FISH SPECIES ABUNDANCE AND DIVERSITY OF RIVER UKE, NASARAWA STATE, NIGERIA

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Abstract. A study was conducted to assess fish species abundance and diversity of River Uke, Uke, Nasarawa State, Nigeria. Fish were sampled from three sites, upper (A), middle (B) and lower (C) courses of the river. The study lasted for ten months from June 2014 to March 2015. A total of two thousand, one hundred and twenty six (2,126) fish comprising of 7 families and 11 species were sampled. Seasonal fish abundance of River Uke revealed that average monthly catch in the wet season was 25 % lower than in the dry season. Cichlidae dominated the sampled fish families accounting for 26.20 % of total catch while Latidae was least abundant with 6.21 %. Monthly fish abundance was dominated by three species, namely, *Clarias gariepinus* (18.44 %), *Tilapia zilli* (14.44 %) and *Oreochromis niloticus* (11.76 %) all accounting for 44.64% of the total catch. The trend of monthly fish abundance also showed a bi–modal peak with the minor peak observed in March (260) and the major peak in November (292). Fish abundance by sites revealed individual catches of 671, 365 and 1090 in Site A, B and C, respectively. Total Shannon–Wiener Diversity index of River Uke in this study was 2.312 and the index values were generally higher in the wet season (except October) than in the dry season. Total Simpson Index calculated for River Uke in this study was 0.892.
Keyword: Fish, species abundance, diversity, seasonal, River Uke.

Introduction

Many fish farmers depend on water bodies such as rivers for sustained artisanal and culture fisheries production.

Consequently, assessment of fish species assemblage and diversity in water bodies has been considered as one of the important aspects of studies of rivers as it could help in the identification of important species that could be valuable for the livelihoods of people in an area.

Fish species abundance studies could also provide relevant information on how common or rare a species is relative to other species in a given community [LOISEAU and GAERTNER, 2015].

Species diversity and variation or similarities in community structure of fish and other aquatic resources in rivers could be revealed through fish abundance studies.

Therefore, information gathered in fish abundance studies could assist in determining ecosystem sensitivity and contribute to sustainable management of aquatic resources.

This could lead to better understanding of specific fish habitats and promotion of fish conservation and management strategies [ESPINOZA, 2008].

As a result of availability of relevant information made possible through species abundance studies, over–exploitation and avoidable decline in fisheries resources could be avoided through adoption of appropriate management strategies for inland waters.

Lawson and Olusanya indicated that an adequate knowledge of species composition, diversity and relative abundance of fish in water bodies are essential for sustainable management of fish resources [LAWSON and OLUSANYA, 2010].

Researchers have assessed the biodiversity of fish fauna of water bodies in Nigeria and have recorded varying outcomes.

Jamu and Ayinla suggested that the yields of the inland water bodies in Nigeria are generally declining due to environmental degradation including water pollution and improper

management of fisheries resources [JAMU and AYINLA, 2003].

Lawson and Olusanya carried out a study to determine fish diversity in Igbesa, Itele and Iba tributaries of River Ore in South west [LAWSON and OLUSANYA, 2010], Nigeria and identified discharges from industries (industrialization) that surrounded the adjacent Ologe lagoon, domestic wastes from boundaries settlements (urbanization) and the farming activities along the tributaries of the river as possible causes of relatively low species diversity observed in the river.

Ayanwale and collab. reported a relatively low catch of fish species in Tagwai Lake, Minna, Nigeria between July and September, 2010, and suggested variation in mesh sizes and large volume of water during the rainy season, which contributed to the dispersal of available species making fishing difficult, were part of the reasons that contributed to the level of catch recorded [AYANWALE et al., 2013].

However, Offem and collab. opined that high level of water and subsequent flood could favour reproductive activities and could contribute to restricted movement of fish making them less vulnerable to catch [OFFEM et al., 2011].

There are indications that anthropogenic activities could also affect the distribution of fish in water body.

Dubey and collab. reported that relatively undisturbed sites of Betwa and Ken were characterized by diverse fish fauna and high richness of threatened species [DUBEY et al., 2013].

According to Espinoza, anthropogenic disturbances on the structure and heterogeneity of a system can have an important effect on aquatic community stability [ESPINOZA, 2008].

Rodrigo and Rodriguez reported no significant correlation between species distribution and environmental variables, and concluded that the water depth, water velocity and geomorphological were major environmental variables that influenced the fish distribution in Terraba River [RODRIGO and RODRIGUEZ, 2008].

