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855 INITIATION OF MARINE MUSSEL CULTURE ACTIVITIES IN DAKSHINA KANNADA DISTRICT, KARNATAKA

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Introduction

The technology for mussel culture using suspended ropes was developed in India during the early seventies. Mussels were grown attached on ropes suspended from floating wooden rafts anchored in the inshore sea off Calicut, Karwar, Vizhinjam and Goa. These experiments showed the technical viability of growing mussels on ropes, besides, it showed the advantages of a tropical environment, which reduced the duration of culture to five months. In spite of the many advantages the technology did not find many takers. In 1995, the raft culture technique was modified by the CMFRI to suit the rough open sea conditions by the design of long-lines to suspend seeded ropes.

Dakshina Kannada district in Karnataka is characterised by a 145 km long coast line consisting mainly of sandy beaches with few rocky patches and islands, but no protected bays. Green mussels (*Perna viridis*) are found distributed in these rocky areas (Fig.1). There are no

precise estimates for the annual quantity of mussels exploited from these areas. A conservative estimate is that annually more than 500 tonnes of mussels are handpicked from the intertidal areas and by diving in subtidal areas by small-scale fishers. The sea is especially rough during the 4 month monsoon season (June-September). Peak breeding of mussels takes place along the coast by the end of the monsoon season timed with the rapid increase in ambient seawater temperature and abundant availability of phytoplankton in the inshore areas.

Long-line culture in open sea

a) Demonstration by CMFRI

Considering the long wave-swept coast line in the district, long-line culture of mussels was mooted for demonstration during January, 1996 in two areas of the district where mussel beds and seasonal small-scale fishery occur, viz., Kaupu and Suratkal. Long-lines each measuring 20 m of 24 mm thick nylon rope was placed in the sea off Kaupu and Suratkal at 8 m depth (Fig. 2). The lines were secured to the bottom with

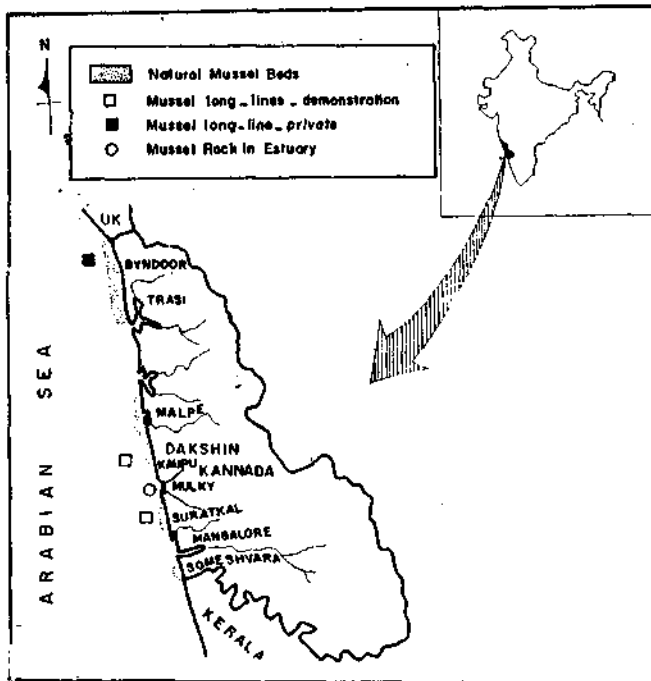


Fig. 1. Map of Dakshina Kannada district showing area of natural mussel abundance and areas where demonstrations and farming of mussels took place.

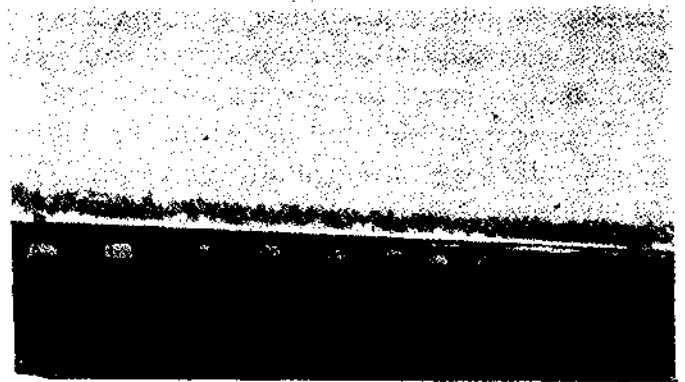


Fig. 2. The 20 m demonstration long-line deployed at Kaupu in January 1996.

