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Fish diversity, abundance and fishing activities in the upper Ekole River, Bayelsa state, Niger Delta, Nigeria

Igbani F and Uka A

Abstract
A thirty-six weeks investigation was carried out to determine the diversity and abundance of fish fauna and fishing activities of the Upper Ekole River in Bayelsa State. This research work was aimed at providing information on the fish stock and fishing gears used by fisher folks in this River. During the survey, fish samples were randomly collected from fisher-folks twice weekly from five sampling stations along the River. The fishes collected were counted, measured, and scientifically identified. Fishing gears used among fisher folks were identified such as cast nets, gill nets, seine nets, drag nets, drift nets, atalla (lift net), gura nets, clap nets, long-lines, hooks and lines, round traps, drum traps, non-return valve traps, cutlasses and machetes. Species diversity and abundance were analyzed using analysis of variance (ANOVA $P<0.05$) and Pearson correlation (2 tailed). The highest mean (31.39 ±77.53) in station B and the least mean (21.88 ±27.96) in station E of the Catches, while Relative Abundance highest mean (11.76 ±10.90) in station D and least mean (10.98 ±9.37) in station E; while in Species Diversity highest mean (2.09±0.94) in station A, and least mean (2.00 ±1.06) in station B. The diversity and relative abundance were determined using standard methods. Results revealed that, the River was composed of 70 species from 37 families, 16 orders and 52 genera from a total catch of 44,124. Fish species diversity was reported highest in Mormyridae (15.71%) and least in Nephropidae (1.43%) amongst others. The fish relative abundance was highest in *Kryptopterus bicirrhis* (16.42%), *Marcusenius senegalensis* (0.88%), *Chrysichthys aluuensis* (0.41%), *Marcusenius cyprinoides* (0.22%), and least in *Chaceon maritae* (0.01%).

Keywords: Anthropogenic, biodiversity, fisheries, freshwater, and morphology

1. Introduction
Fish and fisheries are integral part of most societies that make significant contributions to economic, health and social well-being of the society. It has been estimated that approximately 12.5 million people are employed in fishery-related activities, and in recent years global production of fish from capture fisheries has tended to vary between approximately 85 and 90 million tones. The products from these fisheries are used in a wide variety of ways, ranging from subsistence use to international trade as highly sought-after and highly-valued items. The value of fish traded internationally is approximately US$40 billion per year [1]. Despite this enormous importance and value, or more correctly, because of these attributes, the world's fish resources are suffering the combined effects of heavy exploitation and, in some cases, environmental degradation. The [2] estimated that, in 1999, 47% of the 441 stocks for which some information on status was available were fully exploited, 18% overexploited, 9% depleted and 1% recovering. This pattern is broadly consistent with similar statistics available from other regions. For example, the National Marine Fisheries Service of the United States of America estimated in 1998 that 30% of the stocks in the waters of that country for which information was available were overfished. In the waters of the European Community, it was estimated that in 1990, 57% of the stocks were 'heavily exploited'. Fish stocks throughout the rest of the globe are likely to be in a similar condition to those in these regions.
Biodiversity is normally described in terms of genes, species and ecosystem in correspondence with the three fundamental hierarchical levels of biological organization; these three diversities are respectively referred to as Genetic, Species and Ecosystem diversities. According to[3] biodiversity should not be construed as a simple umbrella covering a mosaic of heterogeneous activities but should represent a composite entity 'shaped by the interactions' [4]. Fish are found in nearly every aquatic habitat [5]. It is believed that out of 4,000 species of vertebrate

recognized world over 22,000 are fish species; of which 8,411 are freshwater while 11,650 are marine and more than 24,500 finfish species exist throughout the world [6]. Fishes exhibit enormous diversity in size, shape, biology and in the habitats they occupy. The great majority comprises bony fishes, mainly teleosts. In addition, there are around 800 species of cartilaginous and 70 of jawless fishes (Lampreys and Hagfishes) [7]. The diverse groups of fishes are also detected in the wide range of morphological, behavioral, and life history attributes that characterize the constituent species [8]. Understanding the life history of individual fish species includes what it eats, how fast it grows and how old and large it gets when it matures and how successfully it reproduces, and other aspects of its biology [9, 10].

The river is repeatedly spilled with crude oil as reported in 2016; the residence of Ekole Creek in Bayelsa, experienced a massive oil leak from an oil field operated by Nigeria Agip Oil Company (NAOC) in the state [11]. They said the spill resulting from the leak destroyed farmlands and aquatic lives in the communities. The people that dwell along this river, bathe, wash, defecate and dump refuse into the River. These are factors that pose threat to the fisheries resources and the biodiversity of the Ekole River in Bayelsa State.

The Aim of this study was to:

1. Determine the fish diversity and abundance in the Upper Ekole River, Bayelsa State.
2. Identify the fishing gears used in the River.

1.1 Materials and Methods

1.1.1 Study area

The study was carried out on the upper part of the Ekole River (Fig. 1). The study area lies along latitudes between 4º 48˙ 00'' North and 5º 24' 10'' South; longitudes between 6º12' 00'' East and 6º39˙ 30'' West. It is bounded by Rivers State on the North and East, Ahoada-East LGA on the North East and West, Ogbia LGA on the South East and Southern Ijaw on the South West [12].

