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Research Article

The Prevalence of *Trypanosoma* Species in Silver Catfish (*Bagrus bajad*) from Zobe Reservoir, Dutsin-Ma, Katsina State

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ABSTRACT

This research investigates the prevalence of *Trypanosome* species in the silver catfish (*Bagrus bajad*) population in Zobe Reservoir, Dutsin-Ma, Katsina State. The study aims to provide insights into the parasitic infection rates, identify prevalent *Trypanosoma* species, and assess its potential impacts on the health and population dynamics of silver catfish in the reservoir. A total of 108 silver catfish samples were collected from Zobe Reservoir in Dutsin-Ma, Katsina, Nigeria at bi-weekly intervals, from July-September; 2023 for the discovery of blood parasites and subjected to thorough parasitological examination. Microscopic analysis, including blood smears and tissue samples, was employed to identify and classify *Trypanosoma* species. Preliminary findings revealed the presence of *Trypanosome* infections in the silver catfish population, with a variation in prevalence rates among the sampled specimens. The study identifies specific *Trypanosome* species affecting the silver catfish in Zobe Reservoir, shedding light on the diversity and distribution of these parasites in the aquatic ecosystem. The *Bagrus bajad* obtained according to sex indicates 29 males and 79 females were examined. Females had the highest percentage of infection, 10.12%, while males had the lowest percentage of infection, 3.45%. The results of this research contribute valuable data to the understanding of *Trypanosome* infections in silver catfish populations, with implications for fisheries management, conservation efforts, and the potential transmission of these parasites to other aquatic organisms. Furthermore, the study underscores the importance of continued monitoring and surveillance to assess the dynamic interactions between *Trypanosomes* and their fish hosts in freshwater ecosystems.

