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Major Pathogenic Crustacean Parasites of Commercially Important Fish Species in Southern Gulf of Lake Tana, North-West, Ethiopia

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Abstract: The study was conducted from November 2013 to April 2014 to investigate different pathogenic crustacean parasites on commercially important fish at southern gulf of Lake Tana. Totally, 624 fish sample were examined with naked eye and stereomicroscopy from the three genera of fish; this were 215, 209 and 200 for catfish (*C. garepienus),Labeobarbus* species and Nile tilapia (*O. niloticus*) respectively. From the total, 108 (17.3%) were found infected with four different species of crustacean parasites (*Argulus, Dolops, Ergasillus* and *Lernernids)* with prevalence rate of (8.2%), (8.5%), (4.3%) and (0.3%), respectively. The distribution of parasites among the external body part were on skin, fins, inner side of gill cover and on the gill filament with respective prevalence rate of 74(11.9%), 21(3.4%), 11(1.8%) and 27(4.3%) and these difference was statistically significant ($p<0.05$).The prevalence rate of crustacean parasites among female and male were 18.4% and 16.2% respectively and it was not statistically significant ($p>0.05$). In regard to the three genera of fish Catfish (*C.gariepinus*), Nile tilapia (*O.niloticus*) and *Labeobarbus* species the prevalence rate was 21.4%, 20.5% and 10.0% respectively and this difference was statistical significance ($p<0.05$). In conclusion *Argulus, Dolops, Ergasillus*and *Lernernids*parasite were investigated by different prevalence rate in this study.

Key words: Commercial · Crustacean · Fish · Lake Tana · Pathogenic · Southern Gulf

INTRODUCTION

Fish have the great economic value for food, recreation and aquarium use and also important to the ecology of water system. Consumption of fish provides an important nutrient to a large number of people worldwide and thus makes a very significant contribution to nutrition[1].A tremendous number of crustaceans have evolved to become dependent on certain animal for existence. Crustaceans have typically three tagmata, or body divisions: head, thorax and abdomen. Often these regions are difficult to distinguish because of fusion of various parts.

There are main groups of parasitic crustaceans affecting commercially important aquaculture species, most of which are external parasites: the branchiura, copepod and isopod [4]. Members of the branchiura and isopod are relatively large and both sexes are parasitic, while copepods, the most common Crustaceans parasites are generally small to microscopic with both free-living and parasitic stages in their life cycle [5]. Research regard to fish disease is in its infancy in Ethiopia as well as Lake Tana[1-10]. A preliminary survey of parasite and bacterial pathogen of fish at ziway by Yimer and Mulualem[6] indicates the occurrence and prevalence of fish disease in fresh water fish in Ethiopia. Since fish disease are one of the important aspect of modern fish farming, knowing the information on the occurrence and distribution of fish pathogen will be essential for our country as well as people who depends on fisheries for local consumption and export purpose.Most of the previous studies studied as a preliminary assessment.

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Dynamic nature of parasitic infection in fish; that depends on number of factors including environmental change and distribution of hosts necessitates the need for more work to be done. In particular, no research has been done concerning crustacean parasites specifically in Lake Tana so the present study designed to fill this gap. There for objective of this study was to investigate and estimate the prevalence of the pathogenic crustacean parasite on commercially important fish species on southern gulf of Lake Tana.

MATERIAL AND METHODS

Description of Study Area: Lake Tana is located in the northwestern of Ethiopia particularly in the Amhara National Regional State 563km far from the capital city Addiss Ababa. It situated at 12° N, 37° 15"??? E and 1,830m altitude northwest highlands.

