Health assessment of Silver catfish (*Chrysichthys nigrodigitatus)*: hydrodynamic and growth performance in Lagos Lagoon, Nigeria

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Abstract

Status of *Chrysichthys nigrodigitatus,* an economic important fish of the Gulf of Guinea was investigated over 24 months in Lagos Lagoon to know the state of well-being of the fish; for fisheries management, public health and food security. Ecological tools employed to determine some hydrodynamic status. Water analysis: temperature (°C), pH, dissolved oxygen (mg l^{-1}), conductivity (µScm), depth (m), turbidity (m), and salinity (‰) were determined. Fish with mean standard length 18.90 ± 1.35 (cm) and mean weight range (201.59 ± 38.29) (g) were randomly collected and separated into sexes. Condition factor and regression analysis determined. Some heavy metal concentrations (Lead, Iron, Zinc Copper, and Chromium) levels were determined in fish tissues. No significant difference (P ≥ 0.05) occurred in water parameters from normal range using ANOVA. Sex ratio indicated higher male to female (40:32) which is nature specific. Morphometric measurement indicated female samples revealed negative allometric, but better condition factor (K) (2.86); while male revealed positive allometric and lower condition factor (K) (0.44) which is sex, reproduction and food availability specific; as robustness indicate state of well-being of the fish. Heavy metal values revealed slight accumulations. Results connoted fish species is relatively safe and of public health value.

Keywords: Condition status, Water parameters, Estuary, Heavy metals, *Chrysichthys nigrodigitatus*

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Introduction

Chrysichthys nigrodigitatus (Lacepede 1803) is a Bagridae mud silver catfish (Table 1), which occurs in most of the major rivers in Africa including Nigeria; the catfish is endemic to inland and coastal waters of Africa: Western, Southern and Central Africa, (Emmanuel &

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Osibona 2013). It is demersal, potamodromous specie that occurs in shallow waters of lakes (less than 4 m), over mud and fine sand bottom, in rivers and in swamps. A benthic omnivorous feeder, with significant ontogenetic shifts in diet composition subsisting and feeding on a variety of benthic food items (seeds, insects, bivalves and detritus), and specializes on its feeding habits with age and size. While newly hatched fries to young adult stages had preference for plankton, matured adults and larger fish may prefer or/ and feed on decapods and fish (Asuquo, Enin & Job 2010; Uneke, Uhuo & Nwangbo 2015).

In Nigeria, *C. nigrodigitatus* (Figure 1) is highly desired, valued food-fish of commercial importance; hence, optimum production of the stock endeared Fisheries management to adopt the fish for aquaculture, (Ezenwa, Kusemiju & Olaniyan 1986; Ezenwa, Alegbeleye, Anyanwu & Uzukwu 1990); as well as engage in parameters such as length-weight relationship, condition factor and sex composition to predict potential yield and size at capture for obtaining optimum yield for rational exploitation (Ugwumba & Ugwumba 2007; Obeten Offem, Akegbejo-Samsons & Tunde Omoniyi 2008).

Table 1. Scientific classification of *Chrysichthys nigrodigitatus*

Classification	Name
Kingdom	Animalia
Phylum	Chordata
Class	*Actinopterygii*
Order	*Siluriformes*
Family	*Claroteidae*
Genus	*Chrysichthys*
Specie	*Nigrodigitatus*
Scientific name	*Chrysichthys nigrodigitatus*
Common name	Silver catfish

Figure 1. *Chrysichthys nigrodigitatus,* Source: (Azeroual et al. 2010).

Challenge with uncontrolled fishing, and human influence on aquatic environment usage is important to the stress experienced by the ecosystem. Anthropogenic influence through aquatic ecosystem degrading including oil spillage, sand milling, pollution and destruction of mangrove swamps have had a considerable impact on the breeding and nursery coastal habitat of *C. nigrodigitatus*; particularly in Nigeria (Anyanwu 1991; Ekanem 1996). Since the complex dynamics of ecosystem relationships with stressors influence the state of well-being as well as production of fish; the aquatic ecosystem mis-use impacts on the health status of *C. nigrodigitatus* in Lagos Lagoon ecosystem. Therefore, environments functions in relation to environmental contaminant through deliberate and un-intentional deeds from varying pollution sources (coastal line near byers or sourced afar finding its way into the environment; through surface runoffs, drainages, into the lagoon system); could result in depleted state of the desired economically important fish stock.

Therefore, as environmental management towards healthy functioning, survival and

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production of fish is important to provide fish-food that is of public health importance for the ever-increasing demands of man as well as for economic importance; hence, health status of *C. nigrodigitatus* in Lagos Lagoon was determined.

Materials and Methods

The experiment was carried out in Lagos Lagoon in Lagos State, Nigeria, West Africa. The Lagos Lagoon (Figure 2) is part of the continuous system of lagoons and creeks that are found along coast of Nigeria from border with Republic of Benin to Niger-Delta. This lagoon bordering Lagos Island is located between longitude 30° 10' and 30° 4' SE and latitude 60° 5' and 60° 36' N. According to Onyema and Popoola (2013), the Lagos Lagoon with a surface area of 208 km^2, is an open, tidal and brackish lagoon which is the largest among the other lagoon systems of the Gulf of Guinea. It is connected and non-parallel to Gulf of Guinea coastline over a distance of 237 km. Ajao (1996) reported that Lagos Lagoon stretches for about 257 km from Cotonuon in the Republic of Benin to the Western edge of the Niger-Delta. The lagoon boarders the forest belt and receives input from a number of important large rivers draining more than 103,626 km of the country. However, Ajao et al. (1996), estimated that the area of the lagoon is 150.56 Km^2. It cuts across the Southern part of the metropolis, linking the Atlantic Ocean (in the West and South) and Lekki lagoon (in the East). It is tidal and shallow with an average depth of 1.5 m except at channels that are continually dredged to accommodate heavy water traffic (Adejare, Nwilo, Olusina & Opaluwa 2011). The Lagos Lagoon consists of three main segments: Lagos Harbour, the Metropolitan end and Epe division segments. The lagoon receives water influx from a number of important large rivers namely Yewa, Ogun, Osun and Om; and empties into the Atlantic Ocean at Lagos harbor (Ajao, Okoye & Adekanmbi 1996).

