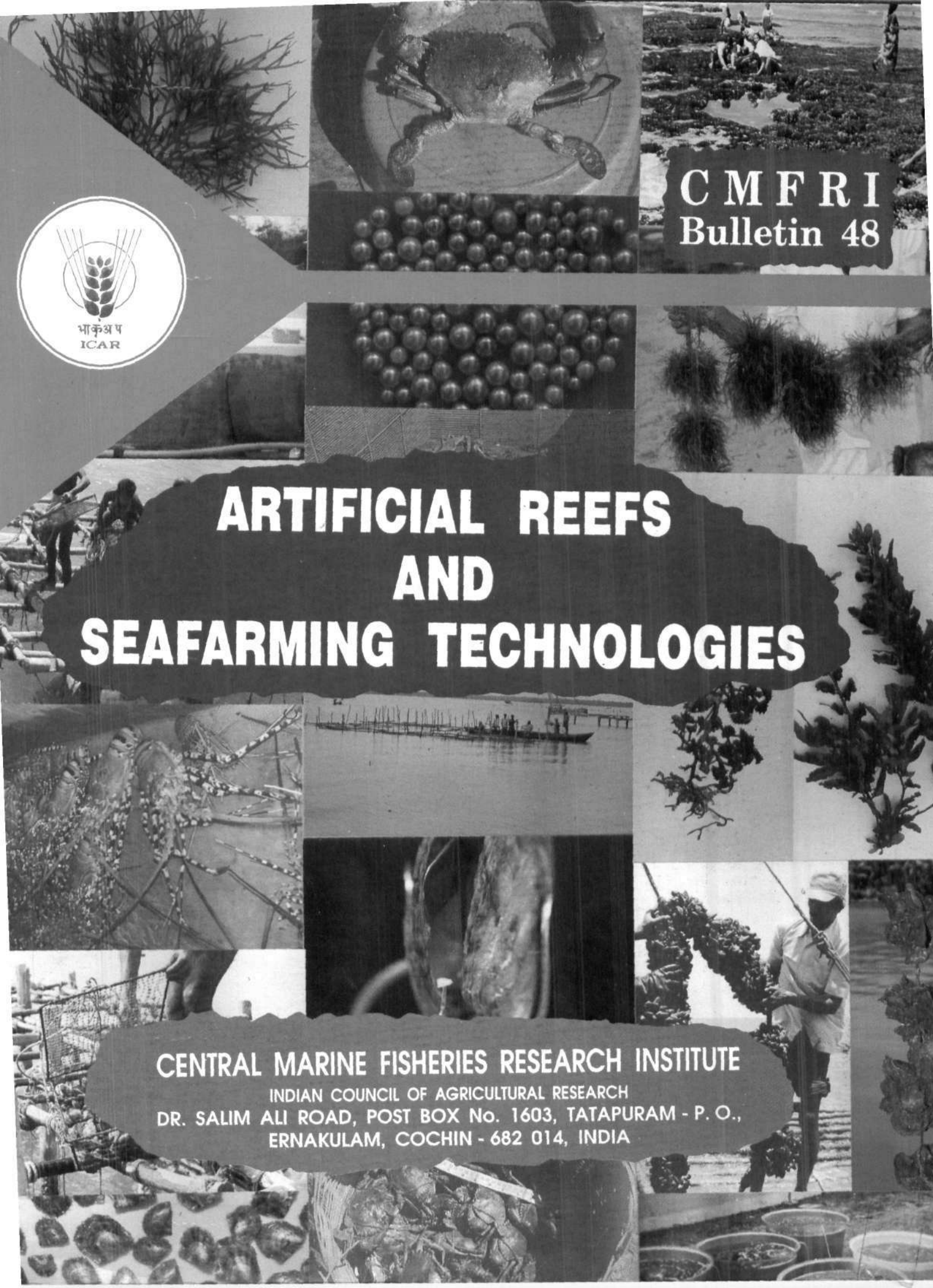

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
DR. SALIM ALI ROAD, POST BOX No. 1603, TATAPURAM - P. O.,
ERNAKULAM, COCHIN - 682 014, INDIA

C M F R I
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ARTIFICIAL REEFS AND SEAFARMING TECHNOLOGIES

Dr. K. Rengarajan

Editor

January 1996

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14

SHRIMP HATCHERY

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Introduction

Successful spawning of *Penaeus japonicus* under controlled conditions and their subsequent rearing upto the juvenile stage by Hudinaga (1942) and his team paved way for the large scale hatchery production of shrimp seed for aquaculture.

