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ASSESSMENT OF PHYSICO-CHEMICAL CHARACTERISTICS AND PHYTOPLANKTON OF A POLLUTED TIDAL CREEK IN AJEGUNLE, LAGOS

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ABSTRACT: *This study assessed the physicochemical quality of the creek and its phytoplankton diversity; samples were collected and analyzed for five months (May-September, 2018). The pH value recorded was within 6.95-7.53 but the total hardness recorded are above the WHO standard as a result of the presence of calcium, magnesium, sulphate arising from TSS, TDS, nutrient input. The level of chlorophyll-a increases with respect to pH, salinity, conductivity, water temperature, phosphate, sulphate and nitrate which reflected in the observed high DO and* BOD_5*, an indication of the high rate of productivity of the water, the diversity and abundance of phytoplankton but negatively correlated with turbidity, TSS. However, the COD value exceeded the acceptable concentrations for a polluted water (20–200 mg/l). This is also confirmed with the presence of high amounts of indicator species like Microcystis spp., Euglena spp.,Phacus spp.and Trachelomonas spp. Measures should be taken to remediate the Ajegunle Creek .*

KEYWORDS: physicochemical quality, phytoplankton diversity, creek

INTRODUCTION

There is no doubt that prevention of the degradation of water quality has become part of the struggles to preserve, maintain and improve the quality of life. Water is an essential commodity (NBS, 2012) and its quality is a matter of growing concern. The UNESCO in her 2006 annual report stated that water is a factor of production in virtually all enterprises, including agriculture, industry, the services sector and it is useful for developmental purposes in both rural and urban areas. Gibbons (2013) and Cosgrove and Rijsbeman (2014) submitted that the importance of water quality to life cannot be overemphasized as it is very useful in many ways among which are domestic, industrial, agriculture, recreation, hydroelectric, transportation and waste disposal. Sheng (2012), Nath and Sengupta (2016) pointed out that the availability, quality and proximity to water source influences the choice of man's allocation of land space for settlement. Planktons are the basis of aquatic productivity and any negative effect on their population detrimental consequences in the food chain and the entire community structure of the aquatic ecosystem (Zohdi and Abbaspour, 2019).

LITERATURE/THEORETICAL UNDERPINNING

According to Obot *et al*. (2016), water quality degradation has become an important issue around the world. As anthropogenic activities increases, the aquatic environment suffers from the detrimental effects of pollution as the discharge of industrial effluents, chemical (agricultural wastes such as pesticides, fungicides and fertilizers) and biological contaminations which may come from human and animal faeces, seepage from pit latrines and septic tanks, refuse dump, industrial, domestic, municipal wastes and storms water run-off released into water bodies has led inevitably to alterations in the quality and ecology of receiving water bodies. Andem *et al*. (2012), Mushahida-Al-Noor *et al*. (2009) explained that the physical and chemical characteristics of water are important parameters as they may directly or indirectly affect its quality and consequently, its suitability for the distribution and production of fish and other aquatic animals. However, the recent chemical investigation of water quality of some Nigerian waters as reported by Nwuko, (2014) revealed that quality is deteriorating in many places, owing to population and its associated pollution.

MATERIALS AND METHOD

Description of Study Site

The Ajegunle Creek is a shallow tidal creek that experienced semi-diurnal tidal oscillations and it is located at an elevation of 36metres above sea level at latitude of 6° 28' 21" N (6.4725°); Longitude: 3° 22' 20" E (3.3722°) and elevation: 4 metres (13 feet). The Ajegunle, creek is a stream (class H–Hydrographic), experience semi-diurnal tidal oscillations and has a unique S-curve shape waterway channel. It is located at the Tin-can Island area, Ajeromi-Ifelodun LGA of Lagos state; it empties into the Badagry creek then into the Lagos lagoon. It is open throughout the year, receives tidal influences which are experienced far inland especially during dry season from the lagoon. The creek is characterised by floating plants such as Pistia and an abundance of water hyacinth (*Eichishoria crassipes*) and *Vassia racemosa*. Further downstream from the stations are *Acrostiscum aureum* (Halophytic fern), *Rhizophora racemosa* (Red mangrove), *Phoenix reclinata*, *Paspalum vaginatum, Cyperus* articulates are common macro floras found along the edges and shore zone of the water ways. The Ajegunle Creek and its adjoining waterways is home to several human activities which include sand mining, dredging, fishing and the disposal of untreated domestic wastes.

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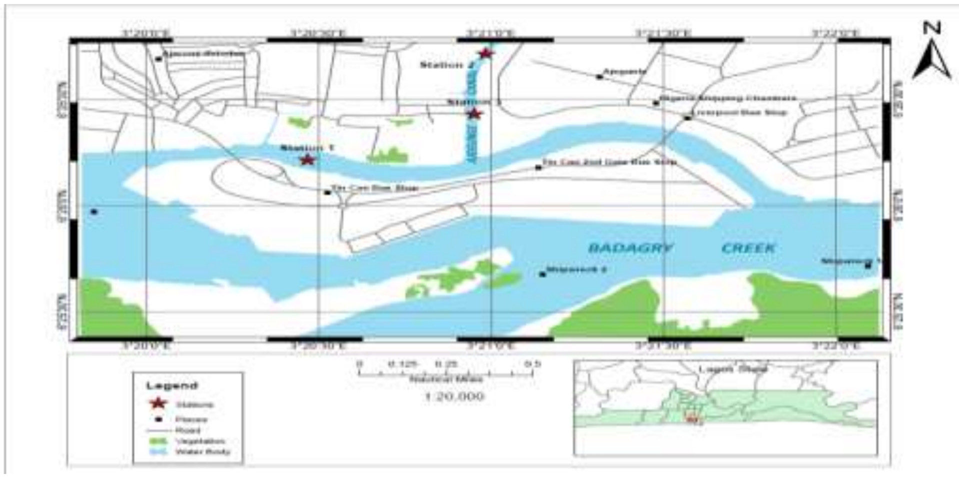

Figure 1: Map Showing the Sample Stations at The Ajegunle Creek

Water Samples Collection

The sampling stations were sampled once a month for five (5) months (May to September, 2018). Water samples were collected each time using 75cl plastic containers with each indicating the month of collection at the study site. Sampling was carried out between 09.00 and 12.00 hours on each sampling day. The plastic bottles were dipped into the water to collect the water samples and were taken to the laboratory for physical and chemical analysis.

Determination of Physical Parameters

The sampling stations were sampled once a month for five (5) months (May to September, 2018). Water samples were collected each time using 75cl plastic containers with each indicating the month of collection at the study site. Sampling was carried out between 09.00 and 12.00 hours on each sampling day. The plastic bottles were dipped into the water to collect the water samples and were taken to the laboratory for physical and chemical analysis. The selected water quality parameter were Total Hardness (mg/L), Chemical Oxygen Demand (COD) (mg/L),Biochemical Oxygen Demand (BOD) (mg/L), Dissolved Oxygen (DO) (mg/L), Acidity (mg/L), Alkalinity (mg/L), Conductivity (µS/cm), Salinity (‰), pH, Total Dissolved Solids (TDS) (mg/L), Total Suspended Solids (TSS) (mg/L), Transparency (cm), Temperature (^{o}C) following the standard protocols of APHA (2005) (Rana and Chhetri 2015). Rainfall data between the periods of sampling (May to September, 2018) was obtained from the Nigerian Institute for Oceanography and Marine research, Victoria Island, Lagos State.

