

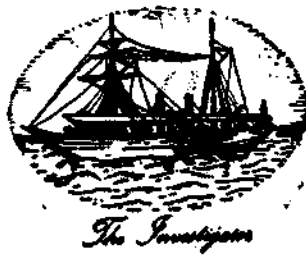
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## PRELIMINARY EXPERIMENTS ON THE CULTURE OF GREY MULLET AT MANDAPAM

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### ABSTRACT

The paper deals with experiments on the culture of grey mullets *Valamugil sehell*, *Liza vaigiensis* and *Liza macrolepis* in monoculture and polyculture systems in seawater ponds and a pen erected in coastal waters at Mandapam.

In a monoculture experiment, *L. vaigiensis* (35 to 77 mm) was stocked at the rate of 1,125/225 m<sup>2</sup> (= 50,000/ha). In polyculture experiments, mullets (*V. sehell*, 25 to 40 mm and *L. macrolepis*, 35 to 80 mm), *Chanos chanos* (45 to 80 mm) and prawns (*Penaeus indicus*, 22 to 52 mm) were stocked at the rate of 100 and 600, 1000 and 300/450 m<sup>2</sup> (= 2,000 and 13,000 ; 22,000 and 7,000/ha) respectively in one pond and mullets (*V. sehell*, 29 to 44 mm), *C. chanos* (31 to 59 mm) and *Sillago sihama* (24 to 48 mm) at the rate of 750 nos. each (= 17,000/ha) in another pond. Mulletts (*V. sehell*, 30 to 43 mm) and *C. chanos* (65 to 71.5 mm) were also stocked in a pen (81 sq. m) erected in coastal waters of the Palk Bay at the rate of 500 nos. each (= 62,000/ha). The stocks were fed with artificial feed composed of equal proportions of rice bran and groundnut oil cake in the form of a paste. The results of the above experiments are discussed in the paper.

Attempts were also made to collect, transport and maintain the adults for the purpose of artificial propagation by hypophysation.

### INTRODUCTION

CULTURE of grey mullets (family Mugilidae) is gaining rapid popularity. Though milkfish is the principal species farmed in estuaries and coastal areas, mullets are more acceptable as food fishes than the milkfish in many Asian countries.

Mulletts are cultured in both freshwater and brackishwater ponds in many countries of the Indo-Pacific region. While in most countries, culture of mullets is on a small scale, they are extensively cultured in Taiwan and Hong Kong. The species cultured in various countries include *Mugil cephalus*, *Liza tade* and *L. dussumieri*. In Taiwan, mullets are cultured mostly in combination with other fish species. Lin (1940) reported on the culture of carps

together with grey mullets in brackishwater ponds in Hong Kong. The culture of grey mullets together with Indian major carps, exotic carps, the milkfish and the prawn in coastal tanks of West Bengal was reported by Pakrasi *et al.* (1975). Fry and fingerlings are collected from nature, acclimatized and stocked in ponds. Experiments to breed mullets under controlled conditions have been conducted in many countries and the first success in rearing larvae (hatched from eggs produced by induced spawning) to fry and fingerlings ready for stocking was obtained in 1968-'69 in Taiwan.

In view of the importance of mullets as food fishes in the country, a comprehensive study on the breeding and culture of mullets was initiated at Mandapam Camp and Cochin.

The results of the experiments on culture of mullets in salt water ponds so far conducted at Mandapam are presented in this paper.

#### MATERIAL AND METHODS

For culture experiments fry and fingerlings of mullets, milkfish, sandwhiting and prawns were collected from Thonithurai, Theedai and Pillaimadam areas (Palk Bay). In Taiwan two kinds of gear are employed to catch the mullet fingerlings. A small floating drag net is used in deeper water and a small beach seine is used in shallow water (Chen, 1976). In the present studies, a drag net made out of nylon mosquito net cloth was used. The seed were transported in fibreglass tanks and plastic buckets to the culture ponds successfully with little mortality. Before stocking the seed in the ponds, measurements and weights were taken for each species by taking sub-samples. Regular measurements and weights were taken at 30 days interval. From these data, the average sizes and weights were calculated for different periods. The size of the pond selected for monoculture was 225 m<sup>2</sup> and for polyculture 450 m<sup>2</sup>. A pen of the size 81 m<sup>2</sup> made out of palmyra leaf stalks was also erected in coastal waters of Palk Bay for growing mullets. The culture experiments were carried out from April to October 1979. Seawater was pumped daily twice into the culture ponds for maintaining the water level of about a metre in depth.

