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CATCH ASSESSMENT OF *Tilapia zillii* IN OGUN ESTUARY, OGUN STATE, NIGERIA

W.O. Abdul, I.T. Omoniyi, Y. Akegbejo-Samsons, S.O. Obasa, A.O. Agbon, A.A. Akinyemi and F.I. Adeosun

Department of Aquaculture & Fisheries Management, Federal University of Agriculture, Abeokuta, Nigeria

ABSTRACT

A study on catch assessment of *T. zillii* was carried out in Ogun estuary located between Ogun Water side and Ijebu East Local Government Area, Ogun State, Nigeria. The lagoon was stratified based on homogenous fishing activities. Fish catches were randomly assessed from commercial landings at selected landing sites. Data were collected on length-frequency distribution, catch landings and water quality parameters. Length-frequency distribution showed that the size of *T. zillii* ranged from 11cm to 37cm with observed weight range, 38.0g – 115.0g. Annual catch landing was 274,333.33kg. The monthly catches ranged from 12264.29kg in March to 39379.36kg in July. There was significant difference ($P<0.05$) between the monthly catch landings of *T. zillii* at selected sites on the estuary. These variations were influenced by the gears used in exploiting the resource and the season of the year. There was no significant difference ($P>0.05$) between the seasonal mean values of temperature, salinity and pH of water measured. For other water quality parameters, conductivity, dissolved oxygen and phosphate, values were significantly higher ($P < 0.05$) during the wet season than the dry season. Measured water quality parameters showed no significant correlation ($P>0.05$) with annual fish yield in the fishery.

Keywords: Length-frequency distribution; *Tilapia zillii;* Ogun estuary; Fish Aggregator

INTRODUCTION

Fish alone contributes 20-25% per caput animal intake and could be as high as 80% in the coastal and riverine communities in Nigeria FAO (2000). Eyo *et al*. (2004) stated that about 50% supply of fish requirement was met through massive importation which translated into huge avoidable drain of Nigeria's foreign exchange. Nigeria spends over N30 billion annually on the importation of fish, because, it is yet to attain self- sufficiency in fish production (Eyo *et al*., 2004; Adamu, 2007). Several efforts made to improve fish production from the rivers, lagoons, estuaries and lakes have not yielded desired positive results due to numerous problems confronting the industry among which is over-exploitation of fisheries resources (Ajayi and Talabi, 1984; Adekoya, 1995; Abdul and Omoniyi, 2003; Eyo *et al*., 2004; Abdul and Omoniyi, 2007). Bankole *et al*. (2004) also

opined that the present trend of unregulated and incessant catching of fish year-in-year-out be assessed for sustainable exploitation. Meanwhile, Faturoti (2010) has reported that artisanal fisheries in Nigeria provides more 82% of the domestic fish supply, giving livehoods to one million fishermen and up to 5.8 million fisherfolks in the secondary sector.

According to Encyclopedia of Earth (2008), Nigeria has 853Km coastline of which Ogun State has about 15km that runs in an east-west direction. Among the important coastal waters in Ogun State is Ogun estuary. In this estuary the species of fish that are commonly caught in a popular brush park fish aggregator called 'Iken'. These include *Chrysichthys nigrodigitatus*, *Sarotherodon galilaeus*, *Tilapia zillii*, *T. mariae* and *Gymnarchus niloticus* amongst others (Abdul and Omoniyi, 2003). Tilapias dominated the landings, representing 50.78% of the total catch. This, therefore, led to the recommendation that effort be directed towards investigating the tilapia fishery to avert collapse.