Hatchery systems

There are two basic hatchery techniques for the mass rearing of larvae of shrimps : Japenese technique and Galveston technique. These techniques have been appropriately modified to suit the different geographical and climatic conditions. Thus many gradations between these two techniques have been noticed in different parts of the world. In some cases, combination of these two techniques have also been followed (integrated system).

The Japanese technique

The well known Japanese system for the mass production of postlarvae of penaeid shrimps is also known as community culture system or fertilized system or large tank hatchery system or Taiwanese system.

In this system, the spawning, hatching, larval and postlarval rearing upto the fry stage are carried out in the same tank (Hudinaga and Kittaka, 1967; Hudinaga, 1969, Shigueno, 1975; Yang, 1975; Muthu, 1980). By fertilizing the water in the tank, phytoplankton and zooplankton organisms which form the food of larvae are also raised along with the larvae in the same tank.

The hatchery tanks are large and vary in size from 60-200 tonnes of water capacity and above. The tanks may be rectangular, square or round in shape having a depth of 1.5 to 2 m. They may be indoor - with transparent roof or outdoor depending on the prevailing weather conditions. Tanks are provided with good aeration systems.

Before starting the larval rearing operations, tanks are cleaned and sun dried. Then the tanks are filled with fresh filtered sea water upto 1/5 of the tank capacity. Vigorous aeration is provided and the water is agitated slowly by rotating vanes attached to an electric motor.

Spawners are then introduced into the tank. In case of infection, spawners may be treated first with 3 ppm $KMnO_4$ or any other chemicals in prescribed strength. They are introduced into the tank in cage nets (@ 1 spawner per m^3 of tank capacity). After spawning, the spawners are removed along with the cage nets. The eggs released, hatch out within 12-18 hrs depending on the water temperature.

After the eggs hatch out to nauplii, the tank water is fertilized with nitrates (KNO_3, 2 ppm) and phosphate ($KHPO_4$, 0.2 ppm). Fertilization helps the growth of naturally occurring diatoms on which the protozoea feed. The water is fertilized daily to maintain a good growth of diatoms (5000 to 20,000 cells/ml). By the time protozoea develop to mysis stage, a good population of zooplankton organisms will also be developed in the tank. Thus a feeding environment very similar to the condition obtained in the sea is created. Anaerobic decay of the dead organisms is prevented by vigorously aerating the water.

From the first day of mysis to the fourth day of postlarvae, fresh, sediment free and clean filtered sea water is pumped into the tank every day until the water level in the tank is increased to the maximum tank capacity. Supplementary feed in the form of *Artemia* nauplii or minced and washed clam meat or formulated feed of appropriate particle size are also provided for postlarval stages.

Although it is difficult to maintain a constant initial stocking density of nauplii in this system, generally the density will be around 100 no/lt. Postlarvae are reared upto PL 25-30 in the same tank within a period of 35-40 days. Final production of PL 25-30 will be within the range of 5-25/l *i.e.* on an average of 10,00,000 PL 25-30 will be obtained from a larval rearing tank of 200 t capacity during a single hatchery run.

Modifications in the feeding pattern has been introduced into this practice by several workers. In Taiwan, Liao and Huang (1972) used oyster larvae produced by artificial fertilization as food when the phytoplankton bloom did not develop well. Yeast @ 2 gm/t per day was used along with mixed diatom to feed protozoea and mysis stages in Philippines. The rotifer *Brachionus* sp. cultured separately is also used at a concentration of 10-25 cells/ml for the mysis and early postlarval stages.

The low maintenance cost, the less requirement of technical expertise to run the hatchery compared to the Galveston system as well as the use of the same tank for rearing larvae through various stages upto the seed size when they could be transferred to the farm are the advantages of this system. The disadvantages are the high initial cost of construction; the lack of control over the intensity of the phytoplankton bloom and the frequent growth of undesirable species of organisms such as dinoflagellates and *Noctiluca* which lead to mass mortality of larvae. As the larvae do not hunt for food, but filter the food particles within their reach in the medium a good amount of food will remain unutilized by the larvae due to relatively low density of the larval population.

