MONOCULTURE OF GREY MULLETS IN COASTAL SALTWATER PONDS AT MANDAPAM

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ABSTRACT

The paper gives the results of a set of six monoculture experiments attempted on mullets, *Liza vaigiensis* and *Valamugil seheli*, fed on artificial diet composed of rice bran and groundnut oilcake in equal proportions at a rate of 5-10% body weight. The experiments were conducted in saltwater ponds at Mandapam and covered in all a period of three years. *L. vaigiensis* stocked at an estimated density of 50000|ha yielded at the rate of 569|kg|ha|year with the survival estimated at 72.9%. *V. seheli*, which was dealt with in all the subsequent five experiments, with stocking densities varied from 22000 to 40000|ha, has given a yield varying from 59 kg|ha|315 days to 782 kg|ha|265 days, with survival rates varying from 18.3 to 81.2%.

INTRODUCTION

That the mullets have high rates of growth, together with that they tolerate wide ranges of environmental parameters, makes them highly attractive for culture purposes. Various forms of mullet farming are being practised. In Philippines, the possibility of raising mullet together with milkfish in the brackishwater ponds was first suggested by Adams et al (1931). In Egypt, successful stocking of *Mugil cephalus* and *Mugil capito* in Lake Qarum had been carried out as early as in 1921 (Faouzi 1936). Lin (1940) had reported on the culture of carps together with grey mullets in brackishwater ponds in Hong Kong. Reference to mullet farming in U.S.A. is given in the U.S. Fish and Wild Life Service (Anon, 1940). In Israel and Taiwan, mullets are reared with carps and *Tilapia* spp. in polyculture system in freshwater ponds (Korringa 1976, Chen 1976). Culture of *Liza subviridis* in Malaysia has been mentioned by Chen (1977). Mullets are the principal fish cultured in the 'Valli' system operated in bays and lagoons along the Adriatic coast of northern Itlay (Ravagnan 1978). Polyculture experiments with *M. curema*, *M. brasillensis* and various species of Gerridae in mangrove ponds near Recife, Brazil, were discussed by Cavalcanti et al (1978).

In India, culture of mullets with other finfishes and prawns is being carsied out traditionally in the states of Tamil Nadu, Kerala and West Bengal. Research in intensive culture began when rearing experiments with young mullet were conducted in Madras at the Fisheries Department farm at Ippur (Campbell 1921, Hornell 1922) and at Chingleput Fort moat fish farm (Gravely 1929). Improvements for the brackishwater farming of mullet in the Gangetic delta were suggested by Hora and Nair (1944). Basu (1946) recommended for the adoption of Chinese and Philippine methods of culture in Bengal farms. Pillay (1947) described its culture in West Bengal, Madras and Kerala. Jhingran et al (1970) indicated the possibility of introducing polyculture of Indian major carps together with mullet and other commercially important euryhaline species, viz., milkfish and prawns, in low-saline waters. Experiments conducted on the monoculture of *M. parsia* and *M. tade* at the brackishwater fish farm at Kakdwip have also been reported (FAO 1974, 1975). Pakrasi et al (1975) refers to the role of grey mullets in polyculture in coastal tanks of West Bengal. Results of culture trials with *Liza* species in the Sunderbans mangrove region of West Bengal have been reported (ICAR, 1978), which are indicative of the potentialities of mangrove ponds for intensive mullet farming.

The present paper deals with the results of a series of experiments conducted during the period 1979-82 on monoculture of grey mullets, *Liza vaigiensis* and *Valamugil seheli*, with different stocking densities, to know the fish productivity of saltwater ponds.

Material and Methods

Pond preparation: Earthen ponds, each of an area of 225 sq.m., of the marine fish farm along the Palk Bay were used for the experiments. The bunds of the ponds were turfed. The pond bottom was mostly sandy with an admixture of clay. The ponds were first drained completely to eradicate the undesirable fishes and other aquatic weeds and then allowed to dry. Seawater was directly pumped into the ponds through pipelines. Water level was maintained at 50-75 cm throughout the rearing periods.