Keywords: *Bagrus bajad*, Catfish, Prevalence, Trypanosomes, Zobe, Reservoir

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INTRODUCTION

Parasitic microorganisms (such as *Trypanosoma,* nematodes, cestodes, and trematodes) can influence a wide range of ecological processes, including growth, mortality, and behaviour, as well as community structure and trophic interactions, but they frequently receive little attention as components of aquatic biodiversity (Cook *et al.,* 2015). The most difficult challenge for ecologists, conservationists, and managers of aquatic reef ecosystems is to comprehend the complex biological interactions that occur within and between reef-associated habitats, as well as how these interactions are influenced by anthropogenic activity (Cook *et al.,* 2015). Freshwater fish infested with parasites of the genus *Trypanosoma,* which is related to the same genus found in mammalian blood. Trypanosomiasis is a disease caused by protozoa flagellate parasites that dwell inside cells called *Trypanosoma*. Parasites that inhabit fish play a vital function in regulating the population of their hosts (Jarallah, 2021). Freshwater and saltwater fishes infected with parasites of the genus *Trypanosoma*, which is identical to the same genus found in the blood of mammals, by the blood sucking insect tsetse fly. Trypanosoma are haemoflagellates with a single free flagellum at the anterior end of their bodies (Jarallah, 2021). *Trypanosoma* infection overwhelms the host system of immunity, resulting in severe illness conditions and, eventually, mortality (Ahmed *et al.,* 2011; Jarallah, 2021). *Trypanosoma* spp. are heterozygous parasitic organisms that spend one stage of their lives in the bloodstreams of various aquatic vertebrate species (amphibians, reptiles and fish) and another in the intestines of leeches, which infect fish populations on multiple continents (Lapirova and Zabotkina 2018; McAllister *et al.,* 2019; DE Sousa *et al.,* 2020). These parasites' trypomastigote forms have an extended shape, especially in the nucleus, kinetoplast, undulating membrane, and flagellum (Eiras *et al.,* 2010; De Sousa *et al.,* 2020). This shape appears to be influenced by the level of metabolism of the blood consumed, with the trypomastigote developing only after the blood is completely digested. This property is also regulated by the temperature and amount of blood consumed (Molina *et al.,* 2016; De Sousa *et al.,* 2020). *Trypanosoma* spp. may result in a variety of clinical symptoms in fish populations, including anorexia, dorsal depigmentation, anaemia, and splenomegaly, all of which can lead to the host's death. Some of these haemoparasites can create haemolytic factors and lower the oxygen carrying capacity of the blood, causing erythropenia and anaemia in hosts (Ahmed *et al.,* 2011; Lapirova and Zabotkina, 2018; McAllister *et al.,* 2019). However, only a few blood manifestations have been reported in Loricariidae species (Fujimoto *et al.,* 2013, Corrêa *et al.,* 2016). Furthermore, it has been proposed that fish that recover from haemoparasite infection can acquire immunity to future infection (Molina *et al.,* 2016; De Sousa *et al.,* 2020). Trypanosomiasis, often known as sleeping sickness, is a disease caused by the protozoa flagellate *Trypanosoma*, which lives within blood cells. Fish parasites serve a crucial role in regulating their hosts' populations. Particular parasitic worms cause illnesses that are transmissible between mammals and fish, such as zoonosis (Jarallah, 2021). Fish, like humans and other animals, suffer from diseases and parasites, but the automatism of fish immunity is similar to that of nethermost vertebrates in that pathogens induce inflammation and modification of fish construct and functionality (Jarallah, 2021). Lotic environments may encourage infection by *Trypanosoma spp* transmitting carriers (vectors) to continue the life cycle of these haemoparasites. Hirudinea vectors are involved in the maintenance of the biological cycle of *Trypanosoma spp*. (Molina *et al.,* 2016; Corrêa *et al.,* 2016 and McAllister *et al.,* 2019), and leeches were found in several specimens of silver catfish (*Bagrus bajad*) during the fish collection phase of the current study. Similarly, several researches (Corrêa *et al.,* 2016; Lapirova and Zabotkina, 2018) have found an increase in leech infection in fish infected with *Trypanossoma spp.* Pathogenicity in fish can thus be caused by leeches and can be more than a simple haemorrhage at the feeding site of these parasites. In severe cases of infection, leeches can induce anaemia and even death in hosts (Molina *et al.,* 2016). Blood parameters can be useful for assessing fish health in response to diseases (Ranzani-Paiva *et al.,* 2013). Anaemia due to erythropenia is one of the most common illnesses that result from *Trypanosoma spp*. in fish (McAllister *et al.,* 2019). However, the aetiology of such illnesses is complex (McAllister *et al.,* 2019). Due to the synthesis of haemolytic agents, several *Trypanosoma spp*. can cause erythropenia and anaemia in the host fish (Ahmed *et al.,* 2011; McAllister *et al.,* 2019). Recent research suggests that the synergistic activity of proinflammatory cytokines is required to maintain protracted anaemia, while other *Trypanosoma* species can directly or indirectly decrease erythropoiesis in hosts, resulting in an anaemic process (De souse *et al.,* 2020). All of this material are essential and should be studied, as their occurrences can result in fatalities and significant economic losses in aquaculture. Trypanosomes are haemoparasites that infect both water-based and terrestrial mammals. Trypanosomiasis is a deadly parasitic disease that affects humans, animals used as pets, fish, and a wide range of vertebrate hosts. It is caused by protozoan haemoflagellates called trypanosomes, which are found everywhere in nature (Muhammad *et al.,* 2017).These protozoan organisms are responsible for devastating diseases in humans as well as significant economic losses in animals that are domesticated and wild (Muhammad *et al.,* 2017). Despite decades of concentrated attempts to prevent the disease in humans and domestic animals, losses related to the disease in aquatic creatures have yet to be assessed. While tsetse flies are known vectors of the disease in human being and animals (OIE, 2013), mosquito and leech bites are responsible for disease transmission in birds and fish, respectively. Due to vector ecology, the relationship of fish trypanosomes with leeches makes it a disease of wild fish.

Trypanosomal disease has been reported in wild different kinds of fish from North to South Africa, most notably in Sudan (Samia *et al.,* 2011), South Africa (Ferreirra and Avenant, 2013), and more recently in North Western Nigeria (Muhammad *et al.,* 2016). On the other hand, there is a lack of evidence in addition reserves on the haemo-parasites worms' position of Silver catfish in Zobe reservoir. As a result, the primary goals of this survey are to determine the presence of *Bagrus bayad* blood parasite worms in Zobe Reservoir Dutsin-Ma, Katsina State, Nigeria, during laboratory and investigative results.

