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PHYSICO-CHEMICAL PARAMETERS AND FISH RICHNESS IN AGBOYI CREEK, LAGOS STATE, NIGERIA

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Abstract
The physico-chemical parameters and fish diversity of Agboyi creek using Shannon's index and Simpson's index were determined for two years between 2005-2007 (both dry and wet seasons). Agboyi creek was characterized with high BOD values of 25.56±3.10mg/l and 18.17±6.06 mg/l, nitrate (1.67±0.15 and 2.61±0.46 mg/l), phosphate (1.30±0.23 and 1.55±0.15 mg/l), ammonia (2.01±0.89 and 2.00±1.30 mg/l) and salinity (3.82 ± 1.59 and 3.75±1.03) during dry and wet seasons respectively. Except for ammonia and salinity, there were no significant differences (P<0.05) between the parameters, locations and seasons. Tilapia zillii, Sarotherodon aureus and niloticus were common to all the three locations sampled (A, B, and C) and for both dry and wet seasons. Fishes such as Pomadasys jubelini and Caranx senegalus were found only in location A; Sardinella maderensis, Trachinus apmatus and Arius gigas were restricted to location B while Pellonula afezeliusi, Hydrocynus lineatus and Elops lacerta were recorded only in location C. Fish diversity differs significantly with seasons (P<0.05) and significantly correlated with DO (r = 0.86). The biodiversity indices showed low fish diversity in the creek throughout the sampling seasons.

Key words: Agboyi creek, biodiversity index, seasons, distribution pattern, environmental changes

Introduction

The Quality of aquatic environment depends on a multitude of physical, chemical and biological interactions (Adefemi *et. al.*, 2007). The water bodies, rivers, lakes, dams and estuaries are continuously subjected to a state of change with respect to the geological age and geochemical characteristics. This is demonstrated by continuous circulation, transformation, accumulation of energy and matter through the medium of living thing and their activities which upset the dynamic balance in the aquatic ecosystem (Adefemi *et al.,* 2007). In Nigeria, most coastal ecosystems have been stressed by human activities such as overfishing, habitat destruction (through sandfilling and dredging) and discharge of sewage (industrial and domestic). These have a devastating impact on aquatic biodiversity and thus on fish population, diversity and distribution.

Generally, ecosystems lack the capacity to adapt to these human imposed stresses and still maintain normal functions and structures. Stress results in a process of degradation which is commonly marked by such signs as loss of biodiversity, lowered resilience to natural disturbance, and reduced primary and secondary productivity (Jackson *et al.,* 2001). This also affects the distribution and seasonal pattern of coastal species. Therefore, there is need for regular assessment of fish diversity, distribution and population towards proper monitoring and enforcement of coastal regulations.

Over a decade, Agboyi creek has been known for its enormous biological diversity which allows the immediate human settlements to rely on it for livelihood. Presently, the status of the fisheries resources cannot be ascertained due to various on-going human activities that are neither controlled nor monitored. Therefore, this study aims to determine the species distribution and seasonal pattern of fish in Agboyi creek using biodiversity indices such as Simpson's index and Shannon's index in order to draw out a proper management program. The status of the physico-chemical parameters will be studied as it affects fish distribution and abundance. The various fish species inhabiting the creek seasonally will be investigated.

Materials and Methods

Agboyi creek (latitude N6^{0}33$^/$52$^{//}$ and longitude E3^{0}24$^/$34$^{//}$) is located at the northern part of Lagos State, Nigeria. It shares boundary on the east with Lagos lagoon which makes Agboyi creek one of its adjoining creek. Agboyi creek receives influx from both Lagos lagoon and River Ogun. Effluents from the immediate community and a canal that carries waste from slaughter houses, industries and domestic waste are channeled into the creek.

