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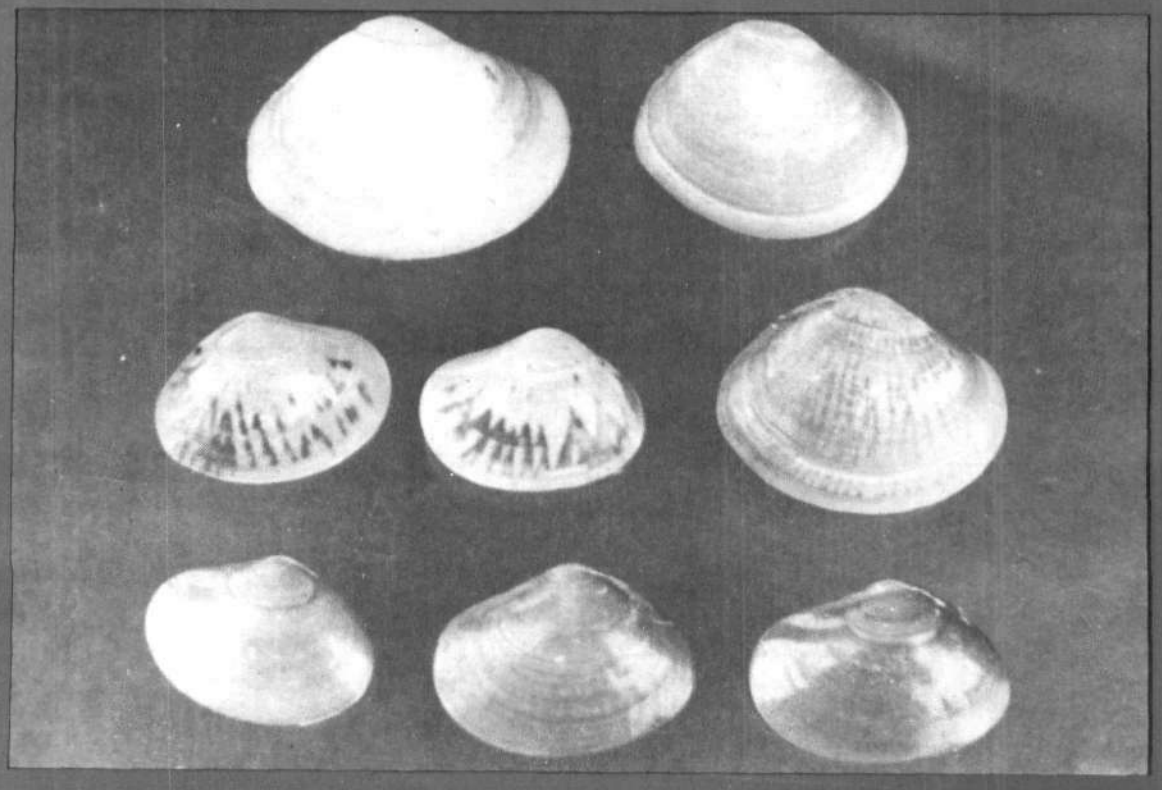

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SEA RANCHING OF SPINY LOBSTERS*

The production and release of juvenile marine organisms in order to augment the fishery is termed as sea ranching. The concept of sea ranching actually originated in USA way back 1870, the main objective being socking the fishing grounds with hatchery reared juveniles and capturing them subsequently. Japanese considered sea ranching as a form of aquaculture and included under sea farming as it involves a degree of manipulation of the natural population and a measure of husbandry. In Japan, sea farming began in 1962, came into focus in 1975 and developed as an alternative to traditional intensive culture systems, requiring high feed inputs. The Japanese Sea Farming Association since then has developed a system of seedling production to supplement the natural stocks and has released more than 45 species; another 80 species are being developed as future culture species. (Davy, F. B. Mariculture Research and Development in Japan, 1991, IDRC). The spiny lobster *Panulirus japonicus* is one among them.

Lobster fisheries throughout the world encounter decrease in harvest and catch per unit effort. In India, spiny lobster fishery has been fluctuating around 2,000 tonnes/year for several years and it is mainly due to indiscriminate exploitation of the resource. India though not a major exporter of lobsters (seventh place in the world) earns around Rs. 30 crores annually in foreign exchange. Diversification of lobster products for export from the traditional frozen lobster tails to the more lucrative whole cooked lobsters to newer markets has resulted in heavy demand for lobsters. Lobsters, unlike the fishes and other commercially important crustaceans are distributed only in certain pockets along the Indian coasts. Among the six species of spiny lobsters occurring in Indian waters namely, *Panulirus homarus*, *P. ornatus*, *P. polyphagus*, *P. versicolor*, *P. longipes* and *P. penicillatus*, only three species, *P. homarus*, *P. ornatus* and *P. polyphagus* contribute to commercial fishery. *P. polyphagus* which occurs along the northwest coast of India is listed in commercial quantities and form almost 79% of the total landings. *P. homarus* and *P. ornatus* contribute the rest and they occur along the southwest and southeast coasts and the south east cost respectively.