MATERIALS AND METHODS

Study Area

Dutsin-Ma LGA is in Katsina Central Senatorial District and is located at latitude 7 8''N and longitude 7 9 9''E, with its headquarters in Dutsin-Ma town. It has a total land area of approximately 527km^2 (Sadauki *et al.,* 2022). The Zobe Reservoir is an earth-filled structure located in the southern part of the Dutsin-Ma LGA at 12°23'18"N and 7°28'29"E. With a base of 2,750 m, a length of 360 m, a height of 48 m, and a storage capacity of 179 million cubic metres (Sadauki *et al.,* 2022), it is one of the largest dams in the State. The dam primary purpose was for residential water supply and irrigation activities, but it has also acted as a source of fish over time, giving a livelihood for fisherman and cheap quality protein for customers (Sadauki *et al.,* 2022).

Sample Collection

For a three-month period, a total of 108 live fish samples of Silver catfish (*Bagrus bayad*) of various sizes were purchased from local fishermen at three (3) landing sites of Zobe reservoir (Site A, Site B, and Site C). The fish samples have been brought live to the Department of Biological Sciences, Federal University Dutsin-Ma, Katsina State's fish biology laboratory in a plastic container filled with water for the identification of blood parasites (*Trypanosoma spp*.) as described Sadauki *et al*. (2022).

Identification of Fish Samples

The experimental fish were instantly identified in the field using Suleiman (2016) graphical chart and Olaosebikan and Raji (2013) freshwater fish identification guide.

Sexing of Experimental Fish

The sexes of the fishes were identified through physical examination of the external characteristics of the fish samples, with males having protruded and elongated genital papilla and females having round opening papilla, as described by Sogbesan *et al.* (2018) and Sadauki *et al.* (2022).

Measurement of Experimental Fish

The standard and total lengths (cm) of the experimental fish samples were measured with a metre rule, and the weight was measured with a top loading sensitive weighing balance using standard techniques described by Sogbesan *et al.* (2018) and Sadauki *et al*. (2022).

Examination of Blood Parasite

Blood samples of Silver catfish were collected from the caudal artery of Silver catfish using a syringe and a 21G gauge needle, depending on fish size, and then stored in tubes with anticoagulant. Three replicate blood smears were produced for each fish, using a single drop of blood deposited on each of three glass slides. Blood smears were allowed to dry for 5 to 10 minutes before being fixed in a dustproof container with 100% methanol. Each fish had one smear stained with a modified solution of Giemsa stain. Blood smears were examined under an optical microscope at 100x magnification and revealed the organisms to be Trypanosoma. A digital camera was used to capture scientific photographs (Cook *et al.,* 2015; De souse *et al.,* 2020; Jarallah, 2021).

Identification of Blood Parasites

The morphology of the blood parasite worm was used to identify it (Paperna, 1996; Smit *et al.,* 2000). The Trypanosome was identified by its tapering anterior and posterior ends, as well as its faintly pigmented flagella.

Parasite Prevalence and Intensity Estimation

The prevalence of parasitic infestation was calculated for sex, location, length and weight using the model described by Sadauki *et al.* (2022):

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

$$\text{Percentage (\%) of infection} = \frac{\text{Number of a specific parasite in the samples}}{\text{Total number of parasite in the samples}} x100$$

Data Analysis

The frequency and intensity of infestation were represented as percentages (%). The prevalence and distributions of parasites were described using descriptive statistics; a simple percentage was employed to present the prevalence and distributions of parasites. The descriptive statistics were used to investigate the relationship between infection and the risk criteria for prevalence.

RESULTS

Table 1 shows the overall prevalence of blood parasite in *Bagrus bayad*. The overall prevalence of *Bagrus bayad* was 8.33%. The infestation of blood parasite according to sex indicates 29 males and 79 females were examined (Table 1). Female had the higher percent of infection 10.12%, while males had the lower percent of infection, 3.45%.

Table 2 shows prevalence of blood parasite in relation to sample collection in Zobe reservoir. Blood parasite were absent in *Bagrus bayad* obtained from sample location A. This could be due to absent of leeches in the sample location. Although for sample C the prevalence was higher 7(19.44%) followed by sample location B with lower percent of infection 2 (5.55%) as showed in Table 2.

Table 3 shows the blood parasite infection in relation to length of *Bagrus bayad*. The length of group 21-25 and 30-35 were recorded 0% of infection. The length of group 25-30 had the highest percent of prevalence 6(15.00%), followed by 35-40 2(10.52%) while 40-45% had lower percent of infection 1(4.76%).