The findings of Rodrigo and Rodriguez were opposed to the tendency for species composition to increase from upstream to the mouth of the river, probably due to two major human activities such as, discharge of waste of pineapple fields and sediments in the main channel [RODRIGO and RODRIGUEZ, 2008].

River Uke runs through the centre of the Uke town as an important water way in Uke community.

River Uke is a major source of water resources for domestic and agricultural activities.

Apart from the common practice of artisanal fisheries, the river is depended on as source of water for fish production and irrigation of agricultural crops such as vegetable.

Fish from this water body is one of the major sources of protein for the populace of Uke community [OPALUWA et al., 2012].

However, there has been report of domestic wastes discharge along the length of the stream and runoffs from agricultural lands that flow into the stream at different points [AREMU et al., 2007], which may have far reaching effects on fish composition in the river.

Lack of adequate information on River Uke may also be a constraint that could limit the effective management and possible future efforts that may be necessary to conserve fisheries resources in this water body.

The purpose of this study is to evaluate fish species diversities and abundance in River Uke during the wet and dry season.

Material and methods
Description of Study area
Uke is a community in Karu Local Government Area of Nasarawa State.

Uke town is located between latitude 8°53' N to 8°56' N and longitude 7°39'E to 7°46' E and stands at has an elevation of 295 m above sea level.

The rainy season in Uke is from May to October while the dry season is between November and April.

Uke community is divided into upper and lower part by River Uke which runs through almost the center of the town.

River Uke is locally called 'Dogon Ruwa' and also known as the Mystery River by non–indigenes.

The river is muddy with a wide rocky course that is filled to the brim at the peak of rainy season.

River Uke provides water for crops and animal husbandry along its path and serves as major source of water for domestic use in the community.

Sampling Sites

Fish were sampled from three sites, upper (A), middle (B) and the lower (C) course of the river (Figure 1).
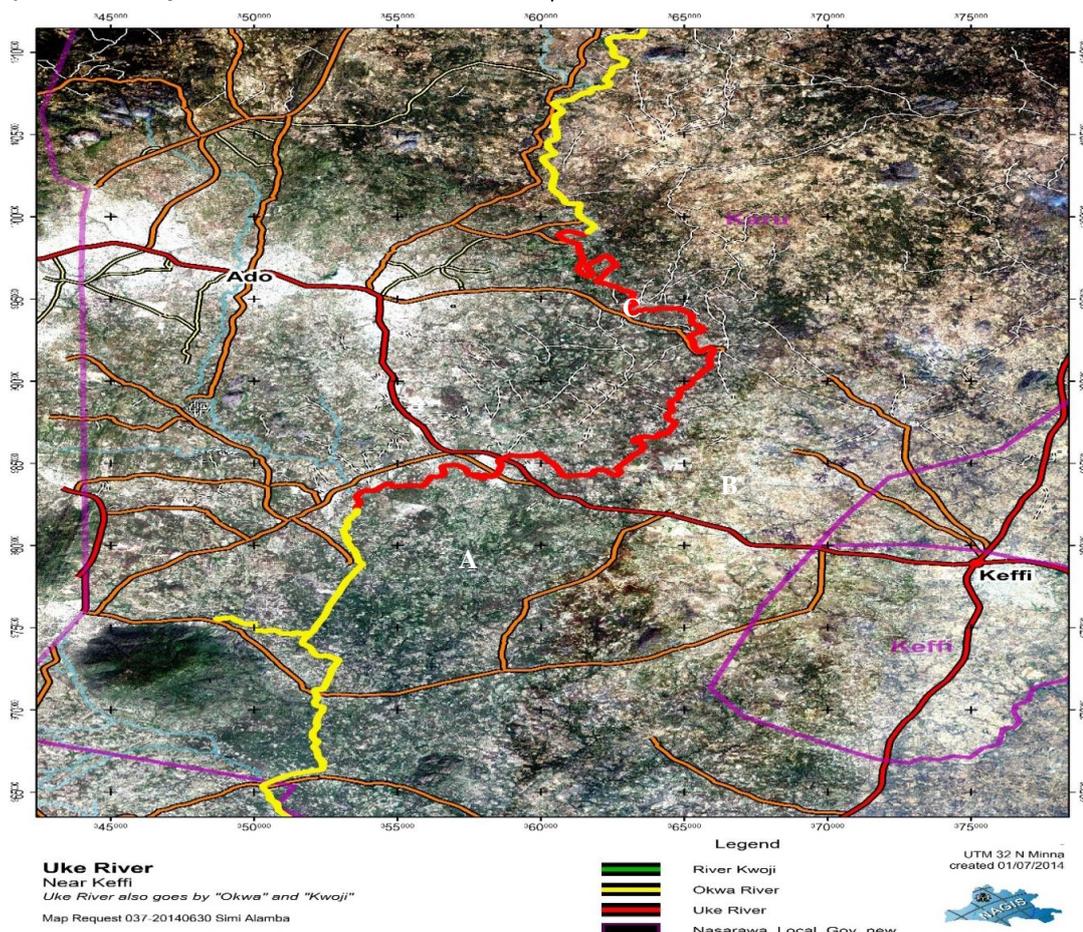

