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A Study of Prevalence of Fish Parasite in Hashenge Lake, Tigray, Ethiopia

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Abstract

This study was conducted at Lake Hashenge, Tigray, Ethiopia to identify parasites of fish. The objective of this study was to identify parasite of fish at Lake Hashenge, to determine the prevalence of parasitic disease of fish, to have baseline information about fish parasite in The lake Hashenge. A total of 442 different species of were sampled from the period of November 2008 to April 2009. Those include 217 of Mirror carp and 225 of Oreochromis niloticus. The fish were thoroughly examined both externally and internally for the presence of parasites. In this study the major parasites identified were CLinostomum genera 96(44.2%) in the Mirror carp and 64(28.4%) of Orechromis niloticus. Clinostomum species recovered from the feaces of the fish (gastrointestinal tract). The nematode genera of Capillaria identified from the GIT of 13(6%) Mirror carp and 14(6.2%) Oreochromis niloticus. The genera of Acanthocephalus were recovered from the GIT of 29(13.4%) of Mirror Carp and 25(11.1%) Oreochromis Niloticus. The adult of the genera Camllanus was recovered from 20(9.2%) of Mirror Carp and 27(12%) of Oreochromis Niloticus.

Keywords: Fish Disease; Lake Hashenge; Fish Parasites

Introduction

Fish culture as a hobby or business is well established in Florida. Increased interest in fish culture has also increased awareness of and experience with parasites that affect fish health, growth, and survival. Catch fish industries has declined significantly due to a series of factors which include over fishing, loss of fish habitants and environmental pollution. Disease out breaks (infectious and non infectious) resulting high mortalities occur more often when fish are held under relatively crowded and confined conditions. Also mass mortality of healthy fish may occur even under good environmental conditions when an infectious agent is accidentally introduced in to the culture system (Freders, 1195).

Water is the most important constituent in which fish are stocked, fed and raised and into which their waste products are voided, changes in the environment affect fish more rapidly and profoundly than terrestrial animals. The adaption of the aquatic habit has many implications for the structure and physiology of fish. The higher density of water when compared with air makes the streamlining and shaping of the body on important prerequisite for successful aquatic life. Each species of fish has preferred ranges for the various parameters of water quality, such as temperature, dissolved oxygen and salinity and ideally the fish should operate at the optimum levels of each parameter to achieve fast growth and efficient performance (Nagasawa, 1979).

Lakes are exposed to many pollutants including untreated sewage, agricultural and industrial wastes which enhance the concentration of heavy metals and compromise the health status of fish and its growth at regular period. In developing countries farmers live around the lake send their animals (sheep, cattle, horse, and donkey) towards the lake for the grazing and drinking purpose. These animals defecate and urinate at the shore or bank of the lake which serves as the main source of pathogen for fish health. In addition to this farmers wash their cloth at the border of the lake by using detergents which are harmful for growth and survival of fish (Donald, 1993) [1].

Ethiopia depends on its inland water bodies for fish supply for its population. The country has a surface area estimated at 7334 Km^2 of major lakes and reservoirs and 275 Km^2 of small water bodies with 7185 Km of rivers within the country (FAO, 2003). Several of these water bodies serve as sources of fish for the country. Fish production system in Ethiopia is mainly fish catch type but there are very limited recent developments in fish farming. In all production systems, subsistence and artisanal fisheries are predominantly practiced (FAO, 2015). Exceptional to this are Lake Tana, Lake Lugo, Lake Chamo, Lake Awassa and Lake Ziway which are widely commercialized (Jank According to Lemma (2013)), many fish diseases are causing huge mortality both in aquaculture and capture fisheries and some are also causing for human diseases in many areas of the world. The author mentioned that parasitic cases are very common in Ethiopia and most parasitic organisms are opportunistic and may be present all the time in the tank or on the fish in low numbers, and only cause disease when the fish is stressed. Several authors also added that some of the detrimental effects of parasites in fish production are causing fish diseases and hence causing mass mortalities, increase farm inputs via increased treatment expenses and cause reduction in growth rate and weight loss during and after the period of parasitic disease outbreak and spoil the appearance of fish and hence lowers the quality and quantity of fish thus resulting in consumer rejection and affect marketability of commercially produced fish in different parts of the country (Eshetu and Mulualem, 2003; Kaddumukasa *et al*., 2006; Ayotunde *et al*., 2007; Kayis *et al*., 2009; Gulelat *et al*., 2013). This disturbs the balance between fish supply and demand. Furthermore, poor environmental conditions and pollution often result in reduced immunity of fish and increased susceptibility to parasitic infections and/or infestations and parasitic diseases (Luque and Poulin, 2004). For example, according to a study conducted in Ethiopia by Lemma (2013), most parasitic diseases occur as a result of poor water quality. In Ethiopia, there are fragmented reports concerning fish endo-parasites. Such fragmented reports are not easily accessible and palatable to police makers and researchers.

