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PARASITES OF CRAYFISH (*P. CLARKI*) AND LOBSTERS (*MACROBRACHIUM VOLLENHOVENIC*) AS INDICATORS OF METALLIC POLLUTION IN GREAT, KWA RIVER, NIGERIA

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ABSTRACT

Studies on parasites of crayfish and lobsters as indicators of metal pollution in Great Kwa River, Nigeria was evaluated using appropriate instruments for determination of Physicochemical parameters and detection of metals. Formol ether centrifugation method was used for isolation of parasites. A total of 150 crayfish and lobsters were analyzed for metals and tested for parasites. All samples of crayfish (100%) and 136 (90.66%) lobsters were positive with parasites. The distribution of parasitic infection in crayfish from the 5 sampling zones showed *Paragonfmus uterobilateralis* prevalence 6.0%, 8.7%, 15.3%, and 10.0% from zones 1-4 respectively and crayfish leech prevalence of 10.3%, 16.0% and 20.0% from zones 3-5 respectively. The distribution of parasites in Lobsters showed *Polymorphus botulus,* 3.3%, 6.0%, 3.6%, and 8.7% prevalence from zones 1-4 respectively. *Nicothoic astaci,* prevalence was 2.0%, 15.3% and 5.0% from zones 2-4 respectively. Prevalence of *Hysterothylacium sp of* 2.0% was observed in zone 3 while that of *Porospora gigantic was* 3.7% in zone 5. Parasite intensity ranged from 2 to 6. Metals detected included Lead (Pb). Copper (Cu), Iron (Fe), Cadmium (Cd), Asenium (As) and Zine (Zn) with Iron being the commonest. Some parasites with high prevalence in zones where certain metals had high concentration were detected. These parasites can be used as indicators of pollution in the study area.

KEYWORDS: Physicochemical, detected, pollution, concentration, indicator and prevalence.

INTRODUCTION

Fish macroparasites as indicators of heavy metal pollution were earlier reported by Scludermann *et al,* (2003) at Austria river sites. Many authors (Bagge and Voltonen, 1996, Zander and Kesting, 1996, Gelmar *et a*l., 1997, D'Amelio and Gerasis, 1997 and Voltonen *et a*l., 2000) have reported parasite community changes due to stress caused by pollution. Conditions for the relationship between parasites and polluted aquatic environments were suggested by Kennedy (1997). These included high abundance of fish host species, easy accessibly of host species and high concentration of the pollutant in host species. Factors suggested for justification of parasites as indicators of environmental pollution or presence of heavy metals in aquatic environment included amongst others, high concentration of parasites in areas of heavy metal accumulation. Schludermann *et a*/. (2003) reported changes in the diversity and richness of endoparasites tested in relation to heavy metal contents in aquatic ecosystem and bioaccumulation potential in aquatic life. Nine helminthes including four species of digeneans *(Aspidogaster limacoide, Allocreadium isoporum, Diplostomum spathacum* and *Posthodiplostonum brevican*..datum), three cestodes *(Carynplyllacus brachycollis, Bothrium rectanguium and Proteocephalus torulosus)* and one acanthocephalan *(P. laevis)* were isolated from Cyprinid barbell *(Barbus barbus)* along with zinc (Zn), lead (Pb) and cadmium (Cd). These metals were also found to accumulate in the parasites isolated from *B, barbus.* Significant difference was observed between the concentration of metals in fish and metals in parasites isolated from fish. (Schludermann *et al.* 2003).

Copper (Cu), Zinc (Zn), Lead (Pb) Cromium (Cr), Cadmium (Cd) and Iron (Fe) are commonly reported in crayfish and lobster at different locations (Beiley et a/, (2002), Abd-Allah and Abdullah 2006 and Morales *et* a/, 2003. Ogri (2004) detected these metals in lobster obtained from Great Kwa River and reported Iron (Fe) as the most abundant metal. Udoh *et al,* (1999) and Ogri (2002) detected similar metals in *Tympanotonus fuscatus.* Other authors including Oboh and Edema (2007) and Giusti and Zhamp (2002) had detected similar metals in fish and waters samples respectively.

