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TECHNOLOGY OF MUSSEL FARMING

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A review of the mussel seed collection in the various countries of the world shows that the dependence is on natural seed stock. The rope culture technique for farming mussels appears to be universal although in countries like France and Philippines other systems are followed to grow mussels in the tidal flats. Progress of 'rope culture' technique adopted in India is given.

INTRODUCTION

The major mussel producing countries are Spain, the Netherlands, France and Italy each with its own system of culture contributing 93% of the total 328,500 tonnes produced throughout the world by farming. (Pillay, 1978 in *Advances in Aquaculture* : 1-10. Fishing News Book Ltd., England,¹ Yugoslavia, Chile, Philippines, Federal Republic of Germany, Korea, New Zealand and Tunisia contribute the rest. There are other countries like Russia, U.S.A., U.K. (Scotland and Ireland) Venezuela, Australia and India where culture practices have begun yielding fruitful results. At this stage it would be of interest to know the methods followed in many of these places for the collection of seeds and culture. It may be stated that in mussel culture, as in oysters, wild source supply is being depended upon by culturist forcing them to operate in close proximity to established, reliable high productivity spawning and settling grounds where young ones may be recruited from natural stocks. An account of the seed collection methods and system designs developed by each country fitting with the environmental conditions is given to understand the present status.

SPAIN

During the breeding season, April-September, seed collectors such as loosely woven and heavily tarred ropes, 12-15 cm diameter made of spart grass or nylon are lowered from the rafts used for growing mussels. 12 mm wooden spacers are used to avoid slipping down

of mussels. The ropes are 10 m long and well above the bottom. In the event of failure of spat settlement seed collection from natural beds from rocky shores is resorted to.

Seed mussels thus collected are tied round ropes in clumps using a fine, large-meshed rayon netting which disintegrates in a few days time leaving the mussel seed firmly attached to ropes. These ropes are then suspended from rafts floated over 'Rias' (sunken river beds). The growth here is fast. When the ropes become heavy, exceeding a certain limit, the mussels are thinned out and distributed over greater length of rope. The harvested mussels are sold to canneries or placed in purification tanks before export.

THE NETHERLANDS

Government allows farmers to collect mussel seed from public seed beds during certain limited periods. The natural seed that settle at the bottom of the shallow sea-bed are gathered by special mechanical mussel boats with dredging arrangements. One dredge load will bring about 500 kg of mussels. At times 15,000 kg of mussel seed are landed per day. A mussel boat can hold up to 50,000 kg of seed mussels. Mussels collected thus are transferred to private plots leased out to individuals and allowed to grow at the bottom. The half-grown mussels are later transplanted to plots for further growth and fattening. Thus the system is a semi-culture.

FRANCE

Initially, rows of poles called 'Bouchots', interwoven with branch-wood are placed in the intertidal zone to allow mussel seed to settle during breeding season. When the seed grow slightly bigger they are transferred to 'bouchots' placed at somewhat higher in the same zone. Nowadays 'bouchots' are obsolete and forbidden since they cause silting. At present seed collection is carried on by supporting loosely woven cocoa fibre ropes, 13 mm diameter and 3 m long in the intertidal area near natural beds during May-July. Seed settlement takes place in 2 weeks time, between the rope strands. These ropes are removed and wrapped round Oak poles, 15-20 cm thick, 4 m long and driven 2 m into the ground. The mussels attain marketable size on the poles.

ITALY

Mussel seed is collected from natural beds as well as by employing spat collectors. Seed collection from beds is done by scraping with the aid of 'raschiette' (sharp blade). The season of collection is from April-May and about 100-1000 kg are collected per day per boat of two persons. Special spat collector ropes 'filimbindo' of 25 mm diameter are also used. This consists of 3 intertwined strings of polythene hung horizontally in parks called 'Vivai', with the help of thin ropes. For a park of 40 × 25 m, 135 m long rope is used. Seeds which settle in January are removed by April-May and restrung in ropes to be hung in the park for further growth. Formerly ropes of sparto grass were used for twisting round clustered mussels. Now 'Netlon' netting is used. The net is closed with synthetic strings and hung from a horizontal rope in the park. These are called 'Pergolari'. A park of 1000 m² carries 715 pergolari. These are periodically inspected and if found heavier the nets are cut into small sections of 1 m length and mussels transferred to thick gauze nets for further growth to marketable size. Periodically the mussels are exposed for 2 hr to kill larval fouling community settling on shells.

PHILIPPINES

To collect mussel seed, extensive bamboo structures are erected in places with muddy bottom. Spat collection and growing are combined since no transplantation is done once spat settle down. The mussels grow to marketable size in 6 months time. Divers pull out the planted poles, strip them clean of grown mussels on board a boat. Well graded and cleaned, the stock is transported rapidly to market. Formerly 'wigwam'

method using 8 long bamboo poles in a circle of 4 m dia. around a central pole and nailed together with short horizontal bamboo braces just above low water mark was followed using central pole as pivot. Slender bamboo poles were thus kept inside the frame. This was found unsuitable resulting in overcrowding of mussel and poor growth. This has been replaced now by 'stage' system of rectangular bamboo structures. Culture is done subtidally in sheltered sites.

