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Research Article

OCCURRENCE OF INTERNAL NEMATODE PARASITES AND CONDITION FACTOR OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*) FISH SPECIES FROM AGNEBY RIVER, COTE D'IVOIRE

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ABSTRACT

The Nile Tilapia *Oreochromis niloticus* fish is a freshwater cichlid that is indigenous to the Nile basin and is one of the world's most important food fishes. It is a fish that is very common in Ivorian waters, used for food, and widely utilized in fish farming. However, it is susceptible to infections caused by nematode parasites, which can negatively impact the fish's condition and there are not well known. A study was conducted from February 2023 to March 2024 to determine the epidemiological indices of internal nematode parasites in Nile tilapia in two stations of the Agneby River. The study focused on 450 specimens of this fish, captured using gill nets of various sizes. The gastrointestinal tract fauna of this fish consisted of *Capillaria pterophylli*, *Camallanus polypteri*, *Eustrongylides sp*. and *Contracaecum sp*. The fish caught in Agboville station were the most parasitized. Seasonal variations in the infestation of this fish by parasitic nematodes have been observed. Generally, the largest and heaviest fish had more parasitic nematodes. The impact of host sex was observed for all nematode parasite load. The study indicated that these parasites have a negative impact on the body condition of this fish. The presence of nematodes causing zoonoses poses a public health risk for people living near this river who have developed the habit of consuming raw or undercooked fish. Therefore, awareness creation activities and control of fish parasites should be conducted in the study river.

Keywords: *Oreochromis niloticus*, Epidemiological indices, Parasitic nematode, Fish welfare, Agneby River.

INTRODUCTION

Nile tilapia (*Oreochromis niloticus*) is one of the cultured freshwater fish that possess good prospects for development. This fish species is widely used in African fish farming thanks to its zootechnical qualities, its taste and its nutritional value (Bagayo *et al.*, 2019). Therefore, Nile tilapia is also one of the potential economic commodities and has increasing demand at the national or international levels. The annual production of nile tilapia in Côte d'Ivoire was approximately 7.700 tonnes (FAO, 2022).

Farmed fish and fish living in natural waters are susceptible to infection with various parasitic species, including nematodes. It well known that Nematodes are round worms that form a zoological group homogeneous belonging to the phylum Nematoda. At numerous trophic levels, their manifestation underlines the very important roles they serve in many ecosystems, often in parasitic forms infesting most plants and animals, human beings included. Nematodes cause diseases of major socio-economic importance. They have a significant effect on fish health, growth, fish weight loss, behaviour, fertility, mortality and economic loss (Akinsanya & Otubanjo, 2006). Parasitic infestations can be devastating to both livestock systems and natural populations due to stressful feeding conditions and frequent deterioration of water quality (Meyer, 1991; Bondad-Reantaso *et al.*, 2005).

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Infected fillets are rejected and can increase production costs. As a result, there is a great threat to the fish industry causing a fall in production and fish infected by some parasites such as *Eustrongylides, Contraceacum, Anguillicola, Philometra, Skrjabillanus,* and *Anisakis* could be unsuitable for human consumption and raising a lot of public health concerns, particularly in regions where raw or smoked fish are eaten. Thus, epidemiological studies are necessary for adapting the management techniques and providing sanitary guidelines. In addition, these data in fish wild environment are important for using of appropriate methods to fight against these pathogens, especially in fish farming.

To date, few studies have been conducted on fsh parasites of Cichlidae, includig *Oreochromis niloticus* in west African countries. These include among other things, studies carried out by Ashade *et al*. (2010), by Olagbemide and Owolabi (2022) in Nigeria and by Abiyu *et al*. (2023) in Ethiopia. In Côte d'Ivoire, there are no studies on the variation of the parasitic indices of nematodes of this fish in the Agneby River, where different anthropogenic pressures are exerted. These activities degrade the water quality, thus promoting massive fish infestation. In addition, *Oreochromis niloticus* fish which was a very popular fish among riparian populations because of its large market size and its frequency in the catches is subject to rejection due to its weight loss. Therefore, this study aimed to provide valuable information on the parasitic index and associated risk factors of internal nematode parasites of *Oreochromis niloticus* fish species harvested from Agneby River by local fisherman.

