Sahel Journal of Life Sciences FUDMA (SAJOLS)
December 2023 Vol. 1(1): 1-7
ISSN: 3027-0456 (Print)
ISSN: xxxx-xxxx (Online)
DOI: *https://doi.org/10.33003/sajols-2023-0101-001*
https://saheljls.fudutsinma.edu.ng/index.php/saheljls/article/view/6

Research Article

A Survey of Ecto-Parasites in *Oreochromis niloticus* (Linnaeus, 1758) (Nile Tilapia) in Zobe Reservoir, Katsina State

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Received: 28th November, 2023 **Accepted:** 21st December, 2023 **Published:** 31st December, 2023

ABSTRACT

This study examined the occurrence and severity of ectoparasitic infestations in *Oreochromis* niloticus (Nile Tilapia) sourced from Zobe Artificial Lake in Dutsin-Ma, Katsina State. A total of 108 Nile tilapia specimens were collected from Zobe Reservoir in Dutsin-Ma, Katsina, Nigeria at bi-weekly intervals during the period from July- September; 2023 for the discovery of ectoparasites and subjected to thorough parasitological examination. Experimental samples was range between 10.0-15.0cm fry, 16.1-20.0cm fingerlings, 21.0-25.0cm adults. Among the examined male Nile tilapia, 40 (45.45%) were found to be infected with ecto-parasites, while a higher infection rate of 75.00% was observed among the females. Overall infection of 55 (50.92%) was recorded in this study. Among the examined individuals, 21 (46.67%) were infected with *Trichodina* spp on the skin. *Trichodina* spp also infected 8 individuals (17.78%) in the gills. No individuals were infected with *Gyrodactylus* spp on the skin. *Gyrodactylus* spp infected 16 individuals (35.55%) in the gills. An overall infection rate, the total infection rate on the skin is 46.67%. While the total infection rate in the gills is 53.33%. The outcomes of this survey serve up as a reference point for upcoming research, offering valuable information for fisheries management and the sustainable conservation of aquatic ecosystems in Zobe Reservoir. High prevalence of ectoparasites was recorded in this study. There is need for proper handling of Nile tilapia from Zobe Reservoir before consumption.

Keywords: Public Health; Food Safety; Zoonosis; Nutrition; Fish Parasites; Parasitism

Citation: Sadauki, M. A., Auta, T. and Ibrahim, J. (2023). A Survey of Ecto-Parasites in *Oreochromis niloticus* (Linnaeus, 1758) (Nile Tilapia) in Zobe Reservoir, Katsina State. *Sahel Journal of Life Sciences FUDMA*, 1(1): 1-7. DOI: *https://doi.org/10.33003/sajols-2023-0101-001*

INTRODUCTION

Globally, parasitic worms pose a pervasive and severe challenge for freshwater fish populaces (Jaiswal *et al*., 2022; Shinkafi *et al*., 2023). Infections by these parasitic worms can lead to various health issues and economic losses for fish aquaculturalists and fishing villages, impacting diverse tissues and fleshy tissue of fishes (Radwan *et al*., 2023). Managing the proliferation of these parasites is complex due to their frequent transmission through polluted water as well as infested intermediary hosts like water invertebrates (Gabriel *et al*., 2022). The occurrence of helminth parasitic woms in pond, river and dam fish varies based on factors such as geographical locality, water quality, fish species, as well as the presence of intermediary hosts among different hosts. A significant proportion of fish populations in numerous freshwater habitats may harbour infections caused by single or other helminth parasitic worms (Sures and Nachev, 2022; Shinkafi *et al.*, 2023).

Helminth-infected fish may experience reduced growth rates and diminished reproductive success (Parker *et al*., 2023). Parasites' impact on the digestive system can adversely affect fish growth and overall health, leading to malnutrition and decreased food intake (Medina-Felix *et al*., 2023). Fish with helminth infections may possess lower market value due to their smaller size, weight, and altered appearance (Sadauki *et al*., 2022; Shinkafi *et al*., 2023). Overpopulation, unfavourable ecological conditions, and contamination resulting from certain practices make fish more vulnerable to parasites and infections, resulting in weakened resistant systems (Sadauki *et al*., 2022; Shinkafi *et al*., 2023). It is estimated that around 30,000 helminth species infect fish, with most posing a significant threat to their hosts. The term "helminth" is a general term encompassing various worms.

