# Endo-helminths Infestation in Nile Perch, *Lates niloticus*, (L.,) and Nile Tilapia, *Oreochromis niloticus* (L.,) in Winam Gulf of Lake Victoria, Kenya

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## Abstract

Nile tilapia, *Oreochromis niloticus* (L., 1758) and Nile perch, *Lates niloticus* (L., 1758) were introduced into Lake Victoria in 1950, mainly to boost the fishing economy. Parasitic infections remain a major concern to the fish industry. It has recently been identified as an important public health problem with considerable economic impact. Data on parasitic infections on the two fish species is scarce; particularly in the Winam Gulf of Lake Victoria. Therefore, this study aimed at investigating the prevalence, mean intensity and mean abundance of endo-helminths infecting *O. niloticus* and *L. niloticus* in the Gulf. A total of 320 fish comprising 151 *O. niloticus* and 169 *L. niloticus* were caught weekly and transported alive to Egerton University. Prior to examination, fish were killed humanely by cervical dislocation. The total length were taken using a calibrated dissecting board and weights were obtained using a sensitive weighing balance (Sartorius ED4202S). Fish were dissected immediately and subjected to parasitological examination using standard procedures. Eleven parasite taxa were recovered from *O. niloticus*, with *Tylodelphys* sp. dominating the community. On the other hand, six parasite taxa were recordedfrom *L. niloticus*, with *Armithalingamia macracantha* dominating (P =5.3% MI = 4.6 and MA = 0.2). We conclude that *L. niloticus* had a poor parasite fauna, while *O. niloticus* had a rich parasite fauna. Despite the low infection level of *Bothriocephalus acheilognathi* and *Heterophyes* sp., are still the major parasites of concern, especially considering their potential zoonotic effect.

**Key words:** Prevalence, mean intensity, mean abundance, *Oreochromis niloticus*, *Lates niloticus*

## Introduction

The Nile tilapia, *Oreochromis niloticus* (L., 1758) and the Nile perch, *Lates niloticus* (L., 1758) were introduced into Lake Victoria, Kenya in 1950, to boost the fishing economy and sport fishing particularly for *L. niloticus* (Sikoyo, 2004 and Pringle, 2005). Currently, these two are the most abundant and economically important fish in Lake Victoria (Ogutu-Ohwayo, 2004). About 93.7% of the fish production in Kenya comes from Lake Victoria alone contributing to 0.3 % GDP of Kenya. Capture fisheries of Lake Victoria are a source of livelihood to many people employed directly as boat owners; fishermen (40,078); fish traders; fish processors and indirectly as fishing gear manufacturers; boat builders and ice producers among others (Otieno, 2011). Despite the great interest in commercial exploitation of the fish fauna in the lake, their parasites have received very little attention. Until recently, the work of Khalil and Thurston (1973); Paperna (1980); Mbahinzireki (1984); Musiba (2004); and Mwita and Nkwengulila (2004) were the only studies on the parasites of fish from Lake Victoria. Majority of the studies are of taxonomical nature and from other gulfs of the lake, not from Winam Gulf. Helminths are fish's important parasites. They include; nematodes, trematodes, cestodes and acanthocephalans which affect both wild and cultured fishes (Hussen *et al*., 2012).

For many endo-helminths, fish act as an intermediate host. It has also been found that the larval of endo-helminths occur everywhere and frequently in the brain, muscle and eyes (Douëllou, 1992). The pathology associated with macro-parasites is directly proportional to parasites intensity (Lasee, 1995). Endo-parasites also compete for food, thereby depriving fish of essential nutrients and inhibiting growth leading to morbidity and mortality with consequent economic losses (Khalil and Polling, 1997). Consuming raw or improperly cooked or processed fish is the main source of infections in humans, and this has been reported from various geographical regions (Park *et al*., 2009). The World Health Organization (WHO) has estimated that the number of people currently infected with fish-borne trematodes exceeds 18 million, and many more are at risk (WHO 1995). Data on parasitic infestations in Nile perch and Nile tilapia is very scarce; particularly in the Winam Gulf of Lake Victoria. Therefore, this study aimed at investigating the prevalence, mean intensity and mean abundance of endohelminths infecting two commercially important species in Winam Gulf, Lake Victoria, Kenya.

