

Impact of some environmental factors on distribution of certain vector snails in five Egyptian Governorates

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ABSTRACT

The present study showed that the distribution of the intermediate host snails of *Fasciola* sp. and *Schistosoma* sp. varied among the five surveyed Egyptian governorates. It was found that the ratios of distribution of *Lymnaea natalensis*, *Bulinus truncatus* and *Biomphalaria alexandrina* snails of the total surveyed sites were 44.1%, 26.9% and 4.9% respectively. Moreover, infected *L. natalensis*, *B. truncatus* and *B. alexandrina* snails in these sites were 1.96%, 3.4% and 0.98% respectively. However, infected *L. natalensis* and *B. truncatus* were found in Damietta and Beheira, while infected *B. alexandrina* were found only in Giza. Spring was the highest season in percentage of collected snails (38.9%), while summer was the lowest one (8.8%). *L. natalensis*, *B. truncatus* and *B. alexandrina* showed high distribution in Ismailia, Damietta and Giza governorates as represented by 4.16, 4.38 and 0.51 snails/site respectively. Some environmental factors were found affecting the distribution of snails. The means of pH and temperature in positive sites for vector snails were 6.8 and 26.7°C respectively. *L. natalensis*, *B. truncatus* appeared in water of electric conductivity mean of 415.5 μ .mhos/cm and 284.5 ppm of mean total dissolved salts, while *B. alexandrina* was found at 481 μ .mhos/cm and 603 ppm respectively.

Keywords: *Fasciola* sp., *Schistosoma* sp., *Lymnaea natalensis*, *Bulinus truncatus*, *Biomphalaria alexandrina*, distribution

INTRODUCTION

Schistosomiasis and soil transmitted helminthes represent more than 40% of the global diseases burden caused by all tropical diseases, excluding malaria (WHO, 2006). Schistosomiasis is a chronic parasitic disease caused by blood flukes of the genus *Schistosoma*. More than 207 million people are so far infected worldwide, with more than 90% of the cases occurring in Africa, at poor communities without access to safe drinking water and adequate sanitation (WHO, 2011). In Egypt, ecological changes by the Aswan High Dam have resulted in more prevalence of *S. mansoni* in the Nile delta (El-Katsha and Watts, 1995). Wilmott (1987) reported that *S. haematobium* is still of predominance infection in Middle and Upper Egypt, while the ecological changes and irrigation practices have introduced *S. mansoni* and its snail vector *B. alexandrina* to these areas. Land reclamation extended the transmission of schistosomiasis to new areas in Egypt (El-Sayed *et al.*, 1995). Khalil and Sleem (2011) stated that the latest report of the Egyptian Ministry of Health indicated that the percentage of infected people with *Schistosoma* has decreased significantly to only 4% compared to 45% during 1960s.

Fascioliasis is a parasitic disease of medical and veterinary importance that causes a great loss in livestock production (Mas-Coma and Bargues, 1997) and can also infect human (Mas-Coma *et al.*, 1999). In Egypt, 830,000 people were found infected with liver flukes in the Nile Delta region (WHO, 1995). Soliman (1998) reported that until 1960, only sporadic human cases of fascioliasis were detected mainly in the Nile Delta. Since 1980, the number of cases has risen drastically and human infection has been reported in different governorates such as Giza, Qalyubia and Dakhlia (Haseeb, 2002). *Fasciola* is being enzootic in different livestock (Haridy *et al.*, 2006). Mostafa *et al.* (2005) studied the distribution of vector snails of schistosomiasis and fascioliasis and infection risks at some rice farming in Kafr El-Sheikh and Gharbia governorates. They found that 10% of sites in Gharbia and 19.95% in Kafr El-Sheikh were infested with infected *B. alexandrina* and *B. truncatus* snails respectively, while *L. natalensis* were found in 16.7% and 8.75% of the examined sites of the two governorates, respectively. Ashour *et al.* (2008) mentioned that the highest number of *L. natalensis* was collected from Giza (38 snails/site), while Kafr El-Sheikh had the lowest one (8 snails/site).

Also, some environmental factors affected the distribution of the intermediate host snails. El-Hawary (1990) found that high pH values up to 9.0 were detected in habitats free of snails. Snails were found by high number in water with salinity range of 340-600 ppm, but under concentration higher than 600 ppm, the number of snails decreased and they completely disappear at 1800 ppm (El-Said, 1997).

