A Study of Diplostomum Parasites Affecting Oreochromis niloticus in Chepkoilel Fish Farm and Two Dams in Eldoret-Kenya

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Abstract
The *Diplostomum* parasite completes its life-cycle in fish eating birds, but spends considerable time in the eye vitreous humor of many fresh water fishes. Its infection in fish causes severe ocular pathology, and leads to increased susceptibility to predation. A study on *Diplostomum* parasites was conducted at Chepkoilel University with an objective of assessing its parasitic indices and effects on *O. niloticus.* A total of 40 fish were collected from the fish farm and 155 from the dams between November 2010 and January, 2011. Fish were weighed and length measured to ascertain their condition factor. The fish were observed for the *Diplostomum* parasite to ascertain parasitic indices in the different habitats. The parasite abundance was related to fish size and condition factor to determine parasite's effect on *O. niloticus*. Fish were found to have a parasitic prevalence (%) of 100, 84 and 66 in Kerita dam, Kesses dam and Chepkoilel fish farm. Parasite mean intensity was 12, 9 and 14 respectively.The wellbeing of the fish was not compromised by the parasites, as was seen in the correlation between condition factor and parasite abundance. There was a Pearson correlation of P = 0.357, 0.516 and 0.565 in Kerita dam, Kesses dam and Chepkoilel fish farm respectively. The dams and the fish farm did not pose significant difference in the parasitic indices, probably due to their proximity. There was seen equal abundance in both fish sexes, implying no sex preference in infection.
Keywords: *Diplostomum*, *Oreochromis niloticus,* prevalence, Abundance, Mean intensity, Condition factor.

1.0 Introduction
The metacercariae of *Diplostomum spp* lives in the eye vitreous humour and the lenses of many freshwater fish without undergoing encystation. *Diplostomum* sp. is widely distributed and one of the commonest parasites of freshwater fishes. This is to some extent due to the acceptance by the parasite of a wide range of hosts at all stages of the lifecycle and also because of extensive dissemination of parasite eggs through the migration and local movement of fish-eating birds. Its infection in fish leads to severe ocular pathology, which increases vulnerability to predation. This disease caused by the parasite, diplostomiasis, parasitic cataract or eyefluke disease is caused by invasion of the eye by larval stage of the parasite which becomes established and grow within the vitreous (Pike and Lewis, 1994).

Diplostomum sp. utilizes many fishes as second intermediate host. Several fish eating birds e.g. heron (*Ardea purpurea*) are primary hosts of the parasite (Parpena, 1980). Their distribution is in many temperate areas of North America, Europe, Asia and Africa (George, 1987).

2.0 Methods
2.1 Study Area
The study was conducted in Uasin Gishu District, with all the sampling stations being within less than 100 km proximity to one another. Uasin Gishu District has common borders with Trans-Nzoia District to the north, Marakwet and Keiyo District to the east, Koibatek District to the south-east, Kericho District to the south, Nandi District to the west and Lugari District to the north-west. Uasin Gishu District is between longitude 34^{o} 50' and 35^{o} 37' east and 0^{o} 03' and 0^{o} 55' north.

