

CULTURE OF *BABYLONIA SPIRATA* (L.)  
(NEOGASTROPODA: BUCCINIDAE)

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ABSTRACT

Adult *Babylonia spirata* were collected from Parangipettai coastal waters (Tamil Nadu, India) and kept in the laboratory. Spawning occurred from January to August. Each female laid 12 to 65 transparent vasiform egg capsules. From 178 to 676 larvae hatched per capsule after 6-8 d. Metamorphosis was completed in 16-19 d. Larvae were fed on *Chaetoceros* sp. and *Skeletonema* sp. Juveniles were fed on bivalve meat (*Meretrix meretrix*). Shell length was 10.5 mm after 60 d and 25.4 mm after 125 d. Feeding rates were 3.5 % (50 days old) and 5.07 % (100 days old) of the total body weight d<sup>-1</sup>. Survival rate of veligers from hatching to settlement was 28.8 %, and 4.4 % for juveniles up to 60 d. There was no mortality after 60 d until the culture was terminated after 200 d.

INTRODUCTION

*Babylonia spirata* (L., 1758) is an economically important gastropod of the Indo-Pacific region. Due to the demand among exporters, active fishing has developed in recent years. Meat and operculum of this gastropod fetch Rs. 250 kg<sup>-1</sup> (about US \$ 6.9) and Rs. 600 kg<sup>-1</sup> (about US \$ 17), respectively. Total quantity of meat exported from India during 1993-1994 was about 300 metric tons. It is expected that the increasing demand may ultimately result in depletion of natural stocks. In order to be able to culture this species, larval development, growth and survival of the juveniles of *B. spirata* were studied.

MATERIALS AND METHODS

*B. spirata* were collected from Parangipettai coastal waters, Tamil Nadu, India (11°29'N; 79°46'E) and maintained in cylindrical plastic tanks filled with filtered sea water. Clean beach sand was provided as substratum and salinity (32 ‰) and pH (8) of the water were kept constant. Shell length of spawners was 4.93 to 5.31 cm, shell width 3 to 3.5 cm, and total weight 28.5 to 31.6 g. Snails were fed on the bivalve *Meretrix meretrix* until spawning was observed. When snails started spawning, the time taken to lay a single egg

capsule, and the number of capsules per snail were recorded. Next, capsules were carefully removed and placed in a cylindrical 20 litre plastic tank with filtered sea water and continuous aeration. Water was replenished daily. Random sampling of egg capsules were made daily. Ten capsules were cut open and egg number counted. Capsules were preserved in 5 % neutral formalin to study the intracapsular development. Hatching was observed and the newly hatched larvae were fed on a mixed plankton culture containing *Chaetoceros* sp. and *Skeletonema* sp. Newly metamorphosed snails were fed on boiled and crushed clam meat, later they were given fresh clam meat as daily diet (Raghunathan *et al.* 1994). The percentage of survival at various stages of development, feeding rate and growth rate were studied for a period of 200 days.

RESULTS

*Spawning and egg capsule*

Spawning of *B. spirata* was observed in the laboratory from January to August, but most capsules were deposited between April and August. Transparent, vasiform egg capsules were attached individually to sand grains by a long, slender peduncle with an adhe-

sive basal disc (Fig. 1a). The peduncle helps the capsule to stand straight above the sandy substratum. The capsule above the peduncle is inverted triangular in shape, with a gradual increase in width towards the top. Each egg capsule measured 24 to 35 mm in length and 4 to 9 mm in width. The peduncle was 10 to 14 mm long. Eggs were immersed in albuminous fluid inside the capsules. Spawners took 16 to 38 minutes to lay a single egg capsule. The number of egg capsules per spawner was 178 and 676, with an average of 611 eggs per capsule. Highest fecundity was 43,112 eggs counted in 65 capsules deposited by one spawner.

