International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Baseline Study of Surface Water Chemistry of Badagry Creek, Lagos Nigeria

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Abstract: ***The baseline hydrochemistry of Badagry Creek (Longitude2º 42' and 3º 23'E and latitude 6º23' and 6º28 N. Lagos, Nigeria was investigated between 2007-2013 from four sampling stations to determine some physico-chemical parameters with the purpose of establishing a baseline data for Badagry creek. This is meant to set the record straight of future references. In doing this, the author followed the procedure of American Public Health Associations (APHA et. al) .The results show that physicochemical parameters did not differ significantly (P>0.05) with respect to location . The surface water of the creek was characterized by high Turbidity (13.84 ±5.73 NTU), Low Dissolved oxygen (4.66±0.51mg/L) High Total Hardness as $CaC0_3$ (1153.74±2130.60 mg/L) High Total Hardness as $MgC0_3$, (828.47±2252.20mg/L); High Conductivity, (2366.33±3449.59µS/cm), High Chemical Oxygen Demand (603.26±457.65) High Biochemical Oxygen Demand (152.75±89.05mg/L). The levels were above the maximum allowable levels set by Federal Environmental Protection Agency (FEPA) and WHO. Analysis of Variance equally revealed that the parameters were significantly high (p<0.05) and different among the study stations. Also the values of the heavy metals recorded were significantly higher when compared with international standards set by both FEPA and WHO. The trace metals analyzed includes Cadmium Chromium Lead (Copper and Zinc all in mg/L respectively. Consequently, continuous monitoring of these parameters in the Creek is highly recommended.***

Keywords: Badagry creeks, Physico-chemical parameters, trace metals Base line, Lagos Nigeria

1. Introduction

The continuous influx of people and rapid development that is fast taking place in this city has called for concern and one cannot but ponders on what the implication could be on the pressure on aquatic environment. This is because most of the people are settling along the coastline stretch. Consequently, most of the domestic wastes and sewages emanating from various homes end up in the creek as many villages around do not have private latrines and the creek invariably becomes the sink for human waste. Also, scattered all over the city are cottage industries such as processing mills and a host of artisan's workshops. Thus when rainfalls, substances such as ions and other substances are carried into the creek via rainfall and may result to pollution to the detriment of drinking water, recreational users and others users of the creek (Chandler, 1994; Ellis and Hvitved-Jacobsen, 1996). Thus the contamination of the creek from point and non-point sources as well as pollution of the creek by anthropogenic activities continues to impair watercourses (Karr and Chu, 2000; McCormick and Cairns, 1994; Moog and Chovanec, 2000).

Human settlements, industrial development, agriculture, deforestation, that is taken place around the city may have significantly impact on the physical and ecological features of the creek. It known that variations in Physico-chemical factors have a profound effect on the distribution and population density of both fauna and flora ((Mahboob, 1986, 1992; Mahboob *et al*., 1988a,b, 1992; Latif, 1990; Hassan, 1998; Mahboob and Sheri, 2001).

This study was undertaken to provide some baseline information on the ecology of the Creek. Because research studies on the aspects of the creeks ecology is of great importance in the developing resources of a water body.

2. Materials and Methods

Study Area

Badagry is an ancient city founded in the 15th century around 1425.It was also reported that Badagry was one of the earliest international ports in the country and one of the earliest gateways for international trade. Other historical attributes includes the first town in west Africa to become urbanized, the first town not only in Nigeria but also through out old west Africa to easily boast of a two story building built in 1845 which still stands on the site of the original church yard till today and also serve as "Canterbury of Nigeria "where Christianity was first preached in 1842 and many more. All of these attributes have opened up Badagry and thus lunched it a city of recognition by the entire world thus the desire to reside in this ancient city by lovers of nature.

The study was carried out at Badagry Creek (Longitude2º 42' and 3º 23'E and latitude 6º23' and 6º28 N. It is a long stretched of water body covering about a distance of 106.5 kilometers. The creek is bounded in the West by River Ajara and Queme, and in the East by Lagos lagoon and Harbour. In the South however, it is bounded by Atlantic Ocean and in the North by several nodal villages and towns.

The major sources of waters into the creek are River Queme and Nakoue lagoon .It is the combination of these two water bodies that form the Badagry creek which joins part of the continuous lagoon known as Osa lagoon that stretches from

Port Novo to Lagos.The creek finally opens into the Atlantic ocean via Lagos harbour in three channels.

