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DISTRIBUTION OF FRESHWATER SNAILS WITH SPECIAL REFERENCE TO SCHISTOSOMIASIS INTERMEDIATE HOST IN EL-GENAID SUGAR CANE FARM, CENTRAL SUDAN

Nagla Gasmelseed¹, Ahmed Babiker²

¹ Institute of Nuclear Medicine Molecular Biology and Oncology, University of Gezira, Wad Medani

² Tropical Medicine Research Institute, National Research Centre, Khartoum

ABSTRACT

Several sugar cane factories for production of sugar in the Sudan. To each of these factories, a sugar cane farm was attached. Snail distribution, and specially distribution of the intermediate host snails of schistosomiasis, in the cane farms, in the Sudan, was never studied. The study was carried out from February 1995 to May 1996. The objectives is to study on the distribution of fresh water snails in a sugar cane farm in the Sudan, To determine the distribution of the different species seasonally in the canalization system of the sugar cane farm, with special reference to schistosomiasis intermediate host snails. Twenty scoops were taken at each sampling site during the monthly visits. Snails were identified to the species level intermediate host snails were screened for patent infection. The canalization system farm is a suitable habitat for fresh water snails. Seven species of snails are found in the canals. The prosobranchs snails, Cleopatra and Melanoides, dominate all other species.

Snail species show marked variation between the canals and in the monthly distribution. The density of all snail species drops during the rainy season.

Environmental factors; such as water flow, water level and density of vegetation; do no effect the distribution of the fresh water snails in the canalization system. The reproduction of *B. pfeifferi* snails in Algenaid farm has been affected by unknown factors which need further investigation to determine the reasons. There is the possibility of a shift from *S. mansoni* to *S. haematobium*.

INTRODUCTION

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Schistosomiasis is a parasitic disease of man and mammals in tropical and subtropical areas. Human schistosomiasis is one of the most wide-spread parasitic diseases. It is second only to malaria in terms of socio-economic and public health importance (WHO, 1985; Doumenge et al., 1987). It is a disease due to host immunological responses stimulated around eggs in different tissues (Jordan & Webbe, 1982). It imposes its hazardous impact on health and the economy through the ease with which it is rapidly disseminated without giving rise to alarming signs and symptoms. It was estimated that 200 to 300 million persons are infected with schistosomiasis; and another 500-600 million persons are at risk of infection (Doumenge et al., 1987; Goldsmith, 1991; WHO, 2002). Malek (1962) and Brown (1980) named a number of gastropods common in the African countries. The medically important ones are: *B. pfeifferi*, *B. truncatus*, *B. rohlfsi* and *B. globosus*. In the Sudan, several malacological surveys were conducted to elucidate the distribution of intermediate snail hosts for both *S. mansoni* and *S. haematobium*. The distribution of relevant snail species was found to be rather patchy. Various physical environmental factors have considerable influence on the distribution of schistosomiasis snail hosts, but the availability of surface water seems to be the key factor (Sulaiman & Ibrahim, 1988).

Several sugar cane factories for production of sugar in the Sudan. To each of these factories, a sugar cane farm was attached. Snail distribution, and specially distribution of the intermediate host snails of schistosomiasis, in the cane farms, in the Sudan, was never studied. The study was carried out from February 1995 to May 1996.

OBJECTIVES

- To study on the distribution of fresh water snails in a sugar cane farm in the Sudan,
- To determine the distribution of the different species seasonally in the canalization system of the sugar cane farm, with special reference to schistosomiasis intermediate host snails.

THE STUDY AREA

ALGENAID SUGAR CANE SCHEME

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Algenaid Scheme is the first scheme for sugar cane production in the Sudan. It started production in 1962/63. A sugar cane farm (the farm) and a factory for sugar production. It lies on the eastern bank of the Blue Nile River 140 km to the south of Khartoum. The area is a flat land with a gentle slope towards the north. The total area of the farm is 40,000 acres. Temperature ranges between 25C in December and 45C in May. The annual rainfall ranges between 200-300 mm per year and is maximum from July to September. Irrigation by gravity through a network of open mud-lined canals. The canalization system consists of : one main, two major and 23 minor canals. The fields are irrigated continuously for 14-16 months before the canes are harvested.

