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16-18 September 1987

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A REVIEW OF MARINE FINFISH CULTURE RESEARCH IN INDIA

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ABSTRACT

The paper deals with a review of marine finfish culture research for development in India. Informations on the marine finfish seed resources and culture potential of the various estuaries, backwaters and coastal waters, the different species of finfishes cultured in mono and polyculture systems and development of technology for the culture of various species of marine finfishes in different culture systems are given. In India, the aquaculture practices so far have mainly dealt with milkfish, grey mullets, Indian Sandwhitting, rabbit fishes, perches and groupers in various ecosystems. Details of methods of pond construction, suitable areas for culture and production, constraints met with in maintenance, management and development of coastal fish farms are presented. The problems in marine finfish culture research for development in India are discussed.

INTRODUCTION

Marine finfish culture which has been an established practice in various parts of India is now undergoing rapid development in order to (i) utilise the extensive areas which are now unutilized but which have possibilities for aquaculture development (ii) to increase the production of animal protein to meet the needs of the fast growing population (iii) to develop special market-oriented products for export and consequently for earning foreign exchange (iv) creating employment opportunities (Pillai, 1972; Qasim, 1975; Silas *et al.*, 1976). Although traditional culture of marine finfishes has been practised in estuaries and coastal areas of Kerala, Goa and West Bengal, the production rate was not high. However, the traditional methods of farming, suitably

modified have shown promising results in certain maritime states.

The scope for an organised system of marine finfish culture in our country was realised by Hornell (1911) who suggested the development of coastal saline swamps, backwaters, estuaries, deltaic marshes and salt pans for the purpose of cultivating saltwater fish. Since then, the Madras Government started a marine fish farm at Hare Island area in 1915, converting some of the lagoons in that area and stocking them with mullets (*Mugil* spp) and sandwhiting (*Sillago* spp). The venture was discontinued after a brief period owing to certain unforeseen circumstances. Marine finfish farming in Kerala was started in 1940 at Narakkal, growing mullets and milkfish with encouraging production rate of 1000 kg/ha/yr. The Madras Fisheries Department renewed fish culture experiments in 1944 at Krusadai Island for growing milkfish and mullets. But the recurring hardship of trails and handicaps forced discontinuance of these experiments. Pioneering attempts on marine finfish culture were made at Mandapam, Krusadai Island, Tuticorin, Madras, Calicut, Narakkal and Mangalore. The significant advances and new approaches have been made by the Central Marine Fisheries Research Institute in finfish culture research (James, 1985; Mahadevan, 1985).

In India, an awareness has developed in recent years on the need to carryout aquaculture on scientific basis as a means to augment fish production through various aspect of research. The past experience in farming underlined the need to evolve suitable hatchery techniques and management strategies. The present paper reviews the experimental culture methods in different ecosystems with the naturally available seed of various species of marine finfish.

