Analysis of Phytoplanktons Distribution and Physico-Chemical Parameters of Osara Dam, at Itakpe Iron Company of Kogi State, Nigeria

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Abstract
The aim is to analyze phytoplanktons distribution as well as physico-chemical parameters of water in Osara dam at Itapke Iron Ore Mining Company of Nigeria. Water samples from the dam were collected in 2 litre bottle samplers before 6-8am in the morning and put in an ice-chest and immediately been transferred to the Obangede hospital laboratory for phytoplankton's identification. The analyses of physico-chemical parameters of water were carried out by the usage of Atomic Absorbing Spectrum (AAS). The species viewed in the Up-stream, Down-stream, Mining-point and Control site which are Bacillariophyceae, Chlorophyceae and Cyanophyceae families done only within six (6) months of dry season. Investigation is based on whether there is interference of effluents from the company into the water body and the available nutrients for phytoplanktons usages. T-test were used to test the mean and degrees of freedom as well as their hypotheses analysis. Graphs were plotted to show variation at different sites of the dam and how effluents affected phytoplanktons levels. There was a significant difference between the control site and mining site. Also, the amount of phosphate and nitrate found at the different sites investigated also had significant difference ($P<0.005$). Also, in the three sites checked there is no significantly different ($P>0.05$) in their temperature ranges. Effective and sustainable management of environments especially in areas where mining exploration takes place should be initiated from local to international and global scale to ensure a sustainable development resource for mankind in Nigeria and the world at lerge.

Keywords: *Phytoplanktons, Zooplanktons, Blooms, Bacillariophyceae, Chlorophyceae*

Introduction

The productivity of any water body is determined by the amount of plankton it contains as they are the major primary and secondary producers (Davies *et. al;* 2009). Thomas, Rossi, and Seibert, (2000) and Chamber *et. al;* (2008) reported that plankton communities serve as bases for food chain that supports the commercial fisheries. Davies *et. al*; (2009) have also reported that phytoplankton communities are major producers of organic carbon in large quantities in rivers, as a food sources for planktonic consumers and may represent the primary oxygen source in low-gradient river's phytoplanktons and they are of great importance in bio-monitoring of pollution within the aquatic regions (Davies *et. al;* 2009). The distributions, abundance, species diversity i.e

Nymphaea alba, a species of water lily composition of the phytoplankton are used to assess the biological integrity of the water body (Thomas, Rossi, and Seibert, (2000).

Phytoplankton also reflects the nutrient status of the environment. They do not have control over their movements thus they cannot escape pollution in the environment. Bonette and Pujalon, (2011) reported that pollution affects the distribution, standing crop and chlorophyll concentration of phytoplankton. The abundance or periphyton also increases with increase in nutrient content. Periphyton can be an important source of food for herbivores. A review of the classification, distribution, control and economic importance of aquatic plants provides fish culturist information on some future challenges in culture fisheries management and practices (Ajayi and Aonai, 2003).

Phytoplankton ('phyto' = plant; 'planktos' = made to wander) are single celled marine algae, some of which are capable of movement through the use of flagella while others drift with currents. These microscopic plants range in size from 1/ 1000 of a millimeter to 2 millimeters and float or swim in the upper 100 m of the ocean, where they are dependent on sunlight for photosynthesis (Akinyemi and Nwankwo, 2007). In addition to light and oxygen (O_2), they require basic simple inorganic chemical nutrients, such as Phosphate (PO_4) and Nitrate (NO_3). They also require carbon in the form of Carbon dioxide (CO_2). Some phytoplanktons, the diatoms, also require a form of Silicon (Silicate, SiO_4) because they have a "glass-like" shell (Ajayi and Aonai, 2003). The marine phytoplankton comes in a myriad of shapes, sizes, and forms, some of them are quite beautiful. Some drift on currents while others have an ability to move around with the aid of flagella (*Gymnodinium sanguineum)*. Some live as single cells while others form chains or colonies. Marine algae are extremely important to life on earth probably the most important living organisms on the planet. They impact us in at least three ways. First, they appear to be a significant factor in controlling atmospheric carbon dioxide (CO_2), a green house gas, which in turn can influence heat retention in the Earth's atmosphere (World Resources, 1990). Secondly, the phytoplankton and bacteria are the basis of the marine food web. At this level, inorganic nutrients like phosphate, nitrate, and carbon dioxide are converted to larger more complex organic molecules necessary for life. In turn, these microscopic organisms provide the food for the higher trophic levels in the food web or larger organisms higher in the food web, such as zooplankton, fishes and mammals. For example, bivalve or shellfish (oysters, mussels, scallops, and clamps) almost exclusively consume phytoplankton for their food.