Sampling Sites

The take-off and the tail ends of the minor canals , the area round the sluice gates , small crossings (bridges) along these minor canals.

MATERIALS & METHODS

Twenty scoops were taken at each sampling site during the monthly visits. Snails were identified to the species level, Intermediate host snails were screened for patent infection , Intermediate host snails were measured and categorized into three groups, small medium and large

At each site, the following were noted and recorded: water velocity, water depth and density of vegetation.

RESULTS

The following species of snails were collected from the study area

B. pfeifferi the intermediate host snail of *S. mansoni*. *B. truncatus* the intermediate host snail of *S. haematobium*. *Lymnaea natalensis*, *Cleopatra bulimoides* , *Lanistes carinatus* , *Melanoides tuberculata* and *Bivalve snails*.

1.DISTRIBUTION OF NON-SCHISTOSOME TRANSMITTING SNAILS

The prosobranchs species, Lanestis, Cleopatra and Melanoides dominated all other species in all canals during the whole period of observation. The pulmonate snails dominated the bivalve snails during most of the study period. All species showed marked reduction in their numbers during July-October.

The monthly distribution, during the study period, of non-schistosome transmitting snails is shown in Fig 1. All non-schistosome transmitting snails showed marked fluctuation in their densities from month to month. Cleopatra snails dominated all snail species and were found throughout the observation period. High numbers of non-schistosome transmitting snails were found in April June and November. There was no significant difference ($P > 0.05$) in the distribution of the different species between the nine canals, but the monthly distribution of the different species was highly significant ($P < 0.001$) (Table 1).

All non-schistosome snail species were found in large numbers in areas of dense vegetation. It seems that the prosobranchs prefer the stretches of the canal with good flow, whereas Lymnaea and bivalves prefer areas with slow moving water. In high water levels, the prosobranchs were found in high numbers. However, there was no significant difference ($P > 0.05$) in the distribution of snails due to any of the environmental factors, or in the number of the different non-schistosome snail species due to these factors.