These reports show that heavy metals occur in rivers and seas. The presence of such metals, due to their human health implications and environmental effects on other lives have raised growing concern among environmentalists, health personnel and government in general. Heavy metals are significant contaminants because of their general environmental prevalence and ease of assimilation in food chain. They are serious toxicological agents worthy of close monitoring and control. Toxicological impact of heavy metals is highly dependent on their forms of occurrence such as metallic salts, oxides and hydroxides and inorganic and organic complexed ions. The qualitative and quantitative identification of elemental chemical speciation (forms) is critically important in assessing

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potential toxic effects of a specific element on susceptible organisms and ecosystem (Cappon, 1990).

This research work is therefore, aimed at investigating diversity pattern of parasites in relation to heavy metal concentrations in crayfish and lobsters obtained from Great Kwa river.

MATERIALS AND METHODS

Study area

Great Kwa River (GKR) is part of the Cross River estuarine system which discharges into the Atlantic Coastal waters of South Eastern Nigeria. GKR originates from Kwa falls at Oban Hills (Cross River State -Nigeria) and runs through a stretch of about 100km long and 1.5km wide. It lies to the eastern most limit of the Bight of Bonny and Calabar Flank. It is located between longitude 8°15[1] and 8°45' East and Latitude 4°3l' and 5°00' North, Figure 1. (Ogri 2002). Extract of sampling zones from study area (GKR) illustrating some human influences in each zone is shown in Figure 2.

Great Kwa River (GRK) and the Estuarine environment of Cross River is becoming increasingly polluted due to indiscriminate disposal of agro-allied, industrial, mining and municipal wastes into the river.

Collection of Samples

Fishermen were provided with hand fishing net for crayfish and lobster harvest. They were also provided with Idm[3] high density polyethylene bottles for collection of water samples. Crayfish, lobster and water samples were collected twice weekly for one year (January to December, 2012).