Table 4 shows the blood infection in relation to the weight of fish. A high prevalence of 35.29%, 6.66% and 3.03% was observed in weight group of 91-130g, 131-160g, and 161-200g respectively. While fish with the weight of 50-90g had a prevalence of 0%.

Table 1: Prevalence of Blood parasite of *Bagrus bayad* in relation to sex in Zobe Reservoir

Sex	No examined	No of infected	% of infection
Male	29	1	3.45%
Female	79	8	10.12%
Total	108	9	8.33%

Table 2: Prevalence of Blood parasite of *Bagrus bayad* in relation to sample location in Zobe Reservoir

Location	No examined	No of infected	% of infection
A	36	0	0.00%
B	36	2	5.55%
C	36	7	19.44%
Total	108	9	8.33%

Table 3: Prevalence of Blood parasite of *Bagrus bayad* in relation to length in Zobe Reservoir

Fish length in cm	No examined	No of infected	% of infection
21-25	8	0	0.00%
26-30	21	6	28.58%
31-35	20	0	0.00%
36-40	19	2	10.52%
41-45	40	1	2.50%
Total	108	9	8.33%

Table 4: Prevalence of Blood parasite of *Bagrus bayad* in relation to weight in Zobe Reservoir

Fish weight(g)	No examined	No of infected	% of infection
50-90	10	0	0.00%
91-130	17	6	35.30%
131-160	15	1	6.67%
161-200	66	2	3.03%
Total	108	9	8.33%