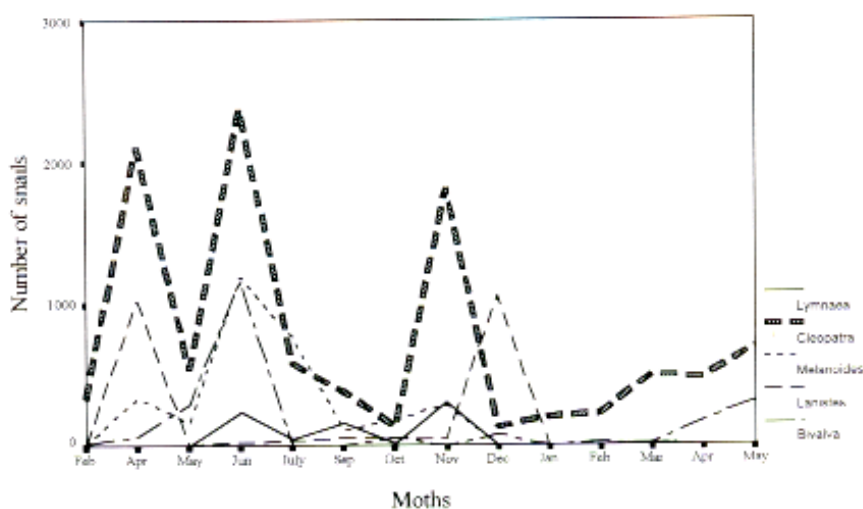


Fig. 1 :Distribution of Non-schistosome Transmitting Snails

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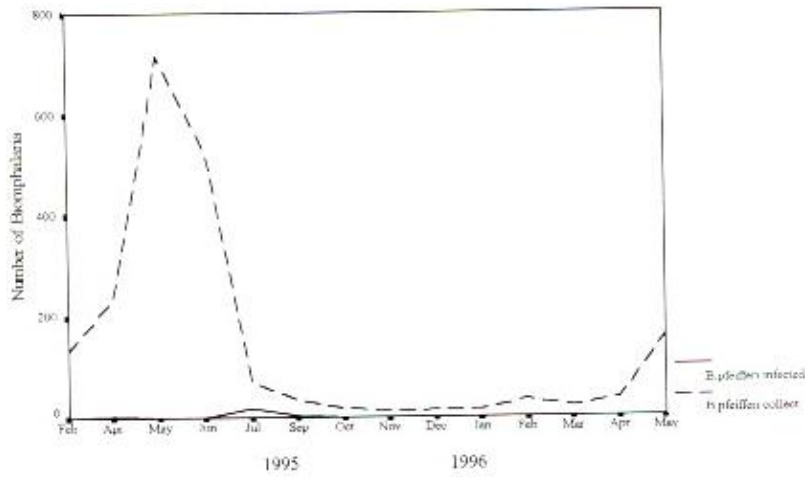
by Month, Algenaid Sugar Cane Farm, February 1995 to May 1996

2. DISTRIBUTION OF SCHISTOSOME TRANSMITTING SNAILS

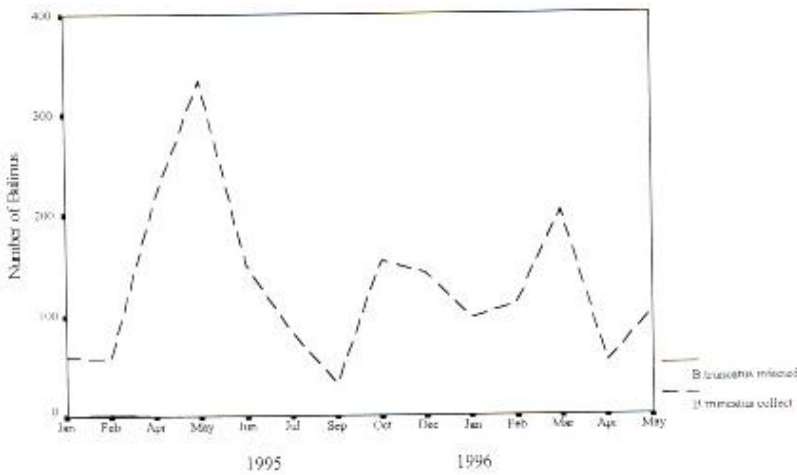
The monthly distribution of the two intermediate host snails is shown in Table 3 and Fig. 2. Snails were found throughout the observation period. The density of *B. pfeifferi* started to decrease from June 1995 and remained very low until May 1996 when they started to increase again. *B. truncatus* showed a marked reduction from July to October 1995 and then it started to increase, with clear fluctuations between October 1995 and May 1996 and a marked peak in March 1996.

During the hot months, April/June 1995, 3 *B. pfeifferi* and 2 *B. truncatus* snails were found infected with *S. mansoni* and *S. haematobium* respectively. Surprisingly, 19 *B. pfeifferi* snails were found during July when snail numbers were usually very low and temperature was relatively low. The remaining infected *B. pfeifferi* snails were found during September (4 snails) and November 1995 (1 snail). During the observation period in 1996, no infected *B. pfeifferi* snails were found, but 2 infected *B. truncatus* were found in February and May 1996. There was no significant difference between the density of the 2 snail species or in the monthly distribution of the two intermediate host snails ($P > 0.05$).

