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EDITORIAL

Distribution of Snails in Elseilate Agricultural Scheme, Khartoum, Sudan.

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Abstract:
The study was carried out in Elseilate Agricultural Scheme, East Nile Province to determine the distribution of snails in the canals. Surveys were conducted during two seasons i.e. March / April 1997 and September / October 1997 using a dip-net scoop from 28 sites. Seven species of snails were found. These were *Bulinus truncatus*, *Bulinus forskalii*, *Biomphalaria pfeifferi*, *Lymnaea natalensis*, *Physa acuta*, *Melanoides tuberculata* and *Cleopatra bulimoides*. The following plant species were also found: Spirogyra sp., Potamogeton nodosus., Typha sp., Cyperus sp., Cynadon dactylon., Cymbopogon sp., Cassia senna., Calotropis procera., Acacia nilotica and Prosopis sp. Most snails species showed high densities during March / April when water in canals was clear compared with September / October season when water was turbid due to the flood season of the Blue Nile. This was particularly so for *B. pfeifferi* and *B. truncatus* which transmit S. mansoni and S. haematobium, respectively. *Cleopatra bulimoides* had a high density during September / October. Snails were observed in this study to have high densities in minor canals and abueshreens. These canals are characterized generally by low currents, low depth and vegetation densities.

مستخلص:
هذه الدراسة نفذت في مشروع السيليت الزراعي ، محلية شرق النيل ولاية الخرطوم لتحديد توزيع الحلزونات في قنوات هذا المشروع. أجريت المسوحات الحلزونية في مارس / أبريل 1997 وسبتمبر / أكتوبر 1997 مستخدمين في ذلك المجرفة. تمت زيارة 28 موقعاً أثناء الفصلين. وجدت سبعة أنواع من الحلزونات في قنوات هذا المشروع هي (Bulinus truncates) *بولاينس ترنكاتس*, (Bulinus forskalii) *بولاينس فورسكالي* (*(Biomphalaria pfeifferi)* *بيومفالاريا فيفراى* (*Lymnaea natalensis*) *ليمنيا نتالينسس*, (*Physa acuta*) *فيسا أكيوتا* (*Melanoides tuberculata*,) *ميلانويدز تيوبركيولاتا* و (*Cleopatra bulimoides*) *كليوباترا بوليمويدز*. أما أنواع النباتات المائية التي وجدت في المشروع كانت كالآتي: طحلب (Spirogyra sp) سبيروجيرا (Potamogeton nodosus) بوتاموجيتون نودوزس، (Typha sp) نوع التيفا ، (Cyperus sp) نوع السيبيروس ، (Cynadon dactylon) سينادون داكتيلون ، (Cymbopogon sp) نوع السيمبوبوجون ، (Cassia senna) السنمكة ، (Calotropis procera) كالوتروبيس بروسيرا العشر ، (Acacia nilotica) السنط النيلية ، و(Prosopis sp) نوع بروزوبيس. أغلب أنواع الحلزونات التي وجدت كانت كثافتها عالية في مارس / أبريل عندما كانت الماء في القنوات نظيفة وصافية مقارنة بشهري سبتمبر / أكتوبر عندما يكون المياه في القنوات عكره تزامناً مع موسم فيضان النيل الأزرق. هذه كانت خصوصاً للحلزونات الرئوية (*Bulinus truncates*) *بولاينس ترنكاتس*, (*Biomphalaria pfeifferi*) *بيومفالاريا فيفراى التي تنقل البلهارسيا المعوية و البولية على التوالي . أما الحلزونات غير الرئوية مثل* (*Cleopatra bulimoides*) *كليوباترا بوليمويدز كانت كثافتها عالية في سبتمبر / أكتوبر . في هذه الدراسة لوحظ أن كثافة الحلزونات عالية في القنوات الصغيرة* (الترع) وأبو عشرين . وهذه القنوات تمتاز عموماً بالتيارات المائية المنخفضة ، العمق المنخفض ، والكثافة العالية في النباتات المائية .

