



वार्षिक प्रतिवेदन
Annual Report
1990- 91



केन्द्रीय खारा-जल जीव पालन अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)

१२, लीथ कैसल स्ट्रीट, सांथोम, मद्रास-६०००२८

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
12, LEITH CASTLE STREET, SANTHOME, MADRAS-600 028



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12, LEITH CASTLE STREET, SANTHOME, MADRAS – 600 028

Published by

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Director

Central Institute of Brackishwater Aquaculture, Madras-600 028

Edited by

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Shri K. N. KRISHNAMURTHY, *Principal Scientist*

Cover Photo

Kuruma prawn, *Penaeus japonicus*

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INTRODUCTION

Brief History

Aquaculture of fish and shellfish in the coastal brackishwater areas has been recognized as one of the high potential areas for increasing production and for deriving economic and social benefits such as better use of unproductive and marginally productive lands, increased production of prawns and fishes, augmentation of exports and foreign exchange earnings, support to food security system, establishment of ancillary industries, generation of employment opportunities, uplift of the socio-economic conditions of the coastal poor and increase in GNP of the country. All these activities would need continuous science and technology support. To provide the R & D support, the Central Institute of Brackishwater Aquaculture (CIBA) was established by the Indian Council of Agricultural Research (ICAR) during 1986, as a VII Plan scheme, by a plan of reorganization of the Fisheries Research Institutes. The Research Centres at Kakdwip, Puri and Madras of the Central Inland Fisheries Research Institute and the Narakkal laboratory of the Central Marine Fisheries Research Institute were transferred to CIBA.

The Institute's headquarters is located at Madras with field laboratories and farm at Muttukadu. CIBA Research Centres are located at Kakdwip in West Bengal, Puri in Orissa and Narakkal in Kerala.

Mandate

- To conduct research leading to development of economically viable system of technology for aquaculture of fish and shellfish in brackishwater areas to increase production and productivity
- To assess brackishwater aquaculture potential taking into account the requirement of maintaining ecological balance and environmental health and
- To act as a nodal agency for providing scientific information and transfer of technology for the development of brackishwater aquaculture in the country

Thrust areas of research for VIII Plan

- Development of physical facilities of infrastructure and modern laboratories for research at the Headquarters and Research Centres of the Institute
- Development of semi-intensive and intensive culture technologies for different species of prawns for different agro-ecological regions of the country
- Research in prawn seed production and nursery rearing technology for different scales of operation with innovations on hatchery feeds and water quality maintenance
- Major research effort on captive prawn broodstock development and management

Development of hatchery technology for finfish and establishment of brackishwater multispecies fish hatchery facility

- Development of fish production technology in ponds, pens and cages
- Development, testing and release of balanced/practical diet formulations for grow-out culture of prawns and fishes
- Development of techniques for *Artemia* cyst and biomass production and evaluation of indigenous strains for use in hatchery production of prawn/fish seed
- Establishment of prawn/fish disease diagnostic and treatment facilities and research on viral, protozoan and metazoan diseases and their prevention, prophylaxis and control
- Basic research on ecophysiology; physiology of digestion, excretion, reproduction; physiological stress; pond bioenergetics
- Aquaculture stock improvement through genetic engineering, ploidy manipulation and selective breeding
- Biotechnological approaches in reproduction, nutrition, growth, disease control and pond health management
- Coastal zone management with reference to aquaculture
- Studies on aquaculture economics
- Aquaculture engineering research for systems, designs and materials for hatcheries and farms
- Transfer of technology through training, demonstrations, information system, publications and consultancy

Organisation and Infrastructure facilities

The research programmes of the Institute are organised under three divisions viz,

Crustacean Culture Division

Finfish Culture Division

Resource and Technology Improvement Division

The programmes relating to the development of technologies for maturation, breeding, seed production and grow-out culture of penaeid prawns, *Penaeus monodon* and *Penaeus indicus*, hatchery designs and layout, and culture of live feeds such as *Chaetoceros*, *Brachionus* and *Artemia* cyst and biomass production were looked after by the Crustacean Culture Division.

Work on development of captive broodstock of candidate species of finfish, their maturation, breeding and seed production and culture, both under mono and polyculture systems, were undertaken by the Finfish Culture Division.

Programmes on fish and prawn nutrition, development of feed technologies, reproductive physiology of *Mugil cephalus*, physiological responses of prawns to various environmental parameters, and disease diagnosis, prevention and health management of fish and prawns were taken up by the Resource and Technology Improvement Division.

Work on characteristics of coastal saline soils from different agro-climatic zones of the country and formulation of management practices for brackishwater aquaculture was also looked after by the Resource and Technology Improvement Division.

Transfer of Technology and Library services were looked after by scientists. The Technical Cell attended the coordination work of the Institute.

The Headquarters of the Institute continued to function from rented buildings at Madras. The research programmes were carried out at its Ennore and Muttukadu Centres. During the year, the ICAR transferred 36.2 ha of brackishwater lagoon area and 0.68 ha of land at Muttukadu from Central Marine Fisheries Research Institute to this Institute. The Government of Tamil Nadu transferred 10.00 acres of land in Mylapore village, Madras to the Institute. A tide-fed (15.6 ha) farm, laboratory and administrative buildings and staff quarters are available at the Institute's Kakdwip Research Centre. An experimental prawn hatchery and a small tide-fed farm (0.68 ha) are available at the Narakkal Research Centre of the Institute. Puri Research Centre functioned from hired building and the field work was carried out at Chilka lake.

Work relating to the Administrative and Accounts wings of the Institute were carried out from the Headquarters and also with some minimum staff at the Research Centres.

Budget

During 1990-91, the Institute incurred an expenditure of Rs.68.85 lakhs under Non-Plan and Rs. 34.96 lakhs under Plan.

Major Achievements

Enhancement of polychaete ration to 4%, keeping the main diet of crab/mussel/squid meat at 15% and goat liver at 2%, led to advancement of maturity in *P. monodon* within four days of eye ablation as against the prawns fed at 2% of polychaetes which required 6-15 days. The procedures on water management, feeding regimes, controlled light conditions etc., were further improved under captive conditions in the hatchery.

In larval rearing of *P. monodon* at a density of 100 nauplii/l, with a combination of *Chaetoceros affinis*, egg yolk suspension and *Artemia* nauplii (San Francisco strain) as feed, a maximum survival of 42.9% between N-6 and PL-2 was obtained and the larvae were very robust and healthy. In the case of the white prawn, *P. indicus*, a maximum survival of 61% was obtained with a mixed culture of diatoms dominated by *Chaetoceros affinis* as larval feed.

In postlarval rearing of *P. monodon* with a density of 20-25/l, using egg custard and *Artemia* nauplii as feeds, survival upto 67.3% was obtained from PL-3 to PL-20. In *P.indicus*, survival rate from PL-5 to PL-20 was 64.75%.

With a view to developing a simple, farmer's level technology, a backyard hatchery model was developed without much of aeration and water exchange. Nauplii of white prawn, *P.indicus* were stocked at 100/l in 2 tonne FRP tanks and raised upto PL-20 in the same tank. No water exchange was done upto PL-3. Subsequently 33% of water was exchanged on alternate days and increased to 50% towards the end of experimental trials. The feeds used were: mixed phytoplankton upto PL-1 and Squilla powder thereafter. A survival of 60.3% was obtained between nauplii and PL-1 and upto PL-20 the survival was 37.6%. An average production of 35,494 PL-20 were obtained per tonne of water.

Thirteen fishes of *Lates calcarifer* of 47-80 cm/3.5-10 kg range obtained from commercial catches have been acclimatised and raised as broodstock in a 300 m² earthen pond with regular water exchange and feeding. Under field conditions, the grey mullet *Mugil cephalus* was induced to breed at Arkakuda near Chilka lake mouth and 18,000 larvae reared upto 13 days using rotifer as feed.

In live feed culture, *Chaetoceros affinis* was produced with density upto 5 million cells/ml in filtered sea water enriched with modified 'F' medium in tanks kept in the open and *C. calcitrans* at 2.8 million cells/ml in Walne's medium in axenic cultures under controlled temperature. Rotifer, *Brachionus plicatilis* gave a maximum production rate of 75-140 no/ml from an initial inoculum of 20/ml with *Chlorella* and baker's yeast as feed, and 200-250/ml in a medium enriched with Urea, Superphosphate and groundnut oilcake.

Artemia cyst and biomass production were taken up on an experimental basis in a private salt pan at Kelambakkam near Madras, using chicken and cattle manure as fertilizers. Comparative studies on the cyst size, no. of cyst/g, hatching efficiency and percentage and size of nauplii were made using different strains from Kelambakkam, Vedaranyam, Tuticorin, Mithapur and Ballarpur areas.

Larval and postlarval rearing experiments of *P. indicus* and *P. monodon* were undertaken exclusively feeding them on formulated feeds consisting of squid waste, prawn waste etc., under different protein levels. The Institute continued its programmes on feed formulations and testing. *P. monodon* grow-out feeds, after initial evaluation in laboratory, were tested in Kakdwip ponds. Broodstock diet with squid meal as major component was developed for *P. japonicus*. Dietary protein and lipid requirements of *Liza macrolepis* and *Etroplus suratensis* were worked out.

Studies on disease diagnosis, control and prophylactic measures were taken up which affect production both in prawn hatchery and grow-out conditions. The causative organisms leading to mortality of *P. monodon* larvae were isolated and identified as *Vibrio alginolyticus*. Black gill

disease infestation was noticed in *P. japonicus* broodstock. The gills were found to be infected with *Vibrio alginolyticus*, which is sensitive to Chloramphenicol, tetracycline and Polymixin B.

In production systems, soft shell syndrome was studied in *P. indicus* at Narakkal and cramped tail syndrome affecting *P. monodon* at Kakdwip. Causes for stunted growth of *P. monodon* under semi-intensive culture in the ponds of DBT/MPEDA/ TASPARG farm at Nellore were studied in detail and remedial measures suggested.

The BOBP/CIBA collaboration project on development of water-stable grow-out feed for *P. monodon* was completed. In the tide-fed experimental ponds of the Institute at Kakdwip, using the experimental diet, the production and survival rates achieved were 1092.4 kg/ha/99 days and 76.5% in treatment with pond fertilization and feed pellets broadscattered. Another BOBP/CIBA collaboration study on shrimp fry by-catch in West Bengal was taken up during the year.

The Institute obtained sanction of a CIBA/CIFT collaboration project on "Studies on quantitative requirements of essential amino acids and fatty acids for the prawn *Penaeus monodon* and use of additives in the grow-out feeds for improving feed efficiency and growth production" funded by the Department of Biotechnology, Govt. of India.

A study on the impact of May 1990 cyclone that hit the Andhra Pradesh coastline on the prawn farming industry was conducted during 16-26 May 1990.

K. Alagarwami,
Director

GENERAL INFORMATION

Institute's Management Committee

The first Management Committee of the Institute was constituted by the ICAR vide Office Order No. 6-35/89-IA-VI dated 9.8.90 with the following composition:

- | | |
|-------------------------------------------------------|------------------|
| 1. Director, CIBA, Madras | Chairman |
| 2. Director of Fisheries,
Govt. of Tamil Nadu | Member |
| 3. Director of Fisheries,
Govt. of Andhra Pradesh | " |
| 4. Dean, Fisheries College, Tuticorin | " |
| 5. Shri Ramalingam, MLA | " |
| 6. Shri J.R. Gopal Rao | " |
| 7. Dr. K.V.Ramakrishna, Principal
Scientist, CIBA | " |
| 8. Dr. L.H. Rao, Scientist (SG), CIBA | " |
| 9. Shri S.R. Das, Scientist (SG), CIBA | " |
| 10. Asst. Director General (MF), ICAR | " |
| 11. Asst. Finance & Accounts Officer,
CIBA, Madras | " |
| 12. Administrative Officer,
CIBA, Madras | Member-Secretary |

The first meeting of the Management Committee was held on 14.11.1990.