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A. B. pfeifferi



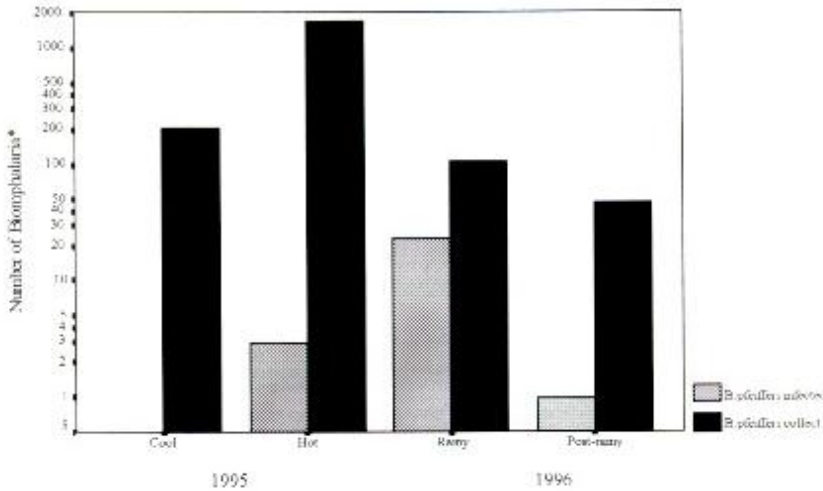
B. B. truncatus

Fig. 2 :Distribution of Schistosome Transmitting Snails and Number Infected by Month, Algenaid Sugar Cane Farm, February 1995 - May 1996

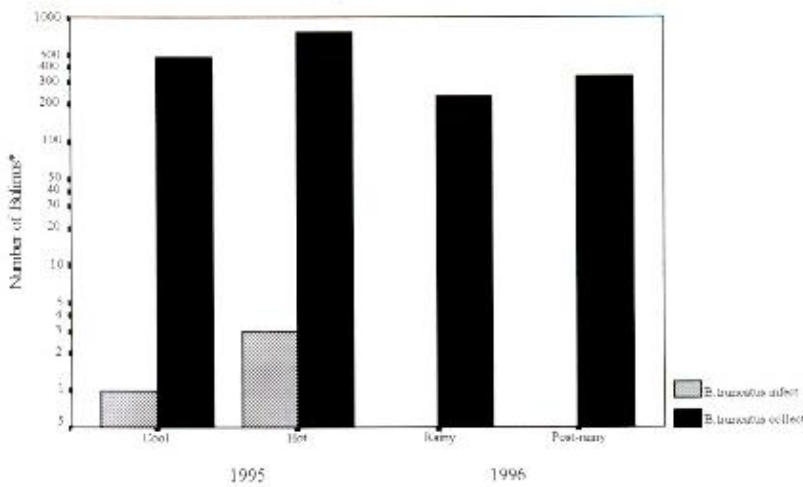
The number of the intermediate host snails increased during hot season. During the rainy season, *B. pfeifferi* snails decreased in number and another decrease was observed during the post-rainy season, but the *B. truncatus* snails increased after the rainy season. The majority of the infected *B. truncatus* snails (3 out of 4 snails) were found during the post-rainy season, whereas the majority of the infected *B. pfeifferi* snails (23 out of 27 snails) were found during the rainy season. The statistical analysis indicated that the distribution of

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the 2 species (number of infected snails not included) in the 4 seasons was not significant ($P > 0.05$). The analysis showed also that the 2 species were not significantly different in their distribution in the different seasons ($P > 0.05$).



A. B. pfeifferi



B. B. truncatus

Fig. 3 : Distribution of Schistosome Transmitting Snails and Number Infected by Season, Algenaid Sugar Cane Farm, February 1995 - May 1996