Three sampling locations (A, B, and C) were selected on the creek (Figure 1). Location A was close to the estuary while B and C were located upstream off the estuary having lower salinity. Water samples were collected from December 2005 to June 2007 covering two dry and wet seasons. Within a depth of 30cm, water samples were collected at 3 points in each sampling location using sampling bottles (2L). After collection, the water samples were tightly covered, labeled, and immediately kept in a vacuum thermoflask filled with crushed ice for preservation. All collected water samples were transported to the chemistry department, University of Agriculture, Abeokuta and samples were kept in the refrigerator at 4 ^{0}C until needed. The period between sampling and analysis were however adhered to as recommended by standard methods APHA, (1995). Parameters tested were; pH, Total Dissolved Solids (TDS mg/l), Nitrates (NO_3 mg/l), Phosphate (PO_4 mg/l), Salinity (‰), Ammonia (NH_3 mg/l), Biochemical Oxygen Demand (BOD mg/l). All the analysis were carried out in triplicates as described by APHA (1995). Water samples for the determination of dissolved oxygen (DO mg/l) were collected into narrow-mouthed glass bottles and fixed immediately on the field with Winkler's reagent. The samples collected were filled to the brim to prevent atmospheric oxygen from the surface of the water and the reagents to prevent loss of dissolved oxygen in the water were added immediately. Analysis was done at the laboratory using the method described by Boyd (1999).

Fish Assessment was carried out. Seven gillnets, each with mesh sizes of 38.1mm, 50.8 mm, 76.2 mm, 88.9 mm, 101.6 mm, 114 mm and 139.7 mm were set overnight at 20.00 h in each of the locations and fish caught were collected separately at 07.00 h the following day and weighed to the nearest 0.1g using a digital laboratory weighing scale. Fish was identified by taxa to species level as described by Idodo -Umeh (2003). Fish species richness was determined by counting the number of fish species found in Agboyi creek. Simpson's index (D) and Shannon's index (H') were the indices used for calculating the fish diversity, using the formula below;

Simpson's index : $$D = \frac{\Sigma n(n-1)}{N(N-1)}$$

Where N – Total number of all individuals in the sample

n – Number of individual in each species

Shannon's index: H = -Σpilnpi

Where

pi – The relative abundance of each species, calculated as proportion of individuals of a given species to the total number of individuals in the community i.e. n/N.

ln – natural log of pi

The data collected were analysed using Analysis of variance (ANOVA) to detect the effects of season and location on fish population and weight. Correlation analysis was used to identify the relationship that exists among the fish (number, diversity and weight) and physico-chemical parameters.

Results and Discussion

Physico-chemical parameters

The values of the physical and chemical water parameters in the three locations (A, B and C) in Agboyi creek are presented in Tables 1 and 2. Temperature ranged between 27.25^{o}C and 27.50^{o}C with an average value of 27.42±0.14^{o}C for dry season while for wet seasons, it ranged from 26.00 – 26.17^{o}C with an average value of 26.28±0.35^{o}C. Temperature was fairly constant throughout the study period, however, water temperatures during the dry seasons were slightly higher than wet seasons. This is an advantage because some species cannot tolerate increased warmth during critical parts of their life cycle and their abundance can be expected to decline (Everett *et. al.*, 1995). Water temperature in the creek was influenced by influx from the lagoon as well as fresh water from river Ogun. However, when lagoon water was static as occurred during the dry season, water temperature largely dependent on radiation from the sun since fresh water flow into the lagoon virtually ceased resulting in high temperature (Ajani, 2001; Ajao and Fagade, 2002). This causes temperature increase in Agboyi creek as observed during the dry season from 26.00^{o}C to 27.50^{o}C. The relatively small range of variations in water temperature observed agrees with the results of Ajani (2001) and that of Ajao and Fagade (2002). They agreed that temperature is a stable environmental factor in the shallow brackish environments of West Africa. In general, the principle oceanographic variables affecting plant and animal life are temperature, winds, currents, salinity, and other physical parameters (Everett, 1997).

