भाकृअनुप
ICAR

ANNUAL REPORT 1985-'86

Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)
MATSYAPURI P. O., COCHIN-682029

ANNUAL REPORT 1985-'86

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
MATSYAPURI P. O. COCHIN - 682 029

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Cover: Training in processing of low cost fish products — for generating self-employment among coastal fisherwomen.

1. INTRODUCTION

The various research and development and extension activities undertaken by the Institute at Headquarters and Research Centres have shown substantial progress during the year.

The Lab-to-Land programme on fabrication of high opening trawl, an improved trawl design, holds promise of popularisation of this gear among the fishermen. The gear yielded enhanced catches when compared to the conventional trawl design. The mini purse seine developed at the Institute has found favour with the traditional fishermen in place of their age-old 'thanguvala', a boat seine, for operation from traditional craft. Extensive trials have shown that encircling gill nets of nylon 210|1|2| with 50 mm. bar mesh are optimum gear for exploitation of mackerel resources along Goa coast.

Original fastening qualities of coir fibres used for fastening various plankings in indigenous craft are retained when treated with the chemical preservatives innovated at the Institute.

The fuel saving modern hearth designed for cooking clam meat has generated great interest among the housewives engaged in processing clam meat. Adoption of this innovation is sure to effect an increase in the family income.

Extra fine surgical sutures could be prepared from fish collagen. This suture compares well with the commercial product in its physical properties.

Studies have shown the red meat of tuna to be highly effective in fighting protein malnutrition and anaemia in children. Incorporation of 0.5% chitin in the normal diet of broiler chicken effected an increase in the live and dressed weight yielding an additional gain of 70% per bird. The advantages of isinglass for use in breweries were brought out.

Retort pouch processing of fish is a novel technique of processing as far as India is concerned. An important step in this direction was taken when Dr. E. G. Silas, former Director of CMFRI, inaugurated a programme on test

marketing of sardines processed in retortable pouches. This programme forms part of the collaborative project initiated in 1983 between CIFT and the Tropical Development and Research Institute, London.

An electrocution box made of fibreglass reinforced plastic for stunning frogs was developed as a humane method of killing frogs for the frog leg processing industry. An Universal Marine Telemeter was developed for simultaneous acquisition of 15 underwater hydrodynamic and environmental parameters using a single instrument and a single cable.

Training and demonstration programmes were continued to be held regularly for the benefit of those sponsored by the fishing and fish processing industry and the fishermen community to transfer the various technologies developed at the Institute. The Institute also participated in many exhibitions during the period and secured the award for the best pavilion among the Central Govt. stalls at the 'Matsyamela' organised by the Kerala State Co-operative Federation for Fisheries Development Ltd. (MATSYAFED) at Trivandrum. The Institute was also awarded a shield in the Congress Centenary Exhibition at Cochin for securing the second prize among pavilions in the Educational and Research Group.

The Institute was further honoured when one of its Senior Scientists received the prestigious and coveted Jawaharlal Nehru Award for 1983 for his doctoral thesis.

(M. R. Nair)
DIRECTOR

1.1. HISTORY

The Central Institute of Fisheries Technology, named at the time of its inception as Central Fisheries Technological Research Station, was set up following the recommendations of a high power committee con stituted by the Ministry of Food and Agriculture, Govt. of India, in 1954. It was started in 1957 at Cochin under the Department of Agriculture and the then Ministry of Food and Agriculture, with a small nucleus of staff for research work in fishing craft and gear. The Processing Division of the Institute was started in 1958 and the Extension, Information and Statistics Division in 1961. The Institute was given its present name in 1962. The administrative control of the Institute was brought under the Indian Council of Agricultural Research from 1st October, 1967.

The Institute is the only national centre in the country where research investigations are undertaken in all disciplines of fishing and fish processing. Research centres located at Veraval (Gujarat), Kakinada (Andhra Pradesh), Burla (Orissa), Bombay (Maharashtra), Panaji (Goa), and Calicut (Kerala) cater to the special regional needs.

1.2. ORGANISATION

The Institute is headed by the Director with whom all administrative and financial powers regarding research and management of the Institute are vested. He is assisted by a Senior Administrative Officer, Administrative Officer and two Assistant Administrative Officers for dealing with matters relating to general administration, an Accounts Officer and Asst. Accounts Officer for looking after the financial and accounting aspects as also internal audit of the Institute. One Junior Technical Officer attends to the technical matters including those connected with research projects handled by the Institute at its Headquarters at Cochin and Research Centres.

The various activities of the Institute including research, are carried out by the following Divisions.

1. Craft Division
2. Gear Division
3. Biochemistry and Nutrition Division
4. Microbiology Division
5. Processing Division
6. Engineering Division
7. Extension, Information and Statistics Division

1.3. ADMINISTRATION

This Division deals with recruitment, service policy, discipline, staff welfare, land and building, procurement of stores, budget expenditure, settlement of claims etc.

The Research Centres continued to function in rented buildings except the one at Calicut. Addresses of the Research Centres are given as Appendix I. List of staff under Scientific, Technical, Administrative,

Auxiliary and Supporting categories as on 31-3-1986 is given as Appendix II.

Details of budget provision and actual expenditure are furnished as Appendix III.

1.4. MANAGEMENT COMMITTEE

The Management Committee of the Institute continued to function with the following members:

1. Director, CIFT : Chairman
2. Director of Fisheries, Govt. of Kerala, Trivandrum : Member
3. Director of Fisheries, Govt. of Tamilnadu, Madras : Member
4. Director of Research, Kerala Agricultural University, Mannuthy P.O., Trichur : Member
5. Chairman and Managing Director, Hindustan Vegetables and Oil Corporation, New Delhi : Member
6. Dr. P. N. Kaul, Scientist S-3, CIFT, Cochin : Member
7. Shri P. Vasudeva Prabhu, Scientist S-3, CIFT, Cochin : Member
8. Dr. K. Devadasan, Scientist S-3, CIFT, Cochin : Member
9. Shri P. D. Antony, Scientist S-2, CIFT, Cochin : Member
10. Asst. Director General (F), ICAR, New Delhi : Member
11. Accounts Officer, CMFRI, Cochin : Member
12. Shri Y. P. Nishad, President, National Federation of Fisheries Co-operatives, New Delhi : Member
13. Administrative Officer, CIFT, Cochin : Member Secretary

The Committee met once during the year under report.

1.5. MONITORING CELL

The Monitoring Cell constituted with the following members of the Institute continued to function during the period under report and met 6 times during the year to review and consider the progress made by this Institute in the Plan expenditure, procurement of stores, construction works, progress made in clearing the outstanding advances and also recruitment of personnel.

1. Director, CIFT : Chairman
2. Scientist-in-Charge, Engg. Division : Member
3. Scientist-in-Charge, Craft Division : Member
4. Scientist-in-Charge, Gear Division : Member
5. Scientist-in-Charge, Microbiology Division : Member

6. Scientist-in-Charge, EIS Division : Member
7. Scientist-in-Charge, B & N Division : Member
8. Scientist-in-Charge, Processing Division : Member
9. Accounts Officer : Member
10. Administrative Officer : Member Secretary

1.6. GRIEVANCE CELL

There are two Grievance Cells functioning— The General Grievance Cell dealing with individual grievances of staff coming under Class II and below and the Grievance Cell dealing with grievances of Senior officers of Class I and above.

The General Grievance Cell is defunct due to expiry of its term and has not been re-constituted as four of its members have to be nominated by the staff side of the Institute Joint Council which is also not functioning in view of court case pending.

The Grievance Cell for Officers of Class I and above constituted as per order No. F. 3-23|81-Admn dated 26th August 1982 functioned till 25th August 1985 with the following members:

1. Director : Chairman
2. Dr. K. Gopakumar, S-3 (S-4 Grade Personal) : Member
3. Dr. T. K. Sivadas, S-3 : Member
4. Dr. Jose Stephen, S-2 : Member
5. Shri V. Vijayan, S-2 : Member
6. Administrative Officer : Member Secretary

On expiry of the term, new cell has not been reconstituted as the Heads of Divisions have to be nominated by the Management Committee of the Institute whose term expired on 27-9-1985.

1.7. STAFF JOINT COUNCIL

During the year under report, the Joint Council of this Institute did not function in view of the court case regarding its constitution, pending in the Munsiff Court, Cochin.

1.8. TECHNICAL SECTION

The Institute's various research projects handled at the Headquarters and Research Centres were compiled for the year 1985-86, taking into consideration the review and recommendations made by the Project Advisory Committee, scientific meetings and Director. Out of the 37 projects implemented, 9 were new projects and 5 reoriented. A brief summary of 8 projects completed during 1984-85 has been given in the research project programmes of 1985-86.

The ongoing projects were reviewed at the Project Advisory Committee meetings held regularly and in the scientific meeting held on 23-7-1985. A review report on the progress and achievements of the research work carried out under each project has been sent to Council as desired by DDG (AS).

The project leaders' files containing the research project proposals, half yearly reports of project leader and associates and annual report pertaining to each project have been systematically maintained. Similarly the individual project files of

scientists were also scrutinised and made ready for presenting to the ASRB Assessment Committee.

Materials for the preparation of fortnightly, monthly and quarterly reports on important activities of the Institute such as significant research findings, major achievements of the projects, seminars, workshops, exhibitions and training programmes conducted were compiled and sent to Council regularly.

Out of the 52 ARS scientists whose assessment for the year ending 31-12-1983 has been conducted, two S-3 scientists got promotion to S-4 Grade Personal, six S-2 scientists got promotion to S-3 and twenty four S-1 scientists got promotion to S-2 grade. The assessment result of one scientist in the grade S-1 is awaited.

