Snail Survey in Water Canals for Detecting Their Infection with Parasitic Trematodes in Al-Fayoum Governorate, Egypt

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ABSTRACT

Freshwater snails have significant consideration as they may act as intermediate hosts of several parasitic infections, mainly trematodes that may cause serious diseases in humans and domestic animals. In Egypt, these are most notably schistosomiasis and fascioliasis. The aim of this study is to survey and examine fresh water snails in some water courses of rural districts at Al-Fayoum governorate for the presence of parasitic infective stages. Eight different watercourses were involved in this study. Snail sampling was conducted seasonally between spring 2018 to winter 2019. Eleven Trematode species of fresh water snails were detected in the chosen watercourses, out of them only 5 species were naturally infected with trematodes, (e.g. B. alexandrina with Schistosoma mansoni, B. trancatus with S. haematobium). Information gained from such studies supposed to help in giving indication on the risk sites and times where the snail vectors of trematodes should be attacked.

KEY WORDS: Fresh-water snails, Trematode, Schistosomes, Parasites and Al-Fayoum governorate.
INTRODUCTION

Freshwater snails have significant consideration as they may act as intermediate hosts of several parasitic infections, mainly trematodes that may cause serious diseases in humans and domestic animals [1]. Globally, 350 snail species are estimated to be of possible medical or veterinary importance. Most intermediate snail hosts of human Schistosoma parasites belong to three genera, Biomphalaria, Bulinus and Oncomelania. The species involved can be identified by the shape of the outer shell. Simple regional keys are available for the determination of most species. The snails can be divided into two main groups: aquatic snails that live under water and cannot usually survive elsewhere (Biomphalaria, Bulinus), and amphibious snails adapted for living in and out of water (Oncomelania). In Africa and the Americas, snails of the genus Biomphalaria serve as intermediate hosts of S. mansonii. Snails of the genus Bulinus serve as the intermediate hosts of S. haematobium in Africa and the Eastern Mediterranean, as well as of S. intercalatum in Africa. In south-east Asia, Oncomelania serves as the intermediate host of S. japonicum, and Tricula as the intermediate host of S. mekongi. Among the snail intermediate hosts of trematodes, the species belonging to the genus Lymnaea are of importance in the transmission of liver flukes. Lymnaea species may be either aquatic or amphibious [2].

In Egypt a survey carried out in Al-Fayoum governorate during Summer and Autumn of 2004, for snails of medical importance, nine species were recovered. These were Biomphalaria alexandrina, B. glabrata, B. pfeifferi, Bulinus truncatus, B. forskalii, Lymnaea natalensis, Bellamya unicolor, Physa acuta and Hydrobia musaensis. Parasitological examination revealed that B. alexandrina, B. glabrata and L. natalensis harboured immature stages of their concerned trematode parasites. Moreover, P. acuta harboured the immature stage of the nematode parasite Parastrongylus cantonensis[3].

Therefore, this work evaluated the current distribution of certain snail species of medical importance in water courses at Al-Fayoum governorate (2018-2019) and their role in transmission of human and veterinary trematode parasites (e.g. Schistosomiasis and fascioliasis).

Materials and methods

This study was conducted in Al-Fayoum Governorate. Eight different watercourses were involved (Senours, Bahr dissia, Hawaret el-maktaa, Bahr El- nazlah, Taton, Kasr El-gebali, Kasr Elbanat and Aboksah). They were selected on the basis of being next to agriculture areas and having obvious human water contact sites. Snail survey in these water courses was conducted seasonally from spring, 2018 to winter, 2019 using a standard dip net [4]. The physical and chemical parameters of water were measured directly in the selected watercourses.

The collected snails were transferred to Medical Malacology Laboratory, Theodor Bilharz Research Institute in ice box for sorting, identification and examination for their natural trematode infection [5].

