VIII

OPEN SEA RAFT CULTURE OF GREEN MUSSEL AT CALICUT

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Employing coir ropes of 5-8 m length, suspended from 6 × 5 m and 8 × 8 m teak wood rafts anchord in the open sea off Calicut at depths 8-10 m, transplanted green mussel seed (20-30 mm size) show a fast growth ranging from 10.6 mm to 13.5 mm per month reaching harvestable size of 80 mm in 5 months. A production range of 4.4 kg to 12.3 kg per metre length of rope has been achieved. Meat content ranges from 34.82-40.5%.

INTRODUCTION

India has a vast resource of green mussel along the coastal areas, but this resource still remains under-utilised. Brown mussel fishery along the Trivandrum coast and fishery for green mussel in the Malabar coast had been going on for several years past. In 1973 CMFRI initiated expermental culture of brown mussels at Vizhinjam. Later, culture of green mussel on suspended substrata in the open sea was started in 1975 at Calicut. This programme carried out at Calicut during 1975-1980 demonstrated that mussels can be grown to marketable size in a short period of 5 months by adopting rope culture technique.

ENVIRONMENTAL CONDITIONS IN THE MUSSEL FARM

The selected mussel farm area in the open sea at Calicut was an active fishing zone and free from industrial pollution and fresh-water influx from rivers. The bottom was muddy at the farm site. During the experimental period October 1975-April 1976 the surface salinity of the area varied from 32.44 to 33.68‰ while it was 31.99 to 33.45‰ over the bottom (Fig. 1). The water temperature for the same period varied from 27.44°C to 30.66°C at the surface and from 26.70°C to 30.26°C at the bottom (Fig. 2). The dissolved oxygen content of the surface water was almost uniform and the values were between 4.43 ml/l and 4.62ml/l. Slightly lower values from 3.79 ml/l were recorded at the bottom (Fig. 3). The sediment load of the surface water was negligible, while higher values were noticed at the bottom (Fig. 4). In December, the sediment load reached a peak of 4.79 ml/l when the clarity of the sea water was the lowest. Hydrographical features of the natural mussel bed at Elathur about 10 km north of

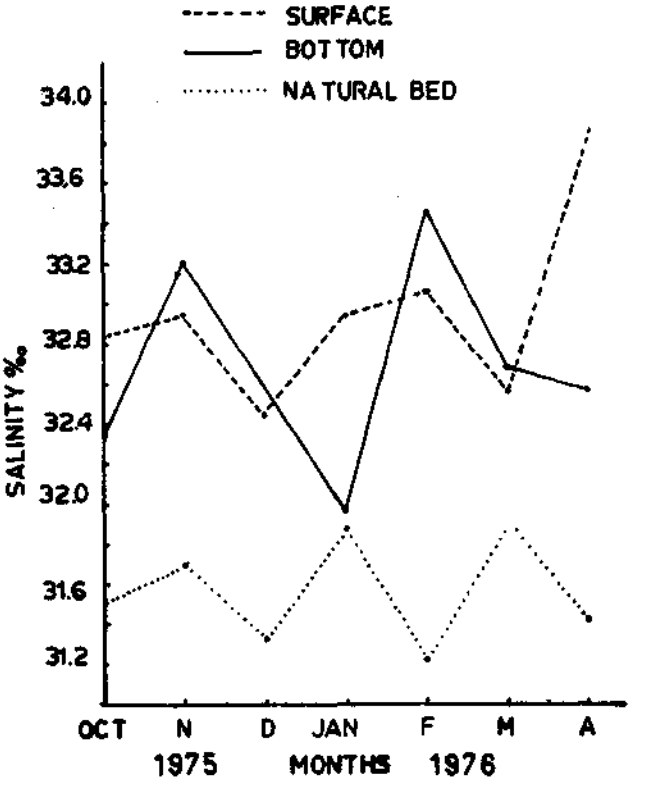

Fig. 1. Monthly average salinity at the farm site and natural bed.

farm area during this period are also presented in Figs. 1-4.

