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A Survey of Fish Species Abundance and Distribution in Komadugu Yobe River

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ABSTRACT

Komadugu Yobe River is a vital freshwater ecosystem in North-Eastern Nigeria, supporting the livelihoods of thousands of fishermen and contributing significantly to regional food security. Despite its economic importance, comprehensive data on fish species composition, abundance, distribution, and water quality parameters along the river's full length have been lacking hence informed this study. Ten sampling locations were established at 20 km intervals along the river from upstream to downstream. Monthly data collection was conducted over a 12-month period. Fish were captured using different fishing gears appropriate for different water depths and foraging behaviors. Water quality parameters were measured onsite and through laboratory analyses following standard methods. Fish species were identified using taxonomic keys, enumerated, and weighed. Data were analyzed using ANOVA, diversity indices (Shannon-Weiner and Simpson), and percentage abundance calculations. A total of 260,674 individual fish (biomass: 80,643.04 kg) belonging to 13 families and 29 species were recorded. Cichlidae and Mormyridae were the most species-rich families (5 species each). Shannon-Weiner diversity index (H'=2.19) and Simpson diversity index (D=0.80) indicated high species diversity. Alestes nurse dominated numerically (17.89%), while Clarias gariepinus contributed the highest biomass (13.45%). Water quality parameters remained within optimal ranges for tropical fish species with no significant spatial variations (P>0.05). The Komadugu Yobe River supports a diverse and evenly distributed fish community, attributable to stable and favorable physicochemical conditions throughout its length. Three species (Barilius senegalensis, Clarias spp., and Tetraodon fahaka) showed evidence of decline and require conservation attention. These findings provide essential baseline data for sustainable fisheries management and biodiversity conservation in the region.

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INTRODUCTION

Komadugu Yobe River, also referred to as River Yobe, flows through Nigeria and the Republic of Niger before draining into Lake Chad. It stands as one of the most economically vital freshwater systems in North-Eastern Nigeria. The river's fisheries resources provide sustenance, employment, and recreational opportunities for hundreds of thousands of residents living along its banks (Audu, 2006). The intensive fishing activities along the river attract numerous fishermen from various northern states of Nigeria. According to Marriott (1991), the river and its floodplains supported 11,092 resident fishermen and 7,143 transient fishermen, with an annual fish catch estimated at 25,392.67 metric tons.

Freshwater ecosystems are home to a substantial proportion of the world's fish biodiversity. Mill, Sparrow-Clark, and Brown (1996) noted that 42% of all fish species inhabit freshwater environments, prompting extensive global research on fish composition and population dynamics in such habitats. Several studies have documented fish species composition, distribution, and abundance across various rivers and water bodies. For instance, Crossman and McAllister (1986) recorded 75 fish species in the Red River Basin (United States), while Underhill (1989) independently documented 80 species from the same system. Similarly, Scarmecchia, Walker, and Rykman (1998) collected 25,000 fish specimens along the Missouri River in Russia, identifying 78 distinct species. In a related study, Ryckman (1981) reported 88 species in the Minnesota River and 65 in the Missouri River. In Argentina, species richness and abundance were observed to increase from upstream to downstream reaches (Bistoni & Hued, 2002), consistent with Horwitz's (1978) findings of a progressive rise in fish species numbers downstream. Ondieki *et al.* (2021) identified 14 fish species in Kenya's Iyabe-Riana River, noting a predominance of non-cichlid species. Delaney, Jamu, and Campbell (2006) documented 12 species in the lower Mnembo River (Malawi and Mozambique), with *Barbus* species being the most numerous (6,709 individuals), while *Labeo cylindricus* contributed the highest biomass (10,434 g). Mohd-Azham and Singh (2019) reported 34 fish species in Malaysia's Keniyam River, with the Cyprinidae family dominating (76%) and *Mystacoelucus marginatus* being the most abundant. In Nigeria, Lawal, Abdullahi, and Abolude (2023) collected 8,273 fish specimens from Mairua Reservoir, identifying 8 species from 7 families, with *Coptodon zilli* being the most prevalent (23.9%). In Akwa-Ibom State, Essien-Ibok and Isemin (2020) found that cichlids, clariids, and cyprinids constituted 46.7% of the fish families in major water bodies. Reed *et al.* (1967) cataloged 107 fish species from 29 families across northern Nigeria's rivers and lakes. Audu (2006) identified 25 fish species within a 25 km segment of the Komadugu Yobe River near its headwaters but did not examine the species' distribution, abundance, or the river's physicochemical characteristics.

The distribution and abundance of fish in aquatic ecosystems are shaped by environmental variables (Ahmad *et al.*, 2011; Obayemi *et al.*, 2024). Numerous researchers have documented the relationship between fish distribution and environmental conditions (Obayomi *et al.*, 2024; Barreto & Uieda, 1998; Oberdorff & Hughes, 1992; Oberdorff & Porcher, 1992; Rahel & Hubert, 1991; Penczak & Mann, 1990). Key factors influencing fish distribution in rivers include temperature, dissolved oxygen, water depth, pH, and turbidity (Tejerina-Garro *et al.*, 2005).