* This article was prepared and presented by E. V. Rahdakrishnan.

Unlike majority of the lobster fishing and exporting countries, no management regulations are enforced in India. In many areas, peak fishing coincides with peak breeding season and during this period, 60-70% of the catch is constituted by active breeders. These breeders are excepted to maintain the population by spawning several times before they are caught at a large size. The indiscriminate exploitation of these breeding populations will have strong repercussions on the fishery in the long run. Probably, the enforcement of a minimum legal size would have saved a major percentage of these breeders. Besides, exploitation by non-selective gears such as trammel nets compounds the ongoing degradation of portions of the Indian lobster fishery and diminishes the long term benefits that are available. In certain parts, the present harvest is only 20-25% of the peak catches. The problem become acute with the export of smaller lobsters in whole cooked condition which offered the maximum price. Probably, this maybe advantageous for the lobster farmer, as they need to grow the lobsters only to 150 g to fetch the maximum price. The mean sizes of lobsters captured are decreasing more rapidly in certain areas (Kanyakumari district). Of the females harvested in Madras by trammel net, 60-70% had not yet reached their reproductive maturity. The situation is so alarming that effective management regulations are to be implemented to conserve the fishery. It is true that enforcement of a uniform pattern of a minimum size of capture to multispecies fishery which employs a variety of gears is difficult. But enforcement of this regulation would contribute to the production of the breeding population and enhance yield per recruit. Probably, the most sensible approach may be banning the export of smaller lobsters which are below a minimum size. Unlike other commercially important crustaceans like prawns, spiny lobsters have a protracted larval life and these larvae are carried to offshore by the currents. Only a very small portion of these larvae were estimated to come back to the coastal areas for settling. Regular removal of the breeding population will slowly lead to decrease in reproduction potential of the population and consequent decline in new recruits to the fishery every year. Once this balance is disturbed, by excessive exploitation, it may take years for the fishery to recover and beyond a critical stage, the fishery may not recover at all. In this context, searching is one management strategy to consider to cope with intensifying fishing effort and decreasing lobster stocks. The hatchery produced seeds could be used to restock areas where populations once flourished, but are now depleted or are in the decline. Inorder to achieve this, high priority research is required to develop a mass seed production technology. The seeds produced thus may be either released in the natural habitats of the juveniles or in artificial habitats developed in suitable area along the coast. Certain species of lobsters, especially the shallow water lobster *P. homarus* were found to inhabit the rocks and tripods which are dumped in the coastal areas to prevent sea erosion.

Spiny lobsters are ideal species for sea ranching as they have very limited migration and can be grown in their natural habitats and harvested when they reach commercial sizes. Determination of the extent to which hatchery reared lobsters contribute to the natural populations is very essential. Tagging studies and detailed ecological investigations have to be conducted regularly to assess the contribution of the ranched population to the fishery. Private entrepreneurs may be encouraged to take up the searching programme as was done in salmon ranching in USA. Private hatcheries release young salmons into the sea near river mouths when the population return to the same area for spawning, are caught. Suitable coastal areas could be leased out to the private entrepreneurs to develop artificial habitats and farm the hatchery produced seeds in the natural conditions. They could be either harvested when they attain juvenile size and farm them in land based ponds or in cages in the sea. The concept of sea ranching of lobster can be thought of only if a mass seed production technology is developed. So, let us examine the prospects and problems in developing a hatchery technology for spiny lobsters. Earlier studies by the Institute have collected lot of information on the larval rearing of the lobsters.

Constraints

The major constriant facing culture of spiny lobster larvae is the prolonged larval life. The characteristically delicate and transparent phyllosoma larvae undergo complex series of metamorphic moults, before settling at the bottom as benthic puerulii. The larvae were estimated to take 4-8 months to change into the post larvae. Lack of complete information on the

food requirements of the larvae during different larval stages further complicates the problem. Phyllosoma larvae of a number of species have been cultured half way through their life cycle. The first attempt to rear the larvae of a spiny lobster upto the last larval stage was unsuccessful in producing the puerulii. The spiny lobster, *P. homarus* , *P. interrupts* , *Jasus lalandii* and *P. polyphagus* were spawned in the laboratory and their larvae reared to 3-6 stages feeding with a variety of diets. The Japanese scientist Jiro Kittaka was the first to rear the larvae of a spiny lobster to puerulus to stage. He reared the phyllosoma larvae of three temperate species of lobsters, *P. elaphas*, *J. lalandii*, hybrid of *J.verreauxi* and *J. novahollandiae* under laboratory conditions. However, tropical lobster larvae are yet to be reared through its entire life cycle. Though the survival is low, it opens up the possibility of culturing the phyllosoma larvae in captivity.

