Natural occurrence of *Diplostomum* spp. in farm-raised African catfish (*Clarias gariepinus*) from Oyo state, Nigeria

Adeshina Ibrahim a,*, Jenyo-Oni Adetola b, Ajani Emmanuel Kolawole b, Adewale Adetunji Yusuf c

a Department of Aquaculture and Fisheries, University of Ilorin, Nigeria
b Department of Aquaculture and Fisheries Management, University of Ibadan, Nigeria
c School of Environmental Life Sciences, Faculty of Science and Built Engineering, Deakin University, Australia

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**Abstract** *Diplostomum* species are the parasites responsible for diplostomiasis in fish which may cause blindness, eyeflake, severe ocular disease, opacity of the lens and many other affections. The parasites use many organisms including fish as a host. African catfish is one of the widely distributed fish species in tropical Africa and has become one of the most important culturable fish species in Africa especially in Nigeria. This study examined the occurrence of *Diplostomum* species in farm raised African catfish in Oyo state. A total of two hundred and sixteen eye samples were collected from 108 fishes in 36 farms. The eye lens and vitreous body were examined for the presence of *Diplostomum* species. The data obtained were analysed using descriptive statistics and regression analysis to the relationship between the eye size and parasite occurrence. The result shows that 33.18% of the samples had *Diplostomum* species. Males had higher occurrence (23.53%) than the females (9.65%). There were statistically significant differences in the percentage, intensity and index of infection between males and females (\(p = 0.010, p = 0.003, \) and \(p = 0.012\) respectively) while the density of infection between both sexes was not statistically significant (\(p = 0.063\)). The relationship between eye diameter and occurrence of the parasites shows positive relationship Pear-son correlation (\(R^2 = 0.125\)). In conclusion, *Diplostomum* species are present in farm raised African catfish in Oyo state-Nigeria with a positive relationship between the eye diameter and occurrence of the parasites.

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1. Introduction

*Diplostomum* species are the parasites responsible for diplostomiasis in fish. Diplostomiasis in fish results in blindness, eye fluke, severe ocular disease, opacity of the lens and brain-
infection among others. It is a widely distributed parasite and has ability to survive without becoming enclosed in a capsule (encystations) as seen in most freshwater fishes. The parasite has become an organism of concern because it uses many organisms including fish as a host and predatory birds as a carrier [1]. Esc and Fernandez [2] reported that genus of Diplostomum are widely distributed and are common parasites in aquatic environments. Fish eye lens, retina, spinal cord, nasal spaces, as well as the brain are major areas where Diplostomum dominate [3].

African catfish is one of the widely distributed fish species in tropical Africa. Over the years it has become one of the most important culturable fish species in Africa especially in Nigeria. Its wide acceptance might be associated with some important characteristics such as high quality flesh, hardy in nature, high tolerance level of water characteristics and production performance among others. It also attracts significant market values. Clarias gariepinus belongs to the family Claridae. It has a specific organ used for air breathing which allows the fish to survive in wide range of water and environmental parameters such as low dissolved oxygen levels which is usually harmful or lethal to other species. It has ability to consume varieties of conventional and non-conventional feed including kitchen waste [4–6]. It has been cultured singly and/or with other species in form of polyculture in Nigeria. Occurrence of Diplostomum in snail and birds had been recorded in Nigeria but there is paucity of information of its occurrence in C. gariepinus hence the need for this study.

Since some of the physiological activities of the fish such as feeding, swimming, mating etc are vision dependent, it is important that fish has clear vision ability to enable it compete well in the system. Fish with impaired vision will rely on feed that come it way thereby affecting its growth and consequently affecting fish farming business as a profitable business. It could also expose the fish to predation and therefore increase mortality. The objective of this study is to report the occurrence of Diplostomum species in farm raised African catfish in Oyo State.

2. Materials and methods

The study was carried out in Oyo State, located in the South-West geopolitical zone of Nigeria on Latitude N8°00’0” and Longitude E4°00’0” [7]. The four agro-ecological zones of Oyo State were adopted for this study (OYADEP). The zones are Ibadan/Iharapa, Oyo, Saki and Ogbomoso zones [8,9]. Farms in each zones were sub-grouped into Large, Medium and Small scales using stratified methods as described by [10–13]. A total number of thirty-six (36) farms were selected (9 farms from each zone). However, in each zone, the nine (9) selected farms were made of 3 Large, 3 Medium and 3 Small scales farms, selected randomly.

2.1. Sample collection

A total number of one hundred and eight (108) live fish were collected four times in a week in the month of February 2016 and transferred to the Department of Veterinary Parasitology, University of Ilorin for parasites examination. Since most farms are operating all year round, investigation in farm raised fish could affected by season. The mean body weight and total length were 626.56 ± 136.99 g and 45.42 ± 5.72 cm respectively. The sex differential of African catfish was performed using genital papillae commonly used in C. gariepinus as described by [14].

