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Composition and Diversity of the Fish Fauna of Omuechi Stream, Aluu, Rivers State, Nigeria.

Ibim Adaba Tonye[1], Owhonda,Mavis[2]
(Department of Fisheries, Faculty of Agric., University of Port Harcourt, Nigeria)

***Abstract**: A thirteen week survey was carried out in the Omuihuechi stream, New Calabar River, in the Niger delta basin, Nigeria to ascertain its composition and diversity using standard methods. Results revealed a total Composition of two hundred and fifty two (252) fishes from twenty (20) genera, ten (10) families and four (4) orders. Fish species composition was highest in week 3 and week 7(total 27 species) and least in week 10(total 8 species). Family Composition was highest amongst Cichlids, but lowest amongst the Alestidae and others with a single species. The Cichlid family showed highest diversity, having five species, while families like the Nanididae showed the lowest diversity having one species. Fish species diversity was highest in week 3 with 17 species and lowest in week 10 with 6 species. In conclusion generally, composition and diversity of fish species is high, however most families have few species and thus not very diverse. Secondly, composition and diversity were higher in the earlier weeks than the later weeks. In conclusion, the fishes in this stream need to be protected as, the stream is associated with high hydrocarbon exploration and fish exploitation.*

***Keywords:** Fish Species and Families Composition and Diversity, Omuihuechi stream.*

I. Introduction

Fishes are organisms adapted to living in water, possessing internal or external skeletal frame, could be a fin or non-fin fish, typically a gill-breather. Examples of fishes are crustacea, aquatic molluscs, turtles, marine sponges, and other forms of aquatic life [1]. Fishes exhibit enormous diversity in size, shape, colour, biology and in the habitat they occupy.The type of species found in freshwater rivers vary particularly between fast moving and slow moving streams. The Omuihuechi stream is a freshwater tributary emptying into the Upper reaches of the New Calabar River. The stream is of great economic importance to the Omuihuechi villagers as it provides the inhabitants with a source of water (for drinking, swimming and washing), fish food and nutrients. Dredging is also an economic activity in this river system and the stream also provides breeding grounds for a variety of freshwater fish species. Nigerian inland water bodies are primarily used for fishing and freshwater fish species are richest in West Africa [2]. Furthermore, there has been rereported an appreciation of fish species commonly exported from Nigeria [3]. Also, [4] reports show that, rapid increase in world population resulted not just in a huge increase in the demand for fish for the traditional uses of animal protein and other nutritional requirement but also for aesthetic purposes. Consequently, the status of several species are affected as they are declining or going into extinction. This decline has been further compounded by several other issues such as water management projects, over harvesting, drought, etc, [5] (Shumway, 1999), traditional fishing gears and methods of catching fish, amongst others. Despite this dire situation facing fish species, there is a dearth of information on the fish species assemblage of the Omuihuechi Stream. This study was thus designed to investigate and identify document the fish species composition, diversity and abundance of the Omuihuechi Stream.

II. Materials and Methods

2.1. Study Area

The study was carried out in Omuihuechi stream (fig. 1). It is one of the important streams in the Aluu area that drains into the New Calabar River. It stretches from Isiokpo in the north to Aluu in the south. It is also in the vicinity of the rapidly expanding oil city, Port Harcourt in Rivers State, Southern Nigerian.

