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substances including heavy metals, which eventually settle in bottom sediments [4,5] stated that microbial and redox processes may change the properties of sediments and a ect the composition of interstitial water, while reworking of the sediments by organisms will also bring sediments to the surface, where a signi cant fraction of heavy metals will be released. A good knowledge of the distribution of heavy metals in water and sediments plays a key role in detecting the sources of pollution in aquatic systems [5]. Bottom sediments can therefore be used to monitor heavy metal pollution in aquatic ecosystems, Ebonyi River is vital to the people of Ebonyi State and other surrounding communities. It is important natural surface water in the area for drinking and domestic uses. ere are numerous heavy metals, some of which are highly toxic, like mercury, lead, arsenic, and cadmium. Fish accumulate toxic materials at various levels, depending on species, age, season, feeding habits, and so on. None of the metals are biodegradable, and though they can change forms from solid, to liquid, to dust and gas, they never completely disappear. e ones that are toxic in even the same minute amounts create instant cellular destruction in any of their forms. Marine animals such as sh are able to readily absorb metals and their bodies regulate to accommodate their presence. ey are easily stored in fatty tissue and will bioaccumulate if the sh is exposed to further contamination [6].

Heavy metals are commonly found in natural waters and some are essential to living organisms, they may become highly toxic when present in certain concentrations. ese metals also gain access into ecosystemms, t5drs isf ts htrations.ionio222 t in cerst.5(of )0.5ed

the upland adjacent to lowland areas. Crops grown in the area include; rice, yam, cassava, cocoyam, groundnut, cowpea and vegetables. Livestock farming, especially the extensive system of rearing sheep, goats and native cattle, is also practiced by the people. Fishing activities are predominant in all the zones of the state.

Ekpe noted that three main seasons prevail in the area: the rainy (wet) season, which spans from early April to early November, the harmattan period which lasts between mid-November to late January and the dry season, which lasts from late January to early April. However, a short dry spell is usually experienced during the month of August, and this is termed the August break. Lowland areas popularly called, FADAMA are largely available and serve as good sites for rice and sh farming during the rain and dry season vegetable farming.

Some non-farm activities prevalent in the State include: quarrying, petty trading, pottery, weaving etc. Medium to large-scale industries also exist in the state. Notable among them are the Abakaliki rice milling industry, the fertilizer blending plant and the building materials industry. Large deposits of solid mineral resources such as lead, gold, gellena, zinc, iron, oxide, quartz, grease, gypsum, limestone, marble stone, common salt and others are found in Ebonyi State.

## Field sampling

ree locations within the river systems in Ebonyi State, lying close to mine sites were sampled on monthly bases for two years beginning from March 2011 to February 2013. en a river system which does not lay close to any mining site was used to serve as control 1. en culture pond water using urban tap water to cultu Clarias albopunctatus was used as control 2. Specimen Clarias albopunctatus were collected from the ebonyi state university earthen pond and acclimatized to the laboratory conditions for een days. e shes were fed with industrial couphen industrial feed at the 3% body weight twice daily. e shes, measuring 4 to 6 cm in length and weighing 8 to 10 gm were selected for the experimental purpose. e physiochemical parameters of the water were estimated according to Apha 1981. e test specimen were stocked in a concrete pond supplied with urban tap water. e water was changed bimonthly. e experiment was sampled monthly, for onward processing and preservation for analytical purpose. Samples for water quality were taken and analyzed in IITA according to Fishers Standard Methods (FSM standards) for sediments samples.

Multimesh gillnets were used to monitor the abundance and structure of the sh fauna. Strati ed random sampling was carried out in each water body. e shes were caught, identi ed, counted, graded, measured and weighed according to species. e species for chemical and histological analysis were taken immediately a er weighing to the laboratory.

Concentration of metals were studied in sh blood, liver and in the tissue lying between the lateral lines and the ns, since high concentrations of metals do not imply that the metal have a toxic e ect [9]. Toxicity of metals is mostly associated with vital physiological functions, such as enzyme activity, modi cations in membrane, lipid composition and changes in tissue structures. e research looked at the e ects of the following heavy metals (Cadmium, Nickel, Mercury, Chromium, Lead, and Arsenic) on the physiology, gill,liver, blood and n functions of ngerlings, juveniles and table size Clarias albopunctatus in the laboratory of the Fisheries and Aquaculture Department of Ebonyi State University, Abakaliki.

