SEASONAL VARIATION IN SPECIES ABUNDANCE, DIVERSITY AND COMPOSITION OF FISH FAUNA IN LAGOS LAGOON, NIGERIA

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Abstract

The seasonal variation in species abundance and composition of fish fauna of Lagos Lagoon were studied monthly from January to December, 2013. A total of 11,332 fish specimens made up of juveniles and adults caught were identified. They comprised of forty-nine species belonging to 28 families. Ethmalosa fimbriata (27.4 %) had the highest in terms of number followed by Chrysichthys nigrodigitatus (11.4 %). Twelve species occurred only once during the period of study. The fish reported in this study were group into three; first group were caught during the rainy season, second group were caught during the dry season, and the third group were caught throughout the year. The largest catch was recorded in May (51.05 kg) followed by July (45.34 kg). The least catch was recorded in January; dry season (4.5 kg). The mean value of water temperature (29.8 ℃), salinity (7.49 ‰), pH (7.17), dissolved oxygen (5.49 mg/L) and turbidity (5.68 NTU) were recorded. The results from this work will be a useful contribution to the current knowledge of fisheries needed for proper management and conservation of fisheries resources of Lagos lagoon.

Key words: Season, species richness, Clupeidae, Salinity

Introduction

Brackish waters are regarded as some of the most productive aquatic ecosystems in the world, and are of great socio-economic importance. The Lagos Lagoon system is not an exception with aquatic resources highly diversified and intensively exploited. Out of the three hundred and thirty two (332) fish species belonging to the three categories of fish recorded in the Lagoon systems of the West Africa, seventy-nine (79) species have been documented from the Lagos Lagoon (Durand *et al.*, 1994).

Lagoons of south-western Nigeria are characterized by seasonal fluctuation in salinity (Olaniyan, 1957; Hill and Webb, 1958). Olaniyan (1969) suggested salinity as an ecological factor in the Lagos Lagoon. Other works on the fisheries of Lagoon include, among others, Lawal-Are (2001), Lawal-Are and Kusemiju (2000), and Soyinka *et al.*,(2010). However, the actual catch of fish fauna and its composition have changed over the years in the lagoons for various reasons.

The recent works on the composition of fish fauna in south-western Nigerian lagoon concentrated on Epe, Ologe and Badagry Lagoon. There is very little recent quantitative data regarding the Lagos Lagoon based on a comprehensive investigation on ichthyofauna composition, hence a need for studies on the seasonal variations in species abundance, diversity and composition of fish fauna of the Lagos Lagoon.

Study Area:

Lagos Lagoon complex is the largest lagoon systems of the Gulf of Guinea coast in West Africa. It stretches from Cotonou in the Republic of Benin and extends to the fringes of Niger Delta in Nigeria along its 257 km course. The lagoon lies between longitudes 3° 22′ E and 3°4′ E and Latitude 6° 17′ N and 6° 28′ N. The Lagoon is generally shallow with a depth range between 0.3 and 3.2 m with the exception of some dredged parts, notably in the Lagos harbor. Lagos Lagoon and its coast was the study area for this project. Landing sites and fishing villages were identified and determined through surveys and with the aid of digitized Lagos lagoon map (Figure 1).

Materials and Methods

Collection of sample: Samplings were done once a month for Twelve months (January 2013 to December 2013). Fishes were caught by artisanal fishermen, while some were also purchased from fishermen at the stations marked in Figure 1.

