

## Population dynamics of freshwater snails (Mollusca: Gastropoda) at Qena Governorate, Upper Egypt

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### ABSTRACT

Monthly and seasonal fluctuations in densities of freshwater snails were recorded in six different sites at Qena Governorate during the period of March 2009 February 2010. The study revealed the occurrence of 13 species of freshwater snails belonging to 9 families of class Gastropoda. The snail species and their total catch were: *Cleopatra bulimoides* (1704 specimens), *Lanistes carinatus* (1468 specimens), *Melanoides tuberculata* (1036 specimens), *Gabbiella senaariensis* (731 specimens) *Theodoxus niloticus* (670 specimens), *Bellamyia unicolor* (588 specimens), *Physa acuta* (213 specimens), *Lymnaea natalensis* (145 specimens), *Succinea cleopatra* (85 specimens), *Bulinus truncatus* (73 specimens), *Biomphalaria alexandrina* (41 specimens), *Gyraulus ehrenbergi* (12 specimens) and *Helisoma duryi* (2 specimens) in a descending order. The densities of the recorded snails varied seasonally and the general seasonal peak was recorded during Autumn while the lowest density observed during Winter. Ecological factors which may influence the distribution of the recorded snails were also determined (water temperature, pH, dissolved oxygen conductivity, total hardness, total dissolved salts, water depth and percentage of macrophytes).

**Keywords:** Population dynamics , snails ,Qena Governorate, Egypt

### INTRODUCTION

Freshwater molluscs have been known to play significant roles in the public and veterinary health and thus need to be scientifically exploring more extensively (Supian & Ikhwanuddin, 2002). About 100 species of freshwater gastropods are reported to act as intermediate hosts for the diagnostic trematode parasites and among Prosobranchs, members of the family Pilidae and Thiaridae were recorded to harbor larval trematodes (Subba-Rao, 1993). Several factors are considered as affecting the ecology of snails and other intermediate hosts of diseases, hence their focal and seasonal distributions. These include physical factors such as water current, temperature, turbidity, transparency and distribution of suspended solids, chemical factors such as ion concentration and dissolved gases in water as well as biological factors such as availability of food, competition and predator-prey interactions (Williams, 1970; Ofoezie, 1999). Besides, the aquatic macrophytes have been shown to play vital roles in the distribution of snails in different parts of Africa (Ofoezie, 1999). However, the importance of different ecological factors vary significantly from one ecological zone to the other and even from one water body to the other, suggesting local investigations to identify important factors in each zone or water bodies (Dazo *et al.*, 1966; Klumpp & Chu, 1977; Imevbore *et al.*, 1988; Ofoezie, 1999). Many studies concerned with the ecology and population dynamics of the

group of gastropods which play an important role in transmitting diseases to man and his livestock have been conducted by Abd El-Malek (1958); Dazo *et al.* (1966); Barbosa & Barbosa (1994); Utzinger *et al.* (1997); Kloos *et al.* (2001); Karimi *et al.* (2004); Cañete *et al.* (2004) Kazibwe *et al.* 2006 and Mostafa, 2009). These studies have led to general opinion; that the development of an effective strategy of integrated control requires the study of population dynamics of the intermediate hosts and its relation to environmental factors. Population dynamics of these animals depend on the physical geography of a given region, also land contours, soil composition, hydrography and climate all have effect on snail population dynamics (El-Khayat *et al.*, 2011).

This study is intended to produce data on the distribution, monthly and seasonal variations in densities of gastropod molluscs at Qena Governorate with emphasis on environmental factors affecting them.

## MATERIALS AND METHODS

**Sites of investigation:** The collecting of snails was carried out in six sites at Qena Governorate, three sites situated on an irrigation canal (El-Kelabia) (sites I, II and III), while the other three sites found on the River Nile (sites III, IV and VI). These sites are: Ezbt El-Bosa (Naj Hamadi) (I) ( $26^{\circ} 06' N / 32^{\circ} 20' E$ ); Faw Bahary (II) ( $26^{\circ} 06' N / 32^{\circ} 22' E$ ); Dandara (III) ( $26^{\circ} 09' N / 32^{\circ} 40' E$ ); El-Halla (Qus) (IV) ( $25^{\circ} 54' N / 32^{\circ} 46' E$ ); El-Madamod (Luxor) (V) ( $25^{\circ} 44' N / 32^{\circ} 42' E$ ) and El-Bogdade (Luxor) (VI) ( $25^{\circ} 39' N / 32^{\circ} 36' E$ ), (Fig. 1).

