Ocean Life Food & Medicine Expo 2004

PROCEEDINGS

International Conference & Exposition on
Marine Living Resources of India
for Food and Medicine

27-29 February 2004,
Image Hall, MRC Nagar, Chennai, India.

Organisers

Tamilnadu Veterinary and Animal Sciences University, Chennai

University of Madras, Chennai

Annamalai University, Chidambaram

Manonmaniam Sundaranar University, Tirunelveli

Aquaculture Foundation of India, Chennai

Published by

Aquaculture Foundation of India

4/40, Kapaleeswarar Nagar, Neelankarai, Chennai - 600 041.

2005

Editors :

Late Dr. S. Ramamurthy, AFI
Dr. K. Alagaraja, Retired Principal Scientist, CMFRI
Dr. E. Vivekanandan, Principal Scientist, CMFRI
Dr. G. Mohanraj, Principal Scientist, CMFRI
Dr. P.V. Sreenivasan, Principal Scientist, CMFRI
Dr. S. Rajagopalan, CAS, Porto Novo

Secretarial Assistance :

Mr. E. Nagenthiran, AFI
Mr. G. Sampath Kumar, AFI

Published by :

Dr. M. Sakthivel, President,
Aquaculture Foundation of India
4/40, Kapaleeswarar Nagar,
Neelankarai, Chennai - 600 041.

Printed by :

Antony Enterprises
15, Hawker Jesson Lane,
Seven Wells, Chennai - 600 001.
Tel. : +91-44-55475307
H/P : 94441 85977

2005

FINFISH MARICULTURE IN INDIA

P. Nammalwar
Project Leader (DST & DOD Projects), C/o.Aquaculture Authority (Ministry of Agriculture, Government of India), 26, Haddows Road, Chennai - 600 006, India

ABSTRACT

The paper deals with the sustainable mariculture of several cultivable candidate species of finfishes such as milkfish (*Chanos chanos*), greymullets (*Mugil cephalus, Liza macrolepis, L. parsia, L. tade, L. cunnesius, L. waigiensis and Valamugil seheli),* sandwhiting (*Sillago sihama*), rabbitfish (*Siganus* spp.), pearlspot (*Etroplus suratensis, E. maculatus*), seabass (*Lates calcarifer)*, groupers (*Epinephelus tauvina, E. malabaricus, E. diacanthus*), redsnappers (*Lutjanus johni, L. malabaricus*) and seabreams (*Lethrinus* spp., *Sparus* spp.). Information on seed resources of cultivable marine finfishes along the Indian coast and their culture potential in ponds, pens, net enclosures and cages is given. The available cultivable areas, methods and management techniques for mariculture of finfishes in India are presented. The prospects for development of fish farms, cages, pens, and net enclosures are highlighted. The progress of mariculture of finfishes in other countries for sustainable development is also discussed.

INTRODUCTION

In recent years, there is global awareness on increasing fish production, which has emerged as a major frontier of fish production in the developing countries both for domestic consumption and export. Mariculture which has been identified as a prime industry to tap the enormous sources of self - renewable bioenergy for the benefit of mankind has good future in India. In order to meet the protein demand of the growing human population, it is imperative to increase finfish production which could be supplied through active research and developmental programmes.

In India, mariculture of finfishes is an emerging sector, which is poised for a rapid development in order to (i) utilise the extensive unutilized potential areas, (ii) increase the production of animal protein to meet the needs of the fast growing population, (iii) develop special market-oriented products for export and earning foreign exchange, and (iv) create employment opportunities. At present, mariculture practices of finfishes are entirely supported by the supply of seed collected from the natural environment which is the only major source in the absence of any standard technology for the mass production of marine finfish seed by induced breeding.

CANDIDATE SPECIES OF FINFISHES

The most common cultivable candidate species of finfishes of marine origin which inhabit estuaries, backwaters, lagoons, tidal pools and tidal creeks and can tolerate wide variations in salinities are the milkfish (*Chanos chanos*), greymullets (*Mugil cephalus, Liza macrolepis, L. parsia, L. tade, L. cunnesius L. waigiensis and Valamugil seheli*), sand whiting (*Sillago sihama*), rabbitfish (*Siganus* spp.,) pearlspot (*E. suratensis, Etroplus maculatus*), seabass (*Lates*

calcarifer), groupers (*Epinephelus tauvina, E. malabaricus, E. diacanthus*), redsnappers (*Lutjanus johni, L. malabaricus*), and seabreams (*Lethrinus* spp., *Sparus* spp).