The low transparency values observed during the dry and wet seasons (0.78±0.07 and 0.66±0.13m respectively) may be due to high quantity of decomposable materials deposited in the creek through the various

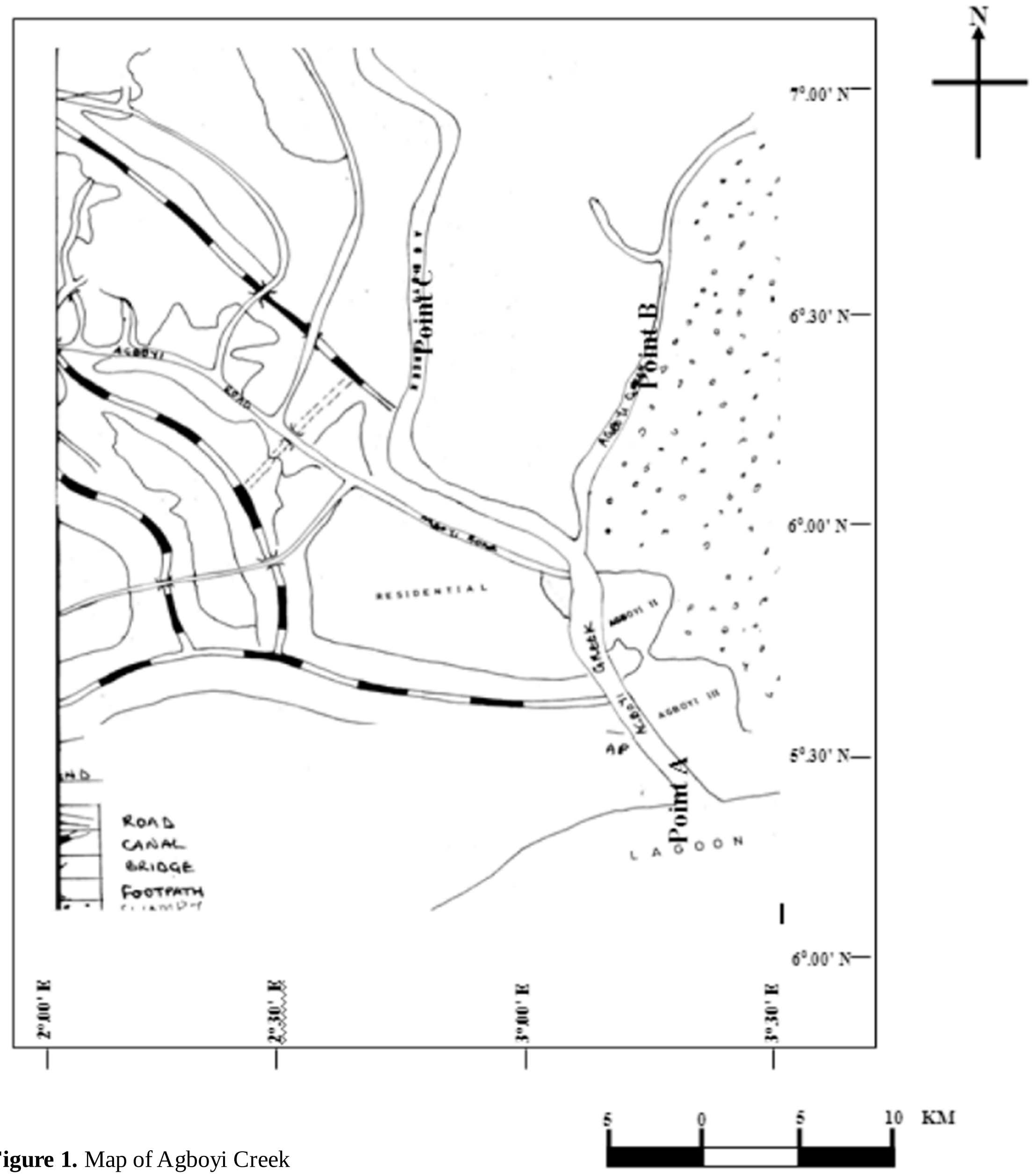

Figure 1. Map of Agboyi Creek
Source: Ketu Development Scheme Map, Ketu Lagos State, Nigeria (2003)

