J. mar. biol. Ass. India, 1987, **29** (1 & 2) : 69-73

LARVAL DEVELOPMENT OF SALT-MARSH SNAIL *MELAMPUS CEYLONICUS* (ELLOBIIDAE : PULMONATA) FROM PITCHAVARAM MANGROVES, TAMIL NADU

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ABSTRACT

The early larval development of a salt marsh snail *Melampus ceylonicus* was studied from the Pitchavaram mangroves, Tamil Nadu. It was found that the pulmonate snail follows a semilunar synchrony in it's egg laying and hatching. The trochophore comes out after 9-11 days and the veliger 13-15 days. The eggs collected from the field were being brought to the laboratory and further development was observed by placing them in the petridishes having moistoned filter paper. The development can be observed successfully upto the veliger stage. Free swimming veligers are also seen in the water samples collected from it's habitat. From the water sample collections it was noticed that the veligers spent 3-6 weeks before settling.

INTRODUCTION

THE SALT MARSH SNAIL *Melsmpus ceylonicus* belongs to family : Ellobiidae and order : Basommatophora and inhabits the high spring tidal lands of Pitchavaram mangroves of the east coast of South India (Lat. 11° 29′N ; Long. 79° 46′ E). The habitat of this snail is wetted during the spring tide and completely exposed during the neap tide and so it accomodates a semiterrestrial environment. This group of ellobiid snail is generally regarded as a primitive and also lung snails in the class : Pulmonata. As in all pulmonates, in this species the mantle cavity has been modified to a gill-less vascularised lung and these ellobiid snails are functionally ' air-breathers '. Eventhough, certain anatomical features remain considerably less specialised than those in more typical Pulmonata (Morton, 1955 a, 1955 b) and the Ellobiidae retain a number of features more diagnostic of archetypic marine gastropods which are their ancestors. In the life cycle of certain ellobiid snails, including *Melambus*, a free-swimming veliger larva is retained, as in no other pumonata. Only certain gastropods (the class : Pulmonata and particularly in the tropics—certain genera in four Prosobranch superfamilies) are found on land and they are probably less than twenty per cent of molluscan species Russell-Hunter, 1964 ; Boss, 1971).

Many studies are available on life-cycle, reproduction and larval development in pulmonate molluscs. Raven (1946 a) studied the development of *Lymnedea stagnalis* ; Morton (1954) studied the ecology and annual cycle of *Carychium tridentatum* at Box Hill region ; Morton (1955 b) studied the functional morphology with a description of the developmental stages of the British ellobiid snails, *Leuophytia bidentata, Ovatella myosotis* and *C. tridentatum* ; Holdon *et al.* (1957) and Holle and Dineen (1957) studied the life history of the salt marsh snail *Melampus bidentatus* ; Duncan (1959) made some studies on the life cycle and ecology of the freshwater snail *Physa fontinalis* ; Ghose (1962, '63) studied the early stages of the development in *A. fulica* ; Russell-Hunter and Apley (1966) studied the quantitative aspects of early life history in the salt marsh pulmonate snail *M. bidentatus*. Apley *et al.* (1967) studied the annual reproductive turnover in *M. bidentatus*; Berry *et al.* (1967) studied the genital systems of *Pythia cassidula* and *Auricula* from Malayan mangrove swamps; Berry (1968) studied the fluctuations in the reproductive condition of a Malayan mangrove ellobiid snail *C. auris-felis*; Apley (1970) made field studies on life history, gonadial cycle and reproductive periodicity in the ellobiid snail *M. bidentatus*; Coles (1970) observed the egg-laying behaviour in *Biomphalaria*; Russell Hunter *et al.* (1970) studied the semilunar and other factors influencing hatching from egg masses of *M. bidentatus* in the field and in the laboratory; Russel-Hunter *etal.*, (1972) studied the early life history and the significance of semilunar synchrony in *Melampus*; Plummer (1975) made observations on the reproduction, growth and longevity of a laboratory colony of *Archachatina* (Calachatina) *marginata* (Swainson) subspecies *ovum*; Calow (1978) studied the evolution of life cycle strategies in some freshwater gastropods; Hodasi (1979) studied the life history of *Achatina* (Achatina) *achatina*; Rudolph and White (1979) observed the egg laying behaviour of *Bulinus octoploidus*; Tompa (1979) studied the oviparity, egg retention and ovoviviparity in pulmonate; Rudolph (1980) studied the sequence of secretory product formation in maturing reproductive systems of the freshwater lymnaeid snail *Stagnicola elodes*; Smith (1981) studied the copulation and oviposition in *L. truncatula*.

The authors thank Dr. K. Krishnamurthy, Director, CAS in Marine Biology, Parangipettai for facilities, and UGC and DOE, New Delhi for the financial support.

MATERIAL AND METHOD

The egg masses of the salt marsh snail *M. ceylonicus* were collected from the field just 1 day before or on the new and full moon day itself. They were brought to the laboratory and the development was observed by placing them in the petridishes having 50 : 50 distilled and filtered sea water (corresponding roughtly to the salinity of the habitat water during the days between spring tidal floodings) moistened filter paper in the room temperature (27° to 30° C). The development of the egg was examined under a stereozoom binocular microscope and the *camera lucida* drawings were made.