MATERIAL AND METHODS

Samples of snails in the present study were collected from 51 sites in four successive seasons from spring 2009 to winter 2010. These sites were distributed in five governorates, Giza (13 sites), Sharkia (3 sites), Ismailia (9 sites), Beheira (13 sites) and Damietta (13 sites). The selected sites were sampled using a standard dip-net (Yousif *et al.*, 1992). The sampling started at the edge of canals water towards the stream midline, where the net was shaken in water after being filled with plants. The collected snails were placed in numbered plastic bags containing water and the bags were brought in cool boxes to the laboratory for counting, sorting and examined for natural trematode infection. Temperature and Hydrogen ion concentration (pH) were measured by pH meter electrode (HANNA HI 9024). Electric conductivity and total dissolved salts were estimated by conductivity meter electrode (HANNA HI 9635). In the laboratory, collected snails were maintained in plastic aquaria containing dechlorinated tap water and a small amount of vegetation from the field. They were examined for larval trematodes by two methods: one by exposure of snails to natural or artificial light for one hour, at 25°C, for cercarial shedding (Abdel Malek and Cheng, 1974), second by crushing of snails for detection of the interamolluscan stages, using a binocular microscope (Jackson, 1958).

So, the aim of this study is to evaluate the effect of some environmental factors on distribution of snail vectors of *Schistosoma* and *Fasciola* in certain water streams in Giza, Sharkia, Ismailia, Beheira and Damietta governorates.

RESULTS AND DISCUSSION

Table (1) shows that the total number of collected snails was 938 including 423 *L. natalensis*, 409 *B. truncatus* and 106 *B. alexandrina* (Fig. 1). Moreover, the spring was the highest season in ratio of collected snails (38.9%) and represented (51%) of

infected snails, while summer was the lowest one (8.8% and 3.7%) respectively (Fig. 2). El-Said (1997) reported that the cold seasons were more favorable for vector snails reproduction than warm ones.

Table 1: Total and infected snails collected during four seasons.

Seasons	Snail population									Total collected snails	%*
	<i>B. alexandrina</i>			<i>B. truncatus</i>			<i>L. natalensis</i>				
	Total No.	Inf. No.	Non-Inf. No.	Total No.	Inf. No.	Non-Inf. No.	Total No.	Inf. No.	Non-Inf. No.		
Spring	81	6	75	151	5	149	133	3	130	365	38.9
Summer	1	0	1	26	0	26	56	1	55	83	8.8
Autumn	20	1	19	118	7	111	75	0	75	213	22.7
Winter	4	0	4	114	3	111	159	1	158	277	29.6
Total	106	7	99	409	15	394	423	5	418	938	100

Total collected snails in season

$$\text{Inf.} = \frac{\text{Infecte}}{\text{Total collected snails during four seasons}} \times 100$$

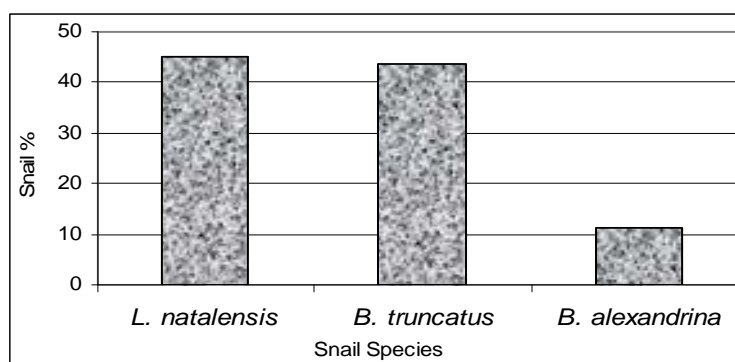


Fig. 1: Percentages of different snails species collected during four seasons.

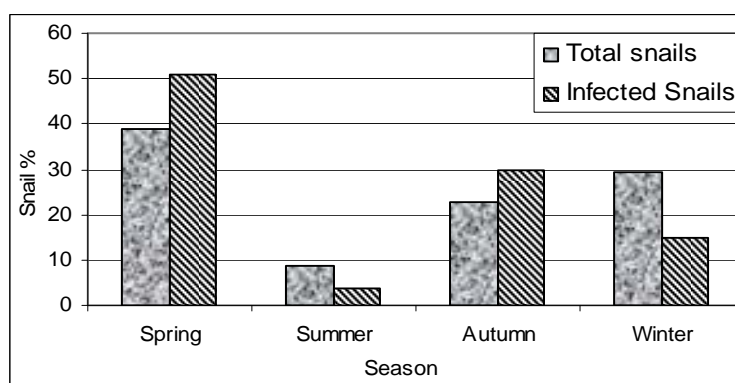


Fig. 2: Percentages of total and infected snails collected during four seasons.