identified human activities. This is similar to the observation of Oyewo (1998) Ajani (2001) and Ajao and Fagade (2002) on the studies of transparency level in Badagry creeks and Lagos lagoon respectively. Turbidity of Nigerian coastal waters is accounted for by the presence of suspended organic matter in the effluent, silt and sand. The pH of the three locations ranged between 7.12 mg/l and 7.33mg/l during the dry season with mean value 7.22±0.11mg/l while in wet season is between 6.81 and 6.92 with mean value 6.86±0.05mg/l. Tilapia can survive in pH ranging from 5-10 but do best in pH range of 6-9 (Pinkate et al., 2003). This explains the abundance of Tilapia recorded during the study. Total dissolved solids (TDS) obtained during the dry and wet seasons were low 31.75± 0.21 and 31.17±10.87 mg/l respectively. The low TDS, low DO content and low transparency recorded in the creek revealed the deteriorating condition of the water quality and probably due to discharges of industrial and domestic wastes into the creek.

Mean DO values in dry and wet seasons were 3.25±0.26 and 3.50±0.08 mg/l respectively. These were below the critical level of 4 mg/l for fish. Tilapia survives dissolved oxygen concentration less than 0.3mg/l;

this is considerably below the tolerance limits for most other fish (Madsen et. al., 2000). This may be as a result of organic waste overloading the natural system causing a serious depletion of the oxygen supply in the water (Ajani, 2001). The distribution of oxygen and other dissolved gases is mostly controlled by temperature, salinity, biological activity, currents and mixing processes. However, a positive correlation (r = 0.86) between DO and fish diversity in Agboyi creek was obtained.

However, nitrate values of 2.01±0.89 and 2.61±0.46mg/l (FEPA, 1988) respectively were obtained for dry and wet seasons. The presence of large quantities of nitrates i.e. above the recommended limit of 0.05mg/l is indicative of waste water pollution. At high concentration, nitrate becomes toxic and can be used as an indicator of poor water quality. According to Pinkate et al., 2003, Nitrite is toxic to many fish because it makes the heamoglobin less capable of transporting oxygen; however, Tilapias are more tolerant of nitrite than many freshwater fish hence its abundance in the study area. Phosphorus concentration in excess of 0.015 mgl^{-1} and nitrogen in excess of 0.3 mgl^{-1} are sufficient to cause algae bloom (Oketola *et al.*, 2006). Thus, high phosphorus level (1.30±0.23 mg/l and 1.55±0.15 mg/l) in dry and wet seasons may be attributed to algal bloom that is continually experienced on the creek. High nutrient concentrations also interfere with recreation and aesthetic of water resources by causing reduced water clarity, fish kills, odours and blooms of toxic and non-toxic organisms (Radojevic and Bashkin, 1999). The ammonia level (2.01±0.89 mg/l and 2.00±1-30 mg/l) of the water was relatively higher than FEPA water quality criteria. The source of this may be from the domestic effluents discharged directly by the community into the creek as well as influx from the lagoon and Ogun River. Ammonia is toxic to fish, and its toxicity can lead to loss of equilibrium, increase breathing, cardiac output and increased oxygen uptake and eventual death of fish (Odiette, 1999). The BOD was high (25.56±3.10 mg/l and 18.17±6.05 mg/l) in both dry and wet seasons respectively; an indication of an ecological system under stress resulting in oxygen depletion which is not favourable for biological growth. This could be as a result of pollution associated with parameters such as phosphate and nitrate which causes euthrophication (algae bloom), increase biomass and deplete oxygen during decay of the biomass (Ajao and Fagade, 1990, Akpata *et al.*, 1993 , Ajibola *et al.*,, 2005 and Adebowale *et al.*, 2008).

The salinity obtained ranged from 2.14 - 5.31‰ in dry season and 3.14 - 4.94‰ in wet season. According to Ajao and Fagade (2002), the seasonal salinity cycle was a simple basic cycle following the rainfall regime; these seasonal fluctuations correlates positively with the volume of rainfall into the lagoon. Inward decrease in salinity was observed from locations A to C on the creek as this tends to be more fresh water. The linear correlation of parameters presented in Table 3 shows a strong negative relationship between DO and BOD (r = -0.88; p>0.05), Salinity (r = -0.99; p>0.05) and Ammonia (r = -0.81; p >0.05) .The result obtained shows that salinity, ammonia and biochemical oxygen increases as dissolved oxygen decreases which conform with Chapman, 1992, (as cited by Ajibola *et al*, 2005) that solubility of oxygen decreased as temperature and salinity increased.