These are worm-like parasitic worms that represent an important group of pathogens and cause infections and diseases in fish in both freshwater and marine environments (Jyrwa *et al.,* 2016; Hazarika and Bordoloi, 2022). Fish serve as hosts for a variety of taxonomically diverse parasites (Barber *et al.,* 2020). They are primarily infected by four groups of helminths: trematodes, tapeworms, nematodes, and superficial worms. The World Health Organization (WHO) estimates that more than 18 million people are currently infected with fish fluke alone, and many more are at risk. People who eat raw, lightly smoked, lightly salted, dried, and pickled fish are most at risk (Jyrwa *et al.,* 2016; Hazarika and Bordoloi, 2022).

Fish disease outbreaks due to helminth infestations are a major problem in aquaculture. It affects the normal health status of fish, causes fish mortality, and causes significant economic losses to fisheries. Therefore, successful research on fish parasitology is of great importance in various fisheries development programs, as improved fish yield can be mainly achieved through healthy fish stocks (Hazarika and Bordoloi, 2022). Tropical freshwater fishes, such as *Bagrus badyad, Oreochromis niloticus, Coptodon zillii,* and *Clarias gariepinus*, have been reported to act as definitive or intermediate hosts for numerous protozoan, metazoan, and crustacean parasitic worms. Parasitic infection/parasitism in fish has been reported to severely impact production and its commercial sustainability. The frequency and severity of parasitic infections are closely related to the environmental conditions of the water body and the health status of the fish (Sadauki *et al.,* 2023). Research on fish parasites is essential as it not only improves the livelihood of fish in their natural environment, but also serves as a basis for information on the potential risks of diseases and pathogens associated with fisheries and fish farming in Nigeria (Adegoroye *et al.,* 2019). Numerous researchers and scientists have studied the occurrence and distribution of ecto-parasitic helminth fauna in freshwater fishes of north-western Nigeria. Additionally, several researchers have described new parasite species from different fish hosts, making further progress in this field. Considering the importance of aquaculture as a source of livelihood for most people in north-western Nigeria and the economic losses caused by fish diseases, this study surveyed the ectoparasites common on *Oreochromis niloticus* in Zobe Reservoir in Dutsin-Ma Local Government Area of Katsina State, north-western Nigeria.

MATERIALS AND METHODS

Study Area

Zobe Reservoir is situated between 12°20ʹ 34.62ʺ N and 12°23ʹ 27.48ʺ N and between 7°27ʹ 57.12ʺ E and 7°34ʹ 47, 68ʺ E in Dutsin-Ma LGA of Katsina State, Nigeria. It coverings an area of approximately 968,544 km^2. The Zobe artificial lake it is impounded from two main rivers consisting of the river Gada and river Karaduwa. The Zobe artificial lake built on the River Karaduwa had a total length of approximately 7 km and a region of approximately 4,500 hectares, with annual rainfall of 600 to 700 mm and annual average temperature of approximately 25°C (Sadauki *et al.,* 2022). For the reason of this survey, 3 (three) major locations nearby the reservoir was carefully chosen: Site A, Site B, and Site C.

Sample Collection

Fish samples were collected over a period of 3 months in the selected study area. Six samples were collected from three different sampling locations (site A, site B, and site C). Site A is situated on the entrance to the artificial lake (dam) in the Karaduwa River canal somewhere fishing activity is going on, Site B is situated in the centre of the lake/dam somewhere human being activity other than rain farming and dry farming are minimal, as well as Site C is situated at the end of a lake where agricultural, dry farming as well as many fishing activity take place. Alive/live experimental fish samples was conveyed in 25 litre plastic containers, mostly filled with water, to the Department of Biology, Federal University of Dutsin-Ma, Katsina State, for proof of identity and morphometric assessment, before parasites inspection, gathering and detection as describe by Sadauki *et al.* (2022).

