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Spatial distribution of fresh water snail intermediate host in Yenagoa Metropolis, Bayelsa State, Nigeria

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Field investigation to establish the density of fresh water snail intermediate host in four water bodies of Yenagoa metropolis were carried out between January and March, 2016. Snails were collected in each water body using scooping and handpicking methods. The identification of snails and the determination of physico-chemical parameter of the water body followed standard procedures. Three snail species were identified. They are *Lymnaea natelensis* (91.89%), *Bulinus globosus* (2.25%), and *Oncomelania* species (5.86%). The differences in the snail abundances were not significant (F=1.8911; p>0.05). The snails' abundance by location was Etegwe (44.54%), Okutukutu (48.05%), Azikoro (6.76%), Kpansia (4.05%), and Okaka (3.60%). Differences between snail abundance and locations were significant (F=2.244; p<0.05). *B. globosus* was exclusive in Azikoro and Etegwe, while *Oncomelania* was exclusive in Azikoro and Okaka. *L. nataensis* were widely distributed in all locations. Snail species vary across microhabitat. The difference in snail abundance across microhabitat was significant (F=6.045; p<0.05). Sympatric association exists between *B. globosus* and *L. natalensis* at Etegwe. The physico-chemical parameters analyzed were temperature, pH, biochemical-oxygen demand, turbidity, and conductivity. The effect of physico-chemical parameter on the snail population across locations was not significant (F=1.9022; p>0.05). The public health implication of this study has call for timely control intervention.

Key words: Fresh water snail, intermediate host, spatial distribution, physico-chemical parameter, Yenagoa.

INTRODUCTION

Most fresh water snails (family: Planorbidae) are intermediate hosts of highly infective fluke (tremades) larvae in human and animal (Hamburger et al., 2004; Akande et al., 2011). Over 350 fresh water snail species of medical and veterinary importance have been identified (WHO, 1993). In Africa, *Biomphalaria* serves as intermediate hosts for *Schistosoma mansoni,* while *Bulinus globossus* serves as the intermediate hosts for *Schistosoma haematobium* and *Schistosoma intercalatum*, *Oncomelania* serves as the intermediate host for *Schistosoma japonicum*, while *Lymnaea natalensis* are important in the transmission of liver flukes

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causing fascioliasis in sheep and cattle (Keiser, 2005; Gabriel, 2014).

Schistosomiasis and fascioliasis are both public health diseases of human and animal in tropical and subtropical Africa, ranking second only to malaria in terms of its socio-economic impairment (McCullough, 1992). Schistosomiases are endemic in 74 tropical countries, where over 200 million people living in rural and agricultural areas are infected and 500 to 600 million people are at risk of the infection; children aged 10 to 15 years are the most predisposed people (Kenneth, 2002). Fascioliasis is a disease of sheep and cattle. It is also an important emerging zoonotic disease of humans (Gabriel et al., 2014). More than 2.4 million people are infected and 91.1 million are living at high risk environments (WHO, 1997). Environmental modification and poor drainage system are factors that increase the density of the snail intermediate host, while lack of health education on the choice of water body for recreational purposes is a factor that predisposes people to the risk of the infection.

In Nigeria, the population density of the snail intermediate host has been studied (Mafiana et al., 2003; Ngele, 2012; Salawu and Odaibo, 2014). The correct identification of the snail intermediate host within living environment is a basic pre requisite to mounting long term control strategy (Rudge et al., 2008; Hamburger et al., 2004; Labbo et al., 2008; Clennon et al., 2006; Opara et al., 2007; Oladejo and Ofoezie, 2006). There is paucity of this information in Bayelsa State. This study is a preliminary investigation on the spatial distribution of fresh water snails across communities in Yenagoa metropolis.

MATERIALS AND METHODS

Study area

This study was conducted in Yenagoa metropolis (4° 53′N and 5°17′E). It is the capital city of Bayelsa State and also the head quarter of Yenagoa municipal. The cross sectional survey was undertaken to study the spatial distribution of fresh water snail in five communities in Yenagoa metropolis during January to March, 2016. The communities are Okaka, Kpansia, Azikoro, Okutukutu, and Etegwe.

