

Prevalence of Internal Parasitic Helminthes Infected *Oreochromis niloticus* (Nile Tilapia), *Clarias gariepinus* (African Catfish) and *Cyprinus carpio* (Common Carp) in Lake Lugo (Hayke), Northeast Ethiopia

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Abstract

An investigation was conducted from November, 2010 and August, 2011 in Lake Lugo (Hayke), northeast Ethiopia, with the aim of determining the prevalence and identifying the species of internal parasites from freshwater fish. A total of 412 randomly selected fishes comprising of 225 *Oreochromis niloticus*, 72 *Clarias gariepinus* and 115 *Cyprinus carpio* were examined for internal helminthes parasites. An overall prevalence of 47.8% (197/412) internal parasitic infestation was assessed. Statistically significant difference at $p < 0.05$ was noted in the prevalence of internal parasites among the different species, length and weight of fish. However, the difference between sexes was not statistically significant at $p > 0.05$, but the prevalence was a bit higher in females (48.31%) than males (47.44%). Prevalence of internal parasites was higher in *Clarias gariepinus* (91.7%) followed by *Oreochromis niloticus* (50.22%), and *Cyprinus carpio* (15.6%) species. Six parasite species: three nematodes (*Contracecum* spp., *Camallanus* spp., *Eustrongylides* spp.); one trematode (*Clinostomum* spp.) and two cestodes (*Ligula intestinalis*, *Proteocephalus* spp.) were identified from the body cavities and gastrointestinal tracts of fishes. In conclusion, the prevalence of internal parasitic infestations was very high and the study determined six parasitic species present in fish, which were not previously examined in this Lake.

Keywords: Ethiopia; Fish; Lake Lugo; Internal Parasites; Prevalence

Introduction

As a landlocked country following the secession of Eritrea in 1993, fisheries in Ethiopia come exclusively from inland sources. In 2008, fish catch was estimated at around 17,000 tons (accounting for about 1.7% of the regional volumes), the bulk of which (74%) originating from the six main lakes (Tana, Ziway, Langan, Hawassa, Abaya and Chamo) and a further 26% from the other water bodies. The countries fish potential is estimated at 45,000–51,500 tons per year, according to several sources. Thus, less than 38% of this potential is currently exploited, demonstrating considerable room for further expansion through proper management. The construction of new reservoirs, under-exploited river fisheries and aquaculture are some of the development prospects to this end [1]. Aquaculture is recognized as an alternative means of achieving food security and poverty reduction in the rural area, and is now considered an integral part of rural and agricultural development policies and strategies in Ethiopia. However, much remains to build institutional capacity in the areas of research, technology and training, which will requires external assistance [2].

A hundred local fish species have been identified, while the bulk of the production is made of Tilapia, Lates, Barbus, Bagrus, Clarias and Labeo species. Approximately 80% of the catch is Tilapia, although Nile perch is caught in large quantities on Lakes Chamo and Abaya, as well as in major riverine fisheries. Most of the remainder of the lake catches consists of catfish and Barbus [1].

Lake Lugo (Hayke) provides a habitat to different fish species, water birds and aquatic organisms. The fish production potential of the Lugo Lake is estimated as 400 ton/year, and the off take rate is 83% as reported by FDRE (Federal Democratic Republic of Ethiopia) [3].

In both natural environments and in culture, disease has a serious impact on fish. Disease is universally recognized as one of the most serious threats to the commercial success of aquaculture [4]. Parasitic diseases of fish are among these diseases which has great economic and

public health importance particularly in the tropics [5]. In many cases, they have proved to be a serious problem causing economic losses in the fishing industry and in aquaculture. In fish farming, parasites may lead to epidemics and mortalities, and as the culture of fish becomes more intensive and widely spread, fish parasites infection will be more liable to become more serious economic and health issues [6].

Knowledge of the parasites of fish has accumulated in many parts of the world especially in Europe, Russia and USA, but such comparative studies in Africa have been lacking until recently. Research commitments to the study of parasites of fresh water and marine fishes of the African continent have been sporadic and inadequate considering the fish wealth of the continent. This has been attributed to the lack of laboratory equipment, skilled man power, lack of public awareness on the fish production and health, library facilities [7,8]. Regarding the diseases of fish in general and parasitic diseases in particular, in Ethiopia information is scant and inadequate except for few researches which have not been well documented, hitherto, no any research have been conducted in Lake Lugo (Hayke).

