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Fish Species Distribution and Water Quality Parameters of Kwadon Stream, Yamaltu-Deba Local Government Area Gombe State, Nigeria

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Abstract
Fishery resources are decreasing in Nigeria due to over exploitation and inadequate management of inland waters. For sustainability of these resources, an adequate knowledge of species distribution, diversity and relative abundance of water bodies must be understood and vigorously pursued. The study was carried out for the period of six months, from July to December, 2016, to determine the distribution of fish species in the stream, to assess the level of physicochemical parameters of the stream and its effects. Seventeen (17) fish species were identified from eleven (11) families. The families Cichilidae 17.6% recorded the highest number and Schilbadae 5.9% had the lowest family, while species Tilapia galilaea 13.1% recorded the highest number and Malepterurus electricus(1.7%)had the lowest number. The Physico-chemical parameters measured include; temperature, transparency, pH, dissolved oxygen, free carbon dioxide, conductivity, alkalinity, ammonia, phosphorus and nitrogen. The temperature ranged from 18.11 °C to 24.52 °C, transparency depth from 11.77cm to 13.77cm, pH from 6.15 to 7.04, Dissolved Oxygen from 3.91 mg/L to 4.95mg/l, free carbon dioxide from 1.62 mg/L to 2.48mg/L, Conductivity between 90.35Us/cm to 96.48 Us/cm, Alkalinity from 16.25 mg/L to 21.33 mg/L, Ammonia from 0.41 mg/L to 0.78mg/l, Phosphorus between 2.10 mg/L to 4.07 mg/L, Nitrogen between 1.58 mg/L to 0.04 mg/L respectively. Therefore continuous Limnology should be carried out on the stream and all surrounding water bodies to monitor the level of illegal human activities which contribute to water pollution and affect fish species distribution and growth with other aquatics lives.

Keywords: Parameters, limnology, distribution, species, physicochemical, stream

Introduction

Aquatic ecosystems are critical components of the global environment and provide a variety of services for human populations, including water for drinking and irrigation, recreational opportunities, and habitat for economically important fisheries [31]. However, aquatic systems have been increasingly threatened and added stress due to various factors of global climate change [28].Clean, safe and adequate freshwater is of utmost importance to human existence and the survival of all living components in the ecosystem. Water quality issues are complex and diverse, deserving urgent global attention and action [13]. The decline in water quality has become a global issue of concern because of its inherent ability to cause major alterations to the hydrological cycle [12]

Fish assemblages have widely been used as ecological indicators to assess and evaluate the level of degradation and health of water bodies at various spatial scales [1]. Fresh water aquatic systems represent about 2-3% of the marine area, yet contain 40% of known fish species. As the fields of resource management and conservation continue to move towards more spatial and ecosystem-based approaches (e.g. terrestrial reserves, marine protected areas), there is a growing need for spatially explicit, quantitative information on species distributions and a better understanding of biotic and abiotic determinants of those distributions, [2,3].

Identification of fish fauna of an aquatic ecosystem and its water quality is the first and the most important step in the full exploitation of its fishery resources. Therefore this research is aimed at studying the fish species distribution in relation to water quality of Kwadon Stream with the following objectives; to determine the distribution of fish species in the stream, to assess the level of physicochemical parameters of the stream and its effects on fish species distribution.

Study area

The study area is Kwadon stream located in Kwadon, Yamal-tu Deba Local Government Area of Gombe State, Nigeria. The area lies between latitude 10° 16' 15'N to 10°17' 7"N and longitude 11° 16' 44"E to 11° 18' 28"E. The various activities carried in/around the stream include; fishing, farming, washing and bathing. Three sites were selected for this work, and were identified as; A, B and C described as: Station A (fishing site) Station B (farming site) and Stations C (washing and bathing site)

