ECOLOGICAL SURVEY OF FRESHWATER ECOSYSTEMS OF OVIA, EDO STATE NIGERIA FOR GASTROPOD MOLLUSCS

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ABSTRACT

The survey for freshwater snails in streams, rivers and a lake in Ovia Southwest LGA of Edo State, Nigeria was carried out from June to November, 2013. Samples were collected by using sweep-net and by hand picking of snails within the open water habitat, at marginal areas and on submerged vegetation at edges of the habitats. A total number of 579 individual snails belonging to 6 families, Ampullariidae (Lanistes varicus), Mutelidae (Aspatharia subreniformis), Thiaridae (Melanoides tuberculata), Bulimlidae (Bulimulus teniussimus, Drymaeus multilineatus), Bithyniidae (Gabbiella humerosa), Hygrniidae (Monacha catiana) were collected. In terms of number and distribution, the Lanistes varicus was the most dominant species consisting of 258(44.6%) of the total number of snails collected. 330(56.9%) number of snails were collected from the open water, 209(36.1%) in the marginal areas and 40(6.9%) on submerged vegetation.

Keywords: Freshwater snails, *Ampullariidae, Mutelidae, Thiaridae, Bulimlidae, Bithyniidae, Hygrniidae,* Submerged vegetation, Ovia, Edo State, Nigeria

INTRODUCTION

Freshwater snails belong to a larger group of shelled animals called molluscs. Freshwater, marine and terrestrial snails number well over 50,000 individual species. Most species of freshwater snails originally evolved from saltwater habitats, although, several species evolved from terrestrial habitats to freshwater. Snails usually play a dominant role in the ecology of freshwaters by providing food for many other animals and by grazing on vast amounts of algae and detritus (Hayes, 2009). They are critical to the normal ecological processes in aquatic habitats. Their unusual common names such as; banded mystery snail, apple snail, pagoda slit snail, knob mudailia, rough horn snail, interrupted rock snail, among many others often belie their importance as a food source to other aquatic animals and as indicators of water quality (Ndifon, 1980). Snail populations are known to vary in seasons and are under the control of climate. This macro distribution of gastropods in freshwater systems has been the subject of many surveys. In most habitats, distribution has been found to be limited by climatic factors such as rain and drought. For this reason, species will probably fail to colonize some habitats while in some other similar habitats, they may be abundant. It is therefore very important 'that factors of the environment that affects macro distribution of gastropods in any environment are investigated and used to understand the biological interaction between the habitats. Freshwater snail fauna of some rivers and lakes in the tropics especially in Nigeria have been studied by several authors (Iheagwan and Okafor, 1984; Imafidon, 1991; Emejulu *et al.,* 1992; Hurst and Meyernus, 1993; Agi, 1995; Owojori *et al.,* 2006). These studies recorded high level of species richness, low density and

considerable heterogeneity in richness and species composition in the different habitats studied. However, there is paucity of information on the freshwater snail species of water bodies within Ovia Southwest Local Government Area of Edo State Nigeria. This study is focused on the identification and distribution of freshwater snails in Ovia Southwest Local Government Area of Edo States in order to provide information on the various types of freshwater snails in water bodies in four different villages which include Ikpoba River and Odighi Lake (Udo village), Ovia River (Iguoriakhi), Atoe River (Ikoka Village) and to assess the distribution and relative abundance of the freshwater snail species within these habitats.

MATERIALS AND METHODS

Study Area: The study was carried out in four water bodies of Ovia Southwest Local Government Area. The water bodies include Ikpoba River (WB1) and Odighi Lake (WB2) (Udo Village), Atoe River (WB3) (Ikoka Village), Ovia River (WB4) (Iguoriakhi Village). The study covered an area of 2,803 sqkm with population of 135,356 (NPC, 2006). Ovia Southwest Local Government Area lies between latitude $7^{0}30'$N and $7^{o}15'$N and longitude $6^{0}30'$E and $6^{o}25'$N (Figure 1).

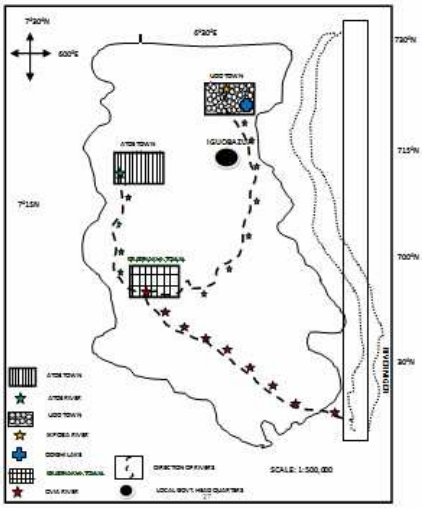

Figure 1: Map of Ovia Southwest Local Government Area showing the aquatic snails sampling sites. Source: Anon (2013)

The inhabitants of these communities rely on the rivers and the lake for various activities including fishing and bathing. The major occupation of the people is farming, producing large scale quantities of melon, maize, rubber and oil palm.