Result

The present data (Table 1) elicited that eleven species of fresh water snails were detected in the chosen watercourses: Biomphalaria alexandrina, Bulinus truncatus,
Lymnaea natalensis, Melanoides tuberculata, Lanistes carinatus, Cleopatra bulimoides, Pila ovata, Theodoxus niloticus, Bellamya unicolor, Pseudosuccinea columella and Physa acuta. From the eleven species only 5 snails were naturally infected with trematodes; Biomphalaria alexandrina, Bulinus truncatus, Melanoides tuberculata, Lanistes carinatus and Cleopatra bulimoides. Also, three species of trematodes cercariae were recorded; two of them were from B. alexandrina snails (Schistosoma mansoni and Echinostoma liei) and the third was from B. truncatus (Schistosoma haematobium).

During spring, the water course Bahr dissia was characterized by the highest density of collected snail species (1961 snails) with 976 naturally infected snails out of the total number of snails collected from this watercourse (49.77% infection rate, Table 2).

Regarding the summer season, the watercourses Bahr El-nazlah and Aboksah were found free from snails. Meanwhile, Hawaret el-maktaa was the highest infested with snail species (1668 snails) with 77.94% naturally infected snails out of the collected snails from this watercourse (Table 2).

For the autumn season, the watercourses Bahr El-nazlah and Aboksah were found free from snails but, Bahr dissia and Hawaret el-maktaa watercourses were characterized by approximately similar snail density (242 and 235 snails, respectively) with the highest infection rate in Hawaret el-maktaa (61.28%) of total number of collected snails from this watercourse.

<table>
<thead>
<tr>
<th>Snail Species</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanistes carinatus</td>
<td>7 (3)</td>
<td>7 (3)</td>
<td>9 (3)</td>
</tr>
<tr>
<td>Cleopatra bulimoides</td>
<td>14 (8)</td>
<td>2 (1)</td>
<td>16 (8)</td>
</tr>
<tr>
<td>Pila ovata</td>
<td>4 (0)</td>
<td>7 (0)</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Theodoxus niloticus</td>
<td>10 (0)</td>
<td>6 (0)</td>
<td>9 (0)</td>
</tr>
<tr>
<td>Bellamya unicolor</td>
<td>5 (0)</td>
<td>4 (0)</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Pseudosuccinea columella</td>
<td>13 (0)</td>
<td>10 (0)</td>
<td>12 (0)</td>
</tr>
<tr>
<td>Physa acuta</td>
<td>179 (0)</td>
<td>15 (0)</td>
<td>26 (0)</td>
</tr>
<tr>
<td>Total no. of Snails</td>
<td>4808 (1583)</td>
<td>2831 (1642)</td>
<td>864 (395)</td>
</tr>
<tr>
<td>% of naturally infected snails</td>
<td>32.92</td>
<td>58.04</td>
<td>45.72</td>
</tr>
</tbody>
</table>
inter season, the watercourse Kasr El-Geballi was also found free from snails. However, Hawaret el-maktaa was infested on by with 99 snails and Bahr dissia exhibited 34.09% naturally infected snails out of the total number of collected snails from this watercourse (Table 2).

**Table (1): Population density of collected and trematode infected snails from the examined watercourses during the four seasons (Spring, 2018 to Winter, 2019).**

<table>
<thead>
<tr>
<th>Snail Species</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Biomphalaria alexandrina</em></td>
<td>4432 (1553)</td>
<td>2696 (1621)</td>
<td>732 (370)</td>
<td>215 (65)</td>
<td>8075 (3609)</td>
</tr>
<tr>
<td><em>Bulinus truncates</em></td>
<td>68 (11)</td>
<td>50 (12)</td>
<td>28 (8)</td>
<td>13 (3)</td>
<td>159 (34)</td>
</tr>
<tr>
<td><em>Lymenae natalensis</em></td>
<td>59 (0)</td>
<td>23 (0)</td>
<td>11 (0)</td>
<td>18 (0)</td>
<td>111 (0)</td>
</tr>
<tr>
<td><em>Melanoides tuberculata</em></td>
<td>17 (8)</td>
<td>11 (5)</td>
<td>17 (6)</td>
<td>4 (2)</td>
<td>49 (21)</td>
</tr>
</tbody>
</table>