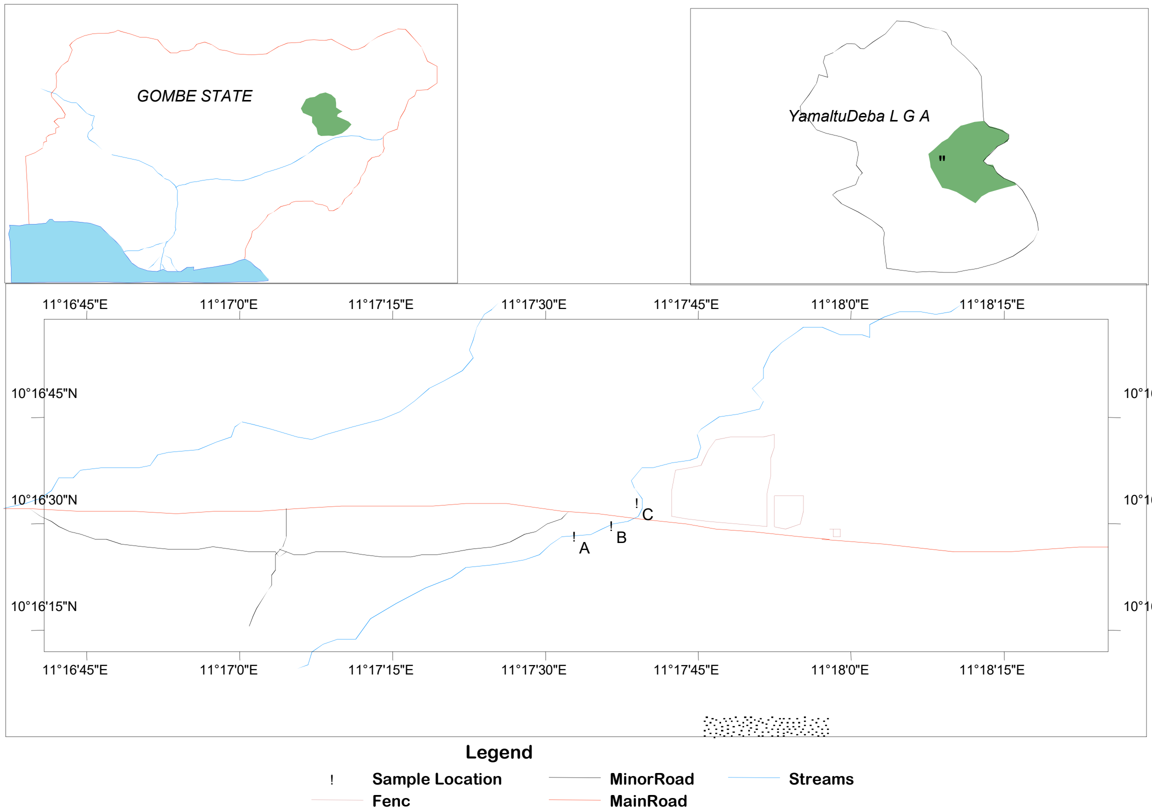

Figure 1. Map of Yamaltu- Deba L.G.A, Gombe State, Nigeria Showing Kwadon Stream
Source: Gombe State Ministry of Land and Survey Gombe (2012)

Materials and Methods

Sampling of fish

Fishes were sampled once a month at 6am local time when fish species caught by fishermen men using cast net and Malian traps at the three stations (Station A: fishing site, Station B: irrigation site, Station C: washing), see (Figure 1). All fish species were sorted, counted, identified and recorded. Fish species that cannot be identified in the study site were labelled and preserved in ice and taken to department of biological sciences laboratory Gombe State University for identification [4]. The method of identification was referenced by [5,6,7]

Water sampling

Water samples were collected from three stations A, B and C once a month for the period of six month from 6am local time. Sampling bottles of 250mL capacity were used, the bottles were rinsed before being filled with water and were taken to the Department of Biological Sciences laboratory Gombe State University for physico-chemical analysis. Only temperature and transparency were measured insitu using mercury bulb thermometer (for temperature) and using secchi disc (for turbidity).Water samples were collected in labelled sampling bottles. The Physico-chemical parameters were determined as follows; pH measured using pH meter (model: Hanna instruments model No H18915ATC)[8]. Dissolved oxygen was determined using portable HANNA electronic dissolved oxygen meter (model: I 2400) [9]. Free carbon dioxide was determined as described by [10]. Electric conductivity was determined as described using portable HANNA electronic conductivity meter (model: EC 215). Total alkalinity was determined [11]. Total ammonia was determined according [38]. Total phosphorus was determined method described [11]. Nitrogen was determined as described by [38].

