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# Prevalence of Eustrongylides Larvae among *Clarias gariepinus* (Catfishes) Found in Lake Hawassa, Ethiopia

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**Abstract:** *Background*: Eustrongylidosis is a nematode parasitic disease that mainly affects wading birds worldwide; however, the parasite's complex, indirect life cycle involves other species such as aquatic worms and fish. Moreover, this disease is zoonotic which means the parasite can transmit disease from animals to humans. Aim: The study determined the prevalence of eustrongylides larvae infection and its association with sex, length and weight of *Clarias gariepinus* (cat fish) in lake Hawassa. *Methods*: The study was designed as cross sectional. A total of 406 catfishes were transported to Parasitology and Pathology laboratory in Hawassa University, then each fish was eviscerated and examined by using standard parasitological techniques to investigate the presence of eustrongylides larvae. Results: A total of 92 cat fishes (22.7%, 95% CI: 18.7- 26.9) were found to be parasitized by eustrongylides larvae. The prevalence of 12.6%, 20.1% and 37.8% were recorded in short, medium and long sized fishes respectively ($\chi^2$ = 24.4, DF= 2, P<0.001). The occurrence of the larvae showed statistically significant variation ($\chi^2$ = 9.35, P = 0.009) among fishes with different weight categories. However, the occurrence of the infection in males (19.4%) and females (25.7%) showed no statistical significance variation ($\chi^2$ = 2.31, P = 0.128). From a total of 92 positives fishes, 29 (31.53%), 42(45.65%) and 21(22.82%) were infected with 1-3 or more larvae of parasites. Conclusion: Prevalence of eustrongylides larvae in *C. gariepinus* in Lake Hawassa seems high and the parasite could bring serious fish production and public health problems. Therefore, further studies on other existing parasites in the lake needed to provide more comparative study and identification of species by molecular biology is important as well as to set appropriate control measure.

**Key words:** *C. gariepinus* · Eustrongylides Larvae · Lake Hawassa · Prevalence

## INTRODUCTION

Fish is important to human population in trade and economy; it is of importance in the diet of different countries especially in the tropics and subtropics where malnutrition is a major problem [1, 2]. As the human population inevitably increases, the demand farming and culture attributable to the increased need for fish as source of protein will grow [3].

In recent times, there has been tremendous increase in the development of fish affordable animal protein especially in the tropics Davies *et al*. [4]. Moreover, fish has become a leading export commodity for Africa, with an annual export value of US$ 2.7 billion [5]. Africa hosts a great diversity of freshwater fish of which more than 3, 000 species have been identified [6].

Ethiopia covers a land area of 1.13 million km of which 99.3 percent is a land area and the remaining 0.7 percent is covered with water bodies and comprises 10 major lakes in the country [7]. More than 200 species of fish are known to occur in lakes, rivers and reservoirs in Ethiopia [8]. Artisanal freshwater fishery is one of the most important economic activities in Ethiopia [9]. Improvements in fishery sector would contribute to poverty alleviation and environmental sustainability in Ethiopia [10].

The annual fish production potential of Ethiopia based on empirical methods on individual lake surface area and mean depth of major water bodies was estimated to be 30, 000 to 51, 000 tones [5, 11, 12]. Despite the availability of huge potential for fish production, the country has annual consumption of 240g per person,

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which is the lowest in Africa. However, 10kg per person per year achieved in areas where there is regular and sufficient supply of fish [13].

As many other countries challenged in the world, population rise urbanization, agricultural development, industrialization and other water resource development activities have resulted in a decrease in the species diversity of freshwater fish species [14].

To improve the productivity of the fishery sector; important constraints remain to be addressed. One of the problems of the fishery sector in the wild population are parasites and disease conditions of fish parasitic diseases reduce fish production by affecting the normal physiology of fish and if left uncontrolled, it can result in mass mortalities or in some cases, can be served as a source of infection for human and other vertebrates that consumed fish [15].

Parasitic diseases of fish are very common all over the world and are of particular importance in the tropics [16]. It produce a weakening of the host`s immune system thereby increasing their susceptibility to secondary infections, resulting in the nutritive devaluation of fish and subsequent economic losses [17]. All species of fish are vulnerable to various parasitic infections depending on species of fish and type of stream inhabited. In both natural environments and in culture, disease has a serious impact on fish and universally recognized as one of the most serious threats to the commercial success of aquaculture [18].