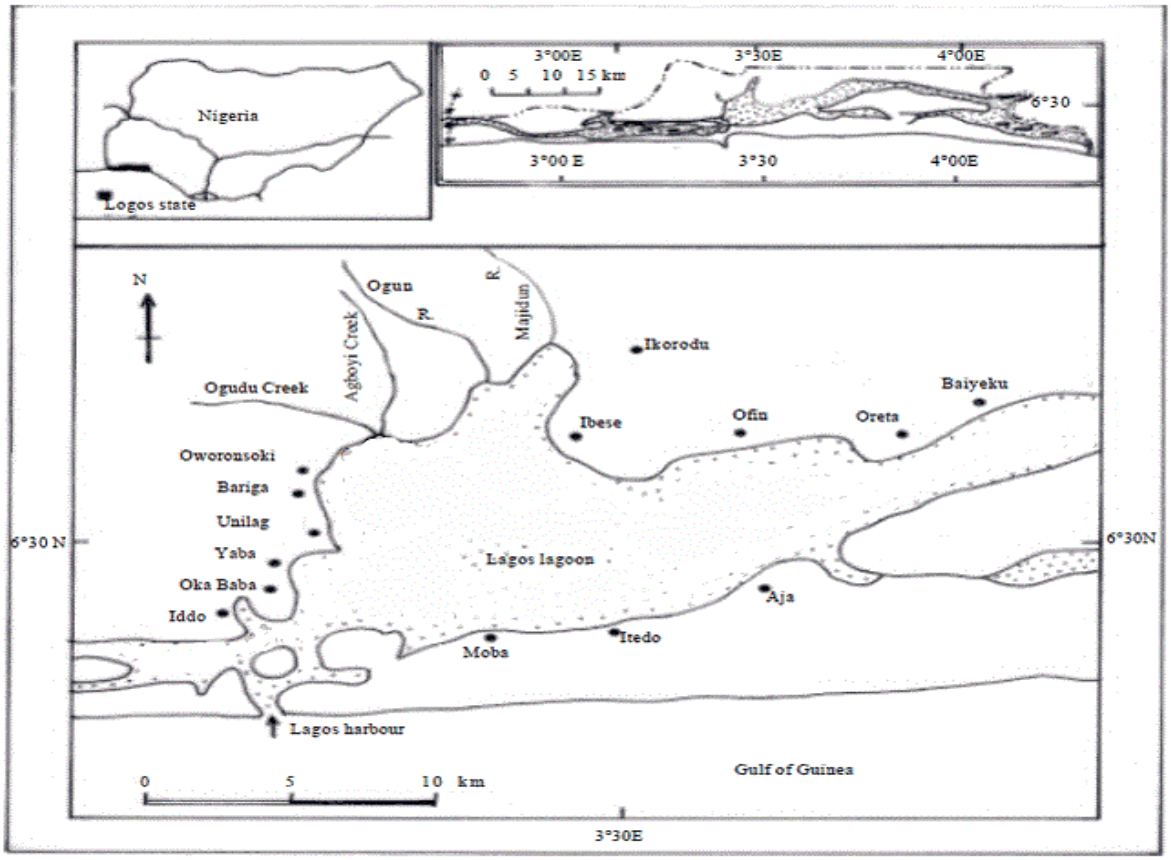

Figure 1: Map of Lagos Lagoon showing the sampling stations

The gear used included cast net, set net and baited hooks through the assistance of local fishers. The fish samples were transferred into ice-chest on the boat and transferred into the deep freezer (temperature -20 °C) at the Marine Biology Laboratory, Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos.

Physico-chemical parameters analysis:

The analysis of physico-chemical parameters; temperature (°C), salinity (ppt (‰)), turbidity (NTU), dissolved oxygen (mg/L) and pH were also carried out in-situ on Lagos Lagoon at the stations marked using Hydrolab HL 002066, made in USA.

Laboratory procedure:

Excess moisture was removed from the preserved fish immediately after thawing and identified to species level using fish identification guides (Schneider, 1990; Idodo-Umeh, 2003; Olaosebikan and Raji, 2013). All the specimens were measured with a 1 m fish measuring board and weighed on a top-loading measuring scale. Update of some species names using Carpenter and De Angelis (2016). All the fish species collected were counted to determine species abundance. Numerical abundance of the fish species was observed and noted. The abundance of each species was estimated according to the following criteria as described by Benech *et al.*,(1983): ≥ 10 % = dominant, 1 to 9 % = subdominant, < 1 % (but caught more than once) = occasional, < 1 % (and caught only once) = rare. The species richness and diversity were determined according to Ogbeibu (2005). Statistical analyses were carried out using Microsoft Excel 2010 and SPSS version 16.

Results

Physico-chemical parameters analysis: The monthly water temperature ranged from 29.09-30.11 °C (mean: 29.38 °C). The monthly salinity content of Lagos Lagoon ranged from 0.93-17.73 ‰ (mean: 7.49 ‰) decreasing sharply in the rainy season. The monthly variation in pH values ranged from 6.87-7.65 with a mean value of 7.17 while the dissolved oxygen of the Lagoon ranged from 4.33-7.6 mg/L with a mean value of 5.49 mg/L and the monthly turbidity ranged from 4.7-6.38 NTU with a mean value of 5.68 NTU. The average monthly variation physico-chemical parameters of Lagos Lagoon are shown in Figure 2.

