

**RESEARCH AND TECHNOLOGY DEVELOPMENT IN MUD CRAB
FISHERIES AND AQUACULTURE AIMED AT SUSTAINABILITY
AND ENVIRONMENTAL COMPATIBILITY**

Keynote Address

Presented at the Inaugural Function of the

**International Seminar-Workshop on Mud Crab
Aquaculture and Fisheries Management
Rajiv Gandhi Centre for Aquaculture**

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By

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Ms. Leena Nair, President RGCA & Chairman MPEDA., Dr. B. Meenakumari, DDG (Fy), ICAR, Dr. Emilia T. Qunitio, Shri T. Munusamy, Ladies and Gentlemen,

It gives me great pleasure to thank Ms. Leena Nair for inviting me to give a Keynote Address at the Inaugural Session of this International Seminar cum Workshop on Mud Crab Aquaculture and Fisheries Management. It has been possible to forge this colloquium involving MPEDA, RGCA and SEAFDEC chiefly through the untiring support from Dr. Emilia T. Qunitio who has visited RGCA a number of times to organize and strengthen our aquaculture programme on the mud crab. Her pre-eminent position in mud crab breeding and culture is well known and she is also a recipient of the Elvira O. Tan Memorial Award for her work on the domestication of the mud crab (*Scylla serrata*). I have nostalgic memories of the mid seventies of last century, when I had the pleasure of developing linkage with the then infant SEAFDEC and the Central Marine Fisheries Research Institute, Cochin with Late Dr. Miravita, Executive Director and Dean Domiciano K. Villaluz, the father of sugpo (tiger shrimp) culture in the Philippines. It was a momentous occasion in 1977 when Dean Villaluz with a band of young scientists from SEAFDEC visited our laboratories at Narakkal, Cochin, Tuticorin, Mandapam Camp and Chennai and infused greater interest in culture of Crustaceans and help develop an exchange programme. The visit also generated a spurt of activity on shrimps and mud crabs resulting in a number of publications on mud crabs by Kathirvel, Marichamy, Manickaraja, Rajapackiam and others at CMFRI. RGCA's linkage since 2005 with SEAFDEC in the aquaculture of the mud crab has been a positive achievement, thanks to Dr. Emilia Qunitio and you are going to hear and see more about this at this meet. Among our other distinguished guest participants, I am also happy that Dr. Jurgene H. Primavera veteran sugpo scientist who has also been spearheading action on impact of coastal aquaculture on mangrove community structure as well as finding replacement of fish as feed in culture operations is with us. I welcome this august gathering. Mud crabs have thrown up challenges in its confrontation with man who sees it and seeks it as high end gourmet food. What are these challenges? How are we meeting them? Let us consider some of the important issues.

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The research output and literature on mud crab fisheries and aquaculture have increased several folds in the recent past, especially through work carried out in countries such as Philippines, Australia, India, Indonesia, Japan, and Thailand. In this Keynote Address, I intend stressing on some issues which we are confronted with.

I. TAXONOMY AND GENETICS

There has been considerable amount of taxonomic ambiguity as far as the species of the Genus *Scylla* de Hann (1833) is concerned which has plagued earlier workers and vitiated catch data of exploited mud crab resources. The revision of the genus *Scylla* by Keenan, C.P., Davis P.J.F., and Mann D.L. (1998) is a milestone in resolving mud crab taxonomy along its range of distribution in the Indo-Pacific. Using allozyme electrophoresis and sequencing two mitochondrial DNA genes (Cytochrome oxidase I and 16s RNA) they have recognized four species from the Indo-Pacific, *S.serrata*, *S.olivacea*, *S.tranquebarica* & *S.paramamosain*, the last said considered earlier by Estampador (1949) as a variety of *S. serrata*. Mud crab taxonomy has had its own advocates of splitters and lumpers. Earlier Stephenson W., and Campell B (1960) studying samples from Australian Waters attributed morphological differences to environmental differences and tentatively clubbed all the four species as one, viz., *S.serrata*.

These studies have not in any way helped resolve the status of the species of mud crabs from India. Using both traditional morphometric analysis and multiple molecular techniques Anup Mandal and his colleagues from the Central Genetic Laboratory, RGCA have examined hundreds of mud crab samples from the West and East Coasts of India and the Andaman Waters and come to a significant conclusion that the genus *Scylla* in India is represented by only two species *Scylla serrata* (green morph) & *S.olivacea* (Brown morph). Accurate identification now helps us to move on to selective breeding as well as genetic stock management. Needless to say, all published literature related to mud crabs from India may have to be re-evaluated.