The supplementary information proformae for 1984 in respect of 19 scientists who had not got promotion for the period ending December, 1983 were sent to ASRB|Council along with the Biodata and Five Yearly Assessment proformae of 9 scientists who were eligible for five yearly assessment for the period ending 31-12-1984.

The pending cases of two more scientists whose assessment|reassessment were due for 1981, 1982 and 1983 were also taken up.

Representations received from 50 scientists for review of their assessment for the period ending December 1980, 1981 and 1982 were scrutinised and sent to ASRB.

Report of the research and extension work carried out at Institute's Headquarters and Research Centres was compiled incorporating infrastructural facilities, review of work done, constraints and remedial measures and technology ready for transfer. Eighty five copies of the report pertaining to Region No. 8 were sent to the Member Secretary for inclusion in the Agenda Note of the 9th Meeting of Regional Committee No. 8 held at Trivandrum on 6 & 7th September, 1985.

Reports of work done by the Institute's Research Centres have been prepared and forwarded to Council for inclusion in the agenda of the Regional Committee Meetings Nos. 5 (Burla), 6 (Veraval) and 7 (Goa & Bombay).

The recommendations of the various ICAR Regional Committees were studied and action taken for their implementation.

The up-to-date biodata of 108 ARS scientists of the Institute were sent to Council and IARI, New Delhi on request. A write-up covering the programmes proposed to be undertaken by the Institute upto 2000 AD was prepared as required by the Council.

Seventy two scientific|technical papers including research notes, popular articles etc. received from scientists seeking permission for publication|presentation were scrutinised and Director's approval of 64 papers conveyed.

A scheme on gainful employment for women based on post harvest technology drawn up in collaboration with Department of Science and Technology, Govt. of India and Kerala State Government for generation of employment among fisher women was approved by Council for implementation. Smt. P. J. Cecily, T-7 and Shri M. K. Ka-

ndoran, Scientist S-3, are the Principal Coordinator and Co-Principal Coordinator respectively of this project.

1.9. PROJECT ADVISORY COMMITTEE

The Project Advisory Committee of the Institute critically examined the research project proposals submitted by the individual scientists for the year and finalised the proposals which were subsequently approved by the Staff Research Council and Management Committee of the Institute and the ICAR.

At the end of each quarter, the Committee met under the Chairmanship of Dr. K. Gopakumar, Scientist S-3 (S-4 Grade Personal) and reviewed the progress made in the research projects. Comments of the Committee on the progress were communicated to individual scientists for guidance in implementing the programmes as per the schedule.

1.10. COMMITTEES REPRESENTED BY THE INSTITUTE

Director served on the following scientific and allied bodies.

1. Chairman : ISI, AFDC-27, Fish and Fishery Products Sectional Committee.
2. Member : ISI, AFDC-36:9, Metallic Contaminants Sub Committee.
3. Member : Scientific Panel for Fisheries Research, ICAR, New Delhi.
4. Member : Task Force on Agro Processing and Post-harvest Technology and Environmental Committee, Govt. of Kerala.
5. Member : Committee on delienation of Discipline in Fishery Science in Agricultural Research Service.
6. Member : Panel of Experts for hearing appeals (Export Inspection Agency).
7. Member : Board of Directors, Kerala Fisheries Corporation.
8. Member : Board of Studies, Univercity of Cochin.
9. Member : Board of Examiners, University of Agricultural Sciences, Bangalore.
10. Member : Board of Studies for D.F.Sc. course of CIFE, Bombay.
11. Member : Board of Examiners for D.F.Sc. Course of CIFE, Bombay.
12. Panel Member : To discuss the use of pre-enrichment media for testing salmonella.
13. Member : Expert Committee to determine the wastage of shrimp in processing plants.
14. Member : Expert Committee to formulate norms for marketing IQF products.
15. Member : Committee on cryogenics in fish freezing industry.

16. Member : MPEDA team to inspect the Marine Products Export Processing Zone in Calcutta.

17. Adviser : UPSC Selection Committees.

18. Member : Committee on mechanization of boats in the country.

19. Member : CIFNET Consultative Committee.

20. Member : IFP Consultative Committee.

21. Member : Central Board of Fisheries.

22. Member : Committee on Marine Based Industries, Govt. of India.

23. Member : Management Committee, Krishi Vigyan Kendra, CMFRI, Narakal.

24. Member : Resource Management Cell, Dept. of Fisheries, Kerala.

25. Member : Standing Committee at the level of Ministry of Agriculture to coordinate the functions of the Fisheries Institutes under the Ministry of Agriculture and Indian Council of Agricultural Research.

26. Member : Standing Committee at Local Level of Training for harvest and post harvest technology, Ministry of Agriculture.

The following scientists also represented the Institute in various committees:

1. *Dr. K. Gopakumar, Scientist* S-3 (S-4 *Grade Personal*):

   a) *Member: Committee for technical* scrutiny of applications received under Scheme for Extending Financial Assistance of Sea Food Processors for upgrading the efficiency of freezing units.

   b) Alternate Member: ISI, AFDC-27:5 Fish Meal Sub-committee.

   c) Board of Examiners, University of Cochin.

2. *Dr. C. C. Panduranga Rao, Scientist* S-3 (S-4 *Grade Personal*):

   Member: ISI, AFDC-27-Fish and Fishery Products Sub-Committee.

3. *Shri R. Balasubramanyan, Scientist* S-3 (S-4 *Grade Personal*):

   a) Member: ISI, MCPD-2 Indian Harbour Craft and Fishing Vessels Sectional Committee.

   b) Member: Marine Corrosion Sub-Committee of the CSIR.

   c) Member: Consultative Committee for FRP Technology of the National Council of Science and Technology.

   d) Member: Co-ordinating Committee of MPEDA, Cochin to promote shark fishing.

   e) Member: Co-ordinating Committee of MPEDA, Cochin to promote lobster fishing.

f) Member: Expert Committee for the Acquisition of Trawlers for the Tamil Nadu Fisheries Development Corporation Ltd., Madras.

g) Member: Fisheries Resources Sub-Committee of National Consultation Meet on the Deep Sea Fans of the Bay of Bengal.

4. *Shri P. V. Prabhu, Scientist* S-3:

Principal Member: ISI, AFDC-27:5 Fish Meal Sub-Committee.

5. *Dr. T. K. Govindan, Scientist* S-3:
Member: Sub-Committee to Examine Amendments and Instructions for Fish and Fishery Products, Export Inspection Agency, Cochin.

6. *Shri P. Appukutta Panicker, Scientist* S-3:

a) Member: Consultative Committee of Fisheries Survey of India, Tuticorin and Cochin.

b) Member: Working group of FORV 'SAGAR SAMPADA'.

c) Member: Committee on sharing of on board facilities of ICAR Research Vessels.

d) Member: *Committee of* MPEDA for Exploration of Squid and Cuttle Fish Resources.

e) Member: Committee of MPEDA on Pilot Project for promoting shark fishing.

f) Member: Committee on Futurology for Identification of Science and Technology Impact for Lakshadweep Development.

7. *Shri V. C. George, Scientist* S-3:

a) Member: Co-ordinate Committee of MPEDA on the survey of stake nets in Kerala.

b) Member: Inter-institutional Infrastructural Facilities Evaluation Committee of ICAR Fisheries Institutes.

8. *Dr. K. Ravindran, Scientist* S-3:

a) Subject Expert: Faculty of Marine Sciences, University of Cochin.

b) Member: Marine Cargo Movement and Packaging Division Council (MCPDC) of ISI.

c) Member: Standing working Committee on Marine Cargo Movement and Packaging (SWCMC) of ISI.

9. *Shri S. Ayyappan Pillai, Scientist* S-3:

a) Member: ISI Sectional Committee on Fishing Vessels, MCPD-21|A-1

b) Member: ISI MCPD 3:7 - Sub-Committee on Machinery for Dredgers, Tugs, Trawlers, Hoppens, Barges and Mechanised Fishing Boats.

c) Member: Advisory Committee constituted by MPEDA for Technical Scrutiny of subsidy applications for installation of generating sets in seafood processing plants.

d) Member: Committee constituted by MPEDA to study modernisation of seafood processing units.

e) Member: Panel constituted by MPEDA for Acquisition of Refrigeration Units by Seafood Processors.

10. *Shri T. S. Gopalakrishna Iyer, Scientist* S-3:

Member: Panel of Experts for Approval of Factories under IPQC|MIPQC scheme in Kerala region except Calicut.

11. *Shri Cyriac Mathen, Scientist* S-3:

a) Member: Panel of Experts for approval of factories under IPQC| MIPQC system in Tamilnadu region.

b) Member: Committee of MPEDA on IQF Prawns.

12. *Shri K. K. Balachandran, Scientist* S-3:

Principal Member: ISI, AFDC-27:1, Canned Fish Products, Sub-Committee.

13. *Shri H. Krishna Iyer, Scientist* S-3: Member: ISI, AFDC:57, Expert Panel for Preparation of Draft Indian Standards and Methods for sampling of Fish and Fishery Products.

14. *Dr. M. Arul James, Scientist* S-3:

a) Member: State Level Committee for Co-ordination of work on Marine Fisheries, Maharashtra.

b) Member: Panel of Experts for IPQC|MIPQC Scheme for Fish and Fishery Products and IPQC scheme for Frozen Frog legs, Bombay Region.

15. *Shri T. S. Unnikrishnan Nair, Scientist* S-2:

a) Member: ISI, AFDC-27:3, Dry Fish Products Sub-committee.

b) Member: Panel of Experts for IPQC Scheme of Export Inspection Agency, Cochin.

16. *Shri T. Joseph Mathai, Scientist* S-2: Member: Consultative Committee of Fishery Survey of India, Mangalore Base.