Freshwater fish can serve as definitive, intermediate or paratenic (transport) hosts in the life cycles of many species of protozoan, helminthes and crustacean parasites. The parasites usually exist in equilibrium with their hosts as a survival strategy [19]. However, in instances where the hosts are overcrowded, such as in fish farms, parasitic diseases can spread very rapidly and cause gross mortalities [20]. Losses in productivity in different water bodies and also human diseases in many areas of the world [21].

Eustrongylidosis is one of nematode disease caused by several species of roundworms (Eustrongylides species). Adult individuals inhabit the mucosa of the gastrointestinal tract of fish eating birds and can caused large mortality of nestlings younger than 4 weeks [22]. The parasite was first detected in fish. The parasite is then transferred from the fish to the waterfowl when the bird is eating the fish. After consumption, the parasite perforates through the stomach lining often resulting in the death of the host [23].

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 [20].

The habit of raw fish eating is common among fishermen and people in Ethiopia, especially people near to water bodies. Lake Hawassa is the major source of income through eco-tourism while the inhabitants depend on the lake for fishing and recreation. The sum totalities of aquatic and terrestrial habitats adjoining the lake facilitate for the rich diversity of flora and fauna compared to other Ethiopian Rift valley lakes [24]. But potential fish parasites that can easily be disseminated to these water bodies are not sufficiently known especially there is little document available on Eustrogylides larvae in cat fish found in Lake Hawassa and other lakes in Ethiopia, therefore the objectives of this study were:

- To determine the prevalence of the eustrongylides larvae in catfish *C. gariepinus* found in lake Hawassa
- To assess the association of sex, length and weight with prevalence of the parasite.

## MATERIALS AND METHODS

**Description of Study Area:** The study was conducted from November 2014 to April 2015 in Hawassa town, at Lake Hawassa. Lake Hawassa is a Rift valley lake in Southern Ethiopian Peoples Region, Sidama zone lies between 6° 49'N -7°15' N latitude and 38° 17'E-38°44'E longitude, about 275 km south of Addis Ababa at an altitude of 1708 masl. The maximum depth of the Lake is 21.6m with mean depth however is 11m [25] and the catchment has a total area of 1455 km2 of which 93.6 $km^2$ is the surface area of Lake that may increase up to 99.3 $Km^2$ in the rainy season. The annual net groundwater outflow from Lake Hawassa to adjacent basins is estimated at 58 $\times 10^6$ $m^3$ [24].

The lake is situated in the Main Ethiopian Rift Valley system surrounded by flat to slightly slopping lands, escarpments and hills. The area is accessed through the Addis Ababa-moyale main road. The Hawassa basin is in an old caldera in the middle of the Ethiopian Rift Valley,

between the Abijata–Shalla basin to the north and that of Lakes Abaya and Chamo to the south. The walls of the caldera form steep walls to the north and east of the basin while most of the flatter areas are intensively cultivated.

Lake Hawassa is in the lowest portion of the caldera, along with a previously extensive wetland, Lake Shallo and the Shallo swamp. The swamp drains into Lake Hawassa through a small river called TiqurWuha, which means 'black water'. There are no outlets from the lake, but water may seep away through the underlying volcanic ash and pumice. Hawassa is a freshwater lake, even though the system appears to be closed [25].

Hawassa is the smallest of the Rift Valley lakes, but is highly productive. It has a rich phytoplankton (over 100 species have been identified [26] and zooplankton [27]. that support large populations of six fish species. These are *Oreochromis niloticus, Labeobarbus intermidius, Labeobarbus amphigrama,* Aplochelichthys ssp, *Clarias gariepinus* and Garra species [28].

The most important commercial species is *Oreochromis niloticus*, but there are also good populations of catfish and Barbus. The *C. gariepinus* contributes about 3.0% of the total catch of about 500 tons per year [29]. However, contribution rises up to 20% of total landing during the fasting periods of the Orthodox Church followers (march-April, early half of August).

The shoreline is gently sloping and mostly covered with vegetation that can extend 50 m or more into the lake. The lake supplies Hawassa with all its water and supports a thriving local fishery. The town and Lake of Hawassa form a popular resort for local and foreign visitors.

**Study Population:** The study animals were *C. gariepinus* fishes that were collected from the lake and a required parameter was taken after fishes were collected. Large, medium and small size fish were included in my study.

**Study Design:** The study was cross sectional study with simple random sampling technique to determine the prevalence of eustrongylides larvae in *C. gariepinus* fishes at Lake Hawassa. Fishes were examined every morning three times per week, during study period from November 2014 to April 2015.