Two clades have been identified in the Australian population of *Scylla serrata*, all individuals of each clad derived from a common ancestor. Anup has more work to do on Indian crab genetics. He has told me that the West Bengal specimens of *S .olivacea* are much larger than ones collected from the southern parts of India.. It would be worthwhile investigating whether latitudinal changes have any effect on the biological cycles such as growth and sexual maturity.

II. WILD STOCKS, MUD CRAB FISHERIES AND STOCK ENHANCEMENT

We have not paid serious attention to wild stocks of mud crabs which form livelihood security for some of the local coastal communities who visit the mangrove areas, mud flats, estuaries and lagoons to fish for mud crabs using various types of nets and traps as well as hands on operations. There are middlemen who obtain the juvenile and young

mud crabs to supply to farmers and entrepreneurs for crab fattening or for production of soft shelled crabs. A small proportion is also sold to the farms for grow out culture. Unfortunately we do not have any precise quantified data on the exploited resources of the mud crabs from the wild. The statistical information on the export of live mud crabs as well as frozen and other products from crabs issued by the Marine Products Export Development Authority is only indicative as to how a part of the resource is utilized.

Item/ Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Live Crab (MT)	1779	1599	1749	2022	1909	1918	2230	2863	2963	3054
Frozen Others (MT)	4351	4781	5152	4797	4285	4066	4758	4505	3251	2848
Total Crab (MT)	6130	6380	6901	6819	6194	5984	6988	7368	6214	5902
Value in million USD	19	26	29	33	34	40	47	48	48	57

Table 1: Details of Crab Exports from India

Berried mud crabs which move to deeper neritic waters are also caught in trawl and gill nets along with fin fish and portunid crabs such as *Portunus pelagicus*. Until recently species-wise landing data was not available. Similarly, the access to the right type of natural habitat for settlement of the crablets is very important for recruitment. So also, environmental effects of factors such as temperature, sea surface salinity, rain fall and land runoff and primary and secondary production. We have some information for specific areas such as the Kakinada Bay in Andhra Pradesh, an area of about 132 sq km where round the year fishery for mud crabs take place. Parts of the Bay has good mangrove vegetation and *Scylla* landings (Personal Communication: Josileen Jose, CMFRI) are at three main centres, viz., Chollangi, Peddavalasala and Bairavipalem close to Yanam. From each of these centres 20 to 50 kg of live mud crabs are daily caught, size above 550 gms fetching Rs.600/- and above 1 Kg Rs. 1000/- a piece.

In the name of aquaculture and other anthropogenic activities coastal mangrove ecosystems have been denuded in many areas and some developmental activities have proven unsustainable. Mud crab can be considered as a keystone species in our effort to rehabilitate and restore degraded mangrove habitats and protect them. Regulatory measures such as Coastal Zone Regulations; Forest and Wildlife Act; Fisheries and Aquaculture Acts and Regulations and so on are available, but implementation for specified targets is tardy. So how do we go about this? Very specific issues may be involved. For instance, minimum legal size (Carapace width in cm) for male and female Mud crabs in trade and its implementation. Any restrictions on gears used? The collection of juvenile and young crabs for fattening and production of soft shell crab complicates the issue. If hatchery production could meet the demands, a time will come when regulations can be put into force.

RGCA has taken the lead in showcasing to the mud crab farmer that quality crab seed can be hatchery produced and supplied for culturing for grow out, fattening or production of soft shell crabs. An intensive programme of awareness building and hands on training are necessary at all levels to make such programmes successful. This should also be linked with developing an integrated aquaculture - mangrove silviculture programme.

Stock enhancement activities , such as, brood stock management, hatchery production of quality seed and ranching hatchery produced seed and juveniles in mangrove habitats, mark recovery programmes, restoration of mangrove ecosystems and other location specific actions need to be planned, organized and promoted.

III. CAPTURE BASED CULTURE FISHERIES (CRAB FATTENING & SOFT SHELLED CRAB)

Two innovative approaches to mud crab culture are crab fattening and production of soft crabs. In addition, wild seed is also collected and supplied to farms for the grow-out system. Species of *Scylla* lends itself to this type of culture where the grow-out period is greatly reduced.

