FISH DIVERSITY AND PHYSICO-CHEMICAL PARAMETER ASSESSMENT OF RIVER YAURI, KEBBI STATE, NIGERIA

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ABSTRACT
Studies on the fish diversity and physico-chemical parameters of River Yauri was carried out between April 2016 and September 2016. Twenty - five species belonging to sixteen (16) families were recorded. Mormyridae and Alestidae were the most diverse with 4 species, followed by Cichlidae, Claroteidae, Cyprinidae and Mochokidae with 2 species each. Oreochromis niloticus was the most abundant (15.58%) while Polypterus senegalus was the least (0.05%). On the overall Zamare sampling station was the most diverse in fish species, followed by Yelwa while the lowest was Bakin Ruwa. There was no significant differences (P>0.05) in fish abundance at the sampling stations in River Yauri during the period of study. Yelwa was highest in fish richness, followed by Bakin Ruwa and lowest in Kangiwa. In terms of eveness index, Yelwa was the most even, followed by Kangiwa while the least was Bakin Ruwa. Mean physico-chemical parameters at the sampling stations showed variations in the river during the period of study. There were significant differences (P<0.05) in alkalinity, DO_2, PO_4, total dissolved solids, and the values fall within acceptable limits for aquatic life, although depletion of DO_2 was recorded at Yelwa and Kangiwa. Water quality parameters need to be monitored, and also assessment of fish catch on routine basis should be done in order to ascertain any changes that occur in fish diversity.

Keywords: Water quality, Fish diversity, River Yauri, Nigeria

INTRODUCTION
Nigeria is endowed with abundant natural resources, comprises of fresh, brackish and marine water bodies, similarly are plant and animal communities including fishes. Fish is an important resource exploited by human over the centuries. Fisheries involve fishermen, types of fish species, area of water body, methods of fishing, types of boats and purposes of activities (FAO, 2013). Fishes are found in the aquatic environment such as reservoir, river, stream, lake, and swamps. They vary widely in their physiology, morphology, tolerance and response to the surroundings. According to Karr *et al*. (1986) a number of physical factors such as, water quality, its quantity, and habitat structure can limit the ecological success of fish population. Fish accounts for 30% of animal protein consumed in Asia, 20% in Africa and 10% in Latin America and the Caribbean and globally (Prein and Ahmed, 2000).

Diversity is the species quality or state of having many different varieties of fish species in abundance, forms and types.. The importance of water to fish can be equated to that of air to terrestrial animals. Therefore, water quality does not only determine how well a fish is growing, but also whether or not they will survive in a particular aquatic environment. Ufodike and Garba (1992) emphasized that changes in these properties will affect the growth, survival, diversity and distribution of fishes.
This study was conducted to assess the water quality of the river Yauri and its fishery diversity.

MATERIALS AND METHODS
Study Area
River Yauri falls within the wetland and floodplain of the Niger/Sokoto River Basin. It's seasonally flooded by the interwoven connection of River Sokoto and River Rima, which are tributaries of river Niger (Hughes and Hughes, 1991). River Yauri lies in the Northern Guinea Savannah zone between Latitude $4^0$46'40" East and Longitude 10^0 44'5" North. (Figure 1). The climate is characterized by distinct dry and rainy season.

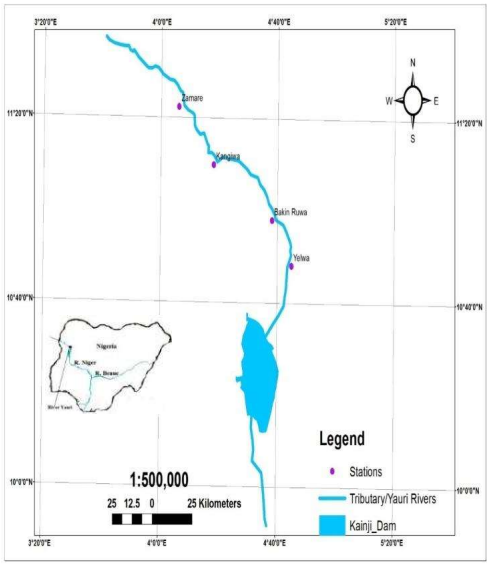

Figure 1: Showing the sampling stations on River Yauri, Kebbi State, Nigeria. (Source: Google earth Maps, 2016).