Figure 1. Map of River Uke [Source: Nassarawa State Geographical Information System [NAGIS]]

The sampling sites were selected based on preliminary survey of the river, with factors such as average depth, volume of water, accessibility, activities taking place in and around the river and security.

Fish were sampled every fortnight between June, 2014 and March, 2015, which covered five months each of rainy and dry seasons.

Fish Sample collection and Identification

Fish were sampled with the assistance of artisanal fishermen using gill nets of various mesh sizes (50–78 mm), local traps (Cane, Wire and Bamboo), baited hooks and lines at each sampling sites.

Identification of the fish species was carried out in the laboratory using the methods described by Scheinder; Reed and collab; FAO; Oguzie. Olaosebikan and Raji [SCHEINDER, 1990; REED *et al.*, 1967; FAO, 1990, 1994; OGUZIE, 1997, OLAOSEBIKAN and RAJI 1998].

Further identification of the species were carried out on the free encyclopedia Wikipedia [WIKIPEDIA, 2010].

Statistical Analysis

The estimation of species' abundance and diversity of fish was done using Margelef's Diversity Index (D), and Simpson's Index (D) methods [1949].

Results and discussion

Fish Abundance in River Uke

The monthly abundance of fish species by families in River Uke is as presented at Table 1.

A total of two thousand one hundred and twenty six (2,126) fish were sampled during the study comprised of 7 families and 11 species.

The seasonal fish abundance in Uke River revealed that the average monthly catch in the wet season (182 individuals per month) was about 25 % lower than the average monthly catch (243 individuals) in the dry season.

In the Cichlidae dominated the families of fish recorded during the study accounting for about 26.2 % of sampled fish while Latidae was least abundant with 6.21 % (Table 1).

The eleven (11) fish species identified were *Clarias gariepinus, Tilapia zilli, Oreochromis niloticus, Hetrobranchus longifilis, Mormyrops rume rume, Synodontis budgetti, Lates niloticus, Labeo coubie, Petrocephalus bane bane Aletes baremose and Gnathonemus tamandua.*

Table 1.

Family distribution of fish abundance in River Uke

Family	Fish species	Abundance (%)
Claridae	*Clarias gariepinus* *Hetrobranchus longifilis*	25.21
Cichlidae	*Tilapia zilli* *Oreochromis niloticus*	26.20
Mormyridae	*Moryrops rume rume* *Petrocephalus bane bane* *Gnathonemus temandus*	19.70
Latidae	*Lates niloticus*	6.21
Mochkidae	*Synodontis budgetti*	8.23
Cyprinidae	*Labeo coubie*	7.99
Alestidae	*Aletes baremose*	6.49

River Uke is depended on by residents of Uke community for domestic and agricultural purposes, particularly fisheries.

There has been a significant level of human activities along the course of River Uke which may impact on the fisheries resources of this important water body.

However, limited information are available on fish species abundance of River Uke.

Consequently, a study was conducted to evaluate fish species abundance and diversity of River Uke in Nasarawa State, Nigeria.

The studies were carried out in 3 stations along the course of River Uke for a period of 10 months between June, 2014 and March, 2015.

The findings of the study suggested seasonal variation in fish population and species abundance in the months and stations sampled.

The variation was suspected to be as a result of anthropogenic activities which are obvious along the river course.

It was concluded that River Uke is fairly rich in fish abundance and diversity which was dominated by a few species.

