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Full Length Research Article

ICHTHYOFAUNA DIVERSITY OF OKWII AND IKWO RIVERS ISHIAGU, EBONYI STATE, NIGERIA

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Abstract
Okwii River which is of economic importance to the inhabitants of Ishaigu is suspected to be disturbed by mining wastes from an active mining pit with deposits of lead and zinc. However, there is a dearth of information on the ichthyofauna of Okwii River which could serve as indicators of water quality. Fish samples were caught biweekly using gillnets from 3 different stations for 3 months and identified using standard guides. Data were analysed using descriptive statistics and Shannon-Wiener's species diversity (*H'*). A total of 194 fish samples belonging to four families and six species were collected. The four (4) families identified were: Clariidae, Cichlidae, Hepsetidae and Clarotidae amongst which Cichlidae exhibited the highest relative abundance (71.65%), contrasting with Clarotidae's lowest (3.09%). Amongst the species identified, *Oreochromis niloticus* (38.66%) and *Pelmatolapia mariae* (31.44%) were the most abundant while *Clarias gariepinus* (3.61%), *Chrysichthys nigrodigitatus* (3.09%), and *Coptodon zilli* (1.55%) were the least abundant. Station 2 (Downstream Okwii River) showed the highest diversity (*H'*=1.145), while Station 3 (Ikwo River) had the lowest (*H'*=0.685). The research findings show a wide contrast in species composition in comparison with other studies in the surrounding water bodies, an expression of the ecological stress in Okwii River. The low fish diversity and abundance suggests that the capacity of the river to support a healthy fish population has been considerably diminished. Therefore, there is an urgent need for regular pollution control measures, and natural habitat restoration works to conserve the biodiversity of the river

Keywords: Bioindicator Species, Disturbance, Fish Diversity, Okwii River, Water quality

Introduction

Freshwater ecosystems, of which rivers are prime examples, are considered the most biologically diversified habitats on earth, sustaining an untold myriad of aquatic organisms, among which fish hold paramount significance ecologically,

nutritionally, and economically (Li, 2024). Fish diversity and abundance are some of the crucial factors used to measure the health and stability of aquatic ecosystems because fish help cycle nutrients, control food-web dynamics, and serve as bioindicators of environmental change (Meinam *et al*., 2023).

The inland freshwater bodies of Nigeria are composed of diverse array of different fish species (Olaosebikan and Raji, 2013). Early research showed that Nigerian inland water bodies are endowed with 100 species in Lake Kanji and 85 in Ogun River. Yem *et al*., (2011) documented 90 species from 25 families in seven Lakes covering the six geographical zones of Nigeria. The ever-increasing human population along with its attendant industrialization had brought about a direct pressure on the fish fauna through overfishing and pollution (Ogamba *et al*., 2017 and Ogueri *et al*., 2018). There are other developmental projects like road/ bridge construction, drainage channeling, dredging and dam construction which have all adversely upset the biotopes of the fish at the detriment of their survival (Olaosebikan and Bankole, 2005). Understanding the diversity and abundance of fish fauna in specific river systems is therefore essential for sustainable fisheries management and conservation planning.

Okwii River, Ishiagu, Ebonyi State, is a river within the southeastern hydrological network of Nigeria. Anthropological activities close to the river include mining, fishing, farming, and washing amongst others (Oyediran *et al*., 2021). Despite its ecological significance and its role in supporting local livelihoods, there is limited baseline data on the ichthyofaunal of the river. Earlier research in adjacent river systems, including the Ivo and Aku Rivers, has demonstrated a varied assemblage of fish and plankton species affected by physico-chemical factors and seasonal fluctuations (Asiegbu *et al*., 2019).

The study is set to investigate the diversity and abundance of the fish fauna in the Okwii River whilst giving information on species composition and distributional patterns. The study will add to the knowledge base on freshwater biodiversity in Nigeria and thus support the conservation of aquatic resources in Ishiagu, Ebonyi State.

