Measurements (in cm) of the specimen of *Sotalia* stranded off the coast of Daman.

Length of the specimen	251.8	Length of the dentate portion	28.5
Span of the flukes	40.3		
Length of the snout	37.5	Number of teeth in each side of the jaw	35

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ON THE OPISTHOBRANCH *HAMINOEA VITREA* (A. ADAMS, 1850) FROM MADH ISLAND (BOMBAY)

ABSTRACT

Several specimens of Opisthobranch mollusc of the genus *Haminoea* were collected from Madh Island (Bombay) during December 1974 and January 1975. The external characters of these specimens differed from those of the recorded characters of the two species *(Haminoea tenera* and *H. crocata)* known from India. The main differences were seen in spawning behaviour, the radula and the nature of the substratum. The biology and the reproduction were also studied in the laboratory. The anatomical features are primitive and simple, typical of an opisthobranch of a herbivorous feeding habit.

VERY little information is available regarding the external characters and biology of Opisthobranchiate molluscs from India (Rao, 1952, 1961; Rao and Alagarswami, 1960; Rao and Krishna Kumari, 1973). The opisthobranchs of the genus *Haminoea* were mainly recorded from the intertidal rocky and muddy shores of the tropical and temperate waters (Rudman, 1971 a). Itaru Usuki (1966) reported the spawning and growth of *Haloa japanica* from Japan and Rudman (1971 a, 1971 b) described the mantle cavity, alimentary, reproductive and nervous system of *Haminoea zealandiae* from Aukland, and *H. cymbalum* and *H. crocata* from Hawaii. Natarajan (1970) discussed the chromosome numbers of *H. crocata* from Porto Novo waters. Kasinathan and Ramamoorthi (1972) described the anatomy, breeding and larval development of the species *H. tenera* from the same area. Some aspects of the external and internal features of *Haminoea vitrea,* collected from Madh Island (Bombay) and its copulation, spawning and early development are described in this note.

We are grateful to Dr. S. Z. Qasim, Director, National Institute of Oceanography, for his encouragement and his keen interest in the work. We are also grateful to Dr. Robert Burn, National Museum of Victoria, Australia, for the identification of the species described in this note.

Materials and methods

The specimens of *H. vitrea* were collected from Madh Island in the Bombay Coast. The animal was associated with other prosobranchs like *Cerithium morus, Gyrineum natator* and *Thais tissoti.* Live specimens were brought to the laboratory in plastic containers and placed in sea water in glass troughs and finger bowls. The morophology and anatomy of the species were studied from the fresh material. The egg masses were removed from the troughs containing animals and maintained separately. The diagrams were drawn with the help of a Camera lucida and measurements were taken with an aid of a standard ocular micrometer fitted in a Zeiss microscope.

Description

Shell: Bubble shaped, thin and brittle; light brown in colour; adult shell measures 1 cm in length and 0.7 cm in width; under microscope, horizontal and vertical lines over the shell clearly seen, except on apertural side; lip is always thinner than rest of the shell.

Animal: After removing the shell, specimens measure from 0.5 cm to 1.6 cm; mature specimens measure from 1 cm to 1.6 cm; the typical opisthobranch characters such as head, foot, cephalic shield and parapodial lobes and 3 mm in width, orange coloured dotted with black pigmentation; black coloured eyes present on forehead; parapodial lobes which were thrown on lateral side of shell, light orange in colour with scattered black pigmentation; foot short, anterior and mid sole yellow whereas posterior region yellow with black dots. Hancock's organ on either side of head yellow in colour.

Mantle and its contents: Mantle dark red in colour with numerous black dots; circulatory system well developed in the form of netted blood vessels on dorsal aspect of mantle; an elongated brown coloured gill present in mantle; on lateral side of gill a triangular shaped kindney present; a brown coloured heart located

adjacent to it, but below kidney. When shell of a live specimen is cracked, a whitish pericardial fluid oozes out: anal and reproductive openings occupy mantle cavity.