MATERIALS AND METHODS

Study area

The Agneby River basin (Figure-1) is a coastal river basin located in the south-east of Côte d'Ivoire. It is located between the watershed of the Bandama and Comoe Rivers. This River is situated between 3°50′ and 4°41′ W longitude and between 5°10′ and 6°08′ N latitude (Goula *et al*., 2009). It has an elongated shape and from downstream to upstream, the altitudes encountered are variable and the highest are above 450 m. Located in the forest zone, the watershed experiences recurrent flooding that impacts homes, roads and fields. The Agneby River rises in the vicinity of the village of Agoua in the department of Bongouanou, where it is called Agbo at an altitude of 250 m, and flows into the Ebrie Lagoon some 30 km west of Abidjan under the name Agneby. This River also shows signs of eutrophication and the water body is invaded by aquatic plants, particularly *Eicchornia crassipes*. Its course is entirely under forest type vegetation. Plantations of coffee, cocoa, banana and oil palm are developped around this River. According to Savané & Konaré (2010), this river basin is entirely in an area with a four-season wet equatorial climate: two rainy seasons and two dry seasons. The high season of rains covers the period from April to July. The short rainy season extends from October to November, interspersed by the small dry season that covers the period from August to September and the long dry season from December to March

In this study, two stations namely Agneby-Agboville and Agneby-village were selected. The Agneby-Agboville station is located between 5°30′ North latitude and 5°40' North latitude and 4°03'West longitude and 4°12'West longitude. Its is characterized by a substrate composed of a mixture of clay, mud, and foliage. The canopy is almost non-existent except in a few places on the border. The river is constantly receiving waste water and garbage from the said city. Furthermore, the Agneby-village station is situated between 5°19′ North latitude and 5°22' North latitude and 4°20'West longitude and 4°29'West longitude. This station is characterized by a type of swamp forest, with mangroves and bamboo. In addition to fishing, this water is used for household activities (washing up, laundry) and for domestic waste (waste water, garbage, faeces).

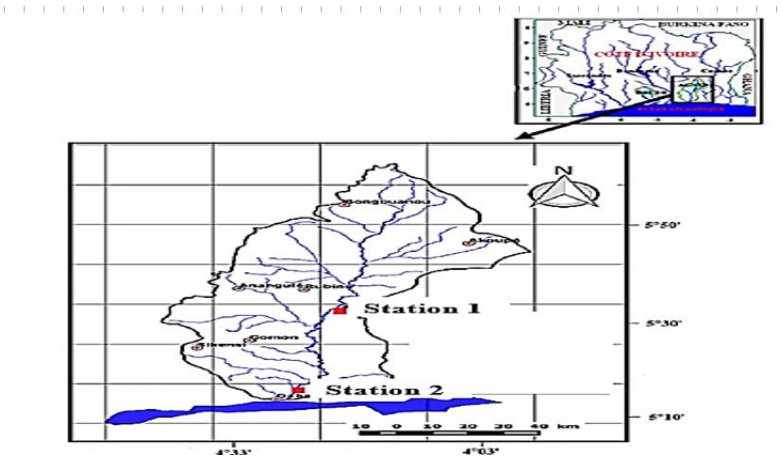

Figure 1. The Agneby River basin.

Sampling fish

The fish sample was collected from local fishermen between February 2023 and March 2024. These fishermen had harvested using different mesh size gill net from the Agneby River. The fish samples were identified to the species level using taxonomic keys of Teugels and Thys van den Audernaerde (2003). Four hundred and fifty *Oreochromis niloticus* specimen fish were collected. All samples of fish were evaluated visually and postmortem examination was done using appropriate postmortem kits using standard evisceration technique previously described by Zhokhov (2007). The gastrointestinal tract of individual fish specimens was dissected from the anus to the lower jaw using a pair of dissecting scissors. The organs such as stomach, intestine, liver, heart, gallbladder and gonads were removed and placed in individual sampling bottle and 5% of formalin was added. The sample was immediately transported to Laboratory.

Determination of length, weight and sex

Once identified after capture, the fish sampled were measured using an ichthyometer and were weighted with an electronic scale. Four different length classes of 50 mm amplitude (class I: SL ranged between 50 and 100 mm; class II: SL ranged between 100 and 150 mm; class III: SL ranged between 150 and 200 mm and class IV: SL ranged between 200 and 250 mm). The fish sex was determined by looking at in the male the presence of genital papillae located on the ventral side, just before the anal fin through which both milt and urine pass. In the female one, there is an oviduct and a urinary pore. This was later confirmed by the presence and absence of testes and ovaries which was observed during dissection.

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Parasitological examination

The external surface of each organ and body cavity of the fish was examined. The nematodes were collected after opening of fish digestive tract. All the collected parasites were preserved in 70% ethanol and fixed in glycerin for further identification. Nematodes species were identified following keys of Amlacher *et al.* (1971) and Pouder *et al.* (2005). Prevalence, mean intensity and abundance were defined according to Bush *et al.* (1997).

Fulton's condition factor (K)

The Fulton's condition factor (K) assumes that the weight of the fish is proportional to the cube of the lenght and was used to assess the general health of the fishes, on individual and population level. Thus, with the weight and total length data, the relative condition factor (Kn) of the parasitized and non-parasitized fish was determined. Fulton's condition factor (K) was calcilated using the formula of Le Cren (1951) :

$$Kc = W \times 100/L^3$$

where w= weight of fish (g), L= standard length (mm), b = coefficient of allometry considered equal to 3. The Fulton's condition factor was multiplied with 100 to get it close 1, and the number 1 indicated a normal condition of the fish, greater 1 indicated fat fish and less than 1 indicated skinny fish.