Lake Tana basin is one of the major basins that significantly contribute to the livelihoods of tenmillions of people in the lower Nile river basin. It basin comprises a total area of 15,096 km^2 including the lake area [8]. Lake Tana is natural type of lake which covers 3000 – 3600 km^2 area at an elevation of 1800 m.a.s.l and with a maximum depth of 15 m. It is approximately 84 km long, 66 km wide [8]. The climate is typical of semi –arid region close to the equator with a high diurnal temperature variation between day time extremes of 30 °C to night lows of 6 °C for a tropical lake. Lake Tana has relatively low water temperature vary only with in a small limits (20.2-20.9 °C) [9]. The mean annual rainfall of the catchment area is about 1280 mm. The annual mean actual evapotranspiration and water yield of the catchment area is es-timated to be 773 mm and 392 mm, respec-tively [8].

The main tributaries in the lake are Gilgel Abbay (Little Nile), Megech, Gumara, Dirma and Ribe Rivers together they contribute 95% of the total annual inflow [10]. The Blue Nile is the only out flowing river. The shallow lake (average depth 8m maximum depth 14m) is Ethiopians largest lake containing halves the countries freshwater resource3 and the third largest in Nile basin. Based on chlorophyll content and Chemistry Lake Tana is oligomesotrophic [11]. The main commercially important fish species in Lake Tana and its tributaries are Nile tilapia (*Oreochromis niloticus*), African Catfish (*Clarias gariepinus*), *Beso* (*Varicorhinus beso*) and large *Barbus* (*Barbus intermedius* complex). The latter represent more than 60% of the commercial catch[12].

Sampling Method and Sample Size: The cross sectional study was conducted from November 2013 to April 2014 on commercially important fish at southern gulf of Lake Tana. The sample would obtained from both motorized and reed boat fishers. The sampele number was determined by using [13] by this principle since there was no any previous study conducted 50% would be expected prevalence (p) and the formula become:

$$n = \frac{1.96^2 \, P \exp (1 - \_ \, pexp}{d^2}$$

Where
(n) = required samplesize;
(P exp) = expected prevalence and
(d) = desired absolute precision.

Based on this calculation the total sample size was 384 but to increase accuracy the total fish sampled was 624.

Parasitic Examination: The fish for examination were accessed at Lake Tana from motorized and reed boat fishers. After examination, first the fish would be carefully examined immediately at the day of collection externally by careful observation for the presence of macroscopic crustacean parasite. *Dolops* and *Argulus* parasite were identified by observing under stereomicroscopone after collecting using 10% formalin.

Data Analysis: The study result was analyzed by using Microsoft excel 2007 for data entry and "SPSS" for using chi-square test to determine the prevalence, significance difference of different crustacean parasite among different external body site of fish, genera of fish and the two sex was calculated.

RESULTS

Size Distribution of Examined Fish: The body weights of sampled fish for the investigation of crustacean parasite were within the range of 200-1500, 300-1800 and 250-3000g for Nile tilapia (*Oreochromisniloticus), Labeobarbus*species and catfish (*Clariasgariepinus)* respectively. There corresponding body lengths were 21-35, 24-49 and 29-60cm respectively.

Occurrences of Crustacean Parasites in Lake Tana Commercially Important Fish: During study period totally 624 fish were examined and out of this catfish

(*C. garepienus*) (n=215(34.5%)), *Labeobarbus* species (n=209 (33.5%)) and Nile tilapia (*O. niloticus*) (n=200 (32.1%)). Out of the total 624 samples 108 (17.3%) were found infected with crustacean parasites. On the group Branchiura two genera of parasites which are *Argulus* and *Dolops* were found with the prevalence rate of (8.2%) and (8.5%) respectively and they took the highest prevalence rate from all the crustacean parasites. On the group Copepoda also two genera of crustacean parasites were found which are *Ergasillus* under the family Ergasilideaand *Lernernids*under Lerneaidea with the prevalence of (4.3%) and (0.3%) respectively.

