Prevalence Of Nematode (Contracaecum) And Cestode (Ligula Intestinalis) Parasites Infection In Two Fish Species At Lake Tana

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ABSTRACT: A cross sectional study was conducted from November, 2011-April, 2012 in two species of fish from Southern Gulf of Lake Tana to determine the prevalence of Contracaecum and Ligula intestinalis parasite infecting fish. A total of 400 fish comprising of 200 (49.5%) Tilapia nilotica (Oreochromis niloticus) were caught by gill nets of variable size and 200 (22.5%) small barbus were caught by the help of scup net. Of all fish examined, 161 (40.25%) were found to harbor Contracecum helminth parasite on both fish species. A significantly higher infection was found in Tilapia nilotica fish species ($p<0.05$). There was no significance variation ($p>0.05$) revealed in the occurrence infections between different size categories in both fish species but there was a tendency of increasing infection with body length in large Tilapia nilotica. The study demonstrated that Contracecum from pericardial cavity was the most prevalent nematode with prevalence of (49.5%) and (31%) in Tilapia nilotica and small barbus respectively. Ligula intestinalis was detected only in small barbus fish species and the prevalence is 22.5%. 8 (4.97%) small barbus fish were found to harbor both Ligula intestinalis and Contracaecum helminthes parasite. Even though no statistical significance difference were observed between the two sex groups in each fish species, 64 (39.75%) males and 89(55.28%) female were infected by Contracecum parasites. From results of the study it was concluded that the parasite was found either free and /or encysted in the pericardial cavity. On average of 4 larvae of Contracecum and a maximum of 3 worms of Ligula intestinalis per fish were collected. The observed infection rates are predominantly related on the distribution of piscivorous birds which are more abundant in area where there are high fishing activities and increase number of discarded filleted wastes.

Keywords: Contracaecum, fish, Lake Tana, Ligula intestinalis, prevalence, small barbus Tilapia

1. INTRODUCTION

Fish are the most diverse group of vertebrates occupying a variety of marine and fresh water habitat. They are cold blooded animals, their body temperature varying passively in accordance with the temperature of the surrounding water. Although fish as a group are tolerant of wide range of temperature from just below 0^oc up to 45^oc, individual species generally have preferred optimum, as well as a more restricted temperature range.[6] Fishing industry is an important economic activity that provides food and job opportunity for millions of people. It includes all activities involved in commercial and recreational production of fish and shell fish. Moreover, fish are an excellent source of protein, one of a chief nutrient people need for a good diet. As the world population has grown too fast the demand for food, especially food rich in protein, the fishing industry has increased its annual catch to help meet this demand. Fish represent very important food source for low income population for whom it is the only source of protein.[35] As well, about a third of the world like Africa, several million people depend on fish for their livelihood from fishing, processing, transporting and retailing.[33] Although stress appears to play a considerably larger role in causing disease in fish, they are susceptible to the same type of agents that affects worm blooded animals, including viruses, bacteria, fungi, parasites as well as various non-infectious problems.[19] Fish are particularly important hosts of parasites in aquatic ecosystem, harboring a wide variety of adult and immature forms and acting either as a sole host in a parasitic life cycle or as one in a series of hosts. Some parasites may be responsible for acute, economically important outbreak of disease, since exploited fish or reduce productivity through nutritional effects. Other may be responsible for chronic long term changes in population structure. Some fish parasites are transmissible to humans, and other reduces the market value of fish products by either spoilaging host tissue or reduces the demand for fish as foods.[11] Most individual fish in wild or cultivated population are infested with parasites, but in the great majority of cases no significance harm parasites to ensue. In cultured fish population, on the other hand, parasites often cause serious outbreaks of disease. The number of parasites (burden) necessary to cause harm to a fish vary considerably with the species and size of the host and its health status.[25] Diseases of fish are well known to cause mortality and losses in productivity, both in aquaculture and inland fisheries and also human disease in many areas of the world.[10] Fish parasites are among the organisms which are involved in fish disease and spoil the appearance of fish that result consumer rejection.[21] Probably because Ethiopians generally are not fish consumers, commercial fishing did not develop to any significance, which in turn did not encourage the government to promote systematic studies on the local fish fauna. The commercially most valuable fish species in Ethiopia are Tilapia nilotica (Oreochromis niloticus), Clarias, Lates, Barbus and Bagrus.[30] Larva ascaridoid nematodes and cestode especially of the genera contracaecum and Ligula is invariably found in the visceral cavity of many species of marine fish, the parasite contracaecum has been observed to kill herring fry in aquaria. The first intermediate hosts of the nematodes are crustaceans and the secondary intermediate hosts are the fish. Larval stages of contracaecum species that infect fresh water fish are usually found as adults in fish eating birds, such as chormorants and pelicans.[26] Nematode infection increase with age and length of fish. Thus in contrast to ligula intestinalis, contracaecum nematodes are found in large fish.[34] Only few studies were carried out to estimate the status of disease causing pathogens (mainly parasites) in fish of Ethiopian water bodies and fish culture. This research focuses on assessing the prevalence and mean intensity of parasitic helminthes which affect important fish species of Lake Tana. Therefore, the objectives of this work were:

- To determine the prevalence of helminthes in fish at Lake Tana.
- To identify the common species of helminthes infecting fish species at Lake Tana.

1. LITERATURE REVIEW

1.1. Etiology

The taxonomic hierarchy of nematode is as kingdom animalia-animal, phylum Nemata- nemas, nematodes, roundworms, threadworms, class secementea, order ascaridida, family anisekidae, genus Contracaecum. Identification of larval nematodes, particularly to species level is not feasible, since the larvae lack genital systems and several other features of adult stage s which are utilized as taxonomic criteria.[20] Cestodes (tapeworms) belongs to the phylum platyhelminthes that encompasses a variety of acoelomate organisms that are bilaterally symmetrically, dorso-ventrally flattened ribbon-shaped and generally longer than wide. Therefore they are more commonly termed as flatworms (tapeworms). Platyhelminthes consists of flatworm (tapeworm) species that reveal great diversity in habitat, anatomy, size and reproduction history strategies. These cestodes are internal (endo) parasitic platyhelminthes that parasitize the vertebrates: fishes, amphibians and reptiles.[25]

1.2. Host range

Larvae of avian Contracaecum species infect a variety of fresh water fish.[32] Larval stages of the Contracaecum species that infect fresh water fish are usually found as adults in fish eating birds, such as cormorants and pelicans. Larval stages are seen in cyprinidae (carp and related species), ictalurids (channel catfish), Tilapia Cichlidae and Percids (perch).[26] The parasite Contracaecum species utilize invertebrate (amphipods, copepods, crab, zoea, and other) as paratenic hosts and growth and development of the larvae to L3 (larvae stage three) takes place in the fish. L2 of C.spiculigerum infects guppies directly and L2 of C.osculatum develop to the L3 stage when injected in to a body cavity of trout. This indicates that invertebrates, although important for transmission, are not a physiological necessity. Some species such as C.spiculigerum may have both marine and fresh water life cycles.[32] Cestodes are taxonomic class of organisms in which the adult stage usually live in intestinal tracts of vertebrates. Intermediate stage live in a wide variety of body location in both vertebrate and invertebrate hosts.[24]

