

## Parasitic Fauna of Landed Fishes from Qua Iboe River Estuary, South- South, Nigeria: It's Application in Bio-monitoring Studies

\*<sup>1</sup> George Ubong, <sup>2</sup> Inyang-Etoh Aniema

<sup>1</sup>Department of Zoology & Environmental Biology, University of Calabar, Calabar, Nigeria

<sup>2</sup>Faculty of Oceanography, University of Calabar, Calabar, Nigeria

[talk2georgeubong@gmail.com](mailto:talk2georgeubong@gmail.com)

**Abstract:** Studies on the parasitic fauna of landed fish from Qua Iboe River Estuary, South- South Nigeria was conducted for 5 months (May – September, 2016) with the aim of Understanding the current status of the Estuary using fish as bio-indicator organism and also provide a model which allows policy-makers and local actors to design programs and policies to improve the existing practices and mitigate future problems. Fish samples were collected monthly in three stations along the estuary and analyzed using standard procedures. Four hundred and forty two (442) fishes belonging to 12 species (*Sarotherodon melanotheron*, *Tilapia guineensis*, *Chrysichthys nigrodigitatus*, *Ethmalosa fimbriata*, *L. falcipinnis*, *Mugil curema*, *Polydactylus quadrifilis*, *Pomadasys jubelini*, *P. peroteti*, *Pseudotolithus elongatus*, *Trachinotus goreensis* and *T. teraia*) were collected from 3 landing sites along the upper reaches of the Qua Iboe River Estuary in Nigeria and were examined for parasites. Parasites isolated were mainly endoparasites throughout the study duration. Endoparasites isolated were nematode, cestode, protozoa and trematode respectively. Total prevalence for all parasites was 34.4%. High numerical abundance was observed in *Sarotherodon melanotheron* and *Tilapia guineensis*. The parasite species were found in the intestine and stomach of the examined fish species. However, the series of human induced activities in and around the study area, coupled with the findings of this study further vindicate the need for proper monitoring and management of our indigenous water bodies. Therefore, it is recommended that fishes from the river system should be properly cooked or smoked before consumption to avoid health risk due to parasitic infestation.

[George, U., Inyang-Etoh, A. **Parasitic Fauna of Landed Fishes from Qua Iboe River Estuary, South- South, Nigeria: It's Application in Bio-monitoring Studies.** *N Y Sci J* 2018;11(3):54-60]. ISSN 1554-0200 (print); ISSN 2375-723X (online). <http://www.sciencepub.net/newyork>. 8. doi: [10.7537/marsnys110318.08](https://doi.org/10.7537/marsnys110318.08).

**Keywords:** Parasite, Fauna, Landed Fishes, Qua Iboe River Estuary, Nigeria, Application, Bio-monitoring

### 1. Introduction

Like humans and other livestock, which are held in captivity at unnaturally high densities, fish suffer from diseases and parasites. All fish carry pathogens and parasites. Usually this is at some cost to the fish. If the cost is sufficiently high, then the impacts can be characterised as a disease. Disease is a prime agent affecting fish mortality, especially when fish are young. Fish can limit the impacts of pathogens and parasites with behavioural or biochemical means, and such fish have reproductive advantages.

Due to poor knowledge of fish parasites, fish industries suffer huge financial calamities each year to parasites and diseases of fishes, which are largely accountable for the deaths of fish and hatcheries (Johnson, 1976; Mamer, 1978). Therefore on a daily basis, the problems of parasites both in the cultured and wild species of fishes are encountered. Knowledge of fish parasites is necessary for ecological studies, economic health of our people, in aqua studies and as database for future environmental management studies.

The use of aquatic fauna in bio-monitoring and the economic importance of fishing as a source of employment and sports has made information on the

knowledge of fish disease to be very fundamental (Ugwuzor, 1987). Fishes have been widely used in recent times as bio indicators of pollution and contaminations of the environment. However, several authors opines that parasites (especially the macro parasites) could be better indicators of pollution making parasites of fin fish a potential valuable indicator of ecological impacts (Lafferty, 1997). As a result, they inferred that pollutants might promote increased parasitism in aquatic animals, especially fish, by impairing the hosts' immune response or favouring the survival and reproduction of intermediate hosts. Studies conducted by (Sures, 2004) observed that the number of ectoparasites such as trichodinid ciliates and monogeneans increased significantly in the gills following exposure to pollutants. Therefore, the incidence or prevalence of a particular parasite on a given fish in a known area could indicate environmental contamination.