EDITORIAL

Introduction:

The freshwater snails of Africa are divided into two groups: the prosobranchs which are characterized by the presence of an operculum, stronger and heavier shell and pulmonates which lack these feature. Although both groups of snails inhabit freshwater, pulmonates are very important from the medical and veterinary point of view since many members of this group are involved in the live cycle of parasites causing diseases to man and his livestock. The presence and the distribution of snails are affected by physical, chemical and biological factors which may affect one another and their combined effect influences a particular species or population (Jordan and Webbe, 1982). These factors include:

Physical factors:

Temperature is a very important ecological factor as it directly affects the metabolic activity of snails (Madsen, 1982). It has pronounced effects on the rate of photosynthesis as well as on the rate of bacterial decomposition and thereby influencing oxygen condition. Temperature also affects directly the amount of oxygen in water.

Snails show tolerance to a considerable range of temperature fluctuations. For example, field recordings of *Biomphalaria sp* and *Bulinus sp* indicate quite broad tolerance ranges, i.e. from 0 to about 40 ˚C (Appleton, 1978), and the optimal temperature for these species is in the range 25-28 ˚C (El-Emam and Madsen, 1982).

Rainfall determines the seasonal fluctuations and density of snails (Appleton, 1978). In permanent habitats the water level may fluctuate greatly throughout the year due to rainfall pattern (Klumpp and Chu, 1977). Rains stimulates egg-laying probably due to reduction in salinity and drop in temperature (Webbe and Masangi, 1958). But if flooding occures , snails will be washed out and their density will drop (Hira and Muller, 1966).

Light indirectly affects snails by its influence on photosynthetic activity of aquatic plants and the availability of food (Malek, 1958). Light and temperature play roles in determining locomotors activity, growth and reproduction of snails (Appleton, 1978; Mazoub *et al*. 1979).

Current velocity of water and fluctuation of its level are important factors in the ecology of snails in general and schistosome intermediate hosts in particular. It is known that snails have strong preference for lentic habitats colonizing slow moving, pools, back water or stagnant water near banks infested with aquatic plants (Appleton, 1978). This preference is associated with availability of food and conservation of airs. Thomas and Tait (1984), observed that prosobranchs snails are better adapted for high currents than pulmonates.

Snail's populations were reported to decline in the Gezira – Managil scheme canals due to high water levels (Babiker *et al*., 1985; Hilali *et al*., 1995). In temporary habitats snails are exposed to desiccation (Appleton, 1978). Schistosome host snails are able to resist desiccation through aestivation (Webbe, 1962; Hira and Muller, 1966; Chu et al, 1967). In the Sudan, Archibald (1933) found that B. truncatus was capable of aestivation in the subsoil from 3 to 4 months during the dry season.

In the canals of the Gezira - Managil scheme in the Sudan, the densities of schistosome intermediate host snails are greatly reduced during the period of turbidity from July to October (Babiker *et al*., 1985; Hilali *et al*., 1985).

Chemical Factors:

Webbe and Masangi (1958) noticed that the highest values of salinity corresponded to a near disappearance of bulinid snails, *Bulinus nasutus* and *Bulinus globosus*. Jennings *et al*., (1973), showed that optimum values of salinity for *Biomphalaria pfeifferi* were in range 300 – 500 ppm.

Expressed as percentage salinity potassium and calcium is among the most important chemical factors for the snails because calcium carbonate makes up the major parts of the shell. There is a great deal of evidence that calcium can influence the distribution and abundance of snails (Harrison and Shiff, 1966; Harrison *et al*., 1970). The oxygen content of water depends on temperature and is closely linked to the Carbon dioxide cycle, these two gases being the great complements of metabolism. Van Someren (1946) considered oxygen content of water to be probably the chief limiting factor in snail ecology. He found that, in Kenya, Lymnaea natalensis snails showed distress when the oxygen tension fell below 75 % of saturation and suffocated when it fell below 10 %. Watson (1958) considered Bulinus truncatus to be rather tolerant to low oxygen tensions.

