https://dx.doi.org/10.4314/dujopas.v10i4c.11
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 10 No. 4c December 2024*

Prevalence of Intestinal Parasites of *Clarias Gariepinus* and *Heterotis Niloticus* in Marma Water Channel, Kirikasamma Local Government Area, Jigawa State – Nigeria

[1]Nasir Tukur Dabo, [2]Nafisa Muhammad Danyaro, [3]Ahmad Maigari

[1,3]Department of Biological Sciences,
Bayero University,
Kano

[2]Department of Science Laboratory Technology,
Hussaini Adamu Federal Polytechnic,
Kazaure

Email: nafisamd1983@gmail.com

Abstract
Water channel is a vital resourse in many countries, as it provides the communities with different economic potentialities. However, impact of human activities via industrialization, urbanization contaminates the water body leading to depletion of an important aquatic biota such as fish. The present study determined the prevalence of parasitic infestation in fish species (C. gariepinus and Heterotis niloticus) along Marma Water Channel, which comprises of Marma, Likori, Dawa and Madachi towns. The study was carried out for a period of 12 months (January to December, 2023). Parasitic prevalence, were evaluated using standard protocol. Two hundred and seventy (270) fresh fish species of both C. gariepinus and H. niloticus were randomly obtained from the landing sites on monthly basis. The overall prevalence of infection was 21.85%, in which higher prevalence rate was recorded in H. niloticus with 22.01% while C. gariepinus had 21.62%. Morphological examination revealed the identity of the encountered fish parasites with Bothriocephalus acheilognathii (40.9%), Biacetabulum infrequens (13.6%), Cecaria heterophiid (27.3%), Rhabdochona congolensis (9.5%) and Cystacanth (larval stage) (13.6%). It was concluded that Cestodes where more predominant with the total number of 17 parasites across the two fish species. It is therefore recommended that fish samples from Marma water channel should be properly cooked to protect consumers from ingesting fish contaminated with parasites.

Keywords: Fish, Jigawa State, Intestinal parasites, Marwa water channel, Prevalence

INTRODUCTION
Fish makes up almost 37% of Nigeria's total protein needs and is the most affordable and significant source of animal protein (FAO, 2024). According to the FAO (2024), fish accounts for about 16% of the animal protein consumed worldwide. In areas with comparatively limited cattle, it is significant source of protein for billions of people, primarily in developing nations (FAO, 2024). Because of their affordability, consumption and demand for high-quality fish protein are on the rise. Unfortunately, parasitic infections in fish are a big problem because they weaken the host immune system, making it easier for disease-causing agents like fungi,

Author for Correspondence

bacteria, and viruses to infect the fish (Auta *et al*., 2019). This makes the fish less nutritious and causes businesses to lose money because they have trouble selling their products (Osimen and Anagha, 2020). In naturally occurring infections, host damage is rarely evident in fish in African aquatic habitats. However, these worms pose a potential risk to native fish species introduced to farming (Nizar et al., 2021). Fish parasites are potential indicators of environmental quality (Dankishiya *et al*., 2019). However, fish Parasites can be grouped into micro parasites and macro parasites on the basis of size. The micro parasites include viruses, bacteria, fungi, protozoans, microsporidians (Uruku and Adikwu, 2017; Auta *et al.,* 2019). On the other hand, the macro parasites are multicellular organisms mainly comprised of the helminths and arthropods. Similarly, parasites can be grouped based on their localization on the affected host as endoparasites and ectoparasites. Ectoparasites are found on the external surfaces such as skin, fins and gills (e.g. gill flukes, anchor worms, fish lice and leeches) (Adewole *et al*., 2018). Endoparasites are found in the internal tissues such as muscles and organs such as the alimentary canal, liver, and kidney (e.g. trematodes, cestodes, acanthocephalans and nematodes) (Abiyu *et al*., 2020). For instance, Danyaro *et al*. (2018) identified four classes of helminths in Marma water channel belonging to cestode (12), trematode (1), nematode (6) and acanthocephalan (3). In addition, Imam and Dewu (2010) identified *Ichthyopthirius* sp., *Trichodina* sp., *Eimeria* spp and *Chilodonella* sp. with prevalence rate of 56%, 10.5%, 5.3% and 3.5% respectively the following fish parasite at Galadima Fish Market, Kano State while Biu *et al.* (2014) reported a 42.9% incidence of *Paramacallanus* and 23.8% of *Contracaceum* in *Oreochromis niloticus* from Alao reservoir, Maiduguri.

