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ARTICLE

Relationship between Physico-Chemical Parameters and the Population Distribution of Fresh Water Snails in Amassoma Community and Niger Delta University Campuses, Bayelsa State, Nigeria

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ABSTRACT

Evaluating the presence of fresh water snails in a location is germane in establishing a snail-borne disease control program. The purpose of the study was to see how physicochemical parameters influenced the population distribution of four fresh water snails (*Lymnaea natalensis*, *Bulinus globosus, Biomphalaria pfeiffer*, and *Melanoides* spp.) in the Amassoma community and Niger Delta University between March, 2021 and May 2021. Snails were gathered by plucking and scooping them by hand. Snail was identified using standard pictorial keys. Physicochemical of the water of the snail habitat were measured using standard in-situ apparatus across eight sites Physico chemical measured were temperature, pH, conductivity, BOD, turbidity, salinity, and alkalinity. A total of 258 snails were gathered from the eight (8) different sites. In all sites, *Lymnaea natalensis* was more abundant. *Bulinus globosus, Biomphalaria pfeiffer*, and *Melanoides* spp. were among the other snails discovered. *Lymnaea* had negative correlation with pH, conductivity, BOD, and alkalinity and a positive correlation with salinity and temperature. *Bulinus* had a positive relationship with pH, salinity, and conductivity and a negative correlation with temperature, turbidity, BOD, and alkalinity. Biomphalaria had a positive correlation with temperature, pH, salinity, turbidity, and alkalinity Melanoides had positive correlations with Temperature, pH, salinity, BOD, and alkalinity and a negative correlation with turbidity and concentration. The was correlation between snails and snails. The presence of these snails suggests that the Amassoma village and Niger Delta University campuses are potential hotspots for a variety of snail-borne diseases.

1. Introduction

Several trematodes parasites in humans and veterinary animals have been linked to fresh water snails of the family Planorbidae [1]. Snail-borne parasitic infections cause 200,000 fatalities each year worldwide, with more than 700 million people living in high-risk locations in 76 countries and more than 207 million people affected with

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one or more snail-borne diseases [2].

Several studies in Nigeria have revealed the snail intermediate's host distribution in various parts of the country [3-5]. The transmission of trematodes parasites has been linked to the snail intermediate host. *Biomphalaria* spp. transmit *Schistosoma mansoni, Bulinus globossus* transmits *Schistosoma haematobium* and *Schistosoma intercalatum, Oncomelania* serves as an intermediate host for *Schistosoma japonicum* [6] and *Melanoides* species alone serve as an intermediate host for over six parasitic diseases in humans and rodents [7].

One of the things that improves the population distribution dynamics of snail intermediate hosts is population-induced environmental changes [8]. The Amassoma community is one of the Niger Delta University's host communities. Several development projects promoting the dissemination of snail intermediates are currently underway in the community and its environs. As a result of several changes in the environment, an ideal breeding location for fresh water snails has developed well within school grounds. The expanding transmission foci of snail-borne diseases are due to the interaction between the infective stage of snail-borne pathogens, snail intermediate hosts, and definitive hosts [9]. An accurate identification of the snail intermediate host in the residential is a prerequisite for beginning a control strategy. Snail surveys and transmission foci identification have been carried out in several parts of Bayelsa State [10]. *Lymnaea*, *Bulinus*, and *Melanoides* have also been found to be common in Amassoma [11]. However, there is one exception. There is no information on how physico-chemical factors affect the regional distribution of the snail intermediary in the Amassoma community and its environs. This is a follow-up study to look at the impact of physicochemical parameters on four freshwater snails intermediate in Amassoma villages and Niger Delta Campuses. The findings of this study will demonstrate the importance of good management of freshwater sources and their surrounds in order to reduce the threat of snail-borne diseases.

2. Materials and Methods

2.1 Study Area

Amassoma community (4 57' - 4 58'N and 16 9' - 6 10'E) is a community in Bayelsa State Southern Ijaw Local Government Area. It also serves as a home to the Niger Delta University. The study locations have been reported in full by Ebenezer and Assumpta [11]. The study was undertaken during February, 2021- May, 2021.

2.2 Snail Collection and Identification

The snails were collected from eight locations within Amassoma community and Niger Delta University Campuses(NDU). The Locations are: 1.ETF building(NDU) 2. Sadioma(Amassoma) 3. Newsite road (NDU) 4. Efeke-ama (Amassoma) 5. Main campus boys hostel(NDU) 6. Fine and applied building(NDU) 7. Newsite Agric road NDU) 8. Boys Hostel new site(NDU).

