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ZOOLOGY | RESEARCH ARTICLE

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Biodiversity of fishes of Tagwai reservoir, Minna, Niger state, Nigeria

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Abstract: The biodiversity of the fishes of Tagwai Reservoir, Minna, Niger State, Nigeria was conducted for a duration of four months (January-April 2018). A set of experimental gill nets comprising nine multifilament nets of stretched meshes 25.4 mm, 38.1,50.8, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8 mm were used to sample the shore, surface and bottom water habitats of the reservoir. Seven species of fish belonging to five families were recorded. The most dominant fish family by number was Cichlidae, with two species *Tilapia zillii* (17.95 ± 4.43) and *Chromidotilapia guntheri guntheri* (4.91 ± 1.47) followed by Characidae with species *Alestes macrolopidotus* (2.11 ± 0.45), Mochokidae family with *Synodontis vermiculatus* (1.63 ± 0.27), Claridae with two species *Clarias anguillarias* (0.60 ± 0.11) and *Clarias albopunctatus* (0.75 ± 0.25), and, Family Hepsetidae with species *Hepsetus odoe* (1.16 ± 0.30). Bottom water habitat shows the presence of all the fish families with their species, while the shore and surface water habitat harbour species *Tilapia zilli* and *Chromidotilapia guntheri guntheri* of family Cichlidae, *Synodontis vermiculatus* of family Mochokidae and *Alestes macrolopidotus* of family Characidae. The study revealed that species *Hepsetus odoe* of family Hepsetidae, and species *Clarias anguillarias* and *Clarias albopunctatus* of family Claridae were only present in the bottom water habitat of Tagwai reservoir. Kwata Bello sampling station recorded the highest population (15.18 ± 1.56) of fish catch during the sampling period, while the least catch of fish population (3.18 ± 0.32) was recorded at Kwata Birgi sampling station. The family Cichlidae with population (22.86 ± 2.86) has the highest distribution in the reservoir. This indicates that Tagwai reservoir has therefore become unique compared to most other tropical man-made lakes and reservoirs in Africa, where Cichlids dominate the fishery soon after impoundment.

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PUBLIC INTEREST STATEMENT

The biodiversity of the fishes of Tagwai Reservoir, Minna, Niger State, Nigeria was conducted for a duration of four months (January–April 2018). A set of experimental gill nets comprising nine multifilament nets of stretched meshes 25.4 mm, 38.1,50.8, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8 mm were used to sample the shore, surface and bottom water habitats of the reservoir. Seven species of fish belonging to five families were recorded. The most dominant fish family by number was Cichlidae, with two species *Tilapia zillii*. Family Cichlid can be cultivated easily within family pond or backyard pond in the house. White meat from these fishes are better for vegetarian than red meat from other sources such as goat, cow and sheep.

Subjects: Environment & Agriculture; Bioscience; Food Science & Technology

Keywords: Tagwai reservoir; Niger State; fish; biodiversity; Cichlidae; Claridae; Tillapia zillii; Chromidotilapia gunteri gunteri; Alestes macrolopidotus; Synodontis vermicularis

1. Introduction

The diversity of fish species in any waterbody is attributed to favourable condition, and fish populations respond to factors such as fishing, pollution and eutrophication among others, which can bring about series of changes in size, species composition and abundance in the aquatic environment (Welcomme, 1999). Generally, aquatic conservation strategies should be able to sustain development, by protecting biological resources in ways that will preserve habitat and ecosystem. Therefore, in order for biodiversity conservation to be effective, management measures must be broad-based. Aquatic diversity management as proposed by Moyle and Yoshiyama (1994) are a systematic management approach for lakes and watersheds, where the primary goal is to protect the aquatic biodiversity in a given area. The best way to properly manage a reservoir is to stop or greatly reduce all human activities contributing to habitat degradation in that area.