The study is designed to have five sampling stations covering the upper part of Ekole River as Shown in Fig.1. The selected stations are numbered thus: Station A-Famgbe, Station B-Yenagoa/Swali, Station C-Agbura/Otuokpoti, Station D-Otuogori/Otuegwe, and Station E-Onuebum. The stations were sampled for fish with the fisher folks at both high and low tide; twice a week, using nets of different mesh types and traps. The study was carried out from May, 2017 to January, 2018 (36 weeks) covering wet and dry seasons.

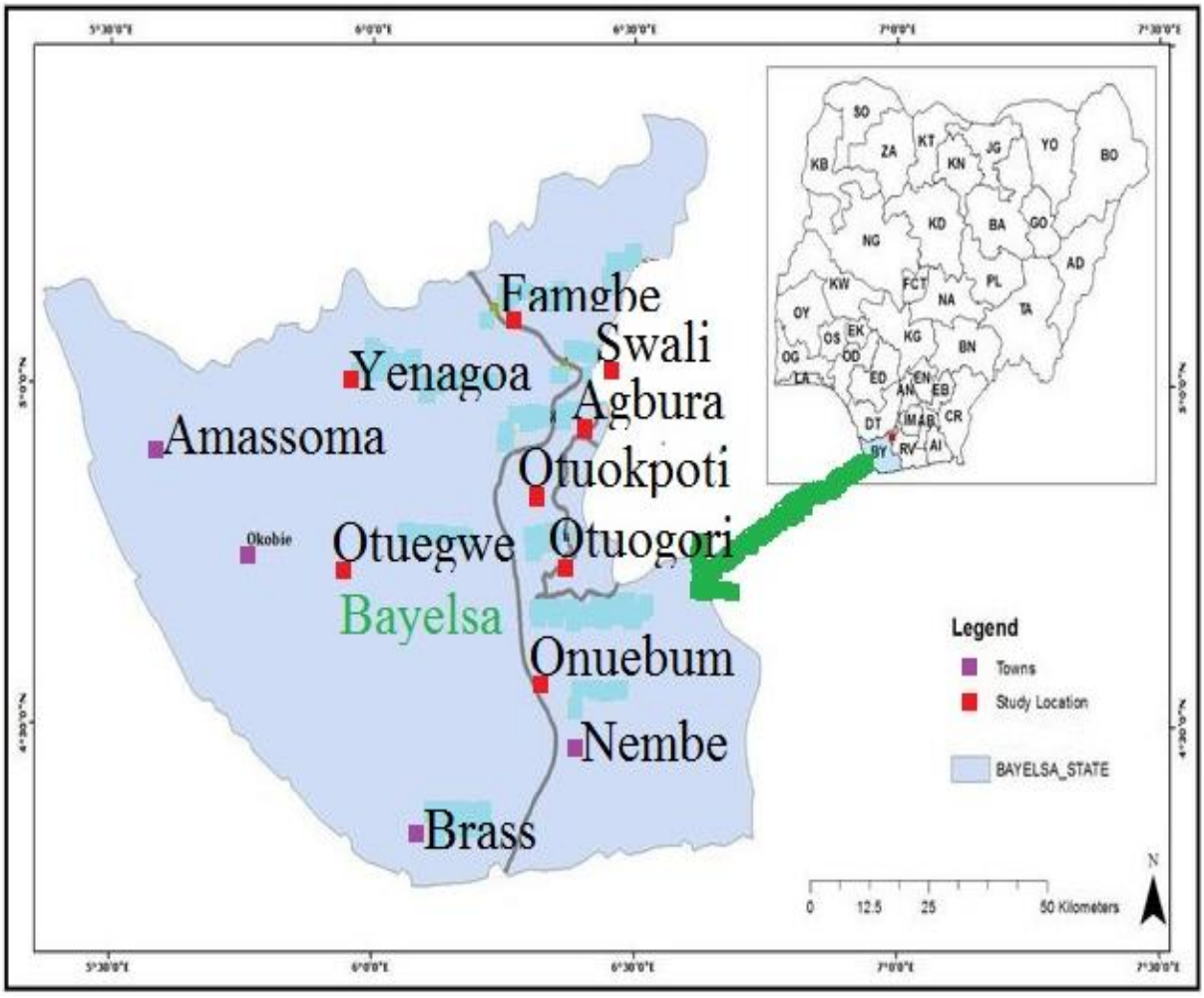

Fig 1: Map showing the five (A-E) sample stations on the Upper Ekole River, Niger Delta. Where A=Famgbe, B= Yenagoa/ Swali, C= Agbura/ Otuokpoti, D = Otuogori/Otuegwe, and E= Onuebum.