Samples and sampling technique

The study population comprise of five communities in Yenagoa metropolis, Bayelsa State. Samples were all water bodies. Four water bodies were identified and classified as gutter/drainage, excavation, water pool and river/stream. The water bodies from five randomly selected communities, namely, okaka, Kpansia, Azikoro, Okutukutu and Etegwe were sampled for the presence of fresh water snails.

Methods of snail collection and preservation

The snails were collected using two methods: scooping and hand picking. The procedures for collection of snails followed standard procedures (Harman and Berg, 1971). The method used for sample collection depends on the depths and sizes of the water bodies. The snails caught were preserved in plastic containers containing clay or sandy soil and transported to the laboratory for macroscopic identifications. Identification was done by a standard pictorial key in Harman and Berg (1971) cited in Salawu and Odaibo (2014).

Measurement of physico-chemical parameters

In-situ determinations of water temperature, pH, biochemical oxygen demand (BOD), turbidity, and conductivity were carried out by standard methods at the Quality Control Laboratory, Bayelsa State Water Board.

Method of data analyses

Data were cross-checked for correctness before analysis. Data checked was entered to Microsoft office excel 2007. Thereafter, it was exported into SPSS version 16.0 for statistical analysis. Percentages were used to express frequency distribution of the snails in respect to location. Analysis of variance (ANOVA) was employed to show significant difference between snails and locations, water bodies' and physico-chemical parameter. Karl Pearson's correlation matrix was used to show the influence of physico-chemical parameters on snail abundance across locations and microhabitat.

RESULTS

Spatial distribution of fresh water snail

Two hundred and twenty two fresh water snails were collected during May, 2015 to January, 2016 in five locations. The snail species in their increasing order of abundance are: *L. natelensis* (91.89%), *B. globosus* (2.25%) and *Oncomelania* species (5.86%). The differences in the snail species abundance were not significant (F=1.8911; p-value=0.124; p>0.05). The overall snails' abundance by location is Etegwe 99 (44.54%), Okutukutu 100 (48.05%), Azikoro 15 (6.76%), Kpansia 09 (4.05%), and Okaka 8 (3.60%). The snail species abundance by location are Azikoro (*B. globosus*, 26.7% and *Oncomelania*, 73.3%), Etegwe (*B. globosus*, 1.1% and *L. natelensis*, 98.9%), and Okaka (*L. natelensis*, 75% and *Oncomelania*, 25%). However, *B. globosus* was exclusive in Azikoro and Etegwe. *L. nataensis* were widely distributed in all locations. Differences between snail population and locations were significant (F=6.045; p-value=0.001; p<0.05). Sympatric association exists between *B. globosus* (20%) and *L. natalensis* (20.10%) in a water pool located at Etegwe. The difference of snail species abundance across microhabitat was significant (F=2.244; p-value=0.020; p<0.05) (Table 1).

Physico-chemical parameter of the snail across micro habitats

The population abundance of the snail vary with the

Table 1. Spatial distribution of fresh water snail across study location and microhabitat during January - March, 2016.

Location	Microhabitat	Species No. (%)			Total
		B. globosus	***L. natalensis***	***Oncomelania* spp.**	
	Excavation	-	6 (66.7)	-	6 (66.7)
	Gutter/Drains	-	-	-	-
Kpansia	Water pool	-	3 (33.3)	-	3 (33.3)
	River/Stream	-	-	-	-
	Total	-	9 (100)	-	9 (4.05)
	Excavation	-	-	2 (18.2)	2 (13.3)
	Gutter/Drains	1 (25)	-	-	1 (6.7)
Azikoro	Water pool	3 (75)	-	-	3 (20)
	River/Stream	-	-	9 (81.8)	9 (60)
	Total	4 (26.7)	-	11 (73.3)	15 (6.76)
	Excavation	-	2 (2)	-	2 (2)
	Gutter/Drains	-	46 (46)	-	46 (46)
Okutukutu	Water pool	-	52(52)	-	52 (52)
	River/Stream	-	-	-	-
	Total	-	100 (100)	-	100 (45.04)
	Excavation	-	2 (2.2)	-	2 (2.2)
	Gutter/Drains	-	46 (51.7)	-	46 (51.1)
Etegwe	Water pool	1 (100)	41 (46.1)	-	42 (46.7)
	River/Stream	-	-	-	-
	Total	1 (1.1)	89 (98.9)	-	90 (40.54)
	Excavation	-	2 (33.3)	-	2 (25)
	Gutter/Drains	-	4 (66.7)	-	4 (50)
Okaka	Water pool	-	-	2 (100)	2 (25)
	River/Stream	-	-	-	-
	Total	-	6 (75)	2 (25)	8 (3.60)
Total		5 (2.25)	204 (91.89)	13 (5.86)	222

