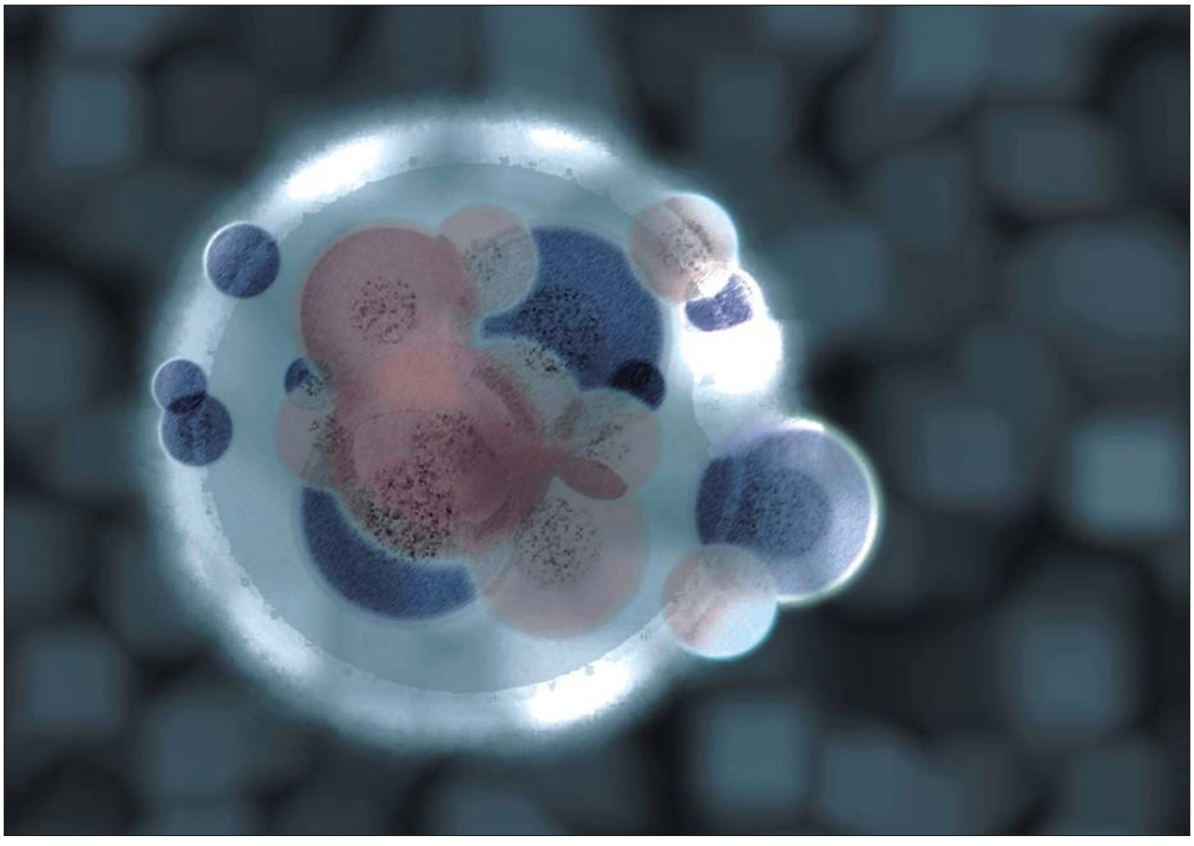

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Fish Assemblage of Majidun Creek, Lagos, Nigeria

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Abstract: The fish species assemblage and diversity of Majidun Creek, Lagos, Nigeria was investigated between January and December, 2010 to provide necessary baseline information that will help to maximize the sustainability of its fishery. Fish were collected with gill and cast nets. Associated environmental parameters such as water temperature and salinity were determined using mercury-in-glass thermometer and salinometer respectively. The specimens were sorted to the lowest taxonomic level and identified with identification manuals. Species diversity was determined by Simpson's index while dominance and evenness by Shannon-Weiner index of diversity. The species assemblage comprised 517 individuals from 18 families, 8 orders, 20 genera and 23 species of fin and shell fishes. The dominant species were *Sardinella aurita*, *Elops lacerta*, *Caranx hippos* and *Mugil cephalus* with 256, 90, 59 and 29 individuals representing 49.52, 17.41, 11.41 and 5.61% of total fish catch respectively. The diversity indices' estimates were Simpson's Index (D) = 0.292, Simpson's Index of diversity (1-D) = 0.708, Simpson's Reciprocal Index (1/D) = 3.423, Shannon-Weiner Index (H) = 1.799, Shannon's equitability ($_eH$) = 0.574, Evenness (E) = 0.263 and Margalef Index (Dmn) = 3.52. Salinity and rainfall greatly influenced the species richness and diversity. High number of juvenile fish in this study is as indication that the creek served as a veritable spawning, breeding or feeding ground for freshwater and marine species. This study is an important contribution to fisheries of this creek where there is paucity of information concerning its fishes and fisheries.

