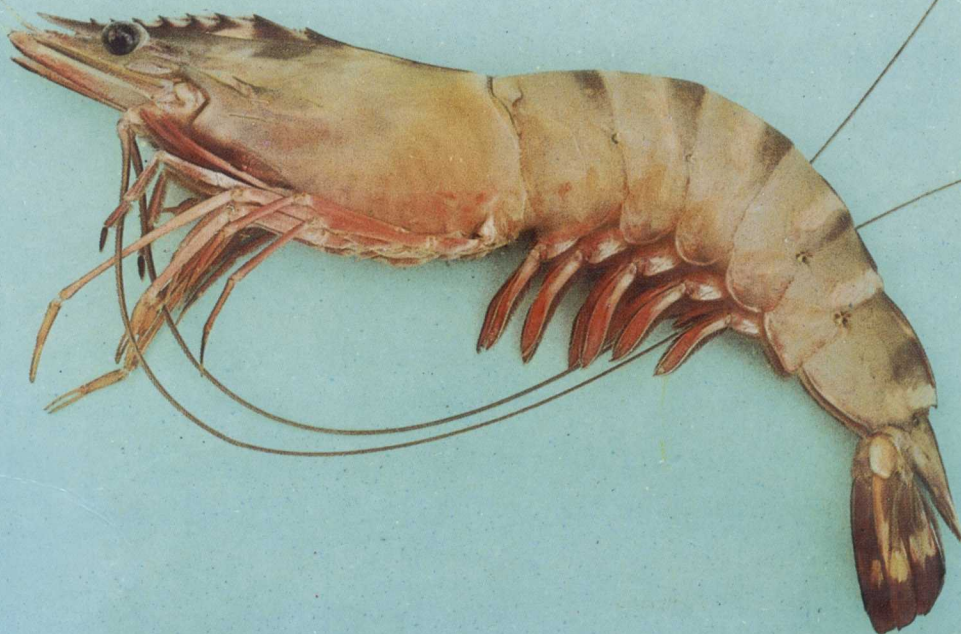




Annual Report

1988



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



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Published by

DR. K. ALAGARSWAMI

Director

Central Institute of Brackishwater Aquaculture, Madras-600 028

Edited by

DR. K. ALAGARSWAMI, *Director*

SHRI K. N. KRISHNAMURTHY, *Principal Scientist*

Cover Photo

The tiger prawn *Penaeus monodon* Fabricius

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INTRODUCTION

Brief History

The Central Institute of Brackishwater Aquaculture (CIBA) was established during the VII Five-Year Plan, from 1-4-1986, with the transfer of three Research Centres at Kakdwip, Puri and Madras of the erst-while Central Inland Fisheries Research Institute and the Prawn Hatchery Laboratory at Narakkal of the Central Marine Fisheries Research Institute. The Krishi Vigyan Kendra (KVK) at Kakdwip came under the administrative control of CIBA later. The Institute started functioning with its own budget and physical funds from 1-4-1987.

Mandate

The Institute has a mandate to conduct multi-disciplinary mission-oriented applied research to develop appropriate technologies for the aquaculture of brackishwater finfish and shellfish to augment production; to provide information base for sustained growth and accelerated development of both industrial and artisanal culture fisheries in the brackishwater sector; and to provide development support through education, training, technology transfer and linkages.

Organization and Facilities

The Madras establishment continued to be the temporary headquarters of the Institute which is functioning from rented buildings. The Ennore and Pulicat Field Centres with an improvised hatchery facility at Ennore formed the main base of field work at the headquarters. Permanent labo-

ratory-cum-administrative building, experimental farm and residential quarters are available at the Kakdwip Research Centre in West Bengal. The Narakkal Research Centre in Kerala has a prawn hatchery laboratory and experimental rearing ponds. Puri Research Centre continued to function from hired building and conducted the field programmes in Chilka Lake. The permanent buildings of KVK at Kakdwip were nearing completion.

The research programmes of the Institute have been carried out under two Divisions, viz., Crustacean Culture Division and Finfish Culture Division. Resource and Technology Improvement Division and Training, Extension and Information Division functioned at sectional level for want of adequate scientific manpower. Fish Farm Survey and Engineering Research Division could not be organised as the posts remained unfilled. Library section was further strengthened during the year. Co-ordination work was looked after by the Technical Cell.

Important Event

The Hon'ble Union Minister of State for Agricultural Research and Education, Shri Hari Krishna Shastriji visited the Institute's Ennore Field Centre on 24th April 1988. The Director and the Scientists explained the work of the Institute at the Headquarters and Research Centres. The Hon'ble Minister evinced a keen interest and appreciated the progress made in the various programmes and research activities of the Institute.

Major achievements

The research management system was improved through the Divisional set-up with responsibilities defined at various levels. In spite of the severe constraints of lack of infrastructural facilities and scientific, technical and administrative manpower, the Institute made considerable progress in the research programmes.

The projects on prawn seed production technology made good progress in experimentation on broodstock development, *in vitro* fertilization, larval rearing, water quality management and larval feed development. Full maturity of *Penaeus monodon* was achieved through unilateral eye-stalk ablation, and larval and postlarval rearing was successfully carried out in calcium hypochlorite-treated seawater. The highest survival rate achieved was 62.4% from nauplius-6 to postlarva-8 at a stocking density of 36/l. In the case of *P. indicus*, through unilateral eye-stalk ablation of females which were products of *in vitro* fertilization, full maturation, mating and spawning were achieved and an F₂ generation was successfully raised to juvenile stage. Success was achieved on spawning and larval rearing of *P. semisulcatus* with 80.6% survival at PL-2 stage through thinning of the larval density. By salinity improvement with addition of common salt during low-saline period, *P. indicus* larvae were reared to PL-2 stage with a survival rate of 43%. However, the same method did not work in the case of *P. monodon*. Satisfactory results in larval and postlarval rearing were achieved in all cases feeding them with *Chaetoceros*, egg custard, *Brachionus* and green mussel meat. Due to very poor availability of spawners of *P. merguensis*, there was not much progress on this species.

In prawn culture technology, the programmes were directed towards improve-

ment of Institute's experimental ponds and culture practices at Kakdwip, monitoring of a pump-fed pond at Pulicat and a detailed physico-chemical and system study of the confined ponds of Chilka lake. Valuable data have been collected in all these projects. The experimental pond at Narakkal did not prove productive due to dense settlement of the backwater clam *Villorita cyprinoides*. A detailed investigation of the pond conditions was carried out.

The projects on finfish breeding ran into problems of non-availability of broodstock of seabass and grey mullets. When a few were available, they could not be maintained in the improvised systems without regular facilities. Through hormonal treatment, *Liza macrolepis* matured and spawned but the embryonic development of fertilized eggs did not go beyond gastrula stage. In view of several handicaps, it was decided to organise a specific subject workshop next year to discuss the problems associated with finfish breeding and seed production. Experimental monoculture of finfishes and polyculture of fish and prawns were carried out in different ecosystems in ponds, pens and cages.

Good strides have been made in development of practical feeds for the growout culture of *P. monodon*. Formula feed-I, developed with the ingredients of squid, soyabean cake, tapioca and rice polish, supplemented with vitamins and mineral mix, giving 37.74% protein level was produced and tested on a laboratory scale and is under trial at the Kakdwip ponds for evaluation. Microparticulate feed for *P. indicus* larvae and a low-protein (20%) feed for growout culture were prepared and were under testing at Narakkal.

The project on food chain and energy flow dynamics of Pulicat lake collected the

basic data on standing crop of plankton, bottom fauna, phytobenthos and fish yield to assess the biological productivity and ecological parameters of this brackishwater ecosystem to help planning culture-based operations.

The Institute got itself recognised by FAO for undertaking training in prawn culture/hatchery operations for seven scientists

from Vietnam and the programme was carried out in three phases successfully. Farmer's level training was given to fishery youth deputed by Government of Gujarat. The Krishi Vigyan Kendra at Kakdwip conducted several on-campus and off-campus training programmes in multidisciplinary fields of agriculture, horticulture and aquaculture.

K. ALAGARSWAMI,
Director.

GENERAL INFORMATION

Seminar

A Seminar on 'Status and Prospects of Brackishwater Aquaculture in Orissa' was organised by the Institute on 14th October 1988 at Puri in connection with the celebrations of 40th Anniversary of Independence and also the 100th birth anniversary of Pandit Jawaharlal Nehru.

The Seminar was inaugurated by the Hon'ble Minister of State for Commerce, Transport, Fisheries and Animal Husbandry, Government of Orissa, Shri Sarat Chandra Panda. The Commissioner-cum-Secretary for Fisheries, Government of Orissa, Shri P. K. Mohanty, presided over the function. Shri G. N. Mitra, Joint Commissioner for Fisheries (Retd.), Government of India delivered the Keynote Address.

The Seminar was attended by 101 delegates from various organisations. These include the Department of Fisheries, Government of Orissa; Brackishwater Fish Farmers Development Agency; Orissa Maritime and Chilka Area Development Corporation; ORI-SEED; Department of Agriculture and Co-operation, Union Ministry of Agriculture; Marine Products Export Development Authority; NABARD; ICAR Fisheries Research Institutes (CICFRI, CIFA, CMFRI and CIBA); Department of Fisheries, Government of Andhra Pradesh, Maharashtra and Pondicherry; IIT, Kharagpur; Anna University, Madras; Andhra University; State Bank of India; Indian Bank and industry. Notably, a group of marginal farmers engaged in prawn farming in Orissa attended the Seminar. Twelve

scientific papers on various aspects of brackishwater aquaculture with particular emphasis on Orissa were presented and discussed in detail in the Technical Sessions of the Seminar. An Exhibition was organised in conjunction with the Seminar with the participation of Department of Fisheries of Orissa and this Institute.

