Indian J. Fish., 59(2) : 165-169, 2012

Note

Observations on broodstock maintenance, breeding and early larval development of the common spider conch *Lambis lambis* (Linnaeus, 1758) in captivity

I. JAGADIS, K. SHANMUGASUNDARAM AND J. PADMANATHAN

Tuticorin Research Centre of Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India
e-mail: ijagadis@sify.com

ABSTRACT

Spider conches are common in shallow waters of the Indian coast. Of the eleven species reported from Indian waters, six species of the genus *Lambis* are categorised under Schedule IV of the Indian Wildlife Protection Act, 1972. Studies on the breeding of *Lambis* spp. are limited Considering its importance, an attempt was made to breed the common spider conch *Lambis lambis,* under controlled conditions. The brooders ranged from 152-184 mm/80-400 g in size/weight. They were maintained on macroalgal diet under static as well as airlift recirculation system. The conch shells, after 4 months of maintenance, exhibited mating behaviour and laid eggs under captivity during October-December 2010. The morphology and development of the embryo within the egg filaments, hatching, embryonic and early larval development up to 35 days post-hatch (dph) is detailed and compared with the similar observation made at Majuro atoll, Marshall Islands.

Keywords: Captive breeding, Common spider conch, Endangered molluscs, *Lambis lambis*

The common spider conch *Lambis lambis* is distributed in shallow waters of the Indo-Pacific. The conches are sought by shell collectors of Philippines, Solomon Islands, Indonesia and India (Carpenter and Niem, 1998). It is harvested and consumed as food in Japan. The conches are found to occur mainly on sandy patches among rocks or on coral reefs, from the intertidal region to depths up to 20 m. Of the eleven known species of *Lambis* from Indian waters (Apte, 1998), six are listed under Schedule IV of the Indian Wildlife Protection Act, 1972, banning commercial exploitation.

At Tuticorin, the conch shells are almost regularly caught as bycatch in the bottom set gillnets operated for lobsters and crabs in Vellapatti, Threspuram and Sipikulam areas. Studies on breeding of *Lambis lambis* are limited, the only known published work being that of Hamel and Mercier (2006). In India, studies on *Lambis* spp. are limited to its habitat and feeding (Siraimeetan *et al*., 1988). The present study is an attempt to collect, maintain and breed the common spider conch *Lambis lambis* under captivity in order to develop a methodology for broodstock maintenance and to study their feeding behaviour, mating, spawning and larval development.

Brooders of *L. lambis* were collected from the landing centre discards at Vellapatti, Tuticorin and transported in aerated containers with seawater to the shellfish hatchery of Tuticorin Research Centre of Central Marine Fisheries Research Institute. The brooders were sexed by their external shell character, shell length and weight were recorded to 1 mm/1 g accuracy and 2 to 3 pairs of male and females were stocked in two types of rearing containers used in the experiment, one in 100 l fibre reinforced plastic (FRP) tanks provided with aeration and filtered (10 µ) seawater replaced once a week. In the second rearing system, a 1000 l FRP tank holding 750 l of seawater with airlift recirculation was used. The recirculation was adjusted to 300% per day. Both types of broodstock holding tanks had the bottom lined with coral sand and boulders with algal encrustations. Macroalgae like *Sargassum* spp., *Padina* spp. and *Ulva* spp. collected from the sublittoral area were supplied in the brooder tanks *ad libitum*. The tanks were kept covered with black cloth during the night. Water quality parameters like salinity, pH and water temperature in the tanks were recorded at fortnightly intervals. Microscopic measurements of the embryo and larvae were taken using Labomed microscope with precalibrated ocular meter.

Day 1 veliger collected from the broodstock rearing tanks were stocked in 5 l glass beaker and 75 l FRP tanks at a density of 100 larvae per litre and their development was monitored. The larvae were fed once in the morning with pure culture of *Isochrysis galbana* at a concentration of 35,000 cells ml^{-1} for 1-5 days and then onwards at a concentration of 50,000 cells ml^{-1} for 6 - 21 days (Davies, 2004). Larval samples in duplicate (10 each) were siphoned

out and their length measured along the siphonal canal and recorded on the day of observation. Larval growth, developmental process and survival up to 35 days post-hatch (dph) are described.

