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Original Research Article

Microscopy - Based Surveillance of Ectoparasites in Farmed African Catfish from Selected Farms in Lokoja, Nigeria

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ABSTRACT
Parasitic disease constrains aquaculture productivity, yet farm-level surveillance of African catfish in north-central Nigeria remains limited. This study estimated the occurrence of ectoparasitic organisms on the skin of cultured Clarias gariepinus from three farms in Lokoja and examined exploratory host correlates. In this cross-sectional pilot survey, 60 live fish (20 per farm) were selected and transported to Federal University Lokoja. Sex, standard length, total length, and body mass were recorded. Unidirectional skin scrapes were examined as saline wet mounts by light microscopy at 100× and 400× total magnification. Prevalence was calculated using standard ecological definition and binomial 95% confidence intervals were computed with the Wilson method. Nine fish samples were positive with an overall prevalence of 15.0% (95% CI 8.1-26.1%). A total of nine organismal observations were made, comprising a ciliate; I. multifiliis (5.0%; 95% CI 1.7-13.7%) which was detected in three fish, and the copepod; Ergasilus (10.0%; 95% CI 4.7-20.1%) which was detected in six fish samples. Farm-specific prevalence was 20.0% (4/20; 95% CI 8.1- 41.6%) at each of two farms and 5.0% (1/20; 95% CI 0.9-23.6%) at the third. Seven of 33 males (21.2%) and two of 27 females (7.4%) were positive, the difference was however, not statistically significant (Fisher's exact $p \approx 0.17$). Mean condition factor ranged from 0.83 to 0.94 across farms. It could be concluded there is a low burden ectoparasitic prevalence (15.0%) in cultured African catfish in Lokoja municipality. The findings inform the recommendation of routine farm surveillance, including regular monitoring of water quality and DNA-based confirmation tests in future studies.

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INTRODUCTION

Aquaculture is increasingly important to food and nutrition, security, employment, and the supply of affordable animal protein. African catfish (*Clarias gariepinus*) is especially valuable in Sub-Saharan Africa because of its rapid growth, air-breathing capacity, market acceptance, and tolerance of intensive production conditions. These production systems are, however, prone to infectious hazards amplification particularly because of when high stocking density, organic loading, unstable water quality, animal movement, and imperfect biosecurity coincide. Parasites may impair feeding, growth, epithelial integrity, osmoregulation, welfare and respiration in fish. Damaged surfaces may also facilitate secondary bacterial or fungal disease (Lieke et al., 2020; Shinn et al., 2023).

Ectoparasites are useful indicators of the relationship between host susceptibility, husbandry, and the aquatic environment. Commonly encountered parasites in freshwater aquaculture include ciliates such as *Ichthyophthirius multifiliis* and Trichodina, monogeneans, branchiurans, and parasitic copepods. Their distribution is often aggregated in such a way that many hosts may carry no parasites while a few carry most of the burden. Factors, such as water temperature, dissolved oxygen, ammonia, pH, stocking density, source of fingerlings, and treatment history may usually affect infection patterns (Ageng'o *et al*., 2024; Lindholm-Lehto, 2023).

There is a substantial catfish production volume in Nigeria, however, surveillance evidence is uneven across production zones. Even though studies from north-central Nigeria have documented diverse branchial and gastrointestinal parasites in freshwater fishes (Onoja-Abutu *et al*., 2021), local data on farmed *C. gariepinus* in Lokoja are scarce.

This pilot study aimed to estimate fish-level occurrence of ectoparasite detected by skin-scrape microscopy in three fish farms in Lokoja. The study also conducted to describe the observed burden using standardized epidemiological indices as well as explore associations with farm, sex, body size, and condition.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional pilot survey was conducted in Lokoja, the capital of Kogi State, north-central Nigeria (approximately 7.8023° N, 6.7333° E). Three privately operated fish farms were selected from the metropolis and coded BS, YB, and AB to minimize disclosure. Sampling was conducted during July and September.

Sample Size and Fish Collection

Sixty live *C. gariepinus* were examined, comprising 20 fish from each farm. Fish samples were transported within three hours in aerated containers containing source-pond water to the Biological Sciences Laboratory, Federal University Lokoja.

Host Identification, Sex, and Morphometry

Fish were identified as *C. gariepinus* using external morphological characteristics. Sex was determined by observing the morphology of their genital-papilla. This was corroborated by the release of milt or eggs upon the application of gentle pressure on the abdomen of adults. Standard length (snout tip to caudal peduncle) and total length (snout tip to the longest caudal-fin ray) were measured to the nearest 0.1cm. Body mass was measured on a top-loading balance to the nearest 0.1g. Fulton's condition factor was defined as $K = 100W/L^3$, where W is mass in grams and L is total length in centimetres.

Skin-Scrape Collection and Microscopy

Each fish was placed on a clean examination work top, thereafter, a clean coverslip was used to scrape epidermal mucus once in a head-to-tail direction with gentle pressure. The collected material on the coverslip was transferred to a grease-free glass slide, mixed with one drop of normal saline (0.9% sodium chloride), covered and examined by light microscopy at 100x and 400x total magnification. Any observed organisms were identified based on morphological appearance as compared with standard parasite atlas. The positive outcome was the detection of at least one ectoparasite organism in a fish. Prevalence was the percentage number of positive hosts divided by the number examined (Bush et al., 1997).