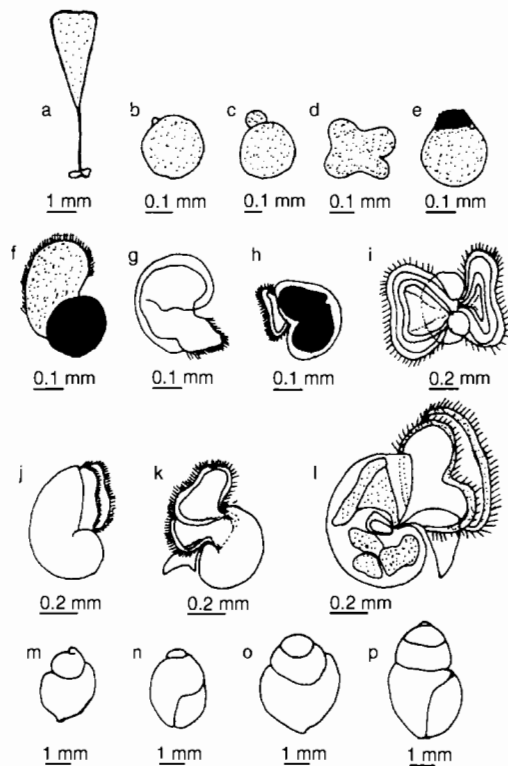


Figure 1. Developmental stages of *B. spirata*. (a). Egg capsule. (b). Fertilised egg. (c), (d), (e). Cleavage stages. (f), (g), (h). Early embryonic stages. (i). Newly hatched larva. (j). Three days old larvae. (k), (l). 8 and 15 days old larva. (m), (n). Dorsal and ventral view of newly metamorphosed juvenile. (o), (p). Dorsal and ventral view of 10 days old juvenile.

Table 1. Diameter of egg and embryo during intracapsular development of *Babylonia spirata*.

Age (hrs or days)	Diameter of egg and embryos (mm)
1-3 hrs.	0.33- 0.40
48 hrs.	0.36- 0.42
3 days	0.34- 0.44
4 days	0.36- 0.40
5 days	0.38- 0.40

#### Intracapsular development

The fertilised eggs were spherical, 0.330 to 0.400 mm in diameter. Tab. 1 shows the size of developing embryos. The first and second polar bodies were formed and the cleavage stage lasted up to 24 hours (Fig. 1 c, d, e, f). An outline of the shell, though not coiled was observed after 48 hours. The intermediate phase of intracapsular veligers was characterised by a globose shell, which was slightly coiled and had a pale yellow tinge. After that, velar ciliation was observed and the shell coiling was more pronounced (Fig. 1 f, g, h). After 5 days, the bilobed velum bordered with cilia, foot and two eye spots were evident in embryos which were very active inside the capsule.

#### Larvae

Larvae hatched between 6 and 8 days after spawning. Newly hatched larvae measured 0.380 to 0.400 mm in diameter. The number of larvae was related to length of the egg capsule. On average 684.5 larvae hatched from 34 to 35 mm capsules and 344.9 larvae from egg capsules of 24 to 32 mm length. Newly hatched veliger larvae had a colourless, transparent, thin shell, and bilobed velum bordered with cilia (Fig. 1 j, k, l). Larvae were positively phototactic and planktotrophic. Velar lobes disintegrated after 16 to 19 days and larvae settled on the bottom of the tank. Growth of larvae is shown in Tab. 2.

#### Juveniles

Newly settled juveniles were pale yellowish

Table 2. *Babylonia spirata*. Growth of larvae to juvenile stage.

Age (days after hatching)	Developmental stage	Shell length (mm)
1.	Veliger	0.38-0.40
3.	Veliger	0.40-0.42
6.	Veliger	0.44-0.50
9.	Veliger	0.55-0.83
11.	Veliger	0.95-1.04
13.	Veliger	1.10-1.25
15.	Late Veliger	1.24-1.36
16.	Metamorphosis	1.34-1.42
18.	Early Juvenile	1.44-1.68
19.	Early Juvenile	1.76-1.86
25.	Juvenile	1.84-1.93

Table 3. Growth of *Babylonia spirata* juveniles reared in the laboratory.