Figure 1: Map of the study area showing the Great Kwa River

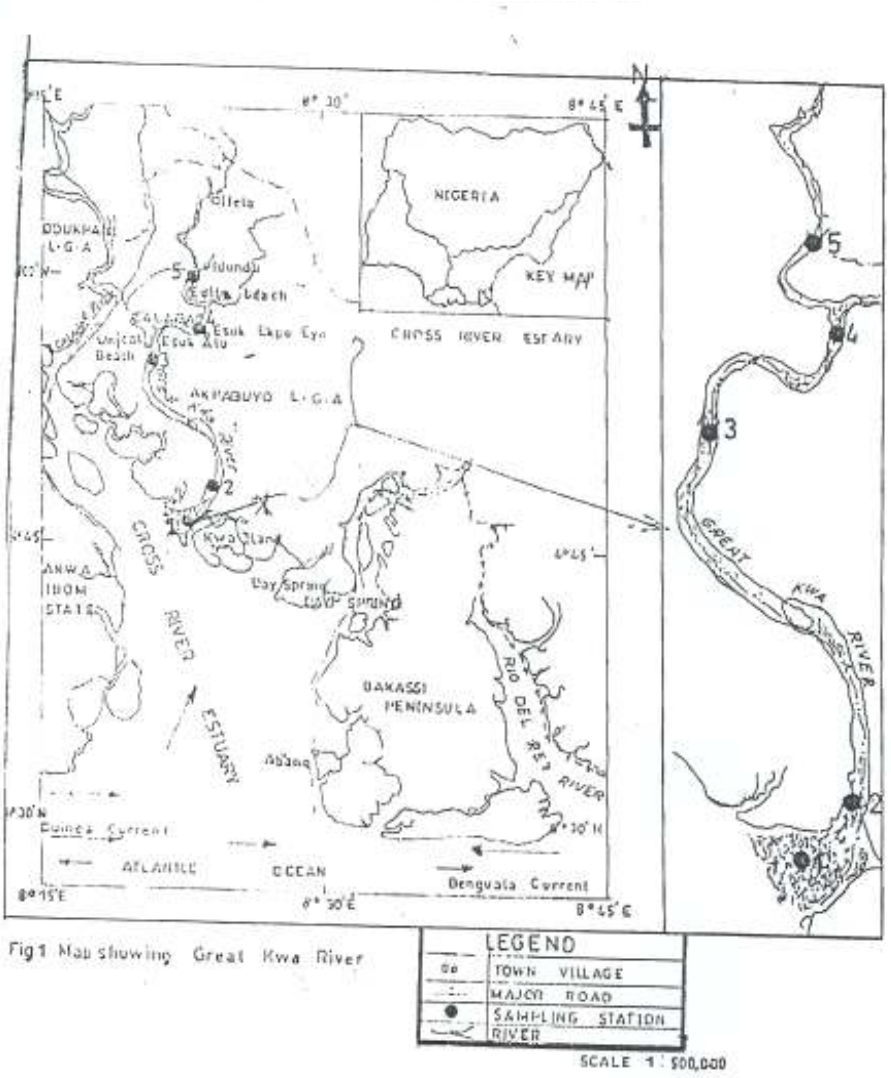

Fig 1 Map showing Great Kwa River

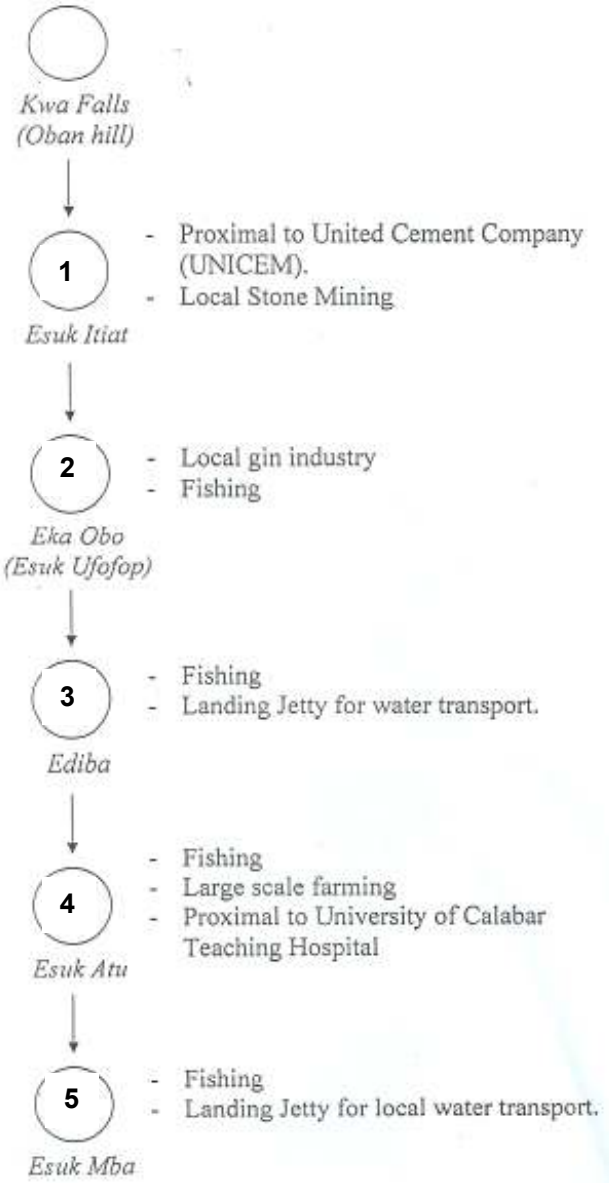

Figure 2: Extract from figure 1 showing all sampling zones with human activities responsible for pollution.

Determination of physicochemical parameters of water samples

Physicochemical parameters of water samples were determined at the sites of collection.

(a) **Dissolve Oxygen**

This was determined by means of oxygard Handy Mk II electronic meter with sensitivity of ± 1.0%. The probes were inserted into the water samples and the reading recorded.

(b) **pH**

WTW-pH electronic meter with sensitivity of ± 0.1% was used to determine pH. The meter was properly calibrated by means of buffer spolution.

(c) **Electrical Conductivity**

This was determined by means of a WTW LF - 90 conductivity meter with sensitivity of ± 0.1%.