Arising from the points made by the Hon'ble Minister of State, Government of Orissa and other dignitaries at the Inaugural Function and from the deliberations at the Technical Sessions, the Seminar made specific recommendations covering various aspects for future R & D efforts in brackishwater aquaculture for Orissa in particular, and for the country in general. These recommendations dealt with

- Publication of Technical Bulletins on past data
- Recruitment studies on seed resources
- Broodstock development
- Natural distribution and abundance of spawners
- Versatility of hatcheries for diversification
- CIFRI prawn feed formula for further trials
- Brine shrimp biomass and cyst production
- Feed technology
- Production technology for Chilka fringe ponds
- Infrastructure development
- Shrimp hatchery development
- Pen culture in brackishwater areas

- Establishment of KVK in brackishwater aquaculture in Orissa
- Coordination in bank financed projects
- Brackishwater aquaculture cooperatives
- Integrated training programme
- Training in seed collection and transportation, and
- Appointment/training of aquaculture engineers.

The recommendations were forwarded to the concerned agencies for consideration and implementation and this Institute itself started seriously the implementation process during the year.

Farmers' Day

A Farmers' Day was organised at the Headquarters of the Institute at Madras on 25 February, 1988. Group discussions on brackishwater aquaculture were held and a number of farmers and entrepreneurs participated in the discussions. An exhibition highlighting the activities of the Institute was also organised which attracted the attention of all the participants. Another Farmers' Meet was arranged on 14-15 March 1988 at the main campus of the Institute.

National Science Day

The National Science Day was celebrated at the Ennore Field Centre on 28 February 1988 to commemorate the birth Centenary of Dr. C. V. Raman.

Services in Committees

Dr. K. Alagarwami, Director served as Member-Secretary, Expert Committee for recommending site for permanent location of the headquarters of Central Institute of Brackishwater Aquaculture, under the Chairmanship of Dr. A. N. Bose, constituted by the Indian Council of Agricultural Research.

— Member, Committee for funding for R & D Support for Drought Relief Hi-Tech

Aquaculture under the Chairmanship of Dr. G. P. Dubey, constituted by the Department of Ocean Development, Government of India.

— Member, Task Force set up by the ICAR Scientific Panel on Biotechnology, ICAR.

— Member, Screening Committee for allotment of Brackishwater lands in Andhra Pradesh by the Government of Andhra Pradesh.

— Member, Project Evaluation Committee set up by Department of Biotechnology, Government of India under the Chairmanship of Dr. S. Z. Qasim.

— Member, Expert Committee for Hatcheries set up by MPEDA.

— Member, Study Group on Fisheries under the Chairmanship of Dr. A. N. Bose, constituted by the Ministry of Agriculture.

— Chairman, Local Management Committee of the Krishi Vigyan Kendra, Kakdwip.

— Special Invitee, Standing Committee on Brackishwater Development constituted by the Government of Pondicherry.

— Special Invitee, Standing Committee on Brackishwater Aquaculture Development, constituted by the Ministry of Agriculture, Government of India.

Dr. (Mrs.) T. Rajyalakshmi, Scientist S-4 served as a Member of the Team to study the feasibility of freshwater prawn culture in Uttar Pradesh and Punjab.

Shri K. N. Krishnamurthy, Scientist S-3, served as a Member of the Task Force set up by the Government of India/ICAR to review the work on the Operational Research Project on Brackishwater Prawn/Fish Culture and mixed farming at Sultanpur, Haryana.

Training

The Institute conducted the following three training courses for officers from Socialist Republic of Vietnam, sponsored and funded by the FAO of UN.

Course I: *Shrimp hatchery technology*

Dates : 18-2-1988 to 11-4-1988

Centres: Central Institute of Brackishwater Aquaculture, Madras, Narakkal and Puri.

Candidates :

1. Dr. Le Thi Nhu Y, Biologist, Shrimp Hatchery, Fishery Service, Nghia Binh Province, Vietnam.
2. Mr. Vo Nhan, Officer-in-charge, Shrimp Hatchery and Pond Construction and Design, Fishery Service, Nghia Binh Province, Vietnam.
3. Mr. Nguyen Vu Thanh, Chief, Shrimp Hatchery, Fishery Service, Nghia Binh Province, Vietnam.

Course II: *Shrimp culture technology*

Dates : 15-2-1988 to 12-4-1988

Centres : Central Institute of Brackishwater Aquaculture, Madras, Narakkal, Kakdwip.

Candidates :

1. Mr. Nguyen Ba Cuc, Vice-Director, Fishery Service, Nghia Binh Province, Vietnam.
2. Mr. Tran Le Phieu, Chief, State Farms, Fishery Service, Nghia Binh Province, Vietnam.
3. Mr. Vo Dinh Tam, Fishery Service, Nghia Binh Province, Vietnam.

Course III: *Shrimp hatchery and culture technology*

Dates : 19-1-1988 to 12-1-1989

Centres : Central Institute of Brackishwater Aquaculture, Madras, Narakkal, Puri and Kakdwip.

Candidate : Mr. Huynh Trang, Asst. Head, Shrimp Hatchery, Fishery Service, Nghia Binh Province, Vietnam.

Fourteen fisher-youth from Gujarat, sponsored by the Department of Fisheries, Government of Gujarat were given training on various aspects of brackishwater aquaculture for three months from 28 December, 1987 to 28 March 1988.

Another batch of fourteen fisher-youth are presently undergoing training for a period of 45 days from 26 December 1988.

In service trainees from the Department of Fisheries, Government of West Bengal and trainees sponsored by the Marine Products Export Development Authority were given lectures and practical training in prawn breeding and culture.

Lectures and short-term practical demonstrations were also given to a number of college students, and departmental officials from different states from time to time.

Extension

Seed of the white prawn, *Penaeus indicus*, numbering 3,38,750 produced at the Narakkal Research Centre were supplied to the farmers and research Institutions.

Advisory services were provided to 20 fish farmers of West Bengal and 16 farmers of Tamil Nadu on shrimp farming.

Technical assistance was provided to Punjab Agro-Industries Corporation, Chandigarh for undertaking trial production of the giant freshwater prawn, *Macrobrachium rosenbergii* and two consignments of the juvenile prawns were transported by air from Calcutta to the Government Fish Seed Farm, Katli, Ropar District, Punjab. Technical data on acclimatisation, packing, transport and survival at stocking were collected.

Library and Documentation

Building up of the Library of the Institute to meet the reference needs of the scientists continued during the year. The Institute has acquired 284 reference books and subscribed to 23 foreign and 15 Indian journals during the year. Exchange relationship was established with a number of International and national organisations. The Library has acquired a good collection of Doctoral Theses on Microfiche, photo reproductions of important publications, pamphlets, Bulletins etc. Besides serving the needs of the Scientists of the Institute, services were also rendered to other Departments and research scholars.

Publications

The following publications were brought out from the Institute during the year :

Brochure highlighting the activities of the Institute.

CIBA Newsletter

Bulletin No. 1. 'An Overview of the Brackishwater Penaeid Shrimp and Finfish Culture Research in India in 1980s' by Dr. (Mrs.) T. Rajyalakshmi.

Annual Report of the Institute for the year 1987.

Special Publication on the Seminar on the 'Status and Prospects of Brackish-water Aquaculture in Orissa'.

Manpower Development

Shri S. Srinivasagam, Scientist S-2 is undergoing NACA One-year Regional Training Programme for Senior Aquaculturists under the auspices of UNDP/FAO/SEAFDEC/University of Philippines at Tigbauan, Iloilo city, Philippines from 13 March 1988 under FAO/NACA Fellowship.

Dr. L. Hanumantha Rao, Scientist S-2 and Dr. C. P. Rangaswamy, Scientist S-2

underwent a training course on 'Backyard Shrimp Hatchery Operation and Management' under FAO/NACA training programme at Bangkok, Thailand during 6 June—1 July, 1988.

Shri R. K. Chakraborti, Scientist S-2 underwent a two months' training course under ICAR/INRA Work Plan 1988-89 on 'Fish Nutrition' from 10 October 1988-8 December 1988 at Station d'Hydrobiologie, Saint Pee sur Nivelles, France.

Dr. (Mrs.) T. Rajyalakshmi, Scientist S-4, Shri K. N. Krishnamurthy, Scientist S-3 and Shri P. Prasad, Junior Stenographer, underwent a part-time course on 'Use of Computers in Office Management' organised by the Committee on Science and Technology in Developing Countries (COSTED) and Madurai Kamaraj University from 6 February 1988 to 6 May 1988.

Dr. K. V. Ramakrishna, Scientist S-3 underwent a course on 'Human Resources Management' at NAARM, Rajendranagar, Hyderabad, during 1-12 August 1988.

Shri A. V. P. Rao, Scientist S-3 and Dr. C. P. Rangaswamy, Scientist S-2 visited Bhabha Atomic Research Centre, Bombay to study the functioning of the analytical laboratory during 2-6 February, 1988.

Shri K. N. Krishnamurthy, Scientist S-3 underwent one-week training course in 'Remote Sensing Methods on Coastal Zone Mapping', at the Institute of Remote Sensing, Anna University, Guindy, Madras during 21-26 November, 1988.

Dr. Mathew Abraham, Scientist S-2, underwent a training course in 'Chromosome manipulations in fish' organised by the Department of Biotechnology, Government of India, at the School of Biological Sciences, Madurai Kamaraj University, Madurai during 11-24 November, 1988.

