



## Gastrointestinal Helminth Parasites of Freshwater Fishes in Kaduna Metropolis, Kaduna State, Nigeria

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### Abstract

Parasitic infections are a major challenge for fish farmers in developing countries, leading to reduced growth, increased mortality and compromised fish welfare. This study aimed to determine the prevalence of gastrointestinal helminth parasites in freshwater fishes from Kaduna Metropolis, Nigeria. A total of 273 fish were collected from three points along the Kaduna River between January and June 2022. Fish were identified and morphometric data (weight, standard length) were recorded. The gastrointestinal tract of each fish was dissected and examined for helminths using standard parasitological techniques. Eight fish species were identified: *Bagrus bayad* (n=5), *Bagrus docmak* (n=27), *Bagrus occidentalis* (n=39), *Clarias gariepinus* (n=2), *Labeo coubie* (n=40), *Labeo senegalensis* (n=29), *Mormyrus rume* (n=83) and *Oreochromis niloticus* (n=48). The overall prevalence of gastrointestinal helminth infection was 50.9% (139/273). Six helminth genera were identified: *Contracaecum spp.* (36.0%), *Capillaria spp.* (24.0%), *Diphyllobothrium spp.* (25.0%), *Clinostomum spp.* (10.0%), *Camallanus spp.* (4.0%) and *ProCamallanus spp.* (1.0%). Prevalence varied significantly among fish species ( $\chi^2=5.88$ ,  $p=0.015$ ), with *C. gariepinus* having the highest rate (100%). Infection was significantly higher in female fish (63.3%) than in males (41.2%) ( $p<0.05$ ) and was associated with fish length and weight ( $p<0.05$ ). We conclude that gastrointestinal helminths are common in freshwater fishes from the Kaduna River. We recommend that relevant government agencies implement measures to control parasite infestations to enhance fish productivity and mitigate potential zoonotic risks to handlers and consumers.

**Keywords:** Gastrointestinal helminth; Parasites; Freshwater; Fish; Kaduna River; Nigeria

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### Introduction

Fish are a crucial source of affordable animal protein, contributing 17% of global animal protein intake and up to 30% in developing countries [1]. The fish industry is a vital economic sector providing employment and supporting the livelihoods of millions in developing nations [2]. In Nigeria, freshwater bodies are rich in fish diversity, hosting over 270 species [3]. However, fish harvests are declining due to factors including disease, overexploitation and environmental degradation [4].

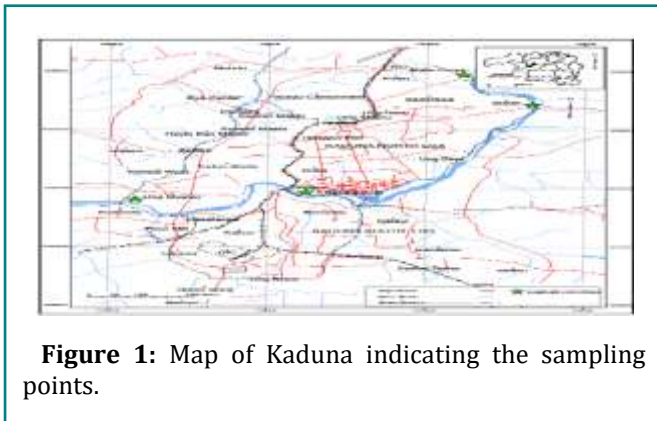
Parasitism, particularly by helminths, is a significant factor impeding fish productivity. Infestations can lead to nutrient depletion, behavioural changes, immune suppression, mechanical injuries, reduced fecundity and mortality [5]. While several studies have documented fish parasites in various Nigerian water bodies, there is a paucity of information on the gastrointestinal helminths of fish in Kaduna Metropolis [6,7]. This study was therefore conducted to investigate the prevalence and burden of gastrointestinal helminth parasites in freshwater fishes from the Kaduna River.



## Materials and Methods

### Study Area

The study was conducted in Kaduna Metropolis, located at latitude 10° 36' 33.5484" N and longitude 7° 25' 46.2144" E. The metropolis comprises Kaduna North, Kaduna South and parts of Igabi and Chikun Local Government Areas. The vegetation is Sudan Savannah, characterized by scattered short trees and grasses. The climate features distinct rainy and dry seasons.



