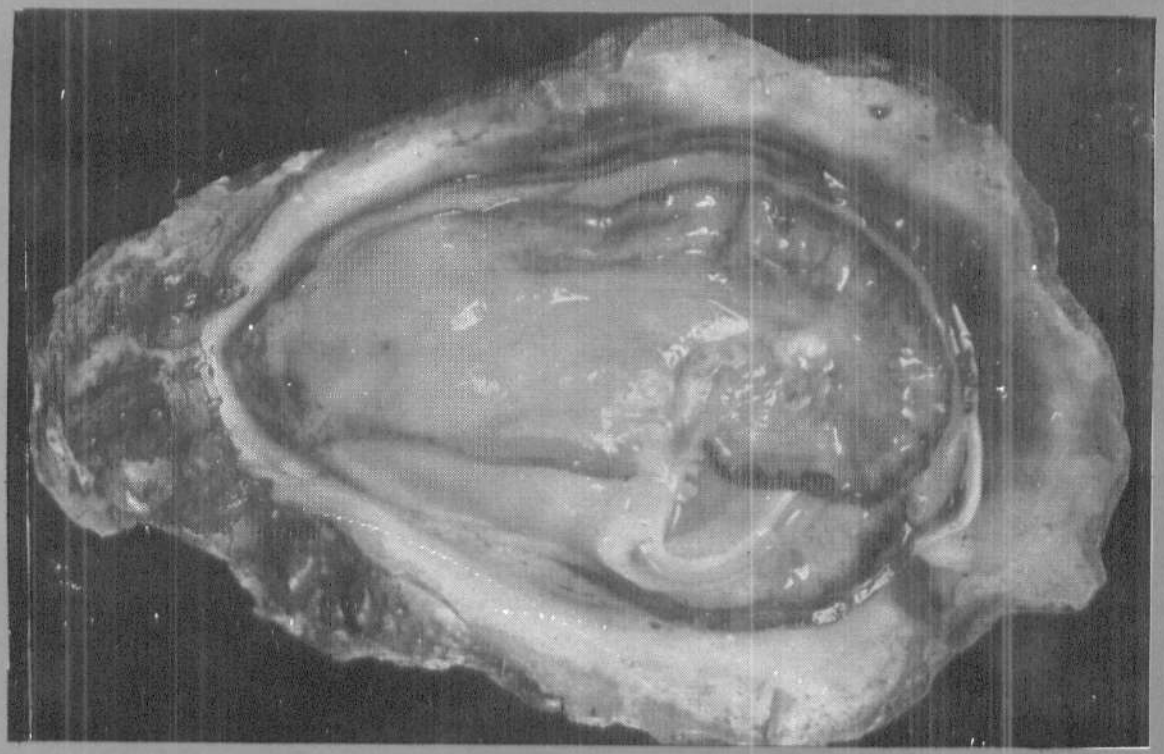
ISSN 0254-380 X

समुद्री मात्स्यिकी सूचना सेवा
MARINE FISHERIES INFORMATION SERVICE

No. 154

MAY, JUNE 1998



तकनीकी एवं विस्तार अंकावली
TECHNICAL AND EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान कोचिन, भारत
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

844 PRODUCTION AND ECONOMICS OF EDIBLE OYSTER CULTURED IN AN ESTUARINE SYSTEM OF KERALA

T.S. Velayudhan, V. Kripa and K.K. Appukuttan
Central Marine Fisheries Research Institute, Cochin — 682 014, India

Introduction

Edible oyster *Crassostrea madrasensis* locally known as "Kadal muringa" in Malayalam occurs in the intertidal zones and estuaries. They are exploited by fishermen and sold in the local market. Oyster culture is practised mainly in temperate countries and the annual world production of oyster by aquaculture was 9,52,195 tonnes in 1992. Many countries in the tropics have embarked upon programmes to develop oyster culture in view of the growing demand for oyster meat in the international market. The Central Marine Fisheries Research Institute has developed technology of oyster culture, including spat production at its Tuticorin Research Centre and recent location testing experiments have indicated that many estuaries of the west coast of India are ideal for establishing small scale oyster culture operations. In India oyster culture on commercial lines has not yet been started. The results of a preliminary study conducted in the Ashtamudi lake to assess its suitability for developing oyster culture is given by Velayudhan *et al.* (*Seafood Exp. J.*, **8** : 5-14, 1995). The encouraging results obtained in the study prompted to expand the oyster farming experiments and demonstrate the culture technology for the benefit of end users and developmental agencies. The results of these experiments are presented here. It is hoped this would encourage fishermen and entrepreneurs to adopt the technology leading to employment and income generation.