Iif conditions are right, phytoplankton can sometimes grow and reproduce at such a high rate that they create dense, highly colored patches in the water (blooms). When this happens, because the growth rate is so high, they deplete necessary nutrients from the water, particularly Dissolved Oxygen (O_2), when this happen fishes and other aquatic organisms can suffocate easily (Dicks, 1998). This sudden depletion in a small contained area can be a serious problem in aquaculture since the fish are constrained in pens and cannot escape into more oxygenated waters. Algal Blooms: Most of the time, marine waters are characteristically bluish or greenish and reasonably clear. In the temperate waters of the northern latitudes, water is seldom as clear as seen in tropical areas, where visibility can exceed 50-75 feet. In temperate waters, the limits of visibility or murkiness are usually the result of algae in the water. Dahl, (1983) however, in some unusual cases, a single micro-algal species can increase in abundance until they dominate the microscopic plant community and reach such high concentrations that they discolor the water with their pigments; these "blooms" of algae are often referred to as a "Red tide". Although referred to as "Red tides", blooms are not only red, but can be brown, yellow, green, or milky in color. These blooms can be caused by high concentrations of toxic algal species and referred to as a "Harmful Algal Bloom" (abbreviated as HAB), however non-toxic species can also bloom and harmlessly discolor the water. Adverse effects can likewise occur when algal cell concentrations are low and these cells are filtered from the water by shellfish such as clams, mussels, oysters, scallops, or small fish. Many animals at higher levels of the marine food chain are impacted by harmful algal blooms. Toxins can be transferred through successive levels of the food chain, sometime (Ezra,2001).

Phytoplanktons are plants (microscopic), drifting at the mercy of water current (Akinyemi and Nwankwo, 2007). They constitute the primary producers of aquatic ecosystems. They convert incident radiant energy of the sun to chemical energy in the presence of nutrients like phosphorous, nitrogen, iron, manganese, molybdenum and zinc. They are restricted to the aphetic zone where there is enough light for photosynthesis. The distribution, abundance and diversity reflect the physico-chemical conditions of aquatic ecosystem in general and its nutrient statue in particular, (Akinyemi and Nwankwo, 2007). Phytoplankton includes several groups of algae (e.g., green algae, golden brown algae, euglenophytes, dinoflagelates and diatoms) and one group of photosynthetic bacteria (Cyanobacteria).

Planktonic algae may be either benthic (attached to a substrate) or planktonic (floating in the water column). There are large numbers of phytoplankton (>400 species) in many bodies of freshwater; phytoplankton's are most common in habitats with high nutrient levels.

In the aquatic ecosystem, the phytoplanktons are the foundation of the food web, in providing a nutritional base for zooplankton and subsequently to other invertebrates, shell fish and finfish (Ezra, 2001). The productivity of any water body is determined by the amount of plankton it contains as they are the major primary and secondary producers (Davies *et al.,* 2009). Thomas, Rossi, and Seibert, (1981) reported that plankton communities serve as bases for food chain that supports the Phytoplankton species in a given dam

Davies *et. al;* (2009) have also reported that phytoplankton communities are major producers of organic carbon in large rivers, its a food source for planktonic consumers and may represent the primary oxygen source in low-gradient Rivers. Phytoplanktons are of great importance in biomonitoring of pollution (Davies *et. al*; 2009). The distributions, abundance, species diversity, species composition of the phytoplanktons are used to assess the number and percentage compositions of phytoplankton families in any given water body.

Research Question

On the basis of the water problems identified, this study will attempt to provide answers to these questions:-

1. Is there any significant relationship between phytoplankton growth and the effluents from the iron ore company at Osara dam.
2. Is there any significant relationship between physico-chemical parameters and the phytoplanktons biodiversity in Osara dam.

Hypothesis

Null Hypothesis (H_o)

H_o: Iron ore exploration does not have deleterious effect on aquatic plants in the Osara dam area of Kogi state, Nigeria.

Alternative Hypothesis (H_1)

H_1: Iron ore mining of Itakpe in Kogi State has deleterious effect on aquatic pytoplanktons in the Osara dam of Kogi State.

Results

Classes of phytoplankton found in Osara Dam

Ttable1 shows the total of twenty-six (26) species belonging to three (3) classes of algae was recorded in Osara Dam River. Bacillariophyceae was represented by 10 species consisting of 38.5% by composition. This was followed by Chlorophyceae (11species) consisting of 42.3%, Cyanophyceae (05 species) consisting of 19.2%.