Symposia/Seminars/Workshops

The scientists of the Institute participated in the following symposia/seminars/workshops :

- All India Workshop on Gainful Employment for Women in Fisheries Field, Society of Fisheries Technologists, CIFT, Cochin, 7-8 March 1988 : Dr. (Mrs.) T. Rajyalakshmi
- National Workshop on Aquaculture Engineering, Anna University, Madras, 6 April 1988 : Dr. (Mrs.) T. Rajyalakshmi, Dr. K. V. Ramakrishna, Shri A. V. P. Rao and Dr. R. D. Prasadam
- National Symposium on Environmental impacts on animals and aquaculture, Kalyani, 14-16 April 1988 : Shri R. K. Chakraborti
- Seminar on Fisheries, Akhila Kerala Dheevara Sabha, Cochin, 29 May 1988 : Dr. A. Laxminarayana
- Seminar on Prospects of Prawn Farming in West Bengal, MPEDA, Calcutta, 9 August 1988 : Shri Hardial Singh and Shri R. K. Chakraborti
- Seminar on Shrimp Farming in Tamil Nadu, MPEDA, Madras, 31 August 1988 : Dr. K. Alagarwami, Shri A.V.P. Rao, Shri K. N. Krishnamurthy
- National Workshop on Inland Fisheries Development and Future Strategy, Indian Institute of Management and International Development Agency, Lucknow, 22-24 September 1988 : Dr. (Mrs.) T. Rajyalakshmi
- Regional Consultation for Information Systems in Fisheries, FAO Bay of Bengal Programme, Madras, 5-8 October 1988 : Shri K. N. Krishnamurthy
- Status and Prospects of Brackishwater Aquaculture in Orissa, Central Institute of Brackishwater Aquaculture, Puri, 14 October 1988 : Dr. K. Alagarwami, Dr. A. V. Natarajan, Dr. (Mrs.) T. Rajyalakshmi, Dr. K. V. Ramakrishna, Shri A. V. P. Rao, Dr. A. Laxminarayana, Shri Hardial Singh, Dr. K.M. Das, Dr. S. M. Pillai, Dr. P. K. Ghosh
- International Symposium on Aquaculture Research Needs for the year 2000, FERRO/OICD/USDA/ICAR, New Delhi, 15-18 November 1988 : Dr. K. Alagarwami
- International Conference on Appropriate Agricultural Technology for Farm Women—Future Research Strategy and Linkages with Developmental Systems, ICAR/IRRI, New Delhi, 30 November-4 December 1988 : Dr. (Mrs.) T. Rajyalakshmi and Dr. K. V. Ramakrishna.
- National Symposium on Aquaculture Productivity, Hindustan Lever Research Foundation, New Delhi, 16-17 December 1988 : Dr. K. Alagarwami
- Workshop on Sea Farming for Mainland and Islands, CIFE, Bombay, 20-21 December 1988 : Dr. K. Alagarwami

Meetings

The meetings of the Staff Research Council of the Institute were held as follows : Headquarters Madras—23 February, 12 April and 6 May 1988 ; Kakdwip Research Centre—8 December 1988 ; Puri Research Centre—8 November 1988 ; and Narakkal Research Centre—5 November 1988.

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

- Central Board of Fisheries 15th meeting, Calcutta, 30 May 1988.

- Study Group on Fisheries, DOAC, Ministry of Agriculture, New Delhi, 15-16 July 1988.
- ICAR Regional Committee No. VIII, Cochin, 16-17 August 1988.
- Crash Programme on prawn farming, CIFE, Bombay, 21-23 August 1988 ; Department of Biotechnology, New Delhi, 26-27 August 1988.
- Prawn Aquaculture Project, Department of Biotechnology, New Delhi, 12-13 September 1988 ; MPEDA, Cochin, 30 December 1988—3 January 1989.
- Local Management Committee of KVK, Kakdwip, 19-20 September 1988.
- Andhra Pradesh Screening Committee for allotment of brackishwater lands, Hyderabad, 25-26 October 1988, 19-20 November 1988.
- ICAR Directors' Conference, New Delhi, 31st October-1 November, 1988.
- Project Evaluation Committee on Aquaculture Biotechnology, Department of Biotechnology, New Delhi, 22 December 1988.
- Working Group on Fisheries, Planning Commission, New Delhi, 12 December 1988.

Budget

*Actual Expenditure in 1988-89
Rs. in lakhs*

| | Budget | Expenditure |
|----------|--------|-------------|
| Non-Plan | 41.00 | 41.44 |
| Plan | 20.00 | 19.99 |
| | <hr/> | <hr/> |
| | 61.00 | 61.43 |
| | <hr/> | <hr/> |

Visitors

The following dignitaries visited the Institute at Headquarters/Research Centres during the year :

Hon'ble Union Minister of State for Agricultural Research and Education, Shri Hari Krishna Shastriji

Kumari Pushpa Devi Singh, M.P., Raigarh

Dr. M. V. Rao, Special Director General, ICAR

Dr. N. G. P. Rao, Chairman, ASRB, New Delhi

Dr. P. V. Dehadrai, Deputy Director General (F), ICAR

Dr. E. G. Silas, Vice-Chancellor, Kerala Agricultural University, Trichur

Dr. A. N. Bose, Former Vice-Chancellor, Jadavpur University, Calcutta

Dr. M. Sakthivel, Director, MPEDA, Cochin

Shri N. P. Bhakta, Director, CICEF, Bangalore

Dr. T. V. R. Pillay, FAO/NACA Consultant, Bangkok

Dr. Chen Foo Yan, Coordinator, FAO/NACA, Bangkok

Dr. Arun G. Jhingran, Director, CICFRI, Barrackpore

Dr. S. D. Tripathi, Director, CIFA, Kausalyagang, Bhubaneswar

Shri V. Manivannan, Director of Fisheries, Tamil Nadu

Thiru M. Ramulu, Director of Fisheries, Pondicherry

Mr. John Wood, Animal Feeds Expert, Overseas Development Administration, (ODA), UK

Mr. Jonathan Coulter, Economist, ODA, UK

- Mr. Rafiqul Islam, Senior Asst. Secretary,
Ministry of Fisheries and Livestock,
Government of Bangladesh
- Mr. A. K. Mamin ul Islam, Asst. Secretary,
Ministry of Fisheries and Livestock,
Government of Bangladesh
- Mr. Mohd. Resaul Karim, Asst. Director
of Fisheries, Ministry of Fisheries and
Livestock, Government of Bangladesh
- Mr. Habibur Rahman Khondaker, Asst.
Director of Fisheries, Ministry of
Fisheries and Livestock, Government of
Bangladesh
- Shri G. N. Mitra, Retd. Joint Commis-
sioner for Fisheries, Government of
India
- Dr. C. S. Singh, Professor of Fisheries
and Limnology, G. B. Pant University
of Agricultural Sciences, Pant Nagar,
U.P.
- Dr. R. P. S. Tyagi, Member, ASRB, New
Delhi
- Dr. V. S. Bhat, Director, P & I, ICAR,
New Delhi
- Shri K. Chidambaram, Fisheries Con-
sultant, Matsya Sagar Consultancy Ser-
vices, Madras
- Shri J. V. H. Dixitulu, Editor, Fishing
Chimes, Visakhapatnam
- Dr. D. Sudarsan, Director General,
Fishery Survey of India, Bombay
- Dr. S. Dutt, Emeritus Professor, Nagarjuna
University, Guntur
- Dr. C. T. Samuel, Cochin University of
Science and Technology, Cochin
- Dr. A. K. Bandopadhyay, Director,
CARI, Port Blair, Andamans
- Dr. Charles L. Angel, Senior Aquaculturist,
BOBP, FAO, Bangladesh
- Dr. Soren Nysan, Danida
- Mr. M. J. Chavez, Consultant, BOBP
- Shri S. Banerjee, Secretary, Fisheries,
Government of West Bengal
- Shri A. K. Pattanaik, Director of Fisheries,
Government of West Bengal
- Shri H. Maity, M.L.A., West Bengal
- Dr. A. N. Ghosh, Former FAO Expert,
Bangladesh
- Shri S. Matta, Head, Leaf Protein Division,
ISI, Calcutta.

PROGRESS OF RESEARCH CRUSTACEAN CULTURE DIVISION

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

Madras : A. V. P. Rao (PL), K. Alagar-swami, L. H. Rao, S. Radhakrishnan and B. P. Gupta

Puri : K. M. Das and P. K. Ghosh

Induction of maturity

Unilateral ablation of eye-stalk was done on *P. monodon* and the prawns were reared under photoperiods 8L : 16D and 12L : 12D. At salinity range 33-35 ppt, pH 8.3 and with a daily exchange of 80% of water, the prawns (100-130 g) did not show any sign of maturity even after 45 days under both photoperiods. The prawns were fed with *Perna viridis* meat at 10% of their body weight.

In another experiment wild specimens after natural spawning were ablated unilaterally. In all, 14 females in the weight range of 75-190 g were ablated and in three of them (190 g, 120 g, 120 g) full-maturity was observed in 9 days, 16 days and 28 days respectively after ablation.

In one of the experiments the ablated prawn mated and spawned viable eggs; a large number of healthy nauplii (2,33,200) hatched out.

During October-December, the percentage of fertilization and hatching were low due to low temperatures (24.5° to 26.5° C).

At Puri Centre, the experiments on induced maturation of *P. monodon* through bilateral ablation of eye-stalk were not successful.

Larval rearing

Three species viz., *P. monodon*, *P. indicus* and *P. semisulcatus* were bred successfully and postlarvae produced. *P. indicus* and *P. semisulcatus* were bred mainly during October-December. Larval rearing of *P. monodon* at different densities at naupliar stage was carried out during February to June viz., 20, 30, 40, 50, 60, 80, 100, 120, 200, 360 and 425 per litre. *Chaetoceros affinis*, *Brachionus plicatilis* and tissue suspension of *Perna viridis* were used as larval feeds. In higher salinities (34-38 ppt) the survival was poor (0-10.1%). At 30-31 ppt the survival rates were higher, being 31.0% at larval density of 80/l and 71.5% at 360/l.

In July an experiment was conducted to assess the efficacy of using water treated with calcium hypochlorite @ 40 ppm. This experiment was conducted at four different densities viz., 36, 82, 100 and 140 nauplii per litre, when the ambient temperature was 28.4°C-29.5°C and salinity 30 to 31 ppt. The survival rates from N-6 to PL-8 were 62.40%, 30.06%, 25.00% and 7.14% respectively for the different densities.

Chaetoceros, egg custard, and *Brachionus* sp. were used as larval feeds upto PL-2 and tissue of *Perna viridis* thereafter.

During February 1988 *P. indicus* larval rearing was done at normal (82/l) and high (356/l) densities using *Chaetoceros*, *Tetra-*

selmis and *Perna viridis* tissue suspension as feeds. Due to thinning at M-1 stage, the average survival at PL-2 stage was 63.9%. The ambient temperature and salinity were 26.5-28.5°C and 30-31 ppt respectively.