Details of experimental site

The Ashtamudi lake (Fig.1) with a water spread of 32 sq.km area has extensive natural oyster beds of *C. madrasensis* and *S. cucullata*. The presence of oyster beds and the fairly calm nature of the lake indicated that the site is suitable for oyster, culture. However, to confirm the suitability of Ashtamudi lake for commercial production of oyster, three sets of experiments were conducted during the period from October 1993 to August 1995 at Dalavapuram, 3 km interior to the bar mouth with salinity ranging from 9 to 31.5 ppt. Depth ranged from 2-3 m in high tide and the bottom was muddy. There is constant incursion of sea water to the experimental site during high tide. The area is calm, without any major fishing activities and is pollution free. The environmental details of the farm area is given in Table 1.

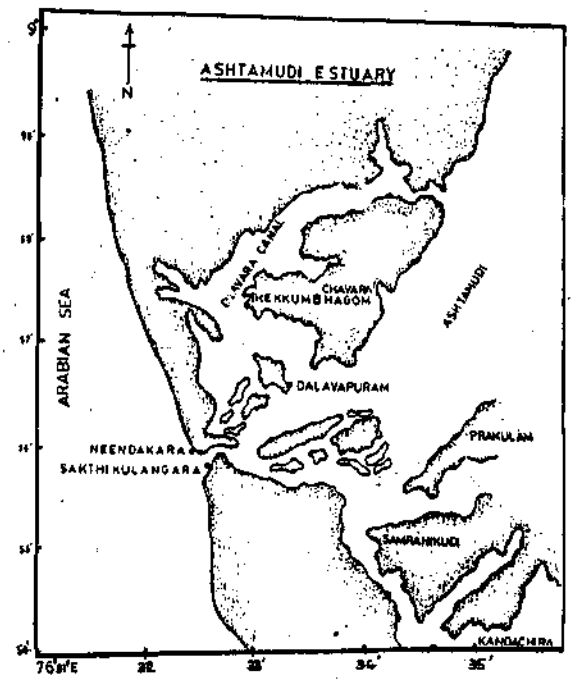


Fig. 1. Map of Ashtamudi lake showing location of the culture.

TABLE 1. *Hydrographic data of edible oyster farm at Ashtamudi lake from September 1994 to August 1995*

Month	Salinity (‰)	Oxygen (ml/l)	Temperature Atm. (C°)	Temperature water (C°)	Productivity Gross (g C/m^3/day)	Productivity Net (g C/m^3/day)	pH
Sep. 1994	14.0	4.6	31.2	28.0	2.0	0.5	7.9
Oct.	9.0	2.0	29.0	28.0	3.59	2.46	8.0
Nov.	19.0	3.0	29.5	29.8	2.05	1.03	8.8
Dec.	24.0	2.6	29.0	30.1	3.05	1.54	8.74
Jan. 1995	31.5	3.1	30.1	29.9	6.1	4.6	8.10
Feb.	31.4	3.4	30.5	28.8	5.3	4.0	7.79
Mar.	30.1	3.8	31.0	28.0	4.6	3.5	7.85
Apr.	28.0	4.1	31.2	28.2	4.4	3.1	7.77
May	24.0	3.6	31.3	23.2	8.9	1.3	7.70
Jun.	21.0	3.6	30.0	28.1	5.34	4.01	7.72
Jul.	10.0	4.0	30.0	28.0	6.68	4.67	7.66
Aug.	15.5	3.4	30.5	28.5	5.30	1.80	7.75

Experiment A

Twelve oyster rens with spat attached on oyster shells were transported from Tuticorin shellfish hatchery to Ashtamudi lake and were suspended at a depth of 2 m from the horizontal platform of a Chinese dipnet. In October 1993, at the time of initiation of the experiment, 471 spat of average length 28.2 mm were present in the 12 rens. These were cultured for a period of 11 months.

