QUALITY ASSESSMENT OF WATER, NUTRITIONAL FITNESS AND PARASITIIC STATUS OF THREE SELECTED FISH SPECIES IN ERO DAM, NIGERIA

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ABSTRACT

Ero Dam has been noticed to exposed to several abuse from human activities and various preliminary studies implicating the river to be polluted has been established judging from the water quality data. However, there is need to continuously assess the quality evaluation of the dam. Therefore, this research is aimed at evaluating the impacts of human activities on some qualitative attributes of the dam using standard laboratory procedures. The physico-chemical attributes of the dam water established that most of the parameters were statistically higher ($p<0.05$) than the National Environmental Standards and Regulations Enforcement Agency's specification for maximum limits allowed for discharge into surface water for all categories of industries. The concentrations of metals in the whole body mass of the three sampled fish species (*Oreochromis niloticus, Tilapia mosambis* and *Clarias gariepinus*) were higher than their values in water. The proximate composition of the body muscle of the three fish species analyzed proofed the fishes to be nutritionally suitable for consumption but the additive effects of the metals in the water samples should be a point of concern to public health. The three Fish species studied were heavily parasitized, with high parasitic prevalence and intensity probably as a result of presence of pollutants in Ero Dam. The polluted water also reduced the parasite species diversity in the three fish species studied. Conclusively, indiscriminate abuse of Ero Dam impaired the quality of water and reduced the diversity and abundance of fishes in the river.

Key words: Nutritional Fitness, Parasitism**,** *Oreochromis niloticus, Tilapia mosambis* and *Clarias gariepinus*

INTRODUCTION

Relationship between water quality and aquatic productivity is a prerequisite for obtaining optimum growth and production (Boyd, 2002 and Olajuyigbe and Fasakin, 2010). Evaluation of the physical and chemical features of an aquatic ecosystem is important for understanding its biological productivity (Okonko *et al.,* 2008). Such aquatic features that influences the quality of water includes temperature, pH, total alkalinity, dissolved gases like Oxygen and Carbon dioxide and dissolved inorganic nutrients like Nitrate and Phosphorus are considered to be important (Mahar, 2002). In view of solving water related problems, the government of the Old Ondo State embarked on the construction of a Dam in Ero Ekiti (Adefemi *et al.*, 2008), now in Ekiti State, Nigeria. Ero Dam in Ikun, Ekiti State Nigeria, is a regional project created for the purpose of water supply (Anisulowo, 2010) in Ero region.

Parasitic infections in fishes have proof to be indicators of pollution in water bodies (Madanire-Moyo and Barson, 2010). Domestic sewage, pesticides, polychlorinated biphenyls, heavy metals, pulp and paper effluents, petroleum aromatic hydrocarbons, acid rain, and others, are known to pose collective threat to aquatic species (Khan and Thulin, 1991). However, chronic exposure to pollutants over a period of time causes biochemical, physiological and behavioral host changes that ultimately influence the prevalence and intensity of parasitism (Khan and Thulin, 1991). Khan (1991) supported the view that pollution influence parasites of aquatic animals; he was of the opinion that pollutants might promote increased parasitism by impairing the host's immune response or favoring survival and reproduction of intermediate hosts. Madanire-Moyo and Barson (2010) examined the relationship between parasite species diversity and organic pollution; the observed results showed that decrease in parasite diversity can be related to increased organic pollution. Studies on parasite communities can also be employed to detect a decline in biodiversity which characterizes habitats affected by pollution (D'Amelio and Gerasi, 1990). This study sets out to investigate the physic-chemical attributes of water in Ero Dam, how they affect mineral composition, proximate composition and parasite distribution in *Oreochromis niloticus, Tilapia mosambis* and *Clarias gariepinus* in the Dam.