According to Vakily, Froese, Palomares, Lourdes, and Daniel (1997) two conventions were signed at Rio de Janeiro on International Trade in Endangered Species (CITES), one dealing with biodiversity and the other on the climatic changes. In Nigeria Rivers, Ita (1993) reported an estimated total of 230 fish species. Olaosebikan and Raji (2003) listed more than 268 fish species from 35 families in Nigeria freshwater bodies. The biodiversity of Africa fishery resources has been reported to be dominated by otophysans (Cyprinidis, Characiforms and a few catfish families), along with Mormyrids and Cypridontiformes, while lacustrines are completely dominated by Cichlid species (Lundberg et al., 2000). Stiassny (1996), reported that 58% of the fishes are marine, 41% freshwater, while only 1% migrates between salt and freshwater. The aim of the present study is to determine the prevailing condition as well as validate the biodiversity of the fish community in Tagwai reservoir, Niger State, Nigeria.

2. Materials and method

2.1. Area of study

The study was carried out at Tagwai Reservoir, Minna, Niger State, Nigeria. Tagwai reservoir has a total surface area of 44 hectares and storage capacity of 28.3 million m^3 of water. It has a depth of 25 m and a length of 18 Km. The reservoir was constructed in 1980 on longitude 60° 39' to 60° 44' East, and latitude 34° to 90° 39' North to South-West of Minna.

2.2. Survey of the fishes

The survey of the fishes in Tagwai reservoir took place at three sampling stations: I (Kwata Bello), II (Kwata Birgi) and III (Hanyin Danladi), by employing experimental gill net fish sampling (see Figure 1). The duration of the survey covers four months and data collected monthly.

2.3. Experimental gill net fish sampling

A set of experimental gill net made up of nine multifilament nets of 25.4 mm, 38.1, 50.8, 63.5, 76.2, 88.9, 101.6, 127.0, and 177.8 mm stretched meshes were used to sample the shore, surface and bottom water habitats. Each net measured 30 m long and 3 m deep with 210/3 twine for the first seven and 210/6 for the last two meshes. The nets were set daily at 5 p.m. and checked at 8 a.m. the next day. The fish caught in each net were removed and placed in labelled plastic bowls. There were separate bowls for each net. Each fish was weighed and measured for standard length and total length (cm), as described by Balogun and Auta (2001).