Table 1: The percentage of total number of phytoplankton species found in Osara dam

CLASS	TOTAL NUMBER OF SPECIES	PERCENTAGE SPECIES COMPOSITION(%)
Bacillariophyceae	10	38.50
Chlorophyeae	11	42.30
Cyanophyceae	05	19.20
TOTAL	**26**	**100**

Table 2: Phytoplankton Diversity in Osara dam (orgs/litre) 0ctober 2024-March, 2025

Phytoplankton Species	Control-site	Up- Stream	Down -Stream	mining Point
Bacillariophyceae				
Amphora	369.00±2.00^{a}	260.00±1.00^{b}	221.67±19.14^{c}	61.33±17.10^{d}
Asterionella	548.25±3.10^{a}	425.50±41.15^{b}	291.25±30.58^{c}	140.00±9.09^{d}
Brebinsonia	944.00±12.83^{a}	658.00±8.49^{b}	457.50±39.08^{c}	448.50±68.50^{d}
Cymbella	909.75±12.12^{a}	538.00±24.01^{b}	382.00±37.10^{c}	200.50±34.45^{d}
Exilaria	683.25±102.93^{a}	497.50±58.01^{b}	143.00±6.48^{c}	94.75±24.60^{d}
Fragilaria	401.25±3.40^{a}	257.00±16.06^{b}	42.75±10.21^{c}	24.75±6.70^{d}
Navicula	306.80±176.70^{a}	132.50±86.80^{c}	107.00±108.10^{c}	10.30±9.50^{d}
Schizonena	392.50±22.75^{a}	263.0±125.91^{b}	201.25±3.50^{c}	180.75±57.73^{d}
Synedra	985.00±42.70^{a}	771.00±130.0^{b}	394.80±71.80^{c}	205.50±33.40^{d}
Tabellaria	53.00±4.2^{a}	20.00±10.49^{b}	7.75±9.39^{c}	1.25±2.50^{d}
Chlorophyceae				
Bulbochaete	65.75±11.59^{a}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{d}
Closterium	61.50±15.46^{a}	2.25±4.50 ^{b}	1.00±2.00^{c}	0.00±0.00^{d}
Micrasterias	68.58±2259^{a}	53.00±21.02^{b}	3.75±7.50^{c}	0.00±0.00^{d}
Microspore	657.25±115.76^{a}	637.75±32.69^{b}	245.50±38.69^{c}	101.50±37.75^{d}
Oedogoniun	151.75±62.25^{a}	85.50±12.23^{b}	65.75±2.99^{c}	46.00±10.03^{d}
Penium	227.75±52.89^{a}	120.75±42.87^{b}	106.50±6.56^{c}	90.75±31.71^{d}
Spirogyra	7.75±15.50^{a}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}
Staurastrum	33.50±10.66^{a}	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{b}
Tetraedron	254.30±620.40^{a}	439.80±20.50^{b}	133.50±70.80^{c}	67.50±34.00^{d}
Ulothrix	229.00±9.83^{a}	152.25±19.64^{b}	160.50±114.06^{c}	30.25±21.6^{d}
Zygnema	447.00±87.40^{a}	107.75±91.59^{b}	84.50±25.83^{c}	75.50±33.99^{d}

Cyanophyceae				
Ceratium	639.50±188.304[a]	594.3±27.505[b]	569.80±4.20[c]	405.80±264.70[d]
Cosmarium	7.25±14.50[a]	5.25±10.50[b]	0.00±0.00[c]	0.00±0.00[c]
Oscillatoria	110.50±75.90[a]	43.00±16.40[b]	40.50±12.20[c]	11.50±23.00[d]
Phormidium	62.75±42.17[a]	16.75±17.95[b]	24.25±20.69[c]	18.50±15.44[d]
Spirulina	74.50±15.15[a]	51.25±14.15[b]	5.25±7.90[c]	1.50±3.00[d]

1. Each value is the mean value of four weeks sampling + Standard deviation of phytolanktons
2. The values marked by different alphabets along the row are significantly different. P≤0.05

