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Fish Community Composition, Abundance and Distributions in Okura River in Dekina Local Government Area, Kogi State, Nigeria

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ABSTRACT: Fish communities can provide valuable insights into the ecological integrity of aquatic ecosystems as they are highly sensitive indicators of water quality. Consequently, the objective of this paper is to investigate the fish community composition, abundance and distribution in the Okura River in Dekina Local Government Area (LGA), Kogi State, Nigeria using appropriate standard procedures. Our results showed a total of seven (7) fish species belonging to six families and five orders. The variation in the Simpson, Shannon, weinner, dominance and evenness was not significantly different in the three dominant fish species encountered in the Okura River. The index measured for fish species, showed slight difference among them. The variation in the Simpson, Shannon, Weiner and Evenness was not significant different in the three dominant fish species in the Okura River. The Simpson index ranged from 0.953 in *E. callipterus* to 0.957 in *T. zilli*, the Shannon index ranges from 3.102 in *E. callipterus* to 3.156 in *T. zilli*. The fish community composition indicates that the fish communities are mature and stable. Periodic checks of the Okura River using fish communities as indicators of water quality can provide a framework for monitoring the ecological health of the water body.

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Introduction:

Fish species and communities are great indicators of ecological and biological integrity due to their continuous exposure to the water conditions (Gardali *et al.*, 2012). Fishes display a range of biotic responses, such as alternation in condition factor, abundance and distribution is related to the status of the environment, eutrophication, organic enrichment, water pollution, thermal changes, chemical toxicity and food availability and thus, is crucial components of biomonitoring programs (Helfman, 2007). Their sensitivity to changes in habitat conditions and water quality enables them play a key role in maintaining the stability and integrity of aquatic ecosystems (Simon and Evans 2017; Jargal *et al.*, 2023). Thus, changes in fish community assemblages can effectively indicate the ecological conditions by highlighting functional changes in aquatic systems under environmental perturbations (Jargal *et al.*, 2022). Biological assessments, such as fish community analyses, can provide valuable

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information into the effects of pollutants, changes in habitat, and restoration efforts (Vadas *et al*., 2022). Fish composition, abundance, distribution, and diversity can provide real-time impacts of pollutants and changes in habitat, as well as offer important insights into the overall health of the river (Bylak *et al*., 2024). Okura River, in Kogi State, Nigeria, is an important source of water for domestic, industrial, and agricultural uses. However, the river is facing numerous environmental challenges, including pollution, habitat degradation, and overfishing (Akinbuwa, 2017). Due to their life history traits, early-warning signals of anthropogenic stress on natural ecosystem dynamics can be inferred. They are sensitive to a wide range of environmental stresses, from parasites, diseases to acidification. Further, due to such factors as rapid growth rates, habitat choice, large body sizes, and trophic level, many fish can bio-accumulate toxic substances (Holmlund and Hammer, 1999).

Previous documented work on fish community studies includes works by Ogidiaka *et al*. (2013), Ogidiaka and Ikomi, (2021), Kim et al. (2024), Jargal et al. (2024. Other reports on the Okura River include studies by Emurotu *et al*. (2016 on the water quality and Onimisi (2022 on the exploitation status of the fishery resources. To the best of my knowledge, there are no documented reports analysing fish community composition, abundance and distributions in the Okura River. Consequently, the objective of this paper is to investigate the fish community composition, abundance and distribution in the Okura River in Dekina Local Government Area (LGA), Kogi State, Nigeria. This study, therefore, attempts to bridge that gap in knowledge.

MATERIALS AND METHODS

Study Area: The Okura River in perspective cuts across several communities in Dekina Local Government Area (LGA), Kogi State. It lies between Latitudes 7˚00´N to 7˚30´N and longitudes 7˚00´E to 7˚30´E of the Greenwich meridian, stretching over a distance of about 81.5km. The river has it source from Igbobe and Olla in Omala Local Government Area of Kogi State and empties into Anambra River (Onimisi and Ogbe, 2018). Water from this river is used for domestic purposes such as drinking and washing by communities along the river course. It is also used for recreational activities such as swimming. Around the river are small farmlands owned by members of the communities where food crops like cassava are cultivated at a subsistent scale, and fishing activities also take place along the river course.

Fish samples were collected with ice pack containers labelled site one to site four, from the fish landing sites (Figure 1).

