SPAWNING AND LARVAL DEVELOPMENT OF *RAPANA RAPIFORMIS* (BORN) (MOLLUSCA: GASTROPODA)

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ABSTRACT

Live *Rapana rapiformis* and their egg capsules were collected from Parangipettai coastal waters. Spawning and larval development were observed under laboratory conditions. The egg capsules are of ampulliform type with embryos suspended in a jelly like fluid. The wild collected and laboratory laid capsules differ slightly in size and number of embryos. The veliger larvae hatched out after 24-26 days. The larvae were fed with mixed phytoplankton culture. Metamorphosis occurred after 23-24 days. Fresh bivalve tissue was given as feed. The juveniles were reared successfully for 90 days.

INTRODUCTION

Rapana rapiformis is the only available species of the family Rapanidae in Indian waters. The operculum is exported to foreign countries and the meat is consumed by the local fishermen (Rajakumar, 1995). The prize of the operculum in Parangipettai coastal area is approximately Rs. 650 per kg and the meat is sold for Rs. 30 per kg. The purpose of the present study was to rear the larvae of *R. rapiformis* under laboratory conditions and to produce viable juveniles. This might then serve as an initiative to the production of juveniles in mass scale.

MATERIALS AND METHODS

Monthly random collection of *R. rapiformis* and their egg capsules were made from November 1995 to April 1996 in the coastal waters of Parangipettai (N 11° 29', E 79° 46'). Groups of different sizes were maintained in cylindrical plastic tanks each of 60 litres capacity filled with filtered sea water of 32 ± 1 ‰ salinity and 7.9 ± 0.2 pH. The egg capsules were then placed in a rectangular fibre glass tank of 40 litres capacity filled with filtered sea water. Individual egg capsules were studied under a dissection microscope. Some egg capsules were also preserved in 5% formalin. This procedure was repeated daily from spawning till the larvae hatched out.

The egg capsules were opened by cutting the apical plate and the number of embryos counted in a Petri dish. The hatched larvae were fed with a mixed culture of phytoplankton and the juveniles were fed bivalve tissue. No additional substratum was provided for the larvae or juveniles.

RESULTS AND DISCUSSION

Spawning

R. rapiformis maintained in the laboratory spawned during February and March 1996. The size of spawners ranged from 6.63-7.32 cm length, 5.32-5.73 cm width and 57-68 g total weight (Table 1). The egg capsules were laid in clusters and found attached to the wall of the plastic tank. Ruangchua and Tantichodok (1992) observed that *C. ramosus* secreted a gelatinous material to attach the egg capsules to the wall of the tank.

In nature, the spawning of *R. rapiformis* occurred predominantly from November to April. Egg masses were found on the shell surface of the same species, dead shells of bivalves and gastropods, intermingled with egg capsules of *Hemifusus* sp. and *Chicoreus*

Table 1. Size of the spawner and number of egg capsules laid under laboratory conditions.

	Spawner size			No. of egg/ capsule	Environmental parameters			
	length (cm)	Width (cm)	weight (g)		salinity	temp.	pH	DO (0_2 ml/l.)
Feb. 96	6.65	5.34	58	87	31.82	26.5	8.0	4.2
	6.63	5.32	57	68	32.5	27	8.0	4.41
Mar. 96	7.04	5.68	64	162	32.8	27	7.9	4.32
	7.32	5.73	68	178	32.8	27	8.0	4.23

sp., or attached to any hard substratum. Similarly, Cahn (1950) found that *R. bezoar* deposit solitary egg masses on any hard substratum.

