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Farm Development and Management for Marine Finfish Culture at Muttukadu Near Madras

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Introduction

In recent years, an awareness has developed on the need to undertake aquaculture on scientific basis to augment increased fish production in India (Qasim, 1975; Anonymous, 1987). The scope for an organised system of marine fin fish culture in our country was realised by Hornell (1911) and thereafter development of coastal saline swamps, back-waters, estuaries, salt pans and mangrove areas for the purpose of cultivating marine fin fishes. In many maritime states, the traditional methods of farming have been suitably modified and promising results have been obtained. Pioneering attempts on marine fin fish culture were made at Mandapam, Krusadai island, Tuticorin, Madras, Calicut, Narakkal and Mangalore by the Central Marine Fisheries Research Institute (James, 1985; Mahadevan, 1985). The past experience in farming underlined the need to evolve suitable techniques for management strategies.

The success of coastal aquaculture farms would depend largely on regular daily exchange of water and at all times sufficient quantity of water in the ponds should be ensured. In India, mariculture farms are located in a wide variety of environments, ranging from enclosed ponds where water flow is regulated to open sea conditions. The coastal fish farm construction and development for marine fin fish culture has been reviewed by many earlier workers (Tampi, 1960; Evangeline, 1968; Tampi *et al.*, 1983);

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Bensam, 1985; Marichamy, 1987). Information on coastal farm development and management are still lacking which form essential prerequisites for large scale culture of marine fin fishes. The present paper deals with the farm development and management for marine fin fish culture at Muttukadu near Madras.

Material and methods

Culture ponds of the size ranging from 0.15 to 1.20 hectares numbering 28 in A, B and C series in 13 hectares area were developed out of 36 hectares as mariculture farm at Muttukadu during 1981-82 (Fig. 1). Eleven experiments under monoculture and another 11 in the polyculture systems conducted during 1983 to 1987. Milk fish, *Chanos chanos* and grey mullets *Mugil cephalus*, *Liza macrolepis*, *Liza parsia*, *Liza tade* and *Valamugil cunnesius* were collected from Adyar estuary, Kovalam backwaters and tidal pools and stocked in ponds under various combinations keeping the number of species not more than three in anyone experiment. The stocking density varied between 2,000 and 15,000 numbers per hectare for milk fish and 1 500 and 7,500 numbers per hectare for grey mullets in monoculture experiments. With regard to polyculture experiments, the stocking density ranged from 3,000 to 10,000 numbers per hectare. In some mono- and polyculture experiments, the ponds were fertilised with N.P.K. (12: 24: 12) at the rate of 200 kg per hectare to increase the fish food organisms. Periodical sampling once a month was done by drag-netting to study the growth in terms of length and weight of cultured fishes. Supplementary feeding was not given for the fish stocks. Drag-nets and cast-nets were used for harvesting the fishes in culture ponds. Hydrological conditions of the water such as temperature, salinity, dissolved oxygen, pH and water transparency were monitored in culture ponds every week during the period of experiments

Results

Farm Site Selection and Construction

Criteria for site selection would vary for different types of culture systems. For any enclosed systems, two factors are considered: (i) soil condition, and (ii) water flow and quality. Further, the basic topographical aspects of sites are related to the existing tidal regime of the area. Productivity of the water, rain water, drainage, flooding and wind force are also to be considered. One of the basic standards is the size of the ponds in which the experiments are carried out and the effect of variables on growth and production can be better determined if the pond size is standardised. In the present study, experiments are designed in small ponds to increase the growth and production. The tidal amplitude is about 60 cm in Muttukadu farm area.

