FRESHWATER SNAILS OF NIGER-CEM, NKALAGU EASTERN NIGERIA: OBSERVATIONS ON SOME DEMOGRAPHIC ASPECTS OF THE SCHISTOSOME-TRANSMITTING BULINIDS

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ABSTRACT

The results of snail collections carried out in the freshwater habitats of Niger-Cem in Nkalagu from August to November 2002 are reported. Also reported are findings on abundance, diversity and age structure of the snails. A total of 3491 pulmonate snails were collected, belonging to 3 families: Planorbidae (3133); Lymnaeidae (199) and Ampullariidae (159). Bulinus globosus was most abundant, with mean abundance (MA = 627.66) followed by B. truncatus (MA = 294) and Biomphalaria pfeifferi, the least abundant (MA = 6.33). Analysis of the collected snails gave the following: Shannon's index of diversity, H = 1.2889; Simpson's index of dominance, D = 0.3642 and the number of snails per man-hour = 174.6. Age structure findings demonstrated a 'lag' phase in the period of peak abundance between B. globosus and B. truncatus. Findings on the reproductive to pre-reproductive (R/P) ratios, suggest similar demographic strategies for the two buliniid mollusc species.

Keywords: Abundance, Diversity, Demographic Strategy, *Bulinus globosus*, *Bulinus truncatus*

INTRODUCTION

Papers on freshwater snails, especially those of medical and veterinary importance in Nkalagu, Eastern Nigeria, are about a decade old: Anya and Okafor (1986), Okafor (1990a,b), Okafor (1991), Okafor and Anya (1991). These studies showed that Niger-Cem was a major focus for transmission of urinary schistosomiasis and that *B. globosus* was the intermediate host snail actively involved in the disease cycle. *Bulinus truncatus* was consistently absent from the previous surveys. Recent observations have recorded the coexistence of this mollusc with *B. globosus* in marshy pools at Niger-Cem.

This is a cause for concern given that this mollusc is currently transmitting the infection in some parts of Eastern Nigeria, notably the Amagunze and Agulu lake environs (Ozumba *et al.,* 1989; Emejulu *et al.,* 1994). This study was, therefore, undertaken to provide: (1) an update on the freshwater snails of medical and veterinary importance and (2), to determine the abundance and demographic strategy of *B. truncatus* vis-à-vis *B. globosus* in the Niger-Cem locality.

MATERIALS AND METHODS

Study Area: The study area is located in Nkalagu lying in the Guinea savannah zone between latitudes $6^0 25^1$ to $6^0 35^1$ N and longitudes $7^0 45^1$ to $7^0\ 55^1$ E (Anya and Okafor, 1986) in the present Ebonyi State in Eastern Nigeria.

Snail Collections: The molluscs were collected from three representative habitats (2 marshy pools, 1 pond and 1 quarry lake). The collection was done, using a plastic kitchen strainer (Ratard and Greer, 1991) of pore size 1.2 x 1.2 mm. Four collections were made, each for the months of August, September, October and November 2002. The snails were identified by shell morphology as in the Danish Bilharziasis Laboratory (DBL) Denmark, reference snails.

Demographic Studies: The monthly collections were summed up to obtain the grand total from which percentage compositions by species were calculated (Kloos *et al.,* 2001). The following parameters were calculated for each species:

Table 1: Fresh water snails from Niger-Cem, Nkalagu with associated population and habitat attributes

Attributes studied	Snail Type							
	B. globosus	***B. truncatus***	***B. senegalensis***	***B. forskalii***	***Biom. pfeifferi***	***Lanistes varicus***	***Lymnaea natalensis***	***Total***
No. Collected	1883	882	288	61	19	159	199	3491
% Collected	53.93	25.26	8.24	1.74	0.54	4.55	5.70	100
Mean Abundance (MA)	627.66	294	96	20.33	6.33	53	66.33	1163.65
Relative Abundance (RA)	1.0	0.46	0.15	0.03	0.01	0.08	0.10	1.83
Habitat type	Marshy Pools	Marshy Pools	Marshy Pools Pond irrigation canals	Marshy Pools ponds irrigation canals	Quarry Lake	Marshy pools		
Associated plants	*Atherna-nthera sessilis Croix lacryma-jobi*	*Lemna* sp	*Panisetum* Rice Maize *Polygonium*	*Panisetum* Rice maize	Algae lichen	Nymphae		
Presence of snail egg masses	Yes	Yes	-	-	-	-	Yes	