Seed collection and transportation: The grey mullet seed (*L. vaigiensis*, 25-75 mm, for experiment I and *V. seheli*, 34-60 mm, for experiments II to VI) were collected from Thonithurai and Pillaimadam in Palk Bay and from Manauli Island in Gulf of Mannar during May-August, using a drag net made out of nylon mosquito net. The seed were transported in fibreglass tanks with adequate quantities of seawater.

Stocking: The ponds were stocked with 1125, 700, 500, 500, 700 and 900 fingerlings (at stocking densities 50000, 31000, 22000, 22000, 31000 and 40000/ha), respectively for the experiments I to VI. Experiment I began in

April 1979. Experiments II and III were initiated respectively in June and September 80 and experiments IV, V and VI during September 81. The respective mean sizes of seed for experiments I to VI, at the time of stocking, were 58 mm (3.3 g), 34.6 mm (0.6 g), 60.4 mm (3 g), 57.2 mm (2.4 g), 57.1 mm (3.3 g) and 54.9 mm (3 g).

Feeding: The fish in all the ponds were fed once a day with an artificial feed composed of rice bran and groundnut oilcake in equal proportion, at the rate of 5-10% of the body weight.

Sampling: Regular sampling was done once a month in all the ponds to observe the growth of the fish. About 10% of the stock in each pond was netted out for taking length and body-weight measurements and were released back into the ponds immediately. The fish were grown for periods of 265 to 365 days.

Salinity, dissolved oxygen and water temperature were recorded at regular intervals throughout the culture period (Fig. 1).

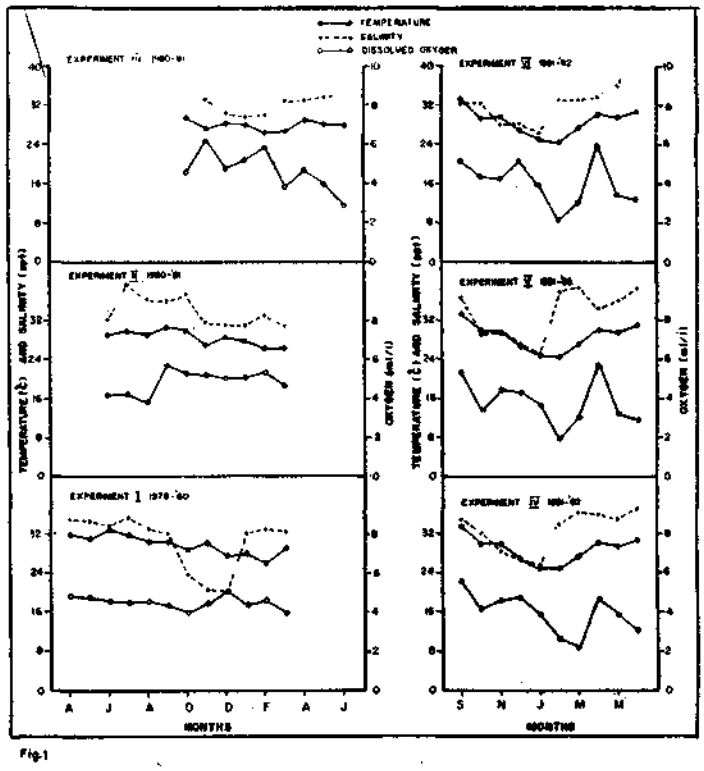

FIG. 1. Hydrological conditions in the culture ponds.

RESULTS

Experiment I: Preliminary observations regarding the stocking size, density and the monthly average growth up to October 79 are already presented by James et al (1980). Further studies have revealed that *L. vaigiensis* attained an average size of 99.9 mm and weight of 15.6 g in 12 months. The harvested fish ranged between 82 mm and 128 mm in length with about 45% above average. Comparatively, the growth was found to be better during the first, second, eighth, eleventh and twelveth months of rearing. The monthly mean growth was 3.5 mm (1.02 g). The calculated production was 569 kg|ha with a survival rate of 72.9%.