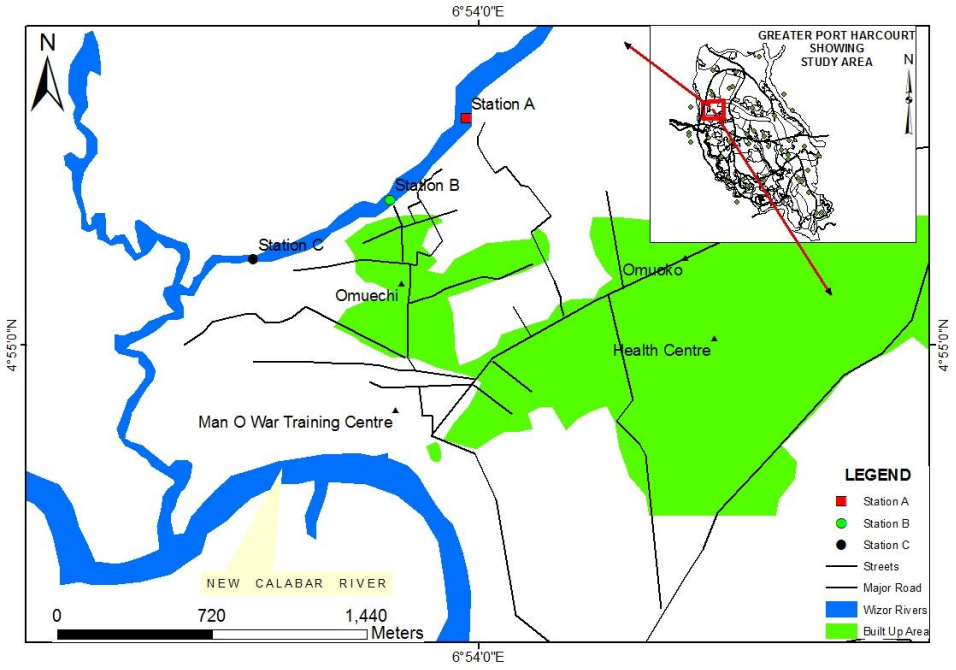

Figure 1: Study Area Showing Sampling Location

2.1.1.Constitution and Vegetation

The Omuihuechi stream is a fresh water body, appearing slightly turbid at certain period of the year, mostly during the rainy season. The bottom sediment at the bank to the stream bottom is fine sand and red stone. The vegetation of this study area is made up of red and white mangrove (*Rhizophora mangle* and *Avicenia spp*., respectively), Nypa palm (*Nypa fruticans*), *Ipomoea aquatica, Nymphea lotus, Mimosa pigra, Eichhornianatans*, water lily, aquatic fern etc. This stream is economically important as a number of human and economic activities are taking place within the study area; for instance, agricultural product transportation, dredging, and fishing which will likely affect the biological diversity of this aquatic ecosystem.

2.1.2 Season

The seasons experienced are wet or rainy season that occur between March to November with annual rainfall between 2,000 and 3,000mm per year [6](Abowei, 2000), and the dry season, from November to February with occasional rainfall [7](Iwena, 2000).

2.2 Experimental Procedure

2.2.1.Experiment Design and Sampling Stations Location

The study was designed to have three sampling stations covering the Omuihuechi Stream as shown in Fig 1. The three sample stations were titled, Station A (Latitude 6.89E and Longitude 4.92N), Station B (Latitude 6.896E and Longitude 4.923N), and Station C (Latitude 6.899E and Longitude 4.926N). The experiment was designed to last from July to October, 2015 (13 weeks).

2.2.2.Fish Samples Collection, Treatment and Preservation,

The sample stations were sampled for fish by a fisherman twice weekly (Mondays and Fridays) using wide range of fishing gears such as traps, gillnet, Hook and line and nets of different mesh-sizes. The fish samples were collected from the local fisher as he landed his catch. Collected fish were then sorted into species and families prior to data collection. Plastic buckets containing 10% formalin solution, taken to the field was used to collect and preserve the fish, after which they were taken to the laboratory and identified to the level of species.

2.3.Data Collection

2.3.1.Fish Composition Determination

Fish composition was determined by ascertaining the Total count of landed fish and identifying them to the species level, aided by fresh samples collected and snap shots of physical features of freshly landed individual types of fishes, captured with a digital camera. The identifications were confirmed using identification keys [8, 9, 10, 11 and 12]

2.3.2 Fish Diversity Determination

Fish diversity was determined using Shannon-Wiener Index [13] as follows: H = -∑is=1Pi In Pi Where Pi is the proportion of individuals found in the species ni is the number of the individuals species, N being the total abundance.

2.3.3.Physico-chemical Parameter Determination.

Water samples of the study area were collected using plastic containers and taken to the laboratory for analysis, to determine various physical and chemical parameters of the study area. Parameters determined were as follows;

2.3.3.1. Temperature*:* Water temperature was measured inserting mercury bulb thermometer in the water body and left for about 2.5 minutes to ensure proper graduation and then taking the temperature reading.

2.3.3.2. Hydrogen Ion Concentration (pH): The pH level of the water samples were measured using a pH metre (P. IIIATC Pen Type pH Meter) standardize with 4.0 and 6.9 (pH) buffer solution.

2.3.3.3. Conductivity: The water samples were measured by inserting an electrical conductivity (EC) metre (Model 4083) probe into the sample and reading the value shown on the meter.

2.3.3.4. Dissolved Oxygen: Dissolved oxygen was measured from water samples in the laboratory using a Millwaki dissolved oxygen meter.