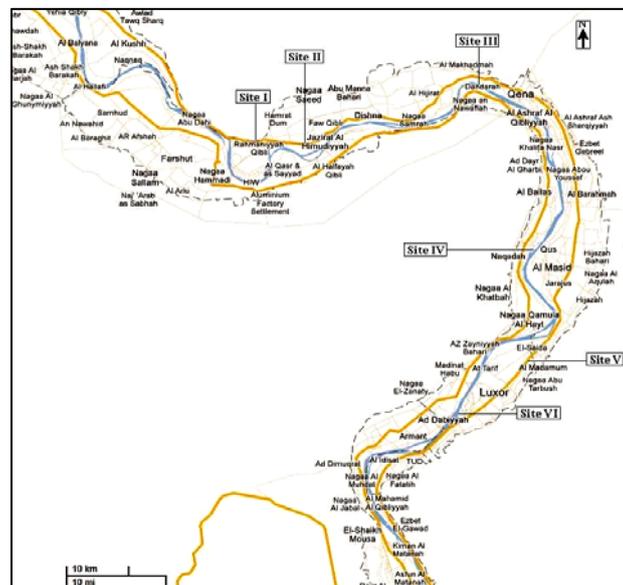


Fig. 1: A map showing the sites of investigation

**Sampling of snails:** Monthly samples of freshwater snails were collected from the six sites during a period of one year (from March, 2009 till February, 2010). Sampling was carried out along the shoreline of each site and always by the same collector. Snails were collected by passing a dip net (30 cm×40 cm) five times through the upper surface of sediment, water and vegetations on a depth of 20 cm (a column of water as parallel rectangles and its base is the rectangular net). The snails attached to the macrophytes were separated and all collected snails were kept in pre-labeled plastic containers. In the laboratory, the snails were counted and identified according

to Brown (1994) and Ibrahim *et al.* (1999) keys' then preserved in 70% ethyl alcohol. The density of each species was calculated as the number of specimens present in the five samples at the volume of water column as parallel rectangles, which was calculated as 120000 cm<sup>3</sup>.

**Ecological factors:** Water temperature, pH, dissolved oxygen, conductivity and total dissolved salts were measured by digital probe apparatuses. Calcium and magnesium concentrations were evaluated by the Atomic Absorption Spectrophotometer and total hardness was calculated according to Vermani & Narula, 1995. Water depth (cm) was measured by a wooden meter. The percentage of macrophytes was determined according to Owojori *et al.* (2006) by simple estimation of the proportion of a site covered by floating and anchored plants and scored as 1 for <10%, 2 for 10-30%, 3 for 31-50%, 4 for 51-70% and 5 for >70%.

**Statistical analysis:** Analysis of Variance on SPSS software package (version 16) (SYSTAT statistical program) was used to test the present data. Perrson correlation coefficients were calculated between the densities of the recorded species and environmental factors (all these variables were inserted in the analysis box of bivariate correlation).

## RESULTS AND DISCUSSION

A total of 13 snail species belonging to 9 families under class Gastropoda were collected from the sites of investigation during the study period. These species are: *Lanistes carinatus* (Olivier, 1804) (Ampullaiidae), *Bellamyia unicolor* (Olivier, 1804) (Viviparidae), *Cleopatra bulimoides* (Olivier, 1804), *Melanoides tuberculata* (Müller, 1774) (Thiaridae), *Theodoxus niloticus* (Reeve, 1856) (Niritidae), *Gabbiella senaariensis* (küster, 1852) (Bithyniidae), *Lymnaea natalensis* (Krauss, 1848) (Lymnaeidae), *Succinea cleopatra* (Pallary, 1909) (Succineidae), *Physa acuta* (Draparnaud, 1805) (Physidae), *Bulinus truncatus* (Audouin, 1827), *Biomphalaria alexandrina* (Ehrenberg, 1831), *Gyraulus ehrenbergi* (Beck, 1837) and *Helisoma duryi* (Wetherby, 1879) (Planorbidae).

