



Nematode infections of Clariid and Claroteid catfish species in River Galma, Zaria, Nigeria

Ibrahim, Z. A.,*¹ Aken'Ova, T.¹ and Luka, S. A.¹

¹Department of Zoology, Ahmadu Bello University, Zaria
email: ojoneufedo@gmail.com

Abstract

Two clariids, *Heterobranchus bidorsalis* (65) and *Heterobranchus longifilis* (15), and two claroteids, *Auchenoglanis occidentalis* (31), and *Chrysichthys auratus* (19) from River Galma were examined for gastrointestinal nematodes from May 2016 to February 2017. Overall, five species of nematodes were recovered from the clariids and claroteids. The nematodes were distributed as follows: in *Heterobranchus bidorsalis*, *Procamallanus laevionchus* (12.31%), *Paracamallanus cyathopharynx* (9.23%) and *Rhabdochona* sp. (1.54%); in *Heterobranchus longifilis*; *Paracamallanus cyathopharynx* (6.67%); in *Auchenoglanis occidentalis*: *Procamallanus laevionchus* (25.81%); in *Chrysichthys auratus*: *Procamallanus laevionchus* (5.26%), *Contracaecum* sp. (5.26%) and *Spirocamallanus spiralis* (15.79%). Nematode prevalence in *C. auratus* was higher in the wet than in the dry season; however, prevalence of infection in *A. occidentalis*, *H. longifilis* and *H. bidorsalis* was higher in the dry than in the wet season. Prevalence of nematode infection was also higher in male than in female *H. longifilis* while it was higher in female *A. occidentalis*, *C. auratus* and *H. bidorsalis* than males of the same species. Nematode prevalence was higher in larger (24.0-31.9cm) *Heterobranchus bidorsalis* and *Auchenoglanis occidentalis*. Prevalence of infection was higher in smaller (8.0-15.9cm) *Chrysichthys auratus*. It is recommended that a larger sample size of especially *Heterobranchus longifilis* and *Chrysichthys auratus*, of which only 15 and 19 specimens respectively, were examined during the period of this study, be examined, to have a clearer picture of their infection by nematodes in River Galma.

Keywords: Nematode; catfish; clariid; claroteid; infection; prevalence.

Introduction

Nematodes or roundworms, infect many different species of cultured and wild fish. Small numbers often occur in healthy fish, but high numbers cause illness or even death. The severity of disease in fish will vary with the life circle stage, species, and number of nematodes present; the age and species of infected fish and the sites of infection. Larval stages of nematodes has been reported to cause more damage than the adult worms in fish [1] including, but not limited to severe gastric upset. Even though adult nematodes are typically found in the intestinal tract of fish, adults and other life circle stages can be found in almost any organ [2].

In Nigeria, *Procamallanus laevionchus* has been reported to infect clariids [3, 4] and, in other parts of the world, *Contracaecum* sp. was reported to infect cyprinids [5] and *Rhabdochona himalayai* in coldwater fishes [6]. To the best of our knowledge, there is no information on the nematode parasites of *H. bidorsalis* Geoffroy Saint-Hilaire, 1809, *H. longifilis* Valenciennes, 1840, *A. occidentalis* Valenciennes, 1840 and *C. auratus* Geoffroy Saint-Hilaire, 1809 in River Galma. This study will therefore provide data and other information on the nematodes that infect these four fish species in River Galma.

Materials and methods

H. bidorsalis, *H. longifilis*; *A. occidentalis* and *C. auratus* were purchased weekly between May 2016 to February 2017 from fishermen along River Galma (Long. 7°42'30''E to 7°47'30''E and Lat. 11°03'20''N to 11°09'10''N). Nematodes were recovered live from the gastro-intestinal tract of fish and placed in cavity blocks containing 0.09% physiological saline. The worms were fixed in hot water and preserved in 5% formalin. Whole-mounts were prepared by dehydrating in 70% and 90% ethanol for 40 minutes each; they were cleared in lacto-phenol, then mounted on glass microscope slides in glycerol. The worms were measured using a calibrated ocular micrometre and photomicrographs were taken using a Panasonic digital camera (DMC-FX77). Nematodes were identified by consulting relevant literature [7-10].

The prevalence of nematodes was calculated and expressed as a percentage (%) using the formula:

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

Student's *t*-test was used to compare the prevalence of nematodes between fish families.