Data analysis

Microsoft Excel 2016 software was used to store the data. In the present study, this test was used to determine the links between parasitism and host size. The relationship that exists between the parasite burden and other tested variables (stations, seasons, size, sex, condition factor) were compared using Chi-square (X^2), Mann-Whitney (U) and Kruskal Wallis (K) tests to assess the significance of the difference. The degree of security for statistical analyses was 95%. The various statistical analyses were performed using STATISTICA version 7.2.

RESULTS AND DISCUSSION

Out of the examined of 450 *Oreochromis niloticus* fish, 270 (60%) were parasitized with internal nematodes. A total of four nematodes species were inventoried from the gastrointestinal tract of this fish. There were *Capillaria pterophylli*, *Camallanus polypteri*, *Eustrongylides sp*. and *Contracaecum sp*. In both stations, fish were infected with the same parasite species. The Table-1 indicates parasitic indices variations noted at the stations of Agneby village and Agneby Agboville. Analysis of the latter indicated that high values for the parasite prevalences of *Capillaria pterophylli* (95.13%), *Camallanus polypteri* (94.25%), *Contracaecum sp.* (45.13%) and *Eustrongylides sp*. (15.04%) were recorded at the Agneby Agboville station. The differences observed between this parasite prevalence were significant (Chi Square test, $p < 0.05$) in both study areas. The corresponding average intensities of these parasite species were respectively 8.2±0.5 parasites by infested host; then 7.2±1.3 parasites by infested host, then 4.5±1.5 parasites by infested host and at least 2± 0.8 parasite by infested host. The Mann-Whitney test applied to intensities revealed that fish sampled at the Agneby Agboville station were the most infested with parasitic nematodes ($p < 0.05$). The variation in epidemiological indices of parasitic nematode species collected from the digestive tract of *Oreochromis niloticus* caught at the Agneby Agboville and Agneby Village stations of the Agneby River is represented by Figures-2 and 3. Analysis of these figures indicates that the highest prevalence values and mean parasitic intensities for each nematode species were recorded during the rainy season. Statistical tests performed (Chi-square test, Mann-Whitney test, $p < 0.05$) indicated that fish were most parasitized during this season.

Table1. Prevalences and mean intensities of *Oreochromis niloticus* parasitic nematode species sampled in Agneby Agboville and Agneby village stations.

Stations	Parasite species	Number of fish examined	Number of fish infested	Number of parasite individuals	P	IM
Agneby Agboville	*Capillaria pterophylli*	226	215	1763	95.13	8.2±0.5
	Camallanus polypteri	226	213	1534	94.25	7.2±1.3
	Contracaecum sp	226	102	459	45.13	4.5±1.5
	Eustrongylides sp	226	34	68	15.04	2±0.8
Agneby village	*Capillaria pterophylli*	224	90	369	40.18	4.1±0.3
	Camallanus polypteri	224	85	298	37.95	3.5±0.1
	Contracaecum sp	224	34	71	15.18	2.09±1.4
	Eustrongylides sp	224	18	18	8.03	1±0.01

P=Prevalence, IM= Mean intensity

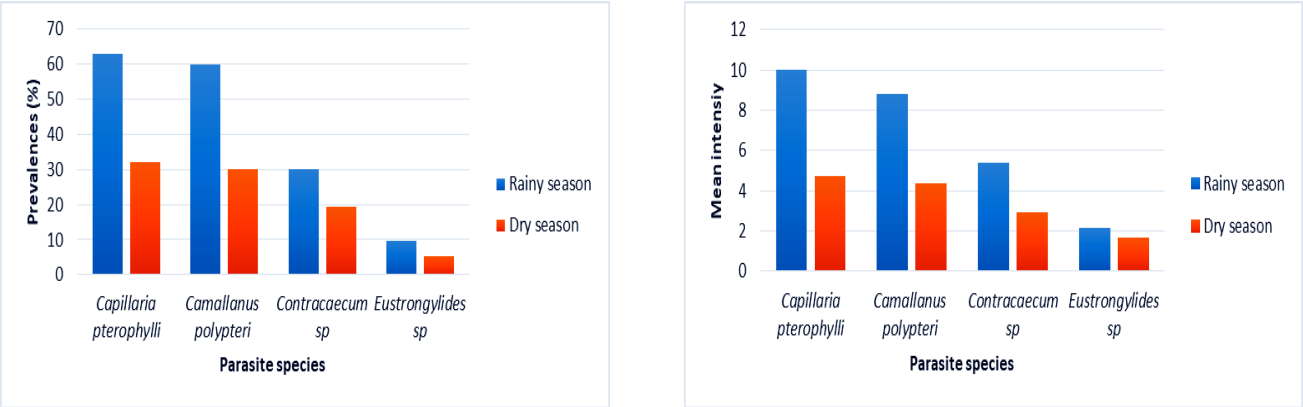

Figure 2. Prevalences and mean intensities of parasitic nematodes from *Oreochromis niloticus* sampled in Agneby Agboville station according to seasons.

