Specie Composition and Diversity of Coastal Trawled Fishes Landed off the Coast of Qua Iboe River Estuary, Ibeno, Nigeria

Abstract

An assessment of the specie composition and diversity of fish species from Qua Iboe River Estuary was carried out over a period of six months (March-August, 2019). A total of thirty - one (31) species representing seventeen (17) families were identified under the families Bothidae, Charangidae, Clupeidae, Cynoglossidae, Drepanidae, Eleotridae, Gobiidae, Haemulidae, Polynemidae, Soleidae, Sciaenidae, Sparidae, Sphyraenidae, Scombridae, Tetraodontidae, Trachinidae and Trichuridae. Monthly abundance was lowest in April (122 specimens; 6.21 %) and was highest in March (545 specimens; 27.72 %). The longest species was *Trichirus lepturus* while the shortest were *Drepane africana* and *Selena dorsalis.* Family Sciaenidae had the highest representation in terms of species and Haemulidae had the highest number of individuals. Shannon-Weiner Index of general Diversity (H) value was showing dominance of in Charangidae family.Evenness Index (E) showed all the species were not equally distributed in the waters. Assessment of the condition factor (K) revealed that 22 out of 31 fish species K values less than 5 showing good body condition and wellbeing of the fish while 11 species showed bad body condition. The estuary has a rich ichthyofauna complex. Effective exploitation measures should be used to deter the menace of local extinction in the near future.

Keywords: Species composition, Diversity, Coastal Trawled Fisheries, Coast of Qua Iboe River Estuary

1.0 Introduction

Fishes are important components of aquatic environment. Moses, (2002) noted that zoologist define it as a streamlined cold-blooded aquatic vertebrate that moves by means of fins and breaths by means of gills whereas, an economist considers fish to be any living aquatic resource exploitable by man for food, income, recreation and other economically useful purposes. However, Onuoha (2009), Ekpo and Essien-ibok, (2013) defined fish as jawed, aquatic (freshwater and marine), poikilothermic, streamlined vertebrate with gill for respiration and fins for movement. According to Ibim and Owhonda, (2017) it is regarded as an organism adapted to living in water and possessing internal or external skeletal frame, could be a fin or non- fin fish, typically a gill breather. Fish constitutes the major source of animal protein in Africa. It is generally regarded as an important part of a healthy diet in that it contains the most balanced amino acid profile and other essential nutrients, low in saturated fat and has Omega 3 fatty acid (Otoh *et. al* 2024 a, b, c, d)**.** Its consumption cuts across cultural and religion barriers, hence the high demand for its worldwide (Ajagbe, 2012; Bolarinwa, 2017; Ekpo and Effanga, 2018; Otoh *et. al*., 2022; Otoh *et. al*., 2023). Apart from constituting human diet, they are exploited for other various purposes such as for scientific researches, sport, aesthetics, and production of fishmeal and for food (Moses, 2002; Taiwo, 2010; Dali *et al.,* 2017).

In Nigeria, some fish species are of economic importance serving as a commodity of export (Ibim and Gogo, 2013). In terms of Gross domestic product (GDP), it is regarded the fastest growth rate when compared to other agricultural subsectors like forestry and livestock. Nigeria is a fishing country and Nigerian are fish eating people (Abiodun and John, 2017). The country is endowed with numerous water confinement suitable for the growth of fish which account for number one in West Africa in terms of abundance (Nazeef *et al.,* 2018). Akpan, (2013) reported that Nigeria has a coastline of 853km bordering the Atlantic Ocean in the Gulf of Guinea with a maritime area of 46,300km2, an Exclusive EconomicZone (EEZ) area of 210,900 km^2 and inland waters of 12.5m ha. The Atlantic Ocean coastline is interrupted by a series of estuaries which forms the river Niger and Benue into the ocean. The total brackish and is estimated as 12,940 km^2 with mangrove comprising 9700km^2 and the saline swamp of the Niger Delta occupying 750,000 hectares (Akpan, 2013). Nine out of the thirty-six state (Ogun, Lagos, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom and Cross River have coastal areas richly engrossed with abundant aquatic resources which is important for artisanal commercial fisheries, transportation etc. (Olaoye and Wahab, 2018).

Although Nigeria has a rich, varied and diverse ichthyofauna resources, over the years, they have been mismanaged. According to Ekpo *et al.,* (2016) the population of many of the recorded species which where once rich in biodiversity or biological productivity is on the decline with some falling under threatened or endangered species. Estimates of the number of fresh and marine water fishes that will become extinct within the next 20-30 years run as high as 300 species (Stiassny, 1998) with factors such as over fishing, water withdrawal, habitat loss and degradation, pollution, introduction of exotic and non-native species been adduced for this decline

(Ayotunde and Ada, 2013; Adaka *et al.*, 2017; Jonah and George, 2019; Jonah, et. al., 2019; Jonah, *et.al*., 2020). However, Taiwo and Olopade, (2017) is of the opinion that trawling in tropical waters is a leading offender in the capture of by-catch and accounts for about 27% of all global discards. In 1994, by-catch from shrimp trawl was estimated to be around 11.2 million tonnes worldwide (Alverson, *et al.*, 1994). By-catch in shrimp trawls and associated discards is an issue affecting the sustainability of marine capture fisheries (Hall, 2000). Shrimp trawling is generally regarded as one of the least selective fishing methods because the by-catch may contain over hundreds of teleost species and outweigh the shrimp catch by 20 to 1 or more (Eayrs, 2007). In many tropical countries, the trawlers come very close to shore in search of shrimp. These nearshore habitats often act as nursery areas for juveniles or many fish species. Therefore, they contain millions of young fish that are necessary to maintain adult populations. When vessels trawl in these nursery grounds, large numbers of juvenile fish are caught. Sustained near shore trawling and subsequent mortality of juveniles is thought to affect many fish populations, particularly those of commercial importance (Broadhurst, 2000). For example, a recent report indicated that 437 vertebrate species (e.g., fish, sharks, rays) and 234 invertebrate taxa (e.g., crabs, squids and scallops) are incidentally caught in Australia’s Northern Prawn Fishery (Stobutzki, 2001).

Qua Iboe River estuary located in the South-East flank of Nigeria is one of the largest and well-known estuaries along the West African sub region (Udo *et al.*, 2017, George and Effiom, 2017;Inyang-Etoh and George, 2018;George, *et. al*., 2020a). It is obvious that fishes are trawled by either pair trawler and otter board trawl with encircling net sweeping across fish of various sizes. Trash is gotten from sorting out on the deck of the vessel. However, these fish are those that should have been returned into the water for optimum growth size but unfortunately, depending on the sizes which have no resistance whatsoever once they are encircled, move straight to the bag to the coned of the net - the area which is highly pressurize by bigger fishes entering the net. Therefore, the smaller fishes always die before the gear is hauled into the vessel which as a result of this cannot be returned into the sea. Very many fishes have been caught this way which shows a wide diversity of fish from marine environment to include finfish and shell fishes.

For sustainability of these resources, an adequate knowledge of specie composition, length weight relationship, condition factor, relative abundance and diversity of the fish resources must be understood. Several publications are available on food and feeding habits of single species of fish in Qua Iboe River estuary on but there is dearth of data on its multispecies’ composition, diversity and relative abundance hence, the reason for this study. This study would therefore contribute to the much-needed information on the species composition, length weight relationship, relative abundance and diversity of the coastal areas of Akwa Ibom State of Nigeria. The information gotten from this research will guide policy makers in decision making in the proper utilization, management and conservation of fish species.