Two-way Analysis of Variance (ANOVA) was used to test the statistical significance of nematode infection among species of fish. Odd's Ratio analysis was used to determine any association between nematode prevalence and sex of fish and, the wet and dry seasons. Correlation analysis was used to show the relationship between fish standard length and parasite prevalence.

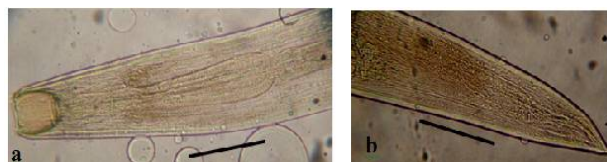
Results

Three species of nematodes: *Procamallanus laevionchus* Wedl, 1862, *Paracamallanus cyathopharynx* Baylis, 1923 and *Rhabdochona* sp. Ralliet, 1916 were recovered from the clariids, and three species: *P. laevionchus* Wedl, 1862, *Contracaecum* sp. Ralliet and Henry, 1912 and *S. spiralis* Baylis 1923 were recovered from the claroteids examined.

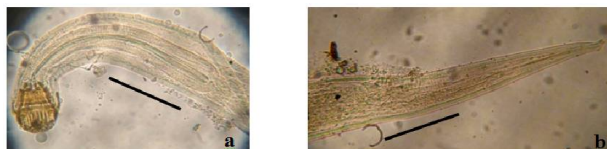
Description of nematodes recovered

P. laevionchus Wedl, 1862 (Plates I) was described based on 4 specimens, body of live specimens reddish, elongated, barrel-shaped buccal capsule or stoma, pharynx medium, 39.99-136.42 (91.55) × 10.77 (10.77) and connects midgut by an opened valve, tail 85.26 (61.03-111.29) terminates with two small and equal sub-ventral processes.

Paracamallanus cyathopharynx Baylis, 1923 (Plates II), described based on 5 adult worms, body white, relatively short, stoma lined with longitudinal processes. Pharynx medium 46.67-61.03 (54.47) × 10.77 (10.77), body smooth, posterior portion 111.32 (104.11-125.65) ends with an emerginate tip.



Plates I. *Procamallanus laevionchus*: a, anterior portion; b, posterior portion. Scale bars: 200 μm; 150 μm.



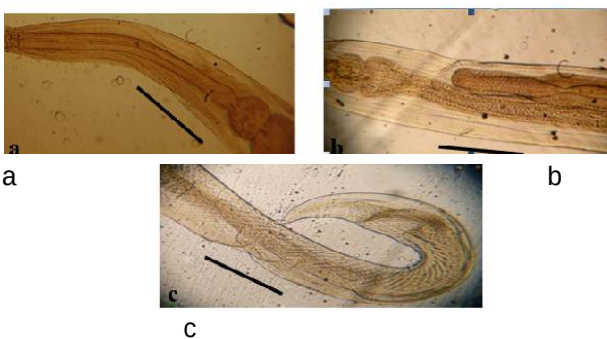
Plates II. *Paracamallanus cyathopharynx*: a, anterior portion; b, posterior portion. Scale bars: 300 μm; 150 μm.

Spirocamallanus spiralis Baylis, 1923 (Plates III), described based on 5 specimens, body of live specimens reddish, elongated, stoma possess chitinised spiral thickening, pharynx is medium, 72.52 (46.67-89.75) × 7.18-10.77 (10.05) and posterior portion, 122.78 (89.75-165.14) tapers with a terminal spine.



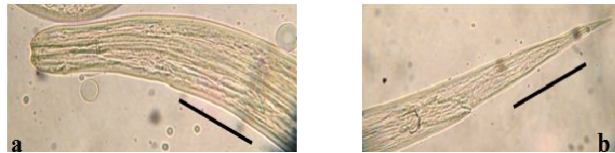
Plates III. *Spirocamallanus spiralis*: a, anterior portion; b, posterior portion. Scale bars: 450 μm; 150 μm.

Contracaecum sp. Railliet and Henry, 1912 (Plates IV) was described based on 2 whole-mounted male specimens; body whitish, elongate and cylindrical, 2 blind caeca present at boundary between pharynx, 111.29-136.42 (123.86) × 10.77 (10.77) and the midgut, tail curved.



Plates IV. *Contracaecum* sp.: a, anterior portion; b, mid-portion; c, posterior portion. Scale bars: 150 μm; 150 μm; 50 μm.

Rhabdochona sp. Railliet, 1916 (Plates V) was described based on measurement of a female specimen; body whitish and elongate. Nerve ring present, single hook-like structures present on both sides of anterior portion, narrow stoma present. Pharynx elongated not easily distinguished from intestine, anus more prominent, posterior portion 143.60, and tappers terminally.



