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Research Article

Studies on Snail Vectors of Helminth Disease Agents along Rima River Valley at Kwalkwalawa Village, Wamakko Local Government Area, Sokoto State, Nigeria

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Abstract

Some species of snails act as intermediate hosts for flukes, and are thus of veterinary importance. Helminths typically parasite vertebrates through snails that act as intermediate hosts. Various snail species transmit different helminth parasites. *Bulinus globosus* serves as intermediate host for *Schistosoma haematobium*, the causative agent of urinary schistosomiasis in man, while *Biomphalaria* sp is the intermediate host for *Schistosoma mansoni* that causes intestinal schistosomiasis also in man. *Lymnaea natalensis* serves as the intermediate host for *Fasciola gigantica*, and *Paramphistomum* sp. Apple snail transmits *Angiostrongylus cantonensis* that causes eosinophilic meningo-encephalitis in man. The study was carried out between the month of February and December, 2006. Three different sampling sites at Kwalkwalawa village were selected to study snails and to determine their infectivity with helminth parasites. Snail samples were collected on weekly basis using scoop net and transferred into plastic containers and taken to Hydrobiology Laboratory, Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto for identification and determination of their infectivity with cercariae. Monthly distribution of snails was recorded. The data obtained were statistically analysed using Chi-Square to show association among variables. A total of 814 snails were collected from the three sites A, B and C. 259 (31.8%), 291 (35.74%) and 264 (32.43%) snails were collected from sites A, B and C respectively. The species of the snails identified comprises of 371 (45.57%) *Achatina fulica*, 229 (28.13%) *Bulinus globosus* and 214 (26.28%) *Lymnea natalensis*. Out of the total snails collected, 230 (28.26%) were found to carry one or more parasite or their infective stages. Of the infected snails, 53 (14.28%) were *A. fulica*, 98 (42.79%) were *B. globosus* and 79 (36.91%) were *L. natalensis*. There was significant difference among the infected snail species at 5% (x^2=0.05). From the snails examined, four types of parasite species were isolated as follows: *Angiostrongylus* (53%), *Fasciola* (63%), *Paramphistomum* (16%) and *Schistosoma* (98%) respectively. The results of the study showed that Kwalkwalawa village is an area of helminth snail vectors endemicity, thus, the need for use of molluscicides, biological control and proper sewage management to reduce snail vectors population and the risk of helminth diseases among humans and animals.

Introduction

Snails are of considerable importance as intermediate host for trematode parasites of man and domesticated animals [1]. Some species of snail act as intermediate host for fluke, and are thus of veterinary importance. These snails serve as first or sole intermediate hosts in the transmission of helminth parasites infecting human and domestic animals [2].

Helminths typically parasitize vertebrates, although invertebrates, especially arthropods and mollusca, act as intermediate hosts [2]. Various snail species transmit different helminth parasites. *Bulinus globosus* serves as intermediate host for *Schistosoma haematobium*, the causative agent of urinary schistosomiasis in man, while *Biomphalaria* sp is the intermediate host for *Schistosoma mansoni* that causes intestinal schistosomiasis also in man. *Lymnaea natalensis* is the intermediate host for *Fasciola gigantica*, the etiologic host for fascioliasis, an important disease in livestock [3]. Apple snail transmits *Angiostrongylus cantonensis* that causes eosinophilic meningoenchephalitis in man [4].

Helminth parasites transmitted by snails cause different degree of diseases which are refer to as snail borne diseases. Transmission of these parasites is usually from eating raw or undercooked snails or other vectors. Infection is also frequent from ingestion of contaminated water or vegetables that may contain small snail and slugs, or have been contaminated by them [4] or having direct contact with fresh water infected with the free swimming cercariae [2]. Of all the helminth parasites, only nematode and trematode are transmitted by snails [5].

The frequent contact of Kwalkwalawa resident with Rima River water (suspected to harbour snails), in the name of fishing, farming, washing and contact with their live stocks might be one of the reasons for the increased ratio of people suffering from helminthiasis in the area. Keeping

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in view the importance of helminth parasites, incidence of their occurrence and lack of documented record on the subject, present research has been planned to study the helminth parasites associated with the snail vectors found in Rima River at different sites. It is in this view the present research is intended to provide a baseline data on the occurrence of the helminth parasites among snail vectors with the following aim and objectives.