As shown in Table (1), the total number of the collected snails was 6768 specimens, from which 2230, 225, 598, 1507, 959 and 1249 individuals were recorded at sites I, II, III, IV, V and VI respectively. By regarding these results, one can conclude that site I and site IV were rich in snails. It was observed that site I characterized by muddy substrate with organic matter; the shore profile is gradually sloping to the bottom; slow water current and rich in different types of water weeds. Site IV had a clay-sandy substratum with decaying matter and a lot of vegetations.

Table 1: The total relative densities of the snail species recorded from the studied sites during the period of investigation.

Site	<i>L. c.</i>	<i>B. u.</i>	<i>C. b.</i>	<i>M. t.</i>	<i>T. n.</i>	<i>G. s.</i>	<i>L. n.</i>	<i>S. c.</i>	<i>P. a.</i>	<i>B. t.</i>	<i>B. a.</i>	<i>G. e.</i>	<i>H. d.</i>	Total
I	823	386	141	116	0	703	3	0	55	3	0	0	0	2230
II	35	58	0	45	0	2	64	0	13	5	0	3	0	225
III	152	26	290	26	3	0	22	48	19	9	3	0	0	598
IV	40	90	505	163	528	21	19	27	82	14	15	3	0	1507
V	5	16	277	644	13	0	0	0	1	3	0	0	0	959
VI	413	12	491	42	126	5	37	10	43	39	23	6	2	1249
Total	1468	588	1704	1036	670	731	145	85	213	73	41	12	2	6768

*L. c.*: *Lanistes carinatus*; *B. u.*: *Bellamyia unicolor*; *C. b.*: *Cleopatra bulimoides*; *M. t.*: *Melanoides tuberculata*;  
*T. n.*: *Theodoxus niloticus*; *G. s.*: *Gabbiella senaariensis*; *L. n.*: *Lymnaea natalensis*; *S. c.*: *Succinea cleopatra*;  
*P. a.*: *Physa acuta*; *B. t.*: *Bulinus truncatus*; *B. a.*: *Biomphalaria alexandrina*; *G. e.*: *Gyraulus ehrenbergi*;  
*H. d.*: *Helisoma duryi*

These results are in accordance with Lacoursiere *et al.* (1975) and Vincent *et al.* (1982); they suggested that gastropod variability may be explained by abiotic factors (depth, current and sediment). Also Strzelec & Królczyk (2004) indicated that

many gastropod species are tolerant to most physicochemical water parameters and their occurrence is affected by the quality of bottom sediments and vegetation abundance and reported that the most suitable substrate for snails in rivers is a sandy bottom covered with thin layer of organic silt.

The values range of physico-chemical properties of water in the sampling stations are shown in table (2), and it was observed that the differences between sites were highly significant except for water temperature

Table 2: The values range of physico-chemical parameters recorded in water at the investigated sites

Site	W. T. °C	pH	DO2 ppm	Cond. mS	T. H. Mg/L	T.D.S. Mg/L	Ca <sup>2+</sup> Mg/L	W. D. Cm	Flo. P. %	An. P. %
I	16-28.7	6.8-7.8	4.8-9.3	0.26-0.71	91-279.8	155-430	16.3-64.1	55-100	-	30-90
II	16.5-28.2	6.4-7.9	4.2-8.4	0.26-0.47	79.9-203.5	155-445	24.1-44.1	77-130	-	10-70
III	18.4-27	6.9-7.8	6.4-9.5	0.28-0.93	103-437.8	168.1-638	26.6-77.5	42-70	<10-90	10-70
IV	18.7-27.3	6.95-8.2	6.4-8.9	0.25-0.51	72.2-180.9	147-304	16.03-48.1	54-89	-	30-80
V	16.5-26.6	7.3-8.3	6.3-12.5	0.24-0.59	92.4-168.8	145-243	29.5-56.1	72-160	<10-70	10-80
VI	17-25.3	7.24-7.95	6.8-9.5	0.24-0.67	93.1-255.1	146-402	14.6-44.1	45-85	<10-70	10-80