Marine finfish seed availability / resources

Survey on the distribution and availability of cultivable finfish seed resources from estuaries, brackishwaters, backwaters and coastal waters of India for locating potential areas and their relative abundance in different seasons have been reported by many early workers. Though the period of occurrence and collection of milkfish (*Chanos chanos*) seed may vary at several centres along the east and west coasts of India, the peak season is from April to July and the secondary season is from October - December.

The seed of the greymullet, *Mugil cephalus* is abundant only from December - March, whereas that of other greymullets, *Liza macrolepis, L. parsia, L. tade, L. cunnesius, L. waigiensis* and *V. sehali* occur throughout the year. Fry and fingerlings of the sandwhiting, *Sillago sihama* are available in good numbers almost throughout the year with a peak in January - April (Pulicat lake), August - November (Adyar estuary), October - June (Chilka lake), January - February (South Kanara and Gangoly estuary), and July - September (Palk Bay & Gulf of Mannar). The fry and fingerlings of the pearlspot, *Etroplus suratensis* and *E. maculatus* are available throughout the year (Kerala and Karnataka coasts) with a peak in April - July (Ashtamudi estuary, Veli lake), November - February (Adyar, Pulicat, Egmore and Sadras estuaries), June - August (Chilka lake), and September - November (Chilka lake). Recruitment of the seed of the rabbitfish *Siganus* spp. takes place during January - May with a peak in March (Pulicat lake, Ennore estuary), January - May (Gulf of Mannar & Palk Bay), and January to August, March - May (Vellar estuary). The fry and fingerlings of the seabass, *Lates calcarifer* occur from October to February (Pulicat lake and Muthupet), and May - September (Hooghly - Maltah, Mahanadi estuaries). The seeds of the redsnapper *Lutjanus* spp. are available from January - June, the peak being in March (Pulicat lake, Adyar estuary), and January - April (Gulf of Mannar and Palk Bay), September - October (Vishakapatnam), and January - March (Gopalpur). The fry and fingerlings of groupers, *Epinephelus* spp. are available throughout the year with a peak from January - May (Pulicat, Ennore, Adyar, Kovalam, Edayur, Palar estuaries around Chennai and Gulf of Mannar and Palk Bay). The seeds of seabreams (*Lethrinus* spp. and *Sparus* spp.) occur throughout the year with a peak from January to May (estuaries around Chennai, Gulf of Mannar and Palk Bay).

MARICULTURE / COASTAL FARMING

Pond culture

Although traditional culture of marine finfish has been practised in estuaries, backwaters, tidal creeks / inlets, mangrove swamps, lagoons and coastal regions of Kerala, Karnataka, West Bengal, Goa which is estimated to be 2 million hectares, the production is low. The traditional pond culture in India is carried out in the "Pokkali" fields of Kerala, "Bheris" of west Bengal, `Gazani' farms of Karnataka and "Khazan" lands of Goa accounting for 52,000 hectares for cultivating milkfish, greymullets, prawns and occasionally for seabass, pearlspot and

sandwhiting. The annual harvest ranges from 800 - 1200 kg/ha depending on several factors. Pioneering attempts and significant advances in mono and polyculture of marine finfishes involving milkfish and greymullets at Mandapam, Tuticorin, Madras, Calicut, Narakkal and Mangalore were made in coastal ponds by the Central Marine Fisheries Research Institute during the last three decades.

Pen culture

Pen culture method would be more reliable and profitable for the culture of milkfish and greymullets as they are reared in their own natural habitat with fencing to prevent escape of the stocks and entry of predatory organisms from outside. Hence, there is every possibility for fast growth and high production with supplemental feeding. In view of the operational success of pen culture for raising milkfishes in countries like Philippines, Indonesia, Taiwan, Malaysia, Singapore and Thailand, experiments were undertaken in India to identify suitable areas and show the production capabilities. At Mandapam, and Tuticorin, mono and polyculture experiments in pens (size: 80 m^2) with milkfish, *Chanos chanos*, greymullets, *Mugil* spp., and sandwhiting *Sillago sihama* at a stocking density of 50,000/ha yielded the production rate of 400 - 800 kg/ha.