Aim and Objectives

The aim of the study is to make a survey of different species of potential snail vectors at different sites in Kwalkwalawa village, Sokoto, Sokoto State, with the following specific objectives:

i. To collect and identify the snail species present in Rima River at three different sites in the Kwalkwalawa village.

ii. To determine the monthly distribution of the snail species in the river.

iii. To determine infectivity of the snail samples with cercariae of helminth parasites.

Materials and Methods

The study area

Kwalkwalawa village is a settlement in Wamakko Local Government Area of Sokoto. Wamakko Local Government Area covers about 889 square kilometers of land. The estimated population of the local government was about 181,999 people [6]. The village is located along the Sokoto/Rima River valley on latitude 13° 5'N and longitude 5° 12'E towards the North West of Sokoto city along the Usman Danfodiyo University permanent site as recorded by cartographic unit, geography department, UDUS, 2008 [7,8].

The climate of the area is tropical continental and is dominated by two opposing air masses, the tropical maritime and tropical continental. Dry season commences around October and ends April. While rainy season starts late around April-May and ends around September/October, with a mean annual fall of about 1300 mm. Regarding temperature, the local government is characterized by two extreme temperatures relative to its tropical position (the hot and cold seasons). The highest (extreme) temperature is experienced during the hot seasons in the months of March/April with average annual temperature of about 36 °C. While the cold season is prevalent between November and February and is characterized by cold temperatures and dust winds often accompanied by thick fogs of alarming intensity [6].

Kwalkwalawa village is predominantly inhabited by two main ethnic groups namely, Hausas and Fulanis. Other ethnic groups include Yorubas, lgbos and Nupes.

However, the common spoken language is Hausa. The inhabitants of the area are mainly subsistent farmers, engaged in arable crop farming, cattle rearing and petit trading. Rima River beside which Kwalkwalawa is situated serve as source of income for some farmers, who catch fish and sell them by the road side. Kwalkwalawa residents especially the children are seen fetching water, swimming and washing clothes by the river side. Cattle are also seen grazing and drinking from the river. The farmers also used the river for irrigation during the dry season.

Kwalkwalawa residents have access to the major hospitals within Sokoto metropolis, which include Usmanu Danfodiyo University Teaching Hospital (UDUTH), Specialist Hospital, Maryam Abacha Women and Children Hospital and Women and Children Welfare Clinic (WCWC) and other private clinics within the metropolis.

Collection of snail samples

Three different areas comprising of North West (site A), North East (site B) and South West (site C) of the river were studied. The land shape of sites B and C slop down the river and are the major areas where human and cattle activities occur. Site A is high and only fishermen are seen emptying their fishing gears and collecting fishes. Snail samples were collected from each area on weekly basis using scoop net. The scoop net consists of a triangular frame with a handle of 8 feet long. The net is tied to the frame and is of fine mesh. 10 scooping were done for each site per visit. Manual picking with a long forceps was also used. The snail samples were then transferred into a plastic container and taken to the laboratory for identification and record. In the laboratory, the snail samples were first transferred into aquaria of dimension 35 cm by 75 cm by 35 cm. The aquaria contained tap water from borehole and substrates of washed sand/gravels, with some aquatic plants associated with the snails from their natural habitats.

Identification of samples

The snails were grouped based on their shells' size, colour, shape, number of whorls, number of tentacles and position of the eyes as described by Needham and Needham, Hegner and Engemann and Brown and Wright [9-11]. Control samples obtained from zoological museums of departments of Biological Sciences of Usman Danfodiyo University, Sokoto and Ahmadu Bello University, Zaria helped in the identification of the snail species. Samples of flukes were identified using the control samples from zoological museum of Usman Danfodiyo University, Sokoto.

Examination of snail for cercariae

The snails were kept in the aquaria for 3-4 days to acclimatize and fed with aquatic vegetation. Using forceps, the snails were then placed individually into a 400 ml beaker containing some water and leaves from the aquaria. The beakers were then covered with rubber net and tightened at the tip to prevent the snails from coming out of the beakers. The beakers were then put inside the aquaria (10-15 beakers per aquarium). The aquaria were then exposed to bright day light and electric light for 24 hrs to facilitate the emergence of cercariae. The snails were also subjected to sudden change of temperature by putting ice block in the aquaria for 15-20 minutes. This also stimulated the release of cercariae.

The beakers were then taken out of the aquaria and the rubber net was loosened from each beaker. The water and leaves in each beaker were then observed for the presence of cercariae using hand lens and microscope. However, these cercariae may be seen with naked eyes. The cercariae were identified by observing the head and tail as described by Brown and Wright [11].