Materials and Methods

Description of Study Area

The study was carried out in Okwii River in Ishiagu, Ivo Local Government Area of Ebonyi State. Ishiagu is located on latitude 5°56'32.99" N and longitude 7°33'59.99" E in southeastern Nigeria. Ishiagu area covers an expanse of about 450 km^2 and supports an estimated population of over two hundred and fifty thousand persons (Sha'Ato *et al*., 2020). It lies in the tropical climate region influenced by two seasons, which are the rainy season from March to October and the dry season, which lasts from November to February. Ishiagu has an average temperature of 27 °C (Iyi *et al*. 2021) with an average annual rainfall of 1500mm – 2300mm (Ozibo-Igwe and Anike, 2024). Notably within the study area is Federal College of Agriculture Ishiagu, Ebonyi States. Solid minerals including pyrite, quartz, lead and zinc are commercially mined at both artisanal and industrial scales in the area exposing the ecoregion to mining pollution.

Study design

A longitudinal study design was used for this study. Samples were collected bi-weekly for 3 months between December 2020 – February 2021.

Collection of Fish Samples

Fish samples were collected from three different stations (described below) biweekly for 3 months using an experimental gillnet according to the method of Alamba *et al*. (2016).

Station 1: Okwii River upstream at Ihietutu Ishiagu, where the lead and zinc mining wastes are being discharged

Station 2: Okwii River downstream at Ihietutu Ishiagu, where fishing activities take place.

Station 3: Ikwo River in Ishiagu, close to Ishiagu/ Mile 2 express road.

The sampling sites were selected based on preliminary survey of the river, with factors such as average depth, volume of water, accessibility, activities taking place in and around the river and security obtained. Experimental gillnets were set by 6:00pm in the evening and retrieved by 8:00am the following day to determine catch. The fish caught were identified using the guides of Raji and Olaosebikan (2013) and Fishbase (2024).

Data analysis

Absolute count and Percentage abundance was calculated using MS Excel 2019. Fish diversity was determined with Species richness (*S*), Evenness of Diversity (ED) the Shannon-Wiener diversity index (*H'*) using Paleontological Statistical Software Package (PAST 3) (Asiegbu *et al.*, 2019).

Results

The results of the study showed that a total of 194 fish samples were caught which included six fish species belonging to four families (Table 1). Based on the stations, 72, 106 and 16 individual specimens were caught at Okwii River Upstream (Station 1), Okwii River downstream (Station 2) and Ikwo River (Station 3), respectively (See Table 1). Fish of the Family Cichlidae dominated the collection with 71.65 % (n = 139) relative abundance.

Table 1: Fish abundance in the study area

Fish Family	Fish species	Number of fish caught				
		Station 1	Station 2	Station 3	Total	% Relative abundance
Clariidae	*Clarias gariepinus*	0	0	7	7	3.61
	Oreochromis niloticus	41	34	0	75	38.66
Cichlidae	*Coptodon zilli*	0	3	0	3	1.55
	Pelmatolapia mariae	13	48	0	61	31.44
Hepsetidae	*Hepsetus akawo*	12	21	9	42	21.65
Clarotidae	*Chrysichthys nigrodigitatus*	6	0	0	6	3.09

Specie richness (*S*) was highest in station 1 (*S*=4) and station 2 (*S*=4) with 4 species identified in both stations and lowest in station 3 (*S*=2) with 2 species identified. Shannon-Wiener diversity index was highest in Station 2 (*H'*=1.145) and lowest in station 3 (*H'*=0.685), as shown in Table 2. Stations 1 and 2 had similar values for evenness at 0.778 and 0.786 respectively, and a higher value was recorded in station 3 (0.992).

Table 2: Fish diversity indices in the three sampling stations

Ecological measurements	Station 1	Station 2	Station 3
Specie Richness (*S*)	4	4	2
Abundance (Individuals)	72	106	16
Shannon-Wiener Diversity Index (*H'*)	1.135	1.145	0.6853
Evenness	0.7781	0.7857	0.9922

Discussion

The abundance and diversity of fish recorded in this study are below the values obtained in previous works done in some nearby water bodies in the area. Uche *et al.*

