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Fish Assemblage of Amadi Creek, Port Harcourt, Rivers State Nigeria

Adaba T. Ibim[a]*, Lilian C. Njoku[b]

[a]*Department of Fisheries, Faculty of Agriculture, University of Port Harcourt, Nigeria*
[a]*Email: adaba.ibim@uniport. Edu.ng*

Abstract

The Amadi Creek, is a vital inland water body in Port-Harcourt, exploited for numerous reasons, including fishing. However, no information exists on the fin fish assemblage of the creek. This research is aimed at documenting the fish population of the Creek. A twelve week survey was conducted, and landed fish collected from fishers using indiscriminate fishing gears. The Fin fish Composition, Diversity and Abundance were ascertained using standard methods. A total 8,5552 fin fishes composed of 3 families, the Cichlid with two species (*Sarotheredon melanotheron and Coptodon zilli*), the Mugilidae and Clupeidae with one species each (*Mugil cephalus* and *Sardinella maderensis*, respectively) .The *Sarotheredon melanotheron*. Generally, diversity was low with only 4 species in the creek. Quantitatively, the family diversity of the Cichlids were high (50%), the Mugilidae and Clupeidae were low (25%) each. Species diversity revealed *Sarotheredon melanotheron* was higher (97.7%), *Sardinella maderensis* (1.1%), *Mugil cephalus* (0.8%), and *Coptodon zilli* lowest (0.5%) The diversity was significant ($P<0.05$) between the weeks. Species Abundance revealed that *Sarotheredon melanotheron* was dominant, *Mugil cephalus* and *Sardinella maderensis* few, and *Coptodon zilli* rare. It could be concluded that besides the *Sarotheredon melanotheron* the fishes were threatened. It is therefore recommended that prolonged research be carried out to establish the cause of the threat, status of the fin fishes and management strategies be developed to protect the fish species under threat.

Keywords: Abundance; Composition; Diversity; Fin fish.

1. Introduction

In the Niger Delta Area, Nigeria, like in other parts of the world Fish is an important component in the diet of most people, as it provides a cheaper source of high quality and quantity protein, especially in tropical regions of the world where most of the poorer countries exist [16].

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* Corresponding author.

It was also reported to provide high quality poly-unsaturated fatty acids as well as numerous micro-nutrients. In [24], it was reported that, fish constitutes about 40 – 50 % of the animal protein intake of the average Nigerian. According to [40], Fish supplies naturally augment food availability, ensuring good nutritional outcomes, particularly, for the poor and rural populations. It was further stated in [40] that, fish supplies provide the vast number of people engaged in the fishing industry incomes that improve their access to food and livelihood.

The fisheries sector contributes significantly to national economic development of the Niger Delta Area and Nigeria at large, in view of food security, employment, poverty reduction, and gross domestic product and foreign exchange earnings.

Biodiversity is essential for stabilization of ecosystems, protection of overall environmental quality for understanding the intrinsic worth of all species on earth, and it is important for the future sustainability of fisheries resource in order to conserve and increase the needs for fish population [46]. Also [19] reported that, the number of species present and their abundance structure are two fundamental attributes of a community, and their diversity promotes the stability of communities and ecosystem processes. The diversity and community structure of fishes in any water body are important for conservation and management purposes [1]. He added that, biodiversity information within an area is vital for the development of adequate conservation strategies. Fish diversity is threatened by many human activities, but the most significant impacts are from habitat modification, overharvest and introduced species [17]. Many fishes are also threatened because they live in water bodies that are prone to pollution and habitat degradation [42]. Creeks and rivers are used as open channels for the discharge of waste water. Of recent, many creeks and rivers have been greatly polluted with municipal and industrial activities causing an imbalance in the natural environment [22].

Escalating anthropogenic impacts on fish biodiversity have greatly stimulated the need for using taxonomic inventories to understand the diversity patterns [28]. Information on the number of fish in a population is necessary to determine the effects of fishing, other human activities or natural climatic variations to detect any changes in the population [37,35].Therefore, establishing accurate fish assemblage inventories is a must in biodiversity conservation.