Identification of *Oreochromis niloticus*

Experimental fish were identified based on the description of Olaosebikan and Raji (2013).

Sexing of Fish

The sexes of the experimental fish was done through physical inspection of the urinary system. Males are long or swollen, while females become round and reddish as adults. Visual observation of the male gonads and female ovaries is confirmation (Imam and Dewu, 2010).

Measurement of Experimental Fish

Standard lengths were measured with a metric ruler, and weights were measured with a top loading sensitive balance using the method as describe by Sadauki *et al.* (2022).

Examination of Experimental Fish Samples for Ecto-parasitic Worms

The examination of freshly euthanized fish specimens involved a thorough inspection of their external body surfaces, encompassing scales, gills, fins, and gill opercula, to detect ectoparasites and associated parasitological features. A pointer (hand lens) was utilized to promptly identify ectoparasites on the skin and fins of the sampled fish. The skin was also scrutinized for the presence of capsules containing fluke metacercariae, identified as dark spots, as well as yellowish sores/cysts. These were excised from the skin for further examination. To collect samples for microscopic analysis, scrapings from the head region and ventral area of the fish, extending from the head to just after the anal point and including the fins, were obtained by scratching the fish membrane with a cover slip. The slime obtained from this process was then spread on a fresh light microscope slide, with a droplet of normal saline added for optimal visualization. Samples were later sheltered with coverslips as well as observed below a light microscope at 100x and 400x intensification. The ecto part gills were inspected in situ for the occurrence of macroparasites and separated/removed in addition to positioned in Petri dishes comprising regular fish pond water. The gill rakes were separated using tweezers and examined for the presence of worms using a stereomicroscope (Mitiku *et al.,* 2018).

Identification of Parasitic Worms

The identification of parasitic worms was conducted by examining the body shape and morphological features of the gathered samples, aligning them with characteristics described in works by Florio *et al*. (2009) and Woo (1995). To identify the primary taxonomy of both mature and larval parasitic worms in the sampled fish, a modified key from Paperna (1996) was employed.

Parasite Prevalence and Intensity Estimation

The prevalence of parasitic worm's infestation were calculated for sex, location, length and weight using the model describe by Sadauki *et al.* (2022):

$$\text{Prevalence (\%)} = \frac{No\ of\ fish\ host\ infected x 100}{\text{Total no.of fish host Examined}}$$

$$\text{Percentage of infection (\%)} = \frac{Number\ of\ a\ specific\ parasite\ in\ the\ sample \times 100}{Total\ number\ of\ parasies\ in\ the\ sample}$$

Data Analysis

The occurrence and severity of infestation were presented in percentage terms. Descriptive statistics, conveyed through frequencies and percentages, were utilized to explore the relationship between risk factors and the prevalence of parasites. P values were calculated for all analyses.

RESULTS

Out of one hundred and eight (108) fish samples of Nile tilapia, 88 were males and 20 were females (Table 1). Among the examined male Nile tilapia, 40 (45.45%) were found to be infected with ecto-parasites. While among the examined female Nile tilapia, a higher infection rate of 75.00% was observed. Overall infection rate considering both male and female populations, the total infection rate for Nile tilapia in Zobe Reservoir is 55 (50.92%) (Table 1).

Among the Nile tilapia experimented from Zobe Reservoir. A total of 45 parasites were found in the sampled fishes examined, out of which *Trichodina* spp was 29 (64.44%), and *Gyrodactylus* spp had 16 (35.66%) as the least parasitic infestation. Overall infection rate when considering both types of parasites together, the total infection rate is 100%, indicating that all examined individuals were infected with either *Trichodina* spp, *Gyrodactylus* spp, or a combination of both. The parasite that had the highest occurrence were *Trichodina* spp 29 (64.44%) and some infested fishes had double infestation as shown in (Table 2).