During October 1988 one spawner of *P. semisulcatus* spawned completely producing an estimated 124,000 nauplii which were reared at 124/litre. By thinning at M-2 stage, the estimated survival at PL-2 stage was 80.6%. Only 2200 PL-15 could be obtained due to subsequent heavy mortality.

Larval rearing in common salt-added seawater

During November-December the salinity of backwater at Ennore dropped down to 18 ppt, making hatchery operations impossible. The salinity was raised to 30 ppt by adding edible salt. Larval cycle of *P. indicus* was successfully carried out in the above medium with a survival of 43% from N-6 to PL-3 stage. However, a similar experiment in the case of *P. monodon* led to mass mortality at mysis stage (M-2). Egg yolk, *Chaetoceros*, *Brachionus* and tissue of *Perna viridis* were used as larval feeds.

Water treatment

An experiment on larval rearing was carried out in water treated with calcium hypochlorite + UV and calcium hypochlorite alone @40 ppm (Table 1). It was observed that though the average survival

was higher at Protozoal stage in treatment-1, the average survival at subsequent stages, especially PL-5, was higher in treatment-2.

Tolerance of *P. monodon* larvae to ammonia and nitrite

Ammonia: At protozoal stage (Z1) maximum survival was observed at 0.01 and 0.02 ppm of NH₃, with total mortality at 0.05 ppm. At Mysis stage (M2) the maximum survival was recorded at 0.01 ppm. Postlarvae (PL5) had greater tolerance to NH₃-N with the highest survival recorded at 0.08 ppm.

Nitrite: The experiments to understand the larval tolerance limits of nitrite did not indicate any definite trend at the range of concentrations of 0.005 to 0.05 ppm.

Live food culture

Chaetoceros affinis and *C. calcitrans* were mass cultured in filtered seawater enriched with modified 'F' medium. Cell densities ranging 1.0-3.6 lakh/ml were achieved. *Brachionus plicatilis* raised in the salinity range 11.5-28.0 ppt, enriched with extract of cattle dung at 100 ppm and GOC at 50 ppm, gave an average production rate of 29.7/ml in April, 51.4/ml during July-September and 50/ml during October-December.

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

TABLE 1. *P. monodon* larval and postlarval survival according to water treatment

| Treatment | Average progressive survival (%) at | | | |
|------------------------------|-------------------------------------|------|------|------|
| | Z-2 | M-3 | PL-3 | PL-5 |
| 1. Calcium hypochlorite + UV | 81.3 | 38.6 | 26.8 | 9.4 |
| 2. Calcium hypochlorite .. | 56.0 | 38.6 | 28.7 | 25.0 |

Abbreviation : Z-1—Protozoa 1, M-3—Mysis 3, PL-1—Postlarva 1.

TABLE 2. *Production and survival of P. indicus larvae obtained through in vitro fertilization (in '000)*

| Expt. No. | Date | No. of Eggs | No. of nauplii | No. of postlarvae | | | |
|-----------|-----------|-------------|----------------|-------------------|-------|-------|-------|
| | | | | PL-1 | PL-5 | PL-10 | PL-20 |
| 1. | 19-6-1988 | .. 38.64 | 35.28 | 26.90 | 19.60 | 17.30 | 10.60 |
| 2. | 20-6-1988 | .. 2.88 | 2.68 | 2.14 | 1.74 | 1.61 | 1.48 |
| 3. | 1-12-1988 | .. 82.42 | 70.84 | 30.00 | 7.00 | — | — |

Narakkal: A. Laxminarayana (PL) and S. Kulasekarapandian

Three experiments in *in vitro* fertilization of *Penaeus indicus* were conducted in which fertilization rate ranged from 86 to 93.1%. The data on postlarval production by this technique are presented in Table 2. The larvae were normal and comparable to those produced through normal fertilization. The survival from N-1 to P-20 stage was 30% (Table 3). Using *in vitro* fertilization and artificial insemination techniques together, larvae of *P. indicus* were produced during the off-season when natural mating did not take place. Through unilateral eye-stalk ablation of females which were products of *in vitro* fertilization, second generation postlarvae were produced in fairly high numbers (Table 4).

Out of 223 adults ablated unilaterally, 189 matured and spawned successfully. The

average number of eggs produced was 72,010, average number of nauplii was 58,520 and average hatching rate was 81.3%.

During the year 82 larval rearing trials were made at densities between 25 and 100

TABLE 3. *Survival rates (%) of P. indicus larvae produced through natural method and in vitro fertilization*

| Stage | Natural | <i>in vitro</i> |
|--------------|---------|-----------------|
| Nauplii | .. 100 | 100 |
| Postlarva -1 | .. 75.4 | 76.2 |
| .. -5 | .. 53.3 | 55.6 |
| .. -10 | .. 45.6 | 49.0 |
| .. -20 | .. 29.2 | 30.0 |

Note : Total number of nauplii : Natural 34,220 ; *in vitro* 35, 280

TABLE 4. *F-2 generation of P. indicus larval production using parents derived through in vitro fertilization (No. in '000)*

| Sl. No. | Eggs obtained | Nauplii | PL-1 | PL-5 | PL-20 |
|---------|---------------|---------|------|------|-------|
| 1. | .. 52.6 | 48.3 | 39.2 | 35.0 | — |
| 2. | .. 46.1 | 44.8 | 40.3 | — | — |
| 3. | .. 52.8 | 51.3 | 30.8 | 13.6 | 10.4 |

nauplii per litre. The survival from nauplius to postlarvae (PL-5) ranged from 11.4% to 74%. In the single trial where the density was 100 nauplii per litre, the survival upto P-5 was 44.4%. Nursery rearing of postlarvae from PL-5 to PL-20 was done at two densities viz., 1.3 and 1.4 of PL-5 per litre. The survival rates at these two densities were 77.6% and 93.2% respectively. During the period, 3,73,260 seed of *P. indicus* were supplied to farmers, research institutions and scientists besides stocking the 0.6 ha pond under Project CCD/CP/1.4.

Breeding and seed production of *Penaeus merguensis* (CCD/HT/1.3)

Puri: S. M. Pillai (PL), K. M. Das and P. K. Ghosh

Regular monitoring of the artisanal fishery was done to study the spawner availability off Puri Coast at Pentakota, Bali Nolia Sahi and Baliapanda. Fully mature prawns were observed during October-November period and females in the size range of 141 to 200 mm and males of 129-169 mm were recorded. The inshore water during October-February had the following ranges: temperature 23°-30°C, salinity 20-33 ppt and pH 8.0-8.58. Using females 30-40 g, even bilateral ablation of eye-stalk failed to induce maturation perhaps due to low temperature and insufficient aeration.

A wild spawner of 171 mm/40 g size caught off Baliapanda released 145,000 eggs. The size of the eggs ranged 0.25-0.28 mm in diameter with a mean of 0.26 mm. Hatching (94.3%) took place at 24°C between 1800 and 2000 hrs. Due to lowering of ambient temperature to 21°C, survival between N-1 and Z-2 was 9.2% only. No further development was noticed even on day 5.

In outdoor cultures of *Chaetoceros* at a salinity of 22-24 ppt and temperature of

21-25°C, the cell density increased to 6-7 lakh cells per ml in 72 hours.

Studies on the effect of different ecological parameters on the growth and survival of *Penaeus monodon* in tide-fed ponds. (CCD/CP/1.1)

Kakdwip: R. K. Chakraborti (PL), Hardial Singh, B. K. Banerjee, H. S. Mazumdar and A. Chowdhury

Two nursery ponds of 0.05 ha each were stocked with *P. monodon* seed of 16.1 mm size in January and February at density of 60,000 and 100,000 per ha respectively. They were harvested in April and June with average size at harvest being 130.1 mm/15.2 g and 119.5 mm/13.6 g respectively. The projected production rate was very low (274.5 kg/ha/4 months). Six more ponds (3 of 0.02 ha, 2 of 0.06 ha and one of 0.08 ha) were prepared by application of mahua oil cake @ 1500 kg/ha. The ponds had staggered stocking—two ponds @ 150,000/ha in 3rd week of March and early April and 3 ponds during April-May @ 50,000/ha. Though growth was satisfactory, due to heavy rain in June, all the ponds were flooded and the experiment was vitiated.

Two ponds of 0.06 and 0.08 ha area were restocked in July with juveniles of 21.3 mm and 84.5 mm respectively. The growth rate subsequently was slow and in September incidence of soft-shell disease was noticed leading to mortality. The salinity of the water was very low during July-October (7.2 ppt in July to 2.5 ppt in October) and medium (13.0-16.1 ppt) during April-June. The pH of water and soil was alkaline (8.0 to 8.5 in water and 7.9-8.1 for soil). The organic carbon of soil was 0.45 to 0.63%. Total alkalinity was high upto July and low (70 to 96 ppm) from August to November.

Benthos of the ponds comprised of tanaids, amphipods and polychaetes. Tanaids and polychaetes were more abundant in May-June and again in November-December. The numerical abundance of all the groups put together was between 1536-5817 units per m². Zooplankton was represented by copepods, rotifers, cladocerans and mysidaceae. The common forms of phytoplankton were *Oscillatoria*, *Anabaena*, *Spirulina*, *Navicula*, and *Microcystis*.

