वार्षिक प्रतिवेदन
ANNUAL REPORT
2005 - 2006

केन्द्रीय खारा जलजीव पालन अनुसंधान संस्थान
(भारीतय कृषि अनुसंधान परिषद)
75, सन्थोम हाई रोड, राजा अण्णामलैपुरम्, चेन्नई - 600 028.

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(Indian Council of Agricultural Research)
75, Santhome High Road, R.A. Puram, Chennai - 600 028.

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CONTENTS

1. PREFACE

Brackishwater aquaculture continued to grow irrespective of the recurring viral disease outbreaks in the farmed shrimps. With regulations and stipulations enshrined in the Coastal Aquaculture Authority Act, this sunrise sector is expected to grow in an orderly manner to attain highest portals in the segment of foreign exchange earner to the country. Good management practices are followed both in the hatchery and grow-out systems and with formation of farmers associations, cooperatives and aquaclubs, the shrimp farming sector is poised to achieve sustainable growth in the long-run.

One of the major achievements of the Institute was production of 1952 kg/ha of *Penaeus monodon* by adopting improved culture techniques in tide fed ponds at Kakdwip. Improvement in hatchery seed production and nursery rearing of *Lates calcarifer*, development of weaning diet for seabass larvae and grow-out diet for mud crabs, diagnostics for Monodon Baculo Virus, lignocellulosic products for bioremediation of farm discharge water are the other notable research outputs. Twelve sequences pertaining to *P. monodon, M. japonicus, F. indicus and M. cephalus* have been registered to the Genbank. GIS based estimation of aquaculture development of Krishna District and assessment of carrying capacity of Polekuru Island in relation to shrimp farming development gave insights to governance for sustainability of the sector. A series of case studies were conducted to understand the development pattern of shrimp aquaculture related to production and trade.

Under the transfer of technology, the institute conducted training programmes, farmer's meets and brainstorming sessions on various aspects of brackishwater aquaculture in different locations for the benefit of the farmers and other stakeholders of the sector. Two scientists brought acclaim to the institute by winning awards for best paper presentation in seminars.

This report highlights the research and other accomplishments of the Institute during the year 2005-06. The progress achieved was made possible by the concerted and dedicated efforts of all the scientists and staff of the institute. I am extremely grateful to Dr.Mangala Rai, Secretary, DARE & Director General, ICAR for the excellent support received for the march forward of the brackishwater aquaculture sector. I also thank Dr.S.Ayyappan, Deputy Director General (Fy.), Dr.A.D.Diwan, Assistant Director General (M.Fy.), Dr.V.R.Chitranshi, Assistant Director Geenral (I.Fy.) and Shri Anil Agarwal, Principal Scientist (M.Fy.) for their unfailing support and help.

A.G.PONNIAH
Director

2. EXECUTIVE SUMMARY

In consonance with the mandate, the institute has made notable achievements in different issues related to brackishwater aquaculture through ten in-house projects and twelve external funded projects. The significant research achievements made during the year are as under:

- F_4 generation of kuruma shrimp, *Marsupenaeus japonicus* was reared from PL 20 stage in hatchery conditions, matured and bred without eyestalk ablation. The larval rearing of F_5 generation was successfully completed and they are being further reared to produce F_6 generation.
- Developed dot blot technique for detection of white spot syndrome virus as an application for field level surveillance with a capacity to analyse large number of samples.
- *Penaeus monodon* production of 1952 kg/ha of crop was achieved by adopting improved traditional culture techniques.
- Culture of mud crab, Scylla serrata resulted in the production of 118 to 257 kg/ha.
- Based on LISS III satellite data, the potential area identified for development of brackishwater aquaculture in Krishna district of Andhra Pradesh was estimated to 12,854 ha.
- Induced spermiation in male *Mugil cephalus* was achieved by administration of 17∝ methyl testosterone hormone.
- Pond breeding of pearlspot, *Etroplus suratensis* was continued and large quantity of seed was produced. A simplified grow-out culture technique suitable for adoption by small scale farmers is being standardized.
- The domesticated captive broodstock of seabass was induced bred in 16 trials. Successful spawning was observed in 14 instances and there was second spawning in 11 cases. Around 3.74 million hatchlings and 5.57 million 25 day old fry were produced.
- Nursery rearing of seabass fry was undertaken both in tanks and hapas with 58% and 66% survival, respectively.
- Captive milkfish broodstock of 1 to 1.5 kg were maintained for taking up induced breeding trials.
- 24 vibrio isolates were tested for antibiotic susceptibility with tetracycline and oxytetracycline and showed that 33% and 37% of the isolates were resistant to these antibiotics, respectively.

Hon'ble Union Minister for Agriculture Shri. Sharad Pawarji and Dr. Mangala Rai, Secretary DARE & DG, ICAR, in CIBA




Dr. S. Ayyappan, DDG (Fy.) visits CIBA facilities at Muttukadu, Chennai and Kakdwip




3. INTRODUCTION

In India brackishwater aquaculture is synonymous to shrimp farming and from the level of a homestead / traditional type of activity, shrimp aquaculture has taken off to attain the level of an industry practiced by small and marginal farmers. The 8129 km coast line of the country is rich in varied biodiversity with a wide spectrum of fauna and flora. The brackishwater resources of the country comprise 3.9 million ha of estuaries, 3.5 million ha of brackishwater area and 8 million ha inland salt affected areas. Around 1.2 million ha brackishwater area suitable for development of aquaculture is available in the coastal regions of the country and till date around 1.82 lakh ha was developed, contributing production of 1.86 MT which was largely by a single species *Penaeus monodon*.

The Central Institute of Brackishwater Aquaculture was established in April 1987 to serve as a nodal agency for the development of brackishwater aquaculture in the country. The Headquarters of the Institute is located at Chennai with an Experimental Field Station at Muttukadu, about 30 km south of Chennai. The Institute has two Research Centres at Kakdwip (West Bengal) and Puri (Orissa). The Institute has a Director, 44 Scientists, 29 Technical and 21 Administrative and 66 Supporting staff as on 31.3.2006.

MANDATE

- To conduct research for development of techno-economically viable and sustainable culture system for finfish and shellfish in brackishwater
- To act as a repository of information on brackishwater fishery resources with a systematic database
- To undertake transfer of technology through training, education and extension - education programmes
- To provide consultancy service

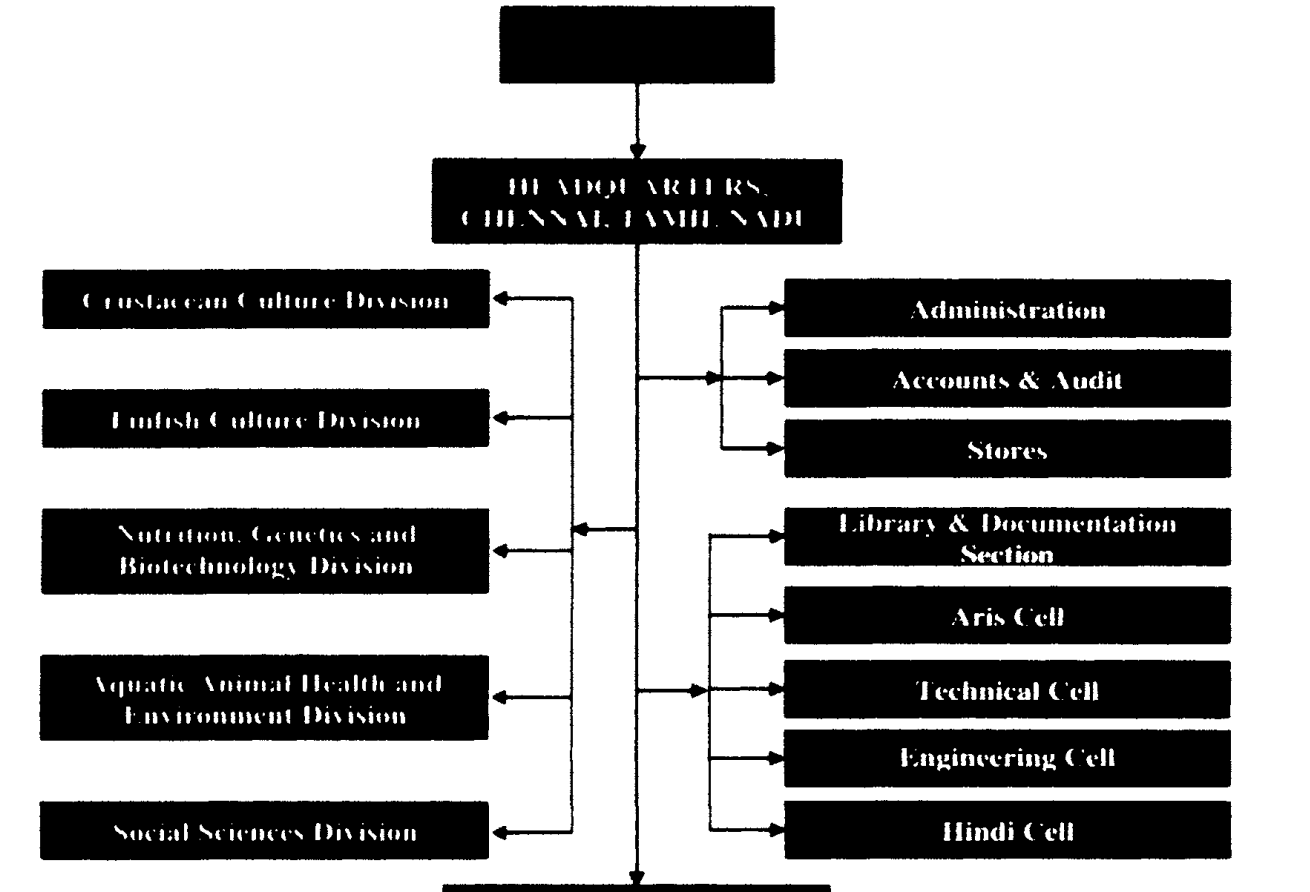
ORGANIZATIONAL SET-UP

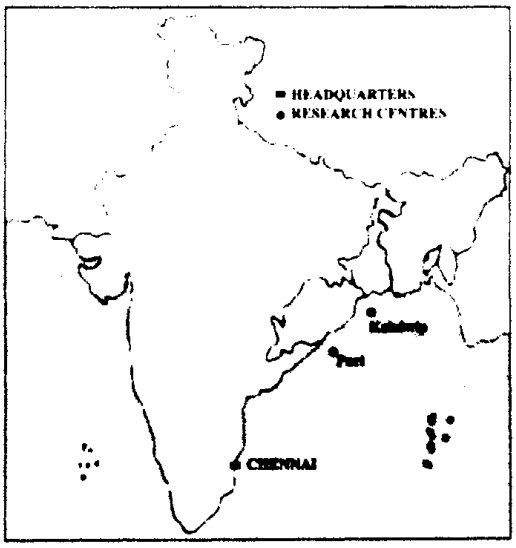
The research activities of the Institute are carried out under five Divisions *viz.*,

- Crustacean Culture Division
- Finfish Culture Division
- Aquatic Animal Health and Environment Division
- Nutrition Genetics and Biotechnology Division
- Social Sciences Division

The Institute has focused its research on 10 in-house projects. In addition to this, nine AP Cess Fund projects, one Indo-French, one Indo-Norwegian, one NACA, one DBT and two network projects were also implemented.

ORGANISATION CHART





ORGANISATION CHART

HEADQUARTERS

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75 Santhome High Road
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Muttukadu Experimental Station of CIBA
Kovalam Post
Muttukadu 603 112
Tamil Nadu
Telephone : 04114-2472344, 954114-2472344, 954114-272061

FINANCIAL STATEMENT

	Allocation	Expenditure
Plan	242.31	242.31
Non-Plan	542.00	541.93

LIBRARY AND DOCUMENTATION SECTION

During 2005-06, 140 books were added to the Library which now has a total of 1900 books. In addition, 23 foreign and 25 Indian journals were also subscribed during the year. Exchange of publications with Indian and international organizations were maintained. Reference and reprographic facilities were also provided to scientists, visitors and students.

THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

The Official Language Implementation Committee of the Institute was reconstituted with the inclusion of in-charges of various sections of the Institute. Meetings were regularly conducted on quarterly basis and the progress report on Hindi was sent to Council on quarterly basis. The in-house publication, CIBA News was published in bilingual form. The Hindi day was celebrated on 24.09.2005 Elocution and song competitions were conducted on the occasion.

Visit of Parlimentery Committee on Official Language at Kakdwip

Hindi Day Celebration

STAFF POSITION

The details of the number of positions sanctioned, filled and remaining vacant as on 31.3.2006 are as follows:

Position	Sanctioned	Filled	Vacant
Director (R.M.P.)	1	-	1
Head of Division	2	1	1
Principal Scientist	2	2	-
Senior Scientist	14	1	13
Scientist	47	44	3
Technical Assistant	32	30	2
Administrative Officer	1	1	-
Finance & Accounts Officer	1	1	-
Junior Accounts Officer	1	1	-
Stenographer Gr.II	2	2	-
Stenographer Gr.III	2	2	-
Assistant	5	4	1
Senior Clerk	6	6	-
Junior Clerk	8	6	2
Supporting Staff	74	64	10
Total	198	165	33

4. RESEARCH ACHIEVEMENTS

IN-HOUSE PROJECTS

CRUSTACEAN CULTURE DIVISION

RESEARCH PROJECTS

- Title of project : Captive broodstock development, breeding, seed production and culture of *Penaeus monodon*, *Marsupenaeus japonicus* and *Fenneropenaeus indicus* (CCD/B&C/1)

  Principal Investigator : Dr.P.Ravichandran

  Location of project : Chennai, Kakdwip and Puri

  Co-investigator : Dr.S.Kulasekarapandian, Dr.S.M.Pillai, Dr.C.Gopal, Dr.C.P.Balasubramanian

  Shri S.R.Das, Dr.T.C.Santiago, Shri R.K.Chakraborti, Dr.G.Gopikrishna, Dr.Azad Ismail Saheb, Dr.M.Muralidhar, Dr.S.V.Alavandi, Dr. M.Shashi Shekhar, Dr.Debasis De, Dr.J.K.Sundaray

- Title of project : Culture of mud crabs (*Scylla* spp.) (CCD/CF/1)

  Principal Investigator : Shri M.Kathirvel

  Location of project : Chennai and Kakdwip

  Co-investigator : Dr.S.Kulasekarapandian, Dr.C.P.Balasubramanian Shri.R.K.Chakraborti, Dr.J.Syama Dayal, Dr.Debasis De, Dr.J.K.Sundaray

- Title of project : Assessment of brackishwater land resources (CCD/RA/1)

  Principal Investigator : Dr.(Mrs.) M.Jayanthi

  Location of project : Chennai

  Co-Investigators : Dr.B.P.Gupta, Dr.M.Muralidhar, Dr.(Mrs.) P.Nila Rekha Dr.M.Kailasam

CAPTIVE BROODSTOCK DEVELOPMENT, BREEDING, SEED PRODUCTION AND CULTURE OF *PENAEUS MONODON*, *MARSUPENAEUS JAPONICUS* AND *FENNEROPENAEUS INDICUS* (CCD/B&C/1)

Captive breeding of *P. monodon*

To improve the quality of eggs produced through induced maturation, five trials were conducted out of which three cycles were completed with a survival of about 20%. In the second set of experiments 15 trials were conducted and in that nine were successful. About 16 lakh eggs were spawned and 14.25 lakh nauplii were obtained. This indicates that the protocol used needs further improvement and alternative methods like hormonal control should be evaluated.

Studies on hormonal control and ovarian development were continued in *P. monodon*. Crude extract of thoracic ganglion was filtered through microfilters and injected in ablated and non-ablated female shrimps. No significant change in the gonadal maturation was observed even after 25 days post injection. Further purification of the extract is being attempted.

Domestication of *M. japonicus*

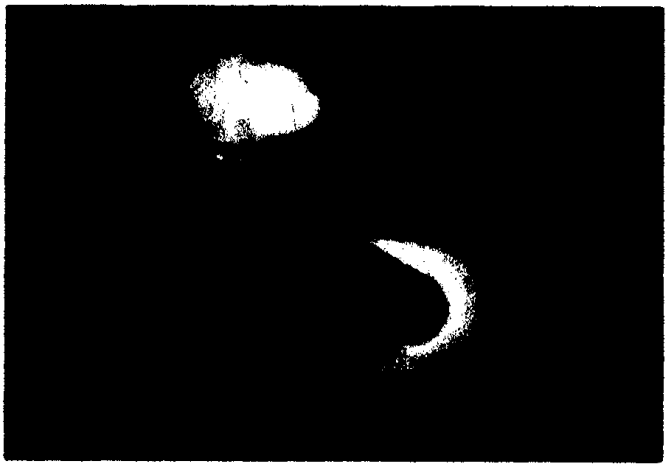
The domestication study of *M. japonicus* was continued with few numbers of F_4 generation adults salvaged from the hatchery after tsunami damage. About 10,000 PL 20 of F_5 generation were produced and from this 1000 nos. are further being reared to adult stage in a concrete tank to assess the performance of domesticated stock with reference to growth, disease resistance and reproduction.

F_5 generation *M. japonicus* seed (PL20) were cultured in a grow-out pond at CIFE, Kakinada. The shrimps attained 8 g in 100 days of culture. The growth rate obtained and the percentage of retrieval were comparatively lower than earlier experiments and was mainly due to the low salinity indicating that low salinity regions may not be suitable for *M. japonicus*.

Captive broodstock development of *F. indicus*

Spawning characteristics of 39 wild caught females of *F. indicus* in the size range of 143 and 175 mm / 40 and 80 g was studied under captive condition. All the females were subjected to unilateral eyestalk ablation. Only 30% of the shrimps matured and spawned repeatedly (minimum 4 times). Mean fecundity was 1, 26, 275. Preliminary investigations on the PL produced in the first and later spawnings revealed that there is no significant difference in their quality. Histological observations of ovary of the first and subsequent spawning were almost similar.

Studies were carried out with male *F. indicus* to understand spermatophore and sperm quality during captive conditions since decline of spermatophore and sperm quality has been reported to be a constraint in broodstock management in penaeid hatcheries. A total of 18 male *F. indicus* were sourced from the wild. Spermatophores were collected and sperm quality (number and viability) was studied and a linear



Spermatophores with ejaculatory duct

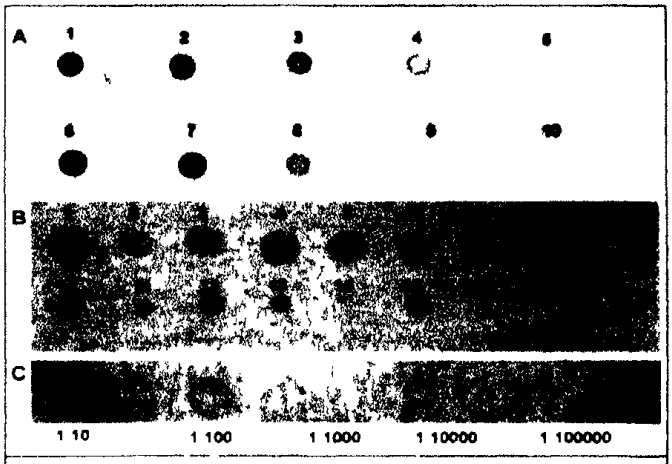
relationship between body weight and spermatophore weight was observed ($Y = -0.0149x$; $R^2 = 0.0328$).

The procedure to collect spermatophore was standardized. Three procedures namely, electro ejaculation, manual pressing and collection using micro forceps were compared. Although all the three procedures yielded successful collection of spermatophore, the use of forceps was found to be advantageous as these shrimps can be used for further studies after collection of spermatophores.

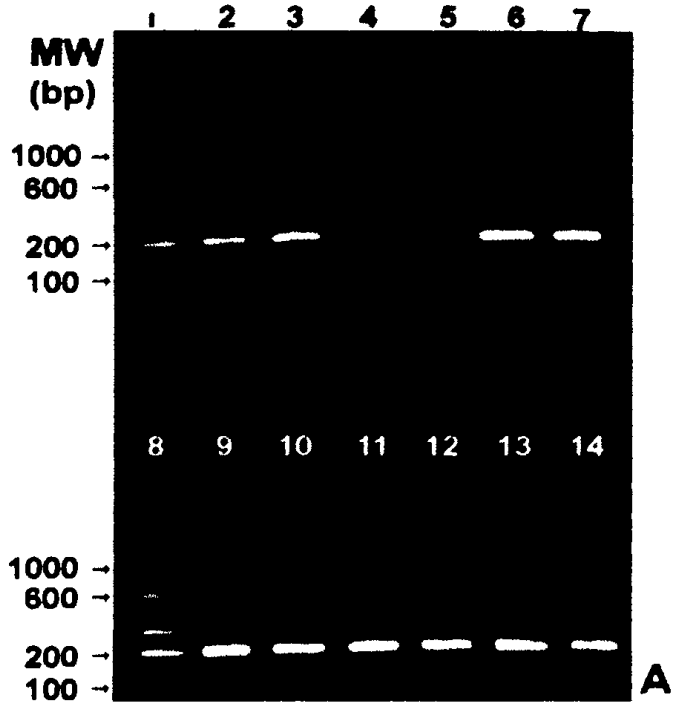
Hatchery facilities at Muttukadu which were seriously damaged during Tsunami, were repaired and restored. As a result of this, the above project work was taken up only during the second half of the year.

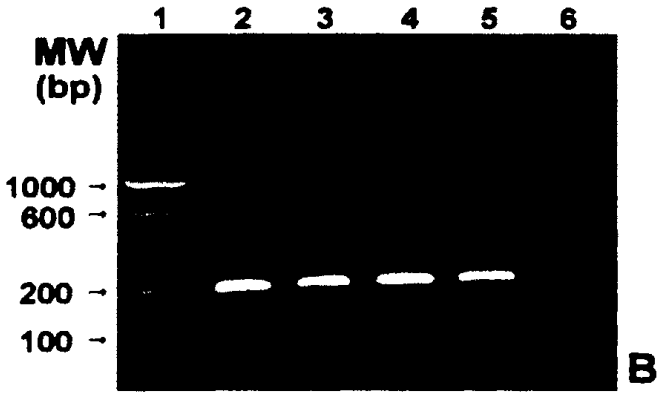
Development of dot blot for detection of white spot syndrome virus (WSSV)

Dot blot for detection of WSSV was developed and its sensitivity was compared with commercially available single tube nested PCR kit. PCR was found to be more sensitive as WSSV specific PCR bands were obtained both in crude and purified DNA samples extracted from pleopod, telson and uropod. Whereas, dot blot showed no reaction with the same purified samples of DNA indicating that the sensitivity of the dot blot gets reduced with the purification of DNA samples. However, the limitation of PCR due to inhibiting factors present in tissues could be overcome with the use of dot blot. Dot blot resulted in positive reaction from the DNA extracted from infected eye stalk containing the eye which yielded no amplification by PCR. The virus load and the severity of infection was also evaluated in different tissues of infected *P. monodon* such as eye stalk, eye stalk with eye ball, gills, cuticle, pleopod, periopods, uropods and telson. This was assessed by variation in obtaining either or all of the three amplified products of 941 bp, 525 bp and 204 bp size using single tube nested PCR kit. The severity of infection was found maximum in cuticle and telson which showed amplification of all the three PCR products followed by gill tissue which was moderately infected resulting in amplification of two PCR products, whereas mild infection was found in other tissues including eye stalk, pleopod, periopods and uropod which showed single band PCR product. These experiments suggest that PCR is a sensitive diagnostic technique to detect WSSV in the infected tissues, but PCR inhibiting factors play a major role in the selection of proper tissues for PCR amplification. Dot blot has an advantage over PCR in allowing use of those tissues which prevent PCR amplification and its applicability at field level for WSSV surveillance on large number of samples. However in comparison with PCR, its application as a diagnostic technique appears limited as it was found to be less sensitive.



Dot blot of WSSV (A) Quantification of DIG labeled probe using 10 fold dilution of control DIG labeled probe ranging from 100 pg μl^{-1} to 0 01 pg μl^{-1} (1-5) Ten fold dilution of experimental DIG labeled probe (6-10) (B) Dot blot hybridization of WSSV infected tissues Crude DNA extracted from (1) eye stalk (2) eye stalk with eye, (3) gills, (4) cuticle, (5) pleopod (6) penopods, (7) uropods, (8) telson, (9) negative control of DNA extracted from healthy gill tissue Purified DNA extracted from (10) eye stalk (11) eye stalk with eye, (12) gills, (13) cuticle, (14) pleopod, (15) penopods, (16) uropods, (17) telson, (18) negative control of DNA extracted from healthy gill tissue (C) A 10 fold dilution of purified DNA extracted from infected gill tissue





PCR of crude and purified DNA extracted from different WSSV infected tissues respectively (A) Lane 1 100 bp marker Lanes 2 & 3 eye stalk, Lanes 4 & 5 eye stalk with eye Lanes 6 & 7 gills, Lane 8 100 bp marker Lane 9 & 10 cuticle Lane 11 & 12 pleopod Lane 13 & 14 periopods (B) Lane 1 100 bp marker Lane 2 & 3 uropods, Lane 4 & 5 telson Lane 6 negative control of purified DNA extracted from healthy gill tissue

Culture of *P. monodon*

At Kakdwip, culture of *P. monodon* was undertaken during summer as well as in post-monsoon period. During summer, culture was carried out in 16 ponds under different treatments with formulated feed, commercial feed with other additives like probiotics, vitamin C and humic acid. The results are given in Table 1. In the experiment with and without chlorination, application of chlorine improved the survival rate but there was no significant difference in FCR and average weight gain. In the experiment with vitamin C and probiotics, best growth and survival were obtained in feed with probiotics. Application of humic acid along with feed did not give encouraging results.

Table 1. Details of *P. monodon* culture conducted at Kakdwip

No chlorination with commercial feed	10	54.75	15.16	162.0	1323.5	1.21
	10	12.98	19.19	59.8	1000.0	1.39
Chlorination with commercial feed	10	63.57	15.53	160.7	1343.6	1.20
	10	65.62	19.29	141.0	1635.7	1.32
Chlorination with locally formulated feed	10	Poor survival				
	10	30.20	14.67	45.6	506.1	3.27
Commercial feed with probiotics	10	73.40	16.86	95.3	1808.3	1.28
	10	68.93	22.32	109.9	1952.0	1.37
Commercial feed with Vitamin C	10	Poor survival				
	10	26.63	25.85	81.8	908.9	2.69
Commercial feed+Probiotics+Vitamin C	10	50.90	22.27	87.4	1459.1	1.48
	10	Poor survival				
Commercial feed + Humic acid	10	36.65	21.34	157.9	1196.2	1.26
	10	21.93	15.47	64.1	793.3	1.91
Locally formulated feed + Humic acid	10	Poor survival				
	10	39.50	13.62	55.1	901.8	2.00

CRABS (*SCYLLA* SPP.)

(CCD/CF/1)

At Chennai

Broodstock development

The crab hatchery damaged during Tsunami was brought back to functional condition during June 2005 and since then four sets of experiments on *Scylla tranquebarica* and two sets with *S. serrata* were conducted to develop broodstock in captivity for breeding and larval production. For all these experiments, live adult females were obtained from Pulicat Lake. Crabs were stocked in the holding tanks for 3-7 days before starting the experiment.

The experiments were carried out in 0.3 to 1.5 ton fiberglass tanks, stocked with crabs @ 1/0.3 ton/0.5 ton and 2/1.5 ton tanks. The salinity was maintained between 32 to 36 ppt for rearing the crabs. A sand bed covering one-third floor area of each tank was provided to meet the burying habit of both the species. The crabs were fed @ 10 % of stocked biomass twice a day with bivalve meat (backwater clam, *Meretrix casta*). The female crabs were subjected to induced maturation by unilateral eye-stalk ablation. Four experiments on *S. tranquebarica* were carried out and the details are given in Table 2.

Table 2. Details of induced maturation of *S. tranquebarica*

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	6	133-156/ 445-625	4	53-73 (av. 64)
2	7	131-149/ 270-430	6	2-40 (av 15)
3	4	140-150/ 400-500	1	25
4	9	150-167/ 550-770	2	38-57 (av 47)

Twenty six adult female *S tranquebarica* were unilaterally ablated and 13 became berried In the experiments 1 and 4, it took a longer period of 38 to 73 days to become berried (average. 55 days), while in experiments 2 and 3, it took 2-40 days (av. 22 days). There was good progress of development of eggs in all the cases.

As the experimental period coincided with prevailing summer/winter months, the incubation period was less in summer months and more during winter months and the details are given in Table 3.