In India, phyllosoma larvae of the spiny lobster *P. homarus* were reared upto six stages in the field laboratory of CMFRI, Kovalam, Madras. The larvae were reared on a diet of brine shrimp nauplii upto the sixth stage in a period of sixty days. According to the estimate, the larvae could be reared to postlarvae (puerulii) in 3 1/2 to 4 months. Change in feeding habits was the main reason for mortality of the larvae. The larvae were reared initially in a mass culture and later they were shifted to individual containers inorder to study the feeding requirements and the moulting behaviour. Food was a significant factor for survival and moulting frequency of the larvae. Phyllosoma larvae require slow moving fleshy organisms as feed during the initial stages. But as they grow, the larvae failed to catch the small brine shrimp nauplii which indicate that they require larger organisms as feed in later stages. Studies show that larvae will fed on fish larvae, zooplankton such as *Sagitta* and hydromedusae and also on frozen adult *Artemia*. Artificial feeds should be of suitable size and buoyancy, so that the feed will suspend in the water column for a longer time and will be available for the larvae.

Another area which needs careful attention is the diseases. Larvae were found to be infected with the plumose protozoan parasites like vorticellids which grow on the various appendages and interfere with the normal swimming activity. Weak larvae are infected with free swimming ciliates. The larvae were successfully treated with 100 ppm formalin. The source of infection was mainly the food. Treatment of brine shrimp nauplii for 10 minutes in 20 ppm malachite green killed the disease organisms. The water used for rearing should be filtered and sterilised by UV lamp. The mother lobster could be a potential disease carrier. The eggs carried by the lobster was generally contaminated by bacteria or fungus. Dip treatment of the lobster in antibiotics or malachite green may be required for 15 minutes daily until hatching. The larvae collected from the spawning tank should be given preventive treatment before releasing into a rearing container. Extreme sanitation of the rearing containers and the hatchery are essential to prevent infection of the larvae. Healthy phyllosoma larvae swims toward a light source and such larvae alone should be used for rearing. A treatment schedule was formulated which include treatment of the breeders, larvae as well as the feed.

Rearing containers

The successful hatchery operation will depend upon the shape of the rearing container and hydrodynamic characteristic of the system. American lobster larvae were successfully reared using a conical bottom tank called plankton kriesel. The system developed by Massachusetts State Lobster Hatchery was successfully utilised by many hatcheries in USA, UK and France. The rearing container is a 40 l capacity subcylindrical fibreglass tank in which fresh filtered sea water is forced out at the bottom of the tank. The effluent water passes through a central screen and flows out. The hydrodynamic characteristic of the circulation device constantly stirred the larvae and the food in a spiral upwelling pattern. This system may be useful for rearing the phyllosoma larvae as the circulation pattern will prevent entanglement of the larvae and may help in uniform mixing of larvae and food. A maximum of 3,000 larvae can be stocked in each tank. The advantage of the system is that a battery of such tanks could be serially connected and this will avoid mass infection of larvae in case of any out break of these epidemics. Moreover tanks infected alone can be disconnected. Development of a suitable culture system, appropriate prophylactic measures to prevent larval infection and suitable diet for the various larval stages are essential for successful culture of phyllosoma larvae. Once the technology for larval culture is perfected, mass seed production

technology could be developed. The puerulii after rearing in the nurseries could be sea ranched after a month.

Discussion

D. B. James: For feeding phyllosoma larvae, did you try copepods?

E. V. Radhakrishnan: No, the larvae cannot eat copepods because of the exoskeleton of the latter.

V. D. Deshmukh: Did you try rearing experiments with *Panulirus polyphagus*?

E. V. Radhakrishnan: No, only with *Panulirus homarus*.

K. H. Mohmed: From what all information we have at present, sea ranching of spiny lobster is a distant possibility. As far as *Panulirus* is concerned, nobody has been able to rear it through all the stages.

The Chairman concluded the discussion by saying that the present discussion on spiny lobster is to create an awareness about the drastic decline in the fishery, the growing demand in the export market, and the urgent need to conserve and enhance the resource. True, there are lot of research gaps which are linked with lack of infrastructure facilities but the projection for the future will resolve sound sea ranching which seem to be the right step in the context of depletion versus demand.