Collection of Plankton Samples

Plankton samples were collected at the study site once a month for five (5) months (May to September, 2018). Plankton samples were collected by hauling horizontally standard plankton net of 55µm mesh size with a sample bottle attached to a motorized boat at an interval of 15minutes while the boat was almost stationary. The filtrate in the attached sample bottle was transferred into a well labeled plastic container with screw caps, indicating the name of the site, date of collection and the period of collection whether dry or wet season. Samples were preserved in diluted 10% formalin and transported to the laboratory for physical and chemical analysis of the plankton samples using standard methods.

Determination of Biomass Using Chlorophyll a (µg/L)

200mL, each of de-ionized water (blank) and samples ($V_{filtered}$) were filtered through 0.45µm glass fiber filters. Each filter was removed and placed in labeled polypropylene tubes. To each tube was added 3ml 90% acetone solution, and macerated at 500rpm for 1min, steeped in the dark for 2hrs at 4ºC and clarified by filtration and then adjusted to 20ml ($V_{extract}$) with 90% acetone solution. The extract was capped and then store in the dark until analysed.3ml of the clarified sample extract was transferred to a cuvette and the absorbance measured at 750, 665, 664, 647 and 630nm, using a spectrophotometer (HACH DR 3900). Thereafter, the extract in the cuvette was acidified with 0.1ml of 0.1MHCl solution, gently agitated and allowed to stand for 90 sec. The absorbance of the acidified extract was read at 750 and at 665nm. Test results were validated with chlorophyll calibration standards (5-20ug/L). The pigments concentrations were calculated as follows:

1. **Chlorophyll-a [corrected; (µg/L)]** $= \dfrac{26.7 * (A664b - A665a) * V_{extract}}{V_{filtered} * L}$
2. **Phaeophytin-a (µg/L)** $= \dfrac{26.7 * [1.7(A665a) - A664b] * V_{extract}}{V_{filtered} * L}$
3. **Chlorophyll-b (µg/L)** $= \dfrac{21.03 * (A647b) - 5.43*(A664b) - 2.66*(A630b) * V_{extract}}{V_{filtered} * L}$

Where:
$V_{extract}$ = volume of extract (mL)
$V_{filtered}$ = volume of sample filtered (L)
L = light path length or width of cuvette, cm
664b, 647b, 630b = corrected absorbance of extract before acidification
665a = corrected absorbance of extract after acidification
The value 26.7 is the absorbance correction factor ($A \times K$)
A = absorbance coefficient for chlorophyll a at 664 nm = 11.0
K = ratio expressing correction for acidification = 2.43

Determination of Biomass In Terms Of Numbers Using Counting Methods (per ml)

Plankton sample was collected with a bottle, stored at around 5°C to slow down physical and chemical reactions that will cause deterioration of species cell structure. It is allowed to settle in the laboratory for 2hours to acclimatize and concentrated to 20ml. 5drops of well-mixed sample was used for investigation and on each occasion, one drop of the sample was thoroughly examined and counted using the Drop Count Method. For each drop five transect were investigated by moving the stage at different positions under a Carl Zeiss Monocular Microscope using different magnifications and direct plankton counts were recorded as number of species per ml. Identifications were made using relevant texts to as described by Jun and Liu (2003).

Margalef Index (d)
Species Richness values ranged between 0.1199 and 2.864 across the stations during the period of study. Station 1 recorded the lowest species richness value in September. Also Station 1 recorded the highest species richness value in May

Shannon-Wiener Index (Hs)
The Diversity Index values varied significantly from 0.0092-0.516 across the stations for the period of study. Station 1 recorded the lowest value in September also Station 1 recorded the highest Diversity Index value in May.

Menhinicks Index (D)
The Menhinicks Index values varied slightly and ranged from 0.008-0.1061 across the stations during the period of study. Station 3 recorded the lowest value while Station 1 recorded the highest value.

Equitability (j)
The Evenness of species slightly varied in all the stations during the period of study. Station 1 recorded the lowest and highest values in September and May respectively.

Simpson's Dominance Index (C)
The Simpson's Dominance Index value varied slightly across the sampled stations during the period of study. Station 2 recorded the lowest value in July. Station 3 recorded the highest value in June.

Total Species Diversity (S)
The Total Species Diversity (S) values ranged from 2-26 with the lowest monthly value highest monthly value of 66 recorded in June while the lowest monthly value was of 18 was recorded in July. Station 1 has the lowest value of the Total Species Diversity of 57 while Station 2 and 3 have the highest value of 70.

Total Species Abundance (N)
The Total Species Abundance (N) value varied widely from 16710 - 22225 across the stations all through the period of study. Station 1 recorded the lowest value while Station 3 recorded the highest value.

Log of Species Diversity (log S)
The log of Species Diversity value also varied slightly from 4.444 -5.50558 across the stations during the period of study. Station 1 recorded the lowest Log of Species Diversity (log S) of was recorded in Station 1 while the highest value of was recorded in Station3 during the period of study.

Log of Species Abundance (log N)
The log of Species Abundance (log N) value varied slightly with the lowest monthly value of 3.5916 recorded in July while the highest monthly value of 4.2383 recorded in June for the three

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sampled stations. Station 1 recorded the lowest Log of Species Abundance (log N) of 4.222 in Station 1 while Station 3 recorded the highest value of 4.3468 in Station3 during the period of study.

STATISTICAL ANALYSIS

The results were subjected to one-way Analysis of variance (ANOVA) using the Statistical Package for the Social Sciences (SPSS Version 23) to determine significant differences. The Duncan (1955) Multiple Range Test was used to separate differences among means. Differences were considered significant at ($P<0.05$) while the Community Structure was estimated for the phytoplankton biodiversity using Species Diversity Index (d), (Shannon and Wiener, 1963), Menhenicks (D), Species Richness (d) (Margalef, 1951), Evenness or Equitability indices (j) (Pielou, 1975) and Simpson's Dominance Index (C).

RESULTS/FINDINGS

Physical Parameters

The physicochemical parameters, nutrients values, heavy metals and biological data of Ajegunle Creek at the Tin-can Island area of Lagos from May to September, 2018 were presented graphically in Figures 2-11.

Air Temperature (°C)

Air temperature showed variation in value from May to September at all three sampling stations during the period of study and ranged from 26 to 31°C. Station 2 recorded the lowest air temperature value in May. Station 3 recorded the highest value in June.

Surface Water Temperature (°C)

The Water temperature values fluctuated as in the air temperature at all stations during the period of study and ranged from 24 to 30.5°C. Station 2 recorded the lowest value in July. Station 1 recorded the highest value in September

Rainfall (mm)

The rainfall values fluctuated throughout the sampling months during the period and ranged from 142.7mm to 329.5mm. The lowest rainfall value was recorded in July, while the highest value was recorded in September.

Total Suspended Solids (mg/L)

There were considerable variations in the TSS values recorded across the stations during the period of study and it ranged from 8 to 45mg/L. Station 1 recorded the lowest TSS value in July. Station 2 recorded the highest value in June.

Total Dissolved Solids (mg/L)

Total Dissolved Solids values fluctuated significantly from 378.4mg/L - 15900mg/L across the stations during the period of study. In June, Stations 2 and 1 recorded the lowest TDS value and the highest value respectively.

Turbidity (NTU)

There was slight variation in the turbidity values from 4.79NTU to 33.01NTU across the three stations all through the period of study. Station 1 recorded the lowest value in June. Station 3 recorded the highest value in August.

pH Value

pH values varied between low acidic and low alkaline. The lowest value (6.95) was recorded in May at Station 2 while the highest value (7.53) was recorded in August at Station 3.

Acidity (mg/L)

The acidity values varied significantly from 15.5 mg/L- 157.2mg /L across the three stations during the period of study. Station 1 recorded the lowest acidity value of in June while Station 2 recorded the highest acidity value in September.