Meanwhile, the biology of African tilapiine fishes has been extensively studied in many Nigerian aquatic ecosystems, notably by Jegede (2008), Jegede and Fawole (2004), Nwadairo (1987) in the Niger Delta regions; Fagade *et al*. (1984), Arowosafe (1983) and Oduleye (1982) in the Southwest, and Akintunde and Imevbore (1979) in the North. King and Etim (2004) have also provided information on the reproduction, growth, mortality and yield of *T. mariae* in the Eastern part of Nigeria. Mortality estimates of four major cichlid fishes, *T. carbrae*, *T. mariae*, *T. zillii* and *Chromoditilapia guntheri* of Umuoseriche Lake in Imo State, Nigeria, have also been carried out (Anene, 2004). Tilapias have been reported as dominant fish fauna in Ogun estuary (Jegede, 2008; Abdul *et al*., 2010) especially *T. zillii* which according to Abdul (2009) contributed 99.27% to the tilapia fish landed. At present, there is dearth of information on its catch statistics and distribution in the estuary. Therefore, the stock needs to be assessed to confirm its status in the fishery.

MATERIALS AND METHODS

Description of Study Site

The study was carried-out in freshwater ecotype of Ogun estuary, Ogun Waterside and Ijebu-East Local Government Areas of Ogun State, Nigeria (Figure 1). It is situated between longitude $4^{0}15^{1}$E – $4^{0}30^{1}$E and latitude $6^{0}20^{1}$N – $6^{0}45^{1}$N and bounded in the East by Lekki lagoon and South by Bight of Benin. The estuary covers an area of 26km^{2} (Ssentongo, 1983). It empties into the Atlantic Ocean via Lagos Harbour. The water does not have direct access to the marine condition but it is linked to the Lekki and Lagos lagoons. The lack of direct access to the Atlantic Ocean couple with the discharge of Rivers Osun, Mosafejo and Oni into the water makes it essentially freshwater. Trewavas (1983) described the water including the Lekki lagoon as freshwater.

Sampling Duration and Procedure

Data were collected for 24 consecutive months. These data were then pooled together as annual data by estimating the means (for each landing centre). A stratified random sampling method was adopted in this study. This involved identifying landing centres of homogeneous fishing activities in terms of landing frequency and fish abundance. The homogeneity was used to reduce the variability of values obtained in each landing centres, so that greater precision could be obtained than with the generalized

random sampling. Using this criterion, five (5) landing centres were randomly chosen. These included Pipeline – Agbalegiyo, Government site, Eyindi, Iwopin, and Ilamo –Imobi (Figure 1).

Catch Assessment and Formation of Size Frequency Distribution

Each landing centre was visited four days in a month via road and water. Ten landings were randomly assessed daily per landing centre and the gears used were noted. *Tilapia zillii* caught by the fishermen were sorted-out and weighed to the nearest 1kg with a spring balance. The data were then pooled together to estimate the catch per gear per canoe per day in the fishery. These were used to estimate catch landing monthly and yearly in each gear, landing centre and the fishery at large as described by Cowx (1991). Meanwhile, sub-samples total lengths (TL) and weights were individually measured to the nearest 0.1cm and 0.01g respectively to form length- frequency distribution data of 1cm class interval.