Parasitic infections are common in natural water bodies, affecting fish growth, development and reproduction (E-Shahawy *et al*., 2017; Areda *et al.,* 2019). Effects of parasite on fish include muscle degeneration, liver dysfunction, interference with nutrition, cardiac disruption, nervous system impairment, castration or mechanical interference with spawning, weight loss and gross distortion of the body (Adewole *et al.,* 2018). Other severe pathological disorders include inflammation and atrophy of the viscera, resulting from compression of organs by the parasites, often together with accumulation of blood stained ascetic fluid (Amechi, 2015). Parasites are also incriminated in severe pathological disorders in the affected fish, resulting in their economic and nutritive devaluation. These diseases, in addition to other factors, cause steady decline in fishery resources in Jigawa State. In view of the forgoing, this research aimed at assessing intestinal parasites of *C. gariepinus* and *H. niloticus* of Marma water channel, Kirikasmma Local Government, Jigawa, State, Nigeria.

MATERIALS AND METHODS

Description of the Study Area

Marma water channel is situated along the river Hadejia in Kirikassama Local Government Area, Jigawa State (Figure 1). It is located at latitude 12°30′00′′- 12 42′07′′ N and longitude 10° 14′24′′- 10° 23′00′′15° E of green which meridian. Marma water channel covers a vast area in term of flow its effects affect not only Kirikasamma Local Government, but it transcends Hadejia, Birniwa and Guri local government areas. River Hadejia has four tributaries, they are: Kafin Hausa, Burumgana, old Hadeja and Marma water channel. Two distinct seasons are experienced annually wet and dry seasons with annual mean temperature of 31°C. The agro-metrological station of Hadejia indicates an estimated average rainfall as 411 mm during months of July and August. The rainy season period lasts from June to September and dry season runs from October to May. The water channel contains muddy substratum and gently flowing, highly turbid with rich algal growth and macrophytes. Sandy- loam and clay – loam are the soil types of the area of which they are rich in nutrients and other minerals (Saiyadi *et* *al*., 2022). The communities around the water channel depend basically on the water body as a source of livelihood by exploiting its abundant resources.

Study Area and Settings

The selected study towns are Marma (latitude 12°39′47′′N - 12º42′07′′N and longitude 10°17′11′′E - 10º 23′34′′E), Likori, (12°23′44′′N - 12º32′35′′N and 10°25′51′′E - 10º 31′34′′E), Dawa (12°39′07′′N - 12º39′45′′N and 10°19′53′′E - 8º 22′19′′E), and Madachi (12°33′09′′N - 12º39′21′′N and longitude 10°14′24′′E - 10º 22′31′′E). Town selection was based on closeness to the water channel and human or biological activities such as fishing, farming, and cattle rearing.