## Materials and Methods

### Study Area

Lake Victoria is the largest tropical lake in the world, and is shared between Tanzania, Uganda and Kenya. Only 6% of the total lake area is in the Republic of Kenya. The lake lies in a shallow continental sag between the two arms of the Great Rift Valley, 1170 m above sea level. The lake has a maximum depth of 84 m, a volume of 2760 $km^3$, an average depth of 40 metres and a surface area of 68,800 $km^2$ (Bootsma and Hecky, 1993). The mean surface temperature is about $25^0$C, while the temperature of deeper layers is about 1 to 2 degrees lower (Witte and Van Densen, 1995). The primary inflows into the lake basin originate from the slopes of the western ridge of the East African Rift Valley including; Sio, Nzoia, Yala, Nyando, Sondu Miriu, Kuja, Kibos and Kisat rivers. The present study was conducted in Dunga beach, at ($00^0$ 08´ 52.6´´ S, $034^0$44´ 04.8´´ E, 1146 metres above sea level (a.s.l)), Kendu bay ($00^0$ 11.827´´ S, $034^0$ 46.991´E, 1141 meters above sea level) and Nyamware Beach ($00^0$ 10.600 ´´S, $034^0$ 46.516´ E, 1139 m a. s. l) in the Winam Gulf (Kavirondo) which stretches from $34^0$13' and $34^0$ 52' East to $0^0$4' and $0^0$32' South (Figure 1).

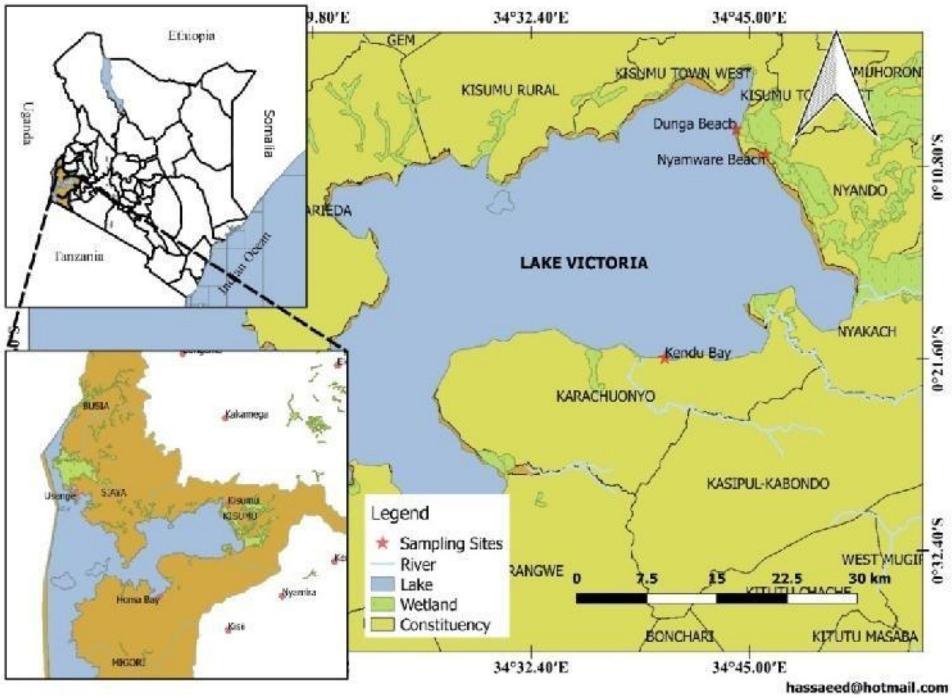


*Figure 1: Map of the study area showing the location of the study sites (Dunga, Nyamware beach and Kendu bay) in Winam Gulf of Lake Victoria (Saeed, 2017)*

The Gulf has an average depth of 6-8 m and a shoreline extending up to approximately 550 km (Gordon *et al*., 2009). The surface water temperatures range between 23.5$^0$ C and 29.0 $^0$C. Wind induced currents influence water mixing in the gulf. The Secchi transparency ranges from 35 to 155 cm.