1.1.2 Collection and identification of samples

Fish samples were identified by harvesting fish species which were properly positioned, snap shots were taken to capture their physical features using a digital camera and also study their morphology by looking at fish shapes (head, body, tail, mouth, spines, scales, fins, colour, rays and branched rays). Identification keys such as [13]; Nigerian Freshwater Fishes [14], Taxonomy, Ecological Notes, Diet and Utilization [15];

Atlas of Fin Fishes of the Andoni Rivers in Niger Delta [16]; Field Guide to the Commercial Marine Resources of the Gulf of Guinea [17], and Fishbase [18].

A 10% formalin was used to preserve the samples. Immediately after collection, fishes were preserved in the formalin solution and taken to the laboratory and were identified to the level of species.

Fish diversity was determined using: [19]

: derived with the formula below:

$$\text{Fsi (\%)} = \frac{Si}{\sum fsi} \chi \frac{100}{1}.$$

Where F = family or number of species families,

Si = individual number of fish species family.

Abundance were determined by relative abundance method which involved counting the total number of fish species caught per sample site per time which were recorded and the relative abundance score of the species were estimated, thus: 1-50 = Rare (R), 51-100 = Few (F), 101-200 = Common (C), 201-400 = Abundant (A) and > 400 = Dominant (D) [20].

Analysis of Variance (ANOVA: $P< 0.05$) factorial Experiment Layout, Randomized Completely Block Design (RCBD) and Pearson correlation (at 0.01 level, (2-tailed) were used to analyze the species diversity, relative abundance and catches.

2. Results

2.1 Species diversity

The species diversity (Table 1) showed a total of 70 fish species belonging to 37 families, 16 orders and 52 genera. The species diversity amongst the families found in the river during the research work was reported in descending numerical order. Mormyridae (15.71%), Cichlidae (10.00%), Mochokidae (7.14%), Clariidae (5.71%), Polypteridae and Eleotridae (4.29%), Channidae, Alestidae, Palaemonidae, Schilbeidae, Cyprinidae and Claroteidae (2.86%), Mastacembelidae, Anabantidae, Latidae, Solecurtidae, Donacidae, Viviparidae, Ampulariidae, Hepsetidae, Distichodontidae, Bagridae, Gymnarchidae, Phractolaemidae, Arapaimidae, Pantodontidae, Notopteridae, Siluridae, Clupeidae, Nandidae, Carangidae, Poeciliidae, Cynoglssidae, Citharinidae, Malapteruridae, Geryonidae and Nephropidae (1.43%).

2.2 Species abundance

A total of 44,124 fishes were caught along the Upper Ekole River during the period of sampling. The relative abundance (Table 2) of all species is as reported in a descending numerical order. *Kryptopterus bicirrhis* (16.42%), *Sierrathrissa leonensis* (15.06%), *Chrysichthys nigrodigitatus* (7.09%), *Brycinus macrolepidotus* (4.11%), *Macrobrachium macrobrachion* (2.58%), *Eutropius niloticus* (2.51%), *Mormyrus macropthalmus* (2.22%), *Citharinus citharus* (2.04%), *Schilbe mystus* (1.96%), *Synodontus budgetti* (1.94%), *Distichodus rostratus* (1.77%), *Mormyrus rume* (1.76%), *Tilapia zillii* (1.69%), *Synodontus membranaceous* and *Bagrus filamentosus* (1.55%), *Cyprinus barbus* (1.53%), *Xenomystus nigri* (1.41%), *Erpetoichthys calabaricus* and *Mormyrus anguilloides* (1.34%), *Marcusenius deboensis* (1.29%), *Protopterus annectens* (1.26%), *Synodontis gambiensis* (1.22%), *Oreochromis niloticus* (1.21%), *Ctenopoma petherici* (1.18%), *Hyperopisus bebe* (1.15%), *Gnathonemus petesii* (1.13%), *Caranx hippos* and *Hepsetus odoe* (1.10%), *Homarus americanus* (1.09%), *Alestes baremoze* (1.08%), *Parachanna africana* (0.99%), *Mastacembelus longicuada* (0.94%), *Marcusenius senegalensis* (0.88%), *Synodontis batensoda* (0.87%), *Sarotherodon melanotheron* (0.85%), *Parachanna obscura* (0.82%), *Hemichromis fasciatus* (0.80%), *Phractolaemus ansorgii* (0.77%), *Gnathonemus tamandua* (0.69%), *Hippopotomyrus psittacus* (0.67%), *Hippopotomyrus pictus* (0.65%), *Oreochromis aureus* (0.64%), *Labeo senegalensis* (0.63%), *Synodontis nigrita* (0.62%), *Tilapia guineensis* (0.58%), *Polypterus senegalus* (0.56%), *Macrobrachium vollenhovenii* (0.55%), *Gymnallabes typus* (0.53%), *Clarias gariepinus* (0.46%), *Chrysichthys aluuensis* (0.41%), *Heterosis niloticus* (0.39%), *Sarotherodon galilaeus* (0.38%), *Eleotris senegalensis* (0.35%), *Pantodon buchholzi* (0.34%), *Heterobranchus bidorsalis* (0.33%), *Polycentropsis abbreviata* (0.30%), *Gymnarchus niloticus* (0.26%), *Marcusenius cyprinoides* (0.22%), *Clarias anguillaris* (0.18%), *Malapterurus electricus* (0.14%), *Aplocheilichthys spilauchen* (0.12%), *Lates niloticus* (0.11%), *Pila globosa* (0.07%), *Bellamya bengalensis* (0.06%), *Cynoglossus senegalensis* and *Bostrychus africana* (0.04%), Iphigenia brasiliensis (0.03%), *Eleotris vittata* (0.02%), *Tagelus peruvianus* and *Chaceon maritae* (0.01%).