Fish farming or aquaculture and fishing has remained a major economic activity of many communities in riverine regions of Nigeria where over 35 million people depend wholly or partly on the fisheries sector for their livelihood (FAO, 1996). Recent researchers in the Niger delta of Nigeria such

as (Ekanem, 2010; Obiekizie, 1995; Ekanem and Obiekizie, 2000; Onwuliri and Mgbemena, 1987; Anosike *et al.*, 1992; Ezenwaji and Ilozumba, 1992; Aken'ova, 1999; Auta *et al.*, 1999; Okaka, 1999; Emere, 2000; Ibiwoye *et al.*, 2000, 2006; Olurin and Somorin, 2006; Akinsanya *et al.*, 2007) have made tremendous advances in the study of fish parasites, mainly in Nigerian water bodies.

However, there remains a large vacuum in the knowledge of fish diseases and pathology in Nigerian waters. Epidemiology of fish diseases is therefore necessary to provide effective control in wild and cultured fish. Due to incessant crude oil spills and blow outs in the Niger Delta areas, and concomitant dredging activities, many researchers believe that fisheries and biodiversity of aquatic animals are adversely affected (Nwilo and Badejo, 2001). Thus, a study of fish and their parasites in the area will provide data on the fish species adversely affected, degrees of infection and interaction of the organisms within polluted and non-polluted waters. The idea is to promote the possible use of fish parasites as indicators of water pollution. Therefore, this study is

aim at investigating the current status of the Estuary using fish as bio-indicator organism and also provides a model which allows policy-makers and local actors to design programs and policies to improve the existing practices and mitigate future problems.

## 2.0 Materials And Methods

### 2.1 Study area

Qua Iboe River estuary (Fig. 1) is located on the South Eastern coast in the Niger Delta region of Nigeria where it empties into the Atlantic Ocean. It lies within latitude  $4^{\circ} 40'30''N$  and longitude  $7^{\circ} 57'0''E$  on the south Eastern Nigeria Coastline. The geomorphology of the lower reaches of Qua Iboe River Estuary consist of sandy coastal beach, small mixohaline lagoons, wetlands, tidal creeks; notable among them is Stubbs creek and Douglas creek, and tributaries fringed with mangrove vegetation made up of species of *Avicennia*, *Rhizophora* and *Nypa*. The coastal vegetation of the area is mainly thick mangrove swamp. The Estuary is also rich with abundance of edible aquatic biota (fin and shell fishes).