2.4. Data Analysis

The data was analyzed using the computer package SAS (1999) to calculate the Analysis of variance (ANOVA) at a probability of <0.05, to compare the relative abundance of fish species between stations and weeks.

III. Result

3.1 Species Composition:

A total of two hundred and fifty two (252) fishes belonging to twenty (20) genera, ten (10) families and four (4) orders were recorded from the Omuihuechi stream, as shown in the checklist of fish species in Table 1 and total fish composition in Table 2. At the family level, the Cichlidae had the highest representation with five species (T. zilli, P. mariae, H. fasciatus, C. guntheri gutheri, and P. ansorgii) belonging to five (5) genera. This was followed by the family Mormyridae with four species (G. petersii, H. bebe, P. simus and P. sauvagii) belonging to three genera. The Claroteidae and Notopteridae were the next, represented by three species (P. monkei, A. akiri and C. alluensis) and (P. afer, X. nigri, N. notopterus) respectively, belonging to three genera each. Anabantidae (M. lineatum, C. petherici) was represented with two species belonging to two genera. However, the Nandidae (P. abbreviata), Mochokidae (S. gutata), Channidae (P. obscura), Hepsetidae (H. akawo), and Alestidae (B. longipinus) all had a single species from one genera each. The fish composition (table 2) showed that the highest fish species composition was recorded in week 3 and week 7 with a total of 27 species; followed by week 5 (24) and the least recorded in week 10 (8).

3.2 Species Diversity:

Generally speaking, the species diversity (table 3) of fishes found in the Omuihuechi Stream during this study showed that the family Cichlidae was the most diverse, comprising of five different species (T. zilli, P. mariae, H. fasciatus, C. guntheri gutheri, and P. ansorgii) belonging to five (5) genera. The next most diverse were the family Mormyridae with four species (G. petersii, H. bebe, P. simus and P. sauvagii) belonging to three genera, Claroteidae and Notopteridae with three species (P. monkei, A. akiri and C. aluuensis) and (P. afer, X. nigri and N. notopterus) belonging to three genera each. The families with the lowest diversity were Anabantidae with two (2) species (M. lineatum, C. petherici) belonging to two (2) genera, and Nanididae, Mochokidae, Channidae, Hepsetidae and Alestidae having one species (P. abbreviata), (S. gutata), (P. obscura), (H. akawo), and (B. longipinus) belonging to one genera respectively. The highest fish species diversity (Table 4) was recorded in week 3 with 17 species, followed by week 6 with 15 species, week 7, 8 and 12 with 14 species each and the least observed in week 10 with 6 species.

Table 4: Showing Species Diversity within Weeks

Weeks	Number of Species
1	9
2	8
3	17
4	8
5	12
6	15
7	14
8	14
9	11
10	6
11	12
12	14
13	9

3.3 Data Analysis

The analysis of variance (ANOVA, Table 11) showed that species diversity differed significantly ($P<0.05$) between the sampling weeks, however, week 6 ($1.11E0\pm0.006^{b}$) was not significantly different from week 7($1.11E0\pm0.006^{b}$), same as week 5 ($1.06E0\pm0.012^{cd}$) and 12 ($1.07E0\pm0.006^{cd}$); week 1 (0.91 ± 0.006^{f}) and 13 (0.91 ± 0.006^{f}); and lastly week 2 (0.85 ± 0.012^{g}) and 4 (0.85 ± 0.012^{g}). The highest diversity was recorded in week 3 with a mean of ($1.19E0\pm0.006^{a}$), followed by week 6 ($1.11E0\pm0.006^{b}$) and week 7 ($1.11E0\pm0.006^{b}$). Diversity was relatively high in week 11 ($1.08E0\pm0.006^{c}$), week 12 ($1.07E0\pm0.006^{cd}$), week 5 ($1.06E0\pm0.012^{cd}$), week 8 ($1.05E0\pm0.012^{d}$) and week 9 ($1.01E0\pm0.006^{e}$). Low diversity was recorded in week 1 (0.91 ± 0.006^{f}), week 13 (0.91 ± 0.006^{f}), week 2 (0.85 ± 0.012^{g}) week 4 (0.85 ± 0.012^{g}) and week 10 (0.75 ± 0.006^{h}).