Plates V. *Rhabdochona* sp.: a, anterior portion; b, posterior portion.
Scale bars: 300 μ m; 150 μ m.

Gastrointestinal nematode infection in relation to fish species

The data of nematode infections of the fish examined during this study are presented in Table 1. *H. bidorsalis* was infected by *Procamallanus laevionchus*, *P. cyathopharynx* and *Rhabdochona* sp. with the highest prevalence (12.31%) shown by *P. laevionchus* and the lowest (1.54%) by *Rhabdochona* sp. *H. longifilis* was infected by only *P. cyathopharynx*. *C. auratus* was infected by *P. laevionchus*, *Contracaecum* sp. and *S. spiralis*, with the highest prevalence shown by *Spirocamallanus spiralis* (15.79%) and the lowest by *Contracaecum* sp. (5.26%). *Auchenoglanis occidentalis* was infected by only *Procamallanus laevionchus* (25.81%). The highest overall prevalence of nematode infection was shown by *P. laevionchus* (25.81%) in *A. occidentalis* and the lowest by *Rhabdochona* sp. (1.54%) in *H. bidorsalis*.

The mean intensities of nematode infection in all four fish species are also presented in Table 1.

Heterobranchus bidorsalis had the highest mean intensity with *P. cyathopharynx* (6.25), and the lowest mean intensity with *Rhabdochona* sp. (1.0). *S. spiralis* (12.67) and *Contracaecum* sp. (1.0) showed the highest and lowest mean intensities respectively in *C. auratus*. The prevalence of nematodes in each of the fish species was statistically significant ($p < 0.05$). *Nematode prevalence in fish species in relation to the wet and dry seasons.*

The prevalence of nematodes in relation to season is shown in Table 2. *A. occidentalis* had higher prevalence of nematode infection in the dry (38.46%) than in the wet (16.67%) season. *C. auratus* was not available for examination in the dry season. *H. longifilis* had a higher prevalence of nematode infection in the dry (8.33%) than in the wet (0%) season, although very few fish were examined in the wet season. *H. bidorsalis* had higher prevalence of *P. cyathopharynx* infection in the dry (15.15%) than in the wet (3.13%) season whereas, the prevalence of *P. laevionchus* infection was higher in the wet (15.63%) than in the dry (9.09%) season. The highest overall prevalence of nematode infection was recorded in the dry season in *A. occidentalis* (38.46%) and the lowest in the wet season in *Rhabdochona* sp. (3.13%), and *P. cyathopharynx* (3.13%) in *H. bidorsalis*.

Gastrointestinal nematode infections in relation to sex of fish

Sex-related prevalence of nematodes in the four fish species is shown in Table 3. Female *A. occidentalis* (38.89%), *C. auratus* (63.64%) and *H. bidorsalis* (20%) had higher prevalence of nematodes than males (7.69%, 25% and 16% respectively). In contrast, male *H. longifilis* had a higher prevalence (42.86%) of nematodes than the females (12.5%). Overall, the highest prevalence of nematode infection was in female *C. auratus* (63.64%) and the lowest in male *A. occidentalis* (7.69%).

Table 1. Nematode prevalence according to catfish species.

Fish species	Helminth species	NE	NI(%)	NN	MI $\pm$ SE
<i>Heterobranchus bidorsalis</i>	<i>Procamallanus laevionchus</i>	65	8 (12.31)	50	6.25 $\pm$ 0.32
	<i>Paracamallanus cyathopharynx</i>	65	6 (9.23)	30	5 $\pm$ 0.51
	<i>Rhabdochona</i> sp.	65	1 (1.54)	1	1 $\pm$ 0
<i>Heterobranchus longifilis</i>	<i>Paracamallanus cyathopharynx</i>	15	1 (6.67)	5	5 $\pm$ 0.2
<i>Chrysichthys auratus</i>	<i>Procamallanus laevionchus</i>	19	1 (5.26)	12	12 $\pm$ 0.45
	<i>Contracaecum</i> sp.	19	1 (5.26)	2	2 $\pm$ 0
	<i>Spirocamallanus spiralis</i>	19	3 (15.79)	38	12.67 $\pm$ 0.16
<i>Auchenoglanis occidentalis</i>	<i>Procamallanus laevionchus</i>	31	8 (25.81)	33	4.13 $\pm$ 0.24

Key: NE – Number of fish examined. NI – Number of fish infected.
NN – Number of nematodes recovered. MI Mean Intensity. SE – Standard error.