Method of Culture

Raft construction :

Rafts were fabricated using teak wood and bamboo poles lashed together with coir and nylon ropes (Plate I, Fig. A). The poles were treated with coal-tar. Each

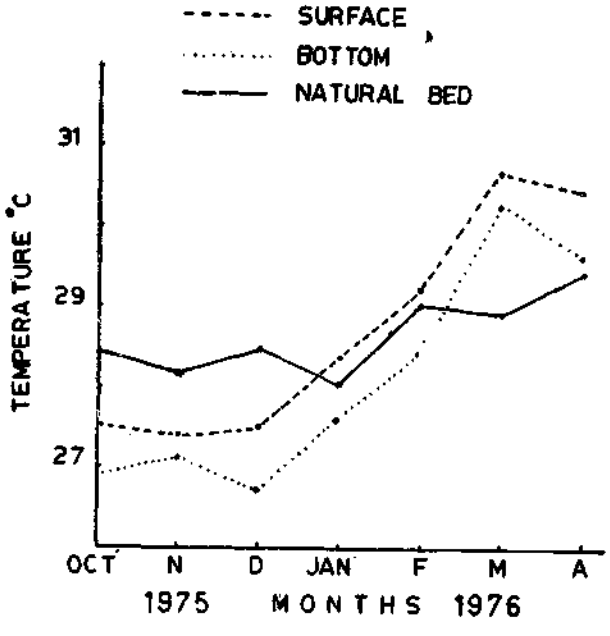

Fig. 2. Monthly average temperature at farm site and natural bed.

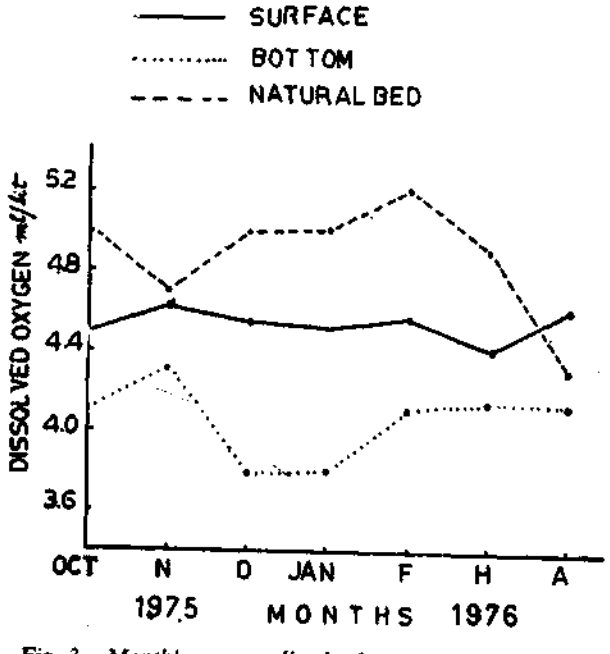

Fig. 3. Monthly average dissolved oxygen at the farm site and natural bed.

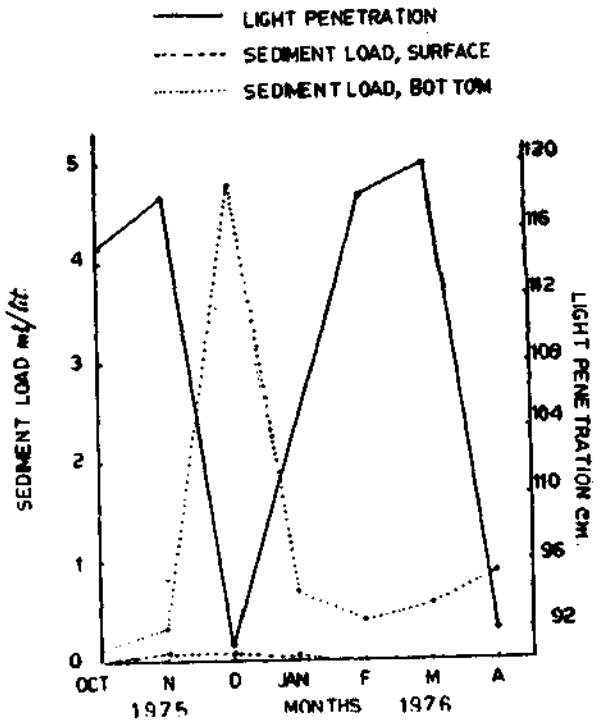

Fig. 4. Monthly average sediment load and clarity of the sea water at the farm site.

raft was mounted over five sealed empty metal drums of 200 l capacity, painted with anticorrosive paint. A few rafts were floated using high density plastic drums of 200 l capacity coated with antifouling paints. Four of these drums were fixed at the four corners and one at the centre fastened with iron bands. A few wooden planks were fixed on the raft to provide working space. Rafts of the size 6 × 5 m to 8 × 8 m were fabricated and used for the experiments. Each raft was anchored using 3 irons anchors weighing 100 kg each with iron chain links of 13 mm diameter. The rafts were ahchored at depth ranging from 8 to 10 m in the open sea about 1-1.5 km away from the shore.