Monitoring of prawn culture in the Chilka lagoon under ERRP, ADAP and BFDA schemes (CCD/CP/1.2)

Puri: S. M. Pillai (PL), K. M. Das and P. K. Ghosh

Four ponds each were selected under the three schemes viz., ERRP, ADAP and BFDA for regular monitoring in the Sunamuhin area. These ponds were developed and handed over to the small farmers by the BFDA for prawn farming. In these confined ponds which receive rain water during June/July, two crops of prawns are raised. The stocking material was obtained from several sources such as the hatcheries at Gopalpur and Paradip and also from wild collection. Regular liming was done in all the ponds and hence the pH was alkaline. The ranges for the various physico-chemical conditions were as follows : depth 14-120 cm, transparency 7-42 cm, water temperature 25-34°C, salinity of water 2-23 ppt, pH 7.2-8.4, dissolved oxygen 4.4-10.4 ppm, free CO₂ 0 to 6 ppm, total alkalinity 10-176 ppm, PO₄-P 0.0004 to 0.01 ppm and NO₃-N 0.56 to 7.840 ppm. In the soil phase pH was 6.54-8.50, electrical conductivity 1.620 to 8.690 mmhos/cm, organic carbon 0.03 to 1.32%, available phosphorus 0.98-4.80 mg/100 g soil and available nitrogen 0.56-17.08 mg/100 g soil.

The area of the ponds varied between 0.16 to 0.5 ha. The stocking density for the monsoon crop practised by the farmers was in the range of 6250 to 22,220 per ha. Stocking size of *P. monodon* seed varied between 15 to 80 mm. The culture duration ranged between 112 to 167 days. The average final weight attained was from 25.0 to 34.4 g, with a survival between 32% and 91.2%. Production ranged between 100 to 561 kg/ha crop. The net income varied from Rs. 2415 to Rs. 15,104.

The manuring schedule is limited to initial dose of cattle dung from 800-2500 kg/ha. Excepting in ERRP ponds, where urea at 50-100 kg/ha and superphosphate at 25-1000 kg/ha were applied, in the other ponds chemical fertilizers were not used. The prawn farming, in the absence of water change, fertilization etc., is exclusively sustained by feeding the prawns with the flesh of the pond snail, *Pila globosa* at 10-15% in the first month and 20-30% thereafter. The conversion ratios obtained were between 1.2 to 3.4 in the various ponds. Plankton and benthos qualitatively and quantitatively are very poor in these ponds. The winter crop for which stocking was done in October-November period was in progress.

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

Madras: K. Raman (upto 31-5-1988), K. Gopinathan (PL), C. P. Rangaswamy, B. P. Gupta and K. O. Joseph

Under this project, a farmer's pond at Attipattu near Ennore and the pond of Department of Fisheries were used for monitoring the prawn culture. The 0.05 ha pond at Attipattu was stocked at a density of 70,000/ha with hatchery reared *P. monodon* seed supplied by the Institute. The stock was fed with mussel and oyster

meat, rice bran and groundnut oil cake. When the stock was harvested after six months in February 1988 the average weight at harvest was 22.4 g. The projected production works out to only 400 kg/ha/6 months due to water not being maintained at required level. The same pond was restocked in March with hatchery reared PL-20 of *P. indicus* at density of 1 lakh per ha. After 4 months of rearing, the projected production was 280 kg/ha. The growth and production were very low, due to low levels of water in the pond. The various physico-chemical parameters were : water temperature 30.2°C-35°C, salinity 37.5-40.0 ppt, dissolved oxygen 8.3-8.6 ppm, total alkalinity 60.0-75.0 ppm and specific conductivity 75.6 to 79.2 mmhos/cm at 26°C.

The State Fisheries pond at Pulicat (1.06 ha) was stocked in July with juveniles of *P. indicus* of size 45-65 mm and 2-3 g at density of 54,000/ha. It is a pumped pond and the physico-chemical parameters are : depth 30-60 cm, seepage loss 3-5 cm in 12 hrs, water temperature 31.0° to 33.2°C, pH 8.1 to 8.4, dissolved oxygen 4.9-7.4 ppm ; total alkalinity 70-98 ppm, salinity 32.5 to 38.5 ppt, PO₄-P 0.05-0.07 ppm, NO₃ 0.1 ppm. The soil comprises of 79.5% sand, 12.5% silt, 8.0% clay with a pH of 7.9 to 8.1, organic carbon 0.28-0.30%, available phosphorus 3.2 to 3.7 mg/100 g of soil and available nitrate 18.5 mg/100 g of soil. The pond is poor in plankton. The zooplankton is represented by copepods and cladocerans. The phytoplankton consists of diatoms such as *Skeletonema*, *Chaetoceros* and *Pleurosigma*. Bluegreen algae such as *Lyngbya*, *Oscillatoria* and *Anabaena* were also recorded. In the benthos no animals were seen. Pelleted feed and prawn head waste were used as feed. After 97 days of rearing with a reported survival of 92.1%, the production was 832 kg. The

average weight of individual at harvest was 14.1 g with a range of 9-18 g.

Under this project, investigations were taken up to study the pollution, if any, near the growout area. At Pulicat only some organic pollution on account of decomposition of weeds was noticed in June, with low oxygen values. In Ennore backwaters slight environmental degradation during rainy season was noticed as evidenced by high turbidity, low O₂ (3.2 mg/l) and pH (6.72).

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

Narakkal : S. Kulasekarapandian (PL), A. Laxminarayana, Syed Ahmed Ali, M. K. George, L. Krishnan and K. V. George

A 0.6 ha perennial and undrainable pond was stocked with *P. indicus* in March at density of 21,900 per ha. After 55 days the prawns grew from 26 mm/0.133 g to 111.7 mm/9.4 g. Due to poaching the production was very low, with only 37.5% retrieval. The same pond, after treating with *Croton tiglium* seed at 23.5 kg/ha, was restocked in June 1988 with *Chanos chanos* at density of 3,700 numbers per ha. The size at stocking was 40.4 mm/1.05 g. As the growth rate slowed down, supplementary feeding with pelleted feed, initially at 2 kg/day and later 3 kg/day, was given from the 90th day. The proximate composition of the feed was 29.3% crude protein, 5.8% lipid, 39.7% carbohydrate, 6.7% crude fibre, 6.5% moisture and 12% ash. Harvesting was done after culturing the fish for 167 days. The final size at harvest was 248.7 mm/98.9 g. The projected production is only 255.2 kg/ha/167 days. The poor production was due to large scale colonization of the pond by the clam, *Villorita cyprinoides*

and low fertility of the pond soil. This pond after treatment with *Croton tiglium* seed powder at 30 kg/ha was again stocked in December with *Penaeus indicus*.

The water and soil conditions were studied. In the water phase the various parameters had the following ranges : temperature 28°C in August to 34°C in May ; salinity 1.21 ppt in September to 18.2 ppt in December ;

pH 7.1 in July to 8.5 in June ; dissolved oxygen 1.6 ppm in July to 8.4 ppm in June. In the soil phase the organic carbon is low (0.66-0.83%) and pH is slightly acidic (6.6 to 7.4). Available nitrogen and phosphorus are low. The low dosage of urea, superphosphate and cattle dung given from September onwards did not materially improve the nutrient status of the pond.

FINFISH CULTURE DIVISION

Development of broodstock of grey mullets, Pearl spot and *Lates calcarifer* (FCD/BS/1.1)

Madras : K. N. Krishnamurthy (PL), T. Rajyalakshmi, Mathew Abraham, Munawar Sultana and V. Sreekrishna

Lates calcarifer : Observations made during the year indicated that the adults of *Lates calcarifer* occur off the barmouth of Ennore creek at nights around full/new moon phases. Fish ranging from 410.0 mm to 700.0 mm and 1.0 kg to 5.5 kg collected from H & L catches were transported to the experimental field hatchery at Ennore without mortality. After initial treatment with antibiotics and acclimation, the fish were stocked in cages (50 m²) made of velon screen fixed in Ennore backwaters, ponds (500 m²) and FRP tanks (10 t). The fish were fed with live trash fish and prawns. Fish maintained in FRP tanks died due to loss of scales and fungal infection.

Etroplus suratensis : Fish of average size 141.3 mm/106 g were collected and stocked in plastic pools (10' × 2') and fed with artificial feeds. Since they did not thrive in the pools, the stock was transferred and maintained in a shallow sump grown with weeds. At the end of 3 months they attained average size 152.7 mm/126 g.

Liza macrolepis : Attempts to maintain mullets under captivity in the hatchery were unsuccessful as the fishes died within 2-3 days of stocking. However, a few *Liza macrolepis* (210.0 mm/119.0 g females and 160.0 mm/90.0 g males) stocked in plastic pools (10' × 2') were found to withstand the stress and survive for a period of a week or more under constant aeration and 50% of water exchange daily.

Feeding trials : With a view to keep the fish in healthy condition and develop them as broodstock, feeding trials with formulated feeds were undertaken. The following ingredients were used in the formulated feeds :

Feed 1—Fresh trash fish 50.0%, Fish meal 17.5%, Soyabean 7.5%, Rice bran 17.5%, GOC 5.0%, Wheat flour 2.5%.

Feed 2—Soyabean 50.0%, Rice bran 25.0%, GOC 10.0%, Wheat flour 15.0%.

Feed 3—Algal powder (*Chaetomorpha*) 40.0%, Soyabean 15.0%, GOC 10.0%, Rice bran 15.0%, Tapioca 20.0%.

None of the feeds was accepted by *Lates* and *Etroplus* whereas feed 3 was accepted by mullets. In the sump where *Etroplus* were stocked, they were found to feed

voraciously on the dense algal mats brought in by the tide waters into sump. In the pond where *Lates* were stocked, they were found to feed well on live trash fish.

Induced maturation of *Liza macrolepis*

Liza macrolepis ranging in size 185-275 mm/90-200 g, with ova of average diameter of 24.0 m.d., were treated with hormones. 25 mg of carp pituitary glands (homogenized) and 1500 IU of HCG per kg body weight of female were administered. No appreciable change in ova diameter was observed.

Biochemical analysis

The biochemical analysis of gonad, muscle and liver of *L. macrolepis* was carried out and the protein, lipid, glucose and glycogen levels have been recorded.