Among the Nile tilapia experimented from Zobe Reservoir, the gill were the most infected 24 (53.33) of tissues examined, shadowed by the skin with 21 (46.67) (Table 3). Among the examined individuals, 21 (46.67%) were infected with *Trichodina* spp on the skin. *Trichodina* spp also infected 8 individuals (17.78%) in the gills. No individuals were infected with *Gyrodactylus* spp on the skin. *Gyrodactylus* spp infected 16 individuals (35.55%) in the gills. An overall infection rate, the total infection rate on the skin is 46.67%. While the total infection rate in the gills is 53.33%.

Out of 108 samples obtained as well as inspected from 3 different sites in Zobe Dam, the whole occurrence of 55(50.92%) were documented (Table 4). In occurrence amongst samples obtained from the numerous sample sites, *Oreochromis niloticus* gotten from sample C 25 (69.44%) sheltered the moderately higher proportion of parasitic worms, shadowed by sample A 19 (52.77%), whereas those experimented samples from sample B site had the smallest percentage of invasion 11 (30.55%)

Experimental fish found from Zobe showed that Nile tilapia with lengths of 21-25cm sheltered more parasites 24 (52.17%) followed by 16-20cm 18 (54.54%) and followed by those with 10-15cm 13 (44.83%) that had the lesser parasite found (Table 5).

Among fish found from Zobe showed that Nile tilapia with weight of 131-160g harboured more worms 29 (58.00%) followed by 91-130g 16 worms (48.48%), and then lastly followed by the lesser one 50-90g (40.00%) (Table 6).

Table 1. Prevalence of Ecto-parasite in Comparative to Category of Sex

Sex	No. Examined	No. Infected	% Infection
Male	88	40	45.45
Female	20	15	75.00
Total	**108**	**55**	**50.92**

Table 2. Prevalence of Ecto-parasite in Relation to Taxa of Parasites

Parasite	Taxa Group	No. of Parasite	% Infection
Trichodina spp	Protozoans	29	65.45
Gyrodactylus spp	Monogeneans	16	35.55
Total		**45**	**100%**

Table 3. Prevalence of Ecto- in Comparative to Location of Infection

Parasite	Skin	Gills
PROTOZOANS		
Trichodina spp	21	8
MONOGEANS		
Gyrodactylus spp	0	16
Total	**21(46.67%)**	**24(53.33)**

Table 4. Prevalence of Ecto-parasites in Comparative to Sample Site

Sites	No. Examined	No. Infected	% Infection
A	36	19	52.77
B	36	11	30.55
C	36	25	69.44
Total	**108**	**55**	**50.92**

Table 5. Prevalence of Ecto-parasites in Comparative to Length of Fish

Length	No. Examined	No. Infected	% Infection
10-15cm	29	13	44.83
16-20cm	33	18	54.54
21-25cm	46	24	52.17
Total	**108**	**55**	**50.92**