## Fish Sampling and Examination

A total of 151 *O. niloticus* and 169 *L. niloticus* were caught using seine netting by fishermen between March and May 2016 (weekly). The fish were killed humanely by cervical dislocation and their total lengths and weights measured. This was followed by dissection prior to parasitological examinations. The eyes, gills, brain, kidney, liver, spleen, intestine, gut, gall bladder, swim bladder, urinary bladder, muscles and body cavity were examined. The acanthocephalans, nematodes, trematodes, and cestodes were processed using standard parasitological methods and identified based on their morphological structures following standard techniques by Anderson (2000), and Paperna (1996). Nematodes were stained with Horen's trichome stain, cleared in lactophenol and temporary mounts made in lactophenol examined under the light microscope at ×100, ×400 and ×1000 magnification (Biu and Akorede, 2013). Trematodes, cestodes and acanthocephalans were stained with Grenache's borax carmine (Mahony, 1973); fixed and preserved in either 4% formalin or ethanol (96 %).

## Data Analysis

The prevalence (P), mean intensity (MI) and mean abundance (MA) were calculated as described by Bush *et al*., (1997). The parasite community structure was described using the Shannon-wiener index, Simpson's index, the Margalef Richness index and Berger-parker Dominance index

(Magurran 1988). These indexes were calculated using online Biodiversity calculator (Danoff-burg and Xu, 2005).

## Results and Discussion

Parasites were present in 75.5% of all *O. niloticus* examined. Almost all the infected *O. niloticus* had more than one parasite taxon. The parasite taxa identified were: *Acanthosentis tilapiae Armithalingamia macracantha*, *Contracaecum multipapillatum*, *Proteocephalus largoprolotis*, and *strigeid*sp. *Procamallanus laevionchus*, *Tylodelphys* sp., *Neascus* sp., *Clinostomum tilapiae* and an *Heterophyes* sp. *Tylodelphys* (Digenea) was dominating with a prevalence of 31.8 %, mean intensity of 9.4 ± 10.1 and mean abundance of 3.0.This metacercariae was found actively swimming alive in the eye (aqueous humour) (Table 1). Majority of the parasites were found aggregating in the intestinal wall while the rest were found in the gut, gill, muscle and gallbladder.

**Table 1: Occurrence of Endo-helminths in *Oreochromis niloticus* in Winam Gulf of Lake Victoria, Kenya (n=151, SD± standard deviation)**

| Parasite | Site of infection | No infected | P (%) | MI±SD | MA |
|---|---|---|---|---|---|
| *Acanthosentis tilapiae* | Intestinal wall | 32 | 21.2 | 1.8±1.5 | 0.37 |
| *Armithalingamia macracantha* | Intestinal wall/gut | 8 | 5.3 | 1.8±1.2 | 0.09 |
| *Contracaecum multipapillatum* | Intestinal wall | 15 | 9.9 | 1.5±0.5 | 0.15 |
| *Clinostomum tilapiae* | Gill | 1 | 0.7 | 1±0.0 | 0.01 |
| *Neascus* sp | Skin | 1 | 0.7 | 1±0.0 | 0.01 |
| *Heterophyes* sp | Muscle | 3 | 2.0 | 1±0.0 | 0.02 |
| *Proteocephalus largoprolotis* | Intestinal wall | 1 | 0.7 | 1±0.0 | 0.01 |
| *Procamallanus laevionchus* | Intestinal wall | 3 | 2.0 | 2.3±0.6 | 0.05 |
| *Tylodelphys* sp | Eye | 48 | 31.8 | 9.4±10.1 | 3.0 |
| *Strigeid*sp | Gall bladder | 1 | 0.7 | 1±0.0 | 0.01 |

P = prevalence; MI = mean intensity; MA = mean abundance

Parasites were present in 16.6 % of all specimens of *L. niloticus* examined. Six parasite taxa were recovered from this host namely: *A. macracantha*, *Acanthosentis* sp. *C. multipapillatum*, *Bothriocephalus acheilognathi*, *Tylodelphys* sp. *And Strigeid.* The dominant species in terms of prevalence; was *A. macracantha* with the prevalence of 5.3 %. Majority of the parasites were recovered from the intestinal wall and the gut while the other organs such as liver, spleen, and eyes were also infected (Table 2).