Occurrence of Crustacean Parasites at Different External Body Part: From the external body part examined skin was highly infested by three parasite species with the total prevalence rate of 11.9% from this *Argulus* and *Dolops* species took the highest prevalence rate 5.3% and 6.2% respectively and least prevalent one was *Lernaeids*0.3%. The least infested body part were the fins and inner side of the gill cover that were infested by *Argulus* and *Dolops* with the prevalence rate of 1.6%and 1.8 for fins and 1.3% and 0.5% *s* for the inner side of the gill cover respectively. The gill was found infected only by one parasite *Ergasilus* species with the prevalence rate of 4.3%. There was a statistical significant difference in the prevalence of parasite among the difference site ($\chi 2$=6.240; p-value=0.00; p<0.05) for total prevalence with site and (χ^2=2.618; p-value=0.000; p<0.05) for individual parasite with site (Table 1).

Occurrence of Crustacean Parasites at Two Sex Group of Fish: From the total number of fish examined 309 were females and 315 males with the prevalence rate of 18.4% and 16.2% respectively. *Dolops* species of parasite took the highest prevalence rate 8.4% from all parasite species found in female fish. The second more prevalent parasite found was *Argulus* species with the prevalence rate of 7.4%. *Ergasilus* and *Lernaeids*species of parasite were also found with the prevalence rate of 3.6% and 0.6% respectively in female fish. In male fish *Argulus* took the highest prevalent rate 7.6% from all parasites found in male fish. The second and the third parasites were *Dolops* and *Ergasilus*species of parasite with the prevalence rate of 5.4% and 4.8% respectively whereas *Lernaeid*species of parasite was not found on male fish. But in general there was no statistical significance difference between the two sex group (χ^2=0.543; p-value=0.461; p>0.05) for total parasite prevalence and (χ^2=6.740; p-value=0.456; p>0.05) for individual parasite prevalence (Table 2) [14-20].

Occurrence of Pathogenic Crustacean Parasites among the Three Genera of Fish: From the three commercially important fish genera studied at the study sit, Catfish (*C.gariepinus*) were show high infestation by these crustacean parasites as compared with the other two. Catfish (*C.gariepinus*), Nile tilapia (*O.niloticus*) and *Labeobarbus* species shows prevalence rate of 21.4%, 20.5% and 10.0% respectively.

From all parasite group *Argulus* species was found the most prevalent (10.2%) in catfish (*C.gariepinus), Dolops* and *Ergasilus*species took the second and third level with the prevalence rate of 7.9% and 5.6% respectively. *Lernaeids* species of parasite were not found on catfish *(C.gariepinus*). In Nile tilapia (*O.niloticus*) species of fish *Argulus* and *Dolops* species of parasite took the highest prevalence rate 9.5% and 9.0% respectively. *Ergasilus* species of fish took the second level with the prevalence rate of 4% but *Lernaeids* parasites were not found.

From the three commercially important fish genera studied at the study site *Labeobarbus* species of fish was least infested by those crustacean parasites as compared to other two but the two *Lernaeid* parasites were found on this fish species. The prevalence rate of those four parasite species were 2.9%, 3.8%, 2.9% and 1% for *Argulus, Dolops, Ergasilus and Lernaeids* respectively. There was statistical significant difference in the prevalence of pathogenic crustacean parasite within the three genera of commercially important fish (χ^2=11.631; p-value=0.003; p<0.05) (Table 3)[21-31].

Table 1: Occurrence of crustacean parasites at different external body part

	Predilection sit				
Parasite species	Skin fins gill	Inner side of gill cover			Overall
Argulus	33(5.3%)	10(1.6%)	-	8(1.3%)	51(8.2%)
Dolops	39(6.2%)	11(1.8)	-	3(0.5%)	53(8.5%)
Ergasillus	-	-	27(4.3%)	-	27(4.3%)
Lernaeids	2 (0.3%)	_	_	-	2(0.3%)
Total	74(11.9%)	21 (3.4%)	27(4.3%)	11(1.8%)	133(21.3%)

χ^2=6.240; p-value=0.00; p<0.05 for total prevalence with site and χ^2=2.618; p-value=0.00; p<0.05 for individual parasite with site.