(W.T.: water temperature, DO2: dissolved oxygen, Cond.: conductivity, T. H.: total hardness, T. D. S.: total dissolved salts, W. D. water depth, Flo. P.: floating plants, An. P: anchored plants)

According to the numbers of collected snails, the species were arranged in a descending order as: *Cleopatra bulimoides* (1704 specimens), *Lanistes carinatus* (1468 specimens), *Melanoides tuberculata* (1036 specimens), *Gabbiella senaariensis* (731 specimens), *Theodoxus niloticus* (670 specimens), *Bellamyia unicolor* (588 specimens), *Physa acuta* (213 specimens), *Lymnaea natalensis* (145 specimens), *Succinea cleopatra* (85 specimens), *Bulinus truncatus* (73 specimens), *Biomphalaria alexandrina* (41 specimens), *Gyraulus ehrenbergi* (12 specimens) and *Helisoma duryi* (2 specimens) table(1).

Seasonally, the total catch of snails showed its highest value during Autumn (representing 38.8%), followed by Summer (24.8%), then Spring (18.6%), whereas the least catch was recorded in Winter (17.8%) Fig. (2). The present result agrees with Karimi *et al.* (2004) where they found that late Summer and Autumn had the optimal temperature required for breeding and reproduction of snails, and partially agrees with El-Kady *et al.* (2000); they stated that April, May and June showed the highest number of snails in Sinai Peninsula, while the lowest number was recorded during January and February.

#### - Monthly and seasonal variations of the recorded snail species

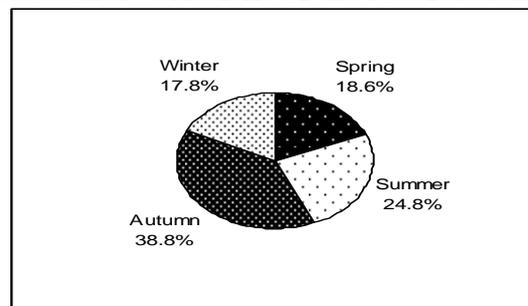


Fig. 2: The seasonal percentages of the snail species collected from the studied sites.

Also, partially agrees with Zaki (2008) who reported that the snail population was high in Autumn and low in Summer and Spring in Abis district, Alexandria. In

the contrary, Dazo *et al.* (1966) indicated that snails were abundant in summer, decline during late summer and undergo a lesser increase during Autumn, and Diab (1993) reported that the snail abundance was high in Spring and low in Summer in Beheira Province.

Figure (3) showed the monthly variations in the density of each snail species collected from the studied sites (except *G. ehrenbergi* and *H. duryi* due to the few numbers recorded).