Table 2. Seasonal prevalence of infection of fish with nematodes.

Fish species	Helminth species	Season				NI (%)	NN (MI)
		Wet			Dry		
		NE	NI (%)	NN (MI)	NE		
<i>Heterobranchus bidorsalis</i>	<i>Procamallanus laevionchus</i>	32	5(15.63)	20(4)	33	3(9.09)	30(10)
	<i>Paracamallanus cyathopharynx</i>	32	1(3.13)	10(10)	33	5(15.15)	20(4)
	<i>Rhabdochona</i> sp.	32	1(3.13)	1(1)	33	0	0
<i>Heterobranchus longifilis</i>	<i>Paracamallanus cyathopharynx</i>	3	0	0	12	1(8.33)	5(5)
<i>Chrysichthys auratus</i>	<i>Procamallanus laevionchus</i>	19	1(5.26)	12(12)	0	0	0
	<i>Contracaecum</i> sp.	19	1(5.26)	2(2)	0	0	0
	<i>Spirocamallanus spiralis</i>	19	3(15.79)	38(12.67)	0	0	0
<i>Auchenoglanis occidentalis</i>	<i>Procamallanus laevionchus</i>	18	3(16.67)	9(3)	13	5(38.46)	24(4.8)

Key: NE – Number examined. NI – Number infected. NW – Number of worms.
MI – Mean intensity.

Table 3. Prevalence of nematode infections in relation to sex of fish.

Fish species	Worm species	Sex				NI (%)	NN (MI)
		Male			Female		
		NE	NI (%)	NN (MI)	NE		
<i>Heterobranchus bidorsalis</i>	<i>Procamallanus laevionchus</i>	25	4(16)	15(3.75)	40	8(20)	35(4.25)
	<i>Paracamallanus cyathopharynx</i>	25	2(8)	10(5)	40	4(10)	20(5)
	<i>Rhabdochona</i> sp.	25	1(4)	1(1)	40		0
<i>Heterobranchus longifilis</i>	<i>Paracamallanus cyathopharynx</i>	7	3(42.86)	4(1.33)	8	1(12.5)	1(1)
<i>Chrysichthys auratus</i>	<i>Procamallanus laevionchus</i>	8	1(12.5)	4(4)	11	2(18.18)	8(4)
	<i>Contracaecum</i> sp.	8	1(12.5)	2(2)	11	0	0
	<i>Spirocamallanus spiralis</i>	8	2(25)	12(6)	11	7(63.64)	20(2.86)
<i>Auchenoglanis occidentalis</i>	<i>Procamallanus laevionchus</i>	13	1(7.69)	14(14)	18	7(38.89)	19(2.71)

Key: NE – Number examined. NI – Number infected. NW – Number of worms.
MI – Mean intensity.

Gastrointestinal nematode infections of catfish species in relation to size (Standard length)

Infection by nematodes according to standard length of fish is shown in Figure 1. *H. bidorsalis* and *A. occidentalis* had their highest prevalence of nematode

infection in the length range 24.0-31.9 cm. *C. auratus* had the highest prevalence in the length range 8.0-15.9 cm, while *H. longifilis* had its highest prevalence in the length range 16.0-23.9 cm.

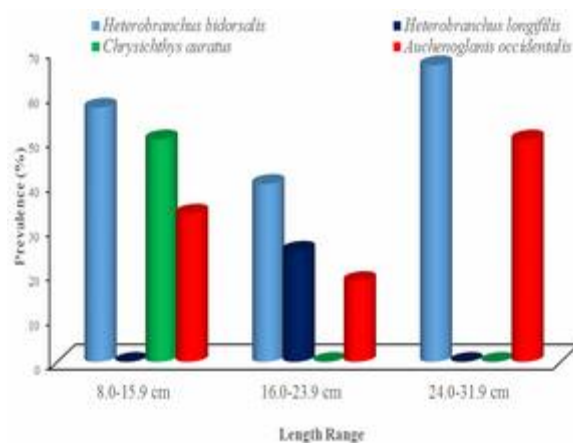


Figure 1. Nematode prevalence in relation to size of fish.

Discussion

The gastrointestinal tracts of two catfish families (Clariidae and Claroteidae) examined in this study were infected with *P. laevionchus*, *P. cyathopharynx*, *S. spiralis*, *Contracaecum* sp. and *Rhabdochona* sp. These worms have been reported by several workers, from members of the same fish families, other fish species in Nigeria and other parts of the world, especially in the tropics.

