THE VARIATION IN WATER CHEMISTRY PARAMETERS AND PHYTOPLANKTON AT THE MAJIDUN AND AGBOYI CREEKS, LAGOS

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Abstract: Phytoplankton are important components of aquatic ecosystems, providing food for a wide range of aquatic organisms, supporting fisheries and other economic activities. This study investigated the variation in water chemistry parameters, phytoplankton diversity and distribution at the Majidun and Agboyi creeks in Lagos. Water samples were collected from October 2023 to March 2024. The water chemistry conditions varied from fresh through low brackish water conditions. Records for Salinity (0.06 – 8.38‰), Nitrate (2.55 – 26.87mg/L), Dissolved Oxygen (2.85 – 5.7mg/L), Alkaline pH (6.8 – 7.94), Alkalinity (34.4 – 156.1mg/L), Transparency (32 – 161cm) and Water temperature (26 -30°C) were reported among others. The phytoplankton diversity consisted of three main algal groups namely - Diatoms, Blue-green and green algae. A total of 21 taxa belonging to 14 genera were observed. Diatoms formed the more abundant group making up 16 taxa from 2 Orders. The Blue-green and green algae recorded 4 taxa from 2 Orders and 1 taxon from 1 Order respectively. In terms of numbers, the wet season (October – November 2023) recorded a relatively higher phytoplankton abundance (N) than the dry season. In terms of diversity, the Diatoms, reported 76.2% (Centric - 33.3% and Pennate diatoms - 42.9%), while the Blue-green and green algae recorded 19.1% and 4.8% respectively. The biological indices reflected a similar trend of occurrence as the species composition and distribution. Notable species were *Coscinodiscus lineatus*, *Nitzschia closterium, Synedra crystallina, Lyngbya limnetica, Microcystis aureginosa*, *Oscillatoria* sp. and *Volvox* sp. for the water chemistry parameters of these creeks.

Keywords: Brackish, Creeks, Dry, Fresh, Phytoplankton, Wet, Water chemistry.

Introduction

Water chemistry parameters such as temperature, salinity, pH, nitrate, phosphate, ammonia, silicate, and dissolve inorganic phosphate are widely influenced by spatial and temporal variations in phytoplankton distribution (Vajravelu *et al*., 2018). Sudden changes in physicochemical parameters have a significant effect on the distribution and abundance of many species of phytoplankton (Shekhar *et al*., 2008). Since the physical and chemical parts of aquatic environment are very important factors affecting the biological life in the aquatic system, adequate knowledge of these in relations to aquatic life is necessary (Olawusi-Peters, 2008). Physicochemical parameters constitute an important abiotic component of aquatic ecosystems and they influence species composition, diversity, stability, abundance, productivity, migration, biodiversity and physiological condition of aquatic organisms (Paturej *et al.*, 2017; Zeppilli *et al*., 2018). These parameters are used to detect any perturbation in the aquatic environment. Physicochemical parameters have been identified to affect phytoplankton abundance (Wassie *et al*., 2017; Sharma *et al*., 2016).

Integrated physicochemical parameters are important for expertise in the sustainable development process and for management of healthy marine ecosystem (Kennish, 2000). To assess the pollution aquatic ecosystem, the basic information of water chemistry parameters is crucially important. Water parameters of temperature, pH, DO, turbidity, salinity, and nutrient are used as indicator in the condition of the water ecosystem (Aknaf *et al*., 2017). Knowledge of quality water and its response to aquatic biodiversity are also essential in the management of fisheries resources to provide more economic and environmental balance ecosystem. Discharges of waste from human-induced activities either point sources or non-point sources are influences by surface runoff and water quality parameters vary with season depend on the climate of the specific region (Singh *et al*., 2004).

Creeks are water channel that flows into rivers, estuaries, lagoons or an aquatic system especially enroute to the sea (Onyema, 2009). Creek ecosystems in the Lagos area are especially rich and diverse (Chukwu, 2002; Emmanuel and Onyema, 2007). They serve as feeding, nursery and breeding grounds for finfish, shellfish and even migratory and shore birds (Nwankwo, 2004; Onyema *et al*., 2007 and Lawal-are, 2009). Majidun and Agboyi creek are relatively a small, narrow and shallow water body. They are tidal creeks that flow into the Lagos lagoon from the Northern axis.

