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N. G. Menon and P. P. Pillai

Central Marine Fisheries Research Institute, Cochin

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Hatchery seed production and nursery rearing of Indian pearl oyster *Pinctada fucata* (Gould) under onshore and offshore conditions at Mandapam, Tamil Nadu

A.C.C. Victor, D. Kandasami, I. Jagadis, Boby Ignatius, A. Chellam, G. Chitra, P. Villan and M. Rajkumar
Mandapam Regional Centre of C.M.F.R.I. Mandapam Camp

ABSTRACT

A full fledged pearl oyster hatchery was established at R.C. of CMFRI, Mandapam Camp along with a temperature controlled micro algal culture laboratory. The hatchery house four 5 ton capacity circular FRP tanks for storage of filtered sea water and 28 nos of 1.5 ton rectangular FRP tanks for larval rearing. A central drain of 80 m length connects the hatchery to the sea. Sea water supply is effected through 7.5 and 10 HP pumps connected to

sedimentation tanks, ground level sumps and to overhead tank. Two sand filters were errected for effective filtering of sea water. Aeration is provided with air blowers and air compressors. The annual production capacity is estimated to be 2.8 million spats. Induced spawning and larval rearing gave encouraging results and 0.7 million spats were produced during June-August 1997.

The temperature controlled micro algae laboratory holds stock culture of 5 important species. The laboratory can supply mono culture of micro algae to the tune of 500 l per day with cell concentration of 1 million/ml, along with a stock of 1000 l for subsequent harvest. Uni algal culture of Isochrysis galbana, Nanochloropsis *sp and mixed culture of* Chaetoceros *sp were attempted and the results discussed.*

Observation on the growth performance of laboratory produced spats was made under onshore and offshore conditions and the results and short commings are discussed.

Introduction

Pearl culture work at the Regional Centre of CMFRI was started during the end of 1995. A total of 5,000 adult oysters and 3,500 spats were transferred from Tuticorin and stocked in the farm. Preliminary observation on the growth, survival and pearl production in the inshore waters of both Gulf of Mannar and Palk Bay was very encouraging and full fledged pearl oyster farming was taken up at this Centre through two research projects. For a successful farming operation and pearl production a steady supply of oyster spat is the basic requisite. Eventhough, the Gulf of Mannar supports rich resources of pearl oysters, the Mandapam area is devoid of any substantial sized `paars'to support pearl culture on a commercial scale. This prompted in developing a full fledged pearl oyster hatchery by adopting CMFRI techniques (Alagarsami, 1987). The salient features of the hatchery, results of the induced spawnings, growth performnce of the oyster spats on onshore and offshore conditions and problems encountered and prospects were discussed.

Ecology of the Mandapam coast

The sea off Mandapam is normally calm between November and April along the Gulf Mannar while the Palk Bay sea is calm during May

to October. The sea is very shallow and the substratum is sandy, rocky with luxuriant growth of sea weeds in patches. The general trend of the environmental parameters of both the seas were observed during the year 1996-97 period and the data are given in Table 1. As there is no major industrial units within 100 km of the coastal stretch, the sea is free from pollution and ideal for aquaculture.

Table 1. Environmental parameters of Gulf of Mannar and Palk Bay sea during 1996-97.

	Gulf of Mannar		Palk Bay	
Parameters	Minimum	Maximum	Minimum	Maximum
1996				
Air Temperature °C	26.0(Aug)	32.0(May)	25.0(Sep)	33.0(Apr)
Sea Water Temperature °C	25.0(Aug)	30.8(Jul)	26.0(Dec)	33.0(May)
pH	8.0(Nov)	8.4(Jun)	8.0(Dec)	8.8(Jun)
Salinity ppm	29.0(Jan)	34.7(Mar)	26.9(Jan)	35.0(Sep)
D.0 ml/l	3.7(Apr)	5.5(Jan)	3.0(Apr)	6.0(Dec)
1997				
Air Temperature °C	26.2(Aug)	32.5(May)	26.8(Aug)	31.8(Jun)
Sea Water temperature °C	25.3(Aug)	32.0(May)	25.7(Aug)	331.5(Apr)
pH	8.2(Nov)	8.4(Jun)	8.2(Nov)	8.6(Jul)
Salinity ppm	31.0(Sep)	36.0(Aug)	30.9(Apr)	35.6(May)
D.0 ml/l	3.6(May)	5.5(Aug)	2.8(Sep)	5.4(Jul)

Establishment of hatchery

Existing two blocs of the Institute measuring 85 m length and 6.5 m width were converted into a hatchery and nursery units (Fig.1 and 2.) The hatchery consisted of the following facility such as a central drain of 80m length and 0.5 m width and connected to the sea. It also has 28 drain pits of 0,45x0.45x0.45 m size for facilitating easy operation. The hatchery is provided with a seawater pipe line of 110 mm dia from the over head tanks (30 t). The overhead tanks receive water supply from sedimentation tanks and a ground level sump of 100 t capacity (Fig.3).