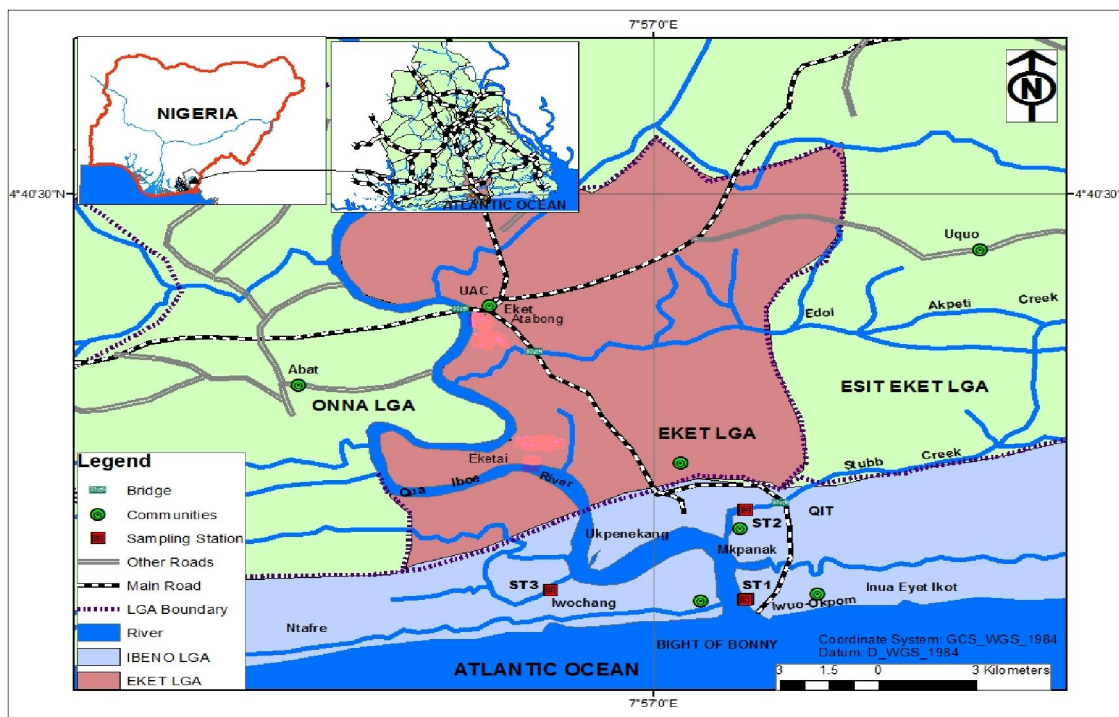


Fig1: Map of Study Area

### 2.2 Field sampling

A total of 442 fish specimen belonging to 8 families were collected from the study area for a period of five months (May – September, 2016). The fish were purchased from artisanal fishermen operating around the landing sites using gill and cast nets, as well as wire and basket traps of various mesh

sizes. The sampled fishes were collected and transported in ice chest to Devine Concept Integrated Laboratory, Port Harcourt, for identification and examination.

### 2.3 Identification / Examination of samples for ectoparasites

The sampled fishes were separated into groups and identified using identification sheets by (Schneider, 1990) using morphometric and meristics characters. The identified fishes were measured to the nearest mm and checked for macro ectoparasites in the skin and gills of the fish specimen. The scrape portion on each of the organs were smeared on clean glass slides, covered with cover slides and examined under light microscopes for ectoparasites. The isolated parasites were collected and fixed in 4% phosphate buffered formalin (PBF) for further processing and species identification (Paperna, 1980; 1996). Each sample was examined independently for parasites according to the protocol outlined in Obiekizie and Ekanem (1995). Skin scrapings and wet mounts from skin and gills were examined for abundance and distribution of ectoparasites. Identification of parasites was carried out according to Obiekezie and Enyenihi (1988), Obiekezie and Ekanem (1995) and Roberts (2000).

#### 2.4 Examination of samples for endoparasites

The cavity of each fish was cut open ventrally with a pair of scissors and the internal organs removed for examination. Organ squashes of some organs (liver, spleen, heart, kidney) were made and examined as wet mounts under the microscope while other parts were fixed in phosphate buffered formalin (PBF) for isolation, and identification of parasites (Paperna, 1980, 1996).

#### 2.5 Determination of percentage incidence of fish parasites

The percent incidence of both ectoparasites and endoparasites were calculated according to Tombi and Bilong (2004).

$$\text{Percentage incidence (\%)} = (n/N) \times 100$$

Where;

n = the number of individual parasites species isolated,

N = the total numbers of parasites isolated from individual fish.

#### 3.0 Results

The fish species identified were Cichlidae (*Sarotherodon melanotheron*, *Tilapia guineensis*), Clarotidae (*Chrysichthys nigrodigitatus*), Clupeidae (*Ethmalosa fimbriata*), Mugilidae (*L. falcipinnis*, *Mugil curema*), Polynemidae, (*Polydactylus quadrifilis*), Pomadasidae (*Pomadasys jubelini*, *P. peroteti*), Sciaenidae (*Pseudotolithus elongatus*) and Trachinidae (*Trachinotus goreensis*, *T. teraia*). The endoparasites were found in Cichlidae, Clarotidae, Clupeidae, Mugilidae, Sciaenidae and Trachinidae. No parasite was isolated from the Polynemidae and the Pomadasidae. A total of four hundred and forty two (442) fishes were examined, one hundred and fifty-two (152) of the fishes were infected with a

prevalence of 34.4%. The parasites isolated were mainly endoparasites found on the intestine and stomach of the fish species throughout the period of study. The fish species were evenly distributed in all the stations during the period of sampling (Table 1)