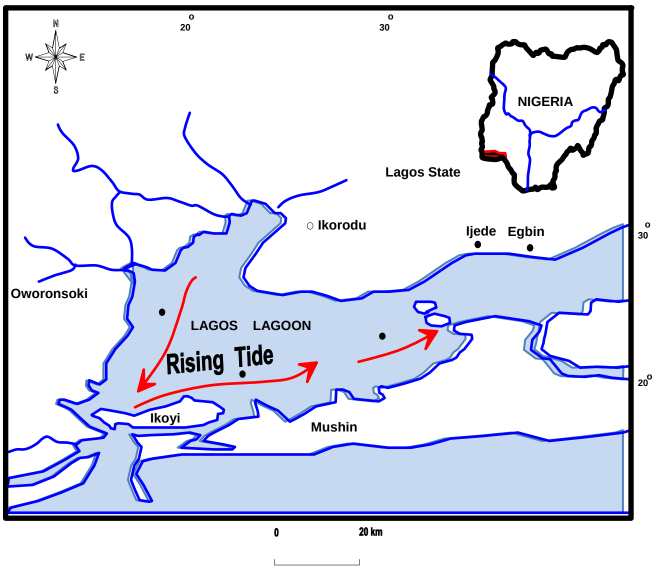

Figure 2. Map of Lagos Lagoon.

Table 2 shows the notable attributes of the sampling points on Lagos Lagoon.

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Table 2. Notable attributes of Sampling Points within Lagos Lagoon

Sampling Locations	Bottom Type	Tide/wave Action
Oworonshoki (LLOW)	Silt soil	Low/Minimal
Lagoon centre: Off third mainland bridge (LLCE)	Brownish loamy soil	High/ Extreme
Okobaba (LLOK)	Black loamy clay that ooze offensive odor.	Low/ minimal

1.) **Oworoshoki sampling point:** notable with human influence through solid waste dumps, and sand mining activities.

2.) **Lagoon Centre sampling point:** Exposed to human interference causing anthropogenic pollution.

3.) **Okobaba sampling point**: Exposed to wood logs, saw milling, burning, and anthropogenic pollutants.

Field work duration

Monthly study was carried out on Lagos Lagoon over 24 months and random collections of samples were made for health determination.

Physico – chemical analysis

Some water analysis at point locations in Oworoshoki (LLOW), Lagoon center (LLCE), Okobaba (LLOK) on Lagos Lagoon were carried out by monitoring ecological parameters such as: air and water temperature (°C), pH, dissolved oxygen (mg l^{-1}), conductivity (µScm), depth (m), turbidity (m), transparency (m) and salinity ($‰_0$) using standard methods, (APHA 2005).

Collection of fish and growth determinations

Chrysichthys nigrodigitatus fish were randomly collected through assistance of local fisherman using traps and set nets and were immediately transported to laboratory where standard length (SL) (cm) to nearest 0.01 cm were determined using graduated board; and weight (W) (g) of fish samples were measured to nearest 0.01 (g) using Mettle Toledo electronic weighing balance (Model; PB8001). Length and frequency of occurrence of fish were recorded, and growth rate was determined using Length-Weight Relationship (LWR) of fish regardless of sex and year class using the equation:

$$W = a L^b \qquad \text{(Pauly 1984)}$$

Where W = weight (g) of fish

L = length (cm) of fish

'a' = regression constant

'b' = regression coefficient which lies between 2 and 4; while isometric (symmetric) growth is indicated at 3, and values other than 3 will indicate allometric growth i.e values greater than 3 = positive allometric growth, and values less than 3 = negative allometric growth); and Condition factor of fish collected were determined using formula:

$$K = (100W) / L^b \qquad \text{(Abowei 2009)}$$

(Where K = condition, W = Weight (g), L = Length (cm), b = isometric value).

Heavy Metals measurements were carried out on fish samples collected. Lead (Pb), chromium (Cr), iron (Fe), zinc (Zn), and copper (Cu) were estimated using standard methods according to FAO/SIDA (2003). Digested samples were analyzed for Pb, Fe, Zn, Cu and Cr using buck 211 model atomic absorption

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spectrophotometer with aqueous calibration standard prepared from stock standard solutions of respective elements.

Statistical Analysis

Software Package for Social Sciences (SPSS, version 18) was used to analyze the data collected; and standard deviation of means were calculated using software package for social sciences (SPSS) 18.

i.) Duncan test was used to determine the significant relationships between water parameters of Lagos Lagoon;

ii.) Regression analysis was used to determine the growth sequence of length and weight of fish; and

iii.) Descriptive analysis and Duncan further range test were used to determine the significant relationship of the measured heavy metals concentration in the fish samples.

Results

Water parameters ranges determined in Lagos Lagoon indicated ranges determined falls within normal parameter ranges for optimum functioning for Brackish water (Table 2), (APHA, 2005). Table 3 revealed spatial water parameter ranges among point locations within the Lagoon system. Tables 4 – 7 revealed seasonal variation among point locations; which is in line within parameter ranges for normal functioning operations within the aquatic environment.

Mean water parameters variations determined in Lagos Lagoon are revealed in Table 3. There is no significant different ($P > 0.05$) in point locations for air temperature; but was highest in LLOW (29.14 ± 0.06 °C). Water temperature assessment revealed no significant difference ($P > 0.05$) in point locations but lowest in LLCE (28.24 ± 0.06 °C). There is no significant different ($P > 0.05$) within point locations for pH value determined; but highest value was recorded in LLCE (6.69 ± 0.02), and lowest value in LLOW (6.44 ± 0.01). Conductivity assessment no significant difference ($P>0.05$) within point locations with highest value recorded in LLCE (765.10 ± 0.01µScm). Significant differences ($P<0.05$) were recorded in Dissolve oxygen level within Lagos Lagoon sampling points; highest level was experienced in LLCE (8.20 ± 0.54mg l^{-1}), while lowest level was in LLOK (6.20 ± 0.02 mg l^{-1}).

Depth assessments within point locations recorded significant difference ($P<0.05$) only in LLCE (3.72 ± 0.02 m) which is highest depth recorded, while lowest depth was recorded in LLOK (1.67 ± 0.01 m). Significant difference ($P < 0.05$) was recorded in transparences within Lagos Lagoon sampling points with highest value in LLCE (1.43 ± 0.01 m) and lowest value in LLOK (0.97 ± 0.02 m). Significant difference ($P<0.05$) with highest value occur at LLCE (1.49 ± 0.01 m), and lowest value in LLOK (1.02 ± 0.02 m). Salinity level recorded no significant differences ($P > 0.05$) within location, highest value was in LLOK (7.71 ± 2.79 $‰_0$).