Statistical analysis

All data were subjected to analysis of variance (ANOVA) using SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA). When significance occurred, means were separated by Tukey's HSD test ($p < 0.05$). The data were presented as the mean ± standard errors of 3 measurements.

Results and Discussion

Fish species identification

The identified fish species is presented in Table1. A total of seventeen (17) fish species and eleven (11) Families were identified in the stream and classified into Scientific, common and local names (Hausa names). This showed that the family *Cichilidae* has the highest with 17.6% and three (3) species followed by Bagridae, *Clariidae, Citharinidae* and *Mochokidae* each with 11.8% and two (2) species, the least family are *Cyprinidae, Gymnarchae, Arapamidae, alapterudae,Mormyridae* and *Schilbadae* each with 5.9% and one (1) species.

Fish species distribution

The fish species percentage distribution across site is presented in Table 2 shows percentage of fish species distributions at Kwadomstream.Table3 shows percentage distributions of the fish species family. This shows that percentage distribution of fish species identified were, Tilapia *galilaea* had 13.1% the highest followed by *Clariasgariepinus*12.8%, T*ilapia zilli*11.7%, *Labeosenegalensis* 8.6%, *Clariaslazera* 8.3%, *Schilbemystus* 6.9%, *Mormyrusrume* and *Synodontisbetasonda*had 4.8%, *Oreochromisniloticus* 4.5%, *Bagrusdomack* and *Synodontisschall* had 3.8%. *Heterotisniloticus* 3.4%, *Citharinuscitharus* and *Gynarchusniloticus* had 3.1%, *Bagrusbayad*2.8% and *Citharinuslatus* 2.8% and the least species is *Malepteruruselectricus* 1.7%.

Table 2 shows that Site A had the highest fish species distribution with all the seventeen (17) species and Site B with seven (7) species while Site C had no fish species recorded during this study. Table 2 shows the numbers of individual species occurring in Site A, B and C where 250 Fish were recorded in Site A, 40 Fish recorded in Site B while no fish was recorded in Site C.

Table1. Fish Species Identified by Family, Species, Common and Hausa names, in Kwadom Stream

S/N	Family Names	Scientific Name	Common Names	Hausa Name
I	*Bagridae*	*Bagrusbayad*	Bayad	Dinko
		Bagrusdomack	Semutundu	Dinko
II	*Clariidae*	*Clariasgariepinus*	North African catfish	Tarwada
		Clariaslazera	Catfish	Tarwada
III	*Citharindae*	*Citharinuslatus*	Moonfish	Falia
		Citharinuscitharus	Moonfish	Falia
IV	*Cyprinidae*	*Labeosenegalensis*	Labeo	Datta
V	*Gymnarchidae*	*Gymnarchusniloticus*	Aba	Dansarki
VI	*Arapaimidae*	*Heterotisniloticus*	Africanbony tongue	Bali or Kawi
VII	*Malapteruridae*	*Malepteruruselectricus*	Electric catfish	Mijiriya
VIII	*Mormyridae*	*Mormyrusrume*	Trunk Fish	Milligi
IX	*Cichlidae*	*Tilapia zilli*	Tilapia/Mangofish	Karfasa
		Tilapia galilaea	Tilapia/Mangofish	Karfasa
		Oreochromisniloticus	Nile Tilapia	Karfasa
X	*Schilbeidae*	*Schilbemystus*	Silver catfish	Manja
XI	*Mochokidae*	*Synodontisbatesonda*	Upside down Catfish	Kurungu
		Synodontisschall	Upside down Catfish	Kurungu
Total	**11**	**17**	**17**	**17**