Despite the considerable economic importance of the Komadugu Yobe River's fisheries, there remains a lack of comprehensive data on its fish species composition, abundance, distribution, and water quality parameters. This study aims to address this gap by investigating fish species composition, abundance, and distribution along the full length of the Komadugu Yobe River, while also assessing key physicochemical properties of its water.

MATERIALS AND METHODS

Study Area

The Komadugu Yobe River, which inspired the name of Yobe State, has its source in the elevated Jos Plateau of Nigeria (Genthon, Hector, Luxereau, & Descloitres, 2015). It historically discharged into Lake Chad after passing through two northeastern states—Yobe and Borno (Figure 1). According to the IUCN (1997), the river contributed approximately 1% of Lake Chad's total annual inflow. Within Yobe State, it passes through the Local Government Areas of Nguru, Bade, and Gaidam before extending into Borno State. A portion of the river marks the international boundary between Nigeria and the Republic of Niger. Its geographical coordinates range between latitudes 10° N and 13° N and longitudes 9.45° E and 12.30° E (Waziri & Ogugbuaja, 2010).

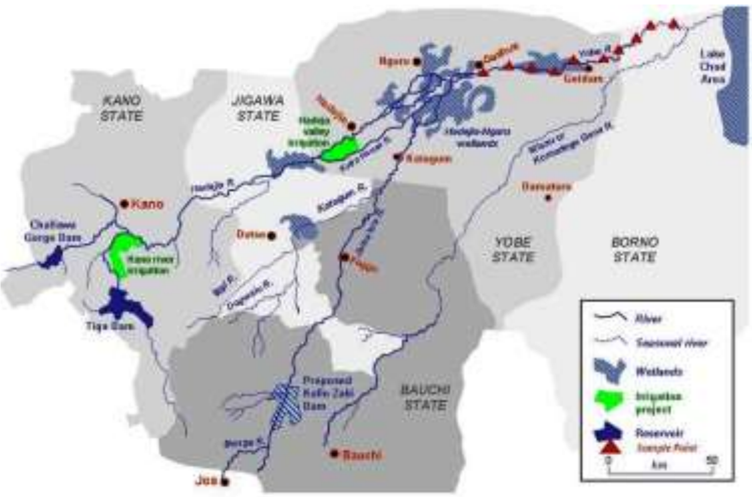

Figure 1: Map of Komadugu Yobe River showing Sample Points

A total of ten sampling locations were selected at 20 km intervals along the river. Monthly data collection was carried out over a 12-month period from June to May 2012, beginning at the upstream section. Each site was visited once per month, and plank canoes were used as the primary means of transportation during fieldwork.

Fish Sampling

Local artisanal fishermen were engaged to capture fish using a range of fishing gear. The equipment used varied according to water depth and included gillnets (30 mm mesh), cast nets (6 mm mesh), basket and Malian traps (25 mm and 20 mm mesh), hooks, dragnets (25 mm mesh), and seine nets (13 mm mesh). Traps were primarily deployed in shallow areas with depths less than one meter. To account for different foraging behaviors across species, fish were collected at different times of the day—morning, afternoon, and evening—during each monthly sampling session.

At each landing site, fish were sorted by species and identified locally with the assistance of fishermen, who used Hausa and Kanuri names. Following identification, specimens were manually enumerated and weighed (in kilograms) using a Camry Premium scale. Two representative samples per species were preserved in 10% formalin for subsequent laboratory identification, following the approach of Bankole, Sule, Okwundu, and Amadi (1994). Taxonomic identification to family and species levels was performed using keys from Reed *et al.* (1967), Trewaves, Green, and Gorbert (1972), Teugels, Reid, and King (1992), and Olaosebikan and Raji (2004).

Water quality parameters—including dissolved oxygen (DO), pH, and temperature—were measured onsite using an ExStik® DO600 multi-parameter meter. Turbidity was assessed using a Secchi disk (Smith, 2001). Depth readings were obtained with a weighted rope. Laboratory analyses for free carbon dioxide and alkalinity were conducted following AOAC (2006) and APHA (2005) protocols. To capture diurnal and nocturnal fluctuations, water quality monitoring was conducted at alternating times (morning, afternoon, and evening).

Ethical Considerations

The authors stated that no ethical approval was required

STATISTICAL ANALYSIS

IBM SPSS (version 20) software was used for the statistical analyses. Data on water quality parameters were analysed by one-way analysis of variance (ANOVA) to determine significant differences at the various fishing points. The difference was checked at $p = 0.05$ level of significance. Treatment means were separated using Tukey's multiple comparisons test. Fish distribution and abundance was computed using Simple percentage. Shannon-weiner diversity index (H') and Simpson diversity index (D) were used to estimate fish species diversity while equitability among species was estimated using Shannon's equitability index (E').