(2016) encountered eight fish families in Ivo River, Ishiagu, Ebonyi State, Nigeria while Asiegbu *et al*. (2019) recorded six families in some selected water bodies in Ivo River Basin covering some parts of Abia, Ebonyi and Enugu States respectively. The lower fish abundance could be connected to suspected environmental disturbance enhanced by the mine discharge. It is suspected that the major fish food, which are plankton, could have been severed by the inorganic particulates that are generated in high amounts during mining activities, and this may affect the plankton community in diverse ways and in turn fall on the fish with harsh consequence of food scarcity. Hena *et al*. (2022) observed the interference of high contamination of metal on plankton community in Calabar, Cross River State, Nigeria. The metal particulates hinder sunlight penetration in the water, leading to a reduction in primary productivity (Obiyor *et al*., 2017). There is also a high possibility of the food chain being compromised when zooplankton subsist on inorganic particles, which is linked with phytoplankton, this poses as a threat to the fish fauna.

The presence of cichlids in Okwii River upstream and downstream and their absence in Ikwo River could probably relate to their ability to tolerate high concentrations of heavy metals such as iron, lead and zinc, unlike the clariids. The absence of family clariidae in Okwii River both in upstream and downstream could be attributed to their demersal nature which allows them to dwell in the floor of the water body, which is mostly mud, coincidentally the bottom niche has sediment with higher concentrations of the heavy metals which are not easily washed away over time as compared to the presence of this metals in water. The lotic system of the river allows natural refreshment, which reduce the concentrations at the littoral level for pelagic species like cichlidae as observed in the present study. Several authors have documented higher concentrations of metal loadings in sediment over surface water samples, Ipeaiyeda and Onianwa (2018) in Alaro River, Oyo State, Osayande and Opoke (2018) in some selected streams in Abakaliki, Ebonyi State and Ayodele *et al*. (2019) in Oyan Lake, Oyo State.

The occurrence and low relative abundance of *Chrysichthys nigrodigitatus,* a clarotidae, in upstream Okwii River could signal either a fresh adaptation of the fish species to the water body, or a threat to the group that was supposedly large in abundance previously. The presence of hepsetidae represented by *Hepsetus akawo* in all the stations showed the species as the only and most cosmopolitan fish species during the study period. The species could fairly adapt to the different ecological conditions in all the selected stations, besides their pelagic nature gives them the advantage of not been exposed to high levels of heavy metals as mostly settled in the sediments. In the work of Adedokun and Fawole (2012) on *H. akawo* in Oba Reservoir, Ogbomosho, the authors reported that they exhibited a wide range of distribution from marine to freshwater habitats.

The low fish diversity (H'<2.0) as recorded across the three stations (H'=1.135, H'=1.145, and H'=0.6853 in station 1, 2, and 3 respectively) suggested that the ecological conditions were not favourable to the fish fauna, the possible high levels of metals and acidic pH, especially in Okwii River because of its proximity to the mining discharge point, could have hindered productivity in the littoral zone. The zone is acclaimed as the interface between the terrestrial and the water body. According to Matern *et al*. (2021), the water phase serves as a spawning, feeding and refuge abode as well as substrate to macrophytes. Ecological disturbance in the phase has a gross consequence on the entire food web, of which fish are inclusive.

Conclusion

The study of ichthyofauna diversity of Okwii River, Ishiagu highlight in grave terms the diminishing status of the diversity and abundance of the rivers ichthyofauna. Only four (4) families (clariidae, cichlidae, hepsetidae, clarotidae) comprising of six (6) species of fish which include *Clarias gariepinus, Oreochromis niloticus, Coptodon zilli, Pelmatolapia mariae, Hepsetus akawo,* and *Chrysichthys nigrodigitatus* were present across the 3 stations. Mining activities, particularly the discharge of inorganic particulates and heavy metals as earlier reported, and other anthropogenic activities may have been tampering with the ecological balance of the river system. Such disturbances probably disrupted the planktonic communities the fundamental components of the aquatic food web, which in turn would initiate a cascade of effects to food shortage and habitat degradation for fish species.

Recommendation

Based on the findings of this study, urgent measures must be taken in line with environmental monitoring and rehabilitation programmes of the study area to restore fish diversity. Conservation practices for sensitive species and community awareness programs can also be implemented to promote sustainable utilization of the river ecosystem.

Conflict Of Interest

The authors declare no conflict of interest.

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