Experiment II: The average size attained by *V. seheli* was 60.7 mm (4.7 g), 72.2 mm (6.9 g), 78.3 mm (8.2 g), 87.5 mm (10.2 g), 97.8 mm (12.6 g), 105.9 mm (18 g), 117.6 mm (21.7 g), 142 mm (37.8 g) and 144.8 mm (39.8 g) in 30, 60, 90, 120, 150, 180, 210, 240 and 265 days, respectively. Growth was better during first, second and eighth months.

On 9-3-81, most of the fish died as a result of sudden oxygen depletion (0.675 ml|l). About 142 dead mullets were collected. The remaining stock was harvested on 12-3-81 (on completion of 265 days). The harvested fish

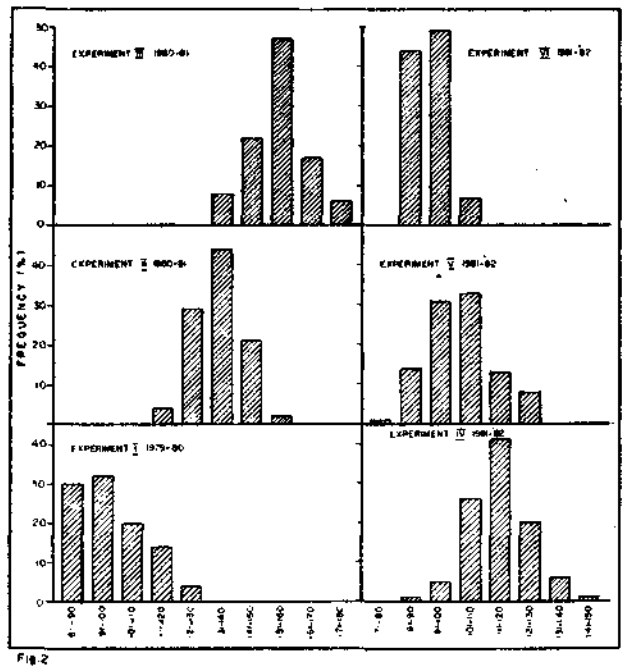

FIG. 2. Size groups of harvested mullets in the culture ponds.

ranged from 118 mm to 163 mm in length and 10 to 60 g in weight. The overall monthly average growth increment was 12.6 mm in length and 4.4 g in weight. About 14.5% of harvested fish had grown beyond the average size. The production per hectare was 444 kg with a survival rate of 36%.

Experiment III: The progresses in growth during 30, 60, 90, 120, 150, 180, 210, 240 and 265 days were 72.6 mm (5.2 g), 86.8 mm (8.7 g), 97.8 mm (12.8 g), 108.2 mm (16.6 g), 119.5 mm (22 g), 128 mm (29 g), 137.2 mm (35 g), 147.8 mm (40 g) and 154.9 mm (43.5 g). From the sixth to the seventh month increase in weight, rather than in length, was noticed.

The rate of production after a rearing period of 265 days was 782 kg|ha, with a survival rate of 81.2%. The size range at harvest in June 81 varied between 135 mm (20 g) and 175 mm (70 g), and about 55% of the fish have grown beyond the average size. On the whole the monthly mean growth was 10.8 mm (4.5 g).

Experiment IV: The fish grew to 63.3 mm (3.4 g) in 30 days, to 64.5 mm (3.7 g) in 60 days, to 67.7 mm (5 g) in 90 days, to 68.6 mm (5.2 g) in 120 days, to 76.7 mm (6.7 g) in 150 days, to 83.9 mm (7.7 g) in 180 days, to 92.5 mm (10 g) in 210 days, to 102.4 mm (13.3 g) in 240 days, to 110 mm (15 g) in 270 days and to 114.9 mm (16.6 g) in 315 days.