(d) **Temperature**
Water temperature was determined using a thermometer. Water samples were acidified with analar grade tetraoxonitrate (v) acid after determining physicochemical parameters.

Examination for parasites

Samples of crayfish and lobsters were dissected after bathing them in distilled water and 1.0% formalin respectively to detach all ectoparasites on samples body. Intestinal contents of dissected samples were examined using method described by Chesbrough (2005).

Isolation of metals

Twenty five grams of oven-dried samples of crayfish and lobsters from the various locations were separately homogenized using a thoroughly cleaned mortar and pestle. The pulverized samples were packed into clean polythene bags labeled C' for crayfish and L for lobsters, The polythene bags were securely tied and preserved in a desiccators for digestion.

Five gram each of the pulverized crayfish and lobster samples were weighed out using metler Toledo Electronic balance and placed in separate 250cm^3 conical flask. Aliquots (125cm^3) of a mixture of Analar grade hydrochloric acid (HCL) and tetraoxonitrate (v) acid ($HN0_3$) in the ratio of 3:1 were added and allowed to stand for 2 hrs before digestion reflux.

Before reflux of acidified samples, each acid treatment was initially refluxed under moderate temperature of 60°C for one hour, and then completely evaporated to dry yellow cake residues at 160°C. The digest were dissolved in small quantities of de-ionized water and transferred to 50.0cm^3 volumetric flask and made up to mark with de-ionized water. They were finally filtered and stored in securely corked polythene sample bottles, ready for Atomic Absorption Spectrophotometer analysis. A blank sample was prepared, using all reagents and applying the same digestion conditions but with neither lobster nor crayfish sample and labeled as such.

Digestion of water samples

Aliquots (200cm^3) of each of the water samples (from different sampling stations) were acidified with 2M tetraoxonitrate (v) acid and mixed properly. These were evaporated to dryness on a steam bath and then cooled in the 250cm^3 Erlenmeyer flasks. Concentrated tetraoxonitrate (v) acid (25cm^3) was added to the residue in the flasks and heated almost to boiling. The flasks were then transferred to hot plates and carefully evaporated to small volumes without spattering in the process. The process was repeated by addition of 25cm^3 of concentrated, tetraxonitrate (v) acid plus small quantities of hydrogen peroxide until complete ashing was attained, (White residue was observed in the flasks).

A little warm distilled water was added to the ash followed by small amount of concentrated, hydrochloric acid to dissolve the cake. The resultant cool solution was filtered and neutralized with cone, ammonium hydroxide and transferred into 50cm^3 volumetric flasks and made up to mark with de-ionized water.

A blank sample was prepared using the same process and conditions but without the river water. The solutions were transferred into correspondingly labeled/ securely corked polyethylene 'sample bottles for Atomic Absorption Spectrophotometer analysis.

Analysis of Data

All the solutions of crayfish and lobster samples and those of the river water were analysed for Cu, Fe, Cd, As and Zn using Atomic Absorption Spectrometer (Model AA 969 Thermo Electron formerly UNICAM).

The instrument operated with continuous signals, under measurement time of 4 sec. and background correction. The flame types was Air-Acetylene (C_2H_2) and the fuel flow rate was 1.01/min.

All the analyses ware done in triplicate, and appropriate standard solutions were prepared and analyzed for all the salts of the metals investigated.

RESULTS

Physicochemical parameters of Great Kwa River measured throughout the duration of research is shown on table 1

Table 1: Physicochemical parameter of the GKR (values are averages measured throughout duration of research)

Station	Temp °C	pH	Conductivity (ms/cm)	DO mg/dm^3
1	24.4	6.56 ± 0.56	24.4 ± 8.49	3.9075 ± 0.32
2^n	24.1	8.36 ± 0.30	27.8 ± 4.80	4.5340 ± 1.50
3	27.3	5. 25 ±0.10	30.3 ± 10.80	5.0756 ± 3.25
4	26.9	6.53 ± .23	34.1 ± 5.40	4.1576 ± 2.62
5	26.5	6.89 ± 0.3	32.5 ± 2.80	6.4819 ± 0.18
Overall average	25.8	6.72 ± 03	29.8 ± 6.46	4,83 ± 1.57

Mean concentrations of heavy metals analyzed for crayfish (*P. Clarkii),* Lobster (*M. vollenhovenii),* and water samples are shown in table 2.