2.0 Materials and Methods

2.1 Study Area

The study was carried out in the estuarine water of Qua Iboe River in Ibeno Local Government Area in Akwa Ibom State, Nigeria (4 49′ 02.88″N; 7o 56 51.09″E (Fig. 1). It is one of the three major hydrographic features in Akwa Ibom State, Nigeria. It is located in the tropical belt with an equatorial climate regime characterized by dry (November - March) and wet (April - October) seasons (Ekpo *et al.*, 2014a). However, due to the effect of the hot humid moisturized air mass (as a result of the areas proximity to Guinea coast) rainfall is expected during every month of the year. The southern-most part of the river basin which constitutes the estuarine zone which consists of sandy coastal beach ridges covering an area of C.560 km2 (King *et al.*, 1990). It has a distance of approximately C.40 km from Eket to Ibeno where it empties into the Atlantic Ocean. The nature of the substratum consists of fine sand, salty and muddy deposits. The estuary consists of tidal creeks, small brackish water lagoons and fringing mangrove swamps. Hence, the shoreline is characterized by muddy/marshy edges. The channel morphology is characterized by very wide channel and very deep pools (Akpan, 1993). The vegetation of the mangrove swamps comprises predominantly the red mangrove (*Rhizophora harrisonni*, *R. mangle*, *R. racemosa)*, white mangrove *(Avicennia africana)*, black mangrove (*Laguncularia racemosa)*, stands of nipa palm (*Nypa fructicans*), *Phoenix reclinata and Acrostichum aureum.*

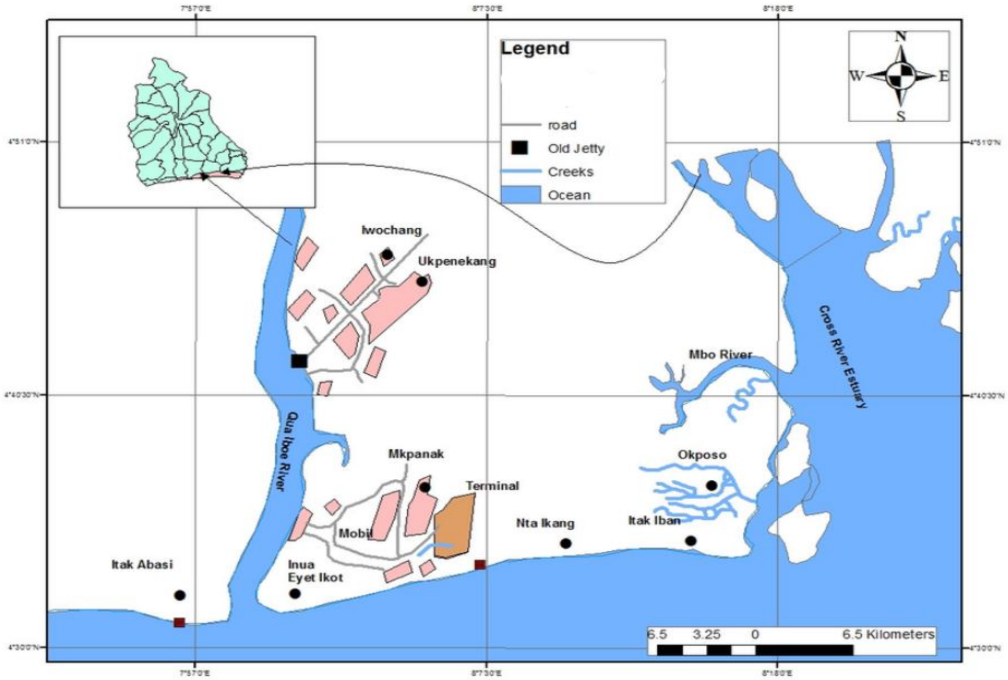


Figure 1: *Map of Ibeno L.G.A showing the sampling station in Ukpenegang, Qua iboe River estuary*

2.2 Fish Samples Collection and Laboratory Work

Monthly samples were collected for six calendar months, from March to August, 2019 from the landings (commonly referred to as "trash or yamayama") of artisanal fishers. Each month, a bag of the frozen fish "trash" containing different species of fish was bought and used for this study.Fish samples were collected from the artisanal fishers' landings in boat brought in from the offshore at Ukpenekang of Ibeno Local Government Area in Akwa Ibom State. The samples were transported to the Fisheries laboratory in the Fisheries and Aquatic Environmental Management Department, University of Uyo, Uyo using iced polyester bags. Pending examination, the specimens were preserved in the refrigerator (-4^0c) to reduce spoilage caused by microbial actions.

2.3 Fish Samples Identification

Samples were identified using identification keys such as Schneider (1990), Idodo-Umeh (2005) and Edwards *et al.,* (2001).

2.4 Data Analysis

2.4.1 Specie composition

This was gotten by counting the number of individual species

2.4.2 Relative Abundance

Relative abundance was computed as the percentage of the number of specimens of a given species over total number of specimens of all species.

$RF = n/N \times 100$

Where;

n= number of specimens of a particular species

N= total number of specimens of all species

2.4.3 Species diversity indices

The data were analysed using the Shannon-Wiener index, Pielou's measure of evenness and Simpson dominance Index. The data were further used to compare the variations in parameters among families

Shannon-Wiener index

Measures the average diversity of a sample and is given by equation:

$$\mathbf{H = - \{ni / N\log2\ ni / N\}}$$

Where H' = Shannon-Wiener index
P = total proportion of each species in sample

Evenness ratio
The species evenness ratio is the ratio of the observed species diversity (H') to the maximum possible for the same number of species in the sample (log S). It is expressed as:
J'=H'/log S.
Where S = number of observed species.
H'= Shannon-Wiener index
If J'=1, the biomasses of the individual species are evenly distributed
among all of the species in the sample (Pielou, 1996).

Simpson's Index
D=1-Ni (n) – I/N (N-1)

2.4.4. Condition Factor (K)

The monthly condition factor or wellbeing (K) of the fish species was computed using the following equation (Pauly, 1983)
$K = Wt. \times 100/L^3$
Where;
K = Condition Factor
W = Wet weight of fish in grams (g),
L = Total length of fish in centimeters (cm)

2.4.5 Length-weight Relationship

The relationship between the length and weight of each sample was estimated using the equation,
$W = a L^b$
Where;
W = Weight of the fish (g)
L = the total length the fish (cm)
a = Exponent describing the rate of change of weight with length (the intercept of the regression line on the Y axis)
b = the slope of the regression line (also referred to as the allometric coefficient).
The data on weight and total length were linearized by a logarithmic transformation to give:
Log W = a + b Log TL
Where;
a= constant
b= slope of the line
The parameters of this relationship were computed for each month and season. The correlation coefficient (r^2), that is, the degree of association between the length and weight was computed from the linear regression analysis as: $\mathbf{R = r^2}$

3.0Result

3.1. Species Composition and taxonomy

A total number of 1966 fish specimens belonging to 17 families and 31 specie were collected during the study period. A check list of the speciesencountered is presented in (Table 1). Of these specimens sampled, the least number of specimens were Syaccum *miccurum*, *Pomadasysperoteti*, *Dicologoglossa cuneata* (1 specimen; 0.05 %) while the highest specimens recorded was *Brachydeuterus auritus* (295 specimens; 15.01 %). The remaining species made the following contributions in descending order: *Trichirus lepturus* (288 specimens; 14.65 %), *illisha africana* (179 specimens; 9.10 %), *Pseudotholitus senegalensis* (170 specimens; 8.65 %), *P. typus* (158 specimens; 8.03 %), *P. elongatus* (155 specimens; 7.88 %), *Pentanemus quinquarius* (121 specimens; 6.15 %), *Galeoides decadactylus* (86 specimens; 4.37), *Drepane africana* (86 specimens; 4.37 %), *Boops boops* (79 specimens; 4.01 %), *Chloroscombus chrysurus* (65 specimens; 3.30 %), *Pteroscion peli* (41 specimens; 2.08 %), *Cynoglossus mondi* (32 specimens; 1.63 %), *Polydactylus quadrifilis* (30 specimens; 1.52 %), *Chonophorus latestriga* (23 specimens; 1.17 %), *Ethmalosa fimbriata* (14 specimens; 0.66), *Cynoglossus senegalensis* (8 specimens; 0.41 %), *Citharichthys stamafili* (8 specimens; 0.41 %), Eleotridae (7 specimens; 0.36 %), *Alectis alexandricus* (4 specimens; 0.20 %), *Lagocephalus lagocephalus* (4 specimens; 0.20 %), *Sphyraena sphyraena* (3 specimens; 0.15 %), *Trichinus lineolatus* (3 specimens; 0.15 %), *Bonthus podas africanus* (2 specimens; 0.10 %), *Pentheroscion mbicus* (2 specimens; 0.10 %) as represented in (Table 1).

Table 1: Species composition, relative abundance by number (%) and condition factor of trashfish landed at Ukpenegang from Qua Iboe River estuary, Ibeno, southern Nigeria.