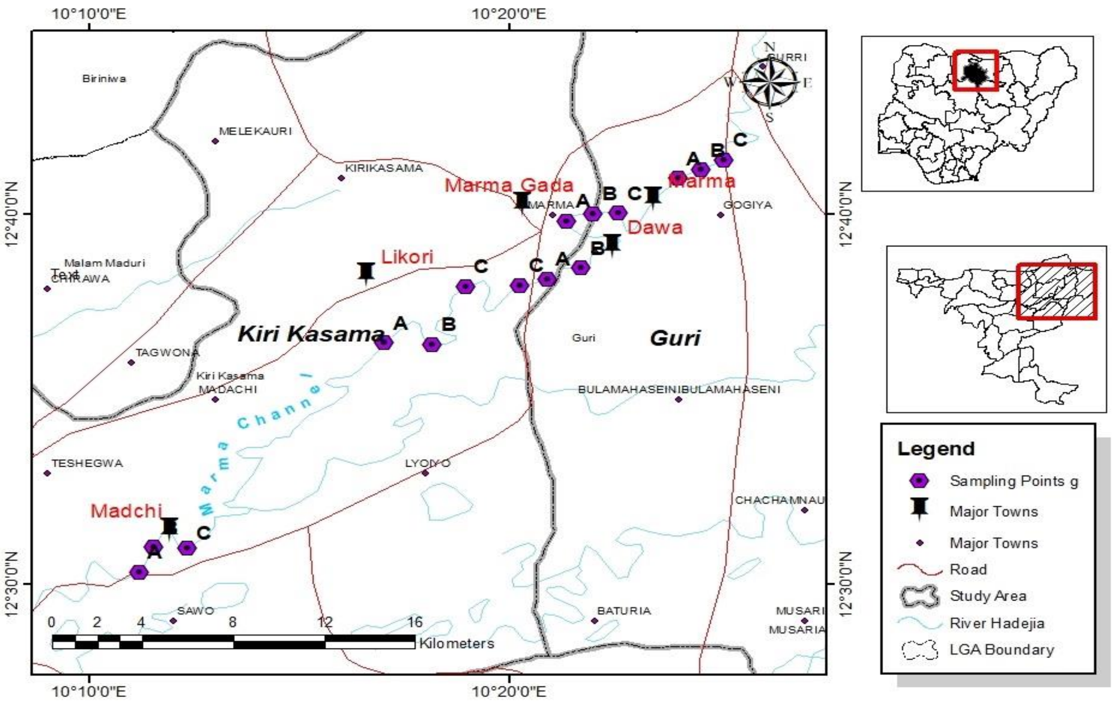

Figure 2.1 Map of the Study Area (Source: GIS Unit, Geography Department, Bayero University, Kano)

Sample Size Determination

The research involves assessment of several variables from the sampling stations using formula for sample size determination described by Morris *et al*. (1992):

$$n = \frac{Z^2 Pq}{d^2} \quad \text{where:}$$

Z = statistic level of confidence interval at 95% = 1.96, P = previous prevalence from other study

d = allowable error of 5%, (0.05)

q = 1 – P

For Fish samples a 22.4% previous prevalence according to Danyaro *et al*. (2019) was used. Hence,

$$n = \frac{1.96^2(0.224)(1-0.224)}{0.05^2}$$

n = 267.1, Round up to 270

Fish Sample Collection and Processing

Fishes were also collected using method adopted by Danyaro *et al.* (2018). Live fresh specimen of C. *gariepinus* and H. *niloticus* of different weights and length group was obtained directly from the local fishermen working in the study area monthly. Freshly killed fish samples were transported from the study site in a cool box to the laboratory for further analysis.

Fish Sample Parasitological Examination
Collected samples were examined as described by Danyaro *et al.* (2018).The intestine was cut open using a pair of scissors and the content was emptied each into a Petri dish containing 10% Formalin solution. The lining of the lumen was scrapped out and put on glass slide covered with slip and then observed using microscope with X10 and X40 objectives lens. Parasites recovered were observed using the taxonomic keys of Paperna (1996).

Ethical Approval
Ethical approval with Reference number MOH/SEC/1.S/7071/V1/3V/1 was obtained from Jigawa State Ministry of Health prior to the commencement of the study.

Statistical Analyses
The overall prevalence of the parasitic infections were analysed using chi-square tests. Significance difference was declared at 5% significance level ($P<0.05$)

Results and Discussion
Overall Prevalence of Helminths Infection in C*larias gariepinus* and *H. niloticus* revealed a total 21.85%. *C. gariepinus* had 21.62% out of 111 fish examined while *H. niloticus* 22.01% (35/159) (Table 1).

