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Prevalence of helminth parasites of *Clarias gariepinus* and *Tilapia zillii* in relation to age and sex in an afrotropical stream

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ABSTRACT

Fish is clearly regarded as the cheapest source of protein for man and other livestock, but fish farmers are constrained by massive mortality of fry and fingerlings due to helminth parasite invasion. Prevalence of helminthic parasite infection of two (2) commercially important and easily-culturable fish species of Nigeria (*Clarias gariepinus* and *Tilapia zillii*) was studied in relation to sex and fish age (length and weight). 51 samples of *Claris gariepinus* and 34 samples of *Tilapia zillii* in Chanchaga River were caught by the use of a trawling net over a period of 24 months (September 2014 and October 2016). Four (4) classes of parasites were encountered between *Clarias gariepinus* and *Tilapia zillii* as the two species were infected with similar parasites: Monogenea, Cestode, Nematodes, and Acanthocephala, although nematode parasites were by far the most abundant. The infection rates of both *Clarias gariepinus* and *Tilapia zillii* with helminth parasites were high as their percentage infection was 88.2 % and 91.2, respectively. Females were slightly more infected than the males for both fish species, although the difference was not significant ($P < 0.05$). Fishes of higher lengths and weight for both *Clarias gariepinus* and *Tilapia zillii* were more prevalent to parasitic infection (higher % infection) than their counterparts with lower lengths and weights (lower % infection). There were no striking differences between *Clarias gariepinus* and *Tilapia zillii* in terms of parasite representation, sex, and age parameters. This phenomenon may not be unconnected to the fact that both fish species shared similar environmental conditions, dietary composition, and feeding habits. This study recommends a change of feeding habits and dietary composition with age and immune system state in order to reduce the infestation of parasites with the goal of increasing field yield efficiency.

INTRODUCTION

Fish is regarded as the cheapest means of obtaining animal protein among the urban and rural settlements for man and his livestock **(Abdel-Gaber *et al*., 2015)**. The quest to have fish as a source of protein is generally on the increase with corresponding increase in human population **(Onyedineke *et al*., 2009)**. Fish farming in forms of natural and aquaculture systems has massively improved in attempts to meet the demands of fish as protein source **(Komatsu & Kitanishi, 2015; Kawe *et al*., 2016).**

Nigeria boasts of different species of culturable fishes including, but not limited to, *Cyprinus carpio*, *Oreochromis niloticus*, *Heterobranchus* sp., *Tilapia zillii*, and *Clarias gariepinus*. On the one hand, among the cichlids group of fishes in Nigeria, tilapia fishes are the only group with the ability to be grown into fully mature market sizes for food; on another hand, among the easily cultivated fishes in Nigeria, Clarias is among the most valued and most environmental and disease resistant, with wide acceptance as food **(Yakubu *et al*., 2002; Keke et al., 2017a)**. However, fish farmers are limited by tremendous loss of fry and fingerlings due to helminth parasite invasion **(Abdel-Gaber *et al*., 2015).** While helminthic parasites of fish are common globally, they are regarded more important in the tropic given the environmental uniqueness of the region **(Soliman & Nasir, 2015)**.

Recently, documented information on parasitic fauna of commercially important freshwater fishes of Nigeria have rapidly increased. However, while such studies regarding *Clarias gariepinus* is gradually increasing even more, there is paucity of information about *Tilapia zillii*. This study provides information on the relationship of sex and age (length and weight) on the prevalence of helminthic parasite infection of two (2) commercially important and easily-culturable fish species of Nigeria (*Clarias gariepinus* and *Tilapia zillii*) with a view to arriving at better management protocols for more efficient and maximum yield.