The Amadi creek, is located in Port- Harcourt metropolis in the Niger Delta area of Nigeria. It is of high economic importance to the residents of Rumuobiakani, Mini-Ewa, Oginigba, Woji and Okujagu communities, as it hosts the activities of major multinational companies around it and serves as a means of water transportation in the area [22]. Also, several human activities such as land filling and dredging, oil trading and pollution, as well as waste disposal are on-going in and around the creek. The Amadi Creek is of primary importance to the communities around it as it sustains fishing activities and, for its enormous fish yield which allowed the immediate human settlement that rely on it for their socio-economic livelihood (Pers. Com). Artisanal or small scale fisheries is the pre-dominant fisheries of the inhabitants around the creek. Apart from being a source of subsistence, the artisanal fisheries there serves as a very unique and veritable source of self-employment to so many families inhabiting the riverine area. Several studies have been carried out on the ichtyofaunal assemblage of Rivers in the Niger delta area such as Lower Nun River [25]; Kolo Creek River [32] ; Brass River [26]; the Lower Nun River [30]; Odhiokwu- Ekpeye local fish pond and flood plains [23]; among

others. Also, several studies are available on adjoining rivers to the Amadi creek such as the Bonny Estuary [34;42;7;41]; Lower Bonny River [3]; Elechi creek in the Upper Bonny River[39;42]; the New Calabar River (Choba end) [20]; the Upper and Lower reaches of the New Calabar River [10]; the Middle Sombreiro River[12]; the Upper Sombreiro River [11]; among others.

However, inspite of the significance of the Amadi creek and the activities on going, there is lack of information on the assemblage of the fish population of this creek. Thus, the aim of this study was to assess, identify and document the abundance, diversity and composition of Fin fish Species of the Amadi creek.

This work would will serve to provide important information for the fish population for this creek; for biomonitoring of the fin fish population of the creek, providing information on the impact of the fishery, impact of human and environmental activities on the fish populations and their ecosystem and also providing vital information for the management of the fisheries of the Amadi creek.