For experiments in transportation, maintenance and artificial propagation, adults of *L. macrolepis* were collected from the stakenet catch (*Kalamkatti valai*) at Manoli Island (Gulf of Mannar) and *V. seheli* and *M. cephalus* from the seine-net catches (*Siraiyan valai*) near Pillaimadam (Palk Bay). The description and operation of the stakenet (*Kalamkatti valai*) are similar to the stakenet (*Bher Jal*) described by T. V. R. Pillay (1954). Sebastian and Nair (1975) stated that ripe spawners

of mullets were transported in plastic buckets. In Taiwan, the mullet breeders are placed in dark coloured plastic bags filled with sea water and oxygen and transported (Chen, 1976). During the present studies, adult mullets were transported by means of a one metre-square transportation cage made out of nylon netting and PVC frame, as well as in fibreglass tanks of the dimensions 75x50x50 cms, to the experimental site successfully. In the case of fibreglass tanks, water was changed frequently. Upto 10 adults could be transported at a time without mortality. Fish were kept in the breeding hapas fixed in the sea or released into the broodstock pond into which sea water was pumped in daily and were maintained in healthy condition. In Taiwan, feeds given in freshwater polyculture ponds where mullet are present consist mainly of rice bran and peanut and or soybean meal (Chen, 1970). The fish stock in all the experiments were fed with groundnut oil cake and rice bran in equal proportions in the form of a paste. Injected fish were kept in hapas of 2 x 1 x 1 m in size and made of synthetic fibre mosquito netting (Sebastian and Nair, 1975). During the present studies, experiments were conducted in the breeding hapas. Acetone dried cat fish (*Tachysurus* sp.) pituitary glands were used for hormone injections. The doses were calculated in mg of gland/kg body weight of the fish. The hormone injection was tried even with the fish which was in the primary oocyte stage to see whether any progress in the oocyte development occurred. Soon after the injection, the fish were kept in the breeding hapas.

#### OBSERVATIONS

##### Monoculture

In the monoculture experiment, the grey mullet *L. vaigiensis*, the seed of which is available in plenty around this area was stocked in the sea water pond at the stocking density of 1,125/225 m<sup>2</sup> (50,000/ha). At the time of

stocking the size ranged from 35 to 77 mm with an average size and weight of 58 mm and 3.3 g. Measurements were taken at an interval of 30 days to minimise mortality due to handling. The average size increased to 65.4 mm (5.5 g), 78.3 mm (7.9 g), 77.2 mm (8.1 g), 78.6 mm (8.3 g), 80.2 mm (8.5 g) and 82.5 mm (9.2 g) during 30, 60, 90, 120, 150 and 180 days period respectively. Thus, an average growth increment of 7.4 mm (2.2 g), 20.3 mm (4.6 g), 19.2 mm (4.8 g), 20.6 mm (5.0 g), 22.2 mm (5.2 g) and 24.5 mm (5.9 g) for 30, 60, 90, 120, 150 and 180 days was obtained for the species. An overall monthly average growth of 4.1 mm (0.98 g) was recorded.

#### Polyculture

In Experiment No. I, grey mullets *L. macrolepis* and *V. seheli* were stocked in association with *C. chanos* and *P. indicus* at the stocking rate of 600, 100, 1,000 and 300/450 m<sup>2</sup> (13,000, 2,000, 22,000 and 7,000/ha for *L. macrolepis*, *V. seheli*, *C. chanos* and *P. indicus* respectively). The average size and weight shown by each species at the time of stocking were 60.5 mm (5.4 g) for *L. macrolepis*, 32.6 mm (1.0 g) for *V. seheli*, 61.4 mm (2.6 g) for *C. chanos* and 34 mm (0.3 g) for *P. indicus*. The average size and weight increase shown by each species in 60, 90, 120 and 150 days period were 43.7 mm (4.6 g), 54.5 mm (7.6 g), 58.2 mm (13.6 g) and 67.1 mm (24.6 g) for *L. macrolepis*; 23.8 mm (7.4 g), 35.2 mm (9.4 g), 62.2 mm (13.4 g) and 83.9 mm (24.6 g) for *C. chanos*; 29.8 mm (1.1 g), 42.1 mm (1.6 g), 44.5 mm (2.7 g) and 47.2 mm (3.1 g) for *P. indicus* respectively. The seed of *V. seheli* was added to the stock during May only, because of the non-availability of the fry in April. The average size and weight increase recorded for the above species were 19.9 mm (3.5 g), 44 mm (9g), 65.9 mm (14.0 g) and 76.6 mm (29.0 g) during 30, 60, 90 and 120 days respectively. Thus, an average monthly growth rate of 13.4 mm (4.9 g), 16.8 mm (4.9 g), 9.4 mm (0.6 g) and

19.2 mm (7.3 g) was recorded for *L. macrolepis*, *C. chanos*, *P. indicus* and *V. seheli* respectively. The results indicate that *C. chanos* showed better growth, followed by *V. seheli*.