Therefore, the objective of this research was to determine the prevalence of internal parasites and to assess the predisposing factors associated with the occurrence of these parasites in Lugo Lake.

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Materials and Methods

Study area

The study was conducted on one of the high land Lakes of Ethiopia; Lake Lugo (Hayke) which is located in South Wollo Zone, Northeast Ethiopia. It is located 440 km north of Addis Ababa, situated at 11°15'N latitude, 39°05'E longitudes, and at an altitude of 2030 m.a.s.l. [9]. The study area is categorized as sub-humid tropical with an annual rainfall of 1173 mm and a mean temperature of 18.2°C. The major rainy season is from July to September.

Lugo Lake has an area of 23km² and a maximum depth of 88.2 m and mean depth of 37.37m [10]. The Lake has no visible outlet and the water is described as clear and greenish. Lake Lugo (Hayke) provides a habitat to different fish species, water birds and aquatic organisms. It also plays an economical role via tourism and fishery. The fishes that inhabit Lake Lugo are *Oreochromis niloticus* (Nile Tilapia), *Clarias gariepinus* (African catfish), and *Cyprinus carpio* (Common carp) [7].

Study design, sample size determination and study animals

Cross sectional study design was used to determine and to identify the prevalent parasitic species on randomly selected three species of fish, namely *Oreochromis niloticus*, *Clarias gariepinus* and *Cyprinus carpio*, which were purchased from fishermen around the lake.

The sample size required for this study was determined based on the expected prevalence of internal parasitic infestation and desired absolute precision according to Thrusfield [11]. Since, there was no previous research done in this area, 50% expected prevalence, 95% confidence interval and 5% precision were used to estimate the sample size. Hence, a minimum of 384 fishes were considered in this study.

Sample collection, Sampling and Examination of specimens for Parasites: 412 randomly selected fresh specimens of 225 *Oreochromis niloticus*, 72 *Clarias gariepinus* and 115 *Cyprinus carpio* recovered by local fishermen were purchased and transported to the laboratory in cool boxes for parasitological examination. The total length (standard length) and weight of each fish were measured and recorded following the procedures described by Paperna [5] and specimens were sexed by examination of the anal fin and gonads. The fishes were categorized into four groups based on their weight to determine their age groups. Fish weighing 0.08-0.1 kg were classified as the fingerlings, 0.11-0.2 kg as juvenile, 0.21-0.3 kg as young and >0.31 kg as adult fish [12]. The average length of fish measured 12.26 cm and average weight was 112.27 gm. The maximum and minimum fish lengths measured were 8 cm and 50 cm and the maximum and minimum weight were 70 gm and 1800 gm, respectively.

According to the methods described by Noga [4] and Marcogliese [13], the fishes were opened dorso-ventrally examined and processed for the presence of internal parasites. The body cavity and visceral surfaces, the gonads, liver, heart and gall bladder were examined for parasites. The viscera and gill filaments were kept on petridishes and bathed with the physiological saline solution (0.7% NaCl solution) for parasites recovery. The organs such as stomach and intestine were opened for the examination of parasites. All the collected parasites were fixed in glycerine for further identification.

Identification of parasites

The helminthic parasites were identified morphologically and parasitologically using standard identification keys and pictorial guides [14-18].

Data analysis

Data were analyzed using SPSS version 17. Descriptive statistics and Chi-square was employed to significant differences between among fish species, sex, age, length and weight.

Pearson's correlation test was also employed to assess the association between the different variables of age, length and weight in relation to the occurrence of internal parasites. In all the analyses, confidence level was at 95% and $p < 0.05$ was set for significance.

Results

Out of the 412 sampled fish, 197 (47.8%) were found infested with internal parasites. Prevalence of 50.22%, 91.7% and 15.6%, were recorded from *Oreochromis niloticus*, *Clarias gariepinus* and *Cyprinus carpio* species, respectively, and the difference between species were found statistically significant at $p < 0.05$ (Table 1). As indicated in Table 1 females had higher prevalence of helminthes infection (48.31%) than their male counterparts (47.4%), but the difference between sexes was not statistically significant body at $P > 0.05$. The prevalence of internal parasites was also evaluated based on different body length and weight (age) categories. Hence, prevalence of 51.97%, 46.9%, 4.6% and 57.53% were recorded from 8-12 cm, 13-17 cm, 18-24 cm and ≥ 25 cm length categories, respectively and the difference was found statistically significant at $P < 0.05$. Similarly, prevalence of 45.36%, 59.72%, 32.78% and 54.11% were observed from fingerlings (70-100 g), juvenile (110-200 g), young (210-300 g) and adult (≥ 300 g), respectively. Likewise the difference between weight categories were also found statistically significant at $P < 0.05$ (Table 1).