COASTAL FISH FARM DEVELOPMENT

Tampi (1960) has discussed about the advantages and disadvantages of establishing a marine fish farm with seven culture ponds spread over a total area of 0.88 ha at Mandapam. The low level of biological productivity is attributed to wide fluctuations in salinity often reaching hypersaline conditions combined with very low concentration of essential nutrient salts and their lack of regeneration (Udaya Varma *et al.*, 1963). The development of small experimental fish farm in the same area has been initiated later with a view to construct a viable farm using various techniques including pumping of sea water into the ponds both during day and night. It was proposed to supplement this facility by erecting a few wind-mill pumps. Recently, at Mandapam, the fish farm has been reconstructed and a total number of 28 ponds spread over a total area of about 15 ha have been developed for experimental work on finfish and prawn farming. The bunds of the ponds were turfed with locally available grass to keep the bunds intact (Bensam, 1985). The coastal fish farm construction and development for marine finfish culture experiments at Mandapam, Tuticorin, Madras, Narakkal and Calicut centres of Central Marine Fisheries Research Institute has been already reviewed (Tampi, *et al.* 1983). At Tuticorin, a total area of 2.5 ha has been developed at Karapad into 12 ponds for the culture of finfish, prawns and crabs during 1972. At Madras, a total extent of 93 acres of salt water area at Muttukkadu about 35 km south of Madras was acquired during 1982, from the Government of Tamil Nadu. Of this, an area of 13 ha has been developed into ponds for experimental programmes by the Central Marine Fisheries Research Institute. At Calicut, a total number of 13 polyethylene lined ponds covering a waterspread area of 0.4 ha has been developed (Lazarus and Nandakumar, 1987). At Kakdwip and Bokhali in West Bengal and Puri in Orissa, the fish farm construction was made by the Central Inland Fisheries Research Institute (CIFRI, Reports, 1962). At Kakinada, the experimental fish farm was developed by the Central Institute of Fisheries Education (CIFE Reports, 1978). The Tamil Nadu State Fisheries Department has developed the brackishwater fish farm at Santhome, Madras (Evangeline, 1968).

MARINE FINFISH SEED RESOURCES

Survey on the cultivable finfish seed resources of *Chanos chanos*, *Mugil cephalus*, *Liza macrolepis*, *Liza parsia*, *Liza cunnesius*, *Siganus* spp., *Etroplus* spp and *Sillago* spp have been reported from estuaries, backwaters and coastal waters of India by many earlier workers. (Tampi, 1973; Evangeline *et al.*, 1969; Prabhakara Rao, 1972; Victor Chandra Bose and Venkatesan, 1982 Dorairaj *et al.*, 1984; Silas *et al*, 1985; Nammalwar, 1986). Regarding the occurrence and collection of milkfish fry, from several centres along the east and west coasts of India, special mention has to be made of Ramanathapuram and Tirunelveli coastal belt which sustains the maximum population of milkfish seed. The season for the large scale collection of these fry may vary from locality to locality. The peak season in most of the places is from April to July and the secondary season from September to November.

Grey mullets rank next only to milkfish as far as salt water and brackishwater fish farming is concerned. The seed of *M. cephalus* is abundant only during October-December in the coastal estuaries around Madras. Other grey mullets species such as *L.macrolepis*, *L. parsia*, *L. tade*, *L. waigiensis*, *L. cunnesius* and *V. seheli* occur for the greater part of the year. (Nammalwar *et al*, MS).

MARINE FINFISH CULTURE RESEARCH IN VARIOUS ECOSYSTEMS

Monoculture

At Krusadai Island and Mandapam, monoculture of *C. chanos* in ponds at the stocking density of 500-1000/ha was conducted (Devanesan and Chacko 1944; Chidambaram and Unni, 1946; Chacko and Mahadevan, 1956). The average monthly growth rate was 14.1-27.0 mm. The production details of these early experiments, however, are not available. At Mandapam, monoculture of milkfish in ponds at the stocking density of 6250-12,500/ha was conducted during 1958-59 despite the poor water quality of the soil, meagre organic content, low nutrient level and hypersaline conditions for most part of the year (Tampi, 1960). The monthly average growth was 18.3 mm. The production was 121 to 455 kg/ha.

