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Gill Parasites of the silver catfish (*Chrysichthys nigrodigitatus)* (Bagridae) (Lacepede, 1803) in Cross River Estuary, Nigeria

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Abstract: Investigations were conducted on gill parasites of the silver catfish *(Chrysichthys nigrodigitatus)* from the Cross River Estuary, Nigeria between April and June, 2018. Results revealed the infestation of the gills of the silver catfish by 7 parasitic fauna namely *Nemathobothrium* sp, *Gryrodactylus sp*, *Dactylogyrus* sp, cysts of *Myxobolusfunduli*, cysts of *Henneguyachrysichthyi* and cysts of *Myxosporea sp*. Total of 133 parasitic individuals were isolated with 17 (12.78%) *Nemathobothriumsp*, 16(12.03%) each of *Gyrodactylus* sp and cysts of *Metacarceriae*,13 (9.77%) *Dactylogyrus s*p, 25(8.80%) cysts of *Myxobolus funduli*, 25 (18.80%) *of Henneguya chrysichthyii* cysts and 21 (15.79%) of *Myxosporea sp* cysts. Overall monthly prevalence of the parasitic infection ranged between 22. 22 – 55.56%, with a monthly incidence of between 1-4 parasites which by these results, some of the hosts had incidence above the international standards. Based on the results of the present study, it is strongly recommended that table size of the fish meant for consumption has to be properly processed to prevent the transfer of the parasite to the consumer as fish parasites are zoonotic and have strong health implications.
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Key words: Gill Parasites, Silver catfish**,** *Chrysichthys nigrodigitatus,* Cross River Estuary, Nigeria

1. Introduction

Fish is an important source of income and food for humans. Well over 35 million people depend wholly or partly on the fisheries sector for their livelihood (FAO, 1996). Parasites play an important role in the ecology of aquatic ecosystems as well as in the aqua-mariculture industries. Apparently, the origin of most diseases in mariculture is likely to be in wild-caught fingerlings and juvenile fish. Parasites of fish are a concern as they often produce a weakening of the host's immune system, thereby increasing their susceptibility to secondary infections, resulting in the nutritive devaluation of fish and subsequent economic losses (Hanek and Fernando, 1978).

Parasites are common in most ecological systems and as free-living organisms, can increase their infections to the hosts. These are some parasites that are zoonotic in nature. This can occur through the consumption of infected animal by human. Parasites show some level of preference for the host they parasitize (Poulin, 1997). Generally, some parasites can show a preference for a certain host species and affect many different host organisms, whereas specialist parasites will only infect a few selected organisms (Poulin, 1997).

Parasites are ubiquitous in both fresh water and marine ecosystem. Studies by Saad-fares and combes, (1992) showed that almost every part of a fish is infected with specific parasites. The omnivorous feeding habit of *Chrysicthysnigrodigitatus* for example, exposes them to varieties of parasites which negatively impact on their health. Infectious diseases are caused by pathogenic organisms (parasites, bacteria, virus, and fungi) present in the environment. In aquaculture, it has been estimated that 10% of all cultured aquatic animals are lost as a result of infectious disease. Environmental circumstances such as poor water quality, fluctuations in temperature, poor nutrition, overcrowding, poor handling and transportation which are common in intensive fish farming, pose stressful conditions to the fish, making the fish more susceptible to a wide variety of pathogens. Francis-Floyd (2005) noted that with diseases, fish is not in balance with itself or its environment.

The silver catfish (*Chrysichthysnigrodigitatus)* is a highly cherished food fish in Nigeria and is currently being subjected to experimental aquaculture in the Institute of Oceanography, University of Calabar, Nigeria by group of scientists (Ama-Abasi *et al.,* 2019).

Many parasites have been discovered in fishes. Examples includes: (*ehtgyophthiiriussp, Ichthyobodosp, Trichodinasp, Chilodonellasp, Uniliferambloplitis, Bivesiculasp, Angillicolasp, Philometrasp, Skijabillanussp, Anisakissp*). These parasites, alongside many others, have been known to cause a number of disorders like anaemia, retarded growth, loss of appetite, cardiac lesions, depressed reproductive performance, with heavy infections resulting in death (Paperna, 1996; and Hassan *et al.,* 2010).