Key words: Shannon-Weiner index, composition, abundance, diversity, equitability

INTRODUCTION

Nigeria is a country blessed with diverse aquatic habitats such as rivers, lakes, creeks and seas. Temperature, rainfall, salinity, pH and dissolved oxygen are the major environmental factors with great influence on these habitats. Human activities like crude oil exploitation, mining and transportation also have serious negative impact especially on fisheries of these water bodies.

The vast Nigerian estuarine systems support commercially important freshwater and marine fishes. However, fishery resources are on the decline due to over exploitation and inadequate management of her inland and coastal waters (Lawson and Olusanya, 2010). For sustainability of these resources, an adequate knowledge of species composition, diversity and relative abundance of her water bodies must be understood and vigorously pursued. A perfect understanding of the ichthofaunal diversity of an estuarine system is an essential prerequisite for successful implementation of fisheries development, sustainable utilization of fishery resources and for adopting suitable conservation measures (Bijukumar and Sushama, 2000). The yields of most of these inland waters are generally on decline due to environmental degradation (such as water pollution) and improper or poor management of fisheries resources (Jamu and Ayinla, 2003). Accounts relating to fish fauna, species richness, abundance, composition and distribution in some regional water bodies of the world have been documented by Adite and Winemiller (1997), Bijukumar and Sushama (2000), Laleye *et al.* (2003), Vidy *et al.* (2004), Gratwicke and Speight (2005), Ramsundar (2005), Zhao *et al.* (2006), Vukovic *et al.* (2008) and Carbajal-Fajardo *et al.* (2009). Reed *et al.* (1967) reported 160 fish species in the Northern region of Nigeria. Ita (1993) listed 230 species in 34 well-known rivers, lakes and reservoirs which constitute about 12% of Nigeria's total surface area put at 94 185 000 hectares. Lawson and Olusanya (2010) in their study on tributaries of Ore River documented 310 individuals comprising 10 families, 10 genera and 11 fish species, while Soyinka *et al.* (2010) provided a comprehensive report on seasonal distribution and richness of fish in Badagry Lagoon, Nigeria. However, in Majidun creek, Nigeria there was paucity of information regarding its fish

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and fisheries. The current study is the first detailed description of its fish assemblage and diversity. The findings provide necessary baseline information in order to maximize the sustainability of the fishery in this important creek.

MATERIALS AND METHODS

Description of Majidun creek: Majidun Creek is relatively a small, narrow and shallow water body. It lies within latitudes 3°48'E and 4°48'E and stretches between longitudes 6°61'N and 7°12'N. It is one of the numerous aquatic habitats that constitute Lagos lagoon complex. Others adjourning include Ologe, Lagos, Lekki and Epe lagoons; Yewa and Ogun rivers; Badagry and Ogudu creeks. However, Majidun creek drains directly into Lagos Lagoon and empties into the Atlantic Ocean via Lagos Harbour. It is a narrow and shallow creek with average depth of 3 m. It is of importance to artisanal fisheries, transportation, sand mining and logging activities. Major source of water into the creek is from Ogun River. Due to seasonal distribution of rainfall, the creek experiences seasonal flooding which introduces a lot of detritus, domestic and industrial wastes and pollutants from the mainland.

The shore of the creek is denticulate and surrounded with forest, typical of those found in the mangrove swamps and brackish water system. Its major biotopes include the mangroves (*Rhizophora racemora*, *Avicennia nitida*); the sedges (*Cyperus articulatus*, *C. papyrus* and *Paspalum vaginatum*); the ferns (*Achrosticum* sp., *Marsilea* sp., *Cyclosorus* sp. and *Ceratopleris* sp.) and the palms (*Pandanus candelabrum*, *Raphia hookeri* and *Phoenix reclinata*).

Collection of samples and field procedures: Fish specimens were caught from Majidun creek between January and December 2010. Gears used for their collected included baited non return valve traps (for cryptobenthic fishes), cast nets (12-22 mm mesh sizes) and gill nets (18-45 mm mesh sizes) for collection of specimens at different depths and two motorized canoes as crafts. Services of local fishermen were also employed. Gears were carefully set to maximize the number of species captured, species not captured after extensive sampling were assumed to be absent or so rare as to be of minimal ecological importance. Rare species were retained; their exclusion according to Goodall (1969) reduces the chances of distinguishing communities represented by a few samples only.

In the field, specimens were fixed in 10% formaldehyde buffer solution. Surface water temperature and salinity were determined with mercury-in-glass thermometer and salinometer respectively, while data on rainfall for Majiudun area of Lagos were obtained from Nigeria Meteorological (NIMET) Department of the Ministry of Aviation, Oshodi, Lagos, Nigeria.