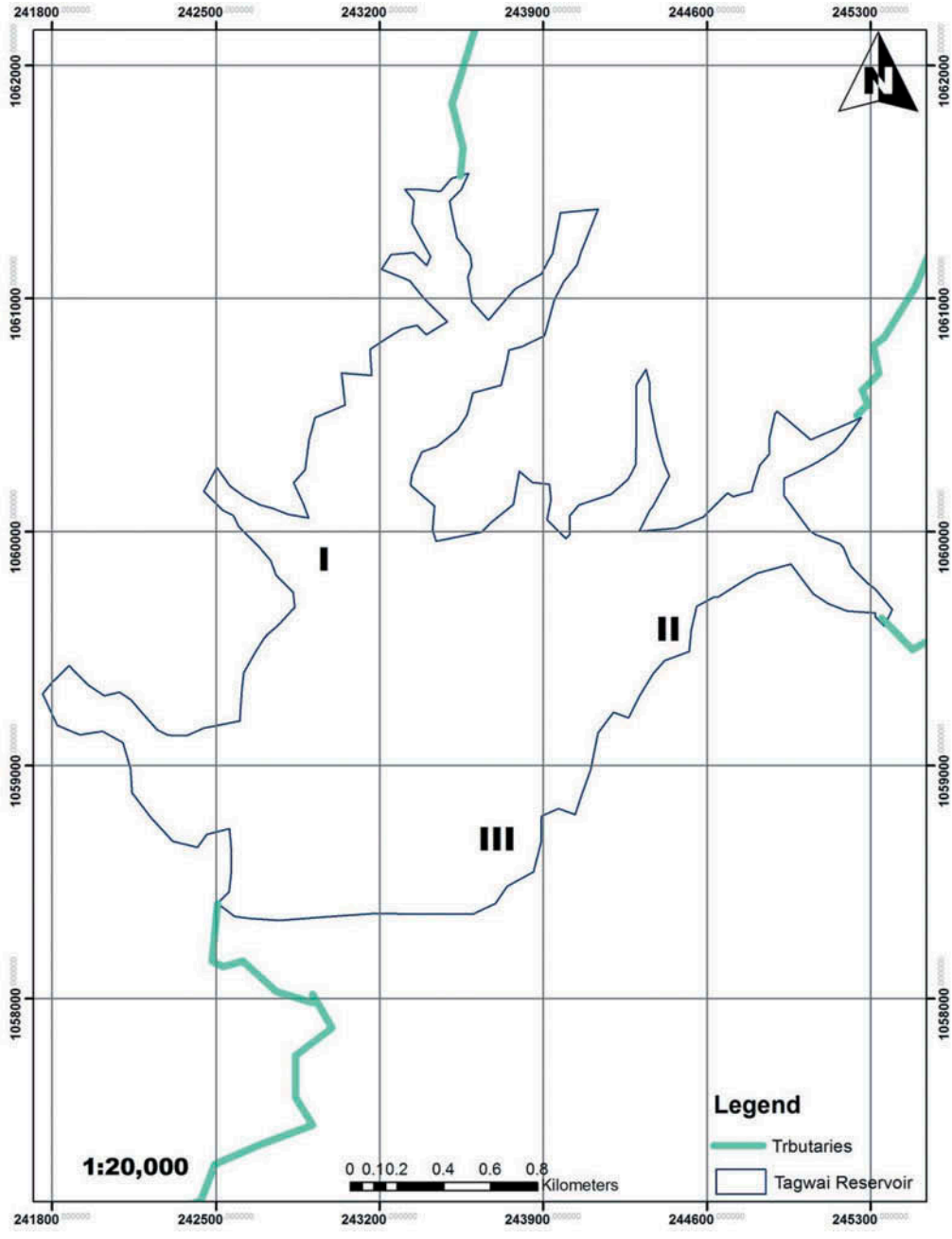

Figure 1. Map of Tagwai Reservoir showing the three sampling stations I, II and III during the study period.

Source: Niger State Water Board, Minna, Nigeria

2.4. Fish measurement

The total length and standard length of the fishes were measured using a measuring board in centimetre. The fresh weight of the fishes were obtained using a spring and weighing balance on the field.

2.5. Fish identification

In the laboratory, each fish was identified up to species level. The identification was done with the aid of relevant reference materials according to Reed, Burchard, Hopson, Jenness, and Ibrahim (1967).

2.6. Statistical analysis

Descriptive statistics was used to calculate means and standard deviation of means. Analysis of variance (ANOVA) was used to test for significant differences in fish abundance (Mahajan, 1997).

3. Results

3.1. Experimental gill net sampling

Table 1 shows the relative distribution by the number of fish families/species in the shore, surface and bottom water habitats of the reservoir. Five families were recorded during the sampling period. Family Cichlidae dominate by number in all the three water habitats, followed by family Hepsetidae, Mockokidae, Claridae and the least number of catch recorded by family Characidae. In terms of species, nine species were recorded belonging to five families, *Tilapia zillii* species recorded the highest catch in the surface habitat (8.52), followed by species *Chromidotilapia guntheri guntheri* in the shore habitat (2.83) of the reservoir. The least catch was recorded by species *Hepsetus odoe* in the bottom habitat (0.07) of the reservoir. *Tilapia zilli* and *Chromidotilapia guntheri guntheri* of the family Cichlidae was the highest at the three habitats (shore, surface and bottom), while *Hepsetus odoe, Clarias anguillarias* and *Clarias albopunctatus* were absent at both the shore and the surface habitats, and present only at the bottom habitat. In terms of diversity, family Cichlidae and family Claridae had two different species each. While others had only one species of fish.