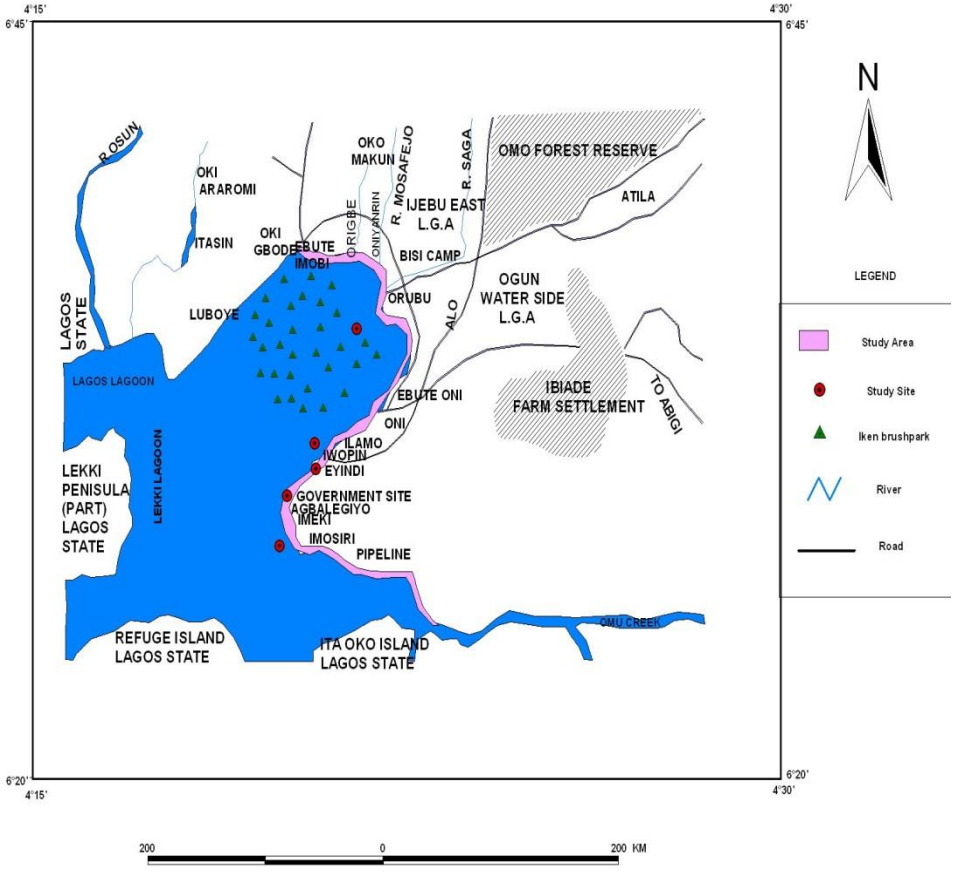

Figure 1: **Ogun estuary**

Water Quality Parameters

Water quality parameters of the estuary were also determined both *in-situ* and *ex-situ* on monthly basis during the study visits. Surface water temperature, dissolved oxygen, pH, conductivity, salinity, and phosphate were determined. The former four water quality parameters were determined using digital meters while others were determined using the analytical methods described by Ademoroti (1996).

RESULTS

Size, Catch Landings and Distribution

The size of *T. zillii* in the estuary ranged between 11-12cm and 36-37cmTL with respective mean weights of 38 -1150g (Table 1). The monthly average size ranged from 22.01cm to 26.10cm TL (September and January), and mean weight ranged between 264.10g and 349.72g (December and May). Mean annual catch landing of *T. zillii* at the study sites showed that Iwopin landing centre had 73,790.65kg, Eyindi had 73,131.83kg, Government site 56,232.61kg, Pipeline–Agbalegiyo had 49,760.79kg and Ilamo-Imobi had 21,521.29kg totaling 274,332.98kg annually from the fishery. Statistical analysis revealed that there was a significant difference ($p<0.05$) among the means of catches of different landing sites of the estuary during the study period. Iwopin landing centre had the highest catch (73,790.65kg) while Ilamo – Imobi had the lowest catch (21,526.29kg) of *T. zillii* annually (Table 2).

Influence of Gear on Catch landings

Table 3 shows that four major gears were commercially used for fishing tilapia fish within the estuary. These included cast net, gillnet, seine net and 'Iken' brushpark fish aggregator (IFA). Gillnet had catch landing that ranged between 1,060.33kg and 12,679.9kg in February and October respectively with a total catch of 5,628.89kg and mean monthly catch of 4635.74kg. Seine net contributed higher than Gill net with a total catch landing of 73,616.59kg, catch range of 2,376.36kg – 12,750.18kg and mean monthly catch of 6,134.72kg. Cast net contributed the highest catch to the total landing in the fishery, 141,344.8 -20,577.92kg (March-July) and a mean monthly catch of 11,778.73kg. Fish Aggregator (IFA) contributed a total of 3,742.7kg with a catch range of 49.78kg –847kg and a mean monthly catch of 311.89kg. IFA contributed least to the catch landings of *T. zillii* in the fishery during the study period. Analysis of variance showed that there was a significant difference ($p< 0.05$) among the means of monthly catches based on by the gear used (Table 3).

