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Experimental Long-line Culture of Mussels *Perna indica* and *Perna viridis* at Andakaranazhi, South India

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Abstract

Mussels were grown on long-lines for the first time in India at Andakaranazhi, 50 km south of Cochin. A long-line unit of 20 x 20 m was moored at 10 m depth, 2 km off Andakaranazhi. One hundred seeded ropes of 4.5 to 6 m length, holding the seed of both, brown (*Perna indica*) and green (*P. viridis*) mussels were suspended from the long-line. For both the species 34 mm average length seed collected from natural grounds in October 1995 were used. The green mussel had grown to 63-87 mm, and brown mussel 63-82 mm in 6 months. The details of growth, meat yield and production rate are given in this paper. Slipping of the mussels during the later part of culture resulted in considerable loss of stock. The remedial measures for optimising the production are indicated. The potential of long-line seafarming of the mussels in India is discussed.

Introduction

Suspended mussel culture using floating rafts at Karwar, Calicut, Vizhinjam, Madras and Kakinada on the Indian coasts was highly productive leading to an average production of 10 kg of mussels per metre length of rope. (Achari, 1975; Appukuttan *et al.*, 1980). While the technology of mussel farming using rafts was highly productive in terms of production per unit area, on many occasions the rafts, being rigid structures, have either drifted away from the place of mooring or damaged due to rough conditions in the open sea. Along the mainland coast of the country, protected bays with adequate depth, which are ideal for mussel farming are absent, and open sea mussel farming by using raft poses serious problems in positioning and maintaining the farm. Long-lines, being flexible, withstand rough sea conditions than rafts. The present experiment on seafarming of mussels using longlines was taken up for testing its suitability for the west coast conditions.

Materials and Methods

The study was conducted at Andakaranazhi (9°43'N 96°17.7'E Alleppey District) a fishing village situated 50 km from Cochin The long-line unit was deployed about 2 km from the shore and the farm site was free from industrial pollution and fresh water influx. The experimental long-line unit consisted of five long-lines, each 20 m long and spaced approximately 5 m apart, kept afloat by 100 l capacity plastic barrels. The entire unit had an area of 400 m^2 and moored with 150 kg cement blocks anchors at both ends in the sea 2 km off Andhakaranazhi at 10 m depth. One hundred seeded ropes were suspended from the long-line. Mussel seed of 25-40 mm size was collected from the sea wall rocks along the Andhakaranazhi coast. Both brown, (*Perna indica*) and green mussels (*P. viridis*) were used for the experiment. The seed was removed with the help of sharp knives/scrapers, cleaned of fouling organisms and seeded to 12 mm nylon ropes with the help of knitted cotton cloth about 6 m long and 0.25 m wide. The cleaned seed was uniformly spread at the rate of 2.5 kg/m along the rope. Bamboo pegs were placed at half-metre intervals of the rope so as to prevent the mussel seed from slipping down. Granite stones weighing 2 kg were attached to rear-end of each seeded rope. The seeded mussels get attached to the ropes within 3-4 days and the cloth cover disintegrates in the seawater within 5 days. Salinity, dissolved oxygen, productivity and the biological characteristics of the mussels were monitored during the experiment, besides attending to periodic cleaning of the mussels and maintenance of the farm. As an endeavour to make the experiment a participatory programme, the people of the fishing village were involved in the experiment. A group of 15 persons comprising 8 men and 7 women were selected and involved in the entire culture operation. The group was given hands-on training in seed collection, cleaning, seeding, setting up and mooring of the farm and entrusted with the maintenance.

Results and Discussion

The salinity at the farm site ranged from 34.5 to 38.1 % o. The dissolved oxygen ranged from 3.71 to 4.92 ml/L. The gross productivity ranged from 1.34 to 6.18 mg C/ m^3 and the net productivity ranged from 0.67 to 2.17 mg C/ m^3 (Table 1).

The growth of mussels in the present experiment were high given the highly productive and conducive environment

Table 1. Hydrographic conditions at Andakaranzhi during the culture period

Month	Salinity %	Dissolved O_2 ml/l	Productivity mg C/m^3 Gross	Net
October 95	36.2	3.9	2.5	1.54
November 95	35.2	4.2	2.8	1.71
December 95	37.4	3.71	6.18	2.17
January 96	38.1	4.03	1.34	0.67
February 96	36.8	4.01	4.37	2.00
March 96	34.5	4.61	4.67	2.00
April 96	35.7	4.81	4.01	1.97
May 96	36.4	4.92	4.32	2.12

Table 2. Month-wise growth details at Andakaranazhi during the culture period.