Nematodes or roundworms

Infect many different species of aquaculture and wild fish. Small numbers of nematodes often occur in healthy fish, but high numbers cause illness or even death. In aquaculture systems, brood stock infected with a small number of nematodes may not even show signs of illness, but they often have reduced reproductive capacity. On the other hand, juvenile fish infected by small numbers of nematodes are more likely to show signs of illness and also have reduced growth rates. In aquaculture situations, fish become infected with nematodes if they are fed live foods containing infective life stages or if they are raised in culture settings that promote the growth of other animals that carry the infective stages of the nematode (vector or paratenic host) or allow nematodes to complete their life cycle (intermediate hosts). Some nematodes can be transmitted directly from fish to fish. Adult nematodes are typically found in fish digestive tracts. However, depending upon the species of nematode and the species of infected fish, adult and other life stages of nematodes can be found in almost any part of the fish, including the coelomic (body) cavity, internal organs, the swim bladder, deeper layers of the skin or fins, and external muscle layers. Prevention, proper identification, and correct therapy for treatable infestations dramatically improve the health and productivity of affected fish.

Acanthecephalans

Acanthecephalans are endoparasitic worms and about one third of the species are found as adults in the intestine of fishes. Acanthcephalans require vertebrate animals for definitive host and arthropods for intermediate hosts. Isopods, amphipods and ostracods are the usual intermediate hosts for aquatic species. Infection occurs when a definitive host consumes the infective stage contained in an arthropod or in a paratenic host worms are typically recruited in to fish populations during the spring with maturation egg production and transmission to intermediate hosts in the summer and early autumn. Adult worms usually live about one (Hagasawa, 1989).

Mucosal tissue is damaged at the attachment site, in fibroplasias that may extend through the sub mucosa and into the muscularis. Occasionally perforation of the gut wall occurs, the mucosal epithelium frequently is compressed or eroded along the trunk of the worm and the tips of the villi may be absent. Destruction of intestinal villi and necrotic, degenerative changes in mucosal epithelium almost certainly will reduce the absorptive efficiency of the fish intestine (Bullock, 1963) [2].

Acanthocephalans lack an alimentary tract and hence uptake of nutrients derived both from leakage of host tissues and from dietary contents in the intestinal lumen of the host is through the tegument. Hydrolytic enzyme activity at the tegumental surface probably assists in obtaining nutrients and in rapid penetration by the worm. Some acanthocephalans penetrate deeply and induce formation of a nodule that extends in to the coelom of the host. Such nodules are extensively vascularaized. Increased leakage of proteins from the blood in to the nodules ensures steady supply nutrients for parasite (Chubb, 1982) [3]. The consequences of acanthocephalans induced reductions in energy efficiency and altered basal metabolism of host are likely to be focused more sharply with increasing emphasis an aquaculture (Bristol, 1984). Digenetic trematode is one of the major fish parasitic platyhelminthes. Digeneans require more than one host to complete their life cycle and their adult stage is parasitic in vertebrates. All major groups of vertebrates serve as hosts for adult digeneans. Aside from being hosts to adult digeneans, fish may be also be infected by the metacercarial larval stage (Donges, 1974)[4].

Metacercarial infection in fish is the main source of disease with subsequent economic loss. Metacercariae may affect growth and survival, or disfigure fish so that they lose their market value as a food or ornamental product (Parna, 1980). Digenean infection of fish required by direct cercariae penetration are linked to seasonal occurrences of snails and their levels of infection (Brooks, 1985) [5].

Adult stage digeneans have a dorsoventrally flattened oval body with a smooth, spiny or corrugated surface, a sucker around the antero-ventral mouth and an additional ventral sucker or acetabulum. Both suckers used for attachment and locomotion. The digestive system consists of a pharynx connected to the mouth opening a short esophagus and two blinded intestinal caeca. The excretory system includes flame cells connected to a duct network which is connected to a posterior opening bladder.

