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# Seafood Export Journal

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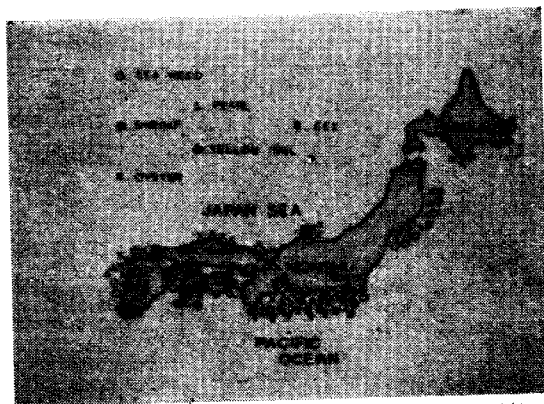
# MARICULTURE INDUSTRY IN JAPAN

**P. Bensam**

*Assistant Fishery Scientist, C. M. F. R. I. Sub-Station, Tuticorin.  
(formerly Japanese Government Research Scholar in Acquaculture)*

In the seafood industry of the world, mariculture has been assuming importance in recent years. Mariculture or the practice of culturing marine plants and animals in suitable localities in the sea or in saline waters in the adjoining land, by using efficient ways and means appears to have been in existence in one form or other from time immemorial. However, the industry in an organised form appears to have had its origin in the sixteenth or seventeenth century; and undergone gradual development ever since in different parts of the world. Yet, only a few countries such as Japan, United States of America, France, Spain and Canada have developed mariculture into a profitable venture. Of them no other country than Japan can boast of achieving remarkable progress in recent years. The average annual production from mariculture in Japan ranges between 800,000 and 900,000 tonnes at present; and the annual national income from this source has increased from about 100 million dollars in 1960 to about 1,500 million dollars in 1970. This is a substantial increase from 25% to 40% of the income from coastal fisheries alone and from 9% to 20% from marine fisheries as a whole. Such a

rapid development in the course of a short period has been accomplished by a few factors, the chief among which is the policy of the Japanese Government aiming at a change over from the traditional capture fishery in the coastal areas and offshore grounds to the modern culture fishery of generating new resources. Another equally important reason is the speedy progress achieved by fishery scientists and technicians in the field of culture techniques, particularly in artificial propagation and rearing methods as well as in the methodology



*Map of Japan showing important area of mariculture.*

of vertically using the shallow waters and making use of the fallow coastal areas. In these days of increasing food shortage, particularly in the developing countries of Asia, the growing demand for the supply of fish from the sea and the limitations of exploiting the stock in the inshore and offshore areas beyond certain levels, call for immediate implementation of making use of the sea within the territorial limits and the saline waters of the adjoining land for farming such of the species which can be cultured. In Japan the following are the important marine resources that are cultured and harvested profitably.

### Sea weed

The sea weed or laver (*Porphyra* spp.), popularly called "Nori" or "Amanori" is high in Vitamin A and contains fifty times the amount found in an equivalent quantity of chicken eggs. It is one of the important items in the Japanese diet from time immemorial and has received attention for culture as far back as the 17th century. Sea weed culture has been prevalent in the southern half of Japan along the Pacific coast including the Seto Inland Sea. The culture period lasts from about September until the following



*Horizontal nets for culturing "Nori"*

March. In the traditional method of culture, bunches of branching bamboo



*Harvesting sea plants cultured on ropes.*

sticks are planted vertically in the muddy bottom. Minute spores of the sea weed liberated by the mother plants during September / October are intercepted by the net work of the branches and get attached to them. The spores germinate and grow to the marketable leafy plants. From about December onwards the leaves are picked, cut, spread on mats and dried in the sun. In the Pre-Second World War record for the year 1941, an estimated 1,500 million sheats were produced. But, since the War the culture techniques have been improved considerably. The modern

method involves the stretching of heavy nets horizontally supported by strong poles for attachment of the spores and growth of the plants. The recent annual production is estimated at 7,000 to 9,000 million sheats.

Culture of another sea plant, "Wakame" (*Udaria pinnatifida*) has been developed all over Japan, particularly in the Seto Inland Sea, from almost nothing in 1960. The recent production has amounted to about 100,000 tonnes per year; and the industry is yet to develop further. These are farmed in waters deeper than the culture grounds for "Nori". Ropes are stretched and held in position by rafts in the sea, horizontally as well as vertically with spore-attaching threads fastened to the ropes. The whole structure is resistant to wave action.