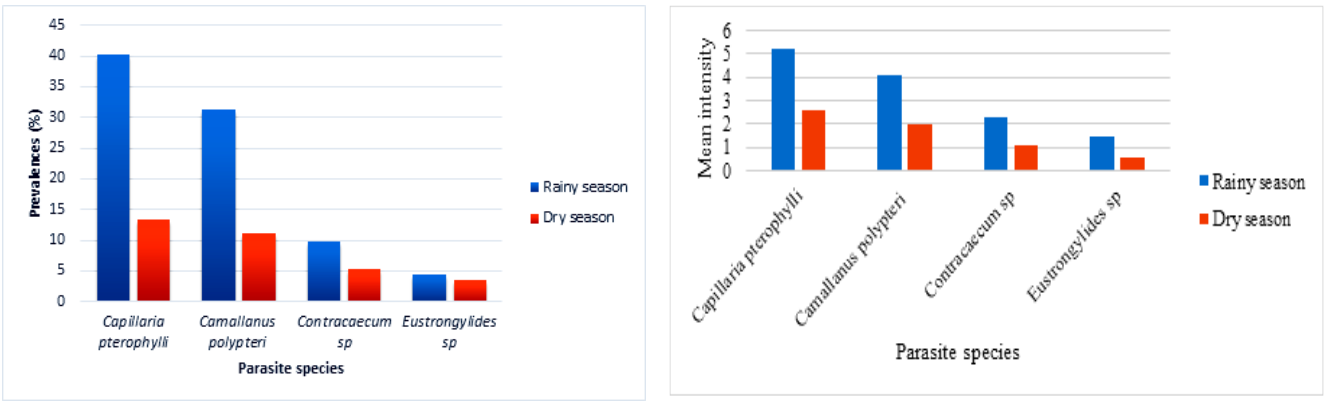

Figure 3. Prevalences and mean intensities of parasitic nematodes from *Oreochromis niloticus* sampled in Agneby village station according to seasons.

The parasitic indices evaluation as a function of the fish size sampled in the Agneby Agboville and Agneby village stations is presented (Figures-4 and 5). At the Agneby Agboville station, these figures reveal that all the three first size classes of fish were infested with *Capillaria pterophylli*, *Camallanus polypteri* and *Contracaecum sp*. The lowest prevalence values for these nematodes were found in smaller fish ([50-100[) while the highest prevalence values were found in larger individuals ([200-250]). The minimum and maximum recorded prevalence values are 54% and 100% for *C. pterophylli*, 42.1% and 84.5% for *Camallanus polypteri* then 25.8% and 50.4% for *Contracaecum sp.* Only the last size classes of fish have hosted the nematode *Eustrongylides sp*. and the maximum

prevalence values obtained is 27.6%. The Chi Square test performed on the prevalence of these nematodes that infest different size classes of *Oreochromis niloticus* fish indicated a statistically significant difference ($p< 0.05$). In this station, the respective minimum and maximum mean intensities obtained of *Capillaria pterophylli* (2 ±0.2 and 8.3 ±2.1), of *Camallanus polypteri* (1.3±0.4 and 6.8±1.9), of *Contracaecum sp* (1.1±0.5 and 3.3±0.7) and of *Eustrongylides sp* (1.1±0.3 and 2.5±0.6) were found in the largest fish. The application of the Kruskal-Wallis (k) tests followed by the post-hoc test indicated that the largest *Oreochromis niloticus* fish have more parasitic nematodes ($p < 0.05$). In the Agneby village station, the parasitic indices variation according to fish size classes is the same as previously. The minimum and maximum prevalence values obtained are 26.3% and 64.3% for *C. pterophylli*, 18.5% and 49.5% for *C. polypteri* and 12.4% and 37.4% for *Contracaecum sp*. then 0 and 15.4% for *Eustrongylides sp*. There was a statistically significant difference ($p<0.05$) between the prevalence of nematodes infesting hosts of different size classes. The minimum and maximum mean intensities noted of *C. pterophylli* (1.4±2.1 and 4.1±0.2), of *C. polypteri* (1.1±0.2 and 3.6±1.3), of *Contracaecum sp* (1.8±1.1 and 1.5± 0.1) and of *Eustrongylides sp* (0 and 1.3 ±0.1) in the largest fish. The application of the Kruskal-Wallis (k) tests followed by the post-hoc on parasite intensity values revealed that the largest *Oreochromis niloticus* fish were the most infested with parasitic nematodes ($p < 0.05$).

