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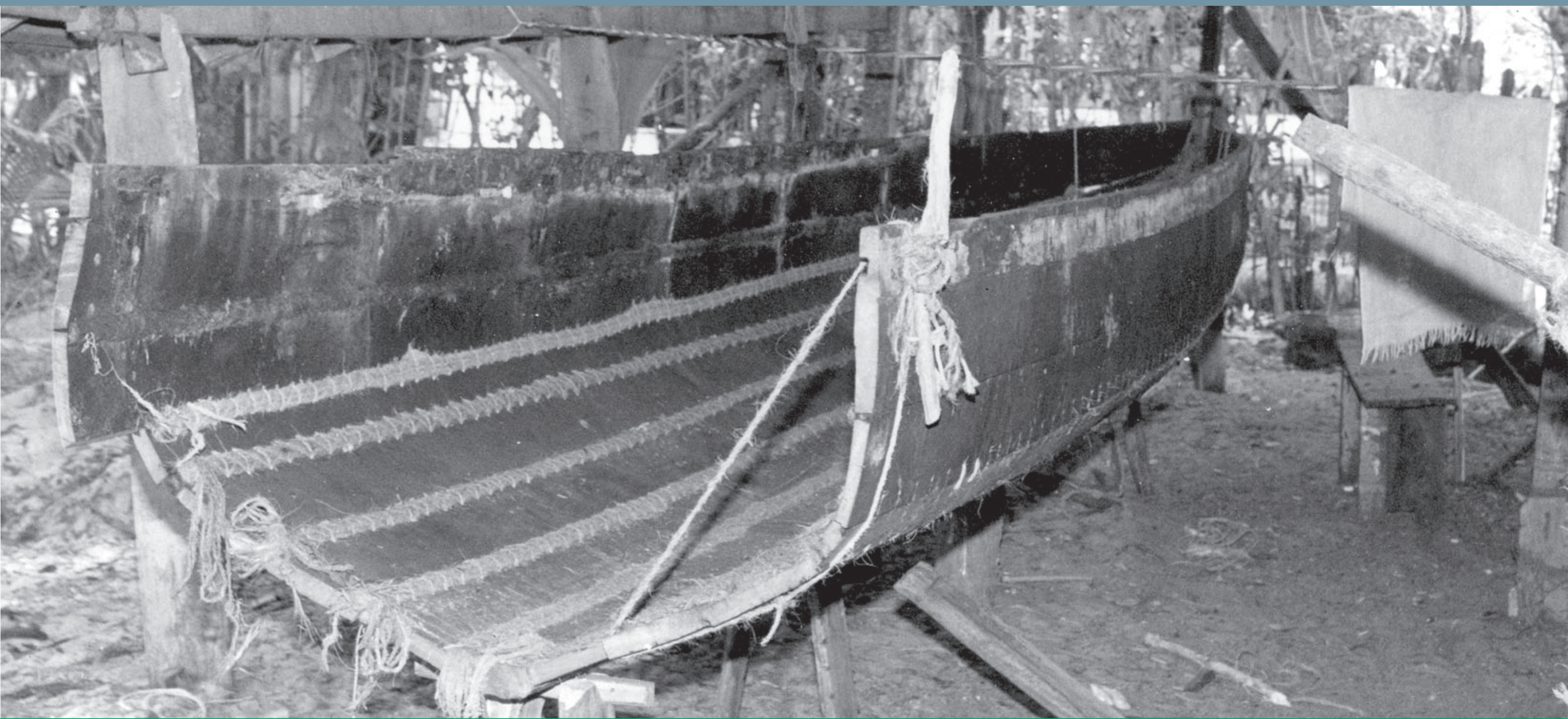

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1078 Captive breeding and seed production of scyllarid lobsters - opening new vistas in crustacean aquaculture

Lobsters have been identified as a valuable seafood delicacy and enjoy great market demand worldwide. World production of lobsters average about 2.1 lakh tonnes per annum. Annual lobster production of India averaging about 2000 tones has been steadily declining over the years, and as with most commercial fisheries, the gap between supply and demand seems to be widening. Commericial lobster fishery in India is supported by three species of spiny lobsters, *Panulirus polyphagus, P.ornatus* and *P.homarus*, the slipper lobster, *Thenus orientalis* and the deep sea lobster *Puerulus sewelli*. Slipper lobsters form only about 8% of the world's lobster production. *T.orientalis* is a commercially exploited lobster in the Indo-west Pacific region (from the east coast of Africa through the Red Sea, India and up to Japan) an the northern coast of Australia.