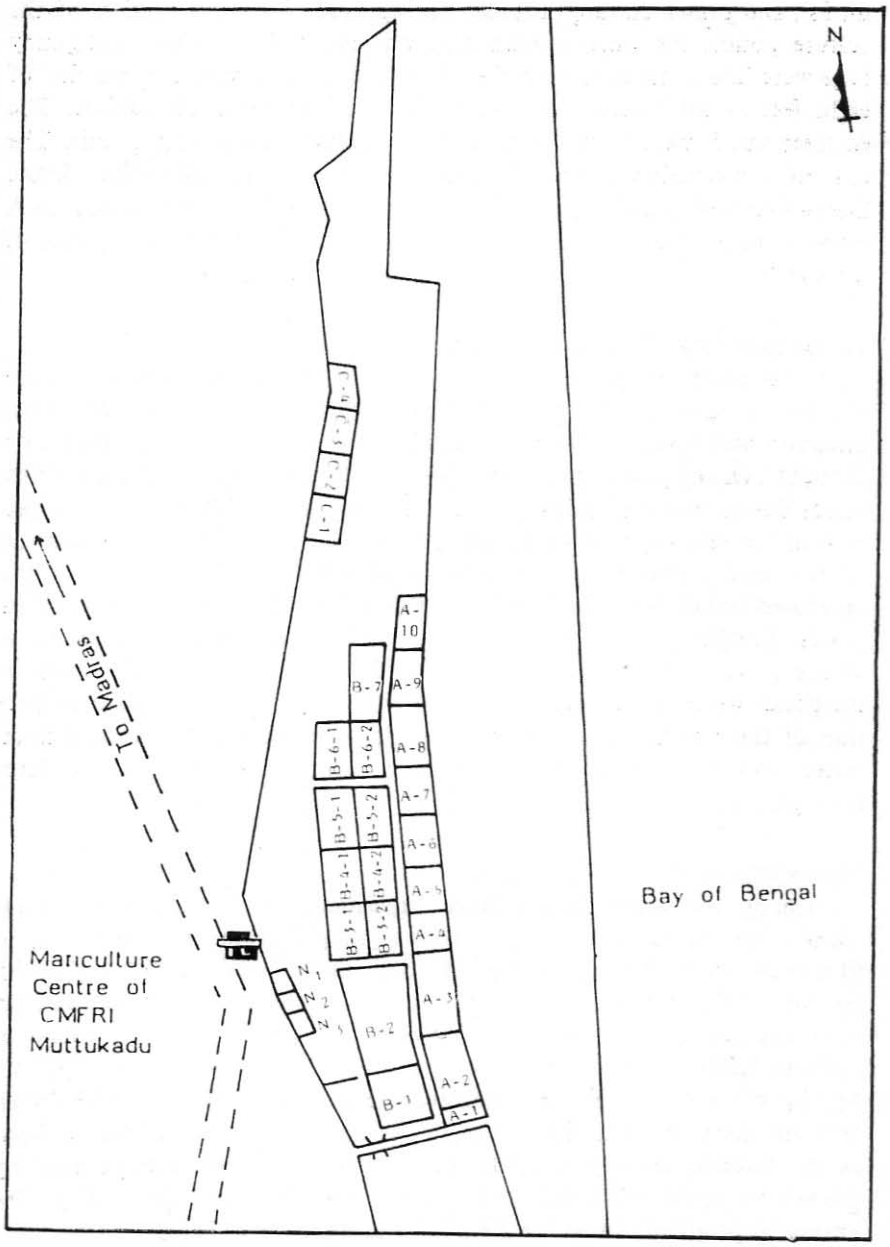

Fig. 1.

A total extent of 36 hectares salt water area at Muttukadu about 35 km south of Madras was acquired from Government of Tamil Nadu during 1981. Out of this, 13 hectares water spread area has been converted and developed into 24 ponds in A and B series for experimental marine

fin fish and prawn culture purposes during 1982. For construction of the culture ponds, the water spread area was marked and sand filled gunny bags were laid in three rows at the bottom of the soil with the breadth of eight feet at the bottom, five feet height and four feet at the surface. The earthern bunds were strengthened with soil excavated from the ponds. The cost of construction for one hectare pond was estimated as Rs 15,000. Deepening and stabilisation of the earthern bunds of the ponds in A series were carried out during 1983. Construction of four new ponds of the size 0.50 hectare each in C series was done during 1985.

Management of the Culture Ponds

In the enclosed culture systems, the major aspects of management are the bunds, sluice, pond depth and flow of water. At Muttukadu, special attention was given to the farm ponds during seasons of flooding and drought. The eroded earthern and damaged bunds of most of the culture ponds due to monsoon rains (October to December, 1983) were repaired in A and B series during April, 1984. Repair works include the excavation of the sand from inside the ponds and canal and stabilisation of the excavated sand over the bund and shaping of the bund of the culture ponds. Further, repair and reconstruction of the earthern bunds of some of the ponds were carried out during May 1986. The eroded bunds of the ponds were fnrther repaired during February 1987. A regular inspection of the bunds for any erosion or damage caused by rain and flood water was also made which form a routine activity in the farm management.