At Madras, six monoculture experiments with milkfish at the stocking density of 906-39402/ha were conducted (Evangeline, 1967). According to one monoculture experiment with milkfish conducted at the brackishwater experimental fish farm of the Central Inland Fisheries Research Institute, at Kakdwip, an estimated production of 710 kg/ha was obtained by supplementary feeding at a stocking density of 3000 nos/ha (Anon, 1978). At Kakinada, in four monoculture experiments with milkfish, wherein the stocking density was 5000/ha the average monthly growth ranged between 20.6 and 23.6 mm (Dwivedi *et al.*, 1980). At Tuticorin, in two monoculture experiments, milkfish was stocked at the rate of 7820/ha and 75,490/ha and the production ranged between 318 and 857 kg/ha (Bensam and Marichamy, 1981). At Calicut, in polythene lined ponds milkfish was stocked at the density of 5600/ha and the average monthly growth was 32.5 mm/28.3 g. The production was 920 kg/ha (Lal Mohan and Nandakumaran, 1981). At Mandapam, in two monoculture experiments, the milkfish was stocked at the rate of 4000/ha, and the average monthly growth of 15.2 mm (58 g) in one experiment and 23.9 mm (31.2 g) in the other was reported. The production was 216 and 852 kg/ha (Mohanraj *et al.*, 1983; Gandhi and Mohanraj, 1986). Further, Lazarus and Nandakumaren (1987) reported that in six monoculture experiments with milkfish, the production rates ranged between 1765 kg/ha/yr and 4663 kg/ha/yr in different stocking regimes.

In the six monoculture experiments with grey mullets, *Liza waigiensis* and *Valamugil seheli*, the stocking density ranged between 22,000 and 50,000/ha (James *et al.*, 1985 a). The average monthly growth was 3.5 mm (1 g) for *L. waigiensis* and 3.5 to 12.6mm for *V.seheli*. The production ranged between 135 and 782 kg/ha. At Madras, monoculture of milkfish under the stocking density of 3000/ha recorded the average monthly growth of 33 mm/12.7 g.

The production was 45 kg/ha (Nammalwar and Kathirvel, MS). Further, four monoculture experiments with milkfish were conducted (Nammalwar *et al*, MS). The mean monthly growth rate ranged from 14.6 to 31.6 mm (6.6-18.0 g) and the production was 60-385 kg/ha. In two monoculture experiments with *Lates calcarifer*, the stocking density ranged from 2500-3000/ha. The production was from 2000-2500 kg/yr (Anon, 1985). In another four monoculture experiments with grey mullets, *M. cephalus* and *L. macrolepis*, the stocking density ranged from 1500 to 7500/ha. The monthly average growth was 41.1 mm/12.6 g for *M. cephalus* and 19.4 mm (7.1 g) to 22.3mm (8.5 g) for *L. macrolepis*. The production was from 72-226 kg/ha (Nammalwar *et al.*, MS).

Polyculture

In two polyculture experiments at Sunderbans grey mullets, craps and prawns altogether yielded a total production range of 139.8-1549.6 kg/ha (Pakrasi *et al.*, 1975). At Mangalore, in a polyculture experiment, *C. chanos*, *L. macrolepis*, *S. sihama* and *P. indicus* were stocked in ponds at the stocking density of 1000-3600/ha (Ramamurthy *et al.*, 1978). The average monthly growth rates for the above species were 57.4 mm, 28.2 mm, 6.7 mm and 10.6 mm respectively. At Madras, two polyculture experiments with *C.chanos* and *P.indicus* with the same stocking density of 3500/ha and 70,000/ha were carried out (Sunderarajan *et al.*, 1979). The average monthly growth rates were 52.2 mm/52.21 g & 43.5 mm/37.5 g for milkfish and 15.8 mm (1.8 g) to 29.8 mm (2.5 g) for prawns. The estimated production rates were 705-1088 kg/ha for milkfish and 135-312 kg/ha for prawn. At Tuticorin, in a polyculture experiment, *C. chanos*, *L. macrolepis* and *Scylla serrata* with the stocking density of 1450, 3000 and 617/ha were conducted (Marichamy *et al.*, 1980). The average monthly growth rates were found to be 14.9 mm/8.6 g, 25.6 mm/21.6 g and 12.4 mm/6.5 g. The estimated total production was 1644 kg/ha/yr. In three other polyculture experiments at Tuticorin, C. *chanos*, *M. cephalus* and *P. indicus* with the stocking density of 3500-4982, 2428-7364 and 43,200-76,382/ha, the average monthly growth rates were 32.4 mm/27.4 g; 24.8 mm/9.1 g and 25.3 mm/22.2 g for milkfish, 26.6 mm/19.1 g, 30.5 mm/22.2 g and 20.1 mm/14.1g for mullets and 9.1 mm/1.5 g and 10.3 mm/2.2 g for prawn. The estimated total production of 498 to 662 kg/ha of milkfish, mullet and prawn was obtained (Marichamy and Rajapackiam, 1982 a & b).