Egg capsules

The egg capsules of *R. rapiformis* are thick, yellowish, of the ampulliform type (Thorson 1940), and pillar shaped (Fig. 1). The capsule wall consists of two membranes, an outer thick layer which gives the capsule its shape and an inner layer, which is in contact with the jelly like fluid. Each capsule is slightly curved towards the free end and it is more or less uniform in shape throughout the length, except at the apical region, where the border of the apical plate extends larger and attains more or less an ellipsoidal shape. The mucoid plug, which is a nipple-like protrusion, is placed eccentrically in the apical plate. The wall of the nipple is thin and transparent and covers the preformed exit hole. The capsules of *R. rapiformis* resemble those of *R. venosa*, being tall and thin with ampulliform sutures (D'Asaro 1991). The wall of the capsule is smooth without wrinkles or ridges. The basal plates of each capsule merge together to form a common basal sheet, which is attached to the substratum. The capsule length was 14.6 to 17 mm and the width from 1.1 to 1.3 mm. Capsules collected in nature ranged from 14 to 18.2 mm in length and 1.1 to 1.3 mm in width. Small sized egg capsules were found along with the large sized capsules in the same egg mass. The small sized capsules were more common towards the end of the spawning season.

Fecundity

The number of egg capsules varied from 68-178 per cluster, with 102 to 248 eggs per capsule. Egg mass from nature contained from 53 to 365 capsules per cluster with 88 to 298 eggs per capsule (Table 2). Cahn (1950) collected egg masses of *R. venosa* and found the numbers to range from 115-220 capsules. Golikov and Scarlato (1967) found that each capsule of *R. venosa* contained between 79 and 1330 eggs. Egg capsules devoid of eggs with only albuminous fluid

Table 2. Mean number of egg capsules per cluster collected from nature.

Nov. 95	Dec. 95	Jan. 96	Feb. 96	Mar. 96	Apr. 96
105	119	200	299	154	252
94	107	179	238	152	244
97	130	209	324	265	62
101	99	300	251	196	154
98	93	63	201	307	207
64	53	55	115	282	139
55	81	105	147	257	102
66	78	89	122	231	251
68	67	70	98	351	291
75	77	40	104	365	283

inside can also be observed in some egg masses. The fecundity depends upon the size of the parent individual (Purchon 1968), the availability of food, and on environmental conditions (Webber 1977). Perron and Corpuz (1982) reported that the number of eggs per capsule were related to the surface area of the capsule.

Intracapsular development.

The fertilized eggs were spherical and yellowish due to the presence of yolk (Fig. 1). The diameter of the eggs ranged from 200 to 210 µm. The cleavage stages lasted up to 48 hours. The embryo at its early developmental stage were spherical or slightly oval and measured about 235-260 µm in diameter (Table 3). Observations of the 4-6 days old embryos showed that the developing larval shells were not well distinguished. After 14-16 days a complete, transparent larval shell was observed. The velar lobes were well developed and cilia developed in two rows along the border. The colour of the surface of the egg capsules changed from yellow to purple at the late stages of development. After 24-26 days the inner contents of the egg capsules was totally exhausted and the larvae hatched out by disrupting the nipple-like mucoid plug.

Morton (1986) stated that the residence time and the size at hatching were positively related to the nutritional resources of the capsule contents. *R. rapiformis* capsules have albumen and yolk material as food reserve while nurse eggs were absent.

The exact mechanism of the hatching in *R. rapiformis* is not known. It may probably be due to chemical agents or increase in osmotic pressure as stated by Davis (1968). Hancock (1959) found that an enzyme softens the plug of the capsule which pops free when the juveniles in *Urosalpinx cinerea* are ready to escape.

Larval development

The hatched out larvae has a thin transparent, globose shell with bilobed velar lobes bordered with long cilia (Fig. 2 g,h). Two rows of cilia were observed. Between the velar lobes was a rudimentary foot. The heart beat could be observed through the transparent shell. The average size of the larvae during the developmental period is given in Table 4. The following changes were noted over time:

Day 3 Irregularly scattered pigment spots developed on the surface of the velar lobes.

Day 6. The larval shell had grown to a large size and the shell became slightly opaque due to calcification (Fig. 2 i). The inner organs were heavily pigmented and observed as a dark mass. The foot was well developed and moved along with the velar lobes.