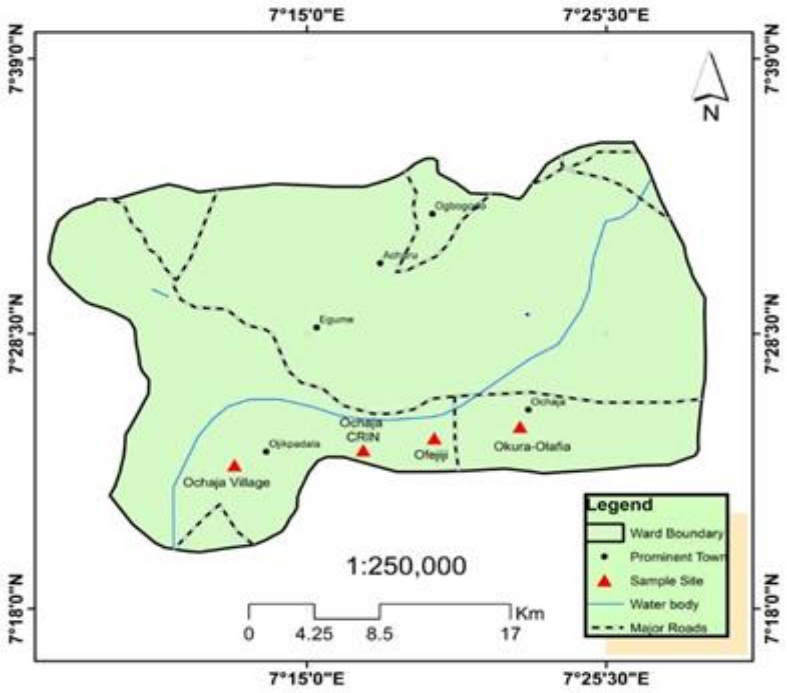

Fig. 1: Sampling locations along Okura River

The sampling points are; Okura-Olafia (7°25.03´N, 07°22.30´E) ; Ofejiji (07°24.55´N, 07°19.39´E) ; Ochaja CRIN (07°24.03´N, 07°17.00´E); Ochaja Village (07°23.55´N, 07°12.50´E). These stations were selected based on the type of anthropogenic activities.

They were taken to the laboratory, identified using standard reference materials (Balogun (2006); Idodo-umeh (2003); Pauly *et al.* (2004)) and counted. Fish community structure was calculated using the diversity indices and Evenness. The Computer BASIC Programmer SP DIVERS, BAS on richness, diversity, and evenness indices were used in characterizing the fish communities. The formulae used are shown below:

Taxa richness: The maximum possible diversity for a given set of data consisting of K category was calculated using the formula;

$$H_{max} = \text{LogK} \quad (1)$$

Where K represents the number of categories

Simpson's Diversity Index (D) was calculated as;

$$(\text{D}) = \frac{\sum(\text{ni}(\text{ni}-1))}{\text{N}(\text{N}-1)} \quad (2)$$

Where ni denotes the number of individuals in a single species, and N represents the total number of individuals in all species.

Shannon-Wiener Index (H) was calculated as**;**

$$\text{H} = \frac{\text{NlogN} - \sum \text{fi} \log \text{fi}}{\text{N}} \quad (3)$$

Where H represents the index of species diversity/degree of uncertainty; N is the total number of individuals; f_1 denotes the proportion of the total sample belonging to i^{th} species

Evenness or Homogenity **(**Equitability index, E) is expressed as;

$$\text{E} = \frac{\text{H}}{\text{Hmax}} \quad (4)$$

RESULTS AND DISCUSSION

Heterobranchus longipinnis, Tilapia zilli and *Enteromius callipterus* (Barb Fish) were abundant in the Okura River, Kogi State. *Tilapia zilli* (13.71) was the most abundant, followed by *Heterobranchus longipinnis* (13.33), while the least was *E. callipterus* (11.29). *Heterobranchus longipinnis* had its highest occurrence in October (15.00), which was not significantly different from September (14.75), November (14.50) and August (14.50) (Table 1).