Ions of heavy metals such as Iron, zinc, copper, cadmium or silver are toxic to snails at even low concentrations (Van Someren, 1946). Such substances may originate from industrial wastes or used in snail control.

The PH-values varies greatly in natural water and the tolerance range of snail is a wide one (Boycott, 1936; Van Someren, 1946). The PH-values tolerated by the intermediate host snails vary within a range of 4.5 and 10.0 (Malek, 1980). Since the PH of water is itself affected by a number of factors, e.g. plant life or chemical composition, which may be factors already affecting the life of snails, it is difficult to separate the two accurately (Cowper, 1971).

biological factors:

The biological factors affecting snail distribution include trematode infection, predation, competition and aquatic vegetation. Parasitism was reported to have a deleterious effect on snails (Cheng, 1971). This is mainly due to mechanical damage caused by migrating larval stages, consumption of digested food materials and toxic substances excreted by the parasites. Trematode infections may have a significant impact on population dynamics of freshwater snails (Cobes, 1982).

Predation by both invertebrates and vertebrates is considered an important population regulation factor for snails (Vermeij and covich, 1978). Predators of freshwater snails include species of virtually every major group of animal kingdom i.e. from mammals to planarians (Ferguson, 1978). As for competition few examples of what to be competitive displacement have been recorded. Barbosa (1973), reported the elimination of Biomphalaria glabrata from a habitat where Biomphalaria straminea was introduced. Predators, competitors and organisms parasitize on snails may have a potential role in biological control of snails transmitting diseases such as schistosomiasis (Madsen, 1992). There are numerous reports of associations between snails and aquatic plants (Klumpp and Chu, 1980; Hilali *et al*., 1985). The snails may be attracted to aquatic plants because they offer a major source of food, protection and egg-laying surface (Ferguson, 1978; Thomas *et al*., 1983).

Distribution of snails in the Sudan:

The varied climatic environment of the Sudan has considerable influence on the distribution of snails. Thus, the occurrence of snails in different parts of the Sudan was reported.

Archibald (1933), reported the presence of Bulinus forskalii in springs in the Nuba mountains in western Sudan. Doumenge *et al*., (1987) mentioned that Bulinus truncatus, the intermediate host of Schistosoma haematobium, seems to tolerate drought and as thus it is the most widespread in Darfur, Kordofan and the area around Kassala. It is also well established in the Nile below Khartoum. Doumenge et al, (1987) also reported the occurrence of Biomphalaria pfeifferi, the intermediate of Schistosoma mansoni, in Jebel Marra area, western Sudan and in the area around Juba in Southern Sudan. Recently, both Bulinus and Biomphalaria snails were found in Jonglei canal region, southern Sudan (Brown *et al*., 1984).

In the White Nile area, the occurrence of *Bulinus truncatus*, *Bulinus ugandae*, *Bulinus forskalii*, *Biomphalaria sudanica* and *Biomphalaria alexandarina* was reported (Malek, 1958; Williams and Hunter, 1968). In the same area, a recent survey conducted in Umm Hani irrigation scheme south of Kosti revealed the presence of Bulinus truncatus, *Bulinus ugandae*, *Bulinus globosus*, *Bulinus forskalii*, *Biomphalaria sudanica* and *Biomphalaria pfeifferi* (Saeed, 1992).