17. *Shri K. K. Solanki, Scientist* S-2:

a) Member: ISI, AFDC-27, Fish and Fishery Products Sub-committee.

b) Member: IPQC Panel.

18. *Shri A. A. Khan, Scientist* S-2:

a) Member: Purchase Committee for Fishing Gear and Boats to Fishermen Co-op. Societies, Hirakud.

b) Member: Co-ordination Committee, Federation of Fishermen Co-op. Societies, Hirakud Reservoir, Sambalpur.

c) Member: Regional Advisory Committee on Technical Schemes (RACTS) in the discipline of Fisheries constituted by NABARD, Bhubaneswar.

19. *Shri Sib Sankar Gupta, Scientist* S-2: Member: Panel of Experts for IPQC and MIPQC scheme of Fish and Fishery Products.

20. *Dr. N. Unnikrishnan Nair, Scientist* S-2:

a) Subject Expert: Marine Biology, University of Cochin.

b) Member: Task Force on Biological Sciences, State Department of Science and Technology, Govt. of Kerala.

21. *Shri K. V. Mohan Rajan, Scientist* S-2:

Member: Consultative Group for Fishery Survey of India, Bombay and Porbander Bases.

22. *Shri P. R. G. Varma, Scientist* S-2:

Member: Panel of Experts, Pre-IPQC| MIPQC, Export Inspection Agency, Cochin.

23. *Dr. M. D. Varghese, Scientist* S-1:

a) Subject Expert: Doctoral Committee, University of Cochin.

b) Supervising Guide: Ph.D. Degree Faculty of Marine Sciences, University of Cochin.

24. *Shri S. Gopalan Nair, Technical Officer,* T-8:

Principal Member: ISI, TDC-42, Textile Materials for Fishing Net Purposes, Sectional Committee.

25. *Smt. K. Radhalakshmi, Asst. Technical Officer,* T-6:

Alternate Member: ISI, TDC-42, Textile Materials for Fishing Net Purposes, Sectional Committee.

1.11. SYMPOSIA/SEMINARS/ MEETINGS ATTENDED

Dr. Gopakumar, Scientist S-3 (S-4 Grade Personal), attended a one day seminar on Quality Development of Dried Fish, organised by Export Inspection Agency, Madras at Tuticorin, 1st February 1985 and presented a paper.

Shri Anil Agarwal, Scientist S-2, attended Indian convention of Food Scientists and Technologists, New Delhi, 3-5 April 1985 and presented a paper.

Shri M. R. Nair, Director, attended a Round Table Meeting of Lakshadweep Administration on Marine Fisheries and Mining at Cochin, 15th and 16th April, 1985.

Shri M. R. Nair, Director and Shri K. Ramakrishnan, Scientist S-1 attended a Seminar on Remote Sensing in Marine Resources jointly organised by CMFRI and Fishery Survey of India, Cochin, 17-18 April 1985.

Shri R. Balasubramanian, Scientist S-3 (S-4 Grade Personal) attended a workshop on Biodetenoration of materials held at National Institute of Oceanography, Goa, 23-25 April 1985.

Shri M. R. Nair, Director, attended Matsya Mela, a three day carnival organised by Matsyafed, Trivandrum 15th May 1985.

Shri S. Ayyappan Pillai, Scientist S-3, attended a workshop on Stirling Cycle Liquid Nitrogen Plants—Maintenance and trouble shooting—organised by the Indian Cryogenics Council (west zone) at IIT, Bombay, 17-21, June 1985.

Shri K. Ramakrishnan, Scientist S-1, attended the Second Indo-Pacific and Fourth All India Symposium on Invertebrate Reproduction at Madras, 25-27 June 1985 and presented a paper.

Dr. T. K. Govindan, Scientist S-3 attended a workshop on Management of All India Coordinated Research Project (Animal Sciences and Fisheries) held at National Academy of Agricultural Research Management, Hyderabad, 25-28 June 1985.

Shri M. R. Nair, Director, attended a seminar on "Role of Information in the development of Backward areas like Lakshadweep-Cochin, 8th July 1985.

Shri T. Joseph Mathai, Scientist S-2, participated in VIII meeting of VII Regional Committee of ICAR at Panaji, 28-29, August 1985 and presented a status paper on the achievements of Goa Research Centre.

Shri S. Ayyappan Pillai, Scientist S-3, attended and presented a paper at the National Seminar-cum-Exhibition on Machinery, Equipments and Accessories for Food Processing and Packaging, organised by Association of Food Scientists and Technologists (I), Madras chapter and Small Industries Service Institute, Madras, at Madras, 5 & 6 September, 1985.

Shri A. A. Khan, Scientist S-2, attended a meeting arranged by Dy. Director of Fisheries-cum-Dy. Registrar of Co-operative Societies for finalising purchase of fishing gear and boats for Co-op. societies under the NABARD assisted scheme, 4th October 1985.

Shri A. A. Khan also attended a meeting of Fishermen Co-op. Societies, Thebra, 9th November 1985.

Dr. K. Ravindran, Scientist S-3 and Dr. N. Unnikrishnan Nair, Scientist S-2, attended a meeting on "Design of Fishing Vessels" organised by the Institute of Marine Engineers at Cochin, November 1985.

Dr. M. K. Mukundan, Dr. Jose Stephen and Shri A. G. Radhakrishnan, Scientists S-2, participated in a Seminar organised by Intensive Child Development Scheme of Kerala State Health Services, 13 December 1985. Lecture classes on principles of nutrition were taken for the benefit of the Anganavady workers of the scheme.

Dr. T. K. Sivadas, Scientist S-3, attended the first conference in Dock and Harbour Engineering, IIT, Bombay, 27-29 December 1985 and presented a paper.

Shri T. S. G. Iyer, Scientist S-3, attended a seminar on Upgradation of Processing and Quality Control of Fishery Products at Calcutta. Shri Iyer also attended two meetings on Enrichment Techniques at MPEDA, Cochin.

Shri M. R. Nair, Director and Shri P. A. Panicker, Scientist S-3, attended a seminar on Managerial Decision Making in Dredging sponsored by Indian Institute of Port Management and Cochin Port, Cochin, 13-15 Januay 1986.

Dr. K. Ravindran, Scientist S3 and Kum. B. Meenakumari, Scientist S-2 attended International Conference on Marine Biodeterioration—Advanced Techniques Applicable to the Indian Ocean, at Goa, 16-20 January, 1986.

Shri V. C. George, Scientist S-3, attended a National Seminar on Perspectives in Hydrobiology organised by Vikram University, Ujjain, 18-20 January 1986.

Shri M. R. Nair, Director and a few scientists of the Institute attended the International Seminar on Training and Education for Marine Fisheries Management and Development organised by Central Institute of Fisheries Nautical and Engineering Training, Cochin, 28-30 January, 1986. Two papers were presented at the seminar.

Shri M. R. Nair, Director and a few scientists of the Institute participated in the

National Seminar on Mussel Watch organised by the School of Marine Sciences, University of Cochin, 13-14 February, 1986.

Shri M. K. Kandoran, Scientist S-3 attended a seminar on "Social Awareness" organised by Pallithodu Social Works Unit, Shertalai, under the auspices of Alleppey Diocesan Charitable and Social Welfare Society, Alleppey, 15th February 1986 and gave a talk.

Scientists of Burla Research Centre attended workshop on Fish Farmers' Problems at Sambalpur organised by State Fisheries Dept. 15 Feb. 1986. Shri Khan delivered a talk on the fishing problems of reservoirs.

Shri G. Narayanappa, Scientist S-3 participated in Consultative Group Meeting convened at Madras and Visakhapatnam Bases of Fishery Survey of India to review the work.

Shri M. R. Nair, Director, attended a conference on Computers in Research in the fields of Agriculture, Forestry, Fisheries and Water Management, Cochin, 20th February 1986.

Shri M. R. Nair, Director, attended an Open House Discussion by the Technical Committee of Export Inspection Council Cochin, 24th February 1986.

Dr. K. Ravindran, Scientist S-3 and Shri A. G. G. K. Pillai, Scientist S-2, attended a Seminar on Prospects of Small Scale Industries, 25-26 February 1986.

1.12. CIFT-TDRI COLLABORATIVE PROJECT ON FISH PROCESSING

A collaborative research project was initiated in 1983 between Central Institute of Fisheries Technology, Cochin and Tropical Development and Research Institute, London, based on a Memorandum of understanding signed between Government of India and Government of U.K. The programme would last for 3 years and would cover the following sub-projects:-

1. Improved utilization of fish.
2. Retortable pouches as an alternative to canning.
3. The development of simple solar dryers.
4. Developing quality control expertise at CIFT, Cochin.

The following are the programmes carried out under each project —

1. Improved utilization of fish

This part of the work was carried out by Dr. C. D. Wood, Scientist, TDRI, London. Losses occurring in cured fish was estimated and the identification was done of the important flies that occur in larval forms and as eggs in dried fish samples collected from various curing centres in India.

2. Retortable pouches as an alternative to canning

About 400 pouches of sardines packed in retortable pouches in Metal Box Factory in U.K. by Shri P. K. Vijayan, Scientist of CIFT, were brought to India. A test marketing was carried out through the Sea Food Exporters Association of India and the Kerala Fisheries Corporation. The services of Mr. Keith D. Jeffs, Director, K. M. Packaging Services, London, were made available by TDRI for this purpose.

Pouches were also kept in TDRI, London for assessing quality variation by the end of 6 months, 1 year and 2 years of storage. This task was performed by Dr. K. Gopakumar, Scientist, CIFT, who visited TDRI in 1985..

Consumer preference studies were conducted by supplying the pouches to consumers and eliciting their opinion through printed proforma.