RESULTS

Egg structure

The egg masses were collected in the month of August in the upper tidal mark which are flooded by the spring tide. The egg masses are gelatinous and have no capsules or protective coatings. The freshly laid eggs are usually irregular hemispheres of 1-1.5 mm in diameter and approximately 0.5 mm thick in the center. The eggs are laid in a single continuous strand (Fig. 1 K) having evenly spaced eggs enclosed in two tubular gelatinous layers. The outer envelope is continuous with that of the succeding egg forming a constricted 'neck' like structure. This 'neck' like structure has been traversed by the inner envelope which is termed as the allochalazal strand, very helpful in keeping the egg proper in position.

Hatching

The eggs were being brought to the laboratoy and maintained on the moist filter paper in petridishes. The filter paper was moistened daily with 50 : 50 distilled water and filtered sea water which is corresponding to the spring tidal flood water, but care was taken to avoid excess water than a thin film of water in the petridishes. Each record of percentage of cleavage stage of the eggs was made by using a medium power (x 15) stereozoom binocular microscope.

Spiral cleavage was seen in the eggs and the further development is as follows:

The first meridional cleavage and 2 cells were resulted after 3-4 hrs of egg-laying (Fig. lb). The 4 cell stage was found after 1-1.30 hrs from the 2 cell stage (Fig. 1 c). The 8 cell stage was seen after 3 hrs from the 4 cell stage. (Fig. 1 d). The 12 cell stge after 1-2 hrs from the 8 cell stage (Fig. 1 e). The multicell stage (or blastula) after 1-1.30 hrs i.e. approximately 9-12 hrs after egg-laying (Fig. 1 f). The trochophore had seen 4 days after the egg-laying (Fig. 1 g). Veliger Shell (Fig. 1 h). The veligers came out on 13-15th day in the laboratory at room temperature (27° to 30°C) (Fig. 1 j).

In the laboratory the development of the eggs could be successfully maintained upto the veliger stage and further metamorphosis into juveniles could not be seen.

In the field the free swimming planktonic veligers had been collected from the plankton samples at 13th to 15th day and it was also found that the free swimming veligers settled for metamorphosis after 3-6 weeks of time.

The pre-hatching veliger has an oval shaped operculum with two ciliated velar lobes. The veligers rotate actively inside the egg anti-clockwise. The breaking up of the egg during hatching involves the combined effect caused by the operculum and velum.

Discussion

M. ceylonicus is a oviparous pulmonate snail as suggested by Tompa (1979) as per his statement 'conspicuously absent from this work list are any members of the Basommatophora or freshwater pulmonates and any pulmonate slugs'. The number and size of the eggs vary from snail to snail. For *M. ceylonicus* it is approximately 400-500 eggs having a size of 1-1.5 mm in diameter and approximately 0.5 mm thick in the center. The eggs are laid in the mud in a single continuous strand having evenly spaced eggs enclosed in two tubular gelatinous layers. The outer envelope is continuous with that of the succeeding egg forming a constricted 'neck' like structure. This 'neck' like structure has been traversed by the inner envelope which is termed as the allochalazal strand that is very

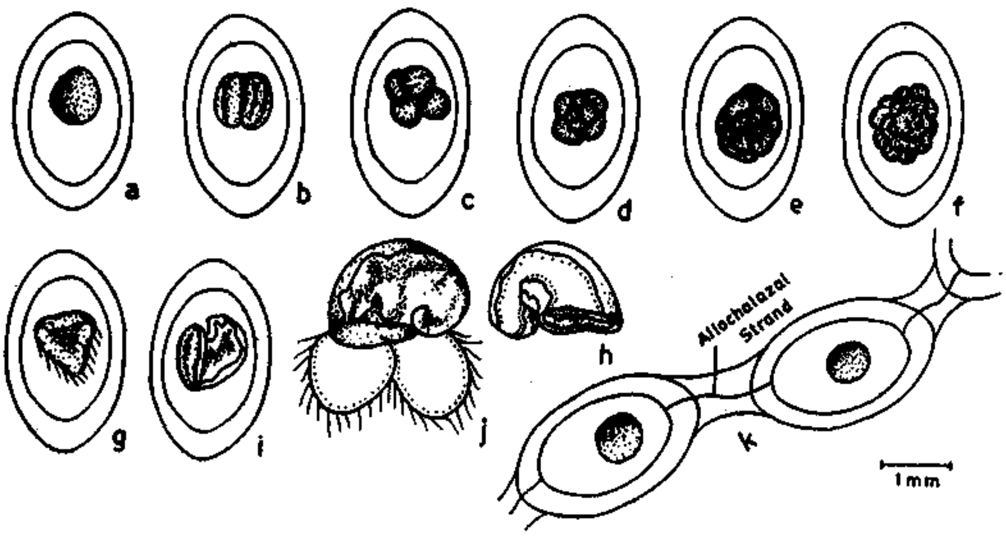

Fig. 1. Development stages of *Melampus ceylonicus*: a. egg, b. Two cell stage, c. Four cell stage, d. Eight cell stage, e. Twelve cell stage, f. Multicell stage, g. Trochophore, h. Veliger shell, i. Veliger in the egg, j. Free veliger and k. egg strand.