MATERIALS AND METHODS

Study Area

River Chanchaga is of great importance to the riparian communities and the town as it is a municipal river mainly used as source of portable water, irrigation and domestic activities such as bathing, washing, mining and industrial activities. It is located at the southern part of Niger State and has a length of about 216km. River Chanchaga lies between latitude $8^0$43'N to $9^0$40'N and longitude $6^0$12'E to $6^0$47'E of the equator (Fig. 1). Its main tributaries include River Wana, Shaho, Dunalape, and Godina which are flowing from their individual highlands and have isolated compound such as Kpewi, Zuru, Gwam and Tsauran Nabi Hills. The study area has two seasons annually and is located in a tropical climate region, the wet and dry seasons. Annual rainfall ranged between 1,200mm and 1,300mm. The rainy season is usually between April and October with a peak rainfall occurring in September while the dry season is between November and March. The area has a mean annual temperature of about 30.2 ^{0}C with relative humidity at 61 %. The vegetative cover is of the guinea savanna zone, characterized by scanty distributed trees species, shrubs and grassland being the most dominant. There are numerous anthropogenic activities going on around the study area, such as irrigation and farming activities, washing, bathing and defecating, fishing and mining activities. This river is also used by Niger State Water Board Authorities as the main source of water distribution to the municipal town of Minna and its surrounding towns and villages.

