Symbiosis

www.symbiosisonlinepublishing.com
ISSN Online: 2475-4706

Research Article | International Journal of Marine Biology and Research | Open Access

Prevalence of Fresh Water Snails Transmitting *Schistosoma Haematobium* in Aponmu-Lona River Basin, Idanre, Ondo State, Nigeria

Peletu BJ[1*], Ofoezie IE[2] and Olaniyan RF[3]

[1]*Department of Biological Sciences, College of Natural and Applied Sciences (CNAS), Wesley University Ondo, Ondo State, Nigeria*

[2]*Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria*

[3]*Department of Biology, Adeyemi College of Education, Ondo, Nigeria*

Received: February 15, 2019; Accepted: March 11, 2019; Published: March 20, 2019

***Corresponding author:** Peletu BJ, Department of Biological Sciences, College of Natural and Applied Sciences (CNAS), Wesley University Ondo, Ondo State, Nigeria, Tel: +2348033605295; E-mail: peletubayo@gmail.com*

Abstract

Background & Objective: Schistosomiasis is a snail-borne, water-based parasitic infection caused by blood-dwelling (hence called blood-fluke) trematode worms of the genus Schistosoma. S. Haematobium as one of the five species causing human schistosomiasis is transmitted by the intermediate host fresh water snail belonging to the genus Bulinus. S. Haematobium is generally endemic in Nigeria. Nigeria is the country with the highest prevalence of human schistosomiasis, especially urinary schistosomiasis. It also occurs in many areas, one of which is Aponmu-Lona community area bordering Aponmu-Lona River Basin, Idanre Local Government Area, and Ondo State.

The aims of the study were to **(i)** identify the freshwater snail species in the River Basin; **(ii)** ascertain their infection patterns density and distribution in correlation with S. haematobium transmission in the study area.

Materials and Methods: Each of the randomly selected seven sites was sampled for snails once every month for a period of twelve months (May 2006 - April 2007) using a standard manual search. The number of each snail species was counted to determine the number of each species or genera per month per site. The established local intermediate host species were measured and examined for schistosomia infection using the light exposure method and crushing method.

Result: The only local intermediate hosts of S. Haematobium and S. Mansoni in Aponmu-Lona River Basin were Bulinus globosus and Biomphalaria preifferi respectively. Out of the seven sites sampled, Bulinus globosus was found only in three sites (3, 4, 5) while biomphalaria pfeifferi was found in five sites (1, 2, 5, 6, and 7). In the twelve-month (May 2006 – April 2007), period of study a total of 6018 snails were collected, the total number of Bulinus globosus was 112 (1.86%) and Bimophalaria pfeifferi was 747 (12.4%). Only 5 out of 112 Bulinus globosus examined for trematode infection were found shedding trematode cercariae. The overall rates of schistosome cercaria shedding of Bulinus globosus were 4.5%. No infection was recorded during the Biomphalaria snails examined.

Conclusion: This study found not that both the density and prevalence of schistosoma infection Bulinus globosus was in December. It is recommended that any control activity may be targeted towards the peak period in December when water level was low with a view to reducing the transmission status in Aponmu-Lona Community.

Keywords: S. Haematobium; Bulinus globosus; Biomphalaria pfeifferi; Urinary schsitosomiasis Aponmu-Lona River Basin; Nigeria;

Introduction

The importance of snails cannot be over emphasized. They play vital roles socially, nutritionally, agriculturally, economically, medically and ecologically. Socially, the durable, beautiful and elegant shells serve as objects of ornamentation in homes and offices (Raylor, 1962). Nutritionally, they are affordable sources of animal protein, e.g. *Archachatinamarginata* (a giant land snail commonly found in tropical areas of West Africa and *Lanites spp*. found in some parts of western Nigeria [30]. Agriculturally, shell serves as important components of poultry feed owing to its calcium richness [5,12]. Some snails also serve as agents of biological decomposition and control of invertebrate pests of economic crops. They are also important raw materials in the tooth paste industry [12]. Medically, some authorities suggest that snails are important component of traditional treatment of ailments such as renal failure, diabetes mellitus, asthma, constipation and haemorhoids [7]. In spite of these benefits, snails