The intake point is in the intertidal region of the Gulf of Mannar (2.0 m depth). Pumping is effected through 7.5 and 10 HP electrically operated pumps. The sea water pumps are also directly connected to the over head tank to provide continuous water supply to the hatchery during any break down / maintenance of pumps. Filteration of sea water is done through a simple slow biological filter made out of 1 ton FRP tanks. The hatchery is housing 28 numbers of 1.5 ton capacity rectangular FRP tanks with black inner lining. Four numbers of 5 ton circular FRP tanks are installed at the corner of the hatachery to serve as storage tanks for keeping filtered sea water. An air compressor of 5 HP ensures the supply of the required aeration to the larval rearing tanks in addition to the main air blower of 10 HP capacity. The nursery unit houses fourteen 5 t capacity circular FRP tanks for the rearing of spats. With this the hatchery can hold about 28 million larvae for a single run and is expected to produce 2.8 million spats of 1-3 mm.

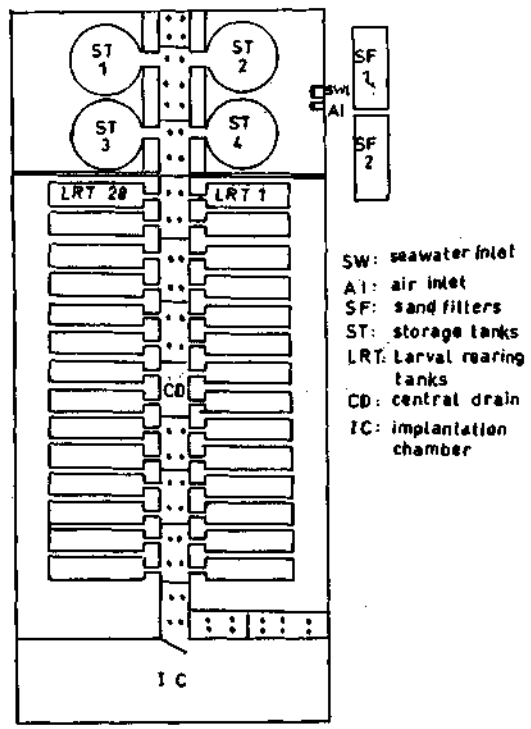

Fig. 1. Layout of pearl oyster hatchery at Mandapam Camp.

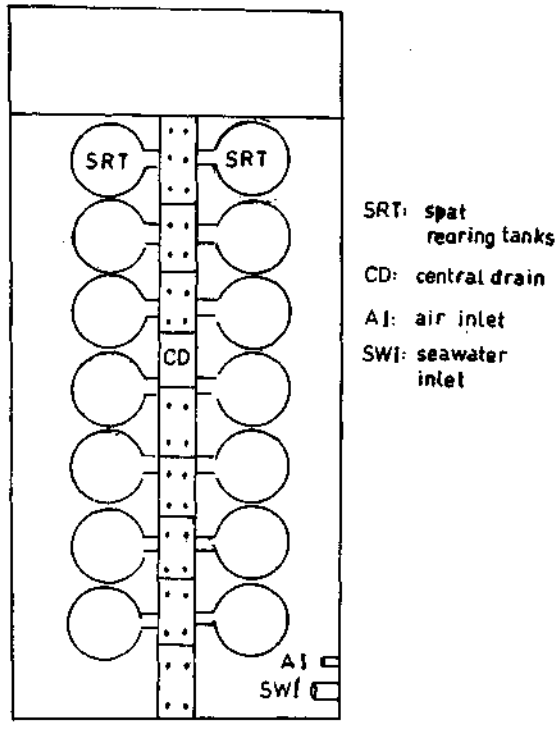

Fig. 2. Nursery unit

Micro algal culture laboratory

A room measuring 5x 6 m was modified into a temperature controlled micro algal culture air conditioned laboratory to supply algal food for the larvae and spats. Required illumination of 1000-1500 lux was attained by installing 40 w flourescent tubes in the culture racks. These racks were fabricated to hold various sized glass / perspex / plastic containers (1-100 l). Two time switch clocks were installed to have 12 h light and dark phase for the micro algal culture. The micro algal laboratory is currently holding pure stocks of 5 species of micro algae belonging to 3 important groups such as *Haptophyceae, Chlorophyceae* and diatoms. The laboratory has the capacity to supply mono culture of micro algae to the tune of 500 litres / day with a maximum cell concentration of around 1 million/ml along with a stock of 1000 liters for subsequent harvests.