Shannon-weiner index (H') was estimated using the formula: $H' = \sum(pi \times In(pi))$

Where: H' = Shannon-weiner diversity index

Pi = proportion of each species

In = natural logarithm

∑ = summation symbol

Simpson diversity index (D) was estimated using the formula: $D = \sum(pi^2)$

Where: D = Simpson diversity index

Pi = proportion of each species

∑ = summation symbol

Shannon's equitability index (E') was estimated using the formula: $E' = H'/H'max$

Where: E' = Shannon's equitability index

H' = Shannon's diversity index

H'max = maximum possible value of H' calculated using the formula $H'max = In(S)$, where S is the number of species

RESULTS

Fish Species Diversity and Abundance in Komadugu Yobe River

Fish species diversity and abundance in Komadugu Yobe River is presented in Table 1. A total of 260,674 individual fish (biomass 80,643.04 kg) belonging to 13 families and 29 species were sampled from ten study sites along the length of Komadugu Yobe River. Cichlidae and mormyridae had the highest number of species (5 species each) followed by cyprinidae having 4 species. Alestidae and Mochokidae recorded 3 species each; clariidae had 2 species, while the remaining 7 families had one species each. The values of Shannon-weiner diversity index (H') (standard: 1.5 - 3.5) and Simpson diversity index (D) (standard: 0 - 1) were 2.19 and 0.80 respectively, indicating high diversity among fish species.

Alestes nurse, though a relatively small fish (mean weight 0.05 kg), showed numerical superiority recording 17.89% of the sampled fish. This was followed by *Marcusenius psittacus* (10.40%), *Tilapia galilaea* (10.31%), *Tilapia nilotica* (10.26%) and *Tilapia zilli* (9.95%). The least abundant species was *Barilius senegalensis* with a numerical percentage of 0.03%. Abundance by biomass showed that *Clarias gariepinus*, a relatively large fish (mean weight 1.4 kg), was the most abundant (13.45%) species while *Barilius senegalensis*, a very small fish (mean weight 0.001 kg) was the least abundant (0.01 kg).

Table 1: Fish Species Diversity in Komadugu Yobe River

Family	Species	Common Name	Number	% Number	Biomass	% Biomass
Alestidae	*Alestes nurse*	Nurse tetra	46639	17.89	2331.95	2.89
	Alestes baremoze	Silverside tetra	4071	1.56	203.55	0.25
	Hydrocynus lineatus	Tiger fish	2134	0.82	853.60	1.06
Auchenoglanididae	*Auchenoglanis occidentalis*	Western catfish	3351	1.29	2848.35	3.53
Bagridae	*Bagrus dogmac niger*	Silver catfish	4918	1.89	7377.00	9.15
Cichlidae	*Hemichromis bamiculatus*	Jewel fish	2537	0.97	761.10	0.94
	Oreochromis niloticus	Nile tilapia	10878	4.17	5449.00	6.76
	Tilapia galilaea	Galilee tilapia	26876	10.31	10450.40	12.96
	Tilapia nilotica	Tilapia or Mangofish	26731	10.26	8019.30	9.94
	Tilapia zilli	Redbelly tilapia	25939	9.95	5187.80	6.43
Claroteidae	*Chrysicthys auratus*	Golden catfish	3490	1.34	3141.00	3.89
Cyprinidae	*Barilius niloticus*	Nile minnow	3825	1.47	81.50	0.10
	Barilius senegalensis	Senegal minnow	84	0.03	9.20	0.01
	Labeo brachypoma	African carp	4917	1.89	989.34	1.23
	Labeo cheriensis	African carp	5329	2.04	1065.80	1.32
Clariidae	*Clarias gariepinus*	Mudfish	8112	3.11	10845.60	13.45
	Clarias spp	Mudfish	1332	0.51	44.96	0.06
Malapteraridae	*Malapterurus electricus*	Electric catfish	1652	0.63	826.00	1.03
Mochokidae	*Synodontis nigrita*	Black synodontis	2733	1.05	546.60	0.68
	Synodontis schall	Schall's synodontis	2154	0.83	6 46.20	0.80
	Synodontis violoceus	Purple synodontis	3618	1.39	1085.40	1.35
Mormyridae	*Gnathonemus cyprinoides*	trunk fish	3686	1.41	1474.40	1.83
	Marcusenius isodori	Elephantnose fish	8821	3.38	352.84	0.44
	Marcusenius psittacus	Elephantnose fish	27112	10.40	813.36	1.01
	Mormyrus rume	African elephantfish	10408	3.99	4163.20	5.16
	Mormyrus hesselquisti	African mormyrid	2257	0.87	682.50	0.85
Protopteridae	*Protopterus annectens*	African lungfish	3287	1.26	2300.09	2.85
Schilbeidae	*Schilbe mystus*	Glass catfish	12901	4.95	7740.60	9.59
Tetraodontidae	*Tetraodon fahaka*	Puffer fish	882	0.34	352.80	0.44
TOTAL			260674	100.00	80643.04	100.00

Fish Species Distribution and Abundance per Sample Site

Percentage fish species distribution and abundance per sample site along Komadugu Yobe River are presented in Table 2. Fish were equitably distributed along the river but abundance of species progressively increased from headwater-downstream. Shannon's equitability index (E') (standard: 0 - 1) value of 0.84 indicated high equitability among fish species across the length of the river. The table shows that Malamfatori, the last sample site downstream, recorded the highest percentage species abundance (12.44%), followed by Yau (12.31%), Gaidam (12.24%), Kanamma (11.42%), Ajeri (11.28%), and Gallaba (11.11%) sample sites. Azbak, the first sample site upstream, recorded the lowest percentage abundance (6.28%). The table further shows that *Alestes nurse* was a dominant species in the river but most abundant (2.15%) in Malamfatori and least abundant in Azbak (0.89%) while, *B. senegalensis* was the species with the lowest percentage abundance (0.03%) in the river.