Table 6. Prevalence of Ecto-parasites in Relation to Weight

Weight	No. Examined	No. Infected	% Infection
150-90g	25	10	40.00

91-130g	33	16	48.48
131-160g	50	29	58.00
Total	**108**	**55**	**50.92**

DISCUSSION

Parasites have attracted increasing interest among parasite ecologists as biological indicators of environmental pollution due to human activities due to their diverse responses to such anthropogenic pollution (Ali *et al.,* 2015). The infestation of *Trichodina* spp. could be attributed to the territorial behaviour exhibited by *O. niloticus*. *Oreochromis niloticus* is known to create and defend shoreline areas, and this territorial behaviour enhances access to and sustained exposure to protozoa, crustaceans, and the free-swimming stages of digenetic trematode metacercariae, as documented by Paperna (1996) and Areda *et al*. (2019). Fish behaviours may place them at risk for easy transmission of parasites between invertebrates and fish intermediate hosts. Corresponding to the report of Illán (2015), Tilapia wants shallow part of the freshwater because of they are herbivores as well as they require wetland for the propagation purpose. In the shallow freshwater (such as lake, pond and river) part, the existing weeds around the lake offered a good condition for the propagation of the intermediary hosts of nematode, fish-eating birds as well as the fresh water snails. This increases the occurrence of parasitic worms (monogeans and trematode) in the *Oreochromis niloticus* similarly connected the multiplication of this category of parasitic worms to the more frequent fishes contact in shallower water as well as the higher levels of pressure throughout spawning activity which similarly lead to a decreased in their wellbeing status (Mitiku *et al.,* 2018). Álvarez Peritero *et al*. (2012) have shown that poor environmental conditions can influence the presence of parasites. This study shows that the parasitic protozoan *Trichodina* species can be found in three research areas. In previous reports, *Trichodina spp*. It has been recorded in fish cultured in cages, ponds, and natural waters in Kenya, Uganda, and Ethiopia (Florio *et al.,* 2009; Mitiku *et al.,* 2018). Monogeneans had a direct lifecycle (with no intermediary hosts) as well as are host and size particular (Klinger and Floyd, 2002) during their range (FAO, 1996). Whittington *et al*. (2000) report that monogeneans could be alive on the skin, scales, fins, lip folds, nases, branchiostegal tissues and gills of their fish (host). In the present investigation, an overall incidence of fish parasites was observed to be 50.92%. This finding aligns with a previous study that reported a prevalence rate of 47.8% in the Oromia region. The difference in incidence rates could be attributed to the potentially higher prevalence of parasitic infestations in cultivated or farmed animals compared to wild populations. This discrepancy may arise from stressful conditions associated with crowding (resulting from high fertility rates) and frequent deterioration in water quality, or the absence of proper waste disposal and management systems, as discussed by Areda *et al*. (2019).

In this study, the comprehensive prevalence of external parasites was determined to be 50.92%. Notably, *Trichodina spp*. (65.45%) and *Gyrodactylus spp.* (35.55%) emerged as the most significant ectoparasitic worms identified in these findings. This observation is consistent with the findings of Tadesse (2009) and Areda *et al*. (2019), who similarly reported the highest incidence of *Trichodina spp*. in cultured systems at Yemlo and Wonji fish ponds, with prevalence rates of 56.67% and 46.70%, respectively. Additionally, a comparable occurrence of 34.6% for Trichodina spp. was documented in Uganda (Florio *et al*., 2009).

CONCLUSIONS

In conclusion, the survey conducted on ecto-parasites in *Oreochromis niloticus* in Zobe Reservoir, Katsina State reveals high prevalence of ecto-parasite among individuals of the species. The prevalence cuts across gender, age and sizes of the fishes. The females were more infected than the males, and *Trichodina* spp is the most common ecto-parasite that infect tilapia in Zobe Reservoir. This similarly occurs in all the touchdown locations surveyed. The study provides a baseline for future research endeavours in the field of fish parasitology, providing a reference point for comparative analyses and longitudinal studies. There is need for proper handling of nile tilapia from Zobe Reservoir before consumption.

Author Contributions: conceptualization, S.M.A. and I.J..; methodology, I.J.; validation, S.M.A. and T.A.; formal analysis, S.M.A. and I.J.; investigation, I.J.; resources, S.M.A. and I.J.; data curation, S.M.A. and I.J.; writing—original draft preparation, S.M.A.; writing—review and editing, T.A.

Funding: This study was not funded by any agency or institution.

Acknowledgments: Our deep thanks to Professor Armaya'u Hamisu Bichi Vice Chancellor, Federal University Dutsin-Ma, Katsiina State, Nigeria, Dr. Akeem Babatunde Dauda and Dr. Joel Umaru of the Department of Fisheries and Aquaculture, Federal University Dutsin-Ma, Katsiina State, Nigeria, for the support and supervision during the course of the study. Similarly to technical staff members of the Department of Biological science, Federal University Dutsin-Ma, who supported in one way or another during the course of the research especially at the Laboratory of Biological Sciences.

Conflicts of Interest: The authors declare that they have no competing interest.

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