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Survey of fresh water snails of Kashimbila dam and environs Taraba state

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Abstract

This research was undertaken so as to provide vital information on the fresh water snails which will complement the few baseline data for Kashimbila dam area and environs. The study was carried out at Kashimbila Dam in Takum located in southern Taraba state, Nigeria. Snail sampling from the identified sites A-E was done twice a month for a period of 6 months from September, 2022 to February, 2023. Snails collected were kept in plastic containers and brought to the laboratory where they were identified to species level on the basis of their morphological characteristics with reference to the standard keys. After collection, the snails were exposed to artificial table lamp for one to four hours to induce shedding of cercariae. Each snail was carefully observed under dissecting microscope and examined for possible emergence of cercariae at regular intervals. Six species, all belonging to the class Gastropoda (*Lymnaea natalensis, Lymnaea truncatula, Melanoides meculata, Bellamya unicolor, Lanistes ovum* and *Pila ovata*), were identified during the study of which only three (*Lymnaea natalensis, Lymnaea truncatula* and *Melanoides meculata*) shedded cercariae. The findings avail the nature of the Kashimbila dam and also provide useful information on the checklists and ecology of the snail species which could be potentially used as bio- indicators for assessing and monitoring the dam and have implication on public health.

Keywords: Kashimbila dam; Fresh water; Snails; Species; Cercariae

1. Introduction

Many freshwater snails are of medical and veterinary importance, serving as intermediate hosts of different helminthic parasites of humans and animals (Abdulhamid *et al*., 2018). The most common and endermic parasites in Nigeria are Schistosoma, Fasciola Dicrocoelium and Paragonimus. Majority of the snail intermediate hosts for human schistosomiasis belong to three genera *Biomphalaria, Bulinus* and *Oncomelania* (Abubakar, *et al*., 2018). The genera *Biomphalaria* and *Bulinus* are the intermediate hosts of *Schistosoma mansoni* and *Schistosoma haematobium* in Nigeria, respectively. The aquatic snail hosts of *Schistosoma* occur in shallow water near the shores of lakes, ponds, marshes, streams and irrigation channels. They live on water plants and mud that is rich in decaying organic matter. The presence of snail intermediate host in an area is one of the major factors maintaining the transmission of schistosomiasis.

The development and management of dams has numerous social and economic benefits such as irrigation, power generation, fishing, transportation and tourism. However, damming of rivers and streams to build such reservoirs gives rise to significant modification in the natural ecology of the original water bodies (Abdulhamid *et al*., 2018). It creates new biotopes which are conducive for breeding of these fresh water snails. The transmission of these infections takes place only in places where fresh water snail intermediate hosts are present, and where there is contact between the population and the infested water (Sanu *et al*., 2020). Disease transmission is therefore facilitated by availability of surface water throughout the year and this is provided by dams (Sanu *et al*., 2020).