Experiment B

This experiment was planned with the objective to collect the natural oyster spat from the extensive oyster beds in the Ashtamudi lake and grow them. A total of 125 oyster shell rens, each holding 6 shells were suspended in November 1993 from this rack. A rack of 30 m length and 10 m width (Fig. 2) was constructed at a depth of

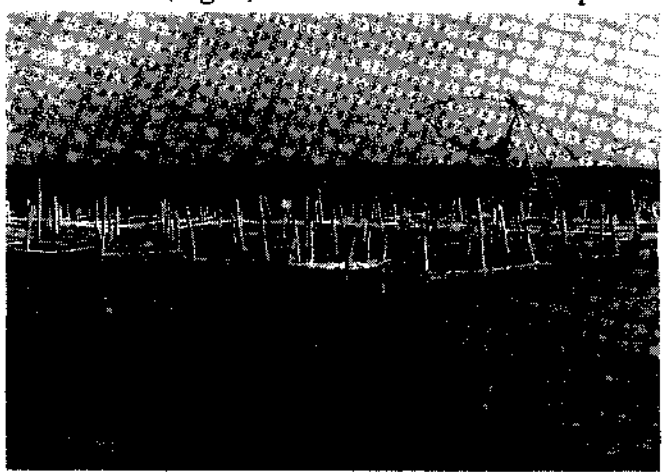


Fig. 2. A view of the oyster farm in Ashtamudi lake, Dalavapuram.

2 to 2.5 m, close to the site of the Chinese dip net platform from where the earlier experiments A was conducted. Locally available empty edible oyster shells were cleaned of all fouling organisms, a hole drilled in the centre and by using 5 mm synthetic rope the shell rens were prepared.

Experiment C

This experiment was conducted mainly to confirm the observations made in Experiment B. The oyster farm area was extended and six racks were erected on 14.12.'94 in the study area covering 0.04 ha. A distance of 2 m was maintained between each rack to provide sufficient space for working. 825 strings with 4,950 oyster shells were suspended from horizontal poles of this rack (Fig. 3).

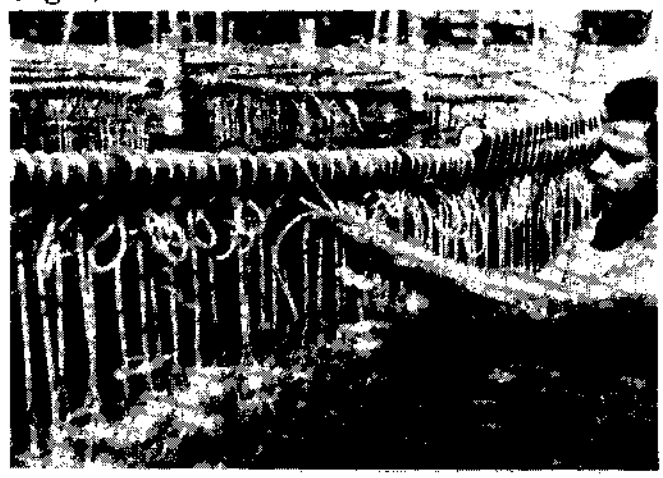


Fig. 3. Oyster shellrens used for spat collection suspended from the rack.

In the present experiment the cleaned shell rens were treated with 5 % bleaching solution for 10 mintues after removing all the epifauna to avoid the slipping of the settled spat during growth.

Sampling procedures

For studying the growth of oysters and production, rens selected randomly from the experimental farms were analysed every month. All the oysters attached to the cultch shells were detached carefully and their number noted. The separated oysters were cleaned thoroughly to remove the encrusting organisms. The growth measurements of all the oysters in the ren were taken separately and the average values calculated. The length in the dorsoventral axis was measured to the nearest 0.1 mm while the total weight and meat weight were recorded to the nearest 0.1 g respectively. Survival was estimated from the difference in the monthly average number of oyster per ren, while production was calculated based on the average total weight and meat weight obtained.

The environmental parameters of the farm area were monitored. The maturity stages of the oysters collected from the natural bed were studied to identify the spat collection period . The economics of oyster culture has been worked out based on the results of growth in experiments A, B and C while the cost involved in setting up and managing a farm as per observations in experiment C.