The digenea are one of the major taxa of parasitic Platyhelminthes and they are invariably endoparasites. Digeneans are heteroxenous and require more than one host to complete their life cycle. The most important limiting factor for digenean dispersal is the intermediate host such as gastropoda and bivalvia (Paperna and Dzikowski 2006). There are a lot of studies about digenean trematodes in fish in the world and they provided details on the morphology and anatomy of parasites species, their life cycle, infection rates, seasonal variations and geographical locations.

This study reviews the effects of parasites of fresh water fish hosts. Like other living organisms, fish harbour parasites either external or internal which cause a host of pathological debilities in them. The parasites live in close obligate association and derive benefits such as nutrition at the host's expense, usually without killing the host. They utililize energy otherwise available for the hosts growth, sustenance, development, establishment and reproduction and as such may harm their hosts in a number of ways and affect fish production. The common parasites of fishes include the unicellular microparasites (viruses, bacteria, fungi and protozoans). The multicellular macroparasites mainly comprised of the helminthes and arthropods are also highlighted. The effects of parasites on their fish hosts maybe exacerbated by different pollutants including heavy metals and hydrocarbons, organic enrichment of sediments by domestic sewage and others such as parasite life cycles and fish population size. Also a questionnaire survey will be carried out to get information about the management of the lake and the way of contamination of the lake by the dwellers· in addition to this the questionnaire survey gives evidence how the people eats the meat fish as raw or cooked.

Therefore, the objective of the current study was:
- To identify the parasite of fish in lake Hashenge
- To determine the prevalence of parasite disease of fish in Hashenge
- To have base line information about fish parasites in the lake

Materials and study methodology

Study area

The study was conducted in Hashenge lake which is found in southern part of Tigray, Ethiopia, particularly in the woreda Ofla near to the town of Korem, which is 150 Km faraway from Mekelle, the capital city of Tigray region. The lake is oval in landscape and covering an area of 20 Km^2 and the capacity the lake to contain water is supposed to be $22.6X10^8$ M3.Hashenge Lake is the largest lake from Tigray region and has an average depth of 21 meter. The woreda Ofla has an annual rain fall of 800-900 mm and temperature in the range of 15-16 ^oC and is located at longitude of 39^0 (east) and latitude 12^031' (north). It has an altitude of 2450m above sea level. lake is natural and used as water source for both human being and animals, irrigation of agricultural land and nowadays used for fish farming system however before nine years the lake was not used for farming of fish because it did no has its own original fish species, but the agricultural bureau of Tigray region had been introduced fish species from other lakes of Ethiopia.

Study animal

The study population was different fish species (Oreochromis niloticus or Nile tilapia and Mirror carp) of Lake Hashenge with their major parasitic diseases.

Study design

A cross sectional study was conducted from November 2008 to Aprill 2009 at Hashenge lake to determine the types of fish species and the prevalence of parasitic infestation or infection of fish .The desired sample size was calculated using the formula given by Thrusfield, 1955. 95% confidence interval, 5% desired absolute precision was considered as statically significant at 50% expected prevalence and by which 384 fish were sampled. But 15% was added to increase the precision of the estimated prevalence of the disease. Therefore, 442 fish were selected (formula step given below) using random systematic sampling method. $\underline{N=1.96^2 X P_{ex} (1- P_{ex})}$

Where N = required sample size; pex = expected prevalence
d^2 = desired absolute precision

Questionnaire survey

Questionnaire format was developed to gather information regarding the dominant fish species in the lake, the origin of fish where they came from and to assess for any incidence of loss of the lake population (fish species) and administered to 60 persons that include fishermen (n=20, 33.3%), restaurant workers (n =15, 25%) and farmers (n=25, 41.7%) and all of them were living at the villages vicinity to the lake.

Study methodology

Sample collection: A total of 442 fish were sampled and of which 217 Mirror carp and 225 Oreochromis niloticus species of fish were examined. All the fish were caught using gillnets with mesh size ranging from 60 to 120 mm that was used for the fishing practice at the lake Hashenge. All the specimens taken from fish were preserved in 10% formalin until it reaches to the place of laboratory examination, Mekelle University College of veterinary medicine parasitology laboratory. During the process of sampling, fish species, sex and site of sample taken was identified and recorded.

Sampling procedure: The fish were examined thoroughly both internally and externally after it has been taken out by the fisherman from the lake, scraping were taken from the skin and fin ,preserved in 10% formalin and sample was taken from the gill and gastro-intestinal tract. An incision was made from the ventrum to the head then faeces have been collected from the small and large intestine.