are also important agents of disease transmission in many parts of Africa, Asia and South America. One of the diseases transmitted by fresh water snails is urinary schistosomiasis caused by parasite trematode worms of *Schistosoma haematobium* [28]. Schistosomiasis remains a major public health problem globally with approximately 779 million estimated to be at risk. Since snail intermediate host is an important link in the Schistosoma life cycle knowledge of their ecology, bionomics and population dynamics is needed to fashion out strategies for designing sustainable control strategies. Information on schistosomiasis and its snail intermediate host species in Ondo state is scanty in spite of wide spread distribution in some of its neighbouring states. Recent mass media reports, however, suggest a probable outbreak of the disease in parts of the state, particularly Aponmu-Lona community in Idanre Local Government Area. This study was, therefore, carried out as part of an overall investigation to confirm the disease and determine its patterns of transmission in the area.

Materials and Methods

Study area

This study was carried out in Aponmu-Lona River, Idanre Local Government Area, Undo State, Nigeria, from May 2006-April 2007. The area is located approximately between Latitudes 5°45'N and 5°50'N and Longitudes 4° 34'E and 4°40'E figure 1.

Aponmu-Lona River Basin has a catchment area of approximately 900 km within the southwestern climatic belt of Nigeria. Its major tributaries are rivers Owena and Anu figure 2. The soil is generally composed of crystline acid rock of the ferruginious tropical type that has been moderately to strongly leach with low hummus content [20]. The substratum is characteristically swampy and banks covered by low to tall grasses.

Most water-related activities in the community take place in the river. These activities include palm oil milling, washing clothes, cooking utensil, and cassava tubers, fermentation of cassava tuber, and fishing, swimming and bathing [1].

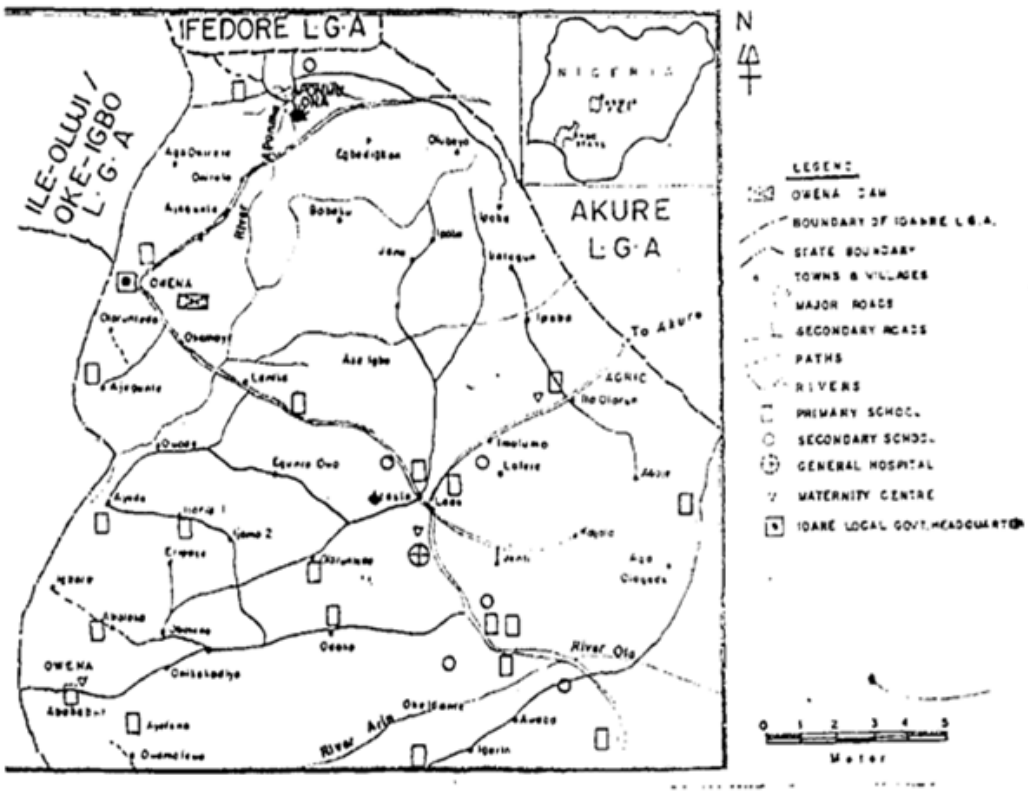

Figure 1: Map of Idanre Local Government Area Ondo State Showing Aponmu Lona Community

