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Fish species biodiversity of Dadin-Kowa reservoir: Current status

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Abstract

The fish composition of the three study sites of the reservoir were studied over a period of fifteen months (January, 2020 – March, 2021). A total of twenty-eight (28) fish species emanating from fourteen (14) families were obtained. The family Cichlidae was the dominant family with *Oreochromis niloticus* being the most abundant fish species while family Malapteruridae was the least with only 0.088% of the total abundance. Biodiversity indices of the study sites such as species richness ranges from 2.79-3.28, while species evenness ranged between 0.73 to 0.84, and diversity index revealed a range of 2.23-2.65. The Dadin-Kowa Reservoir has a rich ichthyofaunal composition which is facing challenges of structural collapse unless if management strategies are fully adopted. The host communities should be made integral components of aquatic resources management team. And other means of livelihood should be made attractive to reduce pressure on aquatic resources and deter possible biodiversity depressions.

Keywords: Fish composition; *Oreochromis niloticus*; Dadin-Kowa reservoir; Cichlidae; Malapteruridae

1. Introduction

A fish refers to a vertebrate that lives, breath and breed in water [1]. Aquatic ecosystem has been estimated to make up 8-9% of the earth's land surface [2]. This made it an important source of fish because of their species richness and unique biodiversity [3]; this vast uniqueness has make it possible for fish species to serve as important sources of employment [4], leisure [5–7], income and trading opportunity [8].

Fishery sector is the largest and fastest food growing (economy) industry in the world [9,10]. Fisheries and aquaculture serves a source of food and income to about 820 million individuals globally [11]. Small scale fisheries (SSF) and aquaculture provide two thirds of the catches destined for human consumption which account for 90% of employment in the sector (Welcomme, 2019). So therefore human societies face enormous challenge of having to provide food and sources of livelihoods to a population well in excess of nine (9) billion people (FAO, 2019).

The collective production of global protein as reported by [12], indicated that fish contributed significantly 19.86% (marine catches) and 17.77% (aquaculture), while freshwater produces only 2.3% with cichlids (87%) and cyprinids forming the most prominent groups of the inland fishery production [13]. Global fish production peaked at about 171 million tonnes in 2016 with aquaculture representing 47% of the total and 53% of non-food uses (including reduction to fishmeal and fish oil) [11].

The precise number of extant fish species is yet to be determined, however according to [14], there were about 28,900 species globally, though this figure bears considerable doubt as some experts feel that the number may be higher. In

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today's diversity; it is estimated to have 34,300 species globally (www.fishbase.org 2020). This number forms about 51% of the 54,711 living vertebrate species recognized [15].

Inland fisheries including Nigeria for decades has been a driving force of economies of most countries of the world contributing to the country's GDP [16]. Inland fisheries are rooted in socially and culturally complex societies [17]; they play a vital role in the livelihood of people in many parts of the developed and developing world [11,17] including Nigeria. At present, inland fisheries are not often a national or regional governance priority and as a result, inland capture fisheries are undervalued and largely overlooked [2]. There's increasing number of fish catch globally [18] and aquatic ecosystem is subject to and can be altered by a range of ecological stressors [3] which can have an impact on fish population that are subject to natural control processes [19]. And this includes habitat destruction, alterations [20] and uncontrolled exploitation [21]. Freshwater ecosystems represent one of the most threatened broad habitats globally despite containing around a third of all vertebrates [22,23] due to increasing human population, socio-economic development which led to a severe pressure being placed on the freshwater ecosystem globally [23].

Biodiversity is a concept to ecology and its measurements is essential to ecosystem health [24]; due to wide variations of ecosystems in distribution, abundance, dominance and biodiversity levels (Omayio and Mzungu, 2019). In a functional diversity context; richness is understood to increase or enhance community functionality and complexity (increases in productivity) (Daly, Baetens, and Baets 2018; Nazeef, 2017). Species richness in sub-lakes was assumed to be positively associated with water depth and aquatic habitat availability with connectivity; in all which increase in wet season [27]. Besides species richness which receives prominent attention however, evenness is also ecologically important as it portrays been a key factor in preserving functional stability of ecosystem as well as improving productivity by enhancing representation of each species' functional traits or characteristics, contrary however, community's uneven dispersion pattern tend to have less resilience to disturbance and environmental stresses [24,26,28]. A central issue in community ecology is understanding and predicting the structure of species assemblages and their spatio-temporal variations across multiple scales [27].