Bardach *et al.*, (1972, *Aquaculture*: 868 pp. Wiley-Inter-science²) report that mussel seed already settled are removed from their natural substrates and reattached for culture. Reattaching is accomplished by placing the seed in a 2 m × 1 m tray with a quantity of cultch of oyster shells or bamboo stakes. The tray is suspended on poles, submerged in water.

Oyster shells with attached mussels are strung in groups of five on No. 10 wires. Strings of shells are above 1 m long provided with loops and spacers and are suspended from bamboo platforms. About 1000 strings can be suspended from a platform of 1 m × 10 m. Bamboo stakes used as cultch consists of the whole tip of spiny bamboo, five cm in diameter at base and 2 m long, but are placed in the tray so that only the upper half is exposed to the mussels. After attachment the bare half of the stakes is driven into the bay floor for growth.

RUSSIA

Rich mussel beds exist in the northern and western sections of Black Sea over muddy bottom even to a depth of 65 m. Mussel parks set up at 5-6 m depth consist of 2 rows of 6 pine poles, each pole 10 m apart with a space of 10 m between 2 rows. The total area covered is 500 m². Each pole is 15 cm thick and of a height to achieve 2 m projection above water surface. They are held in place by employing 6 mm steel wires and 16 anchors. Once the park is in position 10-12 mm kapron chords are stretched from pole to pole and from row to row just above water level. Plates of 8 × 3 cm diameter are inserted 8 cm apart in kapron chords and these are hung as collectors from mussel parks.

There are several other countries where mussel resources are available which are experimenting with culture and spat collection following one or the other of the above methods with local modifications. For instance in Venezuela bamboo poles are used as spat collectors and rafts of 7 × 7 m made of bamboo poles and styrofoam floats are used. Due to vulnerability of the bamboo poles to marine borers attack, this

system is now being changed. In the west coast lochs of Scotland (Sound of Jura) coir rope is used for spat collection and buoyed frames support the ropes used in culturing the mussel. In the inlets of western Ireland coast rafts of timber using expanded poly-styrene as floats are used for rope culture. In the Baltic Sea area of Germany narrow rafts made of 25 cm diameter polythene pipe are used for suspending ropes of different materials. Long net bags of polyethylene (2.5 cm long \times 20 cm dia, with 1 to 2 cm mesh) are filled with mussel seed and suspended from the rafts for growing the mussel. In Australia rafts made of timber supported by 200 litre drums to achieve floating are used for suspending ropes of coir and polypropylene blend on which the mussel seed had settled down earlier. In New Zealand concrete rafts are employed for suspending seeded sisal rope for spat settlement and growth.

Experiments in India adopting rope culture of the green mussel and the brown mussel have succeeded in producing harvestable stock in a period of 5 months and 8 months respectively. Seed collection is done from inter-tidal rocky beds during spat settling season. Spat collectors like frilled nylon ropes and roof tiles are also employed. Seeding is done on coir or nylon ropes of chosen lengths depending on the water depth of the culture site. Mosquito netting or bandage cloth is employed to bring about attachment of seed to the ropes as done in other countries.

Floating rafts of 6 \times 6 m or 8 \times 8 m fabricated out of teak wood poles and bamboo poles duly buoyed and anchored firmly are used for suspending culture ropes in the coastal sea areas at depths ranging from 5-15 m. Marketable size is reached in 5 months in green mussel and in 8 months in brown mussel. In order to withstand the severity during monsoon periods experi-

ments are being conducted with rafts kept positioned below sea surface wherefrom ropes are suspended.

REMARKS

From the foregoing account it is clear that mussel farming throughout the world, including the leading country Spain, depends entirely on nature for the procurement of seed. This is done either by scraping the seed from the natural bed or by employing suitable spat collectors. So far hatchery production of seed has not become necessary to meet the requirements of the culturists. Another point that emerges is that in most of the countries the culture work goes on in sheltered and protected areas. The Spanish style of raft-rope system of mussel culture suitably modified seems to be universal.

An organism cannot be deemed to be a serious contender for large-scale culture until its seed or juveniles are economically made available in sufficient numbers. This implies control over the seed production system. Although natural seed availability in most of the major mussel producing countries does sustain the current culture operations, the magnitude of future expansion depends on the technology of quality seed production and supply. Development thus becomes an inter-play between objectives, resources and measures. Assured seed supply should be accomplished through operation of a managed breeding programme controlling the gametogenesis of the animal. This has not been done for all the species because of lack of knowledge of a cluster of enigmatic variables which influence the inter action of many biological and reproductive physiological aspects of marine animals. These may differ from one eco-system to the other and is therefore a priority area for research and development in the future proposed system of open sea mariculture.