DISCUSSION

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The present study proved that the canalization system, in Algenaid farm, to be a good habitat for all fresh water snails. Seven snail species were found in all minor canals. The snail species found belong to three different orders, namely, Prosobranchia (3 genera), Pulmonata (3 genera) and Bivalves (one genus). The prosobranchs snails dominated all other snails in the canals and throughout the observation period. It seems that the environmental factors; such as water flow, water level and density of vegetation; have no effect in the distribution of the fresh water snails in the canalization system. This is in contrast to the conclusions of Madsen et al. (1988) who stated that the density of *B. pfeifferi*; *B. truncatus*; *Cleopatra bulimondes* and *Lanestis carinatus* were positively correlated with the densities of submerged plants in Gezira irrigated scheme. All non-schistosome transmitting snails as well as *B. truncatus*, the intermediate host snail for *S. haematobium*, showed marked variation from month to month. Surprisingly, *B. pfeifferi*, the intermediate host snail for *S. mansoni*, after the rainy season, were very small in number and did not show any variations or increase in the number. The reason for this is not known. The same observation was recorded in Gezira scheme (Babiker, person. comm.). However, this could be due to a number of reasons. It could be due to the herbicides used in the farm, or due to an unknown pollution by chemicals used by the farmers in the plots designated for vegetables in the farm, or due to changes in the water chemistry in the canals. There was no significant difference in the distribution of *B. pfeifferi* or *B. truncatus* snails in the canals which suggests that the canalization system in Algenaid farm is a suitable habitat for the two species.

CONCLUSIONS

This is the first study to be carried out in the Sudan to determine the distribution of fresh water snails in a sugar cane farm. The findings suggest that the distribution of the snails needs more in-depth studies to obtain useful information about the reproduction of

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the different snail species and their interactions. The distribution of *B. pfeifferi* snails and the factors limiting their reproduction needs a closer investigation.

ACKNOWLEDGEMENT

All members of Algenaid sugar Factory

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Table 1: Distribution of Non-schistosome Transmitting Snails by Month, Algenaid Sugar Cane Farm, February 1995 to May 1996

Month	<i>Melanoides</i>	<i>Cleopatra</i>	<i>Lanestis</i>	<i>Lymnaea</i>	<i>Bivalves</i>
February 1995	9 (0.24)	336 (9.08)	7 (0.19)	0 (0.00)	14 (0.38)
March*					
April	338 (9.14)	2105 (56.89)	1024 (27.88)	1 (0.03)	70 (1.89)
May	168 (4.54)	545 (14.73)	6 (0.16)	0 (0.00)	292 (7.89)
June	1196 (32.32)	2384 (64.43)	29 (0.78)	236 (6.38)	1169 (31.59)
July	767 (21.31)	582 (16.17)	35 (0.97)	47 (1.31)	0 (0.00)

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August*					
September	110 (2.97)	377 (10.19)	58 (1.57)	163 (4.41)	0 (0.00)
October	185 (5.00)	135 (3.65)	53 (1.59)	19 (0.51)	61 (1.65)
November	286 (7.73)	1812 (48.97)	47 (1.27)	307 (8.30)	0 (0.00)
December 1995	9 (0.24)	130 (3.51)	1062 (28.70)	0 (0.00)	83 (2.24)
January 1996	4 (0.11)	203 (5.49)	0 (0.00)	0 (0.00)	0 (0.00)
February	0 (0.00)	228 (6.16)	0 (0.00)	0 (0.00)	25 (0.68)
March	21 (0.57)	497 (13.43)	4 (0.11)	12 (0.49)	12 (0.32)
April	0 (0.00)	476 (12.86)	0 (0.00)	0 (0.00)	176 (4.76)
May 1996	0 (0.00)	696 (18.81)	1 (0.03)	0 (0.00)	309 (8.35)
Total	3093	10506	2326	785	2211
<i>Statistical Analysis</i>					
Kruskal-Wallis one-way analysis of variance on mean values : $\chi^2 = 13.0$ df = 13 P > 0.05					
Freidman two-way analysis of variance on the mean values: $\chi^2 = 26.6$ df = 4 P < 0.001					

() = mean per site * Survey not done

Table 2: Distribution of Non-schistosome Transmitting Snails by Season, Algenaid Sugar Cane Farm, February 1995 to May 1996