S/N		FISH SPECIE	N	%N	K
1.	**Charangidae**	***Alectis alexandricus***	4	0.2035	1.4199
		Hemicaranx bicolour	5	0.2543	0.8739
		Cloroscombus chrysurus	65	3.3062	0.8166
		Selena dorsalis	90	4.5778	0.4711
2.	**Bothidae**	***Bonthus africanus***	2	0.1017	0.9306
		Cithrihthys stampfilli	8	0.4069	0.7846
		Syacium micrunim	1	0.0509	0.4623
3.	**Sparidae**	***Boops boops***	79	4.0183	1.1130
4.	**Haemulidae**	***Brachydeuterus auritus***	295	15.0051	1.2281
		Pomadasys peroteti	1	0.0509	1.0488
5.	**Cynoglossidae**	***Cynoglossus senegalensis***	8	0.4069	0.4353
		Mondi	32	1.6277	0.4194
6.	**Gobiidae**	***Chonophorus latestriga***	23	1.1699	0.5188
7.	**Soleidae**	***Dicologlossa cuneria***	1	0.0509	0.5132
8.	**Drepanidae**	***Drepane africana***	86	4.3744	1.8673
9.	**Eleotridae**	***Eleotridae***	7	0.3561	1.0015
10.	**Clupeidae**	***Ethmalosa fimbriata***	13	0.6612	0.8697
		Illisha africana	179	9.1048	0.6417
11.	**Tetraodontidae**	***Lagocephalus lagocephalus***	4	0.2035	1.6783
12.	**Sciaenidae**	***Pseudotholithis elongates***	155	7.8840	1.9343
		P. senegalensis	170	8.6470	0.6200
		P. typus	158	8.0366	0.5737
		Penthoroscion mbizi	2	0.1017	0.6054
		Pteroscion peli	41	2.0855	1.2353
13.	**Polynemidae**	***Pentanemus quinquarius***	121	6.1546	0.5004
		Polydactylus quadrifillis	30	1.5259	0.4183
		Galeoides decadactylus	86	4.3744	0.7130
14.	**Scombridae**	***Scomber japonicus***	6	0.3052	0.5051
15.	**Sphyraenidae**	***Sphyraena sphyraena***	3	0.1526	0.4711
16.	**Trachinidae**	***Trachinus lineolatus***	3	0.1526	0.7148
17.	**Trichiridae**	***Trichirus lepturus***	288	14.6490	0.424
		Total	1966	100	

N/B: N = Total number of specimens sampled
%N = percentage of number
K = Condition factor

3.2. Abundance

3.2.1 Family Abundance

The composition and abundance of fish family landed in Ukenegang is presented in table 2. The family Sciaenidae had the highest number of specie five (5) followed by charangidae which had four (4) with respective contribution of 16.12 % and 12.90 %. Bothidae had three (3) species representing 9.68 %, Haemulidae and cynoglossidae had two (2) specie each representing 6.45 % of the total catch. Drepanidae, Eleotridae, Gobiidae, Scombridae, Spyraenidae, Sparidae, Soleidae, Trichuiridae and Tracinidae had one (1) species each accounting for 3.22 % of the total catch during the study. In terms of total number of individual fish, the highest was the sciaenidae with 526 fish representing 26.75 % of the total catch followed by Haemulidae with 296 individuals representing 15. 06 %, Trichuiridae (288, 14.64 %), Polynemidae (237, 12.05

%), Clupeidae (192, 9.77 %), Charangidae (164, 8.34 %), Sparidae (79, 4.62 %), Cynoglossidae (40, 2.03 %), Gobiidae (23, 1.17 %), Bothidae (11, 0.56), Eleotridae (7, 0.36 %), Tetraodontidae (4, 0.20 %), Sphyrqenidae and Trachinidae each with 3 species, each representing 0.15 %. Soleidae had te least number of individuals.

Table 2:Family abundance of artisanal trash landed at Ukpenegang from Qua Iboe River estuary, Ibeno, Nigeria.

Family	No. Of Specie	No. of individuals
Bothidae	3(9.68)	11(0.56)
Charangidae	4(12.90)	164(8.34)
Cluepidae	2(6.45)	192(9.77)
Cynoglossidae	2(6.45)	40(2.03)
Drepanidae	1(3.22)	86(4.37)
Eleotridae	1(3.22)	7(0.36)
Gobiidae	1(3.22)	23(1.17)
Haemulidae	2(6.45)	296(15.01)
Polynemidae	3(9.68)	237(12.05)
Scianidae	5(16.13)	526(26.75)
Scombridae	1(3.22)	6(0.31)
Sphyraenidae	1(3.22)	3(0.15)
Sparidae	1(3.22)	79(4.02)
Soleidae	1(3.22)	1(0.05)
Trichiuridae	1(3.22)	288(14.65)
Trachinidae	1(3.22)	3(0.15)
Tetraodontidae	1(3.22)	4(0.20)
TOTAL	**31(100)**	**1966(100)**

3.2.2. Monthly Abundance

Table 3 showed that the lowest number of fish specimens (122 specimens; 6.21 %) was recorded in the month of April while the highest number of specimens (545 specimens; 27.72 %). Specimens' abundance in the other months were; August (433 specimens; 22.02 %) July (349 specimen; 17.75 %), June (316 specimens; 16.07 %) and May (201specimen; 10.22 %).

Table 3: Monthly abundance (2019) of trash fish species landed at Ukpenegang from QuaIboe RiverEstuary, Ibeno, Nigeria

S/N	Month	N	Relative frequency %
1.	March	545.00	27.72
2.	April	122.00	6.21
3.	May	201.00	10.22
4.	June	316.00	16.07
5.	July	349.00	17.75
6.	August	433.00	22.02
Grand Total		1966	100

N: Number of specimens sampled

3.3. Condition Factor (K)

Table 1 revealed that 22 out of 31 fish species including: *Alectis alexandricus, Hemicaranx bicolour, chloroscombus chrysurus, Bonthus africanus, Boops boops, Bracydeuterus auritus, pomadasys peroteti, Chonophorus latestriga, Dicologlossa cuneria, Drepane africana, Eleotridae, Ethmalosa fimbriata, Illisha africana, Lagocephalus lagocephalus, Pseudotholithis elongatus, P. senegalensis, P. typus, Penthoroscion mbizi, Pteroscion peli, Pentanemus quinquarius, Galeoides decadactylus* and *Scomber japonicus* had k values that were ≥ 0.5 indicating good body conditions and wellbeing of the species whereas 9 including: *Selena dorsalis, Cithrihthys stampfilli, Cynoglossus mondi, C. senegalensis, T. lepturus, Syacuim micrunim, Polydactylus quadrifillis, Sphraena sphryaena* and *Trachinus lineolatus* had K value lesser than 0.5 indicating poor body condition of the fish.

3.4. Species diversity

The values of Diversity (H') for each month varied (the H' value ranges from 0.23 to 1.3) as shown in table 4, but all values of H' was low for all families except for the charangidae's which showed moderate. Table 4 also shown that the value of J' for each family had a varied values and category (the J' value ranged from 0.37 to 1) which shows that the spread of all the family was highly even except for the charangidaes'. In addition, the D value also varied (the D value ranges from 0.29 to 1). The result shows that the haemulidae, trichuridae and drepanidae family dominated the catch, bothidae and sphyraenidae fairly dominated whereas the rest of the family: polynemidae, scianidae and cynoglossidae appeared in the low category. The low category of D indicated that the family did not dominate the catch during the duration of study.

Table 4: Diversity (H'), evenness (J') and Dominance (D) index of fish families landed in Ukpenegang, Qua Iboe River estuary, Ibeno, Nigeria.

S/N	Families	Taxa	Individual	Diversity (H')		Evenness (J')		Dominance (D)	
				Value	category	value	category	value	category
1.	BOTHIDAE	3	11	0.76	low	0.71	high	0.57	moderate
2.	CHARANGIDAE	4		1.30	moderate	0.37	low	0.37	Low
3.	CLUEPIDAE	2	192	0.23	low	0.64	high	0.87	high
4.	CYNOGLOSSIDAE	3	103	0.86	low	0.78	high	0.48	Low
5.	DREPANI DAE	1	86	0.00	low	1.00	high	1.00	High
6.	HAEMULIDAE	1	295	0.00	low	1.00	high	1.00	High
7.	POLYNEMIDAE	3	237	0.97	low	0.88	high	0.41	Low
8.	SPHYRAENIDAE	1		0.65	low	0.64	high	0.65	Moderate
9.	TRICHIURIDAE	1	288	0.00	low	1.00	high	1.00	High
10	SCIANIDAE	5	524	1.29	low	0.90	high	0.29	Low
	Average			**0.60**	**low**	**0.79**	**high**	**0.66**	**Moderate**

3.5. Length-Weight relationship

Table 5 below shows the log transformed length-weight relationship (LWR) of some species landed at Ukpenegang off Qua Iboe River Estuary, Ibeno. The morphometric features which included total length (TL) and the totalweight (TW), were calculated in order to determine the LWR. The interval values of the regression coefficients (a and b) and the correlation coefficient (r) were also presented in the Table 5.