Table 3. Mean ± Standard Error of Water parameters in Lagos Lagoon

Parameters	Lagos Lagoon		
	LLOW	LLCE	LLOK
Air Temperature(°C)	29.14 ± 0.06 [a]	28.81 ± 0.06 [a]	28.76 ± 0.02 [a]
Water Temperature(°C)	28.43 ± 0.04 [a]	28.24 ± 0.06 [a]	28.48 ± 0.06 [a]
pH	6.44 ± 0.01 [a]	6.69 ± 0.02 [a]	6.61 ± 0.01 [a]
Conductivity(µScm)	715.43 ± 0.23 a	765.10 ± 0.01a	743.10 ± 0.23a
Dissolved Oxygen (mg l^{-1})	7.07 ± 0.01[ab]	8.20 ± 0.04[a]	6.20 ± 0.02 [b]
Depth (m)	2.18 ± 0.04 [b]	3.72 ± 0.02 [a]	1.67 ± 0.01 [c]
Transparency (m)	1.11 ± 0.02[b]	1.43 ± 0.01 [a]	0.97 ± 0.02c
Turbidity(m)	1.22 ± 0.03[ab]	1.49 ± 0.01 [a]	1.02 ± 0.02c
Salinity (‰)	6.48 ± 0.09 [a]	5.62 ± .04 [a]	7.71 ± 0.09 [a]

LLOW (Lagos Lagoon Oworoshoki), LLCE (Lagos Lagoon Centre), LLOK (Lagos Lagoon Okobaba). Means with the same superscript along the rolls are not significantly different, (P>0.05).

Sex, Frequency and growth determination of *Chrysichthys nigrodigitatus*

A total of seventy-two specimens of *Chysichthys nigrodigitatus* were collected in Lagos Lagoon. Sex frequency and growth trend in male and female specimens revealed male fishes had the highest frequency (40). No significant differents (P>0.05) were revealed in length and weight measurements; but a negative allometric value was recorded. Male fishes had lower condition factors (0.44) than the females (2.86) which might be linked to the sex dimorphism, environmental and food availability. Table 4 represents the frequency and growth parameters of the fish samples. Seasonal variation in growth shows the fish samples are in good state of well-being as condition factors revealed (K > 1), (Table 5).

Table 4. Frequency and Length-Weight Indices of *Chysichthys nigrodigitatus*

Locations	Fish spp.	Frequency	Mean length (cm) ± Standard Error	Mean Weight (g) ± Standard Error	Regression (R^2)	Coefficient (b) ± Standard Error	Condition Factor (K)
Lagos Lagoon	*C. nigrodigitatus*	72	22.68 ± 0.03[a]	196.06 ± 0.16[a]	0.12	8.16 ± 2.81[b]	2.22
Lagos Lagoon Male	*C. nigrodigitatus*	40	22.56 ± 0.05[a]	207.76 ± 0.29[a]	0.01	2.14 ±1.81[d]	0.44
Lagos Lagoon Female	*C. nigrodigitatus*	32	22.85 ± 0.07[a]	180.46 ± 0.36[a]	0.70	2.87 ± 2.12[d]	2.86

Means with the same superscript along the column are not significantly different, (P> 0.05).

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Table 5. Seasonal variations in growth parameters in *Chrysichthys nigrodigitatus*

Chrysichthys nigrodigitatus	Mean±SE standard length	Weight (g)	Condition factor (K)
LLCN wet year 1	13.65 ± 2.12	69.04 ± 2.10	1.30
LLCN wet year 2	21.74 ± 2.27	133.7 ± 1.52	2.70
LLCN dry year 1	19.63 ± 1.52	204.14 ± 4.81	1.41
LLCN dry year 2	24.60 ± 1.32	210.12 ± 5.48	1.49

LLCN – Lagos Lagoon Chrysichthys nigrodigitatus; Wet (May - October); Dry (November - April); Year 1- sample year 1; Year 2 – sample year 2.

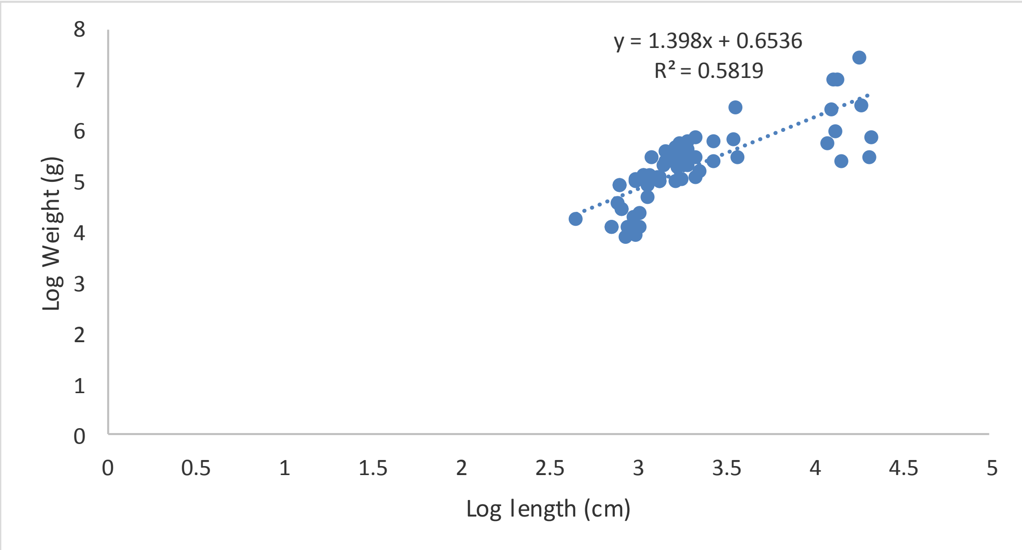

Figure 3. Length – Weight Relationship of *Chrysichthys nigrodigitatus* in Lagos Lagoon.