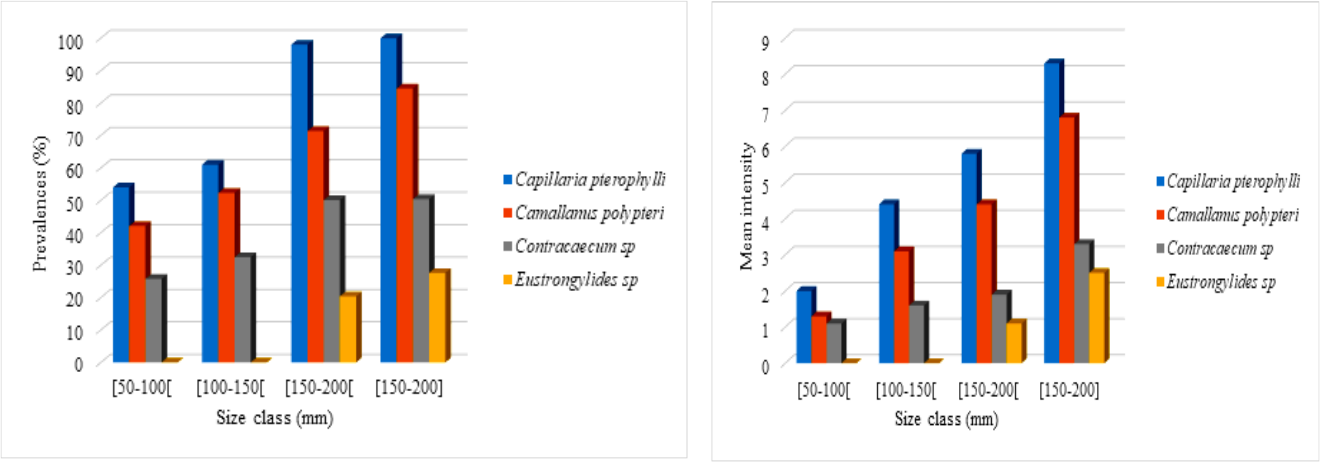

Figure 4. Prevalences and mean intensities of parasitic nematodes according to the size of *Oreochromis niloticus* sampled in Agneby Agboville station.

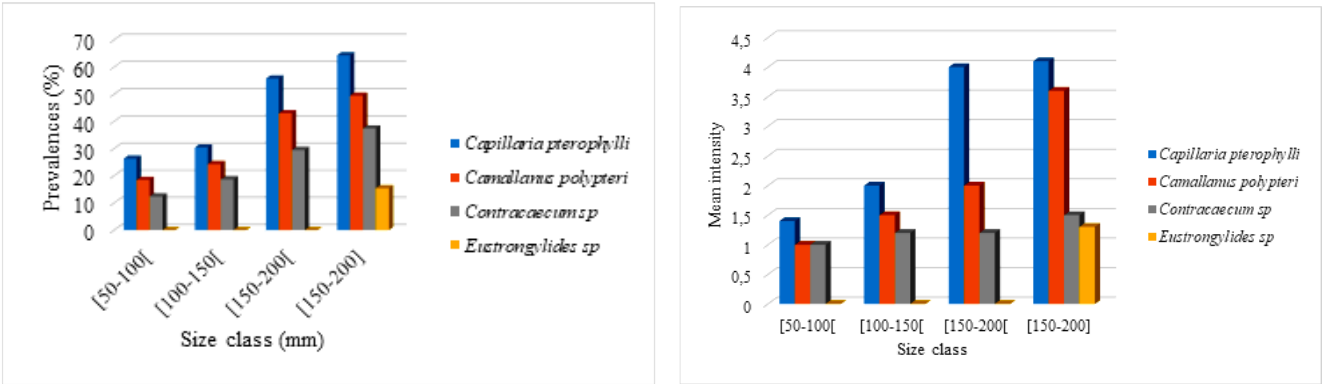

Figure 5. Prevalences and mean intensities of parasitic nematodes according to the size of *Oreochromis niloticus* sampled in Agneby village station.