**Table 2: Occurrence of endo-helminthes in *Lates niloticus* from Winam Gulf of Lake Victoria, Kenya (n=169, SD± standard deviation)**

| Parasites | Site of infection | No infected | P (%) | MI±SD | MA |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| *Armithalingamia macracantha* | Intestinal wall/gut | 9 | 5.3 | 4.6±5.9 | 0.2 |
| *Acanthosentis* sp | Liver/gallbladder/intestine | 4 | 2.4 | 2.3±1.5 | 0.05 |
| *Contracaecum multipapillatum* | Intestine/gut | 9 | 5.3 | 3.1±1.5 | 0.2 |
| *Bothriocephalus acheilognathi* | Intestinal wall | 1 | 0.6 | 1.0±0.0 | 0.01 |
| *Tylodelphys* sp | Eye | 3 | 1.8 | 1.0±0.6 | 0.02 |
| *Strigeid*sp | Spleen | 1 | 0.6 | 8±0.0 | 0.05 |

P = Prevalence; MI = Mean intensity; MA = Mean abundance

Moreover, *L. niloticus* was infected by a relatively rich species of parasite endo-helminths species (Shannon-Wiener index 1.77) compared to *O. niloticus* with 1.18). However, Margalef Richness index of 1.58 was recorded from parasite species of *O. niloticus* as compared to Margalef Richness index of 1.12 from *L. niloticus* (Table 3).

**Table 3: Parasite component diversity characteristics of the fish studied from Winam Gulf of Lake Victoria, Kenya**

| Total component communities | *Oreochromis niloticus* | *Lates niloticus* |
|---|---|---|
| Number of fish | 151 | 169 |
| Number of parasite species | 10 | 6 |
| Shannon-wiener index | 1.18 | 1.77 |
| Margalef Richness index | 1.58 | 1.12 |
| Dominant taxon | *Tylodelphys* sp | *A. macracantha* |

With the growing interest in the development of fishing industry in Kenya, there will be an increasing awareness of importance of fish endo-helminths as one of the major detrimental factors in culturing fish in near future (ADF, 2004). With regard to fish farming or aquaculture some endo-helminths parasites may be highly pathogenic and contribute to high fish mortalities and economic loss, while in natural systems they may threaten the abundance and diversity of native fish species (Mashengo, 2001).

This study revealed an overall helminth proportion of 75.5 % in *O. niloticus* and 16.6 % in *L. niloticus*. The overall infection proportionin *O. niloticus* was relatively high compared to other studies. For example, Amare (2014) reported an overall infection rate e of 50.22% internal parasites in *O. niloticus* from Lake Lugo, Northern Ethiopia; Bekele (2015) reported an overall rate of 16.74% internal parasites from *O. niloticus* in Lake Ziway, Ethiopia; and Biu *et al*., (2014) study in Lake Alau, reported an overall prevalence of 26.3% in *O. niloticus* Maiduguri, Nigeria. The variation of the infection levels between these lakes are probably due to geographical differences offering suitable habits for the parasites and/or affecting the susceptibility of the hosts and the availability of intermediate hosts. Other studies have shown that when new species were introduced into Lake Victoria, there were no attempts made to remove the parasites prior to introduction to the lake (Khalil and Thurston, 1973). Mwita (2014) made an attempt to find out the original parasites and the introduced ones in studies on the parasites of Clariid fish in Mwanza Gulf of Lake Victoria, Tanzania. The study found out that five (*Neogoezia* sp., *Comephoronema* sp.; *Trevnema* sp.; *Quimperia* sp. and *Gendria tilapiae*) among the 32 parasites species found were the original parasites of Lake Victoria before the introduction of alien species. The reason for the absence of these five parasites species in this study could possibly have been due to their host specificity. Therefore, the endohelminths found in this study could have been introduced with the new species.

The reason for the higher parasite taxa on *O. niloticus* than *L. niloticus* may be related to differences in diet in which *O. niloticus,* being omnivorous, feed on what is most available and close to them such as detritus, benthic invertebrates like arthropods; mollusks, mud and small fish. *L. niloticus* occupies deep waters while *O. niloticus* dwell in littoral zones close to the shore where intermediate hosts could possibly be in abundance. All these observations could explain the susceptibility of *O. niloticus* to endohelminths infection compared to *L. niloticus.* This was in agreement with the study by Munyaho (2004) in Lake Victoria, who arrived at the hypothesis that, *L. niloticus* is shielded away from piscivorous birds, infected snails and excessive pollution due to dilution effect in the deeper waters away from the shore.

In the present study, *Tylodelphys* sp. had a higher prevalence of 31.8 % in *O. niloticus* as compared to 1.8 % in *L. niloticus*. The differences in infection levels of *Tylodelphys* sp. from the two fish species could be explained by the chance closeness of infected snails in the area. This was in agreement with Otachi (2009) who reported that chance proximity of infected snails could have implications on prevalence at any one time during sampling. *O. niloticus* prefers shallower waters, where incidentally snails prefer. The presence of *Tylodelphys* sp. in most of *O. niloticus* examined supports the studies by Stables and Chappell (1986) on their almost ubiquitous presence in freshwater fish.