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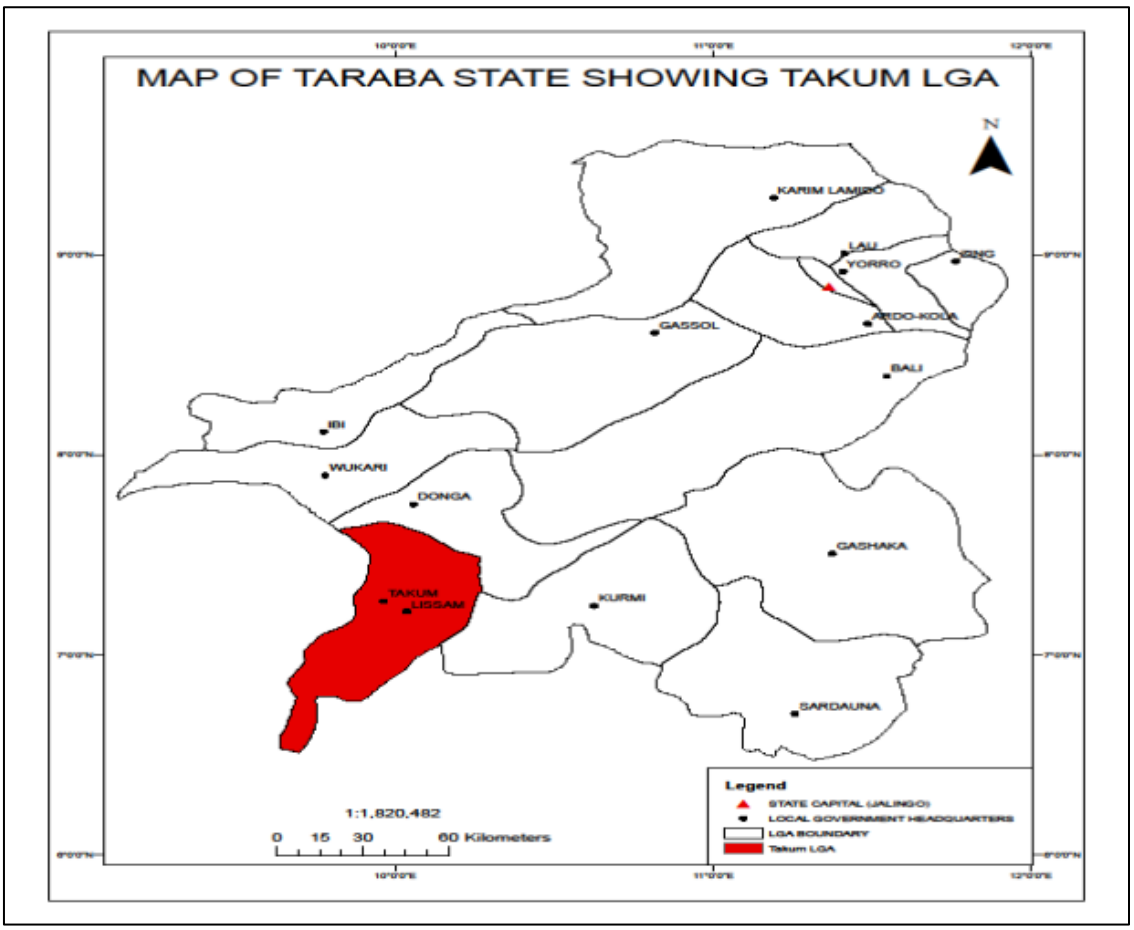
Several studies in Nigeria have associated increase in prevalence of schistosomiasis and other snail borne infections with provision of dams. Some of these include those of Ikuryhel *et al*., (2023) at Fufore Local Government Area in Adamawa State, Abdulkadir *et al* (2017) at Gimbawa Dam, Kaduna State, Timothy *et al.,* (2018) at Zobe Dam, Dutsin-Ma, Katsina State, Sunday *et al.,* (2019) at Dadinkowa man-made reservoir in Gombe State and Sanu *et al* (2020) at Kiri Dam in Adamawa State. All of these reports have observed an increased trend in transmission of snail borne parasitic infections or the occurrence of freshwater snail intermediate hosts of parasites of public health importance where they hadn't been earlier observed. This research was undertaken to assess the diversity of fresh water snails in Kashimbila dam and its environs.

2. Materials and Methods

2.1. Study Area

Takum is located southern zone of Taraba state, and located 250km South-west from the main capital of the state, Nigeria. The natural features of the area are mountains and valleys with an average annual rainfall of about 872mm. Although the area has an average high temperature of 28.6^{o}c (83.5^{o}f) and an average low temperature of 22.5^{o}c (72.5^{o}f). The construction of the dam started in 2007, and have the capacity of supplying about 60,000 cu/m of water to around 400, 000 people. The major occupation of people inhabiting the area are farming, fishing and cattle rearing.



