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Full Length Research Article

DISTRIBUTION AND ABUNDANCE OF ECTO AND ENDO HELMINTH PARASITES OF *Clarias gariepinus* FROM NATURAL AND ARTIFICIAL HABITATS IN ANAMBRA STATE, SOUTHEASTERN NIGERIA.

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Abstract

Helminth parasites have been recognized as a major threat to fish health and cause reduced economic gains worldwide. This study aimed to determine the abundance and distribution of ecto and endo helminth parasites of *Clarias gariepinus* from natural and artificial habitats in Anambra state, Nigeria. A total of 40 live adult *Clarias gariepinus* (15.67–440.08 g body weight) were randomly purchased and examined for ecto and endo helminth parasites. The fish consists of 15 each from natural and 10 from artificial habitats. Standard parasitological techniques were used for the isolation and identification of the ecto and endo helminth parasites. Data obtained was analysed with χ^2 at 5 % significance level. Nineteen (48%) of *Clarias gariepinus* sampled were infected with 59 different species of helminth parasites. Endoparasites identified were: *Procamallanus* sp. (25%), *Camallanus* sp. (37.5%), *Polyonchobothrium* sp. (7.5%), and *Protocephalus* sp. (2.5%) with one ectoparasite *Gyrodactylus* sp. (2.5%) ($P < 0.05$). Natural and artificial habitats have a prevalence of 48% and 0% ($P < 0.05$) respectively. Catfish obtained from Otuocha section of Omambala River habitat with body weight 100-199g, has the highest prevalence (75%), while highest parasite distribution in organs was found in the intestines (40.0%). The higher infection rate observed among natural habitat fish indicates river contamination. Good hygienic practice is advocated among the community members.

Keywords: Prevalence, Abundance, Distribution, *Clarias gariepinus*, Helminths, Natural and Artificial habitats, Nigeria

Introduction

Clarias gariepinus (African catfish) is a major and most common cultured fish species in the sub-Saharan African region including Nigeria (Enyidi and Uwanna, 2019). The African catfish, *Clarias gariepinus* is a freshwater fish species in the family Clariidae which belongs to the order Siluriformes. Catfishes are a highly diverse and widely distributed group of fish with over 3000 species worldwide. *C. gariepinus* (African catfish) are air-breathing fish, characterized by scale-less, bony, elongated bodies, with long dorsal and anal fins and helmet-like heads (Hogan, 2011).

According to Allumma and Idowu (2011), fish provide about 20% of animal protein globally and as high as 64% in most African countries. Aside from its nutritive value, *C. gariepinus* constitute an important source of food and finance worldwide particularly in underdeveloped nations of Africa (Benedict *et al*., 2023). Over 35 million people worldwide reportedly depend exclusively or partially on fisheries or aquaculture for livelihood (Olubiyo *et al*., 2023). However, fish farming is seriously threatened by several diseases caused by parasitic infections (Olubiyo *et al*., 2023; Olugbotemi and Olajumoke 2018). Fish parasites are organisms found in or on fish, whose activities such as attachment, feeding, movement, reproduction, and other physiological responses damage the fish. They are broadly categorized into two: external (ecto) parasites and internal (endo) parasites. They are found on/in the organs of fish such as the gills, skin, and fins for external parasites, and also the stomach, intestine, and muscles, for internal parasites. Fish infection with parasites is mainly caused by unhygienic conditions in the fish habitats (Phan *et al*., 2010). The ectoparasites have specificity for external organs mainly because these organs have many blood vessels that supply the parasites with necessary food nutrients and provide space for growth (Muchlisin *et al*., 2014). On the other hand, endoparasites can have their infective stages ingested along with some food materials. Their impact on fishing activities in natural water bodies and man-made water environments includes a reduction in growing harvested stock and market value, loss of aesthetic value, distortion of metabolic and physiologic functioning, high cost of treatment, and massive fish deaths (Omeji *et al*., 2011). Infections with fish parasites have been recognized as a significant public health issue with attendant economic consequences in terms of morbidity, reduced productivity, and medical expenses (Mokhtar *et al*., 2014).