Table 1: Fish diversity of the upper ekole river

S/N	Species	Family	Order	Number of fish caught	Percentage Diversity (%)
1.	*Mormyrus macropthalmus*	Mormyridae	Osteoglossiformes	978	15.71
2	*Mormyrus anguilloides*	//	//	593	//
3	*Mormyrus rume*	//	//	777	//
4	*Marcusenius deboensis*	//	//	569	//
5	*Marcusenius senegalensis*	//	//	388	//
6	*Marcusenius cyprinoides*	//	//	95	//
7	*Gnathonemus petesii*	//	//	497	//
8	*Gnathonemus tamandua*	//	//	306	//
9	*Hippopotomyrus pictus*	//	//	285	//
10	*Hippopotomyrus psittacus*	//	//	294	//
11	*Hyperopisus bebe*	//	//	507	//
12	*Gymnarchus niloticus*	Gymnarchidae	//	116	2.86
13	*Heterotis niloticus*	Arapaimidae	//	173	//
14	*Pantodon buchholzi*	Pantodontidae	//	148	1.43
15	*Xenomystus nigri*	Notopteridae	//	621	4.29
16	*Schilbe mystus*	Schilbeidae	Siluriformes	867	2.86
17	*Eutropius niloticus*	//	//	1,106	//
18	Synodontis budgetti	Mochokidae	//	858	7.14
19	Synodontis gambiensis	//	//	537	//

20	Synodontis nigrita	//	//	274	//
21	Synodontis membranaceous	//	//	682	//
22	Synodontis batensoda	//	//	386	//
23	*Chrysichthys nigrodigitatus*	Claroteidae	//	3,130	2.86
24	*Chrysichthys aluuensis*	//	//	183	//
25	*Clarias gariepinus*	Clariidae	//	203	5.71
26	*Clarias anguillaris*	//	//	80	//
27	*Heterobranchus bidorsalis*	//	//	146	//
28	*Gymnallabes typus*	//	//	235	//
29	*Bagrus filamentosus*	Bagridae	//	683	1.43
30	*Kryptopterus bicirrbis*	Siluridae	//	7,247	//
31	*Malapterurus electricus*	Malapteruridae	//	63	//
32	*Oreochromis niloticus*	Cichlidae	Cichliformes	535	10.00
33	*Oreochromis aureus*	//	//	281	//
34	*Sarotherodon melanotheron*	//	Perciformes	373	//
35	*Sarotherodon galilaeus*	//	//	166	//
36	*Tilapia guineensis*	//	//	258	//
37	*Tilapia zillii*	//	//	745	//
38	*Hemichromis fasciatus*	//	//	355	//
39	*Polycentropsis abbreviata*	*Nandidae*	//	131	1.43
40	*Caranx hippos*	*Carangidae*	//	486	//
41	*Aplocheilichthys spilauchen*	*Poeciliidae*	//	53	//
42	*Eleotris senegalensis*	Eleotridae	//	154	4.29
43	*Bostrychus Africana*	//	//	18	//
44	*Eleotris vittata*	//	//	9	//
45	*Lates niloticus*	*Latidae*	//	49	1.43
46	*Chaceon maritae*	*Geryonidae*	Decapoda	4	//
47	*Machrobrachium machrobrachion*	Palaemonoidae	//	1,138	2.86
48	*Machrobrachium vollenhovenii*	//	//	243	//
49	*Homarus americanus*	*Nephropidae*	//	479	1.43
50	*Hepsetus odoe*	Hepsetidae	Characiformes	485	//
51	*Distichodus rostratus*	Distichodontidae	//	781	//
52	*Alestes baremoze*	Alestidae	//	478	2.86
53	*Brycinus macrolepidotus*	//	//	1,815	//
54	*Citharinus citharus*	Citharinidae	//	902	1.43
55	*Cyprinus barbus*	Cyprinidae	Cypriniformes	676	2.86
56	*Labeo senegalensis*	//	//	277	//
57	*Ctenopoma petherici*	Anabantidae	Anabantiformes	520	1.43
58	*Parachanna obscura*	Channidae	//	364	2.86
59	*Parachanna Africana*	//	//	435	//
60	*Tagelus peruvianus*	Solecurtidae	Cardiida	6	1.43
61	*Iphigenia brasiliensis*	Donacidae	//	14	//
62	*Mastacembelus longicuada*	Mastacembelidae	Synbranchiformes	415	//
63	*Protopterus annectens*	Polypteridae	Lepidosireniformes	555	4.29
64	*Polypterus senegalus*	//	Polypteriformes	248	//
65	*Erpetoichthys calabaricus*	//	//	593	//
66	*Bellamya bengalensis*	Viviparidae	Architaenioglassa	25	1.43
67	*Pila globosa*	Ampulariidae	//	30	//
68	*Phractolaemus ansorgii*	Phractolaemidae	Gonorynchiformes	341	//
69	*Sierrathrissa leonensis*	Clupeidae	Clupeiformes	6,644	//
70	*Cynoglossus senegalensis*	Cynoglossidae	Pleuronectiformes	16	//
	Total Number of catches			44,124	