Table 2: Metallic concentrations in crayfish, lobster and water samples from GKR

S/N	MetaJs Samples	Pb	Cu	Fe	Cd	As	Zn
1.	C_i	0.344 ± 0.9	10.428 ± 2.7	125.64 ± 1.2	BDL	1.428 ± 2.7	2.976 ± 2.1
	L_i	BDL	2.572 ± 25.2	82. 24 ±2.1	BDL	3.277 ± 1.8	1.528 ± 2.0
	Wi	BDL	0.155 ± 1.3	0.178 ±3.1	BDL	0.136 ±0.8	0.021 ± 1.6
2.	C_2	0.991 ± 3.3	7.988 ± 0.4	109.78 ± 9.2	BDL	6.798 ± 0.2	0.935 ± 1.1
	L_2	BDL	3.277 ± 5.8	57.59 ± 5.8	BDL	1.893 ± 0.8	2.472 ± 1.3
	W_2	BDL	0.087 ± 1.2	0.172 ±2.1	BDL	0.157 ±0.3	0.023 ± 0.1
3.	C_3	BDL	7.548 ±0.5	110.89 ± 1.2	BDL	4.458 ± 1.5	0.910 ± 0.9
	L_3	0.352 ± 0.1	3.797 ± 39.0	101. 27 ±3. 3	BDL	5.590 ± 0.8	2.670 ± 1.2
	W_3	BDL	0.157 ± 1.3	0.230± 12.9	BDL	0.076 ± 0.7	0.024 ± 0.1
4.	• c_4	BDL	8.656 ± 1.4	98.277 ± 3.4	BDL	6.656 ± 0.4	1.811 ± 6,8
	U	BDL	7.150 ±7.8	73.64 ± 7.8	BDL	2.972 ± 0.2	3.510 ± 1.3
	w,	BDL	0.149 ± 1.1	0.213 ±3.1	BDL	0.124 ± 1.1	0.020 ± 0.2
5.	C_5	0.299 ± 0.3	5.989 ± 1.9	97.10 ± 12.9	BDL	8.989 ± 1.9	0.935 ± 2.0
	L_5	0.310 ± 1.0	2.326 ± 0.7	122. 74 ± 13.9	BDL	4.797 ± 1.0	2.190 ± 2.9
	W_5	BDL	0.186 ±0.8	0.180 ±3.1	BDL	0.096 ± 1.2	0.021 ±3.1

Legend:

C = Crayfish
L = Lobster
W = Water
BDL = Below Detection Limit

The means and ranges of the concentrations of all the samples are shown in table3.

Table 3: Mean and ranges of the Metal concentrations in Crayfish, Lobster and Water

Samples / Parameters		Crayfish (µgg-^{1})	Lobster (µgg-^{1})	Water mgdm"^{3}	FEPA guidelines (MdgnV^{3})
Pb	R	0.299-0.991 (C_3)s (C_2)	0.310-0.352 (L_5) (L_3)	BDL	
	$\bar{X}$	0.493	0.132	BDL	1.7
Cu	R	5.989-10.428 (C_5) (Ci)	2.326-7.150 (L_5) (U)	0.087-0.186 (W_5) (W_3)	
	$\bar{X}$	8.124	3.824	0.147	2-4
Fe	R	97.10-125.64 (Ci) (C_5)	57.59-122.74 (L_2) (Ls)	0.172-0.230 (W_2) (W_3)	
	$\bar{X}$	108.436	87.496	0.195	1.0
Cd	R	BDL	BDL	BDL	
	$\bar{X}$	BDL	BDL	BDL	0.2-1.8
As	R	1.428-8.986 (CO (C_5)	1.893-5.950 (L_2) (L_3)	0.076-0.157 (W_3) (W_2)	
	$\bar{X}$	5.683	3.778	0.118	0.5
Zn	R	0.910-2.976 CC_3) (Ci)	1.528-3.510 (U) (U)	0.020-0.024 (W_4) (W_3)	
	$\bar{X}$	1.513	2.474	0.022	50.0