1.3. Distribution

Contracaecum species (C.microcephalum , C.spiculigerm) are found worldwide in piscivorous birds and C.osculatum is widely distributed in seals.[32] Larval nematodes that parasitize the Mayan cichlid fish in southern florida were identified as Contracaecum species.[4] The parasite Contracaecum occure in Israel, Egypt, Mali, most large and small East African rift valley lakes (including laks Kivu, Edward, Albert Zaire and south Africa where it was also reported from brackish water hosts.[5] Prevalence of pericardial Contracaecum infiction among Tilapia in a contaminated pond often approaches 100%, usually with 1-4 worms per fish. In lake Naivasha, Kenya, 85% of tilapia was reported infected with a mean of 9 worms per fish. In lake baringo 70% of Oreochromis niloticus with 5 worms per fish, in lake Magadi 80% of tilapia graham with a mean of 2 worms per fish and lake George 30% of Oreochromis niloticus with a mean of one worm per fish.[21] Infection of the pericardia in cichlidae fish occur in Israel and Lake Victoria, George Nakuru, Baringo and Magadi.[13]

1.4. Life Cycle

Most fish nematods are oviparous. The eggs are released by gravid females in to the intestine of definitive hosts, where they are excreted in to the water with the feces (Roy, 2002). They are also released in to water when whole nematodes are vomited from the stomach by regurgitation. Then eggs are released from such discharged nematodes by oviposition or after death. Following their decomposition eggs hatch within 2-3 days at 24^{o}c, or 5-7 days at 21^{o}c. hatching is not simultaneous and is further delayed in some of the eggs. The eggs hatched to release a free swimming larva, which must be ingested by an intermediate host usually an arthropod.[25] It is the L3 which hatch from the egg. Invertebrates become infected by ingesting the L3 and subsequently transmit the larva to the fish host through the food chain. The infective stage L3 to the definitive host is commonly from the tissue and body cavity of prey fish.[32] Within the intermediate host further larval development of the nematodes occurs. In some species the life cycle is completed when the infected host is eaten by a bird, in which the nematode matures. If fish is as an intermediate or paratenic host, the nematode larvae will penetrate through the gut wall in to the viscera and musculature and encysted there. Such encysted larvae may survive for long period of time and at least in the case of some Ascaridioids like Anisakis.[25] Free living infective (second) stage larvae become firmly attached by their posterior to a substrate in the aquatic habitat. Consumed larvae entered the haemocoel of the copepod for over 40 days. In those fish which become infected after consuming the infected copepods, larva (third stage) migrating into the viscera, entered the swim bladder and finally accumulated in the pericardium within 2 to 4 months worms grow from 0.5mm to 60mm. then they persisted in the pericardium for up to 15 months or throughout the second year after infection.[13] The cestodes of fish have a life cycle involving at least one other host (Robert, 2001). The body of cestodes behind scolex grows from a neck like region; segments contain male and female reproductive organ and produce many eggs. The segments then pass out of the host with the body wastes and release the egg outside of the host.[33] The life cycle of cestodes extremely varied with fish used as the primary or intermediate host.[26] The typical life cycle of these cestodes is indirect with one intermediate hosts. With few exceptions, the adult tape worm is found in the small intestine of the final host; the segments and eggs reaching the exterior in the faces. When the egg is ingested by the intermediate host the gastric acid and intestinal secretions digest the embryophore and activate onchosphere, using its hooks tears through the mucosa to reach the blood or lymph stream or in case of invertebrates, the body cavity. Once in its predilection site the onchosphere loses its hooks and develop depending on the species into metacestodes. When metacestodes is ingested by the final host, the scolex attaches to the mucosa, the remainder of the structure is digested off, and a chain of proglottids begins to grow from the base of the scolex.[31] The life cycle is completed if the latter is eaten by a suitable fish host, bird or mammals.[31][25]