2. Material and methods

2.1. Study Area

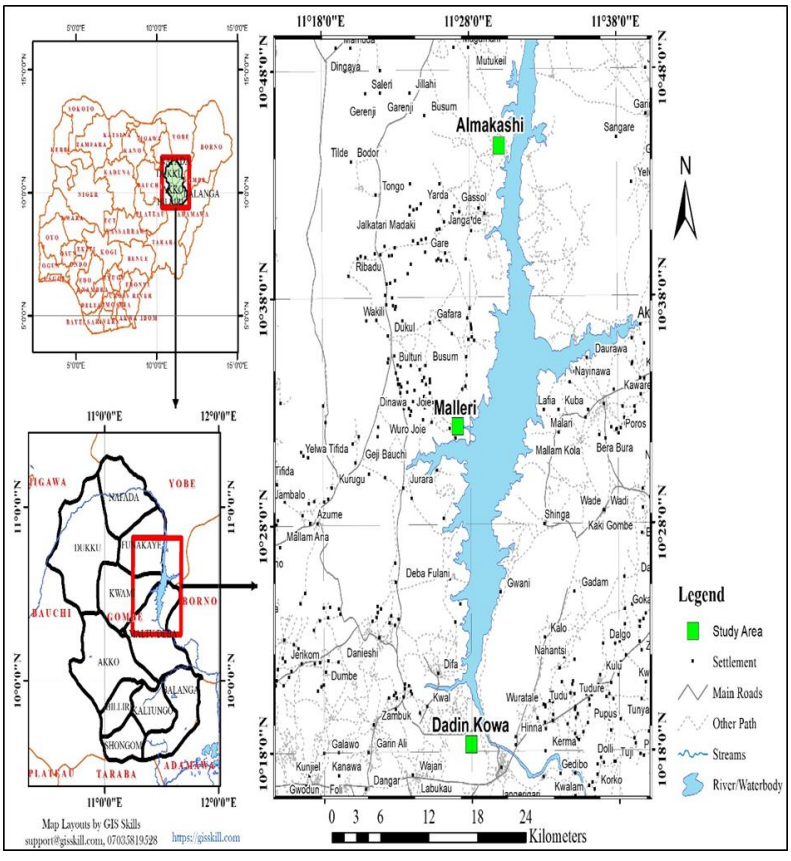

Figure 1 Map of Dadin-Kowa showing study area

The Dadin-Kowa is located in Yamaltu-Deba Local Government area, Gombe State in the north east of Nigeria. Dadin-kowa town is located between Latitudes 10°19′19″N and 10.32194°N; Longitude 11°28′54″E and 11.48167°E. It shares common boundary with Akko Local Government area, to the South and West, Yamaltu-Deba to the East and Kwami to the North. Dadin-kowa has an altitude of about 370 meters above sea level [29].

2.2. Data Collection

Fish samples were collected from three of the four prominent landing sites on a monthly basis for the period of 12 months (January - December, 2020) from artisanal fishermen. The three landing sites were: *Almakashi*: 10°44'40.584''N, 11°30'32.574''E, *Dadin-Kowa*: 10°92'14.142''N, 11°28'43.956''E and *Malleri*: 10°18' 38.539''N, 11°9'13.582''E. The study area has bordered three local government areas of Gombe State each with at least a town having intensive fishing activities, therefore, the aforementioned landing sites were selected reflecting the entire Reservoir coverage, and the local government areas includes Funakaye (Almakashi); Yamaltu-Deba (Dadin-Kowa) and Kwami (Malleri) accordingly.

2.3. Fish Samples Collection and Identification

Fish samples were sampled from the population and their morphometric measurements (Standard length & weight) were measured using a measuring tape and a digital weighing balance (Sartorius) to the nearest 0.1cm and 0.1g respectively, following the methods explained by (Ahmad, *et al*., 2017). Identification of fish samples to the species level was accomplished using identification keys such as Reeds *et al,* (1967), Olaosebikan & Raji (2004) and fishbase.org (identification keys and fish species global glossary).