Assistance rendered

The Institute provided the basic designs, drawings and lay-out for a small-scale prawn hatchery to the Department of Fisheries, Government of

Pondicherry with a production capacity of two million PL.

Technical Assistance was also provided to the BFDA, Karwar, Karnataka, for the establishment of a prawn hatchery at Kumta in Uttara Kannada District.

The Institute participated in a micro level survey programme along with CICEF and State Fisheries Department of West Bengal to find suitable areas for the brackishwater aquaculture development in Nayachor island in West Bengal.

Monitoring of water, soil and biological parameters of the brackishwater prawn culture ponds of the DBT/MPEDA project at Nellore (AP) was also done. The disease problems were also studied in detail and a report thereof submitted to TASPARC/MPEDA.

Services in Committees

Dr. K. Alagaraswami, Director, served as :

- Member, Governing body of the Agency for Aquaculture Development, Kerala (ADAK)
- Chairman, Expert Group to study removal of stake/Chinese nets from fishing in backwaters of Kerala
- Member, Dr. M.S. Swaminathan Research Foundation, Madras
- Technical Director of the Tamil Nadu Pearls (P) Ltd., Madras

- Member, Task Force on Aquaculture and Marine Biotechnology, DBT, Ministry of Science and Technology, Government of India
- Member, Project Monitoring Committee of DBT, Ministry of Science and Technology, Government of India

Dr. L. Krishnan, Scientist (SG), served as a member of the management committee of BFDA, Puri.

Dr. Ambedkar Birth Centenary Celebrations

To commemorate the birth centenary of Bharat Ratna Baba Sahib Dr. B.R. Ambedkar, the Institute conducted a "Coastal Aquaculture Awareness Programme" at its Muttukadu Field Centre on 6 October 1990 for the benefit of the fishermen and other backward communities. Shri S. Machendranathan, I.A.S., Director of Fisheries, Government of Tamil Nadu, was the Chief Guest. Presidents of village Panchayats of Muttukadu and Karikattukuppam and the local fishermen participated in the function. A group discussion was held highlighting the latest developments in brackishwater aquaculture in which all the scientists took active part. An exhibition and film show on brackishwater aquaculture were arranged for the benefit of the participants.

Training

The Institute organised a training programme on brackishwater shrimp farming for a group of 65 rural youth sponsored by Brackishwater Fish Farmers' Development Agency, Valsad and Commissioner for Fisheries, Gujarat, at its Kakdwip Research Centre. The training programme was

organised in four batches of one month duration each from 17.1.1991 to 16.4.1991. The course content included site selection, farm design and lay out, collection and segregation of prawn/fish seed and pond management practices. Both theoretical and practical training were imparted besides hands-on exercise on collection/segregation of seed, conditioning, transport, pond preparation, stocking and feeding.

Two Research Assistants from Department of Fisheries, Government of Andhra Pradesh were imparted training in water quality analysis at the Kakdwip Research Centre under BOBP project (during 19.5.1990 to 24.5.1990).

Mr. Raphael Fernandes de Alaiza, Scientist, from Cuba was given training in shrimp hatchery and culture operations through discussions and field visits from 6 May to 1 June 1990 at the Institute's Headquarters and Research Centres. The programme was arranged under the Indo-Cuban Work Plan.

The Institute gave faculty support to the training programme on "Marine Products and Allied Industries for domestic/export market" organised by the Small Industries Service Institute, Ministry of Industries, Government of India and Association of Food Scientists and Technologists (India) and sponsored by MPEDA and Indian Bank on 28.8.1990. Dr. K. Alagarwami, Director and Shri A.V.P. Rao, Principal Scientist gave lectures on 'Recent trends in coastal aquaculture and hatchery technology of prawn seed production'.

Dr. K. Alagaraja, Principal Scientist, CMFRI, Kochi, gave lectures on fisheries

statistics to the Scientists of the Institute from 5 to 9 November 1990.

Manpower Development

Dr. S.M.Pillai and Dr. B.P. Gupta, Scientists (SG) underwent a short term training course in 'Remote sensing methods' between 4 and 23 April 1990 at the Space Applications Centre, (ISRO) Ahmedabad.

Dr. Mrs. Munawar Sultana, Scientist (SG) underwent a training programme in 'Histo-physiological techniques in Reproductive Physiology' at CMFRI, Kochi during 16.9.90 and 28.9.90.

Dr. L. Krishnan, Scientist (SG) underwent training in Genetic Engineering at the National Institute of Immunology, New Delhi., in March 1990.

Seminars/Symposia/Workshops

The Director and Scientists of the Institute participated in the following Seminars/Symposia/Workshops during the year:

- Project Design Workshop on Coastal Vegetation Management and Dry-land Forestry, organised by the Society for Social Forestry Research and Development, Madras, 20-21 April 1990.

— Dr. K. Alagarswami

- Second Indian Fisheries Forum, College of Fisheries, Mangalore, 27-29 May 1990.

— Dr. B.P.Gupta

- National Seminar on Recent Advances in Coastal Marine Sciences, organised by Institute of Ocean Management, Anna University, Madras, 9 July 1990.

— Dr. K. Alagarswami

Seminar on Shrimp Farming, organised by Department of Fisheries, Government of Tamil Nadu, Madras, 14 July 1990.

— Dr. K. Alagarswami,
Shri M.S. Muthu,

Dr. K.V. Ramakrishna, Shri A.V.P. Rao,
Shri K.N. Krishnamurthy and
Shri M. Kathirvel

- National Workshop on Animal Biotechnology organised by Department of Science and Technology, Government of India and Tamil Nadu Veterinary and Animal Sciences University, Madras, 26-28 July 1990.

— Dr. K. Alagarswami and
Shri A.V.P. Rao

- Seminar on Prawn Culture, organised by MPEDA and Department of Fisheries, Government of Tamil Nadu, Thanjavur, 18-19 August 1990.

— Shri M.S. Muthu

- Training Programme on Brackishwater Prawn farming organised by MPEDA at Madras, 21.9.90.

— Dr. K. Alagarswami

- Seminar on Prawn Farming, organised by CIBA/MPEDA, Department of Fisheries, Government of Tamil Nadu, Tuticorin, 3-4 October 1990.

— Dr. K. Alagarswami,
Dr. K. Gopinathan
and Shri A. Mishra

National Symposium on *Macrobrachium rosenbergii*, organised by Kerala Agricultural University at Fisheries College, Kochi, 12-13 December 1991.

– Dr. K. Alagarswami

National Seminar on Present Status and Future Strategies for Coastal Aquaculture in India, organised by MPEDA/SCICI/ Government of Maharashtra, Bombay, 21-23 January 1991.

– Dr. K. Alagarswami

- National Seminar on 'Productivity Constraints in Coastal Areas', organised by the Indian Society of Coastal Agricultural Research, at Calcutta, 18-21 January 1991.

– Shri M.S. Muthu

- National Symposium on "Aquaculture Development in India - Problems and Prospects" - organised by the Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram, 27-29 November 1990.

– Dr. L.H. Rao and
Shri S. Srinivasagam

- International Inter-disciplinary Dialogue on Biotechnology, organised by Dr. M.S. Swaminathan Research Foundation/ Centre for Research on Sustainable Agricultural and Rural Development, at Madras, 23-25 January 1991.

– Dr. K. Alagarswami

- Seminar on Shrimp Culture Development and Technology - organised by Hanaqua

International Corporation, Taiwan at Madras, 16 November 1990.

– Shri A.V.P. Rao,
Shri M. Kathirvel
and Dr. B.P. Gupta

Meetings

Dr. K. Alagarswami, Director, attended the following meetings :

- Second meeting of the Governing Body of the Agency for Aquaculture Development in Kerala at Thiruvananthapuram, 25-26 February 1990

- Meeting on constitution of National Survey Team for Microlevel Survey of Brackishwater Areas, at New Delhi, 7-8 June 1990

Expert Group Meeting on Stake net/Chinese net Fishery in Kerala Backwaters, at Thiruvananthapuram, 25-28 June 1990 and 18-21 October 1990

Meeting in Department of Biotechnology, Ministry of Science and Technology, Government of India, at New Delhi, 16 July 1990

- Sectoral Review Meeting at Fisheries Division, ICAR, at New Delhi, 6-8 August 1990

- Programme on Administrative and Financial Management for Senior Executives of ICAR, at NAARM, Hyderabad, 3-7 September 1990

Syllabus Committee Meeting of CIFE, Bombay, 9-11 September 1990

- Aquaculture Task Force Meeting of Department of Biotechnology, at New Delhi, 3 December 1990
- Meeting on Shrimp Hatcheries in Private Sector, organised by MPEDA, at New Delhi, 5 January 1991
- National Training Course in Pearl Culture organised by CMFRI/FAO/UNDP Regional Seafarming Development and Demonstration Project, at Tuticorin, 1 February 1991
- ICAR Regional Committee VIII Meeting, at Thiruvananthapuram, 13-15 February 1991
- Seed Capital Screening Committee Meeting of IDBI, at Madras, 25 February 1991
- Research Council Meeting of CIFE, Bombay, 27 February 1991
- Expert Committee Meeting on Shrimp Hatcheries of MPEDA, Kochi, 28 February 1991
- Shri M.S. Muthu, Principal Scientist, attended a meeting to review the progress made under prawn farming projects being implemented at Nellore/A & N Islands by DBT and DOD at New Delhi, on 26 February 1991
- Second meeting of the Agency for Aquaculture Development in Kerala, funded by Kuwait, for Prawn culture in Thiruvananthapuram, on 9 May 1990
- Second meeting of the Expert Group for in depth study on removal of stake nets/Chinese nets from fishing in backwaters of Kerala - held at CIFT, Kochi on 19 October 1990
- Shri M.S. Muthu, Principal Scientist, Dr. C. P. Rangaswami and Shri D. N. Swamy, Scientists (SG) attended a meeting organised by MPEDA to discuss the Research Project Proposals on feed formulations submitted to DBT for funding - held at Madras on 25 October 1990
- Dr. S.M. Pillai, Scientist (SG) served in the Committee constituted by ADAK to select Government lands for prawn farming development and visited Ernakulam and Alapuzha Districts.

Deputation

Dr. K. Alagarswami, Director, visited Thailand and Philippines on a two week study tour for Senior Officers, from 10.3.1991 to 24.3.1991. The Study Tour was sponsored by FAO/BOBP project.

Shri A.V.P. Rao, Principal Scientist was deputed to the Water and Power Consultancy Services (India) Ltd., a Government of India undertaking, as Fisheries Expert for their project in Indonesia, on improvement of water supply to Tambaks at Maros in South Sulawesi for three months in two spells - 16 March to 15 May 1990 and 29 November to 1 January 1991.

Dr. R.D. Prasadham, Principal Scientist, was on deputation for a period of one month from 1.10.1990 to Philippines under the

ICAR/PCARRD work plan in the field of Aquaculture.

Dr. P.K. Ghosh, Scientist (SG) was deputed to Bangladesh, to attend the SAARC Workshop on Innovative Technologies for Shrimp Hatcheries during 6-13 June 1990 at Dhaka, Bangladesh.

Impact of cyclone in Andhra Pradesh

The Central Institute of Brackishwater Aquaculture made a brief study on the impact of cyclone, which hit the coastal districts of Andhra Pradesh on 9th May 1990, on the brackishwater aquaculture systems. The study was made after some means of communication were restored between 16 and 26 May 1990, in the districts of Krishna, West and East Godavari. A visit was also made to some farms in Nellore district immediately after the cyclone.