The Galveston system

Galveston system is otherwise known as closed system or unfertilized system or feeding system or small hatchery system. This system has been developed by the scientists of the Galveston Laboratory in USA (Cook and Murphy, 1966, 1969; Mock and Murphy, 1971; Mock and Neal, 1974; Salser and Mock, 1974). This system is more sophisticated and consists of a number of independant processes - mass production and storage of pure algal culture, mass production of freshly hatched *Artemia* nauplii and larval rearing operations - which involve higher technical skill. The use of desirable species of food organisms and the greater control over the water quality facilities by use of small containers make this method more dependable.

Cook (1969) originally used a small fibreglass tank of 946 lt capacity for spawning and a 19 lt polyurethene carbuoy for rearing nauplii to postlarval stage. The phytoplankton added for feeding the larvae, are prevented from settling to the bottom of the larval rearing carbuoy by providing adequate aeration. Half the volume of water in the carbuoy is replaced every day with fresh filtered seawater, which in effect prevents the accumulation of metabolites in the medium. He stocked 266 nauplii/lt and produced 133 PL/lt using this system.

Later Cook and Murphy (1969) used 1890 lt cylindrical polyethylene containers, connected to a sea water recirculation system with crushed oyster-shell filter beds, for both spawning and larval rearing. The recirculation of water is stopped as soon as pure cultures of desirable species of diatoms and unicellular algae are added to the tank water for feeding protozoea stage. Concentration of phytoplankton is maintained at a cell density of 10,000-15,000 cells/ml. Freshly hatched artemia nauplii are given at the rate of 3-5/ml of water for feeding the larvae from mysis stage onwards.

This system has been further improved by Salser and Mock (1974) by introducing cylindro-conical fibreglass tanks of 2 m^3 capacity for rearing larvae. The shape of the tank facilitates efficient dispersal of food particles and larvae throughout the water column.

The system has been adopted in a modified form in Tahiti (Aquacop, 1975), in Philippines (Platen, 1978) and in UK (Beard *et al.*, 1977). Algae in higher concentrations (30,000-1,00,000 cells/ml) are maintained separately and used for feeding protozoea larvae. *Brachionus* culture maintained separately is also used to feed protozoea. The concentration of *Brachionus* in the larval rearing tanks are maintained at 5-10 rotifers/ml. From postlarvae I onwards, freshly hatched *Artemia* nauplii are used as food; the density being maintained at 5 no/ml of rearing medium.

Nauplii are stocked at the rate of 100-200 no/lt and they are reared upto PL 5 in the larval rearing tanks. Survival from nauplius to PL 5 is about 70%. At PL 5 stage they are transferred to nursery tanks.

This system has many advantages. The hatchery can be operated with few spawners. It is easy to maintain and manage the water quality. The amount of water required is small. Water temperature can be controlled easily. Diseases can be checked and prevented by better water management and antibiotic treatment. Food is not wasted. Survival rate is high.

Integrated system

Although the basic hatchery technologies can be broadly brought under two categories, they have been appropriately modified in different countries so as to suit different geographical and climatic conditions. Thus varying degrees of combinations and permutations of these two systems are in vouge in different parts of the world. The larval rearing technology recently developed in Tahiti and New Caledonia has been described by Autrand and Vidal (1995). This system is based on the exclusive use of microparticles as a replacement for algae and avoiding the water renewal upto first postlarva. Better hygenic conditions are provided by keeping the different units of the hatchery separately, by providing biological filter to the larval rearing tanks from first mysis onwards. Pathogenic risks have been reduced to the minimum by adopting minimum prophylactic treatments, using microparticles and *Artemia* nauplii feed and allotting sufficient dry-out period. Similarly two low cost modified systems have been developed and put to use in the production of shrimp seeds in India *viz.*, Kerala Fisheries Technology (KFT) (Alikunhi *et al.*, 1980) and Central Marine Fisheries Research Institute (CMFRI) technology (Silas *et al.*, 1985).

Kerala Fisheries Technology

Azhicode Hatchery utilising the Kerala Fisheries Technology, is using shrimp meat suspension for feeding the various larval stages of shrimp. 6 to 60 t outdoor pools or concrete tanks of 75 to 100 cm height are used for larval rearing. Cleaned and sun dried tanks are filled to 1/5th of its capacity with filtered seawater. Wild spawners either *P. indicus* or *P. monodon* are introduced into the tank at the rate of one spawner/tonne of water. Spawner is removed after spawning and water level is raised to 1/2 and aeration continued.