2.4. Ichthyofauna composition and Diversity

The ichthyofaunal composition of the Reservoir was estimated from the checklist of fishes obtained from identification of monthly samples. Some indices of diversity were used to describe the diversity of the fish communities in the Reservoir as follows:

2.4.1. Margalef's Index (D)

for species richness (Margalef, 1968).

$$D = (S-1)/\ln N \quad \ldots\ldots (1)$$

Where
S = number of species and
N = number of individuals.

2.4.2. The Shannon-Wiener's Index (H')

of species diversity (Shannon & Wiener, 1963);

$$H' = -\Sigma\, Pi \ln Pi \quad \ldots\ldots (2)$$

Where Pi, is the proportion of the total number of individuals occurring in species **i**.

2.4.3. Pielou's Index (J)

for species evenness (Pielou, 1969);

$$J = H'/\ln S \quad \ldots\ldots (3)$$

Where H' is the species diversity index and **S** is the number of species.

Other alpha biodiversity indices such as Dominance_D, Simpson_1-D, Fisher-alpha, Berger-Parker, and Menhinick were assessed employing the *Diversity* option of PAST software (Version 4.03) [30].

3. Results

3.1. Fish Species Identified

A total of twenty-eight (28) fish species were identified from the three study sites (Almakashi, Dadin-Kowa and Malleri) over a twelve months' period (January to December, 2020), is presented on table one. These fish species represent a

total of fourteen (14) families (Table 1). The family Mormyridae had the highest species representation with six fish species (viz *Hyperopisus bebe*, *Hyperopisus bebe occidentalis*, *Mormyrus rume*, *Mormyrus macrophthalmus*, *Marcusenius senegalensis* and *Pollimyrus isidori*). The family Alestidae ranked second with four (4) fish species (which includes *Alestes dentex, Alestes leuciscus, Brycinus nurse* and *Brycinus macrolepidotus*), while family Bagridae (with *Auchenoglanis occidentalis*; *Bagrus bayad macropterus* and *Bagrus docmac*) and family Cichlidae (having *Oreochromis niloticus*; *Sarotherodon galilaeus* and *Tilapia zilli*) co-ranked third in the list with three species each, but family Cyprinidae and Schilbeidae co-ranked fifth with two species each, while *Citharinus citharus; Clarias lazera* and *Synodontis budgetti* singly represented the families Citharinidae, Claridae and Mochokidae.

Table 1 Fish species identified from the three study sites

Family	Fish species	English name	Local name (Hausa)
Alestidae	*Alestes dentex*	Silversides	Saro
	Alestes leuciscus		Kursa
	Brycinus nurse	African tetras	Kawara
	Brycinus macrolepidotus	African tetras	Kakara
Bagridae	*Auchenoglanis occidentalis*	Catfish	Buro
	Bagrus bayad macropterus	Silver catfish	Ragon ruwa/Doza
	Bagrus docmac	Semutundu	Dinko/Musko
Characidae	*Hydrocynus brevis*	Tigerfish	Tsage
Cichlidae	*Oreochromis niloticus*	Tilapia	Karfasa
	Sarotherodon galilaeus	Tilapia	Karfasa
	Tilapia zilli	Tilapia	Gargaza
Citharinidae	*Citharinus citharus*	Moonfish	Faliya
Claridae	*Clarias lazera*	Catfish	Tarwada
Cyprinidae	*Labeo brachypoma*	African carp	Data
	Labeo senegalensis	African carp	Burdo
Distichodontidae	*Paradistichodus dimidiatus*	Grasseater	Dandubi
Malapteruridae	*Malapterurus electricus*	Electric fish	Minjirya
Mochokidae	*Synodontis budgetti*	Wahrindi	Kurungu
Mormyridae	*Hyperopisus bebe*		Kuma
	Hyperopisus bebe occidentalis	Trunkfish	Tola
	Mormyrus rume	Bottlenose	Sawayya
	Mormyrus macrophthalmus	Trunkfish	Miligi
	Marcusenius senegalensis		Kuma mai lebe
	Pollimyrus isidori		Dunguru
Polypteridae	*Erpeitoichthys calabaricus*	Snakefish	Gartsa
Schilbeidae	*Parailia pellucida*	Glassfish	Nama-waje
	Schilbe mystus	Butterfish	Lulu/Balo
Sisoridae	*Glyptothorax exodon*		Yauka-yauka