Table 3. Incubation period in berried *S. tranquebarica*

[illegible]	[illegible]
1	8 – 15 / 11.5
2	8 – 13 / 10 5
3	12 / -
4	13-14/13 5

The results of the present experiments confirm the earlier observations on induction of maturity under controlled conditions and add further support to the fact that maturity under captivity can be induced throughout the year.

Larval rearing

Among the 13 berried crabs, one died and the rest hatched out the larvae. Though the larvae were fed with live rotifers and *Artemia* nauplii and green water (*Chlorella* sp.), there was gradual mortality in zoea I to III stages. In experiment two alone, few larvae reached megalopa stage. Details of larval rearing are given in Table 4.

The present observation stresses the importance of further study on improving larval survival as mortality was observed to be very high in zoeal stages.

In-door trial on *S. serrata*

Fifteen adult female of *S. serrata* in the size range of 97-137 mm/125-470 g were subjected to unilateral eye-stalk ablation and stocked individually in 0.5 ton tanks. The details of experiments are given in Table 5.

In the first experiment none of the ablated females became berried, while 60% of ablated females became berried in the second experiment. The time taken between the eyestalk ablation and formation of berry ranged from 9 to 58 days with an average of 41 days. The third trial is in progress. The incubation period varied from 9 to 13 days. Another trial with three crabs (108-113 mm CW and 225-240g total weight) was initiated and it is in progress. The details of larval production and larval rearing are given in Table 6.

A total of 119.18 lakh larvae were produced and 6 lakh were further reared to Zoea IV stage by feeding live rotifers and *Chlorella*.

Observations on *S. serrata* indicate that captive broodstock development and larval rearing are similar to that of *S. tranquebarica,* showing year-round maturation and low survival in zoeal stages.

At Kakdwip

Culture of *S. serrata*

Two fenced earthen ponds of 1000 m^2 each were stocked with juveniles of *S. serrata* and reared on an artificial diet prepared locally for 180 days. The details are given in Table 7.

Harvest of *S. serrata*

The crabs were fed @ 1.5% (dry basis) of the stocked biomass. The observed weight gain per month was 13.7g in both experiments. The survival rate was 16.1% in experiment 1, while it was 8.4% in experiment 2. The production obtained was 118 to 257 kg/ha.

Though the production and recovery rate were low, the study highlights the need for improvement in management practices to achieve optimum recovery rate taking in to consideration the burrowing nature of *S. serrata*.

Table 4. Larval rearing of *S. tranquebarica*

Expt. No.	No. of hatching	Total larvae (in lakh)	Av. no. per hatching (in lakh)	No. of larvae reared (in lakh)	Larval stages reached
1	4	67.5	16.9	6.2	Zoea III
2	5	62.3	12.5	13.3	Megalopa
3	1	11.7	11.7	2.1	Zoea III
4	2	43.4	21.7	2.0	Zoea III

Table 5. Induced maturation of *S. serrata*.

1	5	97-100 125-150	0	-
2	10	116-137 275-470	6	9-58 (av. 41)

Table 6. Larval rearing in *S. serrata*

2	6	119.18	19.9	12	Zoea IV

Table 7. Culture of *S. serrata* in earthen ponds

Expt. No.	Size at stocking TW (g)	Size at harvest (180th day) TW (g)	
1	77.9	159.8	13.7
2	58.0	140.0	13.7

ASSESSMENT OF BRACKISHWATER LAND RESOURCES (CCD/RA/1)

Assessment of land resources

IRS 1C, LISS III data was used to prepare existing land use map using ERDAS Imagine 8.5 for Krishna district of Andhra Pradesh. The satellite data was rectified using survey of India toposheets and different classes were identified. The prominent land categories identified were agriculture, aquaculture, settlements, rivers, mangroves, mudflats, lakes, plantations, river bed vegetation, degraded mangroves, sand, salt pan, fallow, tanks and settlements (Fig. 1).

The existing brackishwater aquaculture map was extracted from the land use map. The land use in the Krishna district for aquaculture was 55402 ha, comprising 32157 ha brackishwater aquaculture farms and 23245.91 ha freshwater farms (Fig.1). The areal extent and spatial distribution of aquaculture farms were identified and quantified from IRS 1C, LISS III 2004 data.

The soil samples were collected from nine coastal mandals of Krishna district from different land class and analyzed for pH, EC, organic carbon and soil texture. The water samples from shrimp farms, bore wells and rivers were analysed for pH, salinity, alkalinity, hardness, total ammonia, nitrate nitrogen and available phosphorus and all these parameters were well with in the permissible limit prescribed for aquaculture.

Identification of potential sites for sustainable shrimp culture

Potential sites were delineated after considering the importance of eco systems, soil and water quality and aquaculture authority guidelines.

The following criteria were considered for identification of potential sites:

1. Reserve forest line was transferred from Survey of India (SOI) topographic maps.
2. Mangroves and agricultural lands were considered as non potential areas.
3. 500 m buffer from high tide line (HTL)
4. 500 m buffer from mangroves and agricultural land outside reserve forest (RF) boundary.
5. Soil characteristics

6. Water characteristics.
7. Road network

These details were over layed one over other and potential zones for shrimp were identified from waste land and muddy areas where aquaculture can be developed with out any adverse future environmental impacts. The identified areas are 2297.30 ha of mudflats and 10556.70 ha of waste land. From this study, the potential area of 12,854 ha was identified for the future development of sustainable aquaculture in Krishna district based on LIS III Satellite data.

Impact of aquaculture on mangroves

The area under mangroves was 10390 ha in Krishna district and mangroves were located with in the reserve forest (RF) and aquaculture farms were located outside the RF boundary in most of the places and not affected the mangrove areas. But in between Kottaupakalla and Uppukalara, the aquaculture farms were present adjacent to the mangrove areas upto the distance of 1 km. The study revealed that there was no adverse impact of aquaculture on mangroves in Krishna district.

Impact of aquaculture on agricultural lands

Due to the fear of white spot virus disease and continuous failure of subsequent crops, the aquaculture farms were in the process of reverting back to paddy fields in Nagayalanka and Avanigatta mandals to an extent of 1000 ha in 2004 nearer to Hamsaldivi point. The main problems described were white spot virus disease, vibriosis and salinity problems. In the crop after conversion, the rice production was 10-12 bags/acre and after two crops, yield was stabilized to 30-35 bags/acre which was the normal production. The study indicated the possible cause for abandoning aquaculture farms for agricultural activity and that this conversion did not adversely impact the long term yield of paddy.

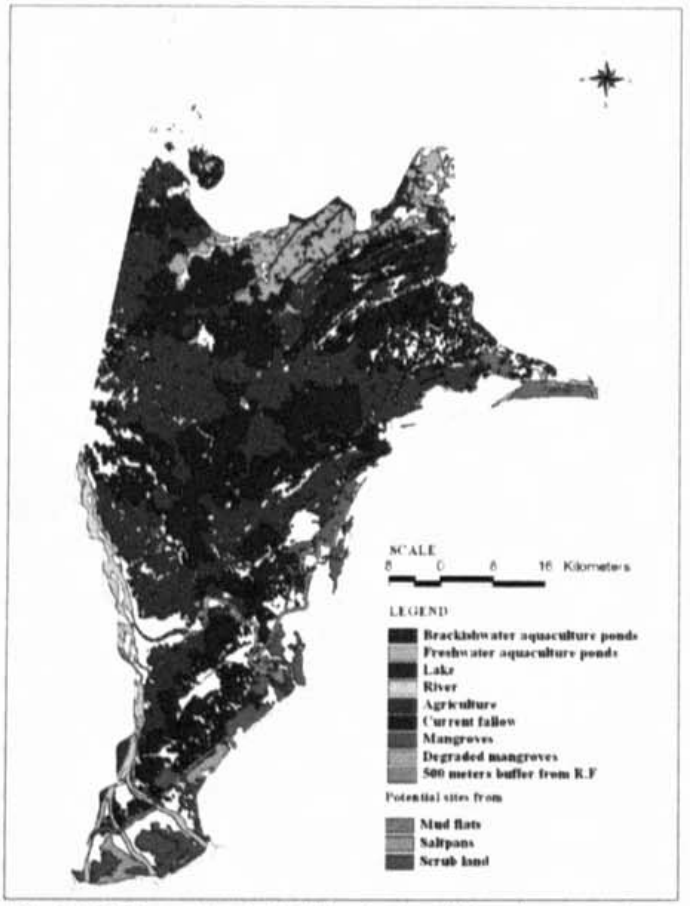


Fig. 1. Existing and potential sites for brackishwater aquaculture

Fig. 2. Mangroves and aquaculture in Krishna district

FISH CULTURE DIVISION

RESEARCH PROJECTS

- Title of project: Broodstock development, breeding, seed production and culture of Grey mullet, *Mugil cephalus* and Pearlspot, *Etroplus suratensis* (FCD/B&C/1)

  Principal Investigator: Dr.M.Natarajan

  Location of project: Chennai and Kakdwip

  Co-Investigator: Dr.Mathew Abraham, Dr C.P. Rangaswamy, Dr.M.Kailasam, Dr.(Mrs).Shiranee Pereira (up to 24.10.2005), Dr.J.K.Sundaray

  Shri R.K.Chakraborti, Dr G.Gopikrishna, Dr.K.K.Krishnani, Dr.(Mrs.)B.Shanthi, Dr. S.V.Alavandi and Dr.Debasis De

- Title of project: Culture of Asian seabass, *Lates calcarifer* (FCD/B&C/3)

  Principal Investigator : Dr.A.R.Thirunavukkarasu

  Location of project : Chennai and Kakdwip

  Co-Investigator : Dr.Mathew Abraham, Dr.M.Kailasam, Dr.J.K.Sundaray

  Dr.T.C.Santiago, Dr.S.A.Ali, Dr.N.Kalaimani, Dr.K.K.Vijayan (up to 12.10.2005) and Dr.J.Syama Dayal

BROODSTOCK DEVELOPMENT, SEED PRODUCTION AND CULTURE OF GREY MULLET, *MUGIL CEPHALUS* AND PEARLSPOT, *ETROPLUS SURATENSIS* (FCD/B&C/1)

Broodstock development and breeding of *M. cephalus*

The sea water supply system was re-established after last year's tsunami damage. The earlier practice of 80% seawater exchange in the broodstock tanks on every alternate day has been dispensed with seawater flow-through for 12 hours daily. Nylon Agro-shade netting cover is provided to both the broodstock tanks to control formation of excessive algal blooms. A seawater re-circulatory system consisting of slow sand filter chamber, biological filter tanks, fluidized sand filter, pressure sand & activated charcoal filter, brine tank, seawater sump, sludge pump, brine pump and seawater pump has also been set up to provide quality water.

Broodstock feed was successfully prepared with minimal changes in the feed formula developed earlier. Fish oil was added as top-coat at the time of feeding. The stock is fed *ad libitum* twice daily.

No parasitic infections or any other health problems occurred during the year. However prophylactic formalin bath (100 ppm for 60 min.) was given at monthly intervals.

All the captive non-oozing male *M. cephalus* were implanted with cholesterol pellet containing 5 mg of 17∝ methyl testosterone to facilitate spermiation and all of them spermiated and were in oozing condition 3 to 4 weeks after hormone pellet implantation.

Captive adult *M. cephalus* (36 nos.) females have been maintained successfully. The stock was regularly monitored for ovarian development and maturation. Development of ovary commenced in August and reached the maximum size in October. Majority of the females matured in captivity and vitellogenic oocytes of over 500 microns were recorded in all females. However due to the early onset of monsoon in October and the consequent drop in water salinity in the mullet broodstock holding tanks, further oocyte development was affected.

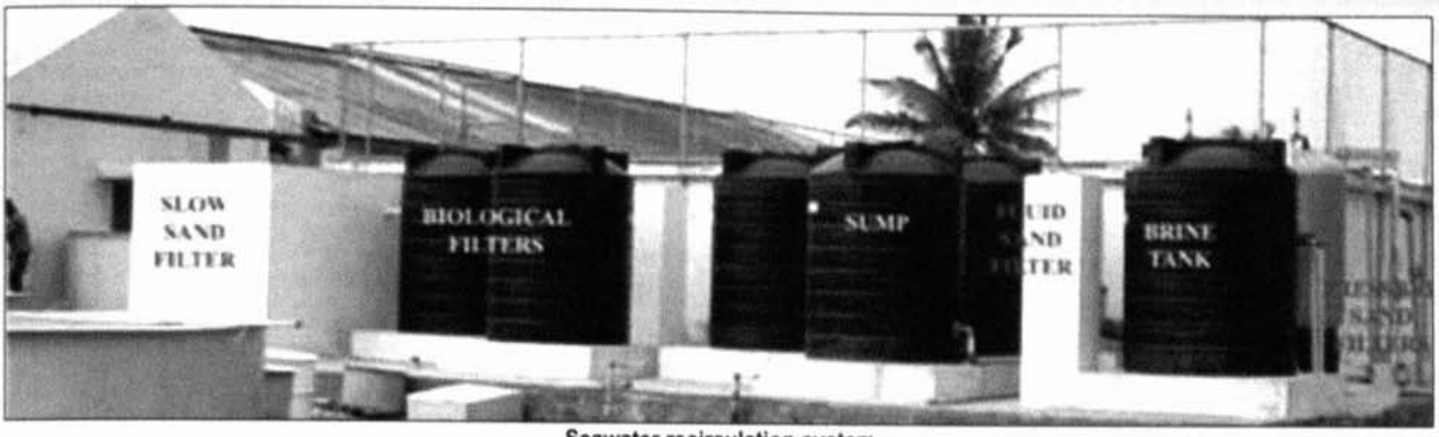
Work during the 2006 season will focus on optimizing the salinity requirement and use of hormonal implants to accelerate the maturation for controlled breeding trials.

Development of species specific DNA markers for mullets

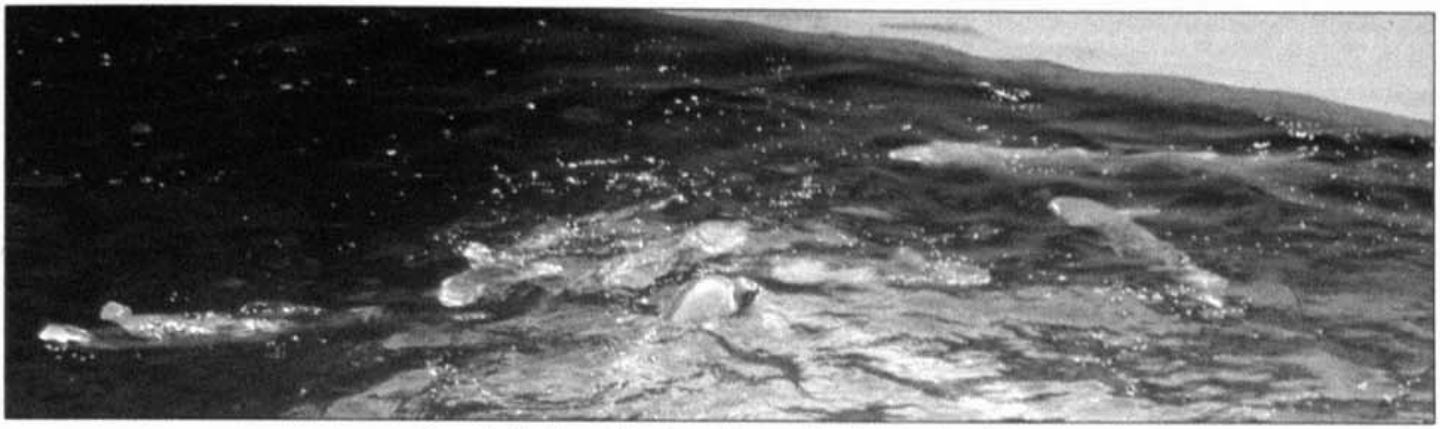
Partial sequence of 16s ribosomal gene segment from *M. cephalus* has been elucidated and submitted to the Genbank. 16s rRNA mitochondrial gene segment from muscle tissue of *Liza parsia, L. macrolepis* and *L. tade* was PCR amplified. The PCR amplified product was analysed for RFLP. Restriction enzymes Nco I, EcoRI, Nsp I, ApoI, Pho I were used for RFLP analysis on 16s RNA gene segment amplified from *L. parsia*. Restriction enzymes Fau I, Tsp 5091, Btg I, Sty I were used for RFLP analysis on 16sRNA gene segment amplified from *L. macrolepis*. Restriction enzymes ApoI, EcoRI, Nco I, Pho I, Nsp I were used for RFLP analysis on 16sRNA gene segment amplified from *L. tade*. Sequence analysis for phylogenetic studies is under progress.

Development of pearlspot broodstock

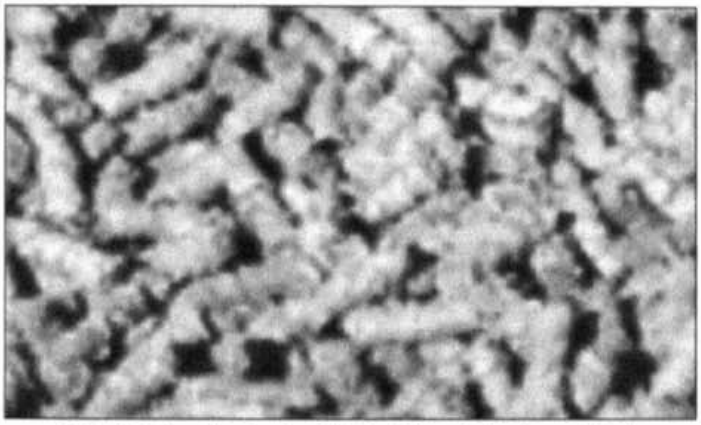
Fifty juvenile *E. suratensis* collected from the wild were reared in a 20 t cement tank at Muttukadu to raise as broodstock. They have attained 22 g. They



Seawater recirculation system

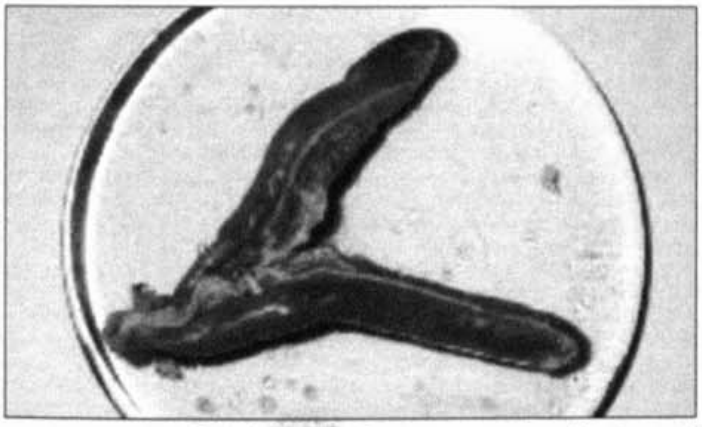


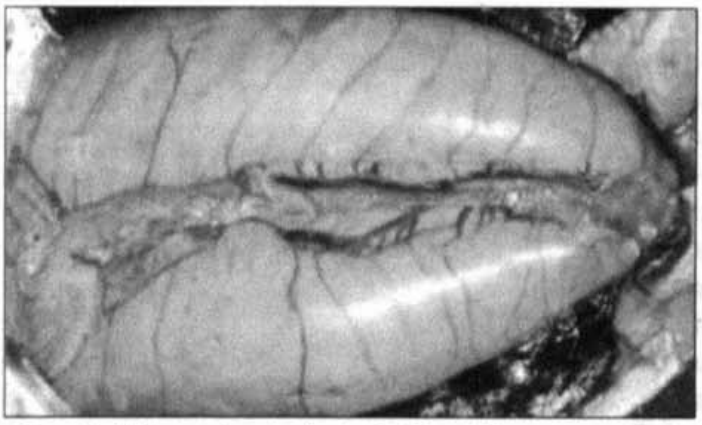
M. cephalus broodstock feeding on floating feed pellets



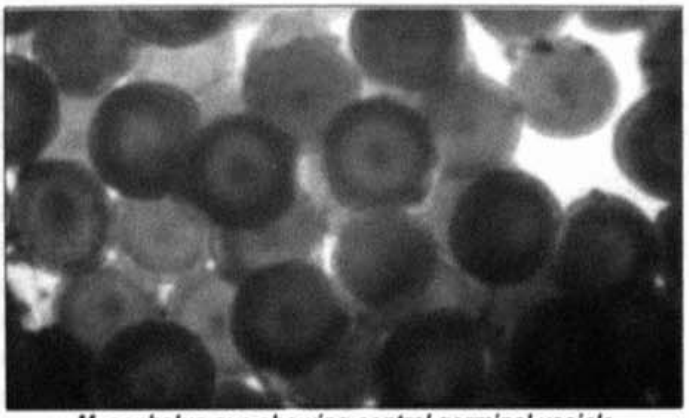
Extruded floating feed pellet for *M. cephalus* broodstock

Induced matured *M. cephalus* in oozing condition





Development of ovary commenced in August (a) and reached the maximum size by October (b).



M. cephalus ova showing central germinal vesicle

were fed *ad libitum* with granulated mullet feed twice daily. Prophylactic formalin bath (100 ppm for 60 mins.) is given at monthly intervals to prevent parasitic infections. The maturation of the fishes is periodically monitored. At KRC of CIBA, one pond (1840 m^2) has been dedicated for broodstock development. Artificial substratum has been provided to facilitate spawning. Based on the breeding trials carried out, a simple technique for pond based seed production which can be adopted by small scale farmers has been standardized.

Pearlspot monoculture

Monoculture of *E. suratensis* was carried out at KRC of CIBA in a 2750 m^2 pond stocked with 2711 fingerlings with an average weight of 4.50 g (range 0.97 to 16.57 g) collected from broodstock pond. Before stocking, the pond was fertilized with urea and single super phosphate @ 20 ppm each. During the first two months of culture, fishes were reared on natural food and after that they were offered locally formulated supplementary feed @ 3.5-5% of the body weight. By the end of December, the pond was harvested and two size groups of pearlspot were observed (70-108mm/10-24g and 155-178mm/100-160g). The overall average final body weight was 30.68 g after a culture period of five months indicating that mono culture of pearlspot may not be a viable proposition.

Mullet culture

At KRC, *L. parsia* seed collected locally were stocked in a 2750 m^2 pond. A total of 9200 fingerlings with an average size of 37.32mm/0.63g were stocked and fed with locally prepared feed @ 10% of the body weight for the first 45 days and then gradually reduced to 3%. The pond was fertilized after 150 days of stocking with farm yard manure @ 20 t/ha and supplementary feed was totally stopped. Harvesting was done after 254 days of culture. It was observed that body size of harvested fish was highly variable (14.2 to 96.98g). A large sized *L. parsia* of 330mm/240g was also recorded. The results of the trial indicated that the technology has to be further standardized for adopting the *L. parsia* culture.

Harvest of *L. parsia*

Table : 8 Water quality of *E. suratensis* culture pond

Depth (cm)	110	84	102
Turbidity (cm)	40.0	25.0	29.4
Salinity (ppt)	6.0	4.0	5.0
Temp (°C)	33.5	28.0	30.2
pH	8.32	7.24	7.89
DO (ppm)	8.0	5 8	7.3
Alkalinity (ppm)	132	100	117

Table: 9 Water quality of *L. parsia* culture pond

Depth (cm)	118	70	89
Turbidity (cm)	37.0	17.0	20.8
Salinity (ppt)	8.0	4.0	5.0
Temperature (°C)	34.0	28.0	27.7
pH	8 52	7 25	7.23
DO (ppm)	8 4	4 8	6 4
Alkalinity (ppm)	132	96	106

CULTURE OF ASIAN SEABASS, *LATES CALCARIFER* (FCD/B&C/3)

Captive broodstock development of seabass

A land based captive broodstock of Asian seabass *L. calcarifer* totaling 70 fishes were maintained in 12m x 6m x 2m RCC tanks. The weight of fishes was in the range of 1.5 to 10.0 kg. During the year, 30 fishes of second year age group reared in a brackishwater pond from the hatchery produced seed of F_1 generation, weighing 1.5 to 3.0 kg were added to the stock. Fifteen fishes of 2.0 to 2.5 kg collected from the wild catch were also stocked in the tanks. The fishes were earlier quarantined in separate tanks for 10 days before they were introduced into the broodstock holding tanks. They were fed daily with low cost fishes like tilapia, oil sardine and horse mackerel @ 5% of the biomass daily.

Health of broodstock fishes was monitored periodically. During October – November and February, the fishes were found to be infected with ecto parasites like *Caligus* sp. and *Dactylogyrus*. Treatment with 1 ppm Dichlorovos for 1 hr. was found to be effective in controlling the parasitic infection. Based on the trials carried for the last few years on captive broodstock development, a technology which can be easily adopted by the hatchery operators is available for transfer to commercial hatcheries.

Maturation and induced breeding

Gonadal maturity started from the month of March in seabass broodstock and gravid females and oozing males could be obtained in June. It took three months to attain gravid condition. Fully matured females with ova diameter more than 0.44 mm and oozing males were selected for induction of spawning. Females were administered with LHRHa (@ 60 µg/kg body weight) hormone intramuscularly below the base of dorsal fin and half the dose of the hormone was given to male fishes. Selection of spawners and hormonal administration were done during early hours of the day and the injected fishes were released in to 20 t spawning tanks in the ratio of 1:2 for

female and males. Spontaneous spawning was observed after 30-38 hr. of hormonal administration.

During June to November, 16 breeding trials were carried out. Successful spawning occurred in 14 cases. Second spawning was observed on subsequent days in 11 cases. A total of 8.01 million eggs were obtained. The egg release varied from 0.3 - 1.2 lakh per kg body weight of the fish. The fertilization rate ranged from nil - 81% with an average of 60%. The total number of fertilized eggs was 4.8 million. The hatching rate was 0 - 90% with an average rate of 78%. A total of 3.74 million hatchlings were produced. Compared to earlier years where the breeding could be carried out up to October, during the current year trials could be carried out up to November, indicating the possibility of extending the spawning period of the captive broodstock.

Larval rearing of seabass

Seabass hatchlings were stocked in FRP tanks of 0.5 m^3 to 10.0 m^3 capacity @ 20 - 40 nos./l. From 2nd day evening, larvae were fed with rotifer *Brachionus plicatilis* @ 15 nos./ml and gradually increased to 30 nos./ml by 10th day of rearing. From 10th day, larvae were fed with combination of brine shrimp *(Artemia)* nauplii and rotifer. The rotifer concentration was kept @ 30 nos./ml where as *Artemia* nauplii was given @ 2 nos./ml on 10th day and increased to 4 nos./ml on 15th day. From 16th day the fry was fed exclusively with *Artemia* nauplii at a concentration of 5 nos./ml up to 25th day. During larval rearing, feed was given thrice daily. Water exchange was done at 30-40% with filtered seawater and algal green water. The algal cell concentration in the rearing tank was maintained at 5000 to 15000/ml. The larval survival rate varied from 2.1 to 43.4% with an average of 15.3%. A total of 5.72 lakh 25-day old fry of 1.0-1.5 cm length were produced. The trial indicated that quality of live feed and water are of paramount importance for survival and healthy larval production. Efforts will be made in the coming season for optimizing the quality of live feed and water quality for increasing the survival rate.

Nursery rearing of seabass fry

Seabass fry of average length 1.2 cm were stocked in nursery tanks fertilized with super phosphate (10 ppm), ammonium sulphate (10 ppm), urea (50 ppm) and inoculated with algal stock culture. Then brine shrimp nauplii were introduced @ 30 nos./ml. Filtrate of blended rice bran was fed to *Artemia* nauplii *ad libitum*. This has resulted in rich *Artemia* biomass production on the 10th day. At this stage, seabass fry of 1.2 cm average length were stocked @ 500-2500 nos./m^3. Rearing was done for 25-40 days. The survival rate varied from 15 - 90% with an average of 58%.

Nursery rearing was also carried out in velon screen net hapa (2m x 1m x 1m) erected in the brackishwater canal. Seabass fry were stocked @ 1000 nos./m^3 and fed with cooked and minced fish/shrimp meat *ad libitum* thrice a day. Feeding was also done with zooplankton like mysids collected from the canal. After 10 days of rearing, the density was reduced to 500 nos./m^3 and reared up to 15 days. Then the density was further reduced to 200 nos./m^3 and reared up to 20 days. The survival rate was 65% for total nursery rearing period of 45 days. The fry had grown from the initial size of 1.2 cm to 7.5 cm. During the period of rearing, grading was done once in three days. Experiments carried out so far revealed that the survival and quality of seed can be improved through supply of proper quality feed and water quality management which will be standardized in the coming months.

Seabass seed produced in the hatchery were supplied to 11 farmers for grow out culture

trials in their farms. A total of 2.10 lakh seed were supplied and realized revenue of Rs.1.70 lakh.