## Data analysis

Analysis of heavy metals bioaccumulation: A er taking fork length measurements and weights of all the shes caught from each water body, ve (5) shes were purposively selected based on age. e blood samples were collected with a syringe guage of syringe into a centrifuge vial and samples of skeletal muscles (2-3) were dissected from the le side between the dorsal n and the lateral line of each sh. e whole livers were dissected, dressed and cleaned with HNO3. Each vial was cleaned with HNO3 for 5 hours and washed thoroughly with deionized water, rinsed 3 times, dried, (samples were dried at 105°C for about 12 hours), ground, packaged, labeled, pre-weighed and packed in plastic boxes with lids. Samples for metal bioaccumulation, enzyme and lipid analyses were taken from each sh simultaneously and placed in separate vials and delivered for analyses at 11 TA laboratory [10-14].

Determination of heavy metals Cd, Ni, Hg, Cr, Pb, and as was done using Buck 211 VGP AAS made by Buck scienti c, Inc., East Norwalk. e digest of the ash of each sample above as obtained in calcium and potassium determination was washed into 100 ml volumetric ask with distilled water and made up to mark. is diluent was aspirated into the Buck 211 VGP Atomic Absorption Spectrophotometer (AAS) through the suction tube. Each of the trace mineral elements was read at their respective wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination.

## Result Presentation

In Figure 1 Fish n had reduced bioaccumulation of cadmium than the blood liver. is ranged in the running e uent areas in 2011/2012 from 0.8-1.4 and 0.6-1.02 ppm in 2012/2013 with the two controls ranging between 0.2-0.4 ppm.

In Figure 2 Nickel bioaccumulation in cat sh n had an ascending bioaccumulation during the two years with the range of 6.0-9.8 and control 1 has 3.1-4.2. Control 2 ranged from 1.0-1.5, showing that shes in pond water had little or no nickel bioaccumulation.

In Figure 3 Mercury bioaccumulation in sh n ranged from 0.4-0.6 ppm and 0.7-1.2 ppm in Akpara Dam and Enyigba shes respectively. Enyigba ranged 0.8-1.2 ppm which was the highest. Ebonyi River ranged between 0.03-0.08 which was control 1 and pond water which was control 2 had no record of bioaccumulation

In Figure 4 Chromium had bioaccumulation in sh which ranged from 15-20 ppm in Akpara and Ebonyi River and had Enyigba sh n at the ranges of 23-29 ppm with the Ebonyi River sh n having 9-11 ppm bioaccumulation and pond water having no record of bioaccumulation in its sh n.

In Figure 5 e variation of lead and its bioaccumulation in the three running sites ranged from 0.5-1.3 ppm. e control which was Ebonyi River had a range of 0.2-0.4 ppm. e pond water had no bioaccumulation in its sh n. Hence, bioaccumulation in sh n increases with increasing age.

In Figure 6 Arsenic had a bioaccumulation range of 0.5-0.7 and 0.8-1.1 ppm in the three running sites but with the rst control which was Ebonyi River sh n registering 0.2-0.5 ppm in 2011 and 0.4-0.5 ppm in 2012 in the second control having no bioaccumulation or less than 0.1 arsenic concentration.

## Discussion

Fish n had reduced bioaccumulation of cadmium than the blood liver. is ranged in the running e uent areas in 2011/2012 from