2. Materials and Methods

2.1 Study Area

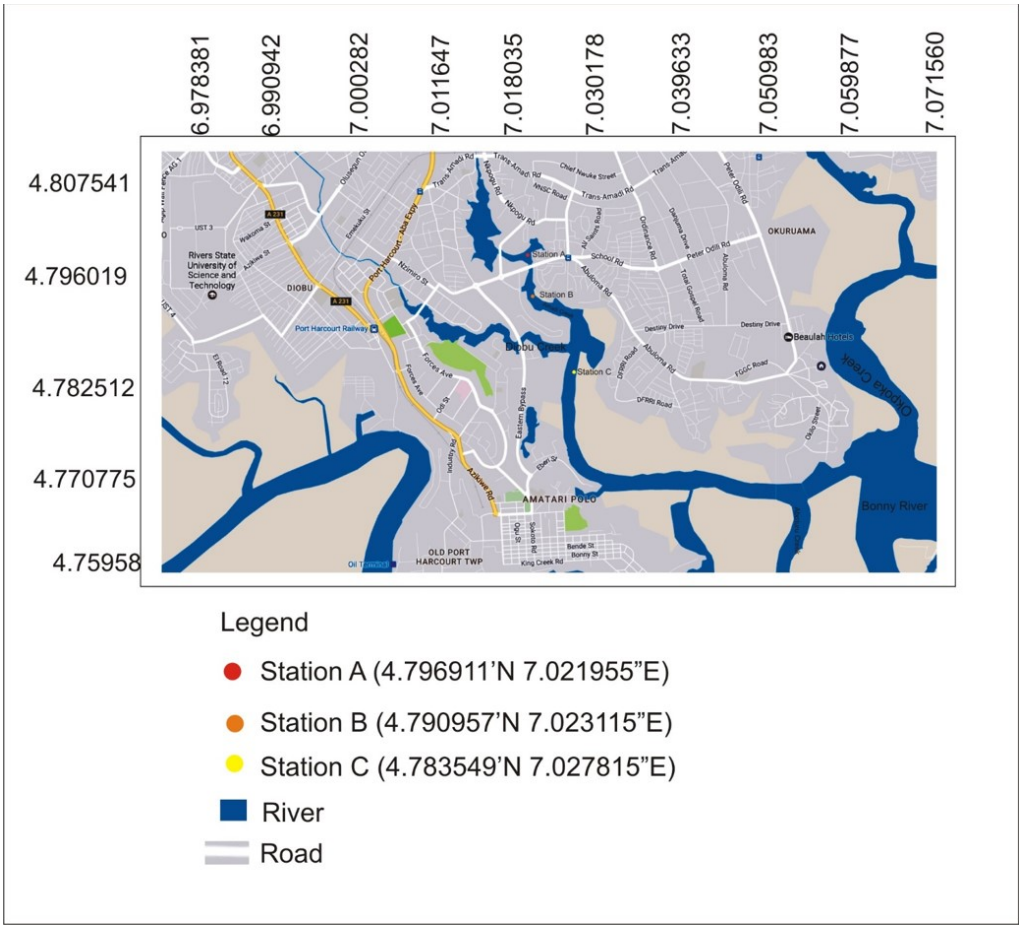

Figure 1: Study Area showing the Amadi Creek (courtesy google maps, 2017).

The study was carried out in the Amadi Creek, shown in Figure1. It is one of the many creeks that constitutes the hydrological system in the Port Harcourt Metropolis of Rivers State. It lies within longitude 4^{o} 46' 00'' E and latitude of 7^{0} 03'00''N. The Amadi creek is found around the Nkpogu, Amadi-Ama, Tera-Ama and Abuloma. It flows from Okrika town down to Mini-Ewa, Rumuobiakani through Woji, Oginigba, Okujagu communities and finally empties into the Bonny river from where it runs into the Atlantic ocean. The creek has connection with Okpoka Creek, Aboturu Creek and Diobu Creek[50].

The water is tidal (semi—diurnal) and flows into the creek during high tide and out at low tide but stagnates briefly at the point of tidal changes [14].

The creek has a sparse Vegetation made up of few red and white mangrove (*Rhizophora mangle* and *Avicenia africana*, respectively) and more of Nypa palm (*Nypa fruticans*) which has almost dominated the creek [14]. The main channel of the Creek is fairly deep with muddy bottom due to dredging activities along the creek. The intertidal banks are covered mostly with chikoko mud.

The Amadi Creek is economically important in the sense that, a number of human and economic activities are taking place within and beside it. It hosts several industries, factories and boat harbours, water transportation and artisanal fishing. The major economic activity is artisanal fishing where the fishers use manually operate wooden (dug—out) canoes and fish with mostly cast net, gill net and seine net.

2.2. Experimental Procedure

2.2.1. Experiment Design and Fish Samples Collection

The study was designed to last for 12 weeks from June to August, 2017. Three sampling stations were sited on the study area to cover the entire Amadi Creek as shown in Fig 1. The sampling sites were labelled Station A, Station B and Station C, indiscriminately. The Stations were sampled for fish by a fisherman twice weekly (Tuesday and Friday) using nets and traps of varying sizes and types. Fish samples were collected from the local fisher as catch were landed. Plastic buckets containing 10% formalin solution taken to the field were used to collect and convey fishes to the Laboratory, fishes were preserved in the formalin solution and taken to the laboratory and identified to the level of species for identified to species level using standard Identification Keys.

2.3. Data Collection

2.3.1. Physico-Chemical Parameter Determination

Water samples of the study area were tested both on-site and in the laboratory to determine various physico-chemical parameters of the study area using standard methods. The water samples taken to the laboratory for analysis was collected using plastic containers with covers, in which the water sample was taken for analysis. The various Physico-chemical parameters were determined as follows:

i. Temperature

Water temperature was measured using mercury bulb thermometer in the field. The thermometer was immersed in the water for about 2.5 minutes to ensure proper graduation before the temperature reading was recorded.

ii. pH (Hydrogen Ion Concentration)

The pH level of the water sample was measured on-site using a pH meter (P. IIIATC Pen Type pH Meter) standardize with 4.0 and 6.9 (pH) buffer solution.

iii. Dissolved Oxygen

Dissolved oxygen was measured from water samples collected and taken to the laboratory, using a Millwaki dissolved oxygen meter.

iv. Salinity

Salinity was measured from water samples in the laboratory using a refractometer.

2.3.2. Fish Composition Determination

Fish composition was determined by counting all landed fish. Fishes were then properly positioned and snaps shots taken to capture their physical features using a digital camera. This was used for identification using identification keys such as Wheeler (1994), Nigeria Freshwater fishes (Olasebikan and Raji, 2004), Taxonomy, Ecological Notes, Diet and Utilization (Idodo-Umeh, 2003), and Fish Base (Froese and Pauly, 2010).