Effects of Seasons on Catch Landings and Gear Catchability

Results as shown in Table 4 indicate that the season of the year affected the catches of *T. zillii*. More *T. zillii* were landed in the wet season, April–September, than in the dry season, October-March. Catch landings in wet and dry seasons were 155425.76kg and 11890.57kg respectively. Statistical analysis showed that the mean monthly catch, 25904.29±10258.9kg in the wet season was significantly higher ($p<0.05$) than that of the

dry season, 19817.93±7209.46kg. It was observed from the catch analysis that the season of the year affected the catches of two out of the four gears used on the estuary for fishing *T. zillii* (Table 4).

Water Quality Parameters

The monthly mean values of water quality parameters are presented in Table 5. The temperature of the water varied from 27.58±0.037 ^{o}C to 28.72±0.037^{o}C (June – December), while the dissolved oxygen ranged between 8.20±0.089mg/l and 9.86±0.040mg/l (February - May). The pH, phosphate, salinity and conductivity ranged from 6.03±0.056 - 6.68±0.048 (August - February), 0.196±0.017mg/l – 0.36±0.019mg/l (December/March - July), 0.21±0.014‰ - 0.62±0.041‰ (October - May) and 366.10±10.770µs/cm – 1189.00±109.960µs/cm (December -April), respectively. There was no significant difference between the seasonal mean values of temperature, salinity and pH of water measured (P>0.05, 2 tailed t-test) and for others, dissolved oxygen, conductivity and phosphate, mean values were higher during the wet season. Results also showed that all the water parameters had positive influence on the fish abundance ('r' ranged between 0.305 to 0.057).

Table 1: Size and mean weight distribution of *T. zillii* in Ogun estuary

Length class(cm)	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Total	Mean Weight (g)
11-12	-	-	-	-	-	-	-	10	-	-	-	-	10	38
12-13	-	-	-	-	-	-	-	6	-	-	-	-	6	41
13-14	-	-	-	-	-	-	-	9	-	-	-	1	10	55
14-15	-	-	-	-	-	-	-	4	-	-	-	3	7	85
15-16	-	-	-	-	-	11	6	5	3	2	3	3	33	85
16-17	-	8	2	-	-	6	6	70	10	4	2	-	108	83
17-18	1	7	5	-	-	10	2	133	18	21	9	25	231	100
18-19	4	-	3	5	21	81	82	87	81	26	26	43	453	137
19-20	9	17	4	26	108	50	65	90	55	53	13	97	589	150
20-21	25	24	37	-	-	133	45	17	30	32	167	67	577	181
21-22	68	76	91	50	90	21	48	30	51	90	159	122	896	185
22-23	110	139	66	16	22	4	75	32	33	72	-	136	705	229
23-24	153	101	76	127	98	190	60	49	24	-	56	98	1032	258
24-25	184	95	87	157	65	104	150	37	54	79	23	85	1120	295
25-26	115	53	79	108	21	44	66	37	28	106	-	-	1120	295
26-27	106	14	51	78	147	16	69	40	78	107	267	39	1012	370
27-28	98	58	54	111	12	31	128	18	32	73	150	69	867	401
28-29	2	22	14	86	120	73	61	171	121	104	184	121	1079	455
29-30	43	57	12	175	168	152	100	55	90	30	185	22	1089	506
30-31	2	-	10	68	145	-	55	29	81	50	78	41	559	555
31-32	-	5	-	20	11	-	26	6	6	1	-	40	114	637
32-33	2	-	-	-	2	-	25	8	5	-	1	25	68	695
33-34	-	4	2	10	-	-	-	1	1	-	-	31	49	759
34-35	1	4	1	-	-	-	-	-	-	-	-	2	8	874
35-36	-	-	-	1	1	-	4	-	-	-	-	-	6	810
36-37	-	-	-	-	-	-	-		-	-	-	2	2	1150
Total	923	684	594	1038	1064	926	1073	944	805	850	1323	1072	11287	
Mean	24.64	24.26	24.21	24.24	26.10	23.9	25.08	22.7	22.01	24.80	25.7	24.40	-	-

length	± 0.075	±0.012	±0.109	±0.092	±0.115	0 ±0.126	±0.112	0 ±0.187	±1.155	±0.122	0 ±0.099	±0.133		
Mean weight	298.39 ±3.41	296.55 ±4.23	299.09 ±5.87	349.72 ±2.72	338.49 ±4.32	287.85 ±3.79	304.88 ±3.28	264.14 ±4.01	328.91 ±3.49	321.01 ±2.98	346.32 ±2.07	347.58 ±3.31	-	325.60 ±1.32