**Sample Size Determination:** The sample size required for this study was determined depending on the expected prevalence of the parasite and the desired absolute precision according to Thrusfield [30]. Since, there was no previous research done in this area, 50% expected prevalence, 95% confidence interval and 5% desired absolute precision were used to estimate the sample size. Hence, a minimum of 384 fishes were considered in this study. However we were able to examined 406 cat fishes. The sample size was computed using the formula given in Thrusfield [30] as follows;

$$N = \frac{1.96^2 x P_{exp}(1 - P_{exp})}{d^2}$$

where:

N = Required sample size;
Pexp = Expected prevalence;
d = Desired absolute precision.

**Study Methodology:** A total of 406 different size fishes were collected from the lake for 6 months (November 2014 – April 2015) using different mesh size gill nets and hooks by fishermen. The gears were set in the afternoon and lifted in the morning. All samples of fishes were clearly labeled with the date of sampling and the necessary parameters including length and weight were taken and sexes of the fishes also identified. The total length (TL) and weight (TW) of each fish was measured and recorded following the procedures described by Paperna. Based on the above procedures fishes were categorized in different groups. In respect to their length, fishes with the length of 10-30 cm, 31-60 cm and greater than 60 cm were categorized as short, medium and long fishes respectively. In addition, the weights of the fishes were measured and fishes with the weight of 60-250 gm, 251-500 gm and greater than 500 gm were categorized as small, medium and large respectively.

The sexes of fishes were determined externally by visualizing of sexual papillae and internally by inspecting the gonads. The males possess distinct sexual papillae that are located behind the anus. This sexual papilla is absent in females [31].

Finally each sample of fish was evaluated visually and postmortem examination was done using appropriate postmortem kits using standard evisceration/incision technique [32]. According to the methods described by Noga [18]. The fishes were opened dorso-ventrally and examined for the presence of internal parasites. The fish was killed by cutting the pectoral region with knives. The skin can be removed relatively easy by making an incision around the catfish's head and down its belly. Grab the skin with forceps and pull it down toward the tail. A mid-ventral cut the length of the fish was made to

expose the body cavity. The body cavity and visceral surfaces, the gonads, liver, heart and gall bladder were examined for parasites. Flesh of fish can be filleted or cut into steaks and examined for the presence of parasite. Finally the samples were put in plastic container containing 10 % formalin and labeled with all necessary information.

**Data Management and Statistical Analysis:** Collected data was entered and stored in to Microsoft excel and managed. All the data analysis was done by Statistical Package for Social Science (SPSS) software. Descriptive statistics such as percentages and frequency distribution was used to describe the nature and characteristics of the data. The prevalence of eustrongylides was analyzed using percentages. The associations of different risk factors with prevalence of eustrongylides were computed by Chi- square ($X^2$) test. A value of $p < 0.05$ considered to be statistically significant at 95% confidence interval.

## RESULTS

**Overall Prevalence of Eustrongylides Larvae in *C. gariepinus* Fishes:** A total of 406 samples of *C. gariepinus* fishes were examined from the lake Hawassa. Out of these 92 *C. gariepinus* fishes were infected with one or more larvae of eustrongylides species. The overall prevalence of eustrongylideslarva in *C. gariepinu* fishes was found 22.7% (95% CI: 18.7- 26.9).

**Prevalence of Eustrongylides Larvae in Respect to Sex of Fishes:** Sexes of fishes were determined in order to observe parasite influence between the sexes of the fishes. As indicated in Table 1 females had higher prevalence of Eustrongylides larvae infection than their male counterpart, however the observed difference between sexes was not statistically significant (P>0.05).

**Prevalence of Eustrongylides Larvae with Different Lengths of Fishes:** The prevalence of Eustrongylides larvaewas determined in relation to their total length; and it was found that statistically significance variation (Df = 2. $X^2$= 24. P-value = 0.00) among the three categories body lengths (Table 2). The prevalence of was high in fishes with long body size and lowest record in prevalence was obtained in small body size fishes.

**Prevalence of Eustrongylides Larvae with Different Body Weight of Fishes:** The weight of fishes was categorized into small (60-250 g), medium(250-500 g) and large(>500 g) and the prevalence of Eustrongylides larvae was determined in these weight categories of fishes. Statistical significance variation was observed ($P < 0.05$) among the different body weight categories (Table 3).