Depending on the depths and sizes of the water bodies, the snails were collected either by scooping or hand picking. The snails were sorted into several containers with labels indicating where they were caught, when they were caught, and how many snails were caught in each location. The snails were taken to a laboratory to be identified further. The snails were identified using standard pictorial keys [12].

2.3 Physico Chemical Analysis of Water Samples

The water samples of the snail microhabitats were collected and transported to the Niger Delta University Central Research Laboratory, Wilberforce Island, Bayelsa state, were in-situ analysed using portable electronic multipurpose meter (Extech Instrument Corp. Waltham, MA) and pH meter (CE Portable pH meter). Dissolved oxygen was measured using YSI 550A DO meter.

2.4 Methods of Data Analysis

Data was entered into a Microsoft Excel. Data was analyzed in SPSS software version 20. Both descriptive and (simple percentages) and inferential statistics(ANOVA) were employed. The frequency of the snail across microhabitats was calculated using simple percentage, while significant difference between snail species and microhabitats was analyzed using ANOVA at a confidence level of $p = 0.05$. Correlation between physicochemical parameters and snail abundance was analysed using correlation matrix. Correlation coefficient analysis was used to assess the correlation between physico-chemical parameter and snail species.

3. Results

3.1 Freshwater Snail Species Composition in the Study Location from March to May 2021

A total of 258 fresh water snails from four different species were gathered from eight locations. *Lymnaea natelensis*, *Bulinus globosus, Biomphalaria pfeifferi*, and *Melanoides* spp. are the snails recovered from the locations. The snail species in their frequency is illustrated in Figure 1; *Lymnaea natelensis* (66%), *Biomphalaria pfeifferi* (13%), and *Bulinus globosus* (13%) *Melanoides* spp. (8.0%). The differences of the snail species were

significant ($p<0.05$) (Table 1). The distribution of these snails differed significantly across locations ($p<0.05$). The details in Table 2 showed that, *Lymnaea natalensis* was widely abundant in all locations with the exception of location 2 and 6. However, the differences in *Lymnaea* abundance across location were not significant ($p<0.05$). *Bulinus globosus* population was exclusive in locations 1 and 3, but there was no significant difference in the *Bulinus* population between location 1 and 3 ($p>0.05$). The abundance of *Biomphalaria pfeifferi* was exclusive in location 2 while the population of *Melanoides spp*. was significantly higher ($p<0.05$) in location 6 than in locations 2 and 8.

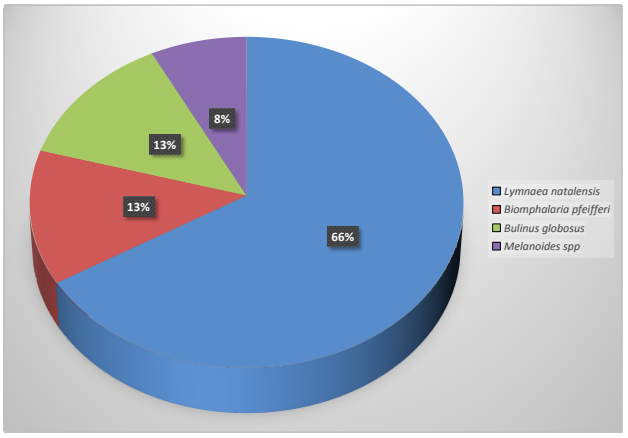

Figure 1. Snail Species Collected from the Study Location During March, 2021- May, 2021

Table 1. Analysis of Variance of Snail Population Across the Study Locations

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Snail Samples	32751.29	7	4678.755	105.5762	0.0024	2.057531
locations	1655458	11	150496.2	3395.948	0.0019	1.838792
Interaction	277216.1	77	3600.209	81.23875	0.0021	1.353976
Within	8508.748	192	44.3164			
Total	1973934	287				

Table 2. Distribution of snail species and physico chemical parameter across the study Locations