Fish species composition

A total of 11,332 individuals of fish species made up of juveniles (72 %) and adults (28 %) caught with different fishing gears types in the Lagos Lagoon were identified and classified. They

comprised forty-nine species belong to 28 families. The forty-nine (49) species were *Cynoglossus senegalensis, Sardinella maderensis, Chrysichthys nigrodigitatus, Sarotherodon melanotheron, Mugil cephalus, Eucinostomus melanopterus, Pomadasys jubelini, Ethmalosa fimbriata, Coptodon guineensis, Caranx hippos, Pomadasys peroteti, Elops lacerta, Polydactylus quadrifilis, Liza falcipinis, Lutjanus goreensis, Scomberomorus tritor, Caranx senegallus* and *Hemichromis fasciatus.*

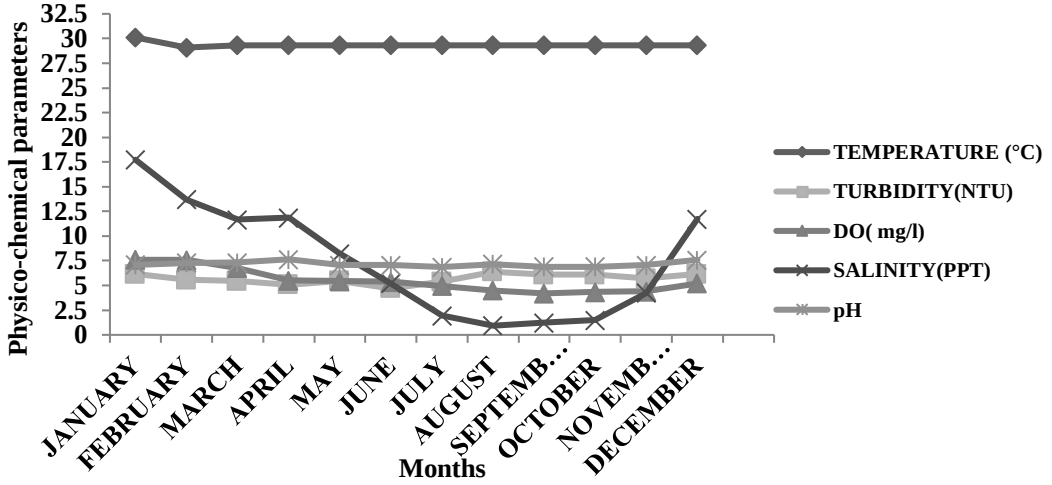

Figure 2: Variation in average monthly physico-chemical parameters of Lagos Lagoon (Jan.-Dec. 2013)

Others were *Hemiramphus braziliensis, Psettias sebae, Pseudotolithus elongatus, Trachinotus teraia, Cynoglossus monodi, Pseudotolithus senegalensis, Sphyareana barracuda, Galeoides decadactylus, Sphyraena quanchanco, Pteroscion pelii, Pseudotolitus epipercus, Citharius linguatula, Sphyraena afra, Lutjanus dentatus, Chloroscombrus chrysurus, Pellonula leonensis, Bathygobius soporator, Strongylura senegalensis, Ephippion guttifer, Caranx crysos, Citharichthys stampflii, Batrachoides liberiensis, Ephinephelus aenus, Cynoglossus browni, Drepane africana, Caranx latus, Uranoscopus albesca, Cynoponticus ferox, Synaptura lusitanica, Ilisha africana* and *Plectorhinchus macrolepis* distributed among 28 families (Table 1).

The family Clupeidae had the highest in terms of weight (112,090 g) and abundance (5,732 individuals) followed by the family Cichlidae with a total weight of 42,983 g and 1,290 individuals. The family with least number were Tetraodontidae, Serranidae, Drepaneidae, Uranoscopidae, Muraenosocidae and Soleidae which were encountered once during the study (Table 1). Two families (Clupeidae and Cichlidae) were the dominant families while 11 families were sub-dominants 15 families occurred occasionally (Table 1).

