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Short Communication

Studies on Physico-Chemical Parameter, Fish Species Composition and their Condition Factor in Guma River in Obi LGA of Nasarawa State

Danwali IM[1*], Kigbu AA[1], and Ibrahim AS[2]

[1]Department of Aquaculture and Fisheries Management, Nasarawa State University Keffi, Nigeria.

[2]Department of Fisheries and Aquaculture Technology, Federal University of Technology Owerri, Nigeria

Abstract

Study on the ichthyofauna and physico-chemical parameters of Guma River, Obi Local Government Area of Nasarawa State, was carried out for a period of four months (April-July, 2021). Fish specimen were obtained from the fishers fishing in the river while water sample were analysed twice a month using Lamotte aquaculture testing kit. The result showed that a total of 21 fish species belonging to 10 families were present in the river which was considered rich enough for that type of water body. The families Cichlidae, Characidae, Mormyridae, Bagridae and Clariidae constituted the dominant fish species in the river with 31.11%, 15.98%, 15.00%, 11.95% and 8.20% respectively. The result further shows that most of the fish species has condition factor above 1, with Sarotherodon galileaus having the highest condition factor of 3 while Clarias anguillaris has the lowest condition factor of 0.88. The result of water quality showed slight variations in the monthly means and station values. Despite these variations, the values obtained were within the recommended range for fish culture, for most of the tropical freshwater fish's production.

Keywords: Physico-chemical parameters; Guma River; Fish species and Condition factor.

INTRODUCTION

According to Shivashankar and Venkataramana [1], a river's icthyodiversity basically reflects the variety and quantity of its fish species. Water quality monitoring is the initial step toward aquatic ecosystem management and protection. The distribution and population density of both fauna and flora in any aquatic habitat are significantly impacted by seasonal changes in physio-chemical parameters [2]. According to Chimanat and Traichaiyaporn [3], insufficient water flow, industrial discharges, and municipal effluents can all contribute to poor water quality. Every living thing can function at its best within acceptable bounds of water quality criteria. Their bodily systems are negatively impacted by a sudden decrease or rise within these bounds [4]. Low profits, subpar products, and even health hazards for people can all be caused by poor water quality. Contaminants in the water can hinder growth, development, and production, or even kill the cultivated species, which lowers productivity. Even in little amounts, some pollutants can build up to the point where they endanger human health without having any discernible negative consequences [5]. However, the yields of the majority of these inland waterways are usually declining as a result of environmental deterioration, including water pollution and inadequate or poor management of fishery resources [6]. In order to measure ecological risk in aquatic ecosystems, the Environmental Protection Agency (EPA) suggested species richness and relative abundance [7]. According to Odo *et al*. [8], the Anambra River in Nigeria is home to an estimated fifty-two (52) fish species from seventeen (17) families. Nigeria's fisheries and fish resources are not only extremely valuable economically, but they also significantly contribute to the country's food security and serve as a key source of jobs in rural regions. The amount and quality of the nation's water resources have a direct impact on the diversity of fish stocks [9]. Based on the idea that heavier fish of a given length are in better condition, the condition factor compares the health of a fish [10]. Growth and feeding intensity have been measured using the condition factor [11]. As length increases, condition factors diminish [11]; they also affect the fish reproductive cycle [12]. This study is aim at determining the relationship between physio-chemical parameters and fish species of River Guma in Obi Local Government of Nasarawa State.

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***Corresponding author:** Danwali IM, Department of Aquaculture and Fisheries Management, Nasarawa State University Keffi, Shabu-Lafia Campus, Nigeria, Tel: +2348033847329, 0009-0005-8783-2073

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MATERIALS AND METHODS

Study Area

The study was carried out in River Guma which is one of the perennial rivers in Obi L.G.A of Nasarawa State. The river is situated between latitude 8º. 201N and 8º. 231N and longitude 8º. 401E and 8º. 441E. The River is susceptible to flooding in raining season with high water volume, but less water during dry season.