DISCUSSION

In this study blood parasites were recorded in different size of *Bagrus bayad.* The infection with parasites *Trypanosoma spp*. was minimal in blood fishes of silver catfish (*Bagrus bajad*), 9(8.33%), which may be attributable to the hosts' high health. This outcome was indicated by Jarallah (2021). In dissimilarity, the current study contradicts the findings of De souse *et al*. (2021), who found a prevalence of *Trypanosoma spp*. in *P. pardalis* of 40.6%. Whereas infection with these parasites *Trypanosoma spp* was 8(10.12%) in female silver catfish (*Bagrus bajad*) blood, this could be related to the large number of female samples taken in the research study area. Hassan *et al.* (2007) discovered the haemoparasite *Trypanosoma spp* in *Synodontis clarias* in Lekki Lagoon, Lagos, Nigeria and Koledoye and Akinsanya, 2022) discovered the *Trypanosoma* spp in *Synodontis clarias* from Lekki Lagoon, Lagos, Nigeria. In overall, sixteen fish (9 males and 7 females) were infested with haemoparasites. Blood parasite were absent in *Bagrus bayad* obtained from sample location A. This could be due to absent of leeches in the sample location. Although for sample C the prevalence was higher 7(19.44%) followed by sample location B with lower percent of infection 2 (5.55%). This outcome was indicated by Shahi (2013). Blood parasites (*Trypanosoma* sp.) were absent in the *Bagrus bayad* length group of 21-25 and 30-35cm. This result was indicated by Jarallah (2021); (Koledoye and Akinsanya, 2022). While the infection with parasites *Trypanosoma* sp. was slight higher in blood fishes of length group of 25-30cm with highest percent of prevalence 6(15.00%). Numerous surveys piloted to the establishment of *Trypanosoma* sp. Infection in numerous species of fish (Jarallah, 2021). Trypanosomal infestation amongst wild fish species in African countries was stated from Northern to Southern provinces, particularly in Uganda (Baker, 1959; 1960); Botswana (Smith *et al.,* 2004); Nigeria (Hassan *et al.,* 2007); Egypt (Osman, 2009); Sudan (Samia *et al.,* 2011); South Africa (Ferreirra and Avenant, 2013); as well as in current times more species of fish were stated to be infested in North-Western Nigeria (Muhammad *et al.,* 2016). The high occurrence of *Trypanosoma* sp infestation in fish detected here is in conformity with (Alhayali *et al.,* 2023) who stated a *Trypanosoma* infection rate of 16.6% in fish. The detected mixed infestation with *Trypanosoma* and *Babesiosoma* has similarly been previously described (Pereira *et al.,* 2013). The prevalence of blood parasites in fish are often the result of interactions with leeches (Porter *et al,.* 2009). The persistent homogeneity in parasitic worm's size groups, with distinctive light staining reaction might back previous statement, by Muhammad *et al.* (2017), for specie specificity. Nevertheless occurrence pattern of infestation in this findings is comparable to those stated in Botswana (Smith, 2004) where conclusion was drawn to classification of *Trapanosoma* spp, in agreement with Baker (1960) due to anterior location of the nucleus in whole the 10 families of fish experimented. A high prevalence of 35.29%, 6.66% and 3.03% was observed in weight group of 91-130g, 131-160g, and 161-200g respectively. This outcome was indicated by Shahi (2013). While fish with the weight of 50-90g had a prevalence of 0%. Paperna (1996), identified occurrence of infestation by *trypanosome* in African catfish, *C. gariepinus* and Silver catfish *Bagrus spp* in Lake Victoria was about 50%. *Nico et al.* (2004) also give an account a higher infestation level of *trypanosome* with 79% occurrence in *Synodontis spp* and 43% prevalence in *C. gariepinus*. On the other hand, lower prevalence's or incidences of infestation (8.33%) was noticed in the current study in Silver catfish may probably be due to lower inhabitants of the bloodsuckers (leeches) in Zobe reservoir. In this incident, the lower infestation level may possibly be due to enhanced or developed host (fish) resistance or immunity. The significant high prevalence of infection in males by *trypanosome* in *B. bayda* may perhaps also be attributed to random choice due to the bulky figure of males samples investigated as compared with female fish samples. The absence of leeches in a particular geographic area is due to the lack of vegetation the habitat of bloodsuckers (leeches). The living habitat of many water reservoirs differs from one another. It is natural that the possibility of fish infestation with blood parasites varies. To infect vertebrates that live in water with blood parasites, the conditions for the emergence of leeches, which are blood parasite carriers, must first be met. These invertebrates like well-heated ditch waters or sluggish freshwater lakes with dense thickets of aquatic plants. The existence of favourable temperature conditions for the development of these parasites is the second criterion for infection of fish with blood parasites (Huseynov and Seid-Rzayev, 2016).We looked for blood parasites in *Bagrus bayad* fish that inhabit in the studied water reservoirs, although some fish were free from any blood parasites. The absence of blood parasites in the reservoir is due to the absence of carriers (leeches) in some samples location from the body of water. The absence of parasites in the blood of these fish has its own reason of causes in some cases. In certain situations, this is related to the investigated fish being migratory and semi-anadromous fish, which spend the most of their life in sea and fresh water, where fish cannot be infected with blood parasites. Others are relatively small in numbers and have been examined in a small number, which stopped us from finding any blood parasites in these fish (Huseynov and Seid-Rzayev, 2016).Once swollen with the host's blood, leeches detach and remain in the water on a sheltered substrate (ideally under a stone or in plant debris) until their next meal (Paperna, 1996).

CONCLUSION

In conclusion, the prevalence of blood parasites, specifically *Trapanosoma spp*, in silver catfish (*Bagrus bajad*) in Zobe Reservoir, Katsina State, underscores the importance of continuous monitoring and assessment of the health status of aquatic ecosystems. The presence of these blood parasites raises concerns about the potential impact on the overall well-being of the silver catfish (*bagrus bajad*) population in the reservoir. Parasitic worms affect the marketing value of fish; in addition, they affect financial damages in aquaculture and producing. To our information, this is the pioneer findings examining the occurrence of blood parasitic worms in fish of Zobe reservoir, Nigeria. In the outcome of our study in Zobe artificial lake of Dutsin-Ma, Katsina we examined 108 fish samples for the occurrence of *Trypanosome* seven (7) genera was identified. It is suggested that more investigation on fish blood parasitic worms be done to examine the incidence of blood parasitic worms in water environment in addition to make available evidence on the possible threats to fish wellbeing. This is particularly significant with the rising requirement for fish as an animal protein sources for human being and domestic animals. Additional investigation is needed to describe molecularly the classified morphotypes of *trypanosomes*, ascertain their phylogenic origin and pathogenic consequences on Nigerian fishes

Further research on fish parasites is recommended to investigate the presence of parasites (*Trypanosoma spp*) in aquatic systems and provide information on potential threats to fish health. This is especially important considering the growing need for fish as an animal source of amino acids for human beings as well as animals.

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