Shrimp meat suspension made out of juvenile *M. dobsoni* or squilla meat is fed to the larvae. Mysids and *Acetes* are also used for making meat suspension. The approximate weights of meat feed for (1000 larvae/day) different larval stages are given below.

	M. dobsoni	*Squilla*
Protozoea I	0.5 g	1.0 g
Protozoea II & III	0.75 g	1.5 g
Mysis I	1.0 g	1.75 g
Mysis II	1.25 g	1.75 g
Mysis III	1.5 g	2.00 g
PL 1	2.00 g	3.00 g

From mysis I stage onwards 1/3rd of tank water is exchanged daily. Depending on the phytoplankton bloom developed in the larval rearing tanks, water exchange is regulated. The larval rearing tanks are generally stocked with 100-250 nauplii/l. They are reared upto postlarva 10 in the same tank at the survival rate of 75%.

CMFRI Technology

A low cost technology for hatchery production of shrimp seeds suitable to Indian conditions has been developed by the Central Marine Fisheries Research Institute (CMFRI) for the white prawn *Penaeus indicus*. The same technology has been successfully scaled up for the large scale production of PL 15-20 of other commercially important penaeid prawns of India especially *P. monodon*, *P. semisulcatus* and *P. canaliculatus*. Further, using this technology CMFRI has established a hatchery for *P. indicus* (with a capacity to produce 1 million seeds per run) for MATSYAFED at Cannanore. An experimental hatchery for *P. semisulcatus* with a capacity to produce 1 million seeds per year has been established at Mandapam Camp of CMFRI.

The cost of production of postlarvae 15-20 has been made minimum, as this technology

mainly makes use of the available natural conditions of the Indian Coast, such as good sun light, ideal temperature, sea water of above 30 ppt salinity and locally available candidate species. It was found that the protozoea and mysis stage larvae of all the commercially important Indian penaeid prawns could be reared successfully by feeding them exclusively with the diatom *Chaetoceros* which can be easily developed and maintained in fibreglass tanks in indoor hatcheries, with translucent roofing - a major factor, which helped to make this technology a low cost one.

This technology (developed for *P. indicus* and adaptible for other commercially important penaeid shrimps), is infact site specific and consists of a package of practices involving the following components : (i) Inducing brood stock prawns to mature in captivity in a predictable manner, (ii) spawning of viable eggs with good hatching rate, (iii) hatchery rearing of the nauplii to the postlarval stage with appreciable rate of survival, (iv) production of large scale mixed culture of diatoms to feed larvae and (v) preparation of dry particulate diet for feeding postlarvae.

Site selection is of prime importance for the successful functioning of a hatchery and the following important criteria may be strictly adhered to : (i) areas subjected to sea erosion, soil erosion and natural calamities should be avoided, (ii) sea water should be of good quality. For this the site should be far away from river mouths so that the sea water is not diluted by the freshwater discharge. Flood water from the rivers also brings in a lot of silt and detritus adding to the turbidity of the water, (iii) hatchery should not be located near sources of thermal, sewage or industrial pollution, (iv) the sea bottom near the site can be sandy or rocky, not clayey and (v) uninterrupted electricity and freshwater should be available in the vicinity.

Broodstock maintenance

It is essential to have a broodstock facility for the uninterrupted production of seed particularly for large hatcheries and for hatcheries producing non-native species. The brood stock tanks are preferably circular with central drain having a capacity of 10-15 t with a water depth not less than one metre. The tanks are provided with recirculation facility, biological filter, provision to get good quality filtered sea water and continuous aeration. The tanks may be housed in a dark room with facilities to control photoperiodicity. For broodstock maintenance adults of males and females may be collected from the wild. The animals having proper weight and without injury, may be transported to the hatchery without stress. These animals are disinfected using formalin; acclimatised and then transferred to the broodstock tanks. Male : female ratio being 1:1 to 1:2. Depending on the species, the stocking density can be 5 to 7 animals/m^2. These animals are subjected to unilateral eyestalk ablation and fed *ad libitum*. Clams, shrimps and polychaetes of marine origin are found to be ideal food for the broodstock shrimps. The success of maturation is directly dependent on the water quality management; clear sea water, conforming to the following hydrological parameters are conducive for maturation.

Parameter	*Permissible range*
Salinity	29 to 34 ppt
Temperature	28 to 30°C
pH	8 to 8.2
Dissolved oxygen	4 to 5.5 ml/lt

The pH of the seawater in the pool is maintained between 8 to 8.2 by addition of sodium carbonate. The unused food and faecal matter are siphoned out every morning. The water in the maturation tank is totally replaced before introducing a fresh batch of ablated females.

