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Evaluation of the Ichthyofaunal Diversity of Some Sections of Omambala, Ezu and Ahommiri Rivers in Anambra State, Nigeria

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Abstract— *Fish constitute more than half of the total number of all the aquatic vertebrates in the world; thus, a study was carried out for six months from January-June, 2016 to investigate the physico-chemical parameters, composition, abundance and diversity of ichthyofauna present in some sections of Omambala, Ezu and Ahommiri Rivers in Anambra state, Nigeria. Water samples were collected for physico-chemical analysis and fish samples were also collected with the assistance of artisanal fishermen using different types of traditional fishing gears namely - gill nets, cast nets, hook and line, local traps (baited) and bag nets to evaluate fish species composition and abundance. The result of the physico-chemical analysis showed uniform values for temperature (25±0.16^{o}C-30±0.48^{o}C), dissolved oxygen (3.65±0.78-5.65±0.11mg/l) and biochemical oxygen demand (13±0.03-16±0.08mg/l) which favoured the distribution of fishes present in different sections of the three Rivers. A total catch of 11,031 fishes were recorded from the three Rivers which comprised 11 orders, 29 families, 43 genera and 69 species. Umuoba-Anam section had 9691 catches, Ebenebe section (702) and Awa section (638). Monthly composition showed highest in March (1,909) and June (2,294) for dry and rainy seasons respectively. Seasonal composition showed highest during the rainy season with a total number of 5922 fishes while 5109 fishes was recorded for the dry season. The diversity indices of the three Rivers indicated diverse communities with ten common species variety and Shannon Weiner (H') diversity index of 2.755-3.682. Tilapia zilli (22.2%) was the most common and abundant species followed by Clarias anguillaris (21.4%), Malapterus electricus (18.9%), Heterobranchus bidorsalis (15.4%), Xenomystis nigri (14.6%), Heterotis niloticus (13.0%), Auchenoglanis monkei (11.0%), Tilapia dageti (10.2%), Hepsetus odoe (8.1%) and Bagrus filamentosus (7.2%). The study revealed that taxa richness and species diversity increase with increased water level and uniform physico-chemical changes. Further survey of fish species diversity and abundance should be carried out continuously for a longer period on a larger scale for a thorough assessment of the water bodies and their fishery potentials.*

Keywords— Diversity, Evaluation, icthyofauna and Rivers.

I. INTRODUCTION

In the agricultural sector of the Nigerian economy which employs about 70% of the active labour force, fish occupies a unique position in that it is the cheapest source of animal protein consumed by the average Nigerian, accounting for up to 50% of the total animal protein intake (FDF, 2009).

According to Ehrlich and Willson (2011), biodiversity is essential for stabilization of ecosystem, protection of overall environmental quality for understanding intrinsic worth of all species on the earth. However, the diversity of the fishes mainly depends upon the biotic and abiotic factors and type of the ecosystem, age of the water body, mean depth, water level fluctuations and morph-metric features (Pallavi and Ajay, 2013). Freshwater biodiversity constitute a valuable natural resource, in economic, cultural, aesthetic, scientific and educational terms. They may also offer increased resistance against ecosystem collapse in the face of disturbance (Loreau *et al*., 2001).

For sustainable exploitation of these fisheries resources, a crucial management tool is to have a comprehensive understanding of the ichthyofaunal composition and distribution of the water bodies. With this new found source and readily available protein, coupled with the ever increasing human population, there is need to evaluate the

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fish diversity of the Rivers in Anambra state for present and future sustainability of fisheries resources.

II. MATERIALS AND METHODS

Description of the Study Areas

The study areas Umuoba-Anam section of Omambala River, Anambra East L.G.A; Ebenebe section of Ezu River, Awka North L.G.A and Awa section of Ahommiri River, Orumba North L.G.A which are representatives of major rivers in three senatorial zones (Anambra North, Anambra Central and Anambra south respectively) of Anambra State, Nigeria were investigated (Fig. 1). The three rivers are located at longitude 6˚36˚.0'E and 7˚12.0'E, and latitude 5˚42˚.0'N and 6.36.0'N within the tropical rain forest belt.