2.2. Parasite examination

The skin around the eye was cleaned with a sterile cotton wool and the eyes were gently pulled with forceps for examination. The optic nerve was cut using scissors and the eyes were placed in a sterile disposable petri dish. From the 108 fish, a total of two hundred and sixteen eye samples were purposively collected for investigation. The eye lens and vitreous were examined for the presence of Diplostomum species under microscope and was presented as described by [15–16]. The eye diameter was measured using meter rule calibrated in millimeter as described by Dörüce et al. [17]. Percentage of infection, density of infection, intensity of infection and index of infection were calculated using the following equations.

\[
\text{Percentage of infection} = \frac{\text{Infected samples}}{\text{Total samples examined}} \times 100
\]

\[
\text{Density of infection} = \frac{\text{Number of parasites collected}}{\text{Total samples examined}}
\]

\[
\text{Intensity of infection} = \frac{\text{Number of parasites collected}}{\text{Number of infected samples}}
\]

\[
\text{Index of infection} = \frac{\text{Number of samples infected} \times \text{Number of parasite collected}}{\text{Total samples examined}}
\]

2.3. Statistical analysis

The data obtained were analyzed using descriptive statistics and regression analysis for the relationship between the eye diameter and parasite occurrence. A Chi-square test was performed in order to determine the significance of parasite occurrence between males and females. Significance of difference in the intensity of the infection between males and females was analyzed by Mann–Whitney U test (p > 0.05) and infections among the agroecological zones were compared using one-way analysis of variance with the aid of IBM SPSS version 20.

3. Results

Fig. 1 shows fish ponds of the visited fish farms covered with net to prevent birds, frog, snails and other fish enemy from gain access to the pond. All the visited farms (100%) in the study area used net to cover the pond for three months to enable the fish grow to the size it would be difficult for birds to pick.

Fig. 2 shows the parasites recovered from the sampled eye. The two major observed organisms were Diplostomum sp. and Austrodiplostomum sp.

The site of infection in this study was eye lens. Table 1 shows that 33.18% of the samples had Diplostomum species. Males had higher occurrence (23.53%) than the females (9.65%). Index and density of infection were higher in males (21.41 and 0.89 respectively) than females (7.04 and 0.64).
respectively). However, intensity of the infection was higher in females (6.64) than males (3.79). There were statistically significant differences in the percentage, intensity and index of infection between males and females ($p = 0.010$, $p = 0.003$, and $p = 0.012$ respectively) while the density of infection between both sexes was not statistically significant ($p = 0.063$).

Table 2 shows that highest number of infected eyes (13) was observed in Saki zone and least in Ibadan/Ibarapa zone (6). Saki zone had highest number of parasites (64), highest percentage of infection (24.07%), highest index of infection (15.41) and density of infection (1.19) while Ibadan/Ibarapa zone had the least (18, 11.11, 3, and 0.33 respectively).
However, the intensity of infection was highest in fish sampled from Ogbomosho zone (6.89) while Ibadan/Ibarapa zone had the lowest (2.00). There were statistical significantly differences in percentage of infection, intensity of infection, index of infection and density of infection among the agroecological zones ($p = 0.021$, $p = 0.006$, $p = 0.034$, and $p = 0.009$) respectively.

The model $\text{Eye diameter (cm)} = 0.017\text{Number of occurrence} + 0.359$ which implies that for increase in eye diameter, the number of occurrence of Diplostomum species tends to increase by 0.017 unit. The Pearson correlation ($R^2 = 0.125$) equivalent to about 12.5% fitness was weak (Fig. 3).

### 4. Discussion

The study shows that about 33.18% of the samples had Diplostomum spp. The result recorded in this study was lower than value (84%) recorded in Chepkoilel farm in Kenya by Migiro et al. [16], 78% observed in Acanthobrama marmid in Turkey by Dörüce [17], and 52% in pond farm in Kenya by Fioravanti et al. [18]. The low value observed in this study might be attributed to the uses of net to cover the ponds in the farms in Oyo State which might prevent bird from having access to the pond. According to Chappell et al. [3] predatory birds are one of the major carriers that aid the distribution of the Diplostomum species. The parasite requires three hosts to complete its life cycle. Fish predatory bird passes it onto snail and fish before it completes its life cycle. Therefore, prevention of fish predatory birds from access to the farm might be responsible for its low occurrence. The presence of Diplostomum species may cause blindness and even death of host fish as documented by Shariff et al. [19]. However, there was a positive relationship between eye diameter and occurrence of the Diplostomum spp. although the relationship (0.125) in the study was very weak. According to Migiro et al. [16] presence of diplostomum species is capable of reducing feeding efficiency of the fish. The high occurrence in males recorded in this study was in agreement with the work of Mohamed [20] who reported that males have high prevalence than the females.

More so, across the zones, the higher occurrence of the Diplostomum spp. recorded in Saki zone might be attributed to the rural nature of the zone. The forestry nature of Ibadan/Ibarapa zone where birds could not easily access the ground might be responsible for the low values recorded in the zone. However, in other zones which are derived savannah, wild animals are naturally found in higher quantity in the zones, urbanization is low but agricultural activities are highest. The high presence of birds which could act as carriers of Diplostomum species could be responsible for the recorded higher values.

### 5. Conclusion

The study revealed that Diplostomum species were present at a low incidence in African catfish (C. gariepinus) raised in Oyo State and there was a positive relationship between the eye diameter and occurrence of the parasite which shows a potential of affecting the fish physiological performance.

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