Laboratory examinations: Skin scraping was taken from randomly selected fish type particularly from the route of the fin. The skin scraping has been preserved in 10% formalin and taken to the laboratory. In the laboratory scrapings were scrapings were dissolved with 10% KOH and smear was examined using the 10x magnification power of the light microscope. Any sample which was not showing the typical intact parasites or whole egg was considered to be negative.

Fecal direct to microscopy procedure was conducted to see parasitic eggs, larvae and adult parasites from the specific samples from each fish species. Fecal sedimentation and floatation techniques have been carried out to identify parasite egg and adults. Gill samples were also examined to assess external parasitism.

Data analysis

The obtained data from questionnaire survey and laboratory findings were summarized and then analyzed using simple mathematical calculations and SPSS version 10 analyzing software to calculate the prevalence rate of the parasitic infestation in the study fish species and chi-square test was calculated to test association between the fish species, sex and site or sample source with the occurrence of parasitic infestation.

Results

Parasitological survey

The species Clinostomum were the most prevalent parasites affecting both species of fish in the lake Hashenge. Trematode parasites were recovered from 96(44.2%) of Mirror carp and 64(28.4%) of Oreochromis niloticus from the gastro intestinal tract of the fish. The eggs of genus Acanthocephalans were recovered from 29 (13.4%) of M.carp and 25(11.1%) of O.niloticus of fish from its gastro intestinal tract. The egg of genera capillaria was found in 13(6%) Mirror carp and 14 (6.2%) of Oreochromis niloticus. The egg of Camallans was found in 20(9.2%) of Mirror carp and 27(12%) of Oreochromis niloticus.

Table 1 showed that the overall prevalence of the fish parasite was 65.11% in the study area and 72.8 % was for Mirror carp and 57.78% for the Oreochromis niloticus.

Fish species	Number of examined fish	number of fish affected	%
Mirror carp	217(49.1%)	158	72.8
O.niloticus	225(50.9%)	130	57.78
Total	442(100%)	288	65.11

Table 1: Comparison between species of fish and parasitic prevalence

Table 2 indicate the maximum number of parasites found was belonging to the genera of Clinostomum recovered from 96(44.2%) of Mirror carp and 64(28.4%) of Oreochromis niloticus and the minimum number of parasites belonging to the genera of Capillaria recovered from 13(6%) of Mirror carp and 14(6.2%) of Oreochromis niloticus.

Parasite genera					
Fish species	**Clinostomum**	**Capillaria**	**Camallanus**	**Acanthocephalus**	**%**
Mirror carp (n = 217)	96	13	20	29	72.8
O.niloticus (n=225)	64	14	27	25	57.9
Total	160	27	47	54	65.1

X^2 =16.052, P (z) <0.05, df =4

Table 2: Prevalence of fish species versus parasites

As seen from table 3, there was no any significant (X^2 = 6.345, P (z) > 0.05) variation among the sex categories of the prevalence rate of the parasite.

Parasite genera					
Sex	**Clinostomum**	**Capillaria**	**Camallanus**	**Acanthocephalus**	**%**
Female (n = 188)	64 (34%)	13(7)	17(9%)	18(9%)	59.57
Male (n=154)	96(38%)	14(5.5%)	30(12%)	36(14%)	69.3
Total (n=442)	160(36%)	27(6%)	47 (11%)	54 (12%)	65

X^2 =6.345, P (z)>0.05, df =4

Table 3: Prevalence of sex versus parasite

As we can see from table 4, there was a significant variation among the site versus parasite categories. Most of the parasite egg genera were found from the gastro-intestinal tract (63.8) while no parasite was found from the samples taken from the gill, skin and fin.

	Parasite genera				
Site	**Clinostomum**	**Capillaria**	**Camallanus**	**Acanthocephalus**	**%**
Skin/fin (n = 50)	0	0	0	0	0
GIT (n=328)	160	27	41	54	63
Gill (n=64)	0	0	0	0	0

X^2 =287.29, P (z) <0.05, df =8

Table 4: Infection prevalence variation among site (sample source)

Questionnaires survey

From the table 5, the most dominant fish species in the lake were Mirror carp and Oreochromis niloticus (53.33%) according to the questionnaire survey of the respondent indicated while 5% of the respondent said barbus species.