**Figure 1:** Map of Kaduna indicating the sampling points.

### Sample size determination

The sample size was determined using the formula for simple independent proportions [8]:

$$n = (Z^2 P(1-P))/d^2$$

Where: Z=Z-score at 95% confidence level (1.96), P=Estimated prevalence (0.364, from a previous study), d=Margin of error (0.05) [9]. This calculation yielded a minimum sample size of 239 fish. A total of 273 fish were sampled to improve the robustness of the study.

### Sample collection and examination

Fish samples were collected monthly from January to June 2022 from local fish sellers and by direct casting of nets in the Kaduna River. Fish were transported alive in oxygenated plastic containers to the Department of Biological Sciences laboratory, Nigerian Defense Academy, Kaduna.

In the laboratory, each fish was identified to species level using standard taxonomic keys [10,11]. Standard Length (SL) was measured from the tip of the snout to the base of the caudal peduncle using a meter rule. Body weight was determined using a DT 1000 digital weighing scale.

### Sex determination

Sex was determined by macroscopic examination of the gonads after dissection. The presence of testes or ovaries was confirmed and a smear of gonadal tissue was

examined under a microscope to check for sperm or eggs in ambiguous cases.

### Dissection and examination for helminth parasites

Each fish was dissected ventrally using a scalpel to expose the visceral cavity. The entire gastrointestinal tract (from oesophagus to anus) was carefully removed and transferred to a petri dish containing physiological saline (0.9% NaCl). The gut was longitudinally opened and the contents were washed and scraped into the saline. The suspension was examined for helminths under a dissecting microscope (Leica EZ4, 10–40x magnification). Recovered helminths were fixed in 4% formaldehyde solution. Nematodes were cleared in lactophenol for identification. Helminths were identified to genus level based on morphological characteristics using standard parasitological keys [12].

### Data analysis

Data were analyzed using IBM SPSS Statistics Version 20.0. Descriptive statistics (frequencies, percentages) were used to summarize the prevalence of infection. The Chi-square ( $\chi^2$ ) test was used to assess associations between helminth infestation and independent variables (fish species, sex, length, weight). A p-value of less than 0.05 was considered statistically significant.

## Results

A total of 273 fish, representing eight species, were examined (**Table 1**). The overall prevalence of gastrointestinal helminth infection was 50.9% (139/273). Prevalence varied significantly among species ( $\chi^2=5.88$ ,  $p=0.015$ ), with *Clarias gariepinus* showing the highest prevalence (100%), followed by *Labeo coubie* and *Bagrus bayad* (60.0% each). *Bagrus docmak* had the lowest prevalence (37.0%).

**Table 1:** Prevalence of gastrointestinal helminth infestation in fish species from River Kaduna.

Fish species	No. examined	No. infected	Prevalence (%)
<i>Mormyrus rume</i>	83	47	53.4
<i>Labeo coubie</i>	40	24	60
<i>Clarias gariepinus</i>	2	2	100
<i>Bagrus occidentalis</i>	39	21	53.8
<i>Labeo senegalensis</i>	29	14	48.3
<i>Oreochromis niloticus</i>	48	23	47.9
<i>Bagrus docmak</i>	27	10	37
<i>Bagrus bayad</i>	5	3	60
Total	273	139	50.9
$\chi^2(7) = 5.8805; p = 0.0153$			



The distribution of helminth genera among the fish species is shown in **Table 2**. Six genera were recorded: *Contracaecum* was the most prevalent (36.0%), followed

by *Diphyllobothrium* (25.0%) and *Capillaria* (24.0%). *Oreochromis niloticus* harboured the highest diversity of parasites.