Crab fattening is done by keeping young male and female crabs separately in pens at a stocking density of about 1.5 per sq. metre as monoculture. The pens could be in mangrove areas or in any suitable water body with muddy/sandy bottom where the salinity ranges between 15 and 30 ppt. They are also grown individually in cages/ compartments (males 200 - 250gms & females 100 - 150gms) which can be maintained in water bodies. They are fed trash fish and bivalves at 10% body weight daily twice, 40% in the morning and 60% in the evening. After a number of moults the crabs attaining marketable size (females 300gms upwards and males 350gms upwards) are removed in a progressive manner. Empty compartments are restocked with fresh young crabs.

Production of soft shelled crabs are done in cages/compartments where the individually stocked young crab moult and before hardening of the shell at about 80 -120gms size they are harvested for processing.

In fattening as well as in production of soft shelled crabs and crab aquaculture the seed and feed components are the most crucial and this is an area where R & D comes in to develop hatchery production of seed and find economically viable alternatives so that use of trash fish can be phased out. Incidentally, one of the large companies involved with the production of soft shelled crab for export, had to shut down operations as it was depending for juveniles sourced from the wild and stocks were depleted. In order to reduce pollution through presently used fresh feeds, such as trash fish, bivalve and gastropod meat and slaughter waste of uncertain quality, pellet feed suitable for different stages of mud crab growth may have to be developed.

IV. HATCHERY PRODUCTION OF MUD CRAB SEED STOCK

The most pressing need at the moment is the hatchery production of healthy mud crab seed for multifarious aspects of crab culture. I am really proud that the RGCA has made a head start in this at its Hatchery facility at Thoduvai Village, which you will be visiting. The new Mud Crab Hatchery was inaugurated last evening and this will manifold enhance the activities and seed stock production capacity to meet the greater demands and service the farms. Mud crab hatcheries are a rarity, and presently they exist only in the Philippines, Vietnam, India and China. The RGCA mud crab hatchery has been supplying crab instars and seed reared to crablet sizes to various institutions and farmers and have also carried out ranching in estuarine and mangrove areas in Tamil Nadu from time to time for natural stock enhancement.

Being highly cannibalistic in disposition and extremely low in survival, the larval rearing poses several challenges not confronted in other crustaceans and finfish. The life-history habits may differ from species to species, some being more aggressive and cannibalistic and less tolerant to changing environmental parameters. According to a recent study by H. Fushumi & S. Watanabe, (1999: *UJNR Tech.Rep.*,28:9-13) *S.oceanica* is more aggressive as compared to the more docile *S.tranquebarica*, the latter capable of yielding a much greater quantity of seed.

I must congratulate the scientists of RGCA, especially Ganesh, Arul Raj and others for achieving a breakthrough in enhancing the survival rate during larval rearing from zoea to crab instars to an average of 6 % against the world average survival rate of 3 %. In some of the individual runs they have achieved up to a maximum of 18.1 % survival. This is going to be the model for other certified hatcheries to be developed in the future as mud crab aquaculture expands. RGCA is disseminating the hatchery and farming technologies through its Training and Technology Transfer Centre (TTTAC) to farmers and entrepreneurs. I am sure, Dr. Emilia Quintio will be happy to see how things have grown at RGCA.

V. AQUACULTURE OF MUD CRABS

With the maladies confronting shrimp farming in the nineties and first half of this decade, we have been looking for alternatives and mud crabs was an option. The farmer at first was a little reluctant as crustaceans were carriers of some of the diseases such as white spot which was plaguing shrimp aquaculture. It took some time for awareness building and acceptance of crab culture and today the demand far exceeds the supply of hatchery seed. The following two tables give details of the training programmes organized for farmers where 53 have been trained to date and the mud crab seed production and supply by RGCA hatchery during the period 2004 – 2005 to 2012 -2013, year-wise.