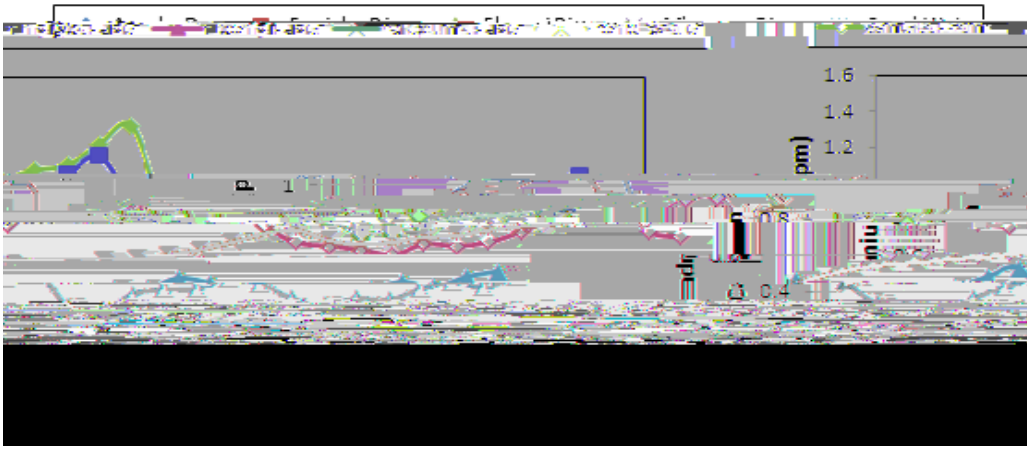



Figure 1: 9 D U L D W L R Q V R I F D G P L X P F G F R Q W H Q W L Q W K H ¿ Q R I F D W ¿ V K L Q ¿ Y H P L Q L Q J V L W H V L

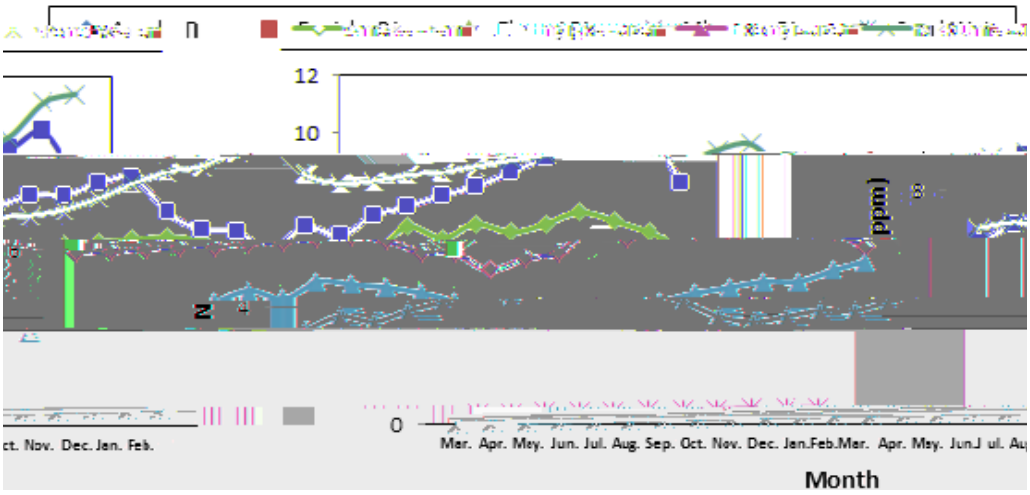



Figure 2: 9 D U L D W L R Q V R I Q L F N H O Q L F R Q W H Q W L Q W K H ¿ Q R I F D W ¿ V K L Q ¿ Y H P L Q L Q J V L W H V L


Figure 3: 9 D U L D W L R Q V R I P H U F X U \ K J F R Q W H Q W L Q W K H ¿ Q R I F D W ¿ V K L Q ¿ Y H P L Q L Q J V L W H V L