Table 2. Percentage Distribution of Fish Species across sites

S/N	Species	Station A	Station B	Station C	Total	% Abundance
I	*Bagrusbayad*	8	0	0	8	2.76
II	*Bagrusdomack*	11	0	0	11	3.79
III	*Clariasgariepinus*	29	8	0	37	12.76
IV	*Clariaslazera*	20	4	0	24	8.28
V	*Citharinuslatus*	8	0	0	8	2.76
VI	*Citharinuscitharus*	9	0	0	9	3.10
VII	*Gymnarchusniloticus*	9	0	0	9	3.10
VIII	*Heterotisniloticus*	10	0	0	10	3.45
IX	*Labeosenegalensis*	19	6	0	25	8.62
X	*Malepteruruselectricus*	5	0	0	5	1.72
XI	*Mormyrusrume*	14	0	0	14	4.83
XII	*Oreochromisniloticus*	13	0	0	13	4.48
XIII	*Schilbemystus*	14	6	0	20	6.90
XIV	*Synodontisbatesonda*	9	5	0	14	4.83
XV	*Synodontisschall*	11	0	0	11	3.79
XVI	*Tilapia zilli*	30	4	0	34	11.72
XVII	*Tilapia galilaea*	31	7	0	38	13.10
TOTAL		**250**	**40**	**0**	**290**	**100**

Table3. Percentage Distribution of Fish Species and Family

S/n	Family	Species No/Family	Percentage (%)
I	*Bagridae*	2	11.8
II	*Clariidae*	2	11.8
III	*Citharindae*	2	11.8
IV	*Cyprinidae*	1	5.9
V	*Gymnarchidae*	1	5.9
VI	*Arapaimidae*	1	5.9
VII	*Malapteruridae*	1	5.9
VIII	*Mormyridae*	1	5.9
IX	*Cichlidae*	3	17.6
X	*Schilbeidae*	1	5.9
XI	*Mochokidae*	2	11.8
Total	**11**	**17**	**100**

Physicochemical parameters

The value for the monthly variation in temperature is presented in Table 4: with the highest value of 24.52^{0}C recorded in the month of October and lowest value of 18.11^{o}C in December, this shows significant difference (P<0.05) between site and month. Table 5: showed the result of monthly means of transparency with the highest value of 13.77 and lowest mean is 11.77. The mean value of transparency of different month and sites showed no significant difference (P>0.05). The mean value of monthly variation of pH is shown in Table 6: with the month of December having the highest pH value of 7.04 Site A and lowest at 6.15 in October. The pH mean value shows no significant difference (P>0.05). Table 7: showed monthly variation in Dissolve Oxygen where the chi- square values shows no significant difference (P>0.05). The highest value recorded is 4.95 in October and lowest is 3.91 in December.

The monthly variation of free carbon dioxide ranged from 1.62 in September to 2.48 in November showed in Table 8. This shows no significant difference (P> 0.05). Within month and between Sites

The monthly variation of Conductivity is presented on Table 9. The monthly mean ranged between 90.35 in December to 96.48 in November. This result showed no significant difference (P>0.05).

The value for the monthly variation of Alkalinity is presented in Table 10: July recorded the highest value of 21.33 Site A and November recorded the lowest value 16.25 in Site A. This means there is no significant difference (P>0.05) within month and between sites.

Table 11: shows that there is no significant difference in monthly variation of Ammonia at (P>0.05).The value recorded ranged from 0.41 to 0.78 in Site B all in August. Site A, B and C.

The mean value for monthly variation of Phosphorus is shown in Table 12. The monthly mean ranged between 2.10 in September Site B to 4.07 in December Site A. This showed that there is no significant difference (P>0.05).

The value for the monthly variation of Nitrogen is shown in Figure 13.The highest value was recorded in November 1.58. In Site B and the lowest value recorded in October 0.04 In Site B. The Nitrogen mean value showed no significant difference because (P>0.05).