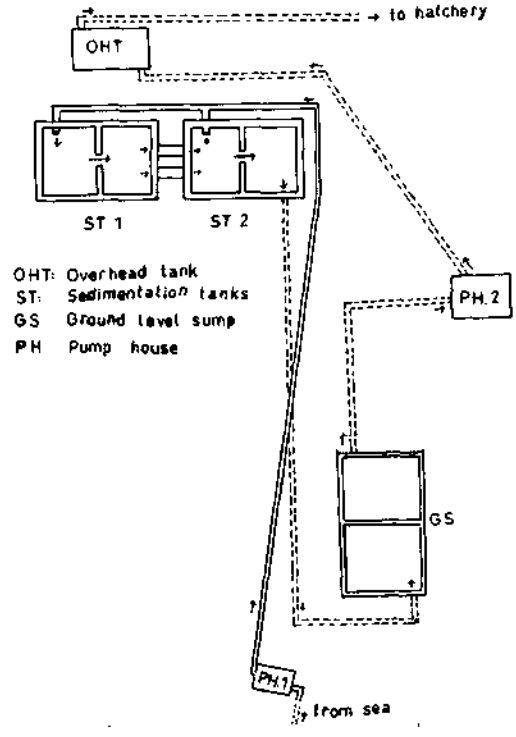

Fig. 3. Layout of sedimentation tanks and ground level sump

Observations on the culture of micro algae

Isochrysis galbana was used as the primary food for the pearl oyster larvae. Attempts were made to culture the micro algae by using conventional Conways medium on continuous basis for feeding the larvae. Under controlled conditions a maximum cell density of 2.5 ml was achieved within 5 days.

Isochrysis galbana have been hitherto cultured under controlled condition on mass scale. An attempt was made to culture this species under open condition with the temperature ranging from 27 to 30°C using the same Conways medium. A maximum cell concentration of 2 million/ ml was achieved within a period of 2 days of innoculation. However, the culture maintained outdoor got contaminated by ciliates within 3 harvests. Few more culture trials would throw more light on the possibility of continuous contamination free outdoor culture of *Isochrysis galbana.*

Mixed culture of *Chaetoceros* spp (80%) was attempted using mixed culture medium comprising potassium nitrate, sodium EDTA, sodium silicate and potassium di hydrogen orthophosphate in the ratio of 2:1:1.1. The maximum cell concentration of 5 lakhs was achieved over a period of 12hrs of exposure to bright sun light.

Attempts were made to develop *Nanochloropsis* spp in the microalgal laboratory under controlled conditions. It was also found that the culture of this algae remained in the growth / exponential phase with a density of 6-8 million cells/ml for more than 15 days.

Observations on spat production

Induced spawning : Controlled spawning in *Pinctada fucata* and their early embryonic developments have been described (Alagarsami,1983a; 1983b). Oysters maintained in Gulf of Mannar was found to grow faster, and attain quick sexual maturity and spawn naturally. However, for regular production of larvae the ripe oysters were subjected to induce spawning by following the technique of subjecting the ripe oyster (20-25nos) for aerial exposure for about 20 minutes and then transferring them to a trough containing 30 l of cool filtered sea water (24°C).

Larval rearing : After spawning is completed the water is left undisturbed after removing the oysters for about 2 hrs to allow complete fertilisation. On many occassions high fertilization rate of 90-95% was achieved. The fertilized eggs settled down on the bottom . Then the water is filtered through a 20 μ nylo bolt sieve and the eggs thus collected were washed in filtered sea water to eleminate the excess sperms and then transferred to a FRP tank of 1 ton capacity containing 750 l of filtered sea water. The early embryonic development starts after 45 minutes of fertilization and the eggs metamorphose into veliger larvae within 20 hrs of spawning. The veliger larvae measured an average size of 62.5 μ. Later the veligers were seived through a 40 μ nylo bolt sieve and the numbers estimated. A stocking density of 1 million larvae/one tonne of sea water was maintained. Feeding was done daily and 100% water exchanged once in two days. The following feeding schedule was followed for the rest of the culture.