Laboratory procedures: Fixed specimens were transported to Research laboratory of the Department of Fisheries, Lagos State University, Lagos for further investigations. The specimens were removed from the formaldehyde, rinsed with tap water and mopped with cleaned and dried clothes.

The specimens were sorted to lowest taxonomy level and identified following Reed *et al.* (1967), FAO (1990), Oguzie (1997), Schneider (1990) and Olaosebikan and Raji (1998). The fishing gears were identified with reference to Catalogue of Small Scale Fishing Gears in Nigeria by FAO (1994).

The biometric data Such Total Length (TL) and Body Weight (BD) measurements were obtained for individual fish, standard measuring tape was used to determine TL with snouts facing left and Sartorious balance (model: 1106) for BD. TL was measured to the nearest 0.01 cm and BD to the nearest 0.01 g.

Statistical analysis: Number of individuals (n) of a species was determined monthly from pools of the weekly collections. The sample size (N) was the sum total of all individuals of the different species encountered in the study:

$$N = \Sigma (n_1+n_2+n_3+n_4+\ldots\ldots\ldots\ldots+n_i)$$

where, 1, 2, 3, 4,…… and i are index numbers for species 1, 2, 3, 4…….. and i of the sample.

The frequency of abundance was the percentage of the number of individuals that made up of each species relative to total number of individuals of all fish species that were encountered in the study. Thus:

$$\text{Frequency of abundance} = n\times\frac{100\%}{\Sigma(n_1+n_2+n_3+n_4+\ldots\ldots\ldots\ldots+n_i)}$$

or:

$$= n\times\frac{100\%}{N}$$

Species biomass was taken as total weight of individuals of a species while the percentage biomass was percentage of each species biomass relative to sum total biomass of all fish species encountered in this study. Thus:

$$\text{Biomass} = \frac{\text{Total biomass of individuals of a species}}{\text{Sum total biomass of all fish species encountered}}\times 100\%$$

The occurrence of fish species in this study was described using a subjective acronym (COR): (C) common or (O) occasional or (R) rare species. Common, when a species occurred above 20 individuals; occasional, when often below 20 individuals and rare, when not found often usually less than 10 individuals.

Fish diversity, a measure of species richness and evenness of their distribution were undertaken through the following indices:

- Simpson's Index (D) = -Σn(n-1) /N(N-1)
- Simpson's Index of Diversity = (1-D)
- Simpson's Reciprocal Index = (1/D)
- Shannon Diversity Index (H) = Σpilnpi
- Shannon's Equitability (E_H) = H/lnS
- Evenness (E) = e^H/S
- Margalef Index (Dmn) = (S-1)/log (N)

where, N is Total number of organisms of all species found, n is number of individuals of a particular species, D is diversity index, i is an index number for each species present in a sample, pi = ni/N is the number of individuals within a species i divided by the total number individuals (N) present in the entire sample. ln is natural log, Σ is sum the values for each species and S is total number of species.

All the statistical analyses were considered at significance level of 5% ($p<0.05$).

The Statistical Package for Social Sciences (SPSS, version 16) and Microsoft Office Excel software were also implored in this study.

RESULTS

Environmental parameters of Majidun creek: Temperature, salinity and rainfall profile of Majidun creek is presented in Fig. 1. Water temperature varied between 27.0 in January and 28.6°C in February 2010 with mean value of 27.53±0.27°C. The monthly variations in temperature were not significantly different ($p = 0.05$) in this creek.

The salinity was as low as 0.20‰ in July and August and was at its peak (16.80‰) in May 2010. The mean value was 6.92±1.93‰.

The rainfall ranged from 40 mm in January to 336 mm in July 2010 (Mean = 130.25±27.82 mm). Rainfall data showed distinct dry and wet seasons, former was a period of harmattan and was characterized by low or scanty rains. Dry months included January-April, November and December 2010 when rainfall was between 40 and 77 (54.33±15.95 mm). The wet months were May-October 2010, when rainfall ranged from 100 to 336 (206.17±79.59 mm). The average salinities for dry and wet seasons were 10.41±5.14 and 3.43±6.57‰, respectively.

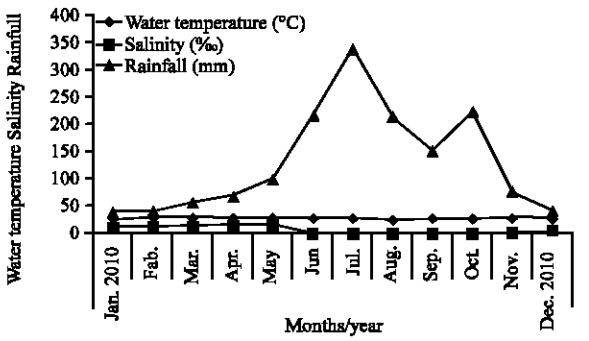

Fig. 1: Water temperature, salinity and rainfall profile of Majidum creek Logos, Nigeria

Species composition: Species composition of Majidun creek (Table 1) comprised some fin and shell fishes, most of which originated from freshwater and marine environments. A total of 517 individuals comprising 8 orders from 18 families, 20 genera and 23 species of bony and shell fishes were encountered.