Table 2: Fish Species Abundance per Sample Site in River Yobe

SPECIES	NUMBER AND PERCENTAGE ABUNDANCE OF SPECIES										TOTAL
	Azbak	Daskum	Dumburi	Girwan	Ajeri	Gallaba	Gaidam	Kanamma	Yau	Malamfatori	
A. nurse	2332 (0.8946)	3264 (1.2521)	3731 (1.4312)	4664 (1.7892)	5597 (2.1471)	4663 (1.7888)	5597 (2.1471)	5596 (2.1467)	5597 (2.1471)	5598 (2.1475)	46639 (17.8916)
A.	204	326	285	489	405	407	478	488	493	496	4071

baremose	(0.0782)	(0.1250)	(0.1093)	(0.1875)	(0.1553)	(0.1561)	(0.1833)	(0.1872)	(0.1891)	(0.1902)	(1.5612)
H. lineatus	139 (0.0533)	128 (0.0491)	160 (0.0613)	192 (0.0736)	235 (0.0901)	256 (0.0982)	244 (0.0936)	267 (0.1024)	256 (0.0982)	257 (0.0985)	2134 (0.9732)
A. occidentalis	235 (0.0901)	178 (0.0682)	267 (0.1024)	336 (0.1288)	402 (0.1542)	330 (0.1265)	401 (0.1538)	400 (0.1534)	403 (0.1545)	399 (0.1530)	3351 (1.2855)
B. dogmac niger	344 (0.1319)	245 (0.0939)	492 (0.1887)	393 (0.1507)	586 (0.2248)	499 (0.1914)	590 (0.2263)	601 (0.2305)	558 (0.2140)	610 (0.2340)	4918 (1.8862)
H. bamiculatus	165 (0.0632)	152 (0.0583)	190 (0.0728)	228 (0.0874)	279 (0.1070)	317 (0.1216)	279 (0.1070)	304 (0.0411)	305 (0.1170)	318 (0.1219)	2537 (0.9732)
O. niloticus	653 (0.2505)	707 (0.2712)	814 (0.3122)	979 (0.3755)	1197 (0.4591)	1305 (0.5006)	1359 (0.5213)	1198 (0.4595)	1306 (0.5010)	1360 (0.5217)	10878 (4.1726)
T. galilaea	2016 (0.7733)	1727 (0.6625)	1745 (0.6694)	2411 (0.9249)	3225 (1.2371)	2956 (1.1339)	3339 (1.2809)	2957 (1.1343)	3158 (1.2114)	3342 (1.2820)	26876 (10.3097)
T. nilotica	2005 (0.7691)	1738 (0.6667)	1604 (0.6153)	2406 (0.9229)	2940 (1.1278)	2807 (1.0768)	3341 (1.2816)	3208 (1.2306)	3343 (1.2824)	3339 (1.2809)	26731 (10.2537)
T. zilli	1686 (0.6467)	1556 (0.5969)	1945 0.7461	2335 (0.8957)	2853 (1.0944)	3113 (1.1942)	3246 (1.2452)	2983 (1.1443)	2980 (1.1431)	3242 (1.2436)	25939 (9.9502)
C. auratus	175 (0.0671)	244 (0.0936)	279 (0.1070)	350 (0.1342)	418 (0.1603)	349 (0.1338)	418 (0.1603)	417 (0.1599)	419 (0.1607)	421 (0.1615)	3490 (1.3384)
B. niloticus	191 (0.0782)	233 (0.0893)	346 (0.1327)	381 (0.1461)	458 (0.1756)	371 (0.1423)	458 (0.1756)	471 (0.1806)	450 (0.1726)	466 (0.1787)	3825 (1.4717)
B. senegalensis	1 (0.0003)	1 (0.0003)	20 (0.0076)	12 (0.0046)	10 (0.0038)	6 (0.0023)	11 (0.0042)	9 (0.0034)	4 (0.0015)	10 (0.0038)	84 (0.0319)
L. brachypoma	319 (0.1223)	295 (0.1131)	369 (0.1415)	443 (0.1699)	540 (0.2071)	590 (0.2263)	614 (0.2355)	541 (0.2075)	591 (0.2267)	615 (0.2359)	4917 (1.8858)
L. cheriensis	346 (0.1327)	319 (0.1223)	399 (0.1530)	481 (0.1845)	587 (0.2251)	639 (0.2451)	666 (0.2554)	639 (0.2451)	586 (0.2248)	667 (0.2558)	5329 (2.0438)
C. gariepinus	487 (0.1868)	527 (0.2021)	608 (0.2332)	771 (0.2957)	973 (0.3732)	852 (0.3268)	933 (0.3579)	973 (0.3732)	1014 (0.3889)	974 (0.3736)	8112 (3.1119)
Clarias spp	93 (0.0356)	79 (0.0303)	94 (0.0360)	127 (0.0487)	159 (0.0609)	147 (0.0563)	149 (0.0571)	160 (0.0613)	161 (0.0617)	163 (0.0625)	1332 (0.5109)
M. electricus	124 (0.0475)	107 (0.0410)	99 (0.0379)	149 (0.0571)	182 (0.0698)	207 (0.0784)	198 (0.0759)	181 (0.0694)	199 (0.0763)	206 (0.0790)	1652 (0.6323)
S. nigrita	175 (0.0666)	164 (0.0629)	205 (0.0786)	246 (0.0943)	287 (0.1100)	341 (0.1308)	343 (0.1358)	301 (0.1154)	328 (0.1258)	343 (0.1315)	2733 (1.0509)
S. schall	140 (0.053	129 (0.049	140 (0.053	215 (0.082	217 (0.0832	258 (0.0989	269 (0.1024)	215 (0.0824)	280 (0.1074	291 (0.1116)	2154 (0.8251