In the Experiment II, *V. seheli* (29-44mm) was stocked with *C. chanos* (31-59 mm) and *Sillago sihama* (24-48 mm) at the stocking rate of 750/450 m<sup>2</sup> each (17,000/ha). The average size and weight at the stocking time for *V. seheli*, *C. chanos* and *S. sihama* were 33.9 mm (0.4 g), 45.6 mm (1.1 g) and 31.0 mm (0.2 g) respectively. After 30, 60, 90 and 120 days, the average size and weight increase shown by these species were 25.4 mm (5.1 g), 37.1 mm (5.8 g), 53.1 mm (8.8 g) and 63.3 mm (12.3 g) for *V. seheli*; 35.6 mm (5.9 g), 61.5 mm (11.7 g), 72.9 mm (17.0 g) and 82 mm (20.5 g) for *C. chanos* and 22.1 mm (2.8 g), 34.6 mm (3.8 g), 38 mm (5.4 g) and 45.8 mm (7.8 g) for *S. sihama*. Thus, the average monthly growth increments for the species were found to be 15.8 mm (3.1 g) by *V. seheli*, 20.5 mm (5.1 g) for *C. chanos* and 11.4 mm (1.9 g) by *S. sihama* respectively. In this experiment, *C. chanos* showed better growth than in the first experiment, whereas *V. seheli* showed good growth in the first experiment. Perhaps it may be due to the stocking density which was lesser for *V. seheli* in Experiment No. I and for *C. chanos* in Experiment No. II.

#### Pen culture

In Experiment III, the grey mullet *V. seheli* was stocked in the pen in association with *C. chanos* at the stocking rate of 500 each/81 m<sup>2</sup> (62,000/ha). The average size and weight at the time of stocking were 35.2 mm (0.5 g) for *V. seheli* and 66.4 mm (6.2 g) for *C. chanos*. In the pen, the average size and weight increase recorded for *V. seheli* were 22.6 mm (9.6 g) in 30 days, 51.1 mm (14.5 g) in 60 days and 73.8 mm (18.5 g) in 90 days. On the other hand, *C. chanos* showed an average size and weight increase of 25 mm (4.3 g), 46.8 mm (8.0 g), 81.9 mm (27.9 g) and 120.3 mm (48.4 g)

in 30, 60, 90 and 120 days respectively. Thus, the average monthly growth increments for *V. seheli* and *C. chanos* were 24.6 mm (6.2 g) and 30.1 mm (12.1 g) respectively.

The overall picture in the above mentioned experiments indicated that the growth rate of mullet has been better in the pen in coastal waters when compared to that obtained in the ponds, although Bardach *et al.* (1972) mentioned that most Indian mullet ponds are fertile enough to provide for fairly rapid growth. Similarly, *C. chanos* also showed good growth in the pen than in the ponds. The results are summarised in Tables 1 and 2.

TABLE 1. *Monoculture of the grey mullets L. vaigiensis at Mandapam*

Months	Size range (mm)	Mean size (mm) and mean weight (g)	Growth increment in size (mm) and weight (g)
April	35-77	58 (3.3)	..
May	40-91	65.4 (5.5)	7.4 (2.2)
June	61-105	78.3 (7.9)	20.3 (4.6)
July	50-106	77.2 (8.1)	19.2 (4.8)
August	50-105	78.6 (8.3)	20.6 (5.0)
September	60-106	80.2 (8.5)	22.2 (5.2)
October	60-109	82.5 (9.2)	24.5 (5.9)

During the above experiment, apart from the natural food available in the ponds, artificial food, namely rice bran and groundnut oil cake were given in equal proportions in the form of a paste. It was observed that mullets accepted the supplementary feed readily. The surface temperature ranged between 27 to 34°C in all the ponds. The salinity and oxygen values ranged between 33 to 35.6‰ and 4.18 to 5.16 ml/l respectively. Simultaneously, data were also collected from the sea which indicated that there were no significant differences between the values from ponds and sea.