Species composition consisted three categories of fish that included:

- Species that occurred in dry season only when water temperatures were 27.0-28.6 (27.98±0.54°C); salinity, 2.25-16.8 (10.41±5.14‰) and rainfall, 40-77 (54.33±15.95 mm). Three (3) species were represented in this season. These included: *Trachinotus teraia*, *Psettias sebae* and *Chrysichthys aluuensis*
- Species that occurred in wet season when water temperature was between 25.1 and 28.2(27.08±1.04°C), salinity, 0.20-16.8 (3.43±6.57‰) and rainfall, 100-222 (206.17±79.58 mm). There were seven species in this category. *Hydrocynus forskalii*, *Sierrathrissa leonensis*, *Plesiopenaeus edwardsianus*, *Sarotherondon melanotheron*, *Eleotris vittata*, *Bathysolea lactea* and *Schilbe intermedius* were included in this category
- Species that appeared in both seasons when mean temperature was 27.5±0.27°C, salinity, 6.92±1.93‰ and rainfall, 130.25±27.82 mm. These included 13 species as follows: *Sardinella aurita*, *S. maderensis*, *Callinectes pallidus*, *Elops lacerta*, *Mugil cephalus*, *Caranx hippos*, *Eleotris senegalensis*, *Eucinostomus melanopterus*, *Pomadasys peroteti*, *Pseudolithus elongatus*, *Scomberomorus tritor*, *Sphyraena afra* and *Chrysicthys nigrodigitatus*. They were species found inhabiting this creek throughout the year

Table 1: Species composition of Majidun Creek, Lagos, Nigeria

Order	Family	Genus	Species	Habitat status
Characiformes	Characidae	*Hydrocynus*	*H. forskalii*[b]	Freshwater
Clupeiformes	Clupidae	*Sardinella*	*S. aurita*[a,b]	Marine
			S. maderensis[a,b]	
		Sierrathrissa	*S. leoneusis*[b]	Marine
Decapoda	Aristeidae*	*Plesiopenaeus*	*P. edwardsianus*[b]	Marine
	Portunidae**	*Callinectes*	*C. pallidus*[a,b]	Marine
Elopiformes	Elopidae	*Elops*	*E. lacerta*[a,b]	Marine
Mugiliformes	Mugilidae	*Mugil*	*M. cephalus*[a,b]	Marine
Perciformes	Carangidae	*Caranx*	*C. hippos*[a,b]	Marine
		Trachinotus	*T. teraia*[a]	Marine
	Cichlidae	*Sarotherodon*	*S. melanoteron*[b]	Freshwater
	Eleotridae	*Eleotris*	*E. senegaleusis*[a,b]	Freshwater
			E. vitata[b]	Freshwater
	Gerreidae	*Eucinostomns*	*E. melanopterus*[a,b]	Marine
	Haemulidae	*Pomadasys*	*P. peroteti*[a,b]	Marine
	Monodactylidae	*Psettias*	*P. sebae*[a]	Freshwater
	Sciaenidae	*Pseudotolithus*	*P. elongatus*[a,b]	Marine
	Scombridae	*Scomberomorus*	*S. tritor*[a,b]	Marine
	Sphyranidae	*Sphyraena*	*S. afra*[a,b]	Marine
Pleuronectiformes	Soleidae	*Bathysolea*	*B. lacted*[b]	Marine
Siluriformes	Bagridae	*Chrysichthys*	*C. nigrodigitatus*[a,b]	Freshwater
			C. aluueusis[a]	
	Schilbeidae	*Schilbe*	*S. intermedius*[b]	Freshwater

[a]Represents dry season (January-April and November-December) [b]Represents wet season (June-October) *Gamba shrimp, **Swimming crab