	7)	4)	7)	4)	)	)			)		)
S. violoceus	235 (0.0901)	217 (0.0832)	271 (0.1039)	326 (0.1250)	397 (0.1522)	434 (0.1664)	456 (0.1749)	399 (0.1530)	433 (0.1661)	450 (0.1726)	3618 (1.3874)
G. cyprinoides	285 (0.1093)	221 (0.0847)	258 (0.0989)	350 (0.1342)	405 (0.1553)	442 (0.1695)	400 (0.1534)	430 (0.1649)	444 (0.1703)	451 (0.1730)	3686 (1.4135)
M. isodori	573 (0.1047)	529 (0.2029)	662 (0.2543)	794 (0.3045)	970 (0.3721)	1058 (0.4058)	1102 (0.4227)	971 (0.3724)	1059 (0.4062)	1103 (0.4231)	8821 (3.3839)
M. psittacus	1627 (0.6241)	1762 (0.6759)	2033 (0.7799)	2440 (0.9360)	2982 (1.1431)	3253 (1.2479)	3389 (1.3000)	2982 (1.1439)	3254 (1.2483)	3390 (1.3004)	27112 (10.3995)
M. rume	624 (0.2393)	677 (0.2597)	781 (0.2996)	937 (0.3584)	1144 (0.4388)	1249 (0.4791)	1301 (0.4990)	1144 (0.4388)	1250 (0.4795)	1301 (0.4990)	10408 (3.9912)
M. hesselquisti	147 (0.0563)	135 (0.0517)	169 (0.0648)	203 (0.0778)	237 (0.0909)	270 (0.1035)	284 (0.1089)	248 (0.0951)	271 (0.1039)	293 (0.1124)	2257 (0.8653)
P. annectens	214 (0.0820)	147 (0.0563)	197 (0.0755)	246 (0.0843)	212 (0.0813)	194 (0.0744)	311 (0.1193)	162 (0.0621)	1296 (0.4971)	308 (0.1181)	3287 (1.2609)
S. mystus	774 (0.2969)	839 (0.3218)	668 (0.2562)	1161 (0.4453)	1419 (0.5443)	1548 (0.5938)	1613 (0.6187)	1419 (0.5443)	1548 (0.5938)	1912 (0.7334)	12901 (4.9485)
T. fahaka	53 (0.0203)	57 (0.0218)	66 (0.0253)	79 (0.0303)	97 (0.0372)	106 (0.0406)	110 (0.0421)	97 (0.0372)	106 (0.0406)	111 (0.0425)	882 (0.3379)
TOTAL	16362 (6.2768)	16681 (6.3992)	19038 (7.3034)	24149 (9.2641)	29413 (11.2834)	28967 (11.1123)	31899 (12..2371)	29761 (11.4169)	32092 (12.3112)	32436 (12.4431)	260674 (100.00)

Values in parenthesis are percentages

Monthly Fish Species Abundance in Komadugu Yobe River

The monthly percentage fish abundance in Komadugu Yobe River is presented in Table 3. The table shows that highest percentage abundance of all fish species was in the month of November (16.227%) and the least percentage abundance was in August (1.604%). Monthly abundance of the species shows that *T. galilaea* was most abundant in the months of January (1.856%), *Mercusenius psittacus* dominated the fish population in the month of February (1.144%), March (1.664%), and April (2.288%), *Alestes nurse* predominated the fish population in May (1.431%), June (0.894%), July (1.253%), August (0.357%), September (0.178%), October (4.831%), and November (2.862%), while in December *T. zilli* was the most abundant (2.292%) species.