Malacological surveys conducted in old and new irrigation schemes showed the presence of Biomphalaria pfeifferi and Bulinus truncatus in the Gezira – Managil (Karoum, 1988; Hilali, 1992), Rahad (Elias, 1992; Meyer – Lassen, 1992) and New Halfa (Madsen *et al*., 1988) irrigation schemes. Madsen *et al*, (1988) found the following snail species in Gezira – Managil and Rahad schemes: *Lanistes carinatus*, *Cleopatra bulimoides*, *Melanoides tuberculata*, *Gabiella senaariensis*, *Biomphalaria pfeifferi*, *Bulinus truncatus*, *Bulinus forskalii*, *Lymnaea natalensis*, *Ferrissia sp*, *Gyraulus costulatus* and *Ceratophallus natalensis*.

In Khartoum state, both Bulinus truncatus and Biomphalaria pfeifferi were found in bump schemes in Khartoum north (East Nile Provence) by Malek (1962) and William and Hunter (1968). In a recent survey, both Bulinus truncatus and Biomphalaria pfeifferi in addition to Bulinus forskalii, Physa acuta, Lymnaea natalensis, Melanoides tuberculata and Cleopatra bulimoides were found in irrigation canals in all of the three provinces of the state i.e. Khartoum, East Nile and Omdurman (Hilali *et al*., 1996).

EDITORIAL

Objectives:

Schistosomiasis and its intermediate host snails were reported to be widespread in Seilate Agricultural Scheme, the largest scheme in Khartoum state . The present study was conducted to give further details on distribution of snails in this scheme. The specific objectives are as follows:

1. to identify different snail and aquatic plants species present in this scheme.
2. to investigate the distribution of snails in relation to factors such as season, canal type, position of site, water depth, water current and vegetation .
3. to give a detailed description of snail distribution in this scheme as a basis for further studies aiming to control schistosomiasis.

Materials and Methods:

Study area:

The study was conducted in the irrigation canals of Seilate Agricultural Scheme (SAS) which lies in the East Nile Province, Khartoum State. The scheme was inaugurated in November 1976. It covers an area of approximately 30,000 feddan. (Fig.1.). There are about 14 villages distributed within or at the periphery of the scheme with an estimated population of 200,000.

Snail's collection and other recording:

The different areas of the scheme were visited during two periods i.e. March / April and September / October of the year 1997. Different types of the canals were randomly selected and visited during the two periods of the study. Snails were collected using a standard dip-net scoop 30x40 cm with a 2m metal handle. The collection was by passing the scoop across the substratum to 1m from the edge of the collection site, the scoop was then drawn up and all snails on it were collected using a fine forceps and spoon. Snails collected from each site were pooled together in a plastic container with some aquatic weeds and brought to the laboratory where they were identified to species and counted. Identification was made following the field guide prepared by the Danish Bilharziasis Laboratory for the identification of north-east African freshwater snails (1984). 15 scoops were taken from each site. In addition to the snail collection the following recorded date and type of canal, site of collection, temperature, water depth were recorded. An arbitrary scale used to estimate water current and vegetation percentage cover, made in each site:

Data analysis:

Snail's data showed abnormal distribution and hence one-way analysis of variance (Kruskal-wallis) was used to test differences in snail densities (mean per site per 15 scoops) in relation to season, canal type, position of site, water depth, water current and vegetation cover. P-values of 0.05 were considered as significant.