Statistical Analysis

Data were subjected to statistics using descriptive analysis for aggregate counts, two-sided Fisher's exact test for comparing sex-specific positivity and Wilson 95% confidence intervals were for proportions. For all analyses, Microsoft Excel was used and statistical significance was set at $p<0.05$.

Ethical Consideration

This study was carried out in compliance with the Code of Ethics of the World Medical Association (Helsinki Declaration) for animal experiments following approval by the ethics committee of Federal University Lokoja certificate No. FUL/EC/2024/006

RESULTS AND DISCUSSION

Overall Occurrence and Burden

Nine of 60 fish had at least one ectoparasite, giving an overall prevalence of 15.0% (95% CI 8.1–26.1%). Two parasite observations were recorded among the nine positive fish (Table 1)

Table 1: Parasites from Skin-Smear Microscopy

Ectoparasite	Morphotype Categories	Positive Fish	Prevalence %, (95% CI)
Ergasilus sp.	1	6	10.0 (4.7–20.1)
I. multifiliis	1	3	5.0 (1.7–13.7)
Combined	2	9	15.0 (8.1–26.1)

Farm-Level Occurrence
Four fish were positive at BS, four at YB, and one at AB farms respectively. This is translated to a Farm-specific prevalence of 20.0%, 20.0%, and 5.0%, respectively (Table 2). However, the confidence intervals overlapped widely meaning that the pilot sampling was not particularly focused towards establishing between-farm differences.

Table 2: Fish-Level Occurrence by Farm

Farm Code	Examined	Positive	Within-Farm Prevalence %, 95% CI	Contribution to Total Sample %
BS	20	4	20.0 (8.1–41.6)	6.7
YB	20	4	20.0 (8.1–41.6)	6.7
AB	20	1	5.0 (0.9–23.6)	1.7
Overall	60	9	15.0 (8.1–26.1)	15.0

Host Sex, Morphometry, and Condition
Out of thirty-three males and 27 females that were examined, positivity was 21.2% (7/33) and 7.4% (2/27) in males and females respectively (Figure 1). This disparity in point estimate, even though it was higher in males, revealed no statistically significant association (Fisher's exact p≈0.17).

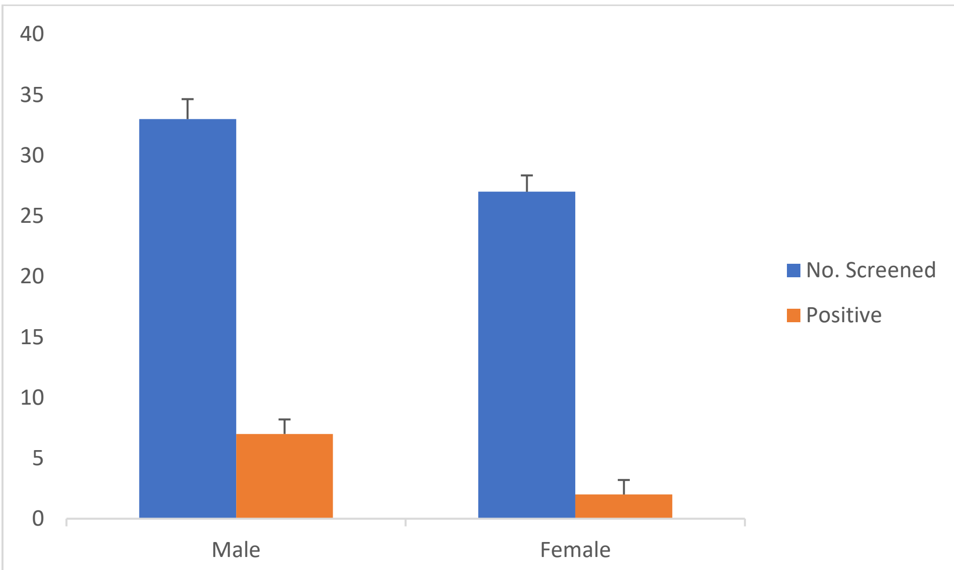

Figure 1: Fish - Level Parasite Occurrence by Host Sex

Morphometric Measurements
The morphometric measurements varied considerably among the three farms signifying that there is difference in management practices between farms. Fish collected from YB farm recorded the highest mean standard length, total length, and body mass, with values of 25.45 cm, 28.85 cm, and 225.75 g, respectively. This was followed by fish from AB farm, which had a mean standard length of 23.18 cm, mean total length of 26.90 cm, and mean body mass of 167.50 g. Fish sampled from BS farm were comparatively smaller, recording the lowest mean standard length of 20.63 cm, total length of 23.38 cm, and body mass of 106.65 g.