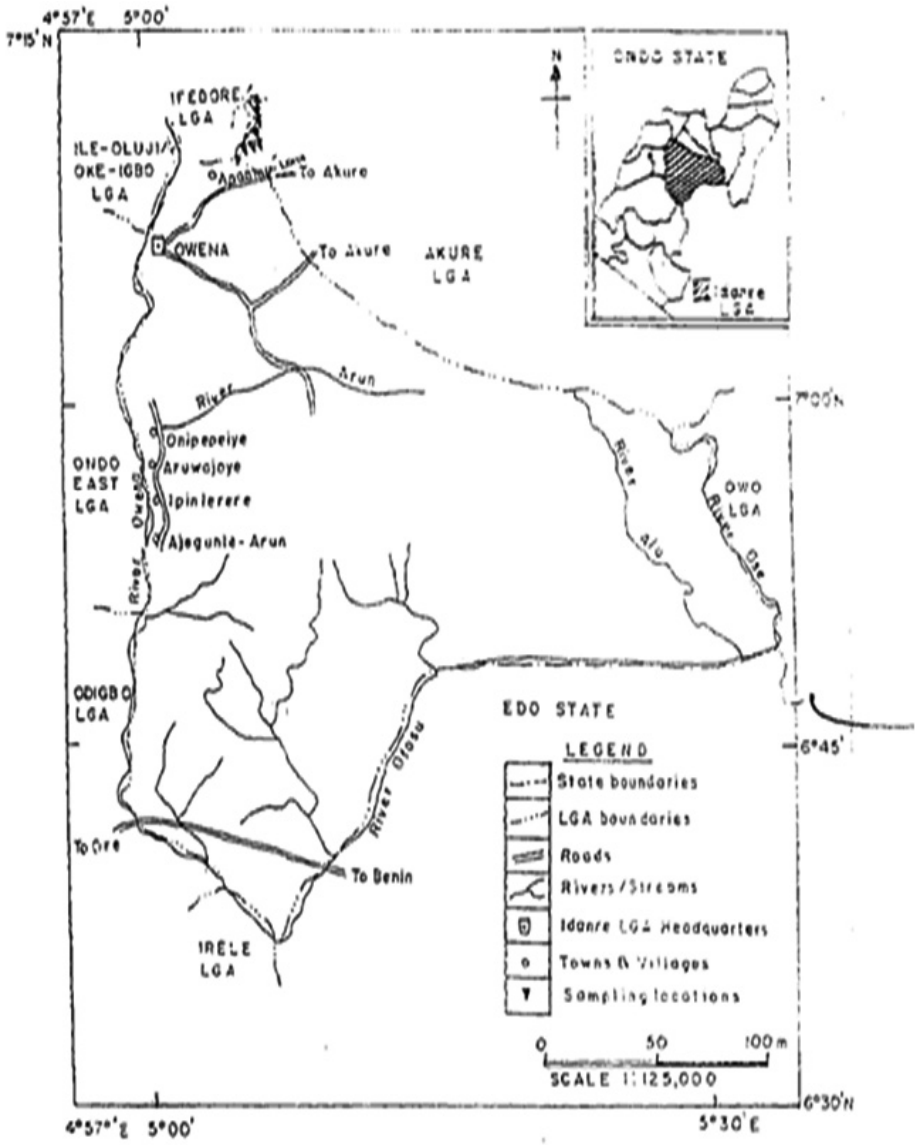

Figure 2: Map of Aponmu – Lona River Basin showing Sampling Station

Snail Sampling

Each of the seven sites was sampled for snails once every month for a period of twelve months (May 2006 – April 2007), using a standard procedure comprising 30 passes of kitchen scoops and a manual search for 30 people– minutes [18]. The scoop is attached to a metal pipe of about 2.5m long. Sampling in each site was carried out from five designated spots