2.3.3. Fish Diversity Determination

Fish diversity was determined using Shannon-Wiener Index (Krebs, 1999) as follows: $H = -\sum_{i=1}^{s} Pi \text{ in } Pi$

Where Pi is the proportion of individuals found in the species (i.e. Pi = $\frac{ni}{N}$ where ni is the number of the individuals species, N being the total abundance.

2.3.4. Fish Species Abundance Determination

Abundance was determined by Relative abundance method which involved counting the total number of fish species caught per sample site per time which was recorded and the relative abundance score of the species was estimated following the criteria of Allison and his colleagues (2003) as 1-50=Rare(R),51-100=Few(F), 101-200=Common(C), 201-400=Abundant(A), and 400=Dominant(D).

2.4. Data Analysis

This was carried out using the Microsoft word Excel (2010) package. The ANOVA at probability (<0.05) to compare the relative abundance and diversity of fish species between weeks to identify the significance of the values.

3. Results

3.1. Physico-Chemical Parameters

The mean physico-chemical parameters are shown in Tables 1.

Temperature: The temperature ranged between 27.2°C - 28.7°C with a mean of 27.8°C. Dissolved Oxygen: The Dissolved Oxygen ranged between 4.6mg/L and 6.1mg/L throughout the duration of the study with a mean of 5.26mg/L.

Hydrogen Ion Con. (pH): The pH ranged between 5.2 – 6.9 and an average of 6.5.

Salinity: The salinity ranged between 4.1ppt and 5.95ppt.

Conductivity: The conductivity ranged between 7.2 – 9.05 and an average of 8.4,.

Table 1: Average Physico-Chemical Parameters in Amadi Creek, PortHarcourt**.**

Parameters	Range	Mean	Standard Error (±)
Temperature °C	27.2-28.7	27.83	0.05
Dissolved Oxygen (mg/L)	4.6-6.1	5.26	0.05
Ph	5.2-6.9	6.49	0.05
Salinity (ppt)	4.1-5.95	5.64	0.05
Conductivity	7.2-9.05	8.42	0.05

3.2. Composition

The result of the study revealed a total fish composition of eight thousand five hundred and fifty two (8552) specimens over a period of 90 days in 12 weeks as shown in the Fin Fish Composition the Amadi creek (table 2). The total fish composition revealed 4 species belonging to 4 genera from 3 families and 3 orders, as shown in the Checklist of species caught in the Amadi Creek (table 3). The Cichlidae had the highest representation at family level with two (2) Species (*Sarotherodon melanotheron, Coptodon zilli*) belonging to two (2) genera. The Mugilidae and Cluepidae (*Mugil cephalus*) (*Sardinella maderensis*) both had one (1) species each from one (1) genera respectively.

Table 2: Composition of Fin Fishes of the Amadi Creek, Port Harcourt Local Government Area, Rivers State.

S/N	Names of Fish Species	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	Sarotherodon melanotheron	1083	1097	1014	523	715	896	635	420	336	585	580	471	8355
2	Sardinella maderensis	0	23	0	0	2	0	0	0	0	11	0	5	41
3	Mugil cephalus	5	3	11	3	0	22	7	15	25	0	0	0	91
4	Coptodon zilli	10	0	6	32	0	0	0	9	0	4	0	4	65
	Total	1098	1123	1031	558	717	918	642	444	361	600	580	480	8552

Table 3: Checklist of the Fin Fishes of the Amadi Creek, Port Harcourt Local Government Area, Rivers State.

S/N	Names of Fish Species	Genus	Family	Order
1	Sarotherodon melanotheron	Sarotherodon	Cichlidae	Perciformes
2	Sardinella maderensis	Sardinella	Clupeidae	Clupeiformes
3	Mugil cephalus	Mugil	Mugilidae	Mugiliformes
4	Coptodon zilli	Coptodon	Cichlidae	Perciformes

3.3. Diversity

The fin fish diversity (Table 4) showed that the fish family Cichlidae with 50%, was the most diverse, comprising of two (2) different species (*Coptodon zilli and Sarotherodon melanotheron*) belonging to two (2) genera. The remaining two families had lower diversities with Mugilidae (*Mugil cephalus*) (25%) and Clupeidae (*Sardinella maderensis*) (25%) belonging to one (1) genera each. The species diversity(Table 5) revealed that *Sarotheredon melanotheron* had the highest species diversity been (97.7%), followed by *Sardinella maderensis*(1.1%) , *Coptodon zilli* (0.8%) and least occurring *Mugil cephalus (*0.5%).