1.5. Pathogenesis

Contracaecum and L.intestinalis may have a negative impact on the lake fish stock. Fish parasites have direct impact on fish population dynamic because they influence reproductive potential, predation, disintegration and necrosis of major vital organs.[36] Neither encysted nor free Contracaecum larva will severely affect fish. Tissue reaction, inflammation, epitheloid formation and fibrous encapsulation around encysted larvae are localized. Multiple infections of the mesentery resulting in extensive inflammation, fibrosis and even some visceral adhesions, where seen only in large fish, with no apparent impact on their body condition.[17] Worms inhabiting the pericardial cavity do not induce any visible damage. Large tilapia (800-1000g) can accommodate 4 worms in average, which may reach a length of 6 cm and 2-3 mm in diameter. Larval nematodes occur either encysted in the tissue or free in the pericardial cavity. Larval of contracaecum tends to escape from their cysts, and crawl out of their host body after its death. There is clearly a strong cellular reaction to most nematode infection. This is not surprising their size and tendency to migrate prior to entering the restig state.[20][8] Larval cestodes called Plerocercoids are some of the most damaging parasites to fresh water fish when affecting vital organs such as brain, eyes or the heart.[6] The cestodes (tapeworms) particularly fish tapeworms have the pathogenic and veterinary importance causing harm in their hosts in various ways. Some of the harm full effects include introducing metabolic by products, acting as vectors of other pathogens, surviving in the expense of the fish (host) food, causing mechanical injury such as irritation; injury; and atrophy of tissues. Sometimes cestode of fish parasites can negatively affect the health state of cultured fish and cause death to heavily infect mostly of vulnerable young (fry fingerlings) fish. Plerocercoids of pseudophyllidean, ligula intestinalis cause parasitic castration of fish mainly in cyprinid fishes.[9]

1.6. Diagnosis

Intestinal nematode infections should be suspected, if fish eat well, but are thin (wasted), if brood stock production declines overtime or if juveniles grow more slowly than expected or are stunted (unusual small). Nematodes may also infect other tissues and organs in the body resulting in signs related to organs system affected and degree of damage. Since other disease can create similar signs, positive identification of parasitic infestation of nematode Contracaecum is important. The identification can be complete necropsy of a representative sample of affected population.[36] During necropsy of a small group of fish, tentative identification of infection by Contracaecum species can be made based up on larval nematodes in the pericardial cavitys.[26] Isolated nematode should be fixed in warm (80-90^{o}c) neutral or saline formation, or 70% alcohol, and preserved in either solution, mixed with 1% glycerine. For fish nematode also barbagallo liquid or 4% formaldehyde are used for fixation (so as to preserve).[37] Large tapeworms found in the body cavity and larval tapeworm found in the ovaries and muscle[15] and the adult tapeworm infects the alimentary tract, muscle or other intestinal organs.[6] Heavy infected fish have distended abdomen, sometimes infected fish also develop a variable degree of aseptic dropsy.[22] Clinical signs of cestodiasis include emaciation, anemia, discoloration of the skin and susceptibility to secondary infection.[24]

1.7. Zoonotic importances

The third stage larvae of Ascaridoid nematodes from fish can infect man if ingested with raw or slightly cured fish. Most human infection has been with anisakis larvae through Contracaecum have been implicated. The nematode does not mature in man but can cause eosinophilic granulomas of the stomach wall. Larvae are killed by cooking to a temperature of at least 60^{o}c or deep freezing to -20^{o}c.[32] The infected fish by Diphyllobotrium usedas an intermediate hosts to infection of animal and human when they ingested uncooked fish.[31][25]

1.8. Economic Importance

There are various ways in which parasites May impacts on economically important fisheries. Direct mortality associated with highly pathogenic infections or indirect mortality resulting from increased level of predation on exploited stocks, may reduce the number of fish available in the harvestable stock, and poor growth performance.[11] Nematodes are usually considered as the most economically important helminthes parasites of fish of the world. Most adult nematodes are found in the intestine of fish, but it is the larval stages in the fresh and viscera which cause disease and economic problems. It is also the larval stages which are infective to human and who have the greatest impact on consumer acceptance of fish as sources of protein.[32] Numerous tapeworms cause disease in fish and the problems of tapeworms in aquaculture and fisheries (marine and fresh water) have been reviewed. Larval cestodes of L.intestinalis decrease carcass value if present in muscle and impair reproduction when they infect gonadal tissue.[26]