Seventeen brooders of *L. lambis* of size/weight ranging from 148-184 mm/50- 400 g were collected and ten sexed conch shells were stocked. Among the many species of seaweeds supplied, *L. lambis* exhibited a preference for *Ulva* sp. and extensively grazed on it, surviving for more than a year without any mortality. This is in contrast to the observations made by Siraimetan *et al*. (1988) who classified *L. lambis* as a carnivore. After a period of four months of rearing in laboratory conditions, the animals exhibited pairing and overlapping. However, actual mating process was not observed during the day time and mating had possibly happened during late evening/night. This is in contrast to the observations on daytime mating in *L. lambis* from Marshall Island waters (Hamel and Mercier, 2006). Subsequently one female conch in both the rearing systems commenced egg laying on 09.11.2009. Several masses of egg filaments of pale brown colour were laid on the tank bottom substrate and the process of egg laying continued for two days. Once egg laying was complete, the female left the egg filaments (Fig.1). This observation is in contrast to the brooding behaviour reported by Hamel and Mercier (2006), where the brooder remained with the egg mass. The brooders were subsequently monitored continuously for almost a year but they spawned only during October 2010. Brooders collected from Sippikulam and maintained in the laboratory also spawned during December 2010 suggesting seasonality in breeding, during October-December months in genus *Lambis*. Shawl and Davis (2004) reported that the reproduction in the genus *Lambis* is during summer months and for a few species of the genus *Strombus* it is year round.

During spawning, several cylindrical white to pale brown coloured egg filaments were released. These egg filaments got attached to the seaweeds/boulders provided at the bottom of the tanks. They were entwined appearing like a continuous coil. The diameter of the egg filament was 1652 µ in November '09 spawning and 1822 µ in October and December '10 spawning which is more or less comparable to the 1800 µ reported by Hamel and Mercier (2006). In the transparent tubular filaments, spherical shaped embryos were found arranged in double rows (Fig. 2). The strands of egg filaments were all entwined and mixed up as a mass, making it impossible to identify and measure the length of a single egg filament.

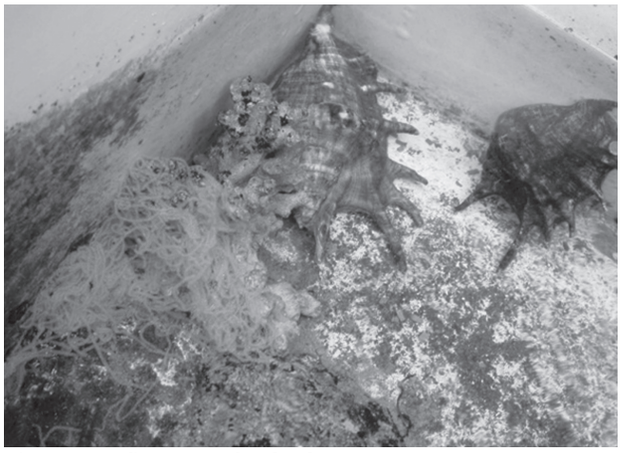

Fig. 1. Egg filaments of *L. lambis*

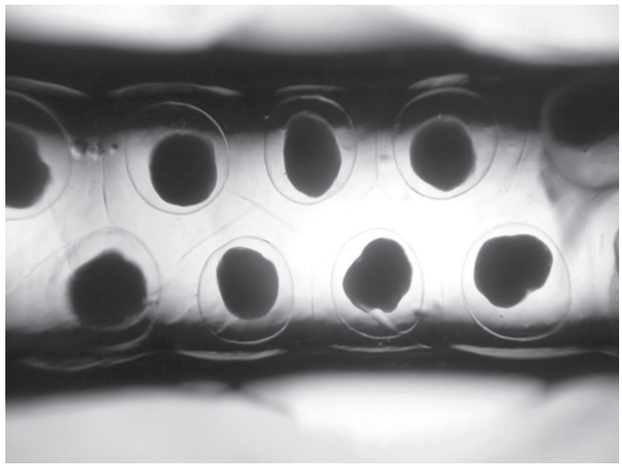

Fig. 2. Embryos in the egg filament of *L. lambis*

The number of eggs in one centimeter egg filament strip was between 22 and 25. The spherical embryos were found enclosed within a transparent globular membrane and measured 535-559 µ in diameter. The cell differentiation started immediately, the micromeres and macromeres were distinctly visible and the embryo became irregular in shape (Fig. 2). Egg development advanced as time progressed and most of the embryos were irregular in shape and immobile till the end of the 2nd day. On day 3, a few embryos developed cilia and started rotating very slowly within the globular membrane. On day 4, the embryos developed well defined larval shell, two lobed velum and crown of cilia as well as two prominent eyes (Fig. 3). On day 5, about 50% of the embryos hatched into free swimming veligers having four lobed velum which is similar to the observation in *Strombus gigas* but for two lobes at hatch (Asaro, 1965). Between the velar lobes, posteriorly a wedge shaped foot was found developed with pink red pigmentation. Entire egg strands hatched and released viable veligers within 5th and 6th day post-spawning. The size of the veliger ranged from 617-637 µ (Fig. 4). These observations are in agreement with that of Hamel and Mercier (2006) except for the veliger size which was 900 µ and the females remaining closer to the egg filaments.