Collection of Fish Specimen

Fish specimen were collected twice in a month from fishermen fishing in the river and was identified according to species and family as described by Olaosebikan and Raji (2013).

Physico-chemical Parameters Analysis

Water sample was collected twice in a month beginning from April, 2021 to July, 2021. Physico-chemical parameters of the water body was analyzed using LaMotte Aquaculture testing kit (model AQ-2 code 3633-03). Water temperature was determined in the field using an analog clinical thermometer of LaMotte aquaculture test kit. The water temperature was taken by lowering the electrode of the thermometer into the water at immersion level for 3-5 minutes and removed, the reading was taken immediately. The readings was taken in degree Celsius. Turbidity was determined in the field using Secchi disc.

Determination of Condition Factor and Fish Species Abundance.

Fish species abundance was checked using a simple percentage, and the condition factor (k) of the fishes was calculated using the k=w (100) connection.

Where: K= condition factor, W= weight of fish (g), L= fish length (Length of fish cm), 100= constant

Statistical Analysis

To confirm a significant difference, SPSS version 20.0 was used to perform a one-way analysis of variance (ANOVA) on the data collected for physico-chemical parameters. Means was separated using least significance difference (LSD) while descriptive statistic was used for fish species composition.

RESULTS AND DISCUSSION

Physico-Chemical Parameters of Guma River

The productivity and survival of the majority of tropical fish species were within the range of the majority of the physicochemical parameters that were examined. The effect of rainfall over the study months, which warms the weather and influences water temperature, may be the cause of the mean water temperature seen between the months. Warm water fish thrive in temperatures between 25.0°C and 32.0°C, according to Obo *et al*. [13], whereas Boyd and Onwughara *et al*. [14] noted that water temperatures in tropical climates are consistently high. Since fish are cold-blooded creatures, their body temperature fluctuates in response to their surroundings, which impacts their physiology and metabolism and ultimately their ability to produce and survive [15] (Table 1).

According to Ombaka *et al*. [16], clay turbidity in water should not exceed 30 cm, which is consistent with the results of this investigation. According to Bhatnagar *et al*. [17], fish health benefits from turbidity levels between 30 and 80 cm.

According to the TSS ranges, the results are within the permissible range for fish production. According to Oluyemi *et al*. [18], a maximum TSS level of 600 mg/L is appropriate for healthy fish production.

The study's average pH falls between the 6.5 and 9.0 range that Buridi and Gedala [19], propose. According to Ombaka *et al*. [16], aquatic life may thrive in a pH range of 5.0 to 9.5.

The main sources of oxygen in water are atmospheric air and photosynthetic planktons. Dissolved oxygen is essential to aquatic species' survival, growth, distribution, behavior, and physiological processes. The higher and more frequent agitation rate by wind current may be the cause of the highest dissolved oxygen readings, which are in the middle of ranges. Reduced oxygen levels in water are a sign of chemical aquifer degradation or microbiological contamination [20] (Table 2).

The study's BOD results demonstrate that the river is clean. According to KEBS (2010), BOD values between 2 and 4 mg L-1 do not indicate pollution, however those above 5 mg L-1 indicate substantial contamination.

According to Stone and Thomforde [21], the total hardness value obtained during the investigation is within the acceptable range of greater than 10 mg L-1as CaCO3, and the ideal range is between 50 and 150 mg L-1as CaCO3. According to Santhosh and Singh [22], fish output can benefit from a hardness range of 30-180 mgL-1.