Table 1:- Overall Prevalence of Helminths Infection in C*larias* and *H. niloticus*

Fish Species	No examined	No infected (%)
C. gariepinus	111	23(21.62)
H. niloticus	159	35(22.01)
Total	270	58 (21.85)

$\chi 2 = 3.44$, d.f = 1(p-v =0.05) (b) $\chi 2 = 6.77$, d.f = 1(P = 0.077)

Table 2 revealed the prevalence of helminth infections in *Clarias gariepinus* and *Heterotis niloticus* in relation to sex. The observed infection rates highlight notable trends between male and female fish across both species. In *C. gariepinus*, 60.86% of males (14/60) were infected, compared to 39.13% of females (9/51). *H. niloticus*, the infection rates were 60.0% in males (21/91) versus 40.0% in females (14/68). Overall, males in both species had a higher infection rates than females, indicating sex-related susceptibility to helminth infections.

Table 2: Prevalence of Helminths infection in C*larias* and *Heterotis* in relation to Sex

Sex	*C. gariepinus*		*H. niloticus*	
	No. examined	No. infected (%)	No. examined	No. infected (%)
Male	60	14(60.86)	91	21(60.0)
Female	51	9(39.13)	68	14(40.0)
Total	111	23	159	35

$\chi 2 = 3.65$, df. = 1(p = 0.95) (b) $\chi 2 = 1.61$, df. = 1(p = 0.05)

Table 3 presents the prevalence of helminth parasites in *C.gariepinus* collected from the sampling sites. The helminth species identified include Cestodea with *Bothriocephalus acheilognathii* having 32.53% and *Biacetabulum infrequens* (11.11%). Trematoda had Cecaria of heterophiid (11.11% females, 7.14% males). Nematoda representatives include: *Rhabdochona congolensis* (11.11% females, 14.28% males); *Enterobius vermicularis* (22.22% females, 20.00 %

males); Anchorworms larvae (33.33% females, 7.14% males); and Cystacanth larval stage with 7.14%.

Table 3: Prevalence of Helminths Parasite in *C. gariepinus* in Marma water Channels

	Female		Male	
Class of parasites	No. recovered	% infected		% infected
Cestoda				
Bothriocephalus acheilognathii	1	11.11	3	21.42
Biacetabulum infrequens	1	11.11		
Trematoda				
Cecaria of *heterophiid*	1	11.11	1	7.14
Nematoda				
Rhabdochona congolensis	1	11.11	2	14.28
Enterobius vermicularis	2	22.22	2	**20.00**
Anchorworms larvae	3	33.33	1	7.14
Cystacanth larval stage	0	0.00	1	7.14
Total	9	100	10	100

(a) $\chi 2 = 3.65$, d.f = 6 (p = 0.05) (b) $\chi 2 = 1.91$, d.f = 6 (P = 0.87)

Table 4, indicates the prevalence of helminth parasites in *Heterotis niloticus* collected from the Marma water channels, comparing infection rates between female and male fish species. *Bothriocephalus acheilognathii*, had 28.57% among females while males recorded 28.57%. Females had 14.28% infections *of Biacetabulum infrequens*, none in males. Cecaria of heterophiid 4.76% among males. *Rhabdochona congolensis* in females (28.57%) and 19.04% in males. *Enterobius vermicularis* (14.28%) in females and 5.88% among males. Anchorworms larvae had 14.28% in males. Cystacanth larval stage had 14.28% in male infection rate and 9.52% in females. Overall infection indicates 14 infections, while males had 21 infections.