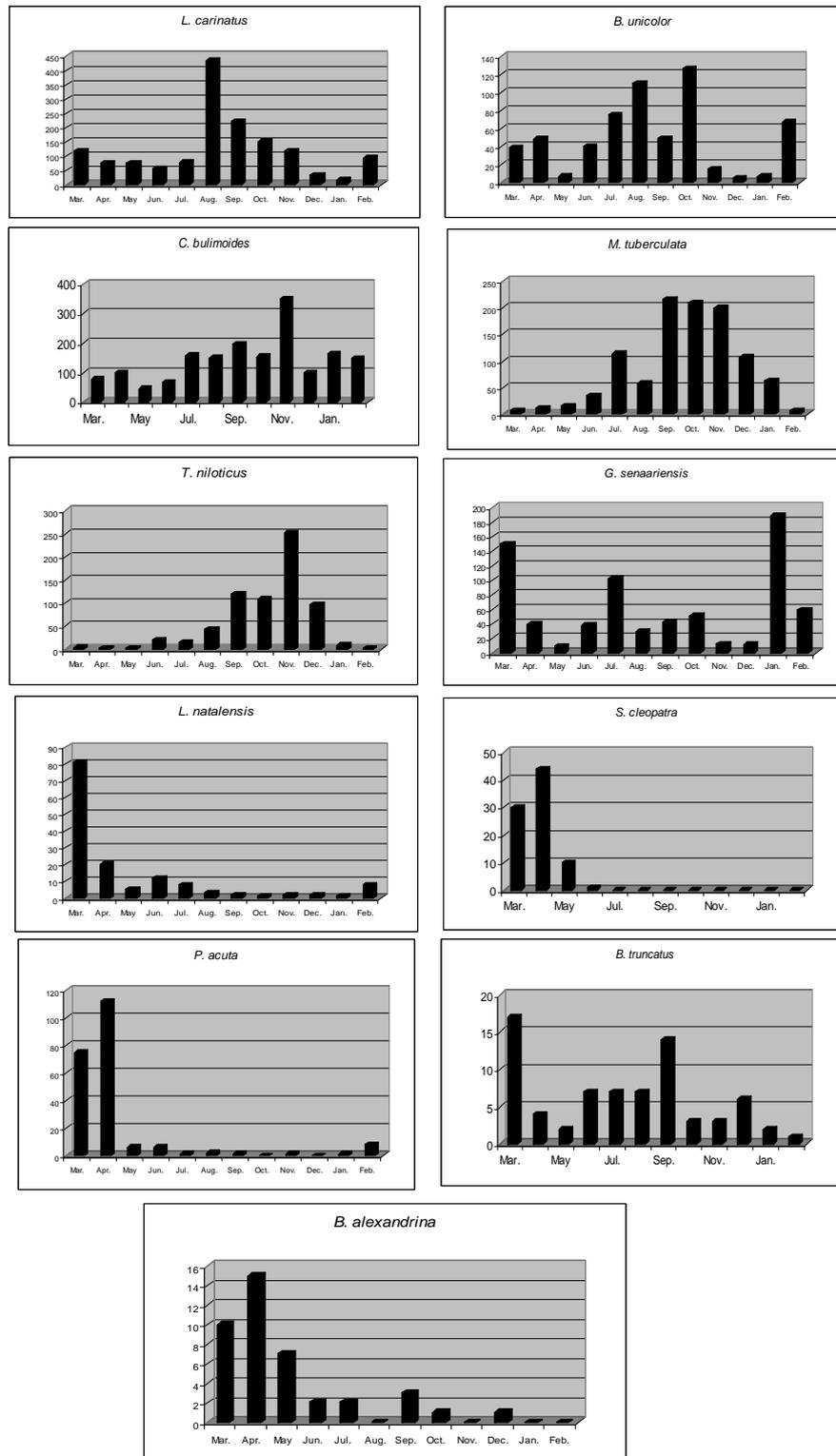


Fig. 3: The monthly variations of the snail species densities collected from the investigated sites.

*L. carinatus* showed the highest peak in August and *B. unicolor* showed a peak in August/October, this agrees with Heikal & El-Sokkary (1986) in Edfina area. *C. bulimoides* and *T. niloticus* showed their peaks in November and *M. tuberculata* showed September-November peak, this agrees with Diab (1993) and Zaki (2008) in Beheira Province and Abis district respectively. *G. senaariensis* showed January peak, this result disagrees with El-Kady *et al.* (2000) where they found the highest number of this species in April. *L. natalensis*, *S. cleopatra*, *P. acuta* and *B. alexandrina* showed March-May peak, while *B. truncatus* showed two peaks in March and September, this is in accordance with Diab (1993), El-Kady *et al.* (2000) and Zaki (2008).

#### - Size structure of the recorded species

*L. carinatus* showed a maximum reproduction during Summer and the most important cohort of small-sized individuals appeared in July 2009. This result is in accordance with that of Aboul-Ela & Beddiny (1970) where they stated that the egg laying of this species, at Cairo, mostly occurred during the warm season (from May to August) and breeding ceases in the winter.

*B. unicolor* showed a high breeding during Summer and the small-sized cohort appeared in June 2009. This result agrees with Brown (1994) who stated that the reproduction took place during the warm season in Tchad Lake and the high birth rate was found from May to June.

