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Survey and population dynamics of freshwater snails in newly settled areas of the Sinai Peninsula

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ABSTRACT

A general survey and the seasonal dynamics of freshwater snails in two irrigation and three drainage channels were carried out in El-Abtal village east of Ismailia governorate during July 1999 – June 2000. The survey revealed the occurrence of 12 species of freshwater snails belonging to 9 families and two subclasses of class Gastropoda. From subclass Prosobranchia, one species was obtained from each of the families Neritidae, Viviparidae, Ampullariidae, Valvatidae, Bithyniidae and two species from the family Thiaridae; while from subclass Pulmonata two species were found from the families Lymnaeidae and Planorbidae and also species from the Physidae. Out of 19640 collected snails, 13975 (71.2%) were obtained from irrigation channels and 5665 (28.8%) from drainage channels. Higher abundance of collected snails from both water systems (18.4%, 16.8% and 17.1%) was reported in April, May and June respectively. No snails were found in the drainage channels during January and February and only low abundance in irrigation channels (0.1% of total snails collected).

Melanoides tuberculata and *Cleopatra bulimoides* (family: Thiaridae) were very abundant in both systems, representing 7598 (38.7%) and 5728 (29.2%) respectively of all collected snails. The *Odoxus niloticus* (family: Neritidae) accounted for 2457 (12.5%) of total snails. Lowest abundance was seen by *Lymnaea columella* and *Lymaea truncatula* (family: Lymnaeidae) (0.1%). Monthly fluctuation of snail species was reported, *Theodoxus niloticus, Melanoides tuberculata* and *Cleopatra bulimoides* were present throughout the year. Winter months (November to February) showed few numbers of some snail species and others were nearly absent. Chemical properties of the water in both systems were analysed and the data obtained are discussed.

KEYWORDS: freshwater snails, survey, population dynamics.

INTRODUCTION

The Sinai Peninsula is a unique area in Egypt with regards its geographical location, topographical nature and fauna. Several ambitious developmental programs have been planned and started in Sinai. The most important seems to be "El Salam canal". This project aims to transfer water from the Nile, via pipes underneath the Suez Canal, to newly reclaimed areas of more than 500,000 acres of Sinai desert to the East. The first stage of this canal is already functioning and Nile water is now available for the East side of Ismailia governorate. The goal of this stage includes the reclamation and cultivation of 100,000 acres and the establishment, over the next 5 years, of 35 new village settlements holding 450-500,000 inhabitants - most of them new graduates.

Freshwater snails play an important role in fresh water ecosystems and some transmit serious diseases to humans, animals and fish (Salem *et al.* 1993; Yousif *et al.* 1993a). The danger of disease spreading into the new areas depends on the possible establishment of snail vectors (Atia *et al.* 1984; Kamel 1984; Salem *et al.* 1993; Yousif *et al.* 1993b, 1998a,b,c & 1999).

The present investigation aims to study the possible establishment of snail vectors of diseases in new settlement areas in Sinai and the seasonal abundance of these snails in irrigation

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and drainage channels. The chemical properties of the water in the two systems were also analysed and the major abiotic components measured.

MATERIALS AND METHODS

Area of investigation: The study site was El-Abtal village, twenty-five km. south of Ismailia, East of Suez Canal. It has been cultivated for 25 years using Nile water that enters through pipes underneath the Suez Canal. Most of this land is newly cultivated with many kinds of fruits and vegetables. For this study, two irrigation channels and three drainage systems were selected. El-Tamier channel, the main channel for irrigation, is approx. 6.5 km in length, 8-10 m wide and 4-5m deep. The second irrigation channel, El-Rafa El-Waty, is 4.5km long, 3-4m wide and 2-3m deep. The other three drainage channels were the main drain No. 3 (3 km long, 1.5-2m wide and 0.5-1.5m deep); the branch drain No. 22 (2 km long, 2-3m wide and 0.5-1.5m deep); and branch drain No. 43 (3 km long, 2-3m wide and 0.4-0.8m deep).