Seed collection and transplantation :

The collection of seed for the culture experiments was made from a marked area of the natural bed at Elatur and Thikkodi so that periodic observations could be made on the rate of growth of mussels in that area (Plate I, Fig. B). Before transplantation, the seed were cleaned in sea water to remove the adhering mud and epifauna. The size of the mussel seed at transplantation, ranged from 20 to 30 mm. Usually 500 to 700 g of juvenile mussels were seeded in one metre length of rope. The seeds were kept around the rope and securely attached by enclosing and stitching in knitted cotton cloth of 25 cm width (Plate I, Fig. C). Coir ropes rang-

ing from 20-25 mm diameter and nylon rope of 14 mm diameter were used for growing mussels from the rafts. The seeded portion of the rope varied from 5-8 m and ropes were suspended from the rafts 0.5 to 1 m apart with the lower free end about 2 m above the bottom. The seeded mussels get attached over the ropes within two to three days and the cloth cover disintegrates in sea water in about 10 days.

Growth

During 1975-76 seed mussels with an average length of 26.7 mm weighing 1.9 g transplanted in October grew to a size of 80 mm weighing 37.3 g within a period of five months, registering an average monthly growth rate of 10.6 mm and 5.9 g in weight (Table 1 and Figs. 5 & 6). During 1977-78, the average monthly growth rate observed in the culture farm was 11.3 mm in length and

TABLE 1. *Showing the growth rate of the farm mussels* (Perna viridis)
(*The figures of length and weight are averages of* 100 *to* 200 *specimens*)

1975-1976

Months			Length mm	Total weight (g)	Shell weight (g)	Meat weight (g)	Mantle water weight (g)	Percentage of shell weight	Percentage of meat weight	Percentage of mantle water weight
November (seed)	1975	..	26.7	1.92	0.84	0.64	0.44	43.7	33.3	23.0
December	1975	..	40.6	6.60	2.55	2.53	1.52	38.6	38.3	23.1
January	1976	..	53.1	11.86	4.76	4.36	2.74	40.1	36.8	23.1
February	1976	..	62.8	18.10	6.96	6.96	4.18	38.5	38.5	23.0
March	1976	..	76.5	29.73	11.68	11.19	6.86	39.3	37.6	23.1
April	1976	..	80.0	37.30	13.75	14.95	8.60	36.9	40.1	23.0

1976-1977

November (seed)	1976	..	21.7	0.80	0.37	0.24	0.19	46.0	30.1	23.9
December	1976	..	28.8	2.00	0.77	0.77	0.46	38.5	38.5	23.0
January	1977	..	40.9	9.80	3.28	3.52	3.00	33.5	35.8	30.7
February	1977	..	52.2	11.40	4.09	4.42	2.89	35.9	38.7	25.4
March	1977	..	67.1	21.60	7.90	8.70	4.99	36.6	40.3	23.1
April	1977	..	77.0	30.20	11.20	12.11	6.89	37.1	40.1	22.8
May	1977	..	89.5	41.00	15.09	16.48	9.43	36.8	40.2	23.0

1978-1979

November (seed)	1978	..	23.6	1.10	0.50	0.40	0.20	46.0	38.0	16.0
December	1978	..	36.0	4.50	1.72	1.74	1.20	38.3	38.6	23.1
January	1979	..	50.6	9.60	3.58	3.81	2.21	37.3	39.7	23.0
February	1979	..	63.7	12.60	5.00	5.59	2.00	39.7	44.4	15.9
March	1979	..	74.9	28.60	10.67	11.40	6.49	37.4	39.9	22.7
April	1979	..	88.2	37.50	14.32	15.18	7.98	38.2	40.5	21.3