Surrounding the Creek is white mangrove forest, sedges and ferns. The mangroves forest includes *Rhizophora racemosa, Phoenix reclinata, Avicennia nitida, Typha australis, Dalbergia ecastaphyllum, Drepanocarpus lunatus.* The sedges are *Cyperus articulatus, Paspalum vaginatum and Cyperus papyrus*.However the dominant ferns are *Achrosticum acereum, Marsilea species, Cylosorus species and Ceratopleris species.* Other plants that can be found around the creek are dotted of palm tress and Raphia palms (*Raphia hookeri)* Fig.1 shows map of Badagry Creek and the sampling locations.

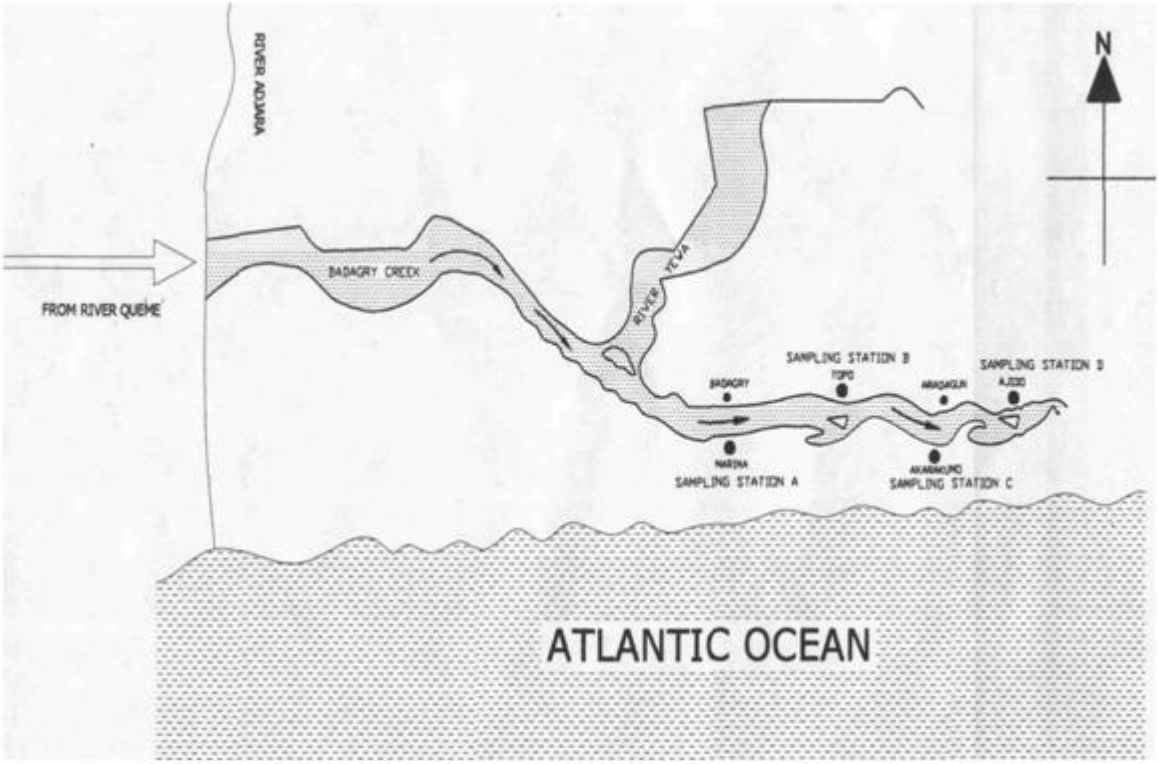

Figure 1: shows map of Badagry Creek and the sampling locations.

Samples Collection

The water samples were collected on monthly basis for a period of five year i.e., from January, 2007 through December, 2012 from the four sampling locations. Water samples were collected with 50 Cl sterile polyvinyl chloride (PVC) plastic water bottles at a depth of 1 meter below the water surface. The samples were subsequently placed on ice in a cooler and transported to the laboratory for analysis. The following physico-chemical parameters were assessed using standard methods APHA *et al*, (1995), temperature, pH, conductivity, Turbidity, Dissolved oxygen, Biochemical Oxygen Demands, Hardness, , phosphates, sulphates, and nitrate. PH was measured with the OORNING pH meter Model 7. Water temperature was measured with mercury in glass thermometer. The conductivity were determined with the portable conductivity meter, Turbidity was assessed with the Horiba water checker. Total hardness and calcium levels of samples were determined by complexometric titration with standard EDTA as titrant and Erichrome Black T as indicator (APHA, 1985). Phosphate was measured by the stannous chloride method; sulphate by the turbid meter method; nitrate by the Brucine method, alkalinity (titration with 0.02 N sulfuric acid to methyl orange endpoint); total hardness (titration to Erichrome Black-T endpoint with 0.01 M ethylenediaminetetraacetic acid);. While heavy metals were determined by Atomic Absorption Spectrophotometer (AAS)