Mono culture of seabass

At Vaniyanchavadi farm of Tamil Nadu Fisheries Department, seabass seed produced during September 2004 were nursery reared and subsequently stocked as fingerlings of 2-3 g @ 5000 nos./ha in a 1.0 ha pond and were harvested in January 2006 (after 13 months of stocking) and March 2006 (after 16 months of stocking). The fishes were fed with minced low cost fishes. At the time of final harvest, fishes were in the size range of 0.20 to 3.0 kg showing a high degree of differential growth. The production achieved was 2.08 t/ha in 16 months. The survival rate was 54%.

Harvesting of seabass

Harvested seabass

At Kakdwip, seabass seed of average size 62.6 mm/ 4.1 g were stocked in a 1940 m^2 pond. Water exchange was done for three days during full moon and new moon phase. The fishes and shrimps that entered in to the pond through the tides formed food for the stocked fishes. In 454 days of culture, the fishes attained average size of 330 mm/600g. However, few fishes were in the size range of 2.0 to 2.4 kg. The production obtained was 342 kg/ha.

The trials indicated that this extensive culture method can be adopted by farmers feeding with low cost fishes as feed. The results revealed that the growth difference with wide variation has to be reduced through periodic culling. The culture duration can also be reduced by stocking large size seed.

Polyculture with scampi

Hatchery produced seabass seed with an average size of 2.5cm were stocked @ 4500 nos./ha in a pond along with Scampi *(Macrobrachium rosenbergii)* juveniles of average size 5cm @ 30000 nos./ha in a polyculture trial in Andhra Pradesh. While formulated feed was fed to the scampi, trash fish was given to seabass. In 4 months, scampi attained average size of 43g with 80% survival and seabass had grown to 100-250g with an average size of 225g. The survival rate was 60%. This trial indicated that seabass seed weaned to inert diet feeding can be grown along with prawns.

Captive broodstock development of milkfish

For controlled breeding trials in future, milkfish, *Chanos chanos* in the range of 1.0-1.5 kg which were reared in a pond from fingerlings stage since 2004 were transferred in to RCC tanks in April 2005 and maintained as broodstock. Daily the fishes were fed with a formulated feed @ 2-3% of the biomass. The broodstock is being monitored for maturity status.

AQUATIC ANIMAL HEALTH AND ENVIRONMENT DIVISION

RESEARCH PROJECTS

- Title of project : Fish health management in brackishwater aquaculture using epidemiology, diagnostics, prophylactics and molecular biology (AAHED/DIS/1)

  Principal Investigator : Dr.T.C.Santiago

  Location of project : Chennai

  Co-Investigators : Dr.N.Kalaimani, Dr.K.P.Jithendran, Dr.K.K.Vijayan (up to 12.10.2005), Dr.S.V.Alavandi

  Dr.A.R.Thirunavukkarasu

- Title of project : Development of technology for the waste water treatment of shrimp farms (AAHED/DWT/1)

  Principal Investigator : Dr.B.P.Gupta

  Location of project : Chennai

  Co-Investigators : Dr.K.K.Krishnani, Dr.M.Muralidhar, Dr.(Mrs.) R.Saraswathy,

  Dr.(Mrs.) M.Jayanthi, Dr.(Mrs.) P.Nila Rekha, Dr.S.M.Pillai, Dr.C.Gopal, Dr. M.Shashi Shekhar, Dr.S.Kannappan and Dr.(Mrs.)Ch. Sarada

FISH HEALTH MANAGEMENT IN BRACKISHWATER AQUACULTURE USING EPIDEMIOLOGY, DIAGNOSTICS, PROPHYLACTICS AND MOLECULAR BIOLOGY (AAHED/DIS/1)

Bacteriology of sea bass *(L. calcarifer)* larval rearing system

To investigate the impact of opportunistic bacterial pathogens in seabass larval rearing system, a study was undertaken for a period of 50 days post-hatch (dph). Vibrios were the predominant group of bacteria in the seabass larval rearing system. *V. harveyi, V. alginolyticus, V. cincinnattiensis, V. pelagicus I, V. marinus, V. mimicus, V. logei, V. furnissi, V. vulnificus, V. splendidus II,* and *V. anguillarium* were isolated during various stages of larval development. *V. harveyi* is an important opportunistic pathogen of seabass larvae, as revealed in the previous studies and was isolated from the brooders only during this study. *V. anguillarium* is also one of the important pathogens and was recovered only once on 28 dph. Total viable counts (TVC) of bacteria in the sea bass larval rearing water ranged from $5.6x10^3$ to 2.98×10^5 (5600 to 298000) colony forming units (cfu) per ml. Highest bacterial counts were recorded from water samples containing egg mass and it peaked on 1st day of post hatch (2.98×10^5). The total vibrio counts in the water samples were in the order of 2.13×10^3 to 7.9×10^4 per ml. Vibrio load was also high in the egg mass and during hatching. TVC of the egg mass stage to larval stages were relatively high and ranged from $40x10^4$ to $52x10^6$ cfu per g and the vibrio load in the corresponding samples was 32×10^3 to 43.2×10^5 cfu per g.

Generally, the bacterial load showed a reducing trend after 5dph. The bacterial load of live feed samples was in the order of 36×10^4 to 33×10^6 cfu/ml *(Chlorella)*, 46×10^4 to 52×10^6 cfu / ml (Rotifer) and 44×10^4 to 19.2×10^6 cfu / g (*Artemia* nauplii) (Fig3.)

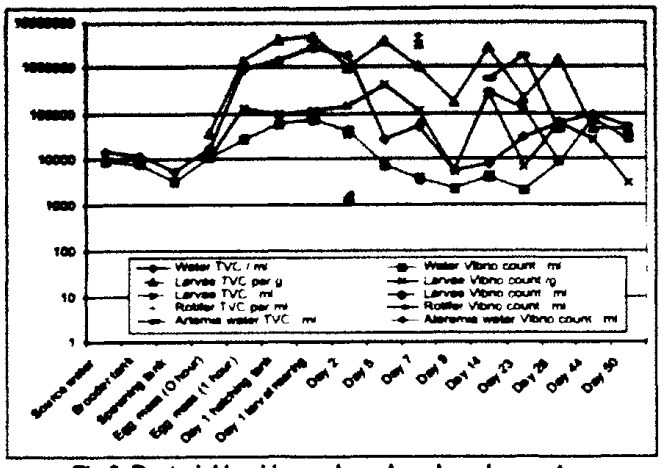


Fig.3. Bacterial load in sea bass larval rearing system

Antibiotic susceptibility

Twenty-four vibrio isolates recovered during the study were tested for antibiotic susceptibility such as tetracycline and oxytetracycline, which are often used in aquaculture systems. Among the 24 isolates tested, 33% and 37% of the isolates were resistant to these antibiotics respectively (Table 10).

No resistant isolates could be recovered for norfloxacin, while 4% were resistant to furazolidone.

Investigations on the mortality of shrimps in Nagapattinam region

Mass mortality of tiger shrimp reported from Mamallapuram region and Nagapattinam district in Tamil Nadu during January and March 2006 was investigated by taking shrimp, soil and water samples. Shrimp tissue samples were tested for WSSV by nested PCR using protocols of Kimura *et al* (1996) and Taura Syndrome Virus (TSV) by RT-PCR using OIE protocols. Haemolymph, soil and water samples were subjected to microbiological examination.

Table 10. Antibiotic resistance patterns of Vibrio isolates (n = 24) for different antibiotics

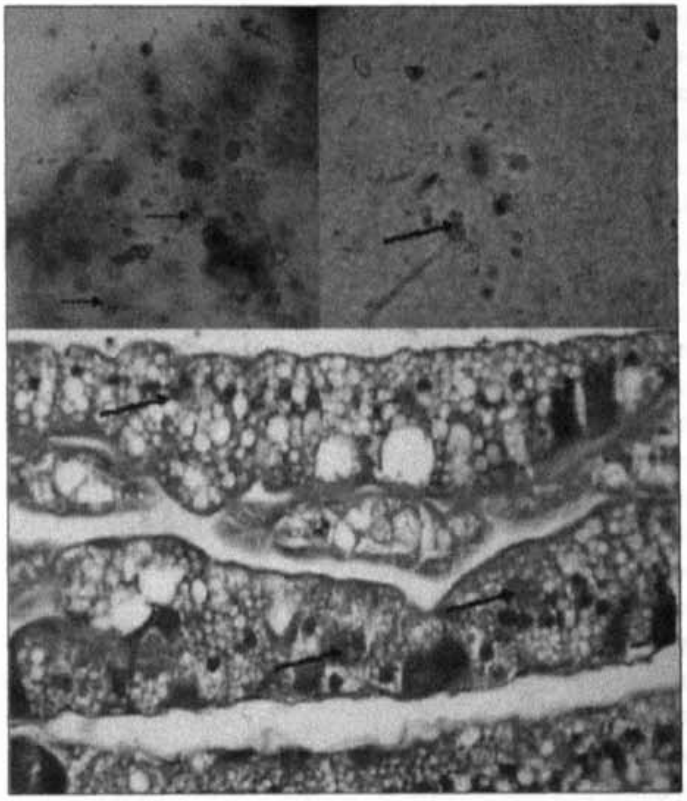
Antibiotics	Concentration (mcg)	Sensitive (%)	Resistant (%)
Chloramphenicol	30	19 (79.16)	5 (20.84)
Furazolidone	50	23 (95.82)	1 (4.17)
Gentamicin	10	19 (79.16)	5 (20.84)
Kanamycin	30	19 (79.16)	5 (20.84)
Oxytetracycline	30	15 (62.5)	11 (37.5)
Nalidixic acid	30	22 (91.66)	2 (8.34)
Neomycin	30	20 (83.33)	4 (16.67)
Norfloxacin	10	24 (100)	0 (0)
Tetracycline	10	16 (66.66)	8 (33.34)

The study has revealed that the mortality of tiger shrimp was due to WSSV infection. The affected shrimps from Mamallapuram were pale, discoloured and lethargic. 2% of the affected shrimp showed ectoparasitic infestation, 90% had choked gills, 25% showed loose shell syndrome and 2% showed WSSV. Moderate counts of *V. parahaemolyticus* and non luminous *V. harveyi* were recovered from haemolymph and hepatopancreas. The study showed that the vibrios found were within admissible levels (10^2 to 4×10^3 cfu ml^{-1}).

Screening brooders and postlarvae of *P. monodon* for prevalence of MBV

Faecal samples of 217 *P. monodon* brooders from three hatcheries from Tamil Nadu were examined for MBV occlusion bodies using malachite green stained wet mount preparations.

The results showed that as many as 83 samples (38.3%) showed the presence of MBV occlusions.



Screening brooders and PL for MBV : Occlusion bodies in malachite green stained squash preparations of hepatopancreas and faecal samples of shrimp brooders (top). Histological section of hepatopancreas stained with H&E stain showing MBV occlusions in hepatopancratocytes

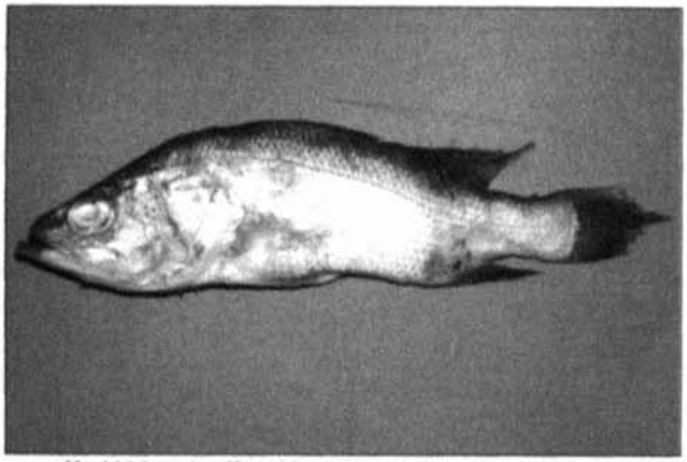
Parasitic infection in seabass

Seabass of 9-20 cm size maintained under captive conditions had mixed infections of monogenean species, *Diplectanum latesi* and *Dactylogyrus sp.* in large numbers with severe gill haemorrhages. The parasite was over-dispersed in the fishes and caused mortality.

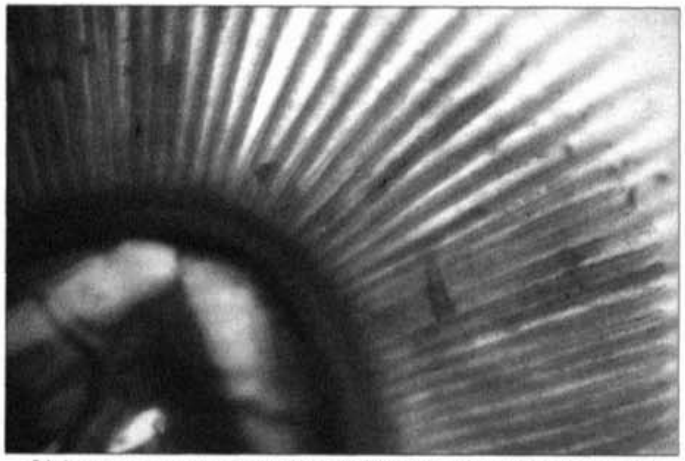
A combination treatment in 150 ppm formalin and 5 ppm acryflavin for 30 min was used for treating the affected fishes. Two fishes died after the treatment and the remaining 27 fishes in different age groups were healthy and parasite free after the treatment with 100 % survival thereafter. The study revealed that combined treatment with formalin and acryflavin was effective in controlling the parasitic infestation.

Antiparasitic effect of medium-chain fatty acids

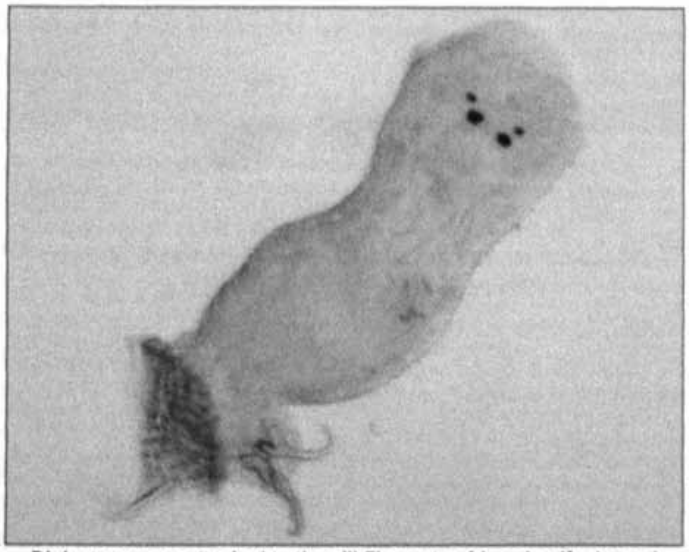
The efficacy of short chain (carbon numbers C2-C4) and medium chain (carbon numbers C6-C10) fatty acids to control ectoparasites was studied. Ciliate (*Trichodina* sp.) parasites from natural source were used in the trial using five fatty acids [Acetic acid (C2), butyric acid (C4), caproic acid (C6), caprylic acid (C8) and capric acid (C10)]. Each fatty acid was dissolved in filtered seawater at a concentration of 1 and 2 mM. The water samples containing ciliates



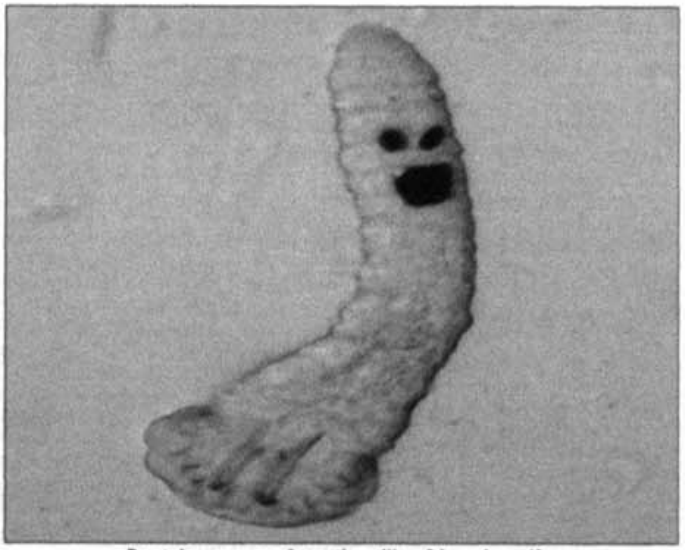
Morbid *L. calcarifer* with severe monogenean infestation accompanied with secondary bacterial infections on tail (arrow)



Diplectanum sp. attached to the gill filaments of *L. calcarifer* (arrow) [Note the haemorrhages on the gill filaments]



Diplectanum sp. attached to the gill filaments of *L. calcarifer* (arrow) [Note the haemorrhages on the gill filaments]



Dactylogyrus sp. from the gills of *L. calacarifer*

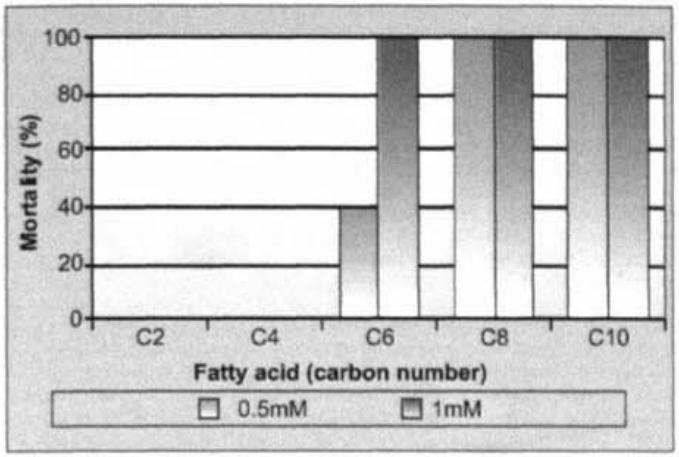


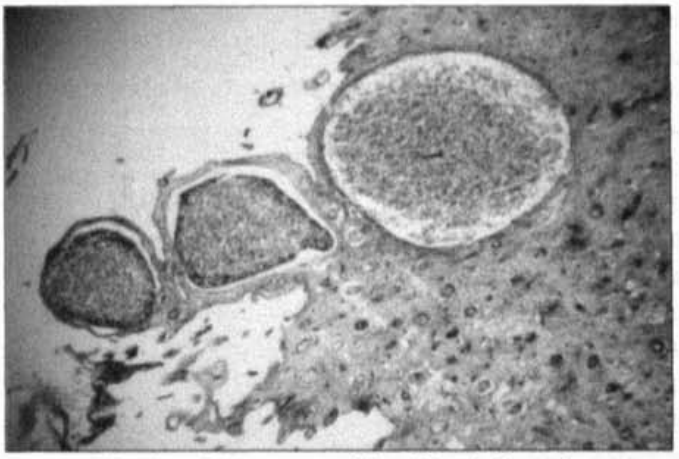
Fig. 4. Antiparasitic effect against ciliate parasites using different fatty acids

were placed into each of five wells of a tissue culture plate. Equal volume of fatty acid solution of each concentration was added to make the final concentration to 0.5 and 1 mM, respectively. The behaviour of the ciliates was observed under the microscope for one hour. The dead parasites were then stained by trypan blue dye exclusion method .Filtered seawater without the fatty acid was used as control. A noticeable effect was observed in media containing C8 and C10 fatty acids in controlling the ciliates at 1 mM concentration (Fig.4) which can be used as therapeutics.

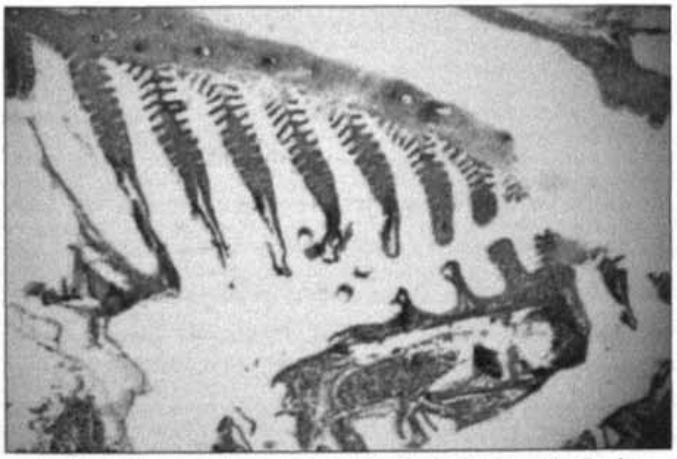
Histopathological studies on *Trichodina* sp. infection in mullet juveniles

Members of the genus *Trichodina* are the most common parasitic protozoans that are seen in juvenile mullets. Infected fishes show hypertrophy and hyperplasia of the epithelial cells of the gill lamellae. Acute hyperplasia was noticeable at the distal end of gill lamellae of host fishes.

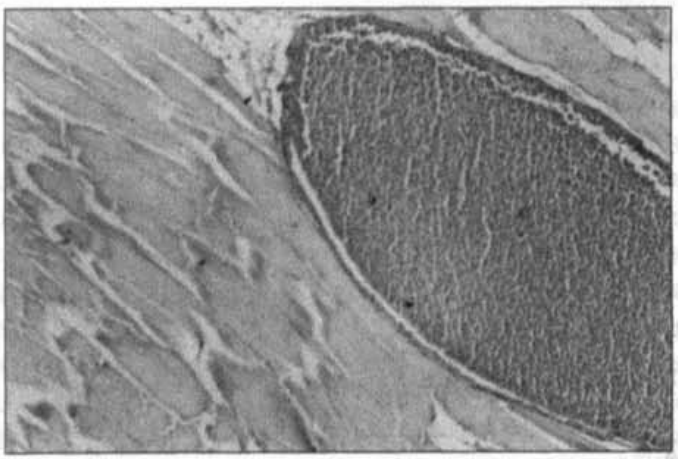
The myxosporidian *Kudoa* sp. infecting mullet has an expanding plasmodium which contains differentiating developmental stages at the periphery and the mature spores towards the center. Inflammatory response to infection is not pronounced. However, minor degenerative changes are observed at the leading ends of the plasmodium. The cysts contain quadrate spores of size 9 ± 0.87 mm length and 9.81 ± 0.84 mm width in polar view, pyramidal with broad posterior and pointed anterior ends in lateral view and possess



Section of the myxosporidian (*Myxobolus* sp.) infections in gill arches of mullet (100x)



Section of the gill filament showing *Trichodina* sp. attached to the fused lamellae. Hyperplasia and hypertrophy of the epithelial cells of the gill lamellae are also seen.

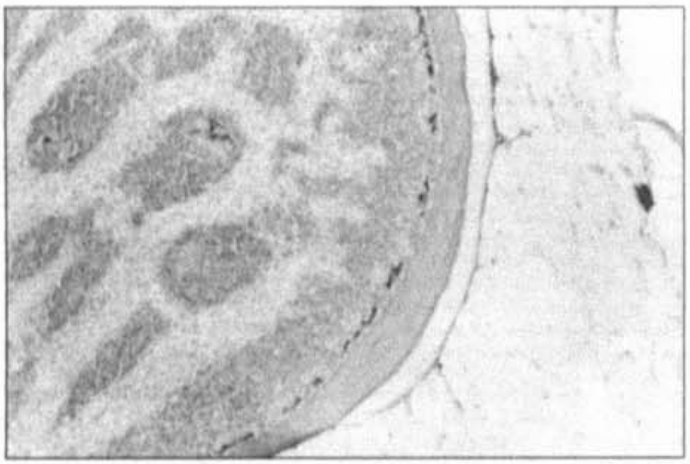


Section of the myxosporidian (*Kudoa* sp.) infections in muscles of mullet (100x)

slight constriction between the walls. Spores contain four polar capsules measuring 3.75 mm in length and 2.5 mm width with a polar filament measuring 17.02 ± 1.63 mm and four valves and sporoplasm finely granular filling the entire extracapsular space. Mucous envelop and iodinophilous vacuoles are absent.

Parasites in mullets

Histopathology of microsporidian *Glugea* sp. in the visceral organ of fish was conducted. The growth and proliferation of the microsporidian within the host cell results in complete destruction of the cells. The developmental stages and mature spores gradually replace the cell contents until the host cell becomes a mere envelope containing the parasite. Host tissue is damaged by pressure atrophy, which elicits proliferation of the connective tissue forming a layer around the parasite mass called xenoma.



Section showing the *Glugea* sp. cysts in the adipose tissue of the fish

Nodavirus infection in fishes

Freshwater aquarium fishes like Gold fish *(Carassius auratus auratus)* and Rainbow shark *(Epalzeorhynchos frenatum)* and its colour varieties (Albino Rainbow shark) were tested for noda viral infections by histopathology and RTPCR. The PCR used external primer, 5′ CGT GTC AGT CAT GTG TCG CT 3′ and 5′ CGA GTC AAC ACG GGT GAA

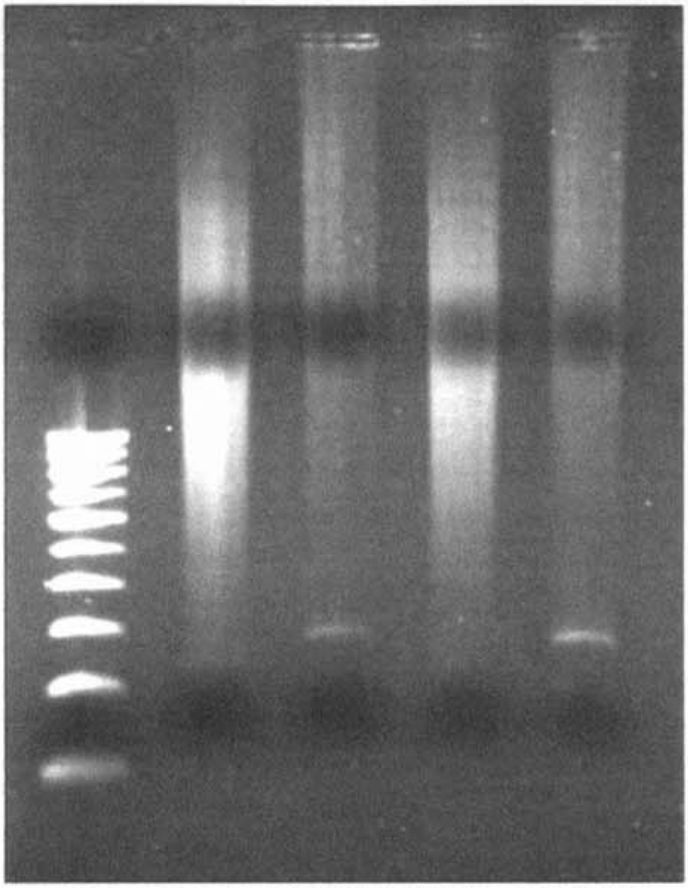
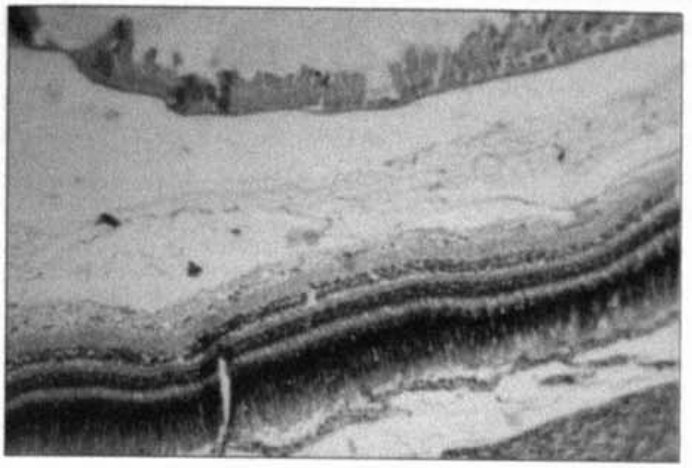


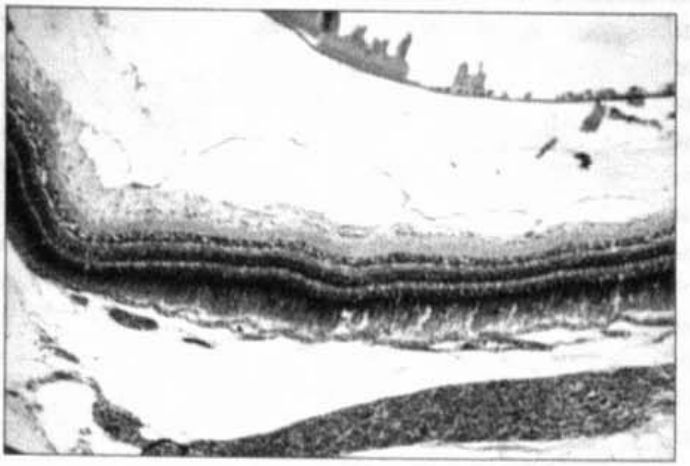
Fig.5. Detection of VNN by RT-PCR using internal primer, amplifying products of 280 bp.