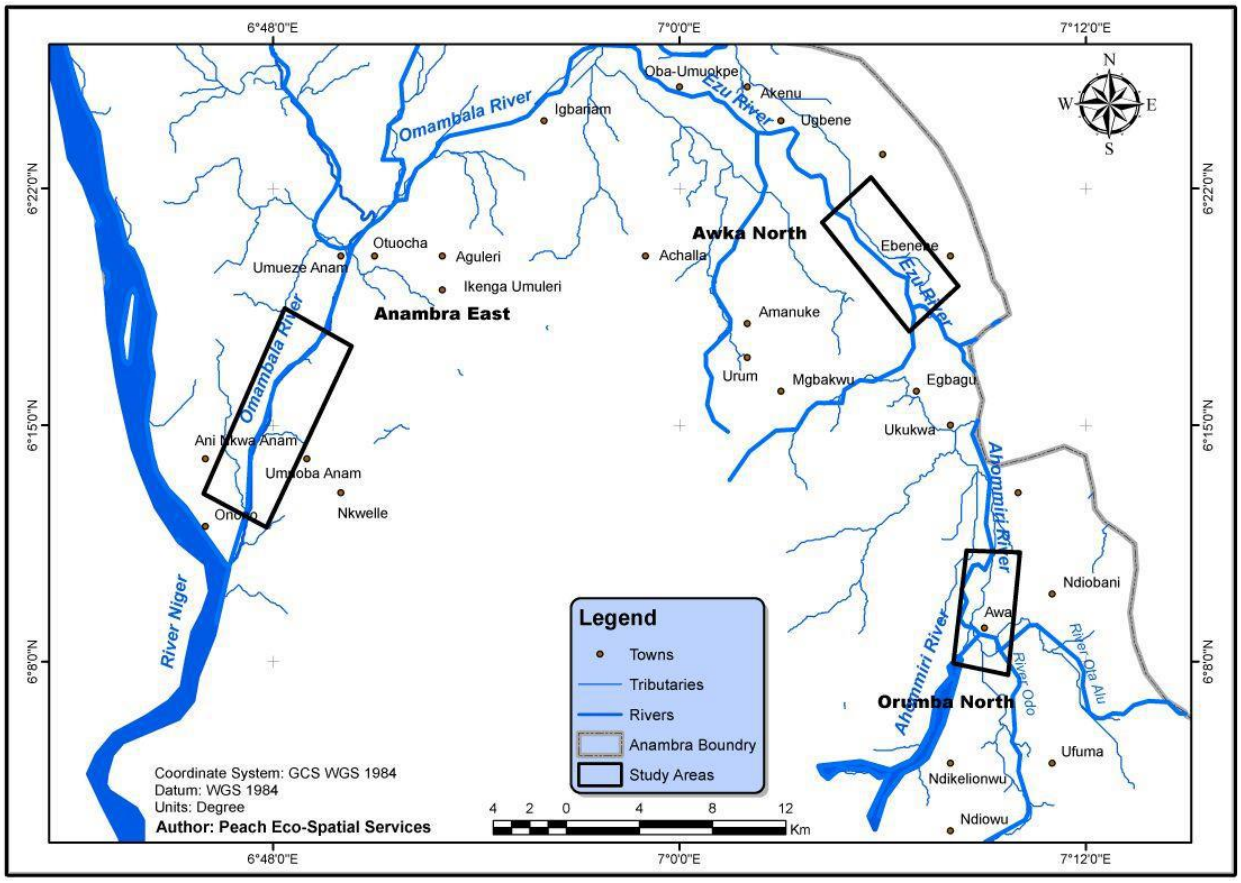

Fig.1: Map showing the Study Sections.

3.2 Selection of the Study Sites

Preliminary survey was carried out on the three Rivers using Global Positioning System (GPS). One sampling site was selected each for the three Rivers throughout the study which include-

Section A-Umuoba-Anam, which covers a distance of 5.8km along the stretch of Omambala River.