3. Results

Physical and Chemical Parameters

The summary of the physical and chemical properties of the study locations is presented in the Table 1. Analysis of variance showed that there is know significance difference ($P>0.05$) between the sampling locations. This is possible because it is the same body of water that runs along the villages that served as sampling point of data collection (Fig. 1)

The mean values of Turbidity, Dissolved Oxygen, Conductivity, COD, BOD, Total Hardness as $CaC0_3$ and lead were higher at some locations station than in other stations.

Temperature

The physico-chemical characteristics of the study stations are summarized in Table 1. The total recorded mean temperature for Badagry Creek for the years 2007and 2012 was 27.59 ±1.12 ^{0}C, with a minimum temperature of 26^{0}C and a maximum of 31^{0}C. Among the sampling stations, Marina recorded the highest temperature of 28.04±1.12^{0}C with the minimum of 27ºC and the maximum of 31^{0}C. Akarakumo sampling station recorded the lowest mean

temperature of 27.28±0.950C.with the minimum of 26^{0}C and maximum of 30^{0}C Table 1

pH

The total mean pH value recorded for the sampling stations for years 2007 and 2012 was 7.50 ±0.81 with the minimum value of 6.4 and the maximum value of 12.0. Comparing the sampling station, Marina station had the highest mean pH value of 7.59±1.09 with a minimum pH of 6.65 and a maximum of 12, where Akarakumo recorded the lowest mean pH value of 7.44±0.73 with a minimum of 6.75 and a maximum of 10.10 (Table 1).

4. Turbidity

The total mean turbidity value of the Badagry Creek for the years 2007-2012 was put at 13.23 ±3.87 NTU with the minimum value of 6.00NTU and the maximum of 28NTU.

Considering the sampling stations, it will be observed that Topo station recorded the highest mean turbidity value of 13.0±5.15 NTU with a minimum of 8.00NTU and a maximum of 28.00NTU. Whereas for the same creek at Ajido sampling station the lowest turbidity value was recorded with the mean value of 12±3.26 with the minimum of 6.00 and a maximum value of 21.00 NTU (Table 1).

DISSOLVED OXYGEN

The total mean oxygen concentration in Badagry Creek was 4.53±0.45mg/L with minimum and maximum concentration of oxygen throughout 2007 and 2012 being 3.35 and 5.60 mg/L respectively. As regards the sampling stations it was observed that Topo had the highest dissolved

Oxygen with a mean value of 4.55±0.52mg/L, a minimum value of 3.80 and a maximum of 5.60 mg/L. This is followed by Akarakumo and Marina sampling stations where a mean Dissolved Oxygen value of 4.54±0.48 mg/L with a minimum value of 3.35mg/L and a maximum level of 5.60mg/L, and 4.54±0.43mg/L with a minimum of 4.00mg/L and a maximum value of 5.40mg/L were recorded respectively. However the lowest mean dissolved oxygen level was recorded in Ajido with a value of 4.49 ±0.38mg/L with the minimum value of 4.00mg/L and a maximum value of 5.20mg/L (Table 1).

Biological Oxygen Demand (BOD).

The total mean value of BOD recorded for Badagry creek was 134.93±74.17mg/L with a minimum value of 9.0mg/L and a maximum value of 380mg/L throughout the years 2007 to 2012. The determination of BOD at the various sampling stations showed that Ajido recorded the highest BOD value of 152.75±89.05mg/L with the minimum value of 12mg/L and a maximum value of 380mg/L. Marina on the other hand recorded the lowest BOD value of 126.42±70.73mg/L with a minimum value of 9.00mg/L and the maximum value of 264.00mg/L (Table 1). Other stations had levels within the reported values for Ajido and Marina.