The present data show that *L. natalensis*, *B. truncatus* and *B. alexandrina* snails were found in 90, 55 and 10 sites respectively, however, infected snails represented 4, 7 and 2 sites respectively of total surveyed sites during four seasons which agrees with Khalil and Sleem, (2011).

Table (2) shows the total number of different snails collected from the five governorates, *L. natalensis* counted 2.07 snails/site for all sites and represented the highest number (4.16 snails/site) in Ismailia, while Damietta, Giza, Skarkia and

Beheira showed 2.44, 1.38, 1.33 and 1.11 snails/site respectively. *B. truncatus* counted 2.0 snails/site for all sites and showed the highest in Damietta (4.38 snails/site), but Beheira, Ismailia, Skarkia and Giza reached 2.0, 1.38, 0.58 and 0.38 snails/site respectively. *B. alexandrina* were 0.51 snails/site for all sites, but were found by high number in Giza (1.94 snails/site), while Damietta 0.057 and Ismailia 0.055 snails/site and disappeared completely from Skarkia and Beheira governorates. Ashour *et al.* (2008) showed that the highest number of *L. natalensis* was collected from Giza (38 snails/site), while Kafr El-Sheikh had the lowest number (8 snails/site). Moreover, similar results were reported by Mostafa *et al.* (2005) and Haseeb (2002). Also, El-Azazy and Schillhorn (1983) stated that *L. natalensis* were most prevalent in the northern parts of the Nile Delta. Refaat *et al.* (2010) mentioned that the prevalence of *Fasciola* in Qena was 30.3%, including 28.6% in cows, 33.7% in buffaloes and 17.2% in sheep.

Table 2: Number of different snails/site collected from five governorates during four seasons.

Governorates	No. of sites in season	Snail Population					
		<i>B. alexandrina</i>		<i>B. truncatus</i>		<i>L. natalensis</i>	
		No. of Snails	*Snail/ Site	No. of Snails	*Snail/ Site	No. of Snails	*Snail/ Site
Giza	13	101	1.94	20	0.38	72	1.38
Sharkia	3	0	0	7	0.58	16	1.33
Ismailia	12	2	0.055	50	1.38	150	4.16
Beheira	13	0	0	104	2.0	58	1.11
Damietta	13	3	0.057	228	4.38	127	2.44
Total	51	106	0.51	409	2.0	423	2.07

$$*\text{Snail / site} = \frac{\text{Total number of snails}}{\text{Number of sites in four seasons}}$$

Table (3) shows the percentage of infected snails that collected from different governorates. The total ratios of infection of *B. alexandrina*, *B. truncatus* and *L. natalensis* snails were 6.6%, 3.66% and 1.18% respectively. *B. alexandrina* infected snails were reported in Giza only, while *B. truncatus* and *L. natalensis* were found in Damietta and Beheira representing 4.82% and 3.84% respectively for *B. truncatus* and 1.72% and 3.14% respectively for *L. natalensis*. This finding was in accordance with Hariston (1973) who reported that low percentage of natural infection is the rule and it depends upon a complex interaction of different factors.

Table 3: Percentage of infected snails collected from five governorates.

Governorate	<i>B. alexandrina</i>			<i>B. truncatus</i>			<i>L. natalensis</i>		
	No. of snails	No. of infected	*%	No. of snails	No. of infected	*%	No. of snails	No. of infected	*%
Giza	101	7	6.93	20	0	0	72	0	0
Sharkia	0	0	0	7	0	0	16	0	0
Ismailia	2	0	0	50	0	0	150	0	0
Beheira	0	0	0	104	4	3.84	58	1	1.72
Damietta	3	0	0	228	11	4.82	127	4	3.14
Total	106	7	6.60	409	15	3.66	423	0	1.18

$$*\% = \frac{\text{Number of infected snails}}{\text{Number of snails}} \times 100$$

However, low infection rate may reflect a small degree of biotic pollution but may also indicate a small proportion of susceptible snails in a population exposed to heavy pollution (Paraense and Correa, 1963) and agrees with (Khalil and Sleem, 2011).

