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# Characters of egg capsules of four gastropods in shatt Al-Arab River system, with comments on the developmental stages of *Lymnaea auricularia* and *Physa acuta*

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## SUMMARY

Egg capsules of four common Gastropoda in the Shatt Al-Arab: *Lymnaea auricularia. Physa acuta. Theodoxus jordani* and *Neritina violacea,* were studied. *Theodoxus jordani* and *Neritina violacea* produce egg capsules in the intertidal zone while *L. auricularia* and *P. acuta* producing their egg capsules subtidally, so as to avoid the desiccation.

The snail *L. auricularia* was found to produce 3-50 egg per capsule and the snail *P. acuta* produces 1-47 egg per capsule. The incubation period was found to depend on temperature. The incubation period was 7-8 days for *L. auricularia* and 7-10 days for *P. acuta* at 28°c. Six embryonic stages were recognized in the development of *L. auricularia* and *P. acuta* ended with a crawling young snail.

## INTRODUCTION

Gastropoda are a major group of macroinvertebrates in the Shatt Al-Arab and its branches (Al-Azzawi, 1986). The most imporant species are *Lymnaea auricularia L., Melanoides tuberculata* (Muller), *Melanopsis nodosa* Ferussac, *Physa acuta* Draparnaud, *Neritina violacea* (Gemlin), *Viviparus bengalensis* Lamarck and *Theodoxus jordani* (Sowerby), (Ahmed, 1975; Rabie, 1986; Al Bassam, 1990).

The ecological aspects of some of these gastropods in the Shatt Al-Arab region have been studied by different authors (Lucka, 1982; Hussain & Ahmed, 1983; Al-Dabbagh & Daoud, *1985; Rabie, 1986; Shihab et al., 1989; Al-Bassam, 1990).*

Researchers working on the egg masses of marine gastropoda, such as Lebour (1937) who recognised 23 types of egg mass, showed the large differences in shape and size between species. Amio (1963) classified eggs on the principle of the arrangement patterns of the egg capsules within the common jelly rather than the over all form of the egg masses and their major types.

However the two freshwater snails *L. auricularia* and *P. acuta* show a good adaptation to laboratory conditions and live safely in the aquarium and often, depositing their egg capsules on the glass walls of the aquarium. These eggs are excellent material for embryological study.

Actually egg laying, fecundity, the incubation period and the embryological developments are very important subjects in life cycle studies. Thus this paper provides some informations on six common gastropods in the Shatt Al-Arab region.

## MATERIALS AND METHODS

Six species of Gastropoda were collected from different places of the main canal of Shatt Al-Arab and Garmat Ali and from Al-Assafiya branches (Fig. 1). These species are *L. auricularia, P. acuta, M. tuberculata, T. jordani, v. bengalensis* and *N. violacea*. They are easily collecated by hands, washed and placed in a separate glass aquarium filled with aerated tap water and some branches of aquatic plant *Ceratophylum sp.*

For dissecting study materials composed of 30-40 individals of each species were used. Capsules were followed daily and were directly fixed in Boun's fluid and sectioned according to Humason (1972).

The shell length of the adults were measured with Vernier Calipers to the nearest 0.02 mm. The number of eggs per capsule and the capsule length and width were measured with the aid of ocular micrometer with the aid of a dissecting microscope. To estimate fecundity, egg capsules of *Lymnaca* and of *Physa* were collected during November and December 1991 and January 1992 and calculated the eggs in each capsule.