METHODOLOGY

The Study Site

The Study Area Ero dam is located at Ikun Ekiti in Moba Local Government Area of Ekiti State. The dam is constructed on Ero River which takes its source from the highland region of Orin-Ekiti in Ido-Osi Local Government. The tributaries include Afintoto, Ayo, Igo, Igbegbe, Ipu, Irara, Ilogbe eran and Ofu Rivers (Adedeji, 1993). Geographically, Ero Dam is located on the intersect of latitude 7^0 35^1N of the equator and on longitude 5^0 31^1E of the Greenwich meridian. The dam site at Ikun Ekiti is bounded in the North by Kwara state, in the West by Ikosu-Ekiti, in the South by Ijesamodu-Ekiti and in the East by Ilejemeje Local Government Area. Ikun –Ekiti is a border town between Ekiti state and Kwara state and it is located at about 70km from Ado-Ekiti, the Ekiti State capital. Three sampling sites (A, B and C) were selected in this study in relation to the fishing activities, agricultural, and domestic effluents that enter the stream. Therefore, the choice of the afore-mentioned sampling points was based on accessibility, the rate at which they receive effluents from different sources and their distances from the residential premises.

Collection of Samples

Surface water samples were collected from the three sampling points twice monthly, starting from April 2016 to November 2016. Water were collected in plastic bottles previously soaked in 3% nitric acid and washed with distilled water (WHO, 2011). Samples for the determination of dissolved oxygen were collected in dark glass containers and fixed on the spot with Winkler's reagent. The water samples for the determination of other parameters were preserved with HCl and digested using standard laboratory procedure. Digested samples were then analyzed using Atomic Absorption Spectrophometer with designated model (AAS- Perlin-Elmer 4100 ZL) because of restriction of the ICP-MS, model (Perkin-Elmer Elan 5000) to detect nickel).

Fish Sample Collection and Analyses

The three fish samples used were *Oreochromis niloticus* (18 males, 14 females)*, Tilapia mosambis* (20 males, 24 females) and *Clarias gariepinus* 22 males, 19 females. Samples were collected fortnightly. Fish specimens were captured using traps, gill nets, and cast nets with mesh sizes ranging from 38.10 mm to 180.00 mm. Collection of fish specimen were done between 06:00 am - 08:00 am. Water from the reservoir was added to the samples at the point of collection and transported to the laboratory in the Department of Pure and Applied Biology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria for further investigations. The collected fish samples were identified immediately after collection. Identification of Cichlids (*Tilapia mosambis* and *Oreochromis niloticus*) were done using the most distinctive characteristic of the family which is the possession of only a single pair of nostrils as reported by Adesulu and Sydenham (2007). Oreoc*hromis niloticus* was distinguished by the characteristic alternating dark and light band on the caudal fin (tail). Identification of *Clarias gariepinus* specimens was done using fish identification guide by Teugels (1986); FAO (1992); Skelton (1993); Olaosebikan and Raji (1998).

Mineral Composition

Accumulation investigation was done after identification; the whole body was oven dried at 70 – 73^{0}C until a constant weight was obtained. The specimens were then ground to fine powder and stored in desiccators in order to avoid moisture absorption before digestion. Five grammes of each of the samples were weighed and transferred into a beaker; then, 5ml of concentrated trioxonitrate (v) acid (HNO_3) was added and allowed to evaporate on a hot plate to the lowest volume possible (15-20ml) before precipitation occurred, another 5ml of concentrated trioxonitrate (v) acid was added to the sample and a gentle refluxing was carried out by covering the beaker with a watch glass. Heating and addition of concentrated trioxonitrate (v) acid continued until the sample became light coloured. Furthermore, 2ml of concentrated trioxonitrate (v) acid were added to dissolve the residue on the wall of the beaker. The beaker walls and watch glass were thereafter washed down with deionized water. The digested samples were then filtered and made up to the mark in 100ml volumetric flask, after which they were stored in pre-weigh sample bottles and placed in refrigerator before analysis of heavy metals.

