

CMFRI
bulletin 39



JANUARY 1987

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(Indian Council of Agricultural Research)
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PROGRESS OF RESEARCH UNDER SCHEME ON PEARL CULTURE, 1974-78

DEPARTMENT OF FISHERIES*, GOVERNMENT OF TAMILNADU

The lucrative pearl fishery in the Gulf of Mannar could not be conducted after 1961 due to the paucity of oysters in the natural beds. So the only way to have continuous supply of pearls is the production of cultured pearls utilising the available oyster resources. This needs preliminary investigations. Only when the cultured pearl production technology, farming and other allied techniques are perfected, a venture can be made in the direction of commercial production.

To perfect the technique of cultured pearl production and farming, the Pearl Culture Scheme of Department of Fisheries, Tamil Nadu Government was started in collaboration with Central Marine Fisheries Research Institute, Tuticorin. The programme commenced functioning from 8-2-1974. During the period under report, significant progress in all aspects of pearl culture were achieved.

Establishment of farm

Modern method of raft culture was employed for farming pearl oysters. Unit raft system was adapted to suit the turbulent conditions prevailing in the sea. The rafts used were of size 5 × 5 m, constructed with 'Ventek' and 'Kongu' timber. To the four corners were attached four wooden barrels which acted as buoys. The wooden frames of the rafts were bolted with iron bolts. The fabrication of the raft was completed on shore, pushed into the sea, towed to a place of desired depth and moored with the help of anchors.

Note : The 'Scheme on Pearl Culture' was an *ad-hoc* project of the Indian Council of Agricultural Research implemented by the Central Marine Fisheries Research Institute in collaboration with the Department of Fisheries, Government of Tamil Nadu during the period 1973-1978. This progress report received from the Department of Fisheries and edited for inclusion in this Bulletin gives the results achieved by the Department under the Scheme during 1974-1978.

Oysters collected from the natural beds by skin-diving and SCUBA diving were segregated size-wise, measured and put in different types of cages which included sandwich type, box type and pigeon-hole cages. The frames of the cages were made of iron rods, which were painted with anticorrosive paints and then woven with nylon twine of 1-2 mm size into meshes of size 2 × 2 cm. Then specified number of oysters were put in the cages according to the size and they were suspended from the raft at a depth of about 6 m.

Rearing of oysters at Tuticorin

A raft was fabricated and floated in the Tuticorin Major Harbour basin on 12-3-1975 for the first time. An initial stock of 1,146 pearl oysters collected from the natural beds were put in box type and sandwich cages and reared. In the subsequent year, the stock of live oysters was raised to 3,328 numbers. The second raft was constructed and kept afloat in the same area on 15-7-1976. In March, 1977 a stock of 840 *Pinctada fucata* and 5,500 flat oysters were there in the farm. From April 1977 onwards the rafts were maintained outside the harbour basin near the wharf wall of the north breakwater. After the damage caused to the rafts in December 1977 due to the cyclonic weather, the rafts were shifted and moored near the jetty of the Hare Island in calm waters. Thereafter the rafts were kept afloat near the wharf wall in the north breakwater from May to September and during the rest of the year near the jetty of the Hare Island. On 30-6-1977, 2,009

* Y. Jeyabhaskaran was the Assistant Director of Fisheries (Pearl culture), Tuticorin in charge of the programme. Others who were associated with the Scheme for various durations were N. Radhakrishnan, Assistant Director (additional charge) and Research Assistants S. M. Dowlath, R. Shaick Jalaludeen, Daniel Sudhendra Dev, S. Subramanian, P. Muthiah, I. Nalluchinnappan and M. Ayyannan (taken from the Report).

flat oysters which could not be utilized for culture work were released in Vantivu Arupagam paar. At the end of 1978, 622 *Pinctada fucata* and 592 flat oysters were there in the rafts.

Farming at Krusadai Island

The first raft at Krusadai Island was fabricated and kept afloat near the jetty of the island on 26-2-1977 and 2,025 *P. fucata* transferred from Turicorin farm were reared in it. The second raft was moored on 21-3-1978 with 2,800 *P. fucata* also transported from the collections at Tuticorin.

Utility of oysters

From the experiments conducted it was found that *Pinctada fucata* is the best suited pearl oyster for the culture pearl experiments. Besides the above species, flat pearl oysters like *Pinctada sugillata*, *P. chemnitzii*, *P. margaritifera*, *P. anomioides* and other *Pinctada* species were also available in the Gulf of Mannar. Since these flat oysters could not be effectively utilized in culture work, they were released in Vantivu Arupagam Paar in batches in January and June 1977 and further collection of flat oysters was stopped.

Planktonology and hydrology of the farm area

From March 1975 after the establishment of farm to the end of the period under report regular plankton and water samples were collected and analysed. Since the results obtained in the different farm areas in these inshore waters did not exhibit any marked difference, the data have been pooled and furnished.