1979-1980

November (seed)	1979	..	20.4	0.90	0.37	0.33	0.24	40.6	36.3	23.1
December	1979	..	35.9	3.70	1.43	1.45	0.82	38.8	39.1	22.1
January	1980	..	50.0	9.10	3.31	3.68	2.10	36.4	40.5	23.1
February	1980	..	59.9	13.50	5.33	5.21	2.95	39.5	38.6	21.9
March	1980	..	73.6	24.10	7.49	9.01	5.59	39.4	37.4	23.2
April	..1980	..	85.0	36.40	12.88	13.21	10.30	35.4	36.3	28.3

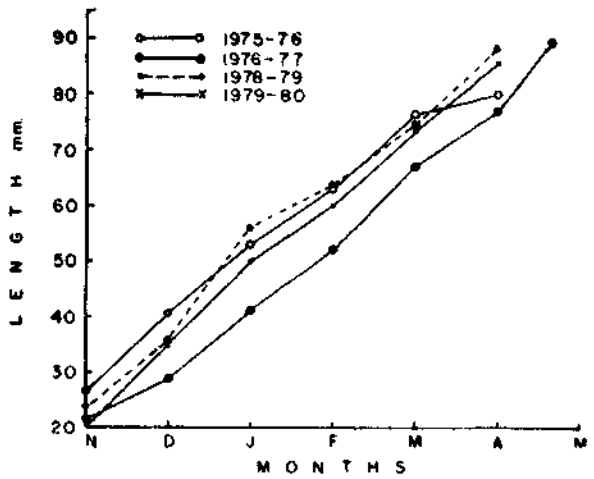

Fig. 5. Growth rate of mussels in the farm.

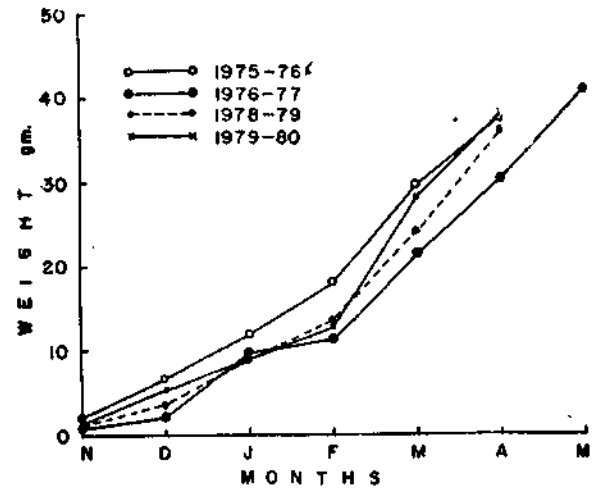

Fig. 6. Monthly average weight of cultured mussels.

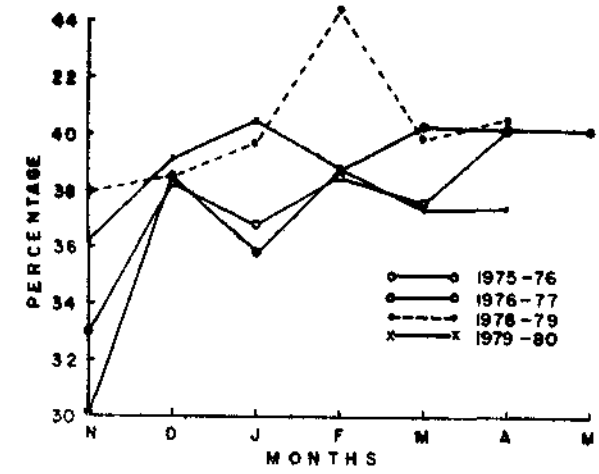

Fig. 7. Monthly average meat yield of cultured mussels.

6.7 g in weight. However, in 1978-79 the monthly growth rate observed was very high, being 13.5 mm in length and 7.3 g in weight. In 1979-80 the monthly growth rate was only 12.9 mm in length and a monthly increment 7.1 g in weight. Compared with this the average monthly growth rate of the mussels in natural bed was only 6.9 mm in length and 3.6 g in weight and 8.6 mm in length and 3.8 g in weight in 1975-76 and 78-79 respectively (Table 2 ; Figs. 8 & 9).