**Table 2:** Prevalence of specific helminth genera in infected fish species.

Fish species	<i>Contracaecum</i>	<i>Capillaria</i>	<i>Diphyllobothrium</i>	<i>Clinostomum</i>	<i>Camallanus</i>	<i>Procamallanus</i>
<i>M. rume</i> (n=47)	40.40%	18.10%	12.00%	7.20%	3.60%	0.00%
<i>L. coubie</i> (n=24)	35.00%	25.00%	20.00%	0.00%	5.00%	2.50%
<i>C. gariepinus</i> (n=2)	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
<i>B. occidentalis</i> (n=21)	28.20%	20.50%	15.40%	0.00%	5.10%	0.00%
<i>L. senegalensis</i> (n=14)	27.60%	20.70%	17.20%	0.00%	3.40%	0.00%
<i>O. niloticus</i> (n=23)	39.60%	25.00%	33.30%	29.20%	33.30%	4.20%
<i>B. docmak</i> (n=10)	14.80%	3.70%	11.10%	7.40%	0.00%	0.00%
<i>B. bayad</i> (n=3)	0.00%	0.00%	20.00%	40.00%	0.00%	0.00%
Overall Prevalence	36.00%	24.00%	25.00%	10.00%	4.00%	1.00%

Analysis of host factors revealed significant associations (**Table 3**). Female fish had a significantly higher prevalence (63.3%) than males (41.2%) ( $\chi^2=13.21$ ,  $p=0.0003$ ). Prevalence was also significantly associated

with fish length ( $\chi^2=6.64$ ,  $p=0.010$ ) and body weight ( $\chi^2=8.89$ ,  $p=0.0029$ ). The highest prevalence was found in fish measuring 56 cm-70 cm (66.7%) and those weighing 301 g-400 g (76.5%).

**Table 3:** Prevalence of gastrointestinal helminths in relation to sex, length and weight of fish.

Variable	Category	No. examined	No. infected	Prevalence (%)	$\chi^2$ -value	p-value
Sex	Male	153	63	41.2	13.21	0.0003
	Female	120	76	63.3	-	-
Length (cm)	10-25	148	77	52	6.64	0.01
	26-40	99	54	54.5	-	-
	41-55	20	5	25	-	-
	56-70	3	2	66.7	-	-
	71-85	3	1	33.3	-	-
Weight (g)	100-200	184	92	50	8.89	0.0029
	201-300	44	27	61.4	-	-
	301-400	17	13	76.5	-	-
	>400	28	10	35.7	-	-

## Discussion

The overall helminth prevalence of 50.9% indicates a substantial parasitic burden in the fish population of the Kaduna River. This rate is higher than the 36.4% reported in a previous study from which our sample size was derived, but comparable to findings in other Nigerian water bodies [5,9,7]. The high prevalence could be linked to anthropogenic pollution, such as domestic sewage and industrial effluents, which can alter the aquatic ecosystem and favour the survival and transmission of parasite larvae [13].

The variation in prevalence among fish species is consistent with ecological and physiological differences. The high infection rate in *Clarias gariepinus* is well-documented and is often attributed to its benthic, omnivorous feeding habits, which increase its exposure to

infective parasite stages [5,14]. The significantly higher prevalence in female fish aligns with studies suggesting that physiological stresses, such as reproduction, may make females more susceptible to parasitic infections [15].

The association between parasite burden and host size/weight is a common finding in fish parasitology [16,17]. Larger, older fish have had more time to accumulate parasites and often occupy a higher trophic level, consuming more infected intermediate hosts. However, our data also showed a lower prevalence in the largest size and weight classes (>71 cm, >400 g). This could be due to the development of acquired immunity in older fish or a sampling effect, as very few large individuals were captured.

The helminth community was dominated by nematodes (*Contracaecum*, *Capillaria*), which is consistent with other surveys in the region [7,18]. The presence of



genera like *Contracaecum* and *Diphyllobothrium*, which include zoonotic species, raises public health concerns for consumers who handle or consume undercooked fish from this river [19].

## Conclusion

This study demonstrates that gastrointestinal helminth parasites are prevalent and diverse among freshwater fishes in the Kaduna River. The infection is influenced by fish species, sex, length and weight. The presence of potentially zoonotic parasites underscores a public health risk. We recommend:

- Regular parasitological monitoring of the Kaduna River.
- Public health education for fishermen and fish traders on the risks of handling raw fish and the importance of proper cooking.
- Further studies to molecularly characterize these helminths to definitively assess their zoonotic potential.

## Authors' Contributions

CUI conceived and designed the study. CUI, EEO, KBD, YAU and MM participated in field collection, laboratory analysis and data interpretation. CUI drafted the manuscript. All authors reviewed and approved the final manuscript.

## Conflict of Interest

The authors declare no conflict of interest.

## Ethics Approval

All ethical guidelines for the use of animals in research were adhered to.

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