Monoculture

Among the seven monoculture experiments with milk fish, *chanos chanos*, the mean monthly growth was ranged from 14.6 mm/6.6 g to 61.0 mm/16.6 g. The estimated production rates ranged from 66 to 770 kg per year. Of the four experiments under monoculture of grey mullets, the three experiments with *Liza macrolepis* at the stocking density range of 1,500 to 7,500 numbers per hectare gave the production range of 123 to 387 kg per hectare per year. The average monthly growth varied between 19.5 mm/7.1 g and 22.3 mm/8.6 g. In the experiment with *Mugil cephalus* at the stocking density of 3,000 numbers per hectare the mean monthly growth in terms of length and weight was 41.1 mm and 12.6 g. The estimated production was 328 kg per hectare per year (Table 1).

Polyculture

In two polyculture experiments, with milk fish *Chanos chanos* and tiger prawn *Penaeus monodon* at the stocking density of 10,000 numbers per hectare, the estimated production was 140 and 364 kg per hectare per year. The estimated production varied between 199 and 752 kg per hectare per year in the other experiments. The monthly mean growth of 19.6 mm/3.0 g

Table 1. Monoculture of milk fish and grey mullets at mariculture farm, Muttukadu, Madras

Expt. No.	Pond No.	Size of the pond tra	Date of stocking	Stocking density Nos/ha	Name of the species	Initial size mm (g)	Size at harvest mm (g)	Duration of culture days	Monthly growth mm (g)	Production kg/ha/yr
1.	B-2	1.2	20.6.83	2500	*C. chanos*	36.4(0.4)	234.6(76.9)	180	33 (12.8)	96
2.	A-2	0.5	20.8.83	5000	*C. chanos*	62 (1.0)	223 (74)	330	14.6(6.6)	66
*3.	A-9	0.4	10.9.84	5000	*C. chanos*	28 (0.1)	231.1(99.3)	240	25.4(12.4)	432
*4.	B-2	1.2	15.3.86	3000	*M. cephalus*	22.6(0.2)	146 (38)	90	41.1(12.6)	328
*5.	A-1	0.1	22.3.86	7500	*L. macrolepis*	24.8(0.2)	161.2(50.2)	210	19.5(7.1)	387
6.	A-3	0.4	4.4.86	4000	*L. macrolepis*	25 (0.3)	174.2(52.1)	210	21.3(7.4)	214
7.	A-2	0.5	11.4.86	1500	*L. macrolepis*	25 (0.3)	181.4(60.3)	210	22.3(8.6)	123
*8.	A-1	0.06	11.4.86	3500	*C. chanos*	124.1(13.9)	268 (122)	180	24 (18)	770
*9.	A-3	0.06	21.5.86	3500	*C. chanos*	41.4(0.7)	231.4(91.5)	180	31.7(15.1)	546
*10.	A-2	0.12	30.8.87	15000	*C. chanos*	35.7(0.3)	92.4(9.8)	110	15.5(2.6)	355
*11.	N-3	0.017	18.8.87	2000	*C. chanos*	38.4(0.5)	178 6(38.8)	69	61 (16.6)	360

*Fertilised Pond.

Table 2. Polyculture of milk fish and grey mullets at mariculture farm, Muttukadu, Madras

Expt. No.	Pond No.	Size of the pond ha	Date of stocking	Stocking density nos/ha	Name of the species	Initial size mm (g)	Size at harvest mm (g)	Duration of culture days	Monthly growth mm (g)	Species-wise production kg/ha/yr	Total production
1.	A-1	0.15	18.6.83	5000	*C. chanos*	25 (0.1)	231.8(90.9)	180	34.5(15.1)	76	140
				5000	*P. monodon*	17.8(0.02)	135.1(17.8)	180	19.6(3)	64	
2.	A-5	0.4	18.6.83	5000	*C. chanos*	25 (0.1)	159.8(38.2)	180	22.5(6.4)	338	364
				5000	*P. monodon*	17.8(0.02)	119.4(12.8)	180	16.9(2.1)	26	
3.	A-1	0.15	12.1.84	1668	*N. cephalus*	40 (1)	256 (168)	180	36 (27.8)	172	
				1666	*L. macrolepis*	42 (1)	195 (90)	240	19.1(11.1)	90	315
				1666	*V. cunnesius*	44 (1)	168 (55)	240	15.5(6.8)	53	
4.	A-5	0.4	13.1.84	2500	*L. macrolepis*	32 (0.6)	182.1(66.1)	270	16.7(6.9)	117	199
				2500	*V. cunnesius*	40 (1)	165.2(45)	270	13.9(4.9)	82	
5.	A-6	0.4	14.1.84	2500	*M. cephalus*	45 (1)	286 (177)	180	40.2(29.3)	100	280
				2500	*L. macrolepis*	30 (0.5)	170 (60)	180	23.3(9.9)	180	
6.	B-1	0.6	19.9.84	1000	*C. chanos*	30 (0.1)	248 (126)	240	27.2(15.7)	122	
					M. cephalus	50 (1)	189 (62)	150	27.8(12.3)	127	254
					L. macrolepis	47 (1)	117 (22)	150	14 (4.2)	5	
7.	A-1	0.15	18.12.84	2500	*M. cephalus*	47 (1.1)	265 (211)	180	33 (35)	190	228
				2500	*L. macrolepis*	56 (2)	164 (70)	180	18 (8.4)	38	
8.	A-5	0.4	25.12.84	2500	*M. cephalus*	45 (0.8)	155 (50)	180	20 (13)	118	
				1250	*L. macrolepis*	26 (0.2)	134 (30)	180	18 (5)	57	294
				1250	*V. cunnesius*	44 (0.8)	139 (30)	180	15.5(4)	39	

