CMFRI

Course Manual

Winter School on

Recent Advances in Breeding and Larviculture of Marine Finfish and Shellfish

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LARVAL AND JUVENILE REARING OF THE SAND LOBSTER THENUS ORIENTALIS LUND, 1793

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Introduction

Over the last fifty years, global aquaculture production has undergone remarkable changes, with production scaling up from less than a million tonnes in the early 1950s to 48.1 million tonnes in 2005. China contributed to 67.3% of the production, followed by India with 5.9%. Aquaculture now accounts for nearly 45% of the world's food fish supply, and this share is expected to reach 50% in 2015 (FAO, 2007). Mariculture is a relatively virgin field with continuous scope for diversification and its ultimate aim is always to enhance high value sea food production through ecofriendly, cost-effective technologies. The present annual mariculture production in India is about 7000t, which is estimated to reach about 1 lakh tonnes in 2020.

Crustaceans contribute more than 20% (in value) to global aquaculture production, ranking first in unit price per kg. Their contribution in terms of quantity is however, meager. Shrimps have formed the mainstay of crustacean aquaculture. Commercial crustacean culture in India is mostly confined to scampi production and culture of the penaeid shrimps *P. monodon* and *P. indicus.* The shrimp culture industry, which saw a sudden expansion in the early 1990s, has now however, been relegated to a stagnation point and there is an urgent need for diversification in this arena. At this point, it is necessary to look into virgin species which hold high market value in fresh or processed form and are amenable to captive rearing. Lobsters and crabs rank next to shrimps in flavour acceptability. Lobsters are the most valued of all seafood delicacies and lobster tails are always in great demand world-wide. Crayfish and rock lobster aquaculture practices are initially capital oriented but deliver high production and income turnover in the long run. This industry has already taken off in countries like the U.S.A. and Australia. Lobster culture in India is in the infancy stage and the C.M.F.R.I. has been spearheading research in the development of culture technologies for different species of lobsters and crabs.

The sand lobster *Thenus orientalis* ranks next to spiny lobsters and tiger shrimp in export value. It is one of the most promising candidates for lobster aquaculture in India. Complete larval development of *T. orientalis* was achieved for the first time in India at the Kovalam Field Laboratory of CMFRI. (Kizhakudan *et al.*, 2004, 2005) There has been only one other earlier report of a similar achievement in *T. orientalis* from Australia. The larval cycle is completed in 26-30 days and juveniles attain a size of 150 g (the minimum legal size for export) in about 300 days. The relatively shorter duration of the larval phase is an advantage in captive rearing of the sand lobster as compared to the spiny lobsters.

Larval rearing

There are four larval (phyllosoma) stages which metamorphose and settle finally as the post-larval nisto stage in about 26 – 30 days. Moulting occurred in the late evening or night hours. The number of days taken for phyllosoma fed on clam meat and live ctenophores collected from the sea, to settle as nisto was 26 – 30 days. The average lengths of the intermoult period for each stage of larval rearing were:

Phyllosoma I	7-9 days
Phyllosoma II	5-6 days
Phyllosoma III	7 days
Phyllosoma IV	7 days

The phyllosoma larva is characteristically flattened, leaf-like and transparent. The cephalic shield is much broader than the thorax. The abdomen is very short and narrow. The pereiopods arise from the thoracic region. The nisto is a non-feeding stage. It resembles the adult lobster but has a transparent exoskeleton. Moulting to nisto marks the end of the planktonic phase of the animal's life and the nisto settles to the substratum stage.It does not swim actively unless disturbed and prepares for the next moult in another 2-3 days, following which feeding on clam meat starts. Hatching occurs in batches over a period of 36 – 42 hours, mostly during the night hours. The larvae that hatch out on the second night are usually found to be more active and healthy and are better for rearing experiments. Complete larval rearing was achieved with the help of wild zooplankton and fresh clam meat.

The hatchery was divided into three rearing sections. The rearing system in each section was modified to suit the habitat requirement at different stages of larval metamorphosis. Phyllosoma I (Plate 1a) were stocked in glass beakers @ 5/litre of seawater. Feed was given twice daily. Mortality and moulting were recorded daily. Upon reaching the Phyllosoma III stage (Plate 1b), the larvae were transferred to floating plastic basins with perforated bottom kept in mildly aerated recirculating seawater., in 1 tonne tanks run with biofilters (Closed Recirculatory System). When the larvae began exhibiting morphological changes and stopped feeding, indicating a readiness to moult into the nisto stage, they were transferred to bigger tanks provided with sand bottom and different substrates to enable larval attachment before moulting into the nisto. Minimum light exposure was given to the larvae during the entire experiment. The nistos were maintained in the same tanks. Feeding was stopped till the formation of the first seed.