Concerning to the effect of environmental factors on distribution of snail vectors, the means of water Hydrogen ion concentration (pH) of positive sites for *L. natalensis*, *B. truncatus* and *B. alexandrina* showed 6.8, 6.9 and 6.8 respectively, but snails completely diapedered in pH more than 8. Moreover, the means pH of positive sites for infected *L. natalensis* and *B. truncatus* snails were 7.4 and 7.0 respectively, while infected *B. alexandrina* was 6.6. This agrees with Carithers (2000) who mentioned that the Lymnaeid snails prefer slightly acidic pH. El-Emam and Roshdy (1981) showed that the number of the collected snails from El-Saff canal, Giza was very few in August 1980, where the pH value was relatively high (9.2). Similar results were obtained by (El-Hawary, 1990). Ashmawy *et al.*, (1994) stated that pulmonata snails as *Lymnaea* sp., *B. alexandrina* and *Bulinus* sp. were collected from large as well as small canals in Beheira governorate and from narrow ditches, where pH ranged from 7.2 to 7.6.

The snail vectors can tolerate a wide rang of temperature 18 – 34 °C, but the highest ratio of snails 43.7% were found in temperature from 22.1 to 26°C, while the highest ratio of infected snails (81.4%) were collected from wider range of temperature (from 22.1 to 30°C) (Fig.3). The mean temperatures of positive sites for *L. natalensis* and *B. truncatus* snails showed no substantial difference, represented by 26.9, 26.4 and 26.8°C respectively. The mean temperatures of positive sites for infected *L. natalensis* and *B. truncatus* snails showed slight difference (27.8, 25.0, 27.0°C respectively). Azzam (2008) reported that the highest distribution of *L. natalensis* appeared during spring at a temperature range from 23 to 25°C.

The present data also indicated that 72.3% of total snails and 51.8% of infected ones were collected under electric conductivity range of 301-600 μ .mhos/cm, (Fig. 4). The means of electric conductivity of positive sites for *L. natalensis*, *B. truncatus* and *B. alexandrina* were 416, 415 and 481 μ . mhos/cm respectively, while for infected ones were 393, 604 and 707 μ .mhos/cm respectively. This agrees with El-Emam and Roushdy (1981) who stated that the average water electric conductivity in the irrigation canals was 300 ± 100 μ .mhos/cm.

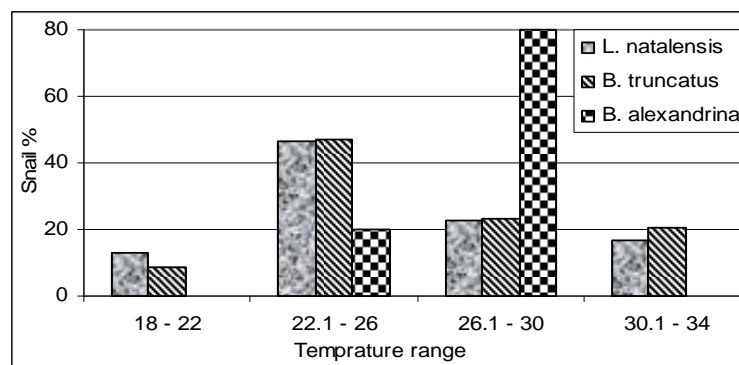


Fig. 3: Percentages of different snails species collected from water of different temperature.

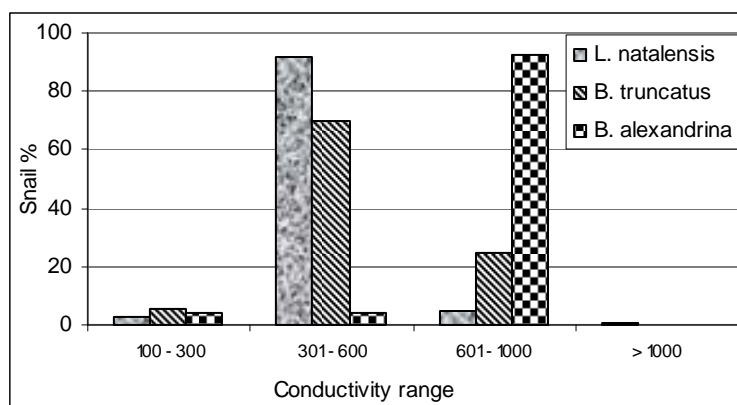


Fig. 4: Percentages of different snails species collected from water of different electric conductivity.