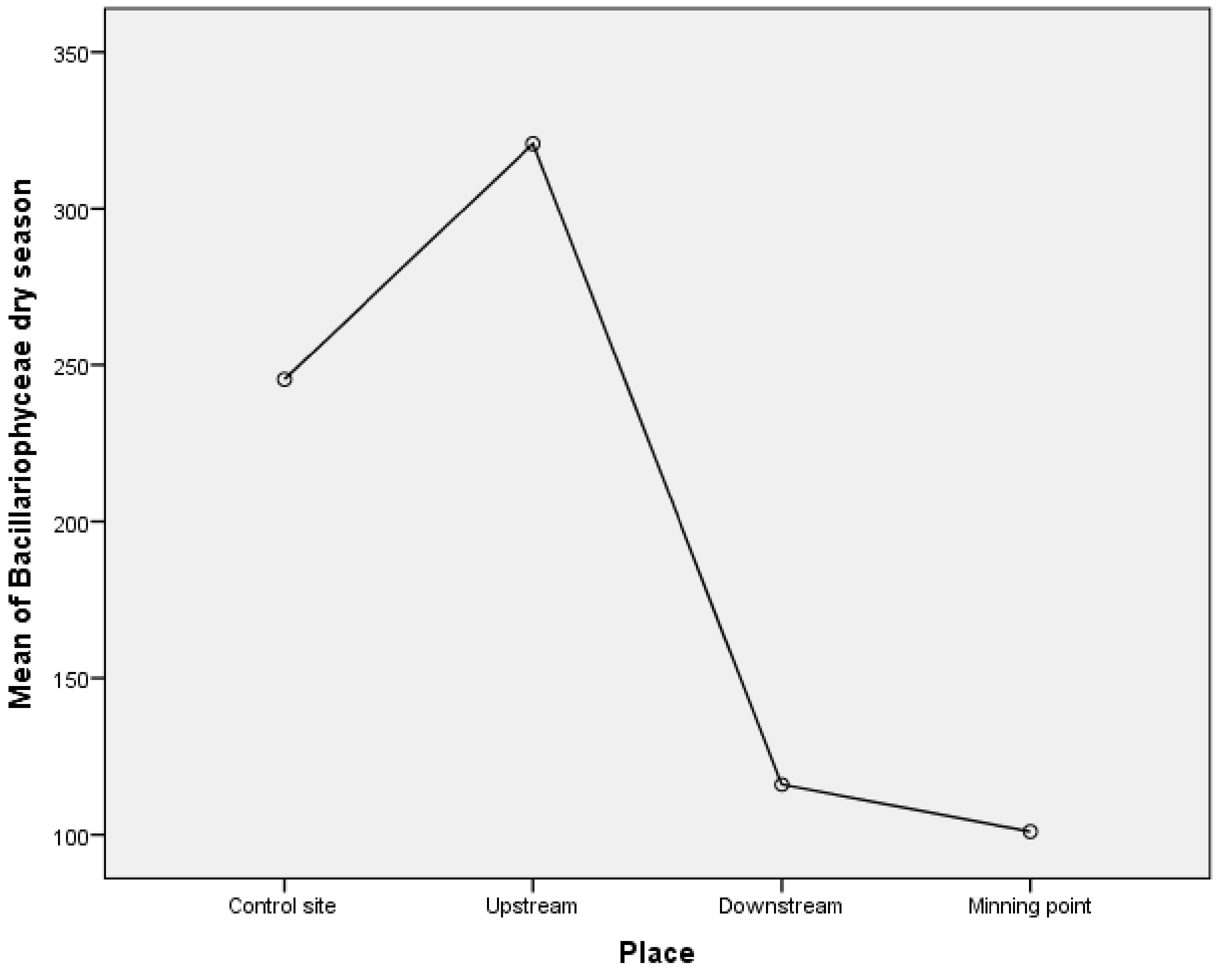
Table 3: Phytoplankton Percentage (%) in Osara dam October 2024-March, 2025

Phytoplankton Species	Control- site	Up- Stream	Down- Stream	Mining-Point
Bacillariophyceae				
Amphora	6.16	6.34	8.47	3.97
Asterionella	9.15	10.38	11.13	9.06
Brebissonia	15.75	16.04	17.48	29.02
Bulbochaete	1.46	0.00	0.00	0.00
Closterium	1.37	0.14	0.13	0.00
Cymbella	15.18	13.11	14.60	12.98
Exilaria	11.40	12.13	5.46	6.13
Fragilaria	6.70	6.267	1.63	1.60
Gyrosigma	6.67	6.80	14.06	11.49
Chlorophyceae				
Micrasterias	1.53	3.24	0.47	0.00
Microspore	14.63	41.21	30.65	24.67
Navicula	5.12	3.23	4.09	0.67
Oedogoniun	3.38	5.23	8.21	11.18
Penium	5.07	7.39	13.30	22.05
Schizonena	6.55	6.41	7.69	11.70
Spirogyra	0.17	0.00	0.00	0.00
Staurastrum	0.75	0.00	0.00	0.00
Synedra	16.43	18.80	15.09	13.30
Tabelaria	0.98	0.49	0.30	0.08
Tetraedron	56.59	26.90	16.67	16.40
Ulothrix	5.10	9.31	20.04	7.35
Zygnema	9.95	6.59	10.55	18.35
Cyanophyceae				
Ceratium	33.77	83.64	89.06	92.80

Cosmarium	0.38	0.74	0.00	0.00
Oscillatoria	58.60	6.05	6.33	2.62
Phormidium	3.31	2.36	3.79	4.23
Spirulina	3.94	7.21	0.82	0.34