Day 12. Torsion occurred throughout this stage. The uniformly pigmented velar lobes extended to their maximum (Fig. 2 j).

Day 14. Growth of the shell along the outer lip and the extension of shell beak was

Table 3. Dimension of the embryos during intracapsular development

Age (days)	Length (µm)	Width (µm)
1	200-210	180-200
2-4	235-260	180-220
4-6	240-275	195-220
8-12	260-280	195-225
14-17	270-290	200-230
17-20	280-300	210-240
22-24	280-310	210-260
24-26	310-320	220-280

Table 4. Average size of the larvae during the larval developmental period.

Age (days)	Size (µm)
1	304
3	314
6	328
12	368
14	384
17	400
20	432

observed. The operculum was clearly seen as a thin plate in the metapodial region.

Day 17. The larvae were found to be more concentrated at the bottom of the tank and they less active. The velar lobes diminished in size and started to disintegrate (Fig. 2 k).

Day 20. The larvae measured about 432 µ m. They crawled or showed feeble movement on the bottom of the tank, the velar lobes were resorbed and larvae settled.

Day 23-24. The larvae metamorphosed. At this stage they were found attached to the wall or on the bottom of the tank. The juveniles measured from 520 to 540 µm in length (Fig. 2 l)

Juvenile growth

After 30 days the juveniles had grown to 1.58 mm in length and 940 - 980 µm in width. During this period juveniles had a band of light brown colour in the middle region of the body whorl. The 60 days old juveniles measured about 1.85 mm. The body whorl had 2 to 3 small wavy ridges (Fig. 2 m). The 90 days juveniles had three whorls with prominent sutures. In the body whorl region 3-4 longitudinal transverse varices were observed. The protoconch was smooth and body whorl sculptured (Fig. 2 n).

The growth was slow, which could be caused by lack of suitable feed. The food preference of the juvenile was not studied. The growth rate and survival of the juveniles varied depending on the stocking density, feed or other external factors.

Survival rate

The survival rate of the veliger from hatching to settlement ranged from 1.6% to 8% with an average of 3.2 % recorded from

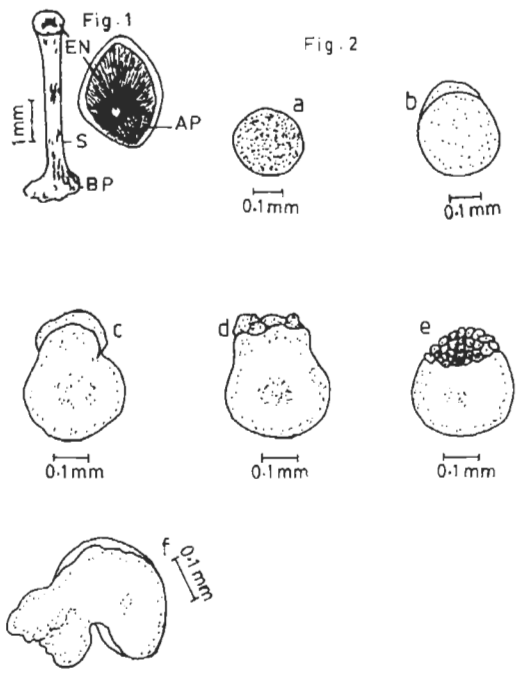

Fig .1. *R . rapiformis*. Egg capsule. S-Stalk; EN-Exit Nipple; AP-Apical Plate. a-Fertilized egg. b, c, d, e and f. Early embryonic developmental stages BP-Basal Plate.