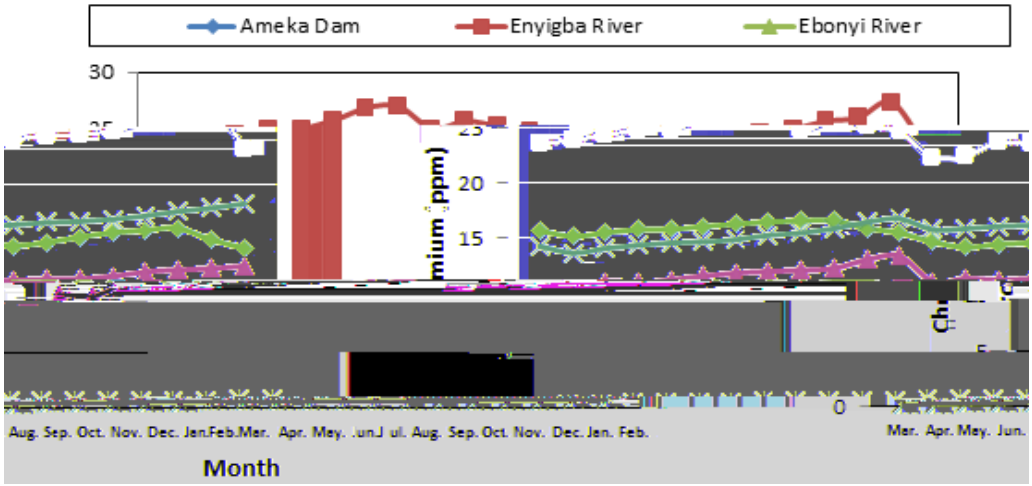
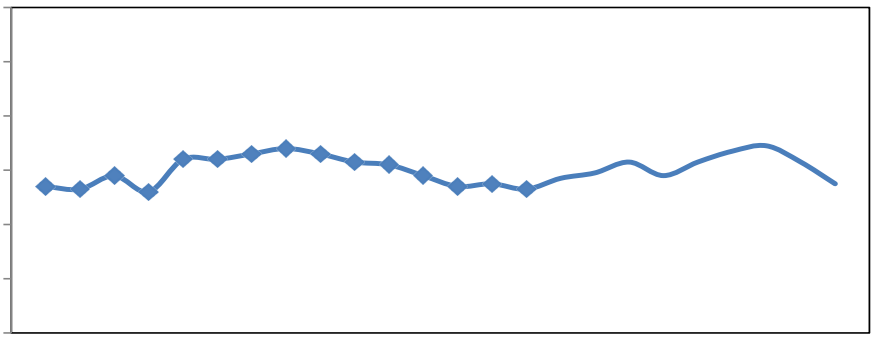



Figure 4: 9DULDWLRQV RI FKURPLXP FU FRQWHQW LQ WKH ¿Q RI FDW¿VK LQ ¿YH PLQLQJ VLWHV



-1.4 and 0.6-1.02 ppm in 2012/2013 with the two controls ranging ween 0.2-0.4 ppm. Variations of nickel (Ni) Content in the Fin Cat sh in Five Mining Sites in Ebonyi State from March 2011 to ruary 2013.

Nickel bioaccumulation in cat sh n had an ascending accumulation during the two years with the range of 6.0-9.8 and trol 1 has 3.1-4.2. Control 2 ranged from 1.0-1.5, showing that sh ond water had little or no nickel bioaccumulation (Figure 1).

Variations of Mercury (Hg) Content in the Fin of Cat sh in Five ing Sites in Ebonyi State from March 2011 to February 2013 rcury bioaccumulation in sh n ranged from 0.4-0.6 ppm and 0.7- ppm in Akpara Dam and Enyigba sh respectively. Enyigba ranged -1.2 ppm which was the highest. Ebonyi River ranged between 0.03- 3 which was control 1 and pond water which was control 2 had no ord of bioaccumulation (Figure 2).

Variations of chromium (Cr) Content in the Fin of Cat sh in Five Mining Sites in Ebonyi State from March 2011 to February 2013 Chromium had bioaccumulation in sh which ranged from 15-20 ppm in Akpara and Ebonyi River and had Enyigba sh n at the ranges of 23-29 ppm with the Ebonyi River sh n having 9-11 ppm bioaccumulation and pond water having no record of bioaccumulation in its sh n (Figure 3).

Variations of Lead (Pb) Content in the Fin of Cat sh in Five Mining Sites in Ebonyi State from March 2011 to February 2013 e variation of lead and its bioaccumulation in the three running sites ranged from 0.5-1.3 ppm. e control which was Ebonyi River had a range of 0.2-0.4 ppm. e pond water had no bioaccumulation in its sh n. Hence bioaccumulation in sh n increases with increasing age (Figure 4).

Variations of As (ppm) content in the n of cat sh in ve mining sites in Ebonyi State from March 2011 to February 2013. Arsenic had a bioaccumulation range of 0.5-0.7 and 0.8-1.1 ppm in the three running sites but with the rst control which was Ebonyi River sh n registering 0.2-0.5 ppm in 2011 and 0.4-0.5 ppm in 2012 in the

Citation:

¾ Safe disposal of domestic wastes and control of industrial e uents should be practical and where possible recycled to avoid these metals and other contaminants from going into the environment.

¾ ere should be further studies on the concentration of heavy metals in other sh tissues (brain, liver, kidney, intestine, and heart) and species.

¾ Neutralization of e uent water is recommended as a modern treatment practice such as lime precipitation of e uent water.

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References

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