Table 2 showed that *C. gariepinus* was the most abundant species representing 18.44 % of the total samples.

The second most abundant species was *T. zilli* and comprised 14.44 % of the fish population, while *P. bane bane* is the least abundant species (4.89 %) in the river.

Fish species abundance across different sites in River Uke is presented at Table 3.

The highest fish abundant was recorded in site C, followed by Site A and the least was Site B with the total of 1090,

671 and 365, respectively. This showed that all fish species occurred more at Site

C compared to the other sites along River Uke, Nasarawa State.

Table 2.

Monthly abundance of fish species in River Uke Nasarawa State

Species	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total	% Abundance
Clarias gariepinus	39	20	18	22	58	73	46	36	36	44	392	18.44
Tilapia zilli	29	21	27	16	43	35	35	22	31	48	307	14.44
Oreochromis niloticus	25	15	18	23	31	22	32	28	28	28	250	11.76
Hetrobranchus longifilis	11	19	14	11	15	19	18	12	11	14	144	6.77
Mormyrops rume rume	11	11	12	10	10	14	15	13	11	17	124	5.83
Synodontis budgetti	21	13	15	11	11	35	21	19	15	14	175	8.23
Lates niloticus	14	12	10	10	15	18	18	11	11	13	132	6.21
Labeo coubie	14	13	10	11	16	18	28	15	24	20	169	7.95
Petrocephalus bane bane	13	9	5	6	7	23	9	11	9	12	104	4.89
Alestes baremose	20	12	12	10	15	14	12	11	14	18	138	6.49
Gnathonemus tamandua	25	14	13	12	13	21	19	20	22	32	191	8.98
Total	222	159	154	142	234	292	253	198	212	260	2126	100.00

Also, the trend of monthly fish abundance in River Uke revealed a bi–modal peak with the minor peak observed in the months of March while the major peak was in November (Figure 2).

Table 3.

Fish species Abundance across sites in River Uke Nasarawa State

Species	Site A	Site B	Site C	Total
Clarias gariepinus	131	51	210	392
Tilapia zilli	108	86	113	307
Oreochromis niloticus	104	34	112	250
Hetrobranchus longifilis.	32	16	96	144
Mormyrops rume rume	35	22	67	124
Synodontis budgetti	48	21	106	175
Lates niloticus	38	21	73	132
Labeo coubie	59	14	96	169
Petrocephalus bane bane	25	34	45	104
Alestes baremose	27	34	77	138
Gnathonemus tamandua	64	32	95	191
Total	671	365	1090	2126

The highest fish abundance was recorded in the month of November with two hundred and ninety two (292) fish followed by March with two hundred and sixty (260) while the least fish abundance was observed in the month of September with a total of one hundred and forty two (142) fish species.

The composition of fish species in this study is lower than those reported by Mondal and Kaviraj [MONDAL and KAVIRAJ, 2009].

Higher abundance of the family Cichlidae may be due to their high level of adaptability to a high range of conditions.

There are reports of high tendency of fish in the family cichlidae and Claridae in this part of the country [FROESE *et al.*, 2012].
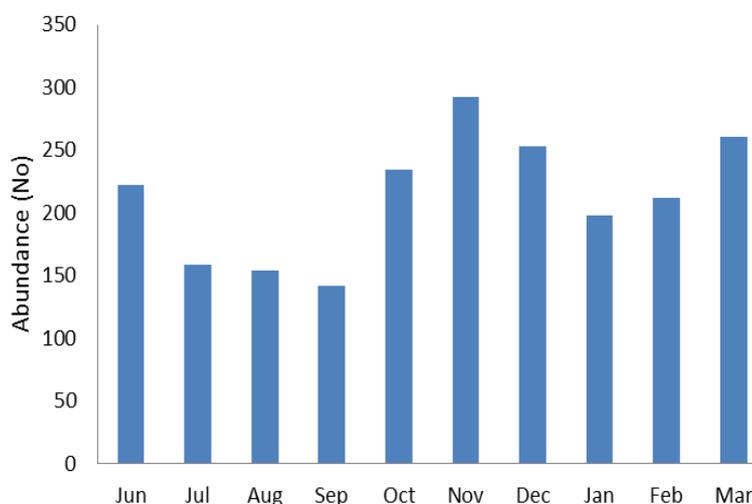
Figure 2. Aggregate Monthly Fish Abundance of River Uke

According to Udoidiong and King [UDOIDIONG and KING, 2000], Cichlidae are rare in areas where they are competitively disadvantaged especially in areas where they co–exist which larger families. Okomoda and collab. [OKOMODA et al., 2013]

reported the dominance of the family Cichlidae in the floodplain of Lokoja, accounting for about 94.8 % of the sampled population while it dominated with 97.5 % occurrence in the adjoining streams.