In the plankton samples, the diatoms recorded were *Rhizosolenia* spp., *Navicula* spp., *Nitzschia* spp., *Coscinodiscus* spp., *Bladdulphia* spp., *Thalassiosira* spp., *Thalassiothrix* sp., *Dityllium* spp., *Planktoniella* sp., *Trichodesmium* spp., *Oscillatoria* spp., *Gyrosigma* spp.,

Pleurosigma spp., *Hemidiscus* sp., *Isthima* sp., *Bacillaria* sp., and *Triceratium* sp. Among the Dinophycean members *Peridinium* spp., and *Ceratium* spp., were observed.

The protozoans identified include *Noctiluca* sp., *Globigerina* sp., *Acanthopteran* sp. and *Tintinopsis* sp. The common copepods noticed were *Eucalynus* spp., *Acrocalanus* spp., *Corycaeus* sp., *Rhincalanus* sp., *Oithona* spp., *Metis* sp. and *Macrostella* sp. The cladocerans seen were *Evadne* sp. and *Penilia* sp.

The copepod abundance was seen in August and November-February. Lucifers and cladocerans were abundant in December and February. *Pleurobrachia* sp. and coelenterate medusae were found in considerable numbers in September and March. *Trichodesmium* bloom was noticed in March.

Among crustacean larvae penaeid nauplius, zoea and mysis were very common. Chaetognath *Sagitta* sp. was abundant during April-September. Trochophore and polychaete post larval stages of annelids were recorded throughout the year. Bivalve larvae were abundant in August and September. The pteropod *Cresels* sp. was noticed in March, May and December. Tunicate *Doliolum* sp. and *Oikopleura* sp. were also recorded.

The hydrographical investigations of the pearl oyster farm were carried out intensively during 1975-78 and the annual range of average values are furnished in Table 1.

Growth studies

From December 1975 till the end of the period under report different growth experiments were conducted. Rate of growth of pearl oysters was observed in groups and in individual oysters.

TABLE 1. Average analytical data of water samples collected from the pearl oyster farm area

Year	Temperature °C	pH	Dissolved Oxygen ml/l	Free CO ₂ ppm	Carbonates ppm	Bicarbonates ppm	Salinity ‰	Phosphate ppm	Silicate ppm	Calcium ppm
1974	24.4-25.5	7.8-8.0	5.04	Nil	18-22	80-85	33.05	Tr-0.02	Tr-4.0	—
1975	26.1-32.3	7.8-8.4	3.9-7.3	Nil	10-28	87-112	32.17-37.00	Tr-0.18	Tr-16.0	9.98-12.99
1976	25.2-30.6	8.0-8.4	3.6-7.4	Nil	9-12	94-118	30.16-36.00	Tr-0.04	Tr-6.0	8.01-10.01
1977	24.8-32.0	8.2-8.4	1.98-6.9	Nil	12-32	70-130	24.2-33.97	Tr-0.08	Tr-14.0	8.74-11.02
1978	29.5-31.0	8.3-8.4	4.4-5.3	Nil	12-22	102-118	34.03-35.63	0.04-0.2	1.0-3.6	10.16-10.81

Two sets of 50 *Pinctada fucata* each belonging to two different size groups were studied for one year. These oysters were collected from Tholyiram paar and reared in box-cage (40 × 40 × 10 cm) in the farm from March 1977 to March 1978. The average values of dorsoventral measurement, hinge length and width of the first batch of young oysters were initially 20.2 × 26.4 × 7.0 mm and at the end of the experiments they reached an average of 48.2 × 41.2 × 18.4 mm. The batch of bigger oysters measuring 47.6 × 40.9 × 16.5 mm initially, attained 57.9 × 47.9 21.7 mm only in March, 1978.

Another experiment to study the individual growth of oysters for one year commenced in January 1978. A special cage called 'Pigeon-hole cage' with 20 cubicles or compartments was designed. The size of the cage was 60 × 45 × 9 cm and that of each cubicle was 12 × 11.2 × 9 cm.

From the experiments conducted it was observed that the growth of oysters was continuous. Young oysters exhibited faster rate of growth and older size group showed comparatively poor and retarded growth. Appreciable and continuous growth measurements were recorded during November to February. In January and February finger-like growth processes were noticed which is evidence of luxuriant growth, especially in young oysters. It was recorded that the growth rate was influenced by temperature, salinity and settlement of foulers on oysters. Faster growth was generally noted when the temperature and salinity of the inshore waters were relatively low and when the settlement of foulers was less.

Isolation and rearing of bivalve larvae

Attempts were made to rear bivalve larvae in laboratory condition by segregating larvae from plankton samples. Rearing of bivalve larvae required many secondary investigations such as phytoplankton culture as food and control of bacterial and ciliary infections etc. This experiment was started in October 1975.

Observations revealed that at 202 μm size foot began to develop and at 280 μm the functional foot and velum were present. At 300 μm velum disappeared and a well-developed foot formed.

Bivalve larvae were isolated from the plankton samples, brought to the laboratory, measured and reared. They were reared in sterilized seawater and fed with cultured phytoplankton. The size of the larvae measured between 48 μm and 448 μm in the experiments conducted. Phytoplankton culture was carried out in Loosanoff's medium and enrichment medium.