EDITORIAL

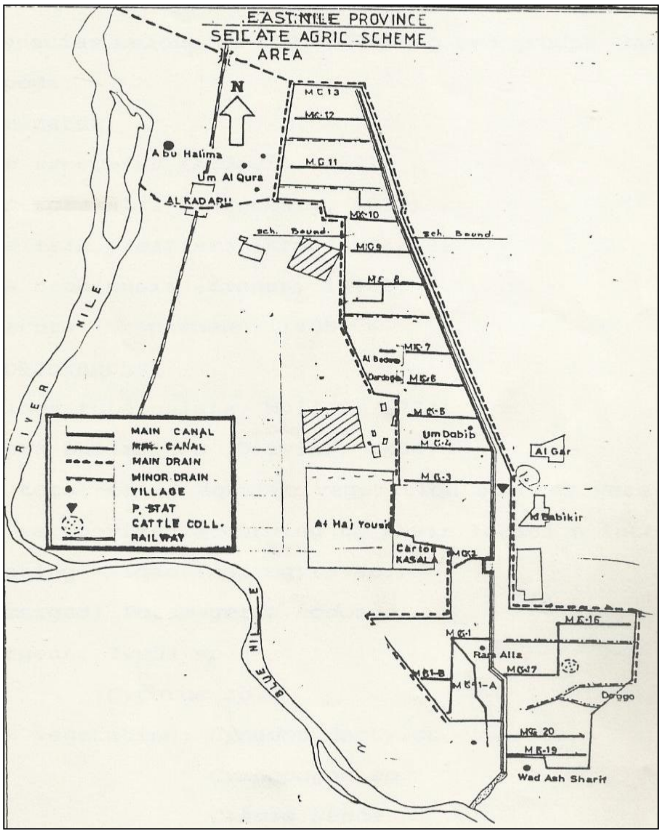

Figure (1). Map of Seilate Agricultural Scheme.

Results:

Snail and aquatic vegetation species:

The study revealed the presence of five Pulmonates (*Bulinus truncatus* (Audouin, 1827), *Bulinus forskalii* (Ehrenberg, 1831), *Biomphalaria pfeifferi* (Krauss, 1848), *Lymnaea natalensis* (Krauss, 1848), *Physa acuta* (Draparnaud, 1805); and two Prosobranchs Cleopatra bulimoides (Olivier, 1804) and Melanoides tuberculata (Muller, 1774)

A total of 10 aquatic vegetation species were found. They can be categorized according to their location into:

1. Floating: Algae (Spirogyra sp).
2. Submerged: Potamogeton nodosus.
3. Emergent: Typha sp and Cyperus sp.
4. Bank vegetation: Cynadon dactylon, Cymbopogon sp, Cassia senna, Acacia nilotica, Calotropis procera and Prosopis sp

Distribution of snails:

The densities (Total number and mean per site per 15 scoops) of different snail species during two seasons (March / April and September / October) are shown in table 1. A total of 3835 snails were collected during March / April compared to only 135 snails during September / October. All snail species recorded, severely declined in density during September / October. However, differences in means were only significant (P < 0.05) for Biomphalaria pfeifferi, Bulinus truncatus and Cleopatra bulimoides. Melanoides tuberculata was the most dominant species during September / October with the total of 128 out of a total of 135 (Table 1). Temperature reading did not show significant differences (I.e. in the range of 17 – 21 C˚) during the two seasons and hence snail data were not presented.

All snail species found in this study showed a tendency to increase in density in minor canals and abueshreens rather than in the major canal (Table 2). Generally Prosobranchs are more frequent than Pulmonates in major canals. However, differences in snail densities between canals were only significant (P < 0.05) for B. truncatus which was denser in the minor canals. The mean densities of this species were 1, 56.4 and 25.6 in major, minor and abueshreens respectively (Table 2).