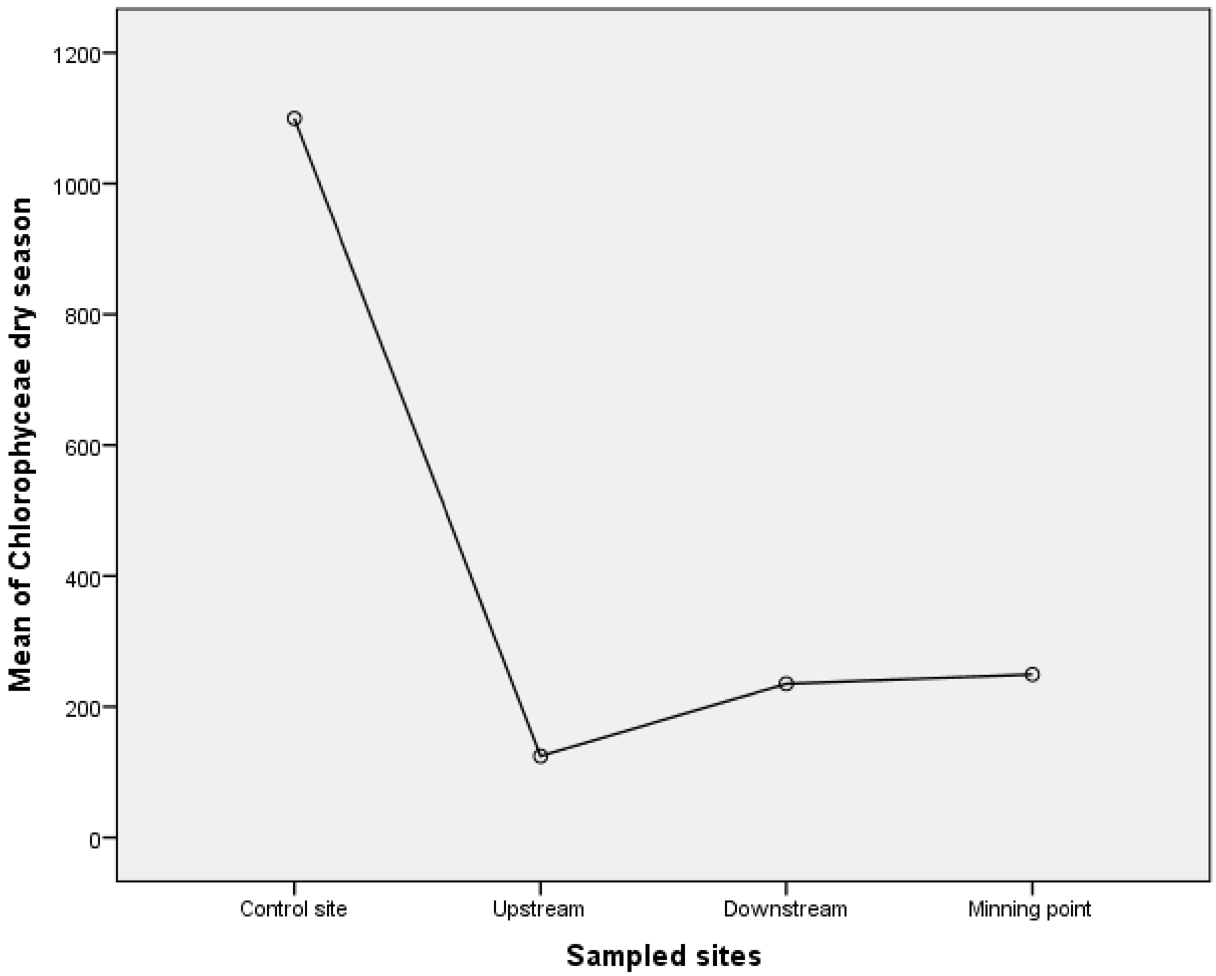
1. Each Value is the mean of four weeks sampling of phytoplanktons

