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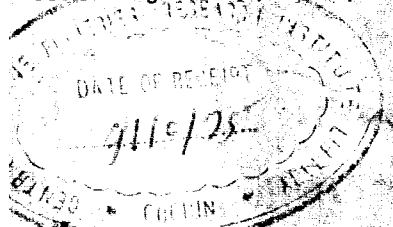
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OUR COVER



An assortment of fish obtained from
composite culture

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EDITORIAL



Aquaculture

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FISH is one of the fine items of food for man. Protein-rich and easily digestible, the role of fish in improving Indian diet and all in all augmenting the food resources of the country cannot be exaggerated. Its export potential also is enormous.

This issue is devoted to culture—the scope and possibilities in fresh, brackish and salt waters. It is estimated that nearly 70 million hectares of these waters are available, of which only 0.6 million hectares are under cultivation. From this, the possibilities of this great sector can be understood.

Faced with the challenges of dwindling food and energy sources, and the ever-worsening problem of pollution, the scientists and planners the world over are looking at earth's resources as an integrated whole where utilization and conservation go hand in hand. An over-intensified exploitation of land for food crops alone will cause suffering to, and progressive depletion of animal and fish resources. Thoughtless and ill-planned development of industries will bring within its wake pollution, particularly of the rivers and oceans. The fish will just vanish. Events in the nature of grave warning have already occurred. This means a totally integrated agriculture, animal husbandry and aquaculture, the whole operation being viewed as one ecological chain, meant for the healthy survival of men, animals and fishes.

In a humble way, this is also the philosophical and programmatic content of ICAR's own operational research projects.

There is also another noteworthy aspect about aquaculture in general. It is a labour-intensive programme. There is tremendous need for production and employment to go hand in hand. Production, without employment and the purchasing power that it creates, can cause its own problems. A close look at the rural areas will easily confirm this simple economic truism.

All in all, the subject deserves close study. The material that we present will help in this direction.

PRODUCTION OF CULTURED PEARLS

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PEARLS are among the gems of the sea and have formed a valuable item of jewellery through the ages. Like the precious corals, they are produced by the metabolism of living animals. The pearl oysters (*Pinctada maxima*, *P. fucata*, *P. margaritifera* and others), wing-shell (*Pteria penguin*) and the abalone (*Haliotis discus*) living in the sea bottom, and the limnetic mussels (*Hyriopsis schlegeli* and *Cristaria plicata*) are the well-known pearl-producing molluscs. Pearls produced by *Pinctada* spp. are highly valued in the gem-trade.

Pearls are collected in nature by gathering these molluscs and removing the pearls when found. In the case of vast natural resources of pearl oysters occurring in several parts of the world, namely India, Sri Lanka, Australia, Japan, Persian Gulf, Red Sea and Mexico, fishing for pearls has been conducted on a large scale and such operations are popularly called pearl fishery. But these resources fluctuate highly in most places and also the yield of pearls in natural fisheries is very low compared to the number of oysters sacrificed.

Japan gave the lead to the world in the production of cultured pearls. Half-pearls were produced in 1893 and round pearls in 1907 for the first time. Following Japan, and in collaboration with her, other countries such as Australia, Philippines, Indonesia and Burma started cultured pearl industry in their areas. It is of great significance that India developed the techniques of pearl culture indigenously. The breakthrough came in July 1973 at the Central Marine Fisheries Research Institute.

Cultured Pearls

Pearls are similar in composition to nacre (mother-of-pearl) which is found on the inner side of the shell of the pearl oyster. Nacre is a secretion of the outer epithelial cells of the mantle. During the process of filtration, foreign particles or minute organisms floating in the sea water get into the body of the oyster. In the course of their entry, a few epithelial cells of the mantle might be scraped. When the foreign particle happens to get 'lodged' in the tissues of the oyster, the epithelial cells regenerate and grow to form the pearl-sac. The pearl-sac epithelium discharges its natural function of secreting nacre which gets deposited over the foreign

particle. The latter now becomes the 'nucleus' and the process of deposition of nacre continues as a metabolic function of the pearl-sac, resulting in the growth of a beautiful and lustrous natural pearl.