3. Development of simple solar dryers

A solar dryer was fabricated by Mr. David Trim, solar drying expert, who was at CIFT Research Centre at Veraval for six weeks in 1985. This dryer was used to produce laminated Bombay Duck, a sample quantity of which was taken to London for exploring market prospects. If this attempt succeeds, more solar dryers would be set up with the assistance of TDRI, and an export drive will be launched with the help of MPEDA.

4. Development of quality control expertise at CIFT

Studies were undertaken by Shri G. B. Ames, Scientific Officer of TDRI visiting CIFT on the development of histamine in Indian oil-sardines. Though the investigation has confirmed the formation of histamine in oil sardines, it was quantitatively insignificant at 0°C and was low and safe at 10°C until fish becomes unacceptable. Amount of histamine was found to be well above acceptable limits when the fish was kept at 23°C for 20 hours and at ambient temperature for 15 hours. It was further observed that if the fish was iced adequately soon after the capture there was practically no chance of histamine formation in the fish.

Under this project Shri P. R. G. Varma, Scientist, CIFT, has undergone training in U.K. during August-September 1985, on the estimation of histamine and sensory evaluation methods for assessment of the quality of fish and fishery products.

1.13. ICAR SPORTS

The ICAR Sports Meet 1985 (Zone V) was hosted by the Central Institute of Fisheries Technology at Cochin during 25-30 November 1985. All the Institutes of Zone V except Sugar Cane Breeding Institute, Coimbatore, participated in the meet. In all, about 300 atheletes from 10 Institutes took part in the various events.

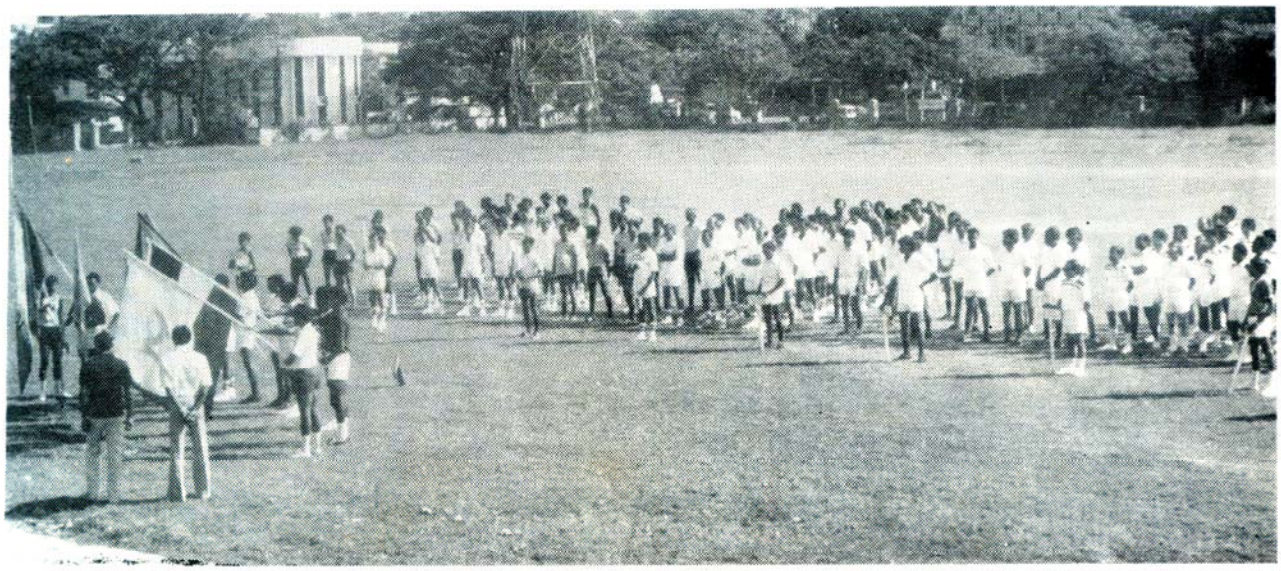
Shri A. Vasanth Shenoy, Scientist S-2, CIFT, won the Badminton Singles title and the CIFT team comprising S|Shri A. Vasanth Shenoy, Jose Kalathil, M. K. Kandoran, P. A. Uthup and G. R. Gokulan, won the Badminton team event. CIFT team bagged the football trophy.

1.14. LIBRARY

The Library system continued to provide library and documentation service to the scientific and technical staff of the Institute, research scholars and students from the Universities, scientists from other Institutes and technicians from the industry.

During the year, 206 books were added to the collection and at present there are 5985 books and 2653 bound volumes of journals.

A Total of 3121 bonafide readers visited the library and 3400 publications were issued and returned during the period under report.



Participants in the ICAR Sports Meet (Zone V), 1985 hosted by CIFT at Cochin in November, 1985.

CIFT bagged the first prize in Badminton (single and team event) and Football — Captains receiving the prizes.

The reprographic unit of the library has made copies and supplied 40,000 pages of the documents on requisition.

The library continued to issue 2 publications for the benefit of the users.

1. Current Contents on Fishery Technology (Fortnightly)
2. CIFT Library Bulletin (Monthly)

The library committee met four times during the year.

1.15. LAB-TO-LAND PROGRAMME

The Lab-to-Land Programme, a novel scheme of technology transfer organised by the ICAR and Ministry of Agriculture and Rural Development, Government of India continued during the year.

Trap fishing is one of the methods used for catching lobsters. CIFT has developed a modern trap for this purpose which is very efficient and has longer life. The Lab-to-Land Programme on Lobster Fishing with Modern Traps was inaugurated at the Fishermen Welfare Society Office, Chowara, Trivandrum, on 19th January, 1986. Bench mark survey was undertaken of the 50 fishermen families at Chowara adopted under the programme. Fifty traps of CIFT design were got fabricated and distributed to the selected families.

The high opening trawl nets developed at the Institute considerably enhanced the catch as compared to ordinary trawl nets. The Lab-to-Land Programme on fabrication of High Opening Trawl envisages popularisation of the fabrication and use of this improved trawl at Puthiyappa, Calicut Dist. The programme was inaugurated in August 1985 and a one week training programme conducted from 19-24 August to orient the fishermen towards the new technology. Thirty five beneficiaries underwent the training in tailoring, assembling and rigging of the improved trawl. Five demonstrations and a film show on development of fisheries were shown. An exhibition projecting the various developments in fisheries technology was also organised.

Ten demonstrations were carried out on the fuel saving modern hearth developed for cooking clams. Locally available less costly fuel such as paddy husk was used successfully to reduce the cost of boiling clams. The participating housewives showed great interest in the programmes. Preliminary survey has shown that by using the modern hearth, each family could save Rs. 5|- per day in boiling clams and gain an additional Rs. 10|- per day by sale of the clam meat processed in the hygienic way.

1.16. FISHING CRUISES

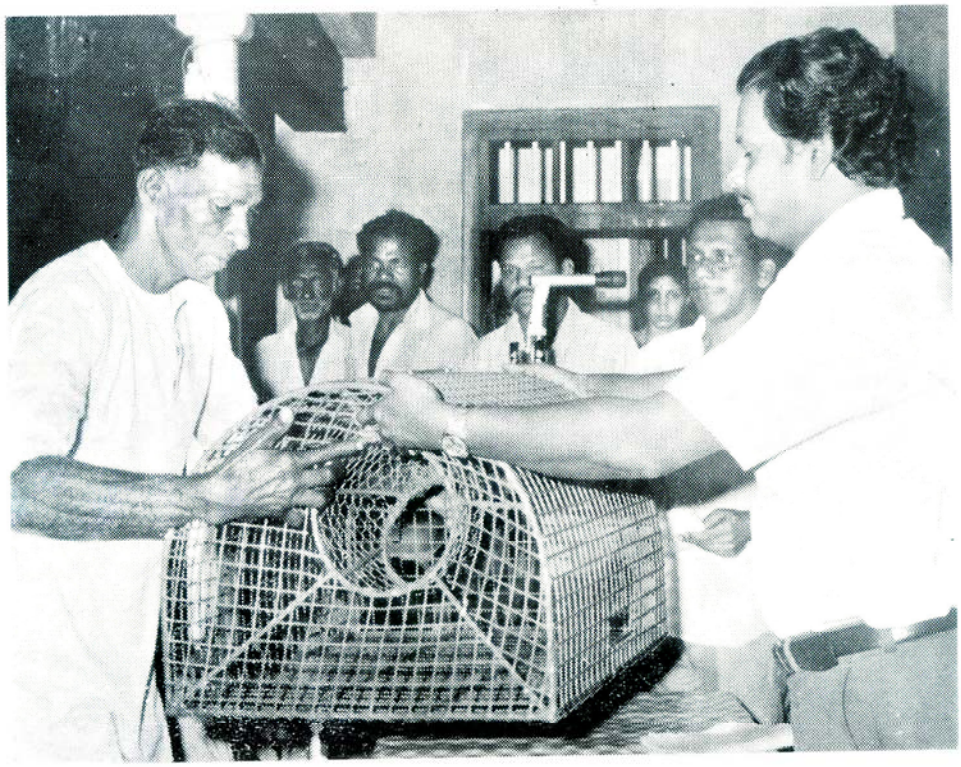
The following scientists participated in the "Sagar Sampada" cruise during the year ending 31st March 1986.

