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Seasonal variation in helminth parasite infections in *Oreochromis niloticus* from sewage ponds in Kano State, Nigeria

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ABSTRACT

This study assessed the seasonal variation in helminth parasite infections in *Oreochromis niloticus* from sewage ponds in Gwale Local Government Area, Kano State, Nigeria. A total of 385 tilapia fish were examined over a 15-month period from January 2024 to March 2025, spanning both dry and rainy seasons. Standard parasitological techniques were used to recover helminths from the gastrointestinal tract and gills. The overall prevalence of infection was significantly higher during the rainy season (48.2%) than in the dry season (18.7%) ($\chi^2=27.16$, $p<0.001$). Three helminth species were identified: *Clinostomum* spp., *Euclinostomum* sp., and *Polyonchobothrium polyepteri*. Trematodes dominated the infection profile, with a peak in parasite recovery between July and September. These results show the influence of rainfall and seasonal ecological shifts on helminth transmission dynamics and emphasize the need for targeted health and food safety measures during high-risk periods.

KEYWORDS: *Oreochromis niloticus*, Helminth parasites, Seasonal variation, Sewage ponds, Prevalence

INTRODUCTION

Helminth parasitism in freshwater fish is influenced by a wide range of environmental and biological factors, among which seasonality is particularly significant. Seasonal variation affects the abundance of intermediate hosts, parasite developmental stages, and host-parasite contact rates. In tropical aquatic ecosystems, especially those impacted by sewage and organic pollution, seasonal shifts, particularly between the rainy and dry seasons, can dramatically alter parasite transmission dynamics (Paperna, 1996; Claar *et al.*, 2021).

Oreochromis niloticus (Nile tilapia) is one of the most widely farmed and consumed fish species across sub-Saharan Africa, including Nigeria. Its popularity is due to its adaptability and nutritional value. However, tilapia harvested from sewage-fed environments often harbor endoparasites that pose significant risks to both fish health and human consumers (Mukhtar *et al.*, 2010). Despite these risks, many urban communities in northern Nigeria continue to rely on such sources for subsistence fishing.

There are numerous sewage-fed ponds in Kano State, Nigeria, particularly in Gwale Local Government Area. These include; *Kukkuba*, *KwarinMota* and *Mai Allo* ponds. These water bodies were originally burrow pits but have now been transformed

into sewage receptacles through the deliberate channeling of residential wastewater. The conversion of these sites into sewage systems has created unique ecological niches that support surprisingly robust populations of Nile tilapia (*O. niloticus*). The fishing economy surrounding these sewage ponds follows a well-established value chain: 1) Local fishermen harvest the tilapia using various methods, 2) Fish are sold to specialized processors, 3) Processors deep-fry the fish to create 'Kawara' (a popular Hausa delicacy) and 4) Final products are distributed to urban markets and roadside vendors.

This practice persists despite several health concerns such as high concentrations of heavy metals (lead, cadmium) in fish tissues, presence of antibiotic-resistant bacteria, bioaccumulation of organic pollutants and potential for parasitic zoonoses (Mukhtar *et al.*, 2010) The study therefore aims to assess the seasonal prevalence and diversity of helminth parasites infecting *O. niloticus* in sewage ponds in Gwale LGA, Kano.

MATERIALS AND METHODS

Study Area

The study was carried out in two sewage-fed ponds, *KwarinMota* pond (Pond A), and *Kukkuba* pond (Pond B), located within

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Gwale Local Government Area, Kano State, Nigeria. These ponds are heavily polluted due to the continuous discharge of household wastewater and urban runoff. They are used for artisanal fishing and are typical of urban sewage ecosystems in northern Nigeria. The region experiences two primary seasons: a rainy season (May to October) and a dry season (November to April), with distinct differences in temperature, humidity, and water inflow (Getso *et al.*, 2021).