Table 4: Prevalence of Helminths Parasite in *H. niloticus* in Marma water Channels

	Female		Male	
Class of parasites	No. recovered	% infected		% infected
Cestoda				
Bothriocephalus acheilognathii	4	28.57	6	**28.57**
Biacetabulum infrequens	2	14.28	0	
Trematoda				
Cecaria of *heterophiid*			1	4.76
Nematoda				
Rhabdochona congolensis	4	28.57	4	19.04
Enterobius vermicularis	2	14.28	1	5.88
Anchorworms larvae			3	14.28
cystacanth larval stage	2	14.28	2	9.52
Total	14	100	17	100

$\chi 2 = 3.65$, d.f = 6 (p = 0.95) (b) $\chi 2 = 1.61$, d.f = 6 (p= 0.05)

Table 5 presents the prevalence of helminth infections in *Clarias gariepinus* and *Heterotis niloticus* in relation to fish length. *C. gariepinus* with mean length 15 - 24.9 cm had 60.86% infection rate while those with length of 25 - 34.9 cm had 21.73%. Those with length of 35cm and above, had 17.39%. For *H. niloticus*: those with length range of 15 - 24.9 cm, 54.28% were observed. Those with length 25 - 34.9 cm, 25.71% were recorded while fish with length 35cm and above: 39 had 20.0% infection rate. Total infections, For *C. gariepinus*, the overall infection rate was 23% while *H. niloticus* showed a total infection rate of 35%.

Table 5: Prevalence of Helminths infection in C*larias* and *Heterotis* in relation to Length

	C.gariepinus		*H.niloticus*	
Range (cm)	No. examined	No. infected (%)	No. examined	No infected (%)
15 - 24.9	45	14(60.86)	79	19(54.28)
25 - 34.9	40	5(21.73)	41	9(25.71)
35 and above	26	4(17.39)	39	7(20.0)
Total	**111**	**23**	**159**	**35**

χ2 = 12.76, d.f = 2 (p=0.67) χ2 = 11.33, d.f = 3 (p= 0.05)

Table 6, presents the prevalence of helminth infections in *Clarias gariepinus* and *Heterotis niloticus* in relation to fish weight. Among *C. gariepinus* with weight range of 1 – 99 g, 39.13% were infected. Fish species with weight of 100 – 199 g, 26.08% were infected. Those with weight range of 200 – 299g, had 17.39% infection rate. Weight range 300 – 399 g, 13.04% were infected while those with 400 and above, had 4.34%. *H. niloticus* with weight range 1 – 99 g, 39.02% were recorded. Among 100 – 199 g, 21.95% were infected compared to 200 – 299 g, 31 where 17.07% were recorded. Fish species with weight range of 300 – 399 g had 12.19% while 400g and above had 9.75% infection rate. *C. gariepinus* had an overall infection rate of 23%, while *H. niloticus* exhibited a total infection rate of 41%.

Table 6: Prevalence of Helminths infection in C*larias* and *Heterotis* in relation to Weight

	C. gariepinus		*H. niloticus*	
Weight (g)	No. examined	No. infected (%)	No. examined	No. infected (%)
1 – 99	52	9(39.13)	47	16(39.02)
100- 199	19	6(26.08)	34	9(21.95)
200- 299	19	4(17.39)	31	7(17.07)
300- 399	14	3(13.04)	26	5(12.19)
400 and above	7	1(4.34)	21	4 (9.75)
Total	**111**	**23**	**159**	**41**

χ2 = 15.90, d.f = 4 (p=0.05) χ2 = 7.05, d.f = 4 (p= 0.05)

Discussion

The overall prevalence of helminth infections in *Clarias gariepinus* and *Heterotis niloticus* were presented. The results revealed the extent of infection across these two fish species, providing insights into the health status of the sampled fish species. The variation of parasitic infection might be attributed to the behavior and ecological niches of the fish species *C. gariepinus* is known for its aggressive feeding habits and omnivorous diet, which may increase its exposure to infected prey and environmental pathogens. Conversely, *H. niloticus* may have different foraging strategies that could affect its susceptibility (Yakubu *et al*., 2002; Auta *et al*., 2018).
Table 2 revealed varying infection rates between male and female among the fish species. The prevalence of *Bothriocephalus acheilognathii* is equal in both sexes, suggesting that both genders have similar exposure to this cestode species. However, females show higher prevalence for *Biacetabulum infrequens*, indicating potential differences in habitat or feeding strategies that may affect exposure. This is in consistent with the finding of Uhuo *et al*. (2014) who recorded *D. latum., Procammalanus sp., Acanthocephala sp.* in Indibe Beach, Ebonyi State. Males had a higher infection rate for *Enterobius vermicularis* (23.80%) compared to females (14.28%). This is attributed to the variation in feeding habit and level of immunity among others factors. This trend aligns with observations in other fish species, where male fish often present higher parasitic loads due to behavioral factors (Karam *et al*., 2018). The presence of Anchorworms larvae only in males could also point towards behavioral patterns that increase exposure to this parasite during breeding or territorial activities.