Cage culture

At Mandapam, experiments were designed by the Central Marine Fisheries Research Institute to investigate the possibilities of culturing some economically important marine fishes in low cost cages erected in coastal waters. Rabbitfishes, *Siganus canaliculatus, S. javus*, groupers, *Epinephelus tauvina* and *E. hexagonatus* and sandwhiting, *Sillago sihama* were cultured in cages. Further experiments conducted on the culture of groupers *Epinephelus tauvina* in fixed net cages of the size 5 x 5 x 2 m at Mandapam yielded 288 kg in 11 months. Although this experiment is not comparable to the practices in South East Asian countries, it gives indication on the possibility of developing grouper culture on a limited basis in bay - like areas such as Valinokkam (Gulf of Mannar) in India. Several species of marine finfishes are under production in the cage culture system in the open sea and sheltered bays elsewhere in the world. Commercial finfish mariculture has not been established in India.

Potential species for consideration are milk fish *Chanos chanos*, seabass, *Lates calcarifer*, grouper, *Epinephelus tauvina*, redsnapper, *Lutjanus johni* and seabream, *Sparus sarba*. A project for cage culture of groupers and seabreams in the Andaman waters is in progress, the success of which will pave the way for more such ventures. A modest production of 5000 tonnes of marine finfish through off shore cage culture is anticipated in the year 2005.

Hydrological conditions

The optimum hydrological conditions for different culture systems are: salinity: 10-35ppt; temperature 25-32^{0}C; pH 7.8 - 8.0; dissolved oxygen 3.5 - 4 ml/1 and water transparency 50-60 cm.

Mariculture of finfishes in other Countries

Milkfish is extensively cultured in the Philippines, Indonesia and Taiwan, and in Vietnam. In Indonesia, milkfish is cultured in brackishwaters and coastal ponds with a production rate of 250-1,000 kg/ha/yr. In the Philippines, by improved traditional method the yield varies between 500 and 1000 kg/ha/yr, with improved techniques. Taiwan's production rates of milkfish are simply spectacular, ranging between 2,000 and 3,000 kg/ha/yr. The high yield obtained in Taiwan is as a result of improved methods of stocking and harvesting. In Indonesia and Philippines, traditional methods are still followed with a single stocking with one size group of fingerlings leading to one harvest of all fish at the end of the culture period of about 3-9 months. In the improved Taiwanese method of culture, there is multiple stocking of different size groups of fish at intervals of few months. This is followed by selective harvesting of larger fish at frequent intervals.

Greymullets are cultured in Israel, Italy and other Mediterranean countries and in many parts of the Indo-Pacific region including India, Pakistan and Bangladesh. In Israel, *Mugil cephalus* and *Liza ramada* are used in polyculture and mullets account for about 5% of the total fish production. The greymullet *M. cephalus* is extensively cultured in Hong Kong and Taiwan. In Hong Kong, mullets form the main crop in brackishwater ponds. Fingerlings of *M. cephalus* of 75 mm size are stocked at a rate of 10,000 - 15,000 per ha. The mullet stock is thinned to 3,500 per ha when they reach 140 g size, and then intensive feeding with rice bran and oil cake is practised. Rice bran and peanut cake along with human and pig excreta are also given every 2.5 days as manure. In Taiwan, *M. cephalus* are cultured in brackishwater ponds accounting for 12% of the total fish crop. In both Taiwan and Hong Kong, *M. cephalus* attain 300 g in one year, 12,000 g in 2 years and 2,000 g in 3 years. The average yield is about 1,500 - 2,000 kg/ha in 300 day growing period.

Seabass (*Lates calcarifer*) has been intensively cultured in floating net cages and ponds in many southeast Asian countries. Thailand is the most advanced and leading country in the commercial culture and production of seabass. Net cage culture technologies of this species is well developed in Singapore, Malaysia, Indonesia, Philippines and Hong Kong. In Thailand, the marketable size is 600 to 800 g with a stocking density of 300 / cage (size 1 x 1 x 1.5 m). The production rate was 148 kg. In Singapore, net cage of 5 x 5 x 3 m is yielding 600 kg after 6-7 months of culture period. A raft unit of 32 such net cages occupying an area of 5,000 m^2 has been yielding 19.2 tonnes per harvest and 38.4 t/year. In the Philippines, seabass stocked in ponds at 2,000 nos/ha with an initial mean weight of 221 g and cultured for 94 days yield a production of 351 kg. In the Malaysia, ponds stocked with seabass at 3,000 nos/ha yielded 997 kg/ha within a rearing period of 228 days. In many countries, groupers are usually cultured in floating and fixed netcages in the sea. The earliest attempt of culturing groupers *E. tauvina* and *E. malabaricus* along with seabass, snappers and rabbit fishes began in Malaysia, Thailand, Singapore and Hong Kong in the mid seventies. The groupers grow fast, and attain a market size of 600 - 800 g in about 6-8 months, from an initial weight of 80 - 100 g. Based on the estimate of 600 g weight of the fish at harvest, a netcage of 5 x 5 x 3 m dimension would yield 600 kg of fish in about 6-7 months and from an area of about 5,000 sq m water space, an yield of 76.8 t/ha has been obtained in Singapore. Groupers of the species, *E. suillus* and *E. amphycephalus* in Taiwan, red grouper *E. akkara* in Hong Kong and Japan, *E. mexico* and *E. tauvina* in Malaysia, Indonesia, Thailand, Kuwait and India are cultured. The