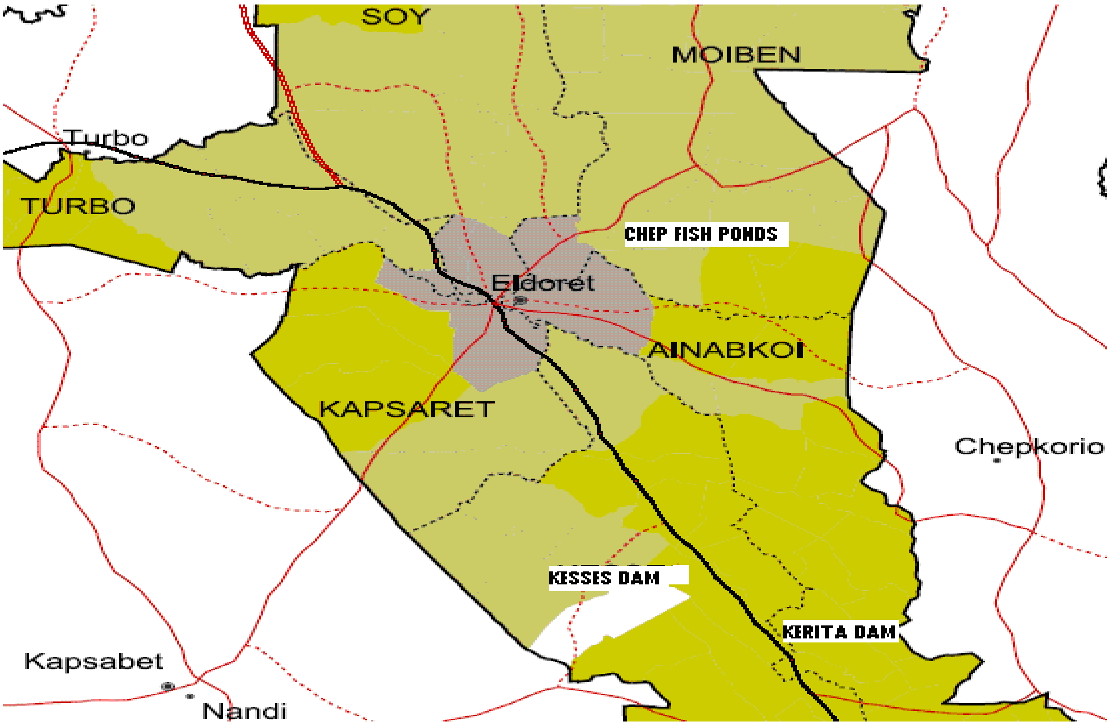

Figure 1: Sampling sites; Chepkoilel fish ponds, Kesses dam and Kerita dam (map not to scale)

2.2 Collection of fish samples

A total of 195 *O. niloticus* were collected between November 2010 and January 2011. 40 of these were from the earthen rearing ponds in Chepkoilel University College fish farm, 78 from Kesses Dam and 77 from Kerita Dam (Figure 1). The fish were caught randomly using a mosquito net of mesh size of 10 mm in the ponds. Gill nets of 2.5 to 5 inches were used to catch fish in the dams. Parasites were removed from freshly killed fish to ensure easy detection of the parasites.

2.3 Parasitic data collection

Fish was weighed to the nearest 0.1 grams using analytical weighing balance after blot-drying excess water from the body. The total and standard lengths were measured to the nearest 0.1 centimeters using a measuring board. The total length was used as a measure of body size of the fish species. The sex of the fish was determined by observing the testes or ovaries after dissection.

2.4 Examination of fish for parasites

To remove the eyes, the skin around the orbit was cut with the tips of a sharp scissors and the eyes pulled with forceps. The eye muscles and the optic nerve were cut and the eyes removed and placed in a petri dish. An incision was made around the eye ball in the equatorial plane and the anterior chamber removed. The vitreous and the lens from the posterior chamber were observed separately under a dissecting microscope. The number of *Diplostomum* sp. metacercariae present from each fish were counted and recorded. The metacercariae in the vitreous was more elongated than those in the lens. The body of metacercariae in the vitreous was elongated and tapering at both ends. The anterior part was broader than the posterior end and longer than wide, dorso-ventrally flattened, unsegmented and possessed oral suckers. Parasitic indices were calculated according to Bush *et al.* (1997)

2.5 Statistical analysis

To determine the relationships between condition factor and the number of parasites, Pearson product moment correlation coefficient was used. Chi-square was then used to compare the prevalence of Diplostomum sp. infection between the ponds and the dams. This was done using MINITAB Statistical Software Release 14. The statistical significance was set at $\alpha = 0.05$. Excel Spreadsheet was used to calculate the condition factor.

3.0 Results

3.1 Parasitic indices

3.1.1 Prevalence

Metacercariae of *Diplostomum* sp. were found actively moving in the vitreous humor and lens. The number of *Diplostomum* sp. in the vitreous was higher than those in the lens in all sampling sites. Prevalence among fish from Kerita dam, Kesses and Chepkoilel fish farm was 100%, 66 % and 84% respectively (Figure 2).