Collection of fish and water samples

Fish and water samples were collected bimonthly between April 2016 and September, 2016 at four landing sites designated as station I (Bakin ruwa), station II (Yelwa), station III (Kangiwa) and station IV (Zamare). Fish samples were obtained from the fishermen that make use of different kind of fishing gears such as gill nets of various mesh sizes, cast nets and clap nets. They were counted, identified and classified using distinctive features described by Idodo-Umeh (2003). Water samples for quality analysis were collected in two polythene rubber of one liter capacity at each station.

Biodiversity Parameters

Diversity:- evenness and richness indices were calculated using the following formulas:

Shannon-Weaver diversity index, $H = -\Sigma$ Pi ln Pi, (Shannon and Weaver, 1949)

Evenness index, $e =$ H/ln s, (Pielou, 1966)

Where H is the diversity index, *Pi* is the relative abundance (s/N), *s* is the number of individual for each species, *N* is total number of individuals, *D* is the richness index, *S* is the total number of species, *e* is the similarity or evenness index and *ln* is the natural logarithm.

Physico-chemical parameters

The following physico–chemical parameters were determined; Water temperature was determined on the field using digital mercury thermometer (Model Ts – 2) calibrated in degree centigrade (°C). The dissolved oxygen was determined by using the modified Winkler Azide method (Lind, 1979, APHA, 1992). The pH of the water was determined with a pH meter (Pye Unicam model 392) at 25 (^{O}C). The electrical conductivity of the water sample collected from the four sampling stations were measured in the laboratory using a conductivity meter (Model Pye Unicam 292). The electrical conductivity of water sample taken was expressed in micro–ohms per second (µs/cm). Total alkalinity was determined by measuring 100ml of water sample in 250ml Elenmeyer flask, three drops of phenolphthalein indicator were added. If the sample turned pink, it would be titrated with 0.02N H_2SO_4, until the pink colour just disappear and the millilitre(s) (ml.) of acid used recorded for alkalinity calculation. Nitrate and Phosphate determination was done as follows:- distilled water was used to rinse the cuvette, and 10ml of distilled water were measured into it and spectrophotometer was adjusted to the zero level. 10ml of water sample was poured into the cuvette, followed by nitrate powder pillow added into the water sample in the cuvette, shake it for few second and analysed it using spectrophotometer, and the Nitrate reading recorded. While for Phosphate – phosphorus, distilled water was used to rinse the cuvette and 10ml of distilled water was measured into it and spectrophotometer adjusted to zero level. 10ml of water sample was added into the cuvette, and phosphate powder pillow added into the water sample in the cuvette. It was shake for few second, and analyzed using spectrophotometer and the reading was recorded (APHA (1992).

Statistical analyses

Means, percentages, standard deviations and ranges were computed from the data collected using descriptive statistics. Analysis of variance (ANOVA) was used to test for significant difference in parameters determined. Least Significant difference (LSD) and new Duncan Multiple Range Test (NDMRT) was carried out to rank means.

RESULTS AND DISCUSSION

The composition of fish from River Yauri is shown on table 1. Twenty-five species of fish belonging to sixteen families were recorded. Dan-kishiya *et al.* (2013) and Ibrahim *et al.* (2010) reported 11 species belonging to 5 families in Lower Usuma Reservoir, and 7 species belonging to 9 families in Kontagora Reservoir respectively, which are lower than the present study. Water body size, species abundance, fish migration, availability of food, and better water quality could have led to this observation. Fish species diversity is a measure of the productivity of a given water body. The families Mormyridae and Alestidae were the most diverse with 4 species each. This could be due to the ability to escape predators, better adaptation, availability of food and season. Although Cichlidae did not record highest diversity, *Oreochromis niloticus* was the most abundant by number in the river. Balogun (1986) reported the dominance of Cichlidae on Kainji Lake, which is in line with the result of this this study because the water body falls within River Niger. Balogun (2005) also reported the dominance of family Cichlidae in Kangimi Reservoir. This is attributed to their high prolific nature and tolerance to environmental condition changes. The low number of *Polypterus senegalus* recorded could be due to their population and preference to swampy environment. Fish diversity was higher in Yelwa sampling station than Yauri and also Bakin Ruwa (Table 2). It is a common observation reported in most water bodies that fish diversity differ based on location. Such observation was also reported by Dan-kishiya (2013) in Lower Usuma Reservoir. This could be attributed to fish distribution, abundance, structure and environmental conditions. *Oreochromis niloticus* was the most abundant in all the sites. This could be due to their adaptive ability to the condition of the river. Dan-kishiya reported the dominance of Cichlids in Lower Usuma Reservoir, which is in line with the finding of this study.