Phase III

Cruise No.	*Period*	*Scientists participated*
3	28-5-1985 to 12-6-1985	1. Sh. P. T. Mathew, S-2 2. Sh. H. N. Mhalathkar, S-2 3. Sh. K. P. Antony, S-1

Cruise No.	*Period*	*Scientists participated*
4	13-6-1985 to 5-7-1985	1. Sh. K. S. Namboodiri, S-3 2. Sh. P. Ravindranathan Nair, S-2 3. Sh. S. Sanjeev, S-2
5	15-7-1985 to 26-7-1985	1. Sh. P. V. Prabhu, S-3 2. Sh. A. V. Shenoy, S-2 3. Sh. K. K. Kunjipalu, S-2
6	31-7-1985 to 13-8-1985	1. Sh. R. S. Manohar Doss, S-2 2. Sh. V. Vijayan, S-1
7	17-8-1985 to 2-9-1985	1. Sh. Sib Sankar Gupta, S-2 2. Sh. Mangayya Naidu, S-1
8	4-9-1985 to 22-9-1985	1. Syed Abbas, S-1
9	27-9-1985 to 21-10-1985	1. Sh. P. N. Joshi, S-2 2. Sh. K. Ramakrishnan, S-1
9a	22-10-1985 to 18-11-1985	1. Sh. K. V. Mohan Rajan, S-2 2. Sh. A. C. Kuttappan, S-1
10	29-11-1985 to 22-12-1985	1. Sh. K. S. Namboodiri, S-3 2. Sh. P. George Mathai, S-1
11	23-12-1985 to 14-1-1986	1. Sh. H. N. Mhalathkar, S-2 2. Sh. N. Kalaimani, S-2
12	17-1-1986 to 12-2-1986	1. Sh. Ayyappan Pillai, S-3 2. Sh. Cyriac Mathen, S-3 3. Sh. T. K. Thankappan, S-1
13	20-2-1986 to 19-3-1986	1. Sh. K. K. Kunjipalu, S-2
13a	20-3-1986 to 24-3-1986	1. Sh. T. P. George, S-2 2. Sh. T. M. Sivan, T-6
14	29-3-1986 to 28-4-1986	1. Sh. T. P George, S-2 2. Sh. T. M. Sivan, T-6

Lab-to-Land Programme on fabrication of high opening trawl at Puthiyappa — Shri M. R. Nair, Director hands over webbings to a beneficiary.



Shri C. T. Sukumaran, IAS, Director of Fisheries, Kerala, hands over a CIFT designed lobster trap to a beneficiary under the Lab-to-Land programme.

Beneficiaries of Lab-to-Land Programme-trainees with nets fabricated under the programme at Badagara

Training on improved method of fish drying

1.17. SCIENTIFIC TALKS

As a part of the scientific pursuit, scientists of the Institute and subject experts from other institutions in India and abroad were invited to present papers in their field of specialisation embrasing the broad areas of fishery research. These talks presented an overview of the advances in the respective disciplines and helped in identifying the areas for future research. Shri M. R. Nair, Director, presided over the scientific sessions while Dr. K. Ravindran, S-3, served as the Convener of the scientific talk. The following scientific talks were held.

Date	*Name of speaker*	*Topic*
13-5-85	Shri K. Sreedharan Namboodiri, S-3 CIFT	An account of the training in Denmark on fishery and oceanographic research.
13-5-85	Shri P. N. Joshi Scientist S-2, CIFT	Fishery and oceanographic research on board F.O.R.V. Sagar Sampada
4-7-85	Dr. Keith D. Jeffs TDRI, London	Retort pouch packaging
18-11-85	Mr. J. Stoneman British Overseas Development Authority, London	British collaboration with overseas countries.
21-11-85	Dr. Geoffrey R. Ames TDRI, London	Histamine in fish
17-12-85	Dr. David Trim, TDRI, London	Solar drying of fish

1.18. FELLOWSHIP/TRAINING/ DEPUTATION

Shri M. R. Nair, Director, visited Japan during the period from 20th-29th April, 1985 as a member of Trade Delegation sponsored by the Ministry of Commerce for holding indepth discussion with the Japanese Authority and trade. The visit was sequel to the recommendation of the National Committee on Cholera problem in the Sea Food Industry headed by the Director, CIFT.

Dr. K. Gopakumar, Scientist S-3 (S-4 grade personal), visited U.K. for four weeks from 26-8-85 under the CIFT-TDRI Project to carry out analysis of pouched sardine and its quality assessment.

Shri P. R. Girija Varma, Scientist S-2 underwent training at Tropical Development Research Institute, London for eight weeks from 2nd September to 25th October 1985 on fish quality control under Colombo Plan.

1.19. AWARD/DEGREES

Dr. P. G. Viswanathan Nair, Scientist S-3, was awarded the Jawahar Lal Nehru Award for 1983 for his Ph.D. thesis on "Fatty acid composition and nutritional qualities of fish lipids" submitted to the University of Kerala under the supervision of Dr. K. Gopakumar, Scientist S-3 (S-4 Grade Personal). Dr. Nair, received the prestigeous award from the Union Minister of State for Agriculture and Vice-President of ICAR Shri Yogendra Makwana at a colourful function held at Vigyan Bhavan, New Delhi on 27th March 1986.

The following scientists of the Institute were awarded Ph.D. degrees during the year.

Name of the scientist	*Thesis particulars*
Dr. N. Unnikrishnan Nair, S-2	Awarded by Cochin University for the work "Studies on the Backwater Oyster Crassostrea madrasentis (preston) of Cochin Harbour—carried out under the guidance of Dr. N. Balakrishnan Nair, Kerala University."
Dr. K. G. Ramachandran Nair, S-2	Awarded by the University of Kerala for the work — Biochemical Investigations on Fish Lipids — carried out under the guidance of Dr. K. Gopakumar, CIFT.
Dr. Chinnamma George, S-2	Awarded by Cochin University for the work —Biochemical changes associated with processing of shell fishes and flavour constituents of body meat and claw meat of crabs—carried out under the guidance of Dr. K. Gopakumar, CIFT.
Dr. P. J. Cecily, J.T.O. (T-7)	Awarded by Cochin University for the work —Materials for fish net, their properties, selection and preservation carried out under the guidance of Dr. C. T. Samuel, Cochin University.

1.20. VISITORS

Important visitors to the Institute's Headquarters and its Research Centres during the year included.

1. Shri Chandulal Chandrarkar, Hon'ble Minister of State for Rural Development, Govt. of India.
2. Shri V. V.Jetley, Dy. Commissioner, Dept. of Agriculture & Co-operation, New Delhi.
3. Dr. Santha Sheela Nair, Director of Fisheries, Govt. of Tamil Nadu.
4. Mr. D. S. Thaine, Trophical Development Research Institute, London.

Shri M. R. Nair, Director (Second from right) with other members of the MPEDA trade delegation at the YOKOHAMA QUARANTINE STATION, Yokohama, Japan

Dr. P. G. Viswanathan Nair, Scientist, receives the Jawaharlal Nehru Award for 1983 for his doctoral thesis from Shri Yogendra Makwana, Union Minister of State for Agriculture.

Shri Yogendra Makwana, Union Minister of State for Agriculture, in the Gear Laboratory.

Dr. N. S. Randhawa, Director General, ICAR, in the Processing Laboratory.

5. Shri Yogendra Makwana, Hon'ble Minister of State for Agriculture, Govt. of India.
6. Mr. B. Blake, British Council, Madras.
7. Admiral A. K. Chatterji, Retd. Chief of Naval Staff.
8. Dr. N. S. Randhawa, Director General, ICAR.
9. Dr. Tibor Farkas, Inst. of Biochemistry, Biological Research Centre, Hungarean Academy of Sciences, Hungary.
10. U.K. delegates, Mr. Lawrance Cock Croft and Dr. George Murdoch, representing M|s Booker Agricultural International, U.K.
11. Group of 4 Nigerian Women Fishery Extension Officers under the UNDP| FAO Project for Artisanal and Inshore Fisheries Devt. in Nigeria.
12. Sub-committee of Committee of Parliament on Official Language.

2. RESEARCH

2.1. HEAD QUARTERS, COCHIN

2.1.1. CRAFT DIVISION

SCIENTISTS ASSOCIATED

R. Balasubramanyan (till August 1985), Dr. K. Ravindran, Dr. N. Unnikrishnan Nair, A. G. Gopalakrishna Pillai, P. N. Joshi.

CHIEF FINDINGS

Studies have shown that the original fastening qualities of the coir fibres used for fastening the various plankings in indigenous built-in-canoes were retained when treated with copper creosote and creoscor, the chemical preservatives innovated at the CIFT. At the same time, the untreated coir fibres were seen to deteriorate quickly necessitating replacement.

A quantitative assessment of the effectiveness of different oil borne wood preservatives traditionally used by the fishermen has shown that traditional preservatives have afforded only marginal protection to the craft. The determination of ultimate compressive strength of wooden members of the craft provided precise method for quantitative assessment of the effectiveness of wood preservatives.

Seven cellulolytic and lignicolous fungal species have been identified as the causative agents for the biodeterioration of indigenous fishing craft. These are Pestalotiopsis mangiferae *(Henn) Steyart,* Fusarium equiseti *(Corda) Sacc,* Botryodiplodia theobromae *(Pat),* Curvularia lunata *(Wakker),* Penicillium citrinum *(Tham),* Aspergillus niger *(van Tieghan) and* Trichoderma koningii *(Oudem).*

An examination of the aluminium sheathed craft drydocked after varying periods ranging from 12-24 *months has shown that although* 50% *of the sheathing accumulated fouling, pitting and crevice corrosion of the sheathing material was only in the range of* 4-10%. *This long term observation provides an experimental proof for the satisfactory use of marine grade aluminium for sheathing purposes.*

Studies on polymer impregnated ferrocement have shown that the enhancement of first crack tensile stress was due to the interfacial bonding between the polymer *impregnated matrix and the steel reinforcement.*

RESEARCH IN HAND

Development of aluminium fishing craft

A craft of 5 m OAL for sheltered waters and one of 8 m OAL for gill netting were identified for detailed design development and engineering. The G.A. Plan is under preparation.

Marine plywood

Marine plywood treated with fortified creosote has shown better resistance to biodegradation. Further observations are in progress to confirm these findings.