The number of each snail species was counted to determine the number of each species or genera per month per site. The established local intermediate host species were measured and examined for Schistosoma infection using the light exposure method. The sizes (i.e. height x width for globose and diameter for discoid) snails were measured using a fine Vanier caliper. Height or length which represents the longest distance between apex and base is measured for globose shells while width is the maximum distance across the shell (globose or discoid).

Statistical Analysis

Snail count per month and frequency of water contact between sites were compared using the Chi square test from the Contingency Table [29]. Differences in the levels of physico chemical parameters of water and duration of water contact between sites and months were determined using the one way analysis of variance [25]. The strength of relationship between snail abundance and the physico-chemical factors, water contact patterns and duration as well as macrophyte density and coverage were assessed using the correlation co-efficience [25].

Results

Variation in Snail Density between Sites

A total of six thousand and eighteen (6,018) snails, consisting of 112 (1.86%) *Bulinus globosus*, 3,898 (61.45%) *Melanoides tuberculata*, 1,355 (22.18%) *Potadomafreethi*, 747 (12.4%) *Biomphalaria pfeifferi* 31 (0.52%) *Lanistes ovum*, 47 (0.78%) *Pila ovata*, 35 (0.60%) *Indoplanorbis exustus* and 12 (0.20%) *BUlinus truncatus* were collected over the twelve months site investigations table 1.

Table 1: Number of snails collected from seven sites investigated in various months in Aponmu-Lona River Idanre LGA Ondo State, Nigeria (May 200-April 2007).

Site	*B. globosus*	*M. tuberculata*	*P. freethi*	*B. pfeifferi*	*L. ovum*	*P. ovate*	*I. exustus*	Type B	Total	% Over all Total
S1	0	0	118	308	3	22	0	0	451	7.49
S2	0	1,124	100	170	13	0	8	0	1,415	23.51
S3	63	966	264	0	0	0	13	0	1,306	21.70
S4	41	554	313	0	2	0	0	0	910	15.12
S5	8	928	401	122	5	15	2	0	1,481	24.61
S6	0	63	132	6	8	0	2	6	217	3.61
S7	0	63	7	141	0	10	11	6	238	3.95
P-value	<0.00	<0.00	<0.00	<0.00						
TOTAL	**112**	**3,698**	**1,335**	**747**	**31**	**47**	**36**	**12**	**6,018**	**100**
% of Overall of Total	**1.86**	**61.45**	**22.18**	**12.41**	**0.52**	**0.78**	**0.60**	**0.20**	**100**	
MONTH										
May	3	113	56	74	0	8	0	0	254	4.22
June	5	69	76	91	0	10	1	0	252	4.19
July	2	88	67	36	0	11	6	0	210	3.49
August	4	128	73	54	5	17	15	0	296	4.92
September	7	190	57	31	1	0	2	0	288	4.79
October	11	314	124	37	0	0	6	0	492	8.18
November	7	354	163	10	4	0	3	0	541	8.99
December	36	1,452	312	108	8	0	3	3	1,922	31.94
January	14	276	213	57	0	0	0	1	561	9.32
February	14	278	76	118	5	1	0	3	495	8.23
March	4	171	83	61	3	0	0	2	324	5.38
April	5	265	35	70	5	0	0	3	383	6.36
TOTAL	**112**	**3,698**	**1,335**	**747**	**31**	**47**	**36**	**12**	**6,018**	**100**