The parasitism study in relation to the host sex in Agnéby Agboville and Agnéby village stations is illustrated by Figures-6 and 7. In the Agneby Agboville station, the maximum prevalence values 98.2% for *Capillaria pterophylli* and 86.3% for *Camallanus polypteri* were noted in male fish while 27.22% and 15% of female fish were infested respectvively by *Contracaecum sp* and *Eustrongylides sp*. Therefore, host species of male sex were more parasitized by *C. pterophylli* (and *C. polypteri* and those of female sex by *Contracaecum sp* and *Eustrongylides sp*. (Chi Square test, $p< 0.05$). The respective mean intensities of these nematodes *C. pterophylli* (7.5 ±0.1) and *C. polypteri* (5.8 ±0.3) were noted in male hosts, while those of *Contracaecum sp* (2.9 ±0.2) and of *Eustrongylides sp.* (2.7 ±1.3) in female hosts. The Mann-Whitney test indicated that male fish harbored more *Capillaria pterophylli* and *Camallanus polypteri* species and female fish was the most infested by *Contracaecum sp* and by *Eustrongylides sp*. In the Agneby village station, maximum prevalences of 71% and 54% were obtained respectively for the species *Capillaria pterophylli* and *Camallanus polypteri* in male fish while 16% and 7.6% of female hosts were infested with *Contracaecum sp*. and *Eustrongylides sp.* The Chi Square test ($p < 0.05$) revealed that host species of male sex were the most infested by *C. pterophylli* and by *C. polypteri* and those of female sex harbored more nematodes *Contracaecum sp*. and *Eustrongylides sp*. The corresponding average intensities of the nematodes *C. pterophylli* (3.4± 0.2) and *C. polypteri* (2.7± 0.1) were obtained in male hosts while those of *Contracaecum sp* (2± 0.2) and of *Eustrongylides sp* (0.14± 0.2) were noted in female hosts. Male fish were the most parasitized by *C. pterophylli* and by *C. polypteri*, and female fish harbored more *Contracaecum sp.* et *Eustrongylides sp* (Mann-Whitney test, $p<0.05$).

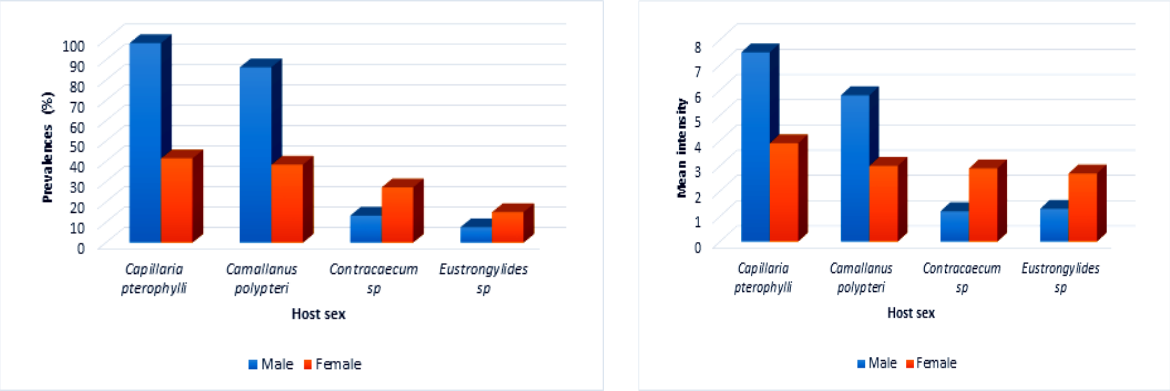

Figure 6. Prevalences and mean intensities of parasitic nematodes according to the sex of *Oreochromis niloticus* sampled in Agneby Agboville station.

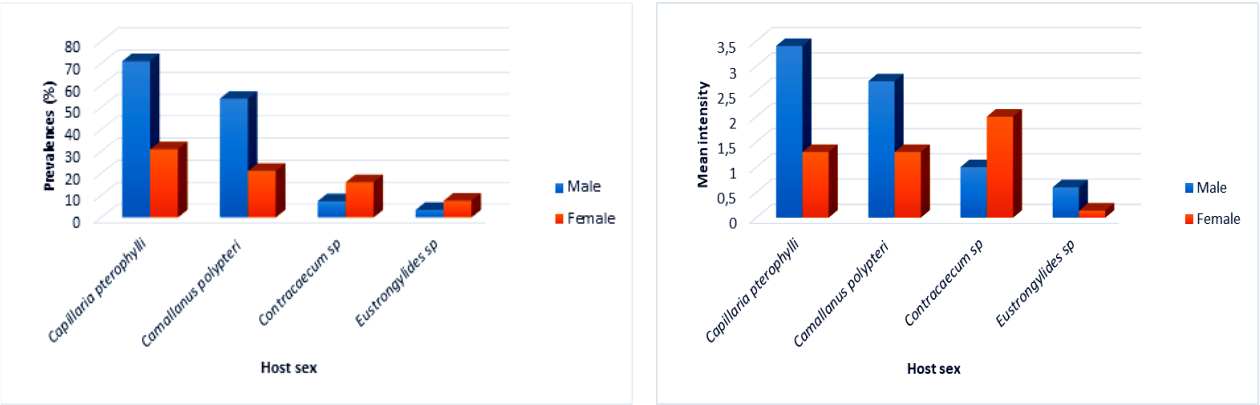

Figure 7. Prevalences and mean intensities of parasitic nematodes according to the sex of *Oreochromis niloticus* sampled in Agneby village station.