1.9. Control and Prevention

Control of nematodes that infect areas of the fish other than the gastrointestinal tract is more problematic. There is no food and drug administration (FDA) approved drugs for use in the treatment of nematodes infectious in bait fish, ornamental fish, or food fish. For the parasites found encysted within the body cavity outsides of the intestinal tract, common deworms are in effective. So, intact surgical removal is the only way to rid fish of internal worms that are not found in the intestine. Prevention is always the best option, especially against, those species of nematodes that infect areas other than the gastrointestinal tracts of fish. Ponds that have not been cleaned or sterilized prior to restocking are at greater risk of harboring large numbers of intermediate hosts. So, cleaning and sterilizing ponds is an effective way of reducing the number of the intermediate hosts of some nematode species.[36] Destruction or reduction of a link in the transmission cycle used to control infectious disease of fish to a limited extent when involving animal parasites. Each stage of development in each host offers a possible means of disrupting the transmission of the parasite. However, eliminating a link in the transmission cycle may not be feasible, because it may mean the elimination of protected animals or birds or of a crustacean or mollusk which cannot be eliminated. So, destruction or reduction of life cycle of fish pathogen should always be considered when methods of disease control are being judged.[23] Prevention of larva nematode infection by keeping away piscivorous birds is impractical not only in fishing areas in natural habitats or manmade impondments, but even in fish ponds. In fish ponds preventive treatments of Contracaecum by elimination of copepods (by insecticides such as masoten or bromex) may be of some value if suitably timed, soon after its contamination by pelicans. Bromex, applied at a level of 3 ppm, killed free living larvae in vitro, but such a dose is about or beyond, the tolerance limit of fish.[32] No successful treatment for plerocercoid however praziquant el at 2-10mg per litter for 1-3 hour in a bath is effective in treating adult cestode infection.[6] Eradication of infection will be more complete if combined with a control of copepods in the pond water by disinfecting the pond.[26]

2. MATERIALS AND METHODES

2.1. Study area

The study is conducted in Bahir Dar town, at Lake Tana. Lake Tana is found in North West highlands of Ethiopia, particularly in the Amhara National regional state. It is situated with the altitude of 1830 m.a.s.l. and covers 3200km^2. The Lake Tana is the source of Blue Nile, the only river which drains Lake Tana from south east corner at Bahir Dar town.[34] The Lake Tana environment has a district seasonal pattern, particularly with respect to dry and wet periods. The water temperature fluctuates between 19^{o}c during winter, January to march, to 24^{o}c during May-June.[7] In Lake Tana, there is one cichlidae, Oriochromis niloticus (Nile tilapia), which is the most widespread Tilapia species in Africa. The catfish family (Claridae) is also presented by one species, Clarias gariepinus (African catfish), which is the most common members of its genus. The largest fish family in the Lake is the cyprinidae, represented by three genera: Barbus, Garra, and varicorhinus.[1]

2.2. Study Animal

The study is conducted on major fish species captured from Lake Tana. These species are obtained by fishering from the Lake by the help of scup net (for the case of small barbus) and from Lake Tana no. 1 fish supply association (tilapia nilotica).

A

B

Figure 1: Fish species examined for parasite investigation
A) O.niloticus (tilapia nilotica) and
B) Small barbus captured by scupnet

Figure 2: *Ligula intestinalis measured by ruler and its host*

2.3. Study design

The study design followed was cross sectional type conducte d to estimate the prevalence of helminthes in Oriochromis niloticus, and small Barbus species of fish from Lake Tana and to identify the prevalent (most common) helminthes of fish.