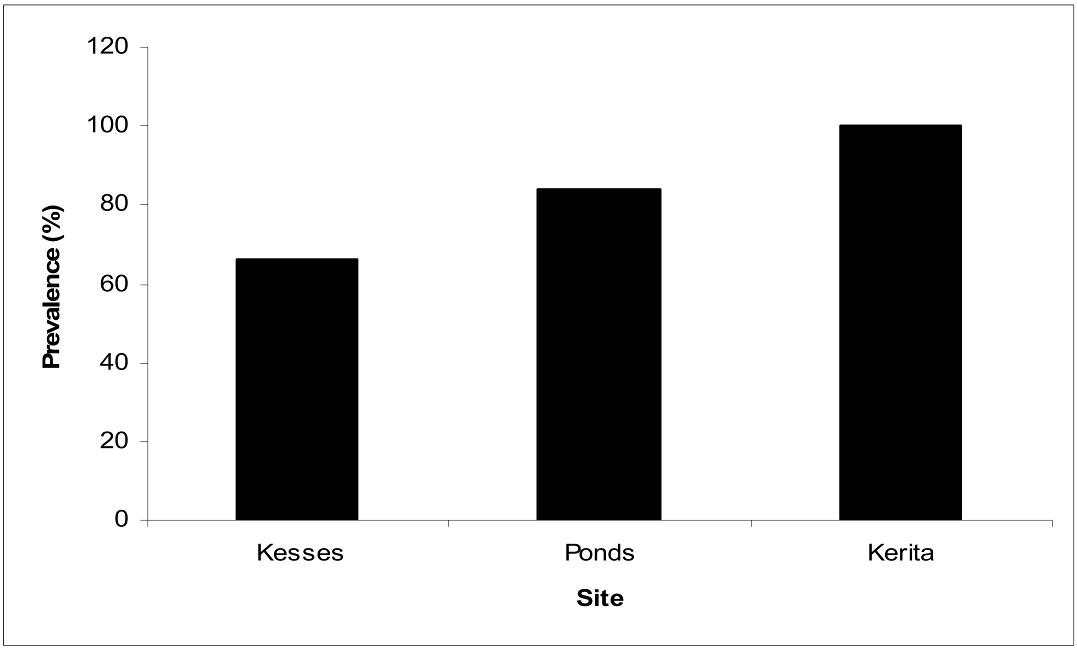

Figure 2: Prevalence of *Diplostomum* sp. on *O. niloticus* from Chepkoilel fish ponds, Kesses dam and Kerita dam. There was found no significant differences in the sites of study at α 0.05.

3.1.2 Mean intensity

O. niloticus from Kesses dam had a mean intensity of 9 parasites per host fish with an abundance range of between 0 and 29 parasite. Chepkoilel fish ponds had a mean intensity of 14 parasites per fish with an abundance range of between 4 and 64 metacercariae. Kerita dam had a mean intensity of 12 parasites per fish with and abundance range of between 1 and 34 parasites (Figure 3).