### **Shrimp**

Since the Second World War, considerable development has taken place in farming the Japanese prawn *Penaeus japonicus*. Artificial hatching was achieved for the first time in 1960; this factor and the discovery of proper food for the prawn larvae, namely the larvae of the brine shrimp *Artemia* and algal cultures have paved the way for making shrimp culture into a profitable industry. The farms are chiefly located at Takamatsu and Yamaguchi in southern Japan. Fertilised females are placed in tanks for raising broods. After about 2 cm. size the juveniles are transferred to large ponds. They are first held in small baskets in the ponds and are fed with clams, worms, etc, until they are large enough to be transferred to larger rearing ponds. Here they are fed on crushed clams. These ponds usually get their sea water supply by the flush-

ing of the tides or by mechanical pumping. About 10,000 to 15,000 prawns, each weighing 20 to 30 grams at the end of 5 to 6 months are raised from each female caused to spawn. The total annual yield is estimated to range from 400 to 600 tonnes at present.

### **Edible oyster**

The culture of the Japanese edible oysters, chiefly *Crassostrea gigas*, which is another marine food resource much esteemed in Japan, was started in Hiroshima area in the 17th century and later spread to the Seto Inland Sea and to the northern Miyagi and Iwate prefectures. In the older method of culture, the young ones called the spat released by the mother oyster attach themselves to branching bamboo sticks planted for this purpose in shallow areas. These spat are either allowed to grow on the same sticks or are removed and sown on the sandy bottom. In this method the production was rather small. But, in the recently developed methods of collecting the spat by specially prepared spat-collectors and rearing them by the hanging method with rafts or long lines, the production has become higher and reached an annual figure of 350,000 tonnes in the recent past. The spat-collector consists of a long wire strung with sufficient number of the shells of scallop, oyster or abalone. These are suspended in shallow water either horizontally or vertically by suitable racks. In rearing the oysters, either rafts or long lines have become most successful. The sizes of the rafts differ from place to place. They are held in position by buoys and anchors. Many ropes studded with a varying number of shells attached with the spat are hung from the

rafts. In the long line method, usually practiced in deeper waters, drums are



*A view of the coastal waters with floating culture rafts.*

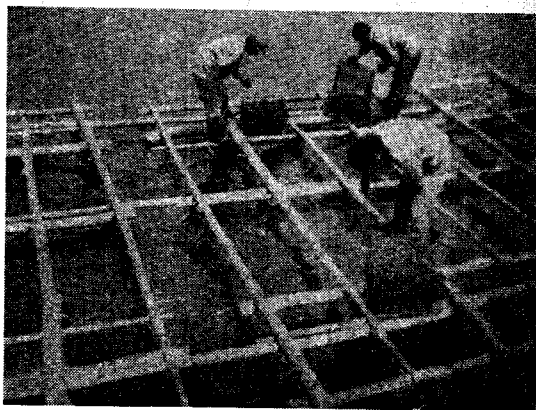
floated in the sea and between the drums a thick main rope is stretched. To this a number of hanging ropes with shells bearing the spat are hung.

The management agencies for edible oyster culture fall under two categories. In the first, oysters are cultured for food domestically; and in the second for the export of oyster seed, mostly to the United States of America. About 75% of the oyster cultured for food comes from Hiroshima area. While production for purposes of food has been increasing in Japan, that for export purposes has been declining lately.

#### **Pearl oyster**

Japan ranks first in the field of producing cultured pearls; and 90% is exported. The annual export in recent years has amounted to 80 to 100 tonnes, bringing in 60 to 100 million dollars as foreign exchange. The most important oyster species which gives cultured pearls is *Pinctada martensii*. The technique of pearl culture involves the

insertion of spherical nuclei made from shells into the oyster in close proximity with its gonad and liver along with a piece of the internal skin called mantle of a donor oyster. After the insertion of the nucleus and conditioning of the operated oysters they are arranged in small net-cages or baskets and are hung from rafts. Due to the irritation caused by the nucleus the pearl producing layer of the skin starts secreting the pearly



*Culture rafts and net-cages used in pearl oyster culture.*



*Insertion of nucleus into pearl oyster*

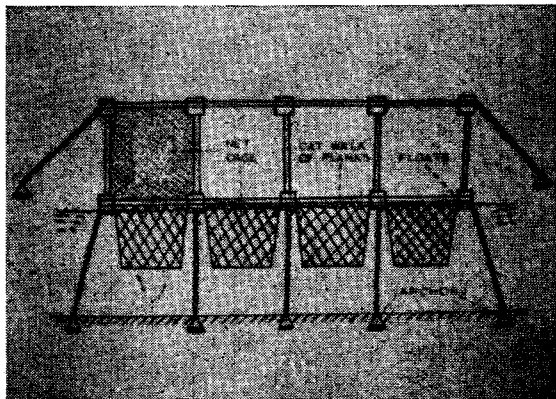
substance all around the nucleus thus resulting in the formation of the pearl.

A recent development in this industry is the improvement of culture techniques, such as artificial propagation of oysters, management of culture grounds and processing methods. Due to these, the culture grounds which used to be concentrated in the Mie prefectural zone in the early fifties, have spread far and wide lately. At present, the Seto Inland Sea, Shikoku and Kyushu areas also have plenty of pearl culture units. The units which numbered only about 360 in 1950 have increased to about 5,000 in 1970.