Higher infection rates were recorded in smaller fish species in both species in the present study. Smaller fish with weight range of 15 - 24.9 cm and 1-99g showed the highest prevalence of infection rate. This trend is consistent with findings in other studies, which indicate that juvenile fish are often more susceptible to parasitic infections due to their less developed immune systems (Nizar *et al*., 2021). The significant prevalence in smaller *C. gariepinus* may suggest a higher exposure to parasites in environments where these fish are foraging or swimming (Dankishiya *et al*., 2013). Decreased infection with increased in size could be due to the robust immune systems that enable them to better fend off infections (Tachia *et al*., 2012; Ejere *et al*., 2014) and bigger fish might also be more selective in their feeding habits, reducing their exposure to infected prey. Similar observation was reported by Abowei and Ezekiel (2011).

Conclusion
The current investigation has revealed that both fish species examined haboured parasites, with the overall prevalence of 21.85 %. Higher infection rate was seen in *H. niloticus* with 22.01% while lower infection rate of 21.62% obtained in *C. gariepinu*s. Parasites identified are: *B. acheilognatha, B. infrequens, cercaria of heterophiid, R. congolonse, E. vermicularis,* Anchorworms larvae, cystacanth larval stage. *B. acheilognatha* had the highest prevalence of 28.57% in both *H. niloticus and C. gariepinus.* It was concluded that factors such as sex, size, and weight may have an impact on the level of infection among the sampled fishes, while nutrition is also likely to play a role in determining the stages at which parasitic infection develops. The existence of these parasites serves as evidence that there are a significant number of parasites in the water channel.

Recommendation
It was therefore recommended that periodic parasitological investigations and public enlighten should be carried out in order to curtail the potential danger of these parasitic fauna which might be harmful to both the fishes and humans in the community.

References

Abiyu, M., Mekonnen, G. and Hailay, K. (2020): Prevalence of Internal Nematode Parasites of Nile Tilapia (*Oreochromis niloticus*) Fish species caught from Southwestern Part of Lake Tana, Central Gondar, Ethiopia. *Journal of Aquaculture Research and Development*, 11(2): 582.

Abowei, J. F and Ezekiel, E. N. (2011). A review of acanthocephla, leeches, parasite crustaceans, and some other parasites of miscellaneous taxa infections in African fish. *International Journal of Animal and Veterinary Advances*, 3(5): 337-351.

Adebambo, A. A. R (2020). Fish Species Parasites: A Review In Nigerian Water Bodies. *Journal of Research in Forestry, Wildlife & Environment Vol. 12(3):223-234.*

Adewole, S. O., Odeyemi, D. F., Fatunwase, O. P., Christopher, V. N., Omoyeni, T. E. and Dada, A. O. (2018): Parasites as Bioindicator for Health Status and Environmental quality of Freshwater Fish species in Ekiti State, Nigeria. *Journal of Biomedical Engineering and Medical Imaging,* 6(2): 1-7.

Alas, A, Oktener A, Solak K. A study on the morphology of Argulus foliaceus Lin., 1758 (Crustacea; Branchiura) procured from Cavuscu Lake (Central Anatolia-Turkey) with scanning electron microscopy. *Turkish Journal of Biology*. 2010; 34(2): 147-151.