Table 1: Prevalence of Eustrongylides larvae in respect to sex of examined fishes

| Sex | No of examined | No of positive (Prevalence%) | 95% of CI | $\chi^2$ (p-value) |
|---|---|---|---|---|
| M | 196 | 38 (19.4) | 14.5-25.2 | 2.31(0.12) |
| F | 210 | 54 (25.7) | 20.3-32.0 | |
| Total | 406 | 92 (22.7) | 18.7-26.9 | |

Table 2: Prevalence of Eustrongylides larvae with different lengths of fishes

| Total length (cm) | No of examined | No of positive (Prevalence) | 95% of CI | $\mu^2$ (p-value) |
|---|---|---|---|---|
| 10 - 30 | 143 | 18(12.6) | 8.1-19.0 | 24.4(<0.001) |
| 31 - 60 | 144 | 29(20.1) | 14.4-27.4 | |
| >60 | 119 | 45(37.8) | 29.6-46.8 | |
| Total | 406 | 92(22.7) | 18.7-26.9 | |

Table 3: Prevalence of Eustrongylides larvae in respect to body weight of fishes

| Total weight (gm) | No of examined | No of positives (Prevalence) | 95% of CI | $\chi^2$ (p-value) |
|---|---|---|---|---|
| 60 - 250 | 102 | 13(12.7) | 7.6-20.6 | 9.4(0.009) |
| 251 - 500 | 114 | 25(21.9) | 19.3-30.4 | |
| >500 | 190 | 54(28.4) | 22.5-35.2 | |
| Total | 406 | 92(22.7) | 18.7-26.9 | |

Table 4: Parasite burden (Number of Parasite larvae per Fish)

| No of Parasite larvae per Fish | No of infected fishes | Percent(%) from total fishes |
|---|---|---|
| 1 | 29 | 31.53 |
| 2 | 42 | 45.65 |
| 3 | 21 | 22.82 |
| Total | 92 | 100 |