Days from spawning	Algal cells/larvae
2 - 5	5,000
6 - 14	10,000
15 - 18	30,000
19 - 24	50,000
25 - 35	50,000 (2:1 ratio of *Isochrysis* & *Chaetoceros*)
36 - 50	1,00,000 *Chaetoceros*
50 - 60	2,00,000

The tanks were covered with black cloth to avoid direct light falling on the larvae. The larvae started descending to the tank bottom on reaching pediveliger stage. The shortest duration noticed was 16 days from spawning and the minimum size of the larvae ranged from 180-190μm. Further rearing was continued in the same tank till they metamorphosed to fully grown spats. The spats were scraped with sponge and spats above 3 mm were transferred to the sea in conventional cages with fine velon inner lining. The results of spawning experiments conducted during 1997 are given in the Table 2.

Table 2. Results of spawning experiments conducted at Mandapam

S.No.	Date	No. of larvae produced	Date of larval descendance Size range μ	No. of spat produced	% recovery
1.	26.06.97	1.0.0 lakhs	16 180-190	75,000	7.5
2.	14.07.97	20.0	16 180-200	3,20,000	16.0
3.	08.07.97	15.0	20 180-225	1,00,000	6.6
4.	12.07.97 13.07.97 14.07.97	35.0	17 192-216	1,50,000	4.3
5.	23.08.97	10.0	16 180-180	75,000	7.5

Observations on the growth of laboratory produced spats

Growth of spats in tanks: Experiments were conducted to find out

the growth rate of the laboratory produced spats in fibre glass tanks of 1.5 and 5.0 ton capacity. Two sets of 1.5 and 5.0 ton tanks (5& 3) were used. A standard stocking density of 10,000 spats/ton of seawater and a feed rate of 1.0 lakh/ml was maintained. 100% water exchange was resorted once in 3 days for 1.5 t. on tanks and once in a week for 5.0 t.on tanks. Constant aeration was provided to each of the tank. Mixed culture of Chaetoceros sp (80 %) was fed once a day in the evening hours. Feed rate was increased linear to their DVM increase. The culture was continued for 80 days. Periodical mortality was observed while changing water, and the dead shells were removed and counted. At the end of the culture period, the spat stocked in 1.5 ton capacity tanks had grown to 3.5 to 9.0mm (6.1mm) from the initial size range of 2.5 to 5.5mm (3.0mm) registering an average monthly growth rate of 0.8mm. The survival rate ranged from 26.0 to 36.3% (30.1%) in different tanks, and in the 5 ton circular tanks the spats from an initial size range of 1.0-4.0 mm (2.1mm) had grown to 2.3 to 12.0mm (5.5mm) registering a growth rate of 1.3mm/ month. The survival ranged from 16.0 to 22.6% (19.0%).

Offshore conditions: Spats of the same batch from the hatchery was used for determining the growth rates in the open sea farm conditions. The spats were stocked in conventional box type cages with fine velon netting and were suspended from the floating rafts and racks errected in the Gulf of Mannar. The average depth at the culture site was 2.5 m. The initial size range of the spats were from 1.5 to 5.5 mm (ave. 3.5 mm). After a culture period of 90 days the spats had grown to a size range of 14.3 to 27.33 mm (ave. 19.1mm) registering an average growth rate of 5.2 mm/month. The survival rate ranged from 26.0 to 50.0% in different cages and the average being 36.4%. Mortality in the cages were found to be more in the cages which were not attended to for a long period due to logistic problems.

Remarks

The shore line of the Mandapam coast (both Gulf of Manner and Palk Bay) is almost straight without much identations. Eventhen, they offer much scope for pearl culture which is evident from the growth achieved. Fouling in these areas is mainly due to barnacle, ascidians, tube worms, sponges etc. The fouling can be easily overcome by periodical monitoring of the cages. Predation of the oyster under culture is also negligible in these areas except for instances in which small crabs and boring gastropods enter into the cages and prey upon the oysters.

The seasonal turbulance and turbidity of sea water during May-October can be overcome by effective filtering systems for getting clean sea water for hatchery operations. The coastal water is not having any major industrial establishment to cause pollution.

Farming operation is possible in both the seas by errecting either rafts or rack. Year round pearl culture is possible and the schedule of the activities have been reported in the same publication.

Preliminary observations on the onshore culture of hatchery produced spats in FRP tanks did not yield a positive result. However, the culture technique can easily be perfected by manipulating some of the key factors like feed, use of alternate algal species *(Nanochloropsis* spp) optimising the feed volume, and feed dispensing methods and water requirement.

Use of *Nanochloropsis* sp as an altlernate algal species for the larvae seems to be more suitable taking into the advantage of the stability of the culture of this species for longer period in high concentrations. Further specific studies on its nutritive value and optimum cell requirement of the species has also to be carried out in detail.

The preliminary run of the hatchery has shown very encouraging results and about 0.70 million spats had already been produced succesfully and being reared. Initial runs show that spat production during July-September has better survival and recovery rates.

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