recent annual production of groupers from these culture practices are Thailand: 450 t, Singapore : 153 t and Malaysia : 143 t. In Taiwan, the culture ponds are stocked with 9-12 cm size fingerlings of groupers upto 40,000 nos/ha. Under optimum management conditions the fingerlings grow to 30 cm in length and 600 - 800 g in weight in 8 months with a survival of 80 - 90% and an yield of more than 20 t/ha. Several species of snappers such as *Lutjanus johni, L. russelli* and *L. sebae* are cultured in floating netcages in Singapore, Malaysia, Thailand and Philippines.

Prospects for mariculture of finfishes in India

Interest in the commercial culture of marine finfishes has grown in recent years following many successful experiments conducted in coastal ponds and pens. With available techniques, and with many suitable species and vast cultivable areas available such as, protected bays, lagoons, vast estuaries, brackishwaters and backwaters areas the scope for marine finfish farming in India on sound scientific lines is promising. Further, employment potential in sea farming is enormous. Continued investigations are needed for the development of low cost technology for intensive culture of suitable species in different ecological systems as well as survey of seed resources in new sites. Formulation of suitable feed mixtures, using low cost ingredients with high conversion ratios will be the priority area of research for expansion of the industry. The methods of fertilisation by using organic and inorganic fertilisers for enriching the ponds should be tailored to soil and water chemistry. The practice of continuous stocking and harvesting with a year round growing season as done in other countries will result in good yield. The venture of marine finfish culture, should be organised on co-operative basis involving fisherfolk to uplift their socio-economic conditions. Besides, production of seed of commercially important culturable marine finfishes in captivity is another priority area to cope up with the regular demand of the private entrepreneurs and fish farmers. The governments must make available derelict marshy areas and coastal lagoons to private entrepreneurs and fish farmers on long term lease basis, besides the development of credit and marketing schemes. Provision of model farms and extension services by the Government Departments on modern scientific lines as technical guidance and training will promote this growing industry. The maritime states should undertake a detailed survey of suitable sites for marine finfish culture for the establishment of pilot scale commercial fish farms.

SELECTED BIBLIOGRAPHY

Annon, (1992). Aquaculture research need for 2000 A.D. Oxford and IBH Publishing Company Pvt. Ltd., New Delhi. pp.414.

Ameer Hamsa, K.M.S., (1983). Present status of pen and cage culture of finfishes in Southeast Asia. *Proc. Natl. Sem. Cage Pan Culture* : 69-79.

Bensam, P., (1990). On construction and maintenance of marine fish culture ponds along southeast coast of India. *CMFRI Bulletin* 44 (2) : 309-316.

Durairaj, K.G., G. Mohanraj, V.Gandhi, A.Raju, V.S.Rengaswamy, and J.X.Rodrigo, (1984). On a potentially rich milkfish seed collection ground near Mandapam along with the methods of collection and transportation. *Indian J. Fish* 31(2) : 259-271.

Gopalakrishnan, V., (1995). Candidate species of finish for Aquaculture in India. INDAQUA 1995. Exposition of Indian Aquaculture, Madras.

James, P.S.B.R., (1985). A review of marine finfish culture in India, its problems and prospects. *Proc. Symp. Coastal Aquaculture,* 3 : 718-731.

James, P.S.B.R., R.Soundararajan, and J.X.Rodrigo, (1985). Preliminary studies on culture of finfishes in cages in the coastal waters of Palk Bay at Mandapam. *Ibid* : 910-915.