Table 4: Family Diversity of Fin Fishes in Amadi Creek, Port Harcourt Local Government Area, Rivers State.

S/N	Family	Species	Number of Species Caught/family	Diversity %
		Sarotherodon melanotheron		
1	Cichlidae	Coptodon zilli	2	50
2	Mugilidae	Mugil cephalus	1	25
3	Clupeidae	Sardinella maderensis	1	25

Table 5: Species Diversity of Fin Fishes in Amadi Creek, Port-Harcourt, Port Harcourt Local Government Area, Rivers State.

S/N	Family	Species	Number of Species Caught	Diversity %
1	Cichlidae	Sarotherodon melanotheron	8355	97.7
2	Cichlidae	Coptodon zilli	65	0.8
3	Mugilidae	Mugil cephalus	41	0.5
4	Clupeidae	Sardinella maderensis	91	1.1

3.4. Abundance

The family abundance of fin fish fauna (Table 6) revealed that the Cichlidae had the highest abundance (49.23%), followed by Mugilidae (1.06%) with the least occurring being Clupeidae (0.48%).At the species level, the relative abundance of all fish species (Table 7) showed that *Sarotherodon melanotheron* was the most

abundant contributing 97.7% to the total catch of the study. It was followed by *Mugil cephalus* with 1.06%, *Coptodon zilli* (0.76%) and the least contributing species was *Sardinella maderensis* (0.48%).

The Abundance score of fin fishes in the Amadi Creek revealed that, amongst the 3 families represented (Table 6), the Cichlidae were the most dominant while the other two families (the Clupeidae and Mugilidae) were few. However, when the species abundance was considered (Table 7) the abundance score revealed that from the four species present, *Sarotheredon melanotheron* was the dominant species with a total presentation 8355, the *Mugil cephalus* and *Sardinella maderensis* were few with a total of 91 and 65 respectively and the Cichlid, *Coptodon zilli* rare with a total representation of 41.

Table 6: Family Abundance of Fin Fishes of the Amadi Creek, Port-Harcourt, Port Harcourt Local Government Area, Rivers State.

S/N	Family	Total Number of Fish Caught	Relative Abundance %	Legend of Rarity
1	Cichlidae	8396	49.23	D
2	Mugilidae	91	1.06	F
3	Clupeidae	65	0.48	F

1-50=Rare (R), 51-100=Few (F), 101-200=Common (C), 201-400=Abundance (A), and >400=Dominant (D).

Table 7: Species Abundance of Fin Fishes of the Amadi Creek, Port Harcourt Local Government Area, Rivers State.

S/N	Fish Species	Family	Total Number of Fish Caught	Relative Abundance %	Legend of Rarity
1	Sarotherodon melanotheron	Cichlidae	8355	97.7	D
2	Coptodon zilli	Cichlidae	41	0.76	R
3	Mugil cephalus	Mugilidae	91	1.06	F
4	Sardinella maderensis	Clupeidae	65	0.48	F

1-50=Rare (R), 51-100=Few (F), 101-200=Common (C), 201-400=Abundance (A), and >400=Dominant

3.5. Data Analysis

An Analysis of variance (ANOVA) at a probability, $P < 0.05$ (Table 8) showed that species diversity differed significantly ($P < 0.05$) between the weeks. The highest significant difference was recorded in Week 1 (2.428 ± 0.1^{az}) and the least occurred in Week 12 (0.079 ± 0.1^{a}). Some weeks were significantly different from other weeks such as Week 1 (2.428 ± 0.1^{az}) and Week 8 (0.744 ± 0.1^{ac}). Some weeks were significantly different from each other, such as Weeks 2 (2.164 ± 0.1^{ae}), week 3 (1.897 ± 0.1^{ad}), week 4 (1.641 ± 0.1^{ac}), week 5 (1.463 ± 0.1^{ab}), while some other weeks were similar such as, 6 (1.254 ± 0.1^{aa}) and week 7 (1.014 ± 0.1^{aa}).