Table 2: Parasite and their prevalence in female and male fish

	Sex		
Parasites	Female	Male	overall
Argulus	23(7.4%)	24(7.6%)	47(7.5%)
Dolops	26(8.4%)	17(5.4%)	43(6.9%)
Ergasilus	11 (3.6%)	15(4.8%)	26(4.2%)
Lernaeids	2(0.6%)	-	2(0.3%)
Total	62(20.1%)	56(17.8%)	118(18.9%)

χ^2=0.543; p-value=0.461; p>0.05 for total parasite prevalence and χ^2=6.740; p-value=0.456; p>0.05 for individual parasite prevalence.

Table 3: Parasites and their prevalence among the three genera of fish

ParasitesFish species				
Catfish(*C.gariepinus*)	Nile tilapia (*O.niloticus)*	*Labeobarbus*species		overall
Argulus	22(10.2%)	19(9.5%)	6(2.9%)	47(7.5%)
Dolops	17(7.9%)	18(9.0%)	8(3.8%)	43(6.9%)
Ergasilus	12(5.6%)	8(4%)	6(2.9%)	26(4.2%)
Lernaeids	_	_	2(1.0%)	2(0.3%)
Total	51(23.7%)	45(22.5%)	22(10.5)	118(18.9%)

χ^2=19.974; p-value=0.010

From the total sample examined, 10 (1.6%) were infected by more than one crustacean parasites. These were 4(0.64%) *Argulus* and *Dolops*, 5(0.8%) *Argulus* and *Ergasilus* and 1(0.2%) *Dolops*and *Ergasilus.*

DISCUSSIONS

From the total fish examined in this southern gulf 108 (17.3%) were infected by crustacean parasites this is highly greater than that of Orion's (unpublished) result which was 7.9%. This could be because of the change in aquatic ecosystem as changes in the environment (natural or anthropogenic) can change the state of balance of the parasite between host and nature, thus resulting in disease. According to Orion (unpublished) studies at three sites which were the southern, eastern and western gulf of the lake; so the western and eastern gulf is not highly polluted but the southern gulf is become polluted from different waste of Bahir Dar town his result also higher on the southern gulf.

On the bases of the result of this study highly prevalent parasites were *Argulus* and *Dolops* under *Argulidae* (Branchiura) group. This could be due to their life cycle; in fresh water species, because mature female lay eggs in rows on any hard, submerged surface and this hard object mostly found on the shore line of the lake and the lake to the southern gulf have many aquatic plants which are also used for lying of eggs of *Argulids.*

The second most prevalent parasite was *Ergasilus* which is under Copepod it was reported as a common parasite in all major African water systems mostly West African water bodies and in some of the east African great lakes. It was recorded in Egypt freshwater cultured tilapia with the prevalence 20% at autumn season and 12% in summer season. In Ethiopia at Lake Tana it was recorded by Orion (unpublished) but its prevalence was 0.5% and very small when it compared with this result 4.2% and this could be due to the change of aquatic ecosystem of the southern gulf of Lake Tana. According to Marcoglies the changes can be environmental such as temperature, climate, or anthropogenic such as pollution and urbanization.

The other crustacean parasite was *Lernaeid* even though it was in less prevalence rate (0.2%). In Orion [14] (unpublished) study it was not found in Lake Tana fish this could be due to less intensity of the parasite or it may emerge as new parasite in the lake. This parasite was reported in all most all parts of the world even in Egypt six *Lernaeid* adult females were isolated from the goldfish with total prevalence of about 33.3 % andintensity of infection about 29 parasites/ fish.

From all, skin was the most affected external organ by those three parasites (*Argulus, Dolops and Lernaeids*). And that was due to the reason that it is an external organ on which parasites prefer for their stay and the parasites by their nature are external. Even though *Argulus* and *Dolops* are ectoparasites their attachment to the host is loose so they can easily remove from the host body so some parasites were found at the inner side of gill cove.