50 kg. rock anchors at either ends and floatation was achieved by tying 8 water-tight 100 l FRP drums to the lines at 2 m intervals.

Mussel seeds (*Perna viridis*; mean size - 22

mm) were obtained, from the intertidal areas in respective sites and seeding on ropes (18 mm - nylon and coir) was done at a rate of 2 kg/m rope. Each seeded portion of the rope measured 5 m in length with 1 m free at either ends. The bottom end was weighted with 2 kg stone anchors. The seeds were wrapped around the ropes uniformly with the help of cotton mosquito cloth. Twenty seeded ropes were suspended from each anchored long-line.

Within 10 days after installation of the lines, the mosquito net cloth disintegrated and the seeds were firmly attached to the ropes. The event got wide publicity in the press and many entrepreneurs evinced interest in starting new mussel culture ventures. During February end, the line at Suratkal was run over by a fishing boat in the night and 12 lines were lost. Similarly at Kaupu also lines were lost due to various unforeseen reasons. By the end of the growing season (May) only few lines remained at both the places and many mussels on these lines too were lost due to slipping. Overall, no harvest was possible, but the activity received wide coverage in the local press and many fishermen/entrepreneurs were convinced of the long-term possibilities.

b) By private entrepreneur

Encouraged by the CMFRI's demonstration, a small scale gillnet fisherman, Mr. D. Shanker Kharvi of Dhombae village in Byndoor at the northernmost point of the district (140 km north of Mangalore) started preparing to launch his mussel line during December, 1996.

With CMFRI's help Shanker set his long-line (10 m long) in the sea off Dhombae at a depth of 6 m. Each seeded rope measured 4 m. The mean size of the seeds was 20 mm. Totally 7 seeded ropes were hung. The seeding rate was in excess of 2.5 kg/m. More than 56 kg of seeds were used to cover the ropes. Floatation was ensured through small net buoys and FRP drums. Shanker looked after his line by examining them during his fishing trips in the sea.

After 155 days of culture Shanker harvested his mussels on 14-5-1997. Because of the high

seeding rate the production per metre rope was 18 kg (Fig. 3). However, due to overcrowding, the mean size was 62.5 ± 9.9 mm and the mean weight per mussel was 16.8 g. All mussels were in fully mature state (sex ratio M 40 : F 60) and the percentage of meat content was high (37.6 %). The average count (no. of mussels/kg) was 68. The growth rate after seeding was worked out to be 8.07 mm/month.



Fig. 3. Uniform growth of mussels on rope cultured in the open sea by Mr. Shanker at Byndoor in 1996-'97

In total Shanker harvested close to 400 kg of mussels from his single line and it fetched him a price of Rs. 5,440 @ Rs. 20/100 mussels). The details of the costs and earnings of the long-line unit set up by Shanker is given in Table 1. The profit margin was higher than 144 % mainly because many of the materials used by Shanker were those already available with him.

To make the public and potential entrepreneurs aware of Shanker's achievements, a "Mus-

TABLE 1. Long-line mussel culture at Byndoor 1996-'97

Costs & earnings	
Size of line	10 m
No. of ropes/line	7 ropes
Length of seeded rope	4 m
Depth of the area	6 m
Size of seed	15-25 mm
Quantity of seed/m	>2.5 kg
a. Initial investment	
Cost of floats	Rs. 600
Cost of horizontal ropes (18 mm)	Rs. 625
Cost of vertical ropes (12 mm)	Rs. 375
Total	Rs. 1,600
b. Operational costs	
Cost of seed (56 kg)	Rs. 125
Labour charges	Rs. 250
Maintenance charges	Rs. 250
Total	Rs. 625
c. Total cost	
a + b	Rs. 2,225
Production	400 kg
Production value	Rs. 5,440
(@ Rs. 20/100 mussel count 68 in 1 kg)	
Profit	Rs. 3,215
Profit %	144

sel Harvest" function was organised by the CMFRI at Byndoor. The programme received wide coverage in the State press and radio and Shanker was interviewed on his experiences in mussel culture by the All India Radio, Mangalore.