Data analysis

The data obtained were statistically analyzed using Chi square (χ^2) to show the associations (i.e. the independency) between the variables, simple percentage and Less Significant Differences (LSD).

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Table 1: Monthly Distribution of Snail Species at Kwalkwalawa Village along Rima River Valley, Sokoto State, Nigeria.

Months	*A. fulica*	*B. globosus*	*L. natalensis*	Total	Prevalence
Feb	0	0	0	0	0
March	0	0	0	0	0
April	0	0	0	0	0
May	0	0	0	0	0
June	136	179	108	423	51.97
July	115	100	57	272	33.42
August	47	45	27	119	14.62
Sept	70	80	30	180	22.11
Oct	3	4	12	19	2.33
Nov	0	0	0	0	0
Dec	0	0	0	0	0
Total	371	229	214	814	99.99
Prevalence	45.57	28.13	26.28	99.99	

There were no significant difference between the distribution of snail species and the months (i.e. the snail species do not depend on the months), at 5% level of significance (i.e. $\alpha\ \chi^2 = 0.05$).

Results

A total of 814 snails were collected from the three sites: 259 (31.81%), 291 (35.74%) and 264 (32.43%) from sites A, B and C respectively (Table 1).

Monthly distribution of snail species identified and recorded was presented in Table 2. There were no snails available for sampling from February to May, November and December. However, a total of 303 (37.22%) were collected in June, 212 (20.04%) in July, 100 (12.28%) in August, 180 (22.11%) in September and 19 (2.33%) in October.

Table 2: Distribution of Snail Species among the Three Sites of Collection.

Sites	Snail Species			Total No. of Snails Collected	Prevalence (%)
	A. fulica	*B. globosus*	*L. natalensis*		
Site A	259(69.81%)	0	0	259	31.81
Site B	41(11.05%)	228(99.56%)	22(10.28%)	291	35.74
Site C	71(19.13%)	01(0.43%)	192(89.71%)	264	32.44
Total	371(45.57%)	229(28.13%)	214(26.28%)	814	99.99

There was significant difference between the snail species collected and the sites (i.e. the snails species depend on the sites), at 5% level of significance (i.e. $\chi^2 = 0.05$).

Table 3: Prevalence of Helminth Infection in Different Snail Species.

Snails Species	No. of Sample Identified	No. Infected	Prevalence (%)
A. fulica	371	53	14.28
B. globosus	229	98	42.79
L. natalensis	214	79	36.91
TOTAL	814	230	28.26

There was significant difference between the infected snail species (i.e. the number of infected snails depend on the snails species), at 5% level of significance (i.e. $\chi^2 = 0.05$).

Figure 1: *Achatina fulica* found at kwalkwalawa village.

The species of the snails identified comprised of 371 (45.57%) *Achatina fulica*, 229 (28.13%) *Bulinus globosus* and 214 (26.28%) *Lymnea natalensis* (Tables 1, 2 and 3). The pictures of snail species identified were shown in Figures 1, 2 and 3. The distribution and prevalence of snail species by site of collection were presented in Table 2: 259 (69.81%) *A. fulica* were identified from site A, 41 (11.05%) from site B and 71 (19.13%) from site C respectively. In the case of *B. globosus*, 228 (99.563%) were identified from site B and 01 (0.43%) from site C respectively. While 22 (10.28%) *L. natalensis* were collected from site B and 192 (89.71%) from site C. However, there were no *B. globosus* and *L. natalensis* collected from site A.

The number and prevalence of snails infected by cercariae and larvae of helminth parasites were recorded in Table 3. Of the total number of snails collected and examined, 230 (28.26%) were found to carry one or more cercaria or larva of helminth species. Of the infected snails, 53 (14.28%) were *A. fulica*, 98 (42.79%) were *B. globosus* and 79 (36.91%) were *L. natalensis*.

Different species of helminth cercariae or larvae isolated from snails were presented in Table 4 as follows: *Angiostrongylus* (53%), *Fasciola* (63%), *Paramphistomum* (16%) and *Schistosoma* (98%). The pictures of *Angiostrongylus* larva and the cercariae of *Schistosoma*, *Fasciola* and *Paramphistomum* species were presented as Figures 4, 5, 6 and 7 respectively.

Angiostrongylus was the only parasite detected in *A. fulica*, *Schistosoma* was also the only parasite detected in *B. globosus*, while *Paramphistomum* and *Fasciola* were identified from *L. natalensis* (Table 4).