All the eight snail species encountered were present in site 5 while only four species were found in sites 1, 3 and 4. *Potadomafreethi* occurred in all sites while the unidentified type B was collected only from sites 6 and 7. *Bulinus globosus* and *Biomphalaria pfeifferithe* were the only local intermediate hosts of *Schistosoma haematobium* and *S. mansoni* were found in Aponmu-lona study area. In 3 and 5 sites, respectively. Density of each snail species also varied significantly from one site to the other. Site 5 was the most snail populated site, habouring about a quarter of all snails (24.6 1%) collected while site 6 where less than a twentieth (3.61%) of all snails was collected was the least populated. Considering the established local intermediate host snails, *B. globosus* was collected only from three sites (3, 4, 5); site 3 being the most populated (63) and site 5 the least (8). Alternatively, *Bulinus pfeifferi* snails were collected from five sites (1, 2, 5, 6, 7) being most populated in site 1 (308) and least in site 6. It should be noted that B. pfeifferi occurred mainly in sites where *Bulinus globosus* was not found. However, while both species occurred in site 5, this is also the site where the least number of Bulinus globosus was collected. The only local intermediate hosts.

Temporal Variation in Snail Density

The monthly variation in the mean number of the *B. globosus and Biomphalaria pfeifferi* snail species collected is shown in figures 3. The figures reveal a temporal variation which is

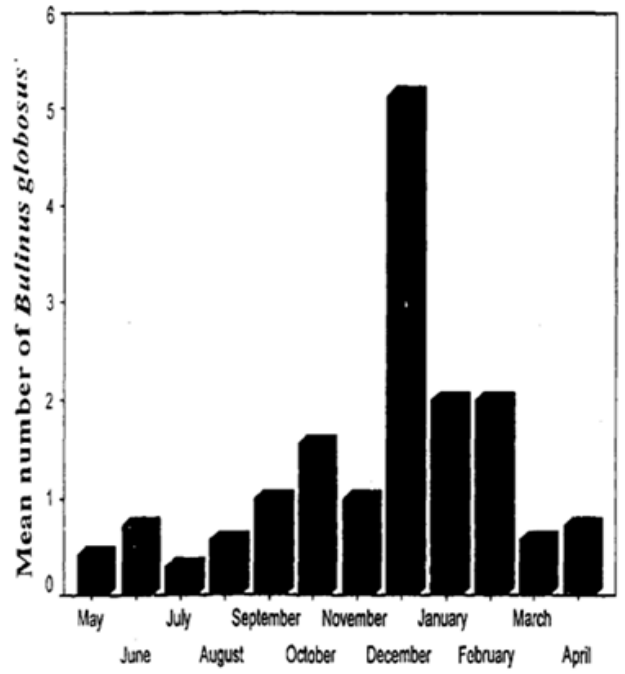

Figure 3: Pattern of monthly variation in mean number of Bulinus globosus collected from seven sites investigated in Apomu-Lona River, Idanre, Ondo State, Nigeria (May 2006 – April 2007)

specific for each snail species. The mean number of *B. globosus, M .tuberculata* and *P. freethi* collected in the seven sites increased marginally from May to December 2006 when it rose sharply to a high peak, dropped sharply in January and gradually rose again to low peak by the end of study in April. However, while peak density of *B. globosus* was attained in July, that of *M tuberculata* occurred in June and *P. freethi* in April. The pattern of variation in the number of the other species encountered was not clearly defined as those of the three species described above. However, peak mean density of *B. pfeiferi* occurred in February and the least in November. For *L. ovum* (the peak mean number was collected in December and the least in May, July, October and January.

Bulinus globosus collected from all the sites ranged from < 3-10.5 mm in height (mean height = 6.2 ± 0.18mm) while *Biomphalaria pfeifferi* ranged from < 3-9.6 mm in width (mean width = 3.8 ± 0.31mm). about 63.4% of *B. globosus* snails collected were less than 3 mm high while only 5.4% were >9 mm high. *B. pfeifferi* snails follow a fairly similar pattern with over 48% measuring < 3 mm wide and about 9%>9 mm wide.

Out of the 112 *Bulinus globosus* snails collected and examined for trematode infection, only 5 (4.5%) were found shedding trematode cercariae table 2. all the 5 snails shedding cercaria were >3 mm long and none of the snails <3 mm size range. Thus only *B. globosus* snails greater than 3 mm were found shedding cercarae and no infection was recorded among the *Biomphalaria* snails examined. Three cercarial types recovered from the infected snails were amphistome cercaria cercariaeum cercaria figure 4, ornate xiphidiocercaria and brevifurcate apharyngeate distome cercaria.