	Question item					
Respondent	**Type of fish species**		**Any disease outbreak**		**Origin of fish**	
	O.n & M	Barbus	Yes	No	Haik	Tana
F.M(N=20)	18(90%)	2(10%)	5(25%)	15(75%)	8(40%)	12(60%)
R.W(N=15)	14(93%)	1(6.7%)	5(33.33%)	10(66.2%)	10(66.2%)	5(37.8%)
Farmers(n=25)	0	0	15(60%)	10(40%)	15(60%)	10(40%)
Total(n=60)	53.3%	5%	41.6%	58.33%	55%	45%

NB: F.M =fishermen, R.W= Restaurant workers

Table 5: Questionnaire survey

The Hashenge Lake was a dead sea which has not its original fish but according to the Questionnaire survey the fish species present in lake were brought from Lake Haik, 272 Km far from Mekelle, and this was supported by 55% of the respondents while 28.33% of the respondent said from Lake Tana. The questionnaire survey indicated that there was an outbreak in 1993 E.C. all the fish have been found dead but the cause of mortality was not known and this previous history of the occurrence of death was supported by 41.67% of the respondents. On the other hand, 58.33% of the respondents replied that they did not have any information about such phenomenon.

Discussion

The helminthes egg parasites belonging to the genera Clinostomum, Capillaria and Acanthocephalus and the adult stage of the genera Camallans was found in the study fish species. The study was conducted in a total of 442 fishes from Lake among which 217(49.1%) were Mirror carp and 225 (50.9%) were Oreochromis niloticus. From the total examined fishes, 290(65.6%) was found to be positive for the genera of parasites. Comparisons were made among each other of the different variables.

The most prevalent egg of trematode was the egg of the genus Clinostomum which was recovered from the gastrointestinal of Oreochromis niloticus (28.4%) and Mirror carp (44.2%). The genus Clinostomum was the most abundant parasites found in the Oreochromis niloticus and Mirror carp. This finding of study was consistent the finding recorded by Teferra wondum (1990), with a prevalence rate of 74.3% in Oreochromis niloticus and 42% in the Mirror carp at Lake Tana. These findings were slightly higher than the finding of the current study in which prevalence rate of 28.4% for Oreochromis nilloticus and 44.2% for Mirror carp was identified. This difference in prevalence rate may be due to management of the water quality, feeding habits and overcrowding of fishes, presence of aquatic birds that contribute to the exposure of fish to the parasite (Anderson, 1992) [6].

The nematode of Camallanus was found from 20(9.2%) of Mirror carp and 27(12%) of Oreochromis niloticus in the present study at the study lake. The result of current study agrees with the Fujita (1927) and is reported from fresh water fishes in Japan and is reported from many hosts from many countries. Nematode usually considered as the most economically important parasite of fishes of the world (Hafsteinsson and Rizvi, 1987).

The genus Acanthocephalus was also found from Mirror carp (13.4%) and Oreochromis niloticus (11.1%). The genus Capillaria was found from 13(6%) of Mirror carp and 14 (6.2%) of Oreochromis niloticus.

The questionnaire survey revealed that the total respondents participated in the study were provided with query type of disease outbreak in the lake previously, about the origin and type of fish species and dominant fish species in the lake at present. Since fish is the main source of protein as food for human being great consideration should be given to the health status of the fish but in developing countries like Ethiopia, Fish farming is not greatly practiced (Bullock, 1963) [2].

Famers who are dweller in the surrounding of Lake Hashenge do not consume fish meat. From the total respondents interviewed; 41.6% of them stated that there was an outbreak of fish disease in the lake while 58.33% of the respondents replied that they did not have any information about such situation of occurrence of disease outbreak in the lake. The most dominant fish species in the lake were Mirror carp and Oreochromis niloticus.

Conclusion and Recommendations

Fisheries have a very full complement of disease like all animals. The disease may be due to internal and external sources. The present work which was conducted in Hashenge lake, Tigray region, revealed that the prevalence of the parasites that affect fish were high, this may be due to lack of management of the lake and shortage of education back ground of the farmers or local dwellers about the importance of fish as source of food. The contribution of the farmers to the lake management was very poor and no attention was given to it at all.

Based on the above conclusion the following recommendation was forwarded

- Creation of awareness about the importance of fish as source of food for society
- Good water and environment management of the lake
- Fish species which can be best fit to the climatic condition of the study area and water ecosystem should be selected and introduced to lake.
- The governmental should be involved in the overall management of the water body and financially support for the successful start of fish production from the lake as to the desired level.
- Training of fishery professionals about the occurrence of fish diseases should be practiced and further research should be conducted in order to increase the productivity of the lake.

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Supplementary Info

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