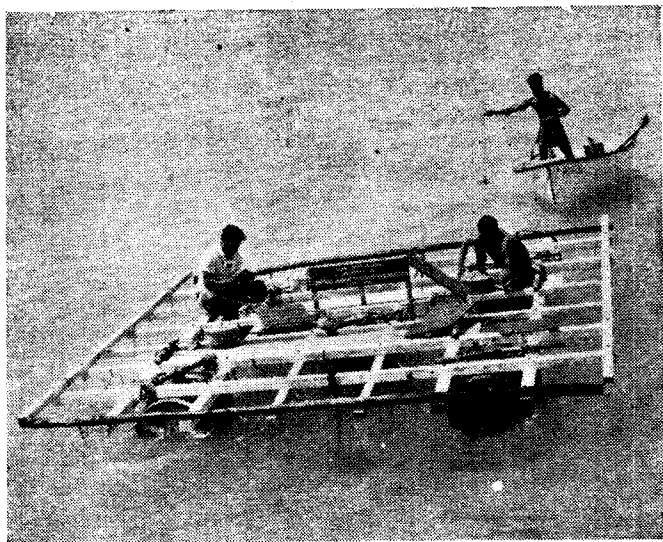
For the production of pearls by culture techniques, we have to set up the above processes in motion by a skilful operation implanting a piece of mantle containing the outer epithelial cells and also a nucleus into the tissues of the oyster. Formation of pearl-sac and secretion of nacre take place in the same manner as described above and the pearl produced is called the 'cultured pearl'. Theoretically, cultured pearls can be produced with nuclei made of any hard material like glass and plastic, but round shell-beads give good results and are universally used.

Development of Techniques in India

Experiments on pearl culture were initiated by the Central Marine Fisheries Research Institute at Tuticorin with a Field Laboratory at Veppalodai on the Gulf of Mannar coast in 1972. Pearl oysters are collected from the natural beds called 'paars' in the Gulf of Mannar off Tuticorin. The oysters are reared at Veppalodai by raft culture. The rafts are made of wooden poles tied together to form a basic unit of about 6 m × 5 m and floated by wooden barrels. Each raft is moored by two anchors. The oysters are arranged in special type of frame nets or baskets and suspended from the rafts. Approximately 2,000 oysters can be reared on a single raft of the above size.

The oysters which have been collected from deep waters are allowed to get acclimatized in shallow water for a few months and thereafter brought to the laboratory. Oysters for operation are selected and conditioned in menthol-seawater medium. Graft tissues are prepared from the mantle edge of healthy oysters. These are trimmed to required sizes (2 to 4 mm). For performing the operation, the conditioned oyster is fixed on a stand and the opening between the valves is regulated with a speculum. Working through the gap an incision is made at the base of the foot of the oyster and, through this opening, a piece of mantle and a nucleus are implanted in the gonad of the oyster. After checking the orientation between the two, the oyster is returned to seawater for recovering from the effects of narcotisation and operation. Multiple implantations are also carried out when two or three nuclei are placed in the oysters. A few days later, the 'seeded' oysters are taken back to the rafts for further rearing.

The first set of free, spherical Indian cultured pearls were produced at Veppalodai on July 25, 1973, which signified the successful development of the technology. Now-a-days pearls are being produced on a routine experimental basis. Pearls of different colours, namely white, light pink, golden yellow, steel grey and a few



Raft used for rearing the oysters at the pearl culture farm at Veppalodai

other shades have been produced. The growth of pearls in the Gulf of Mannar has been found to be much faster than in the temperate Japanese waters, indicating that the duration of culture would be considerably less for the Indian cultured pearls.