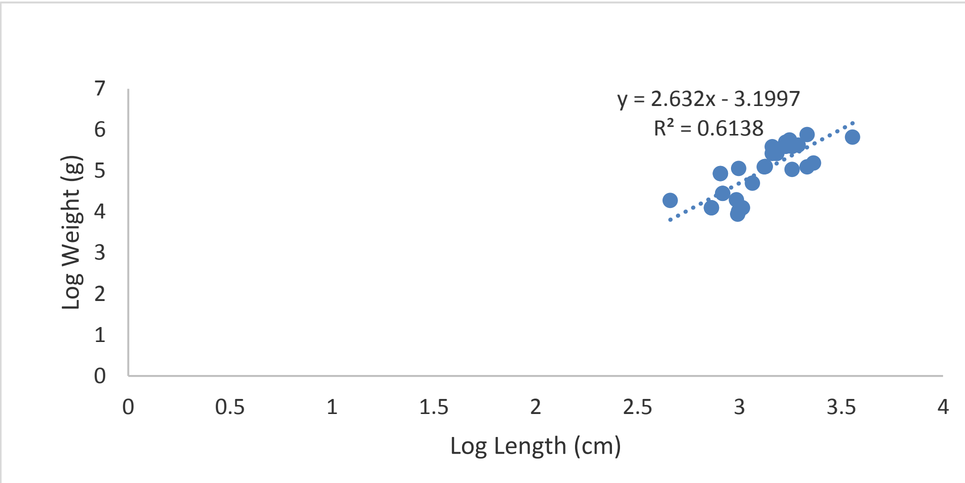

Figure 4. Length – Weight Relationship of Female *Chrysichthys nigrodigitatus* in Lagos Lagoon.

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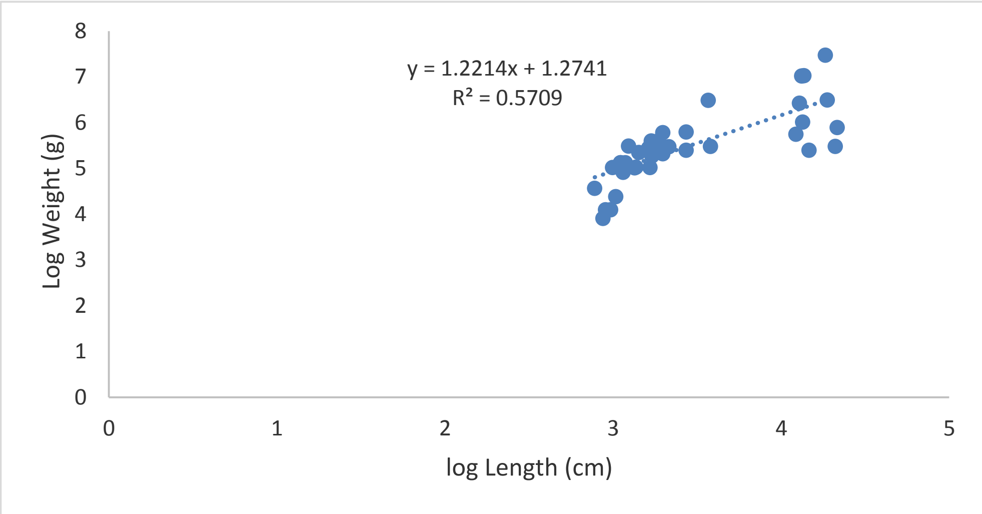

Figure 5. Length – Weight Relationship of Male *Chrysichthys nigrodigitatus* in Lagos Lagos.

Heavy metals determined on *Chrysichthys nigrodigitatus*

Heavy metals determined on *Chrysichthys nigrodigitatus* flesh collected from Lagos Lagoon indicated values obtained in Iron (Fe) range between 0.59 ± 0.03 ppm and 2.02 ± 0.64 ppm. Value obtained for chromium (Cr) range between 0.01 ± 0.00 ppm and 0.06 ± 0.01 ppm. Values obtained in zinc (Zn) ranged from 5.83 ± 0.66 ppm and 9.56 ± 0.96ppm. Values obtained in Copper (Cu): ranged between 0.43 ± 0.08 ppm and 3.69 ± 5.66 ppm. Value obtained in Lead (Pb) ranged between 0.13 ± 0.06 ppm and 0.20 ± 3.40 ppm. The metals ranked Zn > Cu > Fe >Pb >Cr. Figures 6 & 7 revealed monthly and seasonal variations; and Table 6 showed mean and standard deviation heavy metals determined in fish, water and sediments from the environment. Iron ranked highest in the water and sediment, while zinc ranked highest in *C. nigrodigitatus* catfish.

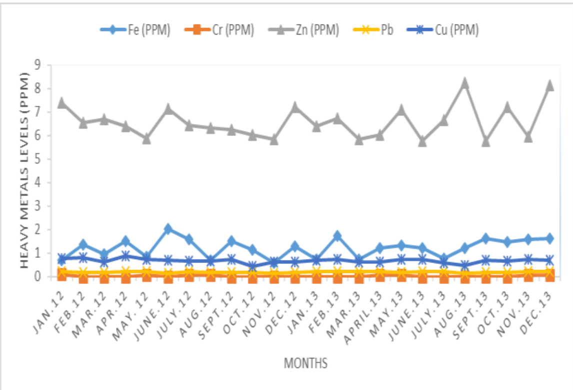

Figure 6. Monthly variations in Heavy metals determined in *Chrysichthys nigrodigitatus* collected from Lagos Lagoon.

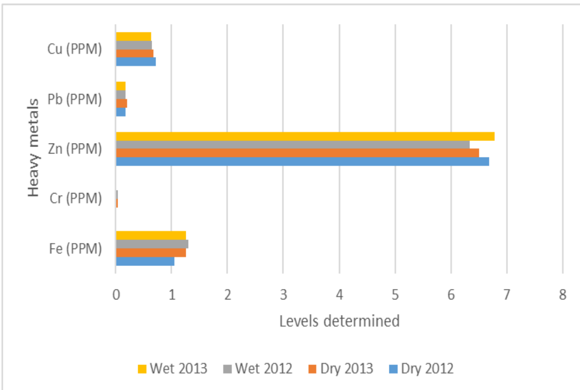

Figure 7. Seasonal variations in Heavy metals determined in *Chrysichthys nigrodigitatus* collected from Lagos Lagoon.