Table 4. Monthly variation of Temperature (°C)

Temperature	July	August	September	October	November	December
Station A	24.2^{a}	21.41^{a}	20.82^{a}	20.23^{a}	18.5^{a}	18.62^{a}
Station B	25.4^{a}	22.4^{a}	21.2^{a}	22.2^{a}	18.8^{a}	19.6^{a}
Station C	23.2^{a}	20.6^{a}	22.2^{a}	27.8^{b}	18.8^{a}	16.1^{a}
Mean	24.27	21.47	21.41	24.51	18.7	18.11
SEM	0.64	0.52	0.41	3.34	0.10	1.04

Mean (X^n) different superscript at p<0.05 is statistically different to each other and vice versa
Mean (X^n) with the same superscript are not statistically different to each other and vice versa at p>0.05

Table 5. Monthly variation of Transparency (cm)

Transparency	July	August	September	October	November	December
Station A	12.21^{a}	12.42^{a}	10.4^{a}	11.61^{a}	12.62^{ab}	14.12^{a}
Station B	13^{a}	13.5^{ab}	12.2^{a}	13.2^{ab}	13.5^{a}	12.1^{ab}
Station C	10.81^{a}	10.4^{ac}	10.23^{a}	10.5^{ac}	15.15^{ac}	15.1^{ac}
Mean	12.01	12.107	10.94	11.77	13.76	13.77
SEM	0.64	0.91	0.63	0.78	0.74	0.88

Mean(X^n) with different superscript at p<0.05 is statistically different to each other and vice versa
Mean with the same superscript are not statistically different to each other and vice versa at p>0.05

Table 6. Monthly variation of pH

pH	July	August	September	October	November	December
Station A	6.72 [a]	6.81 [a]	7.23 [a]	7.81 [a]	6.9 [a]	5.92 [a]
Station B	7.13 [a]	7.3 [ac]	7.14 [ac]	7.21 [ac]	7.2 [a]	7.14 [a]
Station C	5.9 [a]	5.71 [bc]	5.8 [bc]	6.11 [bc]	6.1 [a]	5.38 [b]
Mean	6.58	6.61	6.72	7.04	6.73	6.15
SEM	0.36	0.47	0.46	0.50	0.33	0.52

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 7. Monthly variation of Dissolved Oxygen (mg/L)

DO2	July	August	September	October	November	December
Station A	5.01 [a]	5.95 [a]	6.1 [a]	6.12 [a]	4.01 [a]	4.02 [a]
Station B	4.01 [a]	5.1 [ac]	5.21 [ac]	5.82 [a]	4.23 [a]	4.31 [a]
Station C	3.2 [a]	3.7 [bc]	3.21 [bc]	2.92 [b]	4.34 [a]	3.41 [a]
Mean	4.07	4.92	4.84	4.95	4.19	3.91
SEM	0.52	0.66	0.85	1.02	0.10	0.27

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 8. Monthly variation of Free Carbon dioxide (mg/L)

Free CO_2	July	August	September	October	November	December
Station A	1.15 [a]	0.98 [a]	1.02 [a]	0.93 [a]	0.86 [a]	1.01 [a]
Station B	1.56 [ac]	1.88 [a]	0.89 [a]	2.01 [a]	2.89 [ac]	2.81 [ac]
Station C	3.39 [bc]	2.98 [a]	2.95 [a]	3.02 [a]	3.68 [bc]	3.52 [bc]
Mean	2.03	1.95	1.62	1.99	2.48	2.45
SEM	0.69	0.58	0.67	0.60	0.84	0.75

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 9. Monthly variation of Conductivity (µS/cm)

Conductivity	July	August	September	October	November	December
Station A	112.05 ^{a}	104.05 ^{a}	111.2 ^{a}	116.2 ^{a}	122.5 ^{a}	102.5 ^{a}
Station B	101.15 ^{ac}	109.55 ^{a}	88.3 ^{ab}	99.6 ^{ac}	98.92 ^{ac}	80.12 ^{a}
Station C	67.98 ^{bc}	78.51 ^{b}	77.42 ^{ac}	61.11 ^{bc}	68.01 ^{bc}	88.44 ^{a}
Mean	93.727	97.37	92.31	92.30	96.48	90.35
SEM	13.25	9.56	9.95	16.32	15.78	6.53