The percentage prevalence of parasites in the families Cichlidae was 48.3%, Clarotidae 37.5%, Clupeidae 32.2%, Mugilidae, 22.1%, Sciaenidae 26.7% and Trachinidae 21.4% respectively. The family Polynemidae and Pomadasidae had zero prevalence. The overall parasite prevalence of examined fishes was 34.4% (Table 1).

Percentage incidence of parasites of fish families examined shows that Cichlidae had (55.26%), Clarotidae (5.92%), Clupeidae (24.34%), Mugilidae (9.87%), Sciaenidae (2.63%) and Trachinidae (1.97%) respectively (Table 2).

Table 3 depicts the parasites species isolated for the duration of study. The endoparasites recovered were mostly nematodes, cestodes, protozoa and trematodes. Numerical abundance of parasites showed that a total of 152 endoparasites occurred in the landed fish examined. Nematodes had 70 (46.05%), cestodes 48 (31.58%), protozoa 20 (13.16%) and trematodes 14 (9.21%). Nematoda had the highest number of abundance while trematoda had the least (Table 3).

Numerical abundance of parasites revealed that a total of 152 parasites belonging to four families were encountered in the landed fishes examined. A total of 42 parasites counts belonging to the families' nematodes, cestodes, protozoa and trematodes were isolated in the intestine and stomach of *Sarotherodon melanotheron* during the study period. Similar results were obtained for *Tilapia guineensis*. *Chrysichthys nigrodigitatus* had 9 parasites count, *Ethmalosa fimbriata* had 37 counts, *L. falcipinnis* and *Mugil curema* had 10 and 5 parasites counts respectively. *Pseudotolithus elongatus* had 4 parasite counts while *Trachinotus goreensis* had 2 and *T. teraia* had only 1 parasite isolated during the study. No parasites were isolated in the species *Polydactylus quadrifilis*, *Pomadasys jubelini* and *P. peroteti* throughout the study duration (Table 4). All the parasites isolated were endoparasites observed in the intestine and stomach of the studied species has no ectoparasites was observed throughout the duration of study (Table 4).

#### 4.0 Discussion

This preliminary investigation of the parasite of fauna of landed fishes obtained from Qua Iboe River Estuary presents 34.38% infection rate. This is a bit lower as compared to similar works such as those of Awharitoma and Okaka (1999) that recorded 60.8% infection rate for cichlid fishes from Okhuaihe River

in Edo State and Onwuliri and Mgbemena (1987) who recorded 60.4% infection rate for freshwater fishes from Jos Plateau, Nigeria. In general the prevalence of parasites (34.4%) as observed during the study was low when compared to 59.2% reported by (Oyedineke *et al.*, 2010) during their studies for fishes in the Niger River at Illushi, Edo State. Nevertheless, It was higher when compared with reports by other investigators in the rivers from the same region who reported overall parasite prevalence of 17.1% in the Osse River, 6.9% in the Okhuo River, (7.7%) in the fishes examined from Imo River and 3.3% in the Great Kwa River (Okaka and Akhigbe, 1999; Edema *et al.*, 2008; Ugwuzor (1987); Ekanem *et al.*, 2011). This shows that parasitic infection rates vary greatly from one area to another and this depends on a number of

factors. These variations in the rate of parasitism could be attributed to abiotic and biotic conditions of the environments where the studies were carried out (Koskivaara, 1992; Thompson and Larsen, 2004). Unfavourable environment may counteract fish physiology favouring parasitic infestation and invasion. Rohlenova *et al.* (2011) has reported that unfavourable temperature may alter fish physiology including immune function favouring parasite invasion. Pollution of the fish environment also contributes to parasitizing of fish significantly (Kelly *et al.*, 2010). Comparatively, the high prevalence of parasites observed in the examined fish during the study duration could be credited to the elevated level of pollution in Qua Iboe River Estuary, Nigeria.