. On species diversity, Simpson's (1-D) indices was highest in Yelwa (0.93) and lowest in Bakin Ruwa (0.86). Mergalef Index describes species richness

and this was highest in Yelwa (3.35) and lowest in Kangiwa (2.75). This implies that Kangiwa had the least species richness and also the poorest species diversity (Table 3). This could be due to difference in the topology and environmental conditions of the sampling sites amongst other factors.. The intermediate fish diversity index of Shannon Wirner was found significant at Bakin Ruwa while it was lowest at Yelwa. Evenness index value was significantly high at Yelwa (0.7) , followed by Kangiwa (0.69) while the least even (0.59) was Bakin Ruwa. Dan-kishiya *et al.* (2013) reported values of species richness, species diversity and species evenness of 0.76, 1.64 and 0.76 respectively, which were lower than the values of the present study. Although these indices were different at the sites, the river has high diversity of fish species.

The water in River Yauri showed range of variations of physico-chemical parameters. Electrical conductivity, NO_3 and total alkalinity showed wider ranges (Table 4). This could be due to high quantity of suspended solids or ions, domestic activities, sewage disposal and agricultural activities around the river. Electrical conductivity (60.81 µs/cm), NO_3 (5.12mg/l) and total alkalinity (101.56mg/l) fall within the limits suitable for aquatic life. pH, and total dissolved solids did not show wide range of fluctuations, though also falls within the acceptable range for fish survival and production. The slightly acidic nature of the river could be due to acidic earth metals, mixing of pollutants in the river from human activities such as, washing of clothes, garbage dumping, farming activities among others. Similar observation was reported by Ugwu and Wakawa (2012) in River Usuma. Temperature recorded (30.56^{o}C) was greater than WHO standard (25 ^{o}C) but falls within acceptable range for aquatic life in the tropics. While Bakin Ruwa recorded the highest alkalinity, Kangiwa was lowest, which differ significantly ($P<0.05$). This could be due to difference in the amount of suspended ions and runoffs at these sites. DO_2 with highest value at Zamare (5.85mg/l) and lowest at Kangiwa (3.27mg/l) indicates significant difference ($P<0.05$) between sites. DO_2 above 4mg/l is good and 5mg/l is permissible level in water while below 4mg/l is detrimental to aquatic life. Hence Yelwa and Kangiwa were depleted of oxygen. This could be due to organic load from human activities. PO_4 also differ significantly ($P<0.05$) at the sites where Bakin Ruwa recorded the highest value (5.99mg/l) and Kangiwa lowest value (3.46mg/l). This could be as a result of the level of human activities at sites because domestic activities, runoff from agricultural activities are major sources of phosphates discharge. The significant difference ($P<0.05$) observed in total dissolved solids at sites could be due to the regular discharge of domestic waste and runoff as this work was done during the wet season.

Table 1: Fish composition (%) by number in River Yauri, Kebbi State, Nigeria (April, 2016 - September, 2016)

Family/Fish	No	%
Citharinidae		
Citharinus citharus	143	3.63
Cichlidae		
Sarotherodon galilaeus	321	8.14
Oreochromis niloticus	614	15.58
Clariidae		
Heterobranchus bidorsalis	188	4.77
Claroteidae		
Auchenoglanis occidentalis	155	3.93
Chrysichthys auratus	22	0.56
Latidae		
Lates niloticus	79	2
Mormyridae		
Hyperopisus bebe	201	5.09
Marcusenius senegalensis	152	3.86
Mormyrus rume	434	11.01
Mormyrops anguilloides	235	5.96
Alestidae		
Hydrocynus forskalii	53	1.44
Brycinus nurse	194	4.92
Cyprinidae		
Labeo coubie	276	7
Labeo senegalensis	38	0.96
Mochokidae		
Synodontis gambiensis	109	2.77
Synodontis membranaceus	504	12.79
Bagridae		
Bagrus bayad	88	2.27
Distichodontidae		
Distichodus rostratus	9	0.23
Schilbeidae		
Schilbe mystus	29	0.74
Osteoglossidae		
Heterotis niloticus	76	1.93
Malapteruridae		
Malapterurus electricus	8	0.3
Polypteridae		
Polypterus senegalus	2	0.05
Channidae		
Parachanna obscura	8	0.2
Gymnarchidae		
Gymnarchus niloticus	4	0.1
Total	**3942**	**100**

