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# Embryonic Development of Commercially Imporatant Swimming Crab *Portunus pelagicus* (Linnaeus)

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**Abstract:** The embryonic development of commercially important crab, *P. pelagicus* was studied. The fecundity rate is ranging from 9, 00,000 to 10, 00,000. The incubation period reported to be 6-7 days. Five embryonic (Blastula, Gastrula, Eye placode, Pigment and Heart beat) stages were recognized and each stage is described in detail. The size of the developing egg was increased at every stage. The colour of the egg is initially yellow in colour and it was gradually transformed into orange, brown and black colours. The hatching success of the freshly hatched I zoea was 75%. The salinity test shows that 35 ppt is an optimum salinity to rear the larval forms of *P. pelagicus*.

**Key words:** *Portuns pelagicus*, blastula, gastrula, eye placode and heart beat.

## INTRODUCTION

Crab culture gained its importance from beginning of last decades due to great demand of live crabs and crab products in the export market. Most of the edible crabs caught from marine and brackishwarter environments belonging to the family portunidae. In seas around India, five genera of portunid crabs have been reported by various authors, *Scylla, Portuns, Charybdis, Lupocyclus* and *Thalamita*. Among these the first 2 genera are commercially important. The annual mariner crab landings in India have steadily increased from 20,000 to 48,380 t during 1977-2005, of which *Portunus pelagicus* contribute above 30% (John Samuel *et al*. 2004; Josileen Jose, 2006). Other important species were *P. saguinolentus*, *Charbydis feriata C. lucifera Scylla* spp *Podathalmus vigil*. Hatchery technology was attempted by various authors in India (Josileen Jose, 2006; Soundarapandian *et al.,* 2007). But survival was not encouraging. Many countries like, Japan, Philippines, India, Indonesia, Thailand, Bangladesh, Vietnam, Australia and USA are actively involved in crab culture and research. However, in most of the countries to date, broodstock development and hatchery seed production of crabs has been experimental though the technology has developed for the production of crab seed. The crab culture in India is presently dependent on wild caught seeds that are not sufficient (Keenan, 1999; Fortes, 1999). The natural seed availability is declining due to indiscriminate collection of juveniles for farming. The collected seeds are not uniform in size and availability throughout the year is a big question mark. To solve this problem hatchery technology is very much needed. In order to develop a hatchery technology, the crab larval biology should be thoroughly studied to produce good quality eggs and healthy zoeae from the mother crab. Hence, embryological study forms a base line to get healthy first zoeae from developing eggs. So in the present study an attempt has been made to study the embryonic development of *P. pelagicus*.

## MATERIALS AND METHODS

**Broodstock management:** Healthy gravid females of *P. Pelagicus* with yellowish orange coloured eggs were collected from Parangipettai (Lat. 11º 29'N and Long. 79º 46'E) coast. They were immersed with prophylactic dip of 200-ppm formalin for 30 min. The crabs were retained in separate tanks containing filtered seawater and the tanks were provided with adequate aeration. During the experimental period, optimum environmental parameters were maintained (salinity 33-35 ppt., pH 7.5 – 8.0 and temperature of 28 - 31°C). Every morning, 90% of water was exchanged and crabs were fed with oyster (*Crassostrea madrasensis*) meat twice in a day. Daily colour changes in egg during incubation period could be noted. The diameter of the egg was measured using a micrometer mounted in the ocular of a dissecting microscope. Few eggs were removed from the brood daily, examined under the microscope for the colour change corresponding to development and length of incubation period (Srinivasagam *et al*. 2000). The quality of newly hatched larvae was assessed through different tests like salinity (25,30, 35 and 40 ppt) and starvation. Apart from these two tests the egg and larval quality could also be obtained by the following factors, which play an important role in the quality of the larvae.

**Fertilisation Success:** It is the ratio of developing to dead eggs and was calculated by removing the eggs from the berry and examined under microscope.

**Rate of development:** It is the relationship between egg diameter and degree of temperature. This was achieved by

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measuring the samples of eggs daily under microscope as well as recording the temperature. It was used to predict the day of hatching.

**Fecundity:** Fecundity was calculated by weighing the female directly after extrusion and once again after eggs was hatched. From this the total egg mass was calculated as well as fecundity.

**Hatching Success:** The total number of healthy larvae produced. This was calculated by the number of larvae per milliliter of water in a known volume of water.

## RESULTS

The eggs of *P. pelagicus* crab, changed through different colours with its gradual development. The colour of the egg, immediately after extrusion was yellowish orange and it gradually transformed into orange, brown and black colours. The incubation period was 6-7 days. The eggs at the time of oviposition were quite distinct and large. They could be divided into five stages, viz., blastula, gastrula, eye placode, pigment and heart beat and finally hatched into first zoeal stage (Amsler and George, 1984).