2.4. Sample size and sampling procedures

The total number of fish required for the study was calculated based on the formula given by.[28] As there was no information in the area regarding fish parasite, 50% expected prevalence was used to calculate the sample size using the following formula;

$$n = \frac{(1.96)^2 (p)(1-p)}{d^2}$$

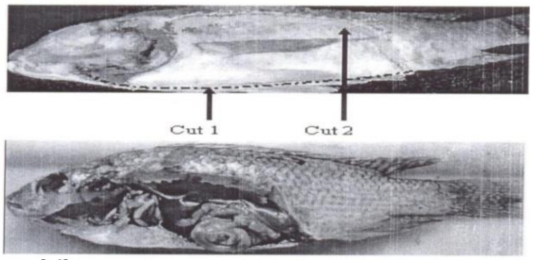
Where; n- sample size
p- Expected prevalence
d- Desired level of precision (5%)

$$n = \frac{(1.96)^2 (0.5)(1-0.5)}{(0.05)^2} = 384$$

Therefore, a total of 400 fishes were sampled to improve the precision of estimates. Sample collection was made by fishering from the Lake (small barbus) and from Lake Tana no. 1 fish supply association. Species are considered as exposing factors. The sampling procedures based on two fish species by measuring their size and weight caught by different mesh size (for Tilapia) and by the help of scupnet (for small barbus).

2.4.1. Fish examination

Fish samples are examined thoroughly internally by keeping them wet throughout the procedure. The abdominal wall up to the mouth along the ventral midline was opened by inserting a sharp end of scissors through the anus (cut 1). Then another incision will be made from the anus up to the lateral line and further along the lateral line up to the gill cover (cut 2). Then the detached part of the abdominal wall was removed and the internal organs examined.



Source: [16]

Figure 3: *Fish dissection from lateral side to examine internal organ*

2.5. Data Management and Analysis

The data obtained from internal examination of fish was properly recorded using a data format and entered in to MS excel computer program. Statistical analysis was made using STATA corp (2009). Prevalence refers to percentage of organisms infected by a particular species of parasite which is calculated by dividing the number of positive fish to the fish number examined and multiplied by hundred. Logistic analysis was employed to observe the influence of the different risk factors on the dependent variable. In all the analysis, p-value < 0.05 was considered to have a significant difference.

3. RESULT

3.1. **Overall prevalence of Contracaecum and L. intestinalis in each fish species.**

From a total of 400 fish examined during the study period, 161 fish had helminthes infection harboring of Contracaecum species and 8 small barbus fish had infected both by Contracaecum and L.intestinalis. The total prevalence infection of contracaecum on both fish species were 40.25% and the prevalence infection of contracaecum only in Tilapia nilotica fish species is 49.5% whereas only in small barbus it was 31%. The total prevalence infection of L.intestinalis in small barbus fish was 22.5%. There was no any infection of L.intestinalis in Tilapia fish species. The prevalence of helminthes detected in each fish species is summarized as follows in table 1.

Table 1: *Prevalence of L.intestinalis and Contracaecum infections in each fish species*

	Number positive (prevalence %)				
Species & no of fish examined	**L.intestinalis Total infection**	**95%CL**	**Species & no of fish examined**	**Contracaecum Spp infection**	**95% CI**
Small barbus (200)	45 (22.5%)	16.7, 28.3	Small barbus (200)	62 (31%)	42.5, 56.5
Total(200)	45 (22.5%)	16.7, 28.3	Tilapia nilotica (200)	99 (49.5%)	24.5, 37.4
-	-	-	Total (400)	161 (40.25%)	35.4, 45.1

CI: confidence Interval

The infection in Tilapia fish species examined revealed a significantly higher prevalence of Contracaecum parasites ($p<0.05$) than small barbus. The overall prevalence of larvae of contracaecum nematode infection in the two fish species were 40.25%. Even though an infection rate of 39.75% and 55.28% were recorded in male and female fish species respectively examined for larvae of contracaecum nematode, statistically the difference was not significant. However, the prevalence was significantly ($p<0.05$) lower in unidentified sex group of fishes as compared to the male and female fishes (table 2).