**Table 1. Fish Species Examine and the Number Infected for the period of study (May – September, 2016).**

Fish family/species	Number of Fish Examined (NFE)	Range of fish size (cm)	Number of fish infected (NFI)	Prevalence (%) NFI/NFE x 100 (P)	Location in/on host (LO)	Place of Collection (PC)
<b>Cichlidae</b>						
<i>Sarotherodon melanotheron</i> (Ruppell)	174	7 - 14	84	48.3	Intestine, Stomach,	Iwuopkom, Mkpanak, Iwuochang
<i>Tilapia guineensis</i> (Bleeker, 1862)						
<b>Clarotidae</b>						
<i>Chrysichthys nigrodigitatus</i> (Lacepede, 1803)	24	7 - 21	9	37.5	Intestine, Stomach	Iwuopkom, Mkpanak, Iwuochang
<b>Clupeidae</b>						
<i>Ethmalosa fimbriata</i> (Bowdich, 1825)	115	7 - 16	37	32.2	Intestine, Stomach	Iwuopkom, Mkpanak, Iwuochang
<b>Mugilidae</b>						
<i>L. falcipinnis</i> (Valenciennes, 1836)	68	7 - 14	15	22.1	Intestine, Stomach	Iwuopkom, Mkpanak, Iwuochang
<i>Mugil curema</i> (Linnaeus, 1758)						
<b>Polynemidae</b>						
<i>Polydactylus quadrifilis</i> (Cuvier, 1830)	11	7 - 20	0	0	–	Iwuopkom, Mkpanak, Iwuochang
<b>Pomadasidae</b>						
<i>Pomadasys jubelini</i> (Cuvier, 1830)	21	5 - 14	0	0	–	Iwuopkom, Iwuochang
<i>P. peroteti</i> (Cuvier, 1830)						
<b>Sciaenidae</b>						
<i>Pseudotolithus elongatus</i> (Bowdich, 1825)	15	6 - 15	4	26.7	Intestine	Iwuopkom, Mkpanak, Iwuochang
<b>Trachinidae</b>						
<i>Trachinotus goreensis</i> (Cuvier, 1832)	14	5 - 10	3	21.4	Intestine	Mkpanak, Iwuochang
<i>T. teraia</i> (Cuvier, 1832)						
<b>Total</b>	<b>442</b>		<b>152</b>	<b>34.4</b>		

**Table 2: Percentage Incidence of Parasites for the Period of Study (May – September, 2016).**

Fish Families	Number Infected	% Incidence
Cichlidae	84	55.26
Clarotidae	9	5.92
Clupeidae	37	24.34
Mugilidae	15	9.87
Sciaenidae	4	2.63
Trachinidae	3	1.97
<b>Total</b>	<b>152</b>	<b>100</b>

For the duration of study all recovered parasites of the examined fish species were endoparasites, there

was no manifestation of ectoparasites observed throughout the study. Endoparasites isolated in this

study include nematode, cestode, protozoa and trematode which is similar to earlier assertion reported by Ekanem *et al.*, (2011). The number of parasitic fauna isolated during the study followed the pattern nematodes > cestodes > protozoa > trematodes. This observation is similar to Okaka and Omoigberale (2002), Onyedineke *et al.*, (2010) and Ekanem *et al.*,

(2011) who reported higher number of nematodes than other parasites. According to Ekanem *et al.*, (2011), nematodes are known to occur in body cavities and subcutaneous tissues. This finding also supports the work of Rosas-Valdez and de Leon (2011) who reported that parasites show some level of preference for the host they parasitize.