*C. bulimoides* was collected in large numbers and the percentages of small-sized individuals were low during all seasons and the highest one was in Autumn and the percentages of adult snails were high during the four seasons and the highest was during Spring. This means that there was no great fluctuation in the population of this species. This result is in accordance with Zaki (2008) who found the changes in size of this species at Alexandria with little differences between months and the smallest size obtained was in Autumn. Pointier *et al.* (1993) reported that snails which remained at high densities showed few fluctuations in their populations. Also Brown (1994) recorded the effect of crowding which inhibit the growth and reproduction in crowded cultures of snails by shortage the food of high quality.

*M. tuberculata* showed a maximum cohort of small-sized individuals in October 2009. Pointier *et al.* (1993) recorded a maximum reproduction of this species in France between June and November and the most important cohort of young snails appeared in June and this species grow slowly and has a long life span.

*T. niloticus* showed the highest number of small-sized individuals in September. This agrees with Zaki (2008).

The highest number of small-sized individuals of *G. senaariensis* was recorded during Winter. Dussart (1979) suggested that the snail *Bithynia tentaculata* showed a maximum production of young throughout Autumn and mid-Winter in England and the young snails grow slowly during Winter and Spring.

*L. natalensis* showed the maximum number of small-sized specimens during Spring. Karimi *et al.* (2004) showed that young snails were observed in Autumn and early Winter and old snails were collected during Summer in Iran. Zaki (2008) collected the maximum number of small specimens of this species in April.

*S. cleopatra* was recorded during Spring only and the highest percentage of small-sized individuals was observed in May. Ramzy (2009) recorded this species (as the land snail *Oxyloma elegans*) in Assiut Governorate all the year of collection and young snails were found during the period of investigation but in low percentages and they flourish only in Spring.

*P. acuta* showed a maximum percentage of small snails in April 2009. Zaki (2008) recorded the smallest sizes of this snail in April and February.

*B. truncatus* showed nearly stable number of small-sized individuals during Spring, Summer and Autumn seasons. Dazo *et al.* (1966) reported that although eggs may be laid in all months, peak egg production occurs from February to April, possibly stimulated by increasing temperature and/or heavy rainfall and the second peak of oviposition in the Autumn season. Demian & Kamel (1972) pointed out that a third Winter generation is recognizable.

For *B. alexandrina*, the small-sized snails reached their highest number in April. This species seems to be sensitive to high temperature, as peak egg production occurred between February and April and could be stimulated by low mid-Winter temperature in December to February (Dazo *et al.*, 1966).

#### **- Relationship between the environmental factors and the snail species**

From table (3), there was a positive correlation between water temperature and *L. carinatus* and *B. unicolor*. Appleton's review (1978) suggested that water temperature is the most important abiotic factor in lentic environments, whereas in lotic environments current velocity is the key factor. Cañete *et al.* (2004) reported that temperature plays an important role in *Lymnaea* sp. abundance. Kazibwe *et al.* (2006) also observed a positive correlation between *Biomphalaria sudanica* abundance and water temperature.

The pH was positively correlated with *C. bulimoides*, *M. tuberculata* and *T. niloticus*, while negatively correlated with *L. carinatus* and *B. unicolor*. This agrees with Owojori *et al.* (2006) where they reported that *Potadoma freethi* was correlated positively with pH (pH range 6.9-7.5), and Kazibwe *et al.* (2006) observed that *Biomphalaria sudanica* abundance was negatively correlated with pH. In the contrary, Abd El-Malek (1958); Ofoezie (1999) and Cañete *et al.* (2004) showed that pH is rarely a factor limiting the distribution of the snails.

*L. carinatus* and *B. unicolor* were negatively correlated with the dissolved oxygen, while *C. bulimoides* and *B. alexandrina* were positively correlated. This result supports the view of Ofoezie (1999) who stated that pulmonate snail species increased with increasing dissolved oxygen, while density of prosobranch snails decreased. Abd El-Malek (1958) reported that oxygen content of the water is very important in conditioning the habitat of Bilharzia vector snails. Maqbool *et al.* (2003) and Karimi (2003) also observed that *Lymnaea* species were seen floating in the surface because they needed a high rate of oxygen consumption.