Alkalinity

The total mean of alkalinity in Badagry Creek for the years 2007 and 2012 was 53.28±27.85mg/L with the minimum value of 12.10mg/L and a maximum concentration of 160.00mg/L. However, the year 2003 recorded the lowest alkalinity of 52.23±17.39mg/L with a minimum concentration of 23.00mg/L and a maximum of 83.25mg/L. The sampling station Ajido recorded the highest mean alkalinity concentration of 57.17±27.07mg/Lwith the minimum concentration of 15.20mg/L and a maximum concentration of 148.00mg/L. Marina station on the other hand recorded the lowest mean alkalinity concentration of 47.81±29.11mg/L with the minimum concentrations of 21.0mg/L and a maximum concentration of 155.00mg/L (Table 1).

Total Hardness as CaCO3

The mean total hardness as CaCO3 concentration in Badagry Creek for the years 2007 and 2012 was 1031. 39±1632.89 mg/L. However the minimum hardness concentration was 58.00mg/L and the maximum value recorded was 9500.00mg/L. With respect to the sampling stations Topo recorded the highest concentration of CaCO3 with a mean value 1476.67±2585.20 mg/L with a minimum value of 9020.00mg/L and a maximum value of 9500.00mg/L. On the contrary, Marina recorded the lowest mean value of CaCO3 of 803.60±982.54mg/L with the minimum value of 90.00mg/L and a maximum value of 3000.00mg/L (Table 4).

Total Hardness as MGCO3

The total mean MgC03 concentrations in Badagry Creek for the years 2007 and 2012 was 522.21±1146.77mg/L with the minimum concentration value of 36.00mg/L and a maximum value of 9899.00mg/L Looking at the variations of MgC03 among the sampling stations, it will be observed that Topo recorded the highest concentration of MgC03 in the month of June with the value of 735.04±2012.30mg/L with the minimum value of 50.00mg/L and a maximum value of 9899.00mg/L. Marina on the other hand recorded the least value of 422.16±588.39mg/L in the month of January with a minimum of 48.00mg/L and a maximum value of 1789.00mg/L (Table 1).

Conductivity

The total mean conductivity value of Badagry creek for the years 2007 and 2012 was 2133.49±3456.47µS/cm with a minimum put at 80.10µS/cm and the maximum of 19690.00µS/cm. With regard to sampling stations, Akarakumo location recorded the highest conductivity value of 2366.33±3449.59µS/cm with the minimum value of 85.00µS/cm and a maximum value of 12,000.00µS/cm. Topo on the other hand recorded the lowest value of 1942.84±3059.96µS/cm with minimum value of 80.10µS/cm and a maximum value of 11188.00µS/cm (Table 1).

Nitrate

The total mean concentration of nitrate in Badagry creek for the year 2007 and 2012 was put at 3.29±2.15mg/L with a minimum value of 0.20mg/L and a maximum value of 9.50mg/L.

With regards to sampling stations, the highest mean nitrate concentrations was recorded at Topo with a mean value of 3.74±2.15mg/L, a minimum value of 0.60mg/L and a maximum value of 9.00mg/L. Akarakumo on the other hand recorded the lowest mean of 2.65±1.87mg/L with the

minimum value of 0.20mg/L and a maximum of 6.50mg/L (Table 1).

Phosphate
The total mean phosphate concentration in Badagry creek for the years 2007 and 2012 was 2.12±1.99mg/L with a minimum value of 0.12mg/L and a maximum value of 15.50mg/L
With respect to sampling stations, Marina recorded the highest mean phosphate concentration of 2.66±3.24mg/L with a minimum value of 0.12mg/L and a maximum value of 15.50mg/L. Akarakumo on the other hand recorded the lowest mean phosphate concentration of 1.64±1.22mg/L with a minimum value of 0.35mg/L and a maximum value of 5.20mg/L (Table 1).

Chemical Oxygen Demand
The total mean COD concentration for the years 2003 and 2004 was 498.67±266.01mg/L with a minimum COD value of 80.00mg/L and a maximum value of 1930.00mg/L. Regarding sampling stations, Ajido recorded the highest mean COD concentration of 594.67±409.49mg/L with the minimum value of 90.00mg/L and a maximum value of 1930.00mg/L. Akarakumo on the other hand recorded the lowest COD mean value of 464.33±170.63mg/L with a minimum value of 82.00mg/L and a maximum value of 722.00mg/L (Table 1).

Trace Metals

Zinc
The total mean zinc concentration for the years 2007 and 2012 was 16.52±19.74mg/L with a minimum value of 0.030mg/L and a maximum value of 88.00 mg/L. Regarding sampling stations, Marina recorded the highest zinc concentration of 19.34±24.79 mg/L with a minimum value of 0.03mg/L and a maximum value of 88.00 mg/L. Ajido station on the other hand recorded the lowest zinc concentration of 13.81 ±15.52 mg/L with a minimum value of 0.03mg/L and a maximum value of 48.00 mg/L (Table 1).