Aquatic Snail Sampling: Sampling of snails was carried out from June to November 2013 in three rivers and a lake. Sampling at each site was done using sweep net for snails in the open water, while along the banks of the water bodies and on submerged vegetation were handpicked. Collection of snails was done fortnightly. The measure of diversity used is the overall species richness was obtained by dividing the total number of species recorded by the mean number of individual species collected (Simpson Index of Diversity). Two sampling techniques were used, namely the hand-net method described by Hairston *et al.* (1958) as adapted by Asumu (1985), Ndifon (1980) and Okafor (1984; 1990) and hand picking technique described by Ofoezie *et al.* (1991). All snails seen on the hand net were collected and taken to the laboratory in pre-labeled wide mouthed plastic containers with perforated lid and containing damp decayed vegetation (DBL, 1973; Brown, 1994) and snails were counted and preserved in 10% formalin. The identification was carried out using standard identification keys (Mandahi-Barth, 1957; DBL, 1973; Brown, 1994). Microscopic examinations were carried out on the individual snail species and the heads of some snails were processed and examined for their radulae.

Physico-chemical Characteristics of the Water Bodies: Air and water temperature, pH, Alkalinity, DO, BOD, Transparency of the water bodies were examined following the methods seen in APHA (2005).

Statistical Analysis: The results were coded, analysed using the Statistical Packages for Social Sciences (SPSS Version 17) software. Data collected were presented in frequency tables and percentages. Other analytical tools deployed include the Chi-square, ANOVA (used to test for level of significant differences in

spatial and temporal variations), Correlation, Shannon-Weiner index ($H = -\sum[(p_i) \times \ln(p_i)]$), Simpson's index was used to compute diversity and dominance within the collected snail species. Values of $p<0.05$ was considered significant for all computations in this study.

RESULTS

A total of 579 individual snails were collected from four different water bodies in this study between the months of June to November 2013. The snail species collected were *Lanistes varicus* 258(44.6%), *Melanoides tuberculata* 82(14.2%), *Gabbiella humerosa* 48(8.3%), *Bulimulus teniussimus* 2(0.3%), *Monacha cantiana* 65(11.2%), *Drymaetus multilineatus* 65(11.2%) and a bivalve species *Aspatharia subreniformis* 59(10.2%) (Table 1).

The monthly distribution and abundance of the snail species indicated that *Lanistes varicus* (258) increasingly dominated throughout the study period, while *Bulimulus teniussimus* had the least number throughout the study (Table 2). There was a progressive decrease in the number of snails collected from the onset of the study, except for *Lanistes varicus* where there was an appreciable increase from August to September and decreased thereafter (Table 2).

Simpson's Index analysis of snail species collected indicated that *Lanistes varicus* was the most dominant species (ST 0.198). The other species in order of increasing dominance were as follows: *Melanoides tuberculata* (ST 0.0198), *Aspatharia subreniformis* (ST 0.010) *Monacha cantiana* (ST 0.012), *Drymaeus multilineatus* (ST 0.012), *Gabbiella humerosa* (ST 0.007) and *Bulimulus tenuissimus* (ST 0.000) (Table 3).

The distribution of snails in the various sites indicating specific abundance at marginal, open water and submerged vegetation of the water bodies sampled showed that with regards to the marginal area, snail collection was highest at Ovia River and least at Atoe River. The open water area had 106 species found in Ikpoba river with the least being 74 at Odighi lake. Submerged vegetation recorded 22 at Ovia River, while Odighi Lake had no occurrence (Table 4). Analysis of variance (ANOVA) showed that snail distribution in the four sites was not significantly different ($p>0.05$).

Physico-Chemical Parameters: Water samples from each of the water bodies were analyzed for some physico-chemical properties that may be influencing the ecology of the study area. The data collected is shown in Table 5. The result of analysis of the data using correlation coefficient indicated a negative correlation of the physico-chemical factors with the snail abundance revealing an inverse relationship between snail abundance and physico-chemical factors. Analysis of variance (ANOVA) revealed no statistical difference ($p>0.05$) in the environmental conditions of the water bodies throughout the study (Table 6). The mean abundance of snail in relation to the water bodies reveals a domineering peak in WB4 with a decrease from WB1 to WB2 and slight increase from WB2 to WB3 (Figure 2), while the snail abundance in relation to the monthly collection showed that snail abundance was peaked in June, almost constant between July and August and decreased progressively in October to November (Figure 3).

