Impact of Heavy Metals Concentrations on the Periwinkle (*Tympanostonus fuscatus*) and the Mangrove Crab (*Uca arcuata*) from Mini-Nda Creek, Rumuolumeni, Rivers State, Nigeria.

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Abstract— *The study investigated the heavy metal level on the periwinkle (Tympanotonus fuscatus) and the mangrove crab (Uca-arcuata) from Mini – Nda creek. Samples were collected in four (4) different stations. Heavy metal was determine using atomic absorption spectrophoto meter- model spectra AA_2O. The order of mental concentration in the Biota concerned are as follows: Fe>Zn>Cu>Cr>Ni>Pb>Cd while crab Fe>Zn>Cu>Ni>Pb>Cr>Cd. In periwinkle the concentration of Lead, Nickel, Copper, and Chromium in the different stations under studies fluctuating from 0.0218-4136, 1.127-7.064, 0.389-13.894 and 0.418-11.346 respectively. However, that of Iron and Zinc ranged from 98.864-181.720 and 49.877 respectively. While in crab Lead, Nickel, Copper and Chromium range were from 0.016-3.279, 0.019-4.103, 1.397-6.932 and 0.287-2.648 respectively. Whereas, that of Iron and Zinc range were found 94.131-114.784 and 48.606-61.489 respectively. The result shows Fe having the highest value while Cd having the lowest value. The concentration of heavy metals in T.fuscatus were slightly higher than Uca arcuata except in Cd which were within 2.0mg/kg of the FAO/WHO recommended tolerable levels for sea food. This implies that continued consumption of the organism from Mini-Nda creek is likely to cause health hazards.*

Keywords: Periwinkles, *Mangrove crab*, Heavy Metals, Niger Delta, contaminants.

1 INTRODUCTION

Industrialization and human activities have partially or totally turned our environment into dumping sites for waste materials. As a result, many water resources have been rendered polluted and hazardous to man and other living system [1]. These contaminants enter the aquatic organisms through the effects of bio concentration, bioaccumulation and the food chain process and eventually threaten the health of human by seafood consumption [2]. Heavy metals are high priority pollutants because of their relatively high toxic and persistent nature in the environmental management programme all around the world [3].

Heavy metal discharged into the environment rapidly associated with particulates and ultimately settles in bottom sediments of water bodies either through direct discharge or surface run-off [4]. Among different aquatic organisms crabs (*Uca arcuata*) periwinkles (*Tympanotonus fuscatus*) accumulate large quantities of heavy metals due to their habitat and feeding nature, they are benthic feeders.

Natural sources of heavy metals include Geochemical, volcanic eruption, soil and rock erosion and forest wild fires. Heavy metal contamination through human activities include, industrial and municipal waste products, rural and urban water run-off, fine sediments eroded from catchments, atmospheric deposition e.g. burning of fossil fuels, inanerationn of waste and industrial emissions and petroleum industry [5], [6].

Heavy metal are classified as essential and non – essential heavy metals and their roles have been recently documented by [7] when the concentration of essential heavy metals such as iron, copper, zinc, manganese etc. exceed the recommended limit, it could be deleterious to the body just as the non – essential heavy metals such as most heavy metals are toxicants that could induce multiple cell damage [8] heavy metal accumulate in the tissue of organism anytime they are taken up and are stored faster than they are excreted.