The condition factor, K, provides an indication of the general well-being, robustness, and nutritional status of fish. YB farm recorded the highest condition factor of 0.94, followed by AB farm with 0.86, while BS farm had the lowest value of 0.83. The relatively higher condition factor observed in fish from YB farm indicates that these fish were heavier in relation to their length and were therefore in comparatively better physiological condition than fish from the other farms. Fish from BS farm, with the lowest condition factor, were relatively less robust and may have experienced poorer nutritional, environmental, or health conditions (Table 3).

Table 3: Descriptive Morphometry and Condition Factor by Farm

Farm	Mean Standard Length (cm)	Mean Total Length (cm)	Mean Body Mass (Weight) (g)	Reported K ($100^*W/TL^3$)
BS	20.63	23.38	106.65	0.83
YB	25.45	28.85	225.75	0.94
AB	23.18	26.90	167.50	0.86

Discussion

The overall ectoparasite prevalence of 15.0% shows that ectoparasitic infection was present but relatively limited among the examined *Clarias gariepinus*. This prevalence was lower than the 20.0% overall parasite prevalence reported for cultured African catfish in Akure State, southwestern Nigeria, and the 33.3% ectoparasite prevalence recorded in farmed *C. gariepinus* in Makurdi (Afolabi et al., 2020; Tachia et al., 2012). However, this difference could be due to difference in sampling season, fish size, number of fish examined, diagnostic procedures and farm-management practices.

Ergasilus sp. was the more frequently detected ectoparasite, with a prevalence of 10.0%, while *Ichthyophthirius multifiliis* had a prevalence of 5.0%. Parasitic copepods and protozoans are recognised frequent ectoparasites of freshwater fish. Members of the family Ergasilidae commonly attach to the gills or other external surfaces of fish, and their transmission can be facilitated by the presence of free-living developmental stages in culture water (Piasecki et al., 2004). The occurrence of *I. multifiliis* is also consistent with the report of Afolabi et al. (2020), who identified the parasite in *C. gariepinus* collected from Nigerian aquatic environments. Its relatively low occurrence in the present study may indicate limited circulation of infective stages during sampling or environmental conditions that were not optimal for rapid transmission.

Farm-level prevalence was highest at BS and YB, where 20.0% of the fish were positive, compared with 5.0% at AB. These differences may reflect variation in stocking density, water exchange, pond sanitation, source of fingerlings and other husbandry practices. Yusuf et al. (2023) similarly associated differences in parasite occurrence among habitats with management conditions, contamination, exposure to infective stages and the introduction of unscreened fish.

Male fish had a higher observed prevalence than females, at 21.2% and 7.4%, respectively. However, the difference was not statistically significant, as indicated by Fisher's exact test. Therefore, the result does not provide sufficient evidence that host sex influenced ectoparasite occurrence. This is in congruence with the study of Yusuf et al. (2023) in which they also found no significant association between sex and parasite prevalence in *C. gariepinus*, although infection levels varied numerically between males and females. In contrast, however, Tachia et al. (2012) recorded a higher proportion of ectoparasites in male than female African catfish. Such inconsistencies suggest that sex-related differences may depend on local ecological conditions, fish behaviour, reproductive status and sample composition rather than sex alone.

Morphometric measurements showed substantial variation among farms. Fish from YB had the greatest mean standard length, total length and body mass, whereas those from BS were the smallest. These differences probably reflect variations in fish age, stocking density, feed quality, feeding frequency and water conditions. The relatively large size of fish at YB may therefore indicate more favourable growth conditions.

The condition factor followed a similar pattern, with YB recording the highest value of 0.94, followed by AB at 0.86 and BS at 0.83. Fulton's condition factor expresses fish body mass relative to length and is commonly used as an indicator of relative robustness or well-being (Richter et al., 2000). Therefore, YB fish were heavier, relative to their length than those from the other farms. However, condition factor is affected by several factors, including species body shape, age, sex, reproductive condition, feeding and season.

The simultaneous occurrence of the highest condition factor and a 20.0% parasite prevalence at YB suggests that the infections detected were probably not sufficiently severe to cause an obvious reduction in average body condition. Larger or older fish may also accumulate greater exposure to parasites over time, Afolabi et al. (2020) reported greater parasite occurrence in some larger weight classes and suggested that increased age, feeding activity and duration of environmental exposure could increase the likelihood of infection. Nevertheless, because parasite status and condition factor were not analysed together for individual fish in the present study, no direct relationship between ectoparasitism and fish condition can be established.

CONCLUSION

Ectoparasites were detected in 15% of 60 pond-reared *C. gariepinus* from three Lokoja farms, with low overall burden and no statistically significant sex association.

The findings demonstrate the presence of *Ergasilus* sp. and *I. multifiliis* in cultured *C. gariepinus* from the three farms, although prevalence was comparatively low. Routine parasite screening, examination of both skin and gills, quarantine of newly introduced fish, control of stocking density and regular monitoring of water quality are hereby recommended. Future studies should include larger samples collected across different seasons and should evaluate parasite intensity, water-quality variables and individual fish condition to identify factors associated with infection more reliably. These improvements would aid stakeholders in the conversion of the study information into aquaculture health policy.

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