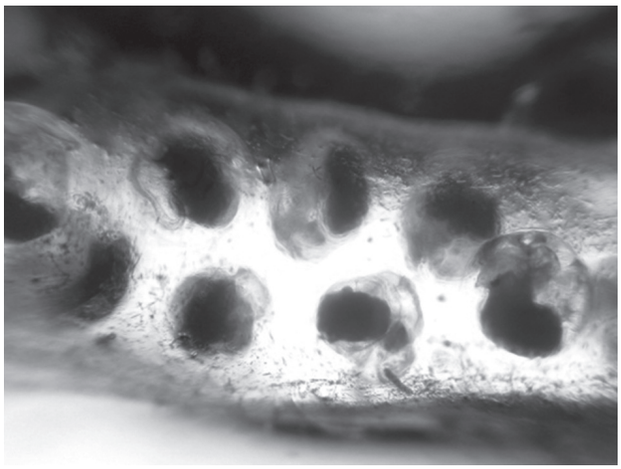

Fig. 3. Developing embryo within egg filament of *L. lambis*

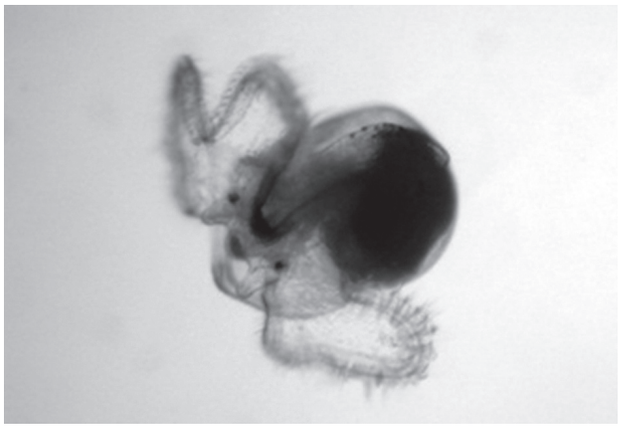

Fig. 4. Day 1 veliger of *L. lambis*

Five days old larvae were observed under a microscope for anatomical details (Fig. 5). The veliger had well defined larval shell, oesophagus, stomach, digestive glands and larval heart. The pulse rate ranged from 56-70 (63) beats per minute at 25 ^{0}C. The larval shell

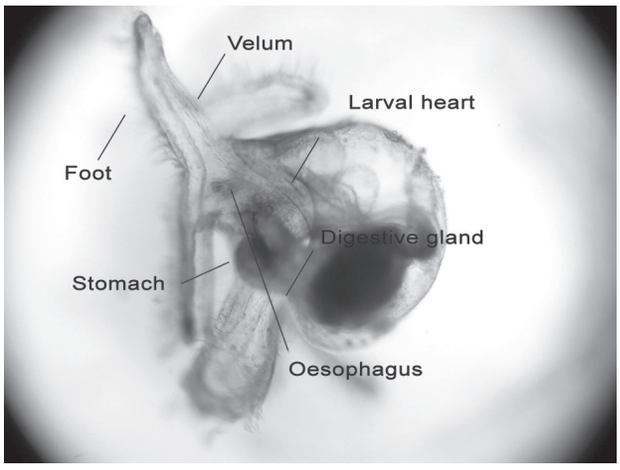

Fig. 5. Anatomy of developed larva of *L. lambis*

was transparent and very thin, the velum had well defined uniform cilia on the periphery and the food groove in the middle was evident. Ingestion of feed through the mouth to the intestine was very clearly visible. The foot was muscular and largely pigmented; the tubular propodium and wedge shaped metapodium with a thin transparent operculum and pink red pigmentation on the periphery of the operculum were also clearly visible.