Sampling of snails: Monthly samples of freshwater snails were collected from the two irrigation and three-drain systems and examined for one year (July 1999 – June 2000). Sampling from both systems was carried out along a 200m length of channel using five dip nets, each measuring 33cm in length and width and 8cm in depth (WHO 1965).

Collected snails were transferred in plastic bags to the laboratory in the Plant Protection Department, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, where they were kept alive under laboratory conditions. They were counted and identified according to WHO (1965); Frandsen (1983) & Ibrahim *et al.* (1999).

Physicochemical properties of water: Water samples were analysed and the major abiotic components were measured. These included pH, EC, Salinity, Anions (HCO_3, Cl, SO_4 and CO_3); Cations (Mg, Na, K and Ca) and total suspended solids (TSS) according to Richards (1954) and Page *et al.* (1982).

Statistical analysis: The data obtained during the present study were statistically analysed. F-test for significant difference between means was used (Microstate Program and G.PIS).

RESULTS

12 species of freshwater snails, belonging to 9 families and two subclasses under class Gastropoda, were found in El-Abtal village. Subclass Prosobranchia included 6 families with 7 species and subclass, Pulmonata included 3 families with 5 species. Subclass Prosobranchia included the families: Neritidae, *Theodoxus* (*Neritena*) *niloticus* (Reeve1856); Viviparidae, *Bellamya unicolor* (Olivier 1804); Ampullariidae, *Lanistes carinatus* (Olivier 1804); Valvatidae, *Valvata nilotica* (Jickeli 1852); Bithyniidae, *Gabbiella senaariensis* (Kuster 1852); Thiaridae, *Milanoides tuberculata*, *Cleopatra bulimoides* (Olivier, 1804). In subclass Pulmonata the following families were discovered: Lymnaeidae, *Lymnaea columella* (Say 1817), *Lymanaea* (*Galba*) *truncatula* (Muller 1774); Planorbidae, *Biomphalaria alexandrina* (Ehrenberg 1831), *Bulinus* (*Isidora*) *truncatus* (Audouin 1827) and Physidae, *Physa acuta* (Draparnaud 1805).

As shown in Table 1, the numbers of snails collected from El-Tamier, El-Rafa El-Waty, D3, D22 and D43 were 8998, 4977, 1794, 2015 and 1856 respectively. Density of snails per m^2 of the above sites were 180, 135, 78, 119 and 81 respectively.

Table 1: Snail abundance in different water channels in El-Abtal village during July 1999 – June 2000

Type of channel	Irrigation channels			Drain channel			
Data	El-Tamier	El-Rafa El-Waty	Total	D3	D22	D43	Total
Length of channel (m)	6500	4500	11000	3000	2000	3000	8000
No. of stations	30	22	52	14	10	14	38
No. of dips/m^2	50	37	87	23	17	23	63
Total collected snail/year	8998	4977	13975	1794	2015	1856	5665
No. of snails/m	180	135	161	78	119	81	90
No. of snails/m^2/monthly	15	11	13	6.5	9.9	6.7	7.5

Monthly abundance of snails was studied in two irrigation channels and three drains from El-Abtal village during July 1999 to June 2000 (Figs 1, 2). Of 19640 snails collected during that year 8998 (47%) were collected from El-Tamier; 4977 (25.8%) from El-Rafa El-Waty; 1794 (9%) from D3; 2015 (10%) from D22 and 1856 (9%) from D43 (Fig 2b). The irrigation channel showed a higher abundance of snails than the drainage channel. April, May and June showed the highest collected number of snails (3608, 18.4%); (3295, 16.8%) and (3356, 17.1%) respectively. January and February showed low abundance of snails {16 (0.08%) and 26 (0.1%) respectively} (Fig 2ab). The same months also showed no snails in the drainage channels. June 2000 showed the maximum abundance of snails in the three drain channels; D3; D22 and D43 (543; 527 and 446 respectively) (Fig 1b). On the other hand, April showed the highest abundance in the irrigation channels; El-Tamier and El-Rafa El-Waty (1857 and 975 respectively) (Fig 1a). No significant difference was recorded between the irrigation and drainage channels.