Figure 2: *Bulinus globosus* found at kwalkwalawa village.

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Table 4: Species-specific Prevalence of Helminth Parasites among Snails.

Snails Species	No. of Examined	No. of Infected	Number and Prevalence (%) of Parasite(s) Isolated			
			Angiostrongylus	*Fasciola*	*Paramphistomum*	*Schistosoma*
A. fulica	371	53	53(14.28%)	0(0.0%)	0(0.0%)	0(0.0%)
B. globosus	229	98	0(0.0%)	0(0.0%)	0(0.0%)	98(42.79%)
L. natalensis	214	79	0(0.0%)	63(29.44%)	16(7.47%)	0(0.0%)
TOTAL	**814**	**230**	**53(14.28%)**	**63(32.8%)**	**16(8.3%)**	**98(42.79%)**

There was significant difference between the infected snail species (i.e. the number of infected snails depend on the snails species), at 5% level of significance (i.e. $\chi^2 = 0.05$).

Figure 3: *Lymneae natanensis* found at kwalkwalawa village.

Figure 4: Larva of *Angiostrongylus species* found in land snail (*A. fulica*) at Kwalkwalawa village (Approx. Mag. X10).

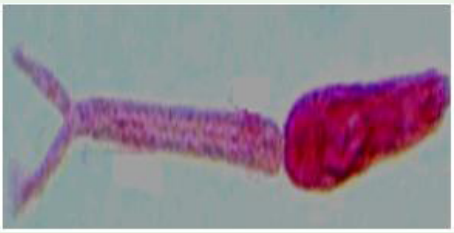

Figure 5: Cercariea of *Schistosoma* species found in fresh water snail (*B. globosus*) at Kwalkwalawa village (Approx. Mag. X10).

Figure 6: Cercariea of *Fasciola species* found in fresh water snail (*L.natalensis*) at Kwalkwalawa village (Approx. Mag. X10).

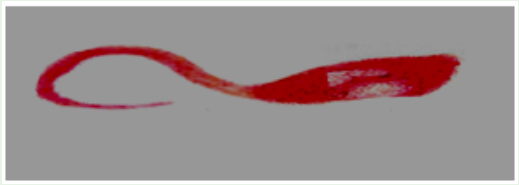

Figure 7: Cercariea of *Paramphistomum* species found in fresh water snail at Kwalkwalawa Village (Approx. Mag. X10).

Discussion

The results of this study showed that *Achatina fulica* was the only snail species collected at site A. This may be because the site was sparsely flooded and *Achatina fulica*, a land snail species, strives well in such environment. *Bulinus globosus* and *Lymnaea natalensis* were found in sites B and C. This may be because the species are fresh water snails and the sites were densely flooded, thus, suitable for their habitation as reported by Appleton [12] that fresh water snails are commonly found in streams, lakes, rivers and small impoundments. However, *A. fulica* was found in all the sites, an indication of its amphibious nature and invasiveness [12].

The population of the snails was zero from February to May. This may be due to the dryness of the studied areas at these periods, thus, the snails might have hibernated or aestivated. This finding was found similar to reports like that of Brown [13] who explained that the drying up of a habitat has a catastrophic effect on the snail population. However, a number of factors determine the survival of snail vectors when they aestivate. Length of exposure to desiccation, presence of trematode infections in snails and age (size) of snail are crucial factors determining the survival of aestivating snails [14-17].

The presence of snails at the raining season confirmed the aestivation action of the snails. Nevertheless, the ability of snail vectors to survive adverse conditions such as aestivation and hibernation for a prolonged period constitutes one of the major problems in their control [11].

Large population of snails was observed at the beginning of the raining period. This may be as a result of quick response of the snails to favourable weather conditions. However, from June to October, there was decrease in population and infection rate of snails. A similar observation was reported by Akogun and Obidiah, Idris and Ajanusi [18,19] that population and infection rate of snails decrease at the peak of raining season.