Marine corrosion

Studies are being carried out on the relative performance of aluminium alloys with respect to salt spray and sea water exposure tests and compatibility of different structural aluminium alloys on the hull and deck.

Wood plastic composites

Studies have been undertaken on the economics of toxic wood plastic composites (TWPC) and the possible areas of their use in fishing boats and other marine installations.

Dual preservative technology for indigenous fishing craft

Studies are also in progress on the advantages of a dual preservative treatment (a water borne preservative followed by an oil bound preservative) to prevent fungal and bacterial decay and also to offset the development of splits and cracks due to weathering in indigenous fishing craft.

The Division is closely associated with the FAO — India training programme on construction of ferrocement fishing boats in an endeavour to popularise alternative materials for construction of fishing craft.

RESEARCH CONTEMPLATED

1. Design and development of an inshore water aluminium craft
2. Cataloguing of traditional fishing craft in India
3. Studies on craft materials with reference to marine corrosion, fouling, boring, biodeterioration and marine coatings
4. Improvements in hull maintenance efficiency of deep sea fishing vessels through heavy duty antifouling coatings.

2.1.2. GEAR DIVISION

SCIENTISTS | TECHNICAL OFFICERS ASSOCIATED

P. A. Panicker, V. C. George, K. A. Sadanandan, H. N. Mhalathkar, K. K. Kunjipalu, T. P. George, B. Meenakumari, P. George Mathai, Dr. M. D. Varghese, A. C. Kuttappan, S. Gopalan Nayar, N. A. George, T. M. Sivan and K. Radhalakshmy.

CHIEF FINDINGS

A 5% less value of twist from equivalent R tex values of nylon twines has been recommended for polypropylene twines and same is being considered for preparation of standard specifications.

Relationship between the deterioration by UV exposure and time of exposure

for different specifications of nylon twines was found to be linear and the rate of deterioration bears a linear relationship with the diameter square.

A 16 m light demersal-cum-pelagic trawl designed for operation from two motorized traditional craft was successfully tried at Cheriyathura, Trivandrum.

The mini-purse seine designed and developed during 1980-82 *for traditional sector has now been taken up by the traditional fishermen to replace their age old 'thanguvala' (a boat seine).*

RESEARCH IN HAND

Work on preparation of standard specifications for polypropylene twines and combination twines was continued. The properties of polypropylene twines of specifications 190|2|3, 190|3|3 and 190|4|3 were studied giving different degrees of twist to the samples, and the twist specifications recommended.

With a view to introducing a new netting matrial, twist specifications of 840d polypropylene yarns for preparation of 840|1|2 twines were worked out. 210 kg. of yarns supplied free of cost by Gujarat Filaments, Baroda, were handed over to GFCCA, Ahmedabad, for making pomfret/ hilsa gill nets of 60 mm mesh bar for field trials. Fabrication of the gear is in progress.

Work on formulation of a test procedure for weather deterioration of netting materials was continued. Nylon twines of different specifications were subjected to UV radiation and the deterioration due to weathering was assessed. The relationship between deterioration by UV exposure and time of exposure and the rate of deterioration and diameter square were found to be linear.

Three models of demersal trawls for the EEZ were fabricated. Fabrication of the gear accessories like otter boards, floats, sinkers and combination rope was in progress. Preliminary tank testing of midwater trawls was carried out at IIT, Madras.

Work on the efficiency studies of demersal and midwater trawls from bigger class of vessels was also continued. Fabrication of 3 prototype demersal trawls and a 24 m midwater trawl have been completed except for the rigging of combination rope which is being made under the supervision of the Division, in collaboration with M|s. South India Wire Ropes, Alwaye. The Scientists and Technical Officers of the Division have undertaken cruises in FORV Sagar Sambada and M. V. Saraswathi to acquaint themselves with the vessels and equipments for the above work.

Efficiency studies of long wing and BOBP trawls are also being continued.

Squid jigging and dipnetting were taken up from a 43 ft. private vessel "Maijo 21" at Vizhinjam and Cochin for popularisation of the methods. Studies were completed on the status of the long line fishery from South Kerala, Karnataka and Goa. Shark long line operation from MV Saraswathi with different types of hooks and baits was continued. Fabrication of similar shark lines for operation from 'Matsyakumari' was also completed.

Mesh selectivity studies with nylon prawn gill nets of 32 to 56 mm mesh size were conducted. Small sized *Penaeus indicus* was caught in mesh size ranging from 32 to 38 mm.

Preliminary survey was conducted for fish traps along the South East and South West coasts of India. Based on this, it is proposed to take up designing of a perch trap with newer material.

RESEARCH CONTEMPLATED

1. Experimental twisting, analysis of properties and preparation of standards of polypropylene of different specifications
2. Preparation and analysis of properties of combination synthetics
3. Preparation and analysis of properties of combination wire rope
4. Field trials with long wing and BOBP shrimp trawls
5. Modelling and tank testing of models of demersal and mid water trawls for large class vessels
6. Studies on flexible floats and introduction of square meshed cod-end for demersal trawls
7. Design, fabrication and field trials with dip-net for sampling pelagic fishes of EEZ
8. Studies on speed of trawling with reference to species composition and depth of operation
9. Selectivity studies, multi-locational testing and standardisation of shark long line
10. Rigging of Matsyakumari for squid fishing and dip netting
11. Selectivity studies of prawn gill nets and multimesh - multipurpose gill nets
12. Design, fabrication and field trials of fish traps

2.1 3. BIOCHEMISTRY AND NUTRITION DIVISION

SCIENTISTS ASSOCIATED

Dr. K. Devadasan, P. D. Antony, Dr. Jose Stephen, Dr. M. K. Mukundan, A. G. Radhakrishnan, Dr. P. K. Surendran, Dr. P. T. Lakshmanan, K. Ammu.

CHIEF FINDINGS

A method was developed to prepare absorbable extra fine surgical suture from fish collagens.

An unsaturated fatty acid enriched lipid fraction isolated from sardine lipids was found to contain 68% polyunsaturated fatty acids, the main fatty acid being the essential fatty acid, arachidonic acid.

Samples of insulin isolated from tuna were found to be comparable to commercial insulin in chemical characteristics.

Mussels were found to be a reliable indicator of the extent of pollution, as they tend to accumulate more heavy metals and pesticide residues, compared to fish and other shell fishes.

Red meat of tuna was found to be good source of all essential nutrients for growing children. It can be used for combating protein malnutrition and anaemia.

Several strains of bacteria were isolated which could produce lipase enzyme. Neutral pH and temperatures $28 \pm 2°C$ *were found to be the optimum conditions for their growth.*

Fresh water, brackish water and marine fishes showed interesting differences in the content of carbonyls in their muscle.

Research in Hand

The influence of species, pH of the medium and temperature on the coagulation characteristics of fish muscle proteins heated in an aqueous medium were studied in detail. Coagulation was pronounced at temperatures above 55°C in all cases. Sulphydril content variations with temperature were found to exhibit irregular variations in different species.

Heat treatment of fish muscle proteins in an aqueous medium generally enhanced the rate of their subsequent hydrolysis by pepsin, trypsin etc.

The sarcoplasmic proteins of muscles also reacted with added fatty acids giving rise to a new fast moving protein band in their electrophoretic patterns. Fatty acids probably got absorbed on the protein micelles giving rise to a more charged molecule with faster mobility. At alkaline pH this band was not present.

During the year, carbonyls of fresh water fish rohu and brackish water fish pearl spot were also studied. Valeraldehyde, octaldehyde, 2 heptanone and octanone were the major carbonyls in pearl spot.

The major carbonyls identified in rohu were acetaldehyde, valeraldehyde, 2 heptanone, octanone, propionaldehyde acetone, butanone, 2 hexanone and heptonone. The relative amounts of these carbonyls in the muscle of each species and their influence on the characteristic flavour of the different species are under study.

Several strains of marine bacteria were isolated which could produce substantial amounts of lipase enzyme. Room temperature (28 ± 2°C) and neutral pH were found to be the favourable condition for their growth.

A crude enzyme mixture prepared from oil sardine guts had 450 units lipase and 1500 units protease activity.

Sardine lipase immobilized on chitosan in presence of CMC, and kept at - 10°C could be stored without loss of activity for over 75 days.

An elaborate feeding study was conducted on children in the age group of 1-5 years to assess the relative merits and demerits of white meat and red meat of tuna. The study proved the superiority of red meat in fighting protein malnutrition and anaemia. The programme was conducted in collaboration with the Intensive Child Development Scheme of the Kerala State Health Services.

Seasonal changes in the biochemical composition of mussels were studied in detail.

The survey on the occurrence of heavy metals and pesticide residues in our marine products was continued. Results showed that our marine products do not contain these pollutants above the permissible limits. Mussels accumulated these pollutants to a greater extent, indicating that they can be good indicators of pollution.

Cured fishery products of commerce were not found to contain any aflatoxins.

A crude preparation of insulin isolated from tuna had chemical properties comparable to the commercial insulin. Biological activity of this preparation is being studied in collaboration with Kerala State Drugs and Pharmaceuticals Ltd.

Attempts were made for the preparation of polyunsaturated fatty acid enriched lipid fractions from lipids of oil sardines. This fraction contained 68% PUFA, with the essential fatty acid arachidonic acid as its major component.

Samples of absorbable extra fine surgical suture were prepared from fish collagens. These suture samples were comparable to the commercial product in its physical properties like thickness, uniformity, breaking strength etc. Its biological activity is under study.