Table 1. Physico-chemical parameters of Agboyi Creek (Dry Season)

Parameters	**A**	**B**	**C**	**Mean**	**SD (±)**
Temp °C	27.50	27.25	27.50	27.42	0.14
Water dept (m)	2.25	2.03	2.68	2.32	0.33
Water transp. (m)	0.78	0.70	0.85	0.78	0.07
pH (mg/l)	7.12	7.21	7.33	7.22	0.11
TDS (mg/l)	39.75	35.25	20.25	31.75	10.21
BOD (mg/l)	22.10	26.50	28.08	25.56	3.10
NO_3 (mg/l)	1.83	1.65	1.54	1.67	0.15
PO_4 (mg/l)	1.44	1.44	1.04	1.30	0.23
DO (mg/l)	2.97	3.29	3.49	3.25	0.26
NH_3 (mg/l)	2.59	2.46	0.98	2.01	0.89
Salinity ‰	5.31	4.02	2.14	3.82	1.59

Table 2. Physico-chemical parameters of Agboyi Creek (Wet Season)

Parameters	A	B	C	Mean	SD (±)
Temp °C	26.00	26.67	26.17	26.28	0.35
Dept (m)	3.03	2.60	3.62	3.08	0.51
Transp. (m)	0.62	0.55	0.80	0.66	0.13
pH	6.85	6.81	6.92	6.86	0.05
TDS (mg/l)	35.33	39.33	18.83	31.17	10.87
BOD(mg/l)	11.33	20.33	22.85	18.17	6.05
NO_3 (mg/l)	2.47	2.24	3.12	2.61	0.46
PO_4 (mg/l)	1.43	1.50	1.72	1.55	0.15
DO (mg/l)	3.50	3.58	3.42	3.50	0.08
NH_3 (mg/l)	2.32	3.11	0.57	2.00	1.30
Salinity (‰)	4.94	3.18	3.14	3.75	1.03

Table 3. The Linear Correlation Analysis of the Chemical Parameters of Agboyi Creek

	pH	Total Dissolved Solids	Biochemical Oxygen Demand	Nitrate	Salinity	Dissolved Oxygen	Ammonia	Phosphate
pH	1							
Total Dissolved Solids	0.988522	1						
Biochemical Oxygen Demand	0.5	0.363427	1					
Nitrate	0.929202	0.862705	0.78466	1				
Salinity	0.790993	0.689483	0.925353	0.961106	1			
Dissolved Oxygen	-0.84856	-0.75888	-0.8825	-0.98402	-0.99492	1		
Ammonia	0.997798	0.996365	0.441464	0.902646	0.748674	-0.8116	1	
Phosphate	-0.94491	-0.88462	-0.75593	-0.99898	-0.94768	0.975	-0.92112	1