Table 2: Relative abundance and abundance scores of fish in the upper ekole river

S/N	Species	Family	Order	Number of fish caught	Relative Abundance	Abundance Scores
1.	*Mormyrus macropthalmus*	Mormyridae	Osteoglossiformes	978	2.22	D
2	*Mormyrus anguilloides*	//	//	593	1.34	D
3	*Mormyrus rume*	//	//	777	1.76	D
4	*Marcusenius deboensis*	//	//	569	1.29	D
5	*Marcusenius senegalensis*	//	//	388	0.88	A
6	*Marcusenius cyprinoides*	//	//	95	0.22	F
7	*Gnathonemus petesii*	//	//	497	1.13	D
8	*Gnathonemus tamandua*	//	//	306	0.69	A
9	*Hippopotomyrus pictus*	//	//	285	0.65	A
10	*Hippopotomyrus psittacus*	//	//	294	0.67	A
11	*Hyperopisus bebe*	//	//	507	1.15	D
12	*Gymnarchus niloticus*	Gymnarchidae	//	116	0.26	C

13	*Heterotis niloticus*	Arapaimidae	//	173	0.39	C
14	*Pantodon buchholzi*	Pantodontidae	//	148	0.34	C
15	*Xenomystus nigri*	Notopteridae	//	621	1.41	D
16	*Schilbe mystus*	Schilbeidae	Siluriformes	867	1.96	D
17	*Eutropius niloticus*	//	//	1,106	2.51	D
18	Synodontis budgetti	Mochokidae	//	858	1.94	D
19	Synodontis gambiensis	//	//	537	1.22	D
20	Synodontis nigrita	//	//	274	0.62	A
21	Synodontis membranaceous	//	//	682	1.55	D
22	Synodontis batensoda	//	//	386	0.87	A
23	*Chrysichthys nigrodigitatus*	Claroteidae	//	3,130	7.09	D
24	*Chrysichthysaluuensis*	//	//	183	0.41	C
25	*Clarias gariepinus*	Clariidae	//	203	0.46	A
26	*Clarias anguillaris*	//	//	80	0.18	F
27	*Heterobranchus bidorsalis*	//	//	146	0.33	C
28	*Gymnallabes typus*	//	//	235	0.53	A
29	*Bagrus filamentosus*	Bagridae	//	683	1.55	D
30	*Kryptopterus bicirrbis*	Siluridae	//	7,247	16.42	D
31	*Malapterurus electricus*	Malapteruridae	//	63	0.14	F
32	*Oreochromis niloticus*	Cichlidae	Cichliformes	535	1.21	D
33	*Oreochromis aureus*	//	//	281	0.64	A
34	*Sarotherodon melanotheron*	//	Perciformes	373	0.85	A
35	*Sarotherodon galilaeus*	//	//	166	0.38	C
36	*Tilapia guineensis*	//	//	258	0.58	A
37	*Tilapia zillii*	//	//	745	1.69	**D**
38	*Hemichromis fasciatus*	//	//	355	0.80	**A**
39	*Polycentropsis abbreviata*	*Nandidae*	//	131	0.30	C
40	*Caranx hippos*	*Carangidae*	//	486	1.10	D
41	*Aplocheilichthys spilauchen*	*Poeciliidae*	//	53	0.12	F
42	*Eleotris senegalensis*	Eleotridae	//	154	0.35	C
43	*Bostrychus Africana*	//	//	18	0.04	R
44	*Eleotris vittata*	//	//	9	0.02	R
45	*Lates niloticus*	*Latidae*	//	49	0.11	R
46	*Chaceon maritae*	*Geryonidae*	Decapoda	4	0.01	R
47	*Machrobrachium machrobrachion*	Palaemonoidae	//	1,138	2.58	D
48	*Machrobrachium vollenhovenii*	//	//	243	0.55	A
49	*Homarus americanus*	*Nephropidae*	//	479	1.09	D
50	*Hepsetus odoe*	Hepsetidae	Characiformes	485	1.10	D
51	*Distichodus rostratus*	Distichodontidae	//	781	1.77	D
52	*Alestesbaremoze*	Alestidae	//	478	1.08	D
53	*Brycinus macrolepidotus*	//	//	1,815	4.11	D
54	*Citharinus citharus*	Citharinidae	//	902	2.04	D
55	*Cyprinus barbus*	Cyprinidae	Cypriniformes	676	1.53	D
56	*Labeo senegalensis*	//	//	277	0.63	A
57	*Ctenopoma petherici*	Anabantidae	Anabantiformes	520	1.18	D
58	*Parachanna obscura*	Channidae	//	364	0.82	A
59	*Parachanna Africana*	//	//	435	0.99	D
60	*Tagelus peruvianus*	Solecurtidae	Cardiida	6	0.01	R
61	*Iphigenia brasiliensis*	Donacidae	//	14	0.03	R
62	*Mastacembelus longicuada*	Mastacembelidae	Synbranchiformes	415	0.94	D
63	*Protopterus annectens*	Polypteridae	Lepidosireniformes	555	1.26	D
64	*Polypterus senegalus*	//	Polypteriformes	248	0.56	A
65	*Erpetoichthys calabaricus*	//	//	593	1.34	D
66	*Bellamya bengalensis*	Viviparidae	Architaenioglassa	25	0.06	R
67	*Pila globosa*	Ampulariidae	//	30	0.07	R
68	*Phractolaemus ansorgii*	Phractolaemidae	Gonorynchiformes	341	0.77	A
69	*Sierrathrissa leonensis*	Clupeidae	Clupeiformes	6,644	15.06	D
70	*Cynoglossus senegalensis*	Cynoglossidae	Pleuronectiformes	16	0.04	R
	Total Number of catches			44,124		