Table 1: Occurrence of Fish Species in Okura River, Kogi State, Nigeria**.**

Months	***Heterobranchus longipinnis***	***Tilapia zilli***	*Enteromius callipterus*
August	14.50±4.12a	17.25±2.22a	16.50±2.08a
September	14.75±4.86a	15.75±2.50ab	14.00±2.45ab
October	15.00±3.74a	14.75±2.22ab	10.75±2.99bc
November	14.50±2.38a	13.00±1.15bc	10.00±3.92bc
December	12.50±2.38ab	11.00±1.15c	9.00±4.08bc
January	8.75±0.96b	10.50±1.00c	7.50±3.79c
Total	**13.33±3.71**	**13.71±2.97**	**11.29±4.28**
p Value	0.113ns	0.000*	0.012*

Site four had the highest occurrence for this species throughout the months of sampling (Fig. 1). No significant difference ($p>0.05$) in fish occurrence was recorded across the months. *T. zilli* had the highest occurrence in August (17.25) which was not significantly different from September (15.75) and October (14.75) but significant different from the other months. Site four had the highest occurrence also for this species (Fig. 2). *E. callipterus* had its highest occurrence in August (16.50), followed by September (14.00) while the least was in January (7.50). Significant difference ($p\leq0.05$) existed across the months (fig. 3). Site four had the highest abundance for this fish species (Fig. 3). Other fish species encountered during the course of the study are listed from the fourth (4^{th}) row in the table 2. During this study, a total of 3 fish species belonging to 3 families and 3 orders were abundant throughout the study period while other four species were also discovered in scanty numbers making the total number of fish species observed to be seven (7) belonging to six families and five orders. This was lower than what was observed by Onimisi (2015) who recorded eight (8) fish species in the same Okura River in 2014. The difference or the drop in the fish species may be as a result of her sampling points which had more points than this present study.

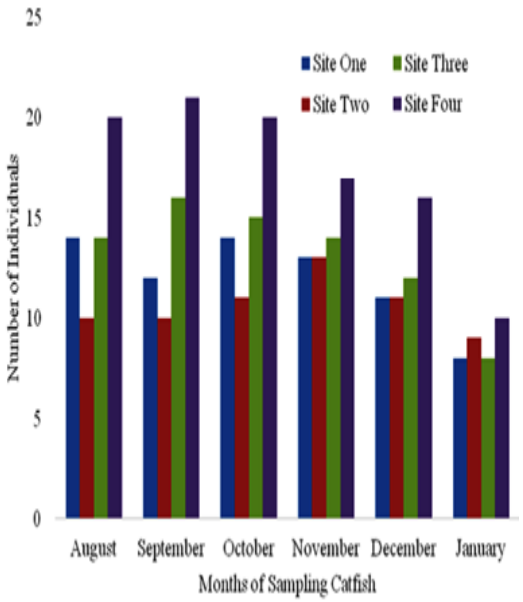

Fig 1: Fish occurrence was recorded across study sites and months in Okura River

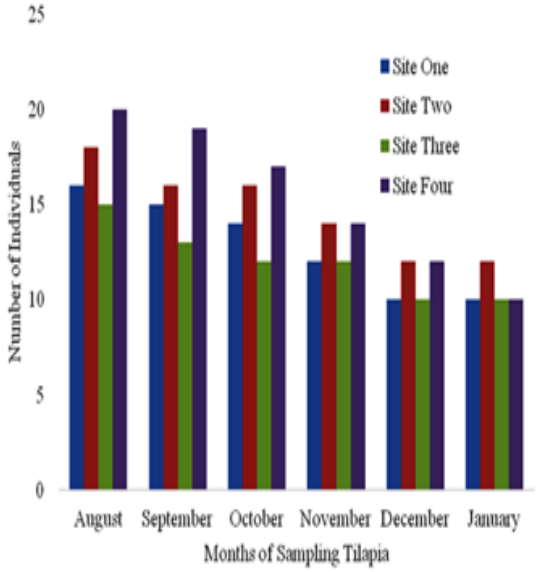

Fig. 2: Monthly distribution of *Tilapia zilli* from Okura River, Kogi State.

The research work in perspective is also lower than what was observed in a study carried out by Niyoyitungiye *et al.,* (2019) in Lake Tanganyika, the Burundian Coast where 75 species belonging to 12 families and 7 orders were recorded. The index measured for fish species, showed slight difference among them. The variation in the simpson, shannon weinner, dominance and evenness were not significant different in the three fish species in Okura River. The Simpson index ranged from 0.953 in *E. callipterus* to 0.957 in *T. zilli*, the shannon index ranges from 3.102 in *E. callipterus* to 3.156 in *T. zilli* (Table 3).