Month	*Perna viridis*				*Perna indica*			
	Average length (mm)	Average meat (g)	Meat %	Condition index	Average length (mm)	Average meat (g)	Meat %	Condition index
Oct 95	34.3	4.80	-	-	33.9	5.2	-	-
Nov 95	35.0	4.80	47.5	83.4	38.4	5.8	40.4	65.9
Dec 95	38.3	4.84	40.5	71.7	50.2	10.6	35.5	67.1
Jan 96	53.9	3.86	31.2	61.6	61.0	17.5	28.5	66.0
Feb 96	59.1	12.00	35.0	68.4	67.1	17.4	41.7	66.5
Mar 96	70.1	25.1	36.4	80.8	72.2	29.1	40.0	72.2
Apr 96	71.2	25.5	45.5	88.6	72.6	27.5	38.9	89.7
May 96	75.1	34.0	31.1	81.3	73.2	31.6	36.0	75.3
Average monthly growth rate = 6.8mm Average total weight = 4.87g Production: Average lennth of seeded rope = 4.38m Average production/rope = 47.22kg (shell-on weight) Production/m rope = 10.73kg/m					Average monthly growth rate = 6.55mm Average total weight = 4.40g Average length of seeded rope - 4.46m Average production/rope = 52.6kg (shell-on weight) Production /m rope = 11.79kg/m			

of the open seas. The meat content was also high, ranging from 28.5 to 41.7% in the brown mussel and 31.1 to 47.5% in the green mussel during the six month period. The average monthly growth rate was only marginally higher in the case of green mussel (6.8 mm) compared to 6.55 mm in brown mussel (Table 2). In the green mussel culture experiments at Calicut in the open sea, the growth rate ranged from 10.6 to 13.6 mm/ month. The meat content ranged from 34.82 to 40.5% (Kuriakose, 1980). At karwar, the meat yield was 38.10% (Pai and Kuriakose, 1981). At Goa, the growth rate was 8 mm/month (Qasim *et al;* 1977).

The mussels were harvested in May, after six months when they had attained the marketable size of 75-80 mm. The average production (shell-on weight) for green mussel at the time of harvest was 47.22 kg per rope and production per metre of rope was 10.73 kg. The average production (shell-on weight) for brown mussel was 52.6 kg per rope and production per metre of rope was 11.79 kg (Table 2). This production rate compares favourably with the production rates achieved in suspended rope culture in many other countries. In Scotland, 25 kg mussel yield per 10 ft rope within 16 to 18 months was achieved. (Mason, 1969). In Spain a production rate of 120 kg/10 m long rope was achieved in 18 months (Milne 1972). However, in India as the present study indicates production rates of over 12 kg per metre are produced in 6-7 months as compared to the over 18 months in the temperate waters.

Similar production rates of 12-15 kg/m were achieved in the suspended raft culture of mussels in the south west coast of India. At Vizhinjam, raft culture experiments yielded 10-12 kg/m in the bay and 15 kg/m in the open sea (Appukuttan *et al* 1980). At Calicut, green mussel culture using rafts in the open sea yielded a production ranging from 4.4 to 12.8 kg/m (Kuriakose 1980). The mussels had to be harvested before May due to the onset relient of monsoon. At Karwar also, the production rate was same as in Calicut (Pai and Kuriakose, 1981). The green mussel experimental raft culture in the inshore waters of Ratnagiri, Maharashtra yielded a production rate of 7 kg/m in six months (Ranade and Ranade 1980). Culture experiments in Goa by rope culture on rafts resulted in tremendous production of 450 t/ha/year but the highly turbulent conditions of the sea during monsoon did not permit the continuation of the experiment (Qasim *et al.*, 1977). Along the east coast, attempts at suspended culture using rafts were futile due to strong wave action. Brown mussel culture using rafts at the Tuticorin Harbour Basin failed due to poor growth and slipping (Nayar, 1980). At Madras, raft culture as well as pole culture experiments were only partially successful due to severe monsoon conditions, although it was possible to produce 2 tonnes of mussel within 4 months at Kovalam (Rangarajan and Narasimham, 1980). Rope culture and bag culture using velon nettings were attempted in two areas in Andamans which yielded a production of 13-23 kg/m within five months (Soundararajan *et al.*, 1987).

The total shell-on yeild expected from the mussel farm was over 3 t. The short-fall in actual production was due to the following reasons: i) During the early phase of the experiment, due to weak anchoring and inadequate bouyancy, the seeded ropes got entangled, resulting in loss of 25% of the seeded mussels, ii) Theft of two longlines in January 1996, resulted in the loss of over 50% of the half-grown mussels from these two lines, (ii) Slipping of the fully grown mussels during the later part of the farming experiment, due to excess weight and increased turbulence of the sea necessitated the immediate harvest of the mussels.

The long-line mussel culture technology, with suitable modifications, can thus be adapted for open sea farming, particularly along the west coast. Nylon netting of 35-45 mm mesh size provided over the seed rope will prevent the seed from falling out. Thinning of the mussels during the initial stages of growth will prevent loss of mussel by fallout as a result of

overweight. Also, non-corrossive or wooden spacers must be provided at 25 cm intervals to prevent fallout out of mussels. Fibro-coated 200 lt, permanent floats will provide sufficient buoyancy and bear the load of the longlines as weight increases.

The long-line mussel culture experiment at Andhakaranazhi, involving the local people, proved that the technology is viable and can be a participatory cooperative farming programme. However, the major constraint was the conflict with traditional fishing operations. Legislative measures and participatory approach can solve these problems. A Government policy on the use of the coastal waters for farming is required. Demarcation of coastal waters as "farming zones" is necessary to promote mussel farming on commercial scale.

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