Plot 1. Means Plots of Bacillariophyceae in the dry season



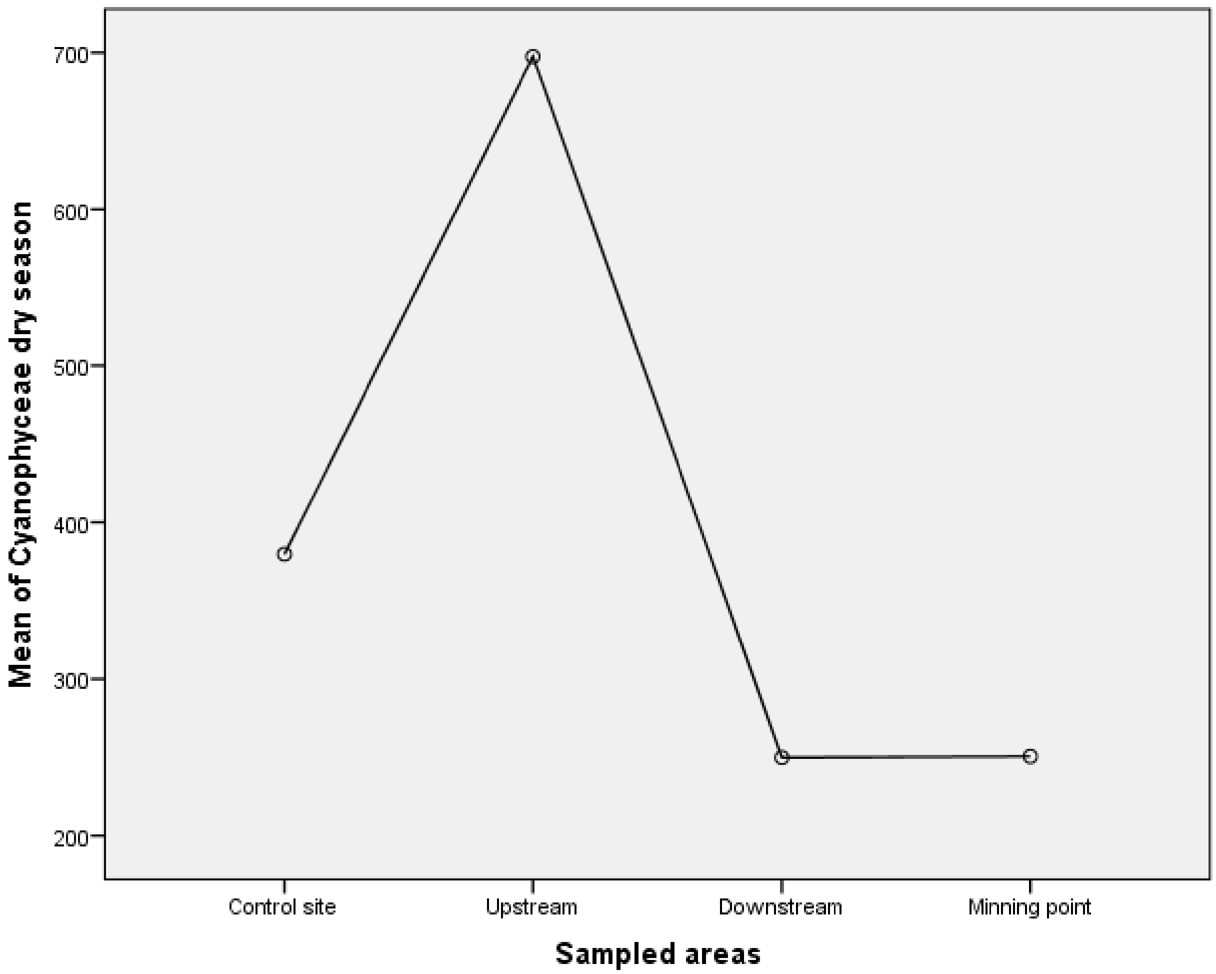
The graph shown the level of Bacillariophycea in the dry season in which the highest record was observed at up-stream moderate at control site, lower at down- stream and lowest at mining point.

Plot 2. Means Plots of chlorophyceae in the dry season



The graph shown the mean of Chlorophyceae in the dry season as the highest in Control-site while lowest at up-stream, lower at down-stream and low at mining-point.

Plot 3. Means Plots of Cyanophyceae in the dry season



The graph shown the variation of cynophyceae at dry season been highest at up-stream, lower at control-site and the same level at downstream and mining-point.

T-Test

Group Statistics

	Seasons	N	Mean	Std. Deviation	Std. Error Mean
Bacillariophyceae	Dry season	40	195.78	210.384	33.265

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Bacillariophyceae	Equal variances assumed	1.407	.239	2.705	86	.008	137.121	50.690	36.352	237.889
	Equal variances not assumed			2.754	85.983	.007	137.121	49.784	38.153	236.089

T-Test

Group Statistics

	Sampled seasons	N	Mean	Std. Deviation	Std. Error Mean
Chlorophyceae	Dry season	32	427.03	794.317	140.417

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Chlorophyceae	Equal variances assumed	10.021	.002	-2.369	74	.020	-292.009	123.263	-537.615	-46.402
	Equal variances not assumed			-2.045	33.120	.049	-292.009	142.788	-582.473	-1.544

T-Test

Group Statistics

	Season of the year	N	Mean	Std. Deviation	Std. Error Mean
Cyanophyceae	Dry season	16	394.50	477.980	119.495