The exponent b value of some of the species such as; *Selena dorsalis* (1.83), *Alectis alexandricus* (1.92), *Pentanemus quinquarius* (2.18), *Galeoides decadactylus* (2.48), *Pseudotholithus elongatus* (0.61), *P. typus* (2.19), *Brachydeuterus auritus* (1.33), *Ethmalosa fimbriata* (1.32), *Illisha africana* (2.43), *Citrihthys stamifilli* (2.21), *Cynoglossus senegalensis* (1.80), *Pteroscion peli* (1.49), *Trichinus lineolatus* (2.40), *Chloroscombus chrysurus* (1.76),*Lagocephalus lagocephalus* (0.91), *Scomber japonicas* (1.93), *Boops boops* (0.87), Chono Eleotridae (0.87) were less than 3 indicating negative allometric growth pattern while others such as *Cynoglossus mondi* (-26.42), *Polydactylus quadrifilli* (-17.74), *Sphyraena sphyraena* (-7.87) were out flyers that is did not fall between range -3 to 3. *P. senegalensis* and *Trichiurus lepturus* showed isometric growth pattern.

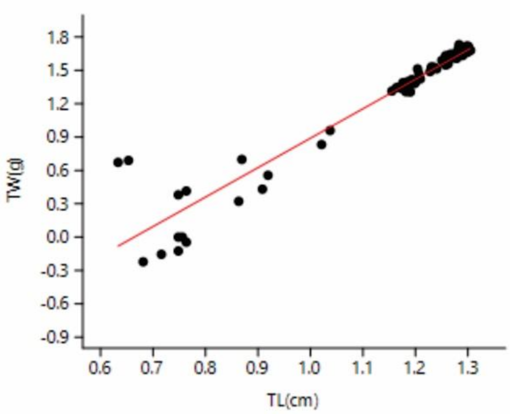
The correlation coefficient which values ranged from 0.82 to 1.00 in all the fish species showed a high degree of positive correlation ($P<0.05$) between their length and weight. The species with the highest mean total length TL (cm) was *Trichirus lepturus* whereas, *Chloroscombus chrysurus* was the smallest species with the least mean total length. The heaviest species in terms of mean total weight was *Trichirus lepturus*, while *Trachinus lineolatus* was the least specie in terms of it mean total weight.

Figures 2 - 8 showed the regression graphs of the species of fish. They showed straight line relationship which depicted that as the length increased, the weight also increased correspondingly.

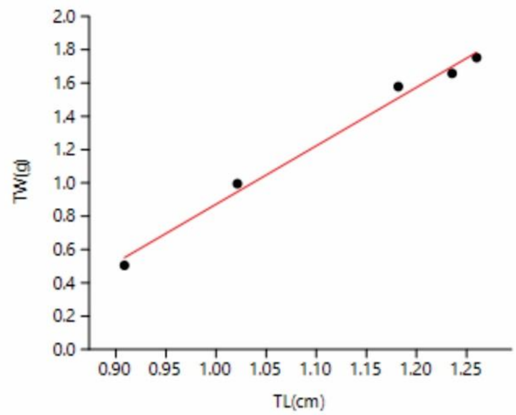
Table 5: Total length and total weight ranges and length – weight relationship parameters of trash fish laded at Ibeno, Nigeria.

Species	Total length (cm)			Total weight (g)			a	b	r	r2
	Min	Max	Mean	Min	Max	Mean				
Drepane africana	4.1	9.7	6.90	0.1	19.8	9.95	4.00	2.63	0.86	0.74
Selena dorsalis	2.1	15.7	8.90	0.1	38.9	19.5	2.78	1.83	0.85	0.72
Alectis alexandricus	8.5	11.4	9.95	5	20	12.5	3.07	1.92	0.98	0.96
Cynoglossus mondi	9.6	21.2	15.35	2.9	38.6	20.75	2.79	26.42	0.83	0.69
Polydactylus quadrifillis	9.5	13.8	11.65	3.0	15.1	9.05	2.11	17.74	0.90	0.81
Pentanemus quinquarius	11.0	19.5	15.25	6.0	50.2	26.10	2.88	2.18	0.81	0.66
Galeoides decadactylus	8.1	19.2	13.65	4.0	52.8	28.10	3.28	2.48	0.90	0.81
P. elongatus	9.5	18.6	14.05	7.8	56.6	32.20	1.63	0.61	0.70	0.49
P. typus	7.1	21.5	14.3	3.7	39.3	21.65	2.95	2.19	0.97	0.94
P. senegalensis	11.2	18.2	14.7	0.5	48.7	24.6	3.64	2.97	0.80	0.64
Brachydeuterus auritus	6.3	16.3	11.3	2.2	32.7	17.45	2.42	1.33	0.85	0.72
Trichirus lepturus	10	59.3	34.65	2.5	152	77.25	3.32	3.88	0.96	0.92
Ethmalosa fimbriata	10	14.1	12.05	9.6	35.9	22.75	2.33	1.32	0.91	0.82
Illisha Africana	5.7	18	11.85	5.5	36.7	21.1	3.21	2.43	0.87	0.76
Cithrihthys stampfilli	5.7	13.8	9.75	2.5	22.8	12.65	3.10	2.21	0.99	0.98
C. senegalensis	12.4	21	16.7	0.7	33.2	16.95	2.51	1.80	0.92	0.85
Pterosion peli	5.7	14	9.85	1.7	43.1	22.4	2.58	1.49	0.95	0.90
Sphyraena sphyraena	10.3	21.7	16	11.4	55.6	33.5	7.19	7.87	1.00	0.99
Trachinus lineolatus	7.4	9.3	8.35	2.7	5.7	4.2	3.27	2.40	0.99	0.97
Chonophorus latestriga	5.7	14.8	10.25	2.1	15.3	8.7	3.25	2.54	0.97	0.95
Cloroscombus	2.4	5.8	4.1	2.4	14.5	8.45	2.65	1.76	0.96	0.91

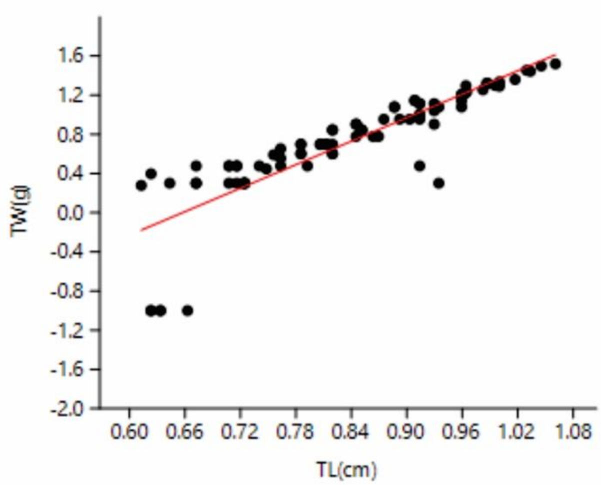
chrysurus										
Hemicaranx bicolour	2.2	18.2	10.2	2.1	56.6	29.35	3.51	2.64	0.99	0.99
Lagocephalus lagocephalus	8.2	10.2	9.2	10.6	21.2	15.9	2.17	0.91	0.97	0.95
Scomber japonicas	16.1	19	17.55	20.6	33.5	27.05	2.70	1.93	0.97	0.94
Boops boops	8.5	10.3	9.4	7.4	18.4	12.9	1.91	0.87	0.82	0.67
Eleotridae	7.9	15.3	11.6	1.8	39.5	20.65	1.91	0.87	0.82	0.67



