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Post-dredging fish species composition and relative abundance of kubanni reservoir Zaria, Kaduna state Nigeria

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Abstract
A survey of fish species composition and relative abundance of Kubanni reservoir was conducted from February 2017 to January 2018 after dredging. 2009 fish, comprising fourteen species belonging to 7 families were caught using an experimental gill net. Family Cichlid has the highest abundance rate of 1091 followed by Latidae with 382. *Oreochromis niloticus* dominated the catches with 918(45.69%) followed by *Lates niloticus* with 382 (19.01). The fish family Cichlid was found to be dominant in all the habitats during the sampling period, followed by Latidae and Schilbeidae. Gillnet with the smaller mesh size has the highest number of catch. The result of fish species composition and relative abundance after dredging shows no significant difference to what was reported before dredging, which could be due to short time exposure of the fish to the effect of the dredging.

Keywords: Species composition, relative abundance, habitat degradation, mesh size and dredging

Introduction
Fish species diversity simply means the measure of fish species relative abundance or richness of an aquatic system, which is one of the most important aspects of fish community, organization and structure [1]. Fish species richness and relative abundance describe basic elements of fish biodiversity [2]. It is currently recognized worldwide shows 25,000 species, of which 10,000 are found to be freshwater species [3]. Fish exhibits the greatest biodiversity among the vertebrates with approximately 25,000 species [4]. In Africa, fish species diversities were observed by several researchers [4-5].
According to Dudgeon *et al*. [6], factors that can pose threats to the global freshwater biodiversity, are overexploitation, water pollution, flow modification, destruction or degradation of habitat, and introduction of alien species. Dredging activities causes an environmental impact at disposal sites [7], habitat degradation is the one of major cause of extinction. Biodiversity loss said be common or more in freshwater habitats due to anthropogenic activities [8], ABU Implementation Committee on Protection of Environment in the Kubanni Dam Drainage Basin suggested in the long term, to reduce the rate of erosion in the drainage basin through reforestation, dredging the reservoir and construction of sediment traps on the headwaters of the reservoir. Dredging activity is an invasive process that can influence fish species and their habitats both directly and indirectly [10], the legacy of contaminants from past dredging remain, meaning we may still see the impact of previous land uses on our water bodies in future [11]. For sustainability of these resources and adequate knowledge of species composition and relative abundance of these water bodies must be understood [12]. The freshwater fish species represents 24% of the global vertebrate diversity with over 10,000 valid species currently [13]. The objective of this study is to assess the post dredging fish species composition and relative abundance in Kubanni Reservoir after dredging.

Materials and Methods
Study area
Kubanni Lake, also called Ahmadu Bello University Reservoir, was constructed on river Kubanni in 1972. The Reservoir catchment's area is 57km^2 (22 square miles), its width is 122 meters (400 feet), mean depth is (20 feet. The Reservoir is located approximately within latitude

11^{o} 11'N and longitude 7^{o} 38'E in Samara Zaria, Kaduna State (Figure 1) is located within the premises of Ahmadu Bello University, main campus. The lake's two tributaries are the Kampagi and Samaru streams.

Experimental Set-Up/Design

A fleet of gill nets consisting of nine monofilament nets of 210d/1" (2.5cm), 210d/1.5" (3.75cm), 210d/2" (5.0cm), 210d/3" (7.5cm), 210d/3.5" (8.75cm), 210d/4" (10.0cm), 210d/5" (12.5cm), 210d/6" (15.0cm), and 210d/7" (17.5cm) with 210/3 twine used for the first eight meshes and 210/6 for the 17.5cm stretched meshes were used across the length of the water body. Each net measured 30m long and 3m deep and formed a curtain of netting hanging vertically in the water, with floats attached to the top and sinkers fixed to the bottom to keep the net in its position. The gill nets were set in the evening between 5.00pm and 6.00pm and lifted the following morning between 7.00am and 9.00am for all the habitats (Shore, Surface and Bottom) of each station.

Relative Abundance

The relative abundance was calculated as follows:

$$\text{Relative abundance} = \frac{frequency\ of\ species\ x\ 100}{frequency\ of\ all\ species} \quad (14)$$

Data Analyses

Data on seasonal variation (dry and raining season) were analyzed using T-test, fish abundance were subjected to one way analysis of variance (ANOVA) and DMRT was used to separate means where differences exist.

Results

Relative abundance and weight of fish in Kubanni Reservoir

A total of 2009 fish individuals weighing 122019.8g were recorded in the Reservoir as presented in Table 1 The family Cichlidae has the highest number of individuals and weight followed by Latidae both in number and weight while Cyprindae recorded least number of individuals and weight. *Oreochromis niloticus* recorded the highest number (45.69%) of individuals and weight (41.88%) followed by *Lates niloticus* in number (19.01%) and weight (33.75%) and the least abundant was *Labeo senegalensis* both in number and weight.