Fish Sampling and Seasonal Grouping

Monthly fish sampling was conducted between January 2024 and March 2025, covering a total of 15 months. A total of 385 fish samples were examined as follows;

Rainy season: 204 fish

Dry season: 181 fish

Fish were collected from both ponds using cast nets and traps with the assistance of local fishermen. Immediately after capture, they were transported in clean, aerated containers to the Parasite Biodiversity Laboratory, Department of Biological Sciences, Northwest University Kano, for examination.

Parasitological Examination

Each fish was euthanized following ethical guidelines and dissected. The alimentary tract (oesophagus to rectum) and gill arches were excised. Gut contents were emptied into Petri dishes containing normal saline and examined under a dissecting microscope. The mucosal lining of each gut section was also scraped onto slides for detailed microscopic observation. Parasites were recovered using fine brushes, counted, and recorded based on their anatomical location. Both trematodes and cestodes were targeted (Nwadike *et al.*, 2023).

Preservation and Identification of Parasites

Trematodes were fixed in 4% formaldehyde after hot saline treatment, while cestodes were flattened and preserved in AFA solution. All specimens were stained with acetocarmine, dehydrated, cleared in xylene, and mounted for identification under a compound microscope. Parasites were identified morphologically using the taxonomic keys of Paperna (1996) and Yamaguti (1971).

Data Analysis

Helminth prevalence, intensity, and abundance were calculated monthly and grouped by season. Chi-square (χ^2) tests were used to assess the statistical significance of seasonal variation in infection rates. Monthly trends were graphically plotted using Microsoft Excel. All statistical analyses were performed using SPSS version 25.0, with significance accepted at $p < 0.05$.

RESULTS

Out of the 385 specimens of *Oreochromis niloticus* examined, 121 fish were found infected with one or more helminth

parasites, giving an overall prevalence of 31.43%. A total of three helminth species were identified namely; *Clinostomum* spp. (encysted trematodes in gills) *Euclinostomum* sp. (intestinal trematodes), and *Polyonchobothrium polyepteri* (cestode). The Trematodes were the dominant group, accounting for over 70% of all recovered parasites.

A clear seasonal difference in helminth infections was observed (Table 1). During the rainy season (May-October), infection prevalence was 48.2%. During the dry season (November-April), prevalence dropped significantly to 18.7%. Chi-square analysis showed a statistically significant difference in prevalence between the two seasons ($\chi^2 = 27.16$, $p < 0.001$).

The monthly prevalence fluctuated throughout the study period, with infection peaking from July-October). The highest prevalence was observed in August (52.9%), while the lowest prevalence occurred in April (12.5%) (Figure 1).

DISCUSSION

The seasonal peak observed in this study, particularly between July and October, coincides with periods of intense rainfall in northern Nigeria. This rainfall results in pond flooding, nutrient enrichment, and the proliferation of aquatic vegetation, creating favorable habitats for intermediate hosts such as snails and copepods. Trematodes, which were the dominant helminths recovered in this study (*Clinostomum* spp. and *Euclinostomum* sp.), rely on snails as obligatory hosts for part of their life cycle. The abundance of these intermediate hosts during the rainy season directly increases the likelihood of parasite transmission to fish populations. This trend mirrors findings previous studies, where helminth

Table 1: Seasonal prevalence and mean intensity of helminth infections in *Oreochromis niloticus*

Season	Fish Examined	Fish Infected	Prevalence (%)	Mean Intensity (parasites/fish)
Rainy	204	98	48.2	2.87
Dry	181	23	18.7	1.42
Total	385	121	31.4	-