Since ammonia nitrogen levels below 0.02 ppm were deemed acceptable by OATA [23], the values found in this study are higher and dangerous for fish. Bacteria that break down organic materials like food scraps, excrement, and sewage may be the cause of this [17]. The lowest

Table 1: Mean Physico- Chemical Parameters Measured at Different Study Sites of Guma River

	Sites		
Parameters	**A**	**B**	**C**
Temperature (°C)	25.50±0.50^{a}	26.45±0.25^{a}	26.50±0.50^{a}
Turbidity (cm)	20.50±0.50^{a}	22.25±0.25^{a}	23.50±0.50^{a}
Total Suspended Solids (ppm)	4.15±0.35^{b}	4.40±0.60^{b}	7.65±0.15^{a}
pH	6.10±0.10^{a}	6.25±0.25^{a}	6.20±0.20^{a}
Dissolved oxygen (mg/l)	6.10±0.10^{a}	5.05±0.05^{a}	4.50±0.30^{b}
BOD (ppm)	1.11±0.10^{c}	2.23±1.40^{b}	2.95±0.15^{a}
Total hardness (ppm)	100.50±0.50^{b}	101.50±0.50^{b}	148.00±3.00^{a}
NH_3-N (ppm)	1.76±0.05^{c}	2.21±0.20^{b}	2.68±0.23^{a}
Alkalinity (ppm)	36.50±1.50^{b}	40.50±0.50^{a}	42.00±3.00^{a}
Electrical conductivity (µs/mm)	170.00±10.00^{a}	132.50±2.50^{b}	132.50±7.50^{b}

Table 2: Mean monthly physico-chemical parameters measured at different study months

	Temperature (^{0}C)	Turbidity (cm)	TSS (ppm)	pH	DO (mg/l)	BOD (ppm)	Hardness (ppm)	NH_3-N (ppm)	Alkalinity (ppm)	EC (µs/mm)
April	26.75^{a}	35.50^{a}	3.80^{c}	6.25^{b}	4.65^{b}	1.16^{c}	101.00^{c}	1.65^{c}	36.00^{d}	162.50^{a}
May	26.25^{a}	33.00^{a}	3.90^{c}	6.35^{b}	4.70^{b}	1.90^{b}	107.00^{b}	1.95^{c}	38.50^{c}	142.50^{b}
June	25.25^{a}	20.50^{b}	6.05^{b}	6.95^{b}	5.25^{a}	2.60^{a}	138.00^{a}	2.35^{b}	40.50^{b}	136.50^{c}
July	25.50^{a}	17.50^{c}	7.35^{a}	7.50^{a}	5.90^{a}	2.71^{a}	140.00^{a}	2.70^{a}	43.50^{a}	127.00^{d}
G.Mean	25.94	26.63	5.28	6.76	5.13	2.09	121.50	2.16	39.63	142.13
SEM	0.34	4.47	0.86	0.29	0.29	0.26	10.19	0.23	1.59	7.50

^{abc} Mean values with different superscript along the row are significantly different ($p<0.05$)

value of 25.50 mg/l may be due to respiration, nitrification, and sulphide oxidation, which decrease or consumed alkalinity, while the highest value of 59.00 mg/l recorded for alkalinity in site 3 may be due to denitrification, photosynthesis, and sulphate reduction, which is primarily responsible for increasing alkalinity [24].

According to Stone and Thomforde [21], the electric conductivity measured in this study falls between 30 to 5,000 m Siemens/cm for fish production.

Fish Species Identified in Guma River and their Percentage Composition

The result of fish species composition of Guma River indicated that the river is very rich in fish Fauna diversity, as 21 species belonging to 10 families were recorded during the study period. The findings of this study concur with those of numerous other researchers, such as Abdullahi [25], who reported 26 fish species found in the River Benue near the Boronji Area; Akanbi [26], who found 26 fish species in the Ogun Estuary, Ogun State; and Nazeef and Abubakar [27], who reported 15 fish species found in Dadin Kowa Dam, Gombe State.