In tidal creeks, the tidal influence is an important control on microscopic biomass which constitutes various types of plankton and can be found all the year round. Periods of sharp rise and fall in salinity levels in these Coastal ecosystems are usually associated with low diversity link to death of the species (Nwankwo, 1996; Chukwu *et al*., 2009).

Phytoplankton are one of the key components of aquatic ecosystems and play an important role in maintaining the balance of aquatic ecosystems (Padedda *et al*., 2017). Phytoplankton community structure is now accepted to be closely related to environmental factors (Kozak *et al*., 2015; Yuan *et al*., 2017; Sabater-Liesa *et al*., 2018; Mishra *et al*., 2019). Phytoplankton exhibit particular sensitivity to changes in the biotic (e.g., grazing pressure), physical (e.g., temperature, water level fluctuation) and chemical (e.g., nutrient content) characteristics of aquatic environments (Zhang *et al*., 2020). Many researchers have conducted studies on the succession of phytoplankton in seas, lagoons, estuarine creeks, lakes and reservoirs and have found that nutrients, water temperature and light availability are the main influencing factors (Liu *et al*., 2010; Dantas *et al*., 2012; Sabater-Liesa *et al*., 2018, Nwonunara, 2018).

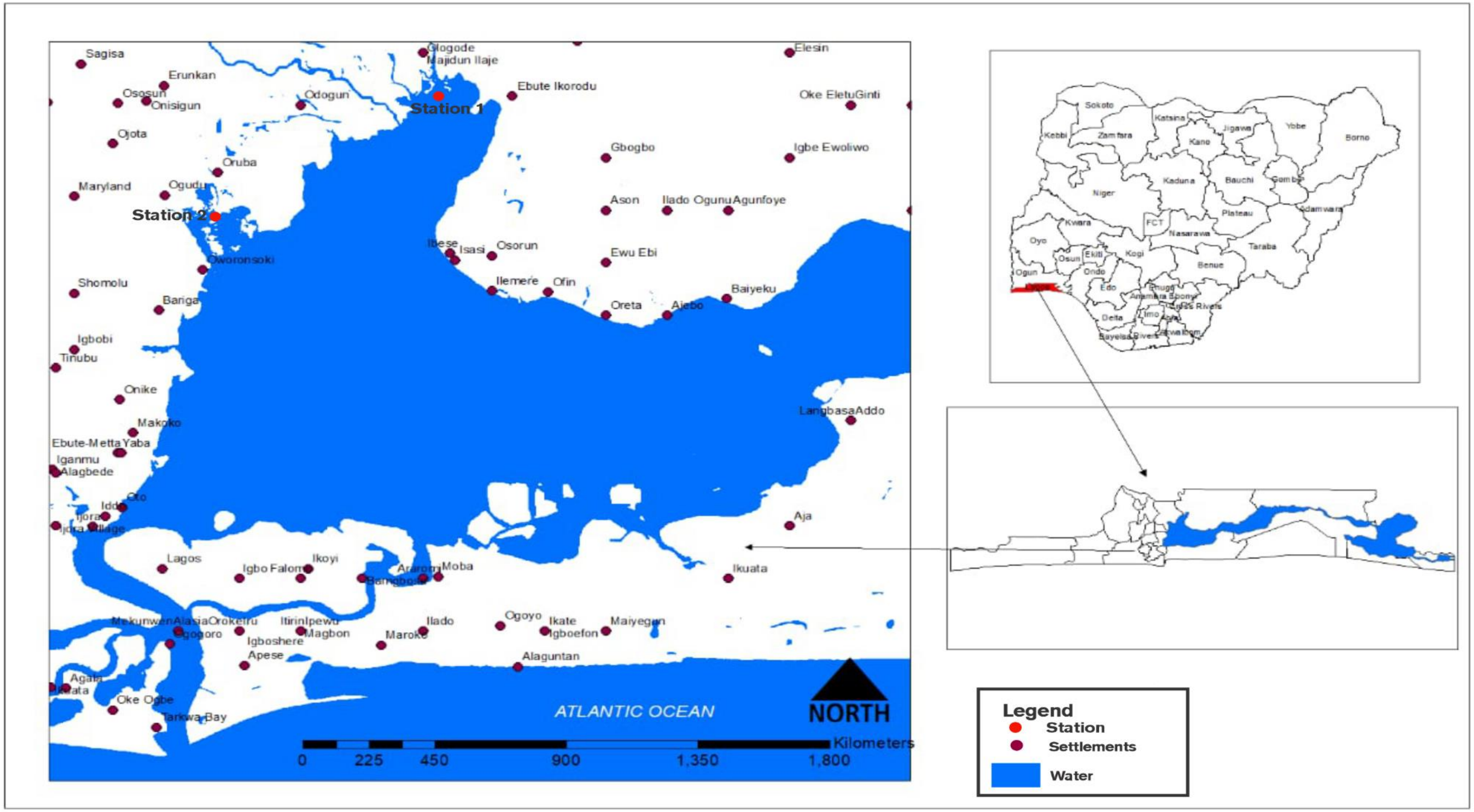

Fig. 1: The study area showing the two sampling Stations – Majidun Creek (Station 1) and the Agboyi Creek (Station 2).

Phytoplankton diversity and successions are usually indicative of the water quality; their changes in succession can be correlated with the change of the aquatic ecosystem and physicochemical parameters such as the influence of nutrient runoffs into the water (Zulkifly *et al*., 2020). However, there is still a lack of information about the variation in water chemistry specifically associated with the phytoplankton community in these study areas. The contributed scientific data about the water quality and checklist of phytoplankton will help to take proper management to maintain the healthy ecosystem in that coastal area. Overall, the available studies indicates that the phytoplankton communities of Majidun and Agboyi creeks are diverse and are influenced by the variation in water chemistry.