**Stage – I – Blastula:** Eggs were round, golden yellow in colour and were undeveloped and mass of undifferentiated cells are found. Yolk granules are denser. Cleavage and gastrulation were not clear. The diameter of the freshly laid *P. pelagicus* egg was reported to be 0.35mm – 0.36mm.

**Stage – II – Gastrula:** Eggs were round and deep yellow or yellowish orange in colour. The space between the egg wall and the inner developing embryo was visible. The diameter of the egg was 0.37mm – 0.38mm.

**Stage – III – Eye placode:** Eggs were round orange in color and yolk granules were not denser. Segmentation and organogenesis were distinct and the eyespots appear as scarlet crescent. The diameter of egg was 39mm–40mm.

**Stage – IV – Pigment:** Eggs are brown in colour with slightly elliptical shape. Appendages of embryonic larvae were pigmented. The diameter of egg was 0.40mm – 0.41mm.

**Stage – V – Heart beat:** The eggs were dark brown or black in color and eyes were round in shape. Heart started to beat vigorously. The diameters of *P. pelagicus* eggs were 0.41mm – 0.42mm.

**Stage – VI – Newly hatched first zoea:** The freshly hatched I zoea moved freely in the water and its carapace length ranges from 1.05mm - 1.25mm. The fecundity rate of *P. pelagicus* was ranging between 9,00,000 to 10,00,000 eggs. The hatching success of freshly hatched I zoea was 75%.

The larvae after hatching when subjected to different stress tests, showed a marked survival rate and success. In the salinity test, the larvae showed good resistance and survival rate (100%) at 35 ppt and reached the second zoea within 3-4 days. At 25, 30 and 40 ppt the larvae were active only 2 days and the survival rate was very less. In the starvation test, all the larvae died within two days. The survival rate, in first day was 70% and in the second day it was 20% and no zoea were survived on third day.

## DISCUSSION

In general, Portunids lay around 1 to 6 million eggs per spawning. Fecundity of the P. *pelagicus* is ranging between 9, 00,000 to 16, 00,000 eggs (Yatsuzuka, 1962; Meagher, 1971). In the present study fecundity rate of *P. pelagicus* was 9, 00,000 to 10, 00,000 eggs. The eggs when deposited are bright orange or yellowish orange, but they become yellow, brown and then dark brown or black before hatching. The colour change is caused by absorption of the yellow yolk and development of dark pigment in the eyes (Sundaramoorthy,1987; Krishnan 1989; Vijayakumar, 1992; Veera Ravi, 1994; Parimalam 2001; John Samuel, 2003).

In the previous study of embryonic development, egg size gradually increases in size at each stage (Sundaramoorthy, 1987; Krishnan, 1989; Vijayakumar, 1992; Veera Ravi, 1994; Parimalam, 2001; John Samuel, 2003). In the present study also egg size increases at each stage viz., Blastula – 0.35 to 0.36mm, Gastrula -.37 to 0.38mm, Eye placode –0.39 to 0.40mm, Pigment – 0.40 to 0.41 mm and Heart beat -0.41 to o.42mm. The Newly hatched first zoea is 1.05 to 1.25mm in size. The bigger size crab produced large eggs and smaller size crab produce small eggs. The egg size and fecundity is always related with crab size. For instance, the egg size of the *S. serrata* and *S. tranquebarica* are larger when compared to P. *pelagicus*.

The eggs swell as they develop so that by the time they are ready to hatch, they are roughly double their new-laid volume. During the development, the colour of the egg changes through brown to grey as the yolk is used up and the outline of the embryo become visible. The eyes and pigment spots appear first followed by the outlines of the abdomen and cephalothorax (Warner, 1997).

In general, in Portunid crabs, hatching occur in the early hours of the day. During the hatching process, the fully developed I - zoea comes out of the egg cases and swims freely in the water column. Davis (1965) reported that in the process of hatching, a period of swelling of the eggs followed by osmotic swelling of the inner egg membrane at the start of hatching. The swelling inner egg membrane then ruptures the chorion by pressure from within the larva plays no part. The inner membrane is subsequently ruptured by mechanical action of the larval abdomen.

The incubation period in the present study is 6-7 days. In general the incubation period for the genus *Portunus* ranges between 6- 8 days (Richard *et al*., 1996). The incubation period of the *S.serrata* is 7-9 days (John Samuel, 2003). In general the incubation period is depends upon temperature, water quality parameters and feed that were maintained during the rearing period.