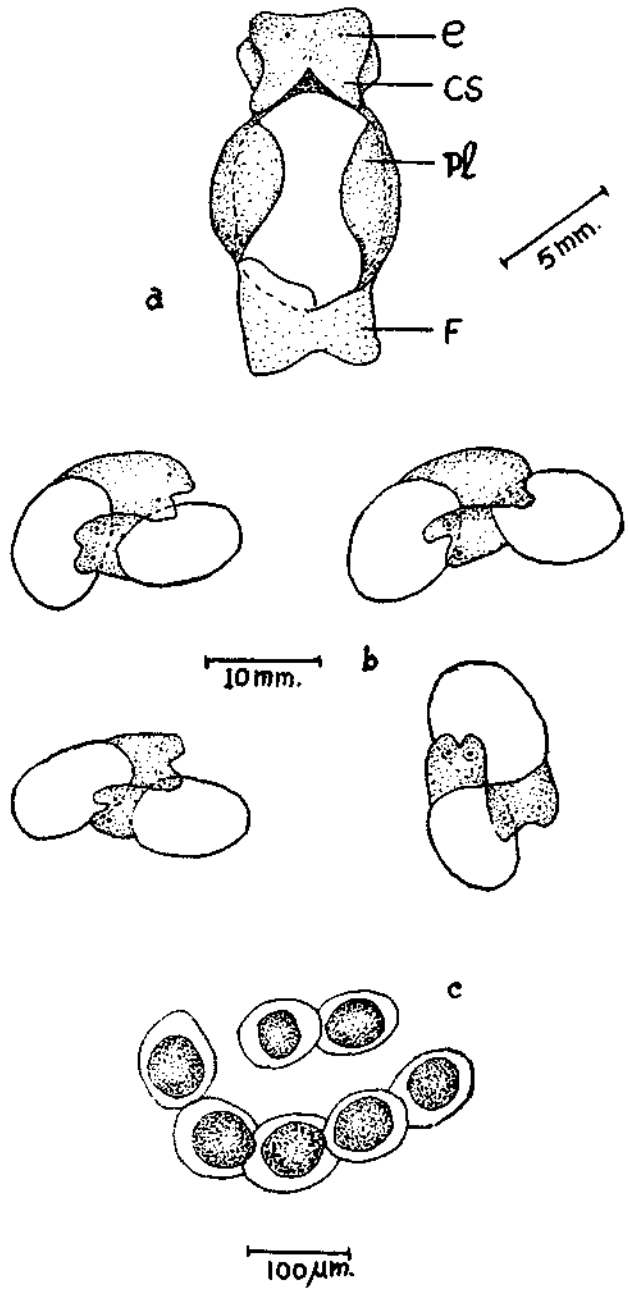

Fig. 1 a. *Haminoea vitrea* (e-eye, cs-cephalic shield, pl-parapodial lobes, f-foot), b. stages of copulation and c. few egg capsules.

Digestive system: General arrangement similar to that of other opisthobranchs; mouth leads into a buccal cavity which has a pair of jaws and radula; jaw triangular measures 1 mm in length; radula consists of 13 teeth per row (6–1–6); in mature specimen about 33–40 rows present in each radula. From the posterior and of buccal cavity, oesophagus runs back to gizzard. Three chitinous, dark coloured gizzard plates present inside. Digestive gland brownish and from stomach a long coiled duct runs over to anus.

Nervous system: Similar to that described by Rudman (1971 a), consists of four principal pairs of ganglia, cerebral, buccal, pedal and pleural, each with their associated nerves.

Reproductive system: Hermaphrodite ovotestis embedded in the digestive gland and yellowish. Ampulla convoluted and runs through mantle and opens into fertilizing chambers, from ampulla a slender tube emerges out and divided into two, one of which runs into anterior muccus gland and other to posterior muccus gland; female opening (vulva) conical in shape and white in colour; sperm duct runs from latero-ventral region of vulva, joins penial bulb which in its turn connected with prostate gland.

Copulation: Large number of copulating pairs were seen during low tide. Copulation was observed both in laboratory and in field. Copulation period lasted for about 2–3 hours. The stages of copulating pairs are shown in Fig. 1 b. Copulated pairs were separated and kept in glass bowls to observe spawning.

Spawning and egg mass: From 12 to 18 hours after copulation, animal began to spawn. Spawning observed during cooler hours of the day in the months of December and January. Observations were made in laboratory and also in field. In field, they preferred to spawn on rocky substratum whereas in laboratory they spawn in glass finger bowels. The egg ribbon was surrounded, by a thick jelly like mucous coating secreted by anterior mucous gland. Spawning time varied from one animal to other and thus length of egg mass varied among different individuals. In the field, snail took about $1\frac{1}{2}$ to $2\frac{1}{2}$ hours for a single spawn during which about 5000–6000 eggs were laid. In laboratory a single female snail laid one or two egg masses in the course of 12–15 days. Size of egg ribbon ranged from 4.0 to 5.0 cm in length and 0.7 cm in breadth. Freshly laid egg ribbon was yellow in colour and capsules were arranged irregularly (Fig. 1 c). Capsule measured 120 um. in diameter and size of egg was 100 µm (Fig. 4 a).