Although spiny lobsters have dominated the lobster export from India, there has been an increase in the contribution of the slipper lobster, *T. orientalis*, which now fetches an export value of Rs.4.51 crores annually. This resource is most abundant off the northwest coast and also along the coast of Tamil Nadu but has been fast declining due to its increased vulnerability to trawling. The price at the landing centre ranges from Rs.200 to Rs. 400/kg depending on the individual weight. This species is found in depth ranges of 8-70 m, but more abundant in depth nealm between 10 and 50 m. They thrive on soft substrates like sand or mud, or oven on a mixture of the two and sometimes on shells or gravel. There are reports that it grows to a maximum length of about 25 cm with a carapace length of about 8 cm. They began to contribute to the fishery significantly from 1983 onwards. Unlike the spiny lobsters, *T. orientalis* has a restriced distribution with minimum movement from its territory. This increases its susceptibility to fishing at every stage of its life especially after it enters the juvenile phase, during which they live in the nearshore habitat. The trends in fishing in Maharashtra echo this fact. In Mumbai, *T. orientalis* disappeared from the fishery in 1995. The all-India landing of this resource has also been on a declining phase. These lobsters have a meat yield of about 30-35%. The major markets are Japan, Taiwan and other south-east Asian countries.

Unlike shrimps, spiny lobsters generally have a complex and prolonged life cycle, which often involves long distance movement during the larval phase. The larvae after hatching transit through several planktonic larval stages and are carried away from the coast by currents. Less than one percent of hatched larvae will survive to adult stages, which requires, on an average, 2-3 years. They are harvested at various stages of their life cycle, many without having the opportunity of reaching adulthood, and the rest without attaining the reproductive size. Currently, no serious management measures, including regulation of fishery of berried lobsters are implemented and this in tandem with the long larval life have resulted in drastic decline in landings.

The practical solution to meet the ever increasing demand for lobsters properly is development of technologies for breeding, hatchery production, fattening and grow-out of juveniles. Successful propagation will depend on a variety of factors relating to maturation and mating in captivity, egg quality, larval nutrition, husbandry and disease. The issue of ensuring a supply of newly hatched larvae over a long period can be achieved by -

- faciitating maturation and breeding of lobsters in controlled environments

- ensuring a continuous and steady supply of newly hatched larvae by maintaining a continuous cycle of maturation/rematuration and mating of a wide size range of females
- subjecting the berried females to different environmental conditions like temperature and light intensity and feeding which favours proper egg development and ensure high hatching rates

Unlike the spiny lobsters, the slipper lobsters have a shorter larval phase. Research work carried out in different parts of the world indicate the amenability of several slipper lobsters to captive breeding and larval rearing. Captive breeding and complete larval rearing are major impediments in the development of a successful technology for commercial production of hatchery-raised seed. While there has been a lot of research and success in breeding of nepropid and palinurid lobsters in different parts of the world, only few slipper lobsters have been reported to have bred successfully in captivity, producing viable, healthy larvae which could also be reared to settlement in captivity.

Broodstock development and breeding

The slipper lobsters, *T. orientalis* and *Scyllarus rugosus* have been successfully bred in captivity at the Kovalam Field Laboratory of C.M.F.R.I, Chennai. The broodstock of *T. orientalis* was constituted by the sub-adult specimens collected from the gill net fishery along the south Chennai coast. The broodstock was held in rectangular FRP tanks through which water was recirculated continuously. The tanks were partially covered by blue cloth to reduce the light intensity. The animals were fed *ad libitum* with the fresh clam, *Meretrix casta*. They attained sexual maturity in the captive conditions and then mated in the holding tank. Experiments revealed that *T. orientalis* and *S. rugosus* mate during the intermoult stage and produce fertlilized eggs. In both the species the spermatophoric mass was seen adhering to the post-ventral sternite and anterior abdominal region of the female in the form of a longitudinal white, jelly-like mass. Mating generally occured in the night and egg extrusion started within 5-7 hours and oviposition was completed within 6-8 hours. The spermatophore was lost in about 12 hours after mating. In both species, the mated males were smaller than the females.

Berried *T. orientalis* were separated and maintained in FRP tanks with *insitu* filter under minimum light. 50% water exchange was given daily. Two adult-sized female *T. orientalis (*75 mm and 70.5 mm carapace length) which matured in captivity, were kept in a FRP tank with an external biofilter. Water was recirculated continuously through the system. Light exposure was controlled so as to provide alternating spells of light and dark for 12 hours each. Light coloured tanks were used for *S.rugosus* broodstock. Adult males (19 mm and 18.5 mm carapace length) and females (17 mm and 25.2 mm CL) were mated in captivity and egg extrusion started a few hours after mating. Oviposition was completed within 6-8 hours. The eggs produced after the first and second matings, in all the cases were viable. Fertilized eggs and larval rearing experiments were conducted with the larvae that hatched from these eggs.