**Table 3: Numerical Abundance of Parasite Species Isolated From Landed Fishes Obtained From Qua Iboe River Estuary (May – September, 2016).**

Parasite Species	Number of Parasites Isolated	Percentage (%)
<b>Nematodes</b>		
<i>Cucullanus barbi</i>	6	8.57
<i>Dujardinascaris sp</i>	8	11.43
<i>Cammallanus sp</i>	14	20.00
<i>Capillaria sp</i>	16	22.86
<i>Spinitectus allaeri</i>	12	17.14
<i>Contraecium micropapillatum</i>	14	20.00
<b>Total</b>	<b>70</b>	<b>46.05</b>
<b>Cestodes</b>		
<i>Bothriocephalus acheilognathi</i>	14	29.17
<i>Amphillina sp</i>	6	12.50
<i>Ligula intestinalis</i>	12	25.00
<i>Lystocistos marcusseni</i>	10	20.83
<i>Protocephalus cargoproglotis</i>	6	12.50
<b>Total</b>	<b>48</b>	<b>31.58</b>
<b>Protozoa</b>		
<i>Hexamita sp</i>	12	60.00
<i>Trypasomes sp</i>	8	40.00
<b>Total</b>	<b>20</b>	<b>13.16</b>
<b>Trematodes</b>		
<i>Pygidopsis metacercariae</i>	8	57.14
Sporocyst of diplomatids	6	42.86
<b>Total</b>	<b>14</b>	<b>9.21</b>
<b>Overall Total</b>	<b>152</b>	<b>100</b>

**Table 4: Numerical Abundance of Endoparasite Encountered in Landed Fishes Obtained From Qua Iboe River Estuary for the Period of Study (May – September, 2016).**

Fish Species	Nematode				Cestoda				Protozoa				Trematoda				Total
	SK	G	I	ST	SK	G	I	ST	SK	G	I	ST	SK	G	I	ST	
<i>Sarotherodon melanotheron</i> (Ruppell)	0	0	13	10	0	0	7	6	0	0	2	1	0	0	2	1	42
<i>Tilapia guineensis</i> (Bleeker, 1862)	0	0	11	12	0	0	6	6	0	0	3	2	0	0	1	1	42
<i>Chrysichthys nigrodigitatus</i> (Lacepede, 1803)	0	0	3	2	0	0	2	1	0	0	1	0	0	0	0	0	9
<i>Ethmalosa fimbriata</i> (Bowdich, 1825)	0	0	7	5	0	0	7	5	0	0	4	3	0	0	4	2	37
<i>L. falcipinnis</i> (Valenciennes, 1836)	0	0	2	1	0	0	2	2	0	0	1	1	0	0	1	0	10
<i>Mugil curema</i> (Linnaeus, 1758)	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	1	5
<i>Polydactylus quadrifilis</i> (Cuvier, 1830)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pomadasys jubelini</i> (Cuvier, 1830)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>P. peroteti</i> (Cuvier, 1830)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pseudolithus elongatus</i> (Bowdich, 1825)	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	4
<i>Trachinotus goreensis</i> (Cuvier, 1832)	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
<i>T. teraia</i> (Cuvier, 1832)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<b>Total</b>	<b>0</b>	<b>0</b>	<b>40</b>	<b>30</b>	<b>0</b>	<b>0</b>	<b>25</b>	<b>23</b>	<b>0</b>	<b>0</b>	<b>13</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>6</b>	<b>152</b>

Where: (Sk =Skin, G = Gills, I = Intestine, ST = Stomach)

In the present study a high rate of parasite were encountered in the intestines of the examined fishes than other organs. This result corroborate the findings of Ekanem *et al.*, (2011) who credited the high rate of parasites in the intestine to the fact that most digestive activities take place in the intestine resulting in the release of parasite ova/cysts in food particles.

No parasite was found on the gills and skin and this observation could be credited to the constant movement of water current over the gills skin which may not support anchoring and continued existence of parasites on such locations. This assertion agrees with the findings of Ekanem *et al.*, (2011) who reported a similar occurrence.

All the fish species examined were infected with parasites of the taxa nematodes, cestodes, protozoa and trematodes exception of *Polydactylus quadrifili*, *Pomadysys jubelini*, *P. peroteti* which had no evidence of disease manifestation. This may be attributed to the low number of the species collected during the period of study.

Upon the basis of findings it could be concluded that fishes obtained from Qua Iboe River Estuary are infected with intestinal and stomach parasites that might possibly pose public health concern to fish consumers. Therefore it is recommended that fishes from the river system should be properly cooked or smoked before consumption to avoid health risk due to parasitic infestation.