3.2. Cumulative Percentage of Fish Species Abundance from the Three Study Sites

The cumulative abundance and percentage abundance of each of the fish species from the three (3) study sites is presented on table two (2). The table showed that *Sarotherodon galilaeus* had the least abundance percentage with 0.02% of the total catch. While *Marcusenius senegalensis*; *Malapterurus electricus*, *Brycinus macrolepidotus*, *Erpeitoichthys calabaricus*, *Tilapia zilli*, *Hyperopisus bebe occidentalis*, *Labeo brachypoma*, *Paradistichodus dimidiatus*, *Bagrus docmac*, *Citharinus citharus*, *Glyptothorax exodon* and *Mormyrus macrophthalmus* had 0.04-0.92% accordingly (Table 2). Whereas the rest of the fish species with the exception of *Oreochromis niloticus*; had an abundance percentage within the range of 1.58-8.88%. The highest abundance was recorded from the cichlid *Oreochromis niloticus* with 30.83% (Table 2).

Table 2 Cumulative abundance percentage of the fish species across study sites

Fish Species	Almakashi	Dadin-Kowa	Malleri	Total	% Abundance
Alestes dentex	117	50	71	238	5.22
Alestes leuciscus	20	42	116	178	3.90
Brycinus nurse	71	62	43	176	3.86
Brycinus macrolepidotus	1	4	0	5	0.11
Auchenoglanis occidentalis	34	59	32	125	2.74
Bagrus bayad macropterus	94	72	32	198	4.34
Bagrus docmac	0	32	1	33	0.72
Hydrocynus brevis	56	6	19	81	1.78
Oreochromis niloticus	836	147	424	1407	30.83
Sarotherodon galilaeus	0	0	1	1	0.02
Tilapia zilli	9	0	1	10	0.22
Citharinus citharus	37	0	2	39	0.85
Clarias lazera	101	105	174	380	8.33
Labeo brachypoma	4	5	9	18	0.39
Labeo senegalensis	72	17	39	128	2.81
Paradistichodus dimidiatus	0	9	9	18	0.39
Malapterurus electricus	0	4	0	4	0.09
Synodontis budgetti	94	164	61	319	6.99
Hyperopisus bebe	66	70	5	141	3.09
Hyperopisus bebe occidentalis	7	1	5	13	0.28
Mormyrus rume	32	30	10	72	1.58
Mormyrus macrophthalmus	24	9	9	42	0.92
Marcusenius senegalensis	2	0	0	2	0.04
Pollimyrus isidori	0	0	154	154	3.37
Erpeitoichthys calabaricus	0	4	2	6	0.13
Parailia pellucida	189	28	188	405	8.88
Schilbe mystus	214	44	70	328	7.19
Glyptothorax exodon	14	19	9	42	0.92

3.3. Fish Species Family Abundance Composition

The fish species family abundance of the three study sites is presented on table three (3). With only 4 individuals of the fish species *Malapterurus electricus*; the family Malapteruridae had the least representation with only 0.088%, while the family Cichlidae with a total of one thousand, four hundred and eighteen (1418) individuals had 31.07% of the total catch of the studies; this is followed by family Schilbeidae with 16.06% with seven hundred and thirty-three (733) cumulative individuals. Family Alestidae had 13.08% and Mormyridae 9.29% accordingly. The remaining families had less than 9.0% of the total fish stock (Table 3).

Table 3 Fish Species Family Abundance Composition

Family	Total Individuals Per Family	Percentage Abundance Per Family
Alestidae	597	13.083
Bagridae	356	7.802
Characidae	81	1.775
Cichlidae	1418	31.076
Citharinidae	39	0.855
Claridae	380	8.328
Cyprinidae	146	3.200
Distichodontidae	18	0.394
Malapteruridae	4	0.088
Mochokidae	319	6.991
Mormyridae	424	9.292
Polypteridae	6	0.131
Schilbeidae	733	16.064
Sisoridae	42	0.920