Fortunately, harvest of the crop was already over in most of the prawn farms by the month of April. In East Godavari, the farms were inundated almost three feet above the earthen bund-level due to heavy rains, causing erosion of the bunds, heavy siltation, damage to electrical installations, sluices, screens and shutters. The electrically operated pumps were completely damaged due to submergence in water and in one instance complete damage was caused to paddle wheel aerators; in another instance, a bulldozer hired for the purpose of raising the bunds was sunk deep due to sliding of the bund. In one farm near Kakinada the bunds remained intact inspite of inundation due to turfing. The feed materials kept in sheds were lost completely. Road communications were cut off for a prolonged period making restoration work and retrieval of installations difficult.

In West Godavari and Krishna districts, in addition to heavy rains, sea water had intruded far inland unlike East Godavari. In most of the farms in these two districts, except the peripheral bund where coconut palms were grown, all the other bunds had collapsed making the farms into one sheet of water, resulting in heavy siltation. Besides heavy loss to electrical installations and machineries, even the masonry structures housing the machineries were completely damaged.

Sluices, shutters and screens were also lost completely. Fertilizers, feeds etc., stored outside were lost totally and the farm implements like nets, and tools were washed away.

In Krishna district some farms which were under the initial phase of construction were totally damaged.

In Nellore district, in some of the farms visited, the damage appeared to be minimum.

The total area affected by the cyclone havoc, as reported by the State Fisheries Officials, was 326 ha in East Godavari, 145 ha in West Godavari and 2203 ha in Krishna Districts.

Honours and Awards

Shri K.O. Joseph, Scientist, was awarded the Ph.D. degree by the Magadh University, Bodh-Gaya, Bihar, for his thesis entitled "Chemistry of estuarine environment in the Madras region with special reference to pollution".

Visits

Shri N. Kalaimani, Scientist (SG), visited the Government Exotic Cattle

Breeding Farm, Eachenkottai, Thanjavur Dt., Tamil Nadu, during 6-10 May 1990 to study the cryopreservation techniques used at the Frozen Semen Bank.

Dr. T.C. Santiago, Scientist (SG), visited the Biotechnology Department of the Madurai-Kamaraj University, Madurai, between 28 November and 1 December 1990 to familiarise himself with the requirements for establishing a Biotechnology laboratory for the Institute.

Dr. C.P. Rangaswamy, Scientist (SG), visited the Central Food Technological Research Institute, Mysore, during 19-22 February 1991 to study the techniques and machinery used in food processing technology.

Library, Information and Documentation *Library Holdings*

The CIBA Library acquired 42 books during the period. To meet the reference needs and for up-dating the current knowledge of the Scientists, subscriptions to 20 Foreign and 23 Indian Journals were also made. The library, in March 1991, had a total holding of 650 books, 400 reprints and photocopies, 200 reports and 400 miscellaneous publications.

Exchange Services

The Library maintained exchange relationship with National and International organisations and Institutions for publications of mutual interest. The Library maintained free mailing of Institute's Annual Report and other publications to various research organisations, Universities and other agencies.

Information Services

The Library Section provided the various reference needs of Institute's scientists and staff. It also extended its information service to the scientific personnel of research organisations, Universities, research scholars, students and individuals through reference of books and journals in the library. The section also provided reprography services to the scientists as and when needed.

Publications

Annual Report for the year 1989-90 was published.

Visitors

The following distinguished persons visited the Institute's Headquarters and the Research Centres during the year:

- R. Wooten Mike Phillips, Institute of Aquaculture, University of Stirling, U.K.
- Dr. Rafael Fernandez de Alaiza, Scientist, Cuba.
- Shri J.P. Shukla, Joint Director of Fisheries, Government of Rajasthan
- Dr. Chen Foo Yan, Project Coordinator, Regional Seafarming Development and Demonstration Project, Bangkok, Thailand.
- Shri S. Chellappa, I.A.S., Director of Fisheries, Government of Andhra Pradesh, Hyderabad.
-

- Dr. M. H. Gunawardena and Dr. Daud Khan, Sr. Fishery Officers, FAO/ World Bank Cooperation Programme, Investment Centre, Rome.
- Shri Dilip Sangrani, Honourable Minister of Fisheries, Government of Gujarat.
- Dr. Alan Matty, University of Stirling, U.K.
- Dr. S. Ramamurthy, Professor and Head of the Department of Zoology, S.V. Universtiy, Tirupati.
- Dr. G.N. Mitra, Fisheries Consultant and Adviser to Government of Orissa.
- Shri R.K. Tripathi, I.A.S., Commissioner of Fisheries, Government of Gujarat.
- Mr. Remus J. Landoy, Civil/Aquaculture Engineer, The World Bank.
- Mr. Mario Pedini, Fishery Officer (Aquaculture), FAO/World Bank Co-operation Programme, Investment Centre, Rome.
- Dr. P.K. Das, Head, Economics and Extension Division, CPCRI, Kasargod.
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PROGRESS OF RESEARCH CRUSTACEAN CULTURE DIVISION

Breeding and seed production of *Penaeus monodon* (CCD/HT/1.1)

Madras : A. V. P. Rao (PL), L. H. Rao,
K. Devarajan, S. Srinivasagam,
S. Kulasekarapandian and
V. Sreekrishna

Narakkal : A. Laxminarayana and S.M. Pillai

Induced maturation of Tiger prawn, *Penaeus monodon*

In experiments on maturation, spawning and egg production of tiger prawn *Penaeus monodon*, the effect of food supplements to the main diet was studied. The main diet continued to be mussel, squid and crab meat at 15% and goat liver at 2% of the body

weight of stock. The food supplements were given at 2% body weight each of polychaetes, *Artemia* biomass and earthworms. Other experimental conditions were 12 h light (40-60 lux) and 200% exchange of water in a flow-through system. Unilaterally eye ablated females together with unablated males were maintained at 2:1 ratio in all the experimental tanks.

Onset of full maturity was observed within six to fifteen days at water salinity ranging 31-34 ppt and pH 8.2-8.4. The trend of data indicate that the average number of eggs and nauplii were the highest with *Artemia* biomass as supplement as compared to earthworms. In the control, the eggs were not viable. The data are presented in Table 1.

TABLE 1. Effect of ARTEMIA biomass and earthworms as feed supplements on spawning, egg and larval production in *P. MONODON*

Treatment		No. of ablated females	No. of spawnings recorded	Average no. of eggs per spawning ($\times 10^3$)	Average no. of nauplii per spawning ($\times 10^3$)	Remarks
I	Meat of <i>Perna viridis</i> /crab + squid + goat liver (Main diet)	17	1	276	-	No hatching
II	Main diet + <i>Artemia</i> biomass	24	24	260.3	148-231	Viable nauplii from 13 spawnings
III	Main diet + earth worms	8	5	189.5	72	Viable nauplii from 3 spawnings
IV	Main diet + polychaetes	10	1	288.0	35	Experiment in progress.

To evaluate maturation response with polychaete supplement at 4%, keeping the main diet at the same level, 10 eye ablated females together with five unablated males were reared in a six tonne black coloured FRP tank kept in a dark shed. Maturation was achieved within four days of eye-ablation as against 6-15 days when polychaete supplement was given at 2% as observed earlier.

Larval rearing of *Penaeus monodon*

In larval rearing trials from nauplius stage, three feeding regimes were used keeping the larval density at 100 nauplii/l. The feeding regimes were :

- i) *Chaetoceros* sp. + egg yolk suspension + *Brachionus plicatilis* + egg custard
- ii) *Chaetoceros* sp. + egg yolk suspension + *Brachionus plicatilis* + local strain of *Artemia* nauplii
- iii) *Chaetoceros* sp. + egg yolk suspension + San Francisco strain of *Artemia* nauplii

Artemia nauplii were introduced at mysis (M₂) stage. The results indicated that the average survival between N₆ and PL-2 stage were 42.9% with treatment (iii), 19.7% with treatment (ii) and 9.18 in treatment(i).

Post larval rearing of *P. monodon*

Higher survival and more robust larvae were obtained in postlarval rearing experiments upto PL-20 stage keeping the density at 20-25 PL/L, when egg custard was used in combination with *Artemia* biomass and nauplii as feed. However, due to rains during May, October and November 1990 and closure of bar mouth in June 1990, the water in the Ennore backwaters became highly unsuitable for

hatchery operation hampering breeding and larval rearing trials.

A consignment of 46,000 PL 20 was despatched from Madras to Kakdwip by Air/Road at a density of 500/l with a survival of 99.6% at destination.

Culture of live food organisms

Culture of diatoms

Pure cultures of *Chaetoceros calcitrans* were maintained at Ennore hatchery in Walne's medium at controlled temperature of 22-25°C. From an initial inoculum of 12,000 cells/ml, the diatom multiplied to 2.8 million cells/ml in a 25 l tank. Multispecies culture of *Chaetoceros* dominated by *C. affinis* was tried in open tanks in modified 'F' medium. The maximum cell density recorded was 5 million/ml. At Narakkal, when yard cultures were maintained in tanks exposed to direct sunlight of 20,000 to 100,000 lux, the cell densities of *C. affinis* reached 100,000 to 125,000 cells/ml.

Rotifer culture

Mass cultures of *Brachionus plicatilis* were maintained in open FRP tanks of 500 l capacity. Cultured *Chlorella* sp. at 100-200 × 10³ cells/individual, and/or Baker's yeast at 1 g/million rotifers were given as feed. The rotifers multiplied from 20 /ml to 75-140 /ml in 7-15 days. By refertilisation of the medium the level of rotifer population could be maintained at 72-96/ml over a period of one month. At Narakkal, *B. plicatilis* reached 200-250 /ml in 4-6 days, when cultured in water enriched with groundnut oilcake, urea and superphosphate at 200 g, 2 g and 2 g respectively per tonne of water.

Water quality parameters at Ennore

During May 1990, due to heavy rains, the salinity in the backwaters was reduced to 10 ppt and water became highly turbid making it unsuitable for hatchery purposes. During June 1990 the bar mouth remained closed due to stoppage of dredging operations by Ennore thermal station for maintenance and repairs of the machinery. This led to stagnant water conditions and increase of pollution load. Hence, hatchery work was carried out with stored water after chlorination with calcium hypochlorite and use of antibiotics. During July-September 1990, the salinity and temperature of water ranged 25-37 ppt and 25°-30°C. However during October - November 1990 due to NE monsoon rains, the salinity was reduced to 5 ppt and temperature ranged 23.4 - 29.4°C. During January 1991, the temperature remained low at 24.5-27.0°C, whereas in March 1991 the temperature of water remained optimal at 27.0-29.0°C.

Breeding and seed production of *Penaeus indicus* (CCD/HT/1.2)

Narakkal: A. Laxminarayana (PL) and
K.V. George

Effect of different larval feeds on survival of larvae

Using one tonne oval FRP tanks, experiments were conducted with five larval feeds keeping the larval density at 100 /l. The feeds used were: mixed phytoplankton, pelleted feed as microparticles, squilla powder and clam meat suspension. Highest survival upto 95.5% was obtained with mixed

phytoplankton as feed upto PL-1. The survival rates obtained with other feeds were: 53.8% (squilla powder), 52.3% (clam meat suspension), 43.7% (pelleted feed as microparticles) and 39.8% (prawn meat suspension). Six experimental trials were conducted on larval rearing without exchange of water with densities ranging 50,60 and 100 nauplii/l. Upto PL-1 the larvae were fed with mixed phytoplankton and with particulate feed thereafter. In five trials mass mortality due to infection characterised by red pigmentation on the dorsal region was noticed. The average survival at PL-1 stage was 61.02%.

Backyard hatchery technology for white prawn *P. indicus*

An experiment in larval rearing of *P. indicus* using a backyard hatchery model was conducted at Narakkal. Using low-cost materials a shed was constructed with transparent roofing made of polythene film. With 2-t capacity FRP tanks, rearing of nauplii upto PL-20 was carried out in the same tank. No exchange of water was done upto PL-3 stage; thereafter on alternate days 33% of water was exchanged, which was increased to 50% at advanced stages. Only minimum aeration was provided to the larval rearing tank. Upto PL-1, mixed phytoplankton was given as feed to the larvae and squilla powder thereafter. The survival upto PL-1 was 64.75% (at 75 nauplii/l) and 59.4% (at 100 nauplii/l), and upto PL-20 stage the survival was 46.2% and 35.7% respectively at the above densities. The average production per tonne of water worked out 35494 PL-20.