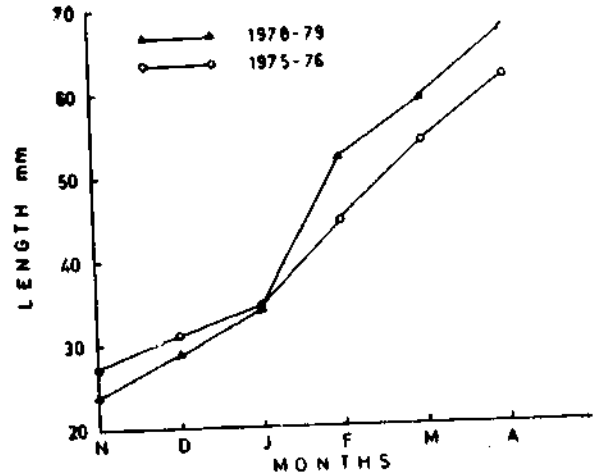

Fig. 8. Growth rate of the mussels in the natural bed.

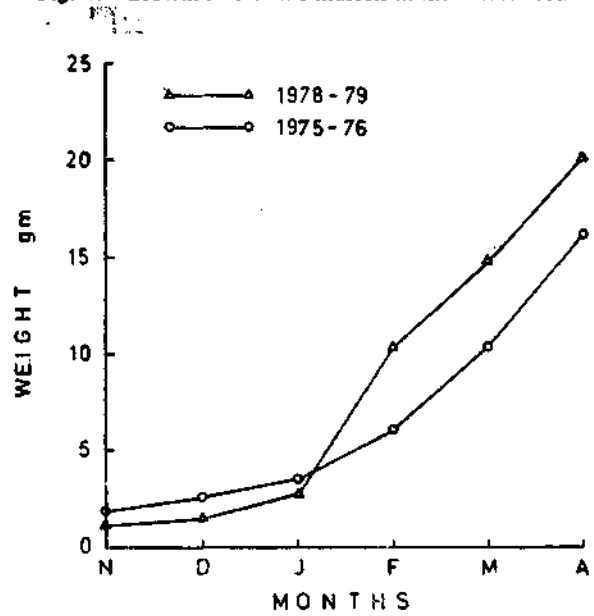

Fig. 9. Monthly average weight of mussels in the natural bed.

Fouling organism

Fouling of mussels and raft materials in the farm was a serious problem. Accumulation of silt and growth of plants over the mussels was negligible. Very often, heavy settlements of the barnacle, *Balanus amphitrite*, was observed within a period of 30 days after transplantation, the settlement being intense at the upper 2 m length of the suspended ropes. The growth of the barnacles over the shell valves was very rapid. In 1976-77, in a particular instance after 60 days, nearly