## References

1. Aken'ova, T. O. (1999). Helminth infection of the gills of *Clarias* species in Zaria, Nigeria. *J. Parasitol.* 20: 113-121.
2. Akinsanya, B., Otubanjo O. A. and Ibidapo, C. A. (2007). Helminth Bioload of *Chrysichthys nigrodigitatus* from Lekki Lagoon Lagos, Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences.* 7: 83-87.
3. Anosike, J. C, Omoregie, E., Ofojekwu, P. C. and Nweke, I. E. (1992). A survey of helminth parasites of *Clarias gariepinus* in plateau State, Nigeria. *J. Aqua. Sci.* 7: 39-43.
4. Auta, J, Onye, S. J. and Adakole, J. A. (1999). The helminth parasites of the gastro-intestinal tract of *Synodontis* species in Zaria, Nigeria. *J. Aqua. Sci.* 2: 47-53.
5. Awharitoma, A. O and Okaka, C. E. (1999). Observation on the cichlid fishes in Ikpoba river and their parasitic infection. *The Nigerian Journal of Parasitology* 20: 129-137.
6. Edema, C. U., Okaka, C. E., Oboh, I. P. and Okogub, B. O. (2008): A preliminary study of parasitic infections of some fishes from Okhuo River, Benin City, Nigeria. *International Journal of Biomedical Health Science*, 4 (3): 107-112.
7. Ekanem, A. P. (2010). Incidence and abundance of trichodiniasis of *Clarias gariepinus* in the University of Calabar fish farm, Calabar, Nigeria. *Trop. Environ. Res.*, 9: 566-570.
8. Ekanem, D. and Obiekezie A. I. (2000). Antiparasitic effects of piperguineense (Husaini) on the Juvenile of *Heterobranchus longifilis* (Cuvier & Valenciennes). *Afr. J. Fish Aquacult.*, 2: 68-74.
9. Ekanem, A. P., Eyo, V. O. and Sampson, A. F. (2011): Parasites of landed fish from great Kwa River, Calabar, Cross River State, Nigeria. *International Journal of Fisheries and Aquaculture*, 3 (12): 225-230.
10. Emere, M. C. (2000). Parasitic infection of the Nile perch *Lates niloticus* in river Kaduna. *J. Aqua. Sci.*, 15: 51-54.
11. Ezenwaji HMG, Ilozumba PCO (1992). Helminth fauna of four West African small *Clarias* species (Osteichthys: Clariidae) from Nigeria. *J. Afri. Zoo*, 106: 391-400.
12. Ibiwoye, T. I. I., Okaeme, A. N., Balogun, A. M. and Ogunsusi, R. A. (2000). Updating the helminth parasites fauna of freshwater fishes in Nigeria in the new millennium. First occurrence of *Eustrongyloides africanus* (Khalil and Thurston, 1973) larvae in *Clarias* species of Nigeria. 15th Annual conference of the Fisheries Society of Nigeria (FISON) Jos, Plateau State. 19-24th March.
13. Ibiwoye, T. I. I., Owolabi, O. O., Ajala, A. A., Oketoki, T. O., Adio, S. M., Adedapo, A. O., Ajeka, P. O. and Agbontale, J. J. (2006). Helminthes Parasites in freshwater fish species from Jebba Lake and Bida Flood Plain Area of River Niger, Nigeria. Proceedings of the 21st Annual Conference of the Fisheries Society of Nigeria (FISON), Calabar, 13th-17th November, 2006. pp. 13-20.
14. Johnson, S. K.. (1976). Ichi White Spot Disease Ichthyophthirius Multifiliis. Extension Services of Mississippi State University.
15. Kelly, D. W., Poulin, R., Tompkins, D. M. and Townsend, C. R. (2010). Synergistic effects of glyphosate formulation and parasite infections and survival. *Journal of Applied Ecology*, 47: 498-504.
16. Koskivaara, M. (1992). Environmental factors affecting monogeneans parasite on freshwater fishes. *Parasitology Today*, 8 (10): 339-342.
17. Mamer, B. E. (1978). The Parasites of Trout in North Western Washington. *Journal of Parasitology.* 64(2):1.