Age (days)	Length (mm) (mean $\pm$ SD)	Width (mm) (mean $\pm$ SD)	Total weight (g) (mean $\pm$ SD)
1	1.58 $\pm$ 0.14	0.96 $\pm$ 0.12	0.009 $\pm$ 0.002
10	2.84 $\pm$ 0.18	1.24 $\pm$ 0.13	0.012 $\pm$ 0.008
25	4.65 $\pm$ 0.23	2.66 $\pm$ 0.20	0.033 $\pm$ 0.012
50	8.11 $\pm$ 0.79	4.77 $\pm$ 0.91	0.177 $\pm$ 0.031
60	10.46 $\pm$ 0.23	6.58 $\pm$ 0.26	0.385 $\pm$ 0.022
75	13.33 $\pm$ 1.24	10.22 $\pm$ 0.91	0.606 $\pm$ 0.182
85	18.21 $\pm$ 1.93	13.88 $\pm$ 0.87	1.222 $\pm$ 0.252
100	21.88 $\pm$ 1.03	15.37 $\pm$ 1.08	2.584 $\pm$ 0.419
125	25.42 $\pm$ 1.30	16.41 $\pm$ 1.03	3.421 $\pm$ 0.586
150	29.1 $\pm$ 0.73	19.08 $\pm$ 0.21	5.897 $\pm$ 0.091
175	31.5 $\pm$ 0.14	20.10 $\pm$ 0.14	7.726 $\pm$ 0.038
200	34.3 $\pm$ 0.12	22.41 $\pm$ 0.16	9.137 $\pm$ 0.043

in colour having one protoconch and one teleoconch whorl and a broad aperture (Fig. 1 m, n, o, p). One more whorl was evident in the teleoconch after four days, and the shell became brown in colour. After 70 days, the shell had 3 whorls of the teleoconch, increasing to 4 (after 98 days) and 5 whorls (after 200 days).

#### Growth rate

Growth of juveniles is listed in Tab. 3. Juve-

niles reached half the size of adult animals after 150 days. The growth in terms of shell length, shell width and total weight in 200 days were 34.3 mm, 22.4 mm and 9.137 g, respectively.

#### Feeding

The rates of food consumption of 50, 75, and 100 days old juveniles were calculated as 4.5, 6.4, and 5.1 % of their total body weight per day. In 150 days old juveniles the rate was 4.62 % of their own body weight per day.

#### Survival rate

Survival rate of veligers was 28.8 % from hatching to settlement. From settlement to 20 days of age survival was 6.8 %, and 4.5 % after 60 days. No mortality was observed from 60 to 200 days of age.

## DISCUSSION

The whelk family Buccinidae is probably one of the largest and most diversified families of marine snails. Larval development of *B. spirata* is indirect with planktotrophic pelagic larvae. The presence of large numbers of small eggs, absence of nurse eggs, and the small sized larvae support this mode of larval development. In tropical species of Buccinidae, indirect larval development is the dominant pattern (Shanmugaraj *et al.* 1994; Poomtong & Nhongmeesub 1996), whereas temperate species, *e.g.*, *Buccinum undatum*, exhibits a direct mode of larval development (Thorson 1935). This species deposits 500-2,000 eggs per capsule, out of which only 10 young emerge. The other eggs serve as nurse eggs.

The spawning behaviour and hatching were the same for both *B. spirata* and *B. areolata* but the time to settlement varied between these species. The larvae of *B. spirata* settled 16 to 19 days after hatching while *B. areolata* larvae settle after 25 days (Poomtong & Nhongmeesub 1996). The difference in settlement time may be due to the local environmental conditions. Spawning was observed in *B. spirata* from January to

August. Poomtong & Nhongmeesub (1996) observed that spawning occurred throughout the year in *B. areolata* with the exception of November and December and the highest spawning frequency was attained in March and July. Other differences were noted between the two species. Growth rate was higher in *B. spirata* compared to *B. areolata* (Poomtong & Nhongmeesub 1996). The feeding rate of juveniles varied within different age groups. In 75, 100, and 150 days the consumption rate of old juveniles was 6.4, 5.1 and 4.6 % of total body weight per day. This rate is comparable to other carnivore snails. The consumption rate of *Hemifusus pugilinus* (Melongenidae) was 4.5 % (Benny *et al.* 1996); Morton (1986) re-

ported (4 %) in *Hemifusus tuba*. Broom (1982) found a consumption rate of 7 % of its body weight per day in *Natica maculosa*. Edwards & Huebner (1977) stated that *Polinices duplicatus* consumed more than 5 - 6 % of its body weight per day.

In the present study 28 % survival rate was observed from hatching to settlement. The high rate of mortality at this stage may be due to overcrowding of the larvae and lack of proper food. The survival rate from settlement to the 20th day was even lower. The main reasons for the low survival were cannibalism and the crawling behaviour of the juveniles. Most of the juveniles crept on the walls of the tank and came out of water, which caused death.

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