Table 3: Monthly Fish Species Abundance in Komadugu Yobe River

SPECIES	MONTH											TOTAL
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
A. nurse	3731 (1.431)	2332 (0.894)	2332 (0.894)	2798 (1.073)	3731 (1.431)	2332 (0.894)	3265 (1.253)	933 (0.357)	466 (0.178)	12593 (4.831)	7462 (2.862)	4664 (1.789)	46639 (17.892)
A. baremoze	326 (0.225)	204 (0.078)	163 (0.063)	285 (0.109)	326 (0.125)	204 (0.078)	285 (0.109)	41 (0.015)	81 (0.031)	1099 (0.421)	692 (0.265)	365 (0.140)	4071 (1.561)
H. lineatus	213 (0.081)	64 (0.02)	43 (0.02)	85 (0.03)	107 (0.04)	149 (0.06)	64 (0.02)	22 (0.01)	43 (0.02)	384 (0.15)	534 (0.20)	426 (0.16)	2134 (0.819)
A. occidental	838 (0.321)	168 (0.06	67 (0.02	167 (0.06	67 (0.02	134 (0.05	67 (0.02	- -	- -	268 (0.103)	670 (0.257)	905 (0.347)	3351 (1.286)

is		4)	5)	4)	5)	1)	5)						
B. dogmac niger	738 (0.283)	492 (0.189)	246 (0.094)	106 (0.041)	90 (0.035)	98 (0.037)	98 (0.037)	54 (0.021)	45 (0.017)	492 (0.189)	984 (0.377)	1475 (0.566)	4918 (1.887)
H. bamiculatus	660 (0.253)	254 (0.097)	127 (0.049)	51 (0.019)	25 (0.009)	12 (0.005)	13 (0.004)	-	-	254 (0.097)	507 (0.194)	634 (0.243)	2537 (0.973)
O. niloticus	1632 (0.626)	1414 (0.542)	544 (0.209)	326 (0.125)	544 (0.209)	544 (0.209)	218 (0.086)	108 (0.041)	218 (0.086)	544 (0.209)	2610 (1.001)	2176 (0.835)	10878 (4.173)
T. galilaea	4838 (1.856)	1344 (0.516)	1344 (0.516)	1075 (0.412)	806 (0.309)	1075 (0.412)	269 (0.103)	538 (0.206)	538 (0.206)	4030 (1.546)	5644 (2.165)	5375 (2.062)	26876 (10.310)
T. nilotica	4010 (1.538)	2138 (0.820)	1069 (0.410)	1337 (0.513)	802 (0.31)	1337 (0.513)	266 (0.102)	535 (0.205)	535 (0.205)	3742 (1.436)	5346 (2.051)	5614 (2.154)	26731 (10.255)
T. zillii	4408 (1.691)	1558 (0.597)	1556 (0.597)	778 (0.298)	1297 (0.498)	778 (0.298)	518 (0.199)	259 (0.099)	1038 (0.398)	3113 (1.194)	4669 (1.791)	5966 (2.292)	25939 (9.951)
C. auratus	175 (0.067)	209 (0.080)	489 (0.188)	873 (0.335)	1047 (0.402)	349 (0.134)	68 (0.026)	- -	- -	70 (0.026)	100 (0.038)	110 (0.042)	3490 (1.339)
B. niloticus	383 (0.147)	115 (0.044)	115 (0.044)	77 (0.029)	38 (0.015)	38 (0.015)	- -	- -	191 (0.073)	1338 (0.513)	956 (0.367)	574 (0.220)	3825 (1.467)
B. senegalensis	11 (0.004)	3 (0.001)	10 (0.004)	21 (0.008)	25 (0.009)	2 (0.001)	- -	- -	- -	1 (0.001)	3 (0.001)	8 (0.003)	84 (0.032)
L. brachypoma	738 (0.283)	246 (0.094)	98 (0.038)	47 (0.018)	55 (0.021)	45 (0.017)	- -	- -	- -	738 (0.283)	1229 (0.471)	1721 (0.660)	4917 (1.886)
L. cheriensis	533 (0.204)	426 (0.163)	159 (0.061)	107 (0.041)	109 (0.042)	105 (0.040)	53 (0.020)	107 (0.041)	- -	799 (0.307)	1599 (0.613)	1332 (0.511)	5329 (2.044)
C. gariepinus	1217 (0.467)	412 (0.158)	400 (0.153)	398 (0.153)	168 (0.064)	162 (0.062)	160 (0.061)	162 (0.062)	166 (0.064)	811 (0.311)	1622 (0.622)	2434 (0.934)	8112 (3.112)
Clarias spp	199 (0.076)	66 (0.025)	67 (0.026)	67 (0.026)	27 (0.010)	25 (0.009)	13 (0.005)	67 (0.026)	40 (0.015)	133 (0.051)	266 (0.102)	362 (0.139)	1332 (0.511)
M. electricus	247 (0.095)	165 (0.063)	165 (0.063)	83 (0.032)	479 (0.184)	17 (0.007)	- -	- -	- -	83 (0.032)	165 (0.063)	248 (0.095)	1652 (0.634)
S. nigrita	191 (0.073)	301 (0.115)	410 (0.157)	541 (0.208)	541 (0.208)	273 (0.105)	137 (0.053)	27 (0.010)	29 (0.011)	80 (0.031)	94 (0.036)	109 (0.042)	2733 (1.048)
S. schall	129 (0.049)	258 (0.099)	345 (0.132)	409 (0.157)	433 (0.166)	194 (0.074)	108 (0.041)	22 (0.008)	19 (0.007)	65 (0.025)	68 (0.026)	84 (0.032)	2154 (0.826)
S. violoceus	253 (0.097)	470 (0.180)	543 (0.208)	760 (0.292)	687 (0.264)	325 (0.125)	144 (0.055)	1 (0.001)	75 (0.029)	72 (0.028)	144 (0.055)	144 (0.055)	3618 (1.388)
G. cyprinoides	368 (0.141)	369 (0.142)	369 (0.142)	194 (0.074)	180 (0.069)	184 (0.071)	111 (0.043)	74 (0.028)	188 (0.072)	369 (0.142)	553 (0.212)	737 (0.283)	3686 (1.414)
M. isodori	794 (0.305)	970 (0.37	1499 (0.57	1853 (0.71	882 (0.33	441 (0.16	176 (0.06	176 (0.06	443 (0.17	- -	882 (0.338)	705 (0.270)	8821 (3.384)