The nematode, *Contracaecum multipapillatum* was found in both species, with *O. niloticus* exhibiting higher prevalence of 9.9 % as compared to 5.3% prevalence in *L. niloticus*. However, a higher mean intensities of 3.1 was recorded from *L. niloticus*. This difference may be a reflection of the differences in feeding habit. The low infection levels observed in this study may indicate low abundance of suitable intermediate hosts particularly pelicans at the sites. This was in line with Paperna (1974) who mentioned that *Contracaecum* parasite is linked with migration of piscivorous birds, particularly pelicans.

Due to lack of prior studies on parasites of these two commercially important fish species, particularly in Winam Gulf of Lake Victoria, we can compare with findings from other systems on similar parasite species from the same fish in Kenya. For example, Gichohi (2008) reported a higher prevalence of 11.6 % *Contracaecum* sp. in wild tilapia from Tana River, Kenya. This parasite species was reported everywhere including Lake Victoria and elsewhere in Africa (Mbahinzireki, 1984, Boomker, 1994; Aloo, 2002). Even if this parasite occurred in high intensities, it does little damages to their hosts (Aloo, 1999), but may render the fish unpleasant for human consumption or may lead to rejection in the market especially if the larvae encyst in the muscle tissue. In an experimental trial that was conducted in Brazil it was demonstrated that

*C.multipapillatum* larvae can cause pathology in cats and rabbits (Vidal-Martinez *et al*., 1994), pointing out the zoonotic potential of this anisakid species to human.

The acanthocephalans found during this survey from *O. niloticus* and *L. niloticus* were identified as *A. tilapiae* 21.5% and *Acanthosentis* sp. 2.4 % respectively. The prevalence of *A. tilapiae* in *O. niloticus* in this study was very low compared to studies such as that by Douëllou (1992) who recorded 63% of *A. tilapiae* from tilapia sp. fish in Lake Kariba, Zimbabwe to be infected. Similar species, '*Acanthosentis*' was reported from other systems.
For instance; Florio *et al*., (2009) found 7.1 % *Acanthosentis* sp. in Kenya and 13 % from Uganda in all the systems (wild and caged) considered with mean intensities ranging from 1.7 to 2.7 parasites/hosts. The differences in prevalences rate could be attributed to feeding habits or the availability of intermediate hosts (Crustaceans).

The cestodes, *A. macracantha*, occurred in both fish species with a similar prevalence of 5.3 %. However, a higher mean intensity of 4.6 was recorded from *L. niloticus*. This may be due to the availability of intermediate hosts possibly copepods (Cyclops). The presence of this cestode from both fish species may indicate the spread distribution of infected Cormorants and possibly presence of crustaceans as suitable intermediate hosts in the Gulf. There is no information about this endo-helminths in Lake Victoria regarding both *O. niloticus and L. niloticus*, but in other systems in Kenya and elsewhere. For instance; Florio *et al*., (2009) reported a prevalence of 14.2% in *O. niloticus* from pond and cage-cultured in Kenya; Akoll *et al*., (2012) reported a prevalence of 38% in *O. niloticus* in various water bodies in Uganda. These differences showed that parasitic infection vary greatly from one system to another and this may depend on a number of factors; which include differences in physical and chemical conditions of the water, and the occurrence of intermediate hosts. The climatic conditions of the area, season and host parasite relationship could also explain the differences. Furthermore, this parasite species was predominantly found in the intestinal wall and in the gut as well, which go contrary with the studies of Aloo (2002); Florio *et al*., (2009); Akoll *et al*., (2012); Otachi *et al*., (2014) who all reported it encysting in the liver as well as in the intestinal wall of tilapias.

In conclusion, it should be noted that despite their low infection levels in the studied fish, the presence of parasites in fish need to be looked into carefully. Some of these parasites like *Heterophyes* sp. raises public health concerns, especially when the infested fish is eaten raw or slightly cooked or smoked at temperatures that are not high enough to kill the parasites (cold smoking). In order to mitigate the likely zoonotic challenges, proper cooking, hot smoking and freezing of fish at low temperatures are recommended.

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