Amaechi, C. E. (2015): Prevalence, intensity and abundance of endoparasites in *Oreochromis niloticus* and *Tilapia zilli* (Pisces: Cichlidae) from Asa Dam, Ilorin, Nigeria. *Research Journal of the Costa Rican Distance EducationUniversity*, 7(1): 67-70.

Amare, A., Alemayehu, A. and Aylate, A. (2014): Prevalence of Internal Parasitic Helminthes Infected *Oreochromis niloticus* (Nile Tilapia), *Clarias gariepinus* (AfricanCatfish) and

Cyprinus carpio (Common Carp) in Lake Lugo (Hayke), Northeast Ethiopia. *Journal of Aquaculture Research and Development*, 5: 1-5.

Areda, T. A., Mitiku, M. A., Woldearegay, Y. H., Teklu, A. and Getachew, S. (2019): Prevalence of major parasites of Nile tilapia (*Oreochromis niloticus*) in south west Showa zone selected fish farms, Oromia region, Ethiopia. *International Journal of Fisheries and Aquatic Studies*, 7(3): 165-170.

Auta, I.K., Badaru1, A.A., Ibrahim, B and Abdullahi,S. A. (2019). Occurrence of Helminths On *Clarias gariepinus* (African Catfish) Caught In Selected Points Along River Kaduna, Nigeria. *Science World Journal Vol. 14*(3): 10.15.

Biu, A. A., Diyawere, M. Y., Yakaka, W. and Joseph, E. (2014). Survey of Parasites infesting the Nile Tilapia *Oreochromis niloticus* Linnaeus 1758 From Lake Alau, Maiduguri Nigeria, *Nigerian Journal of fisheries and Aquaculture*. **2(2):** 6 -12.

Dan-Kishiya, A. S., Oboh, A. and Ibrahim, U.B. (2013).The Prevalence of helminth parasites in the gastrointestinal tract of wild African sharp tooth catfish *Clarias gariepinus* (Siluriformes: Clariidae) in Gwagwalada, Nigeria, *Research journal of the Costa Rican Distance Education University*, 5(1): 83-87.

Danyaro, N. M., Miga, H.I., Bichi, A. H. Dabo, N.T and Ma'aruf, N. (2018). Prevalence of Intestinal Helminth Parasites in *Heterotis niloticus* in Marma Water Channel Along River Hadejia, Jigawa Nigeria. Dutse Journal of Pure and Applied Sciences (DUJOPAS*), Vol. 4 No. 2: 202-212.*

Ejere, V.C., Aguzie, O.I., Ivoke, N., Ekeh., F.N., Ezenwaji, N.E,, Onoja, U.S and Eyo, J.E. (2014). Parasitic fauna of five freshwater fishes in Nigerian freshwater ecosystem. *Croatian Journal of Fisheries,* **72**(1):17-24.

Ekanem AP, Eyo VO & Sampson AF (2011). Parasites of landed fish from great Kwa river, Calabar, Cross River State, Nigeria. *International Journal of Fisheries and Aquaculture,* **3**(12): 225-230.

Eyo, J.E and Iyaji FO (2014). Parasites of Claroteslaticeps (Ruppell, 1832, Silurifomes, Bagridae) at River Niger-Benue confluence, Lokoja, Nigeria. *Journal of Fisheries and Aquatic Science,* **3**(1): 1 – 9.

FAO (2024). In Brief to the State of World Fisheries and Aquaculture 2024Blue Transformation in action. Rome. Pp 234 https://doi.org/10.4060/cd0690en

Karam I. Ashmawy, Fatma A. Hiekal, Somaia S. Abo-Akadda, Nadia E. Laban, L. (2018). The inter-relationship of water quality parameters and fish parasite occurrence. *Alexandria journal of Sciences*, 59(1): 97-106.

Kawe, S.M., God'spower, R.O., Balarabe, M.R and Akaniru, R.I. (2016). Prevalence of gastrointestinal helminth parasites of *Clarias gariepinus* in Abuja, Nigeria. *Sokoto Journal of Veterinary Sciences,* 14(2): 26-33.