		2)	5)	1)	8)	9)	8)	8)	0)				
M. psittacus	2711 (1.039)	2982 (1.144)	4338 (1.664)	5964 (2.288)	2169 (0.832)	1627 (0.624)	1084 (0.416)	- -	- -	1628 (0.625)	2440 (0.936)	2169 (0.832)	27112 (10.400)
M. rume	1561 (0.599)	1353 (0.519)	1145 (0.439)	312 (0.120)	208 (0.080)	312 (0.120)	104 (0.039)	105 (0.040)	104 (0.039)	1457 (0.559)	1665 (0.639)	2082 (0.799)	10408 (3.993)
M. hesselquisti	293 (0.112)	339 (0.130)	271 (0.104)	45 (0.017)	68 (0.026)	45 (0.017)	43 (0.016)	25 (0.009)	- -	271 (0.104)	406 (0.156)	451 (0.173)	2257 (0.865)
P. annectens	131 (0.050)	131 (0.050)	66 (0.025)	33 (0.013)	30 (0.012)	69 (0.026)	822 (0.315)	657 (0.252)	460 (0.176)	526 (0.202)	198 (0.076)	164 (0.063)	3287 (1.260)
S. mystus	646 (0.248)	2838 (1.089)	1419 (0.544)	3225 (1.237)	1032 (0.396)	258 (0.099)	387 (0.148)	258 (0.099)	645 (0.247)	516 (0.199)	774 (0.299)	703 (0.269)	12901 (4.949)
T. fahaka	53 (0.020)	106 (0.041)	141 (0.054)	168 (0.064)	185 (0.071)	79 (0.030)	44 (0.017)	9 (0.003)	9 (0.003)	26 (0.009)	27 (0.010)	35 (0.013)	882 (0.338)
TOTAL	32028 (12.287)	21727 (8.335)	19540 (7.496)	22185 (8.510)	16178 (6.206)	11213 (4.302)	8517 (3.267)	4180 (1.604)	5333 (2.046)	35502 (13.619)	42299 (16.227)	41972 (16.101)	260674 (100.000)

Values in parenthesis are percentages

Water Quality Parameters

The mean physico-chemical parameters (Dissolved Oxygen,, free carbon dioxide, alkalinity, pH, temperature, and turbidity) in all the sample sites are presented in Table 4. Mean Dissolved Oxygen (DO) ranged from 5.99±0.01mg/L in Girwan to 7.30±0.03 mg/L in Ajeri sample sites, while mean free carbon dioxide (CO_2) ranged between 5.03±0.32 mg/L in Gallaba and 9.01±0.00 mg/L in Gaidam. Alkalinity was lowest (56.57±0.01) in Dumburi and highest (60.20±0.00) in Daskum. Lowest pH (6.45±0.02) was recorded in Ajeri while the highest (7.08±0.05) was recorded in Kanamma. Mean Temperature ranged between 27.10±0.00 ºC in Azbak and 30.08±0.00 ºC in Girwan while mean turbidity ranged between 35.10±0.04 cm in Daskum and 40.20±00cm in Ajeri. Statistically, no significant difference (P>0.05) exists between the physico-chemical parameters in all the sample sites.