Copper
The total mean copper concentration value for the years 2007 and 2012 was 4.84±6.63 mg/L with a minimum value of 0.02 mg/L and a maximum value of 28.40 mg/L. With respect to sampling stations, it could be observed that Marina recorded the highest mean copper concentration with the value of 5.18±7.37 mg/L with the minimum value of 0.02mg/L and a maximum value of 28.40 mg/L. Akarakumo station on the other hand recorded the lowest value of 4.65±5.91mg/L with the minimum value of 0.02mg/L and a maximum value 022.10 mg/L (Table 1)

Lead
The total mean Lead concentration in Badagry creek was 1.79±2.13 mg/L with a minimum value of 0.02 mg/L and a maximum value of 10.50 mg/L. With regards to sampling stations, Akarakumo station recorded the highest mean lead values of 2.12±2.54 mg/L, while with minimum value of 0.10mg/L and a maximum value of 10.50 mg/L. While Topo station recorded the lowest mean lead value of 1.32±1.43 mg/L with the minimum value of 0.02mg/L and a maximum value of 6.00 mg/L (Table 1).

Chromium
The total mean chromium concentration in Badagry creek was 0.34±0.54 mg/L with a minimum value of 0.04mg/L and a maximum value of 3.90 mg/L. With regards to sampling stations, Topo station recorded the highest mean chromium values of 0.39±0.76 mg/L, with minimum value of 0.05mg/L and a maximum value of 3.90 mg/L. While Marina station recorded the lowest mean chromium value 0.30±0.44 mg/L with the minimum value of 0.04mg/L and a maximum value of 1.60 mg/L (Table 1).

Cadmium
The total mean cadmium concentration in the Badagry creek for the year 2007 and 2012 was 0.08±0.11 mg/L with the minimum value of 0.00 mg/L and a maximum value of 0.50 mg/L.

As regards sampling stations, Akarakumo and Ajido recorded the highest mean value of 0.10±0.13 mg/L and while Topo and Marina recorded the lowest value of 0.07±0.09 mg/L with minimum value of 0.01 and a maximum of 0.33 and 0.43 respectively mg/L (Table 1).

5. Discussion

Temperature
The temperature range of Badagry creek was 26^0C - 31^0C. It is believed that water temperature controls the metabolic rate and the reproductive activities of aquatic life. Standard set by the environmental protection agency (Federal Environmental Protection Agency FEPA, 1991) for acceptable level of temperature in drinking water is 32°C maximum. Comparing this to the result obtained from Badagry creek water sample, it can be said that the temperature of the creek water is still normal, although lower than the accepted standard. High water temperatures may affect fish metabolic process, thereby causing stress on the fish, while their physiologic demand for oxygen increases (Francis-Floyd, 2003).Not only that, the growth, feeding, reproduction and migratory behavior of aquatic organisms including fish and shrimps are greatly influenced by the temperature of water (Lagler *et al.,* 1977; Suski et al., 2006; Fey, 2006; Crillet and Quetin, 2006).

Turbidity
With higher levels of turbidity, water loses its ability to support a diversity of aquatic organisms. Water becomes warmer as suspended particles absorb heat from the sunlight and cause oxygen levels to fall. Photosynthesis decreases because less light penetrates the water, ((Boulton and Brock 1999; ANZECC/ARMCANZ 2000) resulting in even further drops in oxygen levels. The combination of warmer water, less light and oxygen depletion makes it impossible for some forms of aquatic life to survive. In another study by Blanch et al (1998) highly turbid water was found to prevent the growth of *Vallisneria americana* in the Murray Darling. Decreased water temperatures due to decreased light

Turbidity also limits fish vision, which can interfere with social behaviour (Berg and Northcote 1985), foraging (Gregory and Northcote 1993; Vogel and Beauchamp 1999) and predator avoidance (Miner and Stein 1996; Meager *et al.* 2006). This can have varying effects on fish growth and

survival, depending on a range factors such as ambient light levels and depth; relative visual sensitivities of predators and prey, and non-visual sensory abilities

Dissolved Oxygen

Decreases in the dissolved oxygen levels can cause changes in the types and numbers of aquatic macro invertebrates, plants and animals living in an ecosystem. However, dissolved oxygen levels change and vary according to the time of day, the weather and the temperature. A decrease in the dissolved oxygen levels is usually an indication of an entry of some organic pollutant.