Table 4.
Monthly Diversity indices of fish species in River Uke, Nasarawa State

Diversity indices	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Shannon–Weiner H	2.316	2.366	2.325	2.327	2.181	2.252	2.297	2.313	2.293	2.277	2.312
Shannon–Weiner J (Equitability index)	0.966	0.986	0.969	0.971	0.909	0.939	0.958	0.965	0.956	0.950	0.964
Simpson 1–D (Species heterogeneity)	0.897	0.909	0.901	0.902	0.866	0.878	0.893	0.897	0.894	0.889	0.892
Evar	−2.964	−8.996	−2.851	−3.772	−0.782	−2.033	−2.043	−3.180	−1.986	−1.924	−3.245
Margalef (Species richness)	1.851	1.973	1.985	2.018	1.833	1.762	1.807	1.891	1.867	1.798	1.305
No. of species	11.000	11.000	11.000	11.000	11.000	11.000	11.000	11.000	11.000	11.000	11.000

Braimah [BRAIMAH, 2001] reported that Tilapia dominated fish landing accounting for 38.1 % of the catches in stratum VII of the Volta Reservoir because of still or slow flowing water which is lacustrine in nature.

However, the findings of this study varied from that of Abodi and collab. [ABODI et al., 2014] who reported 52 species made up of 16 families with members of the family Alestidae dominating in species abundance having accounted for 42.2 % of the total weight of the species encountered in lower reaches of the White Volta at Yapei, Ghana.

According to Abodi and collab. [ABODI et al., 2014], the reason for the dominance of

Alestidae in their study is because of the riverine nature of lower reaches of the Volta reservoir, located in stratum VIII of the Volta Reservoir.

The distinct patterns observed in fish abundance in River Uke during the dry and wet season in this study depicts seasonal differentiation of ichthyofauna and consistent with the findings of other studies [HALSTEAD, 1971; SENDACZ et al., 1985; OFFEM et al., 2011].

One of the reasons alluded for higher fish abundance in the dry season compared with the wet season is the large volume of water which encourages higher level of fish dispersal in the wet season.

Similarly, large volumes of water in the wet season favours reproductive activities of several fish species, with the characteristic restricted movement which makes them less vulnerable to catch [OFFEM *et al.*, 2011].

It has also been noted that during the dry season, deep water fishes relocates from the anoxic deep water to the aerated upper water which makes them more vulnerable to catch [ADENIJI, 1991].

Clarias gariepinus dominated (18.0 %) individual species in the study area, in most of the months (6 out of 10) and particularly at sites A & C possibly as a result of escapes from aquaculture ponds in the area as it is a widely cultivated species in the area.

Okomoda and collab. [OKOMODA *et al.*, 2013] attributed relatively high dominance of *Clarias gariepinus* in flooded residential areas adjoining the flooded plains of Lokoja to escapes from flooded fish ponds in the area.

Fish Diversity of Uke River

Monthly fish species Diversity index of River Uke is shown at Table 4.

Conclusions

Fish abundance by sites revealed individual catches of 671, 365 and 1090 in Site A, B and C, respectively. Total Shannon–Wiener Diversity index of River Uke in this study was 2.312 and the index values were generally higher in the wet season (except October) than in the dry season. Total Simpson Index calculated for River Uke in this study was 0.892.

Table 5.

Diversity indices of fish species at various sites in River Uke Nasarawa State

Diversity indices	Site A	Site B	Station C	Total
Shannon–Weiner H	2.242	2.252	2.325	2.312
Shannon–Weiner J (Equitability index)	0.935	0.939	0.969	0.964
Simpson 1–D (species heterogeneity)	0.880	0.880	0.895	0.892
Evar	–1.129	–1.594	–3.748	–3.245
Margalef (Species richness index)	1.536	1.695	1.430	1.305
No. of species	11.00	11.00	11.00	11.00

It was concluded that River Uke is fairly rich in fish species abundance and diversity with a mature and stable community throughout the year and across sampled sites.

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