3.4. Fish Species Biodiversity indices of the Three Study Sites

Table 4 Fish Species Biodiversity Parameters of the Three Study Sites

Biodiversity Parameter		Study Sites	
	Almakashi	Dadin-Kowa	Malleri
Number of fish species identified	22	23	25
Number of families identified	11	13	13
Numeric volume of fish sampled	2094	983	1486
Margalef's index (D) of species richness	2.75	3.19	3.28
Shannon-Wiener's index (H) of species diversity	2.23	2.65	2.37
Pielou's index (J) of species evenness	0.732	0.846	0.736
Taxa_S	22	23	25
Dominance_D	0.1922	0.8887	0.1364
Simpson_1-D	0.8078	0.9111	0.8636
Evenness e^H/S	0.4228	0.610	0.425
Brillouin	2.209	2.6	2.335
Menhinick	0.4808	0.7336	0.6485
Fisher_alpha	3.429	4.215	4.27
Berger-Parker	0.3992	0.668	0.2853

The indices of biodiversity such as the Margalef's index (D) of species richness; Shannon-Wiener's (H) of species diversity and Pielou's index of species evenness (J) for the study sites is presented on table four (4). Site Malleri had the highest species richness (D) with a value of 3.28, followed by Dadin-Kowa with 3.19, where Almakashi ranked third with richness value 2.75. Shannon-Wiener's index (H) of species diversity indicated that Dadin-Kowa ranked first with a value of 2.65; followed by Malleri with 2.37 and Almakashi with 2.23 accordingly. Pielou's species evenness (J) indicated a value of 0.846 for Dadin-Kowa site, followed by Malleri study site with 0.736 and lastly Almakashi with 0.732 accordingly (Table 4). Other biodiversity indices such as Dominance_D, Simpson_1-D, Menhinick and Berger-Parker indicated that Dadin-Kowa study site had the prominent index values, while Malleri ranked first in the chart in respect to Fisher_alpha biodiversity index (Table 4).

4. Discussion

4.1. Fish Species Diversity and Abundance

In this study; twenty-eight (28) fish species originating within fourteen (14) families from the three landing sites of the study area were identified. Cichlids and schilbeids were the dominant fish groups. The fish species composition of this study agreed with the findings of [31] who recorded 28 fish species in New Calabar. Twenty-seven (27) fish species were documented from Kalgwai river (Jigawa State, Nigeria) by [32] and Gilo river (Ethiopia) [33]. However; despite this great conformities, the outcomes of this study yielded lesser fish species biodiversity as compared to other studies such as eighty-three species documented from Jebba (Hydro – Electric Plant) in Nigeria [19]. In line with this category; fifty (50) fish species were also reported from Taraba river [34]. Thirty-five (35) fish species enumerated from Agenebode, Edo State [35]. In non-African countries; [36] reported 69 fish species emanating from Buenaventura Bay (Columbia), whereas 39 fish species were encountered from Palordi river (Bangladesh) by [37]. Following the trend, one hundred and twenty-five (125) fish species were encountered from Cambodia's Mekong river [38] but only eighty-four fish species were documented from the China's giant Ganjiang river by [39]. The Dadin-Kowa fish species complex is however considered to exceed the outcomes of other study areas such as the eleven (11) fish species obtained from Lake Victoria Basin, Kenya [40], Tiga dam also produced nine (9) fish species [41], but Upper Benue River accounted for twenty-six fish species as reported by [42]. And emanating from New Calabar river [43] enumerated similar findings, but [44] recorded eighteen (18) fish species from Asejire reservoir, Nigeria. The differences in fish species representation of Dadin-Kowa reservoir as compared to other study areas may be attributed to the differences in lake-basin morphometry, moderate exploitation, food sources, photo-period, reservoir size, riverine tributaries, seasonal migration [26,38]. While river abstraction, dynamics of hydrological regimes, fish species adaptation to lotic environment, geographical position, environmental, habitat quality, species number vary depending upon differences in sampling methods and sampling effort, as well as fish abundance [34,38,40,45].