Helminth parasites of fish, including trematodes, nematodes, cestodes, or acanthocephalans can be found as larvae or adults in fish organs or gastrointestinal tracts (Anne and Gary, 2012). Some researchers have conducted studies to investigate the prevalence and intensity of helminth parasites of *C. gariepinus* in different parts of the world, as well as sub-Saharan Africa, Ali *et al*. (2020) in Egypt and Hussein *et al*. (2012) in Ethiopia. In Nigeria precisely, numerous studies have also been reported on the prevalence of helminth parasite infection in *C. gariepinus* including studies by Onojafe *et al*. (2021), Afolabi *et al*. (2020), Mgbemena *et al*. (2020), Dan-Kishya *et al*. (2013) and Ayanda (2009). However, there is still a paucity of data on the abundance and distribution of these helminth parasites in the present study area. Hence, this study investigated the abundance and distribution of ecto and endo helminth parasites of *Clarias gariepinus* from natural and artificial habitats in Anambra state, southeastern Nigeria.

MATERIALS AND METHOD

Study Area

The study was conducted in an artificial habitat (man-made pond) in Awka South and one natural habitat each in Anambra East and Awka North Local Government Areas of Anambra state, Nigeria. The man-made pond in Awka South (Afik Pond) is located on latitude 6 12'37" N and longitude 7 4'20" E. The natural habitat, Otuocha section of Omambala River, Anambra East LGA is situated on latitude 6 20' 9N and longitude 6 51' 4 E while the other natural habitat (Awba River) is located on latitude 6 13' 19 N and longitude 7 4' 55" E in Awba-Ofemili town (Nnatuanya *et al*., 2023).

Ethical Approval

The ethical approval for this research was obtained from the Animal Research Ethics Committee of Nnamdi Azikiwe University Awka with the reference number NAU/AREC/2021/00049.

Procurement of *Clarias gariepinus*

The fish were initially identified by the fishermen and fish sellers at Omambala and Awba-Ofemili Rivers, and the name tags were placed on them at the point of purchase. Final confirmation of the fish was done by fisheries and aquaculture experts in the Department of Zoology of Nnamdi Azikiwe University, Awka. *Clarias gariepinus* fishes numbering ten (10) were obtained from the artificial habitat (Afik Pond) while fifteen (15) each were obtained from the natural habitat; Awba and Omambala rivers respectively. The live fish were placed in a clean plastic bowl containing water and taken to the laboratory unit of the Department of Zoology, Nnamdi Azikiwe University, Awka for parasitological examination.

Sex Determination

The long and distended urogenital papillae located behind the anus were used as an identifying feature for the male fish while the round and reddish urogenital papillae were used to determine the female *Clarias gariepinus*.

Length and Weight Measurements

The length of the fish was measured from the tip of the snout to the end of the caudal fin in centimeters (cm), using a calibrated meter rule. The weight of the fish was also obtained with the aid of an electric kitchen scale (QE-KE-4) and was recorded to the nearest gram (g).

Examination of *Clarias gariepinus* for Ectoparasites

The external surface of the fish was observed for signs of parasite infection, and the presence of ectoparasites. This was followed by scraping of the skin of the fish from the head down to the tail. The scrapings consisting of epidermal cells and mucus were added to a test tube containing 10ml of 0.9% Normal saline solution and stirred to homogenize using an applicator stick. A few drops of the mixed solution were collected using a 5ml plastic bulb pipette and transferred onto a slide to make a smear. The smear was first examined using ×10 objectives followed by ×40 objectives for the presence of parasites (Afolabi *et al*., 2020; Ekanem *et al*., 2014), while the parasites found were identified based on small, elongated body, the presence of Opisthaptor (attachment organ) with hooks and anchors (Tabasum *et al*., 2023).

Examination of *Clarias gariepinus* for Endoparasites

To detect endoparasites, dissecting scissors was used to open up the fish from the anus to the lower jaw. Exposed internal structures such as the intestine and stomach were removed and placed into labeled petri dishes containing 0.9% Normal saline. The intestinal and stomach contents were carefully washed using saline solution and

allowed to settle for a few minutes. A drop of the sediment was placed on a glass slide and viewed under the microscope using ×10 and ×40 objective lens (Benedict *et al*., 2023). The helminth parasites were identified using a standard text by Ajala and Fawole (2014), and Kawe *et al*. (2016).