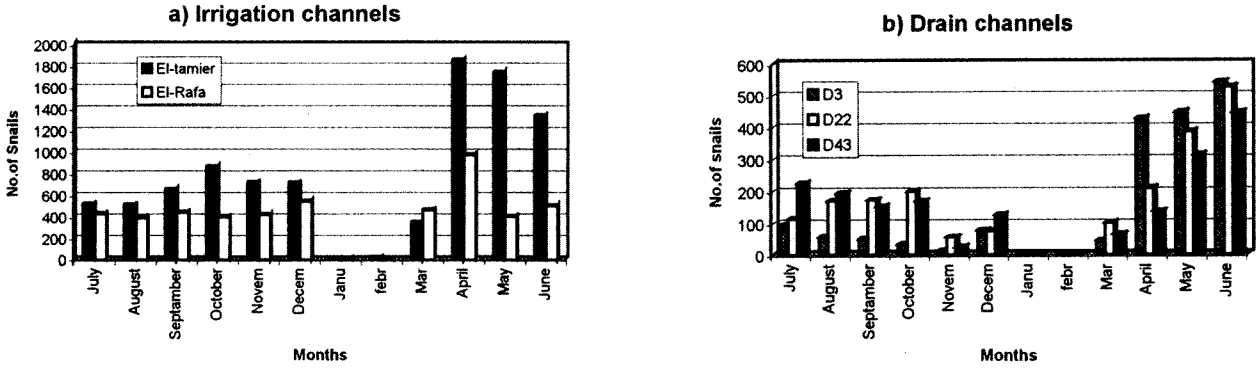

Fig. 1: Monthly abundance of total collected snails in El-Abtal village during July 1999- June 2000 a) irrigation channels b) drain channels

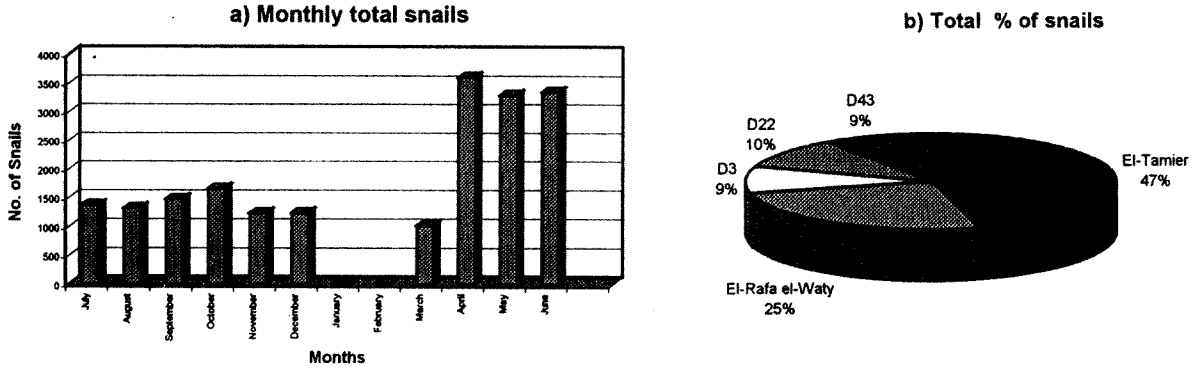

Fig. 2: Total number of Snails in El-Abtal village during July 1999 - June 2000 in irrigation and drain channels a) monthly total snails; b) total % of snails

Identification of snail species collected from El-Abtal village revealed 12 species belonging to 9 families in the two irrigation and the three drainage channels (Fig 3 a,b). Family Thiaridae includes two species (*Melanoides tuberculata* and *Cleopatra bulimoides*, they showed the highest rate of abundance in the irrigation and drainage channel {7598 (38.7%) and 5728 (29.2%) respectively} of the total collected snails (Fig 3 a,b).