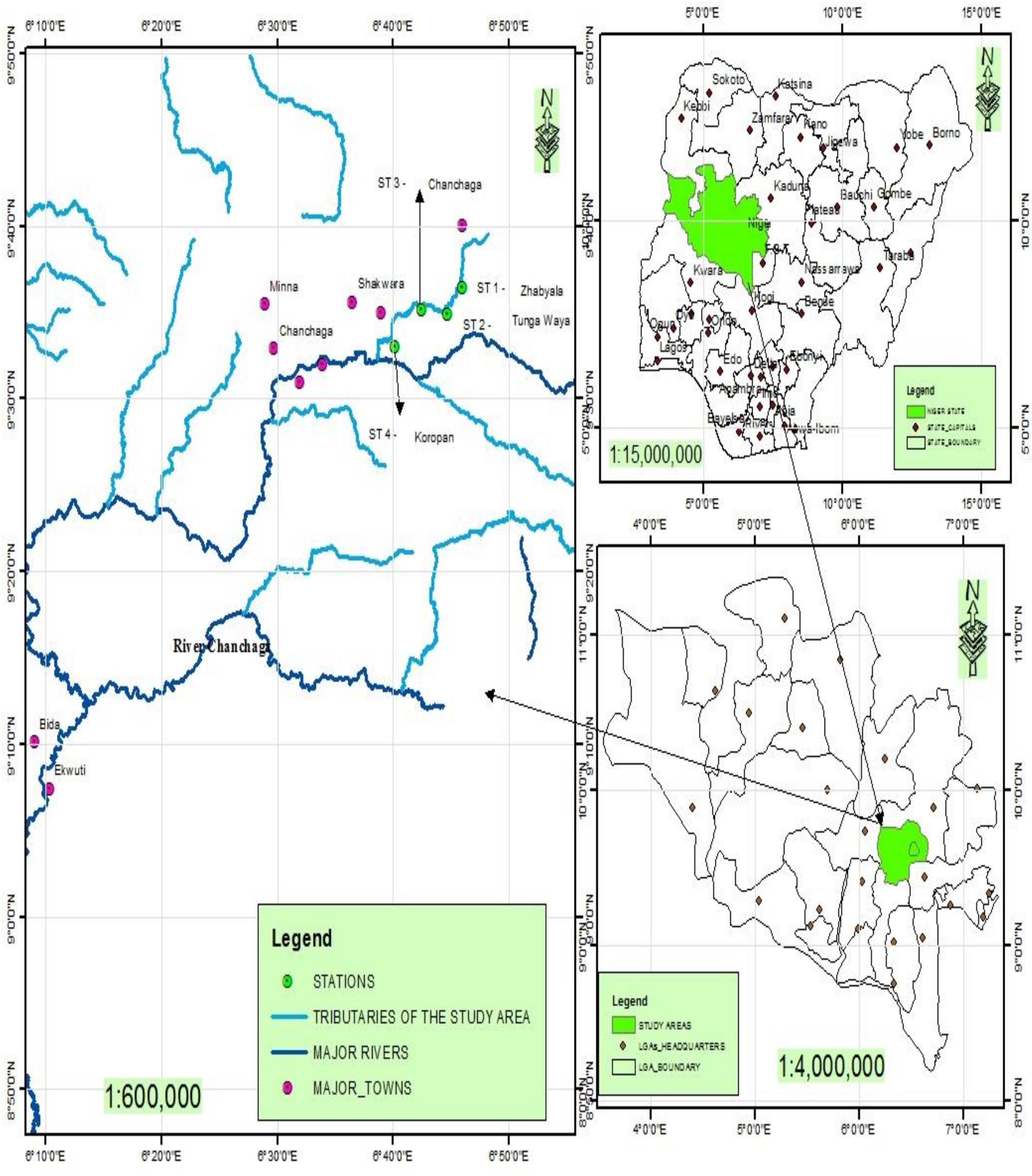

Fig. 1: A map of the study area showing the sampling stations and major towns.
Source: Remote sensing laboratory, Department of Geography, Federal University of Technology, Minna

Sampling and sample preparation

Fifty-one samples of *Claris gariepinus* and Thirty four samples of *Tilapia zillii* in Chanchaga River were caught by the use of a trawling net over a period of 24 months (September 2014 and October 2016). Total length of each fish was measured in centimeters (cm) using measuring tape, while the weight of each fish was recorded in grams (g) using a weighing balance. The sex of each fish was determined by examining the papillae.

Each fish was carefully dissected and samples of middle intestines were taken and kept frozen at –20 ºC until being processed.

The dissected fish were microscopically examined for endoparasites, and helminths parasites were carefully taken with an aid of a dropper and washed repeatedly in petridishes that contained saline solution. The helminth parasites were identified, using their morphological features, according to requisite taxonomic keys and techniques as described by **Chilton *et al*., 1995, Lichtenfels *et al*., 1994, Williams & Jones (1994), and Hoffman (1999).**

Data Analysis

Numbers of fish and parasites caught at the different sampling stations were analysed using simple percentage according to **Marcogliese *et al.* (2006)** and **Bush *et al.* (1997)** as follows:

$$\text{Parasite prevalence (P\%)} = \frac{\textit{Number of infected fish}}{\textit{Total number of examined fish}} \times 100$$

Chi-square test was used to determine the prevalence of parasites in fish species in relation to their sex.

RESULTS

The data on species percentage prevalence of helminths recovered from *Clarias gariepinus* and *Tilapia zillii* is presented in **Fig. 2**. Four classes of parasites were encountered between *Clarias gariepinus* and *Tilapia zillii* as the two species were infected with similar parasites: Monogenea (*Dactylogyrus* sp.), Cestode (*Polyonchobothrium clarias*), Nematodes (*Camallanus* sp., *Cucullanus* sp., *Capillaria* sp., *Eustrongylides* sp., and *Alvinocaris markensis*), and Acanthocephala. 338 individuals of parasites comprising 324 Nematodes (*Camallanus* sp., 129 (38.2 %); *Cucullanus* sp., 43 (12.7 %); *Capillaria* sp., 114 (33.7 %); *Eustrongylides* sp., 31 (9.2 %); and *Alvinocaris markensis*, 7 (2.1 %)), 7 (2.1 %) Acanthocephala, 4 (1.2 %) Cestoda, and 3 (0.89 %) Monogenea were collected from *Clarias gariepinus*; while for *Tilapia zillii*, 244 individuals comprising 237 Nematodes (*Camallanus* sp., 88 (36.1 %); *Cucullanus* sp., 61 (25 %); *Capillaria* sp., 53 (21.7 %); *Eustrongylides* sp., 22 (9 %); and *Alvinocaris markensis*, 13 (5.3 %), 4 (1.6 %) Acanthocephala, and 3 (1.3 %) Cestoda were collected. There was no record of Monogenea individuals collected from samples of *Tilapia zillii*. For *Clarias gariepinus*, *Camallanus* sp. showed highest prevalence (38.2 %), followed by *Capillaria* sp. (33.7 %); while for *Tilapia zillii*, *Camallanus* sp., showed highest prevalence (36.1 %), followed by *Cucullanus* sp. (25 %).