Alkalinity (mg/L)

The alkalinity values varied widely from 84mg/L- 776mg/L across the three stations during the period of study. Station 1 recorded the lowest alkalinity value in the month of September while Station 2 recorded the highest alkalinity in July.

Salinity (%o, at 25ºC)

The salinity values varied slightly from 0.45% - 8.7% across the three stations all through the period of study. Station 2 recorded the lowest value in June. Station 1 recorded the highest value in August.

Conductivity (µS/cm)

Conductivity values also varied widely from 658.3µS/cm- 26500µS/cm across the three stations all through the period of study. In June, Stations 2 and 1 recorded the lowest value and the highest value respectively.

Dissolved Oxygen (mg/L)

The values of Dissolved Oxygen (DO) varied slightly from 0.1mg/L- 4.91mg/L across the three stations all through the period of study. Station 2 recorded the lowest DO value in August. Station 1 recorded the highest value in June, the values decreased slightly in July and August and decreased significantly in September. There were significant decreases in value in other stations.

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Biochemical Oxygen Demand (mg/L) The Biochemical Oxygen Demand (BOD_5) values fluctuated from 2mg/L- 681mg/L across the stations during the period of study. Station 3 recorded the lowest BOD_5 value in September while Station 2 recorded the highest BOD_5 value in August.

Chemical Oxygen Demand (mg/L)
The Chemical Oxygen Demand (COD) values varied widely from 11mg/L - 2212mg/L across the stations during the period of study. Station 3 recorded the lowest COD value in September. Station 2 recorded the highest COD value in July.

Total Hardness (mg/L)
The value of Total Hardness (TH) varied widely from 82mg/L- 2972mg/L across the stations all through the period of study. Station 2 recorded the lowest TH value in August and Station 1 recorded the highest TH value in June.

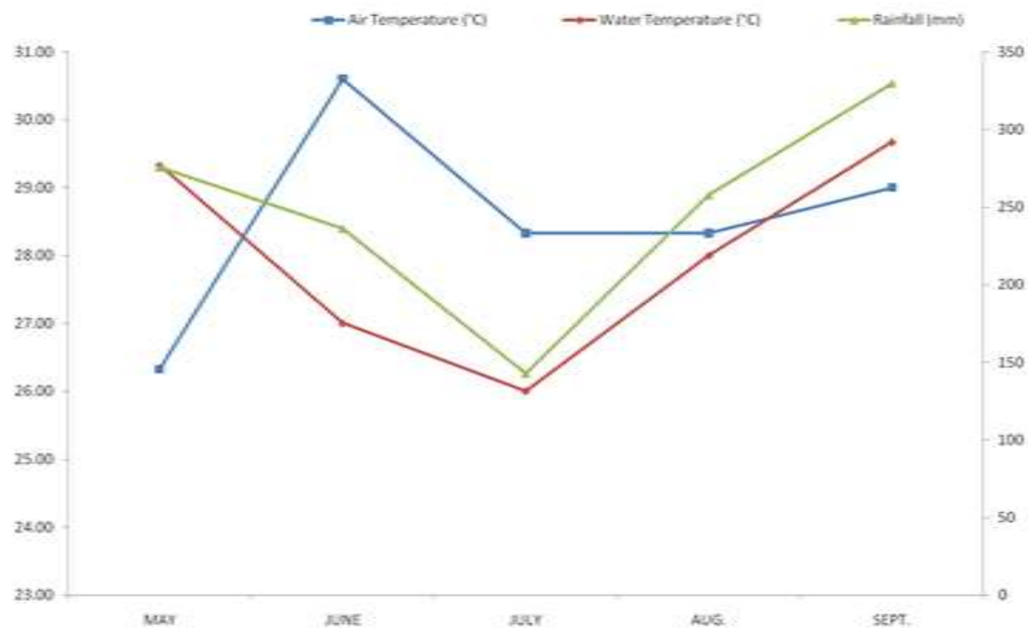

Fig. 2: Monthly Mean Variation in Air Temperature, Water Temperature and Rainfall at Ajegunle Creek (May – September, 2018).

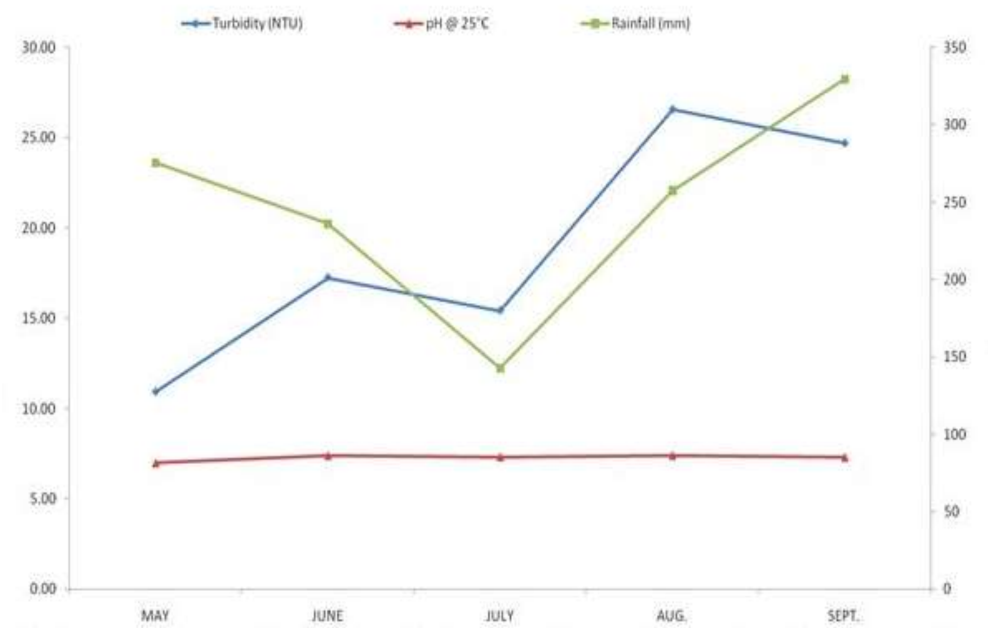

Fig. 3: Monthly Mean Variation in Rainfall, Turbidity, pH and Rainfall at Ajegunle Creek (May – September, 2018).

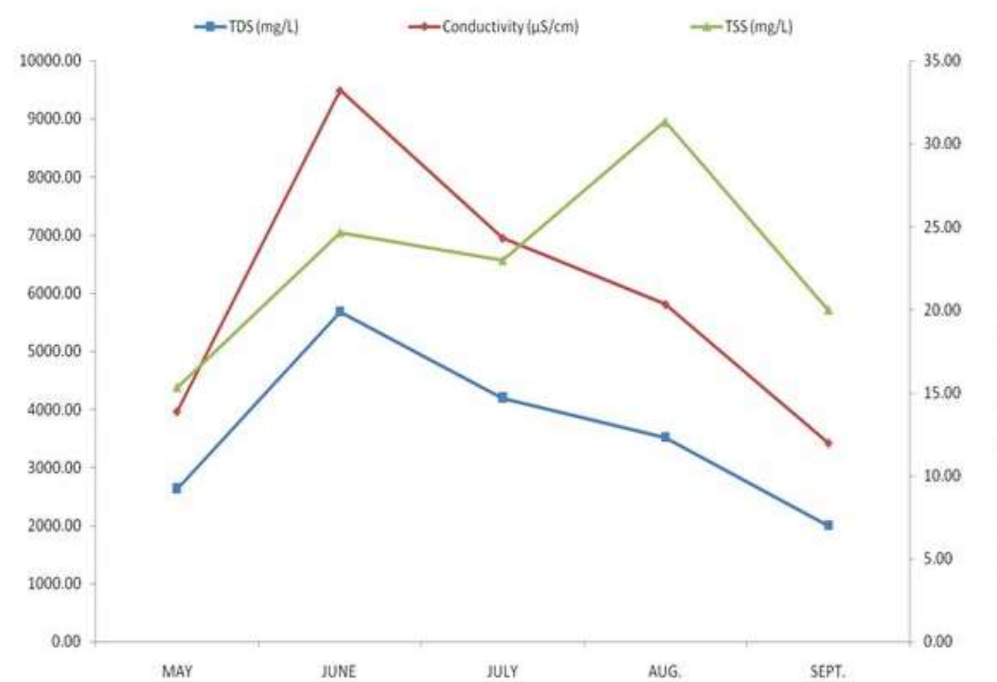

Fig. 4: Monthly Mean Variation inTotal Dissolved Solids, Conductivity and Total Suspended Solids at Ajegunle Creek (May – September, 2018).