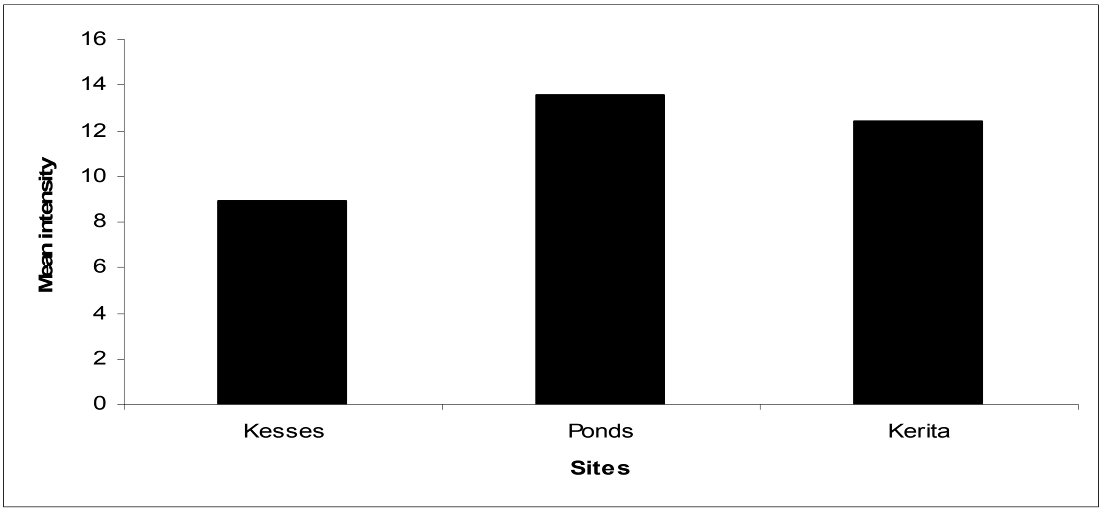

Figure 3: Mean intensity of *Diplostomum* sp. on *O. niloticus* from Chepkoilel fish ponds, Kesses dam and Kerita dam with no significant difference at α 0.05.

3.1.3 Relationship between the number of parasites and the fish's condition factor (Kn)

There was no significant relationship between number of parasites and fish condition factor in all the study sites. (Pearson correlation; *P = 0.516, P = 0.565, P = 0.357* respectively). This meant that the condition factor of the fish did not decrease with increase in the number of *Diplostomum* sp. metacercariae in the eyes of the fish as shown in figures 4,5 and 6.

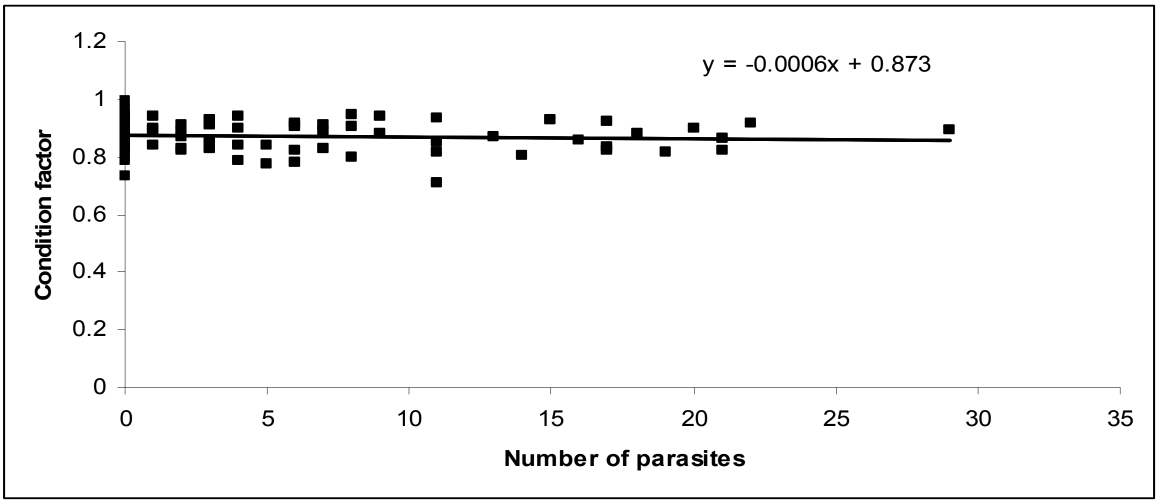

Figure 4: Relationship between the number of parasites and the condition factor in Kesses dam.