The stock was harvested in July 82, on completion of 315 days' rearing. The length of the harvested fish ranged from 89 to 146 mm. The overall monthly mean growth was 5.5 mm in length and 1.4 g in weight. The production and survival rates were 135 kg|ha and 44.6%, respectively. About 56% of the harvested fish grew beyond the average size.

Experiment V: The average sizes recorded were 74.4 mm (7.8 g), 89.7 mm (10.4 g), 90.7 mm (11.1 g), 91.7 mm (11.8 g), 92.5 mm (12.4 g), 93.6 mm (13 g), 96.9 mm (14 g), 98.4 mm (15.1 g), 100.2 mm (17 g) and 102.8 mm (19.1 g) in 30, 60, 90, 120, 150, 180, 210, 240, 270 and 315 days respectively. Thus the monthly average growth increment was found to be 4.4 mm (1.5 g).

The fish were harvested in July 82 on completion of 315 days. The production rate was 164 kg|ha with a survival rate of 48.1%. The harvested fish ranged from 75 to 127 mm in length and about 48% of the fish have grown beyond the average size.

Experiment VI: The average size recorded was 66.1 mm (8 g), 75.6 mm (8.2 g), 82.1 mm (8.4 g), 83.1 mm (8.6 g), 83.2 mm (8.7 g), 83.5 mm (8.9 g), 83.9 mm (9 g), 84.6 mm (9.1 g), 88.3 mm (10.1 g), and 91.8 mm (13.2 g) in 30, 60, 90, 120, 150, 180, 210, 240, 270 and 315 days, respectively. The rate of growth per month was 3.5 mm in length and 1 g in weight.

Fish were harvested in July 82 after a period of 315 days. The rate of production was 59 kg|ha with a survival rate of 18.3%. 51% of the harvested fish have grown beyond the average size.

(Particulars of stocking and harvesting and growth of fish are summarised in Table 1 and 2). Experimentwise size groups of harvested fish are depicted in Fig. 2.)

TABLE 1. *Particulars of stocking and harvesting of grey mullets*

	Liza vaigiensis	*Valamugil seheli*				
	Expt. I (1979-80)	Expt. II (1980-81)	Expt. III (1980-81)	Expt. IV (1981-82)	Expt. V (1981-82)	Expt. VI (1981-82)
Area of the pond (Sq.m.)	225	225	225	225	225	225
Total No. of seeds stocked	1125	700	500	500	700	900
Rate of stocking (No.|ha)	50000	31000	22000	22000	31000	40000
Average length at stocking (mm)	58	34.6	60.4	57.2	57.1	54.9
Average weight at stocking (g)	3.3	0.6	3.0	2.4	3.3	3.0
Culture period (Days)	365	265	265	315	315	315
Average length at harvest (mm)	99.9	144.8	154.9	114.9	102.8	91.8
Average weight at harvest (g)	15.6	39.8	43.5	16.6	19.1	13.2
Mean length|month (mm)	3.5	12.6	10.8	5.5	4.4	3.5
Mean weight|month (g)	1	4.4	4.5	1.4	1.5	1
Total Nos. recovered	820	252	406	223	337	165
Survival rate (%)	72.9	36	81.2	44.6	48.1	18.3
Production (kg|ha)	569	444	782	135	164	59

DISCUSSION

In other countries mullets are usually cultured mixed with other finfishes. Pruginin and Kitai (1957) and Yashouv (1968) had suggested that it is fairly good to introduce mullet or *Tilapia* spp. as secondary fish in the medium-sized carp ponds in Israel. Chen (1976) stated that there is virtually no monoculture of grey mullet *M. cephalus* in Taiwan as the fish is nearly always raised along with Chinese carps and other freshwater fishes. In India, some experiments had been conducted on the monoculture of *M. parsia* and *M. tade* at the brackish-water fish farm in Kakdwip (FAO 1974, 1975). An attempt was made at