Growth

The oysters cultured by the ren method grew from an average length of 28.2, 24.0 and 23.2 mm to 47.8, 52.0 and 65.9 mm in 6 months in experiments A, B and C respectively. The length after 11 months was 63.9 and 68.0 mm in the first two experiments, while in the third experiment it was faster and the oysters attained an average length of 68.3 mm in 8 months. In all the three experiments, growth rate was high during the first six months than in the succeeding period. Growth details of *C. madrasensis* in experiments A and B are presented in Figs. 4 to 6.

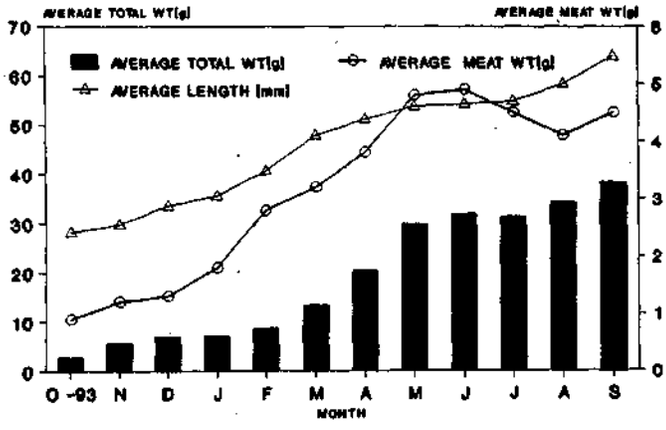


Fig. 4. Growth details of *C. madrasensis* transplanted from Tuticorin and grown in Ashtamudi lake – Experiment A.

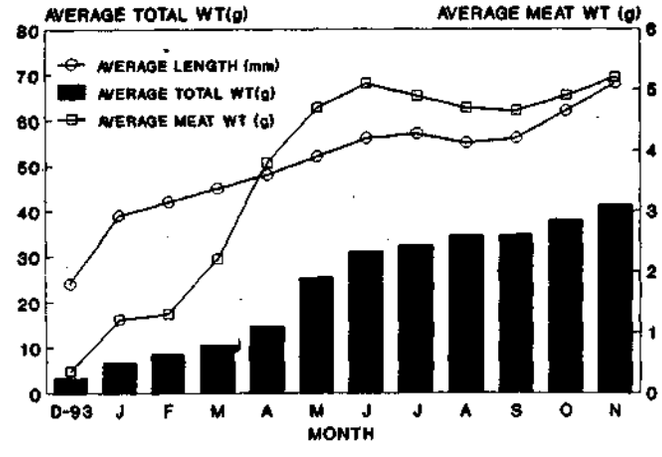


Fig. 5. Growth details of *C. madrasensis* grown in Ashtamudi lake – Experiment B.

The total weight of the oysters showed a progressive increase in all the three experiments. The average total weight of the oysters after 6 months was 13.2, 25.3 and 41.4 g in the experiment A, B and C respectively. After a culture

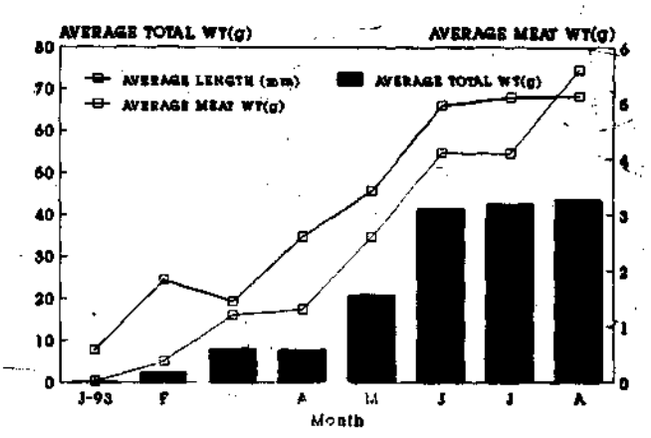


Fig. 6. Growth of *C. madrasensis* grown in Ashtamudi lake – Experiment C.

period of 12 months the total weight of the oysters increased to 38.3 and 41.3 g in the first two experiments while in the third experiment the growth was faster and the oysters had a total weight of 43.5 g in 8 months. The meat weight of the oysters showed a progressive increase during the first six months but thereafter showed wide fluctuations. In experiment A the highest value of average meat weight recorded was 4.9 g in July after 8 months while in experiment B the maximum meat weight recorded was 5.1g in July after 7 months. In the third experiment the highest meat weight was 5.6 g in August after a period of 8 months.

