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Embryonic development and hatching of *Loligo duvaucelii* Orbigny (Loliginidae, Cephalopoda) in the laboratory

P K ASOKAN[1] and V S KAKATI[2]

Karwar Research Centre, Central Marine Fisheries Research Institute, Karwar, Karnataka 581 301

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ABSTRACT

The egg masses and adults of common squid *Loligo duvaucelii* were collected on the shore seine and from the intertidal sandy shore at Karwar. The embryonic development and hatching of the squid was observed in the laboratory. Each egg mop consisted of many egg capsules, each of which, in turn, consisted of 125–150 eggs. Eggs were 2 mm long and 1.75 mm wide and very yolky. The young ones hatched in 5 days measuring 1.83 mm in DML and 3.17 mm in total length including the arms. Mantle width was 1.55 mm. The young ones survived for 5 days in the aquarium.

The bulk of the cephalopod production in Indian waters comprises cuttlefishes (60%) and the rest consists of squids and a negligible quantity of octopods (Silas 1986). The biology and fishery of cephalopods have attracted the attention of many workers in India (Rao 1954, Alagarswami 1966, Silas 1968, 1986, Sarvesan 1969, Silas *et al.* 1982, Sivalingam and Pillai 1983). However, the embryonic development and hatching of the common squid *Loligo duvaucelii* Orbigny has not been studied so far. This squid is a neritic, shallow water species distributed throughout the Indian coast. It is commonly known as the Indian squid though distributed widely in the Indo-Pacific region. The recent appearance and landings of unusually large quantities of this squid at Tadri in Karnataka amounting to 12 tonnes in a single trawl net haul, and at Karwar by trawlers and shore seines, promp-ted this study. The present account deals with the embryonic development and hatching of the squid based on laboratory observations.

Present address: [1]Scientist, [2]Senior Scientist.

MATERIALS AND METHODS

The egg masses of *Loligo duvaucelli* were collected along with adults in the shore seines and also from intertidal sandy shore at Karwar (Lat. 14°50′ N, Long. 74°03′E) at low tide on 21 September 1989. Since this squid aggregated very close to the shore for spawning, collection of egg masses that came along with adult squids in shore seines was very easy. Apart from this, egg masses noticed in the intertidal areas during low tides were also collected. These egg masses were maintained in the laboratory where the hatching took place.

The egg masses or mops were maintained in seawater in 10-litre glass trough under continuous aeration. The water was changed daily. The temperature of the rearing medium was maintained at 28° ± 2°C and salinity at 33 ± 2‰. The first batch of young ones emerged from some egg capsules on 26 September at