Table 11: Data Analysis within weeks on Fish Species Diversity in Omuihuechi Stream ($P<0.05$)

Weeks	Diversity	
1	0.91 ± 0.006^{f}	
2	0.85 ± 0.012^{g}	
3	$1.19E0\pm0.006^{a}$	
4	0.85 ± 0.006^{g}	
5	$1.06E0\pm0.012^{cd}$	
6	$1.11E0\pm0.006^{b}$	
7	$1.11E0\pm0.003^{b}$	
8	$1.05E0\pm0.012^{d}$	
9	$1.01E0\pm0.006^{e}$	
10	0.75 ± 0.006^{h}	
11	$1.08E0\pm0.006^{c}$	
12	$1.07E0\pm0.006^{cd}$	
13	0.91 ± 0.006^{f}	

Note: *Means with the same letter are not significantly different*

3.4 Physico-Chemical Parameters

The physico-chemical parameters are as shown in table 13 for the period of the study, whilst the statistical data is shown in table 14.

3.4.1. Temperature: The temperature reading recorded during the period of this study ranged between 26^{o}C and 27^{o}C with a mean of 26 ^{o}C. The highest temperature was recorded between week 1 – 3 (26.461 ± 0.131), followed by week 12 – 13 (26.222 ± 0.147), week 8-11 (26.222 ± 0.082) and week 4-7 (26.221 ± 0.079). There was no significant difference ($P<0.05$) in temperature throughout the sample period and within stations.

3.4.2.Hydrogen Ion Conc. (pH): The pH recorded during the period of the study ranged between 5.0 and 7.1. There was a significant difference ($P<0.05$) in pH during the 13 weeks period of this study. The highest pH mean was recorded between week 8 to11 (6.7 ± 0.049^{a}). This was followed by week 4 to7 (6.5 ± 0.075^{ab}), the least was recorded in week 12, 13 (6.4 ± 0.075^{b}). There was no difference within stations during the 13 weeks period of this study.

3.4.3.Conductivity: The conductivity value recorded during the period of this study ranged between 3.0 and 20.9µScm^{-2}. There was a significant difference ($P<0.05$) between weeks throughout the period of this study. Week 1-3 ($1.087E1\pm0.35^{ab}$) and week 4-7 ($1.129E1\pm0.96^{ab}$) was significantly different from week 8-11 ($1.302E1\pm0.54^{a}$) and week 12-13 ($1.043E1\pm0.35^{b}$). However, week 8-11($1.302E1\pm0.54^{a}$) was higher than week 1-3 ($1.087E1\pm0.35^{ab}$), week 4-7 ($1.129E1\pm0.96^{ab}$) and week 12-13 ($1.043E1\pm0.35^{b}$).

3.4.4 Dissolved Oxygen: The DO value recorded during the period of this study ranged between 2.2 – 3.0mg/L. Though fluctuations were slight throughout the period of this study, however Week 1-3 ($2.62E0\pm0.048^{a}$) was significantly ($P<0.05$) higher than week 8-11 ($2.58E0\pm0.030^{ab}$), week 4-7 ($2.55E0\pm0.026^{ab}$) and week 12-13 ($2.47E0\pm0.024^{b}$).

Table 14: Physico-Chemical Parameters of Omuihuechi Stream

Parameters	Range	Mean	Standard Error (±)
Temperature (^{o}C)	26 – 27.6	26.3	0.0510
pH	5.0 – 7.1	6.49	0.0383
Dissolved oxygen (mg/L)	2.2 – 3.0	2.57	0.0179
Conductivity (µScm)	3.0 – 20.9	1.17	0.3728

IV. Discussion

The species composition of the stream having a total of Two hundred and fifty two (252) fish species belonging to ten (10) families, twenty (20) genera and four (4) orders from the Omuihuechi stream indicated the presence of a good number of fish species in the stream. The trend of descending dominance of the fish species/family composition exhibited by all fishes, from the highest (Cichlidae) to the least(Claroteidae, Anabantidae, Channidae, Nanidae, Mochokidae, Alestidae and Hepsetidae) is synonymous with that observed in the Upper reach of the New Calabar River [3]from which this Stream feeds. These fishes are the typical freshwater fishes found in the Niger delta area [14]. Also, the Cichlidae are commonly found fishes in the Niger delta area. The dominance exhibited by this family in this stream is similar to that noticed in most freshwater and brackishwater bodies in the Niger delta area [15, 16, 17, 18, 3, 20 and 15] . It was also reported that[20], fish fauna vary according to the type of bottom habitats and water current speeds and where the bottom sand is fine and hard, it is frequented by Cichlids (Tilapias) and others. Family dominance could be due to their ability to tolerate wide range of environments and ability to utilize a wide range of foods in the lower trophic level as herbivores, as well as their high fecundity and prolific nature [21].The family Mormyridae were also dominant as the Cichlidae. This report also tallied with the findings in River Ase [22] in the Niger Delta.The fish diversity of this study showed Cichlidae as the most diverse with five (5) species belonging to five (5) genera. Although no work has been carried out on this stream, similar findings were reported in the New Calabar River from which this stream feeds [3] where high diversity in the family Cichlidae (20.16%) was reported. Also, in the New Calabar River, it was reported [19] that a total of 36 fish species belonging to 29 families, with diversity highest in the family Cichlidae (11.1%). Similar reports of high Cichlid diversity was reported [23 and17].