Table 3: Pearson correlation of relative abundance, catches and locations

	Relative Abundance	**Catches**	**Locations**
Relative Abundance	1	0.326(**)	-0.012
Catches	0.326(**)	1	-0.029
Locations	-0.012	-0.029	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 4: Data analysis within stations of catches, relation abundance and species diversity on the upper ekole river ($P<0.05$)

Stations	Catches	Relative Abundance	Species Diversity
A	27.29 ±55.48^{b}	11.46 ±10.56^{b}	2.09±0.94^{c}
B	31.39 ±77.53^{a}	11.61 ±11.13^{a}	2.00 ±1.06^{a}
C	24.28 ±36.63^{b}	11.11 ±10.83^{b}	2.01±0.88^{b}
D	30.29 ±80.44^{a}	11.76 ±10.90^{a}	2.08 ±0.98^{a}
E	21.88 ±27.96^{c}	10.98 ±9.37^{c}	2.08 ±0.85^{b}

^{abc} Means within the rows with different superscripts differ significantly @ $P<0.05$.

Table 5: Analysis of variance (ANOVA, $P<0.05$) for species diversity, relative abundance and catches

		Sum of Squares	Df	Mean Square	F	Sig.
Species diversity	Between Groups	1.722	4	0.430	0.483	0.748
	Within Groups	1404.952	1577	0.891		
	Total	1406.674	1581			
Catches	Between Groups	20292.249	4	5073.062	1.459	0.212
	Within Groups	5483424.303	1577	3477.124		
	Total	5503716.552	1581			
Relative Abundance	Between Groups	141.467	4	35.367	0.317	0.867
	Within Groups	175993.174	1577	111.600		
	Total	176134.641	1581			