DISCUSSION

The survey showed that snail species were commonly found in areas that have human contacts and activities such as farming, lumbering, fishing and swimming. The indigenes were equally seen using the water for domestic purposes like washing of clothes and dishes, etc. From this study, Ikpoba River and Ovia River were found to have higher population of snails. The dominant snail species encountered in this study was *Lanistes varicus* which accounted for 44.6%. This is in agreement with Omudu and Iyough (2005) who reported 44.78% in the ecological studies of gastropod fauna of River Benue, it was higher than the 25% reported by Imafidon (1991) in a similar study at Ibadan. Analysis of snail occurrence in relation to the physico-chemical parameters showed variations in different physico-chemical factors similar to the findings of Fashuyi (1979).

Table 1: Number of different species of snails collected from the four sites investigated between June – November, 2013 in Ovia Southwest LGA, Edo State, Nigeria

Snail Species	Ikpoba River	Atoe River	Odighi Lake	Ovia River	Total	Percentage
Lanistes varicus	104	36	62	56	258	44.6%
Melanoides tuberculata	0	82	0	0	82	14.2%
Gabbiella humerosa	48	0	0	0	48	8.3%
Aspatharia subreniformis	0	0	0	59	59	10.2%
Bulimulus teniussimus	0	2	0	0	2	0.3%
Monach cantiana	0	0	65	0	65	11.2%
Drymaeus multilineatus	0	0	0	65	65	1I.2%
Total	152	118	127	180	597	100%

Table 2: Total number of different individual snail species collected per month between June – November, 2013 in Ovia Southwest LGA, Edo State, Nigeria

Snail Species	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Total
Lanistes varicus	85	35	44	67	14	13	258
Melanoides tuberculata	0	34	40	0	0	8	82
Gabbiella humerosa	26	0	0	22	0	0	48
Aspatharia subreniformis	0	27	27	0	0	5	59
Bulimulus teniussimus	0	2	0	0	0	0	2
Monach cantiana	37	0	0	18	10	0	65
Drymaeus multilineatus	0	33	23	0	0	9	65
Total	148	131	134	107	24	35	579

Table 3: Simpson's Index of dominance for snail species collected between June – November, 2013 in Ovia Southwest LGA, Edo State, Nigeria

Snail Species	Number (n)	n(n – 1)	Simpson's Index of Dominance
Lanistes varicus	258	66306	ST 0.198
Melanoides tuberculata	82	6642	ST 0.0198
Gabbiella humerosa	49	2352	ST 0.007
Aspatharia subreniformis	59	3422	ST 0.010
Bulimulus teniussimus	2	2	ST 0.000
Monach cantiana	65	4160	ST 0.012
Drymaeus multilineatus	65	4160	ST 0.012
Total	579	87044	ST 0.2588

Table 4: Total number of snails collected in the marginal area, open water and vegetation across the four sites

Sampled rivers	Marginal Area	Open Water	Submerged Vegetation	Total
Ikpoba (WB1)	49	106	3	158
Atoe (WB2)	34	81	15	130
Odighi (WB3)	53	74	0	127
Ovia (WB4)	57	85	22	164
Total	193	346	40	579

Table 5: Correlation analysis of factors affecting snail abundance

Variable	Coefficient	Std. Error	T	P>|t|	[95% Conf. Interval]	
Air Temperature (0°C)	-25.04	8.83	-2.84	0.047	-49.5562	-0.5308
Water Temperature (0°C)	-31.71	8.99	-3.53	0.024	-56.6811	-6.7343
pH	-42.57	9.84	-4.33	0.012	-69.8905	-15.2584
Alkalinity (mg/l)	-13.57	2.29	-5.93	0.004	-19.919	-7.2217
DO (mg/l)	-47.98	14.89	-3.22	0.032	-89.3131	-6.6560
BOD (mg/l)	-34.59	6.71	-5.16	0.007	-53.2160	-15.9618
constant	947.32	241.66	3.92	0.017	276.3629	1618.283

Table 6: A summary of the physico-chemical conditions of the water bodies from June – November 2013

Parameters	Range		Mean	P-value
	Minimum	Maximum		
Air temperature (°C)	26.00	31.00	28.50 ± 1.44	0.929
Water temperature (°C)	25.00	29.00	27.00 ± 1.15	0.552
pH	6.05	8.95	7.50 ± 0.83	0.213
Alkalinity (mg/l)	10.00	20.00	15.00 ± 2.88	0.562
DO (mg/l)	2.50	5.00	3.75 ± 0.72	0.655
BOD (mg/l)	0.80	4.30	2.55 ± 1.01	0.855