Strombid (*Strombus* spp.) larvae take about 3 weeks to reach competency and metamorphose into post-larvae (Davis, 2004). Since *Lambis* spp. also belong to Strombidae and no studies have illustrated the development of more than 7 days post-hatch, the larval development was monitored to investigate the growth and development. Day 1 veligers (October 2010 spawning) were reared in 5 l glass beaker and in 75 1 FRP tank. The larval density maintained was 100 nos. l^{-1} of seawater. On day 2, the velar lobes further divided into six and the larval shell had a single whorl (Fig. 6). The tentacles were small and without any pigmentation, the larval foot was muscular and the propodium was long, protracting/retracting, helping in leverage of the shell when they are placed on a glass slide for observation. The posterior portion of the larval foot, *i.e.*, the metapodium, assumed a spade shape with a transparent larval operculum attached over it. The larvae were swimming up and down in the column and at times retracted fully into the shells. Ony day 5, the eyes were prominent; the tentacle length increased and the gut was dark in colour indicating ingestion of microalgae.

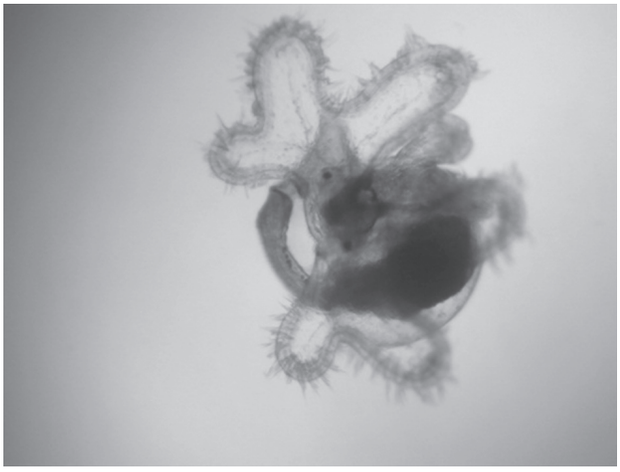

Fig. 6. Two dph larva of *L. lambis*

Brownell (1977) attributed most failures in larval rearing with mortality on the 11th day post-spawning due to proliferation of copepods and protozoans. In the present study also the first large scale mortality (>75%) of the larvae was observed on 9th day and was mainly due to ciliate infestation. The larvae also had severe infestation of *Vorticella* sp. on their shell. Such larvae were observed to

be resting on the bottom of the rearing container exhibiting slow or no swimming movement. Clogging of larvae as well as mucus trailing behind the larvae were also observed, indicating stress and weak condition of the larvae, similar to the observations made in *S. gigas* (Davis, 2004). On day 11, the larvae had almost equal sized tentacle, bulging eyes on the base of tentacles and shrunken velar lobes (Fig. 7) . Further the number of larvae drastically reduced and a very few larvae were found metamorphosing naturally on 16 day post-hatch (dph). Such larvae were completely devoid of velum, with tentacles equal in size, bulging eyes and with a small proboscis developed between the tentacles in contrast to the observations made on larvae of *Strombus* sp. which does not metamorphose naturally (Davis, 2004).

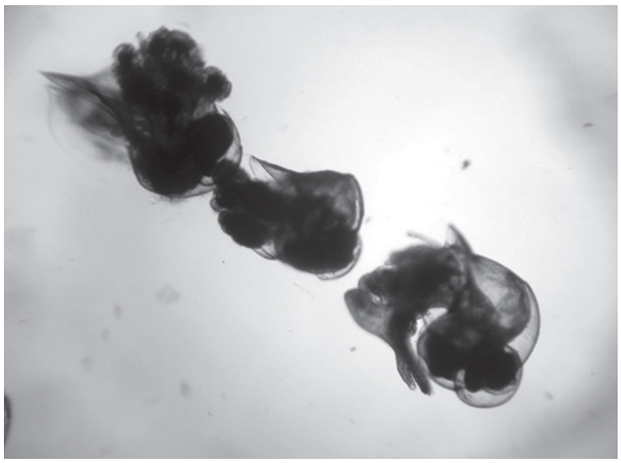

Fig. 7. Eleven dph larvae of *L. lambis*

A few such larvae were allowed to grow on a glass trough with finely sieved sand substratum, and mixed with culture of *Chaetoceros* sp. The metamorphosed larvae were observed to glide over the sand and traces of the foot marks were visible. On day 23, the post-larvae measured 1507 µ and developed 3 shell whorls similar to that of *S. gigas* (Brownell, 1977). The rearing continued up to the 35th day (Fig. 8) and subsequently the surviving few post-larvae also perished. The larvae grew to a size of 850, 996, 1045, 1507 and 2034 µ on 7, 14, 18, 23 and 35 dph respectively. The average daily growth rate was estimated to be 40.3 µ and was comparable to that of the growth of 50 µ considered as good for strombidae larvae (Davis, 2004). The larval survival obtained in the present sudy is higher than that obtained by Hamel and Mercier (2006) which lasted only up to 7 dph, however the size of the larvae reported by them was higher (1100 µ). Induction of metamorphosis is achieved in *S. gigas* larvae using hydrogen peroxide (Boettcher *et al*., 1997). In the present study, the larvae could not be tested for induction of metamorphosis due to very limited survival. The environmental parameters in the rearing containers fluctuated and the water temperature ranged from