#### *Transportation and maintenance of adults for artificial propagation*

During the present studies, adults of *L. macrolepis* were transported from Manoli island to the experimental site (about 6 kms) in fibre glass tanks whereas the other species, *V. seheli* and *M. cephalus* were transported from Pillaimadam area in fibreglass tanks as well as in the transportation cage mentioned earlier. It was found that the later method gave better results in transporting live adults without injuries. The transported fish were kept in hapas and in the pond into which sea water was pumped daily. Those kept in the pond were found to be healthy and no mortality occurred. Similarly, keeping not more than two fish in a hapa in coastal waters showed good survival. Another problem faced in the hapa was that, if the hapas were allowed to remain in the sea for more than a week, undesirable dense filamentous algal growth was found inside the hapas hindering the free movement of the fish. Therefore, keeping the fish in the pond for experimental work appears to be a better method than keeping them in hapas in coastal waters.

#### *Oocyte development*

During the present investigations adult mullets were collected from June to September 1979. Neither gravid females nor milting males of *M. cephalus* were encountered during the period of observation. In the case of *V. seheli* and *L. macrolepis* females were available in good number but those in the advanced stages were very few. A total of 12 specimens of *V. seheli*, 3 of *L. macrolepis* and 2 of *M. cephalus* were administered with pituitary hormone to see the progress of maturity. The dosage given for one *V. seheli* varied from 0.15 mg to 5 mg, for *L. macrolepis* it was 0.1 mg and for *M. cephalus* 0.15 mg of gland/kg body weight. However, the fish died within 48 hours after the first injection. There was no further development of oocytes.

TABLE 2. Polyculture experiments on grey mullets at Mandapam Camp

Species	Stocking rate/ha	Size range at stocking (mm)	Mean size (mm) and weight (g)	Mean size (mm), weight (g)* and growth during various periods										Average monthly growth rate in size (mm) and weight (g)
				30 days		60 days		90 days		120 days		150 days		
				1	2	1	2	1	2	1	2	1	2	
Experiment No. I														
<i>L. macrolepis</i>	13,000	35-80	60.5 (5.4)	—	—	104.2 (10)	43.7 (4.6)	115 (13)	54.5 (7.6)	118.7 (19)	58.2 (13.6)	127.6 (30)	67.1 (24.6)	13.4 (4.9)
<i>C. chanos</i>	22,000	45-80	61.4 (2.6)	—	—	84.2 (10)	23.8 (7.4)	96.6 (12)	35.2 (9.4)	123.6 (16)	62.2 (3.4)	145.3 (27.2)	83.9 (24.6)	16.8 (4.9)
<i>P. indicus</i>	7,000	22-52	34.0 (0.3)	—	—	63.8 (1.4)	29.8 (1.1)	76.1 (1.5)	42.1 (1.6)	78.5 (3)	44.5 (2.7)	81.2 (3.4)	47.2 (3.1)	9.4 (0.6)
<i>V. seheli</i>	2,000	25-40	32.6 (1.0)	52.5 (4.5)	19.9 (3.5)	76.6 (10)	44.0 (5.0)	98.5 (15)	65.9 (14.0)	109.2 (30)	76.6 (29.0)	—	—	19.2 (7.3)
Experiment No. II														
<i>V. seheli</i>	17,000	29-44	33.9 (0.4)	59.3 (5.5)	25.4 (5.1)	71 (6.2)	37.1 (5.8)	87 (9.2)	53.1 (8.8)	97.2 (12.7)	63.3 (12.3)	—	—	15.8 (3.1)
<i>C. chanos</i>	17,000	31-59	45.6 (1.1)	81.2 (7.0)	35.6 (5.9)	107.1 (12.75)	61.5 (11.7)	118.5 (18.1)	72.9 (17.0)	127.6 (21.6)	82.0 (20.5)	—	—	20.5 (5.1)
<i>S. sihama</i>	17,000	24-48	31.0 (0.2)	53.1 (3.0)	22.1 (2.8)	65.6 (4)	34.6 (3.8)	69 (5.6)	38 (5.4)	76.8 (8.0)	45.8 (7.8)	—	—	11.4 (1.9)
Experiment No. III Pen culture at sea														
<i>V. seheli</i>	62,000	30-43	35.2 (0.5)	57.8 (10.1)	22.6 (9.6)	86.3 (15)	51.1 (14.5)	109 (19)	73.8 (18.5)	—	—	—	—	24.6 (6.2)
<i>C. chanos</i>	62,000	65-71.5	66.4 (6.2)	91.4 (10.5)	25.0 (4.3)	113.2 (14.25)	46.8 (8.0)	148.3 (34.1)	81.9 (27.9)	186.74 (54.64)	120.3 (48.4)	—	—	30.1 (12.1)

1. Indicates mean size (mm) and weight (g).
  2. Indicates growth in size (mm) and weight (g).
- \* All weights indicated in parentheses.