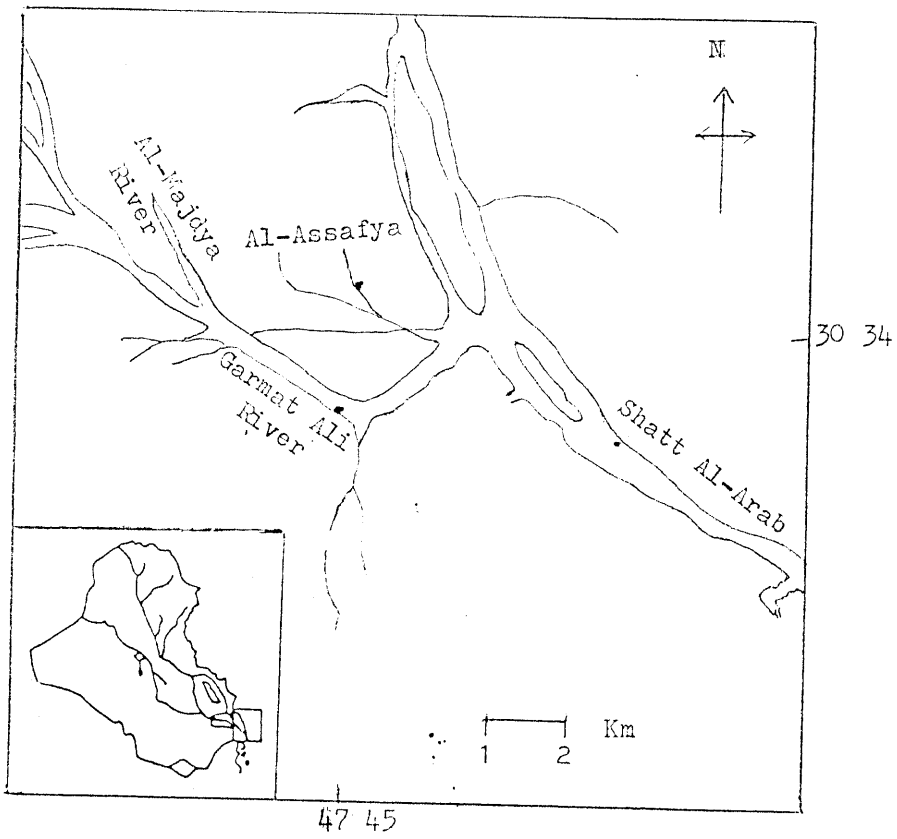


Fig. 1 . Sampling stations

## RESULTS AND DISCUSSION

The results of dissecting showed that *M. tuberculata* in addition to *V. bengalensis* incubate their eggs inside the uterus and realese crawling snail having a complet shell. Youngs can be obtained by dameging the shell. The other four species laid egg capsules.

1. **Egg Capsule of *L. auricularia*.** It is the biggest capsule of all, the shape is rod, gelatinous, elongate, thin and transparent. The incubation period takes 7-8 days at room temperature 28±2°c. The eggs are arrenged inside the capsule properly in one or two classes. Capsules were adhered to aquatic plants or to the aquarium wall, little below the water surface to avoid dessicating. Number of eggs per capsule was ranging between 3-50 with a mean of 20, (n=60).

2. **Egg capsule of *P. acuta*:** They are semi-spherical, shorter than those of *L. auricularia* more wider and less transparent. The eggs inside the capsule are disarranged (squander). Capsules adhered to aquatic plants and to the wall of aquarium. Number of eggs per capsule was ranging between 1-47, with a mean 18 (n=48). The incubation period was 7-10 days at room temperature of 28±2°C. The capsules deposited under the water surface.

3. **Egg capsule of *T. jordani*:** They are small, half rounded, thick, colour orange to yellow, capsules adhered to hard stons and the shells of the dead *M. tuberculata*. The capsules were exposed to the air at low tide.

4. **Egg capsule of *N. violacea*:** They are half rounded too,bigger than those of *T. jordani*, thick, coloured brown. They adhered to rocks and inside the fragment or sticks of the aquatic plant *Phragmites austratis* in the intertidal zone. Thus the capsules are emerged and submerged throughout the tidal cycle.

Size of Egg capsule:

The size frequency histograms of egg capsules length (mm) and egg capsule width (mm) of *L. auricularia*, *P. acuta*, *T. jordani* and *N. violacea* are shown in Fig. 2. In *L. auricularia* egg capsule mean length and mean width were 6.78 and 2.18 mm respectively. In *P. acuta* the egg capsule mean length and mean width were 4.55 and 2.33 mm, respectively. In *T. jordani* the egg capsule mean length and mean width were 0.94 and 0.82 mm, respectively and in *N. violacea* they were 1.32 and 1.08 mm, respectively.