Table 2: Monthly catch distribution of *T. zillii* in freshwater ecotype of Ogun estuary

	Landing site/		Catch (kg)			
Month	Pipeline-Agbalegiyo	Government	Eyindi	Iwopin	Ilamo-Imobi	Total
September	1719.79	2071.23	9924.72	4835.24	49.78	18600.76
October	1453.21	8204	4475.9	9854.71	767.79	24755.61
Novermber	3259.89	4224.87	5765.76	5319.72	145.2	18715.44
December	4982.32	1700.04	4365.61	8171.72	9752.81	28972.5
January	1486.51	2064.88	1877.33	6117.01	2500.19	14045.92
February	13799.86	1060.33	4718.34	3144.79	235.3	22958.62
March	829.56	2221.75	2947.51	2376.36	1084.21	9459.39
April	2604.84	3636.6	2451.6	3383.01	188.24	12264.29
May	3853.05	5866.69	5358.94	3682.06	2953.28	21714.02
June	7265.52	7801.2	7248.96	9115.4	3318.25	34749.33
July	3863.59	7257.97	15318.71	12750.18	188.91	39379.36
August	4642.56	10123.05	8678.45	5040.45	342.33	28826.84
Total	49760.7	56232.61	73131.83	73790.65	21526.29	274442.08
Mean	4146.73[b]	4686.05[b]	6094.32[a]	6149.22[a]	1793.86[c]	22870.18

Mean values with same letters along the row are not significantly different (P>0.05)

Table 3: Contribution of gears to *T. zillii* monthly landings in Ogun estuary

Month	Gill net	Seine net	Cast net	Fish Aggregator	Total
September	2071.23	4835.24	11644.51	49.78	18600.76
October	12679.9	9854.71	1827.57	393.43	24755.61
November	4224.87	5319.72	9025.74	145.2	18715.53
December	1700.04	8171.72	18288	812.41	28972.17
January	1685.44	6117.01	5890.5	352.97	14045.92
February	1060.33	3144.79	18518.2	235.3	22958.62
March	1330.15	2376.36	4905.82	847.06	9459.39
April	1926.6	3208.95	6940.5	188.24	12264.29
May	5163.73	3682.06	12650.55	108.84	21605.18
June	7801.2	9115.4	17754.48	78.23	34749.31
July	5862.35	12750.18	20577.92	18.91	39209.36
August	10123.05	5040.45	13321.01	342.33	28826.84
Total	55628.89	73616.59	141344.8	3572.7	274442.08
Mean	4635.74[b]	6134.72[b]	11778.73[a]	311.89[c]	22861.11

Mean values with same letters along the row are not significantly different (P>0.05)

Table 4: Effects of seasons on fish landings and water parameters

Seasons	Wet	Dry
Parameters		
Fish catch (Kg)	25904.29±10258.9[a]	19817.93±7209.46[b]
Cast net (Kg)	13814.84±1956.41[a]	9742.64±1839.55[b]
Gill net (Kg)	5491.36±1309.42[a]	3780.12±1839.55[b]
Seine net (Kg)	6338.71±1440.86[a]	5830.72±1171.36[b]
Iken fish aggregator (Kg)	159.39±43.33[a]	464.40±121.02[a]
Salinity(‰)	0.397±0.716[a]	0.340±0.502[a]
Conductivity (µs/cm)	627.05±125.700[a]	507.63± 86.989[b]
pH	6.31±0.095[a]	6.58±0.762[a]
Dissolved oxygen (mg/l)	9.26±0.206[a]	8.34±0.312[b]
Temperature (°C)	28.23±0.131[a]	28.28±0.872[a]
Phosphate (mg/l)	0.309±0.283[a]	0.236±0.137[b]