Survival and production

The initial density of oyster was 69 nos/metre length of ren in October 1993. In November this number was reduced to 21 oysters indicating 69.5 % mortality. From November to February there was continuous settlement of oyster spat from the natural oyster population of Ashtamudi lake, with the average number of spat per metre length of ren reaching a maximum of 65 in February. By the end of September 1994 the number was reduced to 42 per metre length of ren indicating a survival of 64.6 %.

In the second experiment the survival at the end of 12 months culture period was 56 %, since the density came down from 125 to 70 number per ren during this period. However, mortality was high during the first six months period. In the second experiment, the survival was 53.4 % after a culture period of 8 months. From the initi-

al density of 144 numbers per ren in January, there was a gradual reduction to 98 number/ren in June. In July there was fresh settlement of spat and the denisity increased to 125, which was followed by a steep decline to 77 numbers per ren in August.

Production

Production in terms of total shell-on weight in the first experiment was 1.4 kg with a total meat weight of 230 g after a culture period of 7 months from October, 1993. The average weight per ren fluctuated in the succeeding months to reach another peak, with average total weight amounting to 1.6 kg and meat weight 189 g in September. In the second experiment, the shell-on weight per ren showed a progressive increase from 296 g to 2.8 kg after a culture period of 12 months. The meat weight was maximum, (392 g per ren) after 7 months and thereafter the meat weight decreased. In the third experiment the initial shell-on weight per ren was 38.16 g in January while the final weight was 3.34 kg indicating 88 fold increase. The oyster meat weight per metre of oyster ren increased from 2.74 g in January to 431.2 g in August. However, the total shell-on weight and meat weight were the highest, 3.5 kg and 528.8 g respectively in July after 7 months of culture in the third experiment. The production per metre of oyster ren using local spat farmed at Ashtamudi lake is given in Table 2 and 3.

A total of 550 strings (1,842 t) shell-on with 230.1 kg meat was harvested (Fig. 7) on two occasions in August 1995. The remaining 275 strings with oysters were maintained in the farm for further studies.

Fig. 7. Harvested edible oyster from the experimental farm at Dalavapuram.

Spat settlement

The peak spat settlement period was observed to be from December to February in the Ashtamudi lake. In December 1993 spat settlement was high with the average number of spat per ren of 6 shells being 147.6 and per single cultch, 24.6 numbers. In January 1995 the spat settlement rate was 144/ren and 24 numbers/single cultch. Moderate spat settlement was observed in April and July on the oyster rens.

TABLE 2. *Production per metre oyster ren reared at Ashtamudi lake – Experiment B*

Month	Total number of oyster	Total shell-on wt (g)	Total meat wt (g)
Dec. '93	147	296	45
Jan. '94	137	917	160
Feb.	106	911	190
Mar.	90	945	198
Apr.	80	1,168	304
May	79	1,998	371
Jun.	77	2,387	392
Jul.	76	2,454	372
Aug.	75	2,595	352
Sept.	75	2,610	348
Oct.	75	2,850	367
Nov.	70	2,870	364

TABLE 3. *Production per metre of oyster ren farmed in Ashtamudi lake, during Experment C in 1995*

Particulars	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug
Total wt. of one ren	639.16	928.8	1,615.56	3,200.0	4,000	4,000	6,000	4,755
Total no. of oysters/ren	144	137	127	120	98	72	128	77
Total meat wt/ren (g)	74	38.27	141.28	207.33	263.20	300.96	524.80	431.2
Av. t. wt/ren (g)	38.16	328.80	1,014.73	922.80	2,044.28	3,196.8	3,520.0	3349.5

Biofouling and boring

Very heavy settlement of barnacle, *Balanus amphitrite*, tubicolous polychaete, *Hydroides norvegicus* were noted in the oyster shells. Apart from these, *Modiolus* sp. the green mussel *Perna viridis* and algae also settled on the oysters. These were removed manually from time to time. Boring by the polychaete, *Polydora ciliata* was observed in a few older oysters. There was heavy

boring by *Martesia* sp. in most of the casuarina poles used for making the racks.

