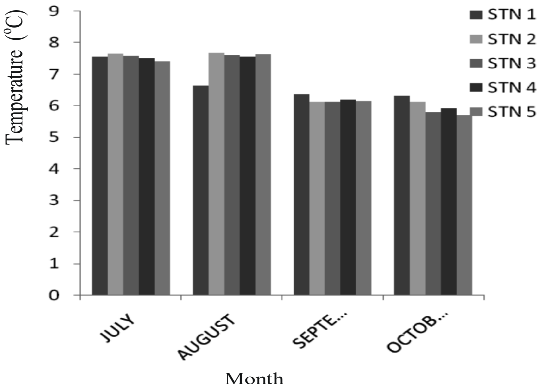

Fig. 1: Values of temperature across the Stations from July to October 2018

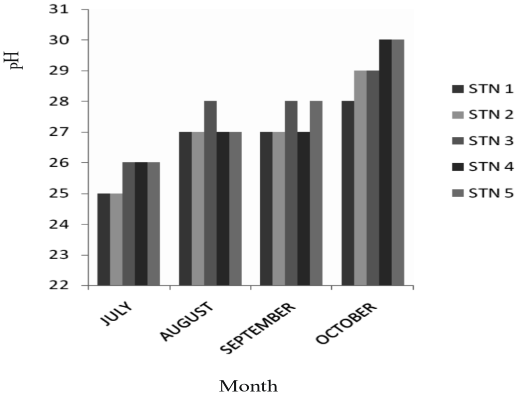

Fig. 2: Values of pH across the Stations from July to October 2018

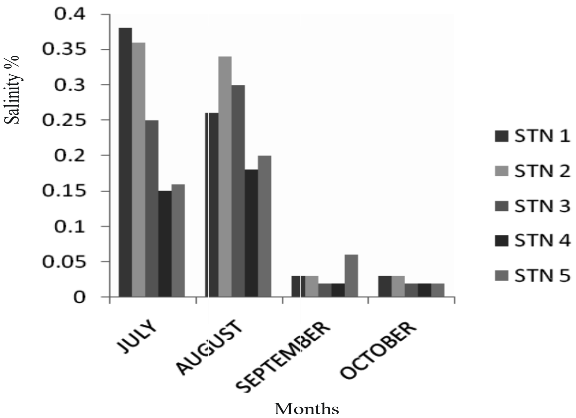

Fig. 3: Values of salinity across the Stations from July to October

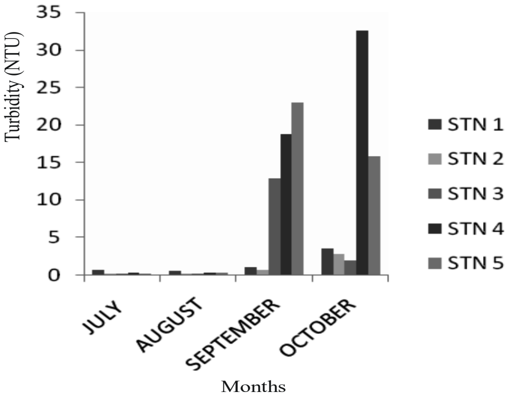

Fig. 4: Values of turbidity(NTU) across the Stations from July to October

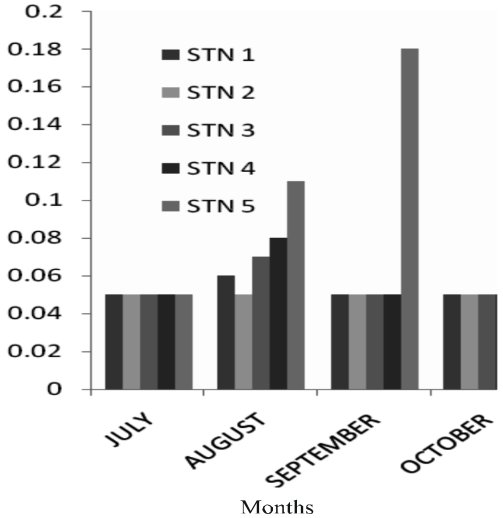

Fig. 5: Values of nitrate across the stations from July to October.

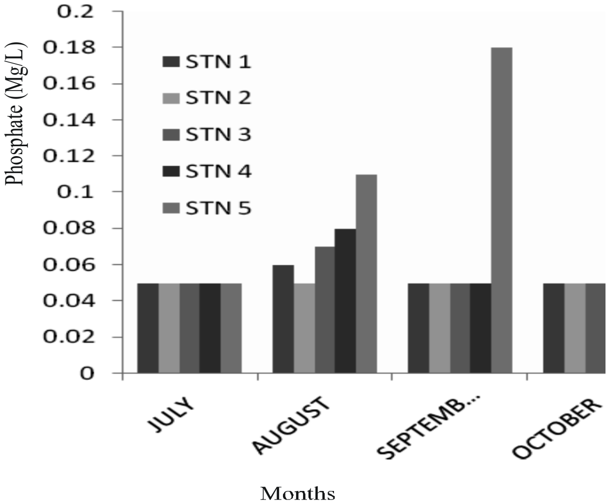

Fig. 6: Values of phosphate across the stations from July to October.