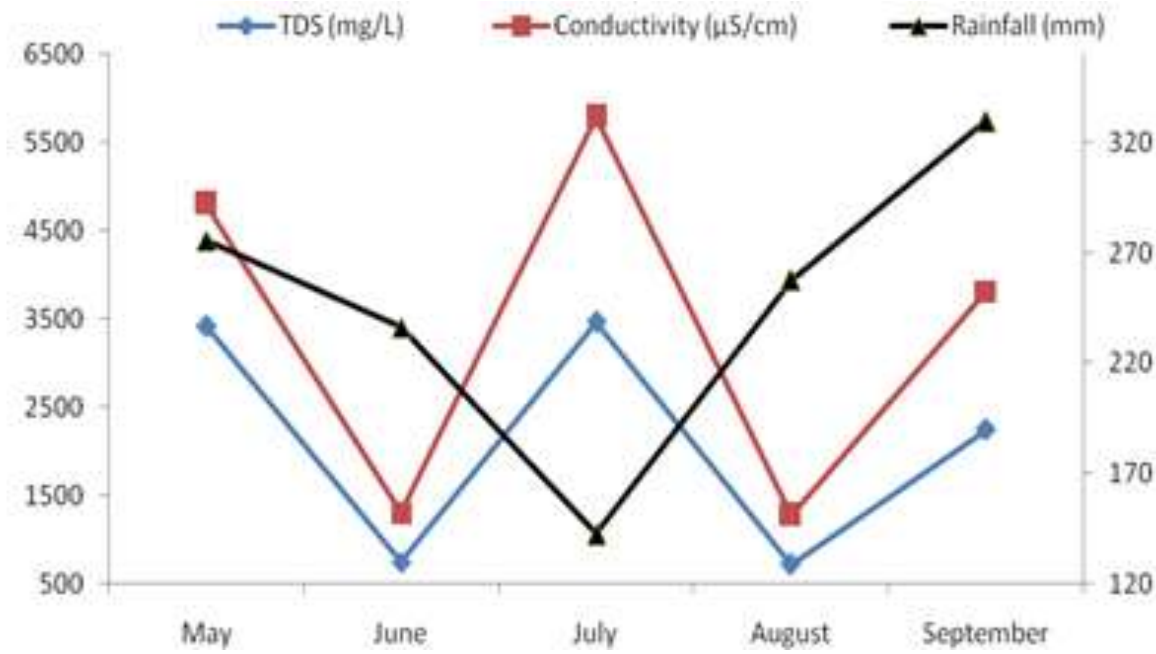

Fig 5: Monthly variation in Rainfall, Total Dissolved Solids and Conductivity at the Ajegunle Creek (May – September, 2018).

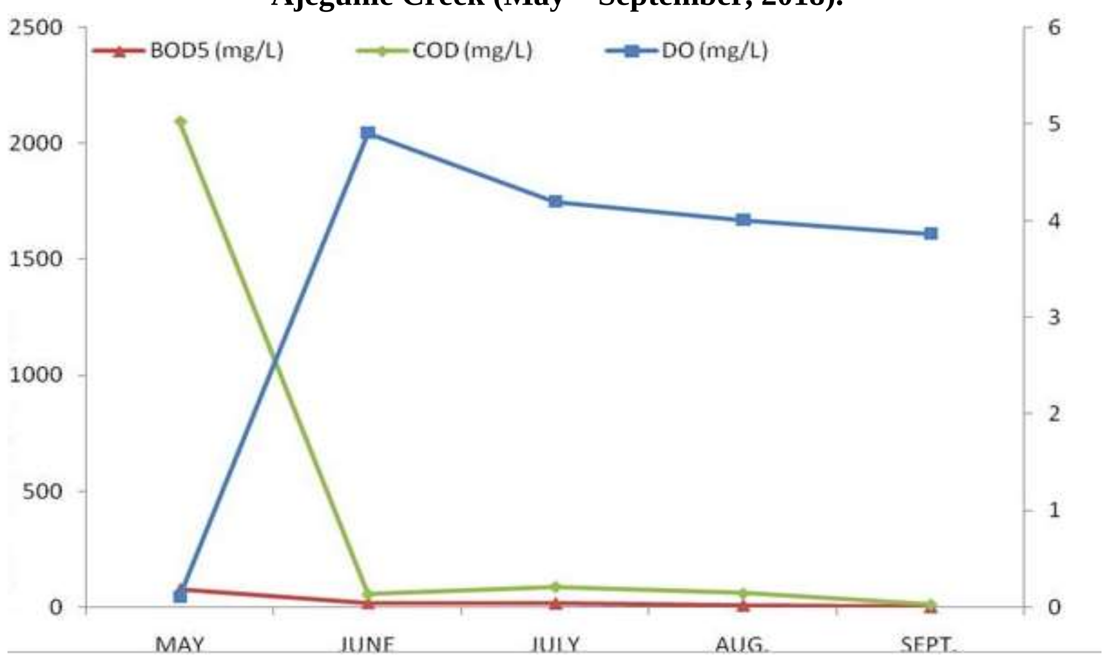

Fig. 6: Monthly variation in Biochemical Oxygen Demand, Chemical Oxygen Demand and Dissolved Oxygen for Station 1 at the Ajegunle Creek (May – September, 2018).