Several studies have been carried out to investigate the presence of heavy metals bioaccumulation and concentration in shellfishes were from [9] report of appreciable quantities, of heavy metals such as iron, copper, barium, lead, cadmium and nickel in periwinkles purchased from public markets in Wari Rivers, Nigeria elsewhere (Bob-Manuel *et al* [10] observed high bioaccumulation of iron (Fe) in the organs of catfish more than other metals from Okilo Creek in Rivers State, Nigeria. Similarly, Olalade [11] reported high bio-concentration in tissues of investigated species of fish, crab and perwinkle with elevated concentrations of manganese and zinc in crab, while cobalt, copper and iron in periwinkle. In a post oil spill brackish water creeks of Niger Delta, Onwuteaka [25] reported high bio concentration of heavy metals in the harvested mangrove oyster. Ijeoma [12] observed higher concentration of heavy metal such as zinc (Zn), manganese (Mn), cadmium (Cd) and nickel (Ni) in the crude oil pollution of Bomadi, Burutu, and Warri. Aina [13] observed phythlates either group and observed accumulative organ differences in *Tilapia zilli* obtained from municipal water supply lakes in Ibadan, Nigeria. Faromi, Adelowo and Ajimoko [14] observed high seasonal variation of metal concentration in catfish, blue crab and catfish from Warri coastal water of Delta State.

Heavy metals are known to be insidious toxic pollutants and their presence in the aquatic environment is of great concern.

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Lead (Pb) for instance at certain exposure levels is a poisonous substances to humans and animals. Lead poisoning affect every part of the body's organ systems, especially the nervous system, bones and teeth, kidneys and the cardio vascular, immune and reproductive systems [15].

Cadmium and its compound may be toxic by ingestion of and inhalation of highly contaminated food results in acute gastro intestinal effects, high level exposure via inhalation may cause acute or chronic disease and chronic renal disease [16] low level of exposure to chromium can irritate the skin and cause ulceration. Long term exposure can cause kidney, liver and damage to circulatory and nervous system.

Zinc is an essential mineral of exceptional biological and public health importance [17]. In children zinc deficiency causes growth retardation, delayed sexual maturation, infection susceptibility and diarrhea, contributing to the death of about 800,000 children worldwide per year [17].

Present study will determine metal contamination in the Mini-Nda Creek from the Rumuolumeni River. Hence, there is abundance of shellfishes (periwinkle & crab) in the studied area and they represent valuable food delicacies in the Niger Delta area, Nigeria.

2 MATERIALS AND METHODS

Study area:

The study was carried out in Mini-Nda Creek (fig. 1) located at the Minikpiti area of Rumuolumeni, Rivers State in the Niger Delta and lies between latitude 4^0 80' 29" N& longitude 6^0 92' 22"E. The creek is tidal in nature. Hence, sea water enters the creek at high tide from the Rumuolumeni River and as the ebbs, water drain from the surrounding mangrove swamp into the river via the creek. The creek is characterized by notably white mangrove (*Avicennia anitide*) Red mangrove (*Rhizophora spp.*) and other biota found include periwinkle, fiddle crab, oyster etc. Three sampling station were chosen within the study area and a sample outside the study area which serves as control.

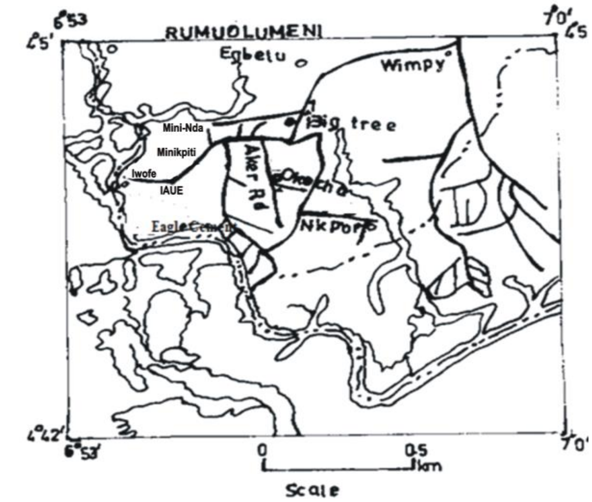

Fig.1: Map showing sampling stations around Mini-Nda Creek

Study area indicating different station: Station A bunkering oil discharge station (a fast growing settlement were several activities such as crude oil, diesel and petrol bunkering takes place. Station B was an extension of creek (where in the flow station was located) that leads to recreational area (swimming). Station C was the station that receives the bulk of discharge of water runoff from domestic and municipal activities in the communities. Station D (reference) an area without any bunkering activities except periwinkle picking and local fishing.