**The number in the parentheses is the percentages of the snail species counted in each location and microhabitat.

physico-chemical parameters (F=1.902208; p-value= 0.126554, p>0.05) (Tables 2 and 3). However, the parameters seem to influence the species richness in each habitat (Table 4). The mean temperature ranges from 27 to 28°C. Temperature was positively correlated with the abundance of *L. natalensis* (r=0.054). The pH of the water bodies was within the range of 7.5 to 7.8. Positive correlation was recorded with the snail abundance; *L. natalensis* (r=0.214) and *B. globosus* (r=0.053), while negative correlation exists with *Oncomelania* spp. (r = -0.266). The overall mean value of biological oxygen demand across the location was 25.1 mg/L. This value varies between water bodies: excavation (16.7 mg/L), water pool (30.4 mg/L), and 28.2 mg/L in gutter. BOD was positively correlated with the abundance of *L. natalensis* and *B. globosus* (r =0.346, r = 0.168), respectively;

The overall mean conductivity value of the micro habitat was 280 µS/cm with gutter having the highest conductivity value (450 µS/cm), while water pool had the least value (180 µS/cm). Conductivity showed positive correlations with *L. natalensis* and *B. globosus* (r=0.147, r= 0.214), respectively. Turbidity also showed positive correlation with *L. natalensis* and *B. globosus* (r=0.083, r= 0.021), respectively. However, *Oncomelania* spp. had negative correlation with all the physico-chemical parameters.

DISCUSSION

The presence of the three fresh water snails, *B. globosus,*

Table 2. Physico-chemical parameter of the snail across location and microhabitat.

Microhabitat	Snail species (Mean±SD)			Physico chemical parameter				
	L.natalensis	*B. globosus*	*Oncomelania*	T^{O}	pH	TUB	BOD	COND
Excavation	12±0.5	0±0.0	2.2±0.2	28±0.0	7.8±0.0	40.8±3.2	17.5±1.2	210±0.0
Gutter/Drainage	55.4±0.3	0.8±0.2	0±0.0	26.8±0.2	7.5±0.02	34.2±5.7	28.6±0.3	430±0.0
Water pool	96.2±0.2	4.2±0.2	2.2±0.2	27.2±0.2	7.6±0.0	28.2±25.7	30.7±0.2	150±0.0
River/Stream	0±0.0	0±0.0	8.5±0.2	25.6±0.3	8.12±0.25	36.2±5.7	30.9±1.56	437±27
Total	40.9±1520.3	1.25±3.25	3.3±11.58	26.9±0.94	7.76±0.11	34.9±30.03	26.9±32.7	314±15099.6

*****The value of the physico-chemical parameters is the mean of the consecutive data collection.

Table 3. Analysis of variance (ANOVA) on the relationship between physico-chemical parameters and snail abundance across locations.

Source of variation	ANOVA					
	SS	df	MS	F	P-value	F crit
Physico-chem	717.7667	4	179.4417	1.902208	0.126554	2.578739
Columns	1269.1	2	634.55	6.726678	0.00278	3.204317
Interaction	1736.733	8	217.0917	2.301325	0.036808	2.152133
Within	4245	45	94.33333	-	-	-
Total	7968.6	59	-	-	-	-

Table 4. Correlation matrix on the influence of physico-chemical parameters on snail density.