Mean values with same letters along the row are not significantly different (P>0.05)

Table 5: Mean annual water quality distribution in Ogun estuary

Month	Ph	Phosphate (mg/l)	Salinity (‰)	Conductivity (µs/cm)	Dissolved Oxygen (mg/l)	Temperature (°C)
September	6.25±0.066	0.251±0.019	0.23±0.20	444.00±17.910	8.88±0.086	28.38±0.020
October	6.45±0.077	0.259±0.021	0.21±0.014	377.00±20.230	7.76±0.107	28.48±0.037
November	6.65±0.097	0.280±0.022	0.34±0.026	390.60±10.770	8.42±0.086	28.50±0.000
December	6.60±0.047	0.196±0.017	0.25±0.014	366.10±10.770	7.60±0.126	28.72±0.037
January	6.67±0.047	0.230±0.023	0.34±0.033	480.00±31.880	8.32±0.110	28.02±0.037
February	6.68±0.048	0.249±0.021	0.38±0.020	505.60±18.720	8.20±0.089	28.44±0.040
March	6.22±0.039	0.196±0.017	0.56±0.031	926.50±18.930	9.76±0.093	28.24±0.068
April	6.64±0.060	0.258±0.025	0.59±0.043	1189.00±109.960	9.08±0.037	28.42±0.037
May	6.55±0.047	0.236±0.022	0.62±0.041	746.70±15.250	9.86±0.040	28.14±0.081
June	6.21±0.011	0.354±0.022	0.43±0.013	596.10±6.850	9.76±0.068	27.58±0.037
July	6.20±0.021	0.360±0.019	0.28±0.013	388.10±14.650	9.42±0.058	28.16±0.040
August	6.03±0.056	0.240±0.016	0.24±0.016	397.70±11.160	8.58±0.020	28.38±0.020
Mean	6.43±0.067	0.259±0.015	0.37±0.043	567.28±75.074	8.80±0.223	28.28±0.007

DISCUSSION

The length-frequency distribution in Table 1 shows that *T. zillii* is a resident species of the estuary as it had a true population representation all year round in the estuary. Hadi (2008) reported a size range of 15 – 27cm TL (71- 441g)) in Lake Umhein in Libya. But in this stud, a size range of 11- 37 cm (38 – 1150g) was recorded which indicated that the species grows bigger in the estuary than lake. The wide range of sizes in the catches might be related to the mesh sizes of the gears used. Abdul (2009) reported the mesh sizes of gears used in the study area to range between 25.5mm and 101.6mm.

The high catch of cichlid fish recorded in December might be as a result of increased number of fishing operation (efforts) in the fishery. According to Abdul (2009), there is always a significant increase in the number of fishing effort during the wet season. During this period too, the fish were believed to have returned from the marginal vegetation where they were hiding during the stormy rains in wet season, when water depth was high. This attracted more fishermen to fish. The least catch observed in March was as a result of low water level which discouraged most fishermen from fishing. At the onset of wet season, the water was refreshed and more fish were caught. Fish aggregators (brush park) have been known to attract fishes for shades, shelter, food, breeding ground and hiding place for predators (Reed *et al*., 1967; FAO 1969; Welcomme, 1972; Solarin and Udolisa, 1993; Alegbeleye *et. al*., 2000; Sureh, 2000; Abdul and Omoniyi, 2003). Abdul and Omoniyi (2003) reported that cichlid tilapias contributed 50.78% of the total fish catch in 'Iken' Brush Park from a section of the estuary.

Iwopin centre had the highest fish landing because the fishermen used motorized canoes with seine nets of 25.4mm mesh size and the great number of fishermen on the water. At Eyindi, the cast net fishermen mostly used live baits to attract fish to the surface before they are surrounded by the gear. Ilamo-Imobi fishing area had the least catch of *T. zillii* because it had the minimum number of fishing operations during the study (Abdul, 2009). Some of the factors that might also cause low catch in "Iken" brush park have been reported by Abdul and Omoniyi (2003). Brush parks were not usually allowed to mature before the aggregated fish are harvested implying that some of the parks only served as refuge traps. According to Solarin and Udolisa (1993), population of fish increases exponentially after one year of brush park installation on water due to reproduction and growth until a stabilization level is reached when excess fish populations move to the open water or adjacent installations.