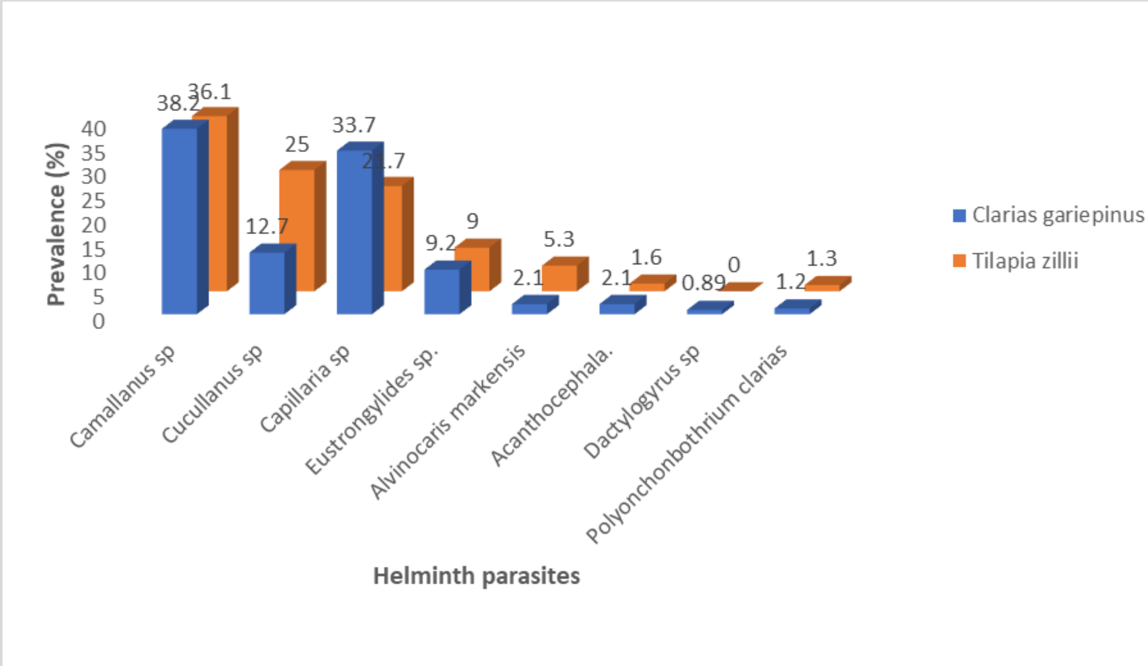

Fig. 2: Prevalence of helminth parasites recovered from *Claria gariepinus* and *Tilapia zillii* in Chanchaga River.

Out of 51 individuals of *Clarias gariepinus* examined, 45 individuals were infected with various parasites; while out of 34 individuals of *Tilapia zillii* examined, 31 individuals were infected (**Table 1**). The infection rates of both *Clarias gariepinus* and *Tilapia zillii* with helminth parasites were high as their percentage infection was 88.2 % and 91.2, respectively. This result also showed that females were slightly more infected than the males for both fish species, although the difference was not significant ($P < 0.05$).

Prevalence of endoparasite infection in *Clarias gariepinus* and *Tilapia zillii* in relation to their standard length is shown in **Table 2**. Infection rate was generally high for all classes of length considered for *Clarias gariepinus*, but fish with higher lengths (20 – 26.9 cm and 34 – 40.9 cm) were more infected (100 % infection rate). Similarly, for *Tilapia zillii*, fish of all length classes were highly infected, but the highest infection prevalence was recorded from fish with the highest length (20.0-26.9).