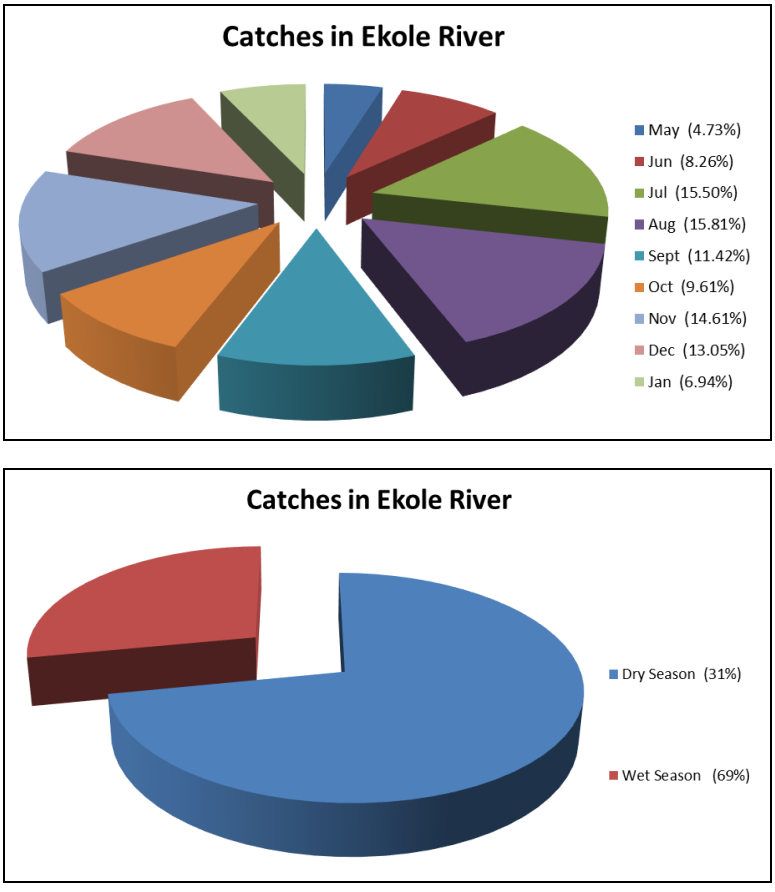

Fig 2: Pie chart showing species seasonal variation

3. Discussion

A total of 44,124 fishes were caught along the Upper Ekole River during the period of sampling. The relative abundance of all fish species as reported (Table 2). This showed that the fish diversity in this upper end of the Ekole River was high, although some species reported higher diversity values than others. There is no existing research work carried out in the section of this river for comparison. Nevertheless, this is in consonant with the report of [21] on their biodiversity and abundance of fish species and some processing techniques in the Lower Niger River, Idah; they recorded 42 species of fish belonging to 18 families and also identified traditional fishing gears such as gill nets, cast nets, long-lines, drag nets, and fish traps used by fisher folks for fishing operations. They also reported the dominant fish species as *Hyperopisus bebe* (10.61%) and in terms of species diversity the family Mormyridae had the highest (18.29%) with 7 species including *H. bebe*.

The fish species abundance reported is related to the species recorded by [22] he researched on biometry, composition and abundance of fish species in the River Nun, Niger Delta. He reported 14 fish species: *Mormyrus rume*, *Mormyrus macrophthalmus*, *Oreochromus niloticus*, *Malapterurus electricus*, *Clarias gariepinus*, *Clarias angullaris*, *Parachanna obscura*, *Synodontis batensoda*, *Heterobranchus longifilis*, *Alestes dentex sethente*, *Auchenoglanis*

occidentalis, Sarotherodon galilalus, Heterotis niloticus and *Tilapia zillii* belonging to seven families. Two families (Characidae and Clariidae) constituted the dominant fish families in the river. Among the Characidae: *Alestes dentex sethente* (23.1) and among the Clariidae (*Clarias gariepinus* (22.8) were dominant. Other fish species with significance abundance were *Tilapia niloticus* (9.3%); *Tilapia zillii* (8.0%), *Oreochromis niloticus* (7.7%) and *Brycinus nurse* (6.4%).

There was a clear variation of fish species catches between the dry and the wet (raining) seasons as shown in the pie chart above (fig. 2), the highest catches were observed during the raining season with 69%, while the dry season recorded 31%. This is in consonant with [23] they observed seasonal variation with the highest species richness during the raining season in May and September, with 16 and 14 species respectively, and the lowest during the dry season (January and February) with 2 and 3 species respectively.

The fishing gears identified are in consonant with [24] they reviewed Fishing Methods and Gears in the Niger Delta Nigeria. They reported 13 fishing gears used in the Niger Delta Rivers: surrounding net, throw/cast net, hand/scoop net, gill net, hook and line/angling, long ling, gura trap, basket trap, dugout canoe, planked canoe, fiber glass boat, fencing and trawl net.

3.1 Data analysis

Correlation was analyzed using the Pearson correlation at 0.01 level as shown in (Table 3) amongst relative abundance, catches and locations (Stations). There was a very high correlation between species relative abundance and catches, while a negative correlation was observed between species relative abundance and locations as well as catches and locations.

Results are expressed as Mean ± SD for triplicate measurements. Values on the same row with same superscript do not differ significantly at $P<0.05$. The result of the analysis (table 4) shows the highest mean (31.39) in station B and the least mean (21.88) in station E of the Catches, while Relative Abundance highest mean (11.76) in station D and least mean (10.98) in station E; while in Species Diversity highest mean (2.09) in station A and least mean (2.00) in station B.

An analysis of variance (ANOVA) at a probability, $P<0.05$ as shown in (Table 5) was carried out within stations for species diversity, relative abundance and catches in their significant levels. It shows that there was a significant difference in species diversity and relative abundance within groups (stations); there was no significant difference in catches within stations.

4. Conclusion

The upper Ekole River could be said to be rich in fish fauna as there are a lot of species represented in this species assessment in spite of its anthropogenic activities. The diversity amongst most families like Mormyridae is high, although, this is not so for others like the Pantodontidae. All the same, it is clear that there is a high diversity of fish species in this river. The abundance of fish species reported was low based on the duration of species sampled along the river. However, this seems to be associated more with fish exploitation (Gear types such as cast nets, gill nets, seine nets, drag nets, drift nets, atalla (lift net), dugout canoe, gura traps, clap nets, long-lines, hooks and lines, round traps, drum traps, non-return valve traps, cutlasses and machetes), human activities and fish adaptation to the natural ecosystem. This study could serve as a baseline data to relevant bodies in the conservation, management and sustainability of the fisheries resources. The fisheries of this river should be monitored from oil spill poisoning, illegal fishing and overexploitation.

5. Recommendations

In view of the above submissions, it is recommended that:

More elaborate and longer research work should be done on the fish stock assessment within the Upper Ekole River, in order to proffer a sustainable managerial ecological method for its fisheries resources.

The anthropogenic activities along the Upper Ekole River should be monitored and checked to avoid undue alteration of the ecosystem and subsequently the fishing grounds.