Correlation	T	pH	TUB	BOD	COND	L.n	B.g	OC
T	1							
pH	-0.734[a]	1						
TUB	0.2945[a]	0.4600[a]	1					
BOD	-0.9914[b]	0.4283[a]	-0.4169[a]	1				
COND	-0.7356[a]	0.3236[a]	0.1681[a]	0.6741[a]	1			
L.n	0.1449[a]	-0.7830[a]	-0.8927[a]	-0.9653	-0.4222[a]	1		
B.g	0.05858[a]	-0.5546[a]	-0.9210[a]	0.0711[a]	-0.5369[a]	0.9434[a]	1	
O.c	-0.722[a]	0.9615[b]	0.2103[a]	0.6420[a]	0.6140[a]	0.1368[a]	0.5675[a]	1

The numbers are correlation values; positive values mean positive correlation; Negative values mean negative correlation; a-correlation is significant; b-correlation is not significant. T: Temperature; pH: Hydrogen ion concentration; BOD: Biochemical-oxygen demand; TUB: Turbidity; COND: Conductivity; B,g: *Bulinus globosus*; L.n: *Lymnaea natalensis*; O.c: *Oncomelania*.

L. natalensis and *Oncomelania* spp. is novel in attempting to establish the distribution of schistosome snail species in a metropolitan city of Bayelsa State. The spatial distribution of *B. globosus* and *L. natalensis* in the study location agrees with Grimes (2015), Ngele (2012), and Gabriel et al. (2014). This also highlights the risk of fascioliasis and urinary schistosomiasis in near future in Yenagoa metropolis. However, this is the first report of *Oncomelania* in South Southern Nigeria. The sympatry of the two fresh water snails: *B. globosus* and *L. natalensis* in a water pool at Etegwe have also been reported elsewhere (Madsen, 1992; Giovanelli et al., 2005). Although, the snails were sympatric, negative association existing between *B. globosus* and *L. natalensis*is; *Oncomelania* spp. and *L. natalensis* agrees with Giovanelli et al. (2005). Eventually, in all the study locations, no snail was recovered from river. According to Jones (1993), snail intermediate hosts do not tolerate strong currents and their breeding sites are usually places where water velocity is below 40 cm/s). In this study, sampling of snails corresponds with the time the rivers were flooded with early rain water.

Environmental factors over time have affected the distribution patterns, the life cycles and population dynamics of fresh water snails (Rollinson et al., 2001). The observed relationship between snail abundance and temperatures, pH, BOD, turbidity and conductivity in this study is consistent with the report elsewhere (Opisa et al., 2011; Salawu and Odaibo, 2014; Olofintoye and Odaibo, 1996; Owojori et al., 2006). The optimum temperature for the hatching of *B. globosus* eggs is between 25 and 28°C (Madsen, 1985). The mean temperature of 27 to 28°C recorded at the different microhabitats in this study is within the limit of snail survival. The positive correlations between temperature and *L. natalensis* and *B. globosus* has been reported by Salawu and Odaibo (2014). The mean pH value of 7.5 to 7.8 recorded in this present study is slightly lower than the pH range of 0.8 to 8.5 value recorded by Salawu and Odaibo (2014). However, the pH value showed positive effect on the two snails' species (*L. natalensis* and *B. globosus)* in all the locations.

The BOD defines as the amount of oxygen required to degrade a biological process. The BOD value of 16.7 to 30.4 showed positive correlation with the snail population. The conductivity and turbidity values observed in this study were higher than those reported in Tubonimi et al. (2010). The implication is that the variation in temperature, pH, BOD, turbidity and conductivity of the water impact on the population variables of the snail species. This is a bio-indicator showing that transmission foci are likely when the snail population is not control. However, the negative correlations between *Onchomelania* spp. with temperature, pH, BOD, turbidity and conductivity lack explanations at the mean time.

Conclusion

This study has established the presence of three snail intermediate host for fascioliasis and schistosomiasis around human environment in Yenagoa metropolis. The result has demonstrated that the snails' abundance was affected by physico-chemical parameters of the water bodies. It is recommended that individual should take cognizance of the possibility of a snail borne infections in the locality and redirect their water recreational activities. Government should also make functional drainages so as to reduce further establishment of the snails around human environment.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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