GA 3′; internal primer, 5′ ACC TGA GGA GAC TAC CGC TC 3′ and 5′ CAG CGA AAC CAG CCT GCA GG 3′ for amplification of a target sequence of 430 and 280 bp, respectively. This primer sets are known to detect all the genotypic variants of fish nodavirus in Asian region. Amplification cycle used was: one cycle of initial denaturation for 95°C for 5 min., followed by 30 cycle at 95°C for 1 min., 60°C for 1 min., 72°C for 1 min., and final extension at 72°C for 5 min..

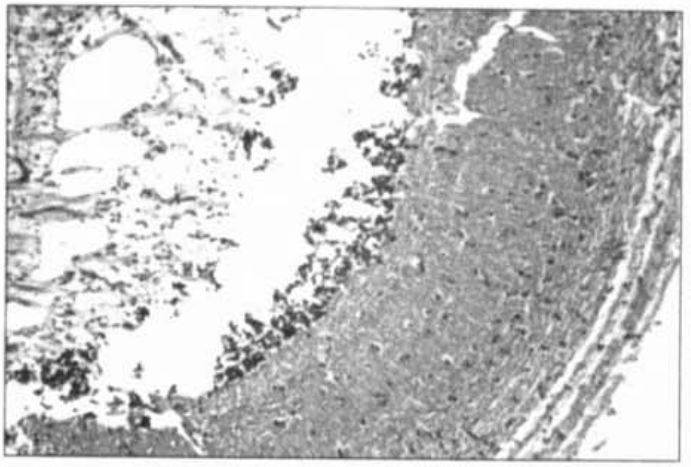
RT-PCR using the primers recommended by OIE for the diagnosis of most of the nodavirus strains was found to give a positive reaction with some of the freshwater aquarium fish species (Fig.5). Histopathology of these fishes also revealed typical lesions of VNN. Further confirmation by electron microscopy is in hand.



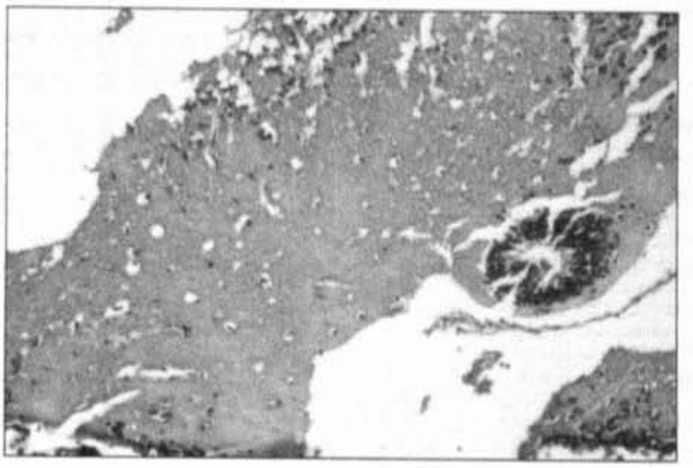
Histological section of cornea of normal fish and shark with mild vacuolation (100 x)



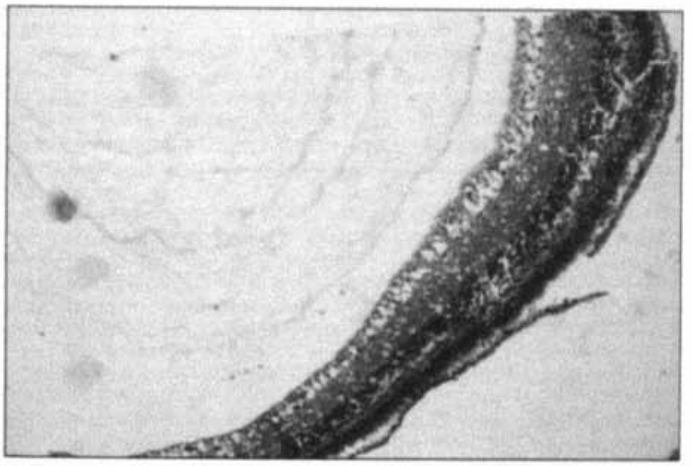
Histological section of cornea of infected Rainbow shark



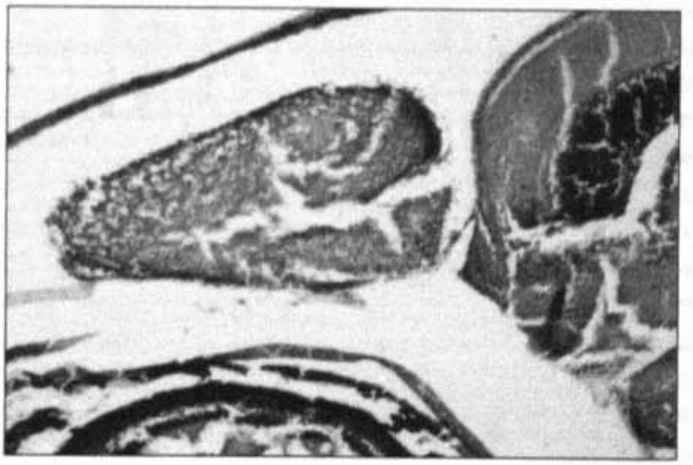
Section of the brain of Gold fish showing mild vacuolation (100 x)



Section of the brain of Rainbow shark showing vacuolation extensive vacuolation (200x)



Enlarged portion of the eye of *Lates calcarifer* with vacuolation in the neuronal and ganglionic layer (200x)



Histological section of cornea of infected Rainbow shark

Prophenoloxidase activity in *S. tranquebarica* as an indicator of health status

The prophenoloxidase system is an important mechanism of innate defence in arthropods. Its active form phenoloxidase (PO), a copper containing enzyme, catalyzes and initiates the synthesis of melanin that will act as a toxin against microorganisms. In decapod crustaceans, prophenoloxidase (proPO) is located mainly in granular haemocytes and haemocyte lysate supernatant was used as the enzyme source. No detailed reports are available for *S. tranquebarica*.

The presence of phenoloxidase (PO) activity in the haemocytes of *S. tranquebarica* was studied. Majority of the enzyme was located as proenzyme, proPO in the haemocytes. Electrophoresis of purified PO by native PAGE revealed a single prominent band of approximately 167.2 kDa which was further resolved to three bands having molecular mass of approximately 77.1, 56.9 and 30.2 kDa respectively, on SDS-PAGE.

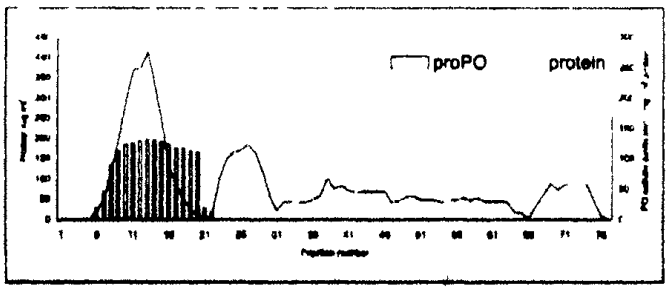


Fig. 6. Elution profile of haemocyte lysate by Sephadex G-200 column chromatography.

In conclusion, phenoloxidase exists as a proenzyme (proPO) in the haemocytes of *S. tranquebarica*. Purification of haemocyte lysate by gel filtration chromatography reveals a major peak of protein with PO activity (Fig.6).

Antioxidants and health status of fish

Spirulina incorporated feeds were fed to *P. monodon* and the antioxidants status of the animals were evaluated by estimating the activities of the enzymes namely superoxide dismutase(SOD), catalase, glutathione peroxidase(GPx), and levels of antioxidants such as vitamin C and E. The lipid peroxidation was also evaluated. The results on antioxidant status of the shrimps are presented in Table 11. The preliminary observations indicate that spirulina is efficient to increase the antioxidant status of the shrimps.

Table 11. Antioxidant status after 15 and 90 days of feeding with spirulina

Parameters	1	2	1	2	1	2	1	2
Protein	0.36	0.38	0.38	0.37	0.81	0.78	0.94	0.86
Catalase	0.016	0.019	0.011	0.015	0.058	0.105	0.154	0 131
GPX	0.002	0.002	0.003	0.003	0.031	0.018	0.011	0.012
GSH	0.070	0.043	0.059	0 060	0.03	0.06	0 12	0.09
SOD	0 114	0.096	0 096	0 104	0.62	0.69	0 55	0.55
LPO	0 14	0.10	0 11	0 11	0.08	0.05	0 07	0 05
Vit C	0 03	0 03	0.03	0 03	0.02	0 02	0 04	0.03
Vit E	0 16	0 10	0 12	0 15	0 18	0 13	0 19	0 25

* Both control and treatment had two replicates

DEVELOPMENT OF TECHNOLOGY FOR THE FARMS (AANED/DWT/1)

Products from lignocellulosic agro-wastes for the removal of nutrient load

Nitrogenous toxicants such as ammonia and nitrite are commonly reported from shrimp farm discharge water. The effect of lignocellulosic products developed from agro-wastes such as coconut husk, bagasse, wheat corns, rice straw and paddy husk in the removal of nitrogenous toxicants and detoxification of hexavalent chromium in water were studied. These products were found to be effective in removal of nitrogenous toxicants from water at a concentration of 1-3 g/l (Fig. 7 and 8). However, bagasse product was found to be more effective than other products in the removal of total ammonia. The product developed from paddy husk was found to be the most effective one in detoxification of hexavalent chromium. Similarly, the use of seaweeds for improvement of quality of discharge water was also examined. The green algae, *Ulva lactuca* was found to be most effective one. The algae support a good growth of bacterial biofilm.

These results may be of value in developing sound remediation strategies. The very low cost of the lignocellulosic materials renders it as suitable alternative for the remediation of priority aquatic toxicants from aquaculture water in tropical regions where factors like low cost and ease of application are of paramount importance.

Development of probiotics for the improvement of water and soil quality

Biostimulation and bioaugmentation are effective tools for using micro-organisms in ponds to enhance the rate of the biodegradation /

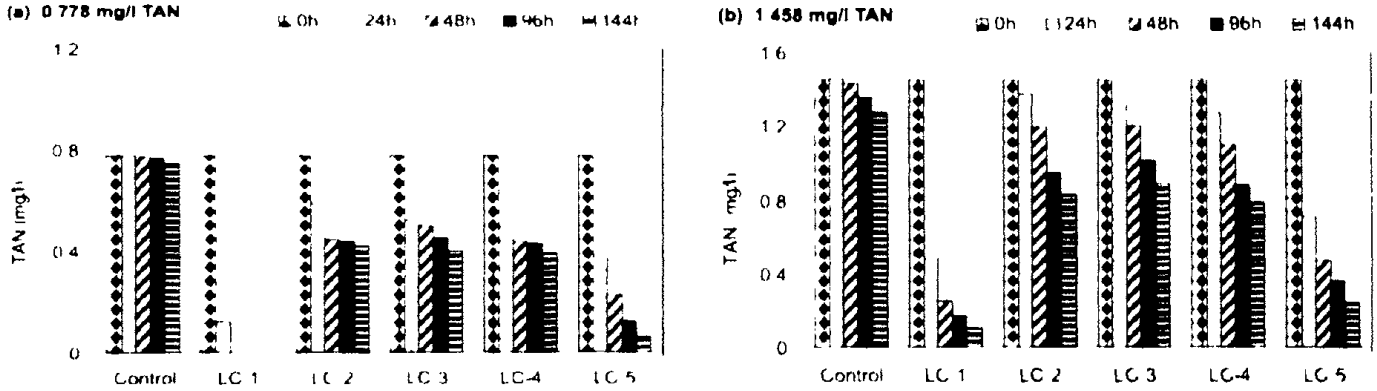


Fig. 7. Removal of total ammonia nitrogen using lignocellulosics from agro-wastes (LC-1: Bagasse, LC-2: Wheat corns, LC-3: Rice straw, LC-4: Paddy husk, LC-5: Coconut husk)

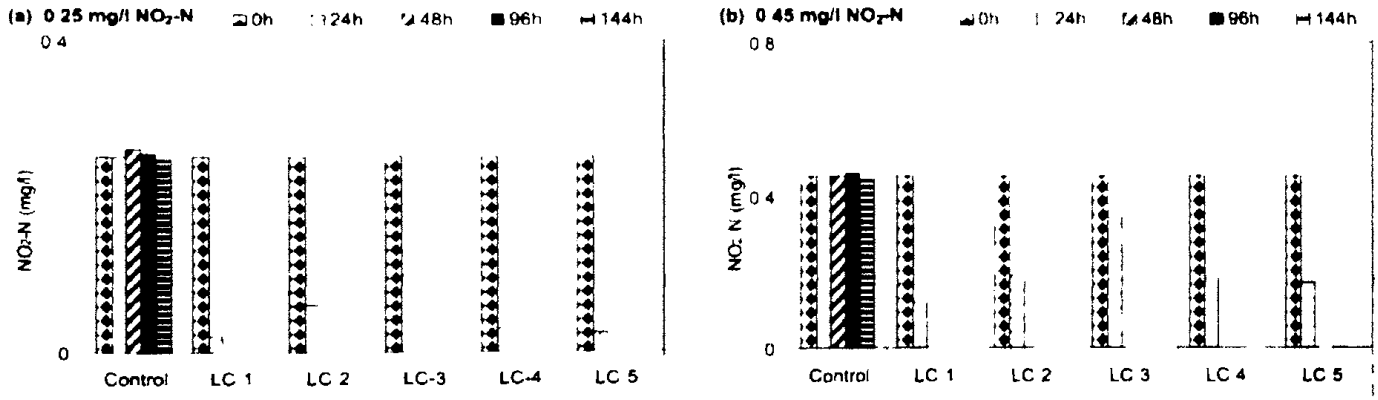


Fig. 8. Removal of nitrite-nitrogen using lignocellulosics from agro-wastes (LC-1: Bagasse, LC-2: Wheat corns, LC-3: Rice straw, LC-4: Paddy husk, LC-5: Coconut husk)

biotransformation of contaminants. Immobilization matrix was developed from bagasse for augmenting bacterial biomass growth and tested for its usefulness as a bioaugmentation product. It was observed that bagasse as biodegradable substrate supports abundant growth of the bacterial consortia and has no residue problem or adverse effect on other water quality parameters.

Bacteria were isolated from the filtrate of fermented rice husk and a formulation was prepared and tested for the improvement of water and soil quality. The experiment was conducted in the laboratory by introducing different concentrations of bacterial cells in water with and without soil. A significant decrease in nitrite N concentration and pH by 0.2 to 0.3 units were recorded in water with lower bacterial cells concentration ($1x10^6$ cells) in the treatments.

Carrying capacity assessment of source waters for shrimp farming

To develop area specific recommendation based on the carrying capacity assessment of water bodies, studies were carried out in two defined geographic areas; Polekuru Island and Mogalthur drain in Andhra Pradesh. Polekuru Island in East Godavari District is surrounded by 4 major source water bodies *viz.*, Bandha creek, Sarrihaddu Kaluva, Gaderu River and Vadalanali creek. Based on the monthly estimates of nutrient loading from the shrimp farms and assimilation capacity for one year, area that can be taken up for shrimp culture was estimated. Out of 2000 ha developed, a total area of 1300 ha can be taken up for culture on the source waters surrounding the Polekuru Island. Mogalthur drain (428 sq. km) in West Godavari District is being investigated as a water source for shrimp farms and sinks for discharge water from both shrimp farms and agriculture. The studies carried out in Polekuru Island and Mogalthur drain can be customized and applied to determine the carrying capacity of other water bodies.

Soil and water quality with muddy – moldy smell problem in shrimps

Soil, water and biological samples were collected from the shrimp *(P. monodon)* farms that were converted from fish ponds and are likely to be affected with muddy and moldy smell and also from the older shrimp farms in Akividu Mandal, West Godavari District.

During the study period muddy and moldy smell was not observed. Total ammonia N and nitrite N concentration in water and organic carbon content in soil were comparatively high in shrimp ponds converted from fish ponds (Table 12). However, in general soil and water quality characteristics can not be attributed to muddy and moldy smell problem.

Table 12. Soil and water characteristics of shrimp farms

Water quality	(Mean ± SD)	(Mean± SD)
Salinity (ppt)	0.5 – 9 (4.25 ± 2.95)	3 – 11 (7.75 ± 2.66)
pH	6.77 - 8.68 (7.87 ± 0.54)	7.26 – 8.03 (7.79 ± 0.29)
Alkalinity (ppm)	72 – 222 (139 ± 45.23)	116 – 200 (151 ± 27.29)
Hardness (ppm)	1040 – 2950 (2020 ± 694)	2250 – 4300 (3260 ± 650)
Total ammonia N (ppm)	0.048 - 2.042 (1.07 ± 0.887)	0.084 – 1.78 (0.876 ± 0.89)
Nitnte N (ppm)	0.067 – 1.549 (0.828 ± 0.64)	0.082 – 1.08 (0.454 ± 0.502)
Phosphate (ppm)	0.097 – 0.448 (0.239 ± 0 112)	0.086 – 0 406 (0.287 ± 0 105)
Soil quality		
Soil pH	7.54 – 8.03 (7.86 ± 0 178)	7.54 – 8 12 (7.91 ± 0.224)
EC (dS/m)	0 87 – 1 83 (1 32 ± 0.38)	0.98 – 2.51 (1 62 ± 0 52)
Organic carbon (%)	0 69 – 1 56 (1 19 ± 0 36)	0 48 – 1 05 (0 79 ± 0 21)

NUTRITION, GENETICS AND BIOTECHNOLOGY DIVISION

RESEARCH PROJECTS

- Title of project: Development and demonstration of balanced feeds for Asian seabass, crabs and improvement of shrimp feeds (NGBD/NT/2)

  Principal Investigator: Dr.S.A.Ali

  Location of project: Chennai and Kakdwip

  Co-Investigators: Dr.J.Syama Dayal, Dr.Debasis De, Dr.K.Ambasankar

  Dr.M.Natarajan, Dr.C.Gopal

- Title of project: Genetic characterization of brackishwater shellfishes and finfishes through molecular techniques (NGBD/MG/1)

  Principal Investigator: Dr.G.Gopikrishna

  Location of project: Chennai

  Co-Investigator: Dr. M.Shashi Shekhar

DEVELOPMENT AND DEMONSTRATION OF BALANCED FEEDS FOR ASIAN SEABASS, CRABS AND IMPROVEMENT OF SHRIMP FEEDS (NGBD/NT/2)

Improvement of weaning diet for seabass larvae

The nutritive value of weaning diet developed for seabass, *L. calcarifer* larvae has been further improved by incorporating polychaete worms that are rich in polyunsaturated fatty acids. The diet was prepared with different levels of polychaete supplementation by freeze drying technique and tested with 18- day post hatch seabass larvae distributed in six 500l tanks @ 1000 larvae per tank. The control group was fed with live *Artemia* nauplii, while the treatment group was fed with freeze dried micro-diet along with *Artemia* nauplii (co-feeding). The live feed was gradually replaced with the micro diet in 15 days from the start of the experiment. Results of the 22-day feeding trial revealed that co- feeding of micro diet along with *Artemia* nauplii improved the growth and survival and resulted in faster metamorphosis of the fish larvae. Further the larvae had grown uniformly with reduced incidence of cannibalism (Table 13).

Development of grow-out feed for seabass

A grow out feed for seabass fingerlings was prepared using fish meal, *Acetes*, squid, soybean cake, wheat flour, minerals and vitamins, containing 40% crude protein and 7% lipid in three different forms -floating pellets, slow sinking pellets and quick sinking pellets by using the twin screw extruder. The feeding trial on seabass larvae with an average size of 150mg indicated that slow sinking pellet is the preferred form of diet. The fry could also consume the feed settled at the bottom. The fishes totally adapted to the formulated diet and attained 150 g in four months.

Determination of feeding rate of *S. serrata*

An experiment was conducted to find out the optimal feeding rate of juvenile *S. serrata* having average size 31.08g. The crabs were individually kept in FRP tanks with four replicates per treatment. They were fed at the rate of 1, 2, 3, 4, 5 and 6% of body weight in two equally divided doses. The results of the 45 days feeding trial showed that up to 3% body weight the crabs could consume the total quantity of feed offered and above this level there was a linear increase in the feed left over in the tank (Fig. 9). Crabs fed at 4% body weight showed maximum weight gain. However, the group fed with 3% body weight showed better FCR. The results indicate that feeding @ 3-4% body weight may be the optimal rate for the crabs.

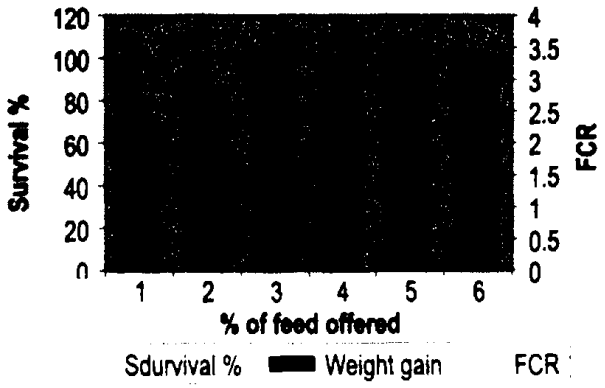


Fig. 9. Fedding rate of *S. serrata*

Performance of mud crab, *S. serrata* fed different types of feeds

At Kakdwip, the growth performance of pellet feed, dry trash fish and poultry offal on the juveniles of *S. serrata* was studied. Crabs were fed at the rate of 2-5% body weight per day, divided into two equal rations given in the morning and evening. After 85 days of rearing it was found that total feed intake was the highest with dry trash fish (72.99g) followed by pellet feed (50.41g) and poultry offal (28.50g). Feed conversion ratio was lower in pellet

feed (1.05g) compared to that of dry trash fish (2.79g) and poultry offal (2.22g) (Table 14). Total body weight gain and average daily weight gain did not differ significantly among the groups. The results indicated that pellet feed can be used for crab rearing in the place of trash fish or poultry offal.

Field testing of grow-out pellet feed for mud crab

A crab pellet feed having 38.4% crude protein and 6.05% lipid was formulated from locally available feed ingredients for grow out culture of crabs. The feed was tested in the grow-out ponds at Kakinada Research Centre of Central Institute of Fisheries Education (CIFE). Six ponds, each 0.081 ha in area, were stocked @ 5,000/ha with juveniles *S. serrata* with an average size of 46.71g. In three ponds the crabs were fed with marine trash fish which served as control and in the remaining three ponds the pelleted crab feed was given @ 2-3% of body weight through tray feeding method. The crabs were harvested after 138 days of culture and the results are summarized in Table 15.

Table 13. Effect of micro diet on seabass larvae

Parameter	Control	
Average initial size (mm/mg)	6.0 / 5.0	6.1 / 5.0
Average final size (mm/mg)	20.1 / 85.0	22.0 / 112.0
Weight range (mg)	65-103	35-200
Survival (%)	80.5	56.25
Shooters at the end of the experiment (%)	3.5	15.2

Table14. Growth of *S. serrata* fed with different feeds

Initial body weight (g)	96.63 ± 6.28	145.00 ± 17.32	125.44 ± 4.94
Final body weight (g)	147.25 ± 0.14	198.25 ± 3.90	138.68 ± 6.54
Weight gain (g)	50.63 ± 6.13	53.25 ± 21.22	13.24 ± 1.59
Average daily weight gain (mg)	595.59 ± 72.17	626.47 ± 249.62	155.77 ± 18.75
Initial carapace length (mm)	80.25 ± 0.72	87.50 ± 3.18	87.63 ± 1.37
Final carapace length (mm)	89.50 ± 1.44	94.25 ± 0.43	87.70 ± 1.44
Initial carapace width (mm)	55.25 ± 1.01	58.13 ± 1.08	57.75 ± 0.14
Final carapace width (mm)	63.50 ± 2.02	64.50 ± 2.60	60.00 ± 0.00
Total feed consumed (g)	50.41 ± 0.14	72.99 ± 3.99	28.50 ± 1.35
FCR	1.05 ± 0.13	2.79 ± 1.19	2.22 ± 0.16

Table 15. Growth of *S. serrata* fed with pellet feed

Treatment	ABL (mm)	ACL (mm)	ABWT (g)	ABL (mm)	ACL (mm)	ABWT (g)	Survival (%)	Yield (kg)	Yield (kg)
Control	44.78	63.81	46.75	69.86	102.5	224.3	19.02	237.8	23.75
Feed	44.83	63.46	46.66	68.3	100.23	235.0	31.58	371.5	33.5

ABL= average body weight. ACL= average carapace length. ABWT= average body weight.

The crabs fed with pellet feed attained higher growth, production and survival compared to the control group. At Kakdwip Research Centre, a crab pellet feed was formulated and tested in two ponds stocked @ 1.0/m^2 with *S. serrata* juveniles (60-70g). They were fed with pellet feed @ 1.5 % biomass. After 160 days of rearing the crabs attained an average size of 163g. The results of the experiment indicated that pellet feed can be successfully used for feeding crabs in grow-out ponds. Further large scale trials are needed for transfer of this technology to farmers.

Lipid distribution in shrimp

Total lipid and cholesterol distribution in *P. monodon* (10-15g) were analysed from hepatopancreas, tail muscle and exoskeleton. Hepatopancreas had the highest lipid content (7.4%) followed by tail muscle and exoskeleton (Table 16). Though the total lipid content was higher in hepatopancreas, the cholesterol content expressed as percentage of lipid content was lower (3.2%) than in hepatopancreas in tail muscle (12.88%) and exoskeleton (13.16%). The study carried out with a view to understand lipid distribution revealed that more lipid is concentrated in the hepatopancreas while more cholesterol is found in exoskeleton and muscle. The fatty acid analysis of the lipid has to be carried out to understand the type of fatty acids required in the diet of shrimp.

CIBA shrimp feed demonstration

Demonstration of CIBA shrimp feed was carried out in two farmers' ponds (0.5 ha), one each in Pulicat and Sirkazhi. The ponds were stocked with *P. monodon* seed @ 10/ m^2 and the shrimps were fed with CIBA feed. The culture period lasted only 60 days at Sirkazhi and 73 days at Pulicat, by this time in both the farms white spot virus disease was noticed. The shrimps were immediately harvested and their average size was 12.0g at Sirkazhi and 9.0g at Pulicat. The trials of feed demonstration revealed that the shrimp fed with CIBA feed showed excellent growth for the duration of culture. The shrimp feed technology is ready for transfer to shrimp farmers.

Broodstock feed for milk fish, *Chanos chanos*

A floating pellet feed (C.P:38%, lipid:7%) was prepared in an extruder for feeding the captive broodstock of milk fish (1-1.5kg). In 120 days, average growth of 850g and feed efficiency of 2.33 were obtained. The pellet feed can successfully be used for raising milkfish broodstock in captivity.

Effect of dietary protein levels on *L. tade*

Four isoenergic (4 Kcal/g) pellet feeds containing 20%, 25%, 30% and 35% protein levels were formulated using locally available feed ingredients, to study the effect of protein levels on growth of *L. tade* juveniles at Kakdwip. The fishes (1.6-2.3g) were stocked @ 5 nos./tank with three replicates for each feed. They were fed @ 10-7% of body weight. At the end of 120 days it was found that the daily body weight gain (mg/d) was the highest (32.11 ± 4.06) in fishes fed with 25% protein diet. It was also found that the feed intake decreased gradually with the increase in dietary protein level. Feed conversion ratio (FCR) was the lowest (7.96 ± 0.91) in group fed with 25% protein diet. Dry matter and crude protein digestibility were also significantly

Table 16. Lipid distribution in *P. monodon* tissues.

Hepatopancreas	**7.396**	**3.2**	**235.2**
Tail muscle	**1.758**	**12.88**	**218.6**
Exoskeleton	**1.984**	**13.16**	**256.2**

higher in the fish at this protein level. Specific growth rate (SGR) showed increasing trend up to 25% protein level in the diet beyond which it started declining. The study reveals that 25% dietary protein level is optimal for *L. tade* juveniles.

Effect of different dietary levels of protein on growth performance of *E. suratensis*.

At Kakdwip, four isoenergic (4 Kcal/g) pellet feeds with 20%, 25%, 30% and 35% protein levels were formulated using locally available feed ingredients to study the effect of protein levels on the growth of *E. suratensis* juveniles (0.41-0.48g). The test diets were fed to groups of twenty five fishes in three replicates. The fishes were fed initially @ 10 % of body weight and gradually it was reduced to 2.5%. In 120 days, the average daily body weight gain (mg/d) was found to be highest (9.25 ± 0.73) in the group fed with 30 % protein. Feed conversion ratio (FCR) was the lowest (4.92 ± 0.19) in group fed with the same diet. Dry matter digestibility, protein efficiency ratio (PER) and specific growth rate (SGR) showed increasing trend up to 30% protein level in the diet, beyond which it started declining. From the present study it can be concluded that 30% protein is the optimal level in the diet of *E. suratensis* juveniles.