Using Agar agar as medium in petriplate technique, monoculture was carried out. The larvae were successfully kept alive for a period of 27 days. Bacterial and ciliary infections caused mortality and antibiotics were tried to overcome this.

Studies on fouling and boring communities

Usually oysters collected from the natural beds exhibited very little fouling. But heavy biofouling on oysters, cages and other material of the rafts pose problems in the farm. The study of fouling organisms commenced along with the establishment of pearl oyster farm in March 1975. The foulers were collected and studied while cleaning oysters, cages and during replacement of wooden barrels. Experiments were conducted to study the intensity of settlement and seasonal abundance of foulers. Settlement was heavy towards the surface. From March onwards an increase in settlement of foulers was noted. However the peak months were May-August. Comparatively high rate of mortality of oysters was observed when there was heavy load of foulers. A decline in settlement was seen from November to January. The best method to minimise the effect of foulers and control them was periodical and regular cleaning.

The predominant fouling organisms throughout the year were barnacles. During the winter months the oysters were vulnerable to the attack of borers like the sponge *Cliona* sp. and polychaete *Polydora* sp.

Seaweeds recorded from the cages include *Enteromorpha* sp., *Dictyota* sp. and *Gelidium* sp. in December, January and March. *Ceratium* sp. was found throughout the year. Hydrozoans, sea anemones and turbellarians were observed in cages and on oysters in March, September and January. Polyzoans *Membranipora* sp., *Thalamoporella* sp. were noted in March, April, May, August and September. Among the annelids *Polynoe* sp., *Perinereis* sp. and *Eunice* sp. were seen in April and May. The arthropod *Balanus* spp. was found throughout the year. *Lytamata* sp. was abundant in August-December and March-May. *Gonodactylus* sp. was recorded in April. Isopods *Cillicaea* sp. and amphipods were seen throughout the year. Decapods *Charybdis* spp. and *Pinnotheres* sp. were found throughout the year. *Fanultrus* sp. and pycnogonids were noted in May and August respectively. Among the molluscs *Cypraea* spp., *Murex* sp., *Drupa* sp., *Pyrene* sp., *Cymbium* sp., *Pleurobranchus* sp., *Doris* sp., *Onchidium* sp., *Pinna* sp. and *Crassostrea* spp. were observed. *Avicula* sp. spat occurred in October. *Modiolus* sp. appeared in April, May and December and green mussel spat was seen in November

and July. Echinoderm *Antedon* sp. was found in June-August. Tunicates *Ascidia* sp., *Diandrocarpa* sp., *Stylea* sp., *Leptoclinum* sp., *Didemnum* sp. and *Botrylloides* spp. were noted in March-May and September. *Rhadocynthia* sp. was found in March-August. Fishes like *Pteroscrites* sp., *Blennius* sp., *Gobius* sp., *Siganus* sp., and *Acanthurus* sp. were also found throughout the year inhabiting the pearl oyster cages and dead shells.

Spat collection employing spat collectors

Variouly designed spat collectors were laid in the farm to attract settlement of pearl oyster spats so that continuous availability of oysters could be ensured for pearl culture experiments in future.

The experiments conducted in this regard during the period 1974-78 yielded very poor results. So far no effective spat collector was found out. Spat collectors such as cement coated iron frames, tar coated iron frames, tiles, tiles white-washed, nylon frills, tar coated wooden planks, cement coated iron cages, fibre-netted frames etc. were used. However the settlement noticed was only stray and very poor. Such stray settlements were noticed on oyster cages, ropes and wooden barrels of the rafts also.

Implantation of nucleus in culture pearl production at Tuticorin and Krusadai

The surgery and implantation of nuclei for the production of cultured pearls was started at Tuticorin laboratory on 3-6-1976. Since there was no needed facility available at Krusadai Island, the implantation work of oysters of the Krusadai farm were conducted at Mandapam in the Krusadai Marine Biological

Station from 7-7-1977. The first pearl at Tuticorin was produced on 12-11-1976 and for the first time pearls were produced in the Kursadai farm on 7-12-1977. Fully formed pearls were collected after three months from the date of implantation.

During the period 1976-78 the success achieved in pearl production was estimated to be upto 38%. The pearls produced were of different shades. The colours were silver white, cream, golden yellow and steel grey. The rate of mortality was successfully brought down during the post-operative period. Use of menthol to narcotise the oysters was minimised, but in an effective way. Multiple implantation was also tried to increase pearl production.

Indigenous production of nuclei

From the inception of this Scheme efforts were made to make chank bead nuclei from the shells of sacred chank *Xancus pyrum*. The outcome with chank beads locally made were not upto the expectations and yielded only poor results.

Use of Japanese nuclei

From 1977 onwards Japanese nuclei were used for implantation work at Tuticorin and Krusadai. Experiments with these nuclei proved that the imported nuclei were the best suited for cultured pearl production.

Instruments for implantation work

Sets consisting of various precision instruments were manufactured and supplied by the Indian Drugs and Pharmaceuticals Limited, Madras. These tools were being effectively employed in the minute surgery during nucleus implantation work to produce cultured pearls.