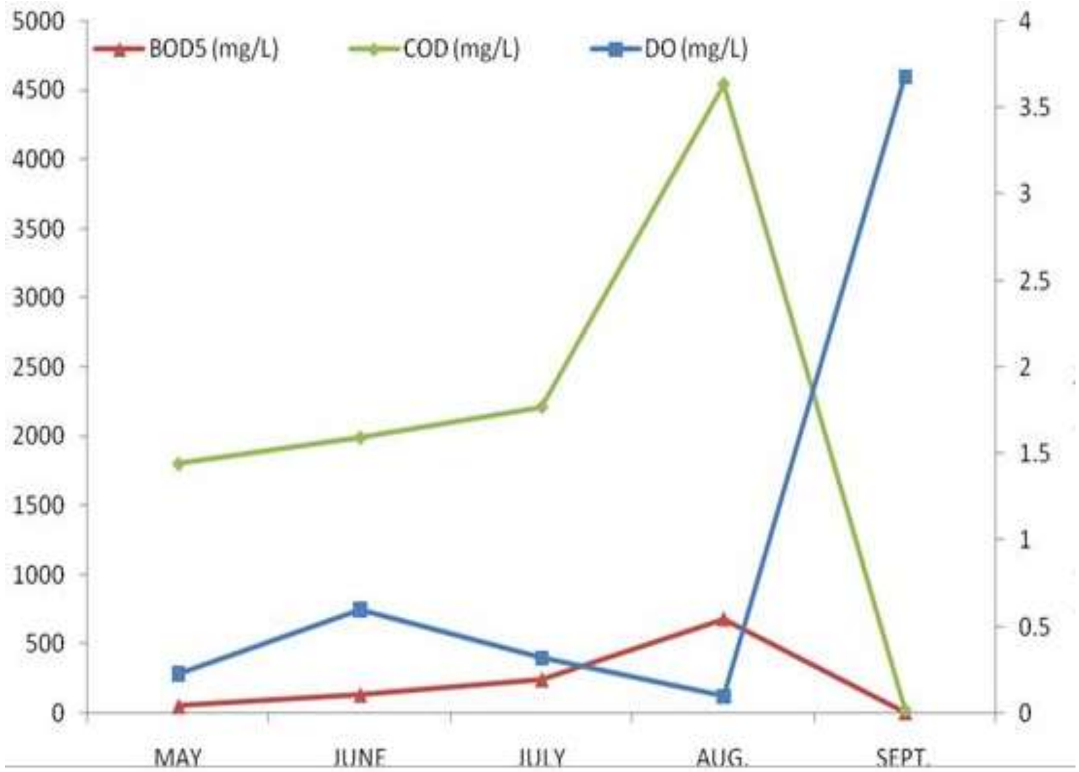

Fig. 7: Monthly variation in Biochemical Oxygen Demand, Chemical Oxygen Demand and Dissolved Oxygen for Station 2 at the Ajegunle Creek (May – September, 2018).

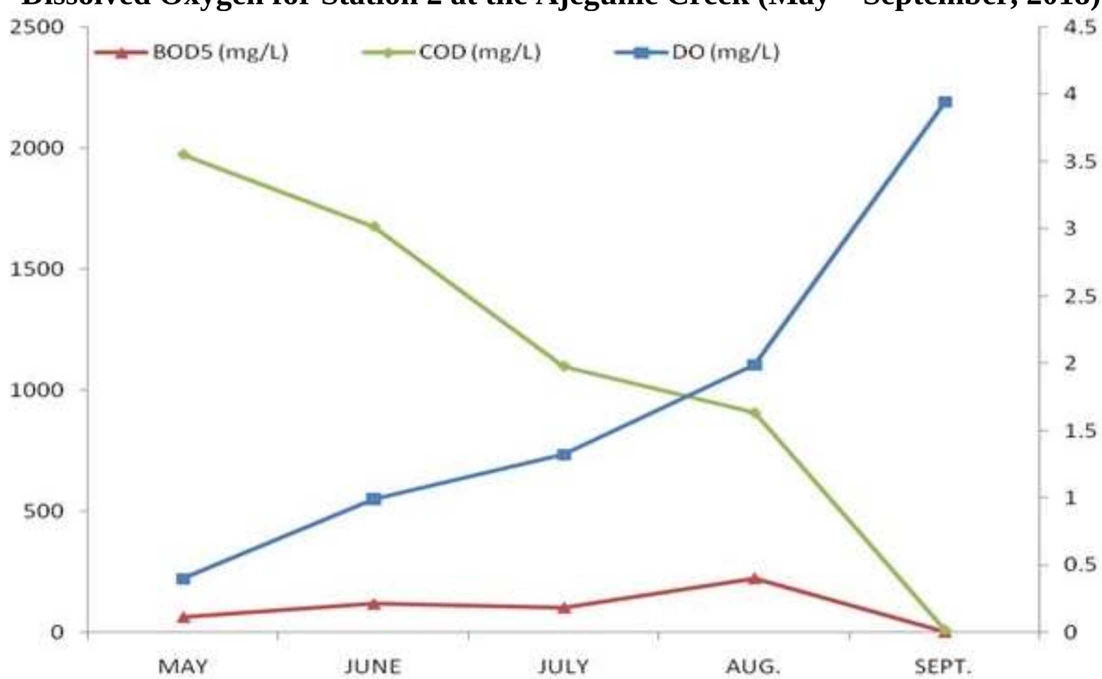

Fig. 8: Monthly variation in Biochemical Oxygen Demand, Chemical Oxygen Demand and Dissolved Oxygen for Station 3 at the Ajegunle Creek (May – September, 2018).

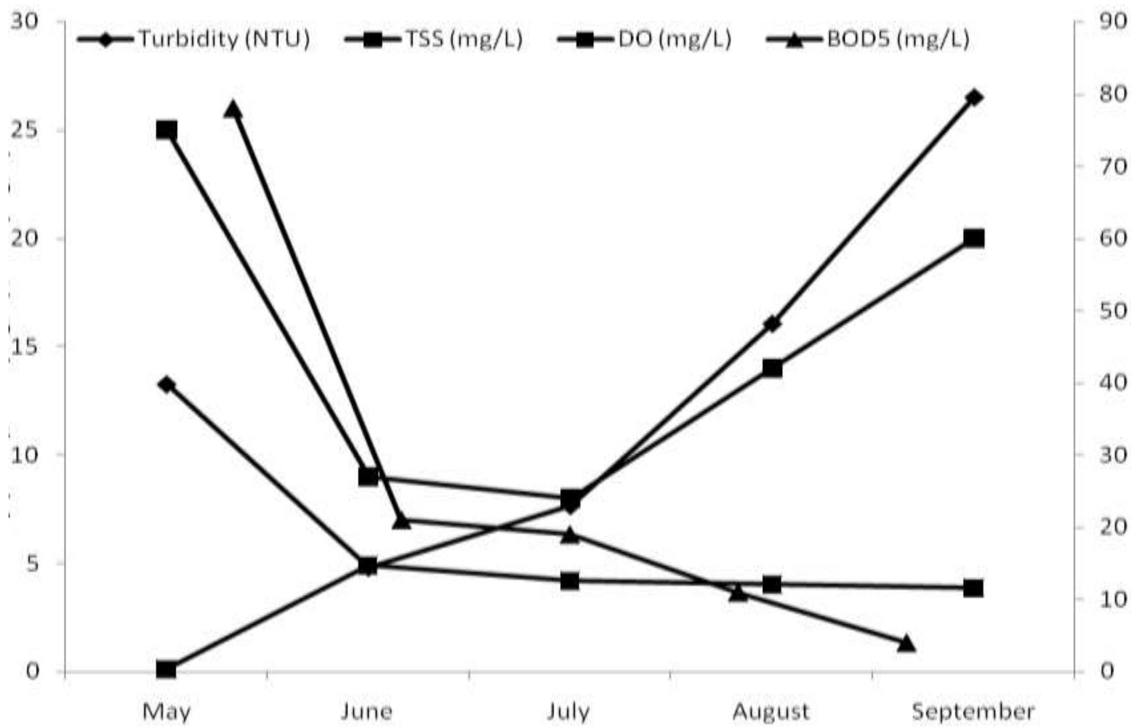

Fig. 9: Monthly variation in Turbidity, Total Suspended Solids, Dissolved Oxygen and Biochemical Oxygen Demand for Station 1 at the Ajegunle Creek (May – September, 2018).