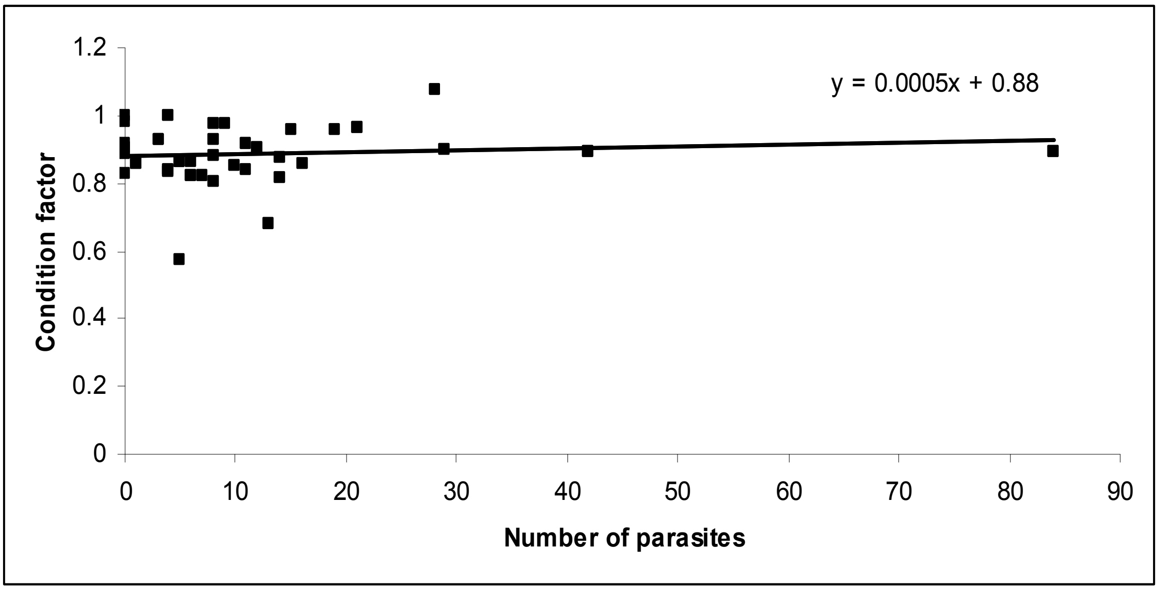

Figure 5 Relationship between the number of parasites and the condition factor in Chepkoilel fish farm.

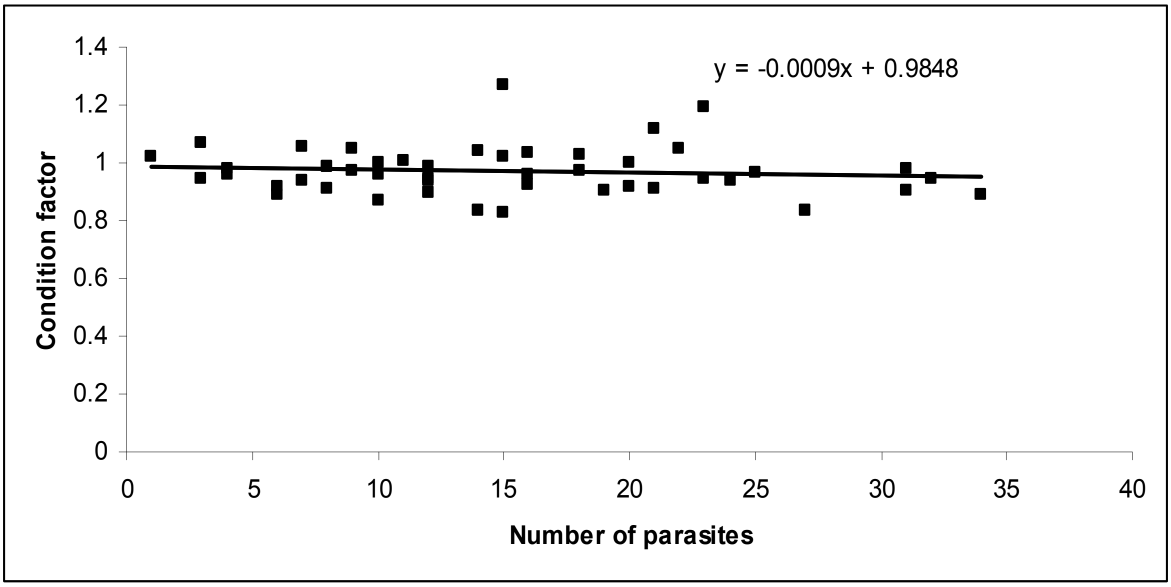

Figure 6: Relationship between the number of parasites and the condition factor in Kerita dam

3.1.4 Comparison of infection prevalence (%) between fish samples from Chepkoilel fish farm and the dams.

There was no significant difference in prevalence of *Diplostomum* sp. between Chepkoilel fish ponds and Kesses dam (Chi-Sq = 0.012, DF = 1, P-Value = 0.914).