Table 2: Size classification and infection patterns of *Bulinus globosus* and *Biomphalaria pfeifferi* collected from Aponmu-Lona River, Idanre, Ondo State, Nigeria (May 2006-April 2007).

Species	Size class (mm)	Number collected	Number infected	% of total collection	% infection with trematodes
Bulinus globosus	<3	71	0	63.4	0
	3.0 – 5.9	22	2	19.6	9.1
	6.0 – 8.9	13	2	11.6	15.4
	≥9	6	1	5.4	16.7
	Total	112	5	100	4.5
Biomphalaria pfeifferi	<3	364	0	48.7	0
	3.0 – 5.9	963	0	21.8	0
	6.0 – 8.9	153	0	20.5	0
	≥9	67	0	9.0	0
	Total	747	0		0

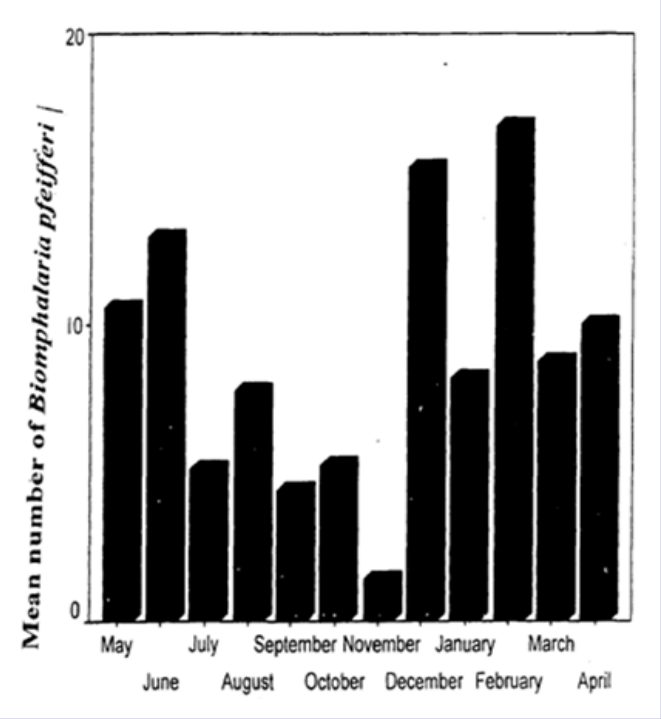

Figure 4: Pattern of monthly variation in mean number of Biomphalaria pfeifferi collected from seven sites investigated in Apomu-Lona River, Idanre, Ondo State, Nigeria (May 2006 – April 2007).

Discussion

Snail Distribution

This study has identified a total of eight snail species namely, *Bulinus globosus, Biomphalaria Pfeifferi, Melanoides tuberculata, Potadoma freethi, Indoplanoribis exustus, Pila ovata, Lanistes ovum and Bulinus truncatus* in Aponmu-Lona River. This level of species diversity is an indication of stable co-existence found only in habitats that are capable of supporting mutually exclusive and conductive ecological niches for different snail populations [4] Most of the snail species in the river showed marked seasonal variation in density that may occur at different times in different species. For instance, the unimodal peak (abundance) of *B. globousus, P. freethi, L. ovum, B. pfeifferi, M. tuberculata* and type B occurred in December while that *P. ovata* and *I. exustus* was recorded in August.

The observed unimoda pattern of density variation agrees with the report of several workers from Southwest [9,10] and southeast [27]. Nigeria. However, it differed from the bimodal pattern recorded in Yola [3] and Oyan Reservoir [18] Nigeria; Lake Volta, Ghana [11,14] and Lake Kariba, Zambia [10]. In all these reports, however, snail density maxima occurred at different periods of the year as a result of variations in local physico-chemical and biological conditions of the particular ecosystem [23]. Probably as a result of this, several of the reports emphasized the importance of a good knowledge of local patterns of seasonal variation in environmental factors in planning sustainable control programmes.