In this study, six parasites namely *Contracecum* spp. (nematoda), *Clinostomum* spp. (trematoda), *Camallanus* spp. (nematoda), *Eustrongylides* spp. (nematoda), *Ligula intestinalis* (cestoda) and *Proteocephalus* spp. (cestoda) belonging to different taxonomic groups were recovered from 197 positive sampled fish.

The frequency distribution of internal parasites among the three fish species (*Oreochromis*, *Clarias* and *Cyprinus* spp.) is presented in Table 2. *Contracecum* (42.6%) were the most frequently found parasite followed by *Clinostomum* (38.6%), *Camallanus* (7.8%), *Ligula intestinalis* (5.2%), *Proteocephalus* (3.1%) and *Eustrongylides* (2.7%), from different sites of the fish body. The highest number of parasites were recovered from *Oreochromis niloticus* 324 (61.95%), *Clarias gariepinus* 172 (32.9%), and *Cyprinus carpio* 27 (5.15%) as shown in Table 1.

The frequency distribution of each parasite with respect to the studied fish species has shown that *Contracecum* was recovered with prevalence rate of 47 (20.9%), 56 (77.8%), and 0 (0%) from *Oreochromis niloticus*, *Clarias gariepinus* and *Cyprinus carpio*, respectively; *Clinostomum* 76 (33.8%) and *Eustrongylides* 6 (2.7%) was found only from *Oreochromis niloticus*; *Ligula intestinalis* 18 (15.7%) was found only from *Cyprinus carpio*. *Camallanus* 19 (26.4%) and *Proteocephalus* 10 (13.9%) were recovered only from *Clarias gariepinus* as shown in Table 2.

Discussion

In this study, an overall prevalence rate of 47.8% was recorded in *Oreochromis niloticus*, *Clarias gariepinus* and *Cyprinus carpio* species. It was observed that significant difference at $p < 0.05$ was noted in the prevalence of internal parasites among the studied fish species. The prevalence was higher in *Clarias* species followed by *Oreochromis* species and *Cyprinus carpio*. Our prevalence finding is in agreement

Risk factors		No. of fishes examined	No. of fish with parasites (%)	Parasites Burden (%)	χ^2 (P-value)
Species	<i>Oreochromis niloticus</i>	225	113 (50.22)	324(61.95%)	103.686 (0.000)
	<i>Clarias gariepinus</i>	72	66 (91.7)	172(32.9%)	
	<i>Cyprinus carpio</i>	115	18 (15.6)	27 (5.15 %)	
Total		412	197 (47.8)	523 (100%)	
Sex	Female	178	86 (48.31)	350(66.92%)	0.031 (0.860)
	Male	234	111 (47.44)	173(33.08%)	
Total		412	197 (47.8)	523 (100%)	
Length	8–12 cm	127	66 (51.97)	194 (37.1%)	38.546 (0.000)
	13–17 cm	96	45 (46.9)	121(23.13%)	
	18–24 cm	43	2 (4.6)	9 (1.73 %)	
	≥ 25 cm	146	84 (57.53)	199 (38.04%)	
Total		412	197 (47.8)	523 (100 %)	
Weight (age)	70–100 gm (fingerlings)	194	88 (45.36)	240 (45.9%)	11.434 (0.010)
	110–200 gm (juvenile)	72	43 (59.72)	125 (23.9%)	
	210–300 gm (young)	61	20 (32.78)	54 (10.3%)	
	≥ 300 gm (adult)	85	46 (54.11)	104 (19.9%)	
Total		412	197 (47.8)	523 (100%)	

Table 1: Prevalence of internal parasitic helminthes in relation to species, sex, length and weight (ages) of fish in Lake Lugo (Hayke).