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Cyanophyceae	Equal variances assumed	.088	.769	-.778	30	.443	-119.000	152.929	-431.322	193.322
	Equal variances not assumed			-.778	28.602	.443	-119.000	152.929	-431.963	193.963

Table 4: The physical and chemical parameters of water samples

Sites	Site 1		Site 2		Site 3	
Parameters	**Range**	**Mean/S.E**	**Range**	**Mean/S.E.**	**Range**	**Mean/S.E**
Temperature ^{0}C	20.0-22.6	$21.6^{a}\pm1.06$	20.8-23.1	$22.08^{a}\pm0.95$	20.5-23.6	$21.72^{a}\pm1.22$
Dissolve Oxygen mg/1	3.90-4.80	$4.3^{a}\pm0.39$	4.2-4.9	$4.5^{a}\pm0.27$	3.6-4.1	$3.8^{a}\pm0.18$
Secchi Disc Visibility (m)	1.0-1.4	$1.2^{a}\pm0.16$	1.4-1.9	$1.6^{b}\pm0.22$	0.5-0.9	$0.7^{a}\pm0.16$
PH	6.3-6.8	$6.54^{a}\pm0.21$	5.9-6.5	$6.14^{a}\pm0.25$	5.9-6.7	$6.12^{a}\pm0.33$
Phosphate mg/g	0.17-0.20	$0.19^{a}\pm0.02$	0.07-0.11	$0.08^{b}\pm0.02$	0.10-0.13	$0.114^{a}\pm0.01$
Nitrates mg/g	1.80-2.10	$1.34^{a}\pm0.11$	1.0-1.3	$1.16^{b}\pm0.11$	1.20-1.7	$1.5^{c}\pm0.2$

Means in the same row with different superscripts differ significantly ($p<0.05$)
S.E: (standard error)

Discussion of Findings

Diversity of phytoplanktons in Osara dam from October 2024-March, 2025

The results of the phytoplankton diversity in Osara dam both calculation and their percentage is presented in Table 2and 3 with Plates up to 4.26 shows the various species identified. A total of 26 species were recorded in the Control- site. The Bacilariophyceae and the Chlorophyceae classes recorded a total of 11 species each while 5 species belong to Cyanophyceae classes. A total of 24 species were recorded in the up-stream area of which 11 were from the Bacillariophyceae classes. The Chlorophyceae and the Cyanophyceae classes recorded 8 and 5 species respectively. The down-stream study area recorded a total of 23 species, out of which the Bacillariophyceae, Chlorophyceae and Cyanophyceae were 11, 8 and 4 species respectively. The minig-point recorded a total of 21 phytoplankton species. 11 species were from the Bacillariophyceae family, while the Chlorophyceae and the Cyanophyceae families recorded 6 and 4 species respectively.

The Control-site showed the highest level of species diversity (27 species) followed by the up-stream (24 species), while the mining point had the lowest species diversity (21 species). The population density of the individual's species were also lowest at the mining point and highest at the Control- site, for example, *Synedra mazamaensis* had a mean population density of 985orgs/litre at the Control site area but only. 205.5orgs/litre was recorded at the mining point. Also Oscillatoria (Plate 4.24) had a population of 110.5orgs/litre at the Control site but only 11.5orgs/litre was recorded at the mining point. It was also observed that *Brebissonia vulgari,* Spirogyra and Staurastrum were recorded only at the Control site areas *Closterium longissima* and *Micrasterias furcata* were also not recorded at the mining point. Tabellaria and Spirulina had low abundance at the mining point as compared with the Control- site (1.25 and 1.5 orgs/litre) respectively. Species belonging to the Bacillariophyceae and Chlorophyceae were dominant (about 11 different species were recorded in each) while Cyanophyceae recorded fewer species (5 species). There were significant differences in the abundance of the different species recorded at the Control-site, up-stream and down-stream and mining point as indicated by the alphabets (Table 2) .

The mean result of the phytoplankton diversity and abundance in Osara dam is presented in Table 3. A total of 22 species were recorded in the control-site. The Bacillariophyceae had a total of 10 species, the Chlorophyceae and the Cyanophyceae had 8 and 4 species respectively. A total of 9 species were recorded in the up-stream area out of which 10 were from the Bacillariophyceae. The Chlorophyceae and the Cyanophyceae recorded 5 and 4 species respectively. The down-stream study area recorded a total of 12 species respectively. The mining-point recorded a total of 9 phytoplankton species. 3 species were from the Bacillariophyceae namely Asterionella, Frailaria, and Synedra, while the Chlorophyceae and the Cyanophyceae recorded 4 and 2 species (Ceratium and Oscillatoria) respectively.