9.	A-6	0.4	15.12.84	2500	*M. cephalus*	25 (0.2)	194 (86)	300	16.9(8.6)	183	
				1250	*L. macrolepis*	20 (0.1)	181 (75)	300	16.1(7.5)	76	268
				1250	*V. cunnesius*	15 (0.1)	118 (30)	300	10 (3.3)	18	
*10.	A-2	0.1	3.2.87	1800	*L. parsia*	57.1(2.1)	193 (70.1)	240	16.9(8.5)	87	
				1200	*M. cephalus*	51.2(1.5)	275.1(187.0)	240	27.9(23.3)	240	415
				600	*L. tade*	57.8(2)	247.5(150.2)	240	23.7(18.5)	88	
*11.	A-6	0.2	27.2.87	4500	*L. parsia*	55.9(1.9)	169.3(55.4)	240	14.2(6.7)	114	
				3000	*M. cephalus*	48.9(1.4)	253.8(150.2)	240	25.6(18.6)	541	752
				1500	*L. tade*	56.6(1.9)	193.3(68.2)	240	17.1(8.3)	97	

*Fertilized Pond.

and 16.9 mm/2.1 g was recorded in *P. monodon* in experiment in 1 and 2 respectively. The mean monthly growth ranged between 22.5 mm/6.4 g and 34.5 mm/15.1 g for *C. chanos*; 16.9 mm/8.6 g and 40.2 mm/29.3 g for *M. cephalus;* 14.0 mm/4.2 g and 23.3 mm/9.9 g for *L. macrolepis*; 10.0 mm/3.3 g and 15.5 mm/6.8 g for *V. cunnesius;* 17.1 mm/8.3 g and 23.7 mm/18.5 g for *L. tade* and 14.2 mm/6.7 g and 16.9 mm/8.5 g for *L. parsia* (Table 2).

Environmental Conditions of Culture Ponds

Monthly mean values of environmental parameters such as temperature, salinity, dissolved oxygen, pH and water transparency of the culture ponds during the period of study have been presented in Table 3. In the case of water temperature, higher values (32° to 35°C) were recorded during the month of April and May in all the years. The lower temperatures of 26° to 27°C were observed during November and December in 1983, November in 1984, June in 1985 and 1986 and January, February and December in 1987. The salinity which was above 30 per cent in September 1983 which started decreasing from October 1983 onwards and remained low throughout 1984 and 1985 not exceeding 30 per cent. The salinity started shooting up from March 1986 and remained above 35 per cent till October, 1986 and decreased slightly and rose again from April 1987. The increasing trend was registered up to October 1987 (35 per cent). By November, 1987, the salinity started decreasing and reached 17 per cent in December 1987. The dissolved oxygen values varied between 2.2 and 5.9 ml per l whereas the pH ranged from 6.8 to 8.7. The water transparency was high during January and February (50 to 73 cm) in 1984 and 1985.

Constraints

The major constraint in the pond type culture farms is water management. The mariculture farm at Muttukadu is virtually an enclosed system for most part of the year due to closure of the bar mouth and also insufficient tidal flow when the bar mouth is open. Further, exchange of water was not possible for want of sluice or inlet and outlet pipes which has resulted in extreme environmental conditions of the water, poor survival and production rates of fishes in many of the culture experiments. Flooding and breaching of the bunds of the culture ponds during the monsoon periods resulted in cultured fish stocks which made good their escape. The frequent poaching of the fish stocks in culture ponds by the local fishermen resulted in poor production. Fencing around the culture ponds and watch and ward personnels for security measures are inadequate.