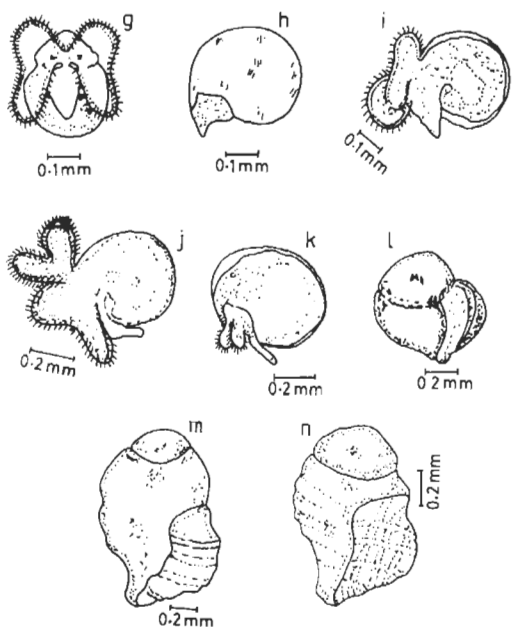

Fig . 2 - Larval development.; g - hatched out larva; h - Larval shell; i - 6 days old; j - 12 days old; k - 17 days old; I - newly metamorphosed juvenile; m - 60 days old juvenile; n - 90 days old juvenile.

batches reared at different stocking densities. Several batches suffered from protozoan infestation, which lead to mass mortality of the larvae. The average rate of survival from settlement to 3 month old juvenile was 1.43%. Hahn (1989) observed that the percentage of survival depends on the stocking density, animal size and management practices. In this study, the mortality rate was very high during settlement, which may be due to fouling by algae on the settled larvae, or by protozoan infestation.

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REFERENCES

Amio, M., 1963. A comparative embryology of marine gastropods with ecological consideration. - J. Shimonoseki Univ. Fish. **12**(2/3): 229-353.

Cahn, A.R., 1950. Oyster culture in Japan. - U.S. Fish. Wild. Serv., Fish. Leaflet. **383**: 60-62.

Davis, C.C., 1968. Mechanisms of hatching in aquatic invertebrate eggs. - Oceanogr. Mar. Biol. Annu. Rev. **6**: 215-227.

D'Asaro, C.N., 1991. Gunnar Thorson's World Wide collection of prosobranch egg capsules (Muricidae). - Ophelia, **35**(1): 1-101.

Golikov, A.N. & O.A. Scarlato, 1967. Mollusks of the possiet sea (Sea of Japan) and their ecology. - Tr. Zonl. Inst. Akad., Nauk USSR **42**:1-154.

Hahn, K.O., 1989. Hand book of culture of Abalone and other marine gastropods. CRC Press Inc. Florida: 342.

Hancock, B., 1959. The structure of the capsules and the hatching process in *Urosalpinx cinerea* Say. - Proc. Zool. Soc. London. **127**:565-657.

Morton, B., 1986. Reproduction, juvenile growth, consumption and effects of starvation upon the south China whelk *Hemifusus tuba* (Gmelin) (Prosobranchia: Melongenidae). - Jour. Exp. Mar. Biol. Ecol. **102**: 257-280.

Perron, F.E. & G.C. Corpuz, 1982. Costs parental care in the gastropod *Conus pennaceus*: Age specific changes and physiological constraints. - Oecologia (Berlin) **55**: 319-324.

Purchon, R.D., 1968. "The Biology of the Mollusca". Pergamon, Oxford: 560.

Rajkumar, T., 1995. Studies on *Rapana rapiformis* (BORN). (Gastropoda: Muricidae: Rapaninae) from the Parangipettai coastal waters. Ph.D. Thesis, Annamalai University, India.

Ruangchua, T. & P. Tantichodok, 1992. Comparative morphology of egg capsules and fecundity of *Chicoreus ramosus* from different localities. - Phuket. Mar. Biol. Cent. Spec. Publ. **10**: 76-79.

Thorson, G., 1940. Studies on the egg masses and larval development of Gastropoda from the Iranian Gulf. Dan. Scient. Invert. Iran. **2**:159 - 238.