In the present study, the highest numbers of *B. truncatus* and *L. natalensis* snails were found under low total dissolved salts (TDS) of 100-300 ppm, but *B. alexandrina* snails were obtained from a range of 601-1000 ppm (Fig. 5). However, the means of TDS for positive sites of *L. natalensis*, *B. truncatus* and *B. alexandrina* snails represented 286, 283 and 603 ppm respectively, while infected snails were reported at 237, 391 and 870 ppm respectively. El-Said (1997) found higher snail numbers at total dissolved salts range of 340-600 ppm, while at higher levels than 600 ppm, the number of snail vectors of *Fasciola* sp. and *Schistosoma* sp. were decreased.

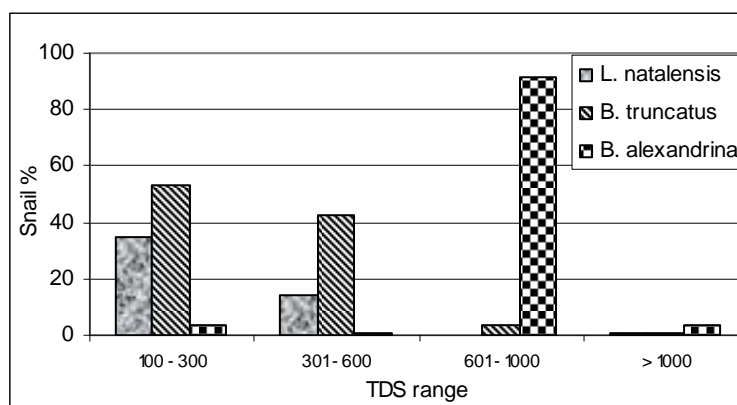


Fig. 5: Percentages of different snails species collected from water of different total dissolved salts (TDS).

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ARABIC SUMMARY

تأثير بعض العوامل البيئية على توزيع قواقع معينه من العوائل الوسيطة فى خمس محافظات مصرية

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فى هذه الدراسة تم عمل مسح لإنتشار و معدل توزيع قواقع العوائل الوسيطة لطفيلي الفاشيولا و البلهارسيا فى بعض المواقع من خمس محافظات مصرية و هى الجيزة و الشرقية و الإسماعيلية و البحيرة و دمياط. حيث أن توزيعها يختلف فى تلك المحافظات و أن قواقع ليمنيا ناتالينسيس كانت الأكثر إنتشاراً حيث تواجدت فى 44.1% من المواقع، بينما كانت نسبة قواقع بولينيس ترنكاتس 26.9% و لكن قواقع بيومفلاريا أليكسندينا كانت الأقل إنتشاراً حيث و جدت فى 4.9% من المواقع. أما قواقع ليمنيا و بولينيس و بيومفلاريا المصابة بالعدوى فكانت 1.96% و 3.4% و 0.98% من المواقع على الترتيب. كما تواجدت قواقع ليمنيا و بولينيس المصابة بمحافظتى دمياط و البحيرة، أما قواقع بيومفلاريا المصابة فوجدت بمحافظة الجيزة فقط. و كان فصل الربيع الأعلى فى نسبة القواقع المجمعة بنسبة 38.9%، بينما كان فصل الصيف الأقل بنسبة 8.8%. و كانت محافظات البحيرة و دمياط و الجيزة الأعلى فى نسب إنتشار قواقع بيومفلاريا و بولينيس و ليمنيا بنسب 4.16 و 0.51 و 4.38 قواقع/موقع على الترتيب. كما وجد أن بعض العوامل البيئية تؤثر على إنتشار القواقع حيث وجد أن متوسط درجات الأس الهيدروجينى للمواقع الإيجابية للقواقع المجمعة هى 6.8 و درجة حرارة 26.7 درجة مئوية. بينما و جدت قواقع ليمنيا و بولينيس عند متوسط درجة توصيل كهربى و أملاح ذائبة كلية 415.5 ميكروموس/سم و 284.5 جزء فى المليون ، أما قواقع بيومفلاريا فكانت عند 418 ميكروموس/سم و 603 جزء فى المليون على الترتيب.