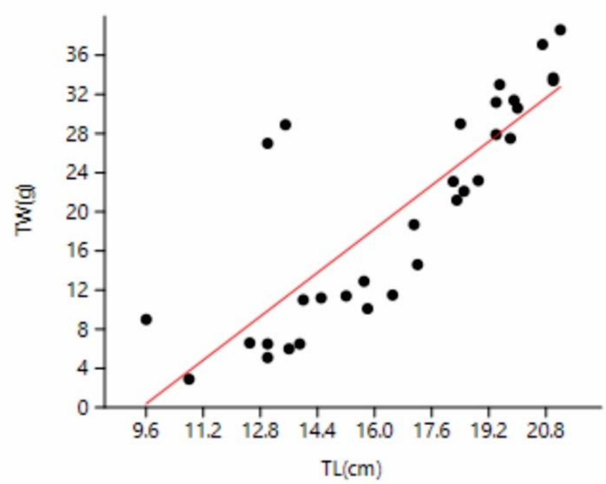
Cloroscombus chrysurus



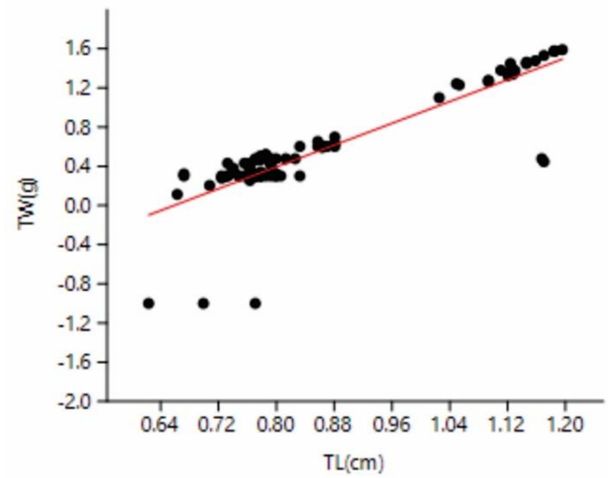
Hemicaranx bicolour



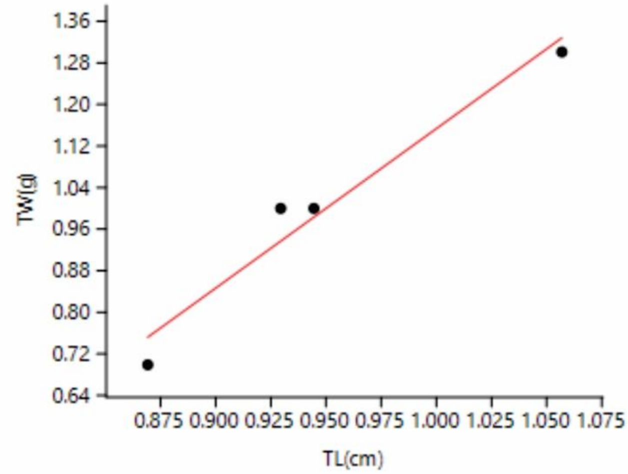
Drepane africana



Cynoglossus mondi

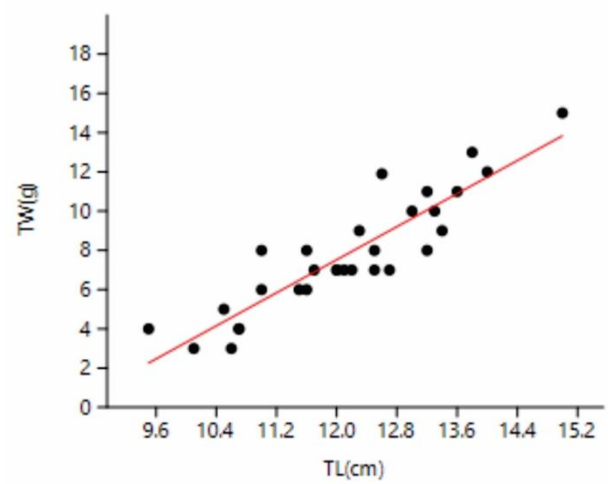


Selena dorsalis

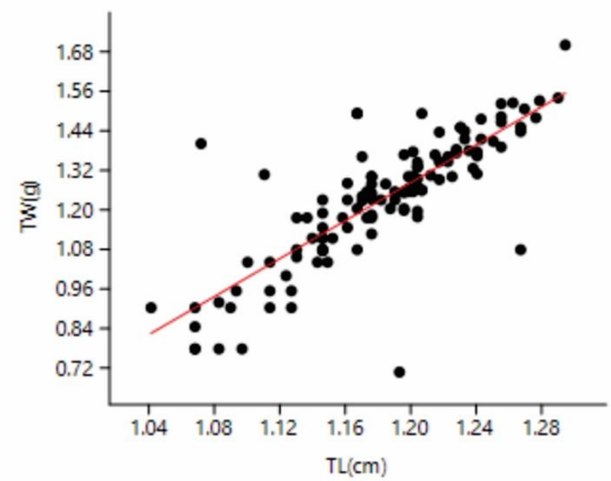


Alectic alexandricus

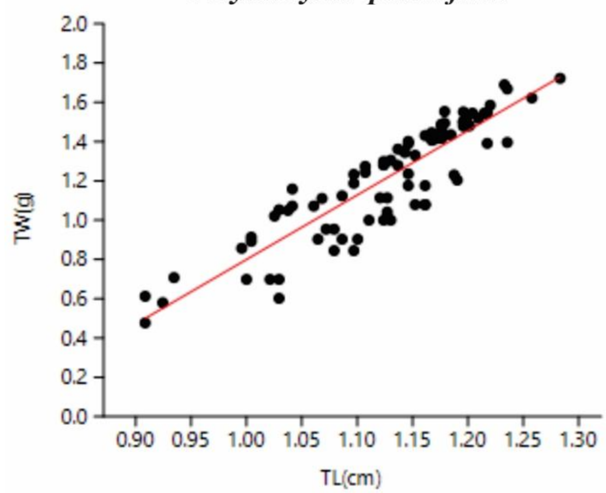
Fig. 2: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.



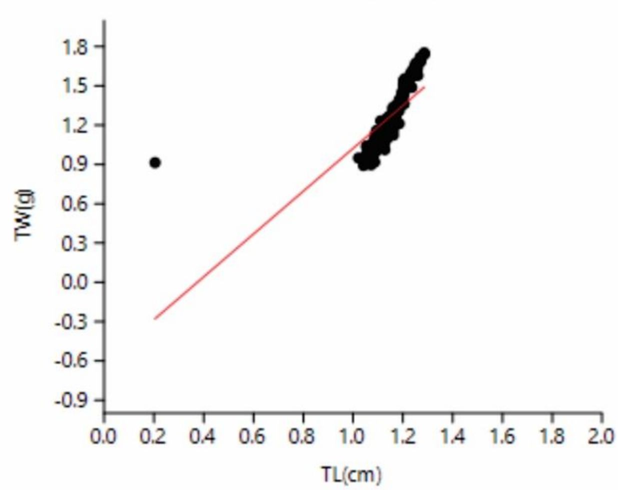
Polydactylus quadrifillis



Pentanemus quinquarius



Galeoides decadactylus



Pseudotholithus elongatus

Fig. 3: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.