Table 2: Summary of the species abundance of Majidun Creek, Lagos, Nigeria

Family	Species	Abundance	Frequency of abundance (%)
Bagridae	*C. nigrodigitatus*	2	0.39
	C. aluueusis [f]	6	1.16
Carangidae	*C. hippos* [m]	59	11.41
	T. teraia [m]	2	0.39
Characidae	*H. forskalii* [f]	1	0.19
Cichlidae	*S. melanoteron* [f]	6	1.16
Clupeidae	*S. aurita* [m]	256	49.52
	S. madereusis [m]	2	0.39
	S. leonensis [m]	2	0.39
Elopidae	*E. lacerta* [m]	90	17.41
Eleotridae	*E. senegalensis* [f]	3	0.58
	E. vittata [f]	3	0.58
Gerreidae	*E. melanopterns* [m]	5	0.97
Haemulidae	*P. peroteti* [m]	5	0.97
Monodactylidae	*P. sebae* [f]	2	0.39
Mugilidae	*M cephalus* [m]	29	5.61
Schilbeidae	*S. intermedius* [f]	1	0.19
Sciaenidae	*P. elongatus* [m]	6	1.16
Scombridae	*S. tritor* [m]	5	0.97
Soleidae	*B. lactea* [m]	9	1.74
Sphyranidae	*S. afra* [m]	5	0.97
Aristeidae*	*P. edwardsianus* [m]	8	1.55
Portunidae**	*C. pallidus* [m]	10	1.93
N		517[N]	100.00

[N]Sample size, *Gamba shrimp, **Swimming crab, [m]Marine species, [f]Freshwater species

The most dominant order was perciformes and was represented by families Carangidae, Cichlidae, Eleotridae, Gerreidae, Haemulidae, Monodactylidae, Sciaenidae, Scombridae and Sphyranidae. Orders Characiformes, Clupeiformes, Elopiformes, Mugiliformes and Pleuronectiformes, the least dominant were represented by families Characidae, Cluipeidae, Elopidae, Mugilidae and Soleidae, respectively.

The most dominant family, Cluipeidae was represented by *Sardinella aurita*, *S. maderensis* and *Sierrathrissa leonensis*. The least dominant families (species) were Carangidae (*C. hippos* and *T. teraia)*, Eleotridae (*E. senegalensis* and *E. vitata*) and Bagridae (*C. nigrodigitatus* and *C. aluuensis*).

Eight species of freshwater origin and 15 from marine environments inhabited Ogudu Creek. However, species such as frill fin goby, *Bathygobius soporator* and mudskipper, *Periophthalmus papilio* that are indigenous of brackish water were absent from the creek.

Species abundance: Summary of the Species abundance of fish in Majidun creek, Lagos, Nigeria is presented in Table 2. Clupeidae was the most abundance family of fish in Majidun creek, *Sardinella aurita* was the most

Table 3: Summary of the species biomass of Majidun Creek, Lagos, Nigeria

Family	Species	No. caught (n)	Biomass (g)	Biomass(%)
Bagridae	*C. nigrodigitatus*[f]	2	546.85	3.49
	C. aluueusis [f]	6	177.42	1.13
Carangidae	*C. hippos* [m]	59	1063.73	6.78
	T. teraia [m]	2	27.01	0.17
Characidae	*H. forskalii* [f]	1	79.61	0.51
Cichlidae	*S. melanoteron* [f]	6	162.41	1.04
Clupeidae	*S. aurita* [a,b]	256	5863.18	37.38
	S. madereusis [m]	2	87.35	0.56
	S. leonensis [m]	2	5.36	0.03
Elopidae	*E. lacerta* [m]	90	4107.31	26.19
Eleotridae	*E. senegalensis* [f]	3	92.67	0.59
	E. vittata [f]	3	149.89	0.96
Gerreidae	*E. melanopterns* [m]	5	131.34	0.84
Haemulidae	*P. peroteti* [m]	5	224.94	1.43
Monodactylidae	*P. sebae* [f]	2	47.15	0.3
Mugilidae	*M. cephalus* [m]	29	1139.59	7.3
Schilbeidae	*S. intermedius* [f]	1	24.7	0.16
Sciaenidae	*P. elongatus* [m]	6	118.59	0.76
Scombridae	*S. tritor* [m]	5	196.34	1.25
Soleidae	*B. lactea* [m]	9	97.59	0.62
Sphyranidae	*S. afra* [m]	5	689.52	4.4
Aristeidae*	*P. edwardsianus* [m]	8	117.46	0.75
Portunidae**	*C. pallidus* [m]	10	533.49	3.40
		517	15, 683.5	100.0

[N]Sample size, *Gamba shrimp, **Swimming crab, [T]Total biomass, [m]Marine species, [f]Freshwater species

dominant species and it consisted of 49.52% of the fish population. Of the clupeids, *S. maderensis* and *Sierrathrissa leonensis* contributed 0.39% each. Families Elopidae and Carangidae contributed 17.41 and 11.80%, respectively. *H. forskalii* and *S. intermedius* of the families Characidae and Schilbeidae respectively were the least abundant species, each contributing 0.19% of the fish population.