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Table 6. Heavy Metal Determination in *Chysichthys nigrodigitatus*, Water and Sediment from Lagos Lagoon

Heavy Metals↓	*C. nigrodigitatus*	Water	Sediment	Recommended limits (mg g^{-1})	References
Fe	1.24 ± 0.67	6.27 ± 2.68	0.17 ± 0.07	0.300	SON, 2007
Cd	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.003	WPCL, 2004
Cr	0.03 ± 0.02	0.02 ± 0.01	0.14 ± 0.10	0.013	USFDA, 1993
Zn	7.54 ± 0.20	0.25 ± 0.05	1.88 ± 1.10	3.000	SON, 2007;
Cu	1.00 ± 1.76	0.00 ± 0.00	0.12 ± 0.09	0.003	IAEA-407, Wyse et.al, 2003
Pb	0.18 ± 0.04	0.16 ± 0.07	0.17 ± 0.15	0.050	WHO, 2001

Bio-accumulation and Bio-concentration of Heavy metals in *Chrysichthys nigrodigitatus*

Percentage bio-accumulation and bio-concentration of respective heavy metals in the tissues of *C. nigrodigitatus* from the environment indicated that *C. nigrodigitatus* bio-concentrate Fe, Cr, and Zn majorly from the aquatic environment than from sediment constituent of the environment. The fish bio-accumulate Cu and Pb majorly from the sediments; while determination of Cadmium (Cd) from the aquatic and sediments environment is negligible, (Figure 8).

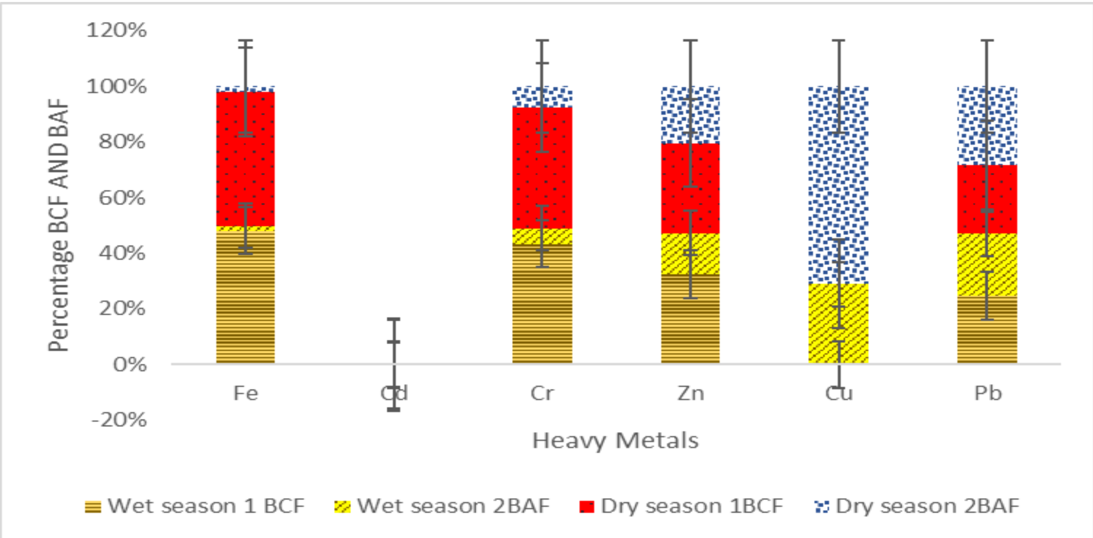

Figure 8. Bio- Concentration and Bio-Accumulation of Heavy Metals from Water and Sediment to Determination in *Chrysichthys nigrodigitatus* Catfish in Lagos Lagoon. 1BCF- Wet season year 1 Bio-Concentration Factor; Wet season 2BAF-Bio- Accumulation Factor; 1BCF – Dry season year 1 Bio-Concentration Factor; Dry season 2BAF- Bio- Accumulation Factor.

Correlation Analysis of Heavy metals in *Chrysichthys nigrodigitatus*, Aquatic and Sediment in Lagos Lagoon environment

Table 7 showed correlation analysis of determination of heavy metals in *Chrysichthys nigrodigitatus*, aquatic and sediment environment of Lagos Lagoon. Result indicated that weight of *C. nigrodigitatus* is positively significant to its length at (P > 0.01). Fe concentration in *C.*

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nigrodigitatus is negatively significant to its length at (P > 0.05), and to its weight at (P > 0.01).

Concentration of Cr in *C. nigrodigitatus* is positively correlated to its Fe concentration at (P > 0.05); while concentration of Zn is negatively correlated to Fe concentration at (P > 0.05) in the fish. Concentration of Cu in *C. nigrodigitatus* is positively correlated to its Cr concentration at (P > 0.01); and negatively correlated to its Zn concentration at (P > 0.01). Concentration of Pb in *C. nigrodigitatus* is positively correlated to its Fe concentration at (P > 0.05); and negatively correlated to its Zn concentration at (P > 0.01).

Correlation assessments indicated concentration of Cr in Lagos Lagoon water is negatively correlated to Fe concentration in Lagos Lagoon water at (P > 0.01); while concentration of Pb in the water is negatively correlated at (P > 0.05) with length of *C. nigrodigitatus* and positively correlated with Cr in Lagos Lagoon water both at (P > 0.01).

Concentration of Fe in Lagos Lagoon sediment is positively correlated with concentration of Cr in Lagos Lagoon water; and negatively correlated with concentration of Fe in Lagos Lagoon water at (P > 0.05).

Concentration of Zn in Lagos Lagoon Sediment is positively correlated with concentration of Pb in Lagos Lagoon water at (P > 0.01), and concentration of Fe in Lagos Lagoon sediments at (P > 0.05).

Concentration of Cu in Lagos Lagoon sediment is negatively correlated with fish length, Fe concentration in Lagos Lagoon water and positively correlated with concentration of Cr in Lagos Lagoon water at (P > 0.05). Concentration of Cu in Lagos Lagoon sediment is also positively correlated with concentration of Pb in Lagos Lagoon water and concentration of Zn in Lagos Lagoon sediment at (P > 0.01).

Concentration of Pb in Lagos Lagoon sediment is negatively correlated with concentration of Pb in *C. nigrodigitatus* and positively correlate with concentration of Cr in Lagos Lagoon water at (P > 0.05). Concentration of Pb in Lagos Lagoon sediment is also positively correlated with concentration of Pb in Lagos Lagoon water and concentration of Cu in Lagos Lagoon sediment at (P > 0.01).