Materials and Methods

Description of Study Site

Majidun Creek is relatively a small, narrow and shallow water body. It lies within Latitude N 6° 36'26'' and stretches between Longitude E 3°28'15''. It is one of the numerous aquatic habitats that constitute Lagos lagoon complex. However, Majidun creek drains directly into Lagos Lagoon and empties into the Atlantic Ocean via Lagos Harbour. It is a narrow and shallow creek with average depth of 3 m. It is of importance to artisanal fisheries, transportation, sand mining and logging activities. Major source of water into the creek is from Ogun River.

Agboyi Creek is located at the western side of Lagos and northern section of Lagos lagoon. It lies within Latitude N 6° 33'52'' and stretches between Longitude E 3°24'29''. The creek derives its source from Ogun River and receives input from Ogudu Creek towards the middle of its course before it empties into the Lagos lagoon at Oworonshoki. It serves as a major drainage channel for the area, receiving domestic wastes and industrial effluents which are discharged from nearby industries at Agege, Maryland, Isheri, Ikeja, Magodo and Ogudu areas of Lagos State (Onyema and Ojo, 2008). It has a length and average depth of 7.63 km and 2.7m respectively (Fig. 1).

Collection of Water Samples

The sampling stations were sampled for six months (October, 2023 - March, 2024). Water samples were collected each month using 75cl plastic containers with each indicating the month of collection at the study site. Sampling was carried out between 07.00 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.

Collection and analysis of Plankton Samples

Plankton samples were collected on each occasion and at each station, between 07.00 and 12.00 hours each sampling day, for six months (October, 2023 – March, 2024) with a 55µm mesh size standard plankton net using filtration method. The filtered plankton was emptied into well-labelled 750ml plastic containers with screw caps. Each sample was preserved with unbuffered dilute 10% formalin and transferred to the laboratory for further analysis as described by Onyema (2008) and Wu *et al*., (2014).