Statistical Analysis

The data obtained was subjected to statistical analysis using SPSS version 23. Prevalence rates were calculated and expressed as percentages. The Chi-square (χ^2) test was used to determine the association between the variables studied and prevalence of ecto and endo helminth parasites of the fish. *P-value* < 0.05 was considered significant.

Results

Classification of Catfish Parasites in Artificial and Natural Habitats

The parasites found in this study (59) were observed to be distributed among three taxonomic groups of parasites namely: Nematoda, Cestoda, and Trematoda (Table 1). The endoparasites obtained from the catfish include 2 nematodes (*Procamallanus* spp., and *Camallanus* spp.), 2 cestodes (*Protocephalus* sp., and *Polyonchobothrium* sp.), while the ectoparasite found is 1 trematode (*Gyrodactylus* spp.). All the parasites recorded here, came from the *Clarias gariepinus* found in the natural habitat, as none was obtained from the artificial habitat.

Table 1: Classification of Helminth Parasites of *Clarias gariepinus* in Artificial and Natural Habitats

Taxa group	Parasites found	
	Artificial	Natural
Cestoda (endoparasite)	Nil	*Protocephalus* sp., *Polyonchobothrium* sp.
Nematoda (endoparasite)	Nil	*Procamallanus* sp., *Camallanus* sp.
Trematoda (ectoparasite)	Nil	*Gyrodactylus* spp.

Prevalence and Abundance of Helminths from Studied Habitats

The result in Table 2 indicates that out of forty (40) *Clarias gariepinus* examined, the overall prevalence was 48.0 % (n = 19). The prevalence of helminth parasites of fish was higher in the natural habitat (48%) than in the artificial habitat (0%) (P < 0.05). Comparatively, Awba River recorded higher, 67.0 % prevalence of helminth parasities than Otuocha section of Omambala River with 60.0 % prevalence. However, the mean abundance of helminth parasites obtained in Awba River, 2.5 parasites per infected fish is lower than 3.8 parasites per infected fish obtained in Otuocha River.

Prevalence of Helminth Parasites of *Clarias gariepinus* in Relation to the Body Weight

The results of parasite prevalence in relation to body weight, as shown in Table 3, revealed that catfish obtained from the Otuocha section of Omambala River, with body weight 100-199g, has the highest prevalence (75%), while a prevalence of 60% was recorded for body weight range of 200-299g. No parasite (0%) was observed in catfish obtained from the artificial habitat with the following body weight range: 1–99g to 400-499g. Also no parasite was found among the catfish with body weight ranging from 100–199g and 400-499g obtained from Awba River.

Table 2: Prevalence and Abundance of Helminth Parasites from the Natural and Artificial Habitats

Location	Prevalence and abundance of infection in *Clarias gariepinus* reared in wild and pond				
	Number examined	Number Infected	Prevalence (%)	No of parasite	Mean abundance
Afik Pond	10	0	0.0	0	0.0
Awba River	15	10	67.0	25	2.5
Otuocha section of Omambala River	15	9	60	34	3.8
TOTAL	**40**	**19**	**48**	**59**	**3.1**

Table 3: Prevalence of Helminth Parasites of *Clarias gariepinus* Based on Body Weight

Habitat	Body weight (g)	Number Examined	Number Infected	Prevalence (%)
Afik pond	1 – 99	10	0	0.0
	100 – 199	0	0	0.0
	200 – 299	4	0	0.0
	300 – 399	4	0	0.0
	400 – 499	2	0	0.0
Otuocha section of Omambala River	1 – 99	15	0	0.0
	100 – 199	4	3	75.0
	200 – 299	10	6	60.0
	300 – 399	1	0	0.0
	400 – 499	0	0	0.0
Awba River	1 – 99	15	10	67.0
	100 – 199	0	0	0.0
	200 – 299	0	0	0.0
	300 – 399	0	0	0.0
	400 – 499	0	0	0.0

Distribution of Helminth Parasites in *Clarias gariepinus* by Organs infected / infested

Results on the parasite distribution based on body organs sampled indicated that the highest parasite distribution in organs was found in the intestines (40.0%), followed by the stomach (32.5%). However, there was no parasite found in the gut and skin of the *Clarias gariepinus* examined. The result of the study shows that there was a significant relationship between parasite distribution and organs of *Clarias gariepinus* in the study area (χ^2=53.99, p=0.00) as shown in Table 4.