The water quality and feed are the important criterion in rearing of berried crabs. If they are not maintained properly diseases will attack which leads to the hatching of unhealthy larvae and their mortality in the early stages itself. The mortality of the eggs has been attributed to fungus, predation, and suffocation in fouled water and changes in temperatures. In order to select the best eggs for incubation and subsequent rearing, an assessment of egg quality had to be established and this could be achieved immediately after extrusion. Churchill (2001) reported that, the newly hatched larvae could be subjected to a variety of stress tests including ammonium, salinity, formalin and starvation stress tests and the results of these tests would ultimately be the deciding factors in classifying eggs as good or poor quality.

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## REFERENCES

Amsler, M.O. and R.Y. George, 1984. Seasonal variation in the biochemical composition of the embryos of *Callinectes sapidus* Rathbun. J. Crust. Biol., 4: 546-553.

Churchill, G., 2001. Selecting criteria to evaluate the quality of mud crab, (*Scylla serrata)* eggs in South Africa. Workshop on mud crab culture, ecology and fisheries, Can Tho University, Vietnam, 8 – 10th January.

Davis, C.C., 1965. A study of the hatching process in aquatic invertebrates: XX. The blue crabs, *Callinectes sapidus*, Rathbun. Chesapeake Sci., 6(4): 201-208.

Fortes, R.D., 1999. Mud crab research and development in the Philippines: An overview. In: Mud crab aquaculture and biology. C.P. Keenan and A. Blackshow, (Eds.). Proc. Intl. Sci. Forum, Darwin, Australia, pp: 9-13.

John Samuel, N., 2003. Fishery potential of commercially important Portunid crabs along Parangipettai coast. M.Phil. Thesis, Annamalai University, India. pp: 35.

John Samuel, N., N. Thirunavukkarasu, P. Soundarapandian, A. Shanmugam and T.Kannupandi, 2004. Fishery potential of commercially important portunid crabs along Parangipettai coast, Proc.internatl.conf. exposition on marine living resources of India for food and medicine, Aquaculture foundation of India, Chennai, pp: 165-174.

Josileen J., 2006. Broodstock development, seed production and farming of crabs. Summer school on recent advances in seed production and grow out techniques for marine finfish and shellfish, CMFRI, Mandapam., pp: 230-252.

Keenan, C.P., 1999. Aquaculture of the mud crab, genus *Scylla* – past, present and future. In: Mud crab aquaculture and biology, C.P. Keenan and A. Blackshaw, (Eds.). Proc. Intl. Sci. Forum, Darwin, Australia, pp: 9-13.

Krishnan, T., 1989. Yolk utilization, larval development and effects of salinity and starvation on the edible estuarine crab, *Thalamita crenata* (Latreille) reared in the laboratory. Ph.D. Thesis, Annamalai University, India. pp: 134.

Meagher, T.D., 1971. Ecology of the crab *Portunus pelagicus* (Crustacea: Portunidae) in South Western Australia. University of Western Australia. Unpublished Ph.D, Thesis, pp: 232.

Parimalam, K., 2001. Embryonic and larval development of the hermit crab, *Clibanarius longitarsus* (De Haan) (Crustacea: Decapoda: Anomura). M.Phil. Thesis, Annamalai University, India. pp: 48.

Richard, F., Lee, Kristen O' Malley and Yugi Oshima, 1996. Effect of toxicant on developing oocytes and embryos of the Blue crab, *Callinectes sapidus*. Mar. Env. Res., 42(1-4): 125-128.

Soundarapandian, P., E. Thamizhazhagan and N. John Samuel, 2007. Seed production of commercially important blue swimming crab *Portunus pelagicus* (Linnaeus). J. Fisher. Aquat. Sci., 2(4): 302-309.

Srinivasagam, S., M. Kathirvel and S. Kulasekharapandian, 2000. Captive broodstock development induced breeding and larval stages of mud crab (*Scylla* spp.) CIBA Bulletin no.12, pp: 26.

Sundaramoorthy, S., 1987. Taxonomical, development and larval bioassay studies in the mangrove crab, *Neoepisesarma (Muradium) tertragonum* (Fabricius), 1798. (Grapsidae: Brachyura: Decapoda). Ph.D. Thesis, Annamalai University, India. pp: 321.

Veera Ravi, A., 1994. Biochemical changes during embryonic and larval development of the edible Portunid crab *Charybdis lucifera* (Fabricius). Ph.D. Thesis, Annamalai University, India., pp: 97.

Vijayakumar, G., 1992. Yolk utilization, impact of salinity, phosphomidan and cadmium on the larval development of the mangrove crab, *Sesarma brockii* De Man. Ph.D.Thesis, Annamalai University, India., pp: 124.

Warner, G.F., 1997. The Biology of crabs. Elek Science, London. pp: 202.

Yatsuzuka, K., 1962. Studies of the artificial rearing of the larval Brachyura, especially of the of the larval blue – crab *Neptunus pelagicus*, Report of the USA Marine Biological Station No.9.