Legend:
R = Range
$\bar{X}$ = Mean

All metals analyzed, lead (Pb), copper (Cu), iron (Fe), cadmium (Cd), Asenium (As) and zinc (Zn) were detected in considerable concentrations except Cd which was Below Detection Limit (BDL) in all samples including water. Pb was below detection limit in the water sample, but detected in crayfish samples from stations 1, 2, 5, and in lobster samples from stations 3 and 5 (table 1). While Iron (Fe) was detected at a higher concentration compared to others metals with $\bar{X}$n = 108.436 µgg-1, 87.496 µgg-1 and 0.195 mgdm-^{3} (table 3) in crayfish, lobster and water samples respectively, lead (Pb) was far less so; with x = 0.493ugg-^{1} and below detected level (BDL) in crayfish, lobster and water samples respectively. The trends of concentrations of the metals detected in all samples in decreasing order of concentration was Fe ($\bar{x}$ = 108.436µgg – i) > Cu ($\bar{x}$ – 8.124µgg-^{1} > As ($\bar{x}$ 5.683µgg-^{1}) > Zn($\bar{x}$=1.513 µgg-^{1}) > Pb ($\bar{x}$ = 0.493µgg-^{1}) > Cd (BDL) (table 2).

Inter-zonal (inter sampling zones) differences in concentrations were observed. Concentrations of 10.428µgg-^{1}, 7.998µgg-^{1}, 7.54µgg-^{1}, 8.656µgg-^{1} and 5.989µgg^{-1}, were recorded for copper (Cu) in Crayfish from zone one to zone 5 (Table 2)

Differences between these data were significant at P<0.01. Also, differences between the concentrations, 125.64µgg-^{1}, 109.78µgg-^{1}, 110.89µgg-^{1}, 98.277µgg-^{1} and 97.10µgg-^{1} of Iron (Fe) in crayfish from the five zones were significant at P<0.01. on the other hand differences between the prevalence, 6.0%, 8.7%, 15% and 3.3%, recorded for *Paragonimus uterobilateralis* in crayfish from the different zones were significant at P<0.01. significant differences (P<0.01) were observed

between the difference in the values of *Polymorphus botulus* prevalence, 3.3%, 6.0%, 3.6% and 8.7% in lobster (Table 4). Differences in Metallic concentrations of 2.572µgg-^{1}, 3.277µgg-1, 3.799µgg-^{1}, 7.150µgg-^{1} and 2.326µgg-^{1} of Cu and 82.24µgg-^{1}, 57.59µgg-^{1}, 101.27µgg-^{1}, 73.64µgg-^{1} and 122.74µgg-^{1} of Iron (Fe) in Lobster from the 5 sampling zones (table 2) were significant at P<0.01.

GKR water sample had lower concentrations of metals than crayfish and lobster samples. However; the trend of metals concentrations was similar to concentrations in crayfish and lobster samples as stated above (table 2 and 3).

Table 4: Prevalence and intensity of parasites isolated from crayfish and lobster samples obtained from GRK.

Sample points	Experiment samples	No of sample examined	No. (o/o) of sample infected	Parasites Isolated	Stage of parasite isolated	Parasite intensity (par/mil)
1.	C	300	18(6.0)	*Paragonimus uterobilateralis*	Degenerated eggs and Miracidium	2 3
	L	300	10(3.3)	*Polymorphus botulus*	Adult	3
2.	C	300	26(8.7)	*Paragonimus uterobilateralis*	Eggs and Miracidium	4
	L	300	18(6.0) 6(2.0%)	*Polymorphus botulus* *Nlcothoicastaci*	Adult Adult	3
3.	P	300	31(10.3) 45(15.0%)	Crayfish leech *Paragonimus uterobilateralis*	Adult Miracidum	6 3
	L	300	46(15.3) 11(3.6) 6(2.0)	*Nicothoic actasi* *Polymorphus botulus* *Hysterothylaactum sp*	Adult AdultAdult	3 3 2
4.	C	300	10(3.3)	*Paragonimus uterobilateralis* Crayfish leech	Eggs and Miracidium Adult	3 2
	L	300	26(8.7) 15(5.0)	*Polymorphus botulus* *Nicothoic astaci*	Adult Adult	3 3
5.	C	300	20(6.7)	Crayfish leech	Adult	2
	L	300	11(3.7)	*Porospora gigantica*		2