RESEARCH CONTEMPLATED

1. Influence of pH, temperature and species on the coagulation characteristics of fish muscle heated in aquous medium
2. Free fatty acid induced protein denaturation in the muscle of different fish species
3. Isolation of lipase enzyme from bacterial sources
4. Carbonyls from fish muscle: Isolation and identification
5. Nutritional evaluation of fresh fish and processed fishery products
6. Hypocholesterolemic effects of fish proteins and fish lipids
7. Occurrence of toxic heavy metals and pesticide residues in fresh and processed marine products
8. Aflatoxins in cured fishery products
9. Preparation of absorbable extra fine surgical suture from fish collagens
10. Biological activity of fish insulin

2.1.4. MICROBIOLOGY DIVISION

SCIENTISTS ASSOCIATED

K. Mahadeva Iyer, Dr. P. K. Surendran, Nirmala Thampuran, S. Sanjeev, V. N. Nambiar, K. V. Lalitha.

CHIEF FINDINGS

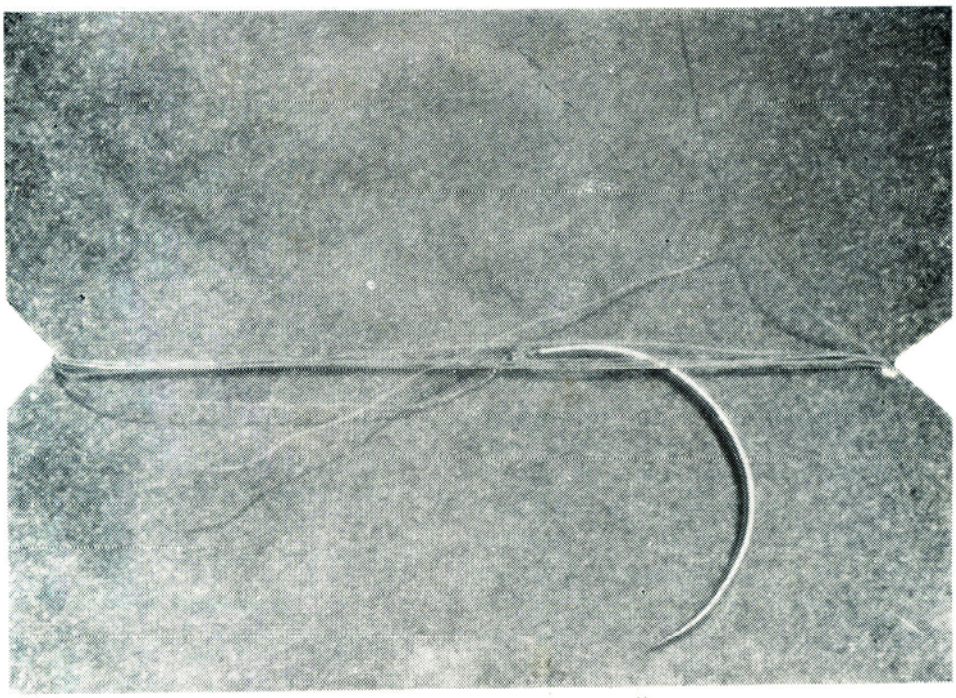
Acinetobacter and Aeromonas were the major groups of bacteria found in mrigal. There was a high incidence of Escherichia coli *and faecal streptococci in the guts of rohu and calbasu and Aeromonas in the gut and on the skin of mrigal.*

A medium containg tryptose, soytone, sodium chloride, K_2HPO_4 *and glucose was found to give best recovery of cold stressed cells of* E. coli *from fish.*

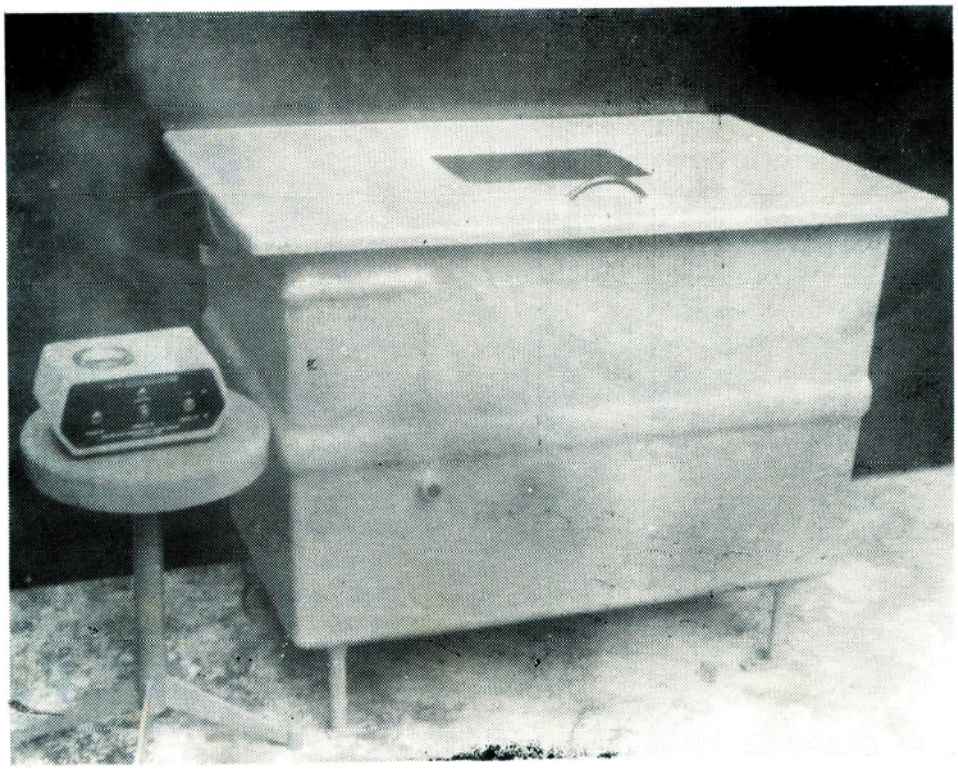
About 25% of fresh fish collected from the landing centres and markets around Cochin was found to be contaminated with salmonella.

RESEARCH IN HAND

Studies on the bacterial flora of cultured mrigal (*Cirrhina mrigala*) from Udayemperoor culture farm and rohu (*Labeo rohita*) and calbasu (*L. calbasu*) from the Muhamma culture farm were completed during the year. The bacterial populations on the skin and in the gills and gut were determined in all the above fishes. The bacterial counts of mrigal were in the range 10^5 — 10^6 / g or cm^2 Distribution of bacteria in the culture pond was also determined. They were in the order of 10^3 / ml with total coliforms in the range 10^2 / ml, *E. coli* 20/ml and faecal streptococci, 10/ml.



Surgical suture developed from fish collegen



The electrocution box designed for stunning frogs for the frogleg processing industry.

Qualitatively, the majority of bacterial strains from the skin surface of mrigal was gram negative asporogenous short rods or cocci with only a small percentage of gram positive rods and cocci. They were classified into *Acinetobactor* (22.5%). *Aeromonas* (22.5%), *Bacillus* (15%), *Micrococcus* (15%), *Vibrio, Pseudomonas* and *Enterobacteriaceae* (7.5%). Majority of strains from the gut of mrigal was *Aeromonas* (75%) followed by *Bacillus* (15%) and *Enterobacteriaceae* (7.5%). An interesting observation in the case of mrigal was the high incidence of *Aeromonas* in the gut and skin surfaces. *Vibrio* was virtually absent.

Distribution of aerobic bacteria, including coliforms and faecal streptococci on the skin and in the gill and gut region of rohu was also determined. There was a high incidence of *E. coli* (10^3 g) and faecal streptococci (10^3/g) in the gut of rohu as well as calbasu.

The bacterial population of the pond water from which the above fishes were caught was also assessed. The total bacterial population was 1.6 x 10^4/ml., Coliform count 5.6 x 10^2/ml., and *E. coli* 40|ml.

Work was continued on the recovery of cold stressed cells of *E. coli* and development of suitable media for the recovery of the cold stressed cells from frozen fishery products. As observed earlier, trypticase soy broth was found to be best repair medium and suspending the cold stressed cells in it for 30 minutes before plating facilitated the recovery of maximum of such cells. Tryptone, soytone and casitone were also found to improve the recovery of cells in solid media. On the basis of these trials three media combinations were formulated of which a medium containing tryptose, soytone, sodium chloride, K_2 HPO_4 and glucose was found to give the best recovery of cold stressed cells of *E. coli.*

Investigation on pathogenic microorganisms in sea foods was continued. Ninety five samples of fresh fish collected from landing centres and retail markets in Cochin were examined for salmonella contamination. All the samples showed a total plate count in the range of 10^4 to 10^7 / g. Twenty four samples were found to be contaminated with salmonella. The salmonella cultures were isolated and their morphological and biochemical characteristics were studied. Serological identification of cultures was also carried out with a view to ascertaining the prevalence of different *Salmonella* serotypes in Cochin area.

Fifty nine samples of fresh fin fishes and shell fishes and dried fishery products collected from local markets were tested for the presence of *Vibrio parahaemolyticus, Staphylococcus aureus, Vibrio cholerae* and *Shigellae. V. parahaemolyticus* was isolated from 30 samples with a load varying from 3 to 200 cells|g. All the dried fish samples tested were found to be free from *V. parahaemolyticus. V. cholerae and Shigellae* could not be detected in any of the samples. As in the previous year, enterotoxigenicity of *Staphylococcus aureus* strains was determined by cellophane-over-agar method and Optimum Sensitivity Plate (O.S.P.) method. Enterotoxin, D, A and C were produced more often than the B & E toxins. The antibiotic sensitivity of the cultures was also assessed.

Clostridium perfringens was detected in low numbers in fishes. Most Probable Number (MPN) procedure was found to be more efficient than the agar plating me-

thod for the enumeration of this micro-organism.