A negative correlation was recorded between the total hardness and *B. alexandrina*. Abd El-Malek (1958) observed that Bilharziasis vectors were tolerant of a wide range of hardness and waters of very low hardness showed reduction in individual number and shells become relatively thin. Cañete *et al.* (2004) indicated that total hardness seemed to play some important role in *Lymnaea* abundance.

Calcium concentration was negatively correlated with *B. unicolor*, *S. Cleopatra*, *P. acuta* and *B. alexandrina* (decreased with increasing Calcium). Several authors showed that calcium concentration is an important factor in controlling the abundance and distribution of molluscs in freshwater (Boycott, 1936; Macan, 1950; Mckillop & Harrison, 1972; Dussart, 1976, 1979; Mckillop, 1985 and Supian & Ikhwanuddin, 2002).

A negative correlation occurred between water depth and *C. bulimoides*, *T. niloticus*, *S. cleopatra* and *B. truncatus*. El-Kady *et al.* (2000) recorded that the most effective ecological factors acting upon snail population density in irrigation channels maybe the water depth, aquatic weeds and water temperature.

Table 3: Correlation coefficient for association between different species with ecological factors during the period of investigation

		Water temp.	PH	DO2	Cond.	Total H.	TDS	Ca <sup>2+</sup>	W. depth	Flo. P.	Anch. p.
<i>L. Carinatus</i>	R Sig.	0.190 **	-0.199 **	-0.256 **	-0.002 NS	-0.040 NS	-0.005 NS	-0.072 NS	-0.044 NS	-0.081 NS	-0.056 NS
<i>B. Unicolor</i>	R Sig.	0.184 **	-0.263 **	-0.306 **	-0.084 NS	-0.087 NS	-0.071 NS	-0.134 *	0.030 NS	-0.215 **	-0.017 NS
<i>C. bulimoides</i>	R Sig.	-0.036 NS	0.317 **	0.199 **	0.072 NS	-0.034 NS	0.038 NS	0.094 NS	-0.258 **	0.077 NS	-0.080 NS
<i>M. tuberculata</i>	R Sig.	0.001 NS	0.229 **	-0.001 NS	-0.062 NS	-0.063 NS	-0.057 NS	0.094 NS	0.112 NS	-0.233 **	-0.063 NS
<i>T. Niloticus</i>	R Sig.	-0.024 NS	0.254 **	0.102 NS	-0.003 NS	-0.010 NS	-0.014 NS	0.053 NS	-0.208 **	0.019 NS	-0.110 NS
<i>G. senaariensis</i>	R Sig.	-0.103 NS	-0.114 NS	-0.080 NS	-0.038 NS	-0.058 NS	-0.029 NS	-0.117 NS	-0.059 NS	-0.181 **	0.241 **
<i>L. Natalensis</i>	R Sig.	-0.076 NS	-0.092 NS	-0.013 NS	-0.080 NS	-0.058 NS	-0.087 NS	-0.077 NS	-0.033 NS	0.103 NS	0.136 *
<i>S. Cleopatra</i>	R Sig.	0.024 NS	-0.104 NS	0.094 NS	-0.033 NS	-0.109 NS	-0.025 NS	-0.155 *	-0.141 *	0.569 **	0.203 **
<i>P. Acuta</i>	R Sig.	-0.014 NS	-0.092 NS	0.038 NS	-0.022 NS	-0.061 NS	-0.024 NS	-0.168 *	-0.084 NS	0.249 **	0.246 **
<i>B. Truncatus</i>	R Sig.	0.077 NS	0.053 NS	0.103 NS	-0.046 NS	-0.021 NS	-0.029 NS	-0.087 NS	-0.154 *	0.174 *	-0.051 NS
<i>B. alexandrina</i>	R Sig.	0.023 NS	-0.034 NS	0.186 **	-0.074 NS	-0.134 *	-0.069 NS	-0.210 **	-0.096 NS	0.516 **	0.237 **
<i>G. ehrenbergi</i>	R Sig.	0.076 NS	0.072 NS	0.048 NS	-0.109 NS	-0.098 NS	-0.113 NS	-0.074 NS	-0.041 NS	0.072 NS	-0.049 NS

\*\* Correlation is significant at the 0.01 level. \* Correlation is significant at the 0.05 level. NS Correlation is not significant.