The present study indicated that Dadin-Kowa reservoir harbors a total of fourteen (14) fish families; this family composition is in line with the findings of other researchers such as [46] who reported 15 fish families from New Calabar, Zira et al. (2017) reported 15 fish families from Kiri reservoir. Whereas [48] recorded fifteen (15) families from Donga river Taraba State. This is similar to the sixteen (16) families enumerated from Upper Benue (Nigeria) [42]. Olopade et al. (2020b) reported 15 fish families from New Calabar. Going across African lakes and water confinements, Hu et al. (2019b) recorded 15 families from China's Ganjiang lake. Besides these outstanding accords, the fish family composition of Dadin-Kowa reservoir illustrated contrary accordance to the outcomes of other lakes and water confinements such as Otammiri river where 10 families were recorded [50], with the documentation of 28 expected fish families from Pendjari river, Lake Volta. Going by this family variations; Pius et al. (2020) identified 20 fish families in Taraba river. Tiga dam (Kano State) also hosted seven fish families [41]. Whereas 29 families emerging from Buenaventura Bay were encountered [36]. This differences were also strengthened by the eleven (11) and twelve (12) fish families enumerated from New Calabar [43] and Asejire reservoir [44] accordingly.

The susceptibility of a fish species to a fishing gear is likely linked with the habitat of fish species; unlike non-riverine system, riverine aquatic ecosystems are characterized with fluctuations of increasing species abundance, diversity and richness [45]. Habitats differences in species abundance can be as result of differences of sediments accumulation which serves as a precursor to food generation and liberation. Additionally; environmental factors such as salinity and suspended particles, natural or anthropogenic causes can definitely bring differences in the composition of fish species and families [36].

The present study inferred that Dadin-Kowa Reservoir is dominated with four main categories of fish groups or families precisely. These families include Cichlidae (31.08%, but *Oreochromis niloticus* singly made up 30.83%), this is followed by Schilbeidae (16.06% combined, *Parailia pellucida,* and *Schilbe mystus*), then Alestidae (13.08%) with four species, mormyrids constituted six fish species making up 9.26%, and lastly Claridae with *Clarias lazera* being the sole

representative constituting 8.32%. The dominance of cichlids especially *Oreochromis niloticus* from this study is in agreement with numerous outcomes of other studies across Nigeria, this includes the works of Oladipo et al. (2021), Solomon et al. (2017), [51] from Omuechi stream, Pius *et al*, (2020), Abdulkarim *et al*, (2020), Dienye *et al*, (2018), Olopade (2020) and Omoike, (2021) all recorded the dominance of cichlids. This dominance of cichlids is attributable to quite a number of outstanding factors which includes high proliferation and being the second most diverse family of freshwater fish [52] with global distribution [53]. This assertion was supported by Leveque (1997) in Olopade (2020) who stated that "cichlids are the most diverse fish family in Africa. Good parental care (mouth brooding as found in some species such as *Tilapia galilaeus*), high rates of juveniles, adult survival, strong competitive capabilities [46], diverse feeding protocols, high population in response to predation and other forces of population decay, while adaptation to both lotic and lentic ecosystem, productivity and changes to hydrological regimes [19,26] are considered the unique features warranting the dominance of *Oreochromis niloticus*. Besides cichlids; schilbeids formed the next highly abundant group with 16.06% combined. This outstanding abundance is attributed to their adaptability to diverse feeding protocols, moderate body size in relation to growth speed, moderate level of fecundity, availability of macrophytes and debris as sources of nutrition [34]. Alestids which includes major players such as *Alestes dentex* and *Brycinus leuciscus* also bear similar living strategist as of the schilbeids especially prolific capacities as they serve as dietary source (ecological niche) to other trophic levels such as the African pike (*Hepsetus odoe*) which warrants their diversified sustainability. Mormyrids on the hand in this study bears six species with a total of 9.26% of the entire fish abundance composition, *Pollimyrus isidori* being the most abundant in this category indicated that this species advanced due to food availability, relative small-size with potentially high growth capacity enables this fish species to attain maturity in short span of time and ultimately high prolific nature. The family Claridae constituted the last category of highly abundant fish species, *Clarias lazera* singly represented the family with an abundance percentage of 8.32% of the total fish catch. It was understood that this fish species has an outstanding records of high proliferation, hardy in nature with abilities to resist broad set of diseases, possession of atmospheric air breathing accessories, ability to withstand oxygen deficiencies in turbid waters and soft bottoms [36] and their generalist feeding features which implies that food is not a limiting factor [40].