18. Nwilo, P. C. and Badejo, O. T. (2001). Impacts of Oil Spill along the Nigeria Coast. *The Association for Environmental Health and Sciences*. 10(2):140—192.
19. Obiekezie, A. I. (1995). Chemotherapy regimens for diseases management in the nursery phase of African catfishes (clariidae) (Ext. Abstr.) First African fisheries Congress (Fish '95), July 31-August, 5. Narrobij Kenya.
20. Obiekezie, A. I. and Ekanem, D. (1995). Experimental infection of *Heterobranchus longifilis* (Teleosti: Clariidae) with *Trichodina maritinkae* (Ciliophora: Peritrichida). *Aqua. Liv. Res.*, 8: 439-443.
21. Objekezie, A. I. and Enyenihi, U. K. (1988). *Henneguya Chrysichthyo* Sp. Nov (Protozoa: myxozoa) from the gills of the estuarine catfish, *Chrysichthys nigrodigitatus* (Lacepede) in the Cross River Estuary Nigeria. *J. Afr. Zool.*, 102: 33-42.
22. Okaka, C. E and Akhigbe, J. E. (1999). Helminth parasites of some Tropical Freshwater fish from Osse River in Benin, Southern Nigeria. *Tropical Freshwater Biology* 8: 41-48.
23. Okaka, C. E. and Omoigberale, O. M. (2002). Parasites of fishes of Okhuaihe River Edo State. *African Scientist* 3(1): 1-2.
24. Olurin, K. B. and Somorin, C. A. (2006). Intestinal helminths of the fishes of Owa Stream, South-west Nigeria. *Research Journal of Fisheries and Hydrobiology* 1(1): 6-9.
25. Onwuliri, C. O. E. and Mgbemena, M. O. (1987). The Parasitic fauna of some freshwater fish from Jos Plateau, Nigeria. *Nigerian Journal of Applied Fisheries Hydrobiology* 2:33-37.
26. Onyedineke N. E, Obi, U., Ofoegbu, P. U. and Okogo, I. (2010). Helminth parasites of some fresh water fish from River Niger at Ilushi, Edo State, *Nig. J. Ani. Sci.* 6(3): 11-15.
27. Paperna, I. (1996). Parasites infections and disease of fishes in Africa. CIFA Technical paper no. 31 Food and Agriculture Organization, Rome.
28. Paperna, I. (1980). Parasites, infections and diseases of fish in Africa. Food and Agricultural Organization. *C.I.F.A. Technical Paper* 7: 216.
29. Roberts, R. J. (2000). Fish pathology. 3rd edition. Hagerman, Idaho, p. 472.
30. Rohlenova, K., Morand, S., Hyršl, P., Tolarova, S., Flajšhans, M. and Sinkova, A. (2011). Are fish immune systems really affected by parasites? An immunological study of common carp (*Cyprinus carpio*). *Parasites and Vectors*, 40: 120-138.
31. Rosas-Valdez, R. and de Leon, G. (2011). Patterns of host specificity among helminth parasite fauna of freshwater Siluriformes: testing the biogeographical core parasite fauna hypothesis. *Journal of Parasitology* 97 (2): 361-363.
32. Schneider, W. (1990). Field guide to the commercial marine resources of the Gulf of Guinea. FAO species identification sheets for fishery purposes.
33. Thompson, L. C., Larsen, R. (2004): Fish habitat in freshwater stream. Farm Water Quality Planning FWQP; Reference Sheet 10.3, Publication 8112. University of California, California.
34. Tombi, J. and Bilong, C. F. (2004). Distribution of gill parasites of the Freshwater fish *Barbusmartarelli* Roman, 1971 (Teleostei: Cyprinidae) and Tendency to inverse intensity evolution between myxosporidia and management as a function of the Host Age.
35. Ugwuozor, G. N. (1987). A survey of helminth parasites of fish in Imo River. Nigeria. *J. fish Hydrobiol.*, 2: 23- 30.

3/17/2018