In all the pearl culture areas in the world, shells of freshwater mussels found in the Mississippi river and its tributaries in the U.S.A. are imported and used for the production of nuclei. Although shell-bead nuclei produced from the above shells in Japan were used in the early experiments at Veppalodai, attempts were made to produce nuclei indigenously. Using the shells of Indian conch (*Xancus pyrum*), popularly known as the sacred chank, a technique was developed to make spherical shell beads comparable to a great extent with the imported nuclei. The chank-bead nuclei were used in the operations and good pearls were produced.

Besides developing the technique of pearl culture, the experiments at Veppalodai also showed that settlement of the young ones of pearl oysters (spat) takes place on the suspended oyster baskets and frame nets. The spat were reared in the farm and when sufficiently grown up, used for production of cultured pearls.

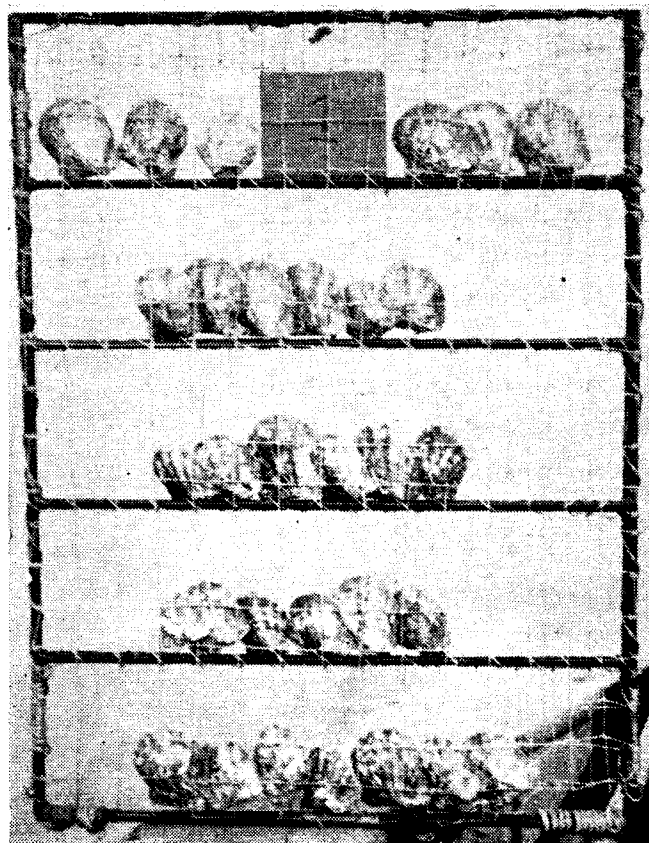
Pearl Oyster Resources — New Findings

In pearl culture, it is of great importance that a steady supply of oysters is found. The well-known pearl oyster beds of India in the Gulf of Mannar and Gulf of Kutch have, in the recent years, been the least productive and hence no pearl fishery could be conducted. However, it has been proved that it is possible to find the resources in areas hitherto not known to bear the oysters, as a result of the Institute's work at Vizhinjam,

near Trivandrum, along the Kerala Coast. Similarly, pearl oyster resources have recently been located in the major harbour of Tuticorin. Good settlement of spat has been observed on the submerged granite stones recently laid for the formation of breakwaters of the harbour. Pearl oysters have also been collected from the Palk Bay. The oysters of these areas have been successfully used for the production of bright cultured pearls.

Prospects

India is importing pearls from several countries, 91 per cent of which come from Japan. The average value of import is about Rs 8.2 million a year, of which cultured pearls account for Rs 4.6 million. While there is a re-export of natural pearls after processing, the cultured pearls are almost entirely used within the country. The rapid progress made by this Institute in developing the techniques of pearl culture, raising pearl oysters from spat and locating resources hitherto not known within a period of two years from the taking up of the programmes has laid down the foundation for commercial production of Indian cultured pearls. As a first step in this direction, pilot projects on pearl culture have been proposed which are expected to be implemented this year.



A frame with the pearl oysters