Fecundity

The fecundity of *L. auricularia* with size (Fig. 3A) according to

$$\text{Log } Y = 0.025 + 1.059 \text{ Log } X$$

when Y= number of eggs
X= shell length (mm)
n= 39
r= 0.457

This equation shows that the lowest number of eggs in capsule was 3 eggs for a snail with a shell length of 7mm and the greatest number of eggs was 50 eggs in a snail of a shell length of 15.4mm. Fig. (3B) shows the relationship between number of eggs and shell length for the snail *P. acuta* which could represente by the equation

$$\text{Log } Y = -0.19 + 1.568 \text{ Log } X$$

when Y= no. of eggs
X= shell length (mm)
n= 35
r= 0.631

The lowest number of eggs was one egg in a capsule of a snail of shell length 6mm and the largest one was 47 eggs in a capsule of a shell length 10.2 mm.

The relationship between the number of eggs per egg capsule (mean $\pm$ S.D.) and the size of *Lymnaea* and *Physa* shown in (Fig. 4-A & B) respectively. The larger snails laid more eggs/egg capsule than smaller snails and it is appearent that snails less than 9 mm laid on the average fewer eggs/egg capsule than snails more

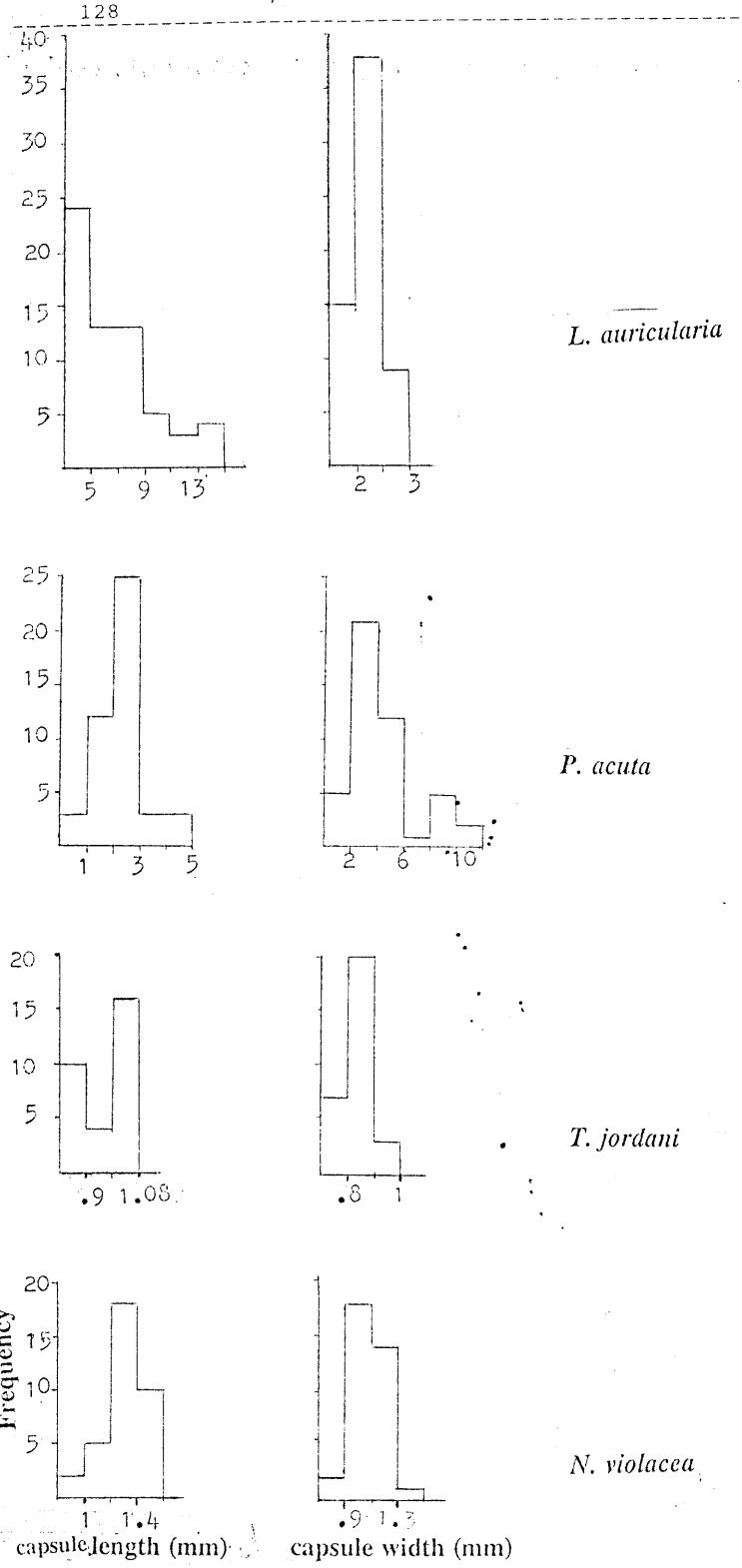


Fig. 2. Size frequencey histograms of capsule length (mm) and capsule width (mm) for four species of gastropoda in Shatt Al-Arab region.

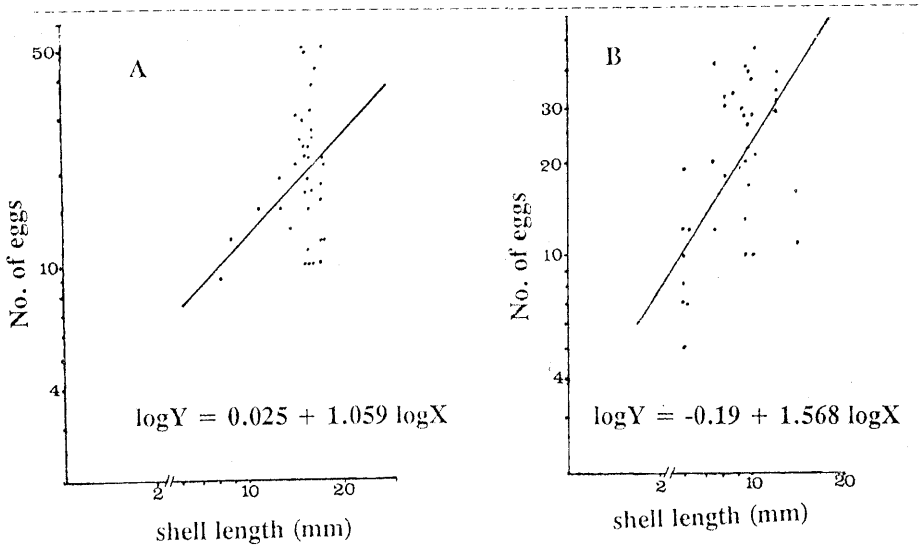


Fig. 3. The relationships between shell length (mm) and number of eggs. (A) *L. auricularia*, (B) *P. acuta*.

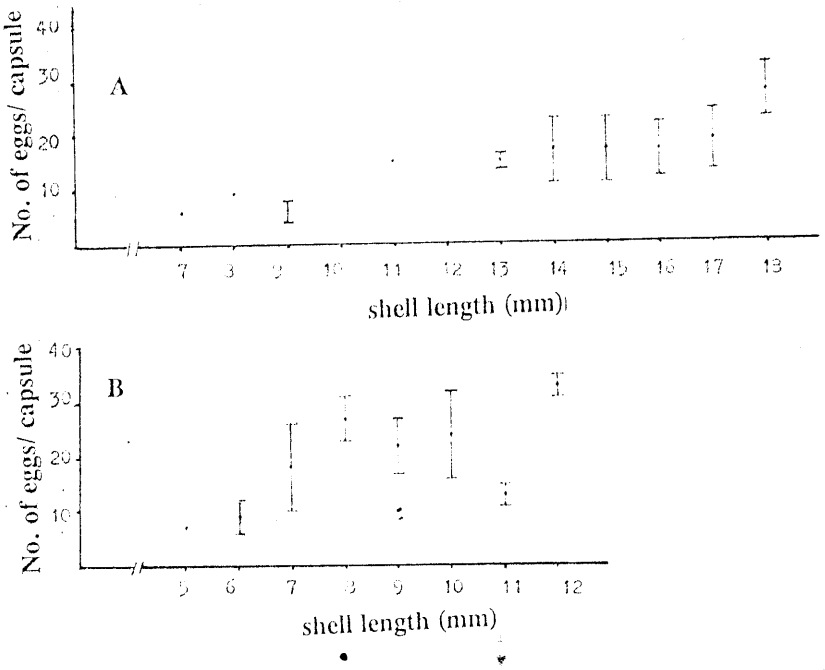


Fig. 4. The relationships between shell length and mean number of eggs/egg capsule (mean ± S.D.), (A) *L. auricularia* (B) *P. acuta*.

than 11 mm for *Lymnaea*, and the same result is true for *physa*. Figs. 5, 6 show the relationships between three factors, capsule length (mm), capsule width (mm) with number of eggs for *Lymnaea* and *physa*, respctively.