Total No. of training programmes conducted	06
Total No. of farmers benefited	19
Total No. of Technicians & Aquaculture consultants benefited	21
Total No. of Academe & Govt. officials benefited	05
Total No. of MPEDA extension officials benefited	08
Total Number of Beneficiaries	53

Table 2. Details of Training Programmes in Mud Crab culture organized by RGCA

YEAR	No. Of Cycles	TOTAL PRODUCTION	Total SHIFTED TO RGCA DEMO FARM *	TOTAL SALE **	
				Crab Inst.	Crablets
2004 -05	6	28,253	—	—	—
2005 -06	13	88,400	50,621	—	—
2006 -07	12	98,615	45,923	5,350	310
2007 -08	12	81,745	71,115	—	350
2008 -09	2	7,225	7,225	—	—
2009 -10	8	1,01,420	96,695	—	—
2010 -11	10	2,27,526	1,18,251	—	617
2011 -12	17	4,27,628	1,79,880	1,71,600	—
2012 -13	17	4,30,254	1,73,785	2,38,250	—

Table 3: Details of Mud Crab Seed production and sale at the Mud Crab Hatchery

Some of the crops taken by farmers using Crab instars from RGCA in Andhra Pradesh (Krishna Guntur, West Godavari and East Godavari districts) have been innovative adopting polyculture practices. Stocking Mud Crab instar @ 1000 nos per acre and Tiger Shrimp seeds @ 5000 nos per acre in a rearing period of 120-140 days and obtaining a yield of 300-350 Kgs of Crabs of 700 grams and above and 400 Kgs of Shrimp of 20 count size.

In Tamil Nadu, Crab Farming is practiced by stocking Crablets sourced from RGCA at a density of 1200-1500 nos/acre in monoculture. In a culture period of 5-6 months, yields of 500 to 600 kg/acre with crabs weighing between 500 gms to 1Kg have been obtained.

Selling Price:

- Sizes of 500 gms : Rs. 550-600/Kg
- Sizes of >700 gms : Rs. 850-900/Kg

An enhanced programme for mud crab seed production and culture is under way during the XIIth Five Year Plan Period. Mud crabs are hardy and less prone to diseases and handling stress. With these and qualities such as high fecundity (1 to 6 million eggs depending on size and species); protracted spawning period, fast growth and early maturation; adaptability for live transportation for long durations; and high fish gate and market price for live crabs as well as frozen and processed crab products, mud crabs are an attractive alternative for shrimp and finfish farming. Crab culture is one activity in which women could play an important role.

VI. CONCLUDING REMARKS

In concluding, I must mention that domestication of the mud crabs has been the prime concern of RGCA. Achieving this and at the same time conserving and managing the mangrove habitats and wild stocks of mud crabs which have been a source of livelihood security and subsistence to some of the local communities has been an underlying principle. Blending this with mud crab farming as an alternative to shrimp farming through research and technology development and transfer from lab to land and streamlining this are the objectives. Towards this:

- 1 Hatchery technology has been developed for providing quality seed for aqua-farms and this is to be extended for other activities such as crab fattening and production of soft crab. Awareness building programmes and hands on training are organized to equip the farmer with the concepts of technologies.**
- 2 Ranching of mud crab seed in mangrove habitats in Tamil Nadu is being done to ensure stock enhancement and this will be on going.**
- 3 A Data Centre is being developed for the mud crab and for hatchery production, training, farming and farm and trainee feedback information.**
- 4 There are gaps in our knowledge of mud crab biology, nutritional requirements, crab health, population diversity, behaviour, natural prey predator relationship, mud crab associated species, migration, especially egg bearing females and their survival, recruitment and so on. RGCA as a nodal Centre would initiate programmes, some on a collaborative mode.**
- 5 RGCA is also taking up the hatchery development and culture of other portunid crabs such as *Portunus pelagicus* & *P. sanguinolentus*.**
- 6 RGCA will promote post harvest product development to add value to products for domestic and export markets on a collaborative mode with organizations such as Central Institute of fisheries Technology and NIPHATT, Cochin.**
- 7 Considering the tremendous inputs into Mud Crab culture and propagation by RGCA, it should rightly evolve as a centre of excellence in Crab Research & Domestication.**

"I wish the deliberations at this Seminar cum Workshop all success to help increase our knowledge about Mud Crab and utilize this resource in a sustainable and ecofriendly way"

THANK YOU



Dr. E.G. Silas, Chairman of the Scientific Advisory Committee of RGCA, formerly served as the Director of Central Marine Fisheries Research Institute and Vice Chancellor of the Kerala Agricultural University. Starting in 1954, Dr. Silas has authored nearly 300 scientific publications in several International and national journals. Dr. Silas has also contributed over 550 books, 500 journals and 3500 copies of reports & proceedings of various seminars & workshops and reprints of scientific papers from his personal collection to Rajiv Gandhi Centre for Aquaculture which are placed in a separate section at the RGCA Aquaculture Library at Sirkali.