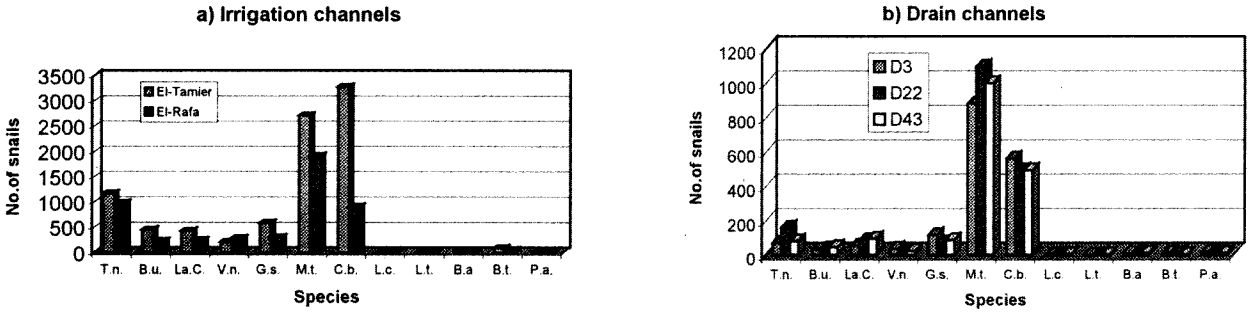

Fig. 3: Abundance of different snails' species collected from El-Abtal village during July 1999 - June 2000.
a) irrigation channels; b) drain channels. *T.n: Theodoxus Niloticus; B.u: Bellamya unicolor; La.c: Lanistes carinatus; V.n: Valvata nilotica; G.s: Gabbiella senaariensis; M.t: Milanoides tuberculata; C.b: Cleopatra bulimoides; L.c: Lymnaea columella; L.t: Lymnaea truncatula; B.a: Biomphalaria alexandrina; B.t: Bulinus (Isidora) truncatus; P.a: Physa acuta.*

On the other hand, Family Lymnaeidae included two species (*Lymnaea columella* and *Lymnaea truncatula*) with low abundance {24 (0.12%)} for both species. Table (2) shows the monthly abundance of *Melanoides tuberculata* and *Cleopatra bulimoides*, they were present throughout the year. June 2000 showed high numbers of *Melanoides tuberculata* (1574) and April 2000 a high abundance of *Cleopatra bulimoides* (1508). No snails were found in January and February except the two previous species and the *Theodoxus niloticus* species (Table 2). *Lymnaea columella* and *Lymnaea truncatula* were found only during July to October 1999.

Table 2: Monthly abundance of snails collected from irrigation and drain channels in El-Abtal village during July 1999 – June 2000. *T.n: Theodoxus Niloticus; B.u: Bellamya unicolor; La.c: Lanistes carinatus; V.n: Valvata nilotica; G.s: Gabbiella senaariensis; M.t: Milanoides tuberculata; C.b: Cleopatra bulimoides; L.c: Lymnaea columella; L.t: Lymnaea truncatula; B.a: Biomphalaria alexandrina; B.t: Bulinus (Isidora) truncatus; P.a: Physa acuta*

Species / Months	*T.n.*	*B.u.*	*La.c*	*V.n.*	*G.s.*	*M.t.*	*C.b.*	*L.c.*	*L.t.*	*B.a.*	*B.t.*	*P.a.*	Total
July 1999	210	89	172	1	10	543	344	2	1	3	3	2	1380
August	235	68	149	5	12	569	274	3	-	3	-	3	1321
September	301	74	109	3	12	720	228	5	11	7	4	1	1475
October	422	92	64	6	13	831	189	14	12	14	-	9	1666
November	462	19	44	36	10	436	185	-	-	14	5	24	1235
December	257	26	28	141	3	587	165	-	-	12	-	21	1240
January 2000	7	-	-	-	-	5	4	-	-	-	-	-	16
February	5	-	-	-	-	14	7	-	-	-	-	-	26
Marsh	66	5	8	228	7	492	201	-	-	-	10	5	1022
April	291	124	208	93	513	764	1508	-	-	-	86	21	3608
May	128	117	95	61	334	1090	1404	-	-	8	41	17	3295
June	73	177	33	-	256	1547	1219	-	-	12	23	16	3356
Total	2457	791	910	574.	1170	7598	4131	24	24	73	172	119	19640

The chemical properties of water in the two systems are summarized in (Table 3). Number of snails appears to be greatly affected by water quality as high numbers were observed in the irrigation channel as opposed to the drainage channel.