Larval rearing of *T. orientalis* to settlement was done for the first time in India. The incubation period in laboratory bred female *T.orientalis* was observed to be about 35 days. The phyllosoma metamorphosed through four stages before finally metamorphosing to the post-larval 'nisto' stage. The larval phase was completed in 26 days after hatching. The average duration of each larval stage is shown in Table-1.

Table 1 : Intermoult duration of phyllosoma larvae of *Thenus orientalis*

Stage	Mean Intermoult duration (days)
Phyllosoma I (1st instar)	1
Phyllosoma I (2nd instar)	6

Phyllosoma II	5
Phyllosoma III	7
Phyllosoma IV	7

The larvae after hatching were reared in plastic containers of 1 litre capacity. The larvae were stocked @ 5 nos/litre of seawater. Mild aeration was maintained through external fanning. The rearing system used was 'Clear water system'. with no algal medium. Larvae were exposed to low light intensity (<100 lux) and the light exposure was restricted to 12 hours during the daytime. The larvae were fed with chopped meat of the clam *M. casta* and live ctenophores collected from the sea. The larvae on transition to Phyllosoma state III were transferred to floating plastic basins (2 litre capacity) with bottom netting, in 1 tonne tanks fitted with biofilters (Closed Recirculatory System). The larvae were stocked @ 5 nos./basin. On the final day of the phyllosoma IV stage, the larvae underwent considerable change in appearance, with the abdomen turning cylindrical and the tail becoming opaque. At this stage the larvae stopped feeding and were swimming actively. When provided with clinging surfaces/substratum like net pieces, oyster shells and sand, the larvae immediately clung to these materials. Moulting to postlarvae (nisto) occurred during midnight. The larvae become rigid, holding the appendages stiff. The setae on the walking legs kept beating vigorously and the nisto broke out of the carapace through jerking movements. The nisto were initially transparent and later attained a brownish hue. The nisto showed a characteristic backward swimming movement when disturbed, as seen in adult lobsters. Moulting from nisto to juvenile took place on the fourth day after nisto formation, i.e. on the 30th day after hatching. The nisto stage was a non-feeding stage. On transition into the juvenile stage, the animals started feeding. The exoskeleton in the juveniles was hardened and the juvenile appeared in all respects like a miniature adult.

The number of phyllosoma I stocked at the start of the experiment was 100 and the survival rate from Phyllosoma I to nisto was 22%. Maximum mortality was noticed during the first three days, especially during and immediately following the first moult. The survival rate from nisto to juvenile was 100%. Water quality control, regulation of aeration, feed and strict feeding regime played a key role in the success of larval rearing.

The only success reported in complete larval rearing of *T. orientalis* earlier has been from Australia and the present success is the second instance on a global level and the first in India.

Larval rearing of *S.rugosus*

Laboratory bred female *S. rugosus* produced viable fertilized eggs and the incubation period ranged from 23 to 35 days.

The phyllosoma advanced through eight stages before metamorphosing into the post-larva (nisto) stage. The total number of days taken for the phyllosoma to settle as nisto was 32 days after hatching. The average duration of each larval stage is shown in Table-2.

The larvae were stocked in 500 ml beakers @ 10 nos./500 ml of seawater. Mild aeration was maintained through external fanning. The rearing system used was 'Clear Water System', with the microalgae *Nannochloropsis* sp. being added only at the time of feeding with *Artemia* nauplii during the first three phyllosoma instars. Larvae were exposed to light for 12 hours in the daytime. The larvae were fed with chopped meat of the clam *M.casta* from phyllosoma IV onwards. The initial number of larvae stocked was 100, out of which one metamorphosed into the postlarval nisto stage. The nisto remained alive for only about two hours after moulting. This species holds good potential as an ornamental lobster that can be kept in marine aquaria, due to its small size, easy maintenance and peculiar appearance.

Table 2 : Intermoult duration of phyllosoma larvae of *Scyllarus rugosus*

Stage	Mean Intermoult duration (days)
Phyllosoma I	2
Phyllosoma II	6
Phyllosoma III	4
Phyllosoma IV	5
Phyllosoma V	3
Phyllosoma VI	4
Phyllosoma VII	4
Phyllosoma VIII	4

The short larval phase, high survival and fast growth under captive condition are positive characteristics which qualify the species for commercial farming. Large scale seed production and a grow out feed is required for successful pond farming of sand lobsters. The research programmes are directed towards achieving this goal.

Prepared by : **Joe K. Kizhakudan, P.Thirumilu, S.Rajapackiam and C.Manibal, Madras Research Centre of C.M.F.R.I, Chennai.**