Species biomass: Table 3 presents summary of the species biomass of Majidun Creek, Lagos, Nigeria. Total body weight rather than the number of individuals of a species was determinant of biomass of fish in this study. There were variations in biomass from one species or family to another. Biomass varied between 0.16% in *S. intermedius* and 37.38% in *S. aurita*. *C. hippos* with 59 individuals produced 6.78% while *M. cephalus* with 29 recorded higher biomass of 7.27%. Species such as *E. melanopterus*, *P. peroteti*, *S. tritor* and *S. afra* each with 5 individuals produced biomass of 0.84, 1.43, 1.25 and 4.4%, respectively. The eleotrids, *E. senegalensis* and *E. vitata*, each with 3 individuals produced 0.59 and 0.96% biomass, respectively.

Species occurrence: Summary of the Species Occurrence of Majidun creek is given in Table 4. Of the 517 individuals and 23 species that were encountered in the study, 434 individuals (from 4 species), 10 individuals of a species (*C. pallidus*) and 73 individuals representing 18 species were categorized as common, occasional and rare species, respectively. Common species are *S. aurita*, *E. lacerta* and *C. hippos* and *M. cephalus* with 256, 90, 59 and 29 individuals representing 49.52, 17.41, 11.41 and 5.61% of total fish catch respectively. The only occasional and rare species represented 1.93 and 14.12% of the fish population, respectively.

Species diversity indices: Table 5 presents diversity indices of fish species in Majidun Creek. The indices estimates were Simpson's Index (D) = 0.292, Simpson's Index of diversity (1-D) = 0.708, Simpson's Reciprocal Index (1/D) = 3.423, Shannon-Weiner Index (H) = 1.799, Shannon's equitability (EH) = 0.574, Evenness (E) = 0.263, Margalef Index (Dmn) = 3.52. These were indications of high diversity and unevenness of fish species in Majidun creek.

DISCUSSION

The slight seasonal variations in water temperatures (27.98±0.54 for dry and 27.08±1.04°C for wet) in the creek were not differ significantly. The temperatures were typical of tropical and subtropical waters of the world. Higher water temperature of 20.0-30.50 (28.07±0.18°C) was reported by Lawson (2011) in mangrove swamps of the neighbouring Lagos lagoon that drains this creek. These values are within the acceptable levels for survival, metabolism and physiology of aquatic organisms in tropical and subtropical regions.

Table 4: Summary of the species occurrence of Majidun Creek, Lagos, Nigeria

		Occurrence		
Family	Species	Common (C)	Occasional(O)	Rare (R)
Bagridae	*C. nigrodigitatus*			*6 (1.16)
	C. aluuensis			*2 (0.39)
Carangidae	*C. hippos*	*59 (11.41)		
	T. teraia			*2 (0.39)
Characidae	*H. forskalii*			*1 (0.19)
Cichlidae	*S. melanoteron*			*6 (1.16)
Clupeidae	*S. aurita*	*256 (49.52)		
	S. leonensis			*2 (0.39)
	S. maderensis			*2 (0.39)
Elopidae	*E. lacerta*	*90 (17.41)		
Eleotridae	*E. senegalensis*			*3 (0.58)
	E. vittata			*3 (0.58)
Gerreidae	*E. melanopterns*			*5 (0.97)
Monodactylidae	*P. sebae*			*2 (0.39)
Mugilidae	*M. cephalns*	*29 (5.61)		
Haemulidae	*P. peroteti*			*5 (0.97)
Schilbeidae	*S. intermedins*			*1 (0.19)
Sciaenidae	*P. elongates*			*6 (1.16)
Scombridae	*S. tritor*			*5 (0.97)
Sphyranidae	*S. afra*			*5 (0.97)
Soleidae	*B. lactea*			*9 (1.74)
Aristeidae*	*P. edwardsianus*			*8 (1.55)
Portunidae**	*C. pallidus*		*10 (1.93)	
Sample size		434 (83.95)	10 (1.93)	73(14.12)

Values represents percentage of individuals species, **Swimming crabs, *Gamba shrimp

Table 5: Diversity indices of fish species in Majidun Creek, Lagos Nigeria

Diversity index	Values
Number of species	23
Number of individuals	517
Simpson's index (D) = --Σ(n-1)/N(N-1)	0.292
Simpson's index of diversity = (1-D)	0.708
Simpson's reciprocal index = (1/D)	3.423
Shannon-weiner index (H) = -Σpi ln pi	1.799
Shannon's equitability (E_H) = H/ln S	0.574
Evenness (E) = eH/S	0.263
Margalef Index (Dmn) = S-1/ln N	3.52

N: Total number of organisms of all species found, n: No of individuals of a particular specie, D: Diversity index, i = an index number for each species present in a sample, pi = ni/N = the number of individuals within a species (ni) divided by the total number individuals (N) present in the entire sample. ln = natural log, Σ: Sum the values for each species

The salinities of 0.20 to 16.80‰ recorded in the present study are indication that Majidun creek is a low brackish water environment. These are typical of creeks, estuaries, lagoons and mangrove swamps that associated with brackish waters. Similar salinity regimes (0.2-16.75, 8.995±0.01‰) were documented in Lawson (2011) in Lagos lagoon. These in addition fell within what were reported by Edokpayi *et al.* (2008, 2010). Furthermore 1.2-4.6‰ was reported in Ologe lagoon by Olukolajo and Oluwaseun (2008) and 1.0 to 8.0‰ in Badagry creek by Soyinka *et al.* (2010). The salinity of the water within the estuary tells us how much fresh water has mixed with sea water.