Concentrations below 5 mg/l may adversely affect function and survival of biological communities and below 2 mg/l can lead to death of most fishes (Water Quality Assessments, 1996). Behaviorally, fish may avoid low dissolved oxygen conditions by physically moving out of an area. Finally, low oxygen levels can also increase toxicity of contaminants to anadromous fish, including ammonia, zinc, lead, and copper (Colt *et al* 1979, Davis 1975).

Conductivity (µS/CM)

Conductivity values reflect that the creek is brackish water, and is relatively high when compared to the very low conductivities. Conductivity values are indication of mineralization and nutrient level of the water (Uka and Chukwuka 2007).

Low Conductivity (0 to 200 µS/cm) is an indicator of pristine or background conditions. Mid range conductivity (200 to 1000 µS/cm) is the normal background for most major rivers. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or bugs. High conductivity (1000 to 10,000 µS/cm) is an indicator of saline conditions. Waters that have been heavily impacted by industry can fall into this range. (Wetzel, 1983)

The Chemical Oxygen Demand COD

The chemical oxygen demand (COD) is a measure of the total quantity of oxygen required to oxidize all organic materials into carbon dioxide and water (Barnes et al., 1998). It does not differentiate between biologically available and inert organic matter. The high level of the COD documented indicates that the river is polluted. The contamination may be due to domestic materials or substances that are released into the river body either directly or indirectly.

Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand (BOD) is a measure of the quantity of oxygen consumed by micro-organisms during the decomposition of organic matter. It was reported that a high BOD generally indicates the presence of excessive amounts of organic matter (EPA, 1987). This high BOD level may cause acceleration in bacterial growth and consumption of oxygen level in the river (Fafioye, 2011).

PH

PH value of the water sample in the river falls within the pH of water for domestic use (6 to 9) of the target water quality range (TWQR) (DWAF, 1996a). Most aquatic species are sensitive to changes in pH, likewise some streams have a neutral to slightly basic pH of 6.9 to 8.5. If stream water has a pH less than 5.5, it may be too acidic, while stream water with a pH greater than 8.6 may be too basic for fish to survive inside (Barnes et al., 1998). Therefore, the recorded pH of water of Azikwe River can be said to be normal for its organism.

The pH higher than 7, but lower than 8.5 is ideal for biological productivity while pH lower than 4 is detrimental to aquatic life (Abowei, 2010). Most organisms including shrimps do not tolerate wide variations of pH over time and if such conditions persist death may occur.

Alkalinity

Alkalinity which has the capacity to neutralize acids is examined in conjunction with pH (Barnes et al., 1998). Since the pH of the river is 7.75 which is slightly higher than neutral and tends toward alkaline, thus, it can be said that the river water is slightly rich in alkaline. The World Health Organisation documented that highly alkaline waters are unpalatable and can cause gastrointestinal discomfort (WHO, 1984). Alkalinity is slightly related to salinity of a river. An increase in the alkalinity of water indicates an increase in the salinity of such river water. The salinity of the river water sample was 60 mg/l, which is still normal for salt concentration in fresh water.

Phosphate

The phosphate level of the water sample is 5.02 mg/l and is specific since there is no effective standard for phosphorus (EPA, 1987). However, the nitrates concentra-tion of the creek water sample was 98.60mg/l, this is too high since the standard level of nitrate in fresh water bodies is 88.60mg/l giving a difference of 10 mg/l (EPA, 1987). In view of this, it can be deduced that the nitrate concentration in the analysed river water is significantly high. The ecological health effects of this may be severe on the users. The concentration level of sulphate in the river is 14.20mg/l. According to the standard regulations stated (EPA, 1987), 250 mg/l was recommended as the standard level of sulphate in fresh waters. In comparism, it can be documented that the concentration of sulphate in the river is minimal and will support life of its organisms. The concentration level of zinc (0.379 mg/kg) recorded in the river water sample is lower than the target water quality range of 0.00 - 3.00 mg/l zinc recommended for domestic use (QDWS, 1998). This showed that the water from the river could be used for domestic purpose.

The Kerschmann (2000), which by conversion is equivalent to 0.50%. Similarly, a higher level of 0.30 % phosphate in fish was reported in another work (Hunt et al., 2001). However the values recorded for this experiment cannot pose any health problem or risk, because the percentages of phosphate in the fish sample are minimal. The sulphate concentrations of 2.70 and 2.58% for T. nilotica and S.aurita respectively fall within the standard level (FAO, 2001).