Accumulation of Fe in female (0.01 ± 0.01) and male (0.02 ± 0.02) revealed no significantly different (P > 0.05); but Cr was significantly different at P < 0.05, and a high significant different at P < 0.001. There was no significant effect in time (months) for Cr, Zn, Cu and Pb. Significant different at (P < 0.05) were revealed in Zn, Cu and Pb determined between sexes (P > 0.05); Zinc in female fish is (8.04 ± 1.90); male fish (7.41 ± 1.74); Cu determination between sex indicated significant difference at P < 0.05; female (0.94 ± 1.74) and male (0.67 ± 0.19); Pb revealed significant difference at P < 0.05 in female (0.94 ± 1.74) and male (0.67 ± 0.19).

Table 7. Correlation analysis of Relationship between *Chrysichthys nigrodigitatus* Morphometric, Heavy metal determination in tissues, Lagos Lagoon Water and Lagos Lagoon Sediments

	Length	Weigtht	CnFe	CnCd	CnCr	CnZn	CnCu	CnPb	LLWFe	LLWCd	LLWCr	LLWZn	LLWCu	LLWPb	LLSFe	LLSCd	LLSCr	LLSZn	LLSCu	LLSPb
Length	1.000	.733**	-.267*	ND	-.092	-.030	.171	.058	.132	ND	.004	-.162	ND	-.261*	-.100	ND	.221	-.160	-.263*	-.110
Weight		1.000	-.324**	ND	-.073	-.115	.145	.214	.213	ND	-.020	-.020	ND	-.150	.005	ND	.098	-.095	-.196	-.224
CnFe			1.000	ND	.395*	-.300*	.223	.257*	-.081	ND	-.024	-.019	ND	.188	.061	ND	.026	.148	.172	.247
CnCd				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CnCr					1.000	-.833**	.735**	.116	-.210	ND	-.063	.150	ND	.226	.040	ND	.098	-.175	-.081	.039
CnZn						1.000	-.936**	-.442**	.046	ND	.021	-.021	ND	-.069	-.092	ND	-.049	.097	-.016	.073
CnCu							1.000	.469**	-.032	ND	-.074	-.055	ND	-.008	.030	ND	.093	-.163	.000	-.067
CnPb								1.000	.037	ND	-.243	.004	ND	-.069	-.027	ND	-.213	.157	-.003	-.256*
LLWFe									1.000	ND	-.384**	-.010	ND	-.097	-.294*	ND	-.081	-.156	-.257*	-.194
LLWCd										ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LLWCr											1.000	.043	ND	.461**	.256*	ND	.145	.200	.275*	.322*
LLWZn												1.000	ND	.047	-.109	ND	-.143	.069	-.043	.002
LLWCu													ND	ND	ND	ND	ND	ND	ND	ND
LLWPb														1.000	.078	ND	.024	.340**	.416**	.422**
LLSFe															1.000	ND	.066	.270*	.256*	.168
LLSCd																ND	ND	ND	ND	ND
LLSCr																	1.000	-.104	.067	.131
LLSZn																		1.000	.342**	.202
LLSCu																			1.000	.650**
LLSPb																				1.000

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).
ND is constant; Cn is *Chrysichthys nigrodigitatus*; LLW is Lagos Lagoon Water; LLS is Lagos Lagoon sediments.
Fe (Iron); Cd (Cadmium); Cr (Chromium); Zn (Zinc); Cu (Copper); Pb (Lead).

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Discussion

Air and water parameters indicated no significant difference in temperatures ranges in air and water, and water pH values. Conductivity revealed no significant difference within location. Significant differences recorded in Dis solved Oxygen level within point locations which is indicated of environment to varying ecological factors: (Abulude, Fapohunda & Awanlenhen 2006).

There occurred significant difference at central sampling location (LLCE). Hence significant relationship in depth is indicative of shallow level of the lagoon system an attribute of breeding ground for some marine animals. Transparency assessments indicated no significant relationship experienced. This is because of differences in sequence of operation of the ecological factors; while turbidity in Lagos Lagoon indicate significant different. This condition is attributed to high water wave and current experienced in the locations; while salinity level assessed revealed no significant difference within locations; and between locations significant differences occurred. This can be as a result of the different water type (fresh and brackish) and their ion constituents (Ololade & Lajide 2010).

Distribution and Morphometric measurement of *Chrysichthys nigrodigitatus*

Length and weight of *Chrysichthys nigrodigitatus* Lagos Lagoon revealed no significant difference in length of fish. This inference growth is in normal sequence. **Condition factor (K)** of male samples was 0.44, which indicate low state of well-being than female samples K- factor (2.86). Low condition factor in male fish may be as a result of fluctuation in feeding condition, physical physiology, age-class length and weight as result of random collection made (Le Cren 1951); or biological circumstances, parasitic infections or / and physiological (Attributed to reproduction) (Elias, Azinge, Umoren, Jaja & Sofola 2011). The female K-factor 2.86 at 51.81%, male K factor 0.44 at 7.97%, while both sexes had water K factor 2.22 had 40.22%. This result is in line with the findings of Froese (2006) who stated that condition factor (K) of fish can be reproductive, sex, location specific, and feeding specific, (George, Luba, Richard, Julie, Taylor, Hedy, Wald & Shmuel 2013).

"b" Allometric and isometric measurement of *Chrysichthys nigrodigitatus*

Result of sample collected revealed that mean parameter b values obtained on *C. nigrodigitatus* samples collected from Lagos Lagoon indicated negatively allometric for male (2.14 ± 1.81) and female (2.87 ± 2.12), the work is line with the work of Froese (2006).

Heavy metals concentration in *Chrysichthys nigrodigitatus* Flesh

Fe revealed higher value from concentration limit (0.300 mg g^{-1}) (SON 2007; El-Moselhy, Othman, Abd El-Azem and El-Metwally 2014); (0.450 mg g^{-1}) (WPCL, 2004) and (0.500 mg g^{-1}) (Amani & Al-Jubouri 2012). Concentration

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of Fe (2.02 mg g^{-1}) determined was lower than concentration level (3.58 mg g^{-1}) obtained by Aderinola, Clarke, Olarinmoye, Kusemiju & Anatekhai (2009); as Davis, Wiegand, Alan & Chamberlain (2008) reported that excess Fe in biological tissues causes rapid increase in pulse rate and coagulation of blood in blood vessels, hypertension and drowsiness; such that is implicative on state of well-being and stress conditions.