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.0$

Table 10. Monthly variation of Total Alkalinity (mg/L)

Total Alkalinity	July	August	September	October	November	December
Station A	25.23 ^{a}	16.21 ^{a}	20.53 ^{a}	22.23 ^{a}	15.57 ^{a}	16.88 ^{a}
Station B	18.43 ^{b}	15.98 ^{a}	16.66 ^{a}	16.55 ^{a}	17.99 ^{a}	19.55 ^{a}
Station C	20.33 ^{b}	16.55 ^{a}	16.55 ^{a}	18.11 ^{a}	16.98 ^{a}	15.66 ^{a}
Mean	21.33	16.25	17.91	18.96	16.85	17.36
SEM	2.03	0.17	1.31	1.69	0.70	1.15

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 11. Monthly variation of Total Ammonia (mg/L)

Total Ammonia	July	August	September	October	November	December
Station A	0.32 ^{a}	0.2 ^{a}	0.21 ^{a}	0.3 ^{a}	0.42 ^{a}	0.3 ^{a}
Station B	1.02 ^{a}	1.86 ^{a}	0.21 ^{a}	0.3 ^{a}	0.61 ^{a}	1.02 ^{a}
Station C	0.72 ^{a}	1.05 ^{a}	0.82 ^{a}	0.8 ^{a}	0.87 ^{a}	1.02 ^{a}
Mean	0.69	1.04	0.41	0.47	0.63	0.78
SEM	0.20	0.48	0.20	0.17	0.13	0.24

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 12. Monthly variation of Total Phosphorus (mg/L)

Total Phosphorus	July	August	September	October	November	December
Station A	3.76^{ab}	4.23^{a}	2^{a}	2.98^{a}	2.98^{a}	4.98^{a}
Station B	4.1^{ac}	3.11^{a}	1.99^{a}	2^{a}	2.33^{a}	2.99^{bc}
Station C	2^{ab}	3.33^{a}	2.32^{a}	3^{a}	3.34^{a}	4.23^{ac}
Mean	3.29	3.56	2.10	2.66	2.88	4.07
SEM	0.65	0.34	0.11	0.33	0.29	0.58

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$

Table 13. Monthly variation of Total Nitrogen (mg/L)

Total Nitrogen	July	August	September	October	November	December
Station A	1.02^{a}	0.21^{a}	1^{a}	0.21^{a}	2^{a}	1^{a}
Station B	1^{a}	1.11^{a}	0.01^{a}	0.01^{a}	2.11^{a}	1.65^{a}
Station C	1.42^{a}	1.22^{a}	0.99^{a}	1^{a}	0.62^{b}	1.12^{a}
Mean	1.15	0.85	0.67	0.40	1.58	1.26
SEM	0.14	0.32	0.33	0.30	0.48	0.20

Mean(X^n) with different superscript at $p<0.05$ is statistically different to each other and vice versa
Mean(X^n) with the same superscript are not statistically different to each other and vice versa at $p>0.05$.

This study revealed that, a total of 290 fish was recorded and identified into 11 families and 17 species during this study. The family *Cichilidae* with 17.6% with the highest percentage and specie *Tilapia galilaea* with 13.1% while the following family; *Cyprinidae, Gymnarchidae, Arapaimidae, Malapteruridae, Mormyridae*and*Schilbeidae*with 5.9% having the lowest percentage while *Malepteruruselectricus* species with 1.72% as the lowest percentage.

The distribution of fish species was found to be high in Site A, B while Site C has no species recorded This may be as a result of biotic and abiotic factors supported by [29], and also the larger water body the greater the diversity and distribution fish species Conner and McCoy, (1979). The spatial differences in physical and chemical variables (water temperature, electric conductivity, nitrogen and phosphorus concentrations, and pH), and biotic interactions competition and predation [30, 17, 27] affect the distribution of species in streams. Also the current rate of destruction, alteration, and fragmentation of natural habitats as a result of human activities noticed around the stream which includes irrigation, washing and bathing, dumping of waste, livestock urine and droppings that will led to an alarming loss of global biodiversity [27].