Source: Modified satellite imagery using Art GIS Vasion 10.19

Figure 1 Map of Taraba state showing Takum local government area

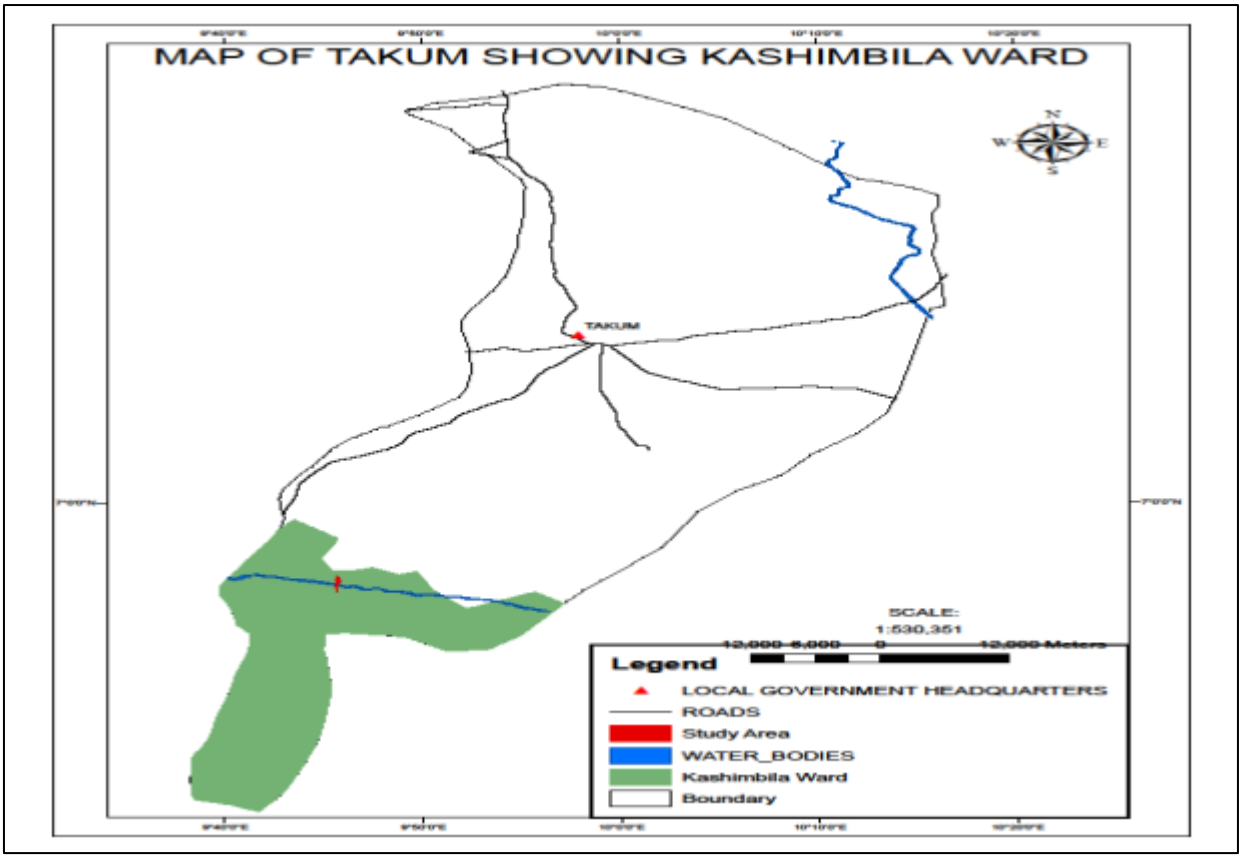


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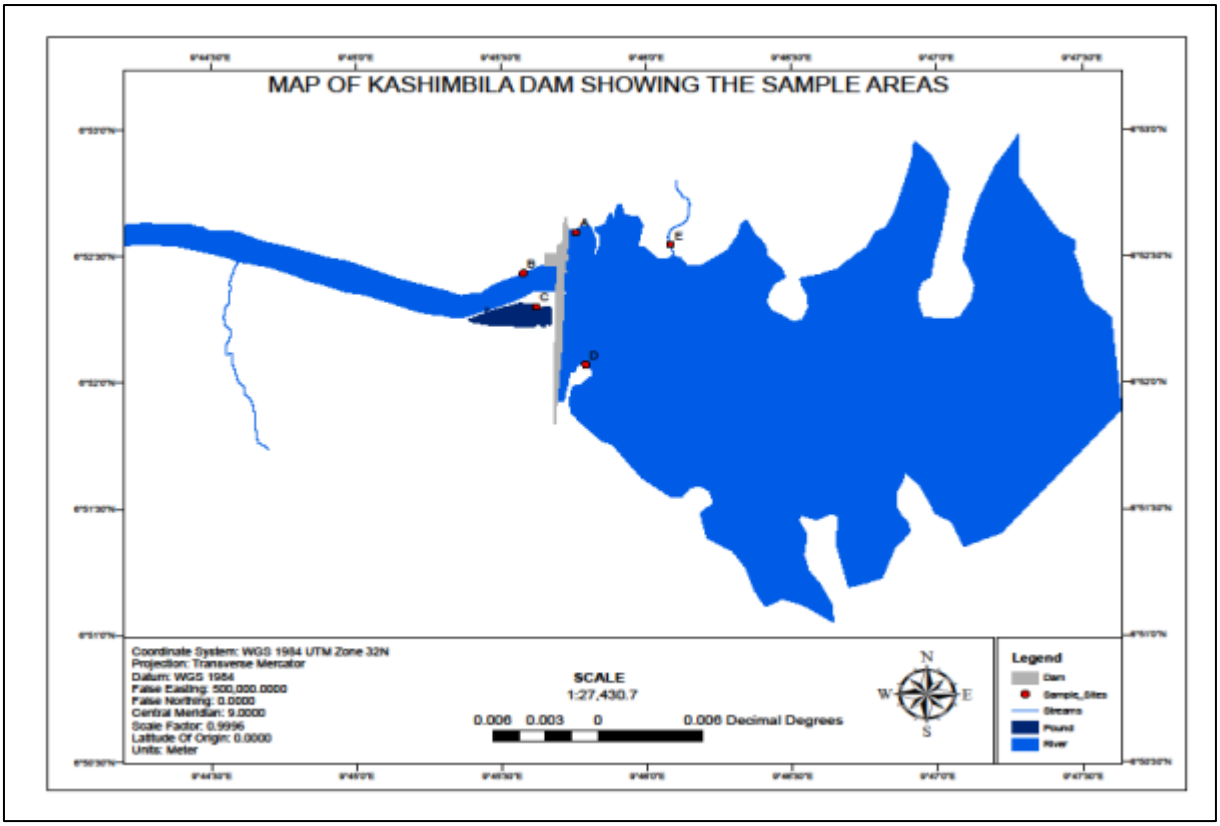
Figure 2 Map of Takum Local Government Area showing Kashimbila Ward