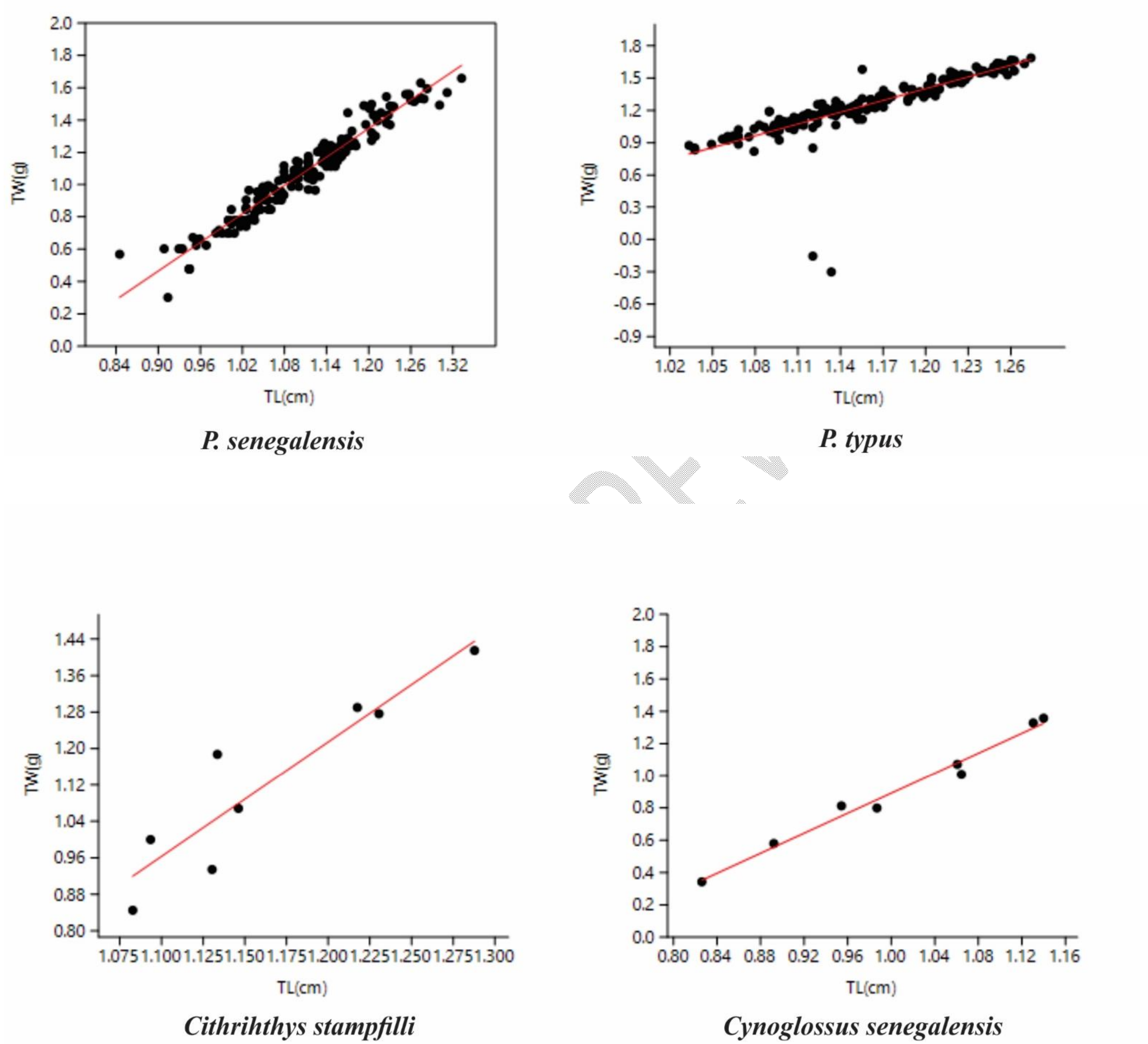


Fig. 4: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.

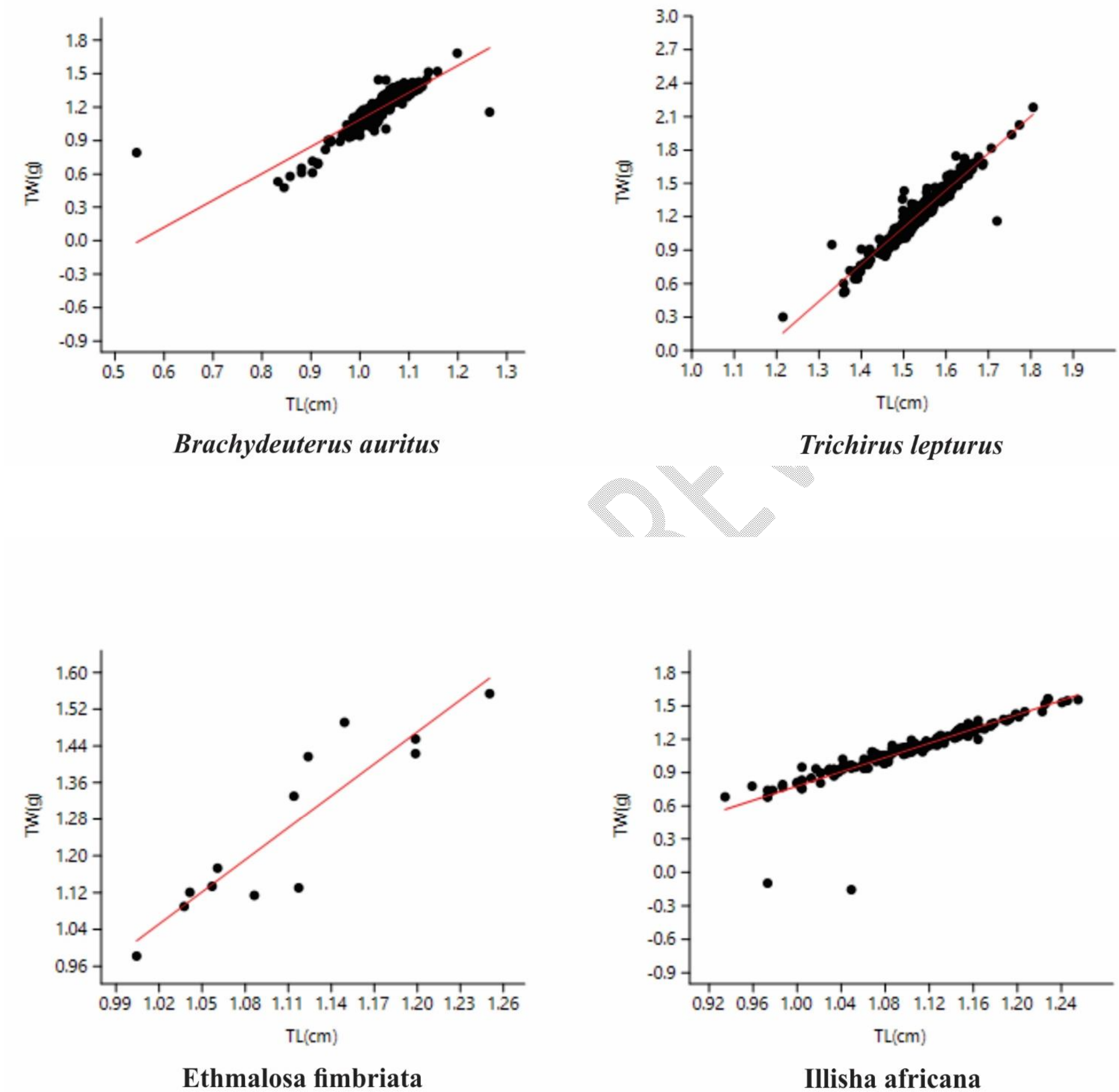


Fig.5: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.