Layout, systems and design of small scale prawn hatchery (CCD/HT/1.4)

Madras : K. Alagarswami (PL), M.S. Muthu, A.V.P. Rao, L.H. Rao and A. Mishra

Basic drawings incorporating all the essential systems like water supply, drainage, maturation, larval and postlarval tanks, acclimatisation room, power supply, aeration systems etc., were prepared for the construction of a small-scale hatchery with a production capacity of ten million PL-20 per annum. Two associates of the project visited the commercial prawn hatcheries at Vishakhapatnam, Gopalpur, Nilankarai, Muttukadu and Tuticorin to familiarise with the designs and layout of these hatcheries.

Additional information on management of maturation systems, was obtained by experimentation on maturation diets. Survival rates upto PL-1 were improved upto 42.9% and from PL-2 to PL-20 upto 67.3%, through rational use of *Artemia* nauplii in the larval and postlarval rearing of *P. monodon*. Likewise in live feed culture experiments, production rates could be enhanced upto 2.8 million cells and 5 million cells/ml in pure culture of *Chaetoceros calcitrans* and yard cultures of mixed phytoplankton. In Rotifer culture, production level at 72-96 individuals/ml could be maintained over

a long duration in *B. plicatilis* culture, through refertilisation.

Breeding and Seed Production of *Penaeus japonicus* (CCD/HT/1.5)

Madras : S. Srinivasagam (PL), K. Devarajan and V. Sreekrishna

Adult 'kuruma' prawn *P. japonicus* was held in 1 tonne capacity FRP tanks with partial sand bottom. With a daily exchange of 30-50% of water and feeding them with mussel and crab meat at 10% of the bodyweight of the prawns once a day in the evening, the prawns were held for one to two months.

Out of the 12 unilaterally eye-ablated females (50-105 g) one attained maturity after 12 days with resorption of gonad three days later. Two matured after 11 and 15 days of ablation and spawned yielding 120×10^3 and 134×10^3 eggs which failed to hatch. Another female matured on the 10th day after ablation and spawned partially yielding 64.8×10^3 eggs. 24.2×10^3 viable nauplii were obtained.

Seven wild caught prawns spawned completely in the hatchery with egg production ranging from 131×10^3 to 335×10^3 (1310 - 4000 eggs. per gram of body weight). The hatching rate of the eggs ranged 42.8% - 95.3% (Table 2).

TABLE 2. Larval rearing of *P. JAPONICUS* at Ennore hatchery

Sl. No.	Wt. of spawner (g)	No. eggs ($\times 10^3$)	No. of nauplii ($\times 10^3$)	% of hatching	No. of PL-2 ($\times 10^3$)
1	80	220.0	180.0	81.8	—
2	85	335.0	300.0	89.6	—
3	70	280.0	120.0	42.8	4.86
4	90	215.0	205.0	95.3	—
5	100	131.0	106.0	80.9	0.42
6	105	312.0	270.0	86.5	0.18
7	105	205.0	150.0	73.2	15.00

Chaetoceros sp. at 20,000 cells/ml, *Brachionus plicatilis* at 10 numbers/ml and prepared egg yolk suspension at 5-10 particles/ml were given as feed to the larvae. Whenever cultured rotifers were not available freshly hatched nauplii of *Artemia* were used as feed at 3-5 nauplii/ml. Daily 30-50% of water was exchanged in the larval rearing tanks.

Rearing of postlarvae from PL-2 to PL-20 was done with two experimental feeds viz., egg custard (whole egg) and mussel meat at 1:1 ratio and *Artemia* biomass in two replicates each. In the former case the survival was 56.5% with a final average size of 11.5 mm at PL-20, while the postlarvae fed on *Artemia* biomass showed a survival of 73.5% with a slightly higher average size of 11.8 mm at PL-20. In another experiment the postlarvae upto PL-5 were fed with *Artemia* nauplii and thereafter, upto PL-20, with a mixture of egg custard and *Artemia* biomass. The survival was 64.2%.

In nursery rearing experiments with postlarvae from PL-30 (16 mm) upto PL-60, two feeding trials were conducted. A formulated pellet feed developed by the Institute with a crude protein level of 47.4% and *Artemia* biomass were used. The group that received the pellet feed showed a survival of 67.1% with a final average size of 32.5 mm. The group which received *Artemia* biomass registered a survival of 57.7% with a final average size of 26.0 mm. In yet another experiment mussel meat was used as feed with PL-20. The postlarvae registered a growth of 35-50

mm from an initial 8-13 mm with a survival of 18.7%.

Culture of *Penaeus monodon* in tide-fed ponds (CCD/CP/1.1)

Kakdwip :Hardial Singh (PL) and R.K. Chakraborti

Pond 1, 2 and 3 in B sector of Kakdwip farm (1960 m² ; 1620 m² and 1840 m² respectively) were stocked with wild caught juveniles of *Penaeus monodon*. The ponds were initially treated with mahua oil cake (*Madhuca latifolia*) at 250 ppm to eradicate the predatory and burrowing organisms. Liming at 500 kg/ha and fertilization with a basal dose of chicken manure at 500kg/ha were done. To provide shelter for the juvenile prawns and development of periphyton, dry palm leaves were provided in all the ponds. Ponds 1 and 2 were stocked with 10 juveniles/m² and pond 3 with 5 juveniles/m². The stocking was done in a phased manner from last week of March 1990 to the middle of April 1990 with segregated seed of *P. monodon*. The stock consisted of two distinct size groups 19-26 mm and 28-45 mm. Before stocking, the inlets of the ponds were protected with net screens to prevent entry of unwanted fishes etc., Feeding was done with powdered formulated feed in dough form initially at 8% and gradually reduced to 6%. The powdered feed was mixed with boiled wheat flour. Feeding was done twice daily at 40% of the ration in the morning and 60% in the evening. Towards the end of the culture for nearly a fortnight feeding could not be done as the feeds could not reach the farm site in time.

Despite precautionary measures, entry of other prawns and fishes could not be prevented, which resulted in poor survival and production. However, the production of

P. monodon ranged from 197.7 kg/ha to 718.3 kg/ha in a period of 109-123 days. The details of stocking, production, survival etc., are given in Table 3.

TABLE 3 : Culture of *P. MONODON* in tide-fed ponds at Kakdwip during 1990

Parameter	Pond Numbers		
	1	2	3
Pond area (m ²)	1960	1620	1840
Stocking density (No/m ²)	10	10	5
Size at stocking (mm/mg)	30-35	28-33	40-45
Group-1	310	250-290	1000
Group-2	20-25 90-150	20-22 80-120	19-26 80-160
Period of stocking	24-3-90 to 1-4-90	31-3-90 to 4-4-90	7-4-90 to 15-4-90
Date of harvesting	3.8.90	3.8.90	3.8.90
Period of culture (days)	123	120	109
Av. weight at harvest (g)	12.2	11.4	13.5
Quantity harvested (kg)			
<i>P. monodon</i>	70.330	116.365	35.830
Misc. prawns	25.540	29.070	30.815
Misc. fish	12.130	2.050	10.975
Projected production (kg/ha)			
<i>P. monodon</i>	358.830	718.300	194.730
Others	192.194	192.099	227.120
Total	551.024	910.399	421.850
Survival (%)	29.4	63.2	28.8

The hydrographic parameters in the ponds during the culture period indicated reducing conditions at the soil water interface and sudden lowering of

salinity during July 1990 due to monsoon rains. The details of hydrographic parameters, nutrients etc. are furnished in Table 4.

TABLE 4. *Hydrological characteristics in one pond of B Sector (1620 m²) during Pre-monsoon crop*

	April	May	June	July
1. Depth (cm)	73	81	95	106
2. Temperature (°C)	28.4	30.0	34.2	29.5
3. Dissolved oxygen (mg/l)	7.2	5.9	9.7	6.2
4. Turbidity secchi disc (cm)	18	24	36	32
5. pH	8.66	8.72	9.06	7.89
6. Redox potential (mv)				
– water	123	167	137	201
– soil	-249	-267	-237	-220
7. Salinity (ppt)	11.7	13.5	13.0	3.0
8. Dissolved reactive phosphorus (mg/l)	0.16	0.11	0.06	0.19
9. Total phosphorus (mg/l)	0.33	0.20	0.19	0.36
10.. Nitrite (mg/l)	0.005	0.004	0.00	n.a*
11. Nitrate (mg/l)	0.007	0.045	0.06	n.a*
12. Primary Productivity (mg C/m ³ /h)	198	394	293	307

* n.a not analysed

In July, incidence of soft shelled condition to the extent of 100% was noticed in ponds 1 and 2 and 15% in pond 3. Cramped tail syndrome to the extent of 3% was also noticed, but this could be controlled by 50% exchange of water.

For the monsoon crop, *P. monodon* juveniles were stocked in a nursery during September 1990 at 75000/ha. However, mass mortality occurred and only 3000 juveniles were stocked in Pond 2 of B sector (18518 no/ha). Due to low stocking density, the growth was 28.6 g in 100 days. From November onwards the prawns became soft-shelled and the production was negligible. The salinity of water in the pond remained at 2 ppt throughout and redox values ranged -168 to -255 mv.

Prawn culture in pump fed ponds (CCD/CP/1.3)

Madras : M. Kathirvel (PL), B.P. Gupta, K. Gopinathan and A. Mishra

Hatchery produced PL-20 of *Penaeus japonicus* (5000 seed) were stocked in a 0.25 ha pond on 25.01.1991. The prawns were fed with a formulated pelleted feed developed by the Institute containing 47.4% crude protein. The prawns had grown from an initial size of 9.6 mm to 87.3 mm in 60 days rearing. Further rearing is being continued to raise the prawns as broodstock. The soil samples collected from 18 stations in the Muttukadu lagoon indicated a predominantly sandy nature (81%) with clay (11%) and silt (8%). The pH of soil ranged 7.0 - 8.7 and the electrical conductivity 15.1-32.2 mmhos/cm. CaCO₃, organic carbon and av. P were 1.2%, 0.55% and 4.4 mg/100 g respectively. Analysis of plankton from the lagoon indicated dominance of copepods among zooplankters and Chlorophyceae and diatoms among

phytoplankton. Bivalves formed 65% and gastropods 30% of the benthos and the central portion of the lagoon was comparatively more productive than marginal areas.

Prawn and fish production in perennial ponds (CCD/CP/1.4)

Narakkal: S.M. Pillai (PL) and K.V. George

During August 1990, one pond (0.6 ha) at Narakkal was treated with ammonia at 10 ppm for the eradication of predatory and weed fishes and later limed at 200 kg/ha. Cattle dung at 2000 kg/ha, urea and super-phosphate at 100 and 250 kg/ha respectively were applied. Initially juveniles of the grey mullet, *Mugil cephalus* (29 mm/0.5g) were stocked at 1250/ha. Refertilisation of the pond at 2000 kg/ha with cattle dung and 250 kg/ha of rock phosphate was done. During December 1990 and January 1991, PL-20 of *Penaeus indicus* was stocked at an overall density of 80,000 no/ha. The survival and production were low. The retrieval was 20.8% in the case of prawns. *M.cephalus* registered a growth of 311.6 mm/336.0 g in 223 days and *P.indicus*, 124.5 mm/ 14.04 g in 96 days and 98.5 mm/6.02 g in 49 days. Low oxygen values, dinoflagellate blooms, clam populations, prolific breeding of *O. mossambicus* were some of the reasons which interfered with the growth, survival and production of stocked prawns and mullets.