TABLE 2. *Particulars of growth of fish in culture experiments*

Duration (month)	*Liza vaigiensis*		*Valamugil seheli*									
	Expt. I (1979-80)		Expt. II (1980-81)		Expt. III (1980-81)		Expt. IV (1981-82)		Expt. V (1981-82)		Expt. VI (1981-82)	
	Leng. (mm)	wt. (g)	Leng. (mm)	wt. (g)	Leng. (mm)	wt. (g)	Leng. (mm)	wt. (g)	Leng. (mm)	wt. (g)	Leng. (mm)	wt. (g)
Apr	58.0	3.3										
May	65.4	5.5										
June	78.3	7.9	34.6	0.6								
July	72.2	8.1	60.7	4.7								
Aug	78.6	8.3	72.2	6.9								
Sept	80.2	8.5	78.3	8.2			57.2	2.4	57.1	3.3	54.9	3.0
Oct	82.5	9.2	87.5	10.2	60.4	3.0	63.3	3.4	74.4	7.3	66.1	8.0
Nov	85.2	12.3	97.8	12.6	72.5	5.2	64.5	3.7	89.7	10.4	75.6	8.2
Dec	87.8	13.0	105.9	18.0	86.8	8.7	67.7	5.0	90.7	11.1	82.1	8.4
Jan	89.5	13.5	117.6	21.7	97.8	12.8	68.6	5.2	91.7	11.8	83.1	8.6
Feb	92.8	13.8	142.0	37.8	108.2	16.6	76.7	6.7	92.5	12.4	83.4	8.7
Mar	99.9	15.6	144.8	39.8	119.5	22.0	83.9	7.7	93.6	13.0	83.5	8.9
Apr					128.0	29.0	92.5	10.0	96.9	14.0	83.9	9.0
May					137.2	35.0	102.4	13.3	98.4	15.1	84.6	9.1
June					147.8	40.0	110.0	15.0	100.2	17.0	88.3	10.1
July					154.9	43.5	114.9	16.6	102.8	19.1	91.8	13.2

Mandapam on the culture of grey mullets, *L. vaigiensis* and *V. seheli,* in the monoculture system of farming primarily because the seed of these fishes are in abundance to collect in the adjacent Palk Bay and Gulf of Mannar. Because of the very slow growth rate that was recorded in *L. vaigiensis* in experiment I, the subsequent experiments were all confined to culturing *V. seheli.*

The stocking densities of mullets discussed by many workers are not helpful for comparison as they have been discussing based on polyculture systems wherein mullet formed one of the components. In the present study, on monoculture system, the stocking density followed was 50000|ha for *L. vaigiensis* and 20000 to 40000|ha for *V. seheli* in contrast to the stocking density of 1850|ha Yashouv (1972) had experimented with in the case of *M. cephalus* under monoculture systems in Israel. Chen (1976) followed a stocking density of 4000 to 10000|ha in the monoculture of *M. cephalus.* In the experiments in the brackishwater fish farm at Kakdwip, stocking densities of 12500, 200000 and 40000|ha for *M. parsia* and 6000|ha for *M. tade* were employed in monoculture system (FAO 1974, 1975). Comparing these different stocking densities, ours was on a much higher side, which may be the reason for the slower growth we have recorded in the present study.

Luther (1967) had stated that most of the species of grey mullets grew better in the culture ponds than in the natural environment. Liao et al (1972) reported that the 54-day old hatchlings of *M. cephalus* obtained by artificial propagation that he introduced in a brackishwater pond reached a size of 20.1 cm (82.3 g) on the 151st day and 28.1 cm (217.4 g) on the 200th day. Yashouv (1972) said that striped mullet in monoculture ponds stocked at 183|0.1 ha grew from an initial size of 30 g to a size of 553 g in 197 days and that in the polyculture system the rate of growth was 2.65 g to 3.68 g|fish| day. In the experiments on the monoculture at brackishwater fish farm at Kakdwip, at a stocking density of 200000|ha, *M. parsia* of 17 mm size is reported to have grown to a length of 90-100 mm in 110 days on providing with a mixture of mustard oilcake and rice bran in the ratio of 2 : 1 at a rate of 500 mg|fish; at a stocking density of 12500|ha the average growth achieved during 120 days was 116.2 mm without supplementary feed and 151 mm with it. In another experiment conducted at Kakdwip, *M. tade* is reported to have registered a growth rate of 11 mm (16 g) per month in monoculture (FAO 1974, 1975).