Table 1: The physicochemical characteristics of the four study stations

PARAMETERS		SAMPLING SITES Akarakumo	Ajido	Topo	Marina	FEPA STD
Temp OC	Mean	27.2±0.95	27.34±0.87	27.76	27.79±1.08	
	Min	26.00	26.50	26.00	27.00	$32^{O}C$
	Max	30.00	30.00	31.00	31.00	
Turbidity(NTU)	Mean	13.63±3.92	12.11±3.60	13.84±5.73	13.26±3.43	
	Min	8.00	6.00	8.00	8.00	10 TNU
	Max	23.00	21.00	28.00	20.00	
pH	Mean	7.44±0.73	7.45±0.63	7.52±0.76	7.59±1.09	6.9-9.0
	Min	6.75	6.40	6.60	6.65	
	Max	10.10	9.30	10.20	12.00	
Dissolved oxygen (mg/L)	Mean	4.64±0.45	4.57±0.39	4.66±0.51	4.62±0.44	
	Min	3.80	4.10	3.80	4.00	5.0mg/l
	Max	5.60	5.20	5.60	5.40	
Conductivity (µS/cm)	Mean Min Max.	2366.33±3449.59 85.00 12000.00	1964.73±3109.90 93.00 71920.00	1942.84±3059.96 80.10 11188.00	2260.04±4274.55 85.00 19690.00	250 (µS/cm)
Chemical Oxygen Demand	Mean	448.47±183.22	603.26±457.65	464.16±233.57	461.42±208.39	80mg/L
	Min	82.00	90.00	85.00	80.00	
	Max	722.00	1930.00	993.00	856.00	
BOD (mg/L)	Mean	128. 83±66.18	152.75±89.05	131.71±70.38	126.42±70.73	15.0 mg/L
	Min	10.00	12.00	10.00	9.00	
	Max	244.00	380.00	290.00	255.00	
Alkalinity (mg/L)	Mean	55.92±27.95	57.75±29.59	52.14±32.68	48.16±32.12	
	Min	12.10	15.20	15.20	21.00	100-150mg/L
	Max	140.00	148.00	160.00	155.20	
Total Hardness as CaCo3 n(mg/L)	Mean	919.91±1282.44	793.17±1167.49	1153.74±2130.60	742.12±994.29	500mg/L
	Min	90.10	58.00	90.20	90.00	
	Max	3330.00	3325.00	9000.00	3000.00	
Total hardness as MgCO3 (mg/L)	Mean	496.89±758.06	439.21±729.77	828.47±2252.20	395.06±564.17	500mg/L
	Min	42.00	36.00	50.00	48.00	
	Max	2260.00	2324.00	9899.00	1603.00	
Nitrate (mg/L)	Mean	2.64±1.92	3.34±2.12	3.94±2.26	3.79±2.69	50 mg/l
	Min	.20	.60	.80	.60	
	Max	6.50	8.10	9.00	9.50	
Phosphate (mg/L)	Mean	1.72±1.33	2.20±1.70	2.12±1.23	2.92±3.61	
	Min	.35	.40	.23	.12	5.0 mg/L
	Max	5.20	6.80	4.30	15.50	

Table 2: The Concentration level of metals analyzed on Badagry creek water sample

		SAMPLING STATIONS				FEPA STDS
		Akarakumo	Ajido	Topo	Marina	
Cadmium (mg/L)	Mean	0.01±0.013	0..10±0.3	0.7±0.09	0.7±0.09	0.003 mg/L
	Min	0.01	0.01	0.01	0.01	
	Max	0.05	0.05	0.033	0.43	
Chromium (mg/L)	Mean	0.34±0.39	0.36±0.052	0.39±0.76	0.30±0.44	0.005 mg/L
	Min	0.04	0.05	0.05	0.04	0.001mg/L
	Max	1.40	2.20	3.90	1.60	
Lead (mg/L)	Mean	2.12±2.54	1.90±2.37.	1.32±1.43	1.81±2.03	0.001 mg/l
	Min	0.10	0.60	0.02	0.08	0.005mg/L
	Max	10.50	10.0	6.0	6.90	
Copper (mg/L)	Mean	4.65±5.91	4.67±6.37	4.85±7.04	5.18±7.37	2 mg/L
	Min	0.02	0.02	0.02	0.02	
	Max	22.10	23.80	25	28.40	
Zinc (mg/L)	Mean	17.45±20.85	13.81±15.52	15.48±16.79	19.34±24.79	3 mg/L
	Min	0.03	0.03	0.03	0.03	
	Max	62.20	48.00	48.30	88.0	

Basically, biological activities of freshwater bodies are regulated by various Physico-chemical factors viz., turbidity, temperature, pH, electrical conductivity, total hardness, nitrates, phosphates etc. This is observed in Badagry Creek and had greatly affected the water quality of the creek.