Table 2 shows relative mean distribution by weight (Kg.) of fish families/species in the shore, surfaces, and bottom water habitat of Tagwai reservoir May-August 2014. Nine species belonging to five different families were recorded during the sampling period. *Tilapia zillii* and *Chromidotilapia guntheri guntheri* of the family Cichlidae has the highest weight of the total catch, followed by *Alestes macrolopidotus*, with *Synodontis vermiculatus* being the lowest. The highest catch by weight was recorded by *Tilapia zillii* (138.69) in the bottom habitat of Tagwai reservoir. In the three habitats, *Synodontis vermilatus* had the lowest weight at the surface (12.47) and shore (8.31), while *Hepsetus odoe* of the family Hepsetidae recorded the lowest weight (6.38) at the bottom of the reservoir.

Table 3 shows the mean distribution by number in the three sampling stations I (Kwata Bello), II (Kwata Birgi) and III (Hanyin Danladi). *Tilapia zillii* of family Cichlidae recorded the highest number (8.62) at Hanyin Danladi sampling station. The least number of fish was recorded at the sampling station Kwata Birgi by *Hepsetus odoe* of family Hepsetidae (0.06), and *Alestes macrolopidotus* of family Characidae (0.06).

Table 1. Relative mean distribution by number of fish families/species in the shore, surface and bottom water habitats of Tagwai Reservoir, Minna, Niger State. Nigeria (January–April 2018)

		MEAN NUMBER OF SPECIES		
FAMILIES	**SPECIES**	**SHORE**	**SURFACE**	**BOTTOM**
CICHLIDAE	*Tilapia zillii*	(8.44 ± 5.67)	(8.52 ± 5.32)	(6.53 ± 5.23)
	Chromidotilapia guntheri guntheri	(2. 83 ± 1.63)	(2.76 ± 1.57)	(2.63 ± 1.32)
HEPSETIDAE	*Hepsetus odoe*	(0.00)	(0.00)	(0.07 ± 0.02)
CLARIDAE	*Clarias anguillaris*	(0.00)	(0.00)	(0.58 ± 0.14)
	Clarias albopunctatus	(0.00)	(0.00)	(0.32 ± 0.12)
MOCHOKIDAE	*Synodontis vermiculatus*	(0.50 ± 0.23)	(0.75 ± 0.36)	(0.52 ± 0.42)
CHARACIDAE	*Alestes macrolopidotus*	(0.11 ± 0.06)	(1.88 ± 1.23)	(0.22 ± 0.08)

Table 2. Relative mean distribution by weight of fish families/species in the shore, surface and bottom water habitats of Tagwai Reservoir, Minna, Niger State. Nigeria (January–April 2018)

		MEAN WEIGHT OF SPECIES (Kg.)		
FAMILIES	**SPECIES**	**SHORE**	**SURFACE**	**BOTTOM**
CICHLIDAE	*Tilapia zillii*	(129.64 ± 102.12)	(102.32 ± 86.12)	(138.69 ± 121.21)
	Chromidotilapia guntheri guntheri	(118.75 ± 86.12)	(104.22 ± 82.32)	(98.62 ± 85.62)
HEPSETIDAE	*Hepsetus odoe*	(0.00)	(0.00)	(06.38 ± 03.58)
CLARIDAE	*Clarias anguillaris*	(0.00)	(0.00)	(88.00 ± 62.12)
	Clarias albopunctatus	(0.00)	(0.00)	(62.36 ± 46.12)
MOCHOKIDAE	*Synodontis vermiculatus*	(8.31 ± 4.32)	(12.47 ± 6.53)	(10.55 ± 6.83)
CHARACIDAE	*Alestes macrolopidotus*	(58.52 ± 23.12)	(37.72 ± 15.72)	(23.54 ± 12.43)

Table 3. Relative mean distribution by the number of fish families/species in Kwata Bello, Kwata Birgi and Hanyin Danladi sampling stations of Tagwai Reservoir Minna, Niger State. Nigeria (January–April 2018)