Statistical Analysis of Data

Descriptive (min, max, mean, standard deviation and standard error) and inferential statistics (one-way ANOVA, CCA, Spearman Correlation and Bryan-Curtis Similarity) using Excel, SPSS 22.0 and PAST 4.0. Data were pooled and presented as monthly, seasonal and spatial mean variances. The data were compared by means of one-way ANOVA in order to evaluate if their difference was significant (p-value < 0.05). Spearman Correlation matrix analysis was employed to identify possible significant relationships among the environmental variables, the photosynthetic pigment, species diversity and species abundance at both 0.01 and 0.05 significant level. The community structure (Diversity, abundance, species richness, Shannon-Wiener and species evenness) indices were analyzed as reported by Ogbeibu (2005) and adopted by Onyema (2008; 2018).

Results and Discussion

Physicochemical Parameters: The water chemistry conditions varied from fresh through low brackish water conditions. Records for Salinity (0.06 – 8.38‰), Nitrate (2.55 – 26.87mg/L), Dissolved Oxygen (2.85 – 5.7mg/L), Alkaline pH (6.8 – 7.94), Alkalinity (34.4 – 156.1mg/L), Transparency (32 – 161cm) and Water temperature (26 - 30°C) were reported among others (Table 1).

Phytoplankton Diversity: The diversity and abundance of phytoplankton at the Majidun creek and the Agboyi creek between October, 2023 and March, 2024 are presented in Table 2. Phytoplankton population were less abundant in the month of January through to March, 2024 when rainfall was lowest and more in the month of October through December, 2023 when rainfall volumes were higher. The phytoplankton diversity was represented by three division namely Bacillariophyta, Cyanophyta and Chlorophyta. A total of twenty-one species belonging to fourteen genera were observed. The Bacillariophyta were represented by sixteen taxa from two Orders (Centrales - 7 taxa and Pennales - 9 taxa). The Cyanophyta were represented by four taxa from two Orders (Chrococcales - 1 taxa and Hormogonales - 3 taxa) while the Chlorophyta were represented by one taxon from one Order (Volvocales - 1 taxa).

The Division Bacillariophyta (Diatoms) had the largest percentage in terms of abundance (49.77%) across my sampling stations (Majidun creek and the Agboyi creek), (Centrales – 35.48% and Pennales – 14.29%). while Division Cyanophyta (Blue-green algae) (Chrococcales – 0.46% and Hormogonales – 47%) and Division Chlorophyta (Green algae) (Volvocales – 2.76%) recorded 47.46% and 2.76% respectively (Fig. 2).

The Bacillariophyta (Diatoms) were dominant group in terms of numbers and species diversity (76.2%), compared to Cyanophyta (19.1%) and Chlorophyta (4.8%) respectively. The notable species of the Bacillariophyta were the *Coscinodiscus lineatus, Hemidiscus cuneiformis* from the Order Centrales and the Order Pennales were represented by *Nitzschia closterium* and *Synedra crystallina*. The Cyanophyta were represented by *Lyngbya limnetica* and *Oscillatoria* sp. while the Chlorophyta were represented by *Volvox* sp. During October, 2023 and February, 2024 at both study sites, environmental factors indicate fresh to low brackish water condition, moderate nutrient levels and organic pollution e.g., *Lyngbya limnetica, Oscillatoria* sp. and *Synedra crystallina* are bioindicators of these environmental factors. While during October, 2023 through February, 2024 featured more phytoplankton species, which indicates that the environmental factors were more favorable for the phytoplankton species. (Fig. 3).

Table 1: Monthly Variations in Water Chemistry Parameters at Majidun Creek (Station 1) and Agboyi Creek (Station 2) (October, 2023 – March, 2024)