GENETIC CHARACTERIZATION OF BRACKISHWATER SHELLFISHES AND FINFISHES THROUGH MOLECULAR TECHNIQUES (NGBD/MG/1)

Development of species specific DNA based molecular marker

16s rRNA and control region segments of mitochondrial DNA (mtDNA) were amplified by polymerase chain reaction (PCR). The amplified products were subjected to Restriction Fragment Length Polymorphism (RFLP) analysis to identify the restriction enzymes which could differentiate the three penaeid shrimp species of *F. penicillatus*, *F. merguiensis* and *F. indicus*. PCR-RFLP analysis was carried out in five *F. penicillatus* shrimp samples collected from Kakdwip (West Bengal), three each of *F. merguiensis* samples collected from Goa, Chennai and Puri and three each samples of *F. indicus* collected from Chennai and Puri. PCR-RFLP of 16s rRNA segment of mtDNA could successfully differentiate *F. merguiensis* from *F. penicillatus* and *F. indicus* using Apo I and Ssp I restriction enzymes. Whereas, in case of PCR-RFLP of control region segments of mtDNA all the three penaeid species could be differentiated separately based on different RFLP profile generated by Apo I restriction enzyme.

PCR-RFLP analysis of mitochondrial control region gene segment in *P. monodon*

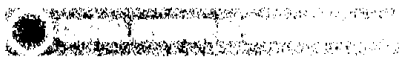
The earlier study had shown that 16s rRNA mitochondrial gene was highly conserved in *P. monodon* samples collected from west and east coast regions of India. The high level of sequence identity observed in 16s rRNA mitochondrial gene segment suggested that it will be more useful to focus on other variable mitochondrial DNA regions such as control region which may be more informative for population studies. Further studies on sequence analysis of control region amplified from *P. monodon* samples revealed sequence variation indicating its potential usage as marker for population studies in penaeids. A total of 44 base substitutions were observed with 75% transitions and 25% transversions. PCR-RFLP analysis confirmed the existence of sequence variation sites in the mitochondrial control region gene, revealing a number of informative sites.

GenBank sequence submission

Twelve sequences pertaining to *P. monodon*, *M. japonicus*, *F. indicus* and *M. cephalus* have been

submitted to the GenBank and is available on the internet through National Centre for Biotechnology Information (NCBI).

1. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ212766: *Penaeus monodon* from India : Kakdwip, control region, partial sequence; mitochondrial.
2. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ212765: *Penaeus monodon* from India: Mumbai, control region, partial sequence; mitochondrial.
3. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ212764: *Penaeus monodon* from India: Chilka, control region, partial sequence; mitochondrial.
4. Shekhar, M.S., G.Gopikrishna, C.Gopal, P.Ravichandran and S.M.Pillai. GenBank Accession number DQ187947: *Marsupenaeus japonicus*, control region, Chennai, partial sequence; mitochondrial.
5. Shekhar, M.S., G.Gopikrishna, C.Gopal, P.Ravichandran and S.M.Pillai. GenBank Accession number DQ187946: *Marsupenaeus japonicus* 16S ribosomal RNA gene, Chennai, partial sequence; mitochondrial.
6. Shekhar, M.S., M.Natarajan, G.Gopikrishna and M.Abraham. GenBank Accession number DQ185446: *Mugil cephalus* 16S ribosomal RNA gene, Chennai, partial sequence; mitochondrial.
7. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ176048: *Penaeus monodon* cytochrome oxidase subunit I (COI) gene, Chennai, partial cds, mitochondrial.
8. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ174275: *Penaeus monodon* control region, Kakinada, partial sequence; mitochondrial.
9. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ173438: *Fenneropenaeus indicus* control region, Chennai partial sequence; mitochondrial.
10. Shekhar, M.S., I.S.Azad and K.P.Jithendran. GenBank Accession number DQ146969: *Macrobrachium rosenbergii* nodavirus RNA-directed RNA polymerase gene, partial cds.
11. Shekhar, M.S., G.Gopikrishna, C.Gopal, P.Ravichandran and S.M.Pillai. GenBank Accession number DQ149968: *Fenneropenaeus indicus* 16S ribosomal RNA gene, Chennai, partial sequence; mitochondrial.
12. Shekhar, M.S. and G.Gopikrishna. GenBank Accession number DQ144237: *Penaeus monodon*, control region, Chennai, partial sequence; mitochondrial.



SOCIAL SCIENCES DIVISION

RESEARCH PROJECTS

- Title of project: Technology transfer, socio economic aspects and informatics in brackishwater aquaculture (SSD/EXTN/3)

  Principal Investigator: Dr.M.Krishnan

  Location of project: Chennai

  Co-Investigators: Dr.T.Ravisankar, Dr.V.S.Chandrasekaran, Dr.(Mrs.) B.Shanthi, Dr.(Mrs.) D.Deboral Vimala, Dr.M.Kumaran and Dr.(Mrs.) Ch. Sarada

Case studies on economic and statistical appraisal of shrimp and fish farming

The following set of case studies were conducted in 2005-06 in consonance with the project objectives for understanding the growth and development patterns of shrimp farming sector in India in the focus on production, trade and transfer of technology aspects.

Study on growth of shrimp farming in India

Growth of shrimp farming has showed significant fluctuations in terms of area, production and productivity over the years and these variations were studied by nonparametric regression method. The analysis revealed that growth of Indian shrimp farming is largely governed by the aquaculture development in the east coast states and the aquaculture potential of west coast has not been exploited. The growth rate is higher in states that practice commercial shrimp farming than in states practicing traditional farming systems. To understand the similarity in overall growth pattern among different states, a dendrogram was constructed by means of cluster analysis considering computed nonparametric regression growth rates. It indicated that two broad clusters among the states following commercial shrimp farming can be formed. Tamil Nadu, Gujarat and Andhra Pradesh form one cluster and rest of the states the other. The second cluster can be further sub-grouped into traditional farming states, *viz.*, Kerala, Karnataka and West Bengal as one sub

group and others as individual states. It may be noted that the growth pattern in shrimp farming is similar for those states which are practicing same system of farming. The findings were related to policy frame work changes needed for accelerating the shrimp farming in the above two clusters and three sub groups.

Statistical analysis of climatic changes on fisheries

A study on the effect of climatic changes on fisheries was attempted to find the correlation between climatic changes and Indian fisheries. Data on landings of different fish species *viz.*, oil sardine, Bombay duck, mackerel, penaeid shrimp and production of cultured shrimp were regressed with time trend and Southern Oscillation Index (SOI). The analysis revealed that an unit change in SOI increases the landings of oil sardine, mackerel, ribbon fish and peanaid shrimp to the tune of 284, 90,148, 26 mt, respectively, while an unit change in SOI decreases the Bombay duck landing and cultured shrimp production to the tune of 15 and 367 mt. The model after extensive validation could be used widely to predict fisheries and aquaculture production in India.

Export performance, competitiveness and future prospects of Indian shrimp

Study was conducted to measure export competitiveness of Indian shrimp to understand the trade preparedness of Indian aquaculture. Secondary data on shrimp exports and domestic prices for 2001-2004 were collected from MPEDA and Tamil Nadu Fisheries Development Corporation. Nominal protection coefficients and Instability indices of prices of Indian frozen shrimp exports were computed. The analysis disclosed that in general nominal protection coefficient values were the lowest during June, July and August. Coppock's Instability indices for domestic prices ranged form 4.9 to 8.8 and 5.7 to 8.5 for export of frozen shrimp prices. The study brings out seasonality in shrimp export prices which needs to be evaluated in detail so as to relate the output from Indian aquaculture sector according to changes in the world prices.

Commodity concentration and geographical spread of Indian seafood exports

One case study was conducted on commodity concentration and geographical spread with commodity wise and country wise seafood exports data for the period 1981-82 and 2003-2004 collected from Marine Products Exports Review (MPEDA) and based on this study Gini-Hirshman's concentration coefficient was computed. The analysis revealed that the commodity concentration gradually decreased from 87% in the early 80's to 68% in 2003-04 indicating that the country is slowly diversifying in to different seafood products for exports. Geographic concentration also gradually decreased from 72% to 50% indicating exports to different countries. The findings firm up the belief that Indian fisheries sector is developing fast and responding to the global situation.

Modelling Indian seafood instability index through co-integration and error correction models

Growth should be coupled with lesser instabilities so that growth is a continuing process. The instability in seafood exports was studied by developing instability index which revealed some important information. Time series data from 1981-82 to 2003-04 on seafood exports earnings were obtained from Marine Products Exports Review and the index was computed. The analysis indicated that in the early eighties instability in the

exports was minimal but it gradually increased in the nineties and it was the highest in 2003-2004.

Causes for Indian seafood export instability were analyzed through co-integration techniques and error correction models. The major determinants causing instability are commodity concentration, geographic concentration, instability in fisheries GDP and non fisheries GDP and shrimp production and these variables are found to exert more influence in the seafood exports in the long run than in short period. The study brought out the importance of diversification of commodities exported from the country and increasing number of the countries to which they are being exported.

Estimation of share of marine and inland fishery GDP

To find out the impact of fisheries on country's economy, another case study was conducted. Estimates of Marine and Inland fishery GDP at constant prices (1993-94) for the year 2003-04 were computed. The analysis revealed that marine and inland fisheries contributed 43.14 and 56.86%, respectively towards fisheries GDP. The share of marine and inland fisheries towards agriculture GDP is 1.91 and 2.51% and towards total GDP is 0.41 and 0.55%, respectively. The study revealed the declining rate of growth of marine sector compared to aquaculture in the country.

Generalised nonlinear growth model for Asian seabass

To find a suitable statistical model for best fit of growth of Asian seabass, a study was conducted. Schnute's Generalized nonlinear growth model was fitted to the age–length growth data of Asian seabass juveniles. A total of 809 fishes were analysed at 12 fort night intervals. Differential growth was observed among the individuals of the same age group of the sampled data. It was observed that variance in length measurements increased over age indicating heteroscedastic nature of the data. The effect of error structure was investigated by considering additive and multiplicative errors for fitting the Schnute's Generalized nonlinear growth model to the data. The shape of the fitted curves suggested that the practical difference was minor within the range of the observed ages. However, based on the goodness-fit-statistics and correlation structure of parameter estimates, it may be concluded that growth model with multiple error fitted well for describing the growth of Asian seabass juveniles under culture conditions.

Length-weight relationship in Asian seabass

In another case study the daily growth and length-weight relationship in Asian seabass larvae were studied. The larvae attained a mean total length, standard length and total wet weight of 10.96±0.49mm, 8.97±0.47mm and 31.93±3.63mg respectively at 21 days of post hatching. Growth rate of larvae was higher with size variation when the feeding regimen was changed from rotifer *(Brachionus plicatilis)* to *Artemia* nauplii and *Artemia* biomass. The correlation co-efficient of total length with total weight and standard length with total weight were highly significant. Log transformed regressions were used to study the length-weight relationship. Total length, total weight and standard-length and total weight relationships indicated the allometric growth pattern in the larvae during hatchery rearing phase and the study provided statistical evidence for variable growth of Asian seabass even at larval stages.

Case studies on extension strategies and models for sustainable brackishwater aquaculture

Case studies were conducted to know the latest situation of traditional farming sector of the country.

Farming systems in Kerala

A field study of shrimp and fish farms (n=53) was undertaken in the seasonal fields (84%) and perennial fields (16%) in Ernakulam district of Kerala during May 2005. The major findings of the study are:

- Pokkali farming generated 222 man days per ha per crop of which 39.63% of the work were for men labourers and rest of the work were for female labourers.
- Chemmeenkettu system offered 264 man days of work, out of which 71.22% was done by men and the remaining work by women.

The major constraints for increasing productivity under these systems were unscientific pond preparation, auto stocking variations and auto entry of predatory fishes.

Awareness and utilization of computers by shrimp farmers

A study was undertaken in Thiruvallur and Thoothukudi districts of Tamil Nadu to assess the awareness of shrimp farmers (n=50) on the use of computers and their constraints. The study revealed that the major sources of awareness for the farmers are personal local information sources like fellow farmers and friends (42%) and mass media channels (34%) followed by extension agency contacts (18%) and internet (8%). Regression analyses on the awareness scores among the respondents revealed that the eight independent variables explained 71% of the variance in the farmers' awareness on use of computers. Further the results showed that four variables *viz.*, age, farming experience, farm size, and mass media exposure would have to be strengthened to increase the awareness on the utility of computers in shrimp farms. Lack of technical knowledge and technical support were the main constraints found in the awareness and utilization of computers by shrimp farmers.

Gender empowerment in hatchery operations

Another case study was designed for the purpose of identifying gender issues of aquaculture especially management of technical set ups like hatcheries.

Periyar Mud Crab Hatchery, Mugaiyur, Cheiyur Taluk, and Periyar Integrated Fish Farm, Vandalur, Chengalpet Taluk, Kancheepuram District managed by women managers and having sizeable women hatchery technicians were selected for the study to define the opportunities for women to participate in the various types and stages of hatchery operations as mangers and technicians. The study covered the motivating and facilitating factors, decision making practices, income and attitude towards their role in hatchery management and also the role of women in aquaculture development, especially when they are given the necessary technical assistance and extension support to gain new skills or improve the existing skills which will motivate them to take up employment in hatcheries.

The rank score analysis revealed that financial necessity (124) and economic independence (117) are the two main factors motivating the rural women to take up job in hatcheries followed by spending their time usefully and raising their standard of living. Analysis of facilitating factors revealed that family members/friends in the same job (105), unmarried status (93) and job security (66) are the main factors that guide the women to take such jobs. Among the problems faced by them physical exhaustion ranked first followed by the long period of working hours, irregular duty hours, lack of training and lack of confidence.

The study emphasized the need of developing drudgery reducing small tools and less labour intensive aquaculture technologies by which more participation of women in aquaculture could be encouraged.

Gender disparity in shrimp farming

Another case study was done with sixty two women labourers from the coastal districts of Andhra Pradesh for assessing the degree of their participation in shrimp farming. It was observed that the involvement of women labourers was marginal and they were engaged in activities such as processing, harvesting (hand picking), pond preparation, farm construction and maintenance and feeding of shrimp. Works such as pond construction, feed preparation, feeding, monitoring, sampling, harvesting and farm management were dominated by men. The low degree of participation of women was due to lack of knowledge on shrimp culture as they were generally not exposed to extension programmes. It is felt that social barriers, beliefs and cultural norms must be first assessed to make extension work more attractive and participatory for women. The disparity in employment can then be overcome by rendering specialized extension training programmes for women in scientific farming practices in order to improve their awareness, knowledge and skills and to incite interest in shrimp farming.

EXTERNALLY FUNDED PROJECTS

Projects funded by AP Cess Fund of ICAR

NATIONAL RISK ASSESSMENT PROGRAMME FOR FISH AND FISH PRODUCTS FOR DOMESTIC AND INTERNATIONAL MARKETS

Principal Investigator **Dr.B.P.Gupta**

Co-Investigators **Dr.M.Muralidhar, Dr.K.K.Krishnani, Dr.C.Gopal, Dr.S.V.Alavandi** *and* **Dr.K.P.Jithendran**

Duration **2003-2006**

Shrimp *(Penaeus monodon)* samples were collected from the farms and landing stations/markets in the coastal districts of Nellore (Andhra Pradesh), Cuddalore and Nagapattinam (Tamil Nadu) and analysed for heavy metals (Lead, Cadmium, Chromium, Zinc, Mercury and Arsenic), pesticides (aBHC, gBHC, bBHC, Heptachlor, Aldrin, Dieldrin, Endrin, ppDDE, Heptachlor epoxide, opDDT, opDDT, ppDDT, ppDDT), microbial load *(Vibrio cholerae, V.parahaemolyticus, Salmonella spp., Aeromonas spp.* and *Plesiomonas shigelloides)* and screening of parasites (protozoan and metazoan). The analyses revealed that heavy metals were present in the shrimp tissues irrespective of locality, though they were below the permissible limit in almost all the samples as per Indian standards. Isomers of BHC and heptachlor were the only detectable pesticides found in the samples. The levels of pesticides recorded were below the maximum permissible limit. Four farm samples in Nellore and 12 market samples (Nellore-8, Cuddalore-3 and Nagapattinam-1) contained enteric pathogens (*Vibrio* spp; *E coli; S. aureus* and feacal streptococci) of public health importance with TPC above the maximum permissible limit of $5x10^5$ cfu/g. The samples from export companies contained low levels of bacterial load compared to samples collected elsewhere. The samples were found free of protozoan and metazoan parasites.

To monitor the quality of seafood after the tsunami fish and shrimp samples collected from markets in and around Chennai were analysed for microbial and heavy metal contaminations. The analysis revealed that some samples of *Sardinella longiceps* (Sardine), *Rastrelliger kanagurta* (Mackerel), *Cybium comersoni* (Seer), *Nemipterus nemurus* (Redspine), *M. cephalus* (Mullet), *M. rosenbergii* (Scampi) and *L. calcarifer* (Seabass) contained *E. coli; V. parahaemolyticus; V. vulnificus* sp.; *S. aureus* feacal Streptococci and above the maximum permissible limit of $5x10^5$ cfu/g. All the samples showed the presence of heavy metals within safe levels except for chromium (Cr) in three samples of sardine.

EVALUATION OF NUTRITIVE VALUE OF (*BRACHIONUS* SPP.) AND THEIR SUITABILITY FOR LARVICULTURE OF ASIAN SEABASS *L. CALCARIFER* (BLOCH)

Principal Investigator **Dr.M.Kailasam**

Co-Investigators **Dr.A.R.Thirunavukkarasu** *and* **Dr.J.Syama Dayal**

Duration **2004-2007**

Morphometric studies of rotifers, *Brachionus* sp. collected from five different localities along the east coast revealed that the lorica length of Krishna strain was the smallest (139 94±17.00 μm) followed by Chilka lake (147.30±19.61 μm), Turicorin (150.94±25.47 μm), Hooghly (174.67±27.07 μm) and Adyar (177.58±28.43 μm) strains.

The nutritive value of *Brachionus plicatilis* cultured with five different micro algae was evaluated and found that total lipid content was highest in *Nannochloropsis oculata* fed rotifers (17.2%) followed by *Skeletonema costatum* (15.2%), *Chaetoceros* spp. (14.9%), *Isochrysis galbana* (11.0%) and *Chlorella salina* (9.8%) fed rotifers. However, the protein level was high in *I galbana* fed rotifer (52.7%) followed by *S. costatum* (51.46%), *Chaetoceros* spp. (49.5%), *N. oculata* (47.2%) and *C. salina* (45.2%). Carbohydrate level varied from 3.8% (*S. costatum*) – 5.6% (*N. oculata*).

The growth of seabass, *L. calcarifer* larvae was assessed by feeding with rotifers cultured with different feeds like *Chlorella salina*, yeast, *C. salina* combined with yeast and frozen rotifer (-20°C). In 10 days rearing, seabass larvae (2 days old) with total length of 2.29±0.21 mm and standard length of 2.16+0.21 mm fed with *C. salina* fed rotifer has attained the maximum total length (TL) of 4.29±0.45 mm and standard length (SL) of 3.86±0.19mm when compared with that fed with rotifer raised under *C. salina* combined with yeast (TL – 3.35±0.36 mm and SL – 3.19±0.46) and frozen rotifer (TL-3.14±0.36 mm and SL – 2.88 ±0.24 mm).

PARTICIPATORY TECHNOLOGY TRANSFER MODEL FOR SUSTAINABLE COASTAL AQUACULTURE

Principal Investigator **Dr.M.Kumaran**

Co-Investigators **Dr.N.Kalaimani, Dr.V.S.Chandrasekaran, Dr.(Mrs.)D.Deboral Vimala, Dr.(Mrs.)Ch.Sarada**

Duration **2004-2006**

This project has been implemented in Andhra Pradesh(AP) and Tamil Nadu(TN) since November, 2004 to study the information management and extension needs of coastal aqua farmers, 'adoption-gap' in Good Management Practices (GMP) for coastal aquaculture, Research-Extension-Farmer linkage in coastal aquaculture and to evolve a model of participatory approach in technology transfer for sustainable coastal aquaculture. The study revealed that feed company technicians, peers (fellow farmers) and aquaculture consultants were the information sources for shrimp farmers. GMP with regard to adoption of shrimp farming, an average gap of 32% and 28% was noticed in AP and TN respectively. Adoption of aquaculture guidelines like Effluent Treatment System (ETS) needs mass education, voluntary cooperation and maximum motivation among the farmers.

The Department of Fisheries (DoF), MPEDA, printed publications were the preferred information sources for fishery extension officers. Farm visit, group meetings, on-off campus trainings, demonstrations and exhibitions were the extension methodology adopted though at less intervals. Fishery extension works had medium

level linkage with MPEDA, Fisheries Colleges and Research Institutions at occasional intervals through joint meetings and inviting technical experts from the above for their training programmes. Fishery research institutions had moderate linkage with other researchers in ICAR research institutions, fisheries colleges and extension agencies like DoF, MPEDA and NGOs. Two parallel extension streams *viz.*, public and private funded fishery extension services operated in the system. Private extension services (offered by farm opinion leaders, aqua consultants and feed technicians) were very active in aquaculture *vis-à-vis* their public counterparts (DoF and MPEDA).They differ significantly in terms of their extension approach and methods, information behaviour, linkage with fishery R&D, frequency of contact, effectiveness and accessibility. Both the extension streams need to work as partners of extension than running a parallel regime.

DEVELOPMENT AND DEMONSTRATION OF HATCHERY AND CULTURE TECHNOLOGY FOR THE BANANA SHRIMP, *FENNEROPENAEUS MERGUIENSIS* AS AN ALTERNATE SPECIES FOR SHRIMP AQUACULTURE

Principal Investigator **Dr.S.M.Pillai**

Co-Investigators **Dr.P.Ravichandran, Dr.C.Gopal and Dr.C.P.Balasubramanian**

Duration **2005-2008**

Broodstock of *F. merguiensis* collected from Andaman and Orissa were maintained in the hatchery and induced matured under controlled conditions. The fecundity ranged from 60,000 to 1,40,000 and the average hatching rate was 45%. Following standard protocols, larval rearing was carried out and PL20 were produced. Development of broodstock was initiated in a pond stocked with 315 juvenile *F. merguiensis* having average weight of 0.7g. In 70 days, the shrimps reached average size of 15.6g. An experiment was conducted to study the growth performance of *F. merguuensis* fed with clam meat, polychaete and commercial feed. In 45 days, the shrimp fed with clam meat showed highest growth followed by polychaete and commercial feed.

INVESTIGATION ON LOOSE SHELL SYNDROME AMONG FARMED TIGER SHRIMP *PENAEUS MONODON*

Principal Investigator **Dr.S.V.Alavandi**

Co-Investigators **CIBA : Dr.T.C.Santiago**
CMFRI : Dr.K.K.Vijayan

Duration **2005-2008**

Regular monitoring of shrimp farms to understand the occurrence and aetiology of loose shell syndrome (LSS) in farmed tiger shrimp was initiated during the summer crop from February 2006, in four farms These farms (0.8-1.0 ha in area) received water from sea, bore wells and creeks and stocked with *P. monodon* postlarvae @ 3-12 m^2. Two ponds from each farm were selected for obtaining periodic information on the soil and water quality, micro-algal density, bacterial load and shrimp health. Three of these four farms developed LSS. In one farm near Pattukottai there was no LSS in the two ponds monitored and the shrimps attained average weight of 50g each, showed good survival (82% and 85%) and production (2585 kg and 2399 kg). LSS incidence in the other three farms resulted in reduced average body weight of shrimp (15-40g) and biomass production (585-1185 kg ha^{-1}) although the survival rate was not significantly low except in one farm (51-72%). Affected shrimps were lethargic, flaccid with a gap between the muscle and the shell.

Bacteriological studies revealed that bacteremia was common in the LSS affected shrimp with predominance of *Vibrio* spp, *Flavobacterium* spp, *Pseudomonas* spp, *Acinetobacter* spp and *Moraxella* spp. Histological studies indicated general atrophy of the hepatopancreatic tubules, reduction in lipid bodies in R-cells and diffused necrosis and separation of tubules of the lymphoid organ. LSS affected ponds had frequent crash of algal blooms and higher ammonia levels. Bioassay experiments suggested involvement of an infectious agent

DEVELOPMENT OF LOW FISH MEAL FEEDS FOR SHRIMP AQUACULTURE

Principal Investigator **Dr.J.Syama Dayal**

Co-Investigators **Dr.P.Ravichandran, Dr.S.A.Ali, Dr.K.Ambasankar**

Duration **2005-2008**

Plant protein sources like ground nut cake, sunflower cake and cotton seed cake were analysed for their nutritive value and included at 0, 2.5, 5.0, 7.5 and 10% levels in shrimp feeds to find out the utilization of these ingredients. The feeds were tested with juveniles of *P. monodon* for 45 days. The maximum weight gain of 186.2g with 1.63 FCR and 100% survival was observed with ground nut cake at 2.5% inclusion level.

THE ASSESSMENT OF LOSSES IN SHRIMPS IN BRACKISHWATER AQUACULTURE DUE TO

Principal Investigator **Dr.N.Kalaimani**

Co-Investigators **Dr.T.Ravisankar** *and* **Dr.S.Kannappan**

Duration **2005-2008**

Survey was carried out in September 2005 in ten villages in and around Nagapattinam and Velankanni in Tamil Nadu to assess loss of shrimp due to diseases in an area of 44.43 ha. During December 2005 survey was conducted in nine coastal villages around Ongole, Andhra Pradesh having potential shrimp aquaculture area of 500 ha. Out of this 312 ha was under shrimp culture and 26.4 ha was used as reservoir. Eight villages in and around Pattukottai were investigated in March 2006, covering 40 farms wherein shrimp farming is practiced in 167.23 ha and here the farmers lost Rs.16,64,300/- mainly due to WSSV and loose shell disease. These surveys revealed that on an average Rs.2,00,000/ha is lost by the shrimp farmers due to diseases. Detailed analysis of the data is in progress.

ASSESSMENT OF POTENTIAL SITES FOR SUSTAINABLE AQUACULTURE USING MODERN TECHNOLOGICAL TOOLS

Principal Investigator **Dr.M.Jayanthi**

Co-Investigators **Dr.P.Ravichandran, Dr.M.Muralidhar** *and* **Dr.(Mrs.)P.Nila Rekha**

Duration **2005-2007**

The project was started from August 2005 with the objectives to assess the impact of aquaculture development on land use pattern, to identify the potential sites for sustainable brackishwater aquaculture and to develop soil and water information system at Nellore district, Andhra Pradesh. The satellite data IRS, IC of Nellore district was processed in GIS platform and land use maps are being prepared. The aquaculture in Pulicat lake areas were mapped and verified by ground truth verification. It was estimated that aquaculture was developed in 3.82 km^2 area around the Pulicat lake channel. The main lake body and its land use pattern were not affected due to the development of aquaculture.

ANALYSIS OF VIRULENCE FACTORS IN

FROM SHRIMP LARVICULTURE SYSTEMS

Principal Investigator : **Dr.S.V.Alavandi**

Co-Investigators : **CIBA : Dr.T.C.Santiago**
CMFRI : Dr.K.K.Vijayan

Duration :

A total of 983 samples from commercial shrimp hatcheries and 133 from shrimp grow-out farms comprising water samples from sources to hatchery / farm, reservoir tanks, treated water (sand filtration), maturation tanks, spawning tanks, larval rearing tanks, samples of larvae, shrimps and shrimp faecas and cases of luminous vibriosis in hatcheries were processed routinely by standard microbiological methods for the recovery of luminescent bacteria. 21.4% of samples from shrimp hatcheries and 9% from farm harboured luminescent bacteria. In hatcheries, water in the brooder, maturation and spawning tanks were found to be the main sources of luminescent bacteria, which could be isolated from more than 50% of the samples. Majority of the *V. harveyi* isolates produced virulence factors such as haemolysins, siderophores and proteases *in vitro*. *V. harveyi* myovirus-like (VHML) particles could be identified by PCR in majority of *V. harveyi* isolates, whereas, it could not be detected in other Vibrio species. However, its role in the pathogenicity of host *V.harveyi* strains needs to be confirmed.