Table 2: *Contracaecum larval infections with respect to sex*

Sex	No. of fish examined	Positive	prevalence (%)	P-value
Male	163	64	39.75	-
Female	192	89	55.28	0.179
Unknown	45	8	4.97	0.009
Total	400	161	40.25	

4.2. Occurrence of L. intestinalis infections only in small barbus fish species.

Out of 200 individual small barbus examined during the study period 45 (22.5%) were infected with L.intestinalis parasites, 62 (31%) infected with larvae of contracaecum parasites and 8 (4.97) infected in both L.intestinalis and contracaecum parasites. The overall parasite in small barbus in the three lengh category was: 21 (20.39%) in shorter length fishes, 20 (22.99%) in medium length fishes and 4 (40%) longer fishes. Occurrence of total infection in small barbus show statistical no significance difference among the different size categories ($p>0.05$). However, the longer fish category seems to be infeseted more frequently than the other categories. The prevalence of L.intestinalis detected in small barbus fish species in different size categories is summarized as follows in table 3.

Table 3: *Prevalence L.intestinalis infection detected in small barbus in different size categories*

Size categories	**Number examined**	Number positive (prevalence %)		
		Total infection	**95%CI**	**P-value**

Short	103	21(20.39%)	12.5,28.3	-
medium	87	20(22.99%)	14.0,31.9	0.664
Long	10	4 (40%)	31.6,72.2	0.166
Total	200	45 (22.5%)	16.7,28.34	

CI: Confidence interval

3.2. Occurrence of Contracaecum infections in both Tilapia nilotica and small barbus fish species

Out of all 400 individuals Tilapia nilotica and small barbus species examined during the study period 161 (40.25%) were infected with Contracaecum parasites. Among them the prevalence of short fish is 88 (45.83%), medium 61 (34.46%) and long fish is 12 (38.71%). There was no significance variation (p>0.05) revealed in the occurrence infections between different size categories in both fish species. The prevalence of Contracaecum detected in Tilapia nilotica and small barbus fish species in different size categories is summarized as follows in table 4.

Table 4: *Prevalence of Contracaecum infection detected in both Tilapia nilotica and small barbus in different size categories.*

Size categories	Number examined	Number positive (prevalence %)		
		Total infection	95%CI	p-value
Short	192	88(45.83%)	38.7,52.9	-
Medium	77	61(34.46%)	27.4,41.5	0.127
Long	31	12(38.71%)	21.2,56.2	0.460
Total	400	161(40.25%)	16.7,28.3	