Parasite species	Taxonomic group	Number of fish infested (%)			Total parasites distribution (%)	Parasites burden (%)	χ^2 (P-value)
		<i>Oreochromis niloticus</i>	<i>Clarias ariepinus</i>	<i>Cyprinus carpio</i>			
Contracecum	Nematoda	47 (20.9%)	56 (77.8%)	0 (0%)	103 (44.4%)	223 (42.6%)	147.324 (0.000)
Clinostomum	Trematoda	76 (33.8%)	0 (0%)	0 (0%)	76 (32.75%)	202 (38.6%)	77.452 (0.000)
Camallanus	Nematoda	0 (0 %)	19 (26.4)	0 (0%)	19 (8.18%)	41 (7.8%)	94.060 (0.000)
Eustrongylides	Nematoda	6 (2.7%)	0 (0%)	0 (0%)	6 (2.6%)	14 (2.7%)	5.060 (0.08)
Ligula intestinalis	Cestoda	0 (0 %)	0 (0%)	18 (15.7%)	18 (7.75%)	27 (5.2%)	48.611 (0.000)
Proteocephalus	Cestoda	0 (0 %)	10 (13.9%)	0 (0 %)	10 (4.3%)	16 (3.1%)	48.397 (0.000)
Total		129 (55.6%)	85(36.6%)	18(7.8 %)	232 (100%)	523 (100%)	

Table 2: Frequency distribution of internal parasites of *Oreochromis*, *Clarias* and *Cyprinus* species at Lugo Lake.

with the reports of Imam and Dewu, [19] and Bichi and Ibrahim [20] that assessed prevalence rate of 47.6% and 43.4% in *Clarias* and *Tilapia* species, respectively. The findings of this research are higher than Akinsanya et al. [21] who found prevalence rate of 38.7% in *clarias* spp.

The higher prevalence of internal helminth parasites in the present study was ascribed to different factors which include absence of proper waste disposal and management system in which the fishes were processed and the waste (scraps and gastrointestinal contents) was dumped in to the Lake Shoreline, traditional ways of fishing which damaged the phytoplankton or zooplankton of the Lake (feed/weed) that enhanced competition for feed and the use of small sized fish nets which trapped the fingerlings and juveniles and environmental pollutions (climate change) and stress caused from the surrounding loges (hotels) and villagers (farmers) of the lake. However, the overall prevalence of internal parasites in the present study was lower compared to the findings of Olofintoye [22] who reported 60.23% prevalence of parasite; suggesting that the distribution of parasites can be varied from one habitat to the other due to host parasite relationship; abiotic factors like dissolved oxygen, temperature and pH.

Edema et al. [23] reported that some of the factors that enhance

parasitic infection in fishes include reduced oxygen content of water, increase in organic matter in the water, and poor environmental conditions. The difference between sexes was not statistically significant, but the prevalence was a bit higher in females (48.31%) than males (47.4%). This observation correspond to the findings of Imam and Dewu [19], Bichi and Ibrahim [20] and Mhaisen et al. [24], that stated female fishes were generally more liable than males to infestations with cestodes, nematodes and trematodes. This could be due to the difference of their physiological condition of the females especially gravid ones [25] which could have had reduced resistance to infection by the parasites [26]. But, it contradicts with the findings of Akinsanya et al. [21] and Allumma and Idowu [12] regarding to sex who found that male specimens presented a higher rate of internal parasite infestation.

The prevalence of internal parasites was also evaluated based on different length and weight (age) categories. This study revealed a higher parasite infestation in the shortest or small (8-12 cm) and longest or big (≥ 25 cm) size classes, and in the juvenile (110-200 g) and adult (≥ 300g). This finding was almost in agreement with the reports of Allumma and Idowu [12] and, Bichi and Ibrahim [20] who stated that larger

fishes were heavily parasitized than the smaller ones. The intensity and prevalence of parasites infection increased with increasing length, size and age of the fish host. Age and sex were shown to influence the degree of parasite infection [25]. The reason for the higher infection rate in adult and young may be because of the longer duration of time the older fish were exposed to the agents in the environment. This increases their chances of acquiring the parasite infection with time. Similar observation of infection being higher in adult was reported by Roberts [27] who noted that longer fish provide greater surface for infection than smaller fish. Moreover, rationale could be deduced from the fact bigger fishes feed on the smaller ones coupled with their greater body size.

Holden and Reed [26] reported that *Clarias* is one of the best examples of an omnivore. However, a slight difference was observed as compared to the above mentioned researchers findings in that higher prevalence in smallest sized and juveniles in this study. This may be due to the random selection of the specimens and to probable high level of immunity built up in the fish specimens as explained by Akinsanya et al. [21]. Among the organs that were observed only the gills, the stomach and body (abdominal) cavities were found to be infected but, there were no parasites found in intestine. The distribution of the parasites in the gut of fishes could be due to the physiochemical factors operating in the gut, such as nutritional level, pH, osmotic tension and oxygen tension [12].