Prevalence of Helminth Parasites Species in *Clarias gariepinus* Reared in Natural and Artificial Water Bodies

The result on the prevalence of helminth parasite species present indicates that the highest was *Camallanus* sp. (37.5%) followed by *Procamallanus* sp., (25%), and *Polyonchobothrium* sp. (7.50%), while the least distribution was found in *Protocephalus* sp. and *Gyrodactylus* sp.

(2.5%) respectively. There was a significant relationship between parasite distribution and species of parasites in the study area (χ^2 =75, p=0.00) as shown in Table 5.

Table 4: Parasite Distribution on *Clarias gariepinus* Based on Organs

Organs	Parasite Distribution on body organs of *Clarias gariepinus*					
	Number examined	Number infected	Parasites found	Prevalence (%)	Chi-Square	*P*-value
Gills	40	3	*Gyrodactylus* sp	7.50	53.99	0.00
Gut	40	0		0.00		
Skin	40	0		0.00		
Stomach	40	13	*Camallanus* sp	32.5		
Intestine	40	16	*Procamallanus* sp. *Polyonchobothrium* sp. *Protocephalus* sp	40.0		

Table 5: Prevalence and Intensity of helminth parasites infection of *Clarias gariepinus*

Parasites	Prevalence of Helminth parasite species						
	Number Examined	No. of fish Infected	Prevalence (%)	Number of parasites	Intensity	*Chi-sq*	P-v
Protocephalus sp.	40	1	2.50	1	1		
Polyonchobothrium sp.	40	3	7.50	3	1		
Procamallanus sp.	40	10	25	15	1.5	75	0.00
Camallanus sp.	40	15	37.5	39	2.6		
Gyrodactylus sp.	40	1	2.50	1	1		
TOTAL	40	30	75	59	3.11		

Discussion

The findings of this study revealed an overall prevalence of 48% in the natural habitat than in the artificial habitat (0%) for *Clarias gariepinus* fish samples. This is higher than the 20.16% infection prevalence reported by Olubiyo *et al*. (2023) in Kogi state, Nigeria. The higher distribution of helminth parasites recovered from the natural habitats might be due to risk indicators such as endemicity, incessant pollution of water bodies, nutritional habits of fish, presence of intermediate hosts that harbor the infective stages of the parasites, and susceptibility of the definitive host thereby resulting to infection of the fish in the water (Kawe *et al*., 2016). This prevalence is also higher compared to the work of Afolabi *et al*. (2020), who recorded a prevalence of 33.75% for catfish parasites in natural habitats; however, we observed no parasite from artificial habitat unlike the 20.54% he reported. The result also corresponds with studies by Yakubu *et al*. (2002) and Dan-Kishiya *et al*. (2013) who reported similar prevalence rates respectively. However, the findings contradict the studies done by Mgbemena *et al*. (2020) who reported a heavy infection rate of 88.2% for the natural habitat of *C. gariepinus.*

The zero percent prevalence of fish helminth parasites of fish in artificial habitat, as reported in the study corresponds with

studies conducted by Ayanda (2009) who reported a similar prevalence (0%) of parasites from fish obtained from artificial habitat. Also, Onojafe *et al*. (2021) reported a lower prevalence of 11% in an artificial habitat. The zero-prevalence recorded from the artificial habitat could be attributed to the use of screened nets around fish ponds to guard against predatory birds which serve as hosts to some of these parasites and can infect the fish ponds with parasite eggs (Aliyu and Solomon, 2012). This may also be due to the wholehearted attention and care given to man-made habitats such as ponds to ensure high productivity and great economic gains. According to Hussein *et al*. (2012), helminths are generally found among freshwater fishes, where their prevalence and intensity are dependent on factors such as parasite species and their biology, host and its feeding habits, physical factors, and hygiene of the water body, and the presence of intermediate hosts where necessary (Hussein *et al*., 2012).