Table 1: Relative abundance and weight of fish in Kubanni Reservoir from February 2017-January 2018

Families/Species	No.	(RA)	Weight (gm)	(RA)
Chichlidae				
Tilapia zillii (Gervais,1848)	147	(7.3)	5555.4	(4.55)
Oreochromis niloticus (Linnaeus,1758)	918	(45.69)	51105.3	(41.88)
Hemichromis bimaculatus (Gill,1862)	26	(1.29)	554	(0.45)
Mormyridae				
Marcusenius ihuysi (Steindachner,1870)	107	(5.33)	2348.3	(1.92)
Pollymrus petricolus (Daget,1954)	19	(0.95)	462.8	(0.37)
Marcusenius senegalensis (Steindachner,1870)	3	(0.14)	104	(0.08)
Clariidae				
Clarias galmaensis (Aken'ova,2007)	57	(2.84)	2931	(2.40)
Clarias gariepinus (Burchell,1822)	16	(0.77)	3195.9	(2.62)
Clarias anguillaris (Linnaeus,1758)	19	(0.95)	3244g	(2.65)
Alestidae				
Alestes nurse (Ruppell,1832)	5	(0.25)	105.2	(0.09)
Cyprindae				
Labeo senegalensis (Valenciennes,1842)	2	(0.49)	70	(0.06)
Schilbeidae				
Schilbe mystus (Linnaeus,1758)	299	(14.88)	11047.6	(9.05)
Eutropius niloticus (Ruppell,1829)	9	(0.45)	111	(0.91)
Latidae				
Lates niloticus (Linnaeus,1758)	382	(19.01)	41185.3	(33.75)
Total	2009	(100)	122019.8	(100)

***Source*:** Fish base

Fish distribution in the shore, surface and bottom habitats of Kubanni Reservoir

A total 655 fish were recorded in the shore, 986 fish recorded in the surface and 368 fish recorded in the bottom habitat of Kubanni Reservoir (Table 2). *Oreochromis niloticus* has the highest percentage number of fish species in the shore (65.34%) and surface (43.91%) while *Marcusenius ihysi* has the highest percentage in the bottom habitat (27.45%) of the Reservoir,

it was followed by *Tilapia zilli* in the shore (18.10%) and *Schlibe mystus* in the surface (28.20%) and *Lates niloticus* in the bottom (25.54%), the least percentage in the shore was recorded by *Clarias anguillaris* (0.15%), in the surface the least percentage of (0.91%) were recorded by *Eutroplus niloticus* while in the bottom *Labeo senegalensis* has the least percentage of (0.54%). *Marcusenius ihysi*, *Pollymrus petricolus*, *Marcusenius senegalensis*, *Clarias gariepinus*, *Alestes nurse*, *Labeo senegalensis*, *schlibe mystus* and *Eutropius niloticus* were not recorded in the shore. *Hemichromis bimaculatus*, *Tilapia zilli*, *Pollymrus petricolus*, *Marcusenius senegalensis*, *Clarias galmaensis*, *Clarias gariepinus*, *Clarias anguillaris*, *Alestes nurse*, *Labeo senegalensis* were absent in the surface while *Tilapia zillii*, *Hemichromis bimaculatus*, *Eutroplus niloticus* were also absent in the bottom habitat.

Table 2: Fish distribution in shore, surface and bottom of Kubanni Reservoir from February 2017 – January 2018

Families/Species	Shore No.(RA)	Surface No.(RA)	Bottom No.(RA)	Total	Diversity
Chichlidae					
Tilapia zilli	147 (22.44)	0 (0.00)	0 (0.00)	147	0.693
Oreochromis niloticus	428 (65.34)	433 (43.91)	79 (21.47)	942	1.154
Hemichromis bimaculatus	20 (3.05)	0 (0.00)	0 (0.00)	20	0.693
Mormyridae					
Marcusenius ihysi	0 (0.00)	13 (1.32)	101 (27.45)	114	0.871
Pollymrus petricolus	0 (0.00)	0 (0.00)	13 (3.53)	13	0.693
Marcusenius senegalensis	0 (0.00)	0 (0.00)	3 (0.82)	3	0.693
Clariidae					
Clarias galmaensis	24 (3.66)	0 (0.00)	33 (8.97)	57	1.033
Clarias gariepinus	0 (0.00)	0 (0.00)	15 (4.08)	15	0.693
Clarias anguillaris	1 (0.15)	0 (0.00)	19 (5.16)	20	0.792
Alestidae					
Alestes nurse	0 (0.00)	0 (0.00)	5 (1.36)	5	0.693
Cyprindae					
Labeo senegalensis	0 (0.00)	0 (0.00)	2 (0.54)	2	0.693
Schilbeidae					
Schilbe mystus	0 (0.00)	278 (28.20)	4 (1.09)	282	0.730
Eutropius niloticus	0 (0.00)	9 (0.91)	0 (0.00)	9	0.693
Latidae					
Lates niloticus	35 (5.34)	253 (25.66)	94 (25.54)	382	1.112
Total	655	986	368	2009	1.206