Prevalence rate of endoparasite infection in *Clarias gariepinus* and *Tilapia zillii* in relation to their standard weight is shown in **Table 3**. Moreover, standard length, percentage infection was highest (100 % infection) in fish samples with more weights (*Clarias gariepinus:* 150-199.9 g, 200-249.9 g, and 300-349.9 g; *Tilapia zillii*: 100-149.9 g, 150-199.9 g, and 200.299.9 g) than fish with less weight for both fish species (*Clarias gariepinus:* 3.0-49.9 g, 50-99.9 g, and 100-149.9 g; *Tilapia zillii*: 3-49.9 g and 50-99.9 g). length and weight classification for both species of fish showed that *Clarias gariepinus* generally grew bigger in size than *Tilapia zillii.*

Table 1: Prevalence of endoparasites in the fish species caught in River Chanchaga in relation to sex

	Clarias gariepinus		
Sex	No examined	No infected	% infected (prevalence)
Male	22	18	81.8
Female	29	27	93.1
Total	51	45	88.2
	Tilapia zilli		
Sex	No examined	No infected	% infected (prevalence)
Male	16	14	87.5
Female	18	17	94.4
Total	34	31	91.2

Chi-square: *Clarias gariepinus* = **1.321**; *Tilapia zillii* = **1.272**

Table 2: Prevalence (%) of endoparasites infection in *Clarias gariepinus* and *Tilapia zillii* collected from Chanchaga River in relation to their standard length

Standard length (cm)	No examined (%)	No infected	Prevalence (% Infected)
	Clarias gariepinus		
6.0-12.9	13 (25.5)	11	84.6
13.0-19.9	22 (43.1)	19	86.4
20-26.9	7 (13.7)	7	100
27.0-33.9	5 (9.8)	4	80
34.0-40.9	4 (7.84)	4	100
Total	51 (100)	45	88.2
	Tilapia zillii		
6.0-12.9	19 (55.9)	17	89.5
13.0-19.9	13 ((38.2)	12	92.3
20-26.9	2 (5.9)	2	100
Total	34 (100.0)	31	91.2

Table 3: Prevalence (%) of endoparasites infection in fish species collected from Chanchaga River in relation to body weight for *Clarias gariepinus* and *Tilapia zillii*

Body weight (g)	No examined (%)	No infected	Prevalence (% Infected)
	Clarias gariepinus		
3.0 – 49.9	32 (62.7)	28	87.5
50.0 – 99.9	5 (9.8)	4	80.0
100.0 – 149.9	6 (11.8)	5	83.3
150.0 – 199.9	3 (5.9)	3	100
200.0 – 249.9	1 (2.0)	1	100
250.0 – 299.9	-	-	-
300.0 – 349.9	4 (7.84)	4	100
Total	51 (100)	45	80.4
	Tilapia zillii		
3.0 – 49.9	13 (38.2)	11	84.6
50.0 – 99.9	12 (35.2)	11	91.7
100.0 – 149.9	4(11.8)	4	100
150.0 – 199.9	1 (2.94)	1	100
200-299.9	4(11.8)	4	100
Total	34 (100)	31	91.2

DISCUSSION

The overall prevalence of endoparasites in this study was high for both *Clarias gariepinus* (88.2 % infection) and *Tilapia* zillii high (91.2 %). This high infection rate for both species of fish could be attributed to anthropogenic pollution of Chanchaga River, given that **Amadi *et al*. (2012)** and **Edegbene *et al***. (2015) had reported the contamination of Chanchaga River by activities such as mining, agriculture, construction works, fishing, domestic and industrial wastes from water processing for municipal supplies. **Khan and Thulin (1991), Abdel-Gaber *et al* (2015) and Keke *et al*. (2017b)** have earlier opined that activities from urban settlements are able to encourage pollution of various human sources, resulting to an increase in the prevalence of organisms, such as parasites. High prevalence of infection in this study may also be as a result of availability of parasites intermediate hosts (e.g. insects, molluscs and copepods) that inhabit the infective larval stages of parasites, and are eventually fed by the fish. Similarly, related high prevalence rates of parasites infection have been reported by earlier studies in Nigeria and elsewhere (**Salawu *et al*., 2013** (75 %); **Amaechi (2014)** 56.4 %; **Abdel-Gaber *et al*, 2015** (65 %); **Kawe *et al*., 2016** (67.5 %). Climatic dynamics that prevail on biotic and abiotic factors of a locality might be responsible for variations in parasites infection rates of different localities. Again, the fact that *Tilapia zillii* showed slightly more infection rate than *Clarias gariepinus* could be possibly an indication that *Clarias gariepinus* has superior resistance to parasites than *Tilapia zillii.*

