Ecology and Distribution of Freshwater Snails in Gimbawa Dam, Kaduna State, Nigeria.

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ABSTRACT

The influence of physico-chemical parameters on the distribution of freshwater snails in Gimbawa dam, Ikara Local Government Area of Kaduna State was investigated between January and December, 2013. Freshwater snails were collected using scoop net and the physico-chemical parameters were determined with appropriate instruments accordingly. Freshwater snails harvested from the study site were morphologically identified. Four thousand two hundred and six (4,206) freshwater snails belonging to seven genera and seven species were recorded during the study. The overall relative percentage of the various snail species recorded was: Melanoides tuberculata (66.4%), Biomphalaria pfeifferi (11.8%), Bellamya unicolor (11.6%), Bulinus globosus (5.5%), Lymnaea natalensis (4.2%), Cleopatra bulimoides (0.5%) and Physa spp (0.1%). Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and pH were found to significantly influence snail distribution in the dam (p<0.05). The snail distribution pattern observed may give an insight into some aspect of the epidemiology of trematode infection in the Local Government Area and the potential risks of human and animals. The implications of these findings for control of snail transmitted trematodes are also discussed.

Keyword: Freshwater snails, Gimbawa dam, Physico-chemical parameters, Trematode.

INTRODUCTION

The development of dams and their management create new habitats that are conducive for breeding of freshwater snails including those that serve as intermediate host to important human and animal diseases (schistosomiasis,trypanosomiasis, fascioliasis)[1]. Many of such freshwater bodies contain potential snail intermediate host [2]. This increases the transmission risk of waterborne disease [3]. About 350 species of freshwater snails in Africa are estimated to be of medical and veterinary importance [4]. It is estimated that 200 million people are infected with schistosomiasis worldwide and 600 million are at risk. Globally 200,000 deaths are attributed to schistosomiasis annually [5]. In Nigeria, about 101.28 million people suffer from the disease [6]. The diseases are acquired through repeated contact with freshwater during washing, swimming or fishing [7]. In Nigeria, several studies on the distribution of freshwater snails of public and veterinary health importance had been carried out to ascertain their role in the

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transmission of trematode infection in humans and animals [8, 9, 10,11]. Similarly in Kaduna State various freshwater snails intermediate host have been collected [12, 13]. Consequently, dams contribute to the spread, endemicity and incidence of water borne diseases especially trematode parasitic diseases that are dependent on water based intermediate host. Several factors such as physical, chemical and biological factors are considered affecting the ecology of freshwater snails and other intermediate host of disease hence, suggesting local investigation to identify important factors in each water body [14, 15]. This study was aimed at determining the local distribution and diversity of freshwater snails and the influence of physico-chemical parameters on their distribution in Gimbawa dam.

MATERIALS AND METHODS
Study area
Kaduna state with it capital in Kaduna is geographically located on $10^0 \ 21^1 \ 23^{11}$ N and $7^0 \ 26^1 \ 2^{11}$ E. It covers an area of 46053 km^2 and has a population of 6,066,562 [16]. The state is endowed with two major rivers (Gurara and Kaduna) that have been dammed at various locations to provide water for drinking, fishing, agriculture and other human needs.

Study site
Gimbawa dam is a conglomeration of many river tributaries. It lies on $11^0 \ 10^1 \ 57^{11}$ N and $08^0 \ 48^1 \ 97^{11}$ E in Ikara Local Government area of Kaduna State. It is 30 km North East from Zaria town with an estimated population of about 194,725 people. The dam provides potable drinking water for communities around as well as for irrigation

to increase food production. Bulk of tomatoes, onions and sugar cane grown in the state are from this area. Occupational activities centered mainly on fishing, irrigation and livestock watering. Vegetation along the bank is mainly grasses with short trees.

Figure 1: Researcher measuring water pH with some farmers washing their vegetables in the water at Gimbawa dam

Snail collection
Freshwater snails were collected with the aid of a scoop net or manually collected with forceps when seen every month for a period of twelve months (January to December, 2013) as described by [17] from sites where there were obvious human activities. Freshwater snails collected were transferred to labeled perforated plastic containers and transported to the Department of Biological Sciences Laboratory, Nigerian Defence Academy Kaduna, sorted and identified to species level using morphological characteristic standard key as described by [18]. Identified snails were counted and recorded.