*Number of infected snails is between brackets.*

**Table (2): Population density of collected and trematode infected snails in the examined watercourses during the four seasons (spring, 2018 to winter, 2019)**

<table>
<thead>
<tr>
<th>Watercourse</th>
<th>Senoures</th>
<th>Bahr dissia</th>
<th>Hawaret el-maktaa</th>
<th>Taton</th>
<th>Kasr Elbanat</th>
<th>Kasr El-geballi</th>
<th>Bahr El-nazlah</th>
<th>Aboksah</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>397 (11)</td>
<td>1961 (976)</td>
<td>727 (201)</td>
<td>541 (188)</td>
<td>373 (43)</td>
<td>327 (41)</td>
<td>250 (98)</td>
<td>232 (25)</td>
<td>4808 (1583)</td>
</tr>
<tr>
<td>Summer</td>
<td>20 (4)</td>
<td>755 (213)</td>
<td>1668 (1300)</td>
<td>240 (85)</td>
<td>75 (13)</td>
<td>73 (27)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>2831 (1642)</td>
</tr>
<tr>
<td>Autumn</td>
<td>18 (5)</td>
<td>242 (101)</td>
<td>235 (144)</td>
<td>171 (88)</td>
<td>128 (35)</td>
<td>70 (22)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>864 (395)</td>
</tr>
<tr>
<td>Winter</td>
<td>27 (9)</td>
<td>88 (30)</td>
<td>99 (19)</td>
<td>49 (10)</td>
<td>33 (6)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>296 (74)</td>
</tr>
<tr>
<td>Total</td>
<td>462 (29)</td>
<td>3046 (1320)</td>
<td>2729 (1664)</td>
<td>1001 (371)</td>
<td>609 (97)</td>
<td>470 (90)</td>
<td>250 (98)</td>
<td>232 (25)</td>
<td>8799 (3694)</td>
</tr>
</tbody>
</table>

% naturally infected

<table>
<thead>
<tr>
<th></th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of naturally infection</td>
<td>6.28</td>
<td>43.34</td>
<td>60.97</td>
<td>37.06</td>
<td>15.93</td>
</tr>
</tbody>
</table>

*Number of infected snails is between brackets.*
Fig (1): Population density of snails in the examined watercourses during the four seasons (spring,2018 to winter,2019) at Al-Fayoum Governorate

Fig(2): Percentage of naturally infected snails in the examined watercourses during the four seasons (spring,2018 to winter,2019) at Al-Fayoum Governorate
From the previous data, the total number of collected snails is 8799 snail/year (Table 2 and Fig 1), the highest snails density was recorded in spring season (4808 snails). Out of the total number of snails collected/year, 3694 snails were found infected with trematodes cercariae, the highest infection rate was recorded during summer season (1642 snails).

Regarding the distribution of snails among the selected water courses, Bahr dissia, Hawaret el-makta and Taton were contain high snails density among the selected watercourses recording 3046, 2729 and 1001 snails/year, however in distribution of naturally infection snails, Hawaret el-makta recorded the highest infection rate during four season.

Discussion

Many species of fresh water snails are intermediate hosts of trematode parasites, which pose serious risks to human and livestock and can adversely affect both agricultural practices and the economy. Water resources development schemes, particularly irrigation ones, can contribute to the introduction and spread of the snail intermediate hosts of parasitic trematodes and facilitate human contact with parasitic risk foci [6]. Therefore, the present study was concerned with snail survey in different water courses at Al-Fayoum Governorate for detecting their infection with trematode parasites during four seasons (spring, 2018 to winter, 2019).

From the present study, it was generally observed that population density of fresh water snails are variable in various habitats and seasons. Thus, the highest number of collected snails during the study period was recorded during spring, 2018 while the lowest one was during winter, 2019. This may be correlated with the recorded water temperature during the study period, as the mean water temperature during spring was 22.9°C and was 14.4°C during winter. This finding is in agreement with that of El-Emamand Roushd [7] who recorded that the optimum water temperature for the snail intermediate hosts of schistosomaisis was between 22-26°C. However, Kariuki [8] did not find a significant link between snail abundance and water temperature.