Contrary to the aforementioned abundance capabilities, the cichlid species *Sarotherodon galilaeus* alongside *Malapterurus electricus* in this study were documented to bear the least fish abundance. The dwindling population of *Sarotherodon galilaeus* might be linked to a possible local extinction of this fish species, only one individual was recorded in the month of June; as there is no restocking programs for the restoration of this species. The fish species is palatable just as in other cichlids, therefore also a possible tendency to its high demand which resulted in its population declination below its exploitation threshold or it might be possible that this fish species was on spawning migration or refuge seeking when it was captured. The family Malapteruridae was represented singly by *Malapterurus electricus*, only few individuals were documented in this study which coincided with outcomes of [54] and contrast that of [55]; implying a very low fecundity, poor competitive strengths, least public demand and that its dietary requirement is salty which can be obtained at reservoir bottoms almost beyond the reach of a fishing gear, for refilling its defensive architecture of electric current, the meat of this species is considered salty and less palatable, thereby attracting the least public interest and hence can be classified as Least Concern (LC).

Generally, it can be understood that fish species abundance and its possible fluctuations are associated with fish harvest intensity, gears used, downstream migration, commercial and domestic water usage, fish shelter, and spawning [42], habitat morphology and hydrology (including water retention and recession) [54], unethical fishing practices such as the use of minute mesh-size nets [44], targeting of spawning biomass (especially mega-spawners) [56]. These factors can alter the structure and composition of any fish community including reservoirs.

4.2. Fish Species Biodiversity Indices

The four main biodiversity indices of the Dadin-Kowa were considered for discussion in this section; thus this includes Margalef's species richness (D), Shannon-Weiner's species diversity (H), Pielou's index of species evenness (J) and Dominance_D accordingly. The present study indicated a peak species richness of 3.28. This index score contrasts the score reported from Jebba (D = 9.73) [19], but higher than the outcome from Konoskhaihaor river, Bangladesh [57]. This result was lower than 4.0 as recorded by [58].

The Dadin-Kowa inferred a peak value of 2.65 of species diversity (H), which is lesser than 3.94 accounted by [19]from Jebba dam, 3.12 as documented by [57]. But this index is higher than the reported score from Raya water [59]; despite this valid variations, the Dadin-Kowa reservoir is said to have attained a moderate species diversity. This is because according to Kreb's index (1989) in [59], species diversity index of greater than 1 and less than 3 is said to be moderate.

The species evenness (J) of this study is documented as 0.84, this value is in line with 0.83 recorded from Gubi Dam [60]. This is relatively greater than the recorded values from Lagos Coastal waters [61], Riau Province, Indonesia [62] and

Lakhandaha reservoir [63]. Reference to Kreb's guidelines; the present outcome of this study is said to have a stable community since species evenness is greater than 0.75, although less than 1 (one) [59].

Dominance_D which reflects on the domination of one fish species that is more dominating than others indicated that the current outcome is relatively greater than the outcomes accounted for from Jebba [19]. Dominance is inversely proportional to diversity index, therefore the lower the value of dominance, the richer the diversity [59].

The fluctuations of diversity, uniformity and dominance of fish communities portrays the influence of physical, chemical and food factors [59]. Fish species had been observed to be influenced by cumulative impacts of aqua-cultural activities such as water quality degradation, intensified intra and inter specific competitions, invasive species and habitat defragmentation [62] but damming or river abstraction [64] alongside water recession and sample size [57] strengthened the justification for the fluctuations of fish species richness including Dadin-Kowa reservoir. However, it was noted that latitude (especially low) increase both size and species diversity of fish communities, this is further supported by lake depth which was observed to contribute to the variations of diversity, probably because deep lakes tend to have larger space with habitat heterogeneity to accommodate wide range of fish species, this followed the Habitat Diversity Hypothesis which states "that diversity is controlled by the availability of different habitats" [65].

5. Conclusion

The Dadin – Kowa Reservoir is said to have a good ichthyofaunal composition coupled with twenty-eight fish species belonging to fourteen families. Biodiversity indices conformed to Kreb's guidelines which revealed moderate species diversity (H = 2.65) and stable community (J = 0.84).

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declares that there is no conflict of interest.

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