		Station 1 – Majidun creek					Station 2 – Agboyi creek				
SN	PARAMETERS	MIN.	MAX.	MEAN	±SD.	±SD. Error	MIN.	MAX.	MEAN	±SD.	±SD. Error
1.	Air Temperature (°C)	21.00	30.00	26.17	3.25	1.33	26.00	32.00	28.75	2.32	0.95
2.	Water Temperature (°C)	26.00	29.00	27.50	1.05	0.43	27.00	30.00	27.83	1.33	0.54
3.	Rainfall (mm)	21.20	211.60	89.85	64.70	26.41	21.20	211.60	89.85	64.70	26.41
4.	Transparency (cm)	32.00	161.00	80.25	51.88	21.18	35.50	97.00	58.92	23.47	9.58
5.	pH (at 25°C)	6.80	7.68	7.16	0.30	0.12	7.04	7.94	7.29	0.33	0.14
6.	Electrical Conductivity (µS/cm)	199.30	15560.00	8169.15	6928.86	2828.69	128.80	10830.00	4656.70	4042.97	1650.53
7.	Salinity (‰ at 25°C)	0.10	8.38	4.26	3.59	1.47	0.06	5.86	2.48	2.18	0.89
8.	Acidity (mg/L, as $CaCO_3$)	11.50	22.10	17.03	3.60	1.47	7.20	30.00	20.48	8.17	3.33
9.	Alkalinity (mg/L, as $CaCO_3$)	40.00	80.20	61.32	14.09	5.75	34.40	156.10	83.78	40.81	16.66
10.	Total Hardness (mg/L, as $CaCO_3$)	44.70	1037.50	556.83	423.36	172.83	38.30	725.50	335.38	255.28	104.22
11.	Dissolved Oxygen (mg/L)	3.33	5.70	4.23	0.79	0.32	2.85	4.72	3.66	0.62	0.25
12.	Biochemical Oxygen Demand (mg/L)	5.00	16.00	9.17	4.79	1.96	6.00	12.00	9.00	2.61	1.06
13.	Chloride (mg/L)	55.25	4629.83	2354.52	1984.64	810.23	33.15	3237.60	1368.33	1205.45	492.12
14.	Nitrate (mg/L, as NO^{3-})	2.55	26.87	10.13	8.59	3.51	3.13	22.24	10.09	6.87	2.80
15.	Calcium (mg/L)	10.80	83.80	53.00	31.41	12.82	10.08	61.80	34.00	21.63	8.83
16.	Magnesium (mg/L)	4.30	201.12	103.08	85.10	34.74	3.18	140.64	60.82	50.57	20.65
17.	Sodium (mg/L)	35.88	3006.39	1528.90	1288.72	526.12	21.53	2102.30	888.52	782.74	319.55
18.	Potassium (mg/L)	0.90	75.42	38.36	32.33	13.20	0.32	52.74	22.22	19.72	8.05
19.	Dissolved Inorganic Nitrogen (mg/L)	0.58	6.07	2.29	1.94	0.79	0.71	5.02	2.28	1.55	0.63
20.	Dissolved Organic Nitrogen (mg/L)	0.01	0.89	0.25	0.34	0.14	0.01	0.72	0.23	0.31	0.13
21.	Particulate Organic Nitrogen (mg/L)	0.01	1.07	0.23	0.41	0.17	0.02	4.44	0.76	1.80	0.74
22.	Oil and Grease (mg/L)	0.01	0.02	0.01	0.01	0.00	0.01	0.02	0.01	0.01	0.00
23.	True Color (pt. Co Unit)	0.90	38.00	12.05	16.02	6.54	1.00	91.30	22.53	35.87	14.64
24.	Redox (mV)	-55.00	15.20	-13.47	27.82	11.36	-53.20	11.00	-11.78	21.95	8.96

Table 2: The Composition and Abundance of Phytoplankton at Majidun Creek (Station 1) and Agboyi creek (Station 2) (October, 2023 – March, 2024).