Key: RA -Relative Abundance

Abundance of fish catches by different gill net mesh sizes in the shore, surface and bottom habitats of Kubanni Reservoir

The percentage number of fish caught by different gill net mesh sizes in the shore, surface and bottom habitats of Kubanni Reservoir from February 2017 to January 2018 is shown in Table 3 Gill net of mesh size 2"inch caught the highest number of fish followed by the gill net mesh size of 2.5"inch and the least number of fish was caught by gill net mesh size of 6"ínch while 7" and 8"inch mesh size caught non during the period of research.

Table 3: Abundance of fish catches by different gill net mesh sizes in Kubanni Reservoir from February 2017- January 2018

Species/ mesh sizes	1''	1.5''	2''	2.5''	3''	3.5''	4''	5''	6''	7''	8''	No	%
Tilapia zilli	8	1	45	29	23	18	16	7	00	00	00	147	7.3
Oreochromis niloticus	118	206	189	151	73	103	38	40	00	00	00	918	45.69
Hemichroms bimaculatus	00	19	7	00	00	00	00	00	00	00	00	26	1.29
Marcusenius ihysi	00	58	41	8	00	00	00	00	00	00	00	107	5.32
Pollymrus petricolus	00	19	00	00	00	00	00	00	00	00	00	19	0.95
Marcusenius senegalensis	00	00	3	00	00	00	00	00	00	00	00	3	0.15
Clarias galmaensis	00	20	26	11	00	00	00	00	00	00	00	57	2.84
Clarias gariepinus	00	00	00	3	5	6	2	00	00	00	00	16	0.78
Clarias anguillaris	00	00	3	2	00	10	1	3	00	00	00	19	0.95
Alestes nurse	5	00	00	00	00	00	00	00	00	00	00	5	0.25
Labeo senegalensis	00	00	2	00o	00	00	00	00	00	00	00	2	0.09
Schilbe mystus	53	178	29	21	18	00	00	00	00	00	00	299	14.8
Eutroplus niloticus	00	5	4	00	00	00	00	00	00	00	00	9	0.45
Lates niloticus	00	20	187	52	46	25	49	3	00	00	00	382	19.0
Total	181	526	536	277	168	162	106	53	00	00	00	2009	100

Key: %-percentage of fish caught, "-inch

Depth of the reservoir before and after dredging

Figure 1 show that there was a decrease in the depth of the reservoir from 6m in 1972 to 5.15m in 1997 before the dredging activity while after dredging there was an increase in the depth from 5.15m to 5.75m in 2015 and 5.73m in 2017