Proximate Analyses

The fish samples were oven dried at 80^{O}C for three days after which they are homogenized using blender or mortar and pestle and were analyzed chemically according to the official method of analysis described by the Association of Official Analytical Chemist (A.O.A.C 1989). All Analysis was carried out in duplicates.

Examination of Fish specimen for parasites

In specimens of *Oreochromis niloticus,* and *Tilapia mosambis,* the sexes were identified by examining the papillae; there are two orifices (openings) in the papillae of female and one in male, Adesulu and Sydenham (2007). Sexes in *Clarias. gariepinus* specimen were identified using the description of Akinsanya and Otubanjo (2006), the male possess a distinct sexual papilla that is conspicuously located behind the anus, the sexual papillae were absent in females. The sexes were further confirmed after dissection with the presence of testes (in male) and ovaries (in female).

Euthanasia was carried out by physical method; Cervical dislocation with the two hands, or cervical transection using a knife inserted caudal to the skull, to sever the spinal cord and cervical vertebrae followed by pitching. Examination of fish for parasites, handling and processing were done using standard procedure of Moravec (2004). Cestodes and nematode parasites recovered were stained using the procedure of Khalil (1991). Fixative used was formalin acetic acid (FAA). Cestodes were stained using acetocarmine; nematodes were stained with Horen's trichome stain; while acanthocephalans were preserved in weak Erlich's haematoxylin solution overnight and dehydrated, cleared in methyl-salicylate and mounted on a slide in Canada balsam. Fish specimens found with parasite were given separate serial numbers to differentiate them from those without parasites. Identification of parasites from *Clarias gariepinus* to species level were undertaken using information provided by Yamaguti (1963); Kabata (1985); and confirmed with the assistance of Oniye *et al*. (2004) and Akinsanya and Otubanjo (2006), who had earlier confirmed the identity of the parasites through the assistance of the British Museum, United Kingdom. While those observed from *Tilapia mosambis* and *Oreochromis niloticus* were identified using information provided by Yamaguti (1963), Juan and Windsor (2006); Edoh *et al*. (2008).

Results

Water samples from the three sampling location along the course of Ero dam in Ekiti state Nigeria were analyzed and compared statistically with the World Health Organization

(WHO) and National Environmental Standards and Regulations Enforcement Agency (NESREA) for some selected physic-chemical parameters. Also, the mineral elements and the proximate composition of some selected fish samples were analyzed to ascertain the nutritional qualities of the sampled fish foods. These results were presented in tables 1, 2 and 3.

Table 1: Physical and Chemical Status of Water Samples from Ero Dam

Parameter	Upstream (A)	Midstream (B)	Downstream(C)	WHO
Physical Parameter				
Temperature (°C)	28.04 ± 0.22a	29.63 ± 0.01b	28.31 ± 0.13bc	Ambient
pH	6.81 ± 0.12a	6.43 ± 0.01b	6.88 ± 0.15ac	6.5-9.5
Colour	1.11±1.29a	1.99±1.084b	2.11±1.39ac	6.5–8.5
Turbidity (NTU)	2.29 ± 0.10c	5.21 ± 0.21a	3.24 ± 0.10a	ND
EC (µscm-1)	1.19 ± 2.10a	4.32± 1.33b	3.01 ± 0.01ab	ND
Total Hardness (mgCaCO3l-1)	65.00 ± 0.01bc	69.22 ± 0.11	59.01 ± 1.36b	<200
Total Solids (mgO2l-1)	28.22 ± 4.00a	152.31 ± 1.22b	139.88 ± 0.71a	<1000
BOD (mgO2l-1)	7.47 ± 2.22bc	10.11 ± 0.11a	8.51± 0.33ab	<500
DO (mgO2l-1)	2.33 ± 0.10a	4.25 ± 0.01bc	2.91 ± 0.34b	6.0
Chemical Parameter				
Sulphate(mgl-1)	22.31 ± 0.12c	33.00 ± 0.02a	28.89 ± 0.22ab	ND
Nitrate (mgl-1)	12.23 ± 0.00bc	19.68 ± 0.22a	16.21 ± 0.00ab	50
Chloride (mgl-1)	1.89 ± 0.00b	1.27 ± 1.12a	1.02 ± 0.11bc	ND
Sodium (mgl-1)	2.28 ± 0.10a	22.92 ± 0.92b	8.06 ± 0.19ab	ND
Calcium (mgl-1)	33.21± 0.11	31.00 ± 0.16a	21.92 ± 12.02c	<200
Heavy Metals				
Lead (mgl-1)	0.03 ± 0.01a	0.04 ± 0.01b	0.20 ± 0.11a	<0.01
Copper (mgl-1)	0.01 ± 0.11a	1.12 ± 0.00b	1.09 ± 0.19b	<2.0
Zinc (mgl-1)	1.12 ± 0.00a	1.85 ± 0.21b	0.96 ± 2.21b	<1.0
Iron (mgl-1)	2.42 ± 0.24a	3.49 ± 0.12b	4.56 ± 2.18b	ND
Mercury (mgl-1)	0.01 ± 0.00a	0.02 ± 0.00ab	0.02 ± 0.11b	ND
Manganese (mgl-1)	0.29± 0.00a	1.33 ± 0.33ab	2.74 ± 0.27b	<2.0
Magnesium (mgl-1)	8.65 ± 1.51a	9.28 ± 2.12ab	6. 22 ± 0.29b	ND