2.2. Sample stations

The study was carried out for a period 6 months (September, 2022 to February, 2023). The study area was categorized into three five stations namely: Station A, B, C, D and E. Station A and D (the main reservoir). Station B (River Katsina-Ala, on which the dam is built), station C is a pond, while E is a stream (a tributary on River Katsina-Ala).



Source: Modified satellite imagery using Art GIS Vasion 10.19

Figure 3 Map of Kashimbila Dam Showing Sample Stations

2.3. Snail sampling and identification

Snail sampling from the identified sites A-E was done twice a month for a period of 6 months from September, 2022 to February, 2023. On each sampling day, each site was thoroughly searched carefully for 30 minutes using a long handle metal scoop net as described by Panda, (2014). Snails collected was kept in plastic containers and brought to the laboratory where they were identified to species level on the basis of their morphological characteristics with reference to the standard keys of Brown, (1994).

2.4. Shedding and harvesting of cercaria from freshwater snails

Freshwater snails were collected from each of the sample stations, thereafter, they were placed separately in Petri dishes containing water. The snails were expose to artificial table lamp for one to four hours to induce shedding of cercariae. Each snail was carefully observed under dissecting microscope and examined for possible emergence of cercariae at regular intervals (Fatima, *et al*., 2018).

2.5. Morphological Identification of Cercaria

Live cercariae shed by each separated freshwater snail species in a Petri dish was transferred in water solution onto a microscopic slide, covered with a cover slip and observed under X40 objective of the light microscope. The observed cercariae was then be stained with neutral red (0.1%). A cover slip was carefully placed on the stained slide and observed under the X40 objective of the light microscope. The movement and the morphological details of the live and stained cercariae observed under the microscope, respectively, was recorded for identification purposes using standard key (Fatima, *et al*., 2018).

3. Results

The snails collected at Kashimbila Dam were made up of 5 genera and 6 species (Table 4.1), all belonging to the class Gastropoda (*Lymnaea natalensis, Lymnaea truncatula, Melanoides meculata, Bellamya unicolor, Lanistes ovum* and *Pila ovata*). The total number of snails collected during the study was 561, with *Lymnaea natalensis* (175), *Lymnaea truncatula* (77) *Melanoides meculata* (188), *Bellamya unicolor* (53), *Lanistes ovum* (47) and *Pila ovata* (31) respectively

Table 1 Cercariae shedding among snail species collected at Kashimbila Dam

Snail species	**No. of snails examined**	**No. of snails shedding**	**Percentage shedding**	**(H')**	**(D)**
Lymnaea natalensis	175	77	44.00	1.04	0.33
Lymnaea truncatula	77	28	36.36		
Melanoides meculata	188	73	38.83		
Bellamya unicolor	53	0	0		
Lanistes ovum	47	0	0		
Pila ovate	31	0	0		

H'= Shannon-Weiner Diversity Index; D= Margalef's Species Richness Index

Table 2 Gastropod snail species with the cercariae types at Kashimbila Dam

Snail species	**Cercaria type**
Lymnaea natalensis	Echinostome cercaria
Lymnaea truncatula	Gymnocephalus cercaria
Melanoides meculata	Longifurcate pharyngate monostome/ Longifurcate pharyngate distome
Bellamya unicolor	None
Lanistes ovum	None
Pila ovate	None

Table 3 Distribution of Snail species at kashimbila Dam.