Table 3: Chemical analysis of water samples from irrigation and drain channels in El-Abtal village . (TSS = Total Suspended Solids).

Type of channels	Irrigation Channel		Drain Channel		
Chemical analysis	El-Tamier	El-Rafa El-Waty	D3	D22	D43
pH	7.9	7.8	7.5	7.6	7.5
EC (dsm^{-1})	0.33	0.31	1.52	1.48	1.48
Salinity	288.7	269.2	972.8	950.7	950.3
Anions (meq l^{-1})					
HCO_3^-	1.3	1.1	3.2	2.8	2.6
Cl^-	2.1	2.2	5.8	6.1	7.8
SO_4^{-2}	1.7	1.5	4.54	4.41	4.2
CO_3^{-2}	-	-	-	-	-
Cations (meg l^{-1})					
Mg^{2+}	1.4	1.3	2.6	2.8	2.5
Na^+	10.2	10.4	12.0	12.5	13.1
K^+	0.15	0.19	0.24	0.22	0.22
Ca^{2+}	1.1	1.15	1.4	1.3	1.3
TSS* (mg l^{-1})	2.95	3.1	8.0	4.48	7.95

DISCUSSION

Development of the Egyptian economy depends to great extent on increasing agricultural production by the reclamation and subsequent cultivation of parts of the desert in the Sinai Peninsula. Therefore, the projects of El-Salam canal (near Ismailia) and El-Sheikh Zaid canal (near Port Said) are very economically important projects.

Our survey of freshwater snails in two irrigation and three drainage channels revealed the occurrence of 12 species belonging to 9 families and two subclasses under class Gastropoda. This survey of freshwater snails agrees with Ibrahim *et al.* (1999) and Yousif *et al.* (1993b, 1998c & 1999) who studied the distribution and abundance of *Biomphalaria alexandrina* and *Bulinus truncatus* in two newly reclaimed areas located West and East of Suez Canal, namely El-Manayef and Morra areas. The results confirmed the occurrence of both *Schistosoma mansoni* and *S. haematobium* transmission. This consequently proves that reclamation of desert land utilizing Nile water had led to the spread of Schistosomiasis to these areas.

Results of the total collected snails during the study period indicate that the most effective ecological factors acting upon snail population density in irrigation channels may be the water depth, aquatic weeds and water temperature. Atia *et al.* (1984) studied the snail population dynamics near Zagazig and found that July showed high abundance while November showed low abundance. Yousif *et al.* (1993b) in their study of *Biomphalaria alexandrina* in Giza and Qalyobiya governorates (1988 – 1990) found two peaks in April – May. Studying the seasonal population is important for snail control. Most authors recommended that the application of snail control measures should coincide with the time when the snails are abundant, when their populations have built up and when conditions are optimal for their breeding and survival (Kamel 1984). Abd El-Latif (1985) reported that *Lymnaea caillaudi* snails were more frequent in

channels than in drains. He also observed their low density in summer and their gradual increase to a maximum density in spring. This may be due to favorable temperature and abundant vegetation in this season.

It has been observed that the different chemical constituents of water play some role in the occurrence of the different species of snails. In snail habitats, low concentrations of different chemicals were found in localities harboring *Bulinus*. Higher concentrations of different chemicals affect population fluctuation and species occurrence.

It was found that number of snails in both El-Tamier and El-Rafa El-Wati water was greater than the other drain water sources. So by increasing water salinity (EC, dSm^{-1}) the number of snails was decreased. It was obviously noted that the high salinity level in the drains (D3, D22 & D43) usually reduced the number of snails. Also, increasing anion and cation concentrations as result of salinity has a similar effect on the number of snails. Thus, the irrigation channels usually have higher number of snails than the drainage channel sources The number of snails was decreased with increasing the TSS.