Rack culture in estuary

Consequent to the success of long-line demonstration, rack culture of mussels was demonstrated by the CMFRI in Mulky estuary about 30 km north of Mangalore. Two sites were selected, both near the barmouth, having an average water depth of 2 m (Fig. 4). The total area of



Fig. 4. Rack culture demonstration : site 1 at Mulky estuary.

the sites was 60 m² (site = 37 m² and site 2 = 23 m²).

a) On ropes

Racks were constructed using bamboo poles during first week of November, 1996 when the salinity in the estuary rose to above 25 ppt. Mussel seeds were obtained from Someshvara, south of Mangalore and seeding (mean size: 19.2) was done as described earlier. The length of each seeded rope was 1 m and the seeding rate was 2 kg/m. In site 1, 49 such ropes were suspended. Considerable slipping of mussels took place and finally only 15 ropes had mussels distributed throughout the rope (Fig. 5). After, 208 days (6.9



Fig. 5. Rope cultured mussels grown in rack at Mulky.

months) of culture, the ropes yielded 148 kg of mussels (see Table 2 for details).

b. In net bags

Since slipping from ropes was a serious problem in the previous demonstration in the open sea, novel tubular net bags were designed to prevent slippages. Old stretchable purse seine nets having mesh size of 10 mm were cut and stitched into tubular bags measuring 10-12 cm diameter and 1 m in length. About 100 g of seeds were first placed at the bottom and 20 cm above



Fig. 6. (A) Mussels grown in tubular net bags at site 2 at Mulky. (B) Mussels attached to outer portion of the net grow well, while those inside are stunted. (C) After vertical slits are made in the nets, the retarded growth is normalised.

this a knot was made and again another 100 g of seeds was placed. Five or six such knots were made in a 1 m long bag, averaging 0.5 to 0.75 kg per metre tube bag (Fig. 6A). 153 such nets were suspended at site 1 and 2. The advantages in using net bags for seeding are :

- Seeding is very fast and less labour intensive,
- No weights need be attached as the net has comparatively less bouyancy than ropes,
- Expensive ropes need not be used and
- There is no slipping of mussels.

Within a few days the seeds got attached to the net material and assumed a ball-like shape. There was considerable accumulation of silt and epiphytic growth on the nets necessitating weekly cleaning by giving it a vigorous shake. After, 186 days of culture, the nets were harvested to yield 231 kg of mussels (Table 2). After

80 days of culture, retardation in growth of mussels in nets was noticed. This was mainly due to the lack of room for growth of mussels within the nets. Those mussels which had attached to the outer side of the nets exhibited good growth (Fig. 6b). Hence, in the 1st week of April (after 136 days) the nets were cut vertically to facilitate growth of mussels inside the net. This improved the growth rate remarkably and at harvest, the growth was almost equal to that in the case of rope (Fig. 6C & 9).

c) In cages

One MS rod cage fabricated as per CMFRI design (Project. MF/CUL/16 - G.P.K. Achary) having a total volume of 0.25 m³ with multitier racks were stocked with mussel seeds during November 1996. The mean size of the seeds was 23.9 mm and the stocking rate 60 kg/m³. The

cage was hung from one of the racks in site 1. Growth of mussels in the cage was good and as the cage became unwieldy due to its weight, a cut was made in the net to sample the mussels. This resulted in predation of the mussels by crabs and considerable stock of mussels in the cage was lost. The remaining mussels spawned in February-March and most of the seeds attached to the inner wall of the cage itself. After 207 days of culture the cages yielded 21 kg of mussels (Table 2).

Cultured mussels from the demonstration rack were harvested on 2-6-'97 in the presence of officials from the State Fisheries Department and invited press. About 400 kg of mussels were harvested (Fig. 7). Since no buyer came forward to



Fig. 7. Portion of the mussels harvested from the rack being brought to the shore.

take the produce, the entire harvest was sold to the Karnataka Fisheries Development Corporation (KFDC), Mangalore on a trial basis at a very low price of Rs. 6/kg of shell-on mussel (Fig. 8). Therefore, the economic of rack mussels culture could not be worked out.