The variation in the level of physicochemical parameters were temperature, free carbon dioxide, ammonia and pH were recorded to be high in site C compare to site A and B while transparency, dissolve oxygen, nitrogen, conductivity and phosphorus were recorded to be low in site C compare to site A and B. The level of human activities (washing, bathing) was also recorded high in site C. These may have contributed in the distributions of Fish species number across the sites, especially Site C where no species was recorded because of high level of some physicochemical parameters example carbon dioxide, pH, Ammonia, transparency compared with site A and B and low level of dissolved oxygen, nitrogen, conductivity, phosphorus and alkalinity.

The variation observed in the physicochemical parameters during this study could be attributed to variation in temperature and rainfall between seasons influenced the physico-chemical characteristics of water bodies as reported by [6] and flow variability, anthropogenic activity and changes in water shed conditions, this agrees with observation of [8]. [14], who reported that the high variability of Water quality may be due to the impact of many factors (e.g. rainfall and surface runoff) and catchment activities which prevailed during the rainy and dry season periods.

The monthly mean variation of temperature values ranged between 18.11°Cand 24.51°C.This work is within the range recommended by [15] in Jakara Lake Kano who reported a temperature ranged of 17-28.5°C and the work of Alabaster and Lioyd (1980) which reported that the normal range of temperature to which fish is adopted in tropics is between 8°C and 30°C. The result varies within the range recommended by World Health Organization (30°C) and National Guideline and Standard for Water Quality (20°C – 33°C). The high temperature could be as a result of the shallow nature of the stream [16], the low Temperature recorded in December and site C may be due to wet season weather condition and anthropogenic activity [18].

The mean monthly variation of Transparency ranged from 10.94cm September to 13.77cm December. This work agrees with the work of [25] in Kigera fish farm, who reported 19cm to 25cm and the range of 8.7-58.2cm observed by [4] in Lake Geriyo. The high transparency recorded could be as a result high amount of rainfall recorded at that month [32] and low transparency could be as a result of sedimentation [32] and anthropogenic activities as recorded in site C where no and increase in debris load by water run-off This agrees with [4] who reported that reduced activity in Lake Geriyo and complete lack of rain accounted for high transparency. According to [4] suspended materials including agricultural waste can clog fish gills, reducing resistance to diseases and growth rates. Higher transparency increases water temperature because suspended Particles absorb more heat; this in turn reduces the concentration of dissolved Oxygen because it reduces photosynthesis, American, Public Health Association [9].

The mean monthly variation of pH values recorded during this study ranged from 6.15 in December to 7.04 in October. This fall within the pH value 5-9.5 recommended by [33] as adequate for aquatic life. And that of Australian Centre for Tropical Water [5] of 6-9 in most tropical natural water [20] reported a pH value ranging from 7.66-8.20 in Pankshin reservoir, which suggested that the values are suitable for fish production. Site C recorded low pH value while Site A had almost normal pH. This could be as a result of various anthropogenic activities [21]. Some of those anthropogenic activities recorded include washing of cloths, bathing, agrochemicals use by irrigation farmers and animal urine (cattle's) that drink water at the stream.

Dissolve Oxygen monthly variation ranged from 3.91mg/l in Site C to 4.95mg/l site A. The variations is within the tolerance range for most fish species, because many species of fish can survive for varying periods of concentrations was below 6mg/l [22]. But the observed value ranges of this work are below 15.78-17.26 mg/l as reported by [18] in Lughu reservoir Michika. Sudden change in the concentration of dissolved oxygen might therefore be in site A as a result of active photosynthesis process and fail in temperature values during the cold period. While decrease in the values may be as a result of anthropogenic activities that leads to the water contaminations with chemicals from detergents, agrochemicals and animal urine.