## REMARKS

There is virtually no monoculture of the grey mullet *M. cephalus* in Taiwan. They are nearly always reared in the same pond with Chinese carps and other freshwater fishes (Chen, 1976). Luther (1967) stated that most of mullet species show good growth in culture ponds than in the natural environment. During the present studies on monoculture, *L. vaigiensis* was tried since this species had so far not been tried and since seed of the species was abundant in the area. But the results indicated very slow growth rate for the species. Hence, it may be stated that this species is not at all suitable for culture.

In the polyculture Experiment I, the growth of *V. seheli* was encouraging. It had shown an average growth of 19.2 mm (7.3 g)/ month, which was higher than that of *C. chanos* (16.8 mm/month). On the other hand, in Experiment II, though mullet showed good growth, the overall monthly average size and weight shown by *C. chanos* were higher. As was in the

case of mullet in Experiment I, the stocking density for *C. chanos* in this experiment was lower. Perhaps this could be the reason for its higher growth rate. Comparatively, the average growth of 24.6 mm (6.2 g) shown by *V. seheli* in the pen was more than its growth in the ponds. This may be due to the availability of food in natural environment in addition to the supplementary feed given. Since the experiments are continuing the mortality rate could not be calculated.

It was observed that rarely, both sexes of the same species in prime condition were available (Radhakrishnan *et al.*, 1976). According to Ching-Ming Kuo *et al.* (1974), the growth of the oocyte is accelerated readily from 500  $\mu$  by daily injection of pituitary gonadotropin. During the present experiment, most of the fish (*V. seheli*) had the ova diameter ranging from 0.1 to 0.24 mm and few *L. macrolepis* had ova diameter upto 0.4 mm only. The results of the present experiments revealed that acceleration of oocyte development was not readily achieved in fish having the oocyte diameter below 0.5 mm.

## REFERENCES

- BARDACH, JOHN E., JOHN H. RYTHER AND WILLIAM O. MCLARNY 1972. Culture of mullets (Mugilidae). In: T. V. R. Pillay (Ed.) *Aquaculture*, Wiley Interscience Press, New York, pp. 285-312.
- CHEN, T. P. 1970. Fertilization and Feeding in coastal fish farms in Taiwan. In: T. V. R. Pillay (Ed.) *Coastal Aquaculture in the Indo-Pacific Region*. The Whitefriars Press Ltd., London and Tonbridge, pp. 410-416.
- 1976. Culture of the grey mullet. In: *Aquaculture Practices in Taiwan*. Page Bros (Norwich) Ltd., pp. 43-53.
- KUO, CHING-MING, COLIN E. NASH AND ZIAD H. SHEHADEH 1974. A procedural guide to induce spawning in grey mullet (*Mugil cephalus* L.). *Aquaculture*, 3: 1-14.
- LIN, S. Y. 1940. Fish culture in ponds in the new territories of Hong Kong. *J. of the Hong Kong Fish. Res. Sta.*, 1 (2): 161-193.
- LUTHER, G. 1967. The grey mullets. *Souvenir, 20th Anniversary, Central Marine Fisheries Research Institute, Mandapam Camp*, pp. 70-74.
- PAKRASI, B. B., N. C. BASU AND R. K. BANERJI 1975. Role of grey mullets in polyculture in coastal tanks of West Bengal. *Bull. Dept. Mar. Sci. Univ. Cochin*, 7 (1): 31-40.
- PILLAY, T. V. R. 1954. The biology of the grey mullet *Mugil tade* Forsskal, with notes on its fishery in Bengal. *Proc. Nat. Inst. Sci. India*, 20 (2): 187-217.
- RADHAKRISHNAN, S., K. V. RAMAKRISHNA, G. R. M. RAO AND K. RAMAN 1976. Breeding of Mullet: by hormone stimulation. *Matsya*, 2: 28-31.
- SEBASTIAN, M. J. AND V. ACHUTHAN NAIR 1975. The induced spawning of the grey mullet, *Mugil macrolepis* (Aguas) Smith and the large scale rearing of its larvae. *Aquaculture*, 5 (1): 41-52.