Section B-Ebenebe, and which covers a distance of 2.1km along the stretch of the Ezu River.

Section C-Awa, which covers a distance of 1.4km along the stretch of Ahommiri River.

Duration of the Study

The study was carried out for a period of six months from January to June, 2016. The research was carried out in two seasons, a period of 3months of dry season (January to March) and April to June for the rainy season and was limited to ichthyofaunal species only.

Experimental Design

Fish sampling - collection of fish samples and preservation

Fish samples were collected from Umuoba-Anam, Ebenebe and Ahommiri sections of Omambala, Ezu and Ahommiri Rivers respectively once every week for the period of six months with the assistance of three local artisanal fisherman accompanied by a canoe using different types of traditional fishing gears namely- gill nets, cast nets, hook and line, local traps (baited) and bag nets. Gill nets were set late afternoon and left overnight and checked in the morning. Cast nets are thrown by hand in such a manner that it spreads out on the water and sinks. Fish are caught as the

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net is hauled back. The hook was attached to a line, and is sometimes weighed down by a sinker so it sinks in the water. The hook was baited with bait fish. A plastic bucket with tight fitting lid containing 10% formation was used for the preservation of fish samples collected. Immediately after collection, photographs were taken and the fish species were injected with ethanol prior to preservation since formalin decolorizes the fish on long preservation. The different fish species were counted and recorded each week for the determination of abundance.

Identification of fish species

Identification of fishes to species level was done in the laboratory and most often in the field. The following parts were used in the identification of various fish species accurately: the mouth, teeth, nostrils, gills, fins, scales, lateral line and colour pattern using standard keys with taxonomic descriptions and indices by Holden and Reed (1972); Teugels *et al*,(1992) and Idodo-Umeh (2003).

Water sampling

Surface water samples from the sampling sites were collected by dipping a plastic container of 7 – 10cm below the surface film of the water body and the samples were taken to Spring Board Research Laboratory, Udoka Housing Estate Awka Anambra State for physico-chemical analysis.

Statistical analysis

Descriptive statistics such as estimation of species abundance, diversity, dominance and evenness of fish species in the rivers were calculated.

III. RESULTS

Table.1: Physico-chemical Parameters of the Three River Sections under Study for the Dry Season.

S/N	PARAMETERS	OMAMBALA	EZU	AHOMMIRI	WHO STANDARD (2011)
1	Hydrogen ion Concentration (pH)	6.55±0.792	6.34±0.283	6.73±0.509	6.5-8.5
2	Total Suspended Solids (TSS) (mg/l)	6.90±1.039	7.02±0.764	6.02±0.007	25-50
3	Temperature (°C)	28.50±1.386	30.00±0.481	30.20±0.106	25-30
4	Biochemical Oxygen Demand (BOD) (mg/l)	14.15±0.120	14.90±0.636	13.70±0.502	≤20
5	Dissolved Oxygen (DO) (mg/l)	4.50±0.269	4.00±0.778	3.65±0.778	5
6	Turbidity (FTU)	6.15±0.113	6.00±0.028	6.00±0.021	5
7	Total Hardness (mg/l)	10.00±0.156	9.00±0.007	9.80±0.106	60
8	Chloride (mg/l)	4.03±0.021	4.95±0.127	4.00±0.106	5
9	Total Dissolved Solids (TDS) (mg/l)	18.60±0.028	11.55±0.389	13.65±0.106	≤500
10	Conductivity (μScm^{-1})	30.75±0.177	19.50±0.354	24.00±0.311	≤500

Table.2: Physico-chemical Parameters of the Three River Sections under Study for the Rainy Season.