Sample Collection and Laboratory Analysis

Sample of periwinkle were hand-picked from the mud flats while that of the crab were caught using drag net at low tide. Samples were stored in an ice chest before transporting to the laboratory for identification with the aid of relevant keys.

In the laboratory animal samples were frozen, later thawed and the whole muscle tissues of the crab were dissected out. Samples were dried on aluminum foil by heating in an oven at 50^0c for 48 hours to constant weight. Heat treatment had the advantage of preserving the tissue for long period. The tissue samples were grinded into fine particles out of which 2.0g weight of each tissue was measured into 100ml beaker containing 10ml of nitric acid and 3ml of per chloric acid. 5ml of distilled water was added and the beaker placed on the hot plate until its volume reduced to 20-3ml, it was then filtered and the filtrate made up to a known volume of 50ml. Then aspiration of an aliquot of this filtrate was made into the flame Atomic Absorption Spectrum (AAS) after an appropriate standard of interest and hollow cathode lamp had been installed.

Table 1. Mean values (±ppm) of heavy metal concentration of periwinkle from Mini-Nda Creek, Rivers State.

Station	Pb	Ni	Cu	Cd	Cr	Fe	Zn
A	4.13±4.1	7.064±3.9	13.894±4.2	0.0316±44	11.346±3.2	181.720±3.9	98.419±3.5
B	2.874±2.8	6.692±3.7	10.736±3.3	0.0217±3.1	13.061±3.2	140.650±3.0	75.484±2.7
C	3.140±3.1	3.140±1.9	7.842±2.4	0.0179±2.5	10.476±3.0	99.372±4.7	57.699±2.1
D(control)	0.0218±2.1	1.127± 6.2	0.389±1.3	<0.001±0.00	0.418±1.2	98.869±2.1	49.877±1.8
Total mean	2.543±0.770	4.579±1.220	8.215±2.500	0.018±0.345	8.825±2.471	117.528±24.708	70.369±9.332
FAO/FEPA(2003)	2.00		3.00	2.00		100	0.3
FAO/WHO(2011)	03.		0.5	2		0.8	
IAEA (2005)	0.12		3.328			146	

Table 2. Mean values (±ppm) of heavy metal concentration of crab from Mini-Nda Creek, Rivers State.

Station	Pb	Ni	Cu	Cd	Cr	Fe	Zn
A	3.279±4.84	4.103±4.69	6.932±4.52	0.0028±3.5	0.742±1.47	114.784±1.47	61.489±2.5
B	1.416±2.09	2.811±3.21	4.596±2.99	0.0041±5.13	2.648±5.24	2.648±5.24	57.438±2.43
C	2.069±3.05	1.728±1.98	2.428±1.58	0.001±1.38	1.372±2.72	1.372±2.72	69.316±2.93
D(control)	0.016±2.36	0.019±1.26	1.397±9.10	0	0.287±5.68	0.287±5.68	2.93±2.05
Total mean	1.70±0.59	2.19±0.73	3.84±1.06	0.002±0.001	1.26±0.44	114.38±6.82	59.21±3.73
FAO/FEPA(2003)	2.00		3.00	2.00		100	
FAO/WHO(2011)	0.3		0.5	2		0.8	0.3
IAEA (2005)	0.12					146	

3 RESULTS

The total heavy metal content in the biota deferred in the sampling sites. The result shows that the control site recorded the least level of heavy metal and a sharp increase at the polluted area (Table 1). The trend of concentration from the biota deferred. Thus, Periwinkle > Crab. The overall heavy metal concentration in the biota sample was Periwinkle Fe>Zn>Cu>Cr>Ni>Pb>Cd, while crab Fe>Zn>Cu>Ni>Pb>Cr>Cd. The average levels of the metals in the tissue of periwinkle and crab studied indicated that the level of Fe was the most bio accumulated heavy metal throughout the study for the biota while Cadmium was the least in the biota as observed along the studied stations. The concentration of copper was higher in *Crassostrea gazer* in station D (table 2) than in *Tympanotonus fuscatus*, while the other metals were more concentrated in the *T. fuscatus*. The bio concentration level was lower in the tissues of *Uca arcuata* than in the *T. fuscatus* except Cd in station D of *Uca arcuata* which was higher.