Season	<i>Melanoides</i>	<i>Cleopatra</i>	<i>Lanestis</i>	<i>Lymnaea</i>	<i>Bivalves</i>
Cold	34 (0.23)	1264 (8.54)	11 (0.07)	18 (0.12)	51 (0.34)
Hot	1702 (9.20)	6206 (33.55)	1059 (5.73)	237 (1.28)	2016 (10.90)
Rainy	877 (11.85)	959 (12.96)	93 (1.26)	210 (2.84)	0 (0.00)
Post-rainy	480 (4.32)	2077 (19.71)	1168 (10.52)	326 (2.94)	144 (1.30)
Total	3093	10506	2325	791	2211
<i>Statistical Analysis</i>					
Kruskal-Wallis one-way analysis of variance on mean values : $\chi^2 = 5.0$ df = 5 P > 0.05					

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Freidman two-way analysis of variance on the mean values: $\chi^2 = 14$ df = 4 P > 0.001

() = mean per site

Table 3: Distribution of the Intermediate Host Snails and Number Infected, Algenaid Sugar Canal Farm by Month, February 1995-May 1996

Canal	No. of Sites	<i>B. pfeifferi</i>		<i>B. truncatus</i>	
		Collected	Infected	Collected	Infected
February 1995	37	132 (3.57)	0 (0.00)	60 (1.62)	0 (0.00)
March*					
April	37	235 (6.35)	3 (0.08)	57 (1.54)	2 (0.05)
May	37	716 (19.35)	0 (0.00)	218 (5.89)	0 (0.00)
June	37	531 (14.35)	0 (0.00)	335 (9.05)	0 (0.00)
July	36	72 (2.00)	19 (0.53)	151 (4.19)	0 (0.00)
August*					
September	37	35 (0.95)	4 (0.11)	84 (2.27)	0 (0.00)
October	37	20 (0.54)	0 (0.00)	32 (0.86)	0 (0.00)
November	37	18 (0.49)	1 (0.03)	155 (4.19)	0 (0.00)
December 1995	37	15 (0.41)	0 (0.00)	142 (3.84)	0 (0.00)
January 1996	37	17 (0.46)	0 (0.00)	97 (2.62)	0 (0.00)
February	37	36 (0.97)	0 (0.00)	112 (3.03)	1 (0.03)
March	37	23 (0.62)	0 (0.00)	204 (5.51)	0 (0.00)
April	37	37 (1.00)	0 (0.00)	53 (1.43)	0 (0.00)
May 1996	37	159 (4.30)	0 (0.00)	103 (2.78)	1 (0.03)
Total	517	2046	27	1803	4
<i>Statistical Analysis</i>					
Kruskal-Wallis one-way analysis of variance on mean values :					
$\chi^2 = 13.0$ df = 13 P > 0.05					
Freidman two-way analysis of variance on the mean values:					
$\chi^2 = 1.4$ df = 1 P > 0.05					

() = mean per site * Survey not done

Table 4: Distribution of the Intermediate Host Snails and Infected Snails, Algenaid Sugar Cane Farm by Season, February 1995-May 1996

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Season	No. of Sites	<i>B. pfeifferi</i>		<i>B. truncatus</i>	
		Collected	Infected	Collected	Infected
Cold	148	132 (3.57)	0 (0.00)	60 (1.62)	1 (0.00)
Hot	185	1482 (13.35)	3 (0.03)	610 (5.50)	3 (0.02)
Rainy	74	107 (1.45)	23 (0.31)	235 (3.18)	0 (0.00)
Post-rainy	111	53 (0.48)	1 (0.01)	329 (2.96)	0 (0.00)
Total	518	2046	27	1803	4

Statistical Analysis

Kruskal-Wallis one-way analysis of variance on mean values :

$$\chi^2 = 5 \quad df = 5 \quad P > 0.05$$

Freidman two-way analysis of variance on the mean values:

$$\chi^2 = 0.00 \quad df = 5 \quad P > 0.05$$

() = mean per site