This study was carried out as part of a larger investigation, to elucidate media speculations that widespread haematuria in Aponmu-Lona was caused by an outbreak of urinary schistosomiasis. The findings of this investigation that *B. globosus*, an established intermediate host species in Southwest Nigeria [9] were shedding schistosome type cercaria is an indication of active schistosomiasis transmission of the disease in the river. This conclusion is further supported by the widespread and heavy intensity patterns of human infection reported by a complementary investigation on human infection [19].

The findings of this investigation provided a strong baseline data not only for understanding schistosomiasis transmission in Apomu-Lona and environs, but also for planning an effective first line control programme against the disease in the area and elsewhere with similar problems. To this end, the investigation has provided a clear trend in both spatial and seasonal distribution of human infection, ecology of snails including *B. globosus,* the local intermediate host species in the area and human water contact patterns in relation to behavioural patterns that drive the various transmission activities. This information is indispensable in sustainable integrated schistosomiasis control.

Schistosomiasis Transmission

Out of the 8 snail species recorded in the river, only *Bulinus* globosus and *Biomphalaria pfeifferi* are established local intermediate host species of schistosomiasis in Nigerian including the Southwest [2,10,18]. The recovery of three cercaria types including the schistosome type cercaria from the snails, albeit few, is a clear indication that 13. Globosus is also the local intermediate host species in Aponmu-Lona River. All the infected snails were collected from site 3 suggesting that this site is the most probable transmission site in the river. However, this conclusion must be drawn with caution as cercaria shed by infected snails in one site may drift to other sites [6]. Besides, inability to pick infected snails from a site is also not definitive evidence they are not present in the river. According to several workers, the probability of picking an infected snail in a water-body is often related to the rate of infection in the snail population, the macrophyte coverage and density of snails in a site [6]. At the observed rate of less than 5%, the probability is very low compared with findings elsewhere in Nigeria [10,16] but it compares favorably with some other records in Nigeria [2,17] and in other parts of West Africa [8,22,26]. However, there is no evidence to demonstrate a threshold field infection rate of snails required to main human infection in communities. [17] For instance, reported an infection rate of 2.9% in snails and 61.6% in human populations. This is a clear indication that the 4.5% snail infection rate recorded by this study is sufficient to sustain an epidemic level transmission and prevalence as reported by the complementary investigation [19]. This conclusion is supported by several other reports in Nigeria [13].