For the former species the capsule increase in length only to load a large number of eggs because the eggs are arranged in a regular manner. In the later species the capsule increases in width and length to contain more eggs.

## Embryonic Development

The embryonic development of *L. auricularia* can be categgorized into six stages:-

A. Eggs inside capsule are elliptical, transparent, with clear nucleus,. The fertilized ovum is spherical, opaque, placed near the edge of egg shell (plate 1-A).
B. The cleavage of the nucleus is clear and it seen like a spherical sinuosoid body with a diameter 0.125 mm. (plate 1-B).
C. Embryo with a developed ciliated epidermal band (velum). The diameter of the embryo is 0.25 mm (plate 1-C).
D. The veliger larvae starts to rotate inside the egg by the ciliary action and the shell become apparent. The largest diameter of the larvae is 0.37 mm (plate 1-D).
E. The larvae resenables the adult in having a clear shell, eyes and foot. The veliger larvae occupied half of egg volume, and become 0.5 mm in length and 0.37 mm in width (plate 1-E).
F. Veliger larvae occuping almost all the egg volum. Head with tentacles and reach a length of 0.75 mm and a width of 0.62 mm (plate 1-F).

The veliger larvae developed into a crawling young snail at a length of 0.87 mm and of a width 0.62 mm. The duration of each stage was about 24 h if temperature is suitable (28 ± 2°c), and the duration of development increases with temperature.

The study shows that at (28 ± 2)°c the incubation period was 6-7 days only. The eggs near the periphery of the egg developed faster than those at the center and the falior of some eggs to develop doesnt effect the other eggs in the same capsule.

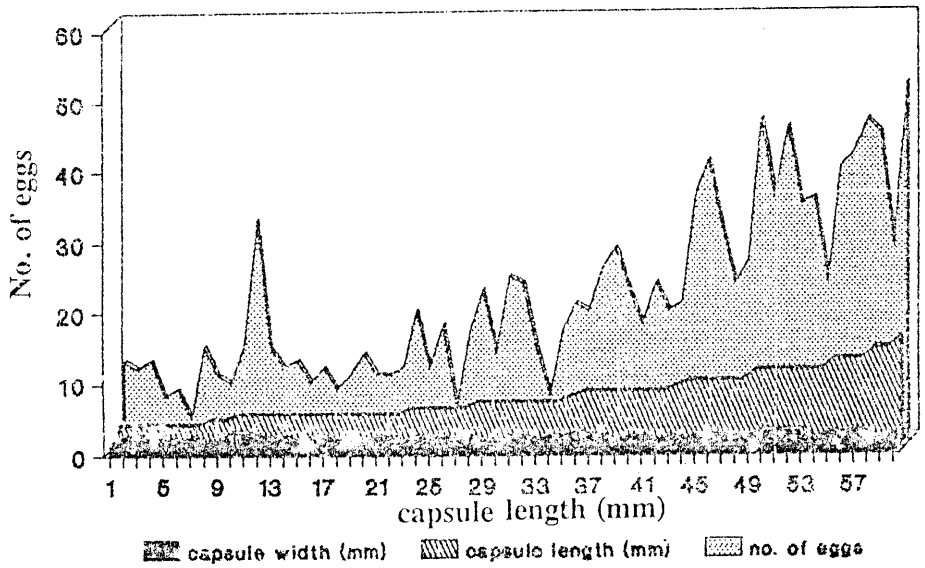


Fig. 5. The relationships between capsule length (mm), capsule width (mm) and number of eggs for *L. auricularia*.