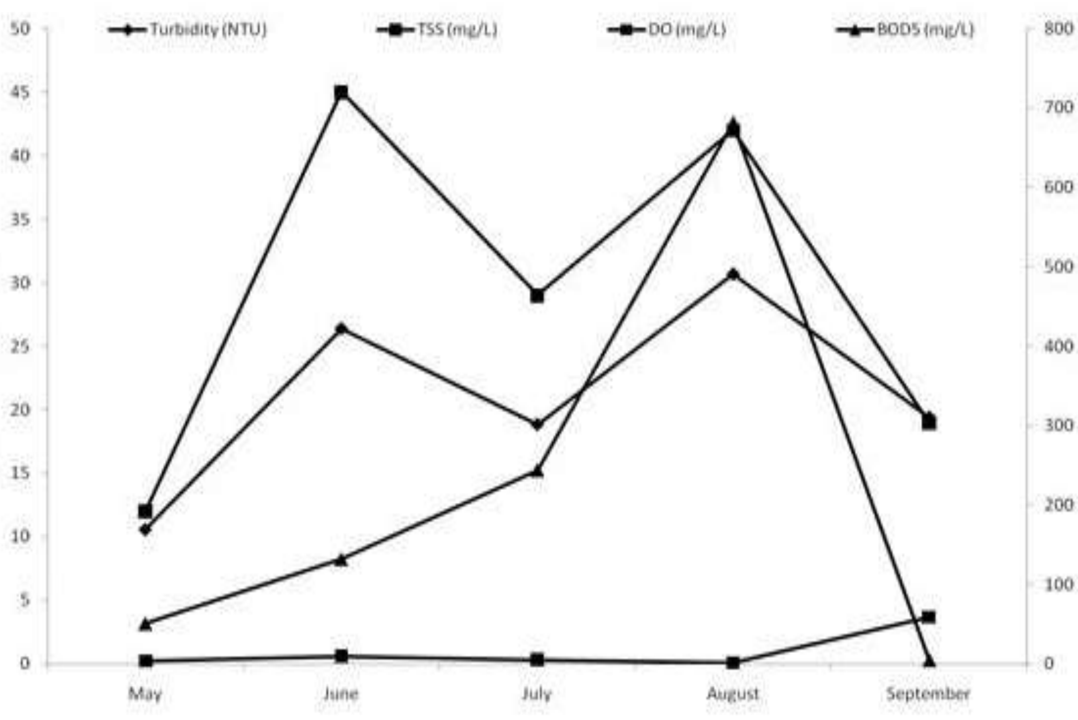

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Fig. 10: Monthly variation in Turbidity, Total Suspended Solids, Dissolved Oxygen and Biochemical Oxygen Demand for Station 2 at the Ajegunle Creek (May – September, 2018).

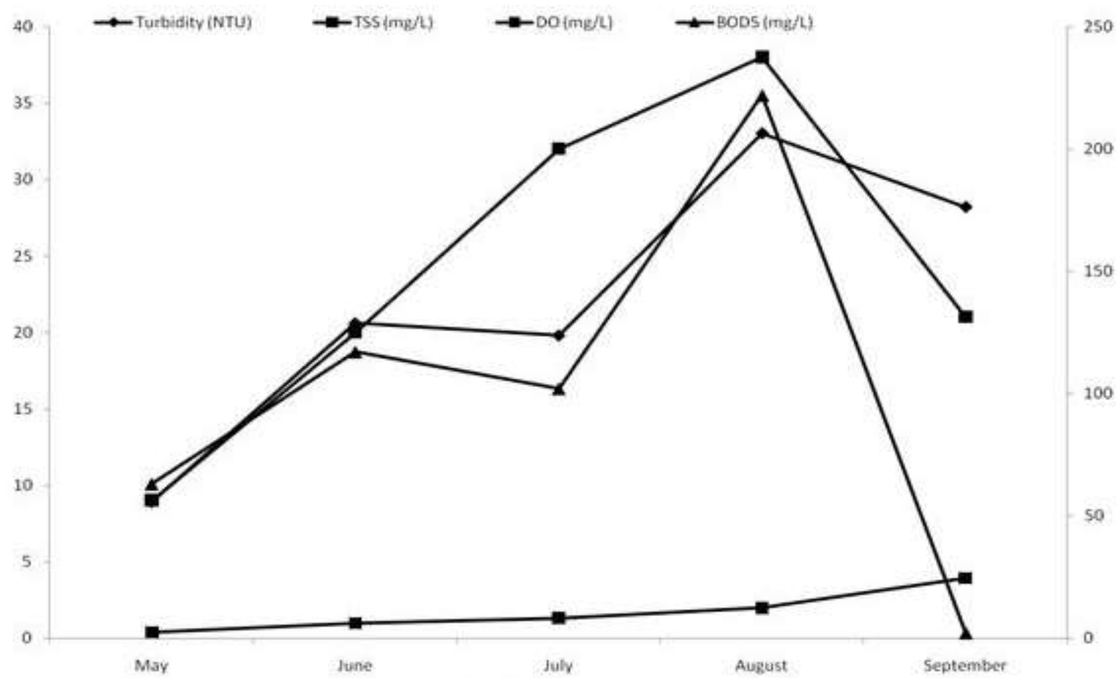

Fig.11: Monthly variation in Turbidity, Total Suspended Solids, Dissolved Oxygen and Biochemical Oxygen Demand for Station 3 at the Ajegunle Creek (May – September, 2018).

PHYTOPLANKTON BIOMASS AND DIVERSITY

Phytoplankton diversity and biomass are represented graphically in Fig. 2 and 3. The phytoplankton of Ajegunle Creek belonged to 5 divisions: Bacillariophyta, (49.45%), Chlorophyta (14.3%) and Cyanophyta (20.88%), Euglenophyta (7.69%) and Miozoa (7.69%). 14 orders were recorded. A total of 91 species belonging to 49 genera were observed. Throughout the sampling period, the highest (15150 (34.34%)) phytoplankton occurrence was recorded in June, the least (4505 (10.81%)) was recorded in September.

The more frequent genera were: *Microcystis aeruginosa* Kützing, which had the highest abundance and occurred in all months, *Oscillatoria tenuis* Agardh had a high number and occurred in only May and June. *Oscillatoria minima* Gicklhorn had a relatively high abundance and occurred in all months except July, *Coscinodiscus centralis* Ehrenberg occurred in all months except August, *Chlorella marina* Butcher occurred in all stations except September. *Spirulina platensis* Geitler occurred in all months except July, while *Cyclotella comta* Kützing occurred in all months except August. Others included *Nitzschia palea* var. *hustedtiana* Compère and

Coscinodiscus marginatus Ehrenberg. Among the euglenoids, *Trachelomonas hispida* (Perty) F. Stein was more prevalent.

The diversity and abundance of phytoplankton at Ajegunle Creek of the Tincan Island area of Lagos Lagoon from May–September, 2018 are presented in Table 2. Phytoplankton abundance was due to increase in rainfall. The phytoplankton diversity was represented by four Divisions which are Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta.The Bacillariophyta has 69 species from two (2) orders, the Chlorophyta has a total of thirty six (36) species from seven (7) orders, the Cyanophyta was represented by eighty-one (81) species from three (3) orders while the Euglenophyta has thirteen (13) species from one (1) orders. The Cyanophyta has the highest percentage of (40.70%) followed by the Bacillariophyta with a percentage of (34.67%) then Chlorophyta with a percentage of (18.09%) and the Euglenophyta with a percentage of (18.09%). The Cyanophyta and Bacillariophyta are the most abundant and dominant in terms of the species and numbers represented at the sampled location in the Ajegunle Creek during the period of study. The most abundant *Cyanophytas* are *Microcystis aeruginosa Kutzing*, *Oscillatoria minima Gicklhorn*, *Spirulina platensis Geitler* while some of the abundant *Bacillariophyta are Cyclotella comta* Kützing, *Aulacoseira granualata* var. *angustissima* (Ehr.) Ralfs, *Nitzschia palea.*

Chlorophyll –*a*

Chlorophyll- a values showed a minute variation across the stations for the period of study and it ranged between 1µg/L and 14.8µg/L. Stations 1 and 3 recorded the lowest value in May and August respectively. Station 1 recorded the highest value of in June.