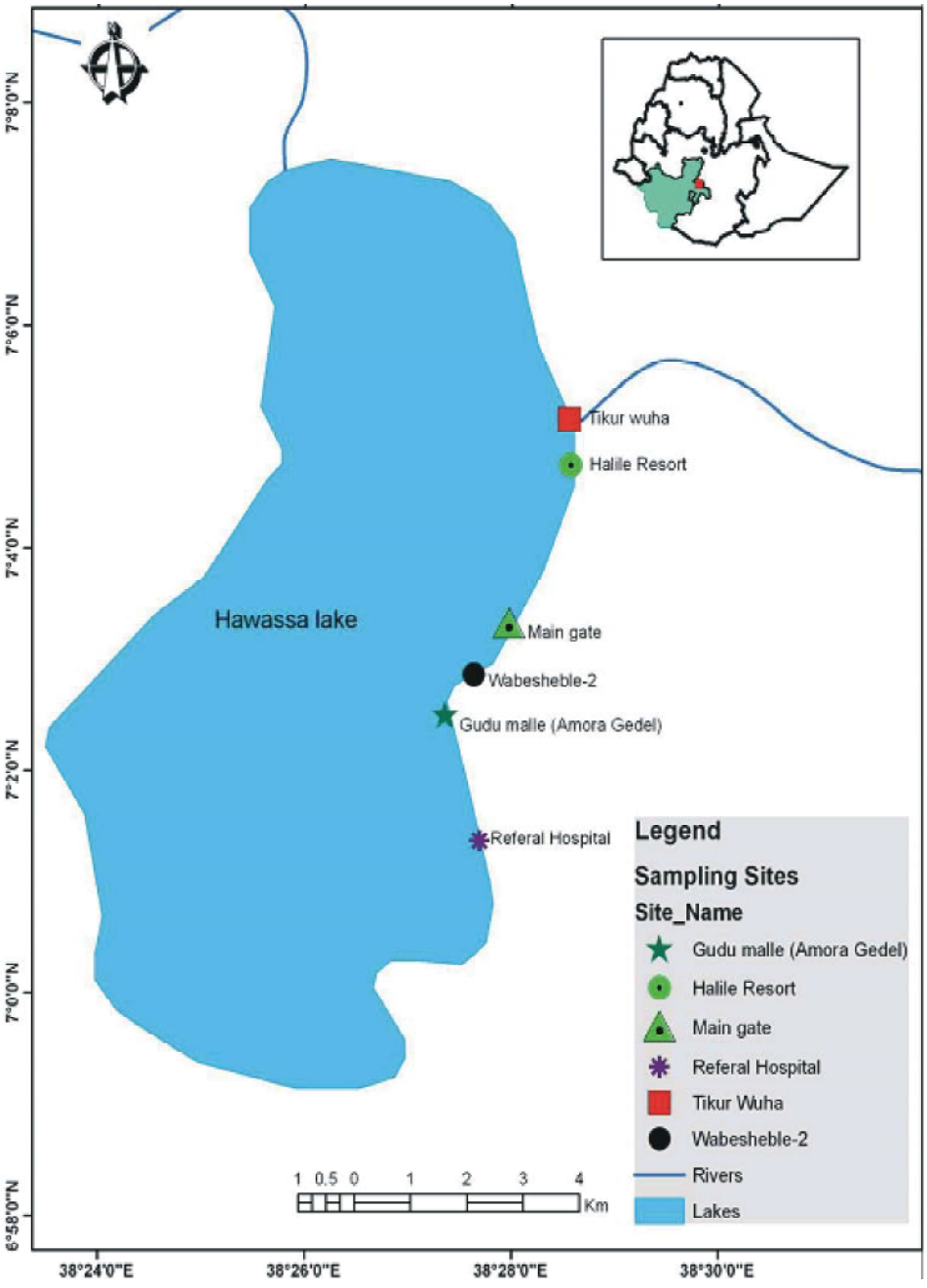


Fig. 1: The map of study area (41)

**Parasite Burden (Number of Parasite Larvae per Fish):** The parasite burden of affected fishes was assessed by counting numbers of Eustrongylides larvae in infected fishes. From 92 positives fishes 29 (31.53%) were infected with one larvae of parasites, 42(45.65%) were infected with two larvae of parasites and 21(22.82%) were infected with three larvae of parasites as shown in Table 4. The average burden of eustrongylides larvae per fish was 1.91±0.73.

## DISCUSSION

In this study the prevalence of Eustrongylides larvae seems significantly high this as a result it may have huge economic losses as they increase mortality and cause reduction in growth rate and possibly weight loss during and after the period of parasitic disease outbreaks. Prevalence among water bodies may varies which may

depend on many factors like feeding habits, physical factor of water body and management systems of fishes. A number of studies showed that a close and highly susceptible link exists between environmental conditions and parasitism [33].

The higher prevalence of parasites 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 [34].

In this study, an overall prevalence rate of 22.7% of Eustronglides larvae was recorded in *C. gariepinus* fishes at Lake Hawassa. The result was far lower than the prevalence (67.5%) reported by Ibiwoye and others [38] in Bida floodplain of Nigeria and higher than the prevalence (11.54%) reported in Danube-Tisa-Danube Canal in Serbia by Bjeliæ-Èabrilo *et al*. [35].

The difference between sexes was not statistically significant however; the prevalence was a bit higher in females (25.7%) than males (19.4%). The results was correspond to the findings of Imam and Dewu [36], Bichi and Ibrahim [37], 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 gravids ones [37]. which could have had reduced resistance to infection by the parasites. This result was contradicts with the prevalencein females had higher (69.5%) than males (23.4%) which reported by Ibiwoye *et al*. [38] in Bida floodplain of Nigeria.

It was also contradicts with the findings of Akinsanya *et al*. [39]. andAllumma and Idowu [40]. Regarding to sex who found that male specimens presented a higher rate of internal parasite infestation [40].

The prevalence of Eustrongylides larvae was also evaluated based on different length and weight categories. Prevalence of parasite was higher in large fishes and the difference was statistically significant ($P<0.05$). This finding was almost in agreement with the reports of Allumma and Idowu [40] and, Bichi and Ibrahim [37] who stated that larger fishes were heavily parasitized than the smaller ones. *C. gariepinus* is one of the best examples of omnivore so the larger fish may consume the smaller one and the chance of getting parasite was increases [40].

The prevalence of parasites infection increased with increasing length and the weight of the fish host. The reason for the higher infection rate in larger fish is 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 the time. Similar observation of infection being higher in adult was reported by Roberts [16] 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.

The parasite burden of affected fishes was assessed by counting numbers of Eustrongylides larvae in infected fishes. From 92 positives fishes 29 (31.53%) were infected with one larvae of parasites, 42(45.65%) were infected with two larvae of parasites and 21(22.82%) were infected with three larvae of parasites.

## CONCLUSION

The prevalence of eustrongylides larvae in *C. gariepinus* in Lake Hawassa than the previously reported from different lakes. Hence, proper waste and offal disposal should be implemented to avoid contamination of the lake; to break the life cycle of parasite and effective parasite control program should be incorporated in the management of the lake. On top of this providing of awareness to consumers about health problem consuming raw or slightly cooked fish to the community is very important.

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