The results obtained at the above mentioned sampling stations are given in table 1. It was found that the following parameters namely turbidity, conductivity, chemical Oxygen Demand, Biological Oxygen Demand, Total Hardness calcium carbonate, and lead were high in concentration when compared with FEPA and WHO standard. As with oxygen value, the concentration value was very low. DO. is the important parameter in assessing water quality and ret1ects the physical and biological processes, prevailing in the water. Good water should have the solubility of oxygen 7.6 and 7.0 mg/l at 30°C and 35 °c respectively (Kudesia ,1985). The low value of dissolved oxygen in the creek in some period of the year could be due to the use of oxygen in biodegradation of organic matters which are present in the creek (Boyd, 1981).

The high level of total BOD,COD,Turbidity, total hardness, electrical conductivity low dissolved oxygen content recorded in the study stations could be an indication of the deteriorating water quality and probably resulted from the discharges of industrial and domestic wastes into the creek through the land based anthropogenic inputs and other sources. Similarly, Ajao and Fagade, (1990); Akpata *et al;* (1993), recorded, high biochemical oxygen demand, low dissolved oxygen content and heavy microbial load at organically polluted sites in the Lagos Lagoon.

According to FEPA (1991) 0-75mg/l is soft water and 300mg/l is hard water. This result showed that Badagry Creek was hard water. Water hardness is mainly caused by the presence of calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate which is reported by Bartram *et. al* (1996) to be abundant in the earth's crust and hence a common constituent of natural water in Badagry creek. Not only that, flowing water as Badagry creek could flow through areas of softer rocks, which supply at least some calcium to the water. Report of Hynes (1960) show that, not many animals are affected adversely by hard water but some; particularly those which form shells requires at least a minimum amount of calcium. Such creatures include shrimps and most other crabs. This is in line with the report of Jones (1948) that most of these animals are found in large numbers in nearby hard stream of Clydach. Bernard (2005) reported that hardness does not cause any severe effects for organisms, it only is known to cause the existence of kidney stones Badagry Creek is ranked as very hard for the value was 180 and above.

Other parameters such as temperature, pH Alkalinity, Total water hardness with magnesium carbonate, nitrate and phosphate were within the acceptable limit stipulated by FEPA, (1991) and WHO, (2004). However, the values are very significant at $P<0.05$). This indicate that the values recorded could have a lot of influence the biological and chemical activities of Badagry creek

Heavy metals considered in this analysis are cadmium, chromium, lead, copper and zinc. Of all, lead is higher than acceptable limit set by FEPA and WHO standards, whereas, others are within the limit. The high level of lead concentration in Badagry creek called for concern as most of the lead pollution in the environment could be traced to industrial production processes and their emissions, road traffic with leaded petrol, the smoke and dust emissions of coal and gas-fired power stations, the laying of lead sheets by roofers as well as the use of paints and anti-rust agents .This is similar to the report of GENF (1989), Nriagu and Coker, (1980) and (Ramamoorthy and Rust, 1978). Research further revealed that years of sampling and source i.e. water and sediment is significant in the distribution of lead in the environment at ($P<0.05$) confidence limit. However sampling stations have no influence on the lead distribution (Table, 1)

There was no significant difference ($P>0.05$) in the mean values of all the Physico-chemical parameters in the four sampling stations (Akarakumo, Ajido, Topo and Marina) throughput the sampling period.

6. Conclusion

This study showed that habitat modification of Badagry Creek is relatively on the increase. The most common forms of habitat modification are: riparian vegetation disturbance or removal, bank reshaping and accelerated erosion, reduction and trampling of stream banks and bed by stock. This may significantly adversely affect sensitive native fish. Like other studies in New Zealand, by Collier and Winterbourn, (2001) this group of fish appears ill-adapted to cope with much habitat disturbance.

7. Acknowledgements

My sincere thanks go to the fishermen and entire household of Oba of Topo and Akarakumo for allowing us to collect samples needed for this research.

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