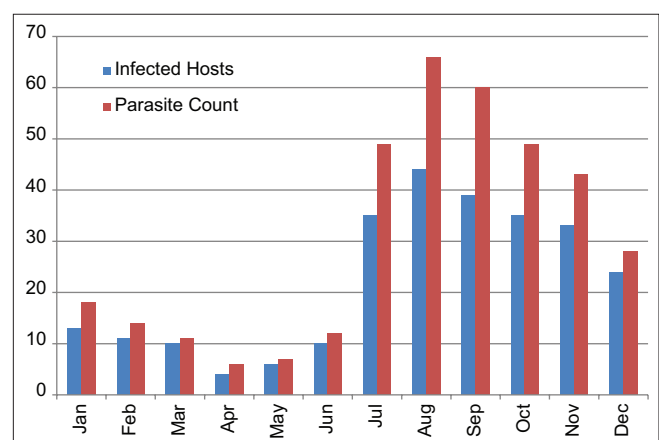


Figure 1: Monthly prevalence of helminth infection in *O. niloticus*

prevalence peaks during wet months (Biu *et al.*, 2014; Bubu-Davies *et al.*, 2021).

The dominance of trematode infections during the rainy season supports the conclusion of Bichi and Ibrahim (2009), who reported that peak infection in *Tilapia zillii* in Tiga Dam, Kano, also occurred in August. They noted that while infection prevalence was low during the dry season, seasonal fluctuations contributed to the biodiversity of the parasite fauna and may facilitate the development of partial resistance in host fish populations. This suggests that while environmental conditions determine transmission intensity, host-parasite interactions are also influenced by adaptive mechanisms in the fish, including tolerance and acquired immunity.

The observed seasonal occurrence of parasites in the present study is also consistent with Paperna's (1996) classical observations in Nungua Lagoon, Ghana, where parasite prevalence peaked during the rainy season but declined during the dry months. According to Paperna, such fluctuations reflect a balance between host susceptibility, intermediate host availability, and environmental conditions. Importantly, both Paperna (1996) and Bichi and Ibrahim (2009) concluded that, despite high parasite loads during certain periods, the aquatic environment remained suitable for fish production, provided that health management practices were adopted. This underscores the dual nature of sewage-fed ponds: while they pose a risk of helminth infection, they still sustain viable fish populations that support artisanal fisheries.

Another noteworthy aspect of this study is the variation in mean intensity of infection, which was higher during the rainy season (2.87 parasites per infected fish) compared to the dry season (1.42). This finding indicates that not only do more fish acquire infections during wet months, but the infected individuals also harbor heavier parasite burdens. Such intensity patterns raise concerns for food safety, especially since fishing activities often intensify during the rainy season when fish stocks are more abundant. If these fish are consumed without adequate processing or cooking, the risk of zoonotic transmission increases (Onoja-Abutu *et al.*, 2021). However, despite the lower prevalence recorded in the dry season, parasite infections were not completely absent. This suggests that certain helminths persist at low levels throughout the year, ensuring survival of their life cycles until favorable environmental conditions return.

From an aquaculture and public health perspective, the findings of this study have several implications. First, seasonal monitoring of parasite infection is critical, as harvesting during peak rainy season may expose consumers to higher risks of infection. Second, the persistence of infections, albeit at reduced levels in the dry season, suggests that control strategies must be continuous rather than seasonal.

CONCLUSION

In conclusion, this study found clear seasonal variation in helminth parasite infections of *O. niloticus* from sewage-fed ponds in Kano State, Nigeria. Infection prevalence was

significantly higher in the rainy season (48.2%) than in the dry season (18.7%), with peaks recorded between July and September. Trematodes, particularly *Clinostomum* spp. and *Euclinostomum* sp. were the dominant parasites, reflecting the abundance of snail intermediate hosts during the rainy months.

RECOMMENDATIONS

Based on the findings of this study and supporting literature, the following recommendations are proposed:

- i. Routine surveillance of parasite infections in tilapia populations should be conducted across seasons, with special emphasis on the rainy season when prevalence peaks.
- ii. Fish harvesting and marketing should consider seasonal infection patterns. Mid-rainy season harvests, when parasite burdens are highest, should be accompanied by thorough inspection and consumer awareness measures.
- iii. Communities dependent on sewage-fed fisheries should be educated on the risks of consuming poorly processed or undercooked fish, particularly during the rainy season.

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