Ethmalosa fimbriata (3,106) had highest in terms of number of which 80% reported were juveniles. Twelve species occurred only once during the period of study, some of which were *Caranx senegallus, Ilisha africana, Ephippion guttifer, Epinephelus aeneus, Cynoglossus browni* and *Drepane africana* among others (Table 2). *Ethmalosa fimbriata and Chrysichthys nigrodigitatus* were dominant species in Lagos Lagoon. *Sarotherodon melanotheron, Mugil cephalus, Eucinostomus melanopterus, Pomadasys jubelini, Sardinella maderensis, Cynoglossus senegalensis, Coptodon guineensis, Caranx hippos, Pomadasys peroteti, Elops lacerta, Polydactylus quadrifilis, Liza falcipinis* and *Lutjanus goreensis* were sub-dominant species in Lagos Lagoon while *Scomberomorus tritor, Hemichromis fasciatus, Hemiramphus braziliensis, Psettias sebae, Pseudotolithus elongatus, Trachinotus teraia, Sphyareana barracuda, Galeoides decadactylus, Lutjanus dentatus, Chloroscombrus chrysurus, Pellonula leonensis, Bathygobius soporator, Strongylura senegalensis, Pteroscion pelii, Pseudotolitus epipercus, Citharius linguatula, Caranx crysos, Citharichthys stampflii, Batrachoides liberiensis, Uranoscopus albesca, Cynoponticus ferox* and *Synaptura lusitanica* were occasional species in Lagos Lagoon. *Caranx senegallus, Cynoglossus monodi, Pseudotolithus senegalensis, Sphyraena quanchanco, Sphyraena afra, Ephippion guttifer, Ephinephelus aenus, Cynoglossus browni, Drepane africana, Caranx latus, Ilisha africana* and *Plectorhinchus macrolepis* were rare species in Lagos Lagoon.

The largest catch was recorded in the month of May having a total catch weight of 51.05kg followed by the month of July with a total weight of 45.34kg. April had the third largest catch per weight of 44.72kg which happened to be the

on-set of the rainy season. The least catch was recorded in the month of January dry season, with a weight of 4.5kg (Table 3).

The organisms reported in this study were group into three; the first group was the eleven (11) fish species reported to occurred only during the rainy season, and the species were *Bathygobius soporator, Synaptura lusitanica, Caranx crysos, Batrachoidas liberiensis, Strongylura senegalensis, Caranx latus, Cynoponticus ferox, Ephippion guttifer, Pellonula leonensis, Galeoides decadactylus* and *Trachinotus teraia.*

The second group was the seventeen (17) species of fish reported occurred only during the dry season, and the species were *Chloroscombrus chrysurus, Epinephelus aeneus, Pteroscion peli, Plectorhynchus macrolepsis, Lutjanus dentatus, Cynoglossus browni, Liza falcipinnis, Cynoglossus monodi, Ilisha africana, Sphyraena quanchanco, Sphyraena afra, Pseudotolitus epipercus, Uranoscopus albesca, Caranx senegallus, Drepane africana, Hemiramphus braziliensis* and *Pseudotolithus senegalensis* and the third group was fishes caught in the lagoon throughout the year. These included twenty-one (21) species as follows: *Ethmalosa fimbriata, Eucinostomus melanopterus, Citharichthys stampflii, Sarotherodon melanotheron, Scomberomorus tritor, Coptodon guineensis, Pomadasys peroteti, Pseudotolithus elongatus, Citharius linguatula, Chrysichthys nigrodigitatus, Sardinella maderensis, Mugil cephalus, Pomadasys jubelini, Polydactylus quadrifilis, Cynoglossus senegalensis, Sphyareana barracuda, Hemichromis fasciatus, Psettias sebae, Lutjanus goreensis, Caranx hippos,* and *Elops lacerta.*

A total number of 29 species were recorded in June with the highest species richness (3.77) while 4 species were recorded in January which has the lowest species richness (0.64). This is indicated in Table 4.