A common fish species in Nigerianfresh water bodies is the silver catfish *(Chrysichthysnigrodigitatus)* (Lacepede, 1803) belonging to the family Bagridae which is a native to Africa. They are highly valuable as a source of cheap protein and are among the dominant commercial catches exploited in major rivers of Nigeria, making up about 80% of the catches by artisanal fishermen in inland water bodies, (Holden and Reed, 1978). The availability of this fish species, however, can be affected by parasites and diseases, which could ultimately affect nutrition and economics of the people. Poulin (1997) stressed the commercial and economic importance of fisheries resources, indicating that fish parasites are a potential threat to fish abundance, distribution and availability. Obiekezie and Enyenilu (1988) reported the incidence of *Aspidogastrid (trematode)*, *Aspidogastreaafricanus* in *Chrysichthysnigrodigitatus*.

Gill myxozoosis due to *Henneuguyachrysichthys* is considered the most important parasitic disease of *Chrysichthysnigrodigitatus*, occurring throughout the year with a maximum prevalence of 76% in April (Obiekiezie *et al.,* 1988). This is a new kind of epidermal papilloma found in the gills of *Chrysichthysnigrodigitatus*. This also causes deformities and skin ulceration. These parasites are ingested by the host through feed or infective spores from infected fish (Klinger and Floyd, 2002). Infected cells usually become enlarged to accommodate the proliferating parasite (Klinger and Floyd, 2002). All fishes are potential hosts to many different species of parasites that cause significant mortalities among cultured and wild fish stocks. Continuous studies and accurate identification of parasites is therefore important for the purpose of the treatment and prevention. Both freshwater and estuarine fish can serve as definitive, intermediate or parenthetic (transport) hosts in the lifecycle of many protozoan, metazoan and crustacean parasites. Parasites occurring in African freshwater fishes require urgent attention; particularly those that infect economically important fishes which in many cases, devalue their aesthetic quality and palatability (Hassan et al., 2010).

The present reports on the gill parasites of the Silver catfish *(Chrysichthysnigrodigitatus)* in the Cross River Estuary, Nigeria, with the following specific objectives to: determine the prevalence of the gills parasites in *Chrysichthys nigrodigitatus*. Identify the different types of species of parasites that infect the gills of the *Chrysichthys nigrodigitatus* in the Cross River Estuary, Nigeria. The results of the present study are expected to enrich the already available information on the parasites infection of this highly esteemed food fish in Nigeria in particular and Africa as a whole.

2. Materials and Methods

The Cross River Estuary takes its rise from Cameroon Mountains and flows westward into Nigeria, then Southward into Atlantic Ocean at the Gulf of Guinea. It occupies an area of 54,000km^2 with 39000km of the area in Nigeria (Ama-Abasi and Holzlohner 2002 and Akpan and Offem, 1993). The Estuary is located approximately between latitude 4° and 3°N and Longitude 7° 30 and 10°E in the South East of Nigeria (Abraham and Akpan, 2012) (Figure 1).