	OCT.		NOV.		DEC.		JAN.		FEB.		MAR.	
PHYTOPLANKTON TAXA	**St. 1**	**St. 2**	**St. 1**	**St. 2**	**St. 1**	**St. 2**	**St. 1**	**St. 2**	**St. 1**	**St. 2**	**St. 1**	**St. 2**
DIVISION: BACILLARIOPHYTA												
CLASS: BACILLARIOPHYCEAE												
ORDER I: CENTRALES												
Aulacoseira granulata var. *angstissima* Muller	-	-	-	-	-	-	-	-	-	-	-	5
Coscinodiscus centralis Ehrenberg	-	-	-	-	-	-	-	-	-	5	-	-
Coscinodiscus lineatus Ehrenberg	-	-	-	-	-	325	-	25	-	-	-	-
Coscinodiscus radiatus Ehrenberg	-	-	-	-	-	-	-	-	-	5	-	-
Coscinodiscus stellaris Ehrenberg	-	-	-	-	-	5	-	-	-	-	-	-
Hemidiscus cuneiformis Wallich	-	-	-	-	-	5	-	-	5	-	-	-
Leptocylindricus danicus Cleve	-	5	-	-	-	-	-	-	-	-	-	-
ORDER II: PENNALES												
Bacillaria paxillifer (O.F. Muller) Hendey	-	5	-	-	-	-	-	-	-	-	-	-
Gomphonema parvulum Grunner	-	5	-	-	-	-	-	-	-	-	-	-
Navicula expansa Hagelstein	-	-	5	-	-	-	-	-	5	-	-	-
Nitzschia closterium (Witesch) W. Smith	5	-	-	-	5	-	10	-	-	-	5	-
Nitzschia sigmoidea (Witesch) W. Smith	-	-	-	-	-	-	-	5	-	-	-	-
Synedra crystallina (Ag) Kutzing	-	35	5	-	-	5	-	10	5	-	5	10
Synedra fascicularis (Ag) Kutzing	-	15	-	-	-	-	-	-	-	-	-	-
Synedra ulna (Nitzsch) Ehrenberg	-	5	-	-	-	-	-	-	-	-	-	-
Pseudo-nitzchia Peragallo	-	-	-	-	-	-	-	-	-	-	10	-
DIVISION: CYANOPHYTA												
CLASS: CYANOPHYCEAE												
ORDER I: CHROOCOCCALES												
Microcystis aureginosa Kutzing	-	-	-	-	-	-	-	5	-	-	-	-
ORDER II: HORMOGONALES												
Lyngbya limnetica Lemmermann	-	475	-	-	-	-	-	-	-	-	-	-
Lyngbya martensiana Meneghini	-	-	-	5	-	-	-	-	-	-	-	-
Oscillatoria sp.	-	-	5	10	-	10	5	-	-	-	-	-
DIVISION: CHLOROPHYTA												
CLASS: CHLOROPHYCEAE												
ORDER: VOLVOCALES												
Volvox sp.	5	-	25	-	-	-	-	-	-	-	-	-
TOTAL SPECIES DIVERSITY (S)	**2**	**7**	**4**	**2**	**1**	**5**	**2**	**4**	**3**	**2**	**3**	**2**
TOTAL ABUNDANCE (N)	**10**	**545**	**40**	**15**	**5**	**350**	**15**	**45**	**15**	**10**	**20**	**15**

The trends in the water quality were greatly influenced by seasonal changes on the various water bodies that were studied. The slight variation in the values of water temperature may be linked with the shallowness of the creeks and regular tidal motions, which ensured the complete mixing of the water (Olawusi-peters, 2014).

Decrease in water temperatures depends primarily on the rate of seasonal rainfall and lower air temperatures (Vajravelu *et al.*, 2018). Temperature plays significant roles in the aquatic ecosystem, which is one of the important parameters to control the physicochemical water The water temperature of the study area varied significantly among the month as regulated by the seasonal cycles of the air temperature as well down pour in particular locations.

In the month of October, 2023, the highest rainfall value was recorded (211.6mm) while December, 2023 recorded the lowest rainfall (21.2mm). The water samples were slightly acidic to alkaline and varied from 6.8 – 7.94 across, the two stations. This alkaline pH may be due to the buffering effects of the seawater (Onyema *et al*., 2007). The variation in pH, which is influenced by factors, such as air temperature, rainfall, water temperature, dissolved oxygen (DO), nitrate levels, and plankton abundance, remained within the alkaline range and did not pose any harm. The correlation coefficient function showed a negative correlation between pH and phytoplankton, indicating that a decrease in pH corresponded to an increase in plankton levels (Siddique *et al*., 2023).

Salinity recorded was higher between the sampling periods of December, 2023 to March, 2024. A similar condition and regimes have been reported by Onyema and Popoola (2013) for the physico-chemical characteristics of the East mole of the Lagos habour. The salinity levels ranged between 0.06 – 8.38‰, recorded at the study sites are indication that Majidun and Agboyi creeks varied from freshwater through low brackish water conditions. These are typical of creeks, estuaries and mangrove swamps that are associated with brackish water (Lawson, 2013). The low salinities were the consequence of higher river discharge from the surface runoff. In addition, tidal cycles influenced estuary with high salinity water and relatively weak vertical mixing, leading to an increase in the vertical salinity gradient (Xia *et al*., 2011). The least salinity (October, 2023) recorded was probably a reflection of dilution from rainfall.