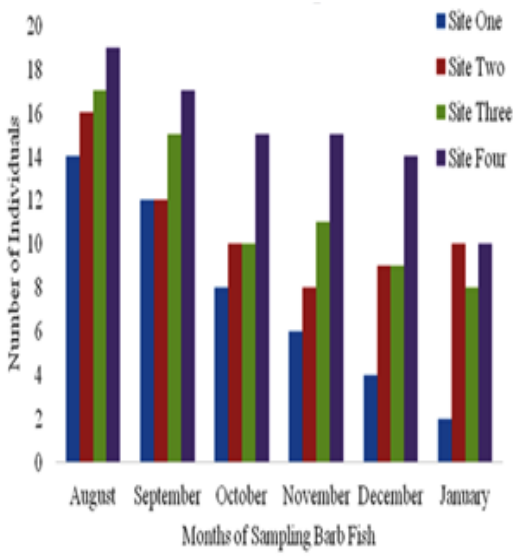

Fig. 3: Monthly distribution of *Enteromius callipterus* from Okura River, Kogi State.

The differences in abundance between seasons and areas commonly present in other surveys conducted were as a result of significant changes in physical and chemical variables (Ribeiroet *et al.,* 2014; Cattani *et al.,* 2016). Fish assemblage structure is shaped by a combination of environmental and biological factors, which provide a conducive habitat for its inhabitants. The higher abundances observed mainly during the rainy seasons in the dominant fish species could be explained by the nutrient input caused by high rainfall. These patterns were also observed in the study of Soeth *et al.,* (2015) and Cattani *et al.* (2016). The study agrees with the findings of Azma and Siti (2015) who show that a Simpson Index value of 0.83 - 0.93 indicates that the communities are mature aQ1nd stable.

Fish communities are sensitive indicators of water quality and can provide valuable insights into the ecological health of aquatic ecosystems. A total of three fish species were observed to be in abundance in River Okura; *Heterobranchus longipinnis*, *Tilapia zilli* and *Enteromius callipterus* and the other four were scarcely noticed. Our study demonstrates the importance of using fish communities to monitor the ecological health of the Okura River. We recommend that fish communities be included in monitoring programs for Okura River and that conservation and management efforts focus on protecting and restoring habitats that support diverse fish communities. The higher abundance of fish recorded in site four may be attributed to minimal human impacts, nutrient availability and suitable bottom substrates.

Table 2: Checklist of fish species encountered in Okura River, Kogi State during the study.of the study

S/N	FAMILY	ORDER	*SPECIES*
1	Clariidae	Siluriformes	*Heterobranchus longifilis*
2	Cichlidae	Perciformes	*Tilapia zilli*
3	Cyprinidae	Cypriniformes	*Enteromius callipterus*
4	Anabantidae	Perciformes	*Ctenopoma petherici*
5	Cichlidae	Perciformes	*Oreochromis niloticus*
6	Characidae	Characiformes	*Brycinus longipinnis*
7	Mormyridae	Mormyriformes	*Marcusenius cyprinoides*

Table 3: Diversity Indices of Fish Species from Okura River, Kogi State

Indices	Dominance	Simpson	Shannon	Evenness
Heterobranchus sp.	0.045 (0.045 - 0.051)	0.955 (0.949 - 0.955)	3.142 (3.065 - 3.137)	0.964 (0.893 - 0.960)
Tilapia zilli	0.044 (0.044 - 0.049)	0.957 (0.951 - 0.956)	3.156 (3.086 - 3.147)	0.978 (0.912 - 0.970)
Enteromius callipterus	0.047 (0.047 - 0.055)	0.953 (0.945 - 0.953)	3.102 (3.009 - 3.103)	0.926 (0.845 - 0.928)

Declaration of Conflict of Interest: The authors declare no conflict of interest

Data Availability: Data are available upon request from the first author and corresponding author.

Conclusion: Fish communities are sensitive indicators of water quality and can provide valuable insights into the ecological health of aquatic ecosystems. A total of three fish species were observed to be in abundance in River Okura: *Heterobranchus longipinnis*, *Tilapia zilli* and *Enteromius callipterus* and the other four were scarcely noticed. Our study demonstrates the importance of using fish communities to monitor the ecological health of the Okura River. We recommend that fish communities be included in monitoring programs for the Okura River and that conservation and management efforts focus on protecting and restoring habitats that support diverse fish communities.

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