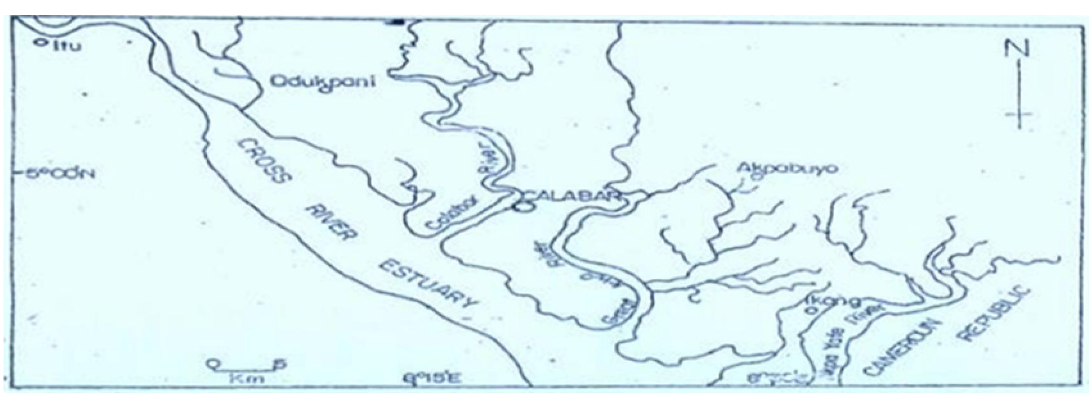

Fig. 1: Map of Cross river Estuary, Nigeria showing study location Adapted from Abraham and Akpan (2012)

Freshly caught and life *Chrysichthysnigrodigitatus* samples were bought from the landings of artisanal fishermen at Nsidung beach, Calabar, one of the major landings of artisanal fisheries of the Cross River Estuary.

The life fish samples were transported in a bucket to Fish Diseases Laboratory Department of Zoology and Environmental Biology for identification.

Identification of fish sample was done using guides by Olaosebikan and Raji (2013). The morphometric measurements such as standard length (SL) and weight were determined to the nearest 0.1cm and 0.1g, respectively by means of a measuring board and a weighing balance after subjecting them to humane killing as recommended by Ostrander (2000).

The opercula of the fish were cut-open by use of a pair of scissors to remove the gills and the dissected gills were placed in a petri dish containing physiological saline (composed of 9%Sodium Chloride NaCl). The gills contained in the petri dish were subjected to microscopy to find and identify parasites. The parasites were gently dislodged from the gill filament by the help of a bent needle and a pair of forceps. The parasites were picked using a fine pipette and placed on a clean slide and covered with a clean cover slip for observation as recommended by Abraham and Akpan (2014) and Abraham & Akpan (2012) The wet mount protocol was used.

Identification of parasites was carried out based on the morphological features. The stage of development (eggs, cysts, adult) was noted and enumerated for each fish sample as recommended by Poulin and Morand (2000).

The epidemiological indices were measured in terms of occurrence of the parasites based on the following parameters:

Prevalence (% prevalence): This is the number of cases that are present within the population at a particular point in time, given by the formula:

$$\frac{\text{Number of fish infected}}{\text{Total number of fish}} \times 100$$

(Hoa and Ut, 2007)

Percentage incidence (%i): This indicates the occurrence of new cases within a stated period. The relative percentage incidence of each of the parasite species was calculated based on the formula: %i= $\frac{n}{N} x\ 100$ (Hoa and Ut, 2007).

where %i = relative percentage incidence of individual parasite species observed (isolated).

n= the number of individual parasite species observed (isolated).

N= the total number of all individual parasite observed (isolated).

Numerical abundance: This was determined by enumeration and summation methods (Ozer and Ozturk, 2005; Crespo and Crespo, 2003).

3. Results

Total of 7 parasitic fauna belonging to 2 parasitic classes were isolated from the gills of the silver catfish *(Chrysichthys nigrodigitatus)* during the period of study. These were adult *Nemathobothriumsp*, adult *Gyrodactylus sp,* Adult Dactylogrus sp and Metacercariae Cysts (all Trematoda) (Plates 1a,2,3,6, and 7b) and Cysts of *Myxosbolus funduli, Henneguya chrysichthyii* and *Myxosperea sp* (all Protozoan parasites) (Plates 1b,5, and 7b) (Tables 1-3).

Adult *Nemathobothrium sp* (Plates 1a and 4), had total of 17 individuals constituting 12.78% of the parasitic population isolated from the gills of the silver catfish *(C. nigrodigitatus)*. Adult *Gyrodactylus sp* and cysts of metacercariae had 16 individuals (12.03%) each. Adult *Dactylogyrus sp* had 13 individuals (9.77%), *Myxosbolus funduli* cysts and cysts of *Henneguya chrysichthyii,* respectively, had 16 individuals (18.80%), each, while cysts of *Myxosporea sp* had 21(15.79%) (Table 5).