Fish Composition and Distribution

The composition and distribution of fish in the study area are presented in Table 4. The most abundant species recorded (in percentage) during the study were *Tilapia zillii* (84.94%), *Oreochromis aureus* (9.23%), *Oreochromis niloticus* (3.6%), and *Hemichromis faciatus* (2.21%). Others species found in the creek especially in locations A and B migrate between the brackish and freshwater because of their proximity to both water bodies (Figure 1), and environmental condition that is more favourable for fishes than C (Olawusi-Peters, 2009). There was overlap of fish species among the locations except for species such as *Pomadasys jubelini* and *Caranx senegalus* which were found only in location A; *Sardinella maderensis*, *Trachinus apmatus* and *Arius gigas* were restricted to location B while *Pellonula* afezeliusi, *Hydrocynus lineatus* and *Elops lacerta* were recorded only in location C. Also, there is seasonal variation in the quantity of fish recorded in each location (Table 3). In dry season, location A, B and C had 696 (34.5kg), 1059(51.0kg) and 645 (28.0kg) of fishes respectively while 1577 (71.5kg), 1018 (40.7kg) and 885 (38.55kg) respectively were recorded during the wet season. More fish species (diversity) was observed in locations A and B; this could be as a result of higher productivity in estuaries and young marine fish in particular use it as feeding grounds (Amadi, 1991). The relationship between the physico-chemical parameters and the fish diversity, number and weight are presented in Table 5. Fish number, diversity and weight are negatively correlated to water depth, pH, biochemical oxygen, and ammonia. Increase in any of these physico-chemical parameters will lead to decrease in fish diversity, number and weight. Any ecological imbalance arising from alterations of the environmental factors will affect the distribution and abundance of fish. Therefore, the low fish composition and diversity observed especially in location C may have been caused by stress imposed by various human activities (sand mining, discharge of domestic and industrial waste) that exist on the creek. Ajao (1990) and Cole (1977) stated that the implications of sand mining are the alteration of bottom conditions over sizeable areas. If such sites are of critical importance in biological terms, such as fish spawning grounds or mollusc settlement areas, then substantial damage may be done.

Table 4. Fish Species found in Agboyi Creek during the Dry and Wet Season (Dec. 2005 – June 2007).

Species	DRY SEASON						WET SEASON					
	A		B		C		A		B		C	
	No	Kg	No	Kg	No	Kg	No	Kg	No	Kg	No	Kg
Liza falcipinis	90	4.2	12	0.9	-	-	-	-	18	0.6	-	-
Monodactylus sabae	12	0.9	6	0.3	-	-	-	-	-	-	-	-
Pomadasys jubelini	3	0.3	-	-	-	-	-	-	-	-	-	-
Arius heudeloti	21	2.4	12	0.6	-	-	3	0.3	-	-	-	-
Arius latiscutatus	15	2.4	6	0.6	-	-	-	-	-	-	-	-
Hemichromis fasciatus	21	1.2	33	2.4	-	-	54	3.4	6	0.6	6	0.6
Tilapia zillii	462	18.6	780	31.2	522	18.9	1,191	45	870	31.3	795	30.6
Sarotherodon aureus	33	1.8	129	8.7	38	2.1	174	12.9	63	3.9	63	5.1
Sarotherodon niloticus	24	1.5	30	1.8	37	2.5	54	2.1	42	2.7	3	0.5
Hepsetus odoe	9	0.9	9	1.8	3	0.3	3	0.6	-	-	-	-
Caranx senegalus	6	0.3	-	-	-	-	-	-	-	-	-	-
Polynemus quadrifilis	-	-	6	0.6	3	0.3	-	-	-	-	-	-
Synodontis nigrita	-	-	3	0.3	3	0.3	-	-	-	-	-	-
Arius gigas	-	-	12	0.6	-	-	-	-	-	-	-	-
Schilbe uranoscopus	-	-	18	0.9	15	0.9	11	0.3	3	0.1	7	0.2
Heterotis niloticus	-	-	3	0.3	3	0.3	-	-	-	-	-	-
Elops lacerta	-	-	-	-	3	0.3	-	-	-	-	-	-
Hydrocynus lineatus	-	-	-	-	15	1.8	-	-	-	-	-	-
Leptocyrus niloticus	-	-	-	-	3	0.3	78	5.7	12	1.2	6	0.9
Trachinus apmatus	-	-	-	-	-	-	-	-	1	0.2	-	-
Pellonula afezeliusi	-	-	-	-	-	-	-	-	-	-	2	0.25
Sardinella maderensis	-	-	-	-	-	-	-	-	3	0.1	-	-
Labeo senegalensis	-	-	-	-	-	-	9	1.2	-	-	3	0.4
TOTAL	696	34.5	1059	51	645	28	1577	71.5	1018	40.7	885	38.55

*No – number of fish
*Kg – Weight in Kilogram

Table 5. Correlation Table showing the Relationship between the Fish and Physiochemical Parameters.