Shannon's Index of diversity, H = 1.2889 Simpson's Index of dominance, D = 0.3642. No. of snails collected per man-hour (3491/20) = 174.6

1. mean abundance (MA = total number of individuals/number of collection sites (Sturrock *et al,* 1994);
2. relative abundance (RA = MA for the given species/ MA for the most abundant mollusc (*B. globosus*);
3. Shannon's diversity index [H = $-\sum$ (pi ln pi)]
4. Simpson's index of dominance [D= $\sum$ $(pi)^2$]

The age structures were determined by sorting the molluscs into 3 size classes corresponding to 3 age groups (older, middle aged and young). The ratio of the reproductive to the pre-reproductive snails was also determined, the older molluscs constituting the reproductive, the middle-aged and young, the pre-reproductive.

Table 2: Age structure of two freshwater gastropods from Niger-Cem Nkalagu

Age Group	Size class	No. Collected	% Composition
		B. globosus	
Older snails	11 – 15mm	330	17.52
Middle-aged snails	6 – 10mm	1060	56.29
Young snails	< 6mm	493	26.18
R/P ratio [a]		330/1553 (0.21)	
		B. truncatus	
Older snails	12 – 17mm	154	18.73
Middle-aged snails	7 – 11mm	274	33.33
Young snails	< 7mm	394	47.93
R/P ratio [a]		154/668 (0.23)	

[a]- R/P ratio = ratio of the reproductive to the pre-reproductive snails.

RESULTS

Demographic Findings on Snails: Seven freshwater gastropods species were collected, 5 planorbids, 1 lymnaeid and 1 ampullariid. The planorbids include: *Bulinus globosus* (Morelet); *Bulinus truncatus* (Audouin); *Bulinus senegalensis* (Müller); *Bulinus forskalii* (Ehrenberg) and *Biompbalaria pfeifferi (*Krauss). The other 2 were *Lymnaea natalensis* (Krauss) and *Lanistes varicus* (Morelet). Snail collections

were as follows: 342 in August (9.79%): 702 in September (20.1%); 1049 in October (30.04%) and 1398 in November (40.04%). Ova were seen at the sites in August and early September. *B. globosus* was the most abundant (1883 individuals), followed by *B. truncatus* (882) individuals). *Biomphalaria pfeiffer*i being the least (19 individuals). It was observed that *Lanistes varicus* coexists with both *B. globosus* and *B. truncatus*. But over 90% of these molluscs were collected from *B. truncatus* microhabitats. *B. truncatus* tended to inhabit more eutrophic parts of the habitats alongside *L. varicus*, whereas *B. globosus* appear to prefer the less eutrophic zones. While the bulinids were most often found immersed and attached to submerged vegetation and decaying organic matter, the lymnaeids seemed to prefer peripheral sites of the water bodies (Table 1). Table 2 shows a pyramidal structure for *B truncatus*, which is suggestive of an expanding population. That of *B globosus* is rather urn-shaped, suggestive of a dying population. The older snails are considered to constitute the reproductive while the middle – aged and young snails, the pre- reproductive age classes.

DISCUSSION

Snail collection findings agree fairly well with those of Anya and Okafor (1986), especially as concerns potential schistosome intermediate hosts in this locality. The absence of some molluscs in this study as opposed to the former studies was due to the fact that the present collections were limited in both time and space. Despite this, the present study reports a greater abundance of snails than is suggested by all previous ones (Anya and Okafor, 1986; Okafor, 1990a; Okafor and Anya, 1991). Although 10 sites were sampled in the previous studies and only 3 in the present, there is a remarkable difference in site abundance of 627 (present) and (41 and 45) (calculated) for 1981 and 1982, respectively and during the same month of the year (Okafor, 1990a). This suggests, therefore, that *B globosus* has undergone a massive increase in population between 1990 and 2002. This situation suggests that neglect of snail control in previous disease control efforts should be redressed. Earlier studies such as those of Noda *et al*. (1990) and Woolhouse and Chandiwana (1989) demonstrated that rainfall has a distinct influence on the densities of *B. globosus.* It would appear that the increase in absolute numbers of the snails found in the present study, can also be explained by the logic of inter-decadal influence of precipitation and temperature on snail numbers thus corroborating the assertions of Githeko *et al. (*2000). Hence, the simulation model of Woolhouse and Chandiwana (1990) which predicated fluctuations in *B globosus* numbers of over 2 orders of magnitude over time-scales of 10 years or more, fits the present findings. *B truncatus* was also isolated but not as abundant as *B. globosus.*