*Mean of parameter in the same row having different superscripts is significantly different ($p \leq 0.05$)
Duncan Multiple Range Test

Table 2: **Minerals Composition of Sampled Fish Species in Ero Dam**

Parameter	*Oreochromis niloticus*	*Tilapia mosambicus*	*Clarias gariepinus*
Lead (mgl^{-1})	1.01 ± 0.01^{a}	1.97 ± 0.01^{a}	1.56 ± 0.11^{a}
Copper (mgl^{-1})	2.01 ± 0.21^{a}	2.87 ± 0.52^{b}	1.78 ± 0.09^{ab}
Zinc (mgl^{-1})	2.33 ± 0.12^{a}	4.54 ± 3.02^{ab}	4.01 ± 0.00^{b}
Iron (mgl^{-1})	3.39 ± 1.41^{ab}	6.01 ± 0.00^{a}	5.96 ± 3.06^{b}
Mercury (mgl^{-1})	0.21 ± 0.11^{a}	0.92 ± 0.10^{a}	0.45 ± 0.12^{b}
Manganese (mgl^{-1})	0.92 ± 0.11^{a}	3.01 ± 1.28^{ab}	1.99 ± 2.19^{ac}
Magnesium (mgl^{-1})	12.04 ± 6.28^{ac}	15.01 ± 8.00^{a}	14.22 ± 6.88^{ab}

*Mean of parameter in the same row having different superscripts is significantly different ($p \leq 0.05$)
Duncan Multiple Range Test

Table 3: **Proximate Composition of Sampled Fish Secies in Ero Dam**

Parameter	*Oreochromis niloticus*	*Tilapia mosambis*	*Clarias gariepinus*
Moisture Content	82.01 ± 1.19^{a}	78.88 ± 0.23^{a}	92.03 ± 1.09^{a}
Ash Content	9.24 ± 1.13^{a}	7.22 ± 1.21^{b}	11.03 ± 2.16^{ab}
Total Protein	55.21 ± 3.01^{a}	52.45 ± 0.01^{a}	71.06 ± 0.33^{a}
Fat Content	7.30 ± 2.03^{a}	6.33 ± 1.99^{a}	13.91 ± 1.12^{b}
Fibre Content	13.13 ± 1.41^{a}	15.29 ± 1.27^{a}	24.65 ± 1.11^{a}
Carbohydrate	17.79 ± 1.16^{b}	15.43 ± 1.23^{ab}	11.96 ± 1.25^{a}

*Mean of parameter in the same row having different superscripts is significantly different ($p \leq 0.05$)
Duncan Multiple Range Test