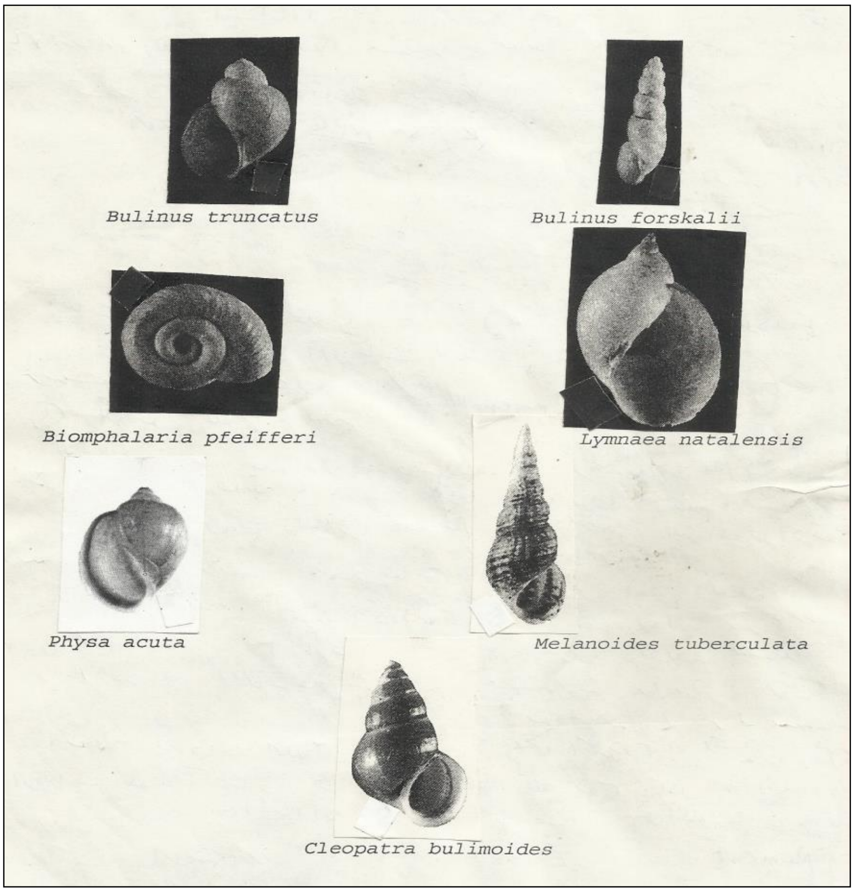

Figure 2: Snails species found in Seilate Agricultural Scheme (Photos copied from Karoum, 1988) Bulinus truncatus, Bulinus forskalii, Lymnaea natalensis, Biomphalaria pfeifferi, Physa acuta, Melanoides tuberculata, Cleopatra bulimoides.

EDITORIAL

The distribution of all snail species according to position of site i.e. head, middle or terminal part of canal did not show a significant variation in this study (Table 3). Similarly were the results in relation to depth of site (Table 4). The total numbers of snails collected were 1489, 1695 and 806 in the sites with a depth of 1-19 cm, 20-39 cm and 40 and above respectively. Except B. forskalii, pulmonates showed low records than Prosobranchs in sites with a depth of 40 and above (Table 4).

Table (1): Total number, mean number per site per 15 scoops of snails collected from Seilate agriculture scheme canals during two seasons, March / April 1997 and September / October 1997. Between the brackets are the numbers of sites visited.

Snail species	Seasons				P*- value
	March / April (20)		September / October (8)		
	Total	Mean	Total	Mean	
Pulmonates					
B. forskalii	263	13.2	1	0.1	> 0.05
B. pfeifferi	455	22.8	0	0	< 0.05
B. truncatus	923	46.2	4	0.5	< 0.05
L. natalensis	27	1.4	1	0.1	> 0.05
Physa acuta	1497	78.0	1	0.1	> 0.05
Prosobranchs					
C. bulimoides	190	9.5	0	0	< 0.05
M. tuberculata	480	24.0	128	16	>0.05
Total	3835		135		

*Kruskal – Wallis oneway ANOVA on mean numbers in the two seasons.

Table 2: Total number, mean number per site per 15 scoops of snails in relation to canal types i.e. major, minor and abueshreens in Seilate Agriculture Scheme. Between brackets are the numbers of sites visited.