		MEAN NUMBER OF SPECIES		
FAMILIES	**SPECIES**	**KWATA BELLO**	**KWATA BIRGI**	**HANYIN DANLADI**
CICHLIDAE	*Tilapia zillii*	(8.56 ± 6.23)	(0.77 ± 0.45)	(8.62 ± 6.62)
	Chromidotilapia guntheri guntheri	(2.32 ± 1.82)	(1.38 ± 1.21)	(1.21 ± 0.82)
HEPSETIDAE	*Hepsetus odoe*	(1.02 ± 0.82)	(0.06 ± 0.04)	(0.08 ± 0.05)
CLARIDAE	*Clarias anguillaris*	(0.28 ± 0.16)	(0.16 ± 0.08)	(0.16 ± 0.08)
	Clarias albopunctatus	(0.32 ± 0.24)	(0.21 ± 0.16)	(0.22 ± 0.18)
MOCHOKIDAE	*Synodontis vermiculatus*	(0.81 ± 0.42)	(0.42 ± 0.21)	(0.40 ± 0.18)
CHARACIDAE	*Alestes macrolopidotus*	(1.87 ± 1.23)	(0.18 ± 0.08)	(0.06 ± 0.03)

Table 4 shows the mean weight distribution of fish species/family at the sampling station in the reservoir during the period of study, *Tilapia zillii* of family Cichlidae record the significantly highest weight (686.56 ± 121.89) at Kwata Birgi sampling station compared to Kwata Bello and Hanyin Danladi sampling stations. This was followed by *Alestes macrolopidotus* of family Characidae (59.60) at Kwata Bello, while the least weight was recorded by *Synodontis vermiculatus* of family Mochokidae (5.18) at Hanyin Danladi Sampling Station.

Table 5 Analysis of variance (ANOVA) showed variation of fish species in the sampling stations, habitats and months for the sampling period May – August, 2014. It showed that there was significant variation among the families/species of fish, Habitats, stations and months. When considering the number of fish, the analysis of variance (ANOVA) (Table 5) showed that the interaction between the species and habitats showed no significant variation ($P > 0.05$) for the sampling period, April – July, 2014. Like wise, the interaction between the species and the stations. The analysis of variance (Table 5), when considering the weight of fish show significant variation ($P < 0.05$) among species, habitats

Table 4. Relative mean distribution by weight of fish families/species in Kwata Bello, Kwata Birgi and Hanyin Danladi sampling stations of Tagwai Reservoir Minna. (January–April 2018)

		MEAN WEIGHTOF SPECIES (Kg.)		
FAMILIES	**SPECIES**	**KWATA BELLO**	**KWATA BIRGI**	**HANYIN DANLADI**
CICHLIDAE	*Tilapia zillii*	(186.26 ± 133.25)	(686.56 ± 121.89)	(66.52 ± 36.25)
	Chromidotilapia guntheri guntheri	122.14 ± 86.23)	(11.10 ± 76.23)	(122.43 ± 92.43)
HEPSETIDAE	*Hepsetus odoe*	(12.52 ± 10.23)	(17.50 ± 12.42)	(7.63 ± 5.23)
CLARIDAE	*Clarias anguillaris*	(34.48 ± 24.28)	(30.42 ± 20.12)	(15.26 ± 10.23)
	Clarias albopunctatus	(20.22 ± 16.26)	(24.21 ± 18.16)	(10.21 ± 8.62)
MOCHOKIDAE	*Synodontis vermiculatus*	(16.50 ± 12.20)	(6.62 ± 4.12)	(5.18 ± 3.10)
CHARACIDAE	*Alestes macrolopidotus*	(59.60 ± 32.40)	(38.20 ± 26.30)	(13.56 ± 10.24)

Table 5. ANOVA showing variations of fish families, fish species in the sampling stations habitats, months for the sampling period January–April 2018.