	Temp	Depth	pH	TDS	BOD	NO	Salinity	DO	NH	PO
Fish No	-0.45	-0.11	-0.67	0.50	-0.78	0.10	0.43	0.57	-0.08	0.43
diversity	0.80	-0.72	-0.80	0.02	-0.29	-0.74	0.06	0.86*	-0.70	-0.07
Fish Wt	-0.40	-0.20	-0.54	0.42	-0.80	0.07	0.51	0.49	-0.18	0.57

* - Significantly different at $p < 0.05$

Seasonal Fish Diversity

Fish diversity in the study area was determined using Shannon diversity of index and Simpson index. In Shannon diversity of index, an area with low index values indicate low diversity, hence the higher the values, the higher the diversity. Whereas in Simpson index, the lower the index values the higher the diversity. Low diversity of fish (as shown in Tables 6-8) was observed in the study area. The low Shannon diversity index and Simpson's index are indication of stressed ecosystem possibly due to pollution and unregulated fishing (Olawusi-Peters, 2009). The Simpson's index was highest in sampling point A (D = 0.57 and D = 0.80 respectively) during the dry and wet seasons. Locations B and C had values of D = 0.75 and D = 0.86 respectively during the dry season while the values during the wet season were D = 0.92 and D = 0.96 respectively. The reduced values of species richness and general diversity of fish upstream (location A) is an indication of water pollution. Contrastly, the higher diversity downstream (location C) is a reflection of stability in ecosystem (Amadi, 1991, Chukwu and Nwankwo, 2003). The species diversity measured by Shannon's index followed similar trend. During the dry season, sampling point A had the highest value of $H^{/}$ (0.93), followed by sampling point B ($H^{/}$ =0.67) while sampling point C index value was 0.36. During the wet season, sampling point A had the highest value of H = 0.47, while sampling locations B and C index values were $H^{/}$=0.22 and $H^{/}$=0.10 respectively. The species richness is highest in dry seasons than the wet seasons. The lagoon and the sea are generally more productive in the dry season. In both the sea and the lagoon, seasonal fish abundance is marked (Fregene, 2002).

Table 6. Fish Diversity using Simpson's Index (D) (Dry Season)

SPECIES	A		B		C	
	N	n(n-1)	n	n(n-1)	n	n(n-1)
Tilapia sp	519	268842	939	880782	597	355812
Arius sp	36	1260	30	870	-	-
Liza falcipinis	102	10302	12	168	-	-
Monodactylus sabae	12	132	6	30	-	-
Pomodasys jubelini	3	6	3	6	-	-
Hemichromis faciatus	21	420	33	1056	-	-
Hepsetus odoe	-	-	9	72	3	6
Caranx senegalus	6	30	-	-	-	-
Polynemus quadrifilis	-	-	6	30	3	6
Auchenoglanus occidentalis	-	-	3	6	3	6
Schilbe uranoscopus	-	-	12	132	15	210
Heterotis niloticus	-	-	18	306	3	6
Elops lacerta	-	-	3	6	3	6
Hydrocynus lineatus	-	-	-	-	15	210
Leptocyris niloticus	-	-	3	6	-	-
Trachinus apmatus	3	6	2	2	-	-
Pellenula afzelius	1	0	-	-	-	-
TOTAL (N)	703	28099	1079	883472	642	356262
Simpson's index	0.5693		0.7595		0.8657	

Table 7. Fish Diversity Using Simpson's Index (D) (Wet Season)

SPECIES	A		B		C	
	N	N(n-1)	N	n(n-1)	n	n(n-1)
Tilapia sp	1419	201214	972	943812	861	740460
Arius sp	3	6	-	-	-	-
Liza falcipinis	-	-	18	306	-	-
Hemichromis faciatus	54	2862	6	30	6	30
Hepsetus odoe	3	6	-	-	-	-
Schilbe uranoscopus	21	420	-	-	-	-
Leptocyris niloticus	18	6006	12	132	6	30
Labeo senegalensis	9	72	-	-	3	6
Trachinus apmatus	-	-	1	0	-	-
Pellenula afzelius	-	-	3	6	-	-
TOTAL (N)	1587	2021514	1012	94428	876	740526
Simpson's index	0.8031		0.9229		0.9661	