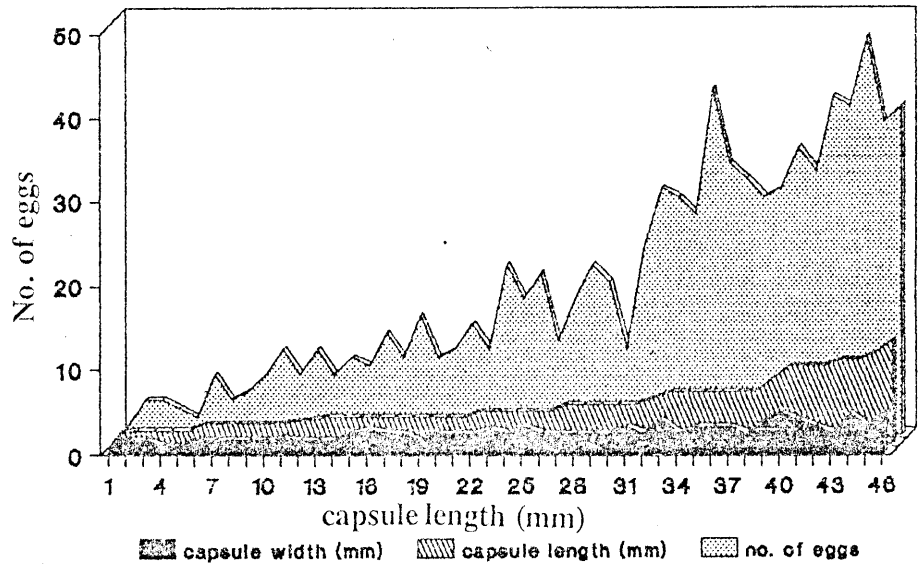


Fig. 6. The relations between capsule length (mm), capsule width (mm) and number of egg for *P. acuta*.