James, P.S.B.R., and R.Marichamy, (1987). Status of seabass (*Lates calcarifer*) culture in India. *Proc. International Workshop.* Darwin, Australia. In : (Eds.) J.X.Copland and D.L.Grey. Management of Wild and cultured Seabass/Barrundi (*Lates calcarifer*), 24-30.

James, P.S.B.R., V. Sriramachandramurthy, and P. Nammalwar, (1996). Groupers and Snappers of India, Biology and Exploitation. In : F.Arreguin-Sanchez, J.L.Munro, M.C.Balgos and D.Pauly (eds.), Biology, fisheries and culture of tropical groupers and snappers. *ICLARM, Conf. Proc.* 48 : 106-135.

Kutty M.N., (1999). Aquaculture development in India from a global perspective, special section : Fisheries - Science and Technology, *Current Science,* 76(3) : pp.333-341.

Mahadevan, S., (1985). Finfish Culture. *Mar. Fish Inf. Serv.* T&E. Ser. 62 : 1-5.

Marichamy, R., G.Venkataraman, K.M.S. Ameer Hamsa, P.Nammalwar, P.Bensam, and S.Shanmugam, (1979). Culture of fishes in cages and pens along the coastal waters of India. *Proc. International Workshop. Cage and pen culture.* SEAFDEC, Illoilo, Philippines : 41-45.

Marichamy, R., (1987). Culture of finfishes along the coast of Tamilnadu. *Mar. Fish. Inf. Serv.* T&E Ser. 25 : 5-11.

Mohanraj, G., A. Raju, V. Gandhi, and V.S.Rengaswamy, (1983). Fish culture in marine farm at Mandapam. *Mar. Fish Infor. Ser.* T&E Ser. 48 : 1-8.

Nammalwar, P., and G.Mohanraj, (1990). A review of marine finfish culture research in India. *CMFRI Bulletin.* 44(2) : 427-435.

Nammalwar, P., and G.Mohanraj (1991). Farm development and management for marine finfish culture at Muttukadu near Madras In : *Aquaculture Productivity* (Ed) V.R.P.Sinha and H.C.Srivastava Oxford & IBH Publishing Co. Pvt. Ltd., N.Delhi, 547-563.

Nammalwar, P., G.Mohanraj, S.Kandasamy, and A.C.Sekhar, (1991). Finfish seed resources of Adyar estuary and Kovalam backwater around Madras. Indian *J. Mar. Biol. Ass. India.,* 33 (1&2) : 59-68.

Nammalwar, P., (1993). Milkfish and grey mullet culture in India. In : *INDAQUA* - India's first Aquaculture show. Marine products Export Development Authority, Madras : 1-9.

Nammalwar, P., R.Marichamy, G.Mohanraj, V.S.Rengasamy, A.Raju, and V.Gandhi, (1994). A review of the systems for culture of marine finfishes in India, *Proc. National symposium on aquaculture for 2000 A.D.,* Madurai Kamaraj University, Madurai, 26-27 November 1994. 231-244.

Nammalwar, P., (1997). Sustainable mariculture for development management issues and environment interaction in India. In : (Ed) Azariah J, H. Azariah and DRJ. Macer, *Bioethics in India*, Department of Zoology, University of Madras, Madras, 191-201.

Nammalwar, P., R.Marichamy, A.Regunathan, and K.Kandasamy, (1998). Prospects of grouper culture in India. *Proc. workshop National Aquaculture Week,* January - February, 1997, Tuticorin. Aquaculture Foundation of India, Madras - 1-6.

Silas, E.G., *et al.* (1989). The prawn, fish and molluscan seed resources along the Kerala and Tamilnadu coasts. *Mar. Fish. Infor. Serv.* T&E Ser. 94 : 1-16.

Sinha, V.R.P., and H.C. Srivastava, (1991). *Aquaculture Productivity*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. pp.868.

Sinha, V.R.P., (1993). *A compendium of Aquaculture technologies for developing countries*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. pp.115.

Tampi, P.R.S., (1973). Culturable marine fish fry resources from brackishwater environments. *Proc. Symp. Living Res. Seas. India*, CMFRI : 390-399.

Venkataraman, G., K.M.S. Ameer Hamsa, and P.Nammalwar, (1985). Fish culture in pens in the Gulf of Mannar, India. *Proc. Symp. Coastal Aquaculture*, 3: 951-954.