Class	**Gastropoda**								
Subclass	Prosobrancha								
Family	Lymnaeidae		Thiaridae	Viviparidae	Ampullariidae				
Species	*Lymnaea natalensis*	*Lymnaea truncatula*	*Melanoides meculata*	*BelLamya unicolor*	*Lanistes ovum*	*Pila ovata*	Total	H'	D'
September	27(35.53)	10(13.16)	18(23.68)	10(13.16)	8(10.53)	3(3.95)	76(26.23)	1.55	0.81
October	19(29.67)	8(12.50)	19(29.67)	6(9.38)	8(12.50)	2(3.13)	64(22.07)	1.51	0.77
November	13(25.00)	8(15.38)	18(34.62)	5(9.62)	6(11.54)	2(3.85)	52(17.93)	1.57	0.83
December	12(29.27)	7(17.07)	14(34.15)	4(9.76)	4(9.76)	0(0.00)	41(14.14)	1.59	0.85
January	11(32.35)	5(14.71)	14(41.18)	2(5.88)	2(5.88)	0(0.00)	34(11.72)	1.52	0.80
February	7(30.43)	3(13.04)	12(52.17)	1(4.35)	0(0.00)	0(0.00)	23(7.93)	1.54	0.82
Total	89(30.69)	41(14.14)	95(32.76)	28(9.66)	28(9.66)	7(2.41)	290(100)	1.53	0.79

H'= Shannon-Weiner Diversity Index; D= Margalef's Species Richness Index

Table 1, further shows that out of 561 snails that were examined, 178 were observed to shed cercariae, of which 77 were *Lymnaea natalensis,* 28 were *Lymnaea truncatula,* 73 were *Melanoides meculata. BelLamya unicolor, Lanistes ovum. Pila ovata* did not shed cercariae. The snail species distribution with the type of cercariae in each of the species is shown in Table 2 below. The results showed that *Lymnaea natalensis, Lymnaea truncatula* and *Melanoides meculata,* shedded cercariae while in *Bellamya unicolor, Lanistes ovum* and *Pila ovata* no cercaria was observed. Table 3 show that, out of the 561 snails, *Melanoides meculata* 95(32.76%) was the most abundant, followed by *Lymnaea natalensis* 89(30.69%). Few *Pila ovata* were encountered 7(2.41%). *Lymnaea truncatula, Bellamya unicolor* and *Lanistes ovum* were

41(14.14%) and 28(9.66%) respectively. Each of the snail species were most abundant during the rains with a peak in September; *Lymnaea natalensis* 27(35.53%), *Melanoides meculata* 18(23.68%), *Pila ovata* 3(3.95%)) whereas, during the dry season months, the snails were less with the lowest abundance in February; *Melanoides meculata* 12(52.17%), *Lymnaea natalensis* 7(30.43%) and *Pila* 0(0.00%)). The monthly collections of snail species in Kashimbila Takum Local Government Area showed diversity index H between the 1.51-1.59 range while the Margalef's species richness was within the range of 0.77-0.85. Table 4 shows the diversity and density of the snail species from kashimbila from the month of September to February. All the species occurred highest at site A and least at site E except for *Melanoides meculata, Bellamya unicolor* and *Pila ovata* which occurred least at site B. *Lymnaea natalensis* occurred the highest (29) and (10) while *Pila ovata* occurred the least (13) and (0) respectively. The result shows a diversity index within the range of 1.50 and 1.59.

Table 4 Diversity and density of gastropod snail species at different stations.

Snail species									
Sampling sites	***Lymnaea natalensis* (%)**	***Lymnaea truncatula* (%)**	***Melanoides meculata* (%)**	***BelLamya unicolor* (%)**	***Lanistes ovum* (%)**	***Pila ovata* (%)**	**Total (%)**	**(H')**	**(D)**
A	89(40.64)	46(21.00)	55(25.11)	22(10.05)	7(3.20)	0(0.00)	219(39.04)	1.54	0.78
B	21(44.68)	1(2.13)	13(27.66)	0(0.00)	12(25.53)	0(0.00)	47(8.38)	1.55	0.79
C	24(26.67)	7(7.78)	30(33.33)	11(12.22)	5(5.56)	13(14.44)	90(16.04)	1.52	0.77
D	31(28.18)	23(20.91)	37(33.64)	9(8.18)	10(9.09)	0(0.00)	110(19.61)	1.50	0.70
E	10(10.53)	0(0.00)	53(55.79)	13(13.68)	19(20.00)	0(0.00)	95(16.93)	1.59	0.81
Total	175(31.19)	77(13.73)	188(33.51)	55(9.80)	53(9.45)	13(2.32)	561(100)	1.53	0.83

H'= Shannon-Weiner Diversity Index; D= Margalef's Species Richness Index

4. Discussion

This study showed that within the Region of kashimbila, freshwater snail species were present in areas with poor drainage system and water bodies with favourable environmental conditions. In addition, areas with slow flowing water bodies have a high risk of snail occurrence than areas with water bodies of high velocity.