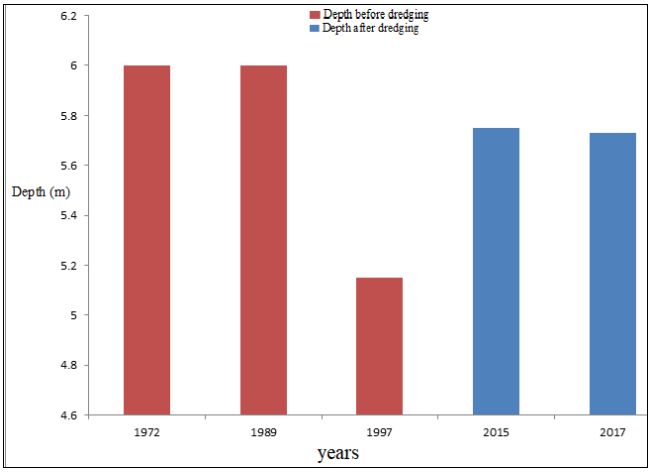

Fig1: Graph showing the depth before and after dredging

Discussion

The study on fish species composition and relative abundance of Kubanni Reservoir from February 2017 to January 2018 revealed fourteen [14] species belonging to seven [7] families were recorded in the experimental gill net sampling. The result obtained shows that there was no significant difference to the unpublished report by [15] and [14] who reported eight [8] families and 14 species (Cichlidae, Latidae, Schilbeidae, Cyprinidae, Mormyridae, Alestidae, Clariidae, Bagridae). In Kubanni Reservoir prior to the dredging activities which indicated that only family Bagridae, was missing in the present studies. Amah [16] carried out a survey on four families, reported a total of 10 species belonging to (Alestidae, Cichlidae, Cyprindae and Mormyridae) families, which indicate that there is a decrease in the number of the species belonging to Mormyridae family when compared to the ones obtained from the present report. The reason for the difference might be attributed to the exposure of the fish species to the effects of dredging and post dredging activities. This agrees with the findings of several authors (Anzecc [17]; Armcanz [18-19-20-21] who reported that risk of detrimental impacts is dependent on exposure characteristics in particular intensity and duration and on the tolerance thresholds to the various stressors for the fish species of concern. It could also be that the missing species were either not susceptible or vulnerable to the gears used or have disappeared and it could be attributed to open access nature of the fisheries resources, coupled with the use of smaller mesh size gears by fishermen who were desperate to increase their catch rate and it may also be attributed to individual family and species response to effect of destruction or degradation of habitat caused by dredging activity. This is in line with the finding of Dudgeon *et al.* [6] that factors pose threats to the global freshwater biodiversity, are overexploitation, water pollution, flow modification, destruction or degradation of habitat, and introduction of alien species. Result from this present study indicates low fish species diversity which corresponds to the report of Dan-Kishiya *et al.* [1] in a similar small water body, who reported low diversity of fish species in Lower Usuma Dam, Bwari, Abuja with eleven [11] species belonging to five [5], Nazeef *et al.* [22] reported 10 species belonging to 9 families in Challawa Gorge Dam while eight [8] species were recorded in Egbe Reservoir [23]. The family Cichlidae was found to be dominant in all habitats, seasons during the sampling period in Kubanni Reservoir, followed by Latidae and Schlibeidae respectively, The high abundance rate of Cichlidae in this study might be due to their wide acceptability to range of food source and high reproductive rate, this agreed with the report of Ayamre and Ekelemu [24] who reported that dominance of the members of the family Cichlidae might be due to the availability of phytoplankton, diversity of food supplement, prolific and good parental care. The dominance of the members of the family Cichlidae in Kubanni Reservoir, agreed with the report before dredging and to other findings conducted in some of the Nigeria Reservoirs. Balogun and Auta [25] reported that Cichlidae was found to be the most abundant in terms of number and weight in Kangimi, Kaduna; similar studies revealed *Oreochromis niloticus* was the most abundant in Egbe Reservoir [23]. Banyigyi [26] reported that *Oreochromis niloticus* was the most abundant in Doma reservoir. In the studies of fish distribution in Kubanni Reservoir, it has been observed that different fish families and species occupied different habitats. The distribution of fish in different habitat in this study is similar to the one obtained before dredging by Balogun [14]. The distribution might be attributed to different foraging behavior, availability of food sources and season this was in line with the report of several authors [28-29] and [30] who stated that the distribution of fish in freshwater habitats is usually affected by multiple abiotic and biological factors, such as hydrological regime, temperature, food resources, predation and competition. Pavlov and Mochek, [31] also reported that the distribution was never static and involves continuous movements, drift and migrations at various scales which change over time (e.g., seasonally) and during the diurnal cycle. The families Cichidae and Latidae were found in almost all the habitats, this could be due to their wide acceptability of different food source, and this is in line with the report of Ayamre and Ekelemu [24]. The highest number of fish catch was observed with gillnets of smaller mesh sizes, this is in line with the findings of Oyewo [32]; this could be attributed to the fishing pressure on the available fish species. The depth obtained from this study reveals that there was an increase in the depth of the reservoir from 5.15m reported by Kwande [33] to 5.73m. This was in line with the findings of Eze *et al.* [9] who recorded an increase in the average depth of the reservoir from 2.65m as reported by ABU Implementation Committee [34] before the dredging to 3.151m in 2015 after dredging. The result obtained in this study indicates that there was an increase depth of about 10% from the depth reported in 1997 before dredging.

Conclusion and Recommendation

The current fish species composition and relative abundance

of Kubanni reservoir shows that there was no significant difference from what was obtained in this present study and that before dredging. It is important to restock the reservoir with fingerlings of indigenous species to enhance its productivity because of the low production. This present study revealed that majority of the fish caught were small which is evident in the fishers' catches. This is attributed to the mesh sizes below 3 inches (76.2 mm) used by most fishers that are against the recommended size for inland water bodies. A minimum mesh size of 3 inches (76.2 mm) has been recommended for gill net fishing. This should therefore be enforced to allow effective growth of all the fish species before exploitation. There was an increased in depth of the reservoir after the dredging activity.

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