The rainfall data of 40-336 (130.25±27.82 mm) were also typical of tropical and subtropical regions that are characterized by heavy rainfall. Patterns of rainfall indicated two distinct periods of wet and dry seasons of six months each, while the former was characterized by heavy rains of 100-330 (206.17±79.59 mm between May-October, 2010 and the latter by the scanty or low rains of January-April, November and December 2010 when rainfall was 40-77 (54.33±15.95 mm). These values were within 2.4-460.9 (149.53±37.39 mm) that were reported by Lawson (2011) in the mangrove swamps of Lagos lagoon. In the present study, fish species assemblage comprised 517 individuals from 8 orders, 23 families and 23 species (Table 1). The most dominant and diverse species was the clupeid, *Sardinella aurita* which constituted 49.52% of the total fish catch (Table 2) and 5863.18 g by body weight (Table 3). Of these, the crabs (*Callinetes pallidus*) and shrimps (*Plesiopenaeus edwardsianus*) were the representatives of the families Portunidae and Aristeidae, respectively. This creek's fish species richness was a departure from what obtained in the neighbouring water bodies but with a similar or related species and families (Fagade and Olamiyan, 1974; Solarin and Kusemiju, 1991; Kumolu-Johnson, 2004; Olukolajo and Oluwaseun, 2008; Soyinka *et al.*, 2010; Agboola and Anetekhai, 2008; Agboola *et al.*, 2008). Olukolajo and Oluwaseun (2008) reported 25 species distributed among 16 families from the neighbouring Ologe lagoon. Soyinka *et al.* (2010) documented 795 individuals representing 37 fish species and 21 families from Badagry creek. In Niger Delta areas, 37 species and 15 families were documented in Lower Nun River by Sikoki *et al.* (1998) and Abowei (2000) accounted for a total of 22 species and 11 families of fishes from Brass River

and Ezekiel *et al.* (2002) gave an account of 25 species from 16 families in Odhiokwu-Ekpeye floodplains. In the neigbouring West Africa countries, Baran (1995) reported values ranging from 52 in Gambia to 153 species in Cote d'Ivoire. In Lake Nokoue, Benin Republic, 35 species belonging to 20 families, with Mugilidae being the most important family were reported by Adite and Winemiller (1997). A total of 4366 individuals, comprising 47 species and representing 26 families were reported in the creeks of the Gambia estuary by Vidy *et al.* (2004). 62 fish species from 48 genera and 30 families were identified by Rodriguez-Romero *et al.* (2011) in the coastal (mangrove) of Baja California Sur, Mexico.

The marine species dominated both in species richness (15 species) and number (95.36% of total catch). This assemblage tends to follow a typical classical estuary pattern and an indication that marine fish migrate inshore, a low brackish water to spend or complete parts of their life cycle. This was also supported by Albaret and Diouf (1994) and Vidy *et al.* (2004). Leveque *et al.* (1992) reported some marine fish species in western African lagoons and lower rivers of coastal basins.

The Cluipeidae (50.29%), Elopidae (17.41%), Carangidae (11.80%) and Mugilidae (5.61%) were marine and diverse families in the present study. These families consist of euryhaline species that are highly migratory. Their representatives: *Sardinella aurita*, *Elops lacerta*, *Caranx hippos* and *Mugil cephalus* are often found in West African lagoons and sometimes in the lower rivers of coastal basin (Leveque *et al.*, 1992). Presence of highly migratory marine fishes such as *Eucinostomus melanopterus* (Gerreidae), *Pomadasys peroteti* (Haemulidae), *Scomberomorus tritor* (Scombridae) and *Sphyraena afra* (Sphyranidae) and the less diverse Gamba shrimp, *Plesiopenaeus edwardsianus* (Aristeidae), swimming crab, *Callinectes pallidus* (Portunidae) and freshwater Tigerfish, *Hydrocynus forskalii* (Characinidae) signifies remarkable species diversity and important of this creek in fisheries. The freshwater species (8 species) were fewer both in number and species richness in Majidun creek; this was in contrast to what obtained from some water bodies in Lagos waters. For example 12 freshwater species were reported from Ologe lagoon byOlukolajo and Oluwaseun, 2008, 13 from Badagry creek by Soyinka *et al.* (2010) and 10 from River Ore by Lawson and Olusanya (2010). Unlike some marine species which migrate upstream (inshore), few freshwater fishes migrate downstream from rivers to more saline lagoon, this reason might account for the presence of few freshwater species in this creek.