Indo-French Collaborative Project

SEABASS PILOT UNIT HATCHERY AND CULTURE

Principal Investigator · **Dr.A.R.Thirunavukkarasu**

Project Associate

Duration :

An exclusive hatchery facility was established for the controlled breeding and seed production of Asian seabass *L. calcarifer*, as a model marine finfish hatchery incorporating all the components of quarantine, broodstock holding, captive maturation, spawning, larval rearing and nursery rearing facilities. The bio-security measures were in-built in the hatchery. It has also an unique re-circulation system for the broodstock maturation and spawning. Facilities for high density algal and rotifer culture have also been incorporated in the hatchery. The Principal Investigator, Project Associate and three Technicians associated with the programme received hands-on experience in the seabass hatchery management from Aquastream Hatchery at Lorient and bio-security protocols at SETE, CREUFOP, France.

Department of Biotechnology

FUNCTIONAL GENOMICS OF *PENAEUS MONODON* AND *PENAEUS INDICUS* IN RELATION TO MICROBIAL INFECTION AND ENVIRONMENTAL STRESS

Principal Investigator **Dr.T.C.Santiago**

Duration : **2005-2007**

Samples from WSSV infected and non-infected shrimps were taken and RNA was isolated. mRNA was purified from these samples and cDNA synthesis was done for constructing cDNA libraries from *P. monodon* and *P. indicus*. Work is in progress to screen the libraries using differential screening techniques to isolate the genes related to disease resistance. Attempts were made to develop shrimp cell lines for testing the virulent pathogens. A cell line isolated from lymphoid organ of *P. indicus* is maintained for more than 300 days after more than 20 passages. The cells were stored in liquid nitrogen for more than 6 months and the cells were revived.

Indo-Norwegian Collaborative Project

MONODON (TIGER SHRIMP) THROUGH WHITE SPOT DISEASE RESISTANCE

Principal Investigator	Dr.P.Ravichandran
Core Staff	Dr.G.Gopikrishna and Dr.C.Gopal
Project Associate	Dr.S.M.Pillai, Dr.K.K.Vijayan, Dr.S.V.Alavandi, Dr.C.P.Balasubramanian and Dr.M.S.Shekhar
Duration	2004-2008

Rearing of 40 families of *P. monodon* from Tamil Nadu and 21 families from Andhra Pradesh was taken up to raise them up to taggable size. Torrential rains which lashed Chennai during October to December resulted in poor quality sea water of low salinity and affected the larval survival seriously. Only 16 families could be retrieved and seven of them were tagged and challenge test was conducted. About 300 nos. from each family is being reared in ponds to adult size.

Network Project

IMPACT ASSESSMENT OF FISHERIES RESEARCH IN INDIA

Principal Investigator	Dr.G.P.Reddy, Sr. Scientist, NAARM,
Project Associate	Dr.T.Ravisankar
Duration	2005-2007

A background paper on "Impact assessment of brackishwater aquaculture research – Parallels and divergences" was prepared as a reference material for the network. Collected data on investments made on research by CIBA from 1987 to 2006 and developed two proforma for data collection from shrimp and scampi farmers in Andhra Pradesh, Kerala, Tamil Nadu and West Bengal.

5. TECHNOLOGY ASSESSED AND TRANSFERRED

The technologies/knowledge-base developed by the Institute were extended during the year to progressive fish farmers, private entrepreneurs, officials of state and central governments etc. through the following short-term training programmes.

Sl.No.	Programme	Duration	Total participants
1.	HACCP	4-7 May 2005	19
2.	Selected technologies of CIBA	9 May 2005	75
3.	Seabass breeding and culture	3-12 August 2005	10
4.	Crab breeding and culture	22-27 August 2005	5
5.	Feed analysis	18-24 September 2005	11
6.	Shrimp breeding and hatchery technology	26 September to 7 October 2005	8
7.	Aquatic animal health management	21-26 November 2005	7
8.	Application of genetics and biotechnology in aquaculture	14-18 March 2006	5

HACCP Training Programme

Crab breeding and culture

Shrimp hatchery technology

Training-cum-demonstration of mud crab and seabass culture technologies for the tsunami affected fisher folk of Pulicat

A one day training-cum-demonstration of mud crab fattening and cage culture of seabass was organized on 28 July 2005 for the tsunami affected fisher folk of Pulicat, Tamil Nadu, as a means of alternative livelihood. The training was jointly arranged by CIBA and Aquaculture Foundation of India with the participation of NGOs and

Training-cum-demonstration of mud crab and seabass culture at Pulicat

Association for Rural Workers and State Bank of India. Lectures and hands-on practicals were handled by Dr.A.R.Thirunavukkarasu, Shri M.Kathirvel and Dr.S.Kulasekarapandian, Principal Scientists and Dr.V.S.Chandrasekaran, Senior Scientist.

Seminar on seaweed and mud crab culture technologies for women self help groups

A one day seminar on "Seaweed and mud crab culture technologies" was organized for women self help groups of Villupuram district at Marakkanam on 6 August 2005 by CIBA, Aquaculture Foundation of India (AFI) and Directorate of Special Panchayat, Government of Tamil Nadu. The programme was inaugurated by Mrs. Nirmala, I.A.S., Director, Special Panchayat. About 300 members of various women self help groups of the district attended. Dr.M.Sakthivel, President, AFI, Shri M.Kathirvel and Dr.S. Kulasekarapandian, Principal Scientists and Dr.V.S.Chandrasekaran, Senior Scientist, CIBA and Mr.V.C.Eraniappan from Periyar Mud Crab Hatchery, Vandalur served as resource persons.

Demonstration of CIBA-STIM shrimp immunostimulant

A method demonstration of CIBA-STIM, shrimp immunostimulant and group discussion with shrimp farmers of Kancheepuram district of Tamil Nadu was organised on 13 March 2006 at Pudupattinam.

Transfer of technology

The shrimp feed technology developed by CIBA has been given as consultancy to Sri. Tapan Mondal, Hoogly district, West Bengal. Consultancy proposal for CIBA shrimp feed technology is also given to M/s Bismi Prawn Farms Pvt. Ltd., Myladuthurai, Tamil Nadu.

Under technology transfer four method demonstrations of CIBA technologies, three farmers' meet and participation in six exhibitions were conducted. Information Kiosk – A touch screen based information system was installed at CIBA HQ. It provides a bird's eye view of the Institute's activities relating to establishment, organizational set-up, mandate, divisional frame work, aqua-statistics, candidate species, on-going projects, TOT programmes, scientists and staff etc.

Method demonstration of CIBA-STIM,

Visitors in CIBA stall at Barrackpore

6. TRAINING AND EDUCATION

HUMAN RESOURCE DEVELOPMENT

Scientific / Technical / Administrative

International

- Dr.G.Gopikrishna and Dr.C.Gopal, Senior Scientists attended a training programme on new techniques in breeding programmes for genetic studies under the Indo-Norwegian Project on "Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance", at AKVAFORSK, Norway, during 14 March to 13 May 2005.
- Dr.M.Krishnan, Principal Scientist participated and presented a paper in the International Workshop on "Effects of climatic change on fisheries" at the Institute of Research in Economics and Business Administration, Bergen, Norway, during 20-23 June 2005.
- Dr.A.R.Thirunavukkarasu, Head, FCD underwent training on "Seabass breeding and culture" at France under Indo-French Collaborative project from 22 February to 23 March, 2006.
- Shri R.Subburaj, Technical Assistant (T-4) and Shri G.Thiagarajan, Technical Assistant (T-2) underwent training programme on "Seabass breeding and culture" at France under In French Collaborative project from 16 Febru to 31 March, 2006.

National

- Dr.J.K.Sundaray, Scientist (SS) attended the training programme on "Development of high end resource materials (Multimedia) for effective teaching and learning organized by the National Academy for Agricultural Research Management (NAARM), Hyderabad, during 28 April to 18 May 2005.
- Shri R.G.Ramesh and Shri R.Kandamani, Assistants participated in the training course on "Pension and other retirement benefits" at the Institute of Secretariat Training and Management (ISTM), New Delhi, during 9-13 May 2005.
- Mrs.K.Nandini, Junior Accounts Officer participated in the training course on "Financial Management" organised by the ISTM, New Delhi during 16-27 May 2005.
- Dr.K.K.Vijayan and Dr.C.P.Balasubramanian, Senior Scientists participated in the training programme on "Intellectual Property Rights in Agriculture" organised by the NAARM, Hyderabad during 26-30 July 2005.
- Shri M.Shenbagakumar, Shri D.Rajababu, Technical Officers (T-5) and Shri S.Rajamanickam, Technical Assistant (T-4) participated in the training programme on "Networking essentials for information management in agriculture", organized by the NAARM, Hyderabad, during 1-11 August 2005.
- Shri C.Ananthanarayanan, Technical Assistant

(T-2) attended the training programme on "Digital imaging", at Central Institute of Fisheries Education, Mumbai, during 3-12 August 2005.

- Dr.(Mrs.)B.Shanthi, Senior Scientist participated in the short course on "Gender analysis and its application to agricultural research and extension" organised by the National Research Centre for Women in Agriculture, Bhubaneswar during 3-12 August 2005.
- Dr.C.P.Balasubramanian, Senior Scientist participated in the training workshop on "Polychaete taxonomy" at Centre of Advanced Studies in Marine Biology, Annamalai University, Parangipettai, during 19-21 September 2005.
- Dr.M.Krishnan, Principal Scientist attended the course on "Planning and implementation of development programmes for fishermen in coastal areas", organized by the National Institute of Rural Development, Hyderabad, during 19-24 September 2005.
- Dr.V.S.Chandrasekaran and Dr.(Mrs.) D.D. Vimala, Senior Scientists attended the training programme on "Participatory rural appraisal and action learning for research and extension in agriculture", organized by NAARM, Hyderabad, during 22-29 September 2005.
- Shri N.Jagan Mohanraj, Technical Assistant (T-2) underwent the refresher course on "Management and health care of laboratory animals" conducted by the Academy of Agricultural Research and Education Management, Haryana, during 1-10 October 2005.
- Shri Mahesh Kumar, Technical Assistant (T-3) attended the Hindi Translation course at Central Translation Bureau, New Delhi, during 3-7 October 2005.
- Dr.T.Ravisankar, Senior Scientist participated in the short course on "Quantitative development policy issues – approaches and applications" organised by the Tamil Nadu Agricultural University, Coimbatore, during 17-26 October 2005.
- Dr.J.Syama Dayal, Scientist (SS) attended the winter school on "Modern techniques for the analysis of fish and fish products" organised at the Central Institute of Fisheries Technology, Cochin, during 19 October to 8 November 2005.
- Dr.K.P.Jithendran, Senior Scientist attended the training programme on "Developing winning research proposals" at NAARM, Hyderabad, during 21-26 October 2005.
- Dr.T.K.Ghoshal, Scientist (SS) attended the winter school on "Aquaculture nutrition and production of live and artificial feeds" at Dept. of Aquaculture, Fisheries College and Research Institute, TANUVAS, Thoothukudi, during 1-21 November 2005.
- Dr.S.Kulasekarapandian, Principal Scientist underwent the training programme on "Strategies for stress management" at National Academy of Agricultural Research Management, Hyderabad, during 17-23 November 2005.
- Dr.S.Kannappan, Scientist (SS) attended the training course on "Molecular techniques for gene characterization and genome analysis" at National Bureau of Animal Genetic Resources, Karnal, during 17-26 November 2005.
- Dr. Akshaya Panigrahi, Scientist (SS) participated in the training course on "Microbial diversity analysis of agriculturally important organisms" at National Bureau of Agriculturally Important Microorganisms, Mau, Uttar Pradesh, during 3-25 January 2006.
- Dr.D.Deboral Vimala, Senior Scientist attended the training programme on "Entrepreneurship development among farm women" organised by the NRC for Women in Agriculture, Bhubaneswar, during 17-21 January 2006.
- Shri D.Ramesh Babu and Shri G.Thiagarajan, Technical Assistants (T-2) participated in the training course on "Biosecured raceway based shrimp farming technology" at the Fisheries College and Research Institute, TANUVAS,

Thoothukudi, during 17 January to 2 February 2006.

- Dr.J.K.Sundaray and Dr.Akshaya Panigrahi, Scientists (SS) attended the training progrmame on "Fish germplasm exploration, cataloguing and conservation" at National Bureau of Fish Genetic Resources (NBFGR), Lucknow, from 29 January to 1 February 2006.
- Dr.V.S.Chandrasekaran, Senior Scientist and Dr.M.Kumaran, Scientist (SS) attended the training programme on "Disaster management in fisheries and aquaculture" organised by the National Institute of Disaster Management (NIDM), New Delhi, during 30 January to 3 February 2006.
- Dr.C.P.Balasubramanian, Senior Scientist participated in the training course on "DNA fingerprinting" at the Cochin Unit of NBFGR, Cochin during 6-16 March 2006.
- Dr.M.Kailasam, Senior Scientist participated in the training course on "Exotic fish germplasm and quarantine" organised by the NBFGR, Lucknow, during 20-24 March 2006

Lectures and demonstrations were conducted for the following at CIBA, Chennai and Muttukadu Experimental Station:

- B.F.Sc. students of College of Fisheries, G.B.Pant University, Pant Nagar, on 12 April 2005.
- B.F.Sc. students of College of Fisheries, Mangalore, on 29 June 2005.
- Mate Fishing Vessel Course trainees from Central Institute for Fisheries Nautical Engineering and Training, Cochin, on 1 August 2005
- Students of the Agricultural Engineering Department, Kerala Agricultural University, Mannuthy, Thrissur, Kerala, on 30 September 2005
- Undergraduate students from Centre for Industrial Fish & Fisheries, Faculty of Science, Cachar College, Silchar, Assam, on 25 October 2005.
- Students of Railway Mixed Higher Secondary School, Perambur, Chennai, on 17 November 2005

8. LINKAGES AND COLLABORATION

During the year the Institute had linkages with the following national and international organisations.

National

1. ICAR Institutes

CIFE
The Central Institute of Fisheries Education, Mumbai is a collaborating Institute under the Indo-Norwegian project on "Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance".

CIFRI
The Institute is collaborating with Central Inland Fisheries Research Institute, Barrackpore in the project on "Paddy-cum-fish culture."

NBFGR
A collaborative project on "Germ plasm exploration, cataloging and conservation of fish and shell fish resources of India" is taken up with National Bureau of Fish Genetic Resources, Lucknow.

NAARM
Collaboration is maintained with National Academy of Agricultural Research Management, Hyderabad in the network project on "Impact assessment of fisheries research in India."

2. Other organisations
   - Rajiv Gandhi Centre for Aquaculture, Myiladuthurai

3. Ministry of Agriculture, Govt. of India
   - Aquaculture Authority, Chennai

4. State Fisheries Departments/BFDAs
The Institute has well established linkages with State Fisheries Depts./BFDAs mainly with regard to transfer of technology programmes.

International

1. M/s.COFREPECHE / Govt. of France
The Institute has taken up an Indo-French Collaborative Project entitled 'Seabass Pilot Unit' with M/s. COFREPECHE / Govt. of France from November 1999 to June 2005.

2. NORAD
The Institute is collaborating with AKVAFORSK, Norway in the project on "Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance".

9. LIST OF PUBLICATIONS

CIBA PUBLICATIONS

- CIBA Annual Report for the year 2004-2005
- Training Programme Calender 2005-2006
- Mud crab fattening technologies (in Tamil), CIBA Extension Series No.31.

The following special publications were brought out:

- Development of brackishwater aquaculture in Andaman Islands
- Breeding, seed production and culture of Asian seabass, *Lates calcarifer*
- Statistical tools for aquaculture
- Status and environment impact assessment of shrimp farming in Diu
- Captive breeding and hatchery technology for penaeid shrimps
- Brackishwater shrimp, crab and finfish culture (in Bengali)
- Diagnosis and management of shrimp diseases
- Application of genetics and biotechnology in aquaculture

PUBLICATIONS BY SCIENTISTS

Abraham, A.V., M. Muralidhar and B.P.Gupta. 2005. Removal of copper (II) and lead (II) from contaminated freshwater and brackishwater by adsorption on to activated carbon from *Casuarina equisetifolia* fruit. In: *National Seminar on "Strategies for Improved Farming and Ecological Security of Coastal Region, 2005. Indian Soc. Coastal Agric. Res.* Trivandrum, 21-24 December 2005. AH-23, pp 76.

Ahamad Ali, S., C.Gopal, J.V. Ramana and A.R. Nazar. 2005. Effect of different sources of starch and guar gum on aqua stability of shrimp feed pellets. *Indian J. Fishereis*, 52(3): 301-305.

Ahamad Ali, S., J. Syama Dayal, K.Ambasankar and M. Poornima. 2005. Some feed additives stimulate phenoloxidase levels in tiger shrimp. *Aqua feeds: Formulations & Beyond*, 2(3):11 and 25

Ambasankar, K., S.Ahamad Ali and J.Syama Dayal. 2005. Effect of dietary and supplementary phosphorus on growth and excretion in the tiger shrimp *Penaeus monodon*. *7th Indian Fisheries Forum*, Bangalore, 8-12 December 2005.

Ayyappan S. and M.Krishnan. 2005. Offbeat attempts needed. *The Hindu Survey of Indian Agriculture* 2005, 134-136.

Ayyappan, S., M.Krishnan and S.M.Pillai. 2005. Coastal aquaculture for integrated coastal management. Special invited lecture *8th National Seminar on Strategies for improved farming and ecological security of coastal region*. Indian Society of Coastal Agricultural Research, Thiruvananthapuram. 21-24 December 2005. p.6.

Ayyappan S., M..Muralidhar and M.Krishnan. 2005. Tsunami and coastal aquaculture: Implications for soil profile, structure and productivity. *J. Indian Society of Soil Science*, 54(4): 558-565

Azad, I.S., M.S.Shekhar, K.P.Jithendran and P.Ravichandran. 2005. Nodaviruses: ...ng challenges for aquaculture health management. *Fishing Chimes*, 25 (7) 41-42.

Azad, I.S., M.S. Shekhar, A.R. Thirunavukkarasu, M. Poornima, M. Kailasam, J.J.S. Rajan, S.A. Ali, M. Abraham and P. Ravichandran. 2005. Nodavirus infection causes mortalities in hatchery produced larvae of *Lates calcarifer* : first report from India. *Dis. Aqu. Organ.*, 83: 113-118.

Barman, U.K., S.N. Jana, S.K. Garg, Anita Bhatnagar and A.R.T. Arasu. 2005. Effect of inland water salinity on growth, feed conversion efficiency and intestinal enzyme activity in growing grey mullet, *Mugil cephalus* (Linnaeus): field and laboratory studies. *Aquaculture International*, 13 (3) : 241-256.

Chakraborti,R.K., J. K. Sundaray, T.K.Ghoshal and D.De. 2005. Production of *Penaeus monodon* under different management practices. In: *7th Indian Fisheries Forum*, Bangalore, 8-12 November 2005. Abstract No. SFW-5, pp-135.

Chandrasekaran,V.S., B.Shanthi and M.Krishnan. 2005. Tsunami, shrimp farming and mangroves. 2005. *INFOFISH International*, Malaysia, No. 5/2005, 10-13.

Chandrasekaran, V.S., D. Deboral Vimala, M. Kumaran and B. Shanthi. 2005. Brackishwater aquaculture extension - the challenges ahead. In: Ocean Life, Food & Medicine Expo 2004 – Proc. International Conf. & Exposition on Marine Living Resources of India for Food and Medicine. 27 - 29 February 2004, Chennai, 398-405.

Chandrasekaran, V.S., B.Shanthi, D.Deboral Vimala, M.Kumaran and C. Saradha. 2006. Human resource development in brackishwater aquaculture in India. *Recent Trend in Fisheries Education and Research, Proc. National Symposium*, REFTER' 04, FC & RI, TANUVAS, Thoothukudi, India. 198-204.

De, D., M.Singh, A.Das and R.Chandra. 2004. Nutritional evaluation of Barhar *(Artocarpus lakoocha)* leaves in crossbred rabbit. *Indian J. Animal Nutrition*, 21 (3): 204-205.

De, D., T. K. Ghoshal, J. K. Sundaray and R. K. Chakraborti. 2005. Nutrient evaluation of different feed in mud crab *(Scylla serrata)* In:*7th Indian Fisheries Forum*, Bangalore. 8-12 November 2005. Abstract No.APS-91, pp-61.

De, D., T.K.Ghoshal, J.K.Sundaray and R.K.Chakraborti. 2006. Effect of replacement of animal protein with plant proteins in diets on nutrient utilization and growth of *Mugil parsia* In: *XII Animal Nutrition Conf., Animal Nutrition Society of India*, 7-9 January 2006, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, Abstract No. 67, p 181.

Ghoshal, T.K. and G. Samanta. 2005. Effects of different forms of trace minerals on the performance of Khaki Campbell ducks. In: *Proc. 3rd Waterfowl Conf.* Guangzhou, China. 3-6 November 2005. p. 267-274

Ghoshal,T.K, D. De, R.K.Chakraborti and J.K.Sundaray. 2006. Effect of proboiotics on *Penaeus monodon* production in pond culture at Sunderban area of West Bengal, In: *XII Animal Nutrition Conference, Animal Nutrition Society of India*. 7-9 January 2006 at College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand. Abstract No.68, p. 181.

Gopal, C., P.Ravichandran and S.M.Pillai. 2005. Bharath mein jhinga palan ke vividhatha bhavi paridrishya (Diversification and prospects of shrimp culture in India). In *National Hindi seminar on "Issues in Aquatic Biodiversity"*, CMFRI. Special Publication No.84. pp. 69-71.

Gopal, C., P.Ravichandran, S.M.Pillai, S. Paul Pandi and R.Sreenivasan. 2005. Kuruma shrimp *Marsupenaeus japonicus* culture in India – A success story. In: *Souvenir, Aqua India 2005. Society of Aquaculture Professionals*, Chennai. 25-26 February 2005.

Jayanthi, M. and T.Ravisankar. 2005. Techno-economic evaluation of wind mill for water

pumping in coastal areas for aquaculture, *Indian J. fish.*,52 (4).412-421.

Jayanthi, M., K.Ponnusamy, I.S.Azad, T.Ravisankar, M.Kumaran and N.Thenmathi. 2004. Technology assessment and refinement in coastal agriculture system for reducing drudgery and post harvest loss. *J. Indian Soc. Coastal Agric. Res.*, 23 (1&2), 339-340.

Jayanthi, M., P.Ravichandran and S.M.Pillai. 2006. GIS based approach to assess the impact of aquaculture on ecologically sensitive coastal areas in Tamil Nadu. *National Conf. on Geomatics for Infrastructure development. Anna University,* Chennai. Abstract p.73.

Jayanthi, M. and P.Nila Rekha. 2005. Assessment of changes in Kolleru lake in A.P due to the development of aquaculture using satellite data. In *Strategies for improved farming and ecological security of coastal region*. CTCRI, Thiruvanthapuram, Kerala. 21-24 December 2005. SW-13.

Jayanthi, M., P.Nila Rekha, M.Muralidhar, K.K.Krishnani and B.P.Gupta. 2005. Changes in aquaculture land use in Krishna district, A.P., 7th *Indian Fisheries Forum*. 8-12 November 2005, Bangalore. ARM-9.

Jithendran, K.P., K.K.Vijayan, S.V.Alavandi and M.Kailasam. 2005. *Benedenia epinepheli* (Yamaguti, 1937), a monogenean parasite in captive broodstock of grouper, *Epinephelus tauvina* (Forskal). *Asian Fisheries Science*, 18: 121-126.

Jithendran, K.P., M. Natarajan and I.S. Azad. 2005. Management of monogenean parasites in brackishwater finfishes. *Aquaculture Asia*, X (4) 38-41.

Jithendran, K. P. and T.K. Bhat. 2005. Dicrocoe-liosis of farm animals in India. Special issue *Proc. National Academy of Sciences (India). Section B, Biological sciences*, Infectious Diseases of domestic animals and zoonoses in India (E. Veena Tandon and B.N.Dhawan), Vol. 75: 173-183.

Krishnan M. and S. Ayyappan. 2005. Economic effects of climate change on fisheries in India. *International Workshop on Economic Effects of Climate Change on Fisheries in India*. Institute of Research in Economics and Business Administration, Bergen, Norway, June 20-23, 2005.

Krishnan M. and S. Ayyappan. 2005. Fish and fish products marketing: facets, fault lines and future. *Indian J. Agric. Marketing*, 19 (2): 1-18.

Krishnani K.K. and S Ayyappan. 2006. Heavy metals remediation of water using plant and lignocellulosic agrowastes. *Review of Environmental Contamination and Toxicology*, 188: 64-85.

Krishnani, K.K and B.P. Gupta. 2006. Biostimulation of shrimp culture water using lignocellulosics. 7th *Indian Fisheries* Forum, 8-12, November, 2005, Bangalore. YSA-8, p.171.

Krishnani, K.K., B.P.Gupta, S.M.Pillai and P.Ravichandran 2005. Periphyton based bioremediation of coastal aquaculture water. *Hindi Conf. CIFT, Cochin*, 21 December 2005.

Krishnani,K.K., B.P.Gupta, V.Parimala and M.Abraham. 2005. Bioremediation of nitrogenous toxicants from shrimp farm wastewater using agricultural waste materials. Bioremediation Poster Session, *International Conf. on Soil, Sediments and Water*, 18-21 October 2005.

Krishnani, K.K., P.Ravichandran and B.P.Gupta. 2006. Pre-harvest off flavor in aquaculture. *Hindi Conf. on "Livelihood issues in Fisheries and Aquaculture"*. CMFRI Cochin, 3 March 2006. pp. 45-46.

Krishnani, K.K., B.P.Gupta, M.Muralidhar, S.M.Pillai and R.Saraswathy. 2005. Phytoremediation of ammonia and nitrite from shrimp farm wastewater using aquatic plants. Poster presentation. 7th *Indian Fisheries Forum*, Bangalore. 8-12 November 2005. Abstract No.EH-32, p.111.

Kumaran M., D.D.Vimala, V.S.Chandrasekaran, B.Shanthi and M.Krishnan. 2004. Knowledge networks in shrimp aquaculture. *Applied Fisheries & Aquaculture*, 4 (2): 59-62.

Kumaran,M., K.Ponnusamy and M.Krishnan. 2004.

Utilization of Information Sources by shrimp farmers, *Ind. J. Extn. Edn*, XXXX (1&2): 63-66.

Kumaran.M, M. Alagappan, S.Raja, D.D.Vimala, C.Sarada, V.S.Chandrasekaran and N.Kalaimani. 2005. Research - extension linkage in coastal aquaculture. *8th National Seminar of ISCAR. Strategies for improved farming and ecological security of coastal region.* Thiruvananthapuram, 21-24 December 2005.

Kumaran, M, S.Raja, M.Alagappan, D.D.Vimala, C.Sarada, V.S.Chandrasekaran and N.Kalaimani. 2005. Extension methodology for sustainable Coastal aquaculture. *8th National Seminar of ISCAR. Strategies for improved farming and ecological security of coastal region.* Thiruvananthapuram, 21-24 Dec. 2005.

Kumaran,M. 2006. Capacity building of fishery extension personnel. *24th National Workshop on 'Planning and management of agricultural extension training'*, NASC, New Delhi, 14 - 15 February, 2006.

Mahalakshmi, P. and K.Ganesan. 2005. Applications of GIS and Remote Sensing to inland fisheries and aquaculture. *In: S. Ramachandran (ed). Proc. of International Conf. on Coastal and Freshwater Issues.* Institute of Ocean Management, Anna University, Chennai. pp 49 - 64.

Mahalakshmi, P., K.Ganesan, K.M.Lakshmana Rao and K.Jayasree. 2006. Developing and validating an optimal location modeling based on multi criteria evaluation: A case study in aquaculture. *In: 93rd Indian Science Congress.* January 3–7, 2006 Acharya, N.G. Ranga Agricultural University, Hyderabad.

Muralidhar, M., B.P.Gupta and M.Jayanthi. 2005. Quantity – intensity relationship and fixation of phosphorus in soils from shrimp farming areas of coastal India. *Indian J. Fisheries*, 52 (4):421-431.

Muralidhar, M., B.P.Gupta and P.Ravichandran. 2005. Status and environmental impacts of shrimp aquaculture in East Godavari District, Andhra Pradesh. *National Seminar on "Strategies for improved farming and ecological security of coastal region, 2005. Indian Society of Coastal Agricultural Research* Trivandrum. 21-24 December, 2005. AH-12, pp 70.

Muralidhar, M., B.P.Gupta R.Saraswathy, A. Abraham and A.Nagavel. 2005. Has tsunami affected the quality of seawater and backwaters? – Case studies in and around Chennai, Tamil Nadu. *Ibid.* BS-14, p 109.