The experiments carried out recently on the induced maturation of *P. indicus* and *P. semisulcatus* in captivity has revealed that shrimps can be induced to mature and spawn in captivity by controlling pH of water photoperiod and providing proper food. The advantage of this method of rematuration over eye-stalk ablation is that the quality and quantity of eggs and larvae produced in successive spawning do not show any deterioration (Maheswarudu, Per. Comm.).

Spawning : Impregnated females with fully mature ovary are maintained individually in 250 lt capacity spawning tanks containing 200 lt of sea water of 30-34 ppt salinity filtered through

50 micron mesh bolting cloth. Spawners are transferred to the spawning tank in the evening. Disodium salt of EDTA is added to the water @ 0.1 g/100 lt of water. The ideal temperature range is 27-30°C and pH 8.0-8.2. A mild aeration is provided and the tank is covered with black lid to protect the female from strong light and to prevent it from jumping out of the tank. Spawning usually takes place during right between 2000 and 0200 hrs. Females, after spawning, are removed from the tank at 0600 hrs. Continuous increased aeration is maintained in the tank. Depending on temperature, hatching takes place within 1200-1800 hrs. and by afternoon all the eggs hatch out to nauplii. Aeration is stopped and nauplii are allowed to congregate at the surface. Dead and unhatched eggs that sink to the bottom are siphoned out along with bottom sediments. Once again aeration is switched on and the water is mixed thoroughly and three, 100 ml samples are taken with beakers and the number of nauplii in the samples counted and the total number of nauplii present in the tank estimated.

Larval rearing : 2 to 5 t capacity cylindro-conical tanks are used for rearing larvae upto postlarva 3-5. Fibreglass tanks or concrete tanks with an inner coating of non-toxic epoxy paint are used for larval rearing. The tanks are first cleaned properly with bleaching powder and then washed thorougholy with freshwater. They are sun-dried for 24 hours. Afterwards, they are once again washed with filtered sea water and then used for larval rearing purpose. To begin with, half of the tank is filled with sea water, filtered through 50 micron mesh bolting cloth. Continuous aeration is provided throughout the larval rearing period. 5-6 hrs after hatching the nauplii are counted and transferred to the larval rearing tank at a stocking density of 75-100 nauplii/lt of water. The difference in the temperature of water in the spawning tank and larval rearing tank must not be more than 1°C. After 36 hrs of hatching, the nauplii will be 5th or 6th stage, depending on the temperature of the medium. At this stage 100 lt of mixed algal culture dominated by *Chaetoceros* sp. or *Skeletonema* sp. are added into the larval rearing tank. Protozoea feed on a variety of diatoms such as *Skeletonema costatum, Thalassiosira* spp. *Dunabella* spp., etc. But it was found that the larvae upto last mysis stage could be reared exclusively on *Chaetoceros* spp.

Concentration of the algal cell in the medium must not be below 20,000 cells/ml. The diatoms thus added will ensure the availability of food in the vicinity of larvae as soon as nauplii metamorphose to first protozoea. From first protozoeal stage onwards 150-200 lt of algal culture are added and the water level is made upto the maximum by adding filtered sea water. From 4th day onwards, daily 1/4th to 1/3rd water from the larval rearing tank is removed and replaced with fresh filtered sea water. Filter bags, with proper mesh size are used while siphoning out water to prevent the escape of larvae from the tanks. If the algal culture used is dominated with *Chaetoceros* spp., no supplementary feed is required until the larvae develop to third mysis stage. Otherwise supplementary feeding with particulate feed or egg prawn custard may be started from first mysis stage onwards. Supplementary feed is provided from third mysis stage onwards along with algal diet. The quantity of algal diet is reduced from first postlarval stage. Larvae are reared upto postlarva 3-5 in the larval rearing tanks and are afterwards transferred to nursery tanks for further rearing.

From 2nd protozoeal stage onwards, daily the sediments from the bottom of the tank are removed. Aeration is stopped allowing larvae to come to the surface before siphoning out the water from the tank or removing the bottom sediments.