Species richness and composition according to Adite and Winemiller (1997) may be affected by geographic proximity (Hugueny and Leveque, 1994) and physicochemical attributes (Baran, 1995). Majidun creek possesses great habitat heterogeneity that is influenced by its proximity to Ogun River, Lagos lagoon and Atlantic Ocean which may affect its ichthyofauna. The species richness, composition and distribution may also be affected by tides, loss of habitat (due to anthropogenic activities, pollution, sand mining/dredging, industrial and domestic wastes), overfishing and poor water quality which are common practices in this creek. The more complex the habitat, the more the fishes, the complex habitats are best for increasing local fish species richness. Habitat types regardless of their complexity play important role in maintain regional fish diversity (Nagelkerken *et al.*, 2000). Fishes use different habitat types at different stages of their ontogenetic development (Nagelkerken *et al.*, 2000, 2001, 2002; De la Moriniere *et al.*, 2002).

The fish assemblage of Majidun creek, were characterized by juveniles that dominated the population, no adult fish was found among the populations. The juveniles might have migrated inshore into the creek in search of food and shelter and may probably complete their life cycle including reproduction within the creek. The prevailing environmental conditions like rainfall and salinity and species tolerance may put limit to this migration. The ecological role of estuaries as nursery ground offers protection and feeding to fish. Their contribution to local fish abundance was documented by Whitfield (1983). Gobies such as frillfin goby (*Bathygobius soporator*) and mudskipper (*Periopthalmus papilio*) which are the indigenous species of brackish waters (Irvine, 1947; Lawson, 1998) were never represented in this study. Presence of gobies in large numbers was documented by Lawson (1998) in Lagos lagoon, Soyinka *et al.* (2010) and Lawson *et al.* (2011) in the Badagry creek, Lagos, Nigeria. The juveniles depend partially or totally on this water body to complete their development until maturity. The juveniles take advantage of the high primary production of the creek which is more productive than the freshwaters or marine to search for food and shelter.

Diversity indices give an idea of how rich a water body is in terms of fish species. To get a better description of fish diversity, a measure of species richness and evenness of their distribution were undertaken in Majidun Creek (Table 5). Diversity indices of Simpson's Index (D) = 0.292, Simpson's Index of diversity (1-D) = 0.708, Simpson's Reciprocal Index (1/D) = 3.423, Shannon-Weiner Index (H) = 1.799, Shannon's equitability (EH) = 0.574, Evenness (E) = 0.263, Margalef Index (Dmn) = 3.52 in Majidun creek were

indications of its high species diversity and unevenness of fish. Naturally, the value of D ranges between 0 and 1. With this, index 0 represents an infinite diversity and 1, no diversity. The bigger the D value, the smaller the diversity. The Simpson's index of diversity (1-D) represents the probability that two individual fish randomly selected from a sample will belong to different species. This index ranges from 0 to 1. The greater the value of (1-D), the greater the sample diversity. The values of Simpson's reciprocal index (1/D) start from 1 represent a community with one species. The higher the value, the greater the diversity. The values of evenness (E) vary between 0 and 1. The closer the value to 1, the more even the populations of fish that form the community.

Shannon-Weiner index (H) affects both number of species and evenness of their population, diversity increases as both increases. Diversity is maximum when all species that made up the community are equally abundant (i.e., have a similar population sizes). The E = 0.263 shows that the species were unevenly distributed.

The diversity is partly a function of the variety of habitats; the more varied habitats tend to be inhabited by a large number of species than less variable ones. Secondly, the older habitats usually contain more species than younger ones. Warmer temperatures, availability and stability of food result in high level of diversity, others include latitudes and longitudes.

CONCLUSION

The fish species assemblage of Majidun creek comprised of 517 individuals from 8 orders, 20 genera and 23 species. Of these were 8 freshwater and 15 marine species. The most dominant fish were *S. aurita, E. lacerta, C. hippos and M. cephalus* while others appeared as occasional or rare species. All fish encountered in this study were juveniles. The creek exhibited high species diversity and unevenness of fish. Species composition was not as rich as what has been reported by other researchers in their work, irrespective of the size of the creek. Therefore there is need for the conservation and management of the fisheries resources of Ogudu creek by relevant agencies. The best approach to the conservation of the species is to disseminate conservation information, education and practices to fishermen and other stakeholders about the danger of extinction of the species and the need for its conservation. Enactment and enforcement of laws and orders by regulating agencies in the management and conservation of the aquatic resources should be considered a top priority for sustenance of present and future exploitation.

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