Muralidhar, M., B.P.Gupta, C.P.Balasubramanian, M.Jayanthi, P.Nila Rekha and A. Nagavel. Are abandoned shrimp farms really waste lands? - Case study on conversion of shrimp farms into paddy fields in Krishna District, Andhra Pradesh. 2006. *7th Indian Fisheries Forum*, 8-12, November, 2005, Bangalore, India. EH – 32. p 112.

Muralidhar, M., B.P.Gupta, C.P.Balasubramanian, M.Jayanthi, K.K.Krishnani and P.Nila Rekha. 2005. Shrimp farming and its impact on environment in Krishna District, Andhra Pradesh. In: *Sustainable Fisheries Development: Focus on Andhra Pradesh.* M.R.Boopendranath, P.T.Mathew, Sib Sankar Gupta, P.Pravin and J.Charles Jeeva (Eds.), *Society of Fisheries Technologists, Cochin*, India.112-118.

Nagamani K., S.Ramachandran and D.Deboral Vimala. 2005. Application of remote sensing and GIS for coastal aquafarming. *Fishing Chimes.*, Vol. 25 .No 8, 46-49.

Pillai, S.M. 2005. Diversification of species in shrimp aquaculture. *National Seminar on Aquaculture Biotechnology*, Acharya Nagarjuna University, Nagarjunanagar. Abstract. No. 9. p.17.

Pillai, S.M. and P.Ravichandran. 2006. Backyard shrimp hatcheries. *Consultation workshop on Coastal resources of Pulicat region : Strategies for enhancement of fishery resources & conservation.* Participatory Learning Action Network & Training Trust (PLANT), Chennai. 23 March 2006.

Ravichandran, P. 2006. Shrimp Farming. Handbook of Fisheries and Aquaculture. ICAR.pp.392-403.

Ravichandran, P. and S.M.Pillai. 2006. Shrimp seed production. In: Handbook of Fisheries and Aquaculture. ICAR. pp. 379-391.

Ravichandran, P. and S.M.Pillai. 2005. Dhaitapoorv chingad palankeliyae bhehatar prabhandhan upas (Hindi). In. *Matsyagandha 2004*. pp. 69-74.

Ravichandran, P. and S.M.Pillai. 2006. Sustainable development of coastal aquaculture in India. *Fishing Chimes*, 26(1):176-178.

Ravichandran, P., S.M.Pillai and M.Jayanthi. 2004. Development of aquaculture and its impact on coastal land resources in Tamil Nadu. *In: Workshop on Integrated management strategies for Tamil Nadu coastal zone and its resources. Indian Society of Geomatics, Anna University, Chennai.* 26 November 2004. pp. 68-75.

Ravisankar T., C. Sarada and M.Krishnan. 2005. Diversification of fish and exports for reducing income variability: A review of recent trends in major shrimp producing countries of *Asia. Agric. Economics Research Review*, 18(2): 187-195.

Sahul Hameed, A.S., V.Parameshwaran, Ravi Shukla, I.S.Bright Singh, A.R. Thirunavukkarasu, R.R. Bhonde. 2006. Establishment and characterisation of India's first marine fish cell line (SISK) from the kidney of seabass *(Lates calcarifer). Aquaculture*, 257, pp 92-103.

Saraswathy, R. and P. Singaram. 2005. Nitrogen losses through leachate and its distribution. *J. Environ. Biol.*, 26. (2): 355-362.

Saraswathy R and R.N. Adhikari. 2006. Particle size distribution of eroded soil under simulated rainfall condition. *Agric. Sci. Digest*, 26 (1): 19-22.

Shanthi B., V.S.Chandrasekaran, M. Kailasam, M. Muralidhar,T. Ravisankar, C. Sarada and M. Krishnan. 2005. Aquaculture as an action programme: An exercise in building confidence and self worth. *Aquaculture Asia Magazine, Thailand*. October – December 2005., Vol X No. 4, pp 10 – 13.

Shanthi B, M.Krishnan, V.S. Chandrasekaran and D.Deboral Vimala, 2005. Community based rehabilitation of mangroves and restoration of fishery wealth. *Proc. Workshop on Conservation, restoration and sustainable management of mangrove forests in India'*, held during 18 – 22 February 2004, at Visakhapatnam. pp. 166 – 173.

Shanthi, B., V.S. Chandrasekaran, S.M. Pillai, C.Sarada, M.Krishnan and D.D.Vimala.2005. Employment opportunities for women in hatchery management. In: *Proc. National seminar on Gender mainstreaming in agricultural research, extension and training -Priorities and problems. National Research Centre for Women in Agriculture, Bhubaneswar.* pp.179-186.

Shanthi B. and M. Jayanthi. 2005. Empowering fisherwomen in coastal sectors a strategy for improving farming. *Proc. National Seminar on Strategies for improved farming and ecological security of coastal region*, December 21 -24, 2005, *Central Tuber Crops Research Institute*, Thiruvanthapuram, Kerala. IE – 8, p. 90.

Shekhar, M.S., I.S.Azad, and K.P.Jithendran. 2006. RT-PCR and sequence analysis of *Macrobrachium rosenbergii* nodavirus: Indian isolate. *Aquaculture*, 252: 128-132.

Shekhar, M.S., M.Natarajan, G.Gopikrishna and M.Abraham. 2005. Partial sequence of 16s ribosomal gene of *Mugil cephalus*. Genbank accession No.DQ 185446.

Swathilekshmi.P.S, K. Chandrakandan, M. Kumaran and N.Balasubramanian. 2005. Socio-economic profile of shrimp farmers and its influence on the extent of adoption of shrimp culture technologies. *Fishery Technology*, 42(2): 225-230.

Syama Dayal, J., S. Ahamad Ali and C. Sarada. 2005. Amino acid and biochemical composition of whole body and molt of the Indian white shrimp, *Fenneropenaeus indicus. Indian J. Fish*, Vol. 52: 351-356.

Syama Dayal, J., S.Ahamad Ali., K.Ambasankar, A.R.Thirunavakkarasu and M.Kailasam. 2006. Corn gluten meal as feed ingredient in Asian seabass, *Lates calcarifer*. XII Animal Nutrition Conference held at Anand. 7-9 January 2006.

Thirunavukkarasu. A.R. 2005. Breeding and culture of Asian Seabass *Lates calcarifer*. Souvenir, Silver Jubilee celebration, April 2004. Scott Christian College, Nagercoil. PP-137-147.

Thirunavukkarasu. A.R. and N. Kalaimani. 2005. Opportunities in coastal aquaculture. Technical

Session on Processing of marine products and exports. *National Expo*. 2005.

Vijayan,K.K., I.S. Bright Singh, N.S.Jayaprakash, S.V. Alavandi, S.Somnath Pai, R.Preetha, J.J.S. Rajan and T.C. Santiago. 2006. A brackishwater isolate of *Pseudomonas* PS-102, a potential antagonistic bacterium against pathogenic vibrios in penaeid and non-penaeid rearing systems. *Aquaculture*, 251 192–200.

Vijayan,K.K., V. Stalin Raj, S.V. Alavandi, V.Thillai Sekhar and T.C. Santiago. 2005. Incidence of white muscle disease, a viral like disease associated with mortalities in hatchery-reared postlarvae of the giant freshwater prawn *Macrobrachium rosenbergii* (De Man) from the southeast coast of India. *Aquaculture Research*, 36: 311-316.

Vijayan,K.K., V.Stalin Raj, C.P.Balasubramanian, S.V.Alavandi, V.Thillai Sekhar and T.C.Santiago. 2005. Polychaete worms-a vector for white spot syndrome virus (WSSV). *Diseases of Aquatic Organisms*, 63: 107–111.

Vimala,D.D., M.Kumaran, V.S.Chandrasekaran and B.Shanthi. 2006. Indigenous technical knowledge in aquaculture. *Recent Trend in Fisheries Education and Research. Proc. National Symposium, REFTER' 04*, FC & R, TANUVAS, Thoothukudi, India. 186-190.

Vimala,D.D., M.Kumaran and M.Krishnan. 2005. Communication behaviour of Shrimp Farmers. *8th National Seminar of ISCAR, on Strategies for improved farming and ecological security of coastal region*. CTCRI, Thiruvananthapuram. 21-24 December 2005.

Vimala,D.D., S.Ramachandran, P.M.Swathilakshmi and M.Kumaran. 2005. Shrimp seed – a critical problem faced by shrimp farmers-a cross sectional analysis. *Ibid*.

10. LIST OF ON-GOING RESEARCH PROJECTS

Title of the Project	Principal Investigator
CRUSTACEAN CULTURE DIVISION	
Captive broodstock development, breeding, seed production and culture of *Penaeus monodon, Marsupenaeus japonicus* and *Fenneropenaeus indicus*	**Dr.P.Ravichandran** Principal Scientist
Culture of mud crabs (*Scylla* spp.)	**Shri M.Kathirvel** Principal Scientist
Assessment of brackishwater land resources	**Dr.(Mrs.)M.Jayanthi** Senior Scientist
FINFISH CULTURE DIVISION	
Broodstock development, breeding, seed production and culture of Grey mullet *Mugil cephalus* and Pearlspot *Etroplus suratensis*	**Dr.M.Natarajan** Principal Scientist
Culture of Asian seabass *Lates calcarifer*	**Dr.A.R.Thirunavukkarasu** Head, FCD
AQUATIC ANIMAL HEALTH AND ENVIRONMENT DIVISION	
Fish health management in brackishwater aquaculture using epidemiology, diagnostics, prophylactics and molecular biology	**Dr.T.C.Santiago** Principal Scientist
Development of technology for the waste water treatment of shrimp farms	**Dr.B.P.Gupta** Principal Scientist
NUTRITION, GENETICS AND BIOTECHNOLOGY DIVISION	
Development and demonstration of balanced feeds for Asian seabass, crabs and improvement of shrimp feeds	**Dr.S.A.Ali** Principal Scientist
Genetic characterization of brackishwater shellfishes and finfishes through molecular techniques	**Dr.G.Gopikrishna** Senior Scientist
SOCIAL SCIENCES DIVISION	
Technology transfer, socio economic aspects and informatics in brackishwater aquaculture	**Dr.M.Krishnan** Principal Scientist
NETWORK PROJECT	
Germ plasm exploration, cataloguing and conservation of fish and shellfish resources of India (CIBA – NBFGR)	**Dr.A.G.Ponniah** Director

Title of the Project	Principal Investigator
FUNDED PROJECTS	
AP CESS FUND	
National risk assessment programme for fish and fish products for domestic and international markets.	**Dr.B.P.Gupta** Principal Scientist
Participatory technology transfer model for sustainable coastal aquaculture	**Dr.M.Kumaran** Scientist (SS)
Evaluation of nutritive value of different strains of rotifers (*Brachionus* spp.) and their suitability for larviculture of Asian seabass *Lates calcarifer* (Bloch)	**Dr.M.Kailasam** Senior Scientist
Development and demonstration of hatchery and culture technology for the Banana shrimp, *Fenneropenaeus merguiensis* as an alternate species for shrimp aquaculture	**Dr.S.M.Pillai** Principal Scientist
Development of low fish meal feeds for shrimp aquaculture	**Dr.J.Syama Dayal** Scientist (SS)
The assessment of losses in shrimps in brackishwater aquaculture due to diseases	**Dr.N.Kalaimani** Principal Scientist
Assessment of potential sites for sustainable aquaculture using modern technological tools	**Dr.M.Jayanthi** Senior Scientist
Investigation on loose shell syndrome among farmed tiger shrimp *Penaeus monodon*	**Dr.S.V.Alavandi** Senior Scientist
Molecular characterization and analysis of virulence factors in pathogenic *Vibrio harveyi* isolates from shrimp larviculture systems	**Dr.S.V.Alavandi** Senior Scientist
IFREMER	
Seabass Pilot Unit (Indo-French Collaborative project)	**Dr.A.R.Thirunavukkarasu** Head, FCD
NORAD	
Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance	**Dr.P.Ravichandran** Principal Scientist
NACA	
Application of PCR for improved health management in India	**Dr.T.C.Santiago** Principal Scientist
DBT	
Gene expression in *Penaeus monodon* and *Penaeus indicus* in relation to microbial infection and environmental stress	**Dr.T.C.Santiago** Principal Scientist
NETWORK	
Impact assessment of fisheries research in India	**Dr.T.Ravisankar** Senior Scientist
Paddy-cum-fish culture	**Shri.R.K.Chakraborti** Principal Scientist

11. CONSULTANCY/COMMERCIALIZATION OF TECHNOLOGY

A consultancy for testing lignin products as binder in shrimp feed has been undertaken for M/s Asia Lignin Manufacturing Pvt. Ltd., Navi Mumbai, Maharastra at a cost of Rs.1,16,668.

12. RAC, IMC, SRC AND IJSC MEETINGS

RESEARCH ADVISORY COMMITTEE (RAC)

The Research Advisory Committee was constituted by ICAR (Council's order F.No.18-2/2004-ASR-I dated 10 June 2004) for a period of three years from 25 July 2004 with the following members.

Dr.N.R.Menon Former Director School of Marine Sciences Cochin University of Science and Technology Fine Arts Avenue Ernakulam Cochin 682 016	Chairman
Dr.Rakesh Bhatnagar Professor Centre for Biotechnology Jawaharlal Nehru University New Delhi 110 067	Member
Dr.(Mrs.) Katre Shakunthala Professor Department of Zoology Bangalore University Bangalore 560 056	Member
Dr.P.Keshavanath Director of Instruction College of Fisheries Mangalore 575 002	Member
Dr.P.Ravichandran Director CIBA, Chennai	Member
Dr.S.M.Pillai Principal Scientist & OIC, Technical Cell CIBA, Chennai	Member Secretary

RAC Meeting

The 11th Research Advisory Committee meeting was held during 7-8 March 2006. The major recommendations are:

- Production of disease free seed of *M. japonicus*
- Hormonal control of oocyte development and maturation in penaeid shrimps in infected and non infected specimens to understand the extent of inhibitory role of infection on maturation process.
- Development of a package for seed production, culture and larval diet for *S. serrata* and *S. tranquebarica*.
- To develop technology packages for seed production and culture of seabass and pearlspot.
- Standardisation of nursery rearing of seabass for uniform growth of larvae and to eliminate cannibalism.
- A national project on disease surveillance of fishes and shellfish should be taken up.
- Identification of causative agents for loose shell disease in *P. monodon*.
- Field testing of products from agriculture waste for bioremediation of shrimp farm discharge water.
- Carrying capacity model developed for estimating shrimp farm in a given source of water body need to be perfected for its application in other regions.
- Technology packages for larval and grow-out diets for seabass and mud crabs have to be developed.
- The role of additives in shrimp feed should be standardized for incorporation in feed formulations.
- Selection programme of *Etroplus suratensis* with growth as a basic factor should be taken up considering the importance of the species as a food fish in certain regions of the country.
- Gene mapping of *P. monodon*.
- Demonstration and popularization of the various brackishwater aquaculture technologies developed by the institute.

INSTITUTE MANAGEMENT COMMITTEE (IMC)

The Institute Management Committee was re-constituted by ICAR vide letter F.No.6-25/2003 IA-VI, dated 15 December 2004 for a period of three years with effect from 8.12.2004 as follows:

Director, CIBA, Chennai	Chairman
Shri Ajitsinha Bajran Patil H-6, Haliopolis, 58-Colaba, Mumbai – 5 103-B, Mittal Tower, Nariman Point, Mumbai – 21	Member
Shri Chidipothu Murali Chellamma Thota Thangutur Post & Mandal Prakasam Dist., Andhra Pradesh 523 274	Member

Director of Fisheries Govt. of Tamil Nadu, Chennai	Member
Director of Fisheries Govt. of Andhra Pradesh Tank Bund Road, Hyderabad	Member
Dean Fisheries College and Research Institute Tamil Nadu Veterinary and Animal Science University Tuticorin, Tamil Nadu	Member
Senior Finance & Accounts Officer Central Marine Fisheries Research Institute Cochin, Kerala	Member
Dr.A.D.Diwan Asst. Director General (M.Fy.) ICAR, New Delhi	Member
Dr.S.Kulasekarapandian Principal Scientist CIBA, Chennai	Member
Dr.A.R.Thirunavukkarasu Principal Scientist, CIBA, Chennai	Member
Dr.T.C.Santiago Principal Scientist CIBA, Chennai	Member
Shri.R.K.Chakraborti Principal Scientist Kakdwip Research Centre of CIBA Kakdwip	Member
Administrative Officer CIBA, Chennai	Member Secretary

The 28th meeting of the Institute Management Committee was held on 9 March 2006. The IMC recommended that measures should be taken to settle the outstanding advance with CPWD for the construction of headquarters' building, re-construction of compound wall in the hatchery complex at Muttukadu, construction of sea water intake system and proposal for two additional posts of Assistant Administrative Officer.

IMC Meeting

STAFF RESEARCH COUNCIL (SRC)

The 18th meeting of the annual Staff Research Council was held on 3 may 2005. The following are the major recommendations.

- To conduct planned experiments at Kakdwip with proper management strategies to bring out a package of practices for the culture of seabass.
- To overcome the problem of low salinity conditions during winter months coinciding with the breeding season of *M. cephalus* through a re-circulation system.
- To develop low cost technology package for culture of *E. suratensis* in homestead ponds.
- To carry out studies on genetic improvement of pearlspot, *E. suratensis* with respect to growth.
- Production of F_1 generation of *M. japonicus* and development of package for its culture.
- Captive broodstock development and raising generations of *F. indicus*.
- Efforts to improve the survival rate of mud crab larvae and development of grow-out crab feed.
- Characterisation, scaling up production of the beneficial bacterial filtrate developed from agricultural waste products for reducing nutrient loads of shrimp farm discharge water.
- To study the carrying capacity of source water bodies of West Godavari district.

SRC Meeting

- Biological and physical filters developed for waste water treatment should be tested in field conditions.
- To carry out mapping of the traditional shrimp farming system in West Bengal in collaboration with CIFRI.
- To take up work on anti-viral genes in *P. monodon*.
- Studies on anti oxidants and probiotics as stress reducers for shrimps.
- To study the current status of the traditional farming system in Kerala and West Bengal and to document the role of ITK in these systems.
- Demonstration of CIBA technologies under TOT programmes.
- To organize more training programmes at Kakdwip.

INSTITUTE JOINT STAFF COUNCIL (IJSC)

(Reconstituted by CIBA for a period of 3 years with effect from 6 May 2003, vide office order F.No.13-1/90-Admn. dated 6 May 2003). The composition of the Institute Joint Staff Council (IJSC) is as follows :

Official side

Director, CIBA	Chairman
Dr.P.Ravichandran, Principal Scientist	Member
Dr.S.Kulasekarapandian, Principal Scientist	Member
Dr.S.M.Pillai, Principal Scientist	Member
Dr.A.R.Thirunavukkarasu, Principal Scientist	Member
Junior Accounts Officer	Member
Administrative Officer	Member

Staff side

Shri V.R.Senthilkumar, Tech. Officer (T-5)	Member
* Shri.R.Kandamani, Assistant	Member
Shri.S.Pari, Upper Division Clerk	Member
Shri.N.Harinathan, SS.Gr.II	Member

* Also member of Central Joint Staff Council, New Delhi.

13. PARTICIPATION IN CONFERENCES/MEETINGS / WORKSHOPS/SYMPOSIA

Dr.P.Ravichandran, Director, attended the following:

- 41st Meeting of the Aquaculture Authority at Chennai, on 4 April 2005.
- Meeting on Fish Seed Certification at Central Institute of Freshwater Aquaculture, Bhubaneswar, on 8 April 2005.
- Meeting to prepare the road map for fisheries development in Andaman and Nicobar Islands, at Central Marine Fisheries Research Institute (CMFRI), Cochin, during 20-21 April 2005.
- Meeting to review the foreign aided projects in Fisheries Division at ICAR, New Delhi, on 8 June 2005.
- Stakeholders Meeting for discussion on ANDFISH – A road map for the development of fisheries in Andaman & Nicobar Islands at Port Blair, during 5-6 July 2005.
- Meeting of the Expert Committee to study and review the long term impact of tsunami on ocean ecosystem and its resources in the Indian maritime zones, at Kochi, during 18-19 July 2005.
- International Conference on "Human centered sustainable development paradigm", organized by the M.S.Swaminathan Research Foundation at Chennai, on 8 August 2005.
- 32nd meeting of the Institute Management Committee of Central Inland Fisheries Research Institute at Barrackpore, on 22 August 2005.
- 43rd meeting of the Aquaculture Authority at Chennai, on 26 August 2005.
- Meeting to review the sanitary import conditions on fish and fishery products of the Aquaculture Authority at Chennai, on 29 August 2005.
- Technical Consultation organized by the Department of Animal Husbandry, Dairying and Fisheries, Govt. of India at Chennai, on 30 September 2005.
- 10th Meeting of the National Committee on Introduction of exotic aquatic species in Indian waters at New Delhi, on 19 October 2005.
- 44th Meeting of the Aquaculture Authority at Port Blair, on 26 October 2005.

- 7th Indian Fisheries Forum at University of Agricultural Sciences, Bangalore, during 8-11 November 2005.

- Meeting of the Directors of Fisheries Research Institutes of ICAR at Project Directorate of Biological Control at Bangalore, during 12-13 November 2005.

- XXXV Academic Council Meeting of Central Institute of Fisheries Education, Mumbai on 16 December 2005.

- 8th National Seminar on "Strategies for improved farming and ecological security of coastal region" organised by the Indian Society of Coastal Agricultural Research at Central Tuber Crops Research Institute, Thiruvananthapuram, during 21-24 December 2005.

- XX Meeting of the ICAR Regional Committee No. VIII at Chennai during 23-24 December 2005.

- Review meeting of the Indo-Norwegian project at Hyderabad during 31 January to 2 February 2006.

- Review meeting of the Task Force Committee at the Directorate of Fisheries, Govt. of Tamil Nadu, Chennai, on 7 February 2006.

- TANSA 2005 Expert Committee Meeting for the selection of awardees in Biological Sciences at Directorate of Technical Education, Chennai, on 6 February 2006.

- National Conference on "Current perspectives in aquatic biology" organised by the University of Madras, Chennai on 18 March 2006.

- Second meeting of the Coastal Aquaculture Authority at Chennai on 27 March 2006.

The scientists / technical staff attended the following Meetings / Seminars / Workshops etc.

- Dr.S.M.Pillai and Dr.M.Krishnan, Principal Scientists attended the Stakeholders Consultation Workshop on Sustainable livelihood rehabilitation project for tsunami affected communities in Tamil Nadu, organized by the International Fund for Agricultural Development and M.S.Swaminathan Research Foundation, at Chennai, during 4-5 April 2005.

- Dr.M.Muralidhar, Senior Scientist attended the meeting of the Core group on "Draft guidelines on procedures and timeliness for collection of samples from shrimp farms, their analysis, subsequent reporting and follow-up action", organized by the Aquaculture Authority at Chennai, during 5-6 April 2005.

- Dr.S.A.Ali, Shri R.K.Chakraborti, Principal Scientists and Dr.J.K.Sundaray, Scientist (SS), attended the National Seminar on "Management challenges in fisheries of rivers and associated ecosystems - issues and strategies" organized by the Central Inland Fisheries Research Institute, Barrackpore, during 16-17 April 2005.

- Dr.S.M.Pillai, Principal Scientist, participated in the meeting to prepare the road map for fisheries development in Andaman and Nicobar Islands, during 20-21 April 2005 at CMFRI, Cochin.

- Dr.S.A.Ali, Principal Scientist, Dr.T.Ravisankar, Dr.M.Kailasam, Dr.(Mrs.)B.Shanthi, Senior Scientists, Dr.K.Ambasankar and

Dr.T.K.Ghoshal, Scientist (SS) participated in the seminar-cum-workshop on "Capacity building programme for Indian Agricultural Research, Extension and Development Organisations in Globalised Economy" organized by the ICAR, at NAARM, Hyderabad, during 29-30 April 2005.

- Dr.B.P.Gupta, Principal Scientist, Dr.K.K.Krishnani, Dr.M.Muralidhar, Senior Scientists, Dr.(Mrs.)R.Saraswathy, Scientist (SS) and Dr.A.Nagavel, Technical Assistant (T-4) participated in the seminar on "Water quality monitoring by rapid methods", organized by M/s Swan Environmental Pvt. Ltd., Chennai, on 9 May 2005.

- Dr.M.Krishnan, Principal Scientist attended the consultation meeting on "Developing a framework for managing land based activities that impact the marine environment in South Asia", at Madras School of Economics, Chennai on 16 May 2005.

- Dr.A.R.Thirunavukkarasu, Principal Scientist attended the review meeting on foreign aided projects in Fisheries Division at ICAR, New Delhi, on 8 June 2005.

- Shri Joseph Sahaya Rajan, Technical Assistant (T-4) attended the workshop on "Fungal biotechnology", organized by the Centre for Advanced Studies in Botany, University of Madras, Chennai, during 7-11 July 2005.

- Dr.S.M.Pillai, Principal Scientist participated in the Expert Committee Meeting of the Aquaculture Programme of Indira Gandhi National Open University at New Delhi, on 6 July 2005.

- Shri M. Kathirvel and Dr. A.R. Thirunavukkarasu, Principal Scientists participated in the Hiralal Chaudhuri Fish Farmers Award-2005 function organized by the Fishing Chimes Ltd. at Visakhapatnam, on 10 July 2005

- Dr.S.M.Pillai, Principal Scientist participated in the Coastal Conservation Enterprise and Livelihoods Consultation Meeting organized by the Covenant Centre for Development at Rameswaram, during 10-12 July 2005.

- Dr.S.M.Pillai, Principal Scientist participated in the project design workshop on "Coastal action planning meeting", organized by the Covenant Centre for Development, at Madurai, during 6-7 August 2005.

- Dr.S.M.Pillai, Principal Scientist participated in the International Conference on "Human centered sustainable development paradigm", organized by the M.S.Swaminathan Research Foundation at Chennai, on 8 August 2005.

- Dr.S.Kannappan, Scientist (SS) attended the workshop on "Fungal Biotechnology" organized by the Centre for Advanced Studies in Botany, University of Madras, Chennai, during 8-12 August 2005.

- Dr.S.M.Pillai, Principal Scientist attended the meeting to finalise the master plan for aquaculture in Kerala organized by the Agency for Development of Aquaculture, Kerala at College of Fisheries, Panangad, Kochi, on 25 August 2005.

- Dr.S.A.Ali, Principal Scientist participated in the National Conference on Intellectual

Property Rights and Management of Agricultural Research organized by the ICAR in collaboration with Indian Potato Association at New Delhi, during 27-29 August 2005.

- Dr.V.S.Chandrasekaran, Senior Scientist and Dr.M.Kumaran, Scientist (SS) attended the Brainstorming session on "Disaster management in fisheries and aquaculture" at National Institute of Disaster Management, New Delhi, during 6-7 October 2005.

- Dr.T.Ravisankar, Senior Scientist participated in the ICAR - short course on "Quantitative methods for development policy - Approaches and applications" held at Dept. of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, during 17-26 October 2005.

- Dr.M.Krishnan, Principal Scientist attended the 19th National Conference on Agricultural Marketing at G.B. Pant University of Agriculture and Technology, Pant Nagar, Uttranchal, during 25-27 October 2005.

- Dr.(Mrs.) B.Shanthi, Senior Scientist participated in the National Seminar on "Gender mainstreaming in agricultural research, extension and training : priorities and problems" at National Research Centre for Women in Agriculture, Bhubaneswar, during 25-27 October 2005.

- Dr.K.K.Krishnani, Dr.M.Shashi Shekhar, Dr.(Mrs.) M.Jayanthi, Senior Scientists, Dr.K.Ambasankar and Dr.Debasis De, Scientist (SS) attended the 7th Indian Fisheries Forum held at Bangalore, during 8-12 November 2005.

- Dr.S.M.Pillai, Principal Scientist participated in the workshop on "Post tsunami rehabilitation and fishing communities" organized by the TRINet Tsunami Rehab Information Network at Chennai, on 11 November 2005.

- Dr.(Mrs.) B.Shanthi, Senior Scientist gave a talk on "Mahalirkku uvar meen valarppu patriya payirchi" in All India Radio, on 11 November 2005.

- Dr.K.P.Jithendran, Senior Scientist participated in the 16th National Congress of Veterinary Parasitology at Indira Gandhi Krishi Vishwavidyalaya (Durg), Chattisgarh, during 6-8 December 2005.

- Dr.S.M.Pillai and Dr.T.C.Santiago, Principal Scientists participated in the National Seminar on "Aquaculture Biotechnology" at Centre for Biotechnology, Nagarjuna University, Guntur, during 17-18 December 2005.