Development: One hour after spawning polar body was seen on top of fertilized egg (Fig. 2 b) and it was followed by the second polar body (Fig. 2 c). After three hours egg undergoes spiral cleavage. First cleavage while occur 3 hours after spawning, was vertical which divided egg into equal halves (Fig. 2 c). Second cleavage resulting in 4 cell divisions (Fig. 2 d) took place three hours after first cleavage. Eight cell divisions (Fig. 2 e) took place after a lapse of three more hours and subsequent divisions took place quickly. Fertilized egg attains blastula stage (Fig. 2 f) in about 24 hours. This was followed by gastrulation (Fig. 2 g, h, i) partly by epipoly and partly by invagination. On third day, it was found that embryo was rotating in an anticlockwise direction about 15 times per minute (Fig. 2 j, k). On fourth day, larval shell, stomach and velar lobe were seen clearly (Fig. 2 o). Further, on fourth day evening rotation of embryo within capsule was more than 50 times per minute and ciliary movements on velar lobes (Fig. 2 m) were clearly seen. On 5th day, fully formed veliger was rotating inside capsule continuously (Fig. 2 n). On

6th day, embryo hatched out as veliger and swam freely in water. At the time of hatching, shell (Fig. 2 *o*) was white and velar lobes were prominent and light brown in colour. Stomach and digestive glands appeared dark brown in colour. Veliger shell measured about 130 μm in diameter.

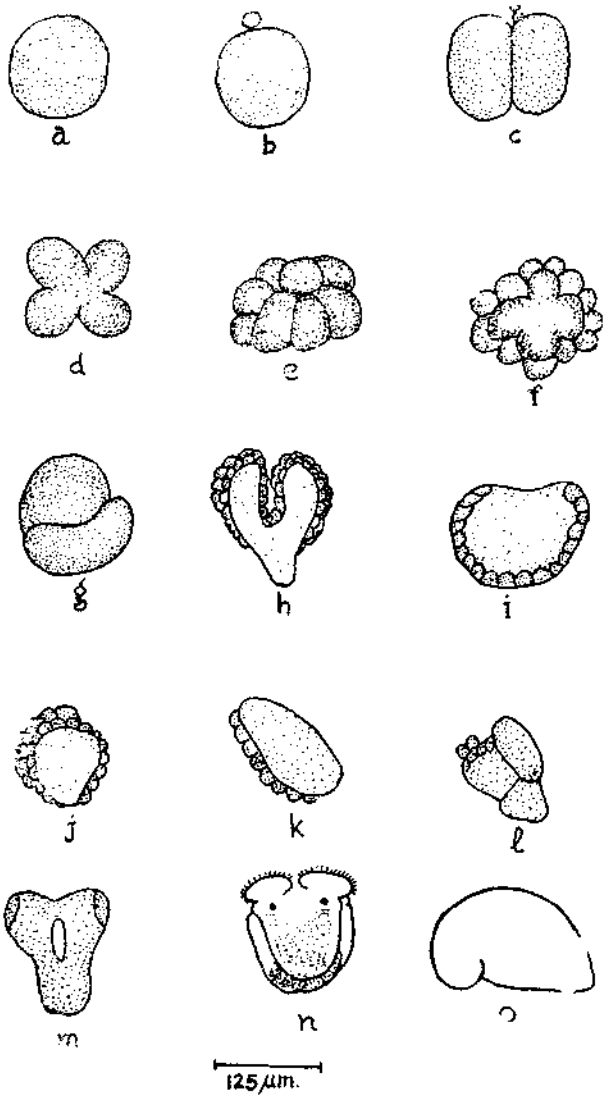

Fig. 2. Development stages : a. egg removed from the capsule, b. first polar body stage, c. second polar body stage, d. four cell division, e. eight division, f. blastula stage, g, h, i. gastrula stages, j, k, l, m, n. embryo and o. veliger stage.

Remarks

In *H. tenera*, the radular formula is 5.1.5 whereas in the present species it was recorded as 10.1.10 by Rudman (1971) and 6.1.6 in the present observation. The