The results of this study show that Kiashimbila dam harbours many species of freshwater snails. The findings in the present study which recorded six freshwater snail intermediate hosts is in agreement with the study by Akai *et al* (2024) who also recorded six freshwater snail intermediate hosts in their work on Distribution of Snail Intermediate Hosts In Selected Areas Of Rivers State, Nigeria and Abe *et al*. (2016), who worked on Malacological survey and geospatial distribution of *Indoplanor bisextus* (Deshayes, 1934) and *Lymnae natalensis* (Krauss, 1848) snail vectors of trematode parasites, in Abeokuta, south western, Nigeria and Sanu *et al* (2020) who stated that species recorded in this study are the most common fresh water snail species that have been reported in Nigeria and in West Africa. Thus, no strange snail species were observed.

It is interesting that of the six species found, only three of them (*Lymnaea natalensis, Lymnaea truncatula* and *Melanoides meculata*) shedded cercariae. This was also in agreement with the result of Sanu *et al* (2020) who also observed three out of the eleven species to shed cercariae, although species were not the same.

The result established *L. natalensis*; an intermediate host of fascioliasis (Moema *et al*., 2008) and *P. ovata*; an intermediate host of a trematode, *Multicotyle purvisi* (Alves *et al*., 2015). These findings were in agreement with the findings of Akai *et al* (2024). The presence of these snail vectors of parasites of diseases indicates the risk of emergence or re- emergence of snail-borne diseases if no control measures are enacted. It also indicates a crash of any existing functional snail control measure.

The appearance of *Melanoides* species in Kashimbila dam is also noteworthy. In particular, *Melanoides meculata* shed any cercariae therefore, it has the potential of infection transmission

M. meculata and *L. natalensis* were found to be the most widely distributed snail species during the study. This partially agrees with the study by Cuervo *et al*. (2010) who observed that *L. natalensis* to the most abundant and most widely distributed snail species due to its great adaptability and survival capacities and this enables them survive and colonize environment with diverse and extreme climatic conditions.

Occurrence of *Bellamya unicolor*, *Lanistes ovum*, and *Pila ovata* in low abundance may be related to reduced human and animal activities in the dam. This is in contrast with the report of (Okeke and Ubachukwu, 2013) in the Gimbawa dam Kaduna State, (Salawu and Odaibo, 2014) in Imo State and that of (Sanu, *et al* 2020) at Kiri dam Adamawa State, Nigeria. Even though they are found not shedding the cercaria in the present study, they are still intermediate hosts of medical and veterinary importance, because together with the other intermediate host of economic importance they are herbivores removing vegetative biomass which may affect the standing crop and distribution of primary producers in the aquatic ecosystem.

In the present study, one (*Bellamya unicolor*) of the six species of snails found was established to be intermediate hosts of schistosomiasis in Nigeria. Even though it is not found shedding the cercaria, the occurrence there strongly suggest possible transmission of *S. mansoni* in future in the area.

5. Conclusion

The preliminary study on snail species of Kashimbila dam, Taraba state revealed the presence of six species, all belonging to the class Gastropoda (*Lymnaea natalensis, Lymnaea truncatula, Melanoides meculata, Bellamya unicolor, Lanistes ovum* and *Pila ovata*), of which only three (*Lymnaea natalensis, Lymnaea truncatula* and *Melanoides meculata*) shedded cercariae. The findings indicate the nature of the Kashimbila dam and also provide useful information on the checklists and ecology of the snail species and macro-invertebrates which could be potentially used as bio- indicators for assessing and monitoring the dam and have implication on public health.

Compliance with ethical standards

Acknowledgement

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Statement of ethical approval

Ethical approval was obtained from all relevant bodies before the research was carried out and the authors have adhered to the accepted ethical standards throughout the research.

Disclosure of conflict of interest

The authors have not experience any conflict of interest during and after the research.

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