CI: confidence interval

4. DISCUSSION

An overall prevalence of 49.5% was recorded in the study for the larvae of Contracaecum nematode in both species of fishes. Whereas Ligula intestinalis cestode parasite infections in small barbus fish was 22.5%. This study revealed that most of the piscivor birds species are highly infected by parasites. Moreover,the result showed that all L.intestinalis pleurocercoid larvae (fig) found only in the body cavity of cyprinids (small barbus). Fish sample in the northern gulf of Lake Tana were highly infected by parasites. This can be related with a large number of aquatic piscivor birds attracted by fish offal avoided by Lake Tana no.1 fish supply association and local fisher men. Although, both Contracaecum and Ligula affect the fish stock, the degree of their impact is different and their distribution differs from place to place. Contracaecum was found from the rift valley lakes of Ethiopia in Lake Hawassa, Chamo, Ziway and the highland lake in Lake Tana (Amare, 1986; Tefera, 1990; Eshetu, 2000; Eshete and Mulualem, 2003). In the current study, more number of fish was infected by Contracaecum. The prevalence of Contracaecum in the pericardial cavity of O.niloticus (Tilapia) fish species was 49.5% with a maximum of 8 worms per fish. This result was lower than the others that were reported by Eshete and Mulualem,[10] which was 59.77% and Tefera[27] that was 68.66% for the same lake and fish species. The different results obtained may be related to the abundance of the first intermediate host, which is more seasonal, and the difference in sampling habitats. Eshete,[9] reported that the infection rate across various habitats was significantly different. The possible reason could be high abundance of copepods intermediate host. According to Eshete (2003), the highest densities of copepods were observed in the dry season (December – April). Furthermore, the high infection time coincides with the major spawning period of Lake Tana fish, which is from June to October.[18] Paperna[21] reported the prevalence of fish infection linked with the host reproductive season. Not only copepods but also the availability of piscivor birds which are most of the time, migrate during the rainy season can affect the prevalence rate of parasites. Contracaecum distribution is linked with the migration of piscivorous birds.[21] Prevalence of parasites infection is also related with sex. The present study showed that 55.28% of the infected fish were females and 39.75% were males, the rest 4.97% fish sex were not identified due to high spoilage and absence of gonads that could be damaged by parasites. In agreement within the finding of Eshete and Mulualem,[10] the most commonly affected fish by L.intestinalis were small size cyprinids (small barbus) in general (Figure 1). This could be related to the feeding habit of these fish where the small size of fish (small barbus) prefers copepods. In contrast to L. intestinalis, Contracaecum was found in large fish. This might be associated with the life cycle of the parasite. After infecting the fish Contracaecum larvae need up to four months to be seen in the body and pericardial cavity of the parasitized fish. Nematode infections increase with age and length of the fish.[12] L.intestinalis and Contracaecum may have negative impact on the lake fish stock. The fish infected by L.intestinalis do have distended abdomen that may contribute to poor swimming then ultimately leads to high chance of predation. Fish parasites have direct impact on the fish population dynamic because they influence reproductive potential, predation and competition within and between species.[9] L. intestinalis pleurocercoid causes distortion, disintegration and necrosis of the major vital organ.[10] Fish infected with L.intestinalis showed poor body condition, inhibited in both gonad maturation and spawing migration.[14] In this study, 22.5% of fish gonads that were infected by L.intestinalis pleurocerciods were not found and there is a strong suggestion that the gonad could be damaged due to this parasite.[22]

5. CONCLUSION AND RECOMMENDATIONS

The study was conducted from Lake Tana which is located in the northern part at which the fishery activity is mainly concentrated. During the study period an overall prevalence of larvae of Contracaecum and L.intestinalis are 49.5% in both Tilapia and small barbus fish and 21.1% only in small barbus fish species, respectively. Larvae of Contracaecum were found occupying the pericardial cavity an average of 4 larvae per fish where as L. intestinalis was found occupying the abdomenal cavity in a maximum of 3 worms per fish. The observed infection rate were predominantly related on the distribution of piscivorous (pelicans) birds which are abundant in area where there is high fishing activities and increase number of discarded filleted wastes. L.intestinalis pleurocercoids larvae cause the fish to have a distended abdomen that often swims poorly and susceptible to predation. It may either decrease the development of gonads or completely destroy them. However, the impact of Contracaecum was not observed on the fish gonad. The presence of larvae of Contracaecum nematode in tilapia fish causes tissue inflammation and if they are in large number even can lead to the death of the fish. More over the presence of the parasite has zoonotic importance and decrease the market value of commercially important fish species including tilapia. Therefore, based on this conclusion the following recommendations are forwarded.

- The nearby fisher men should be aware of fish parasites and at the time of gutting and filleting they should not throw offal to the water bodies so as possible to minimize infection and the number of piscivorous birds visiting the area.
- The third stage larvae from fish can infect man while it is ingested raw or under cooked. Therefore, awareness should be created among fish consumers about its zoonotic importance.
- On the lake the number of piscivor birds increase from time to time (personal observation) and the prevalence of infected fish with this parasites increase from 27.3% (during a study in 2001) to 49.5% (in the current study, 2012). So, the relationship between the birds and these parasites should be studied.
- Training should be provided to fisher men on proper postmortem and antemortum inspection of fish to decrease occurrence of zoonotic disease in the public.

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