One hundred and fifty (10%) and one hundred and forty-nine (9.9%) of 1500 each of crayfish and lobster examined for parasites were infected. Parasites isolated included *Porospora gigantica* (sporozoa), *Nlcothoic astaci* (copepod), *Hysterothylacuim sp* (IMematode), *Paragonlmus uterobilateraiis* (Trematode), Leech-like parasite (Hirudinea: Undefined) and *Polymorphus botulus (Acanthocephala}* were isolated. *Paragonimus uterobilateralis* and leech-like parasite were the only parasites isolated from crayfish. *Porospora gigantica* infestation was only observed in lobster samples obtained from sampling stations at the entrance of GKR to Cross River estuary. No parasite was recorded from the muscles of crayfish and lobster after histopathological examination. All parasites were isolated from the intestinal tract except Crayfish leech

which were observed in the gills and externally on the thorax. Parasite infestation increased from the first to the third sampling station where the highest prevalence of crayfish and lobster respectively were recorded and decreased thereafter (Table 4).

Parasite intensity in the organism examined was low (below 5 parasites/sample) except intensity of Crayfish leech which was moderate (about 8 parasites/sample).

DISCUSSION

The Great Kwa River (GKR) runs on surfaces of rocks and across thick forest at its origin (Oban Hills). This, in addition to diverse human activities at the sampling zones which are proximal to local industries, have contributed to the presence of heavy metals and parasitic fauna in the river.

Heavy metals and parasites isolated from Crayfish and Lobster samples obtained from GKR had earlier been reported in Crayfish, Lobsters and water samples elsewhere. (Ogri, 2002; Guistic and Zhamp, 2002; Beiley *et al.,* 2003; Allah and Abduliah, 2006). However, heavy metal concentration, parasite prevalence and the relationship between these two parameters as a mark of pollution had not been reported in GKR.

Parasites Isolated from Crayfish and Lobster samples, *Porospora gigantic (Protozoa), Nicothoic astaci*(Copepod, *Hysterothylacium sp*(Nematode), *Paragonimus uterobilateralis*(Trematode), a Leech-like parasite (Unidentified) and *Polymorplus botulus*(Acanthocephala), indicated a rich parasite community in GKR. Also, the occurrence of metals in water and animal samples indicated tolerance of the metals by the crustaceans and the adaptive potential of the parasites irrespective of metallic concentration of the examined hosts.

Physicochemical parameters varied in concentration and magnitude across the sampling zone (table 1). The range of dissolved Oxygen (Do) and pH, 3.90-6.48mg/dm^3 and 5.25-8.36 respectively differed significantly at $P<0.01$ from 4.55-66mg/litre and 6.2-7.3 respectively reported by Asuquo (1989), for the same parameters. It is difficult to explain the variability in magnitude and concentration of physicochemical parameters across the sampling zones. Similar observatiosn were reported by Asuquo (1989 & 1999) for Cross River. Factors that are likely to cause inter-zonal differences in physicochemical parameters across the five sampling zones are effluents from local industries located in the zones, various wastes from farms and fishing activities drained to the river or deposited in the river and wastes resulting from social interactions between commercial partners (fishers, fish traders and consumers), in the zones. Also, proximity of the river to the University of Calabar Teaching Hospital and United Cement Company (UNICEM) makes the GKR a recipient of highly concentrated sewage, expired drugs, metallic scraps, chemical solutions, organic and inorganic compounds.

Parasites isolated from crayfish and lobsters and heavy metals detected in water and in the crustaceans appeared to have no influence on the examined crustaceans. No signs and symptoms of infection were observed. Attempts to see isolated parasites and observed concentration of metals as falling within the carrying capacity of the examined animals may not be sufficient to explain the general well-being of the animals. There may be a means through which the organisms excrete or remove heavy metals from their bodies. The organisms serve as vectors of some of the parasites especially *Paragonimus uterobilateralis*, and suffer little or no harm.