Chlorophyll –*b*

Chlorophyll b values showed a minute variation for the period of study and it ranged between 0.1µg/L and 0.9µg/L. Stations 1 and 3 recorded the lowest value in May and June respectively. Station 1 recorded highest value in July.

Pheophytin *a*

Pheophytin a value varied minutely variation all through the period of study and it ranged between <0.1 and 0.4µg/L with the values recorded at all the stations being relatively constant at May. In May, the three stations recorded the lowest value also at Station 3in June. Station 1 recorded the highest value in July.

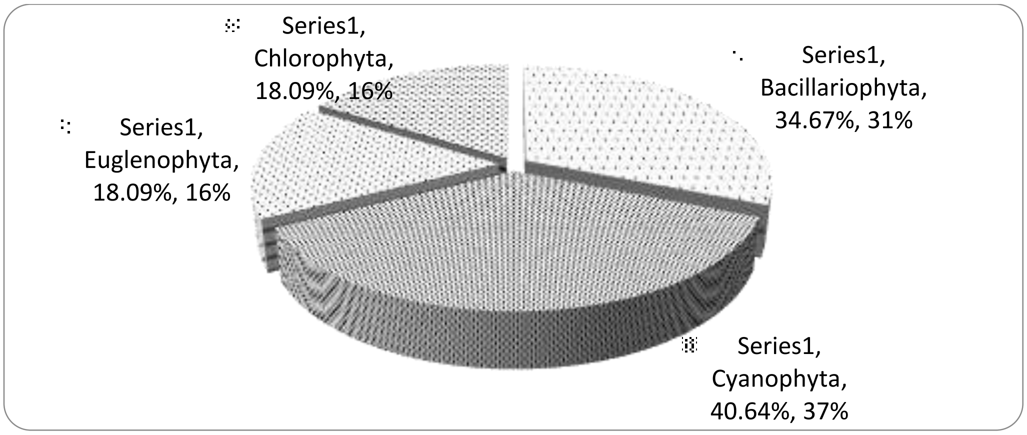

Fig. 12: Percentage Species Diversity of Phytoplankton that occurred at Ajegunle Creek Creek (May – September, 2018).

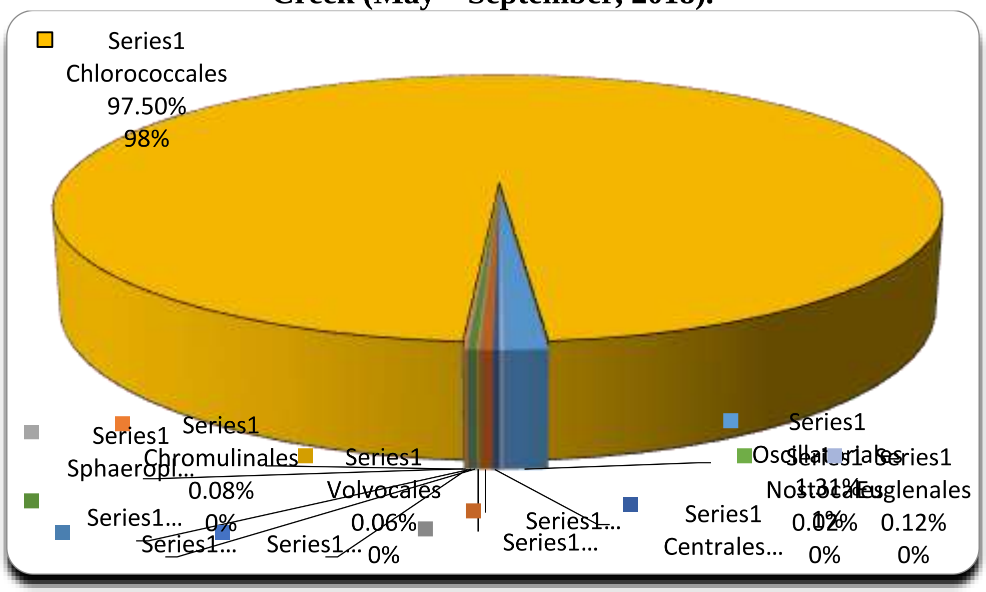

Fig. 13: Relative abundance of phytoplankton orders that occurred at Ajegunle Creek (May–September, 2018)

DISCUSSION

Physicochemical Parameters

Water quality assessment is neither a static condition of a system, nor can it be defined by the measurement of only one parameter but by measuring the range of chemical, physical and biological parameter to determine the influence of season and anthropogenic activities on the water body. These parameters provide a general indication of water pollution, whereas others enable a direct tracking of pollution sources.

There was slight variation in the air temperature and surface water temperature across the three stations all through the period of study. This also varied within the rainfall which was characteristic of the tropics as a result of increased cloud cover condition and reduction in solar insolation. More so, the air- ocean interactions around the Ajegunle Creek results was slightly higher and was responsible for the relatively constant air and surface water temperature reported from July to September which was characteristics of a tropical water environment and falls within acceptable ranges. Similar observations was reported in the adjoining creeks and lagoons in Lagos and its environments by Nwankwo and Onyema (2007a) and Onyema (2008).

In this study, the observed change in pH was within the narrow limit and its alkaline status could be due to the buffering capacity of seawater or attributed to fresh water influx, low temperature, organic matter decomposition and anthropogenic factors, human or industrial or agricultural activities. Anita *et al*., (2012) explained that the pH of water is an important environmental factor and the fluctuation in water is linked with the chemical changes, species composition and life processes. This agreed with what was reported by Folasegun and Kolawole (2008) that the dumping of anthropogenic and industrial effluents affects the acidity and alkalinity of the water and hence the pH of water bodies.

The observed alkalinity in this study was within the acceptable range for natural surface waters of 30 to 500mg/L as reported by Balogun *et al*., (2010) except at Stations 2 and 3 in the months July and August which indicated high presence of carbonates and bicarbonates.

The recorded Dissolved oxygen (DO) values during the period of study at the studied stations were below the recommended value for optimum functioning of the aquatic ecosystem as reported Abowei (2010). He explained that coastal waters typically require a minimum of 4.0mg/L and also do better with 5.0mg/L of oxygen to provide for optimum ecosystem function and highest carrying capacity and anything less than this is an indication of pollution of the water body. Hence, the low level of DO recorded at the studied stations could be due to high organic material deposited on the water bodies/surfaces from anthropogenic activities. Eswari and Ramanibai (2004) explained that DO concentration values may be due to variation in temperature, light penetration, rainfall, climate, salinity, turbulence or rate of flow, atmospheric pressure and photosynthetic activity of algae and submerged plants. The low recorded DO values will affect such attributes as growth, survival, distribution, behaviour and physiology of organisms in this water.

The values of Biochemical oxygen demand (BOD_5) in the studied stations during the period of study increased with decrease in turbidity, increase in the chlorophyll and DO values. (BOD_5) increased, nutrient availability decreased and hence bio-load decreased as seen in the studied stations. The high BOD recorded at the studied stations was due to organic content contamination of the water bodies as a result of anthropogenic activities, industrial and mining activities.

The Chemical Oxygen Demand (COD) values of the sampled stations were above WHO standard of the acceptable concentrations for unpolluted surface water quality which was 20mg/l or less as reported by Eswari and Ramanibai (2004). More so, the high COD values were indication of the presence of organic and inorganic pollutants, respectively. The significantly high mean COD values also exceeded the acceptable concentrations for unpolluted surface water quality which was

20mg/L or less and that of polluted waters (20–200 mg/L) as reported by Eswari and Ramanibai (2004).