Discussion

The economic feasibility of marine fin fish culture in various ecosystems has not been worked out so far. Further, there is a need to

Table 3. Monthty values of environmental parameters in the culture system

(At Muttukadu Farm, Madras)

Month	1983 Environmental Parameters					1984 Environmental Parameters					1985 Environmental Parametres				
	W.T. °C	S. ppt	Do ml/lit	PH	W. trans cm	W.T. °C	S ppt	Do ml/lit	PH	W. trans cm	W.T. °C	S ppt	Do ml/lit	PH	W. trans cm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Jan.	—	—	—	—	—	28.7-30.5	13.9-19.4	3.1-3.5	7.9-8.0	59-61	28.2-29.5	14 4-92.6	4 20-4.7	7.9-8.1	47-62
Feb.	—	—	—	—	—	29.2-30.1	14.8-16.8	2.4-3.3	8.1-8,5	56-73	30-30.6	18.2-32.5	4.1-4.0	8.1-8.5	42-50
Mar.	—	—	—	—	—	31.4-31.6	14.9-21.9	3.3-4.1	8.3-8.5	42-52	31.3-31.7	20.8-44.4	3.1-4.8	7.9-8.3	31-45
Apr.	—	—	—	—	—	34-34.7	20-22.8	4.2-5.9	8.0-8.6	42-44	32.8-33.8	26.1-70.1	4.3-5.8	7.9-8.5	20-34
May.	—	—	—	—	—	32.2-32.3	24.3-27.5	4.1-5.2	8-8.6	42-44	32.5-34.7	29.9-103.6	3.5-5.3	7.9-8.5	21-29
June	28.6-29.5	33.6-56.1	4.7-5.4	8-8.5	22-44	20.6-30	26.9-32.7	3.2-4.3	8-8.2	34-46-	26-32	23.5-58.7	3.2-5.5	7.8-8.5	33-42
July	30.3-32.4	31.1-59.8	3.8-4.6	8.1-8.3	24-49	30.3-30.6	29-30.6	3.5-4	8-8.1	40-49	29.2	26.2	3.4	8.2-	42

(Contd.)

Table 3. (*Contd.*)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Aug.	30.2-31.5	25.1-50.6	4.1-4.6	8.2-8.7	33-48	30.7-31.1	23.7-28.3	3-3.7	7.9-8.0	44-48	29.2	25.0	4.1	8.3	48
Sept.	31.5-31.8	22.5-44.2	4.3-4.7-	8.3-8.5	28-38	31-32.1	26.4-61.4	2.9-3.8	7.8-8.2	45-52	31.2	24.4	3.8	8.1	58
Oct.	29.8-30.1	18.2-30.2	4.7-5.4	8-8.4	33-54	29.4-31.5	17.5-34.6	4.1-4.7	7.9-8.2	54-61	31.1	23.8	3.9	8.6	51
Nov.	27.4-28.0	14.3-22.8	4.6-4.8	8.4-8.6	32-57	27.5-28.3	12.1-18.9	3.4-4.9	6.5-7.9	45-72	—	—	—	—	—
Dec.	26,1-28.8	14.9-26.9	4.9-5.2	8-8.5	47-52	29.5-29.8	13-29.7	3.9-4.8	9.5-7.8	45-54	—	—	—	—	—

Table 3 (*Contd.*)

Month	1986 Environmental Parameters					1987 Environmental Parameters				
	W.T.	S	Do	PH	W. trans	W.T.	S	Do	PH	W. trans
	°C	ppt	ml/lit		cm	°C	ppt	ml/lit		cm
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
Jan.	—	—	—	—	—	27.5	35.5	4.1	7.9	33.5
Feb.	—	—	—	—	—	27.5-30.5	29.5-40.1	3.5-4	8.9-	29.5
Mar.	30.6-32.5	28.1-34.2	3.1-3.8	8-8.3	23-35	30-32.4	30-32.5	3.7-4	8.1-8.4	—
Apr.	33.1-35	34-36.2	3.7-4.4	7.4-7.6	28-12 32.5	32-32.5	33.4-36	3.2-3.3	8-8.1	11-19
May	31-32.2	26.3-41.2	2.9-3.2	7.6-7.9	30-31	32.8-33.3	36.3-40.8	2.8-3.2	7.9-8.1	16-27
June	27.2-30.5	39.9-42.5	2.2-2.3	7.1-7.3	34-35	30.8-31.8	47.2-51.6	4.1-4.2	8-8.3	10 22
July	28.4-29	36-43.9	2.4-2 8	—	28-35	31.6-32.5	36.6-45	3.3	7.9-8.5	22-23
Aug.	20.3-31.9	38.6-39.9	2.5-3.5	7.8-7.9	36-39	30.5-33.3	34.6-43.9	2.8-2 9	8-8.2	19-25