Also, the Analysis of variance (ANOVA) at a probability, $P < 0.05$ (Table 8) revealed that, though Week 2

(13.131±0.1 [a]) and Week 1 (12.839±0.1 [a]) had the highest significant difference in abundance, they were not significantly different from each other, but were significantly different from the rest weeks. Also, some others were significantly different from each other (Week 3 (12.056±0.1 [b]), Week 6 (10.734±0.1 [e])) while other weeks were similar in significance (Week 4 (6.525±0.1 [c]) and Week 11 (6.782±0.1 [c])). The least significant difference occurred in Week 8 (5.192±0.1 [ab]).

Table 8: Data Analysis within weeks on Fish Species Diversity and Abundance in Amadi creek

Months	Week	Diversity	Abundance
June	1	2.428±0.1 [az]	12.839±0.1 [a]
	2	2.164±0.1 [ae]	13.131±0.1 [a]
	3	1.897±0.1 [ad]	12.056±0.1 [b]
	4	1.641±0.1 [ac]	6.525±0.1 [c]
July	5	1.463±0.1 [ab]	8.384±0.1 [d]
	6	1.254±0.1 [aa]	10.734±0.1 [e]
	7	1.014±0.1 [aa]	7.507±0.1 [aa]
	8	0.820±0.1 [d]	5.192±0.1 [ab]
August	9	0.666±0.1 [c]	4.221±0.1 [ac]
	10	0.532±0.1 [c]	7.016±0.1 [ad]
	11	0.345±0.1 [b]	6.782±0.1 [c]
	12	0.162±0.1 [a]	5.613±0.1 [ab]

Note: Means with the same letter are similar and significantly different from means with other alphabets.

4. Discussion

The fin fish composition of four (4) fish species belonging to three (3) families in four (4) genera from a total catch of eight thousand five hundred and fifty two (8,552) fin fishes indicated that, though there was a generally high catch through the study period, there was a poor family/species composition of fin fishes in the creek. There is scarcity of information on the fish species assemblage in Amadi Creek and thus, the result of this study lacks support from previous works on the river system. However, this low fish composition pattern was contrary to studies from the closest adjoining river to the Amadi Creek, the Okpoka creek [8] which recorded a fairly

higher composition of fin fishes with a total number of 11 species from 8 families. Other adjoining rivers, the Lower Bonny river recorded even higher composition having 25 families made up of 57 species [3]; the Elechi Creek had a total of 35 species belonging to 20 families [39]; the Lower and Upper New Calabar rivers [10] recorded twenty (20) genera from ten (10) families, and further down, the Middle Reaches of the Sombreiro River had 31 species in 20 families [12].

Several factors could be responsible for this low fish composition in the Amadi creek. According to [3] such difference in species could be as a result of some species being localized in certain rivers alone while some showed dual habitation. It is also suggested that, the low fish species composition of this creek in comparison to adjoining rivers could be as a result of high human activities. In [7], it was reported that organic waste dump caused environmental stress in coastal waters which resulted in low landing of some important fishes. A high number of Artisanal fishers are known to exploit the fisheries (Pers. Comm.). Fishing pressure and human activities in the creek where industrial activities, indiscriminate waste disposal land filling and, dredging degrades habitats, destroys spawning, breeding, feeding or growth maturity grounds of fin fishes [49]

In the Ologe lagoon in south west Nigeria, Reference [44] reported slight variation in species composition as a result of rainfall affecting salinity However, the high number of Tilapia (*Sarotheredon melanotheron*) alone may be due to the fact that the species is hardy, euryhaline, matures rapidly, among others, and so is able to withstand the stress of the pollution and land filling, fishing pressure taking place in the Creek. The Black chin tilapia is said to tolerates salinity ranges of 0-45ppt and can live in an environment with dissolved oxygen as low as 0.1ppm and Carbon dioxide level as high as 70ppm [51].