Table 2. Fulton condition factor (K) (g/cm^3) of infested and uninfested by nematode parasites of *Oreochromis niloticus*

Stations	Status	Number	Total lenght (cm)	Weight (g)	Facteur de condition (Kc) (g/cm^3)	Valeur de *p*
Agneby Agboville	Fish examined	226				
	Fish infested	215	18.5	20.89	0.33±0.4	0.004
	Fish uninfested	11	16.5	36.83	0.82±0.3	
Agneby village	Fish examined	224				
	Fish infested	90	18.5	31.65	0.5±0.1	0.03
	Fish uninfested	134	16.5	39.53	0.88±0.5	

Table-2 presents the condition factor (K) average values for infested and uninfested fish at the Agneby Agboville and Agneby Village stations. In both stations, the condition factor values remained below 1. At the Agneby Agboville station, the condition factor average obtained is 0.82±0.3 for uninfested fish and 0.33±0.4 for infested fish. The Mann-Whitney U test revealed a statistically significant difference between these values **(***p* < 0.05). At the Agneby Village station, the condition factor average was 0.88±0.5 for uninfested fish and 0.5±0.1 for infested fish. A significant difference was also observed between the condition factor average of both fish species (*p* < 0.05).

The number of parasitic nematode species (*Capillaria pterophylli, Camallanus polypteri Contracaecum sp*. and *Eustrongylides sp*.) observed in this study was slightly higher than three species (*Contracaecum sp*, *Eustrongylides sp* and Camallanus *sp*.) reported by Abiyu *et al*. (2020) in Ethiopia, but slightly lower than five species recorded by Ashade *et al.* (2010) then by Olagbemide & Owolabi (2022) on the same fish species in Nigeria. Therefore, parasite number appeared to vary from one locality to the other and this could be due to factors such as endemicity, availability of intermediate hosts and susceptibility of host to infection. In addition, the difference in parasite species number observed in the fish from the Agneby River could be due also to the differences in physico-chemical parameters expressed in water quality indices in this River. Indeed, the absence of proper waste disposal and management system in which the fishes were processed and the waste and feacal matters close to the environment which is subsequently washed into the river thus providing environmental pollution's which is suitable conditions for parasites to thrive.

The nematode *Capillaria pterophylli* is a nematode known to parasitize various vertebrates, including fish, birds, and mammals. The high presence of this parasite can be explained by its mode of transmission, namely direct and indirect transmission. In direct transmission, fish become infected by ingesting embryonated eggs present in the water, substrate, or on contaminated food. In the case of indirect transmission, fish become infected by consuming an intermediate host, such as small aquatic invertebrates that have ingested the infectious eggs. As for *Camallanus polypteri*, it is a parasitic nematode that mainly infests freshwater fish, particularly polypteridae (*Polypterus spp.*) and other aquarium fish species. This parasite colonizes the host's intestine, where it attaches to the intestinal wall using a specialized mouth structure. The high prevalence and mean intensity values of these parasitic nematode species, obtained in the present study, suggest that the physicochemical parameters of the Agneby River waters, as well as the presence of intermediate hosts, favor their proliferation and multiplication. Concerning *Contracaecum sp*, it is a parasitic nematode (roundworms) that primarily infest fish but can also be found in other vertebrates, including birds, which are often the definitive hosts. These nematodes are typically found in the gastrointestinal tract of their hosts, where they complete their life cycle.The presence of *contracecum* sp. was attributed to the fact that this parasite has and infests wide range of final and intermediate hosts such as fish-eating birds (cormorants and pelicans) and larval stages are seen in cyprinds (carp and related species), channel catfish and tilapia (Yanong, 2002 ; Yimer, 2000) on the other han, since *Contracaecum* spp. in tilapia fish may be a parasite of wild fish more than farmed fish. Its presence could be due to its life cycle that involves migratory bird species (e.g. cormorants). Similar results were found by Blahoua *et al*. (2020) on the parasitic nematodes of *Oreochromis niloticus* fish in Lake Ayamé I in Côte d'Ivoire and by Abiyu *et al*. (2020) in Lake Tana in Ethiopia. Many studies have shown that *Contracaecum* sp. is found in fish in the larvae form in the abdominal cavity (Barson & Avenant-Oldewage, 2006; Gulelat *et al.*, 2013). The fact that *Contracaecum sp* had been recorded from several fish species from water bodies made it a cosmopolitan parasite of fish-eating birds and mammals. In this study, another reason for explaining the presence of *Contracaecum sp* is the fact that an adaptation that probably ensures that the larvae survive to reach the final host without killing the intermediate host. Paperna (1996) urges aquaculturists to control aquatic birds on fishponds as an effective means of reducing *Contracaecum* infection. As for *Eustrongylides* sp, it is a parasitic nematode that primarily infects fish, piscivorous birds, and, in some cases, mammals, including humans. The life cycle of the *Eustrongylides* nematode is indirect, involving multiple

intermediate hosts. The low infestation of this fish by this nematode in the study area suggests that the intermediate hosts of this parasite do not find ideal conditions there.