Salinity ranged from 2.56 ppt in July to 19.57 ppt in March. The pond soil exhibited reducing conditions throughout the period, with high values during July with a gradual decrease during December only to increase subsequently with a value of -1190 mv in March. The details of hydrographic parameters are furnished in Table 5.

TABLE 5. Average values of physico-chemical characteristics of the 0.6 ha perennial pond at Narakkal during 1990-91.

Parameter	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Water Phase									
-Depth (cm)	57.0	55.4	64.4	74.0	82.5	80.9	79.2	76.4	75.1
-Transparency(cm)	57.0	55.4	60.8	56.9	58.5	75.0	52.7	48.8	50.4
-Temperature(°C)	32.0	30.4	32.1	29.8	30.0	29.8	30.0	31.5	32.2
-Salinity (ppt)	2.56	2.81	4.16	5.68	5.84	12.00	16.07	16.45	19.57
-pH	7.82	7.24	7.30	7.31	7.14	7.18	7.70	8.01	7.91
-Dissolved O ₂ (ppm)	3.04	3.55	5.00	5.76	3.18	3.52	4.60	4.10	3.15
-Total alkalinity (ppm)	127.4	151.2	123.0	109.7	91.9	135.8	112.2	109.3	106.8
-Dissolved N (μ g at /l)	3.068	1.645	0.055	1.114	0.573	0.852	0.866	0.277	0.293
-Dissolved P (μ g at/l)	12.508	17.786	5.800	8.084	7.908	10.055	7.265	7.360	7.775
Soil phase									
-pH	8.06	7.46	7.30	7.40	7.26	7.42	7.94	7.99	8.02
-Electrical conductivity (mmhos/cm)	1.76	2.08	2.86	2.50	2.66	2.70	4.90	9.32	9.80
-Redox potential (mv)	-1160	-1580	-874	-452	-166	-122	-900	-1240	-1190
-org. carbon (%)	0.83	0.48	0.92	0.78	0.61	0.84	0.74	0.21	0.41
-Available P (Kg/ha)	222.06	304.64	286.72	176.68	171.68	65.32	207.72	262.08	210.88
-Available N (Kg/ha)	30.104	16.394	32.306	42.680	42.680	24.510	23.960	24.960	22.520

The abundance in space and time of the clam *Villorita cyprinoides* was studied and also the effect of cattle dung and manual removal on their recolonisation. A maximum number of 558/m² was observed in July with a decline to 259 /m² in August, only to increase to 433/m² in September. Initially after the application of cattle dung, within three days, mortality of the clam upto 23.1% was observed. However, the population showed an increase later. During October, the entire population of clams was removed. The density of clams was reduced

and maintained a downward trend at 37/m² upto January. However in February and March, the population again showed an upward trend reaching 87 clams/m².

Experimental culture in confined ponds of Chilka to evaluate methods to improve production (CCD/CP/1.5)

Puri : L. Krishnan (PL) and P.K. Ghosh

During the year, seven ponds of 0.02 ha each in Keutakudi farm were handed over by BFDA, Puri on 20 December 1990.

The ponds were treated with lime at 500 kg/ha and manured with raw cattle dung at 1000 kg/ha, and urea and single superphosphate at 75 kg/ha each. Stocking of ponds was done during first week of January 1991, with *P. monodon* seed of size 18.08 mm/13.14 mg at 30,000/ha in all the ponds. Feeding of the stock with a formulated feed developed by the Institute was done from seventh day of stocking initially at 10% of the body weight which was later reduced to 3% level. After 72 days of rearing the prawns registered an average size of 87 mm/8.5 g. The growth was found to be slow due to presence of miscellaneous varieties of fishes which entered when the ponds were flooded during November 1990.

The physico-chemical parameters of the pond water during the period were : Temperature 24° - 33°C, depth 64-119 cm, turbidity 17-110 cm, dissolved oxygen 5.2-11.2 ppm, total alkalinity 36-130 ppm, salinity 5.0-12.0 ppt and pH 7.2-8.4.

Artemia biomass and cyst production in the laboratory and salt pans. (CCD/AC/1.1)

Madras: S. Kulasekarapandian (PL),
S. Srinivasagam and K.O. Joseph

Cyst production

Three rectangular ponds of 230 m² each in a saltern at Kelambakkam, about 40 km south of Madras were taken up for studies on *Artemia* cyst production. The experimental study was initiated on 26 March 1990 and completed on 1 October 1990. Dry poultry manure at two different doses viz., 500 and 250 kg/ha was tried with a control pond where no fertilisation was done. The ponds subjected to fertilisation were remanured at half the initial dose after 7-10 days. Inoculation of the three ponds with

Artemia nauplii was done at 40 /l on the fifth day of culture. Upto May 1990, the salinity in the ponds was maintained at 70-100 ppt and from June onwards it was raised to 170-200 ppt for inducing cyst formation. The details of the physico-chemical parameters of the ponds are presented in Table 6.

In the pond which received chicken manure at 500 kg/ha, the density of *Artemia* population was 99 animals/l, while the pond which received 250 kg/ha manure, it was 84 /l. In the control pond, the density was least with 80 animals/l. Cyst production was affected by sudden and intermittent rains from May onwards, non-availability of brine of adequate strength in required quantity, temperature stress due to low water levels (sometimes 18 cm), reduced soil pH in manured ponds and widely changing primary productivity.

Biomass production

To evaluate the efficiency of different types of manures on *Artemia* biomass production, an experimental trial was conducted, using pig manure, chicken droppings and cattledung extracts. The manures 500 g each were soaked in eight litres of sea water and aged for 14 days. One hundred ml of these extracts per day were used in tanks having *Artemia* nauplii of Kelambakkam strain at a density of 1200/l. The salinity was maintained at 67 ppt. The control tank received defatted rice bran of 50 micron size particles. The culture data indicated maximum production of biomass with 80% adults and 20% pre-adults in the control tank fed with defatted rice bran. Other tanks which received pig, cattle and chick manure extracts indicated higher percentage of pre-adults and juveniles than

TABLE 6. Physico-chemical conditions of water and soil, population density and cyst production of ARTEMIA in Kelambakkam ponds during 26-3-1990 to 1-10-1990.

Parameter	Control	Pond 1	Pond 2
Water phase			
Depth (cm)	18-65	28-65	25-65
Temperature °C	31-36.2	31-36.3	31-36.5
Salinity ppt			
Apr – May	70-115	70-100	70-115
Jun – Sep	80-200	95-195	100-195
PO ₄ -P (ppm)	trace-0.1600	0.008-0.040	0.010-0.18
NO ₃ -N (ppm)	0.01-0.12	0.31-0.70	0.40-0.80
Total alkalinity (ppm)	120-220	124-230	122-260
D.O. at 10.00-11.00 hrs (ppm)	3.0-5.0	2.8-5.2	2.6-5.0
pH	7.9-8.1	7.9-8.2	7.8-8.3
Primary production (mg C/m ³ /day)	144-1440	432-2880	576-4320
Soil phase			
pH	7.7-8.1	6.5-7.9	6.2-7.5
Available P (mg/100 g)	1.05-1.38	1.5-3.4	1.5-4.7
Available N (mg/100 g)	15.8-16.9	18.5-29.8	19.9-31.2
Organic C (%)	0.26-0.30	0.36-0.48	0.31-0.62
Specific conductivity (m.s./cm)	75-168	75-118	74-210
Max. population density (No/l)	80	84	99
Cyst production - actual (g)	89.811	124.086	198.566
- projected (kg/ha)	3.9	5.4	8.6

adults. The experiment could not be continued beyond 36 days as heavy rains inundated the experimental tanks.

Comparison of Indian strains

A comparative study of the different Indian strains of *Artemia* was made with regard to some characteristics viz., cyst size, no. of cysts/g, hatching efficiency and hatching percentage and size of nauplii. The strains studied were from Kelambakkam, Vedaranyam, Tuticorin, Mithapur and Ballarpur.

The hatching efficiency was found to be maximum for Ballarpur strain while it recorded the smallest cyst and naupliar size. The size of nauplii from Mithapur strain was the largest. The proximate analysis of the different strains on dry weight basis indicated that lipid content was maximum for Vedaranyam strain and lowest for Tuticorin strain. Likewise protein content showed a maximum for Vedaranyam strain with 44.25% with a minimum of 20.75% for the Kelambakkam strain. The details are furnished in Table 7.

TABLE 7. Comparative study of Indian strains of ARTEMIA from different regions

Characteristics	Kelambakkam	Tuticorin	Vedaranyam	Mithapur	Ballarpur
Average diameter of cysts (microns) after 1 h hydration	263.4	260.0	247.69	259.54	232.5
No. of cysts/g (x 10 ⁵)	2.1825	2.3250	2.7475	2.5625	2.7575
Average hatching efficiency (No. of nauplii/g cysts) x 10 ⁵	1.62	—	2.37	2.02	2.60
Average hatching percentage	51.0	—	70.8	67.2	39.0
Size of nauplius (microns)	508.6	512.5	501.3	518.0	471.9
Proximate analysis (% of dry weight)- Total lipid cyst nauplius	10	2.5	15	7.5	7.5
- Total protein cyst nauplius	20	—	25	20	25
- Total protein cyst nauplius	20.75	30.18	44.25	34.25	35.25
- Carbohydrate cyst nauplius	37.50	—	38.75	39.00	41.38
- Carbohydrate cyst nauplius	12.00	26.20	34.00	44.40	36.80
- Carbohydrate cyst nauplius	16.00	—	16.40	20.60	13.80

Monitoring of traditional brackishwater aquaculture systems for improving their productivity (CCD/TF/1.1)

Kakdwip: R.K. Chakraborti (PL), S.R. Das, and A. Chowdhury

Narakkal: K.V. George

A cluster of *bheris* in Nazat area in 24 Parganas Dt. was visited and hydrological and soil characteristics of a weed infested and weed-free *bheri* were investigated. The most common weeds in the *bheris* were *Ruppia maritima* and *Najas* sp. The weed infested *bheris* were low in nutrients and benthic organisms were absent, whereas in weed-free *bheris*, benthic organisms comprising of tanaids, amphipods and mysids were abundant. At the Kakdwip farm, two ponds in B sector were taken up for study in simulating *bheri* conditions during July-November. The salinity in the ponds ranged 2-4 ppt and the ponds were subjected to autostocking. A total production of 190.3 and 217.7 kg/ha/5 months was recorded of which *P.monodon* formed 17.5 and 22.8%

respectively while the rest of the production was accounted by *Liza parsia*, *Lates calcarifer*, *Mystus gulio* and miscellaneous prawns and fish. Though the initial average size of *P. monodon* is not known, the final average size at harvest was 38.4 g and 43.6 g in the two ponds. In both these ponds no soft shelled prawns were observed.

At Narakkal, one seasonal pond of 3.24 ha was selected for monitoring of the traditional farming practices from November 1990 to April 1991. Since there was not much of natural recruitment of seed into the field, 2,50,000 seed of *P. indicus* was released during January 1991. A total of 1728 kg was harvested with *P. indicus* contributing to 37.0%. *M. dobsoni* 56.4% and *M. monoceros* 6.6%. The production rate worked out to be 576 kg/ha. During March, a bloom of dinoflagellates was noticed and mortality of prawns were observed. The hydrographic parameters were: salinity 6.4-19.6 ppt, temperature 30-32°C; DO 2.3-4.7 ppm, pH 7.1-8.2; redox potential - 45 to 900 mv respectively.