Comparison of production between experiments

The total meat yield per string was comparatively high being 431.2 g in the 8 months experiment C than the maximum yield recorded in experiment B (392 g in 6 months) and in the experiment A (220 g in 7 months). The number of oysters per string was also more in experiment C and B than A. The probable reason for this difference in production can be attributed to the fact that the oyster cultches suspended in December in experiments B and C were well prepared by removing all the epifauna and were released in appropriate spat fall period.

Economics of edible oyster culture by rack and ren method in an area of 300 sq.m (30 x 10 m) of 1 unit

		Rs.
I.	**MATERIAL COST**	
	(a) Poles	
1.	Horizontal poles (6 m) 33 Nos. @ Rs. 80/pole	2,640
2.	Vertical poles (3 m) 126 Nos. @ Rs. 40/pole	5,040
	Total	7,680
	(b) Nylon ropes and oyster rens	
1.	Nylon rope for rens and racks : 15 kg @ Rs. 120/- kg	1,800
2.	Cost of 6,360 shells @ Rs. 0.10 for making 1,060 strings including cleaning charges	636
		2,436
	Total (a + b)	10,116
II.	**FIXED COST**	
1.	50 % depreciation on Rs. 7,680 (item No. I (a)	3,840
2.	Interest @ 18 % on initial investment of Rs. 10,116 (Item No.I)	1,820
	Total	5,660
III.	**LABOUR COST AND OTHER CHARGES**	
1.	Fabrication of oyster rens (1,060) @ Rs. 0.65	690
2.	Fabrication of racks	300
3.	Harvest	750
4.	Depuration @ Rs. 250/t	1,075
5.	Heat shucking including fuel cost @ Rs. 15/kg (240 kg)	5,100
	Total	7,915
IV.	**Total cost (II + III) (5,660 + 7,915)**	13,575
V.	**EXPECTED PRODUCTION : SHELL-ON OYSTERS**	4.25 t
1.	Wet meat weight (10 % of total weight)	4.25 kg
2.	Meat shucked meat (8 % of total weight)	340 kg
3.	Shell alone	3.4 t
VI.	**REVENUE**	
1.	Heat shucked meat @ Rs. 60/kg (340 kg)	20,400
2.	Value of shell @ Rs. 400/t	1,360
VII.	Total revenue	21,760
VIII.	Net profit (VII - IV) 21,760 - 13,575	8,185

Note : The actual profit can be VIII + III as the item No. III goes to the farmer himself.

In an area of 1 ha, 24 units of 300 sq. m each can be accommodated. The cost of materials indicated are based on the present market rates. Production of wet meat and shell per hectare is estimated as 10.2 and 81.6 tonnes respectively. There is good demand for shell-on oysters in the international market. In the local market the cost of 100 shell-on oysters is Rs. 25. The international export market value of 1 kg of chilled/frozen oyster meat varies from Rs.125 to 300. The demand and high price of oyster meat in the international market agree well for the expansion of edible oyster culture in the country.

Remarks

The growth of oysters in the present study is slightly less than that observed along the Mangalore coast but comparable with that of the Cochin backwater by others. The higher growth rate observed at Mangalore can be attributed to the fact that the oysters were grown in cages after removing them from the spat collector which resulted in low density and more space for growth. The feral population of *C. madrasensis* inhabiting Mulki estuary and Cochin backwater had growth similar to that observed in the present study indicating that crowding can reduce growth. The survival in the present study is comparatively high. In the Cochin backwater high mortality has been observed during the southwest monsoon period when the salinity dropped below 1 ppt. But in the present study mortality during July-September was low since salinity was above 5 ppt even during the southwest monsoon period.

The spatfall season in the Ashtamudi lake was noted to be during November-February. Purushan *et al.* (1983) recorded high spatfall during January-February while in the Mulki estuary peak settlement of spat was observed

during November-December and March-April.

The series of experiments conducted reveal that the oyster culture can be profitably carried out in Ashtamudi lake from November for a period of 7 to 8 months. The high intensity of spat-fall observed in Ashtamudi lake suggests that large scale spat collection for commercial oyster culture is possible at Ashtamudi lake.

The authors express their sincere gratitude to Mr. C. Radhakrishanan, Joint Director, Kerala State Fisheries Department for his cooperation and assistance.