(*Contd.*)

Table 3 (*Contd.*)

	17	18	19	20	21	22	23	24	25	26
Sept.	29.7-30.6	39.2-41.8	2.5-3.1	7.7-7.8	42-44	31.5-32	35.1-44.7	3-3.3	8.0	30-35
Oct.	29.2-29.5	37.1-39.5	3.7-3.8	7.8	44-54	31.9-33.3	36.9-47.7	3.5-3.8	8-8.1	—
Nov.	28.4-20.6	29.5-30.3	4.4-4.5	7.8-7.9	41-44	29.2-92.3	29.3-29	3-3-3.4	8.2-	—
Dec.	—	—	—	—	—	27	17.3-20.9	3.9-4.1	8.2-8.7	—

identify and propagate selected fast growing species for culture under different conditions. Hence, the present fin fish culture experiments conducted in the ponds at Muttukadu farm have thrown light on the assessment of the production capabilities of different methods.

The stocking density followed in the experiments is very low when compared to the earlier workers. The stocking density under the monoculture system for milk fish was below 5,000 per hectare, excepting one experiment. This is one of the reasons for the low production recorded in the present experiments. The average monthly growth of 14.6, 15.5, 24, 25.4, 31.7 and 33 mm recorded for milk fish in different experiments compares well with the earlier workers, (Devanesan and Chacko, 1944; Chacko and Mahadevan, 1956; Tampi, 1960; Mohan and Nandakumar, 1981; Mohanraj *et al.* 1983, and Nammalwar and Kathirvel, 1987. The mean monthly growth of 61 mm length and 16.6 g weight observed in one of the experiments is due to lower salinity. The average monthly growth of 15.5 mm 2.6 g in the tenth experiment (Monoculture) was because of higher stocking density of 15,000 numbers per hectare and high salinity (44.59 ppt). The production of 335 to 770 kg per hectare per year recorded for milk fish in the fertilised ponds can be matched with the production of 318 and 857 kg per hectare reported by Bensam and Marichamy (1981).

In the present monoculture experiments with the grey mullets the stocking density ranged from 1,500 to 7,500 per hectare in contrast with the stocking density of 20,000 to 50,000 numbers per hectare followed for *V. seheli* and *L. vaigiensis* by James *et al.* (1985) and 12,500 to 2,00,000 per hectare for *M. parsia* (FAO, 1974 and 1975). Johnson (1954) reported a production of 143 kg per hectare of mullets in a fertilised pond. James *et al.* (1985) have reported the production of 569 kg per hectare for *L. vaigiensis* and 59 to 782 kg per hectare for *V. seheli.* The production of 123 to 387 kg per hectare per year was recorded in the present monoculture system.

In the coastal tanks of West Bengal, a net production of 140 to 200 kg per hectare was obtained in the polyculture system (Pakrasi *et al.*, 1975). Sivalingam (1975) has stated that the pond in which mullet fry were stocked, yielded 220 kg per hectare with fertiliser or supplementary feed. In the present experiments, the production of 415 to 752 kg per hectare per year in the fertilised ponds is obtained under the polyculture system. Pillai *et al.* (1985) have recorded, a mean monthly growth of 6 and 12 mm in *L. parsia* and *L. tade* respectively in a low saline pond. In the present experiments the mean monthly growth of 14.2 to 16.9 mm lengths and 6.7 to 8.5 g weight and 17.1 mm 8.3 g to 23.7 mm 18.5 g was recorded for *L. parsia* and *L. tade* respectively. For *L. macrolepis* in the polyculture system, the mean monthly growth has been reported as 28.2 mm by Ramamurthy *et al.* (1978) and 14.9 mm by Marichamy *et al.* (1980). In the present study, the average monthly growth of 14 to 23 mm has been recorded for that species.

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