Evaluation of growth and production

Results of the various experiments carried out are summarised in Table 2. The best growth and production rates were seen in the open sea long-line culture done by the private entrepreneur at Byndoor.



Fig. 8. Harvested mussels after weighing being loaded into KFDC truck.

TABLE 2. Evaluation of growth and production in different systems of mussel culture

Particulars	Byndoor Rope : Open sea	Mulky Rope : Estuary	Mulky Cage : Estuary	Mulky Net bag : Estuary
Date of start	7-12-'96	6-11-'96	7-11-'96	28-11-'96
Seeding rate	>2.5 kg/m	2 kg/m	60 kg/m ³	0.5 kg/net
Mean size	20 mm	19.2 mm	23.9 mm	15.7 mm
Date of harvest	14-5-'97	2-6-'97	2-6-'97	2-6-'97
Duration of culture	158 days	208 days	207 days	186 days
Mean size±std dev.	62.5±9.9	69.6±5.2	60.4±11.5	61.4±6.6
Mean weight	16.8 g	29.3 g	16.0 g	19.7 g
Percentage fresh meat	37.6	27.8	25.0	31.5
Count/kg	68	34	63	50
Total production	400 kg	148 kg	21 kg	231 kg
Production rate	18 kg/m	9.9 kg/m	84 kg/m ³	1.5 kg/net
Growth rate mm/month	8.07	7.3	5.2	7.4

However, the maximum size attained was comparatively less because of overseeding. Because of this the average count/kg was also high. Maximum size and weight were obtained in rope culture in the estuary. It was least in the cage system, mainly because most mussels in the cage were secondary settlers (note the large standard deviation). The cage system would have been a better performer had it not been for the loss due to predation.

The new net bags tried also performed reasonably well although the production rate was low per metre net. This was mainly due to the partial stunted growth after 80th day. After vertical cuts

were made, the growth of mussels improved remarkably (Fig. 9). Finally, the growth rate was comparable to that in rope culture in the estuary. This system can be vastly improved by further experimentation mainly by making the vertical cuts in the net by the end of the first month itself. The other advantages of using net bags have already been detailed.

were in ripe stage in all culture systems. Considering that harvest in the estuary was delayed by 2 weeks, it is presumed that partial spawning had taken place in the estuary leading to lesser meat weight. In the estuary itself meat weight was marginally better in net bags.

Prospects

The mussel culture demonstrations carried out by the CMFRI Research Centre at Mangalore, have captured the attention of many entrepreneurs and fishermen in the State. There is conviction among many that mussel culture ventures can be fruitfully implemented in the estuarine and open sea areas in the district. Many of them have approached the Centre for technical help on the lines that provided to Shanker of Byndoor. The BFFDA, KFDC and NABARD have evinced interest in setting up demonstration farms to further propagate the technology during 1997-'98.

Acknowledgments

The authors are very grateful to all the staff of the RC of CMFRI, Mangalore without whose unstinted help and cooperation the mussel culture demonstrations would not have been possible.

Comparison of growth

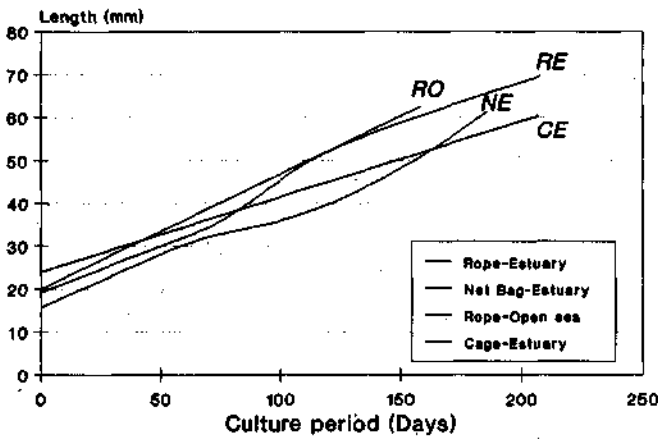


Fig.9. Comparison of growth

In the present trials the meat percentage was the highest in the open sea, while it was the lowest in the cage system. All harvested mussels