Parasite species retrieved. The gastro - intestinal helminth parasites recovered from *Clarias gariepinus* were two Nematodes; *Procamallanus laevionchus* (Wedl, 1862), *Paracamallanus cyathopharynx* (Baylis, 1923) and two Cestodes; *Monobothrium sp. Polyonchobothrium clariae*; In *Oreochromis niloticus,* only one species of Acanthocephalan *Acanthocentius tilapiae* was found while in *Tilapia mosambis* two Nematodes; *Procamallanus laevionchus* (Wedl, 1862) and *Paracamallanus cyathopharynx* (Baylis, 1923) were retrieved.

Table 4 Prevalence and Intensity of Parasites in the Intestines of *Oreochromis niloticus, Tilapia mosambis and Clarias gariepinus.*

Fish species	***Oreochromis niloticus***		***Tilapia mosambis***		***Clarias gariepinus***	
Sex	Male (18)	Female (14)	Male (20)	Female (24)	Male (22)	Female (19)
Number infested	10	09	09	13	16	17
Prevalence (%)	55.56	64.29	45.0	54.17	72.73	89.47
Intensities	0 – 11	0-19	0-8	0-14	0-33	0-41
General Prevalence (%)	59.34		50.00		80.49	

DISCUSSION

The average temperature values for all the three sampling sites were <40 ^{0}C depicting temperature range that is supportive of good surface water quality (NIS, 2007; WHO, 2011). Generally, the variation in water temperature obtained in this work is a direct reflection of low depth of the water bodies and the irregular slow movement which does not ensure a complete mixing of the entire water body. This observation agreed with the submissions of Ajao, (1990) and Oyewo, (1998) on the temperature profile of Lagos Lagoon. This is also in line with the temperature range of 24.5 ^{0}C to 31.5 ^{0}C reported by Adewoye, (2007) from Asa River, in Ilorin Kwara State, Nigeria. There were significant differences between the temperature values obtained for the three sampling sites and between Raining and Dry seasons of the year.

The pH values recorded in this work (6.81 ± 0.12, 6.43 ± 0.01 and 6.88 ± 0.15) for sites A, B and C respectively are indicative of good water quality which were within acceptable limits (NIS, 2007; WHO, 2011). The high values of pH recorded at sampling sites A and C could have been due to the influx of industrial effluent and the synergistic effects of these effluents on the water bodies. The influx of effluent in alkaline form into water could affect the pH. The fluctuations observed in the surface pH indicated the buffering capacity of total alkalinity, high water volume, and greater water retention. Good buffering capacity of total alkalinity may have been the reason why pH was in neutral or moderate alkaline medium during the rainy season and for most part of this study. Using the pH as a water quality index, Ero Dam has good water quality like most natural waters (Tepe *et al*., 2005). Such pH values will also allow the survival of aquatic organisms and its use as drinking water.

By physical examination, the samples analyzed were noted to be slightly turbid. The results obtained were in the order of 5.21 ± 0.21 NTU > 3.24 ± 0.10 NTU > 2.29 ± 0.10 NTU (Sites B>C>A) and this may be due to the type of activities that exist at each sample site of the dam. The highest value recorded by sampling site B may be linked to heavy anthropological activities. The land use within these steep areas is dominated by intensive small scale farming, where majorly food crops and vegetables are grown. The same area occurs in the flood plains with very high human and livestock population density coupled with heavy effluent discharges at sampling site B which flows down to Site C.