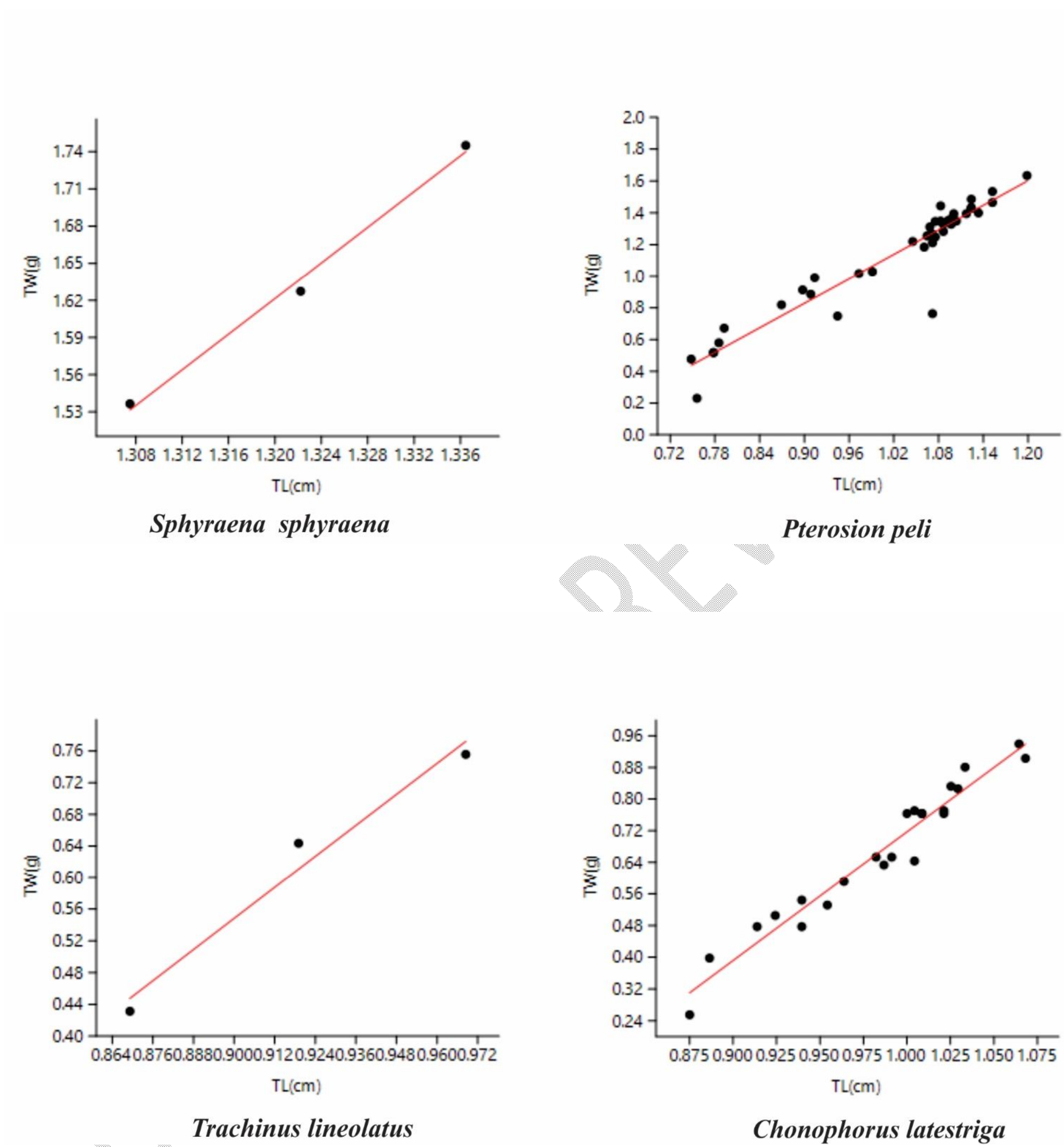


Fig. 6: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.

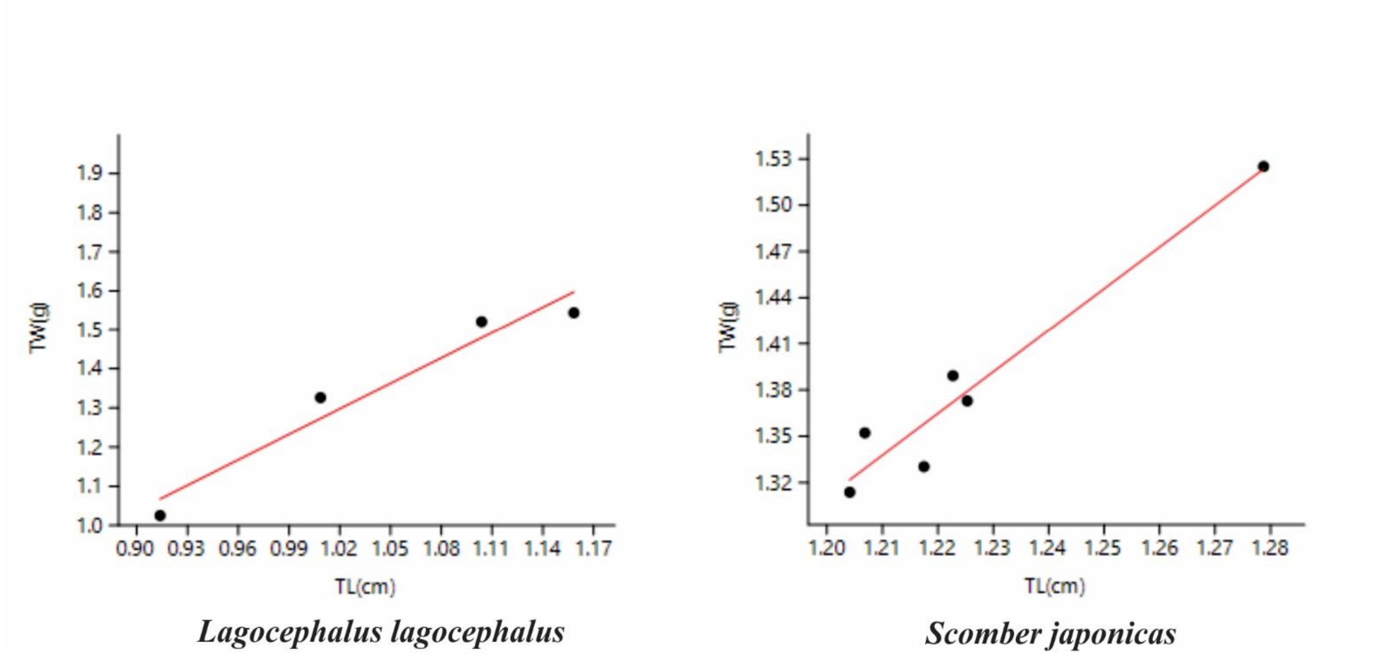


Fig. 7: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River Estuary, Ibeno, Nigeria.

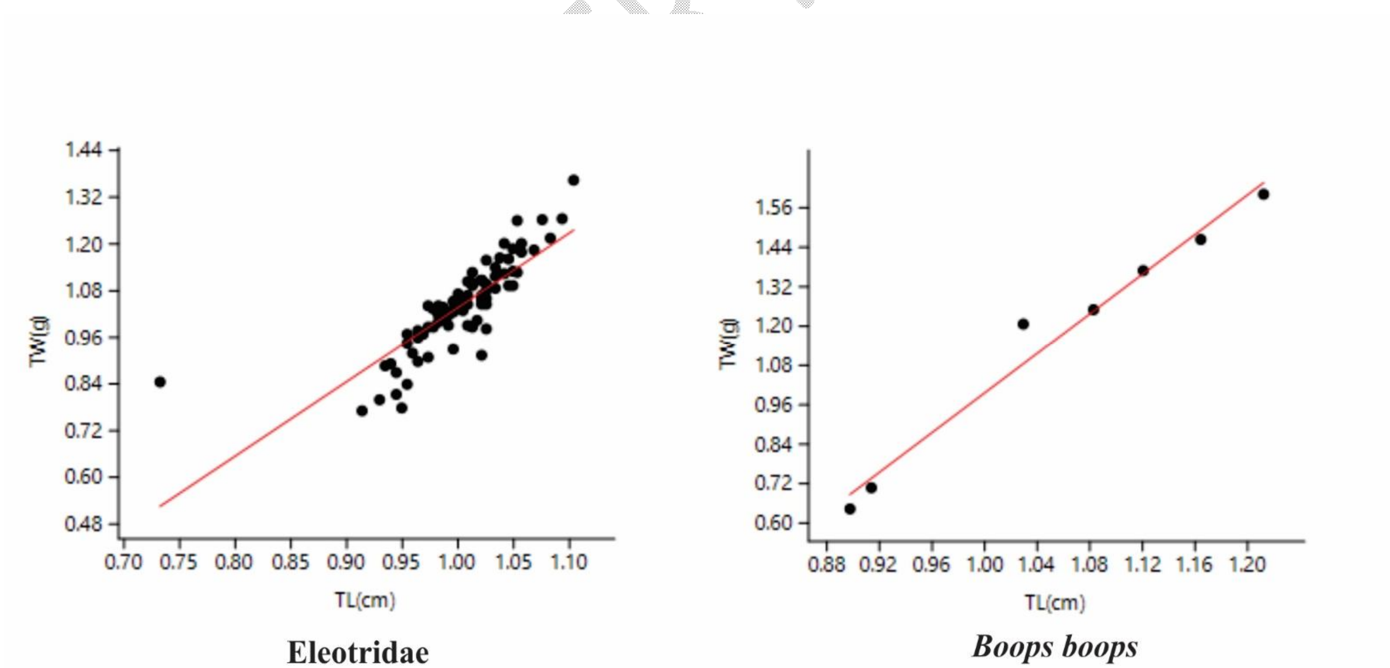


Fig. 8: Length weight relationship of trash fish landed at Ukpenegang from Qua Iboe River estuary, Ibeno, Nigeria.

4.0Discussion

Studies of an existing ichthyofauna composition, diversity and state of balance between fish population in a water body are crucial tool for an effective fisheries management and also very essential in predicting the possibility or otherwise of the population yielding annual harvestable crops.

A total number of 1966 specimens belonging 17 family and 31 species were sampled during the study. This conformed to earlier works carried out in the same sampling site by Ekpo *et al*., (2014a) on the food and feeding habit and condition factor of fish obtained from Qua Iboe river where 543 specimens belonging to 21 families, 29 genera and 31 species were documented; Ekpo *et al*., (2014b) during their studies on the food composition and the feeding pattern of the fish communities in Qua iboe river where 187 specimens belong to 11 families and 17 species where encountered. The change in the piscifaunal abundances could be attributed to changes in water quality and habitat alteration cause by anthropogenic activities (George and Effiom, 2017; George et.al., 2017; Effiom and George 2018; Essien-Ibok and Isemin, 2020; Bate and George, 2021; George *et. al*., 2020 a; b;), observation time (Teugels, 1992) gradual and abrupt changes in physical parameters (Michael *et.al*., 2015; George and Atakpa, 2015a; b; Remires and Pringle, 2001).