Total Suspended Solid (TSS) and Total Dissolved Solid (TDS) values recorded varied across the studied stations throughout the study period and followed a similar trend with the nutrients. It was observed that there was direct relationship in the total suspended solids, dissolved oxygen and total dissolved solids. This could be attributed to the domestic sewage from various activities of human residing around the studied area, reception of effluents containing oxygen-demanding substances. The conductivity of studied site analyzed ranged from 658.3 to 26500µS/cm. Twort and Dickson (1994) established that the conductance of water solution increase as temperature rises and it has a direct relationship with the level of chloride and sulphate. Solomon *et al*., (2013) reported that the high value of conductivity is an indication of water and this is as a result of high concentrations of cations and anions which alter the chemistry of the aquatic ecosystem.

The total hardness of the three sampled stations examined were a bit high and the range were above the WHO standard of 199 – 200mg/l, hence the water is hard. The total hardness of the water has a direct relationship with the quantity of calcium, magnesium, sulphate. This agreed with the submission of Akram and Rehman (2018). that the hardness of water is predominantly caused by cations such as calcium and magnesium.

Phytoplankton

The chlorophyll – *a levels* fluctuated across all the stations during the period of study which has influenced the diversity and abundance of phytoplankton at studied Creek of the Lagos Lagoon. It was observed that chlorophyll-α level was affected by salinity as a result of the increased tidal mixing and this was reflected in the level of dissolved oxygen at the three sampled stations. The phytoplankton composition observed during the period of study correlate with the level of phosphate and nitrate and thus reflected in the phytoplankton production and abundance in July. The level of chlorophyll-a indicates the rate of productivity of the water.

The phytoplankton abundance increased with increase in rainfall. The phytoplankton diversity was represented by four Divisions which were *Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta.* The *Bacillariophyta* had 69 species from two (2) orders, the *Chlorophyta* had a total of thirty-six (36) species from seven (7) orders, the *Cyanophyta* was represented by eighty-one (81) species from three (3) orders while the *Euglenophyta* had thirteen (13) species from one (1) orders.

The *Cyanophyta* had the highest percentage of (40.70%) followed by the *Bacillariophyta* with a percentage of (34.67%) then *Chlorophyta* with a percentage of (18.09%) and the *Euglenophyta* with a percentage of (18.09%). The *Cyanophyta* and *Bacillariophyta* are the most abundant and dominant in terms of the species and numbers represented at the sampled location in the Ajegunle Creek during the period of study. The most abundant *Cyanophyta* are *Microcystis aeruginosa*, *Oscillatoria minima Gicklhorn*, *Spirulina platensis* while some of the abundant *Bacillariophyta* are *Cyclotella comta*, *Aulacoseira granualata* var. *angustissima* (Ehr.) *Ralfs, Nitzschia palea.*

CONCLUSION

Result for the physicochemical parameter obtained were within limits as recommended by NESREA for tropical aquatic life. Although, there was an observed variation in the parameters which could be attributed to rainfall patterns and other anthropogenic activities that may have had a direct implication on the phytoplankton community and structure. It may be necessary to conclude that the Ajegunle Creek of the Lagos lagoon is polluted because most of the species observed in the study stations showed that its major pollutants were organic based pollutants probably as a result of anthropogenic activities going around the creek.

REFERENCES

Abowei, J. F. N. (2010). Salinity, dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger Delta, Nigeria. *Advance journal of food science and technology*, *2*(1), 36-40.

Akram, S., & Rehman, F. (2018). Hardness in drinking-water, its sources, its effects on humans and its household treatment. *J Chem Appl*, *4*(1), 1-4.

Allouche, J. (2011). The sustainability and resilience of global water and food systems: Political analysis of the interplay between security, resource scarcity, political systems and global trade. *Food Policy*, *36*, S3-S8.

Anita, .R, Komorowska A., and Piegza, .M. (2012). Biosynthesis of Phytases and Phosphotases. *African Journal of Biotechnology*, 11 (14); 333-338.

Balogun S.A, and O.E. Fagade (2010). Emulsifying bacteria in produce water from Niger Delta, Nigeria. African Journal of Microbiology Research. Academic Journal Publisher, Nigeria 4 (9) 730-734.

Cosgrove, W. J. and Rijsberman, F. R. (2014). *World water vision: making water everybody's business*. Routledge.

Eswari, Y. N. K. and Ramanibai, R, (2004). Distribution and Abundance of Phyloplankton in the estuarine waters of Chennai, Southeast Coast of India*n. Journal of Marine Biology Association India*. 44: 205-211.

Folasegun, A, and Dawodu, K. (2008). Evaluation of the Effects of Brewery effluents Disposal on public water bodies in Nigeria. *Terrestrial and Aquatic Environment Toxicology* 2 (1):10 – 15.

Gibbons, D. C. (2013). *The economic value of water*. 2013: Routledge.

Margalef, R. (1951). Diversidad de especies en las comunidades naturales. Nath, K. and Sengupta, A. (2016). *An alternative approach for municipal wastewater management: Technology options for small and medium towns.* Water Practice and Technology, 2016. 11(1): p. 157-165.

Nwankwo, D. I. and Onyema, I. C. (2007). A checklist of planktonic algae off Lagos coast. *Journal of Science Research and Development*, 9: 75-82.

Nwankwo, D. I. and Akinsoji, A. (1988). Periphyton algae of a eutrophic creek and their possible use as indicator. *Nigerian Journal of Botany*, 1: 47-54.

Nybakken, J.w (1988), Marine Biology. An ecological approach. Cambridge p.514.

Odum, E. P. (1977). The emergence of ecology as a new integrative discipline. *Science, 195*

(4284), 1289-1293.

Onyema, I. C. (2008). A checklist of phytoplankton species of the Iyagbe lagoon, Lagos. *Journal of Fisheries and Aquatic Sciences*, *3*(3), 167-175.

Pielou, B.C. 1975. Ecological diversity. John Wiley & Sons, New York

Raymont J. E (1980). Plankton & Productivity in the Oceans: Phytoplankton: Pergamon Press Shannon, C. E., & Wiener, W. (1963). The mathematical theory of communities. *Urbana: University of Illinois press*.

Sheng, Y. E., (2012)., *Water quality remediation in a heavily polluted tidal river in Guangzhou, South China.* Aquatic Ecosystem Health & Management, 15(2): p. 219-226.

New york 1,489pp

Solomon, S., J.S. Daniel, R.R. Nelly III, J.-P. Vernier, E.G. Dutton, and L. W. Thomason (2011), The persistently variable "background" stratospheric aerosol layer and global climate change. Science, 333pp.

Solomon, S., Daniel, J. S., Neely, R. R., Vernier, J. P., Dutton, E. G., & Thomason, L. W. (2011). The persistently variable "background" stratospheric aerosol layer and global climate change. *Science*, *333*(6044), 866-870.

Talinli, I., & Anderson, G. K. (1992). Interference of hydrogen peroxide on the standard COD test. *Water research*, *26*(1), 107-110.

Twort A, Dickson CA (1994). Elementary Water Supply Engineering. Vol. 1. Ugochukwu, C. N. C. (2004). Effluent monitoring of an oil servicing company and its impact on the environment: *Ajeam-Ragae*, 8: 27-30.

UNESCO/WHO/UNEP (1992). Water quality assessments: A guide to the use of Biota
Sediments and water in Environmental monitoring. 585; edit. D. Chapman.585pp

Zohdi, E., & Abbaspour, M. (2019). Harmful algal blooms (red tide): a review of causes, impacts and approaches to monitoring and prediction. *International Journal of Environmental Science and Technology*, *16*(3), 1789-1806.