S/N	PARAMETERS	OMAMBALA	EZU	AHOMMIRI	WHO STANDARD (2011)
1	Hydrogen ion Concentration (pH)	6.40±0.283	6.65±0.156	6.35±0.099	6.5-8.5
2	Total Suspended Solids (TSS) (mg/l)	6.00±0.638	4.45±0.035	7.00±0.332	25-50
3	Temperature (°C)	25.00±0.156	26.50±0.354	28.00±0.092	25-30
4	Biochemical Oxygen Demand (BOD) (mg/l)	16.00±0.078	13.00±0.028	14.50±0.127	≤20

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5	Dissolved Oxygen (DO) (mg/l)	5.65±0.106	5.10±0.071	5.30±0.127	5
6	Turbidity (FTU)	7.05±0.050	6.00±0.163	9.50±0.028	5
7	Total Hardness (mg/l)	9.50±0.021	10.00±0.078	9.75±0.028	60
8	Chloride (mg/l)	3.50±0.184	4.50±0.064	5.00±0.092	5
9	Total Dissolved Solids (TDS) (mg/l)	17.00±0.156	13.00±0.064	20.00±0.113	≤500
10	Conductivity (μScm^{-1})	25.00±0.014	20.50±0.057	34.50±0.113	≤500

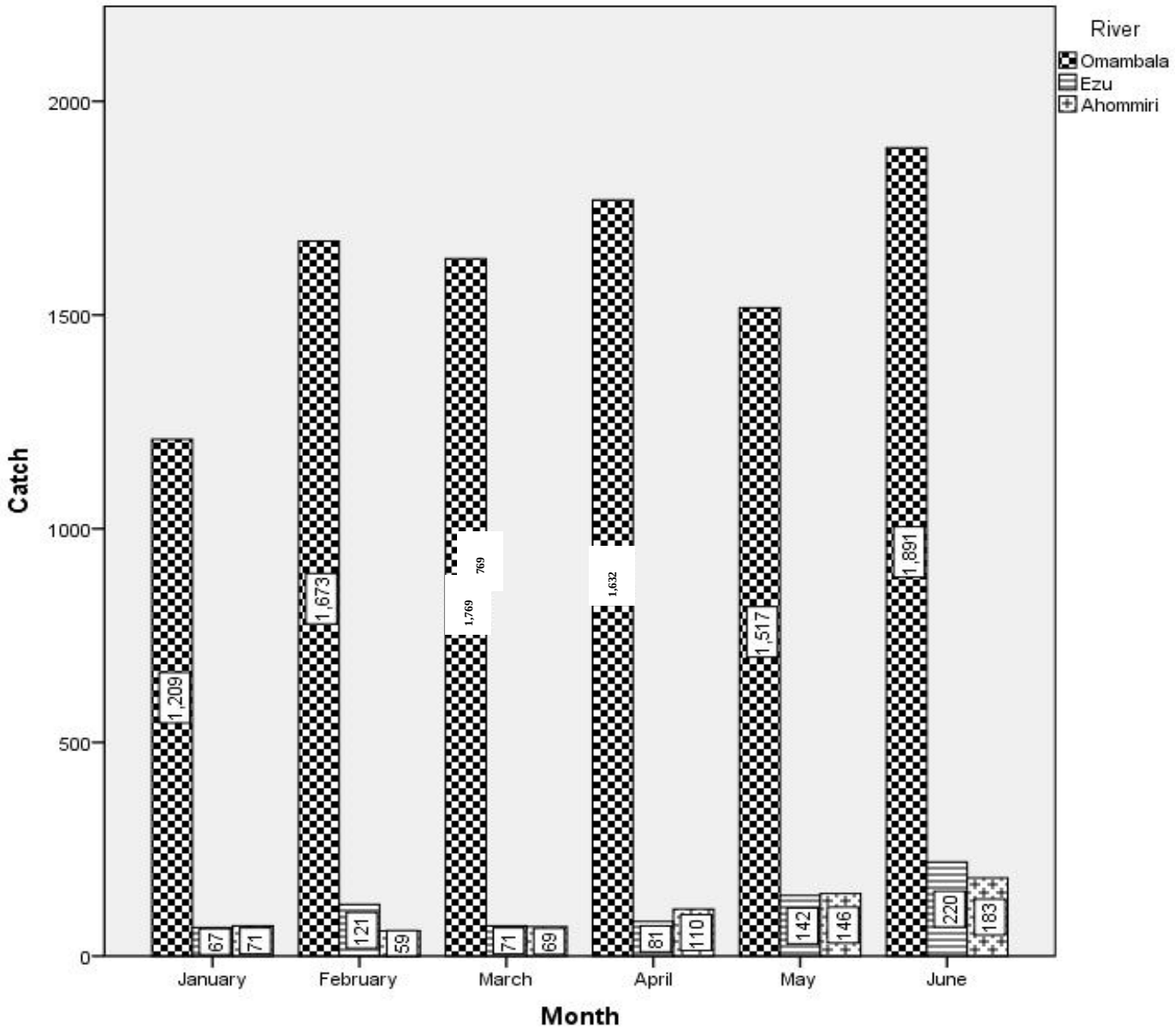

Fig.2: Monthly catch composition of the three rivers from January – June, 2016.

Table.3: Relative Abundance (%) and Diversity Indices of Fish Taxa Identified In Umuoba-Anam Section of Omambala River from Jan- Jun, 2016.

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Order	Family Genus/species	Total Number	Relative Abundance (%)
Siluriformes	**Ariide**		
	Arius heudeloti	103	1.1
	Clariide		
	Clarias camerunensis	541	5.6
	Clarias anguillaris	770	8.0
	Clarias gariepinus	126	1.3
	Clarias macromystax	249	2.7
	Heterobranchus bidorsalis	221	2.3
	Heterobranchus longifilis	2	0.02
	Heterobranchus isopterus	10	0.1
	Gymnallebes typhus	6	0.06
	Bagridae		
	Bagrus filamentosus	17	0.2
	Auchenoglanis monkei	15	0.2
	Auchenoglanis biscutatus	219	2.3
	Malapterinidae		
	Malapterus electricus	111	1.2
	Mochokidae		
	Hemisynodontis membranaceous	36	0.4
	Synodontis clarias	53	0.5
	Synodontis courteti	49	0.5
	Synodontis sorex	45	0.5
	Schilbeidae		
	Silurandon auritus	35	0.4
	Schilbe intermedius	35	0.4