FINFISH CULTURE DIVISION

Breeding and seed production of *Lates calcarifer* (FCD/BS/1.1)

Madras: K.N. Krishnamurthy (PL), K. Gopinathan, N. Kalaimani and V. Sreekrishna

Puri: L. Krishnan and P.K. Ghosh

Development of a broodstock of *Lates calcarifer* for captive breeding was successful during the year. A survey on the occurrence of adult fishes was made from commercial catches landed at Ennore, Royapuram and Kovalam during July 1990 to January 1991. Though stray numbers of small seabass were available during these months, large fishes were available only from February 1991 onwards. During this period 13 numbers of fish ranging 47 - 80 cm/3.5-10.0 kg were collected from Ennore barmouth area and transported to the hatchery site. After acclimation and treatment with antibiotics, they were stocked in a 300 m² earthen pond with provision for water supply and draining. Water exchange with total replenishment is being carried out thrice a week. Regular feeding of the broodstock at 10% of the body weight is being done with live trash fish. At Puri Centre, due to unfavourable environmental conditions, commercial fishing for *Lates* was suspended and no work could be carried out.

Broodstock development, management, breeding and seed production of Grey Mulletts (FCD/BS/1.2)

Madras : K.V. Ramakrishna (PL), R.D. Prasad, Mathew Abraham, K. Gopinathan and V. Sreekrishna

Puri : L. Krishnan and P.K. Ghosh

Broodstock development

At Ennore, 40 fishes of *Liza macrolepis* of 182 mm/60 g (av. size) were stocked in a 12' dia plastic pool fitted with an *in situ* filter to ensure good quality water. Water was exchanged at 20% daily. A formulated feed was given to the stock at 5% of the body weight twice daily. The composition of the feed was: algae - 25%, groundnut oilcake - 30%, soy bean -15%, mineral mix- 5 mg/kg, vitamins K and E - 30 mg/kg each, with maida as binder. The stock was maintained successfully since December 1989. However, during January 1991, due to parasitic infestation (*Caligus* sp.) there was total mortality of the stock.

Induced breeding

At Ennore, 73 fishes of *Liza macrolepis* obtained from commercial catches were treated with carp/mullet pituitary homogenate + HCG, and LHRHa for induction of spawning. Positive response was noticed in

four cases and only in one case successful fertilization of eggs was obtained. Hatching was poor with only 10% and the hatchlings survived only for two hrs.

At Puri a field camp was set up at Arkakuda near Chilka lake mouth from 5 December 1990 to 19 January 1991 for conducting induced breeding experiments on the grey mullet, *Mugil cephalus*. Mature fishes from *Khadi jal* catches were obtained and transported alive to the camp site and maintained in 10' x 3' plastic pools. After ovarian biopsy, gravid fishes were selected for induction of spawning. Carp pituitary homogenate, HCG and Pimozide were used either singly or in combination for induction of spawning. Eleven fishes were treated out of which only two fishes responded positively and one fish spawned naturally without any hormone administration. However the eggs did not hatch. In one case 2.2 million eggs were released and the fertilization was only 2%. The larvae hatched out after 50 h but died immediately. In the second fish 2 million eggs were released with 50% fertilization and 18,000 larvae hatched out in 32-48 h duration.

Larval rearing

Rearing of the above larvae was done under field conditions at Arkhakuda using 6' x 3' dia plastic pools. The larvae were fed from day 3 onwards with cultured live rotifers at a density of 2-4 animals/ml. From day 5 zooplankton collected from adjoining creeks was also given as feed. The larvae could be reared for a period of 13 days.

Seed Production

At Ennore 30,000 larvae of *L. macrolepis* obtained through induced breeding during last week of February 1990 were reared further. A total of 11,000 (20

day old) fry were stocked in a FRP tank and fed with *Brachionus* sp. and formulated feed initially and later on only with formulated feed. Water was exchanged at 20-50% daily. After 90 days of rearing, the fry had grown to an average of 34.70 mm with a survival of 10.5%. The stock was further reared upto February 1991 and they had grown to an average size of 67.3 mm/3.5 g. In March 1991, due to *Caligus* infection there was total mortality.

Broodstock development, breeding and seed production of pearlspot, *Etroplus suratensis* (FCD/BS/1.3)

Narakkal: S.M. Pillai (PL), A.R.
Thirunavukkarasu

Madras: Munawar Sultana

Kakdwip: Hardial Singh, B.K. Banerjee

Broodstock development and management

At Narakkal, three batches of broodstock of pearlspot, *Etroplus suratensis* were developed in 0.02 ha pond. After pond treatment with ammonia at 10 ppm for eradication of unwanted and predatory fishes, liming was done at 1000 kg/ha. During July 1990, the pond was stocked with 12 fishes of average size 174.3 mm/132.5 g. The second batch of 30 fishes of 143 mm/ 79.21 g were stocked during October 1990 and a third batch of 30 fishes of 160.2/112.9 g were stocked during October 1990. The water quality parameters in the pond were: salinity 2.5-20.4 ppt, DO 2.6-6 mg/l, pH 7.1-8.8, total alkalinity 146-199.5 ppm and temperature 28-34°C. The fishes were fed with groundnut oilcake and rice/wheat bran at 1:1 ratio once a day. Water exchange was done periodically either through sluice gates permitting entry of tidal water or by pumping.

At Ennore (Madras), 165 fishes of 92-200 mm (av.wt. 85g) were stocked in a 0.05 ha pond in March '90. Groundnut oilcake and rice bran at 5% of body weight at 1:1 ratio was given to the brood fish daily. The salinity of the pond ranged 5-40 ppt and pH 8.2-10.0. During June 1990, due to heavy rains, the salinity dropped to almost freshwater levels and there was a sudden increase in pH, resulting in heavy mortality of the fish.

During November 1990, a new pond of 100 m² was excavated and filled with water and in December it was stocked with 68 pearlspot of 148mm/ 91 g. Exchange of water was done regularly by pumping and feeding of the stock was done with a mixture of groundnut oilcake and rice bran at 1:1 ratio at 5% of the body weight. The salinity of the pond water ranged 18-40 ppt, temperature 24.2-37.6°C, pH 8.3-8.8 and dissolved oxygen 1.2-9.2 ppm.

At Kakdwip, 42 pearlspot (150 mm/110 g) were maintained in two ponds. They were fed daily with fish meal and rice bran at 1:1 ratio at 2- 3% of their body weight.

Nesting materials were provided in the broodstock ponds at all the Centres where pearlspot were maintained, to facilitate natural breeding.

Seed production

At Narakkal Centre 1000 juveniles of pearlspot of 28-34 mm size were obtained from a 0.02 ha pond in which 12 adult fishes were stocked, during last week of July 1990. At Ennore, 9643 juveniles of 32-44 mm were obtained from 0.05 ha pond, where 165 adults were maintained. At Kakdwip Centre a total of 8352 juveniles were obtained from

two ponds (0.08 and 0.06 ha) from 42 adult fishes maintained in the above ponds.

Feeding experiments and pond rearing of fry of pearlspot

At Kakdwip Centre, the pearlspot fry were fed on a feed mixture of fish meal, groundnut oilcake and rice bran at 2:1:1 ratio at 5% of the body weight and on natural food in the form of adult *Diaptomus* and their nauplii at 5 ml settled volume. The experiments were carried out in one ton FRP tanks for 97 days and 75% of water was exchanged on alternate day. Fry of initial size 30 mm had grown to an average of 36.1 mm with a survival of 66.7% on *Diaptomus* diet and to 39.05 mm with a survival of 83.3% on artificial diet.

At Narakkal, 850 juveniles of 32 mm/0.6 g were stocked in a 0.02 ha pond. Feeding of fish was done at 100% of body weight initially and reduced to 20% later. Ground nut oil cake, rice bran and wheat bran at 1:1:1 ratio was used as feed. After 172 days of rearing the fish had grown to an average of 113.2 mm/33.07 g with a survival of 74.8%. The hydrographic parameters of the pond were - Temperature 29.0- 34.0°C, salinity 4.8-19.8 ppt and pH 7.3-9.1.

Rearing of Pearlspot fry under laboratory conditions

Both at Narakkal and Ennore, experiments were conducted to study the hatching rate of pearlspot eggs in the laboratory. The fertilized eggs laid over the nesting materials in the pond were collected and placed in tanks of 300 l capacity. The salinity of water ranged 12-15 ppt. The hatching rate ranged 7.3 to 25% and the hatchlings suffered heavy mortality.

Studies on the reproductive biology of *Etroplus suratensis*

Wild caught fishes from the backwater around Narakkal were collected for studies on sex ratio, size at first maturity, fecundity etc., The sex ratio of male to female was found to be 1 : 0.92. Peak spawning appeared to be during July and November as observed from occurrence of mature fishes of both sex. The fecundity ranged 831-2975 eggs per fish and number of eggs per g body weight was observed to be 15.

Monoculture of brackishwater fishes in tide-fed ponds (FCD/FC/1.1)

Kakdwip :B.K. Banerjee (PL), H.S. Majumdar and A. Chowdhury

Nursery rearing of *Lates calcarifer*

Two 0.06 ha ponds were prepared by liming at 300 kg/ha and application of poultry manure at a basal dose of 1000 kg/ha. The ponds were stocked with fry of *Lates calcarifer* (86 mm/10 g av.) at 5000 /ha. Split bamboo screen was provided and water exchange was facilitated through the sluiceway, through which forage fish also entered. In addition to natural entry of forage fish, *Lates* were fed with fish collected from nature. In 125 days of rearing the fry had grown to an average size of 197 mm/100 g, with a survival rate of 51.6%.

Monoculture of *Lates*

A 0.12 ha pond was stocked with nursery reared fingerlings of *Lates calcarifer* at 1292/ha. The average size of fingerlings was 197 mm/100 g. The pond was earlier prepared by lime application and basal dose of fertilizers. Forage fishes were collected and fed to the stocked fish. After a culture

period of 127 days, the fishes had grown to an average of 252 mm/240 g with a survival rate of 48%. In another experiment 18 yearlings of *L. calcarifer* of 287 mm/297 g were stocked in a 0.06 ha pond. Forage fish were provided for the stocked *Lates*. After 348 days of rearing the fish had grown to 456 mm/870 g with 83.3% survival.

Nursery rearing of *L. tade*

A 0.06 ha pond was initially prepared and a basal dose of poultry manure at 1000 kg/ha was applied and 7000 fry of mullet, *Liza tade* were stocked. The initial average size of the fry at stocking was 16 mm/42 mg. Feeding was done with a mixture of rice bran, fish meal and mustard oilcake at 2:1:1 ratio at 5% of the bodyweight of the fish daily. Poultry manure at 300 kg/ha and urea and superphosphate at 20 kg/ha were applied at monthly intervals. After a rearing period of 90 days, the fry had grown to a size of 81 mm/6 g with a survival of 65%.

Culture of *L. tade*

L. tade fingerlings of size 81.0 mm/6.0 g were stocked in a 0.06 ha pond @ 75,533 no/ha and in a 120 day rearing period, they had grown to 120 mm/19.7 g with 23% survival. The production rate worked out to 333 kg/ha/4 m.

Nursery rearing of *L. parsia*

In another experiment on rearing of *L. parsia* fry, a 0.06 ha pond was limed at 250 kg/ha and manured at 1000 kg/ha of Poultry manure as a basal dose and 20 kg/ha of Urea + Superphosphate. 6000 no. of *L. parsia* of 23 mm average length were stocked during March 1990 and they were fed with a mixture of rice bran, fish meal and mustard oilcake at 2:1:1 ratio at 5% of body wt. In

60 days rearing the fishes had grown to an average size of 41 mm with a survival of 53.75%.

Polyculture of fishes and prawns in coastal tide-fed ponds at Kakdwip (FCD/FC/1.2)

Kakdwip: S.R. Das (PL), Hardial Singh and A. Chowdhury

Nursery rearing of *Penaeus monodon*

Penaeus monodon post larvae of size 11 mm/6 mg collected from nature were reared in a hapa at 500 PL/m² for 9 days. The seed were fed with an artificial diet in powdered form at 11% of the body weight and at the end of the rearing period, they had grown to 16 mm/20 mg with a survival rate of 41%. During the course of the rearing the water quality parameters in the hapa were : temperature 31-32°C, salinity 15 ppt, pH 7.3-9.5 and DO 5-7 ppm.