#### " Yellow-tail "

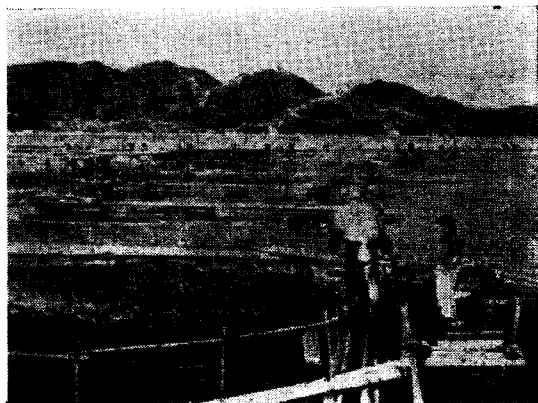
Culture of the carangoid fish *Seriola quinqueradiata*, popularly called the Yellow-tail is practiced in the Pacific coast of central Japan, where the sea water temperature is warm enough in the winter for the normal growth of this fish. For the culture of the Yellow-tail, rafts are floated on the sea with the aid of floats and held in position by anchors. The rafts are demarcated into chambers in which are suspended " net-cages " made of synthetic fibre. The size, depth and mesh of the net-cage may vary according to the size of the fish cultured on it. The young ones of *Seriola* in the size range of 6-12 cm. are caught from the coastal areas and stocked in the net-cages. In certain areas coastal ponds and netted enclosures in the sea are also used for stocking. They are fed with small inexpensive sardines, anchovies, etc. and fish meal as well as other artificial food suitably balanced and vitaminised. As *Seriola* are carnivorous the highly nutritious food are well fed upon; and this results in good growth rate. Young ones in the size range of 6-12 cm. stocked, grow to a size of 20 to

30 cm. at the end of 8 to 12 months, when they are ready for the table.



*Culture rafts and net enclosures for Yellow-tail (diagramatic)*

The coastal areas of Shizuoka, Aichi, Mie and Kochi prefectures and the Seto Inland Sea are the important localities of



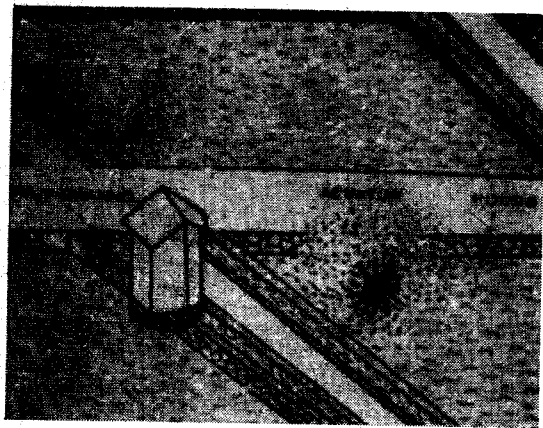
*Enclosures in the sea for Yellow-tail*

Yellow-tail culture. The annual production has increased from about 2,000 tonnes to about 30,000 tonnes at present. This development has been accomplished by the improved methods of rearing the fish in the sea.

#### Eel

The Japanese eel, *Anguilla japonicus* is one of the most popular and delicious

fish foods in Japan. Taking advantage of the fresh water phase in the life history of this marine fish, the young ones (8-16 cm.) are collected and stocked in fresh water ponds during April-June period. They are fed with cheap fish and artificial food; and reared for 9 to 12 months when they attain the marketable size of 70 to 100 cm. The bulk of the production comes from the Tokyo-Osaka sector. Owing to the recent developments in the pond upkeep and collection



*Eel culture ponds (Semi-diagrammatic)*



*Eels, cultured in a pond*

techniques, the annual production has increased from less than 10,000 tonnes in the early sixties to about 60,000 tonnes in recent years.

## Others

The other living resources from the sea which are cultured, but which have not shown notable progress in the recent past are certain miscellaneous shell fish, clams, scallop, etc., the globe fish, octopus, lobsters and mullets. The miscellaneous shell fish cultured range in annual production from 300,000 to 400,000 tonnes; the globe fish from 150 to 200 tonnes; octopus from 800 to 1,000 tonnes; lobsters from 50 to 100 tonnes; and mullets from 150 to 200 tonnes. The culture methods for these are mostly primitive and no positive development measures have been undertaken, except for sinking stones or cultivating the bottom areas of coastal waters and transplantation of seeds. However, experiments are being carried out at present for widening the scope of developing and utilising these resources also on a larger scale.

The enterprising people of Japan have developed the mariculture industry in a remarkable manner in the recent past; and it has come to stay as an important element in their national economy. In view of the growing importance of the mariculture industry in Japan, this subject along with other branches of Aquaculture, as an applied aspect of Fisheries Science, is taught in important Universities. The curriculum includes the biology of the important species involved, the legal aspects of sea farming, selection of site and materials, design and construction of shore facilities, farming techniques in various ecological niches, methods of harvesting, effect of farming on the environment, control of predators, pollution problems, economics of the venture, etc.

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