The most prevalent family was sciaenidae with five (5) species. This agreesfavorably with earlier assertions reported by Taiwo, (2010). The author noted that the family sciaenidae is particularly abundance in many Nigerian coastal waters. The fish species group is primarily marine but also occurs seasonally in brackish water.

The high rate of sciaenid species in estuaries is attributed to natural trait such as movement into the estuarine environment seasonally or nursery ground during the juvenile phase and feeding ground during their adult stage. The result shows that sciaenid species are euryhaline because of their ability to adapt to changes in salinity. Although this happens in some other species. Other are year-round inhabitant of estuaries. Other notable fish family were carangidae represented by four (4) species, polynemidae and Bothidae each represented by three (3) specie, clupeidae and cynoglossidae each represented by two (2) species others had one (1) specie.

The largest number of fish encountered was in march with 545 individuals while the least number of fish was sampled in April with 122 individuals. The monthly abundance in this work disagreed with findings of Udo, (2012) in Ikpa riverwhere the highest number of individual fish was sampled in month of June. These might be attributed to seasonal changes, migration, reproductive cycles, habitat availability and sampling bias.

The LWR is widely recognized as an important tool in fisheries sciences, especially in fish biology, physiology, ecology, population dynamics, and stock assessment (Nash *et al.,* 2006; Abowei *et al.,* 2009;Froese, 2015). It is useful when rapid estimations of biomass are necessary. Also, if the aim is to transform the growth- in - length equations to growth- in- weight, the LWRs have successfully been used to estimate stock biomass from limited sample size, as indicators of fish condition and used for stock assessment models, also to compare the life histories of some species among regions and other aspects of fish population dynamics Udo, (2012).

The exponent b value of some of the species such as; *Selena dorsalis* (1.83), *Alectis alexandricus* (1.92), *Pentanemus quinquarius* (2.18), *Galeoides decadactylus* (2.48), *Pseudotholithus elongatus* (0.61) , *P. typus* (2.19), *Brachydeuterus auritus* (1.33), *Ethmalosa fimbriata* (1.32), *Illisha africana* (2.43), *Citrihthys stamifilli* (2.21), *Cynoglossus senegalensis* (1.80), *Pteroscion peli* (1.49), *Trichinus lineolatus* (2.40), *Chloroscombus chrysurus* (1.76), *Lagocephalus lagocephalus* (0.91), *Scomber japonicas* (1.93), *Boops boops* (0.87), Eleotridae (0.87) were less than 3 indicating negative allometric growth pattern while others such as *Cynoglossus mondi* (-26.42), *Polydactylus quadrifilli* (-17.74), *Sphyraena sphyraena* (-7.87) were out flyers that is did not fall between -3 to 3. *P. senegalensis* and *Trichiurus lepturus* showed isometric growth pattern.This agreed with findings from Udo, (2012) and Ekpo *et. al*., (2014a) in the same study area. This was interpreted according to Khaironizam and Norma-Rashid, (2002) that when the b value is less than 3, it shows negative allometric growth. If any fish has to maintain its shape as it grows, then, its b value must be equal to 3 (Lawal and Bichi, 2014). In the present study, the length weight relationship of the fish examined showed that the b value falls between 0.61 and 26.1. This does not agree with the findings of Orihbabor*et al.,* (2011) who reported a range of 0.97 – 5.67 and Brownson, (2015) who reported a range value of 0.94 – 4.12 during their studies on the trash fishery landed in Qua Iboe River estuary in Ibeno. Ndome and Eteng, (2010) gave reasons for the observed variations in the b values of LWRs to be attributed to ecological conditions of the habitats or variation in the physiology of fish or both. Similarly,Hossain *et. al*., 2009 attributed the observed variation in the value of b to sex and season, feeding rate, gonad development and growth phase. According to Oliva-Paterna (2009) LWR can be influenced by habitat, season, stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the specimen caught. Meanwhile, LWR has been attributed to certain environmental factors such as overfishing, food competition trophic potential of the habitat.

Condition factors recorded showed that most of the fish including: *Alectis alexandricus, Hemicaranx bicolour, chloroscombus chrysurus, Bonthus africanus, Boops boops, Bracydeuterus auritus, pomadasys peroteti, Chonophorus latestriga, Dicologlossa cuneria, Drepane africana, Eleotridae, Ethmalosa fimbriata, Illisha africana, Lagocephalus lagocephalus, Pseudotholithis elongatus, P. senegalensis, P. typus, Penthoroscion mbizi, Pteroscion* *peli, Pentanemus quinquarius, Galeoides decadactylus* and *Scomber japonicus* were in good condition and high nutritional state in the habitat during this study. *Selena dorsalis, Cithrihthys stampfilli, Cynoglossus mondi, C. senegalensis, T. lepturus, Syacuim micrunim, Polydactylus quadrifillis, Sphraena sphryaena* and *Trachinus lineolatus* had K value lesser than 0.5 indicating poor body condition of the fish. Abowei,*et. al.,* (2009) reported that environmental factors, food supply, and parasitism have influence on the health of the fish. Low k value in certain times of the year might be due to low feeding intensity and degeneration of ovaries, while high k values could be attributed to high deposition of fats as preparation for spawning season. Condition factor is not constant for a species or population overtime interval and might be influenced by both biotic and abiotic factors such as habitat condition, feeding regime and state of gonadal development.

Berger–Parker diversity index entirely ignores rare species in the community (Berger-parker, 1970). It is defined as the reciprocal of the relative abundance of the most common species and thus estimates the relative dominance of this species as a proxy for the entire community's diversity. A much more balanced estimate of diversity is provided by the Shannon diversity index, also known as the Shannon–Wiener index, the Shannon–Weaver index and the Shannon entropy. It measures the uncertainty in the outcome of a sampling process.The Shannon index is also the basis of Pielou's evenness index, which is given by $J = H_{Sh}/H_S$, where H_{Sh} is the maximum value of H_S (a function of S). However, this index is in fact a very poor estimate of evenness, since it depends strongly on species richness. Although this weakness is widely known, Pielou's evenness is still the most widely used evenness index in the ecological literature (Beger-parker, 1970).

The Simpson diversity index represents the probability that two individuals taken at random from the community of interest (with replacement) represent the same species, and thus takes values in the unit interval. However, this index is not a very intuitive measure of diversity since higher values indicate lower diversity. Simpson dominance index is the reciprocal of Simpson's original formulation. The term 'dominance' has been attached to this formulation since it gives more weight to common species than to rare species. The Simpson index is also occasionally used as a measure of evenness, but this approach is not appropriate since the index also varies with richness. The diversity indices employed in this study showed that a more all values of Shannon–Wiener index (H') was low for all families except for the charangidae's which showed moderate diversity. Evenness (J') for each family had a varied values and category (the J' value ranged from 0.37 to 1) which shows that the spread of all the family was highly even except for the charangidaes'. In addition, the dominance (D) value also varied (the D value ranges from 0.29 to 1). The result shows that the haemulidae, trichuridae and drepanidae family dominated the catch, bothidae and sphyraenidae fairly dominated whereas the rest of the family: polynemidae, scianidae and cynoglossidae appeared in the low category. The low category of D indicated that the family did not dominate other families. Gokce *et al.,* (2015) noted that diversity does not depend on density or total abundance, but is affected by specie dominating the catch.

4.2 Conclusion

Trawl fisheries are one of the main anthropogenic factors leading to the degradation of coastal areas of the estuary due to the multispecies nature of trawl fisheries. A total of 1966 specimens were identified belonging to the 17 family and 31 species. There is scanty information on the species. Findings in this study has provided basic and crucial information on length-weight relationship, condition factor, and diversity of fish species from Qua Iboe River estuary, Ibeno, Nigeria. These important findings would be useful for fishery managers in evaluating the population dynamics, stock assessment and sustainable management of the 31 species encountered in this study in subsequent study. In order that the fishery is at sustainable level, environmental awareness such as the use of gear that exclude juveniles and fingerlings should be encouraged. Also, future developments, autogenic and anthropogenic threats and harmful practices which can predispose the fish species to extinction should be subjected to environmental scrutiny to maintain the environmental health and integrity of the ecosystem.

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