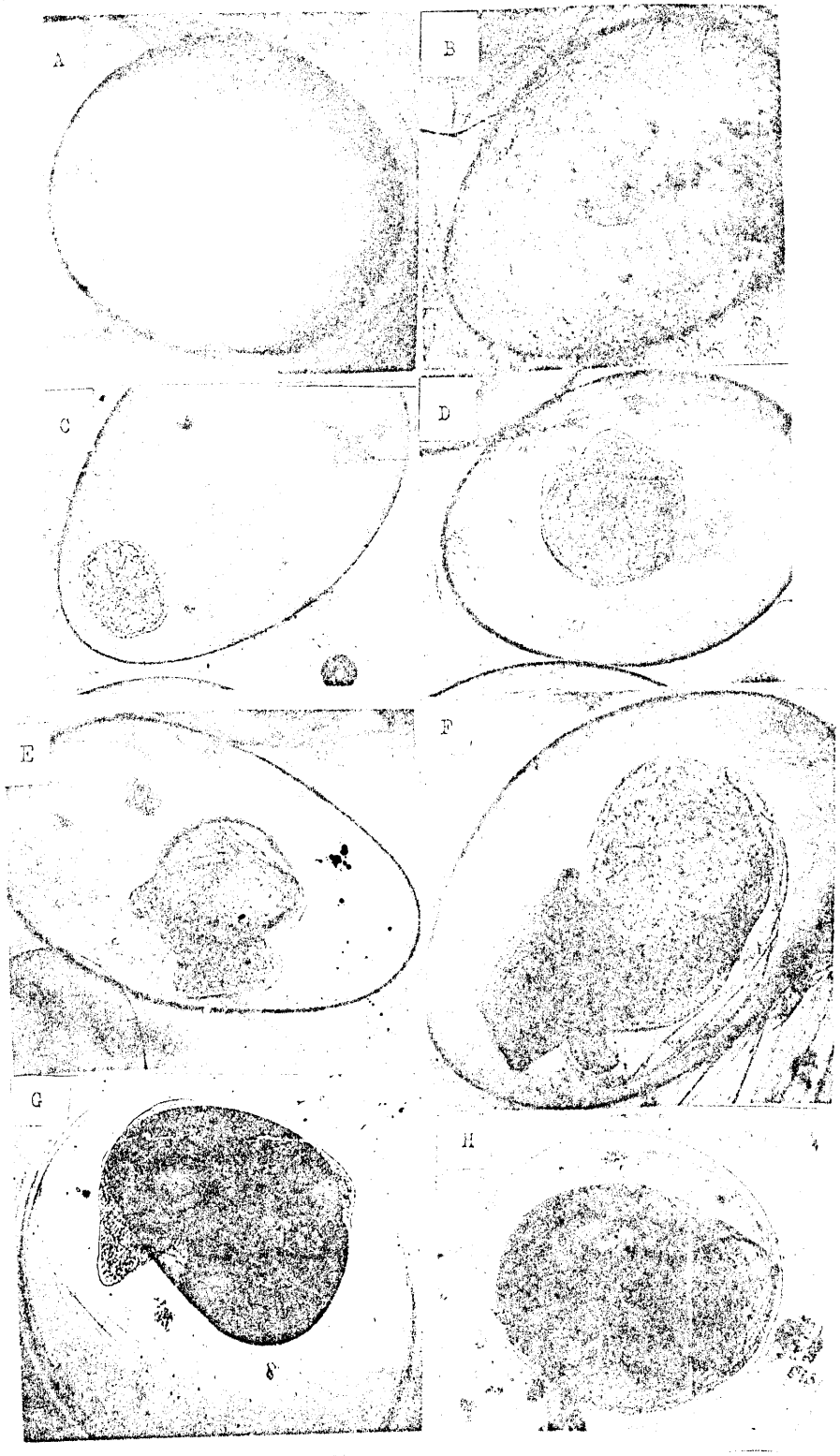


Plate. 1. Embryonic stages of L. auricularia (A-F) and of P. acuta (A-D then G & H).

Embryonic development of *P. acuta*

This species resenables the former one in the first four embryonic stages and the difference starts in fifth stage. The veliger larvae stay inside the shell and moved very slowly with clear eyes and tentacle and measured 0.5 mm 0.43 mm (plate 1-G).

In sixth stage the difference between the two species appear in the form of the shell, it was conical and having a red line round the shell hole. The larvae measured 0.6 mm 0.5 mm and it was a little smaller than the larvae of *L. auricularia* (plate 1.H). The incubation period was 8-10 days in (28 ± 2)°c.

The results show that the snails *M. tuberculata* is nursing their eggs inside the uterus in addition to *V. benglanesis*. This pattern of reproduction have been observed in two species of freshwater bivalve in Shatt Al-Arab region *corbicula fluminea* and *C. fluminalis* (Abdul-Sahib, et al., 1995). Actually this type of behavior is an adaptation to the hard environment, *i.e.* the oligohaline brackish water of Shatt Al-Arab and for avoided predation. However predation of eggs *in situ* is more than spats, so that youngs have more chance to survive. Al-Dabbagh and Daoud (1985) concluded that *M. tuberculata* lay its eggs in the side channels connected to the river, but this conclusion was not true.

In this study the characteristics of egg capsules is in accordance with the conclusion of Soliman (1987) in classifying gastropod eggs masses that the jelly masses are the common type in the opisthobranchs; gelatinous egg masses and solid cases are usual in the prosobranchs, and gelatinous egg masses (with fewer and larger eggs) to calcareous egg shells are characteristic of the pulmonate and Neritacea have an isolated biconvex capsules.

Table 1-compared our results with freshwater gastropoda from other areas. In this study the largest egg capsule of *Lymnaea* in the environment was 40 mm in length and 3 mm in width and contained 180 eggs; the smallest one was 3 mm in length and 1.5 mm in width and contained 3 eggs where as Rabie (1986) found the largest one was 15 mm in length and contained 65 eggs and the smalest one was 1.7 mm and contained one egg only.

Table (1): Egg size and number of eggs/capsule in species of fresh water gastropods.