Table 4: Mean Water Quality Parameters of Sample Sites in Komadugu Yobe River

Sample Site	Parameter					
	DO (mg/L)	Free CO_2 (mg/L)	Alkalinity (mg/L)	pH	Temp (ºC)	Turbidity (cm)
Azbak	6.95±0.21	6.00±1.00	57.54±2.32	6.85±0.00	27.10±0.00	40.00±05
Daskum	7.05±0.08	5.45±0.06	60.20±0.00	7.02±0.09	30.08±0.02	35.10±04
Dumburi	7.05±0.23	6.04±0.00	56.57±0.01	6.85±0.00	27.85±0.00	40.00±01
Girwan	5.99±0.01	8.03±0.01	60.00±2.02	7.01±0.04	30.08±0.00	38.50±04
Ajeri	7.30±0.03	6.09±0.06	58.65±3.00	6.45±0.02	27.98±0.10	40.20±00
Gallaba	6.65±022	5.03±0.32	56.89±0.81	6.55±0.01	30.01±0.02	36.40±00
Gaidam	6.65±004	9.01±0.00	56.78±3.00	7.05±0.00	28.85±0.08	37.20±05
Kanamma	7.11±0.05	6.08±0.00	57,56±2.02	7.08±0.05	27.99±0.05	38.00±00
Yau	6.44±0.05	5.08±0.04	60.11±0.07	6.56±0.03	29.50±0.02	37.30±01
Malamfatori	5.96±0.04	7.00±0.05	58.58±0.65	6.55±0.05	27.50±0.03	35.40±03
P-Value	0.10	0.08	0.65	0.66	1.05	1.06

DISCUSSION

Assessments of fish species richness and distribution are essential for informed fisheries management and biodiversity conservation (Ipinmoroti & Iyiola, 2022). This study recorded a total of 260,674 individual fish, representing 13 families and 29 species. These figures exceed those documented by Audu (2006), who reported 25 species from 17 genera based on 12,638 individuals sampled within a 25 km upstream section of the same river. The greater species count observed in the current study may be attributed to the broader spatial coverage, encompassing both upstream and downstream stretches. Comparable findings of high species richness have been reported by Danba *et al.* (2020), Ohaturuonye *et al.* (2018), and Scarnecchia *et al.* (1998), while lower species numbers were noted by Ipinmoroti and Iyiola (2022) and Ondieli *et al.* (2021).

In terms of species dominance, *A. nurse* was the most abundant in number, whereas *C. gariepinus* contributed the highest biomass. This pattern aligns with observations by Delaney *et al.* (2006) in the Mnembo River, where *Barbus* spp. dominated numerically and *Labeo cylindricus* led in biomass. The prevalence of the Cichlidae family in both abundance and biomass mirrors the results of Ohaturuonye *et al.* (2018). Additionally, species richness in the present study increased progressively from upstream to downstream, consistent with the findings of Bistoni and Hued (2002) and Mostafavi *et al.* (2021).

Monthly variations in fish abundance were also evident, with the highest counts recorded in November and the lowest in August. This seasonal pattern is consistent with the work of Kerschbaumer *et al.* (2020), who observed peak values from September to November and declines in July and December. The elevated abundance in November may be linked to increased food availability and heightened reproductive activity during that period.

Water quality parameters—such as dissolved oxygen (DO), pH, temperature, and turbidity—are critical to fish health and ecosystem productivity (Atlas Scientific, 2024). Suitable water conditions support fish survival and growth (Bhatnagar & Devi, 2019), while poor quality can induce stress and disease (Devi *et al.*, 2017).

In this study, mean DO concentrations across sampling sites ranged from 5.96±0.04 to 7.30±0.03 mg/L, which falls within the recommended minimum of 5 mg/L for optimal fish health (Francis-Floyd, 2003). Free carbon dioxide (CO_2), while not directly toxic, can cause physiological stress at levels above 20 mg/L and become lethal above 60 mg/L (Boyd, 2008). The ideal range for fish production is 5–10 mg/L (Boyd, 2008), and the recorded values (5.03±0.04–9.01±0.00 mg/L) are within this acceptable range. Mean water temperatures ranged from 27.50±0.03 to 30.08±0.02°C, which aligns with the optimal growth range of 25–30°C for tropical fish species (Gosh *et al.*, nd). Total alkalinity, though not directly affecting fish, plays a vital role in buffering pH changes. The recommended minimum for buffering is 20 mg/L $CaCO_3$ (Reboucas *et al.*, 2015), with an upper limit of 200 mg/L $CaCO_3$ for optimal fish production (Wurts & Durborow, 1992). The observed alkalinity range (56.57±0.01–60.11±0.07 mg/L $CaCO_3$) falls well within these thresholds. Similarly, turbidity levels (35.10–40.00±0.05 cm) were within the desirable range of 30–80 cm for healthy fish populations (Bhatnagar *et al.*, 2004).

CONCLUSION

The distribution and abundance of fish species are strongly influenced by the physicochemical properties of their aquatic environment. In a river system where these parameters remain relatively uniform, fish species tend to be evenly distributed. The consistent occurrence of 29 fish species throughout the Komadugu Yobe River can be attributed to the favorable and stable conditions of temperature, dissolved oxygen, pH, alkalinity, free carbon dioxide, and turbidity observed along its course.

RECOMMENDATIONS

Fishermen may harvest any of the identified species from any part of the river, with the exception of *Barilius senegalensis*, *Clarias* spp. (locally known as Hana noma), and *Tetraodon fahaka*, which are already considered endangered. Further research is recommended to investigate the factors contributing to the decline of these three species and to inform conservation strategies.

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