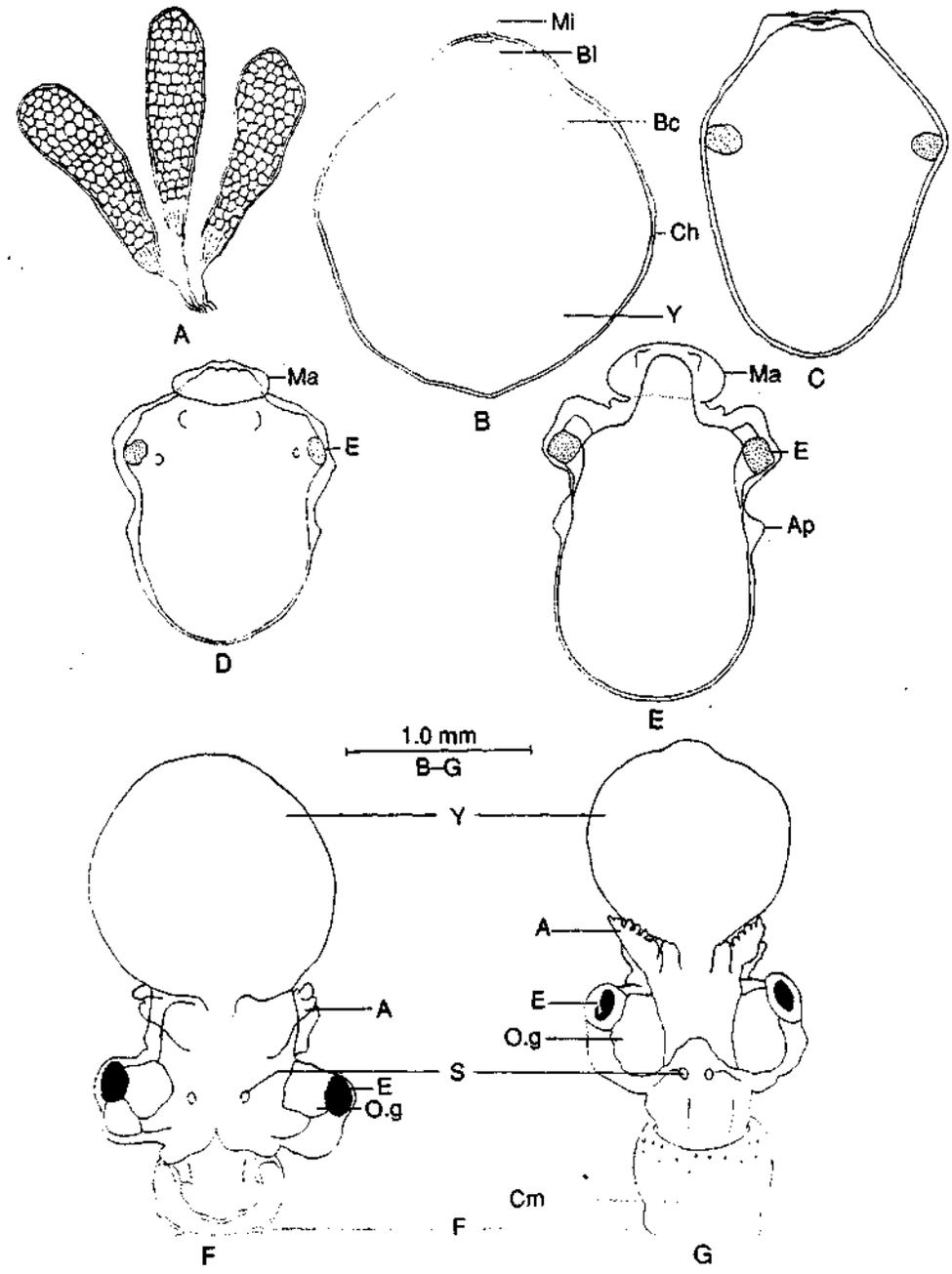

Fig. 1. Embryonic development of *Loligo duvaucelii*. A. Egg capsules. B. Formation of the blastodisc with the micropyle. C, D, E, F and G. Developmental stages.
A, Arm; Ap, Arm primordia; Bc, blastocones; Bl, blastoderm; Ch, chorion; Cm, chromatophore; E, eye; Ma, mantle; Mi, micropyle; O.g, optic ganglion; S, statocyst; Y, yolk.

1030 hrs while other embryos were still in the process of development. The hatching process continued till 29 September in different capsules. Healthy young ones were segregated for further rearing. The hatched young ones were positively phototactic. A few young ones were narcotized by adding magnesium sulphate heptahydrate ($MgSO_4.7H_2O$) so as to get uncontracted specimens for sketching. The specimens were preserved in 5% formalin. Sketches were drawn to scale with a Camera lucida. Embryonic stages were studied from the developing egg capsules.

RESULTS

When the egg capsules were collected the eggs were with apical body and still in the process of development.

Egg mass

The egg mass or egg mop used in the laboratory consisted of gelatinous finger like capsules. The proximal end of the capsule formed an elongated gelatinous strand, and the end of the strand of each capsule was entwined with one another to form the egg mass (Fig. 1A) which was attached to the substratum. The egg mass sways and dangles in the water during wave action. There were 64 egg capsules in the present egg mop, and each of the capsules contained 125–150 eggs. It was observed that all the egg capsules of the mop were not in the same stage of development.

Egg

The egg was large and very yolky. It was telolecithal as in other cephalopods. The egg measured on an average 2 mm in length, and 1.75 mm in width. It was encased in the chorion surrounded by perivitelline space in between and had a micropyle at the animal pole (Fig. 1B).

Organogenesis

The first embryonic organs appeared as a thickening of the outer cell layers forming mantle. The mantle increased in size and spread towards the animal pole and towards the equator of the embryo with the shell gland gradually disappearing. The mantle then formed a prominent ring which grew outwards and over the developing visceral organs forming the mantle cavity (Fig. 1C, D, E). The

Fig. 2. About-to-emerge hatchling of *Loligo duvaucelii* with dwindling yolksac.

eyes, arms and the funnel folds appeared later (Fig. 1 F, G). The eyes appeared as a thickened placode on either side of the embryo which on invagination formed the optical vesicle, the inner wall of which forming the retina. The arms first appeared as thickened buds of cells slightly above the equatorial constriction. These arm primordia grew outwards and differentiated with small sucker buds on their inner surface. The mantle then grew out downwards and covered almost the funnel leaving only the distal portion beyond its cavity (Fig. 2).

Squid hatching

Before liberating from the egg capsule, the young ones were seen making jerky movements inside the chorion. In some, the yolksacs were seen inside the capsule as they got detached from the young ones. In some cases, the yolksac was retained even as the young hatched out (Fig. 3) but subsequently it was dropped.