Plate 1a: Adult *Nemathobothriumsp* (a threadlike trematode) (Paperna, 1996) from the gills of the silver catfish (*Chrysichthysnigrodigitatus*) (Magnification: x100). **b:** A cyst of *Hennuguyachrysichthyi* (Obiekezie & Enyenihi 1988) (Protozoa) from the gills of the silver catfish (*Chrysichthysnigrodiguttatus)* (Magnification: x100)

Monthly variance in the number of parasites isolated

The monthly abundance of the parasites isolated from the gills of the silver catfish stood at 57 (42.86%) in April, 35 (26.32%) in May and 41 (30.82%) in June, giving monthly variations of between 35 (26.32%) – 57 (42.56%) of parasitic abundance in the catfish during the period of study. High parasite abundance was recorded in April, followed by June and May (Table 4).

Plate 2: Adult *Gyrodactylussp (Monogenea,)* (Arrowed) (Paperna, 1996) from the gills of *C. nigrodigitatus* (the silver catfish) (Magnification: x100).

Plate 3: Adult *Dactylogyrussp* (Paperna, 1996) (Monogenea) from the gills of the silver catfish (*C. migrodigitatus)* (Magnification x100).

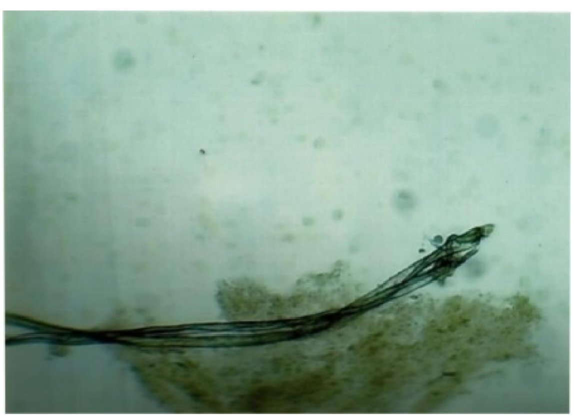

Plate 4: Adult *Nemathobothriumsp* (a tred-like trematode usually occurring in pairs in fish tissues) (Paperna, 1996) Magnification: x100)

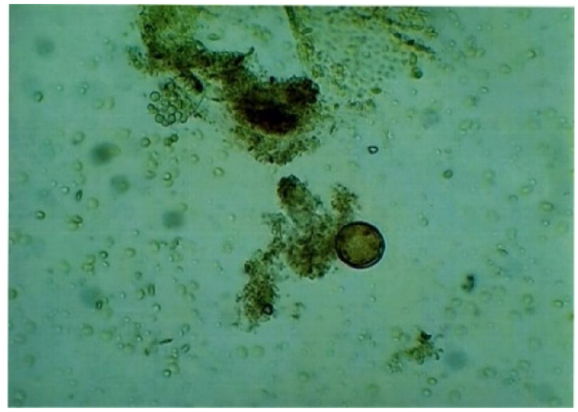

Plate 5: Cyst of *Myxobolusfunduli* (a Protozoa) (Hoffmann, 1999) from the gills of the silver catfish *C. nigrodigitalus* (Magnification: x100)

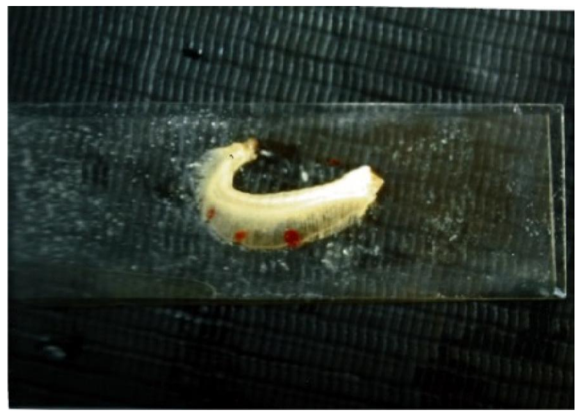

Plate 6: Metacercariae cyst of Digeneantrematode attached to the gill fillaments of the silver catfish *(C. nigrodigitatus).* These cysts usually take translucent light pink to tan colour (Hoffmann 1999), as observed here. (Magnification: x100)