Also there was no significant difference in prevalence of the parasite between the fish farm and Kerita dam. (Chi-Sq = 0.697, DF = 1, P-Value = 0.404)

3.1.5 Infection of *Diplostomum* sp. between sexes

There was no significant difference in *Diplostomum* sp. infection between the male and female *O. niloticus* in the three sampling sites: Kesses dam, Chepkoilel fish farm and Kerita dam (two sample t- test, $P = 0.982$, $P = 0.126$ and $P = 0.933$ respectively).

4.0 Discussion and Conclusion

4.1 Parasitic indices

In this study, it was found that prevalence among fish from Kerita dam, Kesses dam and Chepkoilel fish farm was 100%, 66%, and84% respectively. However, *Diplostomum* metacercariae have been observed in Kenya with prevalence values of 52% for pond farmed fish and 50% in wild fish (Fioravanti *et al*, 2009). Kerita dam recorded the highest parasitic prevalence at 100%, probably due to the fact that many piscivorous birds (mostly herons) were spotted around the dam than were seen in Kesses dam. Studies of parasitic diseases in cultured fish have suggested that extensive monoculture favors persistence of a wide variety of parasitic diseases, since high stocking densities favor increased parasite populations. Therefore the relatively higher infection levels in culture ponds can be attributed to high stocking densities as compared to those in dams.

4.2 Relationship between the number of parasites and the condition factor of fish

Although infection with cercariae such as *Diplostomum compactum* can produce severe damage in hosts including death, the metacercariae counts in the eyes of the host fish during the study were not sufficient to affect their condition factor. Eye flukes are known to cause emaciation, blindness, and death in fish (Shariff et al. 1980; Chappell, 1995). Disruption of vision by metacercariae in the eyes may reduce feeding efficiency, as was observed in dace (*Leuciscus leuciscus*) and threespine sticklebacks (*Gasterosteus aculeatus*). Massive fish kills due to D. *compactum* metacercariae infections in the eyes of cultivated tilapias have been documented in Malpaso and La Angostura reservoirs in the state of Chiapas, Mexico (Chappell, 1995). Total blindness can result when metacercariae counts exceed 40 individuals per eye, depending on fish size (Evans et al. 1976). Under these circumstances, the affected host can lose the capacity to feed, causing growth delays, weight loss and eventual direct mortality by starvation, or indirect mortality by increased vulnerability to predation (Kennedy 1974).

However, using the data reported herein, no effect of *Diplostomum* sp. on growth or condition, as measured by condition factor was detected although the number of *Diplostomum* sp. per individual exceeded 40. This can be attributed to the fact that there were a few number of metacerceriae in the lens to affect the fish condition factor.

4.3 Comparison of prevalence of ponds and dams

According to this study the prevalence of infection between the ponds and both the dams was not significantly different. This is probably because all the sampling sites are found within the same area and therefore exposed to similar ecological conditions. These conditions include temperature, snail species and birds which are definitive hosts of the parasite. The birds spotted at Chepkoilel fish farm, Kerita dam and Kesses dam are cormorant, *Phalacrocorax carbo*; Duck, *Anas* sp.; Grey heron, *Ardea cinerea* and Pied king fisher, *Ceryle rudis*.

4.4 Infection levels according to sex of fish

This study revealed that the parasite had no preference of either male or female fish. However, studies by Mohammed (2005) have shown that *Diplostomum* sp. have high prevalence of infection in males. Still, some authors have suggested that sex differences in disease and parasites have evolved just as sex differences in morphology and behavior, and that they result from selection acting differently on males and females.

Conclusion

Diplostomum parasites affecting *O. niloticus* have no significant contribution to the condition of the affected host. Therefore, this implies that the parasite affects only the visual capacity of the host, thus increasing its vulnerability to predation within duration not warrant great disruption of the host physiological processes.

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