This used for the parasite to prevent them from water current. The Lernaeid parasites also called anchor worms and they attach to the host firmly was found on the skin with firm attachment. All *Ergasilus* parasite was found on the gill of the fish this is because they feed on gill tissue and mucus, [3] and this match with Orion (unpublished) result.

Theprevalence rate of crustacean parasites in female and male fish shows some difference but it is not statistically significant. But in some parasites there may be difference between the two sexes and this could be due to ecological change. For example, niche partitioning involving habitat or diet. This argued that such an ecological origin of parasitism would predict that either males or females could exhibit excess parasitism dependent on their probability of encountering the parasite and that excess parasitism in males may not be as a result of reduced immune competence. Quantitative differences in parasite infection between sexes can be expected and may be explained as a consequence of different habitat occupied by males and females, differences in the diet and/or physiology. However, several researchers found no consistent pattern of infection in terms of prevalence and intensity between males and females. In a study of flat fish, *Paralichthysadspersus*, (Pleuronectiformes) they found that sex affects mean abundance and prevalence for only six out of twenty five parasites. They observed that this means that differences are due mainly to diet and or physiology, but no differences in habitat could be expected for male and female flatfishes, as suggested by the absence of differences in monogenic parasites. Moreover were unable to find differences in diet of male and female are of*P.adspersus*. Thus, differences in some ecological parameters of the infectious process could be a consequence of differential physiology of male and female flatfishes. Guideline *al*. [26] reported that out of forty- one females and eighty-seven males of *Hemisorubimplatyrhychos* studied, there was a significant relationship between host sex and prevalence with the females being more infected.

From the result of this study catfish (*C.gariepinus)* was highly infested with the crustacean parasites and these could be due to softness of its skin and catfish (*C. gariepinus)* breed in flooded areas which is suitable for the breeding of *Argulidae* due to macrophytes growing so that fish can easily accessed by the parasite during that time [27].This result also agreed with Orion [14] (unpublished) (unpublished) result. Nile tilapia (*O.niloticus*) also show almost similar result with that catfish (*C. gariepinus)* and this could be even though the skin is scaly the feeding habit of the fish which is a herbivore and it also breed in a shaded areas with macrophytes which is suitable for parasitic breeding. And during harvesting fishermen collect both catfish and Nile tilapia in one collecting box so parasites can easily transfer from one fish to another fish and this may also contribute to elevation of the prevalence in Nile tilapia; this result contradict with Orion [14] (unpublished) result that shows significant difference in the prevalence of crustacean parasite. In *Labeobarbus*species the result shows less prevalence and the difference was statistically significant. This could be due to the living habit of this species of fish which is mostly lives deep area of the water body [28]. This habitat is not suitable for crustacean and other than the deep habitat of the lake barbus fish migrate to the mouth of the inflow of river at this area macrophyts and crustaceans could not develop due to water current. This result also argued with Orion [14] (unpublished) finding.

CONCLUSION

In this study of pathogenic crustacean parasite *Argulus Dolops Ergasillus*and *Lernernids*species of parasite were foundon commercially importantfish of Lake Tana With total prevalence rate of 17.3% From this the individual prevalence rate were (8.2%), (8.5%), (4.3%) and (0.3%) for *Argulus, DolopsErgasillus* and*Lernernids* respectively. *Argulus* and *Dolops* were found highly prevalent on the skin than fin and inner gill cover whereas *Ergasillu*s was found only on the gill filament. The crustacean parasites that found by this study were not sex specific. The result shows that the prevalence of those parasites varies in the three genera of commercially important fish. Catfish (*C.gariepinus*) and Nile tilapia (*O.niloticus*) were highly infested by *Agulus*and *Dolops*. This study also shows increasing of crustacean parasite prevalence in southern gulf of Lake Tana when compared to other studies. Based on this result change in the aquatic ecosystem also affects the occurrence of the parasite.

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