The young squid led an independent life. It measured on an average 1.83 mm in DML (dorsal mantle length) and 3.17 mm in total length including the arms. The specimens was

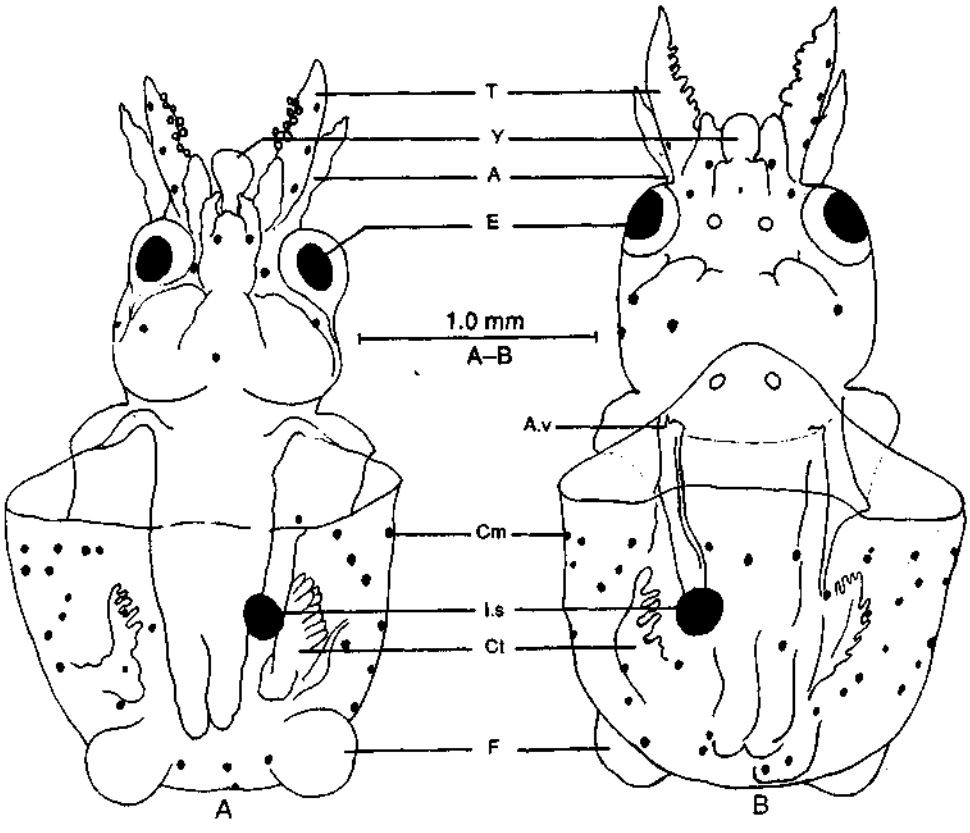

Fig. 3. Hatchling in *Loligo duvaucelii*: Yolk is still in a reduced form. A. Ventral view. B. Dorsal view. A.v, anal valve; Ct, ctenidium; F, fin; I.s, Ink sac; T, tentacle (for other abbreviations *see* Fig. 1).

1.55 mm in mantle width. The mantle being transparent, much of the internal organs could be seen under the microscope. The chromatophores were expanding and contracting. The fins were seen as 2 separate flaps without fusing posteriorly. The suckers on the arms, the funnel and the nuchal cartilage were well developed. The ink gland was seen as a dark patch as were the eyes. During the observation of the live young ones under microscope, one hatchling ejected ink from the ink gland on to the slide. The ctenidia, anal valve and branchial heart were also seen.

All the young ones survived for 5 days in the aquarium after which they all perished due to non-availability of proper food. They did not feed upon live *Artemia salina* nauplii. There was no death in intervening days.

DISCUSSION

The egg capsules were highly structured as observed in *Loligo pealei* (Arnold and Arnold 1977) with a central spiral fold of jelly (Fig. 1A). It was found that the same mop had capsules of different stages of development which indicated that the egg capsules in one mop might have been contributed by different individuals in the same population to form a community pile (Morton 1979).

The incubation in loliginids differs from species to species, and in the same species temperature of water seems to determine the duration as reported by Hamabe (1960) in *Loligo bleekeri*. Fields (1965) and McGowan (1954) also found different hatching periods for the same species at different temperatures. Alagarswami (1966) observed an incubation period of 15 days in *Sepioteuthis lessoniana* (= *arctipinnis*) at 27°–29°C at Mandapam. In the present species hatching was observed on the 13th day at 28°C.

The egg being very yolky, the embryonic development did not follow the typical molluscan pattern of spiral cleavage. There was no larval form. The hatching was direct to a minature adult as is the case in other decapod molluscs. The young one was small as compared to the hatchling of the Palk Bay squid *Sepioteuthis lessoniana* (= *arctipinnis*) which was much larger, measuring 7.5 mm in total length and 3.11 mm in width. The flaps were also fused posteriorly unlike in *L. duvaucelii*.

Since the occurrence of egg masses during September–October is a regular feature on the Karwar coast due to swarming of the adult squids, there is scope for rearing and ranching of young squids along this coast. This may increase the production of the squid which is at present sold up to Rs 45/kg. Therefore, attempts should be made to rear these 'easy to rear' egg masses of this squid on a large scale for sea ranching purpose.

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