Plate 7 a: Bulging effect (circled region) on the gills base of the silver catfish (*C. nigrodigitatus*) caused by cyst of *myxosporea (sp)* (a Protozoa) (Paperna, 1996). b: Metacercariae cysts of Digeneantrematode on the gill filaments of the silver catfish (*C. nigrodigitatus*). These cysts usually take translucent light pink to tan colouration (Hoffmann,1999). (Magnification: x100)

Table 1: Total length (cm), standard length (cm), weight (g) and the different parasite fauna identified from the gills of the fish *(Chrysichthysnigrodigitatus)* (silver catfish) from the Cross River Estuary, Nigeria (April, 2018).

S/N	TL cm	SL (cm)	Wt (g)	Adult *Nemathobothriumsp* (Trematoda)	Adult *Gurodactylussp* (Trematoda)	Adult *Dactylogyrussp* (Trematoda)	Cysts of *myxobolusfunduli* (Protozoa)	Metacercariae cysts of digeneantrematode (Trematoda)	Cyst of *Henneguyachrysichcthyi* (Protozoa)	Cyst of *Myxosporeasp* (Protozoa)
1	48.0	39.0	550.0	2	1	1	1	3	1	1
2	55.0	44.0	900.0	2	-	-	-	3	-	4
3	42.0	34.0	900.0	-	3	2	-	-	2	-
4	40.0	31.0	704.0	-	1	1	-	1	-	2
5	44.0	35.0	900.0	3	-	-	4	2	-	2
6	38.0	29.0	600.0	-	-		2	-	3	-
7	30.0	25.0	500.0	-	1	2	-	-	2	-
8	35.0	27.0	600.0	1	-	1	1	-	-	-
9	33.0	29.0	600.0	1	-	-	-	-	1	-
	Total No. of Parasite			**9**	**6**	**7**	**8**	**9**	**9**	**9**

Table 2: Total length (cm), standard length (cm), weight (g) and the different parasitic fauna identified from the gill of the fish (*C. nigrodigitatus)* (Silver catfish) from the Cross River Estuary, Nigeria (May, 2018)

S/N	TL (cm)	SL (cm)	Wt (g)	Adult Nemathobothriumsp (Trematoda)	Adult *Gyrodactylussp* (Trematoda)	Adult *Dactylogyrussp* (Trematoda)	Cysts of *Myxobolusfunduli* (Protozoa)	Metacercaiae cysts of digeneantrematode (Trematoda)	Cyst of *Henneguyachrysichthyi* (Protozoa)	Cysts of Myxosporeasp (Protozoa)
1	35.0	27.0	670.0	-	1	1	3	1	3	2
2	33.5	28.0	900.0	-	1	-	2	-	3	2
3	39.5	30.0	110.0	-	2	1	4	-	-	-
4	31.8	25.2	800.0	1	-	-	-	1	i	1
5	34.8	27.0	900.0	2	-	-	1	-	2	-
6	27.7	21.0	500.0	-	-	-	-	-	-	-
7	25.5	21.10	180.0	-	-	-	-	-	-	-
8	24.7	19.5	160.0	-	-	-	-	-	-	-
9	23.9	18.6	160.0	-	-	-	-	-	-	-
10	24.7	19.0	100.0	-	-	-	-	-	-	-
Total No. of Parasites				**3**	**4**	**2**	**10**	**2**	**9**	**5**

Table 3: Total length (cm), standard length (cm), weight (g) and the different parasite fauna identified from the gill of the fish (*Chrysicthys nigrodigitatus*) (silver catfish) from the Cross River Estuary, Nigeria (June, 2018)