Controlled breeding and larval rearing of Grey mullets, *Lates calcarifer* and Pearl spot (FCD/BS/1.2)

Madras : K. V. Ramakrishna (PL), K. Alagarwami, K. N. Krishnamurthy, K. Gopinathan, K. O. Joseph and V. Sreekrishna

Puri : K. M. Das, S. M. Pillai and P. Ravichandran

Narakkal : L. Krishnan and M. K. George

Grey mullets

At Ennore, a total number of 30 sets of *Liza macrolepis* comprising 30 females (220-425 mm/125-350 g) and 80 males (200-265 mm/150-195 g) were used in the experiments. The females were treated with a single dose of carp pituitary gland and HCG, alone or in combination, at 5 to 20 mg/kg body weight for carp pituitary and 300 to 1500 IU/kg body weight for HCG. The males were in oozing condition and hence did not require hormonal treatment. Of the 30 sets treated, 8 sets responded positively to

the hormone treatment and a total number of 10,40,000 fertilised eggs were obtained. The development of eggs progressed only upto gastrula stage. The physico-chemical features of the ambient water were monitored. The water temperature, salinity and pH were in the range of 22.0-29.0°C, 30.0-36.0‰ and 8.0-8.3 respectively.

At Puri, near Alupatna (Chilka lake mouth area), one female breeder of *L. macrolepis* (485.0 mm/1,000 g) was stripped along with males (275.0-298 mm/170.0-200.0 g). The stripped eggs did not show any development. The ambient water temperature, dissolved oxygen and salinity were in the ranges of 23.0-24.0°C, 4.0-6.0 ppm and 29.0-30.0 ppt respectively. In Ramchandi lagoon, a number of male *Mugil cephalus* (373-450 mm/300-550 g) in oozing condition were collected. Mature females were not observed except for one spent female of 398.00 mm and 700.0 g size. Pituitary glands were collected from mature males and preserved for future use. At Alupatna, two mature females of 454 mm/800 g and 470 mm/850 g size were stripped after treating them with pituitary hormone. The stripped eggs did not show any development.

At Narakkal, one female breeder of *Mugil cephalus* was slowly acclimated to 32.0 ppt salinity and low water temperature in the laboratory for 3 days. The female was given first dose of 25 mg of CPH. It was observed that the egg diameter increased responding to the hormone treatment. The fish became infected and died. Hybridization experiments with female *L. macrolepis* and male *L. parsia* could not be continued as the treated fish died when transferred to the sea water.

Lates calcarifer

Induced breeding experiments could not be conducted at Ennore since fully ripe breeders were not available.

At Puri, breeding camp was set up at Alapatna during May-June 1988 for conducting breeding experiments on *Lates calcarifer*. Only two specimens could be collected from the net catches. One fish weighing 4 kg was immature and the other weighing 8 kg was in spent condition.

Etroplus suratensis

At Ennore hatchery, natural spawning of pearl spot, *Etroplus suratensis* was observed and it yielded 1,200 numbers of fry during September 1988. They have grown to 50.0-60.0 mm size by December 1988. At all the Centres live food cultures were maintained.

Culture of brackishwater finfishes (FCD/FC/1.1)

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

Collection of seed

The seed of *Liza parsia* numbering 74,985, in the size range 39.65-54.2 mm/0.96-2.3 g, were collected from the intertidal pits. The seed of *L. tade* (18.0-25.0 mm) were collected (600 numbers) as well as purchased locally (1675 numbers). The seed of *Lates calcarifer* in the departmental collections made in the inter-tidal pits and feeder canals was negligible. The fry of *Etroplus suratensis* with an average size of 46.2 mm/3.0 g numbering 1,112 were collected from the feeder canals and were stocked in the pond during May 1988.

Culture of *Liza parsia*

Three ponds of 0.027 ha each were stocked with *L. parsia* at 1 lakh/ha and a pond of 0.067 ha was stocked at 75,000/ha during April. The average initial sizes of *L. parsia* in each pond at stocking were 54.2 mm, 39.65 mm, 46.6 mm and 43.3 mm respectively.

The average size recorded at the end of 8 months (December) from each pond were 98.5 mm, 116.3 mm, 100.5 mm and 102.5 mm respectively. Supplementary feeding with rice bran and fish meal (1:1) was given twice a day at 2-3% of their body weight. The production of *L. parsia* from the four ponds were 5.925 kg, 3.720 kg, 1.540 kg and 0.275 kg respectively. The miscellaneous fishes that gained entry into the ponds accounted for 0.150 kg, 2.20 kg, 3.675 kg and 6.0 kg in the respective ponds. The miscellaneous fishes included the species of *Lutianus*, *Scatophagus*, *Therapon*, *Lates* and prawns.

Culture of *Lates calcarifer*

Experiments on culture of *Lates calcarifer* could not be carried out since the seed was not available in sufficient quantities in the departmental collections.

Culture of *Etroplus suratensis*

E. suratensis (average size 46.2 mm/3.0 g) was stocked in a well prepared pond (0.06 ha) during May at the rate of 1,900/ha. A production rate of 101.26 kg/ha/193 days was obtained. The average size at harvest was 134.4 mm/47.42 g and survival was 11.42%. The miscellaneous species accounted for 127.82 kg/ha. The poor survival was due to total inundation of the pond on 30-7-1988 as a result of which large numbers of *E. suratensis* had escaped. No supplementary feed was given.

Physico-chemical parameters

Fortnightly analysis of physico-chemical parameters of the ponds was carried out. The ranges of water temperature, depth, turbidity, salinity, dissolved oxygen and pH of the ambient waters were 25.0-31.4°C, 84.0-112.0 cm, 18.0-28.0 cm, 2.4-13.5 ppt, 5.5-8.8 ppm and 8.3-8.6 respectively. The ranges of pH and organic carbon of the pond soil were 7.9-8.2 and 0.39-0.75% respectively.

Polyculture of fishes and prawns (FCD/FC/1.2)

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

During the period, two experiments were conducted. In the first experiment, *Penaeus monodon*, *Liza parsia* and *L. tade* were stocked in 0.08 ha pond at a stocking rate of 2 lakh/ha, 50,000/ha and 10,000/ha respectively. The average initial sizes were 18.0 mm 15.0-25.0 mm and 80.0-120.0 mm for *P. monodon*, *L. parsia* and *L. tade* respectively. *P. monodon* has grown to an average size of 135.0 mm/17.0 g while *L. parsia* and *L. tade* registered a size of 60.0 mm/5.2 g and 145.0 mm/40.0 g respectively, during the culture period of 3 months.

In the second experiment, the stocking densities for *P. monodon*, *L. parsia*, *L. tade* and *Etroplus suratensis* were 25,000, 20,000, 5,000 and 20,000/ha respectively. The respective average initial sizes were 72.0 mm/2.5 g, 60.0 mm/5.2 g, 145.0 mm/40.0 g and 40.0 mm/2.3 g. After a culture period of 6 months, the average sizes registered were 135.0 mm/21.0 g, 125.0 mm/25.0 g, 205.0 mm/102.0 g, and 60.0 mm/6.0 g respectively. Prawns were fed with pelleted diet at 2-5% of the body weight and the fishes with a mixture of rice bran and fish meal (1:1) at 2-3% of the body weight. The experiment is in progress.

The bottom fauna, collected monthly, showed average numerical abundance ranging from 650 to 4896 units/m² with peak in December. They consisted of tanaids, gammarids and polychaetes.

Monthly collections of plankton samples showed the dominance of zooplankton over the phytoplankton during the period April-December. The common zooplankters were the species of *Diaptomus*, *Cyclops*, *Brachionus*

and *Moina*. Rotifers, mysids and their nauplii were also encountered in the samples. The phytoplankton consisted of the species of *Anabaena*, *Oscillatoria*, *Navicula*, *Chlorella*, *Spirulina* and *Nitzschia*.

Water samples were collected at fortnightly interval and the soil at monthly interval. The analysis of the samples showed that the depth, turbidity, water temperature, salinity and dissolved oxygen were in ranges of 102.0-149.0 cm, 15.0-30.0 cm, 24.2-31.0°C, 2.5-16.2 ppt and 4.8-7.6 ppm respectively. The values of pH did not show much variation with a range of 8.3-8.6. The soil pH ranged 7.9-8.1 and the organic carbon 0.36-0.75%.

Pen culture of fishes and prawns (FCD/FC/1.3)

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

Monoculture of *Chanos chanos* in pens

At Pulicat *Chanos chanos* (av. 162.3 mm/31.0 g) numbering 1000 were stocked during the month of February 1988 in a pen of 0.125 ha at 8,000/ha. The fish were reared on supplementary feed, a mixture of G.O.C. and R.B. (1:1) at 10% body weight once daily for a period of 7 1/2 months at the end of which they had grown to 217.8 mm/75.5 g. The stock was harvested and 56.8 kg of *C. chanos* and 11.0 kg of auto-stocked species (*Siganus* sp., *L. macrolepis*, *Caranx* sp., *Gerres* sp., *Lutianus* sp., *E. suratensis* and *Bristipoma* sp.) were obtained. The production per hectare for 7 1/2 months worked out to be 454.4 kg of *C. chanos* and 88.0 kg of auto-stocked species. The survival was 75.2%.

Monoculture of *Chanos chanos* in cages

At Ennore *C. chanos* (av. 35.5 mm/0.62 g) numbering 2,500 were stocked in two cages

(50 m² each) during June 1988. The fry were fed on a mixture of G.O.C. and R.B. in the ratio of 1 : 1 at 5% body weight once daily for a period of 4 1/2 months at the end of which they had grown to 121.3 mm/16.6 g on average. A total number of 475 were recovered from both the cages (survival 19.0%). Due to threat of pollution during the monsoon the stock was shifted to Pulicat and the experiment continued from the middle of October 1988. At Pulicat, two cages (50 m² each) were stocked at 48,000/ha and reared on a mixture of G.O.C. and R.B. (1 : 1) at 5% body weight. They had grown to 136.5 mm/21.9 g by December. The experiment is in progress.