At Madras, in four polyculture experiments with *C. chanos*, *L. macrolepis*, *M. cephalus*, *P. indicus* and *P. monodon*, an estimated production of 218 to 1617 kg/ha was obtained by Ramakrishna *et al.*, (1982). At Calicut Lal Mohan and Nandakumaran (1981) conducted five polyculture experiments with milkfish, mullet and prawn in polythene lined ponds but no production results were mentioned. At Sunderbans, in a polyculture experiment, milkfish, mullet, carps and prawn together yielded the production of 1390 kg/ha (Pillai *et al.*, 1985).

At Mandapam, six polyculture experiments with *L. macrolepis*, *V. seheli*, *C. chanos*, *S. sihama* and *P. indicus* were conducted (James *et al.*, 1984 a; 1984 b). In the first experiment *L. macrolepis* and *V. seheli* were stocked in association with *C. chanos* and *P. indicus* at the stocking rate of 13,000, 2,000, 22,000 and 7,000/ha. The average monthly growth rate of 10.7 mm/6.4 g, 13.6 mm/8.6g, 20.1 mm/15.6 g and 10.5 mm/2.3 g was recorded for *L. macrolepis*, *V. seheli*, *C. chanos* and *P. indicus* respectively. The total production was 1464 kg/ha. In the second experiment, *V. seheli*, *C. chanos* and *S. sihama* were stocked at the stocking density of 17,000/ha each. The average monthly growth increment for the above species were found to be 10.2 mm/4.3 g and 17.3 mm/9.5 g and 9.2 mm/2 g respectively. The total production was 1865 kg/ha. In the rest of the four experiments *C. chanos* and *V. seheli* were stocked with the stocking density of 8333/ha and 7777/ha.

The monthly average growth of *C. chanos* and *V. seheli* ranged from 20.7-27.7 mm/20.6-25.9 g and 14.9-16.9 mm/6.9-10.6 g respectively. The total production ranged between 1378 and 1560 kg/ha.

At Madras, in two polyculture experiments, *C. chanos* and *P. monodon* were stocked at the rate of 5000/ha and the monthly average growth was 22.4 mm/6.3 g in one experiment and 34.4 mm/15.1 g in the other for milkfish. In the case of *P. monodon*, the recorded monthly mean growth was 16.9 mm/2.1 g in one experiment and 19.5 mm/17.7 g in the other. The total production was 69 and 183 kg/ha (Nammalwar and Kathirvel; M. S). Further, in seven polyculture, experiments with *M. cephalus*, *L. macrolepis* and *L. cunnesius* at the stocking density of 2500 to 5000/ha the monthly average growth was 17.0-40.1 mm/ 8.2-29.3 g for *M. cephalus*; 16.1-23.4 mm/4.9-12.2 g for *L. macrolepis* and 10.3-15.8 mm / 2.9-6.8 g for *L. cunnesius* (Nammalwar *et al.*, MS). Lazarus and Nandakumaran (1987) reported that in polyethylene film ponds a maximum production of 1007.4 kg/ha/211 days and 1303 kg/ha/169 days was obtained in polyculture experiments with *C. chanos* and *P. indicus*.