In this study, six parasites namely *Contracecum* (Nematoda), *Clinostomum* (Trematoda), *Camallanus* (Nematoda), *Eustrongylides* (Nematoda), *Ligula intestinalis* (Cestoda) and *Proteocephalus* (Cestoda) species belonging to different taxonomic groups were recovered from 197 sampled fishes. A total of 523 parasites were identified using standard parasitological techniques. In this regard *Contracecum* (42.6%) were the most frequently found parasite followed by *Clinostomum* (38.6%), *Camallanus* (7.8%), *Ligula intestinalis* (5.2%), *Proteocephalus* spp. (3.1%) and *Eustrongylides* (2.7%). The higher prevalence recorded of *Contracecum* 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 [16]. Epidemiological studies pertaining to parasitic infestations of fish in Ethiopia are sporadic and were not well documented. However, Moa [28] reported prevalence rate of 42.5% *Contracecum* infestation in *Tilapia* species in Lake Tana, Bahir Dar, Ethiopia. *Ligula intestinalis* recovery was also reported by Woinishet [29] with prevalence of 16.5% in *Barbus* spp. in Lake Tana, Bahir Dar, Ethiopia.

When compared with researches done in other African countries, Bichi and Ibrahim [20] found prevalence rate of 21.2% due to *Clinostomum* spp. in *Tilapia* spp. in Northern Nigeria. Edema et al. [23] reported that all species of fish are vulnerable to various parasitic infections depending on the species of fish and the type of stream inhabited. The highest number of parasites was recovered from *Oreochromis niloticus* 61.95%, *Clarias gariepinus* 32.9%, and *Cyprinus carpio* 5.15%. The higher prevalence of parasite in *Oreochromis* and *Clarias* species may be attributed to random sampling of specimens in which the highest sampled and examined species were *Oreochromis* (n=225) and the high rate of parasitic infestation in *Clarias* is due to its habit of eating almost anything (omnivores) [19]. The prevalence of *Contracecum* (20.9%) in *Oreochromis niloticus* (Tilapia) in the present study was lower than that reported by Moa [28] i.e., 42.5% this could be due to the difference in the physiochemical parameters between the Lake Tana and Lake Lugo. However, higher prevalence due to

Contracecum 77.8% was recovered from *Clarias gariepinus* which is associated with the feeding habit of the fish as described by Holden and Reed [26]; but not in *Cyprinus carpio*. *Clinostomum* (33.8%) and *Eustrongylides* (2.7%) were found only from *Oreochromis niloticus*. *Ligula intestinalis* (15.7%) was found only from *Cyprinus carpio*. This finding was in line with the reports of Woinishet [29] who assessed 16.5% prevalence due to *Ligula intestinalis* in *Barbus* spp. regardless of the species difference. *Proteocephalus* spp. recovery in *Clarias* spp. was reported by Khalil [30], Van As and Basson [31] and Akinsanya et al. [21]. This was attributed to the omnivore nature of this fish species.

In the present study, the prevalence of nematodes (53.15%) was found higher followed by trematodes (38.63%) and cestodes (8.22%). The reason for high prevalence of nematodes infestation may be due to the low host specificity of the adult stages of these parasites which makes them capable of infecting different fish genera and species. It may also be because of the availability of the different host required for the completion of the life cycle of these parasites. These host include the piscivorous carnivorous and man as final hosts and gastropod mollusks and fishes as intermediate hosts [16]. The fish may act as intermediate host in some parasites while in others it is the final host.

Single infestations were the predominant cases; but multiple infestations were also common in this study. Multiple infestations were common due to the fact that the environment supports several parasites species thereby exposing the host to simultaneous infection with many of them. The presence of one parasite and its activity within the host weaken the resistance which makes concurrent infection feasible [12].

In conclusion, the results of the present study in Lake Lugo entailed that the importance of internal parasitic infestation as it affects health, palatability, productivity, market and aesthetic value of fish. The prevalence of internal parasitic infestations was very high and the study determined 6 parasitic species present in fish, which were not previously examined parasitologically in this Lake. Thus, the findings of this study are expected to contribute to future studies to protect and develop the ecological potential of Lake Lugo.

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