This study showed the occurrence of four classes of parasites between the two commercially important fish species in Chanchaga River, namely: Monogenea (*Dactylogyrus* sp.), Cestode (*Polyonchobothrium clarias*), Nematodes (*Camallanus* sp., *Cucullanus* sp., *Capillaria* sp., *Eustrongylides* sp., and *Alvinocaris markensis*), and Acanthocephala. These species are typical parasite checklist of African freshwater fishes **(Imam, 1971; Khalil and Polling, 1997; Yakubu *et al*., 2002; Akinsanya and Otubanjo, 2006).** The present study also reported highest abundance and prevalence of nematodes, especially *Camallanus* sp., *Cucullanus* sp., and *Capillaria* sp; with corresponding low prevalence of cestodes (*Polyonchobothrium clarias*), monogenes, and acanthocephalan. The high abundance of nematodes (*Camallanus* sp., *Cucullanus* sp., and *Capillaria* sp) might be a function of the feeding habits of some fish species which encouraged feeding more on detritus and mud. The record of abundance of nematode has been reported by several other studies across Nigeria (**Arimoro & Utebor, 2013; Thielen *et al*., 2014; Kawe *et al*., 2016; Omalu *et al*., 2017**).

The low prevalence of Acanthocephala might be due to the paucity of adequate intermediate host to enable easier transmission in Chanchaga River. This low record of Acanthocephala from this study is, however, not in conformity to the report by Balarin (1979) that Acanthocephala species are the most common parasitic species of tropical African region. There has been massive report of high prevalence of *Polyonchobothrium clarias* in typical African fishes. For example, Imam (1971) and Sawa (1982) had recorded high prevalence of 42 % and 22 % from Nile Egypt and Manzalla Egypt waterbodies, respectively. On the contrary, low prevalence of 1.2 % and 1.3 % of *Polyonchobothrium clarias* were recorded for *Clarias gariepinus* and *Tilapia zillii*, respectively in this study.

Although prevalence rate was slightly higher in females than in male, there was no significant difference between them for both *Clarias gariepinus* and *Tilapia zillii*. The relatively higher infection in females than male might be a result of their ultimate drive to survive. It could also mean that more females were available for parasitic infestation than males. **Abdel-Gaber *et al*, 2015, Omeji *et al*., and Emere and Egbe, 2006** who also reported higher percentage infection in female fishes attributed it to physiological states of the female fishes with resultant decrease in their ability to resist parasitic infections.

There is a relationship between parasitic prevalence infections and fish length and weight, which are equivalent to fish age **(Oniye *et al*. 2004; Akinsanya and Otubanjo, 2006)**. In this study, fishes of higher lengths and weight for both *Clarias gariepinus* and *Tilapia zillii* were more prevalent to parasitic infection (higher % infection) than their counterparts with lower lengths and weights (lower % infection). This might plausibly be linked to differences exhibited in their feeding habit as a result of age, where the older fishes feed more and as a result become more likely to pick up the parasites through feeding. Second, the mere change of dietary contents as the fish grows from weeds, seeds, zooplankton to animal-based foods (e.g. snails, worms, insects which are intermediate hosts of infective larval stages of parasites) might be a possible reason bigger fishes were more prevalent than the younger ones. Another reason might also be that the younger fishes with supposedly better immunity were more resistant to infections than older fishes with compromised immunity **(Akinsanya and Otubanjo, 2006)**. The length and weight parameters of fish age showed that *Clarias gariepinus* samples were obviously bigger than *Tilapia zillii* fish and this could mean that the former boasts of more market value than the later.

CONCLUSION

In conclusion, there were no striking differences between *Clarias gariepinus* and *Tilapia zillii* in terms of parasite representation and composition, sex, and age parameters. This phenomenon may not be unconnected to the fact that both fish species shared similar environmental conditions, dietary composition, and feeding habits. Like **Oniye *et al*. (2004)** had recommended earlier, this study also recommends a change of feeding habits and dietary composition with age and immune system state in order to reduce the infestation of parasites with the ultimate aim of increasing field yield efficiency.

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