S/NO	TL (cm)	SL (cum)	Wt (g)	Adult Nemathobothrium sp (Trematoda)	Adult Gurodactylussp (Trematoda)	Adult Dactylogyrmsp (Trrcmatoda)	Cysts of Myxobolusfunduli (Protozoa)	Metacercaiae cysts of digeneantrematode (Trematoda)	Cysts of Henneguya chrysichthyi (Protozoa)	Cysts of Myxosporea sp (Protozoa)
1	24.7	19.0	100.0	2	4	-	3	2	4	3
2	21.5	16.9	100.0	2	1	-	3	1	-	-
3	22.6	17.8	800.0	-	-	2	-	-	2	3
4	21.8	17.2	100.0	-	-	-	-	1	-	-
5	20.3	15.8	800.0	1	-	-	1	-	1	1
6	21.4	17.4	100.0	-	1	1		-	-	-
7	20.8	16.5	800.0	-	-	1		1	-	-
Total No of Parasites				**5**	**6**	**4**	**7**	**5**	**7**	**7**

Table 4: Summary of monthly variations in the number of parasites isolated (April - June, 2018)

Months of Study	Total Number of Parasites isolated (n)	Relative abundance (%)
April	57	42.86
May	35	26.32
June	41	30.82
Overall Total	**133**	**100.0**

Table 5: Summary of the Abundance of the respective parasites glance from the Gills of the silver catfish (*C. nigrodigitatus*)

S/N	Parasitic Fauna	Number of individuals (n)	Percent (%)
1	*Adult Nemathobothrium sp*	17	12.78
2	*Adult Gyrodactylus* sp	16	12.03
3	*Adult Dactylogyrus sp*	13	9.77
4	*Myxobolusfunduli (Cysts)*	25	8.80
5	*Metacercariae (Cysts)*	16	12.03
6	*Henneguya chrysisthyi (cysts)*	25	18.80
7	*Myxosporea sp (Cysts)*	21	15.79
	Overall abundance (N)	133	100.0

4. Discussion

From the results of the study, 7 parasitic fauna were observed to infect the gills of the silver catfish. The parasites which consisted of different developmental stages (from cysts to adults) were all in agreement with those of the previous investigators. For instance, Obiekezie and Enyenihi (1988), reported the infestation of the gills of the silver catfish (*Chrysichthys nigrodigitatus*) with cysts of *Henneguya chrysichthyii a*nd was the first report of the infestation of the gills of the catfish with this protozoa. The results of the present study are also in agreement with those of Paperna (1996) and Hoffmann (1999) who respectively reported the infestation of the gills of *Clarias lazera,* a freshwater catfish in Egypt and Ghana. In their reports, Obiekezie and Enyenihi (1988) Paperna (1996) and Hoffmann (1999), maintain that the parasites could be found at various stages of development on the gills of the infected fish.

In this study, various developmental stages of the parasites were observed. These included the cysts, metacercariae and adult stages. The degree of infestation of a particular tissue of any fish has been linked with period of study and length of fish. Poulin (2001) pointed out that a fish species is heavily infested in its natural habitat in periods of nutrient and food availability in the habitat adding that fish length also has a role to play in parasitic infestation of an individual fish. This might have been the premise for the high number of parasites recovered in this study in April, than May and June. Also, ontogenetical changes in feeding behavior might influence parasitic prevalence and abundance in the host and months of study as the availability of food and unimpaired environmental factors might have interplayed in the different months and fish size, thereby influencing the presences or otherwise of a particular parasite fauna in the host. Saad-Fares and Combes (1992), Shotter (1976) and Takemoto *et al* (1996), respectively maintain that the length of fish, quantity and type of food consumed, size of the prey, greater exposure time, the increase in the surface area of the body of the host and changes in habitat according to age, can be responsible for the increment in prevalence and abundance with the advance of the host's age.

In this study, the fish of bigger length were found to be more infected than the smaller hosts. Similar observation was also made by Hanek and Fernando (1978) who, related the phenomenon to the ability of the bigger ones to cover wider areas in search of food, and as a result, take more food than the smaller ones and this exposed them to infection by more parasites.