The fish fishes of Amadi creek were not highly diverse as only 4 species in 3 families were encountered with the family Cichlidae more diverse (50%) having two species, while Mugilidae and Clupeidae had one species each (25% each). This result does not agree with the adjoining Okpoka Creek that flows from the same Okrika River (Davis, 2009) which recorded higher diversity of 11 species from 8 families of fin fishes dominated by Clupeid, *Sardinella maderensis* (47.33%). It also is contrary to the reports of other adjoining creeks/rivers in the Niger delta basin such as the Bonny river [3], the New Calabar River[10] and the Mid.-Sombreiro River [12] all of which reported high diversity of fish fauna. The generally low diversity exhibited in the Amadi creek could be associated with several factors. It was suggested that fish assemblage may differ with location even within similar mangrove habitats of the Niger Delta and this may be due to variation in abiotic factors such as depth, water current and salinity[39]. Also, it was reported [29] that, fish diversity can be affected by a series of factors such as turbidity, stream size and available food. The fluctuations of several environmental variables were reported to affect the dynamics of the fish assemblages in the main channel of the Gambia estuary[33]. However, the result of this study was similar to the case of the Elechi creek reported by [39], though there were a few species with high diversity (the Clupeidae, Mugilidae and Gobiidae) there was a general poor species diversity. They attributed it to the human activities such as dredging of the creek, pollution from petroleum products among others. Low species diversity in the Elechi creek due to chronic hydrocarbon pollution [42]. According to [36], fish communities respond to environmental changes caused by human interference. The influence of human activities on species diversity and abundance was also observed in lkpoba River, Southern Nigeria (Victor and Dickson 1985: Victor and Ogbeibu 1985, 1986 in [39]).

The diversity was statistically different ($p<0.05$) within the weeks, which may be due to the fact that the factors influencing the diversity varied within the weeks. The diversity was statistically different ($p<0.05$) within the weeks, which may be due to the fact that the factors influencing the diversity varied within the weeks. Salinity could be responsible for the significant difference in months of study as the Amadi Creek recorded fluctuating brackish water and fresh water regimes. In [45] similar slight variation/reduced salinity during the wet season. [15], reported that the wet and dry seasons give rise to changes in river salinity and during the wet season (May-October) salinity falls to almost zero throughout the delta.

The pattern of abundance of fin fishes in the Amadi creek did not agree with the pattern of fish abundance in rivers close to this Creek in the Niger Delta basin. In the Bonny river [3] ; Okpoka creek (Davis 2009) Elechi Creek [39]; the Lower and Upper New Calabar rivers [10] and further down, the Middle Reaches of the Sombreiro River [12], all reported that the fin fishes were dominated by the Clupeids (*Sardinella maderensis) followed by* the Mugilids *(M. cephalus*), and then the Cichlids which were mostly abundant, unlike in this study where Cichlid *(Seratherodon melanotheron*) were dominant, and the Clupeids (*Sardinella maderensis)* and Mugilids *(M. cephalus)* few.

However the high *Sarotherodon melanotheron* abundance was similar to the finding in the fresh water Upper Reach of the Sombreiro River [11] where it dominated the catch. This dominance of the Cichlid, *Sarotherodon melanotheron* could be attributed to its higher tolerance rate in aquatic systems. [51], reported the Cichlid to tolerate salinity ranges of 0-45ppt. Thus lower salinities could favour this tilt in dominance of *S. melanotheron* against the *S. maderensis* and *M. cephalus* which prefer more saline environments as seen in the Lower Bonny river and Okpoka creek. The differences in physico-chemical parameters within water body can be related to the rainfall pattern of an area, which in turn could influence variation in diversity and composition[9]. In [45], it was reported that there was reduced salinity during the rainy season but increased salinity in the dry season.

The dominance of the Cichlid against the Clupeid and Mugilid may also be related to the nutrient levels in the Amadi creek. In Amadi creek, it was reported that the water samples showed low nutrient levels[50]. In [3], and [8], reported that the presence/absence of food organisms (planktons) played a major role in the seasonal variation.

The rare occurence/low abundance of the Cichlid *Coptodon zilli,* is not clear but it is believed that fishing pressure might be responsible.

Coastal communities are known to consume fish as a major source of protein and most fishes with low abundance are those appreciated for food by the indigenes of these communities [11]. Thus, it is not unlikely that over exploitation of the resource was the key factor at play. Also, as observed, several human activities capable of destroying the fish habitat were taking place in the Amadi creek. It was reported [21] that many fish species are declining in abundance as a result of human activities that lead to habitat degradation and destruction. Futhermore, social activities in the community affected the days of catch (Pers.Comm) as the fishers would not be available for fish collection during social events in the community.