helpful in keeping the egg proper in position. While Morton (1955 b) found that *O. myosotis* laid clusters of from 35 to 50 eggs, enclosed in a tough protective investing mass, attached securely to stones, pieces of grass, stems and dead twigs in the moist environment generally frequented by the adult animals. Each egg capsule is ovoid in shape, approximately twice as long as wide and one end being narrower and bluntly pointed and the other broader and gently rounded. The capsular wall is very massive and difficult to rupture; it is perfectly transparent. From either end of the albumen space proceeds a long filament, irregularly and loosely convoluted, forming a chalaziform process by which each egg capsule is succesively attached as part of an egg chain as in the egg-strand of *Melampus.* But no chalaziform filament was present in the egg-masses of *Leucophytia* in which there is no apparent inter-connection between egg capsules, lie quite separately in the investing substance. Duncan (1959) found that, in the pond at Stanmore, maximum number of eggs of *Physa fontinalis* were laid on the leaves of *Stratiotes aloides* and some eggs were also seen to be laid on the plant debris and the leaves of *Elodea canadensis*. In the laboratory the mean number of eggs per capsule falls steadily from 11.5 at the first oviposition to 5.3 at the sixth.

While in *M. bidentatus,* Russell-Hunter *et al.* (1972) found that the egg masses are gelatinous and have no capsules or protective coatings, as also observed here in the *M. ceylonicus* eggs. The freshly laid eggs are usually irregular hemispheres of 1-2 mm diameter and approximately 0.5 mm thick in the Centre. There are some 539 to 1240 eggs in each egg mass. The eggs are deposited in a single continuous strand consisting of evenly spaced eggs (each 170 μ long) enclosed in two tubular gelatinous layers. The inner thicker material, concentrated primarily around the eggs but continuous within the egg-strand, can be referred to as the spiral envelope and the layer surrounding this is termed as the string membrane. The spherical envelope continuous to the next one in the strand as a narrow 'neck' within which there is a string-like structure termed as allochalazal strand.

In *L. truncatula* the rate of egg-laying depends on the prevailing temperature (Morel-Vareille, 1973) but under optimum conditions a single snail may lay approximately 3000 eggs before it's death (Kendell, 1953). In *A. achatina*, Hodasi (1979) found that the freshly laid eggs are creamy white in colour and they gradually become white with prolonged exposure to the atmosphere. The number of eggs laid (clutch size) varied between 37 and 305. From the measurements made out of 300 eggs of laboratory reared snalis it was found that the mean length of the egg is 6.8 mm (range 5.4-8.1 mm) and the mean width is 5.5 mm (range 4.2-6.5 mm). In *A fulica,* Pawson and Ronald Chas (1984) found that the eggs were usually laid in one spherical mass 4-8 cm beneath the soil surface. The mean size of the eggs was 4.8 mm by 3.9 mm.

In *M. ceylonicus* the eggs took an average of 13-15 days to hatch while in *L. truncatula* the egg masses had an incubation period of 20 days (Walton and Jones, 1926). Russell-Hunter *et al.* (1972), in the laboratory reared eggs of *M. bidentatus* at constant temperatures of either 18°C or 25°C found that at 18°C, first cleavage takes place 5-7 hours after the egg mass is laid, there is an early blastula by 12 hours but in *M. ceylonicus* the blastula can be seen after 9-12 hours at room temperature (27° to 30°C), a true trochophore by the fourth day while in *M. ceylonicus* it is by 4th day and a well deferentiated and active veliger, by the eleventh day but in *M. ceylonicus* it is by 13-15 days in the laboratory. Corresponding times at 25°C, in *M. bidentatus* are, trochophores by third day, and active prehatching veligers by the ninth day. The *Melampus* is the only species of the family: Ellobiidae having a free swimming planktonic veliger (Morton 1955 b). The hatched out veligers spent a period of 4-6 weeks as plankton, in the case of *M. bidentatus* and 3-6 weeks in the case of *M. ceylonicus* before settling. Plummer-(1975) found that *A. marginata* had an incubation period of 38-43 days. Pawson and Ronald Chase (1984) reported that for *A. fulica* the incubation period (days beween oviposition and hatching) was 1-25 days with a mean of 14 days, due to a variable degree of ovoviviparity exhibited by the snail.

In *O. myosotis*, Morton (1955 b) found that the embryo (pre-hatching veliger) in most of it's feature it greatly resembles that of *Leucophytia*. It has a thin, horny operculum, transversely elongate, covers the upper posterior surface of the foot; and the velum consists of a pair of simple, rounded lobes as in *M. ceylonicus*. There is no sign of the presence of velar cilia in *Leucophytia* while in *M. ceylonicus* the velar lobes are having cilia.

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