The water quality and other conditions conducive for larval rearing are as follows :

Salanity	.. ..	29-34 ppt
Temperature	.. ..	26.0 - 32.5°C
pH	.. ..	8.0 - 8.5
Dissolved oxygen	.. ..	3.0 - 8.0 ml/litre
Light intensity during day	..	20000 to 125000 lux
Total ammonia	.. ..	0.1 ppm or below
Nitrite	.. ..	0.05 ppm or below

Some guidelines on the management of larval rearing tanks of 2 t capacity are given in Table 1. But it must be noted that careful attention to water quality and condition of larvae, the volume of water exchanged and the amount of feed given should be judiciously varied to meet the exigencies of the situation.

TABLE 1. *Management of larval rearing pools*

Day	Stage	Seawater removed	Algal culture added (lt)	Particulate feed (g)	Seawater addition (lt)	Total volume of water made upto (lt)
1	N 2	-	-	-	1000	1000
2	N 5	-	100	-	-	1100
3	PZ 1	-	150-200	-	700-750	2000
4	PZ 2	500	150-250	-	250-350	2000
5	PZ 3	500	150-250	-	250-350	2000
6	M 1	500	150-250	-	250-350	2000
7	M 2	500	150-250	-	250-350	2000
8	M 3	500	150-250	10-15	250-350	2000
9	PL 1	750	100-150	12-15	600-650	2000
10	PL 2	750	100-150	12-25	600-650	2000
11	PL 3	750	100-150	12-25	600-650	2000
12	PL 4	750	100-150	12-25	600-650	2000
13	PL 5	750	100-150	12-25	600-650	2000

Nursery rearing : Postlarvae 3-5 are removed to the nursery for further rearing. The capacity of the nursery tank may be four to five times that of the larval rearing tanks from which the larvae are transferred into nursery. It is better to have rectangular tanks with a depth of 1.2 m. Inside colour of the tank can be grey. In places where good sunlight and less rain are prevalent, it is better to have the nursery tanks in open. As per requirement, temporary covering for these tanks may be provided to cut off excess sunlight and rain. Continuous aeration facility may be provided. If possible these nurseries can be constructed near the larval rearing tanks in such a way that the postlarvae can be directly transferred to the nursery by gravity flow. Postlarvae 3-5 can be reared in nurseries for 15 to 20 days and then transferred to the farms. Larvae can be fed with sufficient quantity of egg-prawn custard. Sediments from the bottom of the tanks are removed atleast twice in a week. As per requirement, daily one fourth or one third water is exchanged. Postlarvae 15-20 are harvested and transported to farms.

Diatom culture

Wherever clear and good quality sea water with temperature between 28° and 30°C and sufficient sunlight for a definite period in an year is available, a mixed culture of diatoms could be develolped and maintained without difficulty. For initiating a mixed diatom culture, fresh unpolluted seawater of 30-34 ppt salinity is filtered through a 50 micron mesh bolting cloth and kept in one or two tonnes capacity fibreglass tanks. The tanks must be white inside and the depth of the water column must not be more than 75 cm. These tanks can be housed in a shed with translucent roofing. Sea water is fertilized with sodium nitrate, potassium orthophosphate, sodium silicate and EDTA disodium salt (12 grams of sodium nitrate and 6 grams each of other chemicals per tonnes of water). The seawater in the tank is well aerated and if the intensity of light during day time varies between 0.2 to 1.2 lakh lux and the temperature between 28° and 34°C, a very good bloom of mixed diatoms develops within 24 to 48 hours. A culture containing 3-4 lakh cells/ml is preferred for feeding the larvae. From this culture it is very easy to maintain batch cultures on the succeeding days for a period of 15 to 20 days. Diatom cultures are started every day using the previous day's culture as inoculum (at the rate of 30-55 lt/m^3 of filtered sea water and fertilized as mentioned above). During prolonged cloudy conditions, maintenance of mixed diatom culture becomes difficult. Therefore it is advisable to have a separate, small, diatom culture unit on the hatchery with air-conditioning and artificial lighting to ensure a steady supply of diatom.

Preparation of prawn-egg custard

Yolk and albumen of hen's egg and meat of small prawns are minced together at a ratio of 1 : 5 by weight and steam-cooked for ten minutes, cooled and kept frozen in a refrigerator. A solid block of this custard, after thawing is made into suitable particle size by passing through proper sieves and fed to the larvae. Custard should not be stored for more than three days.