All the three types of snail species observed in this study were either infected with nematode or trematode parasites. This finding was similar to that reported by Warren and Brown and Wright [11,20]

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who opined that snails are implicated for one type of trematode disease or the other. *Achatina fulica* has been known to transmit *Angiostrongylus cantonensis* in man and *Aelurostrongylus abstrusus* in cat [21]. *Bulinus globosus* transmits *Schistosoma* haemotobium in man while *Lymnaea natalensis* transmits *Fasciola hepatica* in and *Paramphistomum* in cattle. High infection rate at the onset of raining season is an indication of prior infection of the snails. Therefore, it could be said that Kwalkwalawa residents and their livestock could be susceptible to any, if not all the diseases mentioned. This is especially so since all the sampling sites are human and animal particularly cattle water contact points. Idris and Ajanusi [19] reported that human water contract activities go side by side with the amount of contamination and even incidence of infection, especially when the right species of snail vectors are in abundance.

References

1. Roberts JA, Suhardono. Approaches to the control of fasciolosis in ruminants. Int J Parasitol. 1996; 26: 971-981.
2. Smyth JD. Animal Parasitology. Cambridge University Press. 1996; 157-275.
3. Ezeugwu SC and Mafe A. Studies of some current snail species (medical importance) in the lake Chad Basin: The Nigerian Journal of Parasitology. 1998; 19: 101-106.
4. Alicata JE. The discovery of Angiostrongylus cantonensis as a cause of human eosinophilic meningitis. Parasitol Today. 1991; 7: 151-153.
5. Hickman CP and Hickman FM. Principles of Zoology. 6th edn. The L.V. Mosby Company. 1982.
6. Mamman AB and Kudu R. Giant of the Tropics. Sokoto State. Gabamo publishers, Lagos. 2001; 437-438.
7. Bunza MDA, Ahmad A and Fana S. Prevalence and of Paramphistomiasis in Ruminants Slaughtered at Sokoto Central Abattoir, Sokoto. Nig J of Basic and Appl Sci. 2008; 16: 277-281.
8. Bunza MDA, Bena AS and Garba AM. A survey of insects and snail pests of crops along Sokoto/Rima River Valley at Kwalkwalawa village, Sokoto, Nigeria. Biological and Environmental Sciences Journal for the Tropics. 2009; 6: 157-160.
9. Needham JG and Needham PR. A guide to study of fresh water biology. 5th edn. San Francisco: Holden-Day INC. 1962.
10. Hegner RW and Engemann JG. The invertebrate Zoology. 2nd edn. London: Macmillan Pub Co Inc. 1968; 365-366.
11. Brown DS and Wright CA. Molluscs of Saudi Arabia: Freshwater Molluscs. Fauna of Saudi Arabia. 1980; 2: 341-358.
12. Appleton DS. Freshwater Molluscs of Southern African: With a chapter on Bilharzia and it snail hosts. University of Natal Press, Pieter maritzburg. 1994.
13. Brown DS. Freshwater snails of Africa and their medical importance. 2nd edn. London: Taylor and Francis. 1994; 608.
14. Cridland CC. Resistance of *Bulinus (P) globosus*, *Bulinus (P) africanus*, *Biomphalaria pfeifferi* and *Lymnaea natalensis* to experimental desiccation. Bulletin World Health Organization. 1967; 36: 507-513.
15. Hira PR. Studies on the capability of the snail transmitting urinary schistosomiasis in Western Nigeria to Survive dry conditions. West African Medical Journal. 1968; 17: 153-160.
16. Betterton C Ndifon GI and Tan RM. Field studies on aestivation in *Bulinus rohlfsi* (clessin). Bulinus globosus (Morelet) and their susceptibility to local strains of schistosomia haematobium (Bilharz). Annals of tropical medical and parasitology. 1988; 82: 571-579.
17. Badger ELI and Oyerinde JPO. Laboratory Studies on the capability of Biomphalaria pfeifferi (KRAUSS), intermediate host of schistosoma mansoni to survive desiccation. The Nigerian journal of Parasitology. 2003; 24: 173-178.
18. Akogun OB and Obidiah S. History of haematuria among school age children for rapid community diagnosis of urinary schistosomiasis. The Nigerian Journal of parasitology. 1996; 17: 11-16.
19. Idris HS and Ajanusi OJ. Snail intermediate host and the etiology of human schistosomiasis in Katsina State, Nigeria. The Nigerian Journal of Parasitology. 2002; 23: 145-152.
20. Warren KS. Schistosomiasis: The evolution of a medical literature. London: The MIT Press. 1979; 545-1103.
21. Hollingsworth LF. Distribution of Parmarion CF. Martensi (Pulmonata: helicarionidae), a New Semi-slug Pest on Hawai'I Island, and Its Potential as a Vector for Human Angiostrongyliasis. Pacific Science. 2007; 61: 457- 467.

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