Rengaswamy (1978) had reported that *L. vaigiensis* fed daily on a mixture of algal mass and a quarter tablet of Brewer's yeast grew from its initial size of 14 mm (46 mg) to 24.3 mm (236.6 mg) in a period of two months, showing a mean growth of 5.15 mm (95.3 mg) per month. In the present observation the same species, when fed on an artificial feed composed of rice bran and groundnut oilcake, were found to have grown from the stocking size of 58 mm (3.3 g) to a size of 99.9 mm (15.6 g) in a period of 12 months, indicating a monthly growth of 3.5 mm (1 g). *V. seheli* showed a monthly growth rate of 12.6 mm (4.4 g) in experiment II and 10.8 mm (4.5 g) in experiment III. However, the poor growth rate of this species in experiment IV to VI (5.5 mm & 1.4 g, 4.4 mm & 1.5 g and 3.5 mm & 1 g, respectively) during 1981-82 period might be due to the entry of *Tilapia* causing severe competition to the cultured species.

The yield was found to be better for *L. vaigiensis* in the experiment I during 1979-80 and for *V. seheli* in experiment III during 1980-81. Johnson (1954) reported a production of 143 kg|ha of mullets in a fertilized pond. Experiments on *M. cephalus* in Egypt resulted in yields of 192 to 350 kg|ha in fertilized ponds as against 131 kg|ha without fertilization (Zarka and Fahmy 1968). Mires (1969) found that the total production of mullets in mixed culture in fish ponds at Israel was 227 kg|ha. In monoculture system, a production of 1025 kg|ha of mullets was recorded by Yashouv (1972). Linder et al (1975) stated that *M. cephalus* under monoculture in ponds receiving heated effluents had a production range of 293 to 804 kg|ha.

Productions of 480 kg|ha without and 750 kg|ha with supplementary feed consisting of rice bran and mustard oilcake in 180 days and 800 kg|ha|

140 days with mixed feed of rice polishings, vegetable peels, mustard oilcake and fish meal have been recorded for *M. parsia* in monoculture system in the brackishwater fish farm of CIFRI. Monoculture of *M. tade* indicated a yield of 888 kg|ha|11 months at a stocking density of 6000|ha. Compared to these, better yields were recorded in experiments I to III. Production rates of 569 kg|ha|year for *L. vaigiensis* in experiment 1 (1979-80) and 444 kg|ha and 782 kg|ha|265 days for *V. seheli* in experiments II and III (1980-81) were obtained.

Johnson (1954) had reported a survival of 43-63% for mullets stocked at a size of 29.8 mm in length. Yashouv (1972) stated that the survival of *M. cephalus* in Israel was 62-100%. According to Linder et al (1975), the survival of *M. cephalus* in ponds receiving heated effluent was 50-85%. The survival of 81.2% for *V. seheli* in the present study in experiment III during 1980-81 period compares well with the rate of survival reported by Linder et al (1975). The poor survival in the experiment II during that same period was due to oxygen depletion (0.675 ml|l). The low survival rate observed in experiment IV to VI during the period 1981-82 might be due to the mortality that had followed immediately after stocking.

The growth, survival and production rates were lower in 1981-82 experiments was apparently due to the entry of *Tilapia*, perhaps in their very early stages, despite the filtering of the water pumped into the ponds. At the time of harvest in 1982, about 3.5 kg of *Tilapia* in experiment IV, 18.7 kg in experiment V and 17 kg in experiment IV were netted out.

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