The control-site showed the highest level of species diversity (22 species) followed by the up-stream (19 species), while only 9 species were recorded at the mining-point. The population densities of the few individual species that were found at the mining-points were also lowest at the points. Oscillatoria (Plate 4.24) recorded the highest population of 102.25orgs/litre at the control point, which was about 60% of the total population of the Cyanophyceae, as shown in Table 2, but had a population of 11.75orgs/litre at the mining point, about 29% of the Cyanophyceae (Table 3). Micrasterias, Spirogyra condensata and Staurastrum were recorded only in the control area (69.75, 85.25 and 48.75 orgs/litre respectively). Amphora, *Exilaria vaucheriae*, Penium, Tabellaria, phormidium and spirulina were not recorded at the mining- point and the downstream while

Schizonena neglectum, *Frustalia capitata* and *Gomphonema acuminatum* were not recorded at the mining- point. The high value of the standard deviations was due to high reduction in the population density of the individual organisms in each succeeding week. There were significantly differences in the abundances of the Phytoplankton species recorded at the different sampling points; control-point, upstream, downstream and mining point as indicated by the alphabets in Table 3

There was a significant difference ($P<0.05$) in the amount of phosphate and nitrate found in the sites (A,B,C and D) investigated. The variation of the physico-chemical parameters at the 3-study sites is shown in (table 4) with temperature ranging between 20.0–23.60^{0}C and mean value of 21.80^{0}C, the highest value of temperature was recorded in the dry season months of March and April which indicate the hottest month in Kogi state. Mean temperature in the three sites were not significantly different ($p>0.05$). Dissolved oxygen was lower (3.84mg/l) at site 3. This could be attributed to the heavy load of organic matter influx from both the domestic and town sewage that characterize the two sites. Secchi disc visibility was found significantly different between the site with range from 0.5 - 1.9m with the lowest value (0.5m) at site 3; this considered with the lowest acidic pH value at the same site (5.9) and site two, which are heavily polluted by domestic effluent and the (town sewage and solid waste dump).in this table the site design into three due to up and down stream has the same diurnal range of all the physico-chemical parameters.

The graph1 showed the level of Bacillariophycea in the dry season in which the highest record was observed at up-stream moderate at control site, lower at down- stream and lowest at mining point. The graph2 had shown the mean of Chlorophyceae in the dry season as the highest in Control-site while lowest at up-stream, lower at down-stream and lowest at mining-point.

The graph3 shown the variation of cynophyceae at dry season been highest at up-stream, lower at control-site and the same level at downstream and mining-point.

T-test was equally used for quality of the group data analysis and their Degree of Freedom (DF) for example Bacillariophyceae, in the dry season with the mean of 195.78 and Degree of freedom 86 which is significantly at 0.007 point.While Chlorophyceae has mean of 427.03 with DF of 33.12 and significant with 0.005. but the Cyanophyceae with mean of 394.50 with df of 28.60 with no significance of 0.44.

Conclusion

This study has clearly shown that iron ore mining activities in the area have significant effect on the environment. Not only were the abundance of organisms recorded at the mining points and the surroundings during this study were low, in species diversity and also low when compared with what was observed at the control- site (site without effluent). The environmental degradation is largely caused by mining ore pollution resulting from the excavating activities. Domestic refuses were clearly seen on top of the water during the period of this study. Effective and sustainable management of coastal and estuary environment especially in areas where mining exploration takes place should be initiated from local to international and global scale to ensure a sustainable development recourses for mankind in Nigeria. There is a significant difference between the phytoplankton found in mining site to the other sites within the dam. The phosphate (PO_4) level showed significant difference ($p<0.05$) at various sites with the lowest value of (0.07mg/l) at site 2 and a mean of (0.084mg/l). There is no significant different in temperature across the sites. Keeping these facts in mind, the present work is to give importance to phytoplanktons and their conservation. Also the graphical representation shows the variation in their species along the seasons mainly between control site and mining point.

Recommendations

The findings revealed that iron mining activities in the area have significant effect on the water body environment in the dam. Based on these findings, it's pertinent to make the following recommendations:

1. Effective and sustainable management of environments especially in areas where mining exploration takes place should be initiated from local to international and global scale to ensure a sustainable development resources for mankind in Nigeria
2. The survival of native phytoplankton species is threatened and hence urgent attentions needed to revive the aquatic resources. Immediate steps are to be taken for their conservation and sustainable utilization.
3. There is a need for increased legal protection, well designed management practices to conserve the phytoplankton biodiversity. The measure for conservation of aquatic resources should be taken up on priority by different government and non-governmental organizations for the benefit of aquatic organisms and humanity.
4. There should be a documentation and proper assessment of phytoplankton's biodiversity to ascertain the health status and utility of water bodies in mining areas.

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