Zinc (Zn) revealed higher than permissible limit (5.000 mg g^{-1}) (Opaluwa, Aremu, Ogbo, Abiola, Odiba, Abubakar and Nweze 2012), (0.1 mg g^{-1}) (Amani and Al-Jubouri 2012); (3.000 mg g^{-1}) (SON 2007); higher (9.56 mg g^{-1}) than concentration (0.08 mg g^{-1}) obtained by Aderinola et al. (2009) in Lagos Lagoon. Differences in concentrations could be or are linked with location, specie(s), age and size specific (Peakall and Burger, 2003), and zinc may induce toxicity, characterized by symptoms of irritability, muscular stiffness and pain, loss of appetite, and nausea (Jeyaraj, Suhaila, Divya, Prasanna, Kumaran & Ravikumar 2015). Copper (Cu) values were higher than recommended limit (0.03 mg g^{-1}) (Khayatzadeh and Abbasi, 2010) and higher than value obtained in Lagos Lagoon (0.52 mg g^{-1}) (Aderinola et al. 2009); which may cause retarded growth and inhibition or delay in spawning. High concentration of copper can alter haematology (James, Usher, Campbell & Bond 2008); respiratory and cardiac physiology (Sorensen 1991).

Lead (Pb) determined indicated relative values to recommended limit (0.010 mg g^{-1}) (SON 2007), It is influence by water quality and its solubility in the environment. Pb is liable to causes lamella shrinkage degeneracy of epithelium; branchial arterial rupture and ischemia; reduction in growth rate and loss in body weight; neurological defect, renal tubular dysfunction, anemia. These systoms may result in fish stress, hence required to be put on check for relative fish management output.

Chromium (Cr) exceeded recommended limits; major source of Cr in water is via industrial effluents (Ayoola, Idowu, Babalola & Ademoye 2014); deficiency of this could result in impaired growth and disturbances in glucose, lipid and protein metabolism; while excess could have undesirable lethal effect on fish and wildlife (Akan, Abdulrahman, Ogugbuaja & Ayodele 2009). Heavy metals level determined in fish were ranked: Zn > Cu > Fe > Pb > Cr. In all, Zinc (Zn) dominates and top ranked the metals determined. The study revealed *C. nigrodigitatus* fish collected from the sampling stations contains levels to heavy metals that may induce stress to fish, which in environmental influenced.

Conclusion

Health status determination of *C. nigrodigitatus* indicated that the fish revealed slight health challenge which is indicative in the heavy metals accumulation in fish flesh and hence, indicative of ecosystem slight pollution such that could be attributed to anthropogenic influence of human activities along coastline whereby mitigating fish optimum production level. Hence, proper management protocols should be engaged upon

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to abate unhealthy influences for proper ecosystem functioning towards production and reduce bioaccumulation of heavy metals for healthy fish food for public health purposes.

Conflicts of interest

None of the authors has any conflicts of interest to declare.

REFERENCES

Abowei J.F.N. (2009) The abundance, condition factor and length-weight relationship of *Cynoglossus senegalensis* (Kaup, 1858) from Nkoro River Niger Delta, Nigeria. *Advance journal of food science and Technology 1*(1), 57-62.

Abulude F.O. Fapohunda O.O. & Awanlenhen B.E. (2006) Determination of some heavy metals in *Procambaris clakii*, *Paleamon sp.*, *Macrobranchium vollenhovenii* and *Penaeus notialis* from the Coastal water of Ondo State, Nigeria. *Journal of Animal Veterinary Advance* 5(1), 38-41.

Aderinola O.J., Clarke E.O., Olarinmoye O.M., Kusemiju V. & Anatekhai M.A. (2009) Heavy Metal in Surface Water, Sediments, Fish and Periwinkles of Lagos Lagoon. *American-Eurasian Journal of Agriculture and Environmental Science* 5(5), 609-617.

Adejare Q.A., Nwilo P.C., Olusina J.O. & Opaluwa Y.D. (2011) A study of ferry service route network in Lagos Lagoon-Nigeria using graph theory. *Journal of Geography and regional Planning 4*(6), 326-337.

Ajao E.A. (1996) Review of the state of pollution of the Lagos lagoon. *Tech. Pap. Niger. Inst. Oceanogr. Mar. Res* (106), p.20.

Ajao E.A., Okoye B.C.O. & Adekanmbi E.O. (1996) Environmental Pollution in the Nigerian Coastal Waters; A case study of the Lagos Lagoon. *Water Quality Monitoring and Environmental Status in Nigeria. FEPA Monograph 6*, 101-112.

Akan J.C, Abdulrahman F.I., Ogugbuaja V.O. & Ayodele J.T. (2009) Heavy metals and anion levels in some samples of vegetables grown within the vicinity of Challawa indust. Area, Kano state, Nigeria. *American Journal of Applied Science* 6(3), 534-542.

Amani M. & Al-Jubouri M. (2012) An Experimental Investigation of the Effects of Ultra High Pressures and Temperatures on the Rheological Properties of Water-Based Drilling Fluids. Society of Petroleum Engineers DOI: 10.2118/157219-MS.

Anyanwu P.E. (1991) Influence of salinity a survival of fingerlings of the estuarine catfish *Chrysichthys nigrodigitatus* (Lacepede), *Aquaculture* 199 (1/2), 157-165.

American Public Health Association (APHA). (2005) Standard method for examination of water and wastewater, 21st edn. *APHA, AWWA, WPCF*, Washington.

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[DOI: 10.29252/ijaah.5.2.37]

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Asuquo P.E., Enin U.I. & Job B.E. (2010) *Ontogenetic variation in the diet of Chrysichthys nigrodigitatus (Lacepede 1808) in a tropical estuarine ecosystem in Nigeria.* In: 25th Annual Conference of the Fisheries Society of Nigeria (FISON), Lagos, Nigeria, 314-318.

Ayoola S.O., Idowu A.A., Babalola O.E. & Ademoye M.K. (2014) Heavy Metals Accumulation and Enzymatic Biomarker in Commercially Important Fish Species (*Hemichromis fasciatus* and *Chrysichthys nigrodigitatus*) at the Landing Site, Bariga, Lagos Lagoon, *World Applied Sciences Journal* 29 (2), 298-306.