Determination of the physico-chemical parameters of the freshwater body

Surface water sample was collected once monthly from the sampling site by simple dipping.

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The sample of the water collected was transported to the laboratory for chemical analysis while pH, water transparency, surface water temperature, conductivity and total dissolved solids were determined on site.

Water transparency was measured at the site with the aid of Sacchi disc of 20cm diameter with black and white quarters attached to a calibrated cord (cm).

pH of the surface water was determined at the site with a pocket size pH meter, H198103 checker ® pH Tester (Hanna instruments, Inc.).

Surface water temperature, electrical conductivity and total dissolved solids were determined on site with EC/TDS/Temp COMBO meter (Model Com 100,11/05) Myron L. Company.

The methods of [19] were used for the determination of dissolved oxygen (DO) and biochemical oxygen demand (BOD) of the freshwater body.

Data Analysis

T-test was used to compare the relative abundance of freshwater snails during dry and wet seasons. Correlation coefficient was used to find the relationship between each of the physico-chemical parameters in the dam and the relative abundance of freshwater snails. Probability values <0.05 were considered significant.

RESULTS

Four thousand two hundred and six (4,206) freshwater snails belonging to seven genera and seven species were collected during the study period. The freshwater snails were identified as *Melanoides tuberculata* (Muller, 1774), *Biomphalaria pfeifferi* (Kraus, 1848), *Bellamya unicolor* (Olivier, 1804), *Bulinus globosus* (Morelet, 1866), *Lymnaea natalensis* (Kraus, 1848), *Cleopatra bulimoides* (Olivier,1804) and *Physa spp* [18] (Fig.2-8).

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Fig.2 a: Abarpertural view of *Melanoides tuberculata*

Fig.2 b: Apertural view of *Melanoides tuberculata*

Fig.3 a: Abarpertural view of *Bellamya unicolor*

Fig,3 b: Apertural view of *Bellamya unicolor*

Fig.4a: Dorsal view of *Biomphalaria pfeifferi*

Fig.4 b: Apertural view of *Biomphalaria pfeifferi*

Fig.5 a: Abarpertural view of *Lymnaea natalensis*

Fig.5b: Apertural view of *Lymnaea natalensis*

Fig.6a: Lateral view of Physa spp

Fig 6b: Apertural view of Physa spp

Fig.7 a: Abarpertural view of *Bulinus globosus*

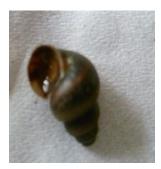**Fig.7 b:** Apertural view of *Bulinus globosus*

Fig.8 a: Abarpertural view of *Cleopatra bulimoides*

Fig.8b: Apertural view of *Cleopatra bulimoides*

Table 1. shows the distribution of the freshwater snail species collected from the dam. It showed marked variation with *M.tuberculata* having the highest relative percentage of 66.4% out of the total snail collected. This was followed by *B. pfeifferi* and *B. unicolar* with 11.8% and 11.6% respectively. The least collection was from *Physa spp* with 0.1% (Table 1).

Table 1. Distribution of freshwater snail species collected from Gimbawa Dam, Ikara LGA, Kaduna State.

Snail Species	Number of Snails	Relative Percentage
M.tuberculata	2793	66.4
B.pfeifferi	495	11.8
B.unicolor	488	11.6
B.globosus	232	5.5
L.natalensis	177	4.2
C.bulimoides	19	0.5
Physa spp	02	0.1

Table 2: Shows the seasonal freshwater snail collection. Two thousand two hundred and forty six (2,246) freshwater snails of different species were collected during the dry season while relatively fewer numbers were recorded in wet season (1,960). Although there was variation from season to season, the difference was not statistically significant (p=0.690 >0.05).