Table 8. Fish Diversity using Shannon-Wiener Index (Dry Season)

		A			B			C	
Species	pi	ln pi	pi ln pi	Pi	ln pi	pi ln pi	pi	ln pi	pi ln pi
Tilapia sp	0.74	-0.30	-0.22	0.87	-0.14	0.12	0.93	0.07	-0.07
Arius sp	0.05	-2.97	-0.15	0.03	-3.58	-0.10	-	-	- *Liza*
falcipinis	0.15	-1.93	-0.28	0.01	-4.50	0.05	-	-	-
Monodactylus sabae	0.02	-4.07	-0.07	0.01	-5.19	0.03	-	-	-
Pomodasys jubelini	0.00	-5.46	-0.02	0.00	-5.89	0.02	-	-	-
Hemichromis faciatus	0.03	-3.51	0.10	0.03	-3.49	0.11	-	-	-
Hepsetus odoe	-	-	-	0.01	-4.79	0.04	0.00	-5.37	-0.02
Caranx senegalus	0.01	-4.76	0.04	-	-	-	-	-	-
Polynemus quadrifilis	-	-	-	0.01	-5.19	-0.03	0.00	-5.37	-0.02
Auchenoglanus occidentalis		-	-	-	0.00	-5.89	-0.02	0.00	-5.37
0.02									
Schilbe uranoscopus	-	-	-	0.01	-4.50	-0.05	0.02	-3.76	0.09
Heterotis niloticus	-	-	-	0.02	-4.09	-0.07	0.00	-5.37	0.02
Elops lacerta	-	-	-	0.00	-5.89	-0.02	0.00	-5.37	0.02
Hydrocynus lineatus	-	-	-	-	-	-	0.02	-3.76	0.09
Leptocyris niloticus	-	-	-	0.00	-5.89	-0.02	-	-	-
Trachinus apmatus	0.00	-5.46	-0.02	0.00	-6.29	-0.02	-	-	-
Pellenula afzelius	0.00	-6.56	-0.01	-	-	-	-	-	-
TOTAL			-0.93			-0.67			-0.37
Shannon's index			0.93			0.67			0.37

Table 9. Fish Diversity Using Shannon-Wiener Index (Wet Season)

		A			B			C	
Species	pi	ln pi	pi ln pi	Pi	ln pi	pi ln pi	pi	ln pi	pi ln pi
Tilapia sp	0.89	-0.11	-0.10	0.96	-0.04	-0.04	0.98	-0.02	0.02
Arius sp	0.00	-6.27	0.01	-	-	-	-	-	
Liza falcipinis	-	-	-	0.02	-4.03	-0.07	-	-	-
Hemichromis faciatus	0.03	-3.81	-0.11	0.01	-5.13	-0.03	0.01	-4.98	-0.03
Hepsetus odoe	0.00	-6.27	0.01	-	-	-	-	-	-
Schilbe uranoscopus	0.01	-4.33	-0.06	-	-	-	-	-	-
Leptocyris niloticus	0.05	-3.01	-0.15	0.01	-4.43	0.05	0.00	4.10	0.03
Labeo senegalensis	0.01	-5.17	-0.03	-	-	-	0.00	-5.68	-0.02
Sardinella sp.	-	-	-	0.00	-5.82	-0.02	-	-	-
Trachinus apmatus	-	-	-	0.01	-6.92	-0.01	-	-	-
Pellenula afzelius	-	-	-	0.00	-6.92	-0.01	-	-	-
TOTAL			-0.47			-0.22			-0.10
Shannon's index			0.47			0.22			0.10

Conclusion

Fish distribution generally follows environmental quality parameters. Most species have fairly narrow zones of preference or of reproduction ability. The deteriorating status of the physico-chemical parameters of Agboyi creek could have been as a result of uncontrolled human activities which could have contribute to the general low fish diversity obtained during the period of study. Therefore, the anthropogenic sources of contamination in Agboyi creek should be carefully controlled in order to have a less stressful ecosystem. There is an urgent need to monitor and control pollution regularly in Agboyi creek.

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