SNAILS					PHYSICO-CHEMICALS						
locations ↓→	*Lymnaea*	*Bulinus*	*Biomphalaria*	*Melanoides*	Temp (T^0C)	pH	Sal ml/L	Conduc. µS/cm	Turbidity (NTU)	BOD**(ml/L)**	Alka**(ml/L)**
*1	12.7 ± 2.1^{a}	1.3 ± 0.6^{b}	-	-	27.7 ± 0.0^{a}	6.9 ± 0.0^{ab}	0.2 ± 0.0^{b}	320.0 ± 1.0^{d}	22.7 ± 0.0^{a}	218.4 ± 0.0^{d}	96.0 ± 1.0^{c}
*2	-	-	12.0 ± 1.7^{a}	0.4 ± 0.0^{ab}	26.8 ± 0.0^{a}	6.7 ± 0.0^{ab}	0.1 ± 0.0^{ba}	251.0 ± 1.0^{d}	18.8 ± 0.0^{a}	242.4 ± 0.0^{d}	86.0 ± 1.0^{c}
*3	7.0 ± 2.7^{a}	0.3 ± 0.6^{b}	-	-	27.6 ± 0.0^{a}	7.1 ± 0.2^{ab}	0.1 ± 0.0^{b}	198.0 ± 1.0^{d}	24.4 ± 0.0^{a}	208.5 ± 0.0^{d}	66.0 ± 1.0^{c}
*4	7.3 ± 3.0^{a}	-	-	-	28.4 ± 0.0^{a}	6.9 ± 0.0^{ab}	0.2 ± 0.0^{b}	38.3 ± 1.0^{a}	27.5 ± 0.0^{a}	254.7 ± 0.0^{d}	125.0 ± 1.0^{c}
*5	12.3 ± 4.5^{a}	-	-	-	28.5 ± 0.0^{a}	6.3 ± 0.0^{ab}	0.1 ± 0.0^{b}	94.8 ± 15.1^{c}	18.5 ± 0.0^{a}	198.3 ± 0.1^{d}	88.0 ± 1.0^{c}
*6	-	-	-	6.3 ± 3.2^{a}	28.9 ± 0.1^{a}	6.9 ± 0.0^{ab}	0.1 ± 0.0^{b}	78.9 ± 6.5^{c}	24.7 ± 0.3^{a}	231.1 ± 19.5^{d}	92.7 ± 3.9^{c}
**7	5.3 ± 2.3^{ab}	-	-	-	27.4 ± 0.2^{a}	6.6 ± 0.1^{ab}	0.1 ± 0.0^{b}	93.1 ± 10.9^{c}	37.8 ± 1.8^{a}	223.9 ± 26.7^{d}	79.0 ± 12.2^{c}
*8	16.3 ± 3.5^{a}	-	-	0.3 ± 0.6^{b}	28.6 ± 0.1^{a}	6.5 ± 0.0^{ab}	0.2 ± 0.0^{b}	96.6 ± 17.0^{c}	56.1 ± 2.7^{a}	235.9 ± 32.6^{d}	86.0 ± 33.8^{c}
TOTAL →	7.6 ± 6.1^{a}	0.2 ± 0.5^{b}	1.5 ± 4.1^{b}	0.9 ± 2.3^{b}	28.0 ± 0.7^{c}	6.7 ± 0.3^{c}	0.1 ± 0.0^{b}	189.4 ± 113.0^{d}	28.8 ± 12.0^{c}	$226.7\pm22..2^{e}$	89.8 ± 19.4^{f}

↓→ Comparison along Row and column. The superscript is used to indicate significant difference recorded among sample interaction, along column at $p<0.05$, Similar letter of the superscript indicate an insignificant difference while two different letter of the superscript indicate significant difference.

1. ETF building 2. Sadioma 3. Newsite road 4. Efeke-ama 5. Main campus boys hostel 6. Fine and applied building 7. Newsite Agric road 8. Boys Hostel new site

3.2 Correlations between the Distribution of Fresh Water Snails and Physico Chemical Parameter

The result showed that there is a link between physicochemical characteristics and the distribution of snail species in the study locations. The relationship was either positive or negative (Table 3). *Lymnaea natalensis* had positive correlation with temperature, salinity, and turbidity and a negative correlation with pH., conductivity, alkalinity and BOD. However, the positive correlation between the four snail's species with temperature, salinity, turbidity, pH, conductivity, alkalinity and BOD was not significant ($p>0.05$). Nevertheless, a strongest positive correlation was recorded between Lymnaea and turbidity (0.449493), *Bulinus globosus* and conductivity (0.401296), *Melanoides* and temperature (0.401296). The negative correlation between Biomphalaria and temperature (-0.63684) was significant ($p<0.05$).

A strong link exists between snail species and another snail species. Although, the correlation was not significant, *Lymnaea natalensis* and *Bulinus globosus* showed a positive correlation. Other snail species had negative correlation among themselves.