Table 2. Total seasonal fresh snail collection in Gimbawa dam, Kaduna State

Freshwater snail species	Snails collected					
	Dry season	Relative Percentage	Wet season	Relative Percentage	Dry and Wet Season total	Relative Percentage
B.globosus	167	7.4	65	3.3	232	5.5
Physa spp	02	0.1	00	00	02	0.1
B. pfeifferi	484	21.5	11	0.6	495	11.8
L. natalensis	175	7.8	02	0.1	177	4.2
M.tuberculata	1114	49.6	1679	85.7	2793	66.4
C.bulimoides	11	0.5	08	0.4	19	0.5
B. unicolor	293	13	195	9.9	488	11.6
Total	**2246**	**100**	**1960**	**100**	**4206**	**100**

Statistically there was no significant difference (p>0.05) in relative abundance of snail collection during dry and wet season.
t=0.429,P=0.6
Table 3. shows the mean values of the physico-chemical parameters of Gimbawa dam. The mean value for dissolved oxygen in the dam for the year was 6.6mg/l while biochemical oxygen demand was 1.9mg/l. The pH was on the alkaline side with 8.8 and surface water temperature was generally on the lower side (28.4°c).
Significant difference (P<0.05) was observed in the relationship between relative abundance of freshwater snails in the dam and dissolved oxygen, biochemical oxygen demand and pH (Table 4).

Table 3: Mean values of physicochemical parameters of Gimbawa dam

Physico-chemical Parameters	N	Mean	SD
Dissolved oxygen (mg/l)	12	6.6	2.4
Biochemical oxygen demand (mg/l)	12	1.9	1.2
Ph	12	8.8	1.4
Water temperature (^{O}C)	12	28.4	2.8
Transparency (cm)	12	38.8	18.7
Conductivity (µs)	12	129.8	28.6
Total dissolved solids (mg/l)	12	73.8	8.5

Table 4: Correlation Coefficients for Abundance of Snails and Physiochemical Parameters

Physiochemical Parameters	N	Correlations	Sig.
Dissolved oxygen (mg/l)	12	0.409[*]	0.000
Biochemical oxygen demand (mg/l)	12	0.312[*]	0.006
pH	12	0.326[*]	0.001
Water temperature (ºC)	12	-0.014	0.966
Transparency (cm)	12	0.049	0.438
Conductivity (us)	12	0.140	0.663
Total dissolved solids(mg/l)	12	0.291	0.068

DISCUSSIONS

The result obtained from the study indicates relatively high abundance and diversity of freshwater snail intermediate hosts in the dam. This could be attributed to human and animal activities at the dam site (farming, bathing, fishing, washing of clothes and vehicles) that makes human parasite contact possible and consequently affect the occurrence of aquatic plants that serve as food and shelter to the freshwater snails thus increasing their number and diversity [20,21]. The relatively high percentage observed in *M. tuberculater* reflect their superior natural adaptation such as the presence of their hard protective shell that can withstand harsh environmental conditions and also protect them against predators and drought, [22, 23]. The occurrence of *B. pfeifferi* and *B. globosus* in the dam is an indication of good nutritional content of the dam coupled with relatively low temperature throughout the year [17]. These freshwater snails are generally encountered in freshwater body that is polluted with human and animal excreta. The organic matter increases the concentration of detritus and possibly the proliferation of algae that forms the diet of planorbid and prosobranch snails [24]. These freshwater snails serve as intermediate host to highly infective larval trematode of the genus *Schistosoma* that is important in terms of public health. The presence of *L. natalensis* in the dam which has been indicated as the chief intermediate host of *Fasciola* predisposes the animals in the local community to liver disease *(fascioliasis)* [9, 25]. The presence of freshwater snails in both seasons reflect the continuous activities in the dam site throughout the year thus the presence of definitive host which influence the occurrence of the freshwater snails. However more freshwater snails were collected in the dry season. Similar observation was made by[17]. This could be due to the fact that in dry season water table is low, water movement is slow so it offers a stable environment for the freshwater snail to lodge on surfaces (objects,

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plants, polythene bags). Statistically (P>0.05) there is no significant difference. [26] made similar observation. Findings from this study showed that the relative abundance of freshwater snails in the dam is significantly (P<0.05) influenced by DO, BOD and pH (Table 3.4). Similar observation was made by [12]. In general, the mean values of the physico-chemical parameters of the dam are comparable with findings from similar studies in African water bodies and are within tolerable limit for freshwater snail intermediate host [27, 28, 29].

CONCLUSION

Freshwater snail intermediate hosts of trematodes are present in Gimbawa dam and the prevailing physico-chemical parameters of the dam are conducive for optimal growth and propagation of freshwater snail intermediate host.

RECOMMENDATION

Further study should be carried out to evaluate the prevalence of trematode infection among the local community surrounding Gimbawa dam.

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