Conclusion and Recommendation

River Yauri recorded 26 fish species belonging to 16 families with Mormyridae and Alestidae being the most diverse. Fish diversity of the river is high compared with other water bodies within the region. There were differences in fish species richness and evenness at the sampling sites. Physico-chemical parameters of the river

Table 2: Fish composition (%) by number at the sampling sites on River Yauri, Kebbi State, Nigeria (April, 2016 - September, 2016)

Family/Fish	Bakin Ruwa		Yelwa		Kangiwa		Zamare	
	No.	%	No.	%	No.	%	No.	%
Citharinus citharus	38	10.6	100	7.76	5	0.71	196	11
Sarotherodon galilaeus	38	10.6	85	6.59	70	9.94	128	7.2
Oreochromis niloticus	102	28.4	120	9.31	100	14.2	292	16
Heterobranchus bidorsalis	10	2.79	68	5.27	39	5.54	71	4
Auchenoglanis occidentalis	3	0.84	47	3.65	47	6.68	58	3.2
Lates niloticus	1	0.28	25	1.94	18	2.56	35	2
Hyperopisus bebe	8	2.23	80	6.21	13	1.85	100	5.6
Marcusenius senegalensis	-	-	50	3.88	47	6.68	55	3.1
Labeo senegalensis	4	1.11	98	7.60	68	9.66	106	5.9
Hydrocynus forskalii	18	5.01	10	0.77	10	1.42	15	0.8
Mormyrus rume	45	12.5	120	9.31	81	11.5	188	11
Mormyrops anguilloides	15	4.18	79	6.13	42	5.97	99	5.5
Synodontis gambiensis	10	2.79	45	3.49	13	1.85	41	2.3
Labeo coubie	13	3.62	73	5.66	23	3.27	85	4.8
Chrysichthys auratus	5	1.39	3	0.33	9	1.28	5	0.3
Synodontis membranaceus	31	8.64	186	14.43	97	13.8	190	11
Bagrus bayad	5	1.39	32	2.48	16	2.27	35	2
Distichodus rostratus	-	-	4	0.41	1	0.14	4	0.2
Schilbe mystus	-	-	10	0.77	-	-	19	1.1
Brycinus nurse	3	0.84	15	1.22	-	-	20	1.1
Heterotis niloticus	10	2.79	28	1.94	5	0.71	33	1.8
Malapterurus electricus	-	-	3	0.23	-	-	5	0.3
Polypterus senegalus	-	-	1	0.08	-	-	1	0.1
Parachanna obscura`	-	-	3	0.23	-	-	5	0.3
Gymnarchus niloticus	-	-	4	0.31	-	-	-	-
Total	**359**	**100**	**1289**	**100**	**704**	**100**	**1590**	**100**

Table 3: Fish diversity indices at various sampling sites on River Yauri, Kebbi State, Nigeria (April, 2016 - September, 2016)

Diversity indices	Bakin Ruwa	Yelwa	Kangiwa	Zamare
Number of species	359	1289	704	1786
Fish taxa	18	25	19	24
Simpson"s (1-D)	0.86	0.93	0.91	0.92
Mergalef Index (M)	2.89	3.35	2.75	3.07
Shannon Wiener Index (H)	2.36	2.78	2.58	2.7
Evenness Index (E)	0.59	0.7	0.69	0.62

Table 4: Mean physico – chemical parameters of River Yauri, Kebbi State, Nigeria (April, 2016 - September, 2016)

Parameter	Mean±SD	Min – Max
Temperature (^oC)	30.56±1.34	28.00-32.00
DO_2	4.03±0.99	2.24-5.85
pH	6.78±0.20	6.30-7.00
Electrical Conductivity (µS/cm)	60.81±12.05	45.00-91.00
Total Alkalinity (mg/l)	101.56±43.04	50.00-200.00
NO_3 (mg/l)	5.12±1.10	2.36-7.36
PO_4 (mg/l)	4.16±1.31	2.44-6.86
Total Dissolved Solids	0.03±0.007	0.024-0.048

Min: Minimum; Max: Maximum; SD: Standard Deviation; DO: Dissolved Oxygen

Table 5: Mean physico-chemical parameters of sampling sites in River Yauri, Kebbi State, Nigeria (April, 2016 - September, 2016)