The occurrence of the *Bulinus forskalii*-group snails *B. forskalii* and *B. senegalensis* in a pond at Ezilo and also at Niger-Cem confirms earlier reports of Anya and Okafor (1986) and Okafor (1990a), that these two were often found associated with one other. Greer *et al.* (1990) reported same finding in Cameroon. Both snails had earlier been shown not to be transmitting the infection in this locality (Anya and Okafor, 1986).

There is a high potential for intensification of transmission of schistosomiasis in this area in the future given the occurrence of *B. truncatus* as well. This follows from the likelihood of a chanced introduction of parasite strains compatible with the snails. The increase in snail density only goes to further enhance such a chance encounter. Such is believed to be the case in the Middle Valley of the Senegal River Basin (SRB), where recent data have demonstrated that the occurrence of *S. haematobium* larvae correlates with snail abundance. Also in the Cameroon's Ratard and Greer (1991) reported a new focus of *S. haematobium / S. intercalatum* hybrid in Kinding Njabi, arising as a chanced introduction of the hybrid schistosome from Loum town. Therefore, even if the Niger-Cem *B truncatus* is not transmitting currently, given their abundance, chanced introduction of the compatible parasite strains possibly from Amagunze or Agulu or from both communities could at some future time be of epidemiological significance.

The age structure findings agree generally with those of Okafor and Anya (1991) on *B globosus.* They equally apply to *B truncatus,* broadly speaking. However, there are slight variations as can be deduced from Table 2. For instance, the similarity in percentage composition of the older snails (17.52 %) for *B globosus and* (18.73 %) for *B truncatus* as well as the R/P ratios 0.21 and 0.23, respectively for *B. globosus* and *B. truncatus* are pointers to the fact that both species have similar demographic patterns. The variations arise when the percentage

compositions of the middle-aged and young snails are compared between the species (Table 2) being 56.29 as against 33.33 respectively for *B globosus* and *B truncatus* with respect to the middle–aged age group at the same time of the year. This indicates that at any point in time in the course of this study, a higher percentage of young snails were graduating from that age-group into the middle-aged age group. And the finding that only 26.18% of the young snails were present in the age structure for *B globosus* as opposed to 47.93 % for *B truncatus* suggests that reproductive activity in the latter species started later than in the former. It therefore appears that there is a 'lag phase' between the period of peak reproduction in *B globosus* and that of *B. truncatus* in these habitats, the *B. truncatus* peaks *coinciding* somewhat with the *B. globosus* depressions. By the same token, peak abundance of *B. truncatus* is expected to lag behind that of *B. globosus.* This appears to have been borne out in the field where the October and November collections of *B. truncatus* were markedly heavier than those of August and September, contrary to *B. globosus* where the differences were not so obvious

Okafor (1990a), has proposed that snail control be included as part of the overall plan of schistosomiasis control and that for these stagnant water habitats, molluscicide against *B. globosus* be timed to begin in the middle of the rainy season (June – August) apparently to coincide with the July peak abundance of this species. Given the findings in this study it is suggested that the period of peak abundance of *B. truncatus* may occur later than for *B. globosus.* Thus there is need to investigate the field age structure of *B. truncatus* as has been done for *B globosus*. The resultant information would enable proper timing of molluscicding in this locality with a view to obtaining effective control of both species of snails.

Conclusion: The findings as reported indicate that there has been an emergence of *Bulinus truncatus* and a massive increase in the population of *Bulinus globosus* in the Niger-Cem locality in recent years.

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