Polyculture of *Penaeus monodon* and mullet, *L. tade*

A 0.275 ha pond was stocked with *P. monodon* seed obtained through nursery rearing experiments and *L. tade* obtained from nature during April 1990. The initial average size of *P. monodon* was 16 mm/20 mg and the stocking density was 50,000/ha. *Liza tade* was stocked at 700/ha at an initial average size of 150 mm/42.5 g. After rearing

for a period of 5 months, the stock was harvested and the survival was 66.6% in the case of *P. monodon* and 48.0% for *L. tade*. The average size of prawn at the time of harvest was 106 mm/10.7 g and that of fish 310 mm/312.7 g and the production rate of prawn was 98 kg/ha and fish 105.8 kg/ha in 5 months. Besides, extraneous fishes and prawns which gained entry through the sluices gave a production rate of 110.3 kg/ha which included *L. calcarifer*, miscellaneous prawns and *L. tade*.

Due to paucity of seed of *P. monodon* during October, *L. tade* alone was cultured at 10,000 fish/ha. The stock was obtained from nursery rearing experiments conducted during July 1990 in a 0.09 ha pond stocked with *L. tade* of 19.5 mm/200 mg at 1,00,000/ha. In 60 days rearing, the fish had grown to 56.9 mm/3.5 g with a survival of 70%. By February, 1991 the fish had grown to 144 mm/46.0 g and a production rate of 350 kg/ha was realised in 5 months with a survival of 70%. The water quality parameters were: temperature 12-32°C; salinity 0-15 ppt and pH 8.8-9.3. The benthic fauna consisted mainly of tanaids, gammarids and polychaetes with numerical abundance ranging 300-345 no/m². The zooplanktonic forms encountered were *Diaptomus*, *Cyclops*, copepod nauplii, mysids and rotifers and phytoplankton was represented by *Microcystis*, *Oscillatoria* and diatoms.

RESOURCE AND TECHNOLOGY IMPROVEMENT DIVISION

Compounded feed formulation and feed technology for Penaeid prawns (RTID/NT/1.1)

Narakkal: S.A. Ali, (PL)

Madras: C. P. Rangaswami,
D. Narayanaswami and C. Gopal

Experimental feeding trials on rearing of prawns (*P. indicus*) with a formula feed CIBA 50 (CP-38.5%) indicated better conversion ratio and growth under laboratory conditions. The FCR was 2.5 and the prawns had grown upto 12-15 g from an initial 5.7 g. The experiments lasted for 172 days. The effect of steaming temperature and steaming time on the water stability of prawn feed pellets was also studied. It was observed that steaming for 10 minutes at 100°C is adequate to achieve maximum water stability.

The formula feed CIBA-50 with a crude protein content of 38.5% was tried in a grow out culture pond with *Penaeus indicus*. After initial pond preparation with application of lime 20 kg, rock phosphate 20 kg and cattle dung 15 kg, the pond (0.05 ha) was stocked with 5000 no. (1 lakh/ha) of prawn post larvae (PL-20 - 15.6 mm/0.3 g). The stocking was done on 21.2.1991 and after 28 days of rearing the prawns had grown to 92.5mm/4.7 g indicating a very good growth in a short time. However, due to heavy rains subsequently, mass mortality took place and the stock was lost.

Feeding experiments with juveniles of *P. monodon* (12 mm/5 mg) was conducted for 60 days using three feeds with mussel meat as control. Two densities of stocking were tried with 25/100 l and 50/100 l. Each treatment was tried in triplicate under a randomised block design. The result indicated that feed No.II gave a good growth with FCR ranging 1.6-1.9. Incidentally the control (mussel meat) also gave a good growth with FCR 1.3 - 2.2.

At Madras a grow out feed for *P. monodon* was formulated with fish meal as a major component (30.4%) and 220 kg of this feed was prepared and sent to Puri for evaluation in the BFDA ponds. A maturation feed with squid as the major component (39%) was formulated and 50 kg of this was prepared for *P. japonicus* broodstock at Muttukadu.

Compounded feed formulation and development of feed technology for finfishes (RTID/NT/1.2)

Madras: C.P. Rangaswami (PL), D. Narayanaswami and C. Gopal

Narakkal: S.A. Ali and S.M. Pillai

Madras

Proximate analysis of various protein sources such as fish meal, shrimp head meal, soya cake, squid meal and mussel meat was carried out and the results are presented in Table 8.

TABLE 8. Proximate Composition of raw materials (in %)

Source	Moisture	Protein	Lipid	Ash
Fish meal	9.1	64.78	5.37	11.5
Shrimp waste meal	1.03	68.28	4.29	10.0
Soyacake	3.35	61.3	2.21	6.0
Squid meal	8.6	63.04	9.0	19.2
Mussel meat	9.2	61.09	10.7	21.0

Nurtitional studies on *L. macrolepis*

To study the optimum dietary protein requirement of the grey mullet *L. macrolepis*, an experiment was conducted with seven purified diets with protein levels ranging 10-60% using casein as protein source and it was observed that the optimum protein level for the fish was 40%. Keeping the protein level at 40% another experiment was conducted to evaluate the lipid requirement of the fish. Using fish oil, sunflower oil and lecithin as lipid source, four purified diets with lipid levels ranging 5-20%, were formulated and fed to fish stocked in experimental containers in the laboratory. It was observed that the optimum lipid level in the diet for *L. macrolepis* is 5%.

Narakkal

Nutritional requirements of Pearlsport, *Etroplus suratensis*

To confirm the earlier results obtained on the protein requirements of *Etroplus suratensis*, further trials were made with six formulated diets ES 6 - ES 11 having crude protein ranging 53.8% - 25.8%. The result confirmed that the diet ES-9 having a crude protein of 37% had positive nitrogen (protein) deposition in the body. Experiments were also conducted to determine the lipid requirement of *E. suratensis*, using seven different oils of both animal and plant origin. The basic ingredient in the feed consisted of fish meal at 54%, ground nut oil cake - 9% and wheat

bran at 8% and tapioca, minerals and vitamins. The lipid source was uniformly kept at 7%. Better growth was observed in fish fed with Cocount oil followed by sardine oil. A maturation feed for *E. suratensis* was also formulated and prepared.

Diseases of finfish and shellfish (RTID/DIS/1.1)

Madras: M.S. Muthu (PL), B.P. Gupta,
A.R. Thirunavukkarasu,
S.V. Alavandi and C. Gopal

Kakdwip: R.K. Chakraborti

Kakdwip

Penaeus monodon stocked in ponds at Kakdwip were affected by soft shell syndrome during August, November and December 1990, and 20-45% of the stock was found to be affected. The ponds in which the problem was noticed had highly reducing soil conditions (redox potential of - 226 to - 279 mv.) low salinity (2 ppt) and very poor benthos. The ponds where the problem of soft shelling was not noticed had a dense population of benthic animals (amphipods and tanaids - upto 64,000 animals/m²), while the affected ponds had no crustaceans in the benthos at all, and a sparse population of polychaetes (2000-4000 worms/m²) which are known to survive in H₂S affected soils, was present.

During July 1990, cramped tail syndrome was also noticed in *P. monodon* at Kakdwip. Microbiological analyses of the haemolymph of the affected animals did not reveal any bacterial or fungal infection. The epibiotic bacterial flora on the cuticle of the cramped tail prawns revealed the presence of *Vibrio* spp., *Alcaligenes*, *Pseudomonas* and *Acinetobacter* which are part of the natural bacterial flora of the pond water. After the pond was flushed with fresh tidal water, the cramped tail problem disappeared.

Narakkal

Soft shelling of *Penaeus indicus* was observed in the Matsyafed farm at Narakkal during July, August and September 1990 and 21-65% of the prawns were found to be affected by the problem. The salinity of the affected ponds ranged 2.4-5.2 ppt and the ponds showed highly reducing soil conditions.

Madras

Investigations conducted in a private prawn hatchery near Madras leading to mortality of *Penaeus monodon* larvae (Mysis) revealed no fungal/protozoan infection. The mortality was found to be due to vibriosis caused by *Vibrio alginolyticus*, which was found to be sensitive to oxytetracycline and Nalidixic acid. Broodstock of *Penaeus japonicus* at Ennore hatchery were affected by black gill disease and the causative organism was found to be *Vibrio alginolyticus* which was sensitive to penicillin, chloramphenicol, tetracycline and polymyxin B.

The causes for stunted growth of prawns (*P. monodon*) in the growout culture ponds at the DBT/MPEDA/TASPARC farm at Nellore, were investigated during October-November 1990. Bioluminescence was also noticed from these ponds, the cause for which was identified to be due to the presence of luminous bacterium, *Vibrio*

fischeri. Other bacterial population in the ponds with bioluminescence was much lower ($0.01-0.6 \times 10^5$ /ml) than in the normal ponds ($7.5-48 \times 10^5$ /ml). The haemolymph samples did not show bacterial/fungal growth on the culture media. The epibiotic microbial flora of the stunted prawns consisted of *Vibrio parahaemolyticus*, *V. vulnificus*, *Micrococcus*, *Pseudomonas* etc., From the ponds showing bioluminescence in addition to *Vibrio fischeri*, *V. fluvialis*, *Pseudomonas*, *Aeromonas*, *Bacillus*, *Micrococcus* and *Flavobacterium* were isolated. From the normal ponds, *Aeromonas*, *Pseudomonas* and *Micrococcus* were isolated.

From *Liza macrolepis* being raised in Ennore hatchery, *Caligus* sp. a crustacean ectoparasite was identified and treatment with potassium dichromate was found to be effective in the eradication of the parasitic infestation.

Reproductive Physiology of Finfish and Shellfish (RTID/RP/1.1)

Madras : K. Alagarswami (PL), Munawar Sultana and N. Kalaimani

Puri : L. Krishnan

Madras

To study the development of gonads of the grey mullet, *Mugil cephalus* under natural environmental conditions, monthly samples of fish were collected from Pulicat, Ennore and Kovalam/Muttukadu area near Madras. Males in stage I and IV and females in stage I (both early and late I stages) occurred in the collections from Madras region. From the fishes collected, blood, muscle, liver and gonad were analysed for their biochemical composition to observe the changes with respect to maturation. Environmental parameters like temperature,

salinity, DO, pH etc., were also monitored. Gut analysis to estimate the food consumed by the fishes was also done. Histological examination of the gonads was done with haematoxylin and eosin stains. The histological examination of pituitary of the fishes stained with Mallory's triple stain, showed different cell types such as the ACTH and prolactin cells in the rostral pars distalis, the gonadotrophs and somatotrophs in the proximal pars distalis and the melanotrophs in the pars intermedia.

TABLE 9. Influence of salinity on metabolism of P. INDICUS

Level of salinity	33 ppt	23 ppt
Mean rate of oxygen consumption	344.53 ml/kg/ha	437.0 ml/kg/ha
Ammonia excretion	0.75 ml/kg/ha	1.55 ml/kg/ha
Ammonia quotient	0.0021	0.0035
Random activity	9 counts/hr	19.3 counts/ha

Puri

During the fish breeding camp from 4-12-1990 to 20-1-1991 at the Chilka lake mouth area (Arkakuda) 18 samples consisting of mature males, maturing and spent females were obtained and detailed biological data collected. Observations on males with different stages of maturity viz., Immature, I, oozing, and females - immature, I, and IV were also made. Samples of gonads, liver, kidney, pituitary glands were collected and fixed in Bouin's fluid for further histological studies.

Physiological responses of prawns to various environmental parameters (RTID/EP/1.1)

Narakkal :A. Laxminarayana (PL)

Madras : K.O. Joseph

Narakkal

Influence of salinity on the metabolism of *Penaeus indicus*

Using *Penaeus indicus* adults of size 140-150 mm/21.2 g, the influence of salinity on oxygen consumption, mean rate of ammonia excretion, Ammonia quotient and random activity of the prawns were studied under two levels of salinity (33 ppt and 23 ppt). The results indicated that the above values showed an increase in lower salinity suggesting higher rate of metabolism in lower salinity. The values are given in Table 9.