4 DISCUSSION

The higher concentration of the metals in the tissues of *T. fuscatus* than those of the *Uca-arcuata* (except Cu) could be accounted for by it being more of a deposit feeder [18], [19], [20] whereas *Uca arcuata* is a filter feeder [21], [22]. The highest value obtained was that of Iron (181.72 ± 3.9) in periwinkle in station A. Also Fe, Pb and Cd are major heavy metals associated with Nigeria crude oil. The result of this study compared favourably with the concentration sequence of metal (Fe>Zn>Cr>Pb) obtained [23].

Several reasons have been attributed to organism bio-accumulation and bio-concentration of metals in aquatic lives to include feeding habit, body mass, sizes to their body cavity. It further buttress the dominance of iron over other metals throughout the study. This finding is consistent with the sequence observed by Bob-Manuel *et al* [10] in the Clarias gariepinus of Okilo Creek.

The Pb metal concentration in the biota tissues varied from 4.13 ± 4.1, 3.140 ± 3.1, 2.874 ± 2.8, 0.0218± 2.1: 3.279 ± 4.84, 2.069 ± 3.05, 1.416 ± 2.09 respectively. This results show variation within stations and samples with no particular trend. Ijeoma [12] reported the following mean values in *T. fuscatus* in an oil polluted site, Cd 0.028mg/kg, Pb 0.63mg/kg^{-1}, Zn 21.03mg/kg^{-1} which also compare with the value obtained in this study. The result obtained in the current study (Table 1 and 2) were generally higher than those stated.

Higher concentration of chromium in the crab tissue from station B than station A (pollution point) show that the anthropogenic activities at this river has impacted on the aquatic ecosystem. The low level of Cd 0.018 ± 0.345, 0.002 ± 0.001mg/kg observed in this investigation is contrary to the reports of Chinda and Braide [24] who observed high values of Cd and Pb in this aquatic organism. Concentrations of Nickel observed in the tissues of the Biota were below the permissible regulatory limit (5mg) of FAO/FEPA.

The bioaccumulation of Zn and Cu in Mini-Nda Creek when compared with the acceptable tolerable values of metals in aquatic organism is found to be high and well above the tolerable value. When compared to the recommended daily intake of Fe (48.0mg/day) and Cu(3.0mg/day) for an adult by FAO/WHO indicates that consumption of *T. fuscatus* and *U. arcuata* from Mini-Nda Creek might pose a health risk to consumers.

5 CONCLUSION

The present study indicates variability in the bio-concentration of some heavy metals (Fe, Zn, Cu, Pb, Cr, Cd) in *Tympanotonus fuscatus* and *Uca arcuata*. Iron (Fe) and Zinc (Zn) were the most concentrated while Cadmium (Cd) was the least concentrated metal in the tissues of the biota 0.018mg/kg, 0.002mg/kg respectively. *T. fuscatus* had a higher potential to concentrate pollutants than *Uca arcuata*. Hence, *Tympanotonus fuscatus* is a better bio monitoring agent of pollution for these metals of all the metals studies, it was only the mean Cd that was within the WHO stated standard for sea food 2.0mg/kg.

6 RECOMMENDATION

Pollution as a global problem is undisputable. Government and organizations should work together to proffer solution to solve the oil spillage problem in the Mini-Nda Creek. Individuals and environmental organizations should work together with the aim of reducing the level of pollutants discharged into rivers system. Cleanup process of creek, strict regulations and enforcement of environmental laws by individual and co-operate bodies should be put in place to help reduce oil pollution in the rivers and creeks of the Niger Delta.

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