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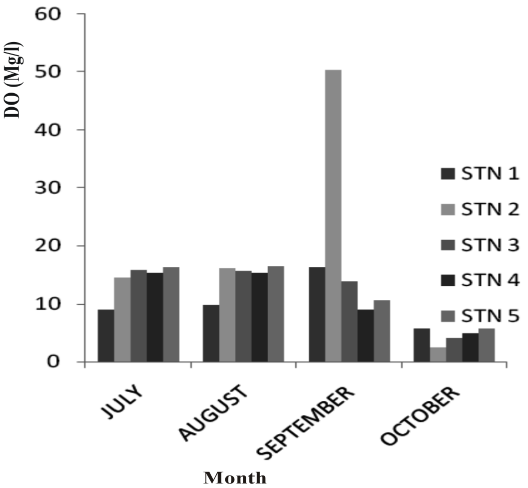

Fig. 7: Values of Dissolved Oxygen(mg/l) across stations during July to October.

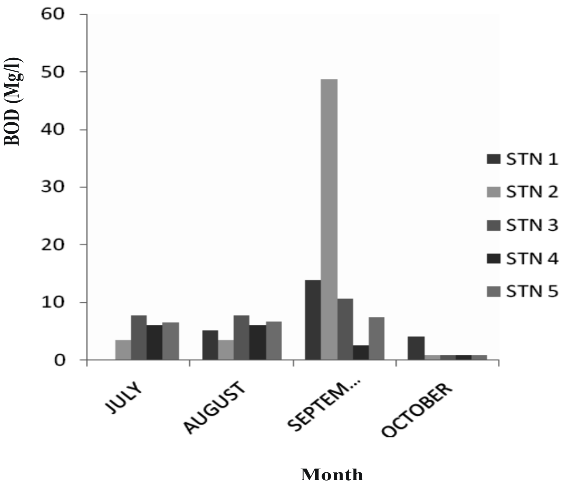

Fig.8: Values of Biochemical Oxygen Demand (mg/l) across stations from July to October.

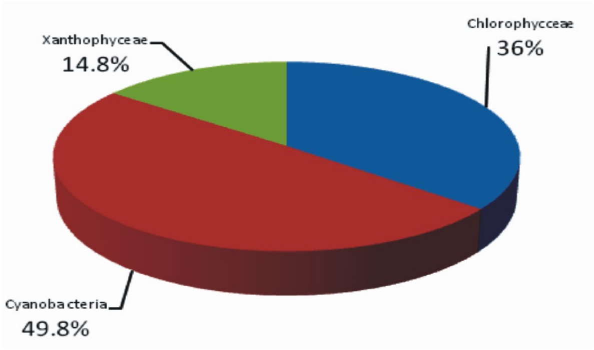

Plate 1: Phytoplankton abundance in July.

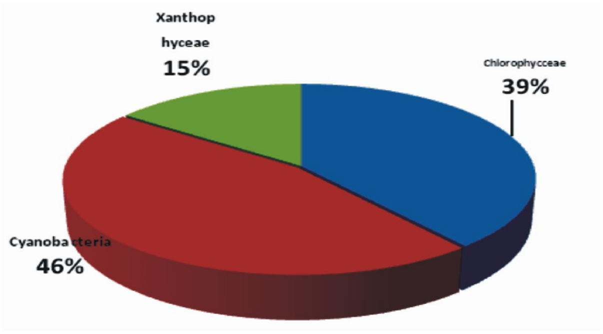

Plate 2: Phytoplankton abundance in August.

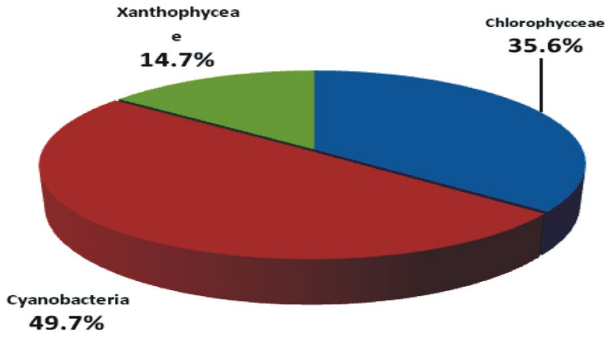

Plate 3: Phytoplankton abundance in September.

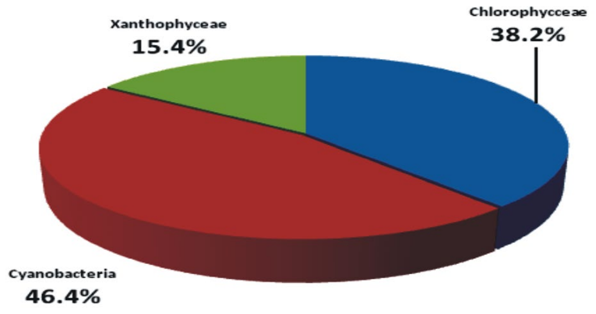

Plate 4: Phytoplankton abundance in October.

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