Juvenile rearing

The first juvenile stage, unlike the nisto, has a hardened shell and begins feeding on fresh clam meat. The early seed stages moult successively with initial increments of almost 100% of the body weight. As the size progresses the inter-molt period increases from six to forty days. The subadult size weighing approximately 35 g in weight is reached in about three to four months time (Fig. 1). In 180 days the animals attain an average weight of about 150 g (160 – 164 mm TL), which is the minimum legal size for export of *T. orientalis*.

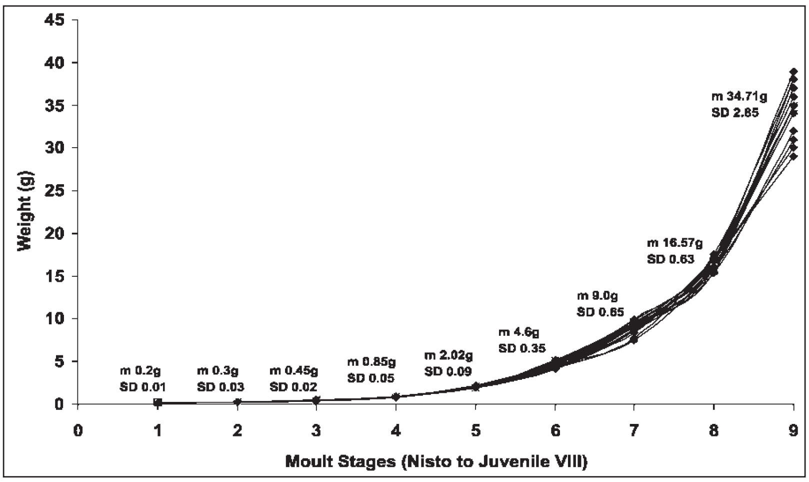

Fig. 1 Growth of laboratory-reared juveniles of *T. orientalis* in 120 days from nisto stage

Plate 1a. Developing larvae in eggs of *T. orientalis* (enlarged view)

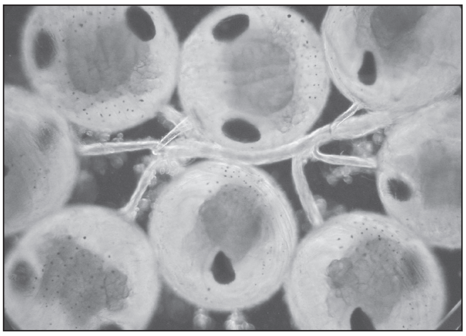

Plate 1b. Phyllosoma I of *T. orientalis* (enlarged view)

Plate 1c. Phyllosoma III of *T. orientalis* (enlarged view)

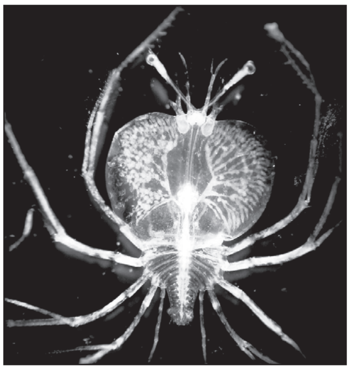

Plate 2a *T. orientalis* - Nisto stage

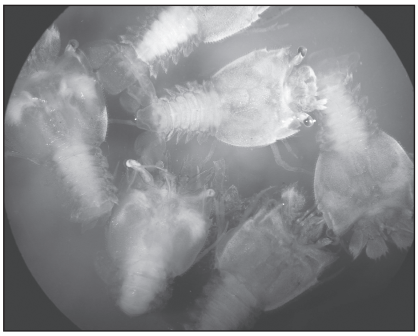

Plate 2 b *T. orientalis* - Laboratory reared juveniles

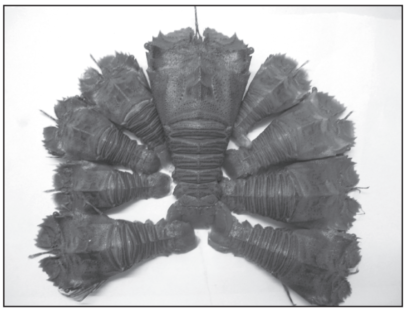

Plate 3a High density rearing of *T. orientalis* juveniles

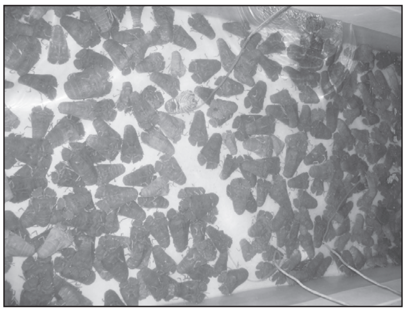

Plate 3 b .Polyculture of *T. orientalis* with *F. indicus*

The animals showed good reception to bivalve meat. Juveniles fed on fresh clam meat show better survival and moult rates. (Table 1).