Bioaccumulated metals were of higher concentration in Crayfish than lobster samples. The mean values of detected metals in the two samples were positively correlated. Differences in heavy metal concentration and prevalence of parasites in Crayfish and Lobster across the zones indicated differences in magnitudes of human influence, flow rate of the Great Kwa River from Oban Hills, across the different sampling zones. The presence of metallic pollutants may also have been contributed to by metal scrap deposited in the river at each zone. Results also show that the concentration of metals and parasite intensity were not according to the flow gradient of GKR (from Oban Hill to Esuk Mba), thereby suggesting .inter-zonal sedimentary processes determined by the mass of metal deposited.

Prevalence of some parasite appeared to be determined by concentration of certain metals. For instance *Polymorphus botulus* infected lobster in 4 of 5 sampling zones with the highest prevalence (8.7%) occurring in zone 4 where high amount of Fe, Cu and Zn were detected. *Nicothoic astaci* was isolated from lobster in 3 of the 5 zones with highest prevalence (15.3%) in zone 3 where high concentration of Fe and As were detected. Similarly, *Paragonimus uterobilateralis* infected crayfish in 4 of the 5 sampling zones with the highest prevalence (15.0%) in zone 3 while the Crayfish leech infected crayfish in zone 3 and 4 with the highest prevalence (15.3%) in zone 3. *Hysterothylacium sp* and *Porospora gigantic* infected lobsters only in zones 3 and 5 respecitvely.

The conditions for survival of *Hysterothylacium sp* and *Porospora gigantic* in only one of the zones each need to be investigated.

Some parasites were isolated from zones where high concentration of certain metals were detected. The presence of these parasites could be used as indicator of these metallic pollutants in the area.

Parasitic faunae throughout the sampling zones exhibited specificity in their choice of host irrespective of metallic bioaccumulation potential in examined crustaceans. *Paragonimus uterobilateralis* and *Polymorphus botulus* were isolated from both Crayfish and Lobsters. Since all metals detected were present in the two animal samples, parasite specificity with respect to Crayfish and lobster in the Great Kwa River may not have been determined by bioaccumulation potentials and physiological demands of the hosts, but by parasite-host preference, which in most cases is determined by the parasite ability to reach its definitive stage in the host with maximum reproduction potential.

The presence of heavy metals in any given environment attracts, concerns especially when their

concentrations reaches toxic levels. Our environment is constantly being polluted by Agro-allied wastes, domestic wastes and industrial effluents which are laden with heavy metals. Concentrated wastes always provide ample conditions for parasite population growth.

Heavy metals and parasites at certain concentrations and prevalence respectively endanger aquatic life. The question of whether man can be infected through polluted water and meals containing aquatic animals is no longer a cause of debate for many decades. Zoonotic possibilities as a result of man's intake of aquatic animals such as Crayfish and Lobsters have been postulated by many researchers including Klinger and Frances-Floyd (2002), Reed et al., (2002) and Abraham et a/., (2003). Although the crustaceans showed no signs and symptoms of infection, there is the possibility of transfer of infection to man.

It is better to apply measures that ensure the prevention of infections other than controlling them in infected animals and man. This is enhanced by the knowledge of causative substances, causative organisms and their habits as well as the point of contact of the infections. This paper establishes the fact that GKR is polluted by heavy metals derived from various sources as stated in its contents, and that the polluted GKR is inhabited by various parasitic faunae evident by detected metals and isolated parasitic faunae in crayfish and lobsters. Isolated parasites can serve as indicators of metallic pollution in the area. Consumers need to be informed of the possibility of getting infected through meals containing these crustaceans.

Health education on preventive measures such as eating only thoroughly cooked meals of crayfish and lobsters, reporting any signs and symptoms suspected from such meals and reporting for regular medical examination was delivered in the study area. Governmental bodies were informed to ensure that aquatic sources of protein such as crayfish and lobsters are assayed for effective zoonotic disesease prevention and control strategies.

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