Conductivity is a numerical expression of the ability of water to carry on electric current, which in ionic strength as conductivity is a measure of total ions. The ionic strength of a sample depends on the ionization of solutes and other substances dissolved in it. The electrical conductivity of the three sampling sites in this work was found to be statistically high at the point of discharge (Site B) to downstream (Site C) compared to upstream (Site A). Sampling site A which is less impacted sub-catchments had lower concentrations as compared to stations located in areas with high anthropological activities like agricultural practices and industrial activities (Sites B and C). Low electrical conductivity experienced at site A might be responsible for soft nature of the water; while high conductivity may be due to high aggregation of total solids recorded in Sites B and C. This observation conformed to the report of Mustapha (2008), Adewoye, (2007) and Ogundiran and Fawole, (2014), on Oyun River and Asa Rivers respectively. This range support aquatic fauna and is ideal for drinking water supply (APHA, 1995). The influx of industrial, domestic and agricultural discharges into sites B and C may be traced to high total hardness recorded in these two sites. High level of conductivity reflects the pollution status as well as trophic levels of the aquatic body (Anitha, 2002).

The high value of total solids recorded in sampling sites (65.00 ± 0.01, 69.22 ± 0.11 and 59.01 ± 1.36 for A, B and C) may be attributed to low volume of water experienced at these sample sites while the dilutions of ionic substances as a result of large volume of water in the area could be the main reasons for lower level of total solids encountered in the rainy season. Also, high value of total solids observed in sites B and C could also be as a result of influx of effluents from industrial and agricultural premises, thereby bringing about increase in the level of conducting ions, electrical conductivity and turbidity of the affected water bodies. It could also be due to siltation, deterioration and heavy precipitation. These observations' agreed with the findings of Rabaru and Okeyo –Owuor, (2002) on River Nyando, Lake Victoria Basin in Kenya, and Ayoola and Kuton, (2009) on Lagos Lagoon in Nigeria. The high BOD recorded in sites B and C could be due to accumulation patterns of organic materials due to continuous influx of wastes into the water body which may eventually results in reduction of oxygen content; and when organic matter is abnormally high in an aquatic phase, the biological oxygen demand level increases and this may eventually disrupt the behavioral responses of the organisms and reduces the fitness of a natural population of fish, this observation conformed with the reports of Adewoye *et al*., (2005), Ayoola and Kuton, (2009) and Ogundiran and Fawole (2014).

The dissolved oxygen (DO) observed in this study was found to be lower than the 6.0 recommended level by NESREA, 2007; NIS, 2007. Olaniran (1991) reported that the desired range for the culture of warm water fish is 5 mgl^{-1} and above but not more than 12mgl^{-1}. Lower value of DO obtained in this work, may be due to low level of dilution rate and water volume with little self-purification process of the pollutants. The DO level obtained for sites B and C fell below the 10 mgl^{-1} recommended for unpolluted waters (WHO, 1988), but far greater than 6.0 recommended value documented by NIS, 2007 and WHO, 2011. The continuous influx of wastes discharge into the water might likely support the growth of aquatic weeds and formation of flocks on the surface of the water, hence a reduction in the dissolution of oxygen into water. Morrison *et al*., (2001) however stressed that the depletion of dissolved oxygen in a water body could be due to common practice of dumping of wastes into such water body.

This investigations revealed that the concentrations of Pb, Cu, Zn, Fe, Cd, Hg, Mn and Mg which were high in sampling site B followed by sites C and generally found in the order of B > C > A. The values obtained in Table 1 for surface water heavy metal concentrations could be adduced to anthropogenic activities going on around the sampling site, because of their exposure to domestic, agricultural and industrial influences. This is similar to the report of Adeniyi *et al*., (2007) based on their research at Agboyi crack segment near the Lagoon and Ogundiran and Fawole, (2014) findings on Asa River. All the heavy metals concentrations obtained in this work were found to be higher than those reported previously by Eleta *et al*., (2003); Eletta and Adekola, (2005); Adewoye, (2008) and were also found to exceeds NESTREA, (2011) specification.