The fish species that are rare should be studied to ascertain the cause(s) of their abundance level and suspected threats in the ecosystem.

6. References

1. Cochrane KL. Reconciling sustainability, economic efficiency and equity in fisheries: the one that got away? Fish and Fisheries. 2000; 1:3-21.
2. FAO. The State of World Fisheries and Aquaculture. 2000. FAO, Rome, 2000.
3. Di Castri F, Younè T. Ecosystem function of international union of biological diversity, 1995a.
4. Krishnamurthy KV. Text Book of Biodiversity, Science Publishers, Inc., Enfield, New Hampshire-03784, United States of America, 2003.
5. Bone Q, Moore RH. *Biology of Fishes*. Third Edition. ISBN 10:0415375622/ISBN 13: 9780415375627. Publisher: Taylor & Francis. Landon, United Kingdom, 2008.
6. Shabir Ahmad Dar, Mohd. Ashraf, Majahid Khan, Najar AM. Conservation Strategies for Fish Biodiversity, Ph.D scholar, Central Institute of Fisheries Education Versova, Mumbai, India-400061. Corresponding author: Shabir Ahmad Dar, 2000.
7. Helfman G, Collette B, Facey D. The diversity of fishes. Blackwell Science, Malden, MA. 1997, 528.
8. Mims MC, Olden JD, Shattuck ZR, Poff NL. Life history trait diversity of native freshwater fish water fishes in North America. Ecology of Freshwater Fish. 2010; 19:390-400.
9. Matthews WJ. Patterns in freshwater fish ecology. Kluwer Academic Publishers, Boston, USA. 1998, 756.
10. Froese R. Life-History Strategies of Recent Fishes: a Meta-Analysis. Habilitationsschrift, Christian-Albrecht Universität zu Kiel. 2005, 209
11. The News Agency of Nigeria (NAN), Oil leak from Agip's field pollutes Bayelsa communities. The News Agency of Nigeria (NAN). Published by Premium Times (Abuja), 2016.
12. Geographical Information System (GIS), GIS Laboratory, Department of Geography and Environmental Management, University of Port Harcourt, Nigeria. Google Earth 2012 Version. Georeferenced in ArcGIS 9.3 world coordinate system, 2012.
13. Wheeler A. Field key to the shore fishes of the British Isles. Field Studies. 1994; 8:481-521.
14. Olaosebikan BD, Raji A. Field Guide to Nigerian Freshwater Fishes. Second edition. Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria.

2004, 111.
15. Idodo-Umeh G. Freshwater Fishes of Nigeria (Taxonomy, Ecological Notes, Diet and Utilization). First Publication, 2003, 233. ISBN 978-8052-01-0. Idodo Umeh Publishers Limited No.52, Ewah Road, P.O. Box 3441, Benin City, Edo State, Nigeria. idodoumeh@yahoo.com.
16. Froese R, Pauly D. (Eds.), Fish Base. World Wide Web electronic publication. 2007, 2009, 2010. http://www.fishbase.org (Version 2007/2009/2010).
17. Sikoki FD, Francis A. An Atlas of finfishes of the Andoni River in Niger Delta, Nigeria. Published by Molsyfem United Services, Port Harcourt, 2007, 69.
18. FAO Field Guide to the commercial marine resources of the gulf of guinea. FAO species identification sheets for fishery purposes-fao regional office for Africa-RAFR Wolfgang Schneider marine resources service. Fishery Resources and Environment Division. Fisheries Department, Food and agriculture organisation of the United Nations. Prepared and Published with the support of the FAO Regional Office for Africa (RAFR), 1990.
19. Nilkolskii GV. Fish population dynamics Oliver and Boyd Ltd. Edinburgh 1991, 320.
20. Allison ME, Gabriel U, Inko-Tariah MB, Davies OA, Uedeme-naa B. The fish assemblage of Elechi Creek, Rivers State, Nigeria. Niger Delta. Biologia, 2003; 2:53-61.
21. Abiodun JA, John P. Biodiversity and Abundance of Fish and Some Processing Methods in the Lower Niger River Idah, Kogi State, Nigeria. Nigerian Journal of Fisheries and Aquaculture. 2017; 5(2):20-25. Copy Right © 2013 Printed in Nigeria. Department of Fisheries, Faculty of Agriculture, University of Maiduguri, Nigeria. http://www.unimaid.edu.ng ISSN-2350-1537.
22. Nwadukwe JB. Survey of the freshwater Fisheries in the Niger Delta, Nigeria, 2000
23. Koutrakis ET, Kokkinakis AK, Elftheriadis EA, Argyropolou MD. Seasonal changes in distribution and abundance of fish fauna in the two estuarine systems of strymonikkos gulf (Macedonia, Greece). Bel. J. zool. 2000, 42.
24. Henry Eyina Dienye, Alaba Olopade Olopade. A Review of Fishing Methods and Gears in Niger Delta Nigeria Journal of Natural Sciences Research www.iiste.org ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online) 2017 70 Department of Fisheries, Faculty of Agriculture. University of port harcourt Choba rivers state, 2017; 7(6).