Snail species	Type of canal						P*- value
	Major (4)		Minor (10)		Abueshreen (14)		
	Total	Mean	Total	Mean	Total	Mean	
Pulmonates							
B. forskalii	0	0	3	0.3	261	18.6	> 0.05
B. pfeifferi	0	0	241	24.1	214	15.3	> 0.05
B. truncatus	4	1	564	56.4	359	25.6	< 0.05
L. natalensis	0	0	1	0.1	27	1.9	> 0.05
Physa acuta	0	0	7	0.7	1491	106.5	> 0.05

EDITORIAL

Prosobranchs							
C. bulimoides	39	9.8	72	7.2	79	5.6	> 0.05
M. tuberculata	9	2.3	188	18.8	411	29.4	> 0.05
Total	52		1076		2842		

*Kruskal- Wallis oneway ANOVA on mean numbers in the three canal types

Table 3: Total number, mean number per site per 15 scoops of snails in relation to position of sites i.e. head, middle and terminal in Seilate Agriculture Scheme. Between brackets are the numbers of sites visited.

Snail species	**Position of sites**						**P*-value**
	Head (11)		Middle (10)		Terminal (7)		
	Total	Mean	Total	Mean	Total	Mean	
Pulmonates							
B. forskalii	1	0.1	0	0	263	37.6	> 0.05
B. pfeifferi	111	10.1	151	15.1	193	27.6	> 0.05
B. truncatus	464	42.2	253	25.3	210	30	> 0.05
L. natalensis	170	15.5	35	3.5	403	57.6	> 0.05
Physa acuta	873	79.4	274	27.4	351	50.1	> 0.05
Prosobranchs							
C. bulimoides	60	5.5	127	12.7	3	0.4	> 0.05
M. tuberculata	2	0.2	21	2.1	5	0.7	> 0.05
Total	1681		861		1428		

*Kruskal- Wallis oneway ANOVA on mean numbers in the three canal positions.

Table 4: Total number, mean number per site per 15 scoops of snails in relation to depth of sites (cm) in Seilate Agriculture Scheme. Between brackets are the numbers of sites visited.

Snail species	**Position of sites**						**P*-value**
	1-19 cm (12)		20-39 cm (12)		40+ (4)		
	Total	Mean	Total	Mean	Total	Mean	
Pulmonates							
B. forskalii	0	0	4	0.3	260	65	> 0.05

B. pfeifferi	277	23.1	176	14.7	2	0.5	> 0.05
B. truncatus	315	26.3	525	43.8	87	21.8	> 0.05
L. natalensis	27	2.3	1	0.1	0	0	> 0.05
Physa acuta	609	50.8	795	66.3	94	23.5	> 0.05
Prosobranchs							
C. bulimoides	55	4.6	61	5.1	74	18.5	> 0.05
M. tuberculata	206	17.2	133	9.4	289	72.3	> 0.05
Total	1489		1695		806		

*Kruskal- Wallis one way ANOVA on mean numbers in the three depths

Table 5 showes the distribution of snails in relation to the estimated water current. Only the differences in means of B. pfeifferi, Physa acuta and L. natalensis are statistically significant (P < 0.05) in the sites with stagnant, low and high water current, the mean numbers of B. pfeifferi were 55.4, 14.8 and 0, the mean numbers of Physa acuta were 121.8, 74 and 0.1 and those of L. natalensis were 5.4, 0 and 0.1 respectively. All snail species recorded in this study, except C. bulimoides had low densities in the sites with high water current.

Table 5: Total number, mean number per site per 15 scoops of snails in relation to water current in Seilate Agriculture Scheme. Between brackets are the numbers of sites visited.

Snail species	Water current						P*- value
	Stagnant (5)		Low (12)		High (11)		
	Total	Mean	Total	Mean	Total	Mean	
Pulmonates							
B. forskalii	0	0	263	21.9	1	0.1	> 0.05
B. pfeifferi	277	55.4	178	14.8	0	0	< 0.05
B. truncatus	190	38	472	39.3	265	24.1	> 0.05
L. natalensis	27	5.4	0	0	1	0.1	< 0.05
Physa acuta	609	121.8	888	74	1	0.1	< 0.05
Prosobranchs							
C. bulimoides	18	3.6	89	7.4	83	7.5	> 0.05
M. tuberculata	82	16.4	435	36.3	91	8.3	> 0.05
Total	1203		2325		442		