- Dr.M.Muralidhar, Dr.(Mrs.)M.Jayanthi, Dr.(Mrs.)D.Deboral Vimala, Senior Scientists, Dr.(Mrs.)P.Nila Rekha and Dr.M.Kumaran, Scientists (SS) attended the 8th National Seminar on "Strategies for improved farming and ecological security of coastal region" organised by the Indian Society of Coastal Agricultural Research at Central Tuber Crops Research Institute, Thiruvananthapuram, during 21-24 December 2005.

- Shri M.Kathirvel, Dr.S.Kulasekarapandian and Dr.A.R.Thirunavukkarasu, Principal Scientists participated in the Seminar on "Conservation of marine biodiversity of Gulf of Mannar and Palk Strait and opportunities for livelihood support of coastal communities" organised by the National Biodiversity Authority and Aquaculture Foundation of India at Ramanathapuram, during 17-18 December 2005.

- Dr.(Mrs.)M.Jayanthi, Senior Scientist participated in the Conference on "Geomatics for infrastructure development" organised by the Anna University, Chennai, during 4-6 January 2006.

- Dr.J.Syama Dayal, Dr.Debasis De and Dr.T.K.Ghoshal, Scientists (SS) participated in the XII Animal Nutrition Conference organised by the Anand Agricultural University, Anand, during 7-9 January 2006.

- Dr.M.Kumaran, Scientist (SS) participated in the National Workshop on Planning and Management of Agricultural Extension Training for the year 2006-07 at National Agriculture Science Centre, New Delhi, during 20-21 January 2006.

- Dr.K.K.Krishnani, Senior Scientist participated in the National Scientific Seminar in Hindi "Livelihood issues in fisheries and aquaculture" at CMFRI, Kochi, on 3 March 2006.

- Dr.S.V.Alavandi, Dr.C.P.Balasubramanian and Dr.M.Kailasam, Senior Scientists attended Aqua India 2006 organised by the Society of Aquaculture Professionals at Chennai, on 3 March 2006.

- Dr.S.M.Pillai, Principal Scientist participated in the Workshop on "Conservation, enterprises, livelihoods coastal management" organised by the PLANT at Chennai, on 23 March 2006.

- Dr.S.Kulasekarapandian, Dr.N.Kalaimani, Principal Scientists, Dr.G.Gopikrishna and Dr.T.Ravishankar, Senior Scientists participated in the National Convention on "Knowledge-driven agricultural development : Management of change" organised by the Agricultural Research Service Scientists' Forum in collaboration with ICAR at New Delhi, during 24-26 March 2006.

- Shri R.K.Chakraborti, Principal Scientist participated in the State level seminar on "Extension methodology" and Farmers' Meet for sustainable aquaculture conducted by the Department of Fisheries, Govt. of West Bengal at State Fisheries Training Centre at Kulia, Kalyani and Nadia, during 27-28 March 2006.

14. SERVICES IN COMMITTEES

Dr.P.Ravichandran, Director, CIBA served in the following committees

- Member, Executive Committee and Governing Body, Rajiv Gandhi Centre for Aquaculture (MPEDA), Mayiladuthurai.
- Member, National Committee to Oversee and Regulate Introduction of Exotic Aquatic Species, Ministry of Agriculture, Govt. of India.
- Member, Aquaculture Authority, Ministry of Agriculture, Govt. of India.
- Member, Tamil Nadu State Marine & Inland Fisheries Advisory Council.
- Member, ICAR Regional Committee
- Member, Expert Committee constituted by the Andaman & Nicobar Administration to scrutinise applicants for giving permission to set up Nauplii Production Centres in Andaman & Nicobar Islands.
- Member, Sub Group-II on Responsible Aquaculture Development and Application of Fisheries Research, Aquaculture Authority of India.
- Member, Expert Group to prepare guidelines on Good management practices in shrimp aquaculture.
- Member, Expert Group to formulate guidelines for setting up and operation of shrimp hatcheries, Aquaculture Authority of India.
- Member, Task Force Committee on Fisheries Development Mission – T.N. State Department of Fisheries, Tamil Nadu.
- Member, Scientific Advisory Committee for Dr.Perumal KVK, Krishnagiri Dist.
- Member, Core Group to formulate guidelines on procedures and timelines for collection of samples from shrimp farms, their analysis and subsequent reporting.
- Member, Board of Advisers of the Journal, AQUACULT – Nature Conservators, Kolkata.

15. WORKSHOPS/SEMINARS/MEETINGS ETC. ORGANISED BY THE INSTITUTE

FARMERS' MEET

- A farmers' meet and demonstration of CIBA immunostimulant (CIBA-STIM) was conducted at Tallarevu, Kakinada, East Godavari Dist., Andhra Pradesh on 18 May 2005 in collaboration with CIFE, Mumbai. A total of 140 brackishwater farmers and 20 officials participated in this programme.
- A farmers' meet on Brackishwater Aquaculture was organized at Kakdwip Research Centre of CIBA at Kakdwip on 7 June 2005. A total of 55 farmers participated.
- Brackishwater aqua-farmers' meets were organised at Surat and Navsari on 28 & 30 March 2006 respectively. A total of 75 farmers in Surat and 50 in Navsari attended these programmes.

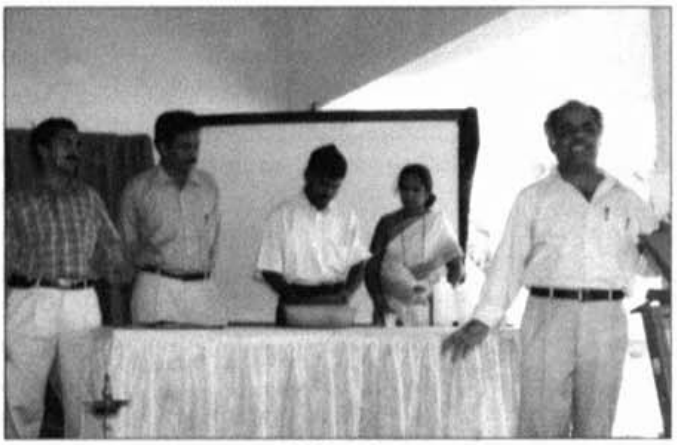
TRAINING WORKSHOPS ORGANISED

The following training workshops / demonstrations were organised by the Institute in different regions.

Sl. No.				No. of [illegible]
1.	Application of PCR for improved shrimp health management in Asian region	17-21 October 2005	CIBA, Chennai	23
2.	Issues limiting the production enhancement in shrimp farming	29 December 2005	CIBA, Chennai	20
3.	Selected technologies of CIBA	21-23 February 2006	CIBA, Chennai	25
	Selected technologies of CIBA	16-18 March 2006	CIBA, Chennai	25

FARMERS' MEET

Kakinada



Kakinada

Kakdwip

Navsari

Surat

TRAINING WORKSHOPS

Application of PCR in Asian Region

Selected technologies of CIBA

Selected technologies of CIBA

STAKEHOLDERS MEETING ON SHRIMP AND PRAWN SEED CERTIFICATION

Meeting on Seed Certification

A stakeholders meeting on shrimp and prawn seed certification was organized on 19 August 2005 to define the quality of good shrimp and prawn seed and also to evolve standard operating procedures for registration / accreditation of shrimp and prawn hatcheries. The meeting was chaired by Dr.P.Ravichandran, Director, CIBA and in his introductory remarks he presented the issues in shrimp seed certification. Dr.(Mrs.) Bindu R. Pillai, Senior Scientist from CIFA, Bhubaneswar presented the seed quality and criteria for certification of freshwater prawn seed. Shri Vishnu Bhat, Joint Director, MPEDA briefed the seed quality testing facility and the contribution of MPEDA on this important area. About 30 people representing the shrimp and prawn hatcheries and scientists of CIBA participated in the deliberations. The meeting decided to prepare the criteria for seed certification, mandatory requirements for shrimp and prawn hatchery operations and standard operating procedures.

CIBA FOUNDATION DAY

- The CIBA Foundation Day and the National Technology Day were celebrated on 20 May 2005 at Chennai.

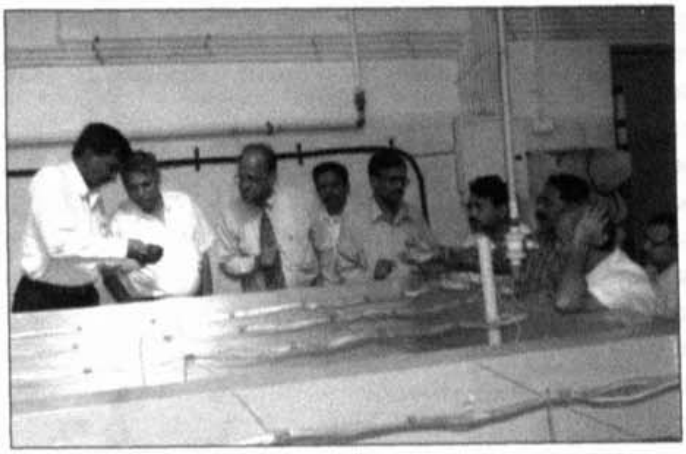
NATIONAL SCIENCE DAY

- The National Science Day was organised on 28 February 2006 with the theme "Nurture nature for our future" at CIBA headquarters. An elocution competition on the above theme was conducted for city college students.

National Science Day Celebration

OTHER MEETINGS

- The Institute observed QUAMI EKTA WEEK from 19.11.2005 to 25.11.2005
- The second project planning meeting on "Application of PCR for improved shrimp health management", India – NACA Regional project was held during 21-22 April 2005.
- The Annual Staff Research Council Meeting of the Institute was conducted on 3 May 2005.
- Review meeting of the Indo-Norwegian collaborative project was held on 5 January 2006.
- Interaction meeting of the Hon'ble Union Minister for Agriculture, Consumer Affiars, Food & Public Distribution with Indian Fisheries Sector was organised by CIBA at Chennai, during 16-17 January 2006.
- An interaction meeting of operators of PCR laboratories and shrimp hatcheries with PCR laboratories was conducted to prepare uniform protocol and reporting procedures for shrimp seed health analysis on 25 January 2006.



Indo-Norwegian collaborative project review meeting

16. VISITORS

The following visited the Institute:

Dr.C.V.Mohan and Mr.Arun Padiyar, NACA, Thailand	21-22 April 2005
Prof. Boonsrim Withyachumnarnkum, Centex Shrimp, Thailand	21-22 April 2005
Shri Vishnu Bhat, Joint Director, MPEDA, Cochin	21-22 April 2005
Prof. Indrani Karunasagar, College of Fisheries, Mangalore	21-22 April 2005
Dr.Darnas Dana, Director, Fisheries Department, Indonesia	21-22 April 2005
Dr.Evan Sergeant, AusVet Services, Australia	21-22 April 2005
Prof. Peter Walker, CSIRO, Australia	21-22 April 2005
Mr.Nick Gudkovs, CSIRO, Australia	21-22 April 2005
Dr.S.Edison, Director, CTCRI, Trivandrum	12 May 2005
Dr.Mangala Rai, Secretary, DARE & Director General, ICAR, New Delhi	4 June 2005 17 September 2005
Shri J.Ravi, Deputy Secretary (Per.), ICAR, New Delhi	22 June 2005
Dr.S.Ayyappan, Deputy Director General (Fy.), ICAR	1-4 July 2005 16-17 September 2005
Dr.W.S.Lakra, Principal Scientist, CIFE	2 July 2005
Dr.R.B.Rai, Director, CARI, Port Blair	14 July 2005
Shri.Chandrasekhar, Under Secretary, DARE, New Delhi	29 July 2005
Shri.P.Sundara Kumar, IAS, Commissioner of Fisheries, Govt. of Andhra Pradesh	1 August 2005
Dr.Y.S.Yadava, Member Secretary, Aquaculture Authority	19 August 2005
Shri.M.Sudarsan Swamy, President, All India Shrimp Hatcheries Association	19 August 2005
Dr.K.Sobhana Kumar, Deputy General Manager (Aquaculture Division), MATSYAFED, Trivandrum	22 August 2005
Dr.A.G.Anilal, Managing Director, MATSYAFED, Trivandrum	22 August 2005
Dr.J.Bojan, Director, MPEDA	24 August 2005

Mr.Warren S Payne, Economic Advisor, US International Trade Commission, Washing DC	24 August 2005
Mr.Kenneth J Pierce, Attorney to Govt. of India, Washington DC	24 August 2005
R. Lane, Washington DC	24 August 2005
Mr.Ryan Palmer, Attorney – Advisor to Commissioner, USA	24 August 2005
Dr.Douglas E New Man, International Trade Analyst, Agriculture Division, USA	24 August 2005
Mr.Fred Forstall, International Trade Analyst, Forest Products, USA	24 August 2005
Dr.Vidya Jayasankar, Japan International Research Centre for Agricultural Sciences (JIRCAS), Japan	29 August 2005
Dr.Marcy N Wilder, Japan International Research Centre for Agricultural Sciences (JIRCAS), Japan	29 August 2005
Shri.Sharad Pawar, Hon'ble Union Minister of Agriculture, Food, Public Distribution and Consumer Affairs	17 September 2005
Dr.B.Sundara, Director, Sugarcane Breeding Institute, Coimbatore	16 November 5, 6 & 14 December 2005
Mr.Jean Pierra Silva, COFREPECHE, France	7 December 2005
Dr.M.Sakthivel, President, Aquaculture Foundation of India, Chennai	29 December 2005
Prof.Ahmad Said Daib, Director, Central Laboratory for Aquaculture Research, ABBASSA, Egypt	8-21 February 2006
Mr.Markus Stern, Director, Swiss Import Promotion Programme (SIPPO), Zurich, Switzerland	27 February 2006
Dr.A.D.Diwan, Asst. Director General (Fy.), ICAR	7-9 March 2006
Dr.P.Keshavanath, College of Fisheries, Mangalore	7-8 March 2006
Dr.N.R.Menon, Centre for Integrated Management of Coastal Zones, CUAST, Kochi	7-8 March 2006
Dr.V.Rajagopal, Director, CPCRI, Kasargod	8 March 2006
Dr.R.C.Maheswari, ADG(TC), ICAR	22 March 2006

Dr. Marcy N Wilder and Dr.Vidya Jayasankar in CIBA

17. PERSONNEL

(Not a Gradation List)

Dr. P. Ravichandran

Dr.Mathew Abraham
Shri M.Kathirvel
Dr.S.Kulasekarapandian
Dr.S.M.Pillai
Dr.T.C.Santiago
Dr.A.R.Thirunavukkarasu
Dr.Syed Ahamad Ali
Shri R.K.Chakraborti
Dr.C.P.Rangaswamy
Dr.B.P.Gupta
Dr. N.Kalaimani
Dr.M.Natarajan
Dr.M.Krishnan

SENIOR SCIENTIST

Dr.G.Gopikrishna
Dr.K.P.Jithendran
Dr.Azad Ismail Saheb (on deputation to Kuwait Institute of Scientific Research, Kuwait from 8.10.2004)
Dr.K.K.Vijayan (transferred to CMFRI, Kochi w.e.f. 12.10.2005)
Dr.C.Gopal
Dr.(Ms.) Shiranee Periera (on deputation to PFA, New Delhi w.e.f. 24.10.2005)
Dr.T.Ravisankar
Dr.V.S.Chandrasekaran
Dr.K.K.Krishnani
Dr.M.Muralidhar
Dr.(Mrs.) M.Jayanthi
Dr.(Mrs.) B.Shanthi
Dr. S.V.Alavandi
Dr.C.P.Balasubramanian
Dr.M.Kailasam
Dr.(Mrs.) D.Deboral Vimala
Dr. M.Shashi Shekhar

SCIENTIST

(Senior Scale)
Dr.P.S.Sudheesh
Dr.J.Syama Dayal
Dr.M.Kumaran
Dr.S.Kannappan
Dr.Debasis De
Dr.K.Ponnusamy
Mrs.M.Poornima
Dr.(Mrs.)R.Saraswathy
Dr. Akshaya Panigrahi
Dr.(Mrs.) Saradha Chundari
Dr. J.K.Sundaray
Dr.(Mrs.) P.Nila Rekha
Dr.K.Ambasankar
Dr.T.K.Ghoshal

SCIENTIST

Mrs.P.Mahalakshmi

TECHNICAL OFFICER

T-6

Shri R.Elangovan
Shri S.Sivagnanam (w.e.f. 14.2.2005)
Shri D.Rajababu (w.e.f. 13.3.2005)

T-5

Shri M.Shenbagakumar
Shri R.Puthiavan
Shri V.R.Senthil Kumar
Shri M.G.Subramani (w.e.f. 1.1.2005)
Shri M.Gopinathan Nair (w.e.f. 1.1.2005)
Shri B.B.Roy (w.e.f. 1.1.2005)

TECHNICAL ASSISTANT

T-4

Shri S.Stanline
Shri S.Rajamanickam
Shri S.Rajukumar
Shri Joseph Sahayarajan
Shri Marella Ravi
Shri A.Nagavel
Shri R. Subburaj

T-3

Shri Maheshkumar (Jr Hindi Translator) (Transferred to NAARM, Hyderabad on 7.11.2005)

T-2

Shri N.Ramesh
Shri S.Saminathan
Shri C.Ananthanarayanan
Shri P.C.Mohanty
Shri K.Paranthaman
Shri R.Balakumaran
Shri P.Manickyam
Shri P.S.Samantha
Ms.Chanda Mazumdar
Shri N.Jagan Mohanraj
Shri D.M.Ramesh Babu
Shri G.Thiagarajan
Shri K.Karaiyan

ADMINISTRATION & FINANCE

Administrative Officer

Shri M.S.N.Murty

Finance & Accounts Officer

Shri K.U.K.Menon (joined on 5.4.2005)

Junior Accounts Officer

Mrs.K.Nandini

Superintendent

Mrs.S.Bhagirathi (V.R.S. on 30.4.2005)

Assistant

Shri R.G.Ramesh
Shri R.Kandamani
Shri P.K.Roy
Shri S.K.Bindu (w.e.f. 28.5.2005)

Stenographer
Grade II

Shri S.K.Halder
Mrs.S.Nalini

Grade III

Mrs.K.Hemalatha
Mrs.K.Subhashini

Senior Clerk

Mrs.V.Usharani
Shri S.Pari
Mrs.E.Amudhavalli
Shri A.Manoharan
Shri A.Sekar (w.e.f. 31.05.2005)
Mrs.Arati Rani Panigrahi (transferred from CIFRI, Barrackpore on 12.9.2005)

Junior Clerk

Mrs.E.Mary Desouza
Shri P.Srikanth
Mrs.R.Vetrichelvi
Shri H.Pandarinath, Hindi Typist (resigned on 15.12.2005)
Shri B.Palanivelmurugan (joined on 27.04.2005)

SUPPORTING STAFF

S.S.Gr.IV

Shri N.C.Jana
Shri S.C.Mondal
Shri L.C.Manna
Shri Prakash Chandra Saha
Shri R.K.Behera
Shri Shyam Bhoi

S.S.Gr.III

Shri M.N.Biswas
Shri A.K.Biswas
Shri Biswanath Mondal
Shri N.N.Mondal
Shri Amulya Bijali (V.R.S. on 30.4.2005)
Shri N.C.Samanta
Shri P.Arumugam
Shri Baman Jally
Shri Sasidar Betal
Shri Rash Behari Das
Shri Gaur Hari Jena
Shri Kalipada Mondal
Shri M.C.Behera
Shri K.C.Samal

S.S.Gr.II

Shri Pani Gharami
Shri Sudarshan Naik
Shri Bijay Bhoi
Shri Balram Das
Shri Patit Paban Halder
Shri Abhimanyu Naskar
Shri R.K.Roy
Shri Pranesh Chandra Saha
Shri M.Santhosam
Shri Maharaga Majhi
Shri N.Harinathan
Shri Narendra Nath Jana
Shri V.Jeevanandam
Shri Amar Gharami
Shri K.Mariappan
Shri Krishna Pada Naskar
Mrs.S.Santhi
Shri Premananda Bisoi
Shri K.Nityanandam
Shri V.M.Dhanapal
Shri B.C.Paik
Smt Lashmi Rani Bhuiya

S.S.G.r.I

Shri M.Subramani
Shri V.Kumar
Shri E.Manoharan
Shri K.V.Delli Rao
Shri C.Saravanan
Shri S.Kuppan
Shri Uttam Kumar Santra
Shri M.Pichandi
Shri R.Kumaresan
Shri S.Selvababu
Shri D.Senthilkumaran
Shri C.Raghu
Shri P.G.Samuvel
Shri M.Sakthivel
Shri R.Mathivanan
Shri A.Paul Peter
Shri R.Indrakumar
Shri G.Dayalan
Shri Kanaka Prasad
Mrs.M.Annamary
Mrs.S.Premavathy
Shri Bholalal Dhanuk
Shri Purna Chandra Das
Shri J.Devaraj
Shri M.Sampath Kumar (joined on 27.06.2005)

18. INFRASTRUCTURE DEVELOPMENT

The following major works were carried out during the year.

Headquarters

- Construction of compound wall in south western side and raising the height of compound wall in south eastern side.

Muttukadu Experimental Station

- Repairs and renovation of shrimp, fish and crab hatcheries damaged in the tsunami.
- Erection of a new 75 KVA generator
- Deep bore well for drawl of seawater
- Construction of a semi permanent shed to conduct yard experiments
- Renovation of four ponds to conduct field studies

Kakdwip Research Centre

- Renovation of A and B sector farm
- Construction of six RCC tanks (30 ton capacity each)
- Repairs of the feed mill room and store room

19. LIBRARY, INFORMATION AND DOCUMENTATION

Library holdings

The library acquired 140 books during the period. Subscriptions were made to 23 foreign and 25 Indian journals. The library had a total holding of 1900 books, 1500 journal back volumes, 650 reprints and photocopies, 1,650 reports / bulletins and 3,750 miscellaneous publications.

ange services

The library maintained exchange relationship with national and international organization of mutual interest. The library maintained free mailing of Institute's Annual Report and other publications to various research organizations, universities and other agencies.

Information services

The library extended information service to the scientific personnel of research organizations, universities, college students, research scholars and other agencies / individuals through reference of books and journals.

20. सारांश

संस्थान ने खारापानी जलकृषि से सम्बधित 10 आन्तरिक एंव 12 बाहरी शोध क्रार्यक्रमो के अन्तगति निम्नलिखित उपलब्धियाँ हासिल की हैं

- PL 20 अवस्था से पालित F4 पीढ़ी के कूरमा झींगा मार्सूपेनिअस जपानिकस का सकूटनशाला परिस्थितियों के नेत्राच्छेदन के बिना प्रजनन किया गया। F5 पीढ़ी के डिबंको का पालन भी पूर्ण हो चूका हैं और F6 पीढ़ी के लिए आगे प्रयास किए जा रहे हैं।
- क्षैतिय स्तर पर काफी मात्रा में नमूनो में वाइट स्पाट वाइरस रोग का पता लगाने के लिए डाट ब्लाट वसाट विधी का विकास किया गया हैं।
- झींगा पी. मोनोडान का ट्रेडिशनल तकनिकी द्वारा 1952 Kg/ ha फसल पैदावार हुई।
- मड केकड़ा साइला सेरेटा का 118 से 257 Kg/ ha का उत्पादन किया गया।
- खारापानी जलकृषि के विकास के लिए किए गऐ LISS -III सेटलाइट इमेज के आधार पर यह पता चला कि आन्ध्रा प्रदेश के कृष्णा जिले के जलकृषि उपयोगी क्षेत्र 12854 ha हैं।
- नर मूगिल सिफेलस में स्पर्मिएशन को 17- - मिथाइल टेस्टोस्टेरोन हार्मोन देकर उदिदपित किया गया।
- पर्लस्पाट एट्रोप्लस सुराटेनिसिस का तालाब मे प्रजनन किया गया तथा काफी मात्रा मे बोजोत्पादन किया गया। लघु स्केल किसानो के लिए एक सरल तक नीकी के मानकीकरण के लिए प्रयास किया जा रहा हैं।
- सीबास बन्धक प्रजनक का 16 बार प्रजनन के प्रयास किया गये जिसमे से 14 बार सफलता हसिल हुई एवं 11 बार दूसरी बार प्रजनन हुआ। लगभग 3.74 मिलियन हैचलिंगस एवं 5.57 मिलियन बिजोत्पादन (25 दिन) किया गया।
- सीबास का टैन्क एवं हापास में नर्सरी पालन से क्रमश 58 % तथा 66 % सर्वाबाइल पाया गया।
- प्रजनन निरिक्षण के लिए, 1- 1.5 Kg बंधक मिल्कफिश प्रजनक का रखरखाव किया गया ।
- एन्टिबायोटिक्स सवेदनशीलता के लिए 24 विबरियो आइसोलेटस का टेट्रासाइक्लिन एवं आक्सीटेट्रासाइक्लिन के लिए परिषण करने से, क्रमश 33 % तथा 37% निरोधक पाये गये।
- झींगा स्फूटनशाला तथा तालाबो में रोगो का अध्ययन करने से पता चला कि WSSV तथा MBV दोनो ही प्रभावी है।
- सीबास के मोनोजीनन पेरासाइटस रोग का 150 ppm फार्मेलिन तथा 5 ppm एक्रिफ्लेविन, का 30 मिनट तक उपचार करने से उपयोगी पाया गया।
- केप्रीलीक तथा केप्रिक अम्लो का 1mM सान्द्रता का उपयोग करने से सिलिएटस का नियंत्रण प्रभावी पाया गया।
- मड केकड़ा साइला ट्रेक्यूबेरिका मे फिनोल आक्सिडेज क्रियाशीलता का, हीमोसाइटस का जेल फिल्टरेशन क्रोमेटोग्राफी द्वारा शुध्दीकरण करके अध्ययन किया गया।
- एग्रोवेस्ट से उत्पन्न किए गये लिगनोसेलुलोसिक पदार्थ जलकृषि में वेस्टवाटर की गुणवता को सुधारने में उपयोगी पाये गये।
- एग्रोवेस्ट से उत्पन्न किए गये इममोबिलाइजिंग मैट्रिक्स का विकास किया गया जिसकी उपयोगिता जलकृषि वेस्टवाटर की गुणवता सुधारने के लिए बायोआगमेंटेशन पदार्थ बनाने में हैं।

- पोलेकूरू झिपसमुह मे कैरिंग केपेसिटी अध्ययन से यह पता चला कि झींगा जलकृषि के लिए अधिकतम क्षैत्र 1300 ha से बढ़कर 2000 ha क्षैत्र हो गया हैं।
- सीबास लार्वे के लिए उपयोग किए जानेवाले आर्टिमिया नौप्लाई की जगह आहार सुश्रीकरण किया गया।
- केकड़ो के लिए 38% प्रोटिन वाला आहार उपयोग करने से अधिकतम वृद्धि एवं पैदावार पायी गयी।
- लीजा टेड तथा ई. सुरेटेन्सिस के लिए आवश्यक प्रोटिन क्रमशः 25% तथा 30% पाया गया।
- पी.मोनोडान में माइट्रोकान्डियल जीन का PCR तथा RFLP विश्लेषण से सेक्वेन्स में भिन्नता पायी गयी जिसका उपयोग पेनियाड झींगा में जनसंख्या अध्ययन के लिए एक मार्कर के रूप में किया जा सकता हैं। पी.मोनोडान, पी.जपनीकस, एम. इन्डिकस तथा एम. सीफेलस से सम्बधित सेकवेन्स को जीन बैन्क में जमा किया गया।
- देश मे उत्पादन, तकनीकी स्थानान्तरण एवं व्यापार से सम्बधित झींगा कृषि के विकास को समझने के लिए झींगा कृषि में वृद्धि, मात्स्यिकी मे जलवायु परिवर्तन, झींगा कृषि का निर्यात भविष्य, समुद्री आहार निर्यात का भौगोलिक फैलाव, भारतीय समुद्री आहार अस्थायी इन्डेक्स, समुद्री एवं अन्तःस्थलिय GDP के आकलन पर अध्ययन किया गया।
- संस्थान के खारापानी जलकृषि से सम्बधित विभिन्न पहलुओ पर 8 प्रशिक्षण कार्यक्रम, तीन प्रशिक्षण कार्यशाला तथा चार कृषक सभा तथा एक ब्रेनस्टामिंग सेशन का आयोजन किया गया।
- संस्थान के वैज्ञानिको ने 78 शोध प्रपत्रो का प्रकाशन किया जिनमे से 28 प्रपत्र अर्न्तराष्ट्रिय पत्रिकाओ में प्रकाशित हैं। दो वैज्ञानिको को सेमिनार में प्रपत्र पढने के लिए पुरस्कार प्रदान किए गये।
- संस्थान के वैज्ञनिक तथा कर्मचारियो को देश विदेश के अलग अलग संस्थानो के मानव संस्थान विकास के विभिन्न पहलुयो पर प्रशिक्षण प्रदान किया गया।