Table 1: Abundance of fish families by weight (g) and numbers recorded

S/N	Family	Weight (g)	Abundance (Number)
1	Clupeidae	112,090	5,732
2	Pristigasteridae	293	15
3	Cichlidae	42,983	1,290
4	Bagridae	40,504	448
5	Mugilidae	28,779	644
6	Haemulidae	28,027	269
7	Gerreidae	20,200	853
8	Carangidae	18,522	467
9	Cynoglossidae	16,400	237
10	Polynemidae	10,462	217
11	Elopidae	9,556	205
12	Lutjanidae	6,349	96
13	Sciaenidae	4,487	179
14	Scombridae	3,514	69
15	Sphyraenidae	3,019	30
16	Hemiramphidae	2,818	319
17	Monodactylidae	2,448	58
18	Citharidae	945	130
19	Belonidae	394	10
20	Gobiidae	394	22
21	Tetraodontidae	390	1
22	Batrachoididae	225	2
23	Bothidae	203	34
24	Serranidae	92	1
25	Drepaneidae	77	1
26	Uranoscopidae	46	1
27	Muraenesocidae	39	1
28	Soleidae	20	1
Total		**353,276**	**11,332**

Table 2. The species abundance (%) of fish fauna of Lagos Lagoon.

Species	Abundance (%)
Ethmalosa fimbriata	27.41
Chrysichthys nigrodigitatus	11.47
Sarotherodon melanotheron	7.18
Mugil cephalus	6.29
Eucinostomus melanopterus	5.72
Pomadasys jubelini	4.31
Sardinella maderensis	4.27
Cynoglossus senegalensis	4.25
Coptodon guineensis	4.14
Caranx hippos	3.75
Pomadasys peroteti	3.62
Elops lacerta	2.7
Polydactylus quadrifilis	2.67
Liza falcipinnis	1.86
Lutjanus goreensis	1.59
Scomberomorus tritor	0.99
Caranx senegallus	0.86
Hemichromis fasciatus	0.85
Hemiramphus braziliensis	0.8
Psettias sebae	0.69
Pseudotolithus elongates	0.39
Trachinotus teraia	0.37
Cynoglossus monody	0.37
Pseudotolithus senegalensis	0.34
Sphyareana barracuda	0.32
Galeoides decadactylus	0.29
Sphyraena quanchanco	0.28
Pteroscion peli	0.28
Pseudotolithus epipercus	0.27
Citharius linguatula	0.26
Sphyraena afra	0.25
Lutjanus dentatus	0.21
Chloroscombrus chrysurus	0.15
Pellonula leonensis	0.13
Bathygobius soporator	0.11
Strongylura senegalensis	0.11
Ephippion guttifer	0.11
Caranx crysos	0.09
Citharichthys stampflii	0.07
Batrachoides liberiensis	0.06
Ephineperus aenus	0.03
Cynoglossus browni	0.03
Drepane Africana	0.02
Caranx latus	0.01
Uranoscopus albesca	0.01
Cynoponticus ferox	0.01
Synaptura lusitanica	0.01
Ilisha Africana	0.01
Plectorhynchus macrolepsis	0.01

Table 3: Seasonal catch weights recorded per season

RAINY SEASON		DRY SEASON	
MONTHS	WEIGHT (g)	**MONTHS**	**WEIGHT**
May	51,005	January	4,513
June	43,494	February	23,055
July	45,034	April	44,725
Aug	14,761	March	35,522
September	27,034	November	32,441
October	15,608	December	16,084
TOTAL	**196,936**	**TOTAL**	**156,340**

Table 4: Species diversity and richness estimated per month

PARAMETERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Number of Species	4	22	21	21	25	29	28	15	23	12	20	21
Numerical Abundance	110	519	939	994	1617	1677	1411	577	1117	817	942	612
Species Diversity	0.77	1.95	1.78	2.35	2.10	2.03	2.35	0.94	1.69	0.87	1.92	1.72
Species Richness	0.64	3.36	2.92	2.90	3.25	3.77	3.72	2.20	3.14	1.64	2.78	3.12

Discussion

The variation of all the physico-chemical parameters with seasons in the lagoon has been attributed to the influence of salinity (Olaniyan, 1969; Ayoola and Kuton, 2009) and the temperature fluctuation is slightly seasonal in nature. However, changes as observed in this study was that apart from the month of January which was high, others were not statistically significantly difference ($p<0.05$). High water temperatures recorded during the study are typical for the region (Fagade and Olaniyan, 1974).