The pattern of snail intermediate hosts distribution in watercourses and the prevalence of their infection with trematodes are among the measurable indicators that reflect the magnitude of transmission [9]. Kishk [10] studied the status of distribution of snail vectors of schistosomiasis and the transmission of the disease in Al-Fayoum governorate and concluded that prevalence of schistosomiasis was substantially high in the hamlets (20–30%) compared to 2–3% in the main village. Such a highly infected community represents a continuous pool of reinfection of the waterways, an issue that needs to be further examined to determine its relation to the hamlets’ specific ecosystem characteristics.

In the present study, status of the snail intermediate hosts of schistosomiasis distribution was recorded in many hamlets in Al-Fayoum Centers during 2018-2019. Results showed that B. alexandrina snails, the vector of Schistosoma mansoni, were highly distributed in all types of examined watercourses selected (canals and drains) with infestation percentage of 91.77% (9482 snails in 2018 and 3694 in 2019).
8075 snails collected out of 8799 snails).

Natural infection of B. alexandrina with S. mansoni was observed in all selected watercourses with infection rate (44.69 %). Meanwhile, B. truncatus snails were observed in all watercourses with infestation percentage of 1.81 % and 159 collected snails/8799 snails. Naturally infected B. truncatus with S. haematobium was observed only in Senours, Bahr dissia, Hawaret el-maktaa, Kasr Elbanat and Taton watercourses with infection rate 21.38%. The present natural infection percentage, among B. alexandrina and B. truncatus, were relatively higher than those in previous studies.

For more exploration, Habib [11] studied the effect of geographical distribution of B. alexandrina snails on their susceptibility to Schistosoma mansoni infection in some localities in Egypt and found very low natural S. mansoni infection, 0.38%, among the collected snails. Also, [12] revealed that natural snails infection can occur in Nile especially in sites where fishing and agricultural activities, but mostly by low ratio for B. alexandrina and B. truncatus snails 0.71% and 0.29, respectively.

On the other hand, the strategic plan designed by the research may perhaps affect the results of certain study. The study of Aboelhadid [13] in Al Fayoum may verify this issue. The authors studied digenetic larval stages in relevant snails, applying a PCR molecular system to diagnose trematodal infection after being negative by the usual microscopic method. The authors recoded 14.84% infection rate among the examined B. alexandrina.

The records of previous authors more or less matches with that recognized by Wanas [14] and Aboelhadid [15] as well, in which 10.50 % and 5.50 % infection rates among snails collected from Giza and Beni-Suef districts respectively.

The present survey recorded some other types of snails next to B. alexandrina & B. truncatus snails, e.g. Physa acuta, Lymnaea natalensis, Cleopatra bulimoides and Melanoides tuberculata. The highest association percentage of each of B. alexandrina and B. truncatus were with Physa acuta followed by L. natalensis. In the meantime, both snails Pila ovata and Bellamya unicolor showed the lowest association with B. alexandrina and B. truncates.

Previous studies recorded the association between B. alexandrina and B. truncatus snails with other snail species. Yousef [16] found that B. alexandrina snails were positively associated with L. carinatus and C. bulimoides while B. truncatus snails were found to be positively associated with Physa acuta snails. Also, Abdel Kader [17] and Abdel Kader [18] reported that B. alexandrina snails mostly existed with L. carinatus and Physa acuta snails. However Frandsen [19], Frandsen & Christensen [20], Madsen & Frandsen [21] and Madsen [22] found that the presence of Helisoma duryi caused an important reduction in the growth of infected Biomphalaria pfeifferi, B. glabrata, B. camerunensis and B. alexandrinawhen being in a direct competition situation.

**CONCLUSION**

The present study aimed to reveal initially vital issues related to the current status of medically important snails, the essential hosts in the life cycle of parasitic
trematodes. The current study revealed that Fayoum water canals harbour many fresh water snails, some of them were found infected with cercariae of trematodes of medically importance. Snails are possibly affected by unsettled and disturbed ecosystem which needs repeated investigations considering the variable influencing factors.

References