Free carbondioxide recorded in this study ranged from 1.62mg/l in September to 2.48 mg/l in November .The values observed fall within the recommended safety limit of 10mg/l reported by [16] and is lower than 6.0mg/l to 7.9mg/l reported by [16] and 2.6mg/l to 4.17mg/l as reported by [19] in River Ilagil Ngurore ,. The lowest value of free CO_2 observed in site A might be due to the utilization of free $CO_2$by phytoplankton for primary productivity [4]. While the high values of free CO_2 recorded in site C might be due to low alkalinity of the River, as [4] reported that high alkaline water bodies are characterized by negative values of free CO_2.

The conductivity mean values obtained ranged from 90.35µs/cm in December to 97.37 µs/cm August. This work fall within the recommended values of 10µs/cm to l000µs/cm [5] and 8-10,000 recommended for drinking water by WHO, but did not agrees with [4] who reported the conductivity values of 4.99 - 44.19µs/cm in Lake Geriyo. The low conductivity recorded in site C could be as a result of narrow fluctuation of pH around the neutral value and low conductivity may cause low condition factor and fecundity of fish [18].

The observed mean variation of alkalinity ranged from 16.25mg/l in August to 21.23mg/l in July. This is contrary with the findings of [22] who reported that the Alkalinity range was 4.05mg/l to 8.10mg/l. And this could be as a result of carbonate and bicarbonates in the stream because they contribute to water hardness especially in site C [23].

The concentration of monthly mean of ammonia ranged from 0.41mg/l to 1.04mg/l. This work is supported by [19] in river Ilagil Ngurore,Yola South L.G.A Adamawa State whose observations ranged from 0.3mg/l to 1.9mg/l but contrary to the ranged of 0.025mg/l and 0.06- 0.07mg/l reported by [7, 4] in lake Geriyo. [16] reported that high ammonia level cause susceptibility to disease and possibly death. This could be in agreement with site C where no fish was recorded due to bathing; washing and chemical dispose in the stream site.

The mean monthly variation of Phosphorus ranges from 2.10 to 4.07mg/l mg/l . The values observed is within the limit of 6.5mg/l set by (WHO) but higher than 0.04 to 0.05mg/l obtained by [21] in river Suka and 0.021-0.046mg/l reported by [19] in river Ilagil. The high values observed could be as a result of anthropogenic activities and waste sedimentation associated with the sites. This agrees with [5] that artificial sources of Phosphorus includes; fertilizers, detergents, waste water, Industrial affluent and animals excreta among others.

The monthly mean total nitrogen ranged from 0.40mg/l in October to 1.58mg/l in November which is higher than 0.25 to 0.34mg/l reported by [19] in River Ilagil. But is within the ranged of 0.02mg/l to 2.0mg/l recommended by [9]. [30] reported that domestic industrial effluents and agricultural run-off are major sources of nitrogen in water. This could be the reason why site B and C had high nitrogen values.

Conclusion

This study revealed that 290 fishes were recorded with 17 species and 11families; 250 fishes from site A, 40 fishes from site B and 0 from site C. The variation in species number per site was as a result of anthropogenic activities and variations in physicochemical characteristics. The families Cichilidae 17.6%, recorded the highest number and *Schilbadae* 5.9% had the lowest, while species *Tilapia galilaea* 13.1% recorded the highest number and *Malepteruruselectricus* 1.7% had the lowest number. However most of the parameters analyzed where within the recommended range for fish survival, only temperature show significance difference at P>0.05, hence this study will be a major step in identifying the fish species habitat priority area in the study site to facilitate site and species protection/conservation.

The study recommended immediate action to control the level of anthropogenic activities to tackle and reduce the amount of pollutant being discharged in to the stream, continuous Limnology studies should be carried out on the stream to monitor the level of changes of its water quality, productivity and biodiversity and further Study on the level of accumulation of metals on certain fish species is recommended.

Declaration of conflicting interests

The authors declared no potential conflicts of interest

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