The increase in salinity in the dry season was probably due to the influence of Lagos harbour, which caused a saline condition in the lagoon although with a reduced influence over a long distance. Low salinity was due to the slight influence of the flood during the rainy season when there was mixing of saline water with the large volume of freshwater discharge from rivers into the Lagos lagoon. From the pH values recorded, the water was relatively neutral and sometime slightly alkaline which was as result of influences of the sea and the flood waters from the rivers. The dissolved oxygen values of 4.33 to 7.60 in this study were similar to the 1.20 to 9.40 reported by Edokpayi and Osimen (2001) in Ekpoma. According to USDA (1992), the level of oxygen depletion depends primarily on the amount of waste added, size and the temperature of the water. The turbidity mean values in this study were still in the range of acceptable limits of 5FTU for natural water according to Akponine and Ugwumba (2014).

The lagoon was relatively habitable for several species. Durand *et al.*,(1994) documented seventy-nine (79) species from the Lagos Lagoon; seventy-two (72) species of thirty-four families reported by Fagade and Olaniyan (1974) with additional seven species from 48 species recorded by Williams (1962) which were not caught during Fagade and Olaniyan (1974) study while forty-nine (49) species distributed among twenty-eight families were recorded in this study. Despite that number of species (49) recorded in this study is different from the previous reports from Lagos Lagoon; the record showed the species richness in the lagoon of tropical climate as that of Nigeria. However, when this was compared to reports on other lagoons of South-western Nigeria such as Olukolajo and Oluwaseun (2008) of 25 species (16 Families) of Ologe Lagoon, Soyinka *et al.*,(2010) of 37 species (21 Families) of Badagry Lagoon, and Soyinka and Ebigbo (2012) of 32 species (27 Families) of Epe Lagoon.

Breber (1996) opined that there is high species richness in warm waters as compared with cold waters. The species richness observed in the Strymon estuarine system was high while 43 species was so far the highest recorded in the Mediterranean (Koutrakis *et al.*, 2000). The reduction in species abundance could be attributed

to increase in fishing, dredging and other anthropogenic activities in the Lagos Lagoon.

Observations from this study indicated that the majority of marine species recorded during the dry season occurred once during the study. However, the wet season was typically the period of the highest fish abundance as well as the period of highest catches and the period of the highest species richness and species composition. The present study showed that a large number of marine species are migrating to Lagos Lagoon with less saline conditions compare to the sea whereas only few fresh water species are moving from the rivers to Lagos Lagoon. Emmanuel and Osibona (2013) reported wet season as the period of the highest fish abundance and species richness in Lekki Lagoon as well as the period of highest population densities of juvenile species.

Like other brackish-water species, only the immature stages of marine species occurred in the Lagos Lagoon. The sexually mature stages are found in the sea. The juvenile stages of many marine species are known to be able to live in water of reduced salinity (Fagade and Olaniyan, 1974). Some of the species found occurring throughout the year in the Lagos Lagoon reported by Fagade and Olaniyan (1974) were also reported in this study. These species include *Ethmalosa fimbriata, Eucinostomus melanopterus, Sarotherodon melanotheron, Coptodon guineensis, Chrysichthys nigrodigitatus, Hemichromis fasciatus, Psettias sebae, Lutjanus goreensis, Caranx hippos,* and *Elops lacerta* which were able to tolerate variations in salinity and other physical features.

Synaptura lusitanica Caranx crysos, Batrachoides liberiensis, Strongylura senegalensis, Caranx latus, Cynoponticus ferox, Ephippion guttifer, Galeoides decadactylus and *Trachinotus teraia* which are marine species, were caught in the Lagos Lagoon during the rainy season. Due to the relationship between the sea and inland waters, the lagoon is characterized by environmental unpredictability. The lagoon supported a high diversity of fish species of fresh, brackish and marine water origins. The fish species must have had ability to adapt and cope with the variable conditions (salinity and temperature) of the lagoon. The interaction between fish and its habitat (physical as well as biological characteristics) might be factors in predicting changes in overall abundance, breeding population size and other aspects of population structure (Koutrakis *et al.*, 2000). The decrease in number of species (49) recorded for Lagos Lagoon in this study indicated that the activities going on Lagos lagoon is having tremendous effect on it.

Conclusions

In conclusion, the species of fish fauna of Lagos Lagoon has reduced tremendously. Perhaps the species richness could have been higher save the extent of disturbance through anthropogenic activities on the Lagoon. Therefore, it is expected that necessary measures be put in place to avert the progressive reduction of fish species in Lagos Lagoon. The results from this work will be a useful contribution to the current knowledge of fisheries needed for proper management and conservation of fisheries resources of Lagos lagoon.

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