PEN CULTURE

At Tuticorin, in two polyculture experiments *C. chanos* and *Mugil* spp. were stocked at the rate of 10,000 and 15,000/ha in pens erected with split-bamboo screens (Shanmugam and Bensam, 1982). The average monthly growth rates for the above species were found to vary between 27 and 51 mm (7.48 g) and 23 and 29 mm (18.26 g) respectively. At Mandapam, five monoculture experiments in net pens with *C. chanos* were conducted (Lal Mohan, 1983). The average monthly growth ranged from 33.8 to 60.9 mm (30.6-57.1 g). Further, *C. chanos*, *V. seheli* and *S. sihama* were stocked at a density of 50,000/ha in a pen made of palmyrah leaf stalks (James *et al.*, 1984 a). The average monthly growth increments for *C. chanos*; *V. seheli* and S. *sihama* were 22.7 mm/10.3 g, 26.9 mm/10.5 g and 16.8 mm/8.1 g respectively. At Mandapam, the results of one mono and one polyculture experiments with *C. chanos* and *Mugil* spp. in bamboo pens indicated that the average monthly growth increments for *C. chanos* was 42. 3 mm (24.7 g) and 50.0 mm (63.4 g). For *Mugil* spp, the mean growth recorded was 18.3 mm/4.7 g (Venkataraman *et al.*, 1985). Except for the details of growth of milkfish and mullet, production data are not available for these experiments.

CAGE CULTURE

At Mandapam, experiments were designed to investigate the possibilities of culturing some economically important marine fishes in low cost cages, erected in coastal waters. Rabbit fishes, *Siganus canaliculatus*, *S. javas*, Groupers, *Epinephelus tauvina* and *E. hexagonatus* and sandwhiting, *Sillago sihama* were cultured in the cages (James *et al.*, 1985 b). The average monthly growth increments for *S. canaliculatus* and *S. javus* were 8.5 mm/ 3.1 g and 6.6-6.2 mm/2-3.1 g respectively. The mean monthly growth for *E. tauvina* and *S. sihama* were 19 mm/87.3 g and 10 mm/1.6 g respectively.

PROBLEMS AND CONSTRAINTS

The problems and possibilities of culture of marine fishes in India have been discussed by Tampi (1967, 1969), Jhingran (1969), Nair and Bensam (1974), Seknaran (1976), James (1980) and Marichamy (1987). The major problem in the culture of marine fishes in India is the task of locating suitable sites for culture. The straight coast line without indentations does not provide suitable sheltered areas and calm conditions for erection of structures like pens and cages in coastal waters.

The major constraint in the costruction of ponds for farms so far developed has been water management. In many places the tidal amplitude is not sufficient to bring the optimum water exchange in the ponds. Consequently the ponds have to be periodically deepened and repaired due to damages caused by monsoon floods every year at considerable cost. Many salt water farms are virtually enclosed systems for most part of the year due to closure of the bar mouth and also insufficient tidal flow when the bar mouth is open. In the lagoon at Mandapam and Muttukadu similar problem exists. The fish ponds at Mandapam and Muttukadu do not have enough exchange of

water due to constant sand accumulation at the main sluice. In Tuticorin farm also water exchange is poor. Similar conditions prevail in the farms of other areas also. Layout of farms is different from centre to centre and the pond sizes vary widely. The facilities created at different centres are also not a uniform standard and everywhere, they fall far short of the requirements. Though extensive survey on the occurrence and abudance of cultivable seed resources have been made, informations are still lacking in some areas which are essential prerequisites for large scale culture of marine finfishes.

Research studies on marine finfish culture have been restricted to only a few species of grey mullets and milkfish mostly. More emphasis is now being laid on the rabbit fish, perches, groupers and sandwhiting. There is a need to identify and propagate selected fast-growing species for culture under different conditions. Nutritional requirements of various cultivable finfish species and the preparation of artificial feeds are to be standardised. In most of the ponds, flooding during south west and north east monsoon seasons occured and caused damage to the bunds and fish stocks in the ponds, necessitating repair and maintenance. Poaching of the cultured finfishes also has often been a source of loss in production. The economic feasibility of marine finfish culture in various ecosystems has not been worked out so far. However, with the constraints so identified, present culture experiments conducted in various ecosystems are aimed at working out these details, leading to further development.

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