Table 1 : Survival and moult performance of juvenile sand lobsters (15 – 20 mm CL) fed on different diets

Feed	15 days	30 days	Total number of moults (%) recovered after 30 days
Clam meat	100	93	63
Mussel meat	90	77	45
Trash meat	47	30	20
**Feed (wet weight) given @ 5% of body weight in three divided doses daily			

Water quality is major factor affecting the success of all rearing works done in captivity. The optimal water conditions that were found suitable for larval rearing and grow-out were :–

Temperature	25 – 27 °C
Salinity	34 – 37 ppt
pH	7.5 – 8.2
Light exposure	6 h light + 18 h darkness
Water exchange	200% - larval phase
	Closed recirculation – nursery & grow-out
Nitrate/Nitrite	monitored closely and kept minimal
Ammonia	monitored closely and kept minimal
Hydrogen sulphide	nil

Experimental rearing to test substrate preference

Seed of 5 – 30 g size collected from the wild were transported to the laboratory and acclimatized to the rearing environment. The rearing tanks were black FRP rectangular tanks with filter beds made of charcoal, seashells, gravel and rubble. The water volume in the tank was maintained at 235 l (70 l for the filter bed). About I tonne of seawater was kept in the reservoir. The filtration rate was maintained at 120 l per hour. The tanks were covered with black cloth to provide sufficient darkness.

The animals were fed ad. libitum with the clam, *Meretrix casta*. Live clams were opened, washed and dropped into the rearing tanks. The experiment was run with two substrate treatments and a control with no substrate. The tanks were stocked with seed (5 – 30 g size) @ 10 per tank. Water salinity, temperature and pH were maintained at 35 – 38 ppt, 28 - 30 °C and 7.7 – 8.0 respectively. The chief variant between the experiments was the substrate, for which brackishwater soil and coastal soil were used. The animals showed better survival when reared with coastal soil substrate.

High density rearing of juveniles

A semi-enclosed intensive system with substrate bed trickling filter, for high density growout of *T. orientalis* was successfully developed and tested at the Kovalam Field Laboratory. Cement tanks of 12.5 sq.m floor space and 0.5 m depth were used. The systems were maintained with 30% water exchange, filter turnover ratio of over eight times, pH 7.8 to 8.2, salinity 36-38 ppt and temperature range of 27º-29ºC. Light exposure was kept to a minimum. The sand lobsters were fed *ad. libitum* with live marine wedge clams. Seed of about 20mm CL (40mm TL) and weighing approximately 5gm, stocked @ 30 and 35 per sq.m, were reared for a period of 250 days. While 71.7% of the lobsters attained more than 100g weight, 58% reached commercially marketable sizes of 150 g and more. The harvest was to the tune of 3.2 kg/sq. m and the total lobster biomass harvested was 40 kg, with a survival rate of 91.5%. The total number of molts recovered was 2083. The FCR was derived to be 1:3.54 kg of clam meat.

Polyculture of sand lobster juveniles with shrimp

Seed of the white shrimp *Fenneropenaeus indicus* (35-40 mm TL; 0.3-0.4 g) was stocked @35 per sq.m towards the completion of sand lobster growout. The number of lobsters stocked initially was 463 (192 males and 271 females) and the number of shrimp stocked was 425. The shrimp were fed commercial pellet feeds and the lobsters were fed with fresh clam meat. About 158.75 kg of clam meat and 2.54 kg of pellet feed was used. At the time of harvest, 98% survival was recorded in the shrimp stock. The survival rate of the lobsters was 82.9%. The total number of molts recovered was 2835 and the average number of molts per lobster was 7.7 in 250 days of growout. The final lobster biomass harvested was 3.02 kg/sq.m and the total lobster biomass harvested was 37.712 kg. The shrimp biomass harvested was 278.6 g/sq.m. The production achieved in the intensive system indicates the possibility of rearing sand lobsters at high densities, along with shrimp, since they do not compete for food and the lobsters do not prey upon the shrimp, thus increasing the chances of deriving higher economic returns from the growout system. The results obtained establish the candidature of *T. orientalis* for aquaculture as the species is relatively fast growing, not aggressive (placid) or cannibalistic, hardy, compatible for polyculture with shrimp and amenable to growing in highly intensive systems like raceways.

Salient Observations in juvenile rearing of *T. orientalis* :

- The animals show a preference for soft substrate during the day.
- They respond promptly to the introduction of feed into the tank.
- Clam meat induces good chemoreception even during day hours.
- Molt death syndrome is frequently observed with difficulties in shedding and hardening of the soft body post molt – this can be possibly overcome with feed supplements which can provide a well-balanced nutrition.
- Males approach maturity faster and at a relatively smaller size; the activity perhaps leads to damages/ erosion of uropod, and their survival rates show a sudden decline.
- Cannibalism is not exhibited by this species.
- Amenable to captive rearing in high density systems
- Amenable to polyculture with the Indian white shrimp, *F. indicus*

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