Azeroual A., da CostaL., Lalèyè P. & Moelans T. (2010) *Chrysichthys nigrodigitatus*. The IUCN Red List of Threatened Species, IUCN. UK. http://dx.doi.org/10.2305/20103. RLTS.T182997A8019531.en.

Davis S.J., Wiegand B.A., Alan C.R. & Chamberlain C.P. (2008) The effect of drainage reorganization on paleoaltimetry studies: An example from the Paleogene Laramide foreland. *Earth and Planetary Science Letters* 275, 258-268.

Ekanem S.B. (1996) Effects of feeding frequency, moist and dry feeds on the growth of *Chrysichthys nigrodigitatus* Lacepede and on pond water quality. *Aquaculture Research 27*(2), 107-112.

Elias S.O., Azinge E., Umoren G., Jaja S.I., & Sofola O.A. (2011) Salt sensitivity in normotensive and hypertensive subjects in *Nigerian quarterly journal of hospital medicine* 21(1), 85-91.

El-Moselhy K.M., Othman A.I., Abd El-Azem H. & El-Metwally M.E.A. (2014) Bioaccumulation of heavy metals in some tissues of fish in the Red Sea. *Egypt. Sciences* 1 (2) 97 -105.

Emmanuel B.E. & Osibona A.O. (2013) Ichthyofauna characteristics of a tropical low brackish open Lagoon in South-western Nigeria. *International Journal of Fisheries and aquaculture 5*(6), 122-135.

Ezenwa B.I.O., Alegbeleye W.O., Anyanwu P.E. & Uzukwu E.O. (1990) Culturable Fish Seeds in Nigerian Coastal Waters. A research Survey (Second Phase: 1986-1989). Nigerian Institute for Oceanography and Marine Research. (N.I.O.M.R.) Tech. p. 66, 37.

Ezenwa B.I.O., Kusemiju K. & Olaniyan C.I.O. (1986) Comparative studies of the catfish, *Chrysichthys nigrodigitatus* (L) in three isolated geographical areas in Nigeria for breeding purpose. *Aquaculture Research African Region Journal* 1, 258-262.

FDA, U. and US Food and Drug Administration (USFDA) (1993). Guidance documents for trace elements in seafood. *Center for Food Safety and Applied Nutrition, Washington, DC, USA.*

Food and Agriculture Organization (FAO) Heavy Metal Regulations – Faolex. Legal Notice no. 66/2003. 2003. http://faolex.fao.org/docs/pdf/eri42405.pdf.

Froese R. (2006) Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology* 22 (4), 241–253.

George A. P., Luba D. A., Richard D. A., Julie S., Taylor A., Hedy S., Wald A. & Shmuel P. (2013) Introducing technology into medical education: Two pilot studies. *Patient Education and Counseling* 93, 522–524.

James T. C., Usher J., Campbell S. & Bond U. (2008) Lager yeasts possess dynamic genomes that undergo rearrangements and gene amplification in response to stress. *Current Genetic* 53(3), 139-152.

Jeyaraj N., Suhaila A., Divya L., Prasanna K. S., Kumaran L. & Ravikumar S. (2015) Heavy Metal Concentration in Fishes from the Coastal Waters of Kasaragod, Northwest Part of Kerala, India. *International Journal of Current Research in Biosciences and Plant Biology* 2(6), 14-20.

Khayatzadeh J. & Abbasi E. (2010) The Effects of Heavy Metals on Aquatic Animals. *The 1st International Applied Geological Congress, Department of Geology, Islamic Azad University – Mashad Branch, Iran* 1, 26-28.

Le Cren E.D. (1951) The length-weight relationship and seasonal cycle in Gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology* 20(2), 201-219.

Obeten Offem B., Akegbejo-Samsons Y. & Tunde Omoniyi I. (2008) Diet, size and reproductive biology of the silver catfish, *Chrysichthys nigrodigitatus* (Siluformes: Bagridae) in the Cross River, Nigeria. *Revista de biología tropical 56*(4), 1785-1799.

Ololade I.A. & Lajide L. (2010) Exposure level and bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) in edible marine organisms. *Journal of Environmental Indicators 5*, 69-88.

Onyema I.C. & Popoola R.T. (2013) The physico-chemical characteristics, chlorophyll a levels and phytoplankton dynamics of the east mole area of the Lagos Harbour, Lagos. *Journal of Asian Scientific Research 3*(10), 995-1010.

Opaluwa O.D., Aremu M.O., Ogbo L.O., Abiola K.A., Odiba I.E., Abubakar M. M. & Nweze N.O. (2012) Heavy metal concentrations in soils, plant leaves and crops grown around dump sites in Lafia Metropolis, Nasarawa State, Nigeria. *Advances in Applied Science Research* 3(2), 780-784.

Pauly D. (1984) Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud. Rev. 8, 325.

Peakall D. & Burger J. (2003) Methodology for assessing exposure to metals: speciation, bioavailability of metals and ecological host factors: *Ecotoxicology and Environmental Safety* 56, 110-121.

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[DOR: 20.1001.1.2345315.2019.5.2.4.7]
[DOI: 10.29252/ijaah.5.2.37]

Sorensen E.M.M. (1991) Metal poisoning in fish. CRC Press Boca Raton USA. p. 243.

Standard Organization of Nigeria, (SON). (2007) Nigerian Standard for Drinking Water Quality; Standards Organisation of Nigeria: Abuja, Nigeria.

Ugwumba A.A.A. & Ugwumba O.A. (2007) Food and feeding ecology of fishes in Nigeria, *Jodetan Ventures, Ibadan.* 91.

Uneke B.I., Uhuo C. & Nwangbo K.N. (2015) Helminth Parasites of *Chrysichthys nigrodigitatus* (Lacepede: 1803) in the Mid-Cross River Flood System, South Eastern Nigeria. *Health Sciences Research* 2(4), 34-38.

Water Pollution Control Legislation (WPCL). (2004) Land-Based Water Quality Classification, *Official Journal*, *Turkey* 256-287.

Wyse E.J. Azemard S. & Mora S.J. (2003) Report on the world-wide intercomparison exercise for the determination of trace elements and methyl mercury in fish homogenates. IAEA-407. Monaco: IAEA/Al/144 (IAEA)/MEL/72 IAEA.

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