The predominant nematodes in clariids and claroteids were *P. cyathopharynx* and *P. laevionchus* respectively. This is possibly a consequence of the food preference of these families as they are known to be mostly predatory and insectivorous [11, 12] respectively.

Heterobranchius longifilis was not as readily available in River Galma as the other fishes examined in this study. According to Skelton [13], this fish is more active at night hence feeding off what is available, therefore unlikely that it would encounter many intermediate hosts of nematodes (such as crustaceans) in its diet.

The recovery of up to three species of nematode in *C. auratus* suggests a feeding behaviour that favours infection by these helminths. Prevalence of nematodes appeared to be high in *C. auratus*; this could be as a result of its varied diet which include mostly arthropods that may have acted as invertebrate intermediate hosts of the nematodes. Fagbenro et al [14] attributed high prevalence of *Procamallanus laevionchus* in *H. bidorsalis* to direct infection or through predation on cichlids by adult fish; Kawe et al [15] also suggested the same reason for the high prevalence of nematodes in the gastrointestinal tract of *C. gariepinus* in Abuja, Nigeria.

The high seasonal prevalence of nematode infection that was observed during the dry than the wet season in *A. occidentalis* could be due to the

decrease in water volume in River Galma during the dry season thereby enabling the fish come in contact with intermediate hosts of these parasites more frequently. However, the higher prevalence in the wet season observed in *C. auratus* can be attributed to the availability of more food in the form of intermediate hosts, thereby providing a greater chance of infection. No *C. auratus* was obtained in the dry season; this may be due to the tendency of *C. auratus* to hibernate or migrate during the dry season [16] which coincided with the fish collection period of this study. In the wet season, *H. longifilis* was not infected by nematodes, this is probably because the collection and examination of this fish coincided with its breeding season (June to October) as observed by Akankali et al [17].

The higher prevalence of nematodes observed in female than in male fish (1.90:1.00) in this study may be the consequence of having more females (77) than males (53) in the sample examined. Females tend to have a higher rate of food intake to meet their dietary requirements [18] for the development of their eggs thereby exposing them to more helminth infective stages and consequently increasing their chances of infection. Ayanda [19] also attributed the higher prevalence of nematode infection in female *C. gariepinus* to increased intake of a variety of food items.

Males of *A. occidentalis* have been reported to guard the eggs laid by female fish [20]; in this study, fewer males were sampled/collected, hence lower prevalence of nematode infection than in females.

The higher nematode prevalence in males of *H. longifilis* could be a consequence of immune-suppression by steroid hormones during spawning, which has been suggested as a major contributing factor for greater susceptibility of males to parasite invasion [21]. Anosike et al [22] and Oniye et al [23] reported higher prevalence of nematodes in male than female *Clarias gariepinus*. Akinsanya et al [24] also reported a higher prevalence of nematode in male than female *C. gariepinus* and *S. clarias*.

Higher prevalence of infection observed in larger *A. occidentalis* and *H. bidorsalis* in this study could be attributed to the accumulation of helminths over a long period of time [25] and consumption of more food items, thereby giving the fish greater chances of consuming the intermediate hosts of the nematode. Oniye et al [23] suggested that as the fish grew older, they became prone to reinfection by nematodes in their environment.

The higher prevalence of nematode infection in smaller *C. auratus* may be related to little or no resistance to nematode invasion at a young stage; similarly, Akinsanya et al [26] and Morenikeji et al [3] also attributed the higher prevalence of infection in smaller-sized fish to susceptibility of the fish.

In conclusion, the nematodes: *P. laevionchus*, *P. cyathopharynx*, *S. spiralis*, *Contracaecum* sp. and *Rhabdochona* sp. occur in the gastrointestinal tract of clariids and claroteids from River Galma. Prevalence of nematode infection in *C. auratus* is higher in the wet than in the dry season in River Galma, whereas, in *A. occidentalis*, *H. longifilis* and *H. bidorsalis* it was shown to be higher in the dry than in the wet season. Prevalence of nematode infection is higher in male than in female *H. longifilis* whereas, it is higher in female *A. occidentalis*, *C. auratus* and *H. bidorsalis* than male of the same species. Nematode prevalence increases with increase in standard length of *A. occidentalis* whereas it decreases with increase in standard length and weight of *C. auratus*, *H. longifilis* and *H. bidorsalis*.

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