Parameter	Bakin Ruwa	Yelwa	Kangiwa	Zamare
Temperature (^oC)	30.88±1.55	30.50±1.51	29.88±1.13	31.00±1.07
DO	4.36±0.93	3.67±0.59	3.27±1.01	4.82±0.72
pH	6.76±0.10	6.85±0.18	6.75±0.33	6.75±0.17
Electrical Conductivity (µS/cm)	58.38±7.60	61.25±14.20	61.00±17.23	62.63±8.53
Total Alkalinity (mg/l)	150.00±53.45	81.25±25.88	75.00±26.73	100.00±0.00
NO_3 (mg/l)	4.74±1.13	5.64±0.63	5.29±1.63	4.83±0.63
PO_4 (mg/l)	5.99±0.69	3.83±0.84	3.46±0.98	3.36±0.42
Total Dissolved Solids	0.041±0.007	0.03±0.005	0.03±0.005	0.03±0.002

DO: Dissolved Oxygen

fluctuated, depletion of DO might have affected fish richness at Kangiwa.

It is therefore, recommended that similar study should be carried out ne for dry season, water quality parameters should be monitored on routine basis and assessment of fish catch on routine basis should also be done in order to ascertain any changes that occur in fish diversity.

REFERENCES

Ajayi, S.S. (1971). Panyam fish farm and the introduction of the European carp (*Cyprinus carpio*). *Nigeria Field,* 36:23-31.

APHA(1992). *Standard methods for examination of water and wastewater*, 20th edition, American Public Health Association. Washington D.C.

Balogun, J. K. (1986). Fish Distribution in Kainji Lake, Nigeria. *Journal of Fish Biology*. 29:489- 498.

Balogun, J. K. (2005). Fish distribution in a small domestic water supply Reservoir: case study of Kangimi Reservoir,Nigeria. *Journal of Applied Science and Environmental Management.* 9 (1): 93-97.

Dan-kishiya, A.S., Olatunde, A. A. and Balogun, J. K. (2013). Ichthyofaunal composition and Diversity of a tropical water supply reservoir: A case study of Lower Usuma Reservoir in Bwari, Abuja, Nigeria. *American Journal of Research Communication,* 1(9):188-203.

FAO(2013).The state of world fisheries and aquaculturewww.fao.org/fi/glossary/default.asp.retrieved.on (24 May, 2013).

Hughes, R. H. And Hughes, J. S. (1991). Directory of African wetlands, IUCN, Switzerland Publication *on Argungu Fishes and Festival, Kebbi State*, Nigeria.

Ibrahim, B.U., Auta, J. A. and Balogun, J. K. (2010). Survey of the fish diversity of Kotangora Reservoir, Niger State,

Nigeria. *Nigeria Journal of Fisheries Science and Technology* 1(1): 77 – 81.

Idodo-Umeh, G. (2003). *Freshwater fishes of Nigeria (Taxonomy, Ecological Notes, Diet and Utilization).* Idodo-umeh publisher limited, Benin City, Nigeria. 232pp.

Karr, J. R., Fausch, K. D., Angermeier, P. L., Yant, P. R. and Schlosser, I. J. (1986). Assessing Biological Integrity in running waters: A method and its rationale. *Illinois Natural History Survey Special Publication 5,* 125pp. Champaign.

Lind, O. T. (1979). *A handbook on limnological methods*. C.V. Mosby Co. St. Louis \publishers, 199pp.

Ufodike, E. B. C. and Garba, A. J. (1992). Seasonal variations in limnology and productivity of a tropical highland fish pond in Jos, Plateau, Nigeria. *Journal Aquatic Science* 7:29-34.

Ugwu, A. I. and Wakawa, R. J.(2010). A study of seasonal physico – chemical parameters in River Usuma. *America Journal of Environmental Science,*8 (5): 569 – 576.

Pielou, E. C. (1966). The measurement of diversity in different types of biological collections. *Journal of Theoretical Biology,* 13: 131 – 144.

Prein, M. and Ahmed, M. (2000).Integration of Aquaculture into Smallholder Farming Systems for Improved Food Security and Household Nutrition. *Food and Nutrition Bulletin* 21(4):466 - 471.

Shannon, C. E. and Weaver, W. (1949). The mathematical theory of communication. University of Illinois Press, Urbana 45 – 47.