In another experiment on *Penaeus indicus* juveniles, hatchery reared animals of 18-31.3 mm/0.04 - 0.056 g, to study the influence of salinity on oxygen consumption, ammonia excretion, ammonia quotient and random activity under six levels of salinity viz., 2.5, 5.0, 10.0, 17.0, 32.0, 35.0 ppt were studied. The results indicated that oxygen consumption was maximum in 5.0 ppt (1842.5 ml/kg/hr) and minimum in 35.0 ppt (639.5 ml/kg/hr). The rate of ammonia excretion which is an index of protein degradation was minimum in 17.0 ppt (4.59 ml/kg/hr) and maximum in 5.0 ppt (21.1 ml/kg/hr).

Madras

To assess the impact of water quality on seed production, the physico-chemical parameters of the Ennore backwaters were studied, from where water is being drawn for both maintenance of broodstock and larval rearing. Samples were collected from three selected stations adjacent to the hatchery. The parameters are given in Table 10.

TABLE 10. *Water quality paraameters in Ennore estuary*

Parameters	Station I near CIBA hatchery	Station II centre of the estuary	Station III opposite side of CIBA hatchery
Colour	Pinkish-brown	Pinkish-brown	Pinkish-brown
Salinity, ppt	29.0	24.0	28.0
pH	8.6	8.6	8.9
Transparency, cm	7.5	7.9	7.6
Total alkalinity (mg L ⁻¹)	304.0	298.0	260.0
NH ₃ (mg L ⁻¹)	1.6	0.9	0.8
NO ₂ (mg L ⁻¹)	0.14	0.12	0.10
C.O.D. (mg L ⁻¹)	18.0	17.0	16.4
Mercury, µg. ml ⁻¹	0.0004	—	—

In order to develop facilities for a farm in the Muttukadu lagoon area, hydrographic studies were initiated to assess the water quality of the existing ponds and the adjoining lagoon. The parameters are given in Table 11.

TABLE 11. *Water Quality Parameters at Muttukadu.*

Parameter	Pond water	Open area
Transparency, cm	24.0 - 36.0	22.0 - 58.0
Salinity, ppt	27.0 - 35.5	24.5 - 32.5
pH	7.9 - 8.2	7.8 - 8.1
Total alkalinity mg-L ⁻¹	134.0 - 162.0	134.0 - 150.0
D.O. "	5.0 - 5.8	5.2 - 6.4
Phosphate "	0.06 - 0.12	0.008 - 0.8
Nitrate "	0.08 - 0.14	0.06 - 0.18
C.O.D. "	2.0	1.60
Suspended particles %	0.01 - 0.02	0.05 - 0.08
Chlorophyll <i>a</i> µg. L ⁻¹	3.2	2.8

Water samples were also collected from the newly constructed bore well at Muttukadu farm. The water was clear and colourless. The results of the chemical analysis of the water are given in Table 12.

Characteristics of coastal saline soils of different agroclimatic zones and formulation of management practices for aquaculture (RTID/ES/1.1)

Madras : B.P. Gupta (PL) and K.O. Joseph

TABLE 12. *Chemical analysis of borewell water at Muttukadu*

Parameters	Water samples collected after pumping for		
	15 minutes	30 minutes	60 minutes
Salinity, ppt	32.0	31.5	31.8
pH	7.7	7.7	7.7
Free CO ₂ , mg L ⁻¹	8.6	10.6	10.10
Total alkalinity mg L ⁻¹	136.0	136.0	132.0
Total settleable solids mg L ⁻¹	0.2	0.2	0.2
Phosphate mg L ⁻¹	0.002	0.009	0.008
Nitrate mg L ⁻¹	2.91	2.60	2.72
Iron mg L ⁻¹	0.04	0.02	0.05
Magnesium mg L ⁻¹	200.0	194.0	200.0

The results indicated that the borewell water is suitable for hatchery purpose, even though the CO₂ is slightly high which may get reduced when it comes in contact with air.

Studies on metabolism of *Penaeus monodon*

Sub-adults of 82 mm collected from Ennore after acclimation were held in fabricated respiration chambers in 20 ppt salinity. Oxygen consumption ranged 526-561 mg/kg/ha and ammonia excretion 11.1-13.3 mg/kg/ha. The calculated O : N ratio varied from 36-41.

To study the soil characteristics from different maritime states, detailed survey and collections were made from Tamil Nadu, Andhra Pradesh and Orissa.

Tamil Nadu

The soil collected from Mahabalipuram is heavier in texture with sand 49.3-60.5%, silt 3.5-14.2% and clay 31.5-37.8%. The soil was found to be alkaline in reaction (pH 7.0-7.8) and salt content (E.C. 33.0-96.0 m.mhos/cm) is satisfactory for brackishwater aquaculture. The CaCO₃ content ranged from 0.50 to 1.75%. The organic carbon

(0.08-0.18%) and available P (2.25-3.75 mg/100 g soil) contents were low.

Soil of Muttukadu had sand 81%, silt 8.3% and clay 11%. The soil was alkaline in reaction (pH 8.2), saline in nature (E.C. 22.1 m.mhos/cm), low in organic carbon (0.55%) and medium in available P (4.4 mg/100g soil).

Samples of Kelambakkam soil had sand 60.5%, silt 12.5%, clay 27.0% and pH 7.9, CaCO₃ 1.32%, organic carbon 0.26-0.30%, E.C. 75.0-168.0 m.mhos/cm and iron 0.54%.

An experiment conducted in ponds at Kelambakkam with the application of poultry manure at two doses (250 and 500 kg/ha) revealed that higher dose of poultry manure considerably increased the organic-C, available P and N of the pond soil.

Soil samples were collected from coastal areas of Tanjore (Thethakudi and Naluvadapatti). The soil of Thethakudi is sandy clay loam, alkaline in reaction and low in nutrient status. But the soil of Naluvadapatti is heavier in texture, alkaline in reaction and medium in nutrient status.

Andhra Pradesh

Soil samples collected from TASPARG Farm at Nellore had clay 45-50%, silt 9.5-16.5%, sand 37.5-43.5%, pH 8.0-8.4, organic-C 0.84-1.0%, CaCO₃ 1.9-2.5% and available P 4.2-4.5 mg/100 g soil.

Orissa

The soil of Gopalpur is heavier in texture and alkaline in reaction but poor in nutrient status. The soil of Uppalpatti is dominated by sand (83.5%). The pH of soil was slightly acidic to alkaline and nutrient status was low. The Sonapur Farm soil was heavier in texture and alkaline in reaction, but the nutrient levels were of medium magnitude. Rushikulya estuarine sediments were also heavier in texture, alkaline in reaction and medium in nutrient status.

Soil samples collected from Ramchandi area is higher in sand content, highly acidic in reaction (pH 3.3-6.1) and poor in salt content (E.C. 2.9 m.mhos/cm) indicating nonsaline nature of soil. Though organic-C of soil was high (2.2%), the available P was low (1.3 mg/100 g soil).

SPONSORED/COLLABORATIVE PROJECTS

Development of water-stable shrimp feeds for use in artisanal brackishwater aquaculture system

The collaborative programme between the Institute and the ODA Post-harvest Fisheries Project of the FAO Bay of Bengal Programme was approved under Council's letter No. ADG (MF)/90-Cor dated 16 January 1990. The objective was to develop a water-stable feed for *Penaeus monodon* culture under tide-fed conditions. The feed trials were carried out at the Institute's experimental farm at Kakdwip Research Centre, West Bengal. Eighteen ponds, each of 0.027 ha waterspread area, were used for nine treatments including control. Feed was prepared according to ODNRI formulation in collaboration with a private feed industry. Feed ingredients used were: Blend A - Wheat flour, soyabean meal (44% cp)/soya flakes (52% cp) and broken rice; Blend B - fish meal (sun dried), shrimp head meal, squid/cuttlefish meal; others - fish oil, soya lecithin, mineral premix, vitamin premix, choline chloride, plaster of paris and sodium alginate. The calculated diet nutrient composition was: dry matter 90%, crude protein 35.7%, total lipid 4.6%, crude fibre 2.7%, ash 10.0%, calcium 2.5%, phosphorus 0.9%, lysine 2.0%, methionine and cystine 1.2% and salt 0.4%.

The ponds were dried and slaked lime applied at 700 kg/ha. After taking in 10 cm water, sun dried poultry manure was applied

at 250 kg/ha. Ponds were later filled to 83-110 cm depth. Pond preparation was completed during 13-26 February 1990. *P. monodon* seed were obtained from the wild and initially nursery-reared in hapas inside the ponds during 3-11 March 1990. The ponds were stocked during 12-15 March 1990 by transferring the seed from hapas, at a stocking density of 1,00,000 seed/ha. Survival in the nursery phase was about 60% and mean size of seed at stocking was 23.6 mm/132 mg. Feed was given in pellet form and doughball form at 10% daily of estimated *P. monodon* biomass in the pond during the first to 5th week, at 7% during 6th and 7th weeks, at 6% during 8th and 9th weeks and at 5% during 10th and 11th weeks. Though culture duration was aimed at 120 days, it had to be cut short to 94 days due to non-availability of feed during the last two weeks (hence no feed supply) and onset of monsoon.

During the culture duration, salinity range was 13-15 ppt and water temperature 25.6°-30.2°C. Dissolved oxygen was lower than 3 pm at 0700 hours during 27 May - 2 June 1990 and it was improved by lifting the pond water by a pump and splashing it on a split bamboo platform. The soil and water quality of pond was monitored throughout the culture period as per schedule.

The ponds were harvested during 17-22 June 1990 (average culture duration 94 days). The production data are presented in Table 13.

TABLE 13. Production data from experimental ponds using water stable shrimp feeds at Kakdwip

S.No	Treatment Code	Average size <i>P. monodon</i> at harvest (g)	Survival rate (%)	Gross yield (kg/ha)	<i>P. monodon</i> yield (kg/ha)
1.	N	3.05	17.2	152.8	52.7
2.	NF	3.29	37.5	319.9	124.6
3.	NP	10.05	69.0	938.5	764.0
4.	NEP	11.33	76.5	1092.4	860.0
5.	NPT	10.77	55.4	1012.3	597.2
6.	NFPT	10.94	59.6	882.8	687.5
7.	NFDT	8.23	60.1	795.8	494.2
8.	NDT	8.12	48.8	599.4	396.4

Code: N - Natural food (control); F - Fertiliser added to pond; P - Feed pellet form; T - feed presented on tray; D - Feed doughball form; E - pellets extruded.

In spite of use of screens at the sluice gate at each pond, autoentry of fish and prawns could not be prevented. This explains the difference between gross yield and *P. monodon* yield. Miscellaneous group included *P. penicillatus*, *Metapenaeus ensis* and *M. brevicornis* among penaeid prawns, *Leander styliiferus* and *Macrobrachium rude*, crabs and fishes like *Liza parsia*, *Therapon jarbua* and gobiids.

The formulated feed in pellet form broadcasted in the fertilised pond gave the best *P. monodon* yield of 860.0 kg/ha/94 days. The yield could have been higher but for the non-supply of feed during the last

two weeks. In the treatments of NFP, NPT, NFPT and NP there was reduction in average size of *P. monodon* from the sampling on day 75 to harvest on day 94.

Study of shrimp fry by-catch in West Bengal

This is a collaboration project between the Institute and FAO Bay of Bengal Programme, approved by Council in letter No. 10(2)/89-ASR (I) dated 7.9.90. The objective of the programme is to: Assess the destruction of organisms during the seed collection operations for *P. monodon* in West Bengal by quantitatively describing the seasonal and spatial variations in the species compositions of organisms other than *P. monodon* capture as by-catch. The programme was implemented at Kakdwip Research Centre of the Institute from 1.10.90 for a period of one year.

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