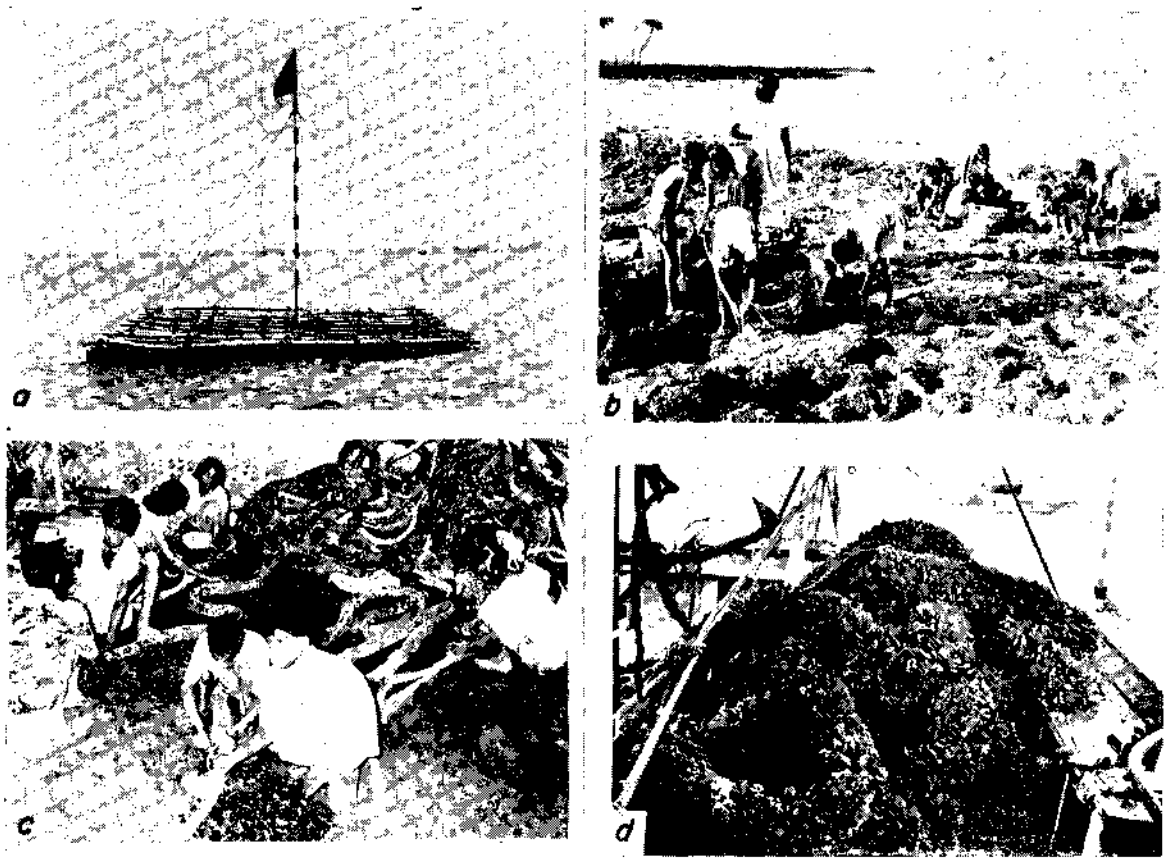

PLATE I. a. Raft used for mussel culture.
b. Collection of seeds from the natural beds.
c. Seeding of ropes.
d. Harvested mussels.

TABLE 2. *Showing the growth rate of mussels* Perna viridis *in the natural bed* 1975-76
(The figures of length and weight are averages of 100 *specimens)*

Months			Length mm	Total weight (g)	Shell weight (g)	Meat weight (g)	Mantle water weight (g)	Percentage of shell weight	Percentage of meat weight	Percentage of mantle water
November	1975	..	26.7	1.92	0.84	0.64	0.44	43.8	33.2	23.0
December	1975	..	31.2	2.49	1.10	0.82	0.47	44.2	32.9	22.9
January	1976	..	34.5	3.12	1.41	1.00	1.72	44.9	32.1	23.0
February	1976	..	44.2	6.01	2.74	1.88	1.48	45.6	31.3	23.1
March	1976	..	52.9	10.35	4.62	3.22	2.51	44.6	31.2	24.2
April	1976	..	61.7	16.16	7.23	5.01	3.92	44.7	31.0	24.3
					1978-1979					
November	1976	..	23.6	1.1	0.49	0.30	0.21	45.5	27.2	27.3
December	1976	..	28.9	1.4	0.83	0.42	0.15	58.9	29.8	11.3
January	1977	..	34.3	2.7	1.36	0.80	0.54	49.6	29.2	21.2
February	1977	..	52.0	10.3	5.1	2.80	2.40	49.2	29.4	21.4
March	1977	..	59.0	14.8	7.3	4.10	3.40	49.2	27.6	23.2
April	1977	..	66.9	20.1	9.8	5.90	4.40	49.2	29.4	21.4

202 barnacles measuring 1-9 mm, in diameter at their base (weighing 23.3 g) were found to have settled over the shell valves of a single mussel. The settlement of barnacles appeared to have adverse effect on the fast growing shell margins of the mussels. The settlement of the barnacles larvae was observed to continue during the entire period of 5 months from November to March. During November and December heavy settlement of larvae of bivalve *Mytilaster arculatula* (the marine mat forming mytilid) was noticed all over the submerged part of the raft materials and on the submerged ropes. Tubiculous polychaetes, ascidians, coelentrates and bryozoans were also common on the mussels and suspended ropes.

Production :

In table 3, the details of production from mussel culture during different seasons are given. In 1975-76, 35 ropes of 4 m length were seeded and suspended from a raft 6 × 5 m. During 1976-77, 533 ropes were suspended from 10 rafts each having 7 × 6.5 m. The seeded length of the rope was 8. In 1978-79, 2400 ropes (of 7 metres seeded length) were used for culture from rafts covering a surface area of 1650 sq. m. During 1979-80, 1000 (ropes of seeded length 6 m) were suspended from 10 rafts each of size 8 × 8 m. The production per metre length of rope in 1975-76 was 5. 1 kg using 0.7 kg of seeds. In 1976-77, from a seed weight of 0.5 kg the yield per metre length of ropes was 4.4 kg showing an increase of 9 times over the seed weight. The production was highest in 1978-79, the yield from a seed weight of 0.57 kg being 12.3 kg/m which is 21 times the initial weight of the seed used for culture (Plate I, Fig. D). The average production per metre length of rope in 1979-80 declined to 5.8 kg/m of rope, the yield being only 7.8 times of the seed weight.