*Kruskal- Wallis oneway ANOVA on mean numbers in the three water currents

Snail counts in various vegetation cover categories are given in table 6. The total number of snails found in the various vegetation cover categories were as follows: 0 in

< 5%, 588 in 5 - 25%, 973 in 25 - 50%, 1418 in 50 – 75% and 991 in > 75% showing a general trend for snails to increase in density with increase in vegetation density. However, only the changes of B. pfeifferi, B. truncatus and C. bulimoides densities are statistically significant (P < 0.05). The highest densities (mean per site per 15 scoops) of B. pfeifferi, B. truncatus and C. bulimoides were in vegetation cover categories 50 – 75%, > 75% and 5 – 25% respectively.

Table 6: Total number, mean number per site per 15 scoops of snails in relation to vegetation cover (%) in Seilate Agriculture Scheme. Between brackets are the numbers of sites visited.

Snail species		**Vegetation cover (%)**					**P*- value**
		< 5 (3)	5-25 (5)	25-50 (11)	50-75 (5)	>75	
Pulmonates							
B. forskalii	T	0	0	261	3	0	> 0.05
	M	0	0	13.7	0.6	0	
B. pfeifferi	T	0	77	1	272	105	< 0.05
	M	0	15.4	0.1	54.4	26.3	
B. truncatus	T	0	248	177	177	325	< 0.05
	M	0	49.6	16.1	35.4	81.3	
L. natalensis	T	0	1	1	1	25	> 0.05
	M	0	0.1	0.1	0.2	6.3	
Physa acuta	T	0	78	42	852	526	> 0.05
	M	0	15.6	3.8	170.4	131.5	
Prosobranchs							
C. bulimoides	T	0	81	46	63	0	
	M	0	16.2	4.2	12.6	0	
M. tuberculata	T	0	103	445	50	10	
	M	0	20.6	40.5	10	2.5	
Total		0	588	973	1418	991	

*Kruskal- Wallis oneway ANOVA on mean numbers in the 5 categories of vegetation cover

Discussion:

The objective of this study was to give further details on the distribution of snails in Seilate Agricultural Scheme which is the largest scheme in Khartoum state. Despite the limited time of the study and the limited data collected the study confirmed previous findings in this scheme as to the species of snails present. The seven species recorded in this study were reported in this scheme and other irrigation schemes in Khartoum (Hilali *et al*., 1996).

The observed differences in snail density during the two seasons (March/April and September/October) particularly for schistosome intermediate host snails i.e. B.

pfeifferi and B. truncatus can be attributed to the effect of turbidity. September/October season coincides with flood season of the Blue Nile (July to October) during which water is highly turbid. The snail densities encountered in this study during the season September/October were low compared to the season March/April. Similar decline in snail densities during the turbid water season was reported in the Gezira-Managil scheme which takes its water from the Blue Nile (Hilali *et al*., 1985; Babiker *et al*., 1985; Karoum, 1988; Hilali *et al*., 1995). The turbidity was reported elsewhere to make the habitat unsuitable for snails (Boycott, 1936; Watson, 1958).
A general tendency was observed in this study for snails to occur in minor canals and abueshreens rather than in major canal. This is mostly due to slow moving water and dense vegetation prevailing in minors and abueshreens which distributed water to the fields. The major canal is designed to serve its function in transport of water to field's irrigation canals. Thus, water level and water current are usually high in major canals. Snails and schistosomiasis intermediate host snails in particular were reported to show marked preference for slow moving or non-flowing regions, such as pools, back waters or slack waters near banks, colonized by aquatic weeds (Appleton, 1978). Similar observations were made in this study for snails in relation to water depth, current and vegetation cover. The effects of these factors on snail presence and distribution were discussed in the introduction.

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