The Dissolved Oxygen range in the two stations ranged between 2.85 – 5.7mg/L. Low dissolved oxygen level recorded could be due to microbial breakdown of organic matter to release nitrate and phosphate and deplete oxygen in the study area (Eliku & Leta, 2018; Umar 2020). Adequate dissolved oxygen (DO) supports plankton growth, while low levels limit phytoplankton and impact zooplankton (Alfonso *et al*., 2017). Elevated dissolved oxygen (DO) concentrations can change the composition of phytoplankton (Abdel-Wahed *et al*., 2018). Dissolved oxygen (DO) serves as the primary oxygen source for aerobic aquatic life, reflecting water quality and metabolic balance, moreover it is crucial for assessing water pollution levels (Hossain *et al*., 2016). High dissolved oxygen values are probably due to the good oxygenation of the surface water as a consequence of the new uptakes of water (Aknaf *et al*., 2017). Agboyi creek recorded the lowest dissolved oxygen values across the two sampling stations throughout the whole six months sampling period. Domestic and industrial effluents, urban storm, agricultural run-offs and waste discharge into the creeks are usual practice in Lagos and are the main reasons for high pollution of the ecosystem.

The influx of contaminants coming from domestic and industrial effluents, urban storm and agricultural run offs into the sampling sites led to the changes in the environmental conditions of the creeks thereby resulting in the increase in alkalinity, acidity, nutrients, and pH of Majidun creek and the Agboyi creek. The cations values (Calcium, Magnesium, Sodium and Potassium) recorded were relatively high and increased with the dry season (Lawal-are *et al*., 2010).

The nutrient levels were fluctuating during periods of the sampling. Olaniyan (1969) while working on the lagoon of south western Nigeria revealed that the variation in nutrients content was related to the pattern of rainfall. The marked variation in nitrate (2.55 – 26.87mg/L), DIN (0.58 – 6.07mg/L), DON (0.01 – 0.89mg/L) and PON (0.01 – 4.44mg/L) is notable during the course of study which are the main inorganic nutrients required by plankton for their growth and reproduction. Most tropical water has low nutrients values, a feature considered common for natural and polluted water. Nitrate recorded low value during the study period probably due to the low amount of organic waste which enters the study area. There will be marked increase in phytoplankton population when there is increase in nutrients i.e., Nitrates, DIN, DON and PON. The increase in nutrients levels value in December, 2023 may be attributed to low freshwater influx and predominately the results of biologically activated reactions. Nitrate, DIN, DON and PON were significant negatively correlated with phytoplankton species diversity, distribution and vice versa. These nutrients indirectly enhance the multiplication of phytoplankton.

Phytoplankton diversity and distribution showed a decline in number during the study period compared to earlier works in these study areas. This may be due to natural and anthropogenic activities. Bacilariopyta (Diatoms) was the dominant group throughout the study in diversity and abundance. The increasing order of dominance values was Bacillariophyta>Cyanophyta>Chlorophyta. Tidal influence played a major role in the nutrient status and phytoplankton community (in terms of species composition, diversity, abundance and distribution) of the study area (Dickson *et al*., 2022).

The qualitative dominance of Diatoms in this study area is noteworthy because they have been known to be indicators of water quality and environmental conditions (Onyema and Popoola, 2013). Diatoms are sensitive and resilient to both high and low tide (Dickson *et al*., 2022). It was observed that the Pennales forms of diatoms were the most dominant Bacillariophyta species among the diatoms across the two stations which could be due to introduction of bottom dwelling forms into plankton either through the artisanal fishing and scouring effects of fishing gear or as a result of shallow depth (Adesalu and Nwankwo, 2008).