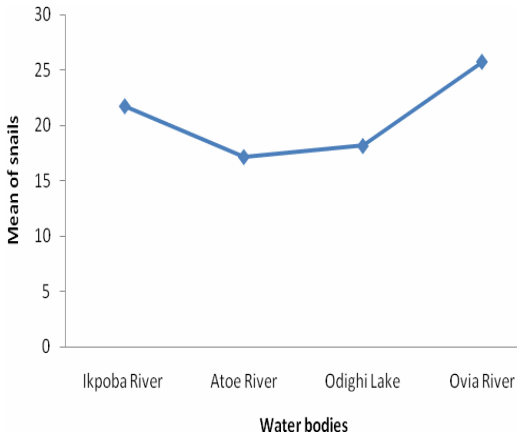

Figure 2: Snail abundance in relation to the water bodies sampled

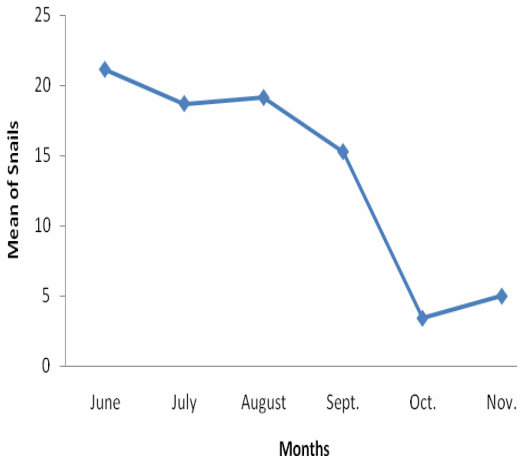

Figure 3: Snail abundance in relation to the monthly collections

High temperature causes thermal stress in snail vectors (Hofkins *et al.*, 1991) and also reduces dissolved oxygen content of water bodies. Most of the snails recorded in the study tolerated the average temperature (air temperature 28^{0}C, water temperature 27.2^{0}C) in the natural habitats. In this study, dissolved oxygen ranged from 2.5mg/l – 5.0 mg/l and it varied with sampling periods and the water body and was similar to the findings of Hira (1970). The minimum and maximum pH values were 7.49 and 8.60 and fell within the WHO permissible limits (WHO, 1990) indicating that pH is optimal for these snails thus corroborating the report of Njoku-Tony (2007). Alkalinity is a measure of the acid-neutralizing capacity of water and in most natural waters; it is due to the presence of carbonates (CO_3^-), bicarbonates (HCO_3^-) and hydroxyl (OH^-) anions. Alkalinity ranged between 4.4 and 17.8 mg/l and this value falls within the permissible limits of standards (WHO, 1990). In this study, the maximum and the minimum alkaline values were 10 and 20 showing that alkalinity of the water bodies had effects on the distribution of snails thereby causing reduction of snail's abundance. Imevbore (1983) reported that contamination of water with faeces increase BOD level because it contains mainly organic matters, which make oxygen less available thereby decreasing the numbers of organisms. In this study the BOD of rivers Ovia and Ikpoba ranged between 0.8 and 2.0 mg/l which enhanced the distribution and abundance of snails while Odighi Lake and Atoe River had high BOD ranging from 2.8 to 4.3 mg/l leading to a marked reduction in number of snails. The physico-chemical parameters across each river and lake showed no significant difference indicating that snails found were more tolerant and adapted to a reasonable range of physico-chemical conditions. Similar conclusions were drawn by Agi (1995), Agi and Okwuosa (2001), Owojori *et al.* (2006) in their studies.

This work revealed that high density of snail species populations were encountered in the open water area which may have been influenced by an unexplained abundance of aquatic macrophyes in the open waters in this area. Snail abundance was typically high during

the rains. This finding is consistent with Akufongwe *et al.* (1995) who attributed the increase of snail population at the onset of rains. It is important to note the finding in these water bodies of arboreal snail species - *Drymaeus* and *Bulimulus* species in Ovia River

The findings of this study have revealed that the water bodies of Ovia Southwest LGA are good habitats for freshwater snails. The physico-chemical qualities of these water bodies are conducive for optimum distribution and abundance of snail species. The absence of snails of medical importance in the rivers and lake poses no threat to environmental health of the area, but given the species abundance and diversity, snail ecologists should keep a watchful eye by conducting frequent surveys there for possible incursion of trematode intermediate snail hosts.

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