The results of the present study are also in consonance with those of Abraham and Akpan (2012) who reported the infection of *Chrysichthys nigrodigitatus* caught from the Cross River Estuary, Nigeria by *Henneguya chysichthyii,* Obiekeze (1983) and Casal *et al (2*002) also report *that Henneguya chrysichthyii* is a common parasite of the silver catfish. However, the stage and location of *the Myxosporean* parasite reported differ in some aspects. The cysts of the parasite *(Henneguya chrysichthyi) was* isolated at the proximal and distal ends of the filament rays of the fish gills in this study Casal *et al.*, (2002) isolated the adult stage of the parasite from organs of the host catfish *(Leporinus frederici*), especially from those organs that are located along the gut and from kidney. Abraham and Akpan (2012) also isolated the cysts of *H. Chrysichthyii* at the proximal and distal ends of the filament rays of the gills of the silver catfish *C. nigrodigitatus* they bought from the artisanal fishermen of the Cross River Estuary, Nigeria.

The overall prevalence range of between 22.22 and 55.56% may be considered to fall between low, medium and high (klinger and Francis – Floyd, 2002; Abraham and Akpan, 2012). Most of the fish samples had monthly parasite above unity and such individuals are considered to have prevalence above the International Standard of 1 parasite per kilogram of fish. Highest monthly parasite of 55.56% in April, 44.44% in May and 57.14% in June and incidence of 57 in April, 35 in May and 41 in June corresponds with the wet season, during which time estuarine salinity becomes considerable reduced due to rain water run-off into the estuary.

This encourages parasites survival, which in turn, increases their ability and possibility of infection in its general perspective (Abraham and Akpan, 2012).

In this study, the varied prevalence and incidence of infection might not be unconnected with the phenomenon of the interplay of fish length (size), nutrient/food availability and rain water run-offs, which gave rise to the salinity reduction in the estuary during the sampling months.

The results of the present study revealed the infestation of the gills of the silver catfish by 7 parasitic fauna namely *adult Nemathobothrium* sp, adult *Gryrodactylus sp*, adult *Dactylogyrus* sp, cysts of *Myxobolusfunduli*, cysts, cysts of *Henneguya chrysichthyii* and cysts of *Myxosporea sp*. Total of 133 individual parasites were isolated with 17 (12.78%) adult *Nemathobothrium sp*, 16(12.03%) each of *Adult Gyrodactylus* sp and cysts of *Metacarceriae*13 (9.77%) adult *Dactylogyrus s*p 25(8.80%) cysts of *Myxobolus funduli*, 25 (18.80%) *of Henneguya chrysichthyi* cysts and 21 (15.79%) of *Myxosporea sp* cysts. Overall monthly prevalence of the parasitic infection ranged between 22. 22 – 55.56% with a monthly incidence of between 1-4 parasites which by these results some of the hosts had incidence above the International Standards (FAO, 1996).

Two new species of parasite *Protoancylodiscoides auratumn* from *Chrysichthys auratus* and *Protoancylodiscoides combesin* from *Chrysichthys nigrodigitatus* have been described by Obiekezie and Enyenihi (1988). These new helminthes differ from the congeneric species by the size of the Haptoralsclerites, the male copulatory organ length, the diameter and morphology of the vagina. At this stage, the present study suggests that *Protoancylodiscoides autatum* is oioxenous, while *Protoancylodiscoides* isstenoxenous. Earlier studies on fish parasite in the Cross River Estuary seen as Ama-Abasi and Obiekezie (2002) Nigeria, who isolated three (3) species of *Trichondina* (*T.maritinkae, T.heterodentata, and T.diaptonm)*, from skin and gills of African catfish *Clarias* obtained from University of Calabar Fish Farm, Nigeria.

Based on the results of the present study, it is strongly recommended that table-sized fish meant for consumption has to be properly processed to prevent the transfer of the parasite to the consumer as parasites of fish are zoonotic and have strong health implications.

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