TABLE 3. *Showing estimated production rate of mussels by rope culture in the open sea at Calicut*

Particulars		1975-76	1976-77	1978-79	1979-80
Total area of the rafts in the sea	..	35 sq. m	450 sq. m	1650 sq. m	640 sq. m
Total number of ropes suspended	..	35	533	2400	1000
Length of the rope seeded and suspended	..	4 m	8 m	7 m	6 m
Weight of seed used for one rope	..	2.9 kg	4 kg	4 kg	4.5 kg
Average production from one rope	..	20.25 kg	34.1 kg	86.2 kg	34.1 kg
Production per metre length of rope	..	5.1 kg	4.4 kg	12.3 kg	5.8 kg

The results indicated that ideal depth for mussel culture in Calicut region is from 8-10 m with a seeded rope of 6-7 m.

The farm mussels gave a better meat yield than the mussels from the natural bed (Fig. 7). The average edible portion of the meat in cultured mussels ranged from 34.82-40.5% whereas in the natural bed the meat yield was only 27.2 to 33.2% of the total weight (Fig. 10).

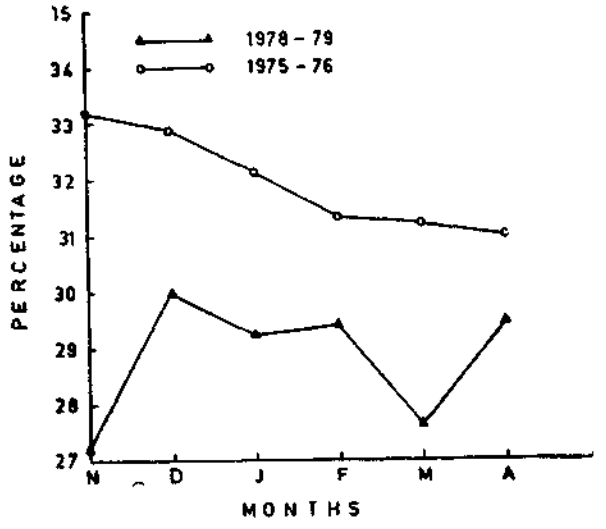

Fig. 10. Monthly average meat yield of natural mussels.

Farm Management

The collected seed can be kept alive in moist condition only upto 24 hrs. Therefore seeding has to be completed within this time. Knitted cotton cloth having a mesh size of 5 mm appears to be ideal for seeding as the above material gradually disintegrates while the mussels start growing. Periodical inspection of the farm is very important. There are possibilities of holes developing in the drums used as floats. These should be replaced immediately. The farm area should be demarcated with suitable light fitting and flags in order to avoid damage to the rafts by fishing boats operating in the vicinity, especially during night. Periodical thinning of the ropes is necessary so as to increase the growth rate of the mussels. The growth and condition of the mussels has to be observed periodically in order to take the harvest when the mussels are in the prime condition.

Remarks

The success of the mussel-farming along the south-west coast of India depends to a great extent on the type of rafts and floats and the changing weather conditions. The sea becomes rough towards the end of April and some of the rafts and harvestable mussels were destroyed in the rough weather. The metallic oil drums used for floating the rafts could withstand for only about 4 months getting corroded and developing holes, thereby causing the rafts to sink. The barrels sometimes collapse with the increase in weight of the fast growing mussels. However, it was found that high density plastic floats used during 1979-80 withstood the rough seas even after suspending 100 ropes from rafts of 8×8 m size. To avoid loss of cultured mussels it is only appropriate that the crop is harvested in April before the sea becomes rough, by which time the mussels reach the marketable size of 80 mm. The production per metre length of rope varied from 4.4 to 12.3 kg. The above results were obtained using rafts of different sizes. It was found that average production of 12.3 kg/m of rope can be achieved by adopting proper culture methods.