Kebede, I.A., Gebremeskel, H.F., Ahmed, A.D., Kebede, S and Dule, G. (2023). External parasites of fish: A comprehensive overview. *Vet Med Open J.*, 8(2): 66-73.

Khan, R. A. (2012). Host- parasite interactions in some fish species. *Journal of Parasitology Research,* 2012:1-7.

Imam, T. and Dewu, R. (2010). Survey of piscine ecto- and intestinal parasites of Clarias species sold at Galadima Road Fish Market, Kano Metropolis, Nigeria. *Bioscience Research Communications*, 22(4): 209 -214.

Morris, A.J., Wilson, M.L. and Reller, L.B. (1992). Application of rejection criteria for stool ovum and parasite examinations. *Journal of Clinical Microbiology* 30: 3213–3216.

Nizar, T.S., Raveendran, M., Parambil, S.C and Kappalli, S. (2021). The occurrence of parasitic copepods and isopods infesting the marine teleost fishes of Kerala coast, India. *J Parasit Dis*. 2021; 45: 78-88.

Omeji, S, Solomon, S. G. and Obande, R. A. (2010). A comparative study of the common protozoan parasites of *Heterobranchus longifilis* from the wild and pond environments in Benue State. *Pakistan Journal of Nutrition* **9** [9]: 865-872.

Onyishi GC & Aguzie IFOM (2018). Survey of helminth parasites of fish in Ebonyi river at Ehaamufu, Enugu State, Nigeria. *Animal Research International,* 15(3): 3112- 3119.

Osimen, E. C and Anagha, L. I. (2020). Endoparasites of fresh water fishes from rivers in Edo State, Nigeria. *Sokoto Journal of Veterinary Sciences*, 18(4): 197—204.

Paperna, I. (1996): Parasites, Infections and Diseases of fishes in Africa- an update, CIFA Technical Paper No. 31, Rome, FAO, 220p.

Saiyadi, A. R., Mustapha, K. U., Ado, I. M and Nafiu S. A. (2022). Assessment of Heavy Metal Concentrations as Indicator of Pollution in *Clarias gariepinus* (African Catfish) of Warwade Reservoir, Dutse, Jigawa State-Nigeria. *Dutse Journal of Pure and Applied Sciences,* 8(1a): 10-21.

Simon-Oke IA (2017). Diversity, intensity and prevalence of parasites of Cichlids in polluted and unpolluted sections of Eleyele Dam, Ibadan, Nigeria. *Cuadernos de Investigación UNED,* 9(1):45-50.

Sures, B., Nachev, M., Selbach, C and Marcogliese, D.J. (2017). Parasite responses to pollution: what we know and where we go in 'Environmental Parasitology'. *Parasite Vectors,*10(1):65 -73.

Tachia, M. U; Omeji, S; and Odeh, L. (2012). A survey of Ectoparasites of *Clarias gariepinus* caught from the University of Agriculture Research. Fish farm; Makurdi, *Journal of Research in Forestry, Wildlife and Environment,* (4)2: 30-37.

Uhuo, A. C., Uneke, B. I., Nwele, D. E., Azi, S. O., Ogiji, E. D., & Okereke, C. N. (2014). The prevalence of acanthocephalan parasites of Tilapian species in Cross River Basin Indibe Beach, Afikpo North Ebonyi State, Nigeria. *Sky Journal of Biochemistry Research*, *3*(4), 42-45.

Uruku, M. N and Adikwu, I. A. (2017). Seasonal prevalence of Parasites of Clariids fishes from the lower Benue River Nigeria, *Nigerian Journal of fisheries and Aquaculture,* 5(2):11-19.

Yakubu, D.P., Omoregie, E., Wade, J.W. & Faringo, D.U. (2002). A comparative study helminthes of gut of *T. zilli* and *C. gariepinus* from river Uke, Plateau State. *Nigerian Journal of Aquatic Science*, 92,137-139.