From the artificial and natural habitats studied, five helminth parasites including *Protocephalus* sp., *Polyonchobothrium* spp. (cestodes); *Camallanus* sp., *Procamallanus* sp. (nematodes), and *Gyrodactylus* sp. (Trematode) were found parasitizing the *C. gariepinus* fish samples. This is in line with other scholars like Ali *et al*. (2020), Dan-kishiya *et al*. (2013), Oniye *et al*. (2004), and Ayanda (2009), who reported various Cestodes, Nematodes, and Trematodes in natural habitat for *C. gariepinus* in Egypt and Nigeria respectively. Ajala and Fawole (2014) in Ore, equally reported the presence of the nematode parasite *Procamallanus laevionchus* and the cestode parasite *Polyonchobothrium clarias in C. gariepinus*.

Studies conducted earlier by Ali *et al.* (2020) and a few others indicate that helminths have a preference for the gut of fish as their site of attachment. In this study, the distribution of gastrointestinal helminth parasites (*Camallanus* sp., *Procamallanus* sp., *Polyonchobothrium* sp., and *Protocephalus* sp.) in the fish revealed a clear preference for the intestine and stomach as sites of attachment which could be attributed to the availability of food in these areas. The nematode parasites were recovered from both the stomach and intestine, while the cestode parasites showed a preference for the intestine. The highest prevalence of parasites recovered from the intestine suggested that it is the most preferred site; this could be due to the favorable conditions that enhance their survival (Owolabi, 2008). Similarly, the peristaltic movement of the stomach muscles during digestion and the acidic medium of the stomach may be responsible for the low number of parasites recovered there (Akinsanya *et al*., 2008; Ajala and Fawole 2014). Similar findings have also been reported in different parts of Nigeria by Yakubu *et al*. (2002), Ajala and Fawole (2014), and Afolabi *et al.* (2020).

The helminth parasites recovered from the various parts of *C. gariepinus* in this study have been reported by Onojafe *et al*. (2021) and Hussein *et al*. (2012). With regards to the abundance of parasites recovered from the catfish studied, *Camallanus* sp. was the most abundant parasite in both habitats studied (Otuocha and Awba Ofemili rivers). Furthermore, the recovery of these parasites in this study poses detrimental physiological consequences as they interfere with the assimilation of food nutrients in the fish intestines.

The majority of the ectoparasites were recovered from the *C. gariepinus* gills than the skin while the endoparasites were majorly recovered from the intestines (40%). This finding conforms with the result of Onojafe *et al*. (2021), who also reported more ectoparasites on the gills of *C.*

gariepinus in Delta State, Nigeria. Similar findings have also been reported by Allumma and Idowu (2011). The higher abundance of parasites observed from the gills could be because gill rakers help in filtering materials as well as acting as the center of filter-feeding and also as a region for gaseous exchange in fish. As such increasing the number of parasites trapped in this region. This result is however not in agreement with the findings of Omeji *et al*. (2011) who reported a higher abundance of parasites on the skin compared to the gills. A higher abundance of parasitic helminths was observed in the larger-sized *Clarias gariepinus* (100-199g) compared to the smaller ones (200-299g) across the two study habitats. This may be attributed to the fact that larger size *C. gariepinus* have a bigger body which may unavoidably come in contact with more water, materials, and organisms that might expose them to helminth parasite infection. Again, the tendency of larger fishes to consume more food substances in water might be another route for their infection through infected or contaminated food items.

Conclusion

This study revealed the presence of parasites among the catfish found in the two natural habitats studied. The parasites recovered were found to belong to these taxonomic groups: Nematoda, Cestoda, and Trematoda. The catfish obtained from the two natural habitats had all the parasites reported in this study, while the ones obtained from the artificial habitat had none. *Clarias gariepinus* of larger size were more infected compared to smaller-sized ones. The nematode, *Camallanus* sp. was the most prevalent helminth occurring in both natural habitats. The cestode *Protocephalus* sp. was found only in *C. gariepinus* from Otuocha section of Omambala River, while *Polyonbothrium* sp. was recovered from *C. gariepinus* in Awba River. The prevalence and abundance of helminths in wild *C. gariepinus* were higher than in the pond.

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Conflict Of Interest

The authors declared no conflict of interest

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