The great contribution of cast net to the total fish landings could be attributed to its popularity. It was commonly used in four landing sites in the fishery (Pipeline-Agbalegiyo, Fishery, Eyindi and Ilamo-Imobi). The fishing operations were carried out towards the shore where water depth is low. This result is in agreement with the observation of FAO (2000) in Kainji lake where cast net accounted for the largest proportion of tilapia landings.

Seasons of the year was noticed to affect the catch (biomass) of *T. zillii* landed during the study period. More fish was landed in the wet season than in the dry season considering the average monthly fish catch (2-tailed t-test, $p < 0.05$)). During the wet season flooding, according to Araoye (1999), food (detritus) and other conditions including water current, pH and temperature change essentially affect the survival of *Synodontis schall*. Seasonal abundance of fish species has been reported to be influenced by a combination of physico-chemical properties and the presence of food items (Fagade and Olaniyan, 1974). Fish abundance during the wet season in this study was in contrary to the propoundment of

Ita (1978) of inverse relationship between water level and catch rate in lakes, explaining the probability of higher concentration of fish at low water levels (dry season). Fishermen in Ogun estuary used various acoustic methods and live baits to enhance their fishing. Araoye (1999) gave similar reason for the insignificant difference in the catch of *Synodontis schall* in the two seasons. The catch from'Iken' brush park followed this rule of inverse relationship between water level and catch rate, although not significant ($p > 0.05$). The non-significance of the weight of *T. zillii* landed might be due to the factors highlighted by Abdul and Omoniyi (2003) on "Iken" brush park assessment study. The similarities in the catches of seine net in the two seasons might be due to the fact that the fishermen are not competed with and they also adopted large seine nets because they move far away from fishing ground and cover a wide range on the water. On the contrary, the relative abundance of fish irrespective of the season might probably be due to success of the fish within the environment due to low predation though Abdul and Omoniyi (2003) reported the seasonal presence of *Gymnarchus niloticus, Hepsetus odoe* and *Sphyraena barracuda* in the water. Also, the characteristic nature of the water bottom might be a factor in successful seine net operation in the area.

Pollution is usually experienced during the dry season which has been confirmed to cause great mortalities of fish in "the brush park. The polluted water is the receding one from inland swamps that had stayed long enough or attained sufficient resident time in the swamp to acquire some characteristics of the peat-like swamps Abdul and Omoniyi (2003). A peat-like swamp has been reported by Alegbeleye *et al.*(2000) to mean water characterized by low dissolved oxygen tension, low pH, low transparency, high level of sulphide and ammonia and low natural productivity. Destruction caused by storm action prominent on the estuary has also been identified as one of these factors Abdul and Omoniyi (2003). During this period, the brush parks were destroyed and all entrapped fish escaped into the open water or the marginal vegetation at the shore line.

The fish catch, from this study, was positively correlated with phosphate, salinity, conductivity, dissolved oxygen content, pH and temperature of the water. According to Elliott and Hemingway, 2002), assemblages of estuarine organisms vary in time and space, largely because estuaries have widely varying environmental conditions. Periods when there were high catches high values of phosphate were recorded in the water. Phosphate and nitrate are described as aquatic fertilizers that determine the productivity of water. The influence of measured water quality parameters on fish abundance and distribution (in terms of weight) as observed in this study is similar to the observation of Pombo *et al.* (2005). The values of water quality parameters in this study were adequate to support fish population (Obande *et al.*,2012).

CONCLUSION

It is observed from this study that *T. zillii* is more widely distributed and abundant in the estuary. *T. zillii* is a resident fish in the estuary, widely distributed and available all year round, therefore referred to as a euryhaline fish species. It grows to a large size in estuary than freshwater environments. Its catch landing is dependent on the gear used, the season of the year and water quality parameters. Water quality parameters have been used to categorize this water body as having more characteristics of freshwater than true estuary water.

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