Hatching of Artemia *eggs*

Artemia cysts are first thoroughly disinfected and partially decapsulated. Cysts are treated with 75 ml bleach (5.25 % active sodium hypochlorite). 75 ml bleach is mixed in 60 lt of freshwater in a bin and 1 kg of cyst is soaked in this for 15 minutes. The treated cysts are collected in a net, washed thoroughly in freshwater and released in hatching tanks containing seawater of 34 ppt and well aerated. Within 24 to 36 hrs they hatch out if the temperature is above 28°C. Freshly hatched out *Artemia* nauplii alone are carefully collected and fed to the larvae.

Larval diseases

Disease in the hatchery is mainly caused by unhygenic conditions and inadequate water exchange. The very serious diseases affecting the larval stages are caused by fungi (*Legenidium, Fusarium*), bacteria (*Vibrio*), filamentous bacteria (*Leucothrix*) and protozoans (*Zoothamnium, Vorticella*). Several antimycotic compounds and antibiotics are available for the treatment of fungal and bacterial diseases. These chemicals should be used with great care as they themselves are toxic to the larvae at higher doses. The best method of controlling the fungal disease is by disinfecting the spawners which are the potential source of infection.

Treating infected larvae is very difficult, often unsuccessful and expensive. The best way is to prevent the diseases. To achieve this, the spawning tanks should preferably be separated from the larval rearing tanks, spawners should be disinfected and good quality filtered or purified seawater should be provided in adequate quantity.

Lightner (1985) has reviewed the diseases of cultured penaeid shrimps and prawns with emphasis on recent discoveries and developments. A list of important larval diseases, their symptoms and treatment are presented below.

	Symptoms	Treatment
Viral diseases		
A. Penaeid baculoviruses	Affects hepatopancreas and anterior midgut of the postlarvae, infects epithelial cells causing high mortality.	None
B. 1 HHN. Infectious hypodermal and hematopoietic necrosis		
Bacterial diseases		
a. Bacterial necrosis	Appears as a localised necrosis or discolouration of any appendage of larval stages.	Prefuran 1 ppm
b. Vibrio infection	Infects haemolymph and midgut. Larvae in acute cases show white turbid liver.	-do-
c. Luminiscent vibriosis	Affects haemolymph, gut, haepatopancreas of larvae. Larvae stop feeding.	-do-
d. Filamentous bacteria	Affects gills, pleopods of larval stages. Gill filaments get attached to body thus chocking the larvae.	KHNO4 25-5 ppm
e. Shell diseases	Affect exoskeleton caused by chitinoverous bacteria.	Formalin 25 ppm
f. Black gill diseases	Affect the gills.	Methelene blue 8-10 ppm
Fungal diseases	Affecting body cavity and appendages of nauplii, protozoea and mysis caused by legenidium leading to heavy mortalities.	Treflin 0.1 ppm
Ecto-commensal infection	Infects gills, eyes, and exoskeleton of larvae.	Formalin 10 ppm
a. Protozoean infection (*zoothamnium* and *vorticella*)		

General remarks

During 1993-'94 the uncontrolled spread of diseases in the hatcheries and farms due to manmade environmental degradation have forced to close down many hatcheries and farms for a considerable period. To avoid recurrence of such situations, the following suggestions are incorporated in planning for the future. Treatment of many diseases in the hatcheries are not only expensive and futile, but also lead to the distruction of many useful bacteria as well. Hence stress to be given for water quality maintenance and management. The seawater should be properly sand filtered. Broodstock shrimps are one of the main source for disease transmission. Hence proper care has to be taken to disinfect them. In rematuration tank it is better to instal proper recirculation system to reduce the exchange of water to the minimum and maintain a constant pH and salinity regime.

The discharge of water from the hatcheries should be properly treated in biopods.

It is advisable to establish independent and isolated units for broodstock maintenance, spawning and larval rearing, and nursery nearing.

Between successive hatchery runs sufficient time gap has to be provided to clean disinfect and sun dry the rearing tanks.

In case of utmost necessity it is also advised to chlorinate and dechlorinate the seawater before using the same for larval rearing.

Economics of hatchery

An insight into the economics of operation (1994-'95) of two types of hatcheries designed using CMFRI technology are presented below.

A medium scale hatchery designed to produce 16 million seeds/year can be established with an investment of Rs. 45 lakhs. The gross income from this unit by way of sale of seed is Rs. 24 lakhs, with a net profit of Rs. 6 lakhs.

A mini hatchery with a capacity to produce 1.65 million shrimp seeds can be established with an investment of Rs. 3.5 lakhs deriving a gross income of Rs. 1.14 lakhs and a net profit of Rs. 35,000.

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