Monoculture of *Lates calcarifer* in pens

At Pulicat, *L. calcarifer* (145.7 mm/39.0 g) numbering 50 were stocked in a 0.05 ha pen at 1,000/ha during February 1988. The fishes were reared on live feed at 10% body weight once daily for a period of 8 months at the end of which they had grown to 304.2 mm/423.5 g. The stock was harvested and 11.86 kg of *Lates* and 4.2 kg of auto-stocked species (*Elops saurus*, *Caranx* sp., *Pristipoma* sp., *Therapon* sp., *L. macrolepis*, *Gerres* sp., *Siganus* sp., *Strongylurus* sp. and *Scylla serrata*) were obtained. The production of *L. calcarifer* and auto-stocked species worked out to 237.2 kg and 84.0 kg/ha/8 months respectively. The survival was 56.0%.

Monoculture of *Lates calcarifer* in cages

At Pulicat, *L. calcarifer* (av. 181.7 mm/83.3 g) numbering 20 were stocked in 50 m² cage at 4,000/ha during June. The fish were reared on live feed at 10% body weight once daily. The fish have grown on an average to 265.9 mm/259.3 g in 6 months. The experiment is in progress.

In another experiment, 50 numbers (av. 170.0 mm/66.9 g) of *L. calcarifer* were

stocked in a 50 m² cage at 10,000/ha during August. The fish were fed on live feed at 10% body weight twice daily. They have grown to 194.5 mm/94.2 g on an average in 4 1/2 months. The experiment is in progress.

In the third experiment, 23 numbers (av. 109.3 mm/17.5 g) were stocked in a 50 m² cage at 4,600/ha during September and reared on live feed at 10% body weight once daily. The fish have grown to 172.1 mm/62.5 g in 3 months at the end of which the experiment was concluded. The survival was 91.3%.

Mono-culture of *Etroplus suratensis* in cages

At Pulicat, *E. suratensis* (av. 81.8 mm/13.0 g) numbering 100 were stocked at 20,000/ha in two 50 m² cages during November and reared on natural food. The fish had grown to 88.9 mm/19.6 g in 50 days. The experiment is in progress.

Mixed culture

At Pulicat, 250 *L. macrolepis* (106.7 mm), 500 *E. suratensis* (103.2 mm) and 20 *C. chanos* (115.7 mm) were stocked in 0.05 ha pen at a combined stocking density of 15,400/ha and reared on natural food. *L. macrolepis* had grown to an average size of 128.6 mm/25.0 g in 6 months, *E. suratensis* to 114.0 mm/36.5 g and *C. chanos* to 262.0 mm/110.0 g in 4 1/2 months. The experiment is in progress.

In another experiment, 500 *E. suratensis* (91.2 mm/20.0 g) and 465 *Penaeus indicus* (78.7 mm/3.0 g) were stocked in a 0.05 ha pen at a combined stocking density of 20,000/ha and reared on natural food. *E. suratensis* had grown to an average size of 94.0 mm/26.1 g in 4 months. The prawns were not encountered in the sampling. The experiment is in progress.

Physico-chemical characteristics of water and soil

At Pulicat, the physico-chemical features of water were : water temperature ranged from 25.0-32.8°C, transparency 20.0-30.0 cm, pH 7.7-8.3, salinity 5.0-44.5 ppt, dissolved oxygen 4.0-8.0 mg/l, total alkalinity 58.0-110.0 mg/l, silicates 1.4-3.2 mg/l and nitrate 0.05-0.16 mg/l. The diurnal studies indicated that the dissolved oxygen was lowest (2.8 mg/l) at 06.00 hrs and high (9.8 mg/l) at 18.00 hrs when the water temperature ranged 29.2-33.2°C. The soil characteristics were : sand 77.0-83.0% silt, 11.8-14.5%, clay 5.2-9.5%, pH 7.5-8.0, organic carbon

0.13-0.52%, CaCO₃ 3.0-4.25%, available phosphorus 2.6-5.8 mg/100 g and available nitrogen 18.5-26.8 mg/100 g.

At Ennore, the physico-chemical characteristics of water were as follows : water temperature 29.6-31.8°C, transparency 24.0-38.0 cm, salinity 32.0-39.0 ppt, dissolved oxygen 4.8-6.8 mg/l, total alkalinity 88.0-104.0 mg/l, phosphate 0.12-0.14 mg/l, silicate 3.2-4.8 mg/l and nitrate 0.03-0.04 mg/l. The soil characteristics were : sand 81.5%, silt 14.75%, clay 3.75%, pH 7.9-8.3, organic carbon 0.40-0.48% and Ec 18.0-26.3 m.S. Cm⁻¹.

FISH FARM SURVEY AND ENGINEERING

Mapping of brackishwater areas using remote sensing methods (FED/R.S./1.1)

Madras : T. Rajyalakshmi (PL) and K. N. Krishnamurthy

The Project was taken up with a view to using remote sensing data in the survey of brackishwater areas in Tamil Nadu, Andhra Pradesh and Orissa. Discussions were held with the Institute of Remote Sensing, Anna

University, Madras which has taken up a programme on coastal area survey with remote sensing data. The project associate was exposed to a week-long training programme. During the course of working out implementation aspects, it was realised that trained manpower and laboratory facilities have to be built up for the purpose. It was decided that implementation of the project may be taken up in future after adequate preparations.

RESOURCE AND TECHNOLOGY IMPROVEMENT

Preparation of balanced feeds for penaeid prawns (RTD/NT/1.1)

Narakkal : Syed Ahmad Ali (PL) and A. Laxminarayana

Madras : C. P. Rangaswamy and L. Hanumantha Rao

At Narakkal

Preparation of particle feed and its evaluation for *P. indicus* larval rearing

Formula feed consisting of prawn waste (30%), fish meal (20%), groundnut cake

(20%) and tapioca (30%) fortified with minerals and vitamins was prepared in particle sizes of 0.2, 0.5 and 1.0 mm at Narakkal laboratory. Postlarval *P. indicus* were reared for 15 days upto PL-15 ; from an initial size of 5.2 mm they grew to 14.1 mm with a survival rate of 86.6%. The same formula feed prepared to particle size of 45 microns was tested on protozoa I of *P. indicus* at a stocking density of 100/l. The larvae metamorphosed to protozoa III in three days with a survival of 73%.

Further rearing could not be continued due to total mortality on the fourth day.

Feed experiments in grow-out ponds

A low protein (20%) diet was formulated to test on *P. indicus* stocked in the grow-out ponds. The formula consisted of prawn waste (30 parts), groundnut cake (15 parts), coconut cake (10 parts), wheat bran (15 parts) and tapioca (30 parts). The feed was tested in the farm of Kerala Agricultural University at Vytilla in 3 ponds, each of 0.15 ha size. The stocking rate was 1 lakh/ha. At the end of two months of grow-out period the prawns attained growth (weight) of 5.2 g. It was subsequently reported that the stock suffered heavy mortality due to sudden decline in salinity.

Evaluation of new feed ingredients

Tuna waste, catfish waste and squid waste were analysed for proximate composition with a view to incorporating them in formulated feeds. The data are given in Table 5.

Feeding trials indicated that the substitution of groundnut cake by squid waste had improved the feed conversion ratio (FCR) of the existing formula. Substitution with catfish waste greatly improved the FCR while that with tuna waste showed only marginal increase.

At Madras

Preparation of feeds

The formula feed I consisted of ingredients such as squid, soyabean cake, tapioca, and rice polish, supplemented by vitamins and minerals. Squid was substituted by prawn head waste and fish meal in the formula feed II. To improve the PUFA status shark-liver oil was also added. About 0.9 t of Feed II was prepared using a laboratory-scale unit assembled at the Institute.

Feed I had the proximate composition of protein (37.74%), carbohydrate (30.64%), lipid (5.63%), crude fibre (3.10%), ash (12.89%) and moisture (10%). In feed II the protein level was raised to 40%.

TABLE 5. *Proximate composition of some new feed ingredients*

| Material | Moisture % | % dry weight | | |
|------------------|---------------|--------------|-------|-------|
| | | Protein | Lipid | Ash |
| Tuna waste .. | 60.0 | 77.48 | 11.89 | 11.20 |
| Catfish waste .. | 50.0 | 53.40 | 22.60 | 26.50 |
| Squid waste .. | 80.5 | 67.50 | 21.00 | 10.40 |

These ingredients were incorporated in the existing feed formulae of the Centre replacing fishmeal, *Squilla* and groundnut cake at different levels, with the objective of determining their suitability as substitutes to these materials. Eight feeds were prepared with these combinations as dry pellets and fed to juveniles of *P. indicus*.

Experimental evaluation of feeds on prawn postlarvae

A formula feed was tested on *P. monodon* postlarvae produced at Ennore hatchery. *Perna* meat was the control diet. At a low stocking density of 1/1, PL 4 at 5 mm size grew to 24 mm (PL-29) with a survival of 24.6%; In the control the final size was

at 20 mm with a survival of 14.3%. At a stocking density of 2/1, the postlarvae at an initial size of 12 mm (PL-16) grew to a final size of 25 mm (PL-32) with a survival of 72.6%. In control, the growth was 22 mm with a survival at 61.5%.

In feed I trial with *P. indicus*, the post-larvae of 9 mm/3 mg, stocked at a density of 2/1, attained a size of 22.7 mm/130 mg in a period of 30 days. The survival was 92.88%. In the control, using *Perna* meat at a similar stocking density the growth was 13 mm/17 mg with the survival of 55.33% only.

Hatchery-produced *P. semisulcatus* post-larvae, at 2/1 and fed formulated diet, grew from 3 mg to 43 mg in 15 days with 100% survival, as against 20 mg in the control.

In all these feed trials, the ambient range was : temperature 26-29.2°C, salinity 26-28 ppt and pH 8.0-8.3.

Preparation of balanced feeds for finfishes (RTD/NT/1.2)

Madras : C. P. Rangaswamy (PL) and R.D. Prasadam

Narakkal : Syed Ahmad Ali

An analytical laboratory for analysis of selected raw feed ingredients and formulated feeds was set up during the year at the Headquarters. Emphasis was also given to development of technology of feed preparation viz., techniques of proper drying of raw feed ingredients, pulverising, mixing, preparation of dough, temperature control, leaching and loss of nutrients, pelletization and drying/cooling and storage.