Finally, the snails' abundance was obvious in localities with a swift current of water. This supports the observations of Gohar & El-Gindy (1962).

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الملخص العربى

حصر وتعداد قواقع المياه العذبة في مناطق الاستصلاح الحديثة في شبه جزيرة سيناء

جمال القاضى ،احمد شكرى ، ليلى رضا ، ياسر البدرى

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تم إجراء حصر عام لقواقع المياه العذبة في قناتين للري وثلاث قنوات صرف بقرية الأبطال شرق محافظة الإسماعيلية خلال الفترة من يوليو ١٩٩٩ حتى يونيو ٢٠٠٠، وقد أظهرت نتائج الدراسة وجود ١٢ نوع تنتمي إلى ٩ فصائل تابعة لتحت صفين: تحت صف بروسوبرنكيا (Prosobranchia) وتحت صف بولموناتا (Pulmonata)، وكلاهما يتبعان صف: جاستروبودا (Gastropoda).

١- كان توزيع الأنواع التابعة لتحت صف بروسوبرنكيا (Prosobranchia) كالتالى: تم تسجيل نوع واحد فقط فى كل من الفصائل التالية: نيريتيديا Neritidae، فيفيباريديا Viviparidae، أمبولاريديا Ampullariidae، فالفاتيديا Valvatidae، بيثينيديا Bithyniidae بالإضافة إلى نوعين من فصيلة ثياريديا Thiaridae

١- كان توزيع الأنواع التابعة لتحت صف بولموناتا (Pulmonata) كالتالى: تم تسجيل عدد ٢ نوع فى كل من الفصلتين: فصيلة ليمنايديا Lymnaeidae، وفصيلة بلانوربيديا Planorbidae، بالإضافة إلى نوع فقط تابع لفصيلة فيسيديا Physidae.

أيضا من خلال الدراسة تم جمع ١٩٦٤٠ قوقع ، منها ١٣٩٧٥بنسبة (٧١,٢ %) جمعت من قنوات الري و ٥٦٦٥ بنسبة (٢٨.٨ %) جمعت من قنوات الصرف . وقد سجل اعلي تعداد للقواقع خلال شهر أبريل ومايو ويونيو في النظامين: الري والصرف، حيث كانت نسب التعداد من المجموع الكلي هي ١٨,٤ % و١٦,٨ % و ١٧,١ % علي الترتيب. بينما اظهر شهر يناير وفبراير عدم تسجيل قواقع في قنوات الصرف بينما وجدت كثافة قليلة في قنوات الري بنسبة (٠,١ %) من المجموع الكلي للقواقع التي تم جمعها . وقد لوحظ أن النوعين:

Melanoides tuberculata and *Cleopatra bulimoides* (Family: Thiaridae)

قد سجلا اعلي كثافة في النظامين (الري والصرف) حيث كان تعدادهما ٧٥٩٨ (٣٨,٧%) و ٥٧٢٨ (٢٩,٢ %) علي التوالي وذلك بالنسبة لتعداد المجموع الكلي، يتبعهما النوع: *Theodoxus niloticus* (Family: Netiridae) بتعداد ٢٤٥٧ (١٢,٥ %). كما لوحظ ان اقل كثافة تواجد للأنواع هي:

Lymnaea columella and *Lymaea truncatula* (Family: Lymnaeidae)

حيث سجلت أعدادها ٢٤ فرد بنسبة (٠,١ %) من المجموع الكلي للأعداد .

وعند دراسة التعداد الشهري للقواقع فقد سجلت الأنواع الآتية على مدار العام كله وهى:

Theodoxus niloticus , Melanoides tuberculata and *Cleopatra bulimoides*

أيضا لوحظ أن اشهر الشتاء من نوفمبر حتى فبراير أظهرت اقل تعداد لأنواع القواقع . وقد تمت مناقشة النتائج مع ما تحصل علية من تحاليل كيميائية للماء في كلا من النظامين.