| Species | egg size mm | mean eggs No./capsule | Authority |
|---|---|---|---|
| **Pulmonata** | | | |
| Lymnaeidae | | | |
| *Acella haldemani* | 1x0.6 | 3-12 | Morrison, 1932 |
| *Lymnaea auricularia* | 1x0.775 | 20 | Present study |
| *L. elodes* | ? | 20-47 | Eisenberg, 1966 |
| *L. humilis* | ? | 6-17 | McCraw, 1961 |
| *L. palustris* | 0.84x0.58 | 10-40 | Bondesen, 1950 |
| | ? | 20 | Hunter, 1975 |
| *L. peregra* | 1.09x0.79 | 200 | Bondesen, 1950 |
| | ? | 12-20 | Russell-Hunter, 1961a |
| *L. stagnalis* | 1.37x1 | 100 | Bandesen, 1950 |
| | ? | 100-150 | Berrie, 1965, 1966 |
| *L. truncatula* | ? | 7-9 | Walton & Jones, 1926 |
| | 0.78-0.53 | 15 | Bondesen, 1950 |
| **Physidae** | | | |
| *Aplexa hypnorum* | 1.21x0.93 | 20 | Bondesen, 1950 |
| *Physa acuta* | 1x0.5 | ? | Bondesen, 1950 |
| | 0.875x0.75 | 18 | present study |
| *P. fontinalis* | 1x0.8 | 20 | Bondesen, 1950 |
| | ? | 6-18 | Wit, 1955 |
| | ? | 5-11 | Duncan, 1959 |
| | ? | 15 | Russell-Hunter, 1961a&b |
| *P. gyrina* | ? | 100-200 | Bondesen, 1950 |
| | 0.79x0.72 | 13 | Dewitt, 1954 |
| *P. virgata* | ? | 11-17 | McMahan, 1975 |

The highest number of eggs per capsule for *P. acuta* in the Shatt Al-Arab region was 33 and for *L. auricularia* was 28. These numbers are nearest to those recorded by Berrie (1965) who, gave about the same numbers while Boag and pearlston (1979) recorded about half the numbers. The average number of eggs/egg mass varied from 61-80. This can be attributed to the differences in the size of the animals at different locations.

The direct positive relationships between the number of eggs/capsule and capsule length was also reported by Lam and Calow (1988) in their study on *L. peregra*. Noland & Carriker (1946) suggested that the gelatinous material may be used as a source of food for eggs. However Lam and Calow (1988) noticed that *L. peregra* increased its eggs load in each capsule by producing larger capsules, and the packaging of more eggs into longer rather than wider capsules has the potentially important effect of maintaining constant

surface area to volume ratio. This might allow the exchange of gases (like $O_2$ and $CO_2$) through the capsule membrane.

Temperature had a direct effect on oviposition. Dewitt (1967) observed a temperature threshold effect in both physid and lymnaeid. It was found in the present study the four species oviposite when the temperature was near 28°c.

Krkac (1982) shows that the minimum tolerable temperature for oviposition in *P. acuta* is between 10 and 15°c and the maximum was close to 30°c and the optimum ones are 20 and 25°c, since the greatest number of egg masses are laid at these temperatures. According to Duncan (1959) *P. acuta* is a species with a reproduction period that depends on local temperature. Most authors agree that the rate of development is considerably faster at higher temperatures.

Demian and Yousif (1973) shows that embryogenesis takes 8 days at 25-30 °c and 20 days at 15-20 °c for the snail *Marisa cornuarietis*. In this study the incubation period was 6-7 days for *L. auricularia* and 7-10 days for *P. acuta* in temperature near 28°c.

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# خصائص محافظ البيض لأربعة انواع من بطنية القدم في شط العرب مع ملاحظات حول مراحل التطور الجنينين *Lymnaea auricularia* و *Physa acuta*

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## الخلاصة

تضمن البحث مقارنة محافظ بيض اربعة أنواع من قواقع شط العرب هي *Neritina violacea* و *Lymnaea auricularia* و *Physa acuta* و *Theodoxus jordani* أن النوعين *T. jordani* و *N. violacea* تنتج محافظ بيض في منطقة المد والجزر وتتعرض للهواء مع دورات المد والجزر بينما محافظ بيض النوعين *L. auricularia* و *P. acuta* تكون مغطاة بالماء دائماً لأن تعرضها للهواء يؤدي الى جفافها.

ينتج القوقع *L. auricularia* ٣-٥٠ بيضة لكل محفظة بينما ينتج القوقع *P. acuta* ١-٤٧ بيضة لكل محفظة. مدة حضن البيض تعتمد على درجة الحرارة، وقد وجد ان مدة حضن البيض للقوقع *L. auricularia* والقوقع *P. acuta* تستغرق ٧-٨ أيام و ٧-١٠ أيام على التوالي عند درجة حرارة ٢٨ ± ٢ °م.

وقد تم تشخيص المراحل الجنينية لهذين القوقعين وتقسيمها الى ستة مراحل تفقس بعدها عن صغير زاحف يشبه الآباء.