The prevalence of cichlid fishes (31.11%) is consistent with what is found in several other African rivers and reservoirs [28]. The family's dominance in terms of species variety, quantity, and weight may be attributed to the abundance of plankton as a food supply, their prodigious capacity for reproduction, their robust adaption to the lacustrine conditions of these bodies of water, and the excellent quality of the water. One possible explanation for the high percentage of *Tilapia zilli* (12.08%) is that their high species index and abundance were a result of the lack of many predators (carnivorous animals) to control their prolific reproduction. Despite the fact that *Tilapia zilli* has been shown to be the dominating species in several African reservoirs [29], the populations of carnivorous and forage species may not be balanced in these reservoirs. The poor breeding rates of *Heterobranchus bidorsalis* and *Synodontis clarias*, changes in the river environment that may make them less appropriate for the species, migration, and overexploitation of the families may all contribute to their low abundance in the families. The species in the river are threatened and might become endangered, especially if there is only one species in each family. According to Wade [30], a condition factor of one or above is favorable. The condition factors of the majority of fish species are more than one. These might be explained by the river's shallowness, excellent water quality, and appropriate spawning habitat. The fish community composition in the river was also influenced by the high survival rate of various species' larvae and fingerlings as well as abundant food sources. The water quality parameter results showed that every parameter is within the range that is advised for fish productivity and other fish food fauna survival [31]. This is perhaps another factor contributing to the river's high recorded variety of fish species (Table 3).

CONCLUSION

The result of this study showed variation in fish species in the study area with Cichlidae being the most dominant fish species in the river. The high number of fish species recorded in this study shows that the river is productive. The presence of dominant species to be either primary or secondary consumers is indicating a high potential for sustainable fish production under adequate management. The good condition factor of the some species shows that there is input of allochthtonous material, and high primary productivities in the river, hence high availability of food resources and increase habitat biodiversity.

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Table 3: Mean value of physico-chemical parameters measured in Guma river compared with recommended range of WHO (2010)

Parameters	Site average	Recommended range (WHO, 2010)
Temperature (°C)	26.15	15-35
Turbidity (cm)	22.08	30-40
Total Suspended Solids (ppm)	5.40	—
pH	6.18	5.5-9.0
Dissolved oxygen (mg/l)	5.22	5.0-8.0
BOD (ppm)	4.12	3.0-6.0
Total hardness (ppm)	116.67	75-150
NH_3-N (ppm)	2.21	0.05-0.15
Alkalinity (ppm)	39.67	25-100
Electrical conductivity (µs/mm)	145	10-100

Table 4: Fish Species Identified in Guma River and their Percentage Composition

Family	Species identified	Number identified	Percentage (%)
Cichlidae	*Tilapia zilli*	87	12.08
	Oreochromis niloticus	65	9.03
	Tilapia dageti	22	3.06
	Sarotherodon galilaeus	16	2.22
	Hemichromis bimaculatus	34	4.72
	Sub Total	**224**	**31.11**
Characidae	*Hydrocynus lineatus*	28	3.89

	Hydrocynus forskalli	49	6.81
	Alestes baremose	38	5.28
	Sub Total	**115**	**15.98**
Claridae	*Clarias gariepinus*	30	4.17
	Clarias anguillaris	18	2.50
	Heterobranchus bidorsalis	11	1.53
	Sub Total	**59**	**8.20**
Mormyridae	*Mormyrus rume*	65	9.03
	Mormyrops deliciosus	24	3.33
	Hyperopisusbebe occidentalis	19	2.64
	Sub Total	**108**	**15.00**
Bagridae	*Bagrus bayad*	57	7.92
	Clarotes laticipe	29	4.03
	Sub Total	**86**	**11.95**
Chanidae	*Channa obscura*	25	3.47
Malapteruridae	*Malapterurus electricus*	12	1.67
Gymnarchidae	*Gymnarchus niloticus*	37	5.14
Osteoglossidae	*Heterotis niloticus*	46	6.39
Mochokidae	*Synodotis clarias*	8	1.11
Total 10	**21**	**720**	**100**

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