The formula feed prepared with prawn head waste, fish meal and soya cake as the main ingredients with a protein level of 40% was used for testing on fish fry (*Liza macrolepis*) as a preliminary step towards formulation of balanced feeds for finfishes.

Attempts were also made to wean juvenile *Lates calcarifer* (174.9 mm/71.7 g) to pelleted feeds from their normal feeding of live organisms.

Five test diets were prepared for testing them on *Etroplus suratensis* at Narakkal Centre. The ingredients used were fish meal, groundnut oil cake, wheat bran, rice bran and tapioca. Proximate composition of these individual ingredients was evaluated.

Breeding of Horse-shoe crab (RTD/H.C./1.1)

Puri : K. M. Das (PL), S. M. Pillai and P.K. Ghosh

The study on horse-shoe crab had been taken up to collect basic information on identification, biology, larval rearing and feeding techniques considering the importance of the species in biomedical research. The distribution of *Tachypleus gigas* was studied further north along Balasore coast in Orissa at the Burbhalong river mouth. It was found to occur in the sandy and muddy bottoms from tide line to a depth of 40 m. Studies on morphology were undertaken and the internal morphology, digestive, respiratory and reproductive systems were also examined. The breeding behaviour in nature was studied. It showed egg laying 1-20 m from high tide mark. Eggs were laid in shallow sand pits. About 1227 eggs were collected for further rearing in laboratory in simulated conditions.

Studies on food chain and energy flow dynamics of Pulicat lake (RTD/EF/1.1.)

Madras : A. V. Natarajan (PL), Mathew Abraham and K. O. Joseph

Assessment of standing crop of plankton, bottom fauna, phytobenthos, fish/prawn/crab, yield and food and feeding intensity of fishes and prawns of Pulicat lagoon was

undertaken by establishing 5 sampling stations in the more productive southern part of the lagoon. Sampling was conducted every fortnight in all the stations.

Quantitatively the concentration of plankton during the period ranged from 0.75 to 9.0 ml/m³. The average standing crop of plankton in the lagoon was 3.36 ml/m³. The identified genera of plankton were: *Nitzschia*, *Fragilaria*, *Navicula*, *Cymbella*, *Oscillatoria*, *Ceratium*, *Paracalanus*, *Eucalanus*, *Brachionus*, *Pedalion*, *Acartia*, *Diaptomus* and crustacean and molluscan larvae. The abundance of the bottom fauna of the lake has shown a range from 0.075 to 11.25 g/m² and the average abundance was 4.95 g/m². The major constituents of bottom fauna were amphipods, polychaetes, tanaisids, chironomid larvae, nematodes and molluscs. The

phyto benthos is mainly constituted by plants like *Halophila*, *Cymodocea* and filamentous algae, mainly *Chaetomorpha*, *Enteromorpha*, *Ulva* etc., and showed a variation in abundance from 110-517 g/m². The distribution is not uniform in the lake.

Fishery yield statistics have been obtained from two major fish landing centres viz., Pulicat and Arambakkam. Landings ranged from 52.166-97.712 tonnes during the period. The main species composition was of *M. cephalus*, *L. macrolepis*, *Sillago sihama*, *Chanos chanos*, *Gerres oycena*, *Tachysurus* sp., *Nematolosa nasus*, *Sparus* spp., *Siganus* spp. and *G. filamentosus*. Among prawns, *Penaeus indicus*, *P. monodon*, *Metapenaeus monoceros* and *M. dobsoni* were dominant. *Scylla serrata* and *Neptunus pelagicus* were the two major species of crabs.

KRISHI VIGYAN KENDRA

The Krishi Vigyan Kendra of the Institute at Kakdwip conducted the following courses during the year :

| Discipline | On Campus | | Off Campus | |
|--------------------|-----------|-------|------------|-------|
| | Men | Women | Men | Women |
| Crop Production .. | 47 | 10 | 240 | 60 |
| Horticulture .. | 80 | 6 | 210 | 30 |
| Fisheries .. | 77 | 10 | 220 | 60 |
| Home Science .. | — | 77 | 40 | 240 |
| Total .. | 204 | 103 | 710 | 390 |

Category of trainees :

| | |
|--------------------|-------|
| Practising farmers | — 580 |
| Youth | — 280 |
| Farm women | — 400 |
| Extension workers | — 140 |
| Teachers | — 7 |
| | ————— |
| | 1407 |

In addition to above training courses, the following demonstrations were also conducted :

Kharif rice cultivation, Bororice, rice-cum-shrimp farming, cultivation of moong, mustard, sunflower, chilli, coconut, tomato and watermelon, brackishwater fish seed collection, nursery pond management, tiger shrimp culture, induced breeding of carps, composite fish culture, fish feed production, cultivation of mushrooms, knitting, tailoring, embroidery, child-care, mother craft, fruit and vegetable preservation.

PERSONNEL

(Not a gradation list)

Director

Dr. K. Alagarwami (from 11-4-1988)

Dr. (Mrs.) T. Rajyalakshmi (Officiated upto 10-4-1988)

SCIENTISTS

Principal Scientist

Dr. A. V. Natarajan
Dr. (Mrs.) T. Rajyalakshmi
Dr. K. Raman (Retired on 31-5-1988)
Dr. K. V. Ramakrishna
Shri A. V. P. Rao
Shri K. N. Krishnamurthy

Scientist (SG)

Dr. R. D. Prasadam
Dr. S. Radhakrishnan
Dr. K. M. Das
Dr. L. Hanumantha Rao
Dr. P. K. Mukhopadhyay (On deputation with IIRI, Calcutta from 16-7-1986)
Shri Hardial Singh
Shri S. R. Das
(On study leave from 16-7-1987)
Shri P. Ravichandran (On study leave from 1-6-1988)
Dr. Mathew Abraham
Dr. A. Lakshminarayana
Dr. S. Kulasekarapandian
Dr. L. Krishnan
Shri A. R. Thirunavukkarasu (On study leave from 1-7-1988)
Shri Syed Ahamed Ali
Dr. S. M. Pillai
Dr. M. K. George

Dr. C. P. Rangaswami
Dr. K. Gopinathan
Dr. B. P. Gupta
Shri R. K. Chakraborty
Shri S. Srinivasagam (On training with NACA upto 17-3-1989)
Dr. P. K. Ghosh
Smt. Munawar Sultana

Scientist

Shri B. K. Banerjee
Shri H. S. Majumdar
Shri K. O. Joseph

TECHNICAL PERSONNEL

Technical Officers

Shri K. V. George, T-8
Dr. Valaja Sree Krishna, T-6
Shri Ashis Chowdhury, T-5

Technical Assistants

Shri P. M. Abdul Kadir, T-4
Shri S. Krishnan, T-II-3
Shri K. K. Surendran, T-2
Shri C. S. Sasidharan, T-2
Shri M. G. Sivadasan, T-2
Shri U. N. Jally, T-1

ADMINISTRATIVE PERSONNEL

Administrative Officer

Shri R. Dorai Raj

Asst. Fin. & Accts. Officer

Kum. S. Chandra (On deputation from
A.G's Office, Madras)

Assistants

Shri M. Subramanian
Shri S. K. Murali (On deputation from
CMFRI)

Senior Clerks

Smt. S. Bhagirathi
Shri A. B. Mondal

Junior Stenographers

Shri P. Prasad
Shri S. K. Halder

Junior Clerks

Shri P. N. Rajasekharan Nair
Shri K. Mani
Shri P. K. Roy
Shri S. K. Bindu
Smt. K. Nandini
Shri R. Kandamani

AUXILIARY PERSONNEL**Drivers**

Shri M. G. Subramani, T-I-3
Shri K. Gopinathan Nair, T-2
Shri B. B. Roy, T-2
Shri P. C. Mohanty, T-1

SUPPORTING STAFF**S.S.Gr. IV**

Shri B. Sasmal
Shri A. K. Mondal
Shri M. I. Raju

S.S.Gr. III

Shri M. Ramalingam
Shri S. S. Maity
Shri D. N. Sahoo

Shri P. Manickyam
Shri N. C. Jena
Shri Sita Ram Das
Shri S. C. Mondal
Shri Gunadhar Das
Shri L. C. Manna
Shri Prakash Ch. Saha

S.S.Gr. II

Shri B. Dhanuk
Shri Gangadhar Santra
Shri A. E. Raju
Shri R. K. Behera
Shri Shyam Bhoi
Shri Biswanath Mondal
Shri M. N. Biswas
Shri A. K. Biswas
Shri K. N. Das
Shri N. N. Mondal
Shri S. R. Bahadur
Shri Amulya Bajali
Shri S. L. Dhanuk
Shri B. K. Jena
Shri N. C. Samanta
Shri K. K. Raman
Shri Dhaneswar Das
Shri P. Arumugam
Shri Baman Jally
Shri N. Mani
Shri Kalipada Mondal
Shri R. Subramani
Shri Sasadar Betal
Shri R. B. Das
Shri Gour Hari Jena
Shri M. C. Behera

S.S.Gr. I

Shri P. Ch. Saha
Shri K. C. Samal
Shri N. K. Shanmugam
Shri P. Gharami
Shri B. C. Paik
Shri Sudarshan Naik
Shri Bijay Bhoi
Shri P. Paban Halder

Shri Abimanyu Naskar
Shri N. Chandra Som
Shri R. K. Roy
Shri Balaram Das
Shri K. U. Gopi
Shri P. S. Samanta
Shri S. Pari
Shri S. K. Venkatachalam
Shri T. V. Shaji
Shri K. Kunjuraman
Shri K. Thangappan
Shri N. C. Mondal
Shri M. D. Suresh
Shri N. K. Jena

Shri M. Santhosani
Shri N. Harinathan
Shri V. Jeevanandam
Shri M. Majhi
Shri N. N. Jena
Shri K. P. Naskar
Shri Amar Gharami
Smt. S. Santhi
Shri K. Mariyappan
Shri A. Jayaraman
Shri P. Bisoi
Shri V. M. Dhanapal
Shri K. Nithyananda
Smt. L. R. Bhuiya

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