The present results indicated that floating plants (such as *Eichornia crassipes* and *Lemna gibba*) were positively correlated with *S. cleopatra*, *P. acuta*, *B. truncatus* and *B. alexandrina* (increased with increasing floating plants) and negatively correlated with *B. unicolor*, *M. tuberculata* and *G. senaariensis*. Also, anchored weeds (such as *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Potamogeton crispus* and *Potamogeton pectinatus*) were positively correlated with *Gabbiella senaariensis*, *L. natalensis*, *S. cleopatra*, *P. acuta* and *B. alexandrina*. Abd El-Malek (1958) reported that water plants are an important factor in the habitat of Bilharzias snail vectors. El-Gindy (1960) concluded that Bilharzia bearing snails deposit their egg masses on hard broad leaves. Dazo *et al.* (1966) recorded that *Potamogeton crispus* and *Eichornia crassipes* were positively correlated with *Bulinus truncatus* and *Biomphalaria alexandrina*. Klumpp & Chu (1980) indicated that *Ceratophyllum demersum* was an indicator for the presence of *Bulinus rohlfsi*, snail vector of *Schistosoma haematobium* in Volta Lake, Ghana and it is the main factor for determining the duration of the cercarial transmission. Van Schayck (1985) reported that the snails are not directly dependent on aquatic plants but they may prefer a habitat with aquatic vegetation.

However, Utzinger *et al.* (1997) concluded that the distribution of freshwater snails is a result of more complex interactions of different habitat factors, and Imfidon (1991); Agi (1995) and Agi & Okwuosa (2001) reported that freshwater snails are known to exhibit high degree of tolerance and adaptation within a reasonable range of physicochemical fluctuation.

## CONCLUSIONS

The results of this study clearly indicate that the densities of the recorded freshwater snails at Qena Governorate underwent changes in numbers during the year

of investigation. Several environmental factors appear to affect the snail populations, in particular, the presence or absence of the aquatic weeds which maybe cleaned to reduce the populations of snails those act as intermediate hosts for digenean trematods.

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## ARABIC SUMMARY

ديناميكية عشائر قواقع المياه العذبة (رخويات: بطنية القدم) في محافظة قنا، صعيد مصر

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تم إجراء دراسة بيئية علي التغيرات الشهرية والموسمية التي طرأت علي كثافة قواقع المياه العذبة في محافظة قنا والتي جمعت من ست مناطق علي مدار عام في الفترة من مارس 2009 حتي فبراير 2010. وقد أظهرت نتائج الدراسة وجود 13 نوعا من أنواع القواقع تنتمي إلي 9 فصائل تحت طائفة بطنية القدم . ولقد رتبت الأنواع المسجلة تنازليا من حيث الكثافة كالتالي: *كليوباترا بليمويدس* (1704 عينة)، *لانيسنس كارينيتس* (1468)، *ميلانويدس تيويركيولاتا* (1036)، *جابيلا سينارينسيس* (731)، *سادوكسس نيلوتيكس* (670)، *بيلاميا يونيكولر* (588)، *فيزا أكبوتا* (213)، *ليمنيا ناتالينسيس* (145)، *سيكسينيا كليوباترا* (85)، *بولينس ترنكاتس* (73)، *بيموفلاريا الكساندرينا* (41)، *جبرلس ايرنبيرجي* (12) *هيليسوما ديوراي* (2). وقد سجلت كثافة الأنواع المختلفة من القواقع تغيرات موسمية حيث ظهرت أعلى كثافة لها خلال موسم الخريف بينما اقل كثافة خلال موسم الشتاء. وتم مناقشة تأثير العوامل البيئية المقاسة علي توزيع الأنواع المختلفة من القواقع، ومن هذه العوامل: درجة حرارة الماء، تركيز أيون الهيدروجين في الماء ، كمية الأكسجين الذائب، معدل التوصيل، عسر الماء الكلي، مجموع الأملاح الذائبة، تركيز عنصر الكالسيوم، عمق الماء ونسبة النباتات المائية الموجودة.