	Schilbe uranoscopus	149	1.5
Ophiocephaliformes	**Channidae**		
	Parachanna obscura	488	5.0
	Parachanna africana	395	4.1
	Cichlidae		
	Chromidotilapia guentheri	249	2.6
	Tilapia zilli	238	2.5
	Tilapia dageti	36	0.4
	Tilapia guineensis	286	3.0
	Hemichromis fasciatus	412	4.3
	Hemichromis bimaculatus	154	1.6
	Sarotherodon macrocephala	30	0.3
	Sarotherodon galilaeus	179	1.8
	Pomadasydae		
	Pomadasys jubelini	48	0.5
	Anabantidae		
	Ctenopoma petherici	52	0.5
	Carangidae		

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	Trachinotus teraia	32	0.3
	Trachinotus goreensis	10	0.1
	Centropomidae		
	Lates niloticus	4	0.04
	Monodactylidae		
	Monodactylus sebae	21	0.2
Mormyriformes	**Mormyridae**		
	Petrocephalus ansorgei	83	1.0
	Gnathonemus cyprinoides	64	0.7
	Gnathonemus senegalensis	150	1.5
	Gnathonemus petersii	223	2.3
	Gymnarchidae		
	Gymnarchus niloticus	92	1.0
Gonorynchiformes	**Hepsetidae**		
	Hepsetus odoe	250	2.6
	Phractolaemidae		
	Phractolaemis ansorgei	242	2.5
Osteoglossiformes	**Osteoglossidae**		
	Heterotis niloticus	603	6.2
	Pontodontidae		
	Pontodon bulchozi	30	0.3
	Notopteridae		
	Xenomystis nigri	127	1.3
Lepidosireniformes	**Protopteridae**		
	Protopterus annectens	419	4.3
Polypteriformes	**Polypteridae**		
	Polypterus senegalus	134	1.4
	Polypterus bichir	28	0.3
Characiformes	**Citharinidae**		
	Citharinus citharus	34	0.4
	Citharinus latus	234	2.4
	Distichodontidae		
	Distichodus rostratus	112	1.2
	Distichodus brevipinnis	124	1.3
	Characidae		
	Alestes baremose	280	3.0
	Hydrocinus brevis	156	1.6
	Brycinus leuciscus	305	3.1
	Brycinus nurse	43	0.4
	Brycinus macrolepidotus	122	1.3
	Icthyboridae		
	Phagoborus ornatus	32	0.3
	Phago loricatus	15	0.2
Pleuronectiformes	**Cynoglossidae**		
	Cynoglossus senegalensis	10	0.1
Cypriniformes	**Cyprinidae**		
	Barbus callipterus	199	2.1
Tetraodontiformes	**Tetraodontidae**		