Sources of variation	Df	Number of fish	Weight of fish
Factors	109	162**	18,623.4**
Family	4	1363**	783,121.4**
Species	6	1582**	38,125.2**
Habitat	2	128*	42,512.6**
Station	2	142*	87,526.4*
Month	3	604*	37,258.3**
Month × family	8	816**	48,522.3**
Month × station	6	92*	18,232.6*
Family × Habitat	7	52^{ns}	34,847.1*
Species × Habitat	9	12^{ns}	16,456.2*
Family × station	7	56^{ns}	4241.4^{ns}
Species × station	9	18^{ns}	2061.2^{ns}
Month × family × Habitat	9	62^{ns}	$11,254.4^{ns}$
Month × species × Habitat	13	5^{ns}	15,286.4*
Month × family × station	11	88*	16,276.0*
Month × species × station	13	22^{ns}	42,425.2**
Error	75	106	18,425.1-

*- Significant $P < 0.05$

**- Highly significant $P < 0.01$

ns- Non-significant $P > 0.05$

station and months, while a non significant variation P > 0.05 existed in the interaction of the species and stations for the sampling period.

4. Discussion

The study of the biodiversity of freshwater fishes of Tagwai reservoir revealed the presence of five families and seven species. This can be compared with other reservoirs such as Kontagora reservoir, where six different fish species belonging to five families were recorded (Ibrahim,

Auta, & Balogun, 2009). Omotosho (1998) reported 21 species of fish from 10 families in Asa Reservoir. The fish families reported are common in most tropical waterbodies of Nigeria. The dominance of family Cichlidae in the different habitats of Tagwai reservoir could be as a result of their feeding habit and high rate of reproduction. Balogun, Balarabe, and Bako (2000) reported the dominance of Cichlidae in the bottom habitat of Zaria Dam. This is in line with the findings of this study. The absence of *Hepsetus odoe, Clarias anguillaris* and *Clarias albopunctatus* in the shore and surface habitat could be due to their feeding habit and life style. Most Catfishes are bottom-dwelling and bottom feeders. The present study also revealed that family Cichlidae recorded the highest weight at the habitats. This agrees with the findings of Adeosun, Omoniyi, Akegbejo—Samson, and Olujimi (2011), who reported the dominant of Cichlidae both in number and weight at Ikere waterbody in Oyo State, Nigeria. Kwata Bello had the highest fish distribution by number. This is due to the fact that it is located at the entry point of the reservoir. The distribution of Cichlidae at Kwata Bello and Hanyin Danladi could be due to their location and availability of food. In addition, *Tilapia zillii* dominated the Cichlid family in Tagwai reservoir. Ibrahim et al. (2009) and Balogun and Auta (2001), reported that *Hemichromis fasciatus* dominated the Cichilids in Kontagora reservoir and Kangimi reservoir. While in Tiga Lake, Bakolori reservoir and Lake Kainji *Sarotherodon galilaeus* and *Oreochromis niloticus* dominated the Cichlids (Balogun, 2005). This could be due to differences in feeding habits, behaviour and populations.

The concentration of the family Cichlidae, Mochokidae and Characidae along the shoreline in this study indicates that the shoreline habitat has been stabilised and is capable of providing enough food, shelter and breeding ground for the littorally inhabiting species, and also they are naturally pelagic species.

There was no significant difference ($P < 0.05$) in the total catch composition of the family Cichlidae and Characidae in the major habitats (shore, surface and bottom). However, in the Hepsetidae, Claridae and Mochokidae, there was a significant difference ($P < 0.05$) among the major habitats, with the highest concentration in the shore and surface water habitat for family Mochokidae, and in the bottom habitat in the family Claridae, while the least catch concentration was recorded by family Hepsetidae in the bottom water habitat.

In conclusion, the present study revealed the presence of five fish families which consist of seven different species, with the family Cichlidae having the highest diversity of two species. The family Cichlidae is of great use as food because of its high protein content, like other fishes such as Claridae. The protein content of Cichlidae is more tolerant in human bodies being white meat than those of red meat from other animal sources such as cow, goat and sheep.

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Competing Interests
The authors declares no competing interests.

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