The blue-green and green algae was also observed to be moderate in the two stations and was comparatively dominated by *Lyngbya limnetica, Oscillatoria* sp. (blue-green algae) and *Volvox* sp. (green algae) respectively. It was observed that the abundance of the blue-green and green algae was significantly affected by the variation in water chemistry parameters.

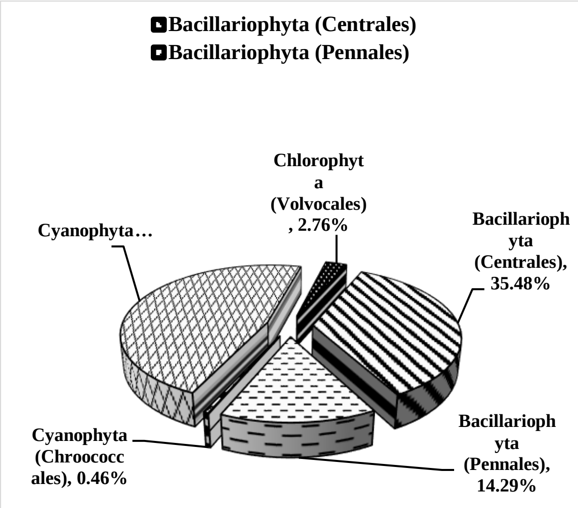

Fig. 2: Relative Abundance (N) of Phytoplankton at Majidun Creek (Station 1) and the Agboyi Creek (Station 2) (October, 2023 – March, 2024)

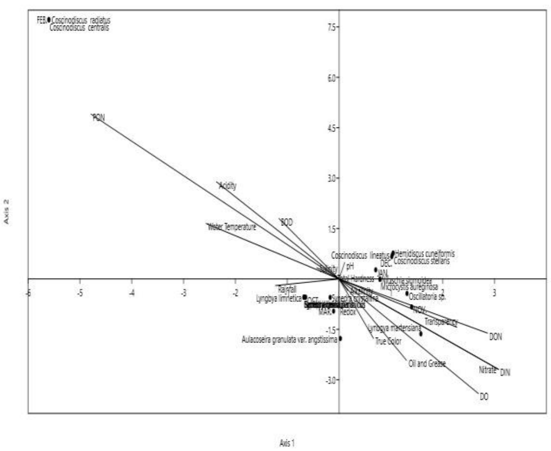

Fig. 3: Canonical Correspondence Analysis (CCA) of Environmental Variables and Biota Abundance at the Agboyi Creek (Station 2) (October, 2023 – March, 2024).

The presence of *Microcystis aeruginosa* and *Oscillatoria* sp. indicates fresh - low brackish water and moderate organic pollution (Onyema, 2021). *Coscinodiscus lineatus, Nitzschia closterium, Lyngbya limnetica* and *Synedra crystallina* indicates low brackish water situation, alkaline pH, mud flat, high cation levels, shallow water conditions and moderate organic pollution at Majidun creek (Station 1) and the Agboyi creek (Station 2) (Onyema, 2021). The differences in the abundance of most species may be attributed to significant variations in the physico-chemical variables and nutrients level within these periods.

The diatoms, blue-green and green algae community structure was influenced by a range of factors including surface water temperature, transparency, pH, DO, BOD, salinity and nutrient availability. The variation in water chemistry parameters of the creeks were within acceptable limits for the continuous existence of the diatoms, blue-green and green algae recorded. Overall, this study highlights the importance of the diatoms, blue-green and green algaes in these creeks, and thus need for further research to understand their ecology and dynamics.

Conclusion

The composition, abundance and growth of phytoplankton species are mainly affected by the variation in the water chemistry parameters of the specific environment in which they are located (Vajravelu *et al*., 2018). In the estuarine environment, productivity primarily depends on phytoplankton, which alone contributes approximately 90% of the total estuarine primary production (Srinivasan & Natesan, 2013). The CCA ordination showed that the major drivers of phytoplankton species diversity and abundance at the Majidun and Agboyi creeks were water temperature, transparency, salinity, alkaline pH, DO, BOD and Nutrients (Nitrate, DIN and PON). This explains the effect of these water chemistry parameters on the phytoplankton diversity and distribution.

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Conflicts Of Authors

The authors declare no conflict of interest.

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