References

1. Adeola. Schistosomna haematobiun infection among school children in Owena Army Barracks, Akure, Ondo state, Nigeria. Nigerian Journal of Parasitology. 1991;41:443-444.
2. Adewunmi CO, Furu P, Christensen NO, Marquis BB, Fagbola M. Endemicity and seasonality of transmission of human schistosomiasis in Ile-Ife, south western Nigeria. Trop Med Parasitol. 1990;41(4):443-444.
3. Akogun OB and Okin BN. The ecology of fresh water snails in Agro-industrial estate in Yola, Nigeria. Nigerian Journal of Parasilology. 1993;14:75-80.
4. Barclay GW. Techniques of Population Analysis. New York, John Wiley and sons Inc. 1958:311.
5. Barnes RD. Invertebrate Zoology. 5th edition. 1987:342-347.
6. Chu KY and Klumpp RK. Focal transmission of Schistosomiasis haematobium in Lake Volta, Ghana Proceedings of an International Conference on schistosomiasis. 1978:85-88.
7. Clapp GH. Pangga (1949); Mead (1961): "Slugs" as Medicine. Nautilus. 1902;16:84.
8. Goll PH, Wilkins HA and Marshall TFDC. Dynamics of Schistosoma haematobium infection in a Gambian community II. The effects on transmission of the control of Bulinus senegalensis by the use of niclosamide. Transactions of the Royal Society of Tropical Medicine and Hygiene. 1984;78(2,1):222-226.
9. Hira PR and Muller R. Studies on the ecology of snails transmitting urinary schistosomiasis in Western Nigeria. Ann Trop Med Parasitol. 1966;60(2):198-211.
10. Hira PR. Aspects of the transmission of Schistosoma haematobium Bilharz, in Ibadan, Nigeria. West Afr Med J Niger Pract. 1969;18(1):28-32.
11. Klumpp RK and Chu KY. Importance of the aquatic weed Caralophyllum to transmission of Schistosoma haematobium in the Volta Lake, Ghana. Bulletin of World Health Organization. 1980;58(5):791-798.
12. Lutz. Ecology of Molluscans Organisms. New York, Harper. 1986:508.
13. Mafiana CF and Beyioku Yo. Schistosoma haematobium infection in Abeokuta. African Journal of Medicine and Medical Sciences. 1998;27(1-2):5-7.
14. McCullough FS. The seasonal density of populations of Bulinus (Physopsis) globosus and B. forskalii in natural habitats in Ghana, Annals of Tropical Medicine and Parasitology. 1957;51(3):235-248.
15. Mead AR. The giant African snail: A problem in economic malacology. Chicago, University of Chicago Press. 1961:35-40.
16. Ofoezie IE, Omevbore AMA, Balogun MO and Christensen NO. Evaluation of health and environmental hazards in small irrigation schemes in Northern Nigeria: findings of preliminary surveys on schistosomiasis, onchocercisis and malaria, unpublished report OD/TN 64,27pp. 1996.
17. Ofoezie IE. The study of urinary schistosomiasis transmission in resettlement communities bordering Oyan River Dam, Ogun State, Nigeria. Ph.D. Thesis, Obafemi Awolowo University, Ile-Ife, Nigeria. 1997.
18. Ofoezie IE. Distribution of freshwater snails in the man-made Oyan reservoir, Ogun State, Nigeria. Hydrobiologia. 1999;416(0):181-191.
19. Olorunda JO. Human behavioral patterns in relation to prevalence and intensity of urinary schistosomiasis in Aponumu-Lona, Idanre, Ondo State, Nigeria, M.Sc, Thesis Obafemi Awolowo University, Ile-Ife. 2010.
20. Oyebode. African Journal of Medicine and Medical Science. 1991;2(3):253-256.
21. Pangga GA. A preliminary report on the biology, ecology and control of giant African snail (Achachatina fulica). Phillipina Journal of Agriculture. 1949;14(1):333-347.
22. Paperna I. Study of an outbreak of schistosomiasis in the newly formed Volta Lake in Ghana. Zeitschrift fur Tropenmedizin und Parasitologie. 1970;21(4):411-425.
23. Peletu BJ. Ecology of fresh water snails transmitting Schistosoma haematobium in Aponmu-Lona River Basin, Idanre, Ondo State, Nigeria. M.Sc. Thesis, 107, Obafemi Awolowo University, Ile-Ife, Nigeria. 2010.
24. RADKE MG, RITCHIE LS, FERGUSON FF. Demonstrated control of Australorbis glabratus by Marsia cornnarietus under field conditions in Puerto Rico. American Journal of Tropical Medicine sand Hygiene. 1961;10(4):370-373.
25. Siegel S and Castellan NJ. Non parametric statistics for the behavioral sciences. 2nd New York, McGraw-Hill. 1988:399.
26. Smithers SR. On the ecology of Schistosoma vectors in the Gambia, with evidence of their role of transmission. Transactions of the Royal Society of Tropical Medicine and Hygiene. 1956;50(4):354-365.
27. Udonsi JK. Human community ecology of urinary schistosomiasis in relation to snail vector bionomics in the lgwun River Basin of Nigeria. Trop Med Parasitol. 1990:41(2):131-135.
28. Weinland. Digenea Schistosomatidae and the intermediate snail host general: Revue de Zoologie Africaine Tervuren. 1858;100:137-152.
29. Zar JH. Biostatistical Analysis, 2nd Edition, Prentice-Hall, Eaglewood Clitts, NJ. 1972.
30. Zhadin VI. Mollusks of fresh and brackish waters in the USSR. Academy of Sciences of the USSR Zoological Institute. 1965;46:456.