Notable mineral elements were found to be accumulated in the whole body of selected fish species sampled from the dam; the sampled species were *Oreochromis niloticus, Tilapia mosambis and Clarias gariepinus*. All fish species analyzed accumulated metals at varied level. Some micro nutrients and heavy metals such as zinc, iron, copper, cobalt and nickel are essential for growth and well-being of living organisms including man (Buss and Robertson, 1976; Mertz, 1981; Oshodi and Ipinmoroti, 1990; Fagbemi and Oshodi, 1991). In summary, it is therefore suggested that a general bi-monitoring programme be established which should include hydrological and geo-morphological features, the chemical and physical water quality as well as these factors are likely to affect the aquatic system. Furthermore, to avoid harmful accumulation of these metals in the human system, the gills, rivers and probably the skin of fishes should preferably be discarded while processing fish for consumption. Removal of these organs will be a judicious step as this would drastically reduce the metal intake by human. Tissue biochemical changes can be used as indicators of fish physiological stress and health. The homogenates of the muscles were analyzed for various biochemical parameters like total protein, total glucose, total cholesterol, total lipids, crude fibre, ash content, moisture content and dry matter. Most of these parameters showed significant variation in the muscles of the sampled species.

The intensities of parasites recovered from *C. gariepinus* and *O. niloticus* were very high compared to reports from other Dams (Ajala and Fawole, 2015; 2019) and this may be due to poor quality of water in the Dam as a result of uncontrolled abuse of the dam by the populace in the area as reported by Khan (1991) which might promote increased parasitism by impairing the host's immune response or favoring survival and reproduction of intermediate hosts. Parasite infection would be higher in pollution-exposed than in control fish and fish with lower immune and health-state parameters would show higher parasitism than fish in better condition. The high parasitic load recorded in *C. gariepinus* probably may be owing to its feeding habit, which was reported to be primarily carnivorous feeding on aquatic mollusks, crustaceans and insects which serves as intermediate hosts to the parasites (Ajala and Fawole, 2016). The study also showed lower parasite species diversity in the three fish species which may be due to the toxicity to free-living stages, intermediate hosts or alteration of the host's physiology (Khan, 1991).

Madanire-Moyo and Barson (2010) also suggested that the decrease in parasite diversity can be related to increased organic pollution in an aquatic ecosystem. D’Amelio and Gerasi (1997) reported that true species richness has been shown to decline in parasite communities of mugilids collected in polluted areas. The presence of the parasites could also be an advantage in that parasites act as sinks for pollutants within their hosts: Some parasites are able to reduce pollutant levels in the tissues of their host (Sures, 2007). The presence of pollutants in the water in Ero Dam is responsible for the high parasitic prevalence, intensity and low parasitic species diversity recorded in the three fish species**.**

Conclusions

Generally all the measured parameters still remained higher even in the downstream part of the river water showing sub-lethal concentrations of contaminants in the water. The volume of these discharges into the analyzed dam was already overtaxing their capacity for self-purification and the prevailing practice of unregulated and uncontrolled discharge of such wastes into water bodies constitutes serious abuse and portends serious danger to the resident species and beneficial use to the municipality. It could be seen in this study that the Ero Dam water was grossly polluted and the level of pollution decreased downstream and it was much higher. Therefore, the data generated in this study, confirmed the presence of sub-lethal concentration of pollutants in Ero Dam and that the fish population are surviving under severe stress, which is apparent from the heavy metal load in the body of resident fish species. Drinking of water and consumption of fishes from these polluted waters could be detrimental to health of humans in terms of bio-concentration which could make the body to be vulnerable to disease outbreak and breakdown of immune system in man.

It is therefore recommended that;

- ✓ Abuse use of the river should be discouraged by strict vigilance of the appropriate Government tiers
- ✓ Existing environmental laws should be duly enforced regarding environmental health
- ✓ A good bio-monitoring program is needed to be established where the hydro-logical and geo-morphological characteristics, the chemical and physical water quality and the river vegetation are taken into consideration as these all affects the aquatic system.
- ✓ Illegal and indiscriminate fishing activities by local fish farmers which is capable of exposing the river to pollutants should be discouraged.
- ✓ The use of brutal means of harvesting fish like electric currents, poisonous plants, dynamites and addition of chemicals, as practised in the area must be stopped.

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