The physical and chemical characteristics of water are important parameters as they may directly or indirectly affect the suitability of water for the distribution and production of fish and other aquatic animals[31]. Though the physico-chemical parameters in this study fluctuated over the period of the study, they were not significant.

The Dissolved Oxygen ranged between 4.6mg/L and 6.1mg/L throughout the duration of the study with a mean of 5.26mg/L. this was in agreement with [50] in Amadi creek who reported ranges of dissolved oxygen as 4.87 to 15.42 mg/l. Similarly, mean values of DO of 2.3-5.11.1mg\l), recorded by [22] with the lowest value of 2.3 mg / l was recorded in September and the highest value of 11.1 mg / l was recorded in October. It was reported that the lower wet season DO values recorded during the rainy season, as observed in the Amadi creek could be attributed to the floods and municipal drains depositing wastes (organic, inorganic and debris) into the estuary that undergo decomposition, thereby reducing the oxygen content of the creek water [38,49]). However, the range of DO observed along the Amadi creek during this study were within permissible limit of 4-10 mg/l previously reported in [49]. McNeely and his colleagues (1979) reported that natural surface water has dissolved oxygen less than 10mg/l. This implies that the Amadi creek having DO values between 4.6mg/L and 6.1mg/L can sustain aquatic life.

The Hydrogen ion concentration pH was found to have slight variations and ranged between 5.2 and 6.9 with an average of 6.5. This similar to previous studies in the Amadi creek where [49] reported a range of 6.73-7.33 and, [22] recorded mean values of 6.3 to 8.4.The lower mean pH value of 6.95 in the wet season is associated with the high fresh water emptying into the creek from the adjoining swamp forest streams and municipal drains ([4] and [49] implying that the rains in this season has a significant role in the pH of the creek [49]. However, the pH values of this study were within permissible limit of 6.5- 8.5 [49].This is an indication that the various anthropogenic inputs did not alter the ambient pH. The narrow pH range recorded favours many chemical reactions inside aquatic organisms (cellular metabolism) that are necessary for their survival and growth.

The salinity ranged between 4.1ppt and 5.95ppt within the study period. This was far from the mean values of previous studies of salinity in the Amadi creek by [22] who reported mean values of Salinity of 0.1 ppt - 2.7 ppt between September and April. They recorded maximum and minimum values of 2.7ppt and 0.1ppt in the month of October and November respectively. In a connecting creek, Woji-okpoka Creek also recorded low salinities between 4 ppt and 14 ppt. it was further reported that Salinity variations are due to the distribution of rainfall [8]. The heavy rains during the study period is the reason for the low salinity reported.The temperature values showed slight variations ranging between 27.2°C - 28.7°C with a mean of 27.8°C. The variations of temperature observed was also found to be consistent with the trends reported in previous studies within the Niger Delta [50;43,49]. Also, [8] working on an adjoining creek, the Woji-okpoka Creek reported similar surface water temperature ranging between 28.46±0.02 ºC to 28.76±0.21ºC with a mean value of 28.64±0.06ºC. Similarly, [31] recorded monthly water temperature values ranged between 27°C and 31°C across the Stations with mean temperatures ranging from 28.98±0.23°C to 29.77±0.15°C in Okpoka Creek. In the Amadi creek however, in [22] recorded mean temperature values of 22.1°C – 29.5°C between September to April. Also, [6], reported a variation in temperature between 25°C and 34°C in Kugbo Creek in the Niger Delta. The temperature was not higher than permissible limit for water, 24-28 [49]. Thus, temperature could not limit fish population in the Amadi creek.

5. Conclusion

The fin fish composition of four (4) fish species belonging to three (3) families in four (4) genera indicated a generally poor family/species composition in the Amadi creek. Also, the fishes of Amadi creek were not highly diverse as only 4 species in 3 families were encountered with the family Cichlidae more diverse (50%) having two species, while Mugilid (*M.cephalus*) and Clupeid (*S. maderensis*) had one species each (25% each). Finally, the Cichlid (*S. melanotheron*) were the dominant species, while the Mugilids (*M.cephalus*) and Clupeid (*S. maderensis*) were few and the *Coptodon zilli*, a cichlid was rare. This shows that the fishes of the Amadi creek are under threat of some kind. Though the reason for this was not known, it is therefore recommended that longer research surveys be carried out to ascertain the root causes of this situation and appropriately develop management/conservation strategies to protect the fishes.

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