4. Discussion

The existence of the four snail intermediate host recorded in the study location is an indication that the environment is suitable for their development and expansion [13]. The high abundance of *Lymnaea natalensis* in this study has been reported in other parts of Nigeria [14,4] and in the similar environment in Bayelsa State [10]. The distribution of *Bulinus globusus, Biomphalaria pfeifferi* and *Lymnaea natalensis* in the study location highlight their role in the epidemiology of fasciolaisis and urinary and intestinal schistosomiasis. The report of *Biomphalaria pfeifferi* in Amassoma and Niger Delta University Campuses is novel. *Melanoides* is an intermediates of more than 6 parasitic diseases. Its invasiveness has been reported in some foci in Amassoma [11]. However, in this presentation, the distribution is increasing across locations. There is need to incriminate the species in disease transmission in Amassoma and its environs.

The abundance of fresh water snail intermediate host is dependence on the physico chemistry of the snail habitats [15]. Temperature, pH, salinity, conductivity, BOD, turbidity, and alkalinity were the physico-chemical parameters studied in this present study. The values of these parameters except for conductivity does not vary significant from location to location. Conductivity in 1-3 differ significantly from location 4, which also differ significantly from location 5-8. This conductivity disparity is in consonance with El-Deeb *et al*. [16]. The tolerance to conductivity varies from snail species to snail species and location to location. Many studies have shown that conductivity is a

Table 3. Correlation Between Physico Chemical Parameter and Fresh Water Snail Distribution

	Lymnaea	*Bulinus*	*Biomphalaria*	*Melanoides*	*Temp*(T^0C)	*pH*	*Sal (ml/L)*	*Cond. (µS/cm)*	*Turb. (NTU)*	*BOD*(ml/L)	Alka(ml/L)
Lymnaea	1										
Bulinus	0.335771	1									
Biomphalaria	−0.47945	−0.1568	1								
Melanoides	−0.44188	−0.16055	−0.08457	1							
Temp(T^0C)	0.28473	−0.21328	−0.63684	0.464275	1						
pH	−0.33129	0.354756	−0.13381	0.169638	−0.15485	1					
Sal (ML/L)	0.036535	0.225732	−0.0410	0.01147	0.102553	0.437568	1				
Cond.(µS/cm)	−0.00083	0.401296	0.209009	−0.35341	−0.3205	0.557778	0.53647	1			
Turb. (NTU)	0.449493	−0.20387	−0.31708	−0.09944	0.264243	−0.28407	0.317183	−0.34679	1		
BOD(ml/L)	−0.1891	−0.19631	0.270794	0.145547	0.003866	0.179988	0.521997	0.37603	0.245099	1	
Alka(ml/L)	−0.03917	−0.0007	−0.07732	0.044762	0.341033	0.097928	0.552795	0.472031	−0.10053	0.14927	1

\+ positive correlation

\- negative correlation

* correlation is significant@ p=0.05 level of confidence

bio-indicator that limit the distribution of fresh water snail intermediate host [17]. In this study, conductivity ranges from (38.3±1.0 -320.0±1.0 $\mu S/cm$). This value was slightly higher than the value (11.30 - 244 µS/cm) reported in Opeyemi and Odaibo [18]. In this study negative correlation exists between conductivity and Lymnaea. This observation agrees with the report of Donnely *et al*. [19]. The negative correlation is an indication that where the value of conductivity increases, the population of *Lymnaea* will decrease, hence, conductivity can be a limiting factor for the distribution of the snail species.

pH has been used to monitor the water quality of aquatic body. In this study the positive correlation between pH and *Bulinus* and *Melanoides* is consistent with Rowel *et al*. [20]. The negative correlation with *Biomphalaria* and *Lymnaea* does also exist [18,19]. However, the pH value recorded in this study falls within the tolerance limit and may have been favorable for the development of the snail. Salinity had a significant positive correlation with *Lymnaea* and *Melanoides* and a significant correlation with *Biomphalaria.* Njoku et al. [15] has also reported that there is a relationship between snail species and physicochemical parameters.

The sympatry correlation between *snail and snail is* in line with Usman's *et al*. account [15]. *Melanoides* has been described as an invasive snail that out numbers all other snails when found associating with other snails [7]. However, the negative correlation between *Lymnaea, Biomphalaria* and *Melanoides* in this study is an indication that there is competition for natural resources among the three snail species. Similar observation has been made by Opeyemi and Odaibo [18].

5. Conclusions

This study suggests that snail species vary in population and growth in relation to the physicochemical characteristics of the water body of the sampling location. The presence of *Bulinus globusus, Biomphalaria pfeifferi* and *Lymnaea natalensis* in the Amassoma community and Niger Delta University campuses is an indication that there is going to be the possibility of urinary, and intestinal schistosomiasis as well as fascioliasis in the study location. To prevent the snails from spreading further, the government should build functional drainage systems in the Amassoma village and Niger Delta University campuses.

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