The Mormyridae with four (4) species, Claroteidae and Notopteridae with three (3) species each and Anabantidae with two (2) species showed relatively low diversity. The families Nanidae, Mochokidae, Channidae, Hepsetidae and Alestidae having only one species each are lowest in diversity. Although there is no information on this stream, similar findings [4] in the Upper Reach of the New Calaber River from where this stream feeds, showed the same low diversity among these families along the Aluu axis of the New Calabar River. They reported that, naturally these families have low species diversity, and also low diversity and abundance for the family Alestidae. The Hepsetidae and Nanidae are known to have one species each as representatives, and the Channidae two species as representatives in Nigeria [24]. Generally, diversity in fishes in a particular habitat could be due to their ability to tolerate wide range of environments, utilize a wide range of foods in the lower trophic level as herbivores, as well as their high fecundity and prolific nature [21].

Generally, the highest fish species composition was recorded in weeks 3 to 7 (with a total of 27 species) and the highest diversity in week 3 (17 species) whilst the least fish species composition was in week 10 and 12, having 8 and 14 species respectively, and the least diversity in week 10 with 6 species. This trend tallied with the seasonal pattern of rainfall in the area. There was a relatively high fluctuation in rainfall pattern within the period of this study. The third week (3) showed the highest diversity and this period was characterized by low rainfall.Afterwards, by week 10 when the diversity lowest, the period was characterized by high rainfall. According to, rainfall affects water volume and depth which in turn affects the distribution of fish fauna and fish migration pattern. Furthermore, it was reported [20 and 25] that, high water levels increase the size of the aquatic environment and enhances migratory and breeding movements of some fish species. Also, the differences in physico-chemical parameters within the water body in the study area could be related to the rainfall pattern of the area, and these in turn would could have influenced the variation in diversity and composition. It was reported that, temperature, pH, Dissolved oxygen and other water quality parameters were reported to have a significant influence on the species diversity, dominance and richness of macroinvertebra in both seasons [26]. Finally, land use and other human activities can affect fish species diversity and abundance[27 and 28]. Considering the level of human activities in this area it is believed that this would have affected the water quality of the area, which in turn affected species diversity and composition

V. Conclusion and Recommendation

It can therefore be concluded that, the Omuihuechi stream is an important water body in the Rivers state and the locality where it's found, as it contributes significantly to the commercial fishery of the Community indigenes and to the fish population of the New Calabar River. This can be supported by the fact that, the stream supports a high composition of freshwater fish species/families of economic importance used for food and ornamental purposes. Secondly, the stream also has a high diversity of fish species/families. However, some fish families (the Cichlidae- 5species, Mormyridae - 4species) are more diverse than others (Hepsetidae and Nanidae with one(1) species each).

Also, the observed variations in composition and diversity of these fish species/families during the period of the study, were more prominent and significant between the first three weeks (with higher composition and diversity) and the seventh to thirteenth week (with lower fish composition and diversity). It is therefore recommended that, immediate fisheries management strategies and policies be developed for the

protection/conservation of the fish population, the fisheries and the water body, in order to ensure their sustainable livelihoods of the fishing communities around the river. Secondly, there is also a dire need to document the fish population in order to enhance the knowledge of the indigenous fish species by Therefore, a follow-up to continuous research surveys cannot be over-emphasizesd as this will go a long way in encouraging the protection and conservation of the fish species, the fisheries and the stream at large.

This study would also serve as reference point for future research in the documentation, management and conservation of fisheries resources in the Niger delta area, especially for the sustainability of the low diversity species/families to prevent their extinction.

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