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Tetraodon fahaka	2	0.02
Total no of orders	11	
Total no of families	29	
Total no of genera	41	
Total no of species	63	
Total no of individuals	9691	
H'	3.682	
d	0.630	
D	0.990	
J	0.889	
1-D	0.01	

Table.4: Relative Abundance (%) and Diversity Indices of Fish Taxa Identified In Ebenebe Section of Ezu River From Jan – Jun, 2016.

Order	**Family** **Genus/species**	**Total Number**	**Relative Abundance (%)**
Siluriformes	**Clariide**		
	Clarias anguillaris	62	8.8
	Clarias macromystax	29	4.1
	Heterobranchus bidorsalis	6	1.0
	Bagridae		
	Bagrus filamentosus	28	4.0
	Auchenoglanis monkei	53	7.5
	Malapterinidae		
	Malapterus electricus	60	8.5
	Mochokidae		
	Hemisynodontis membranaceous	6	1.0
	Synodontis omias	56	8.0
	Synodontis nigrita	37	5.3
	Synodontis violaceous	26	3.7
	Schilbeidae		
	Schilbe uranoscopus	8	1.1
Ophiocephaliformes	**Channidae**		
	Parachanna obscura	73	10.4
	Cichlidae		
	Chromidotilapia guentheri	12	1.7
	Tilapia zilli	40	5.7
	Tilapia dageti	5	0.7
Gonorynchiformes	**Hepsetidae**		
	Hepsetus odoe	27	3.8
Osteoglossiformes	**Osteoglossidae**		
	Heterotis niloticus	13	2.0
	Notopteridae		
	Xenomystis nigri	54	7.7
	Papyrocaranus afer	81	11.5
Polypteriformes	**Polypteridae**		
	Polypterus senegalus	13	2.0
Characiformes	**Icthyboridae**		

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	Phagoborus ornatus	10	1.4
Cypriniformes	**Cyprinidae**		
	Leptocypris niloticus	3	0.4
Total no of orders		7	
Total no of families		13	
Total no of genera		18	
Total no of species		22	
Total no of individuals		702	
H'		2.798	
d		0.793	
D		0.998	
J		0.905	
1-D		0.002	

Table.5: Relative Abundance (%) and Diversity Indices of Fish Taxa Identified In Awa Section of Ahommiri River From Jan – Jun, 2016.

Order	**Family** **Genus/species**	**Total Number**	**Relative Abundance (%)**
Siluriformes	**Clariide**		
	Clarias anguillaris	30	4.7
	Clarias gariepinus	6	1.0
	Heterobranchus bidorsalis	78	12.2
	Bagridae		
	Bagrus filamentosus	19	3.0
	Auchenoglanis monkei	21	3.3
	Malapterinidae		
	Malapterus electricus	59	9.2
	Mochokidae		
	Synodontis sorex	11	1.7
	Synodontis omias	12	1.9
Ophiocephaliformes	**Channidae**		
	Parachanna africana	28	4.4
	Cichlidae		
	Tilapia zilli	89	14.0
	Tilapia dageti	58	9.1
	Tilapia guineensis	41	6.4
	Hemichromis fasciatus	20	3.1
	Anabantidae		
	Ctenopoma petherici	13	2.0
	Ctenopoma kingsleyae	11	1.7
Gonorynchiformes	**Hepsetidae**		
	Hepsetus odoe	11	1.7
Osteoglossiformes	**Osteoglossidae**		
	Heterotis niloticus	31	5.0
	Notopteridae		
	Xenomystis nigri	36	5.6
	Papyrocaranus afer	42	6.6
Lepidosireniformes	**Protopteridae**		