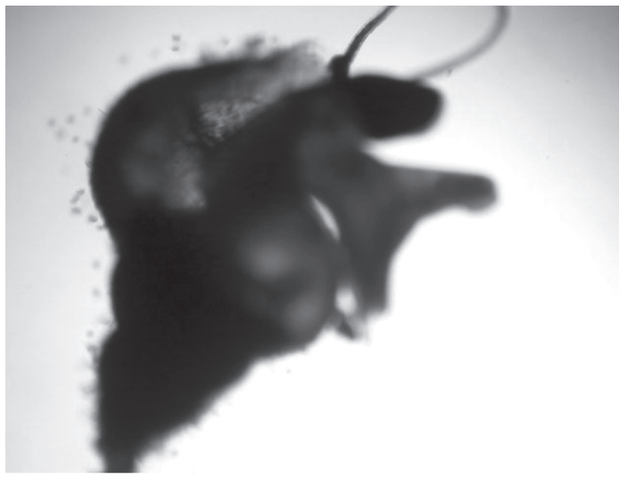

Fig. 8. Naturally metamorphosed larvae (35 dph) of *L. lambis*

26.5 to 29.9 °C, pH from 8.1 to 8.5 and salinity from 31.0 to 34.5 ppt.

The results of the present study , has yielded valuable basic information on aspects like brood maintenance, broodstock feeding protocol, spawning behaviour, egg case morphology, hatching and early larval development of *L. lambis*. The information gained would be useful in devising a complete breeding and juvenile production package for the species. This could also be useful for further strengthening the breeding programme of other valuable endangered species of conservation importance in the Gulf of Mannar area.

Acknowledgements

The authors are thankful to Dr. G. Syda Rao, Director, CMFRI, for encouragement. Sincere thanks are due to Dr. G. Gopakumar, Head, Mariculture Division, CMFRI, for his critical and valuable suggestions. Thanks are also due to Scientist-in-Charge, TRC of CMFRI, Tuticorin, for facilities given to carry out the work. Assistance rendered by Shri N. Jesuraj and Shri Sekar V. Rayer, skin divers and Shri T. Mohanraj, SRF in collection of brood animals is gratefully acknowledged.

References

Boettcher, A. A., Dyer, C., Casey, J. and Targett, N. M. 1996. Hydrogen peroxide induced metamorphosis of queen conch, *Strombus gigas*: Tests at the commercial scale. *Aquaculture*, 148 (1997): 247-258.

Shawl, A. L. and Davis, M. 2004. Captive breeding behavior of four strombidae conch. *J. .Shellfish Res.*, 23 (1): 157-164.

Apte, D. 1998. *The book of Indian shells*. Oxford University Press, 115 pp.

Carpenter, K. E., Niem, V. H. 1998. *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 1. Seaweeds, corals, bivalves and gastropods*. FAO, Rome, 686 pp.

Hamel, J. F. and Mercier, A. 2006. Note on the spawning and development of the common spider conch *Lambis lambis*. *SPC Trochus Information Bulletin,* 12: 19-21.

Davis, M. 2004. Queen conch (*Strombus gigas*) culture technique for research, stock enhancement and grow out markets. In: Fingerman, M. and Nagabhusanam, R. (Eds.), *Marine Biotechnology*. Science Publisher. Inc., p. 127-159.

Siraimeetan, P., Ameer Hamsa, K. M. S. and Satyanarayanarao, K. 1988. On the habitat, habits and food of *Lambis lambis* and *Hemifusus cochlidium*. *Proceedings of the National Seminar on shellfish resources and farming. Bull. Cent. Mar. Fish. Res. Inst*., 42 (1): 111-116.

Brownell, W. N. 1977. Reproduction, laboratory culture and growth of *Strombus gigas, S. costatus* and *S. pugilus* in Los Roques, Venezuela. *B. Mar. Sci.*, 27 (4): 668-680.

Date of Receipt : 08.02. 2011
Date of Acceptance : 29.03.2012