The spatial distribution of parasitic nematodes in *Oreochromis niloticus* fish indicated that the fish sampled at the Agneby Agboville station were the most parasitized. The high infestation of fish at this station could be due to the physicochemical characteristics of this environment. Indeed, this river, which flows through the Agboville town, constantly receives wastewater and household waste from the town. As a result, the water quality in this station is significantly degraded, leading to immunosuppression in fish, which could be the cause of the increased number of parasites (Sorensen & Weber, 1995). These results corroborate the assertion of Adewole *et al.* (2018) and Olagbemide & Owolabi (2022) that parasitic nematodes, being bioindicators, have their abundance linked to the level of pollution or degradation of the environment.

The relatively higher parasites prevalence values and the mean intensity in the rainy season when compared with those of the dry season was likely due to the poorer water quality. Indeed, during this period, located near fields intensively treated with plant protection products, this River receives the water from these plant protection products and domestic wastewater from the city and surrounding villages. The water quality of this River is therefore severely degraded containing various types of pollutants, making aquatic organisms in general and fish species in particular vulnerable to high levels of parasitic infestation. Similar result has been found by Olagbemide & Owolabi (2022) with parasites of the same fish species in Ekiti State dam in Nigeria. Thus, our results support the assertion that increase parasitism in aquatic biota especially fish may be promoted by pollutants as suggested by Oros & Hanzelova (2009). Fish were more infested during the rainy seasons because, at this period, the different vegetation around the river provides ideal conditions for the propagation of intermediary hosts, fish-eating birds and the snails, thus promoting fish infestation. Seasonal variation in the occurrence of parasites in this study may be also attributed to the age of the host and the life cycle of the parasite

The present study revealed that Larger hosts (in lenght and in weight) harbored more parasite burden than smaller ones. This finding is in consistency with those of Allumma & Idowu (2011), Amaechi (2015) and Bichi & Ibrahim (2009) who stated that larger fishes were heavily parasitized than the smaller ones. The reason for the higher infection rate in larger or bigger hosts could be due to the longer duration of time those fish were exposed to the agents in the environment in search of food than the smaller ones. This increases their chances of acquiring the parasite infection with time. Another reason was the ability of larger fish to offer larger outward area used for infection in comparison to smaller fish as suggested by authors such as Bichi & Ibrahim (2009), Allumma & Idowu (2011) and Akoll *et al*. (2012). Thus, higher prevalence and intensity in larger hosts might be due to the accumulation of the worms over a longer period and their larger size which tend to be too big for the piscivorous bird, which will feed on small sized fish. According to Paperna (1996) and Marcogliese (2002), high infestation observed in larger fish could due to their ontogenetic habitat and feeding shifts. However, Biu & Nkechi (2013)*;* and Biu *et al*. (2014) found that the smaller fish were more diseased in comparison to the larger ones. They attributed it to the reality that smaller fish have less resistance contrary to parasitic infestation.

The results indicated that female fish recorded highly infected with parasites than male fish. This finding is similar than those of Abiyu *et al.* (2020) obtained with the nematode parasite of Nile tilapia *Oreochromis niloticus* fish species caught from lake Tana in Ethiopie. The difference in the infection rate of male and female fish recorded in these studies could be attributed to genetic predisposition and differential susceptibility owing to the difference of their physiological condition. Indeed, female fish especially gravid ones are susceptible to helminth infections as this physiological state could reduce the resistance of the fish to infection by the parasites as mentionned by Akinsanya *et al*. (2009). However, this study also presents in contrast with most researchers which have reported that male fish are usually more infected than female (Aloo, 2002 ; Olurin *et al.*, 2012).

This study indicated that the condition factor of infested fish remained lower than that of non-infested fish in the stations of the Agneby River. This would mean that these parasites had an impact on the body condition of this fish in these environments. These findings confirm the assertion of Akinsanya & Otubanjo (2006), who stated that these parasites have a significant effect on fish health, growth, weight loss, and fertility. Furthermore, parasitic infestations increase the hosts' susceptibility to diseases. The condition factor of uninfested fish was lower than 1, indicating that they were in poor physiological condition due to various environmental stress factors exerted on them in their habitat.

CONCLUSION

This study identified four species of nematodes (*Capillaria pterophylli*, *Camallanus polypteri*, *Contracaecum* sp. and *Eustrongylides* sp.) in gastrointestinal tract of *Oreochromis niloticus* fish. Two of these species, *Contracaecum* sp. and *Eustrongylides* sp., are of zoonotic importance. Moreover, the study revealed that the infestation of this fish varies depending on the study locations and the seasons of the year. The size and sex of the fish influence parasitic nematode infestation. These parasites also had an impact on the body condition of the fish in the study area. These informations may provide strategies in aquaculture management to reduce potential economic losses in fry nile tilapia production caused by parasitic infestation.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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