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	Protopterus annectens	22	3.4
Total no of orders	5		
Total no of families	11		
Total no of genera	15		
Total no of species	20		
Total no of individuals	638		
H'	2.755		
d	0.752		
D	0.994		
J	0.920		
1-D	0.006		

H' = Shannon-Weiner diversity index; d = Margalef richness index; D = Simpson's dominance index; *J* = Equitability or Evenness index; *1-D* = Species Heterogeneity.

Table.6: Relative Abundance (%) of Fish Species Common In The Three Rivers Sections.

Species	Relative Abundance (%)
Tilapia zilli	22.2
Clarias anguillaris	21.4
Malapterus electricus	18.9
Heterobranchus bidorsalis	15.4
Xenomystis nigri	14.6
Heterotis niloticus	13.0
Auchenoglanis monkei	11.0
Tilapia dageti	10.2
Hepsetus odoe	8.1
Bagrus filamentosus	7.2

IV. DISCUSSION

The physico-chemical parameters of the sections of Omambala, Ezu and Ahommiri Rivers were recorded during the period of sample collection and were compared with the world approved guideline, World Health Organisation (WHO, 2011). According to Welcomme (1985), studies on the existing physico-chemical parameters, fish composition and diversity of fish populations in water bodies are crucial tools for an effective fisheries management.

During the study, the temperature ranged from 25±0.16-30±0.48 for the three Rivers. The observed uniformity in the readings of the Rivers at various seasons may be linked to the findings of Okoye (2016) in his study on comparative limnology of Unizik and Amansea Streams in Awka which reported that uniformity of climatic region and regular tidal motions ensures the complete mixing of the water.

The dissolved oxygen (DO) levels for the two seasons were relatively high compared to the critical level of 5mg/l for fish by W.H.O (2011). The higher levels of DO suggested why there was higher number of catch, abundance and diversity recorded during the rainy season. This is in line with the recommendations of Hanna, (2003) that dissolved oxygen level of 5mg/l or greater will support healthy growth and diversity of most fishes. Other physico-chemical parameters measured during the study were within permisible range with slight seasonal variations as can be observed with all the parameters measured higher in the dry season except for DO, Biochemical Oxygen Demand (BOD) and Turbidity which were higher during the wet season.

A total catch of 11,031 fishes which include 69 species, 43 genera, 29 families and 11 orders were recorded at the three River sections for six months. This is similar to the observations of Odo (2004) who reported an estimated fifty two (52) fish species belonging to seventeen (17) families from Anambra River which comprised 171, 236, and 169 individual fishes at Ogurugu, Otuocha, and Nsugbe stations respectively.

From the result obtained from the study, the three Rivers showed polydiverse communities with Shannon-Weiner (*H*') diversity indices of 3.682, 2.798 and 2.755 for Omambala, Ezu and Ahommiri Rivers respectively. This concurs with the recommendation of Magurran (2004) that

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Shannon-Weiner diversity index range between 1.5-3.5 and rarely greater than 4 for an ideal ecosystem. The results obtained from this study supports the report of Moses (2001) who noted that differences between the fish diversity compared to others in the same ecozone is attributed to the difference in the floodplain sampled.

V. CONCLUSION

Conclusively from the study, taxa richness and species diversity increased with increased water level. Though the rivers were subjected to varied pressures (anthropogenic and natural); they are still rich aquatic ecosystems. There was therefore high relationship between the seasonal catch and taxa diversity as can be seen from the study where most of the catch was recorded during the rainy season. Further survey of fish species diversity and abundance should be carried out continuously for a longer period on a larger scale for a thorough assessment of the water bodies and their fishery potentials.

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