RESEARCH CONTEMPLATED

1. Aquatic pollution as it affects the microbial quality of fishes
2. Ecology of salmonella and other pathogenic organisms found in association with fish and fishery products
3. Studies on toxin production of microbes (histamine, botulinal toxins).
4. Studies on the recovery of stressed cells of bacteria and improvements in recovery media.
5. Studies on the mechanism of microbial spoilage on fish substrate

2.1.5. PROCESSING DIVISION

SCIENTISTS ASSOCIATED

Dr. K. Gopakumar, K. Mahadeva Iyer, P. V. Prabhu, Dr. T. K. Govindan, P. Madhavan, T. S. G. Iyer, Cyriac Mathen, K. K. Balachandran, M. K. Kandoran, P. A. Perigreen, Dr. Chinnamma George, C. V. N. Rao, Jose Joseph, P. Ravindranathan Nair, A. C. Joseph, A. Lekshmy Nair, Dr. K. G. Ramachandran Nair, P. T. Mathew, Dr. P. K. Surendran, P. K. Vijayan, Nirmala Thampuran, Dr. P. T. Lakshmanan, Francis Thomas, P. R. G. Varma, T. K. Srinivasa Gopal, A. V. Shenoy, R. Thankamma, T. K. Thankappan, K. P. Antony.

CHIEF FINDINGS

Corrugated polypropylene board cartons were found to be suitable for ice storage and transport of fresh fish. Experiments conducted on board FORV Sagar Sampada showed that a delay of six hours at room temperature before icing caused 50% reduction in quality and shelf life of fish. Incorporation of clove, cinnamon and pepper was found to be effective in improving the quality of minced meat from horse mackerel (caranx *sp.*) *during frozen storage.*

Frozen cuttle fish fillets stored at —20°C *had shelf life of* 14 *months. Imbibition of water during the pre-freezing stages was found to be one of the factors for thaw drip in frozen prawns.*

Strong correlations were observed between the levels of water extractable nitrogen, total non-protein nitrogen and the flavour in the case of commercially available frozen prawns.

V. cholera *was found to be totaly absent in* 182 *samples of frozen and raw fish products examined.*

Rohu canned in natural style was found to remain in good condition for a period of one year.

Partial cooking of fresh anchoviella removed some fat and improved the quality and shelf life of the dried fish. Salted and dried fish treated with calcium propionate or sodium benzoate and BHA superficially and sealed in PE|MXXT cellophane pouches exhibited fairly long shelf life. Smoking and drying enhanced the organoloptic quality and shelf life of commercially cured fish.

Salt minces prepared from Scianid *spp. has a shelf life of seven months at* 22 ± 2°C.

Incorporation of 0.5% *chitin in the normal broiler diet increased the live and*

dressed weight, yielding an additional gain of 70% per bird. 0.5% chitin diet also showed better growth in albino rats. The cost of production of chitin could be reduced by keeping the demineralised shell in 3% NAOH for 12 mts. for deproteinisation. Chitosan printed cotton clothes had deeper shade causing a two tone effect. The decrease in viscosity of chitosan solution on storage could be prevented by the addition of 0.5% formalin in the solution without effecting the properties of the solution. Mercury could be removed from solution by passing the solution through chitosan columns.

Taurine and methionine derivatives of lithocholic acid and dehydro-lithocholic acid were identified as the major constituents of frog galls.

Synthetic film pouches were found suitable for packing and marketing of fish pickles.

Research in Hand

Freezing and frozen storage

The freezing and storage characteristics of cuttle fish fillets were studied in detail. The fillets were frozen individually, wrapped in polythene and stored at —20°C and the changes taken place were observed biochemically and organoleptically. The studies were continued upto 14 months. The samples were found to be acceptable organoleptically even though desiccation and change of colour occurred during storage. There was appreciable change in flavour, and the texture of the product became tough.

The effect of different spices in improving the quality of minced meat from horse mackerel has been studied. Minced meat was mixed with spices like pepper, cinnamon and cloves at different proportions (0.05, 0.1 and 0.2%), frozen and stored at —20°C and changes followed chemically and organoleptically upto 28 weeks. During this period, the control samples developed off-odour and rancidity, though the texture and colour were good. All the treated samples were in acceptable condition and were free from off-odour and rancidity. In the case of samples treated with cloves, the quality change during frozen storage was correlated with the changes in TBA values. Higher concentrations (0.1% and above) of spices imparted intense spicy flavour to the product, especially in the case of cloves.

The texture of fish balls prepared using minced fish could be improved by using minces washed with water and ground with salt (2.5%). Balls prepared using unwashed minces had comparatively poor texture and binding properties.

The studies on the frozen storage characteristics of *Psenes indicus* have been completed. The *Psenes indicus* were frozen immediately after catch on board 'Sagar Sampada', stored at —20°C and changes followed biochemically and organoleptically. The fish contained very high amount of fat (51% DWB) and remained in acceptable condition for 28 weeks. On further storage the fish became rancid and lost its juiciness and showed high TBA value.

Attempts were made to remove the skin of *Psenes indicus* and it was found that by treating the fish with 0.5% lactic acid for 15 mts and washing, the skin could be removed easily.

The frozen samples of mackerel stored continuously at —20°C were found to be in poor condition by 8 months storage as judged by biochemical and organoleptic tests. But the fish stored at —35°C for 4 months and then at —20°C for another 4 months were at the border-line of acceptability.

Studies on the prevention of rancidity in oil sardines were carried out. Fresh oil sardines were treated with the antioxidant preparation containing BHA, BHT and citric acid in propylene glycol and frozen and stored at —20°C along with untreated control samples. The treatment improved the physical appearance of fish. After 3 months of storage, slight rancid flavour and odour were noted in the control samples, whereas the treated samples were free of these defects. The texture of treated samples was also better than that of control samples.

Canning

Preliminary experiments were conducted to evaluate prawn curry processed by canning as compared to freezing in flexible pouches.

Storage studies of rohu (*Labeo rohita*) canned in natural style showed that the product retained all the characteristics for one year. Subsequently some slight internal rusting was observed in certain cases. Experiments were conducted to study the effect of bleeding of freshly caught fish on the colour of the canned meat and the discolouration in the can interior. Initial observations showed that bleeding had no effect on the colour of the meat or the can interior.

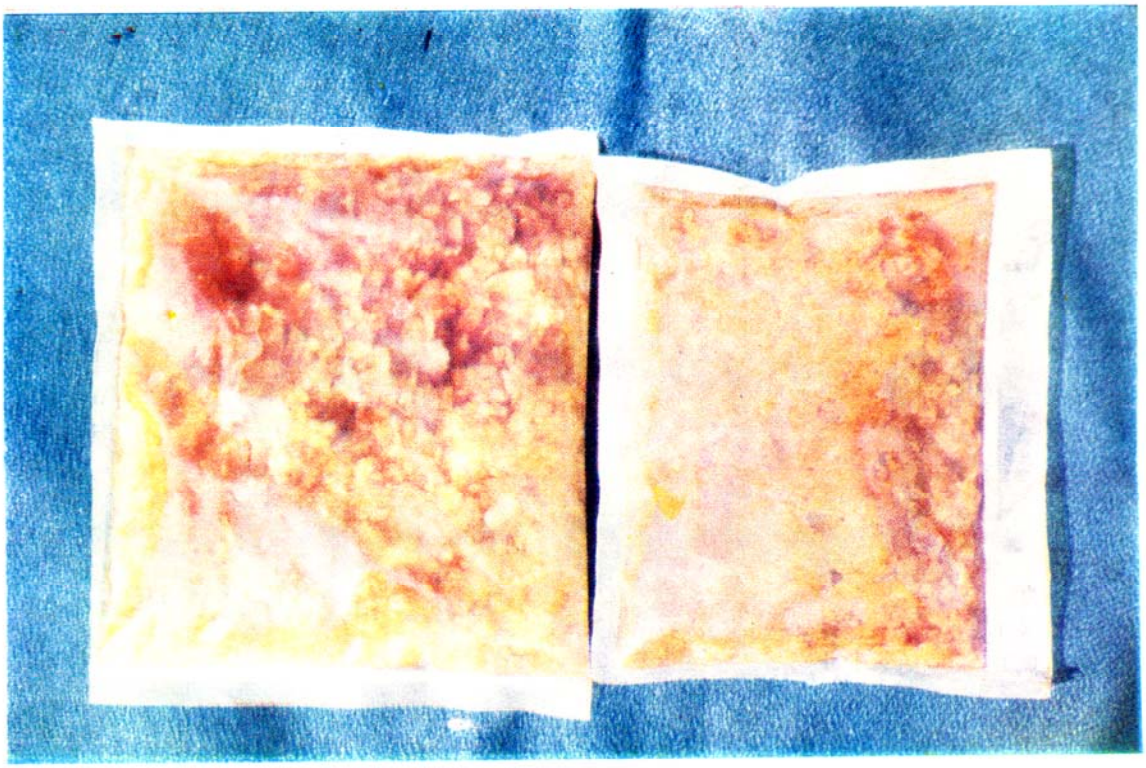
Studies revealed that the prawn curry samples processed without green peas remained in good condition without significant changes. A maximum storage period of 18 months could be recommended for this product.

An improved formula was worked out replacing tomato by tartaric acid and an emulsifying agent for the preparation of prawn curry. The earlier investigations showed that the probable cause of deterioration in taste|flavour of prawn curry was the presence of tomato which undergoes some undesirable changes during storage. By the modified method, acidity and taste could be very well controlled and the consistency maintained. Addition of carboxy methyl cellulose at 2g|kg of fish meat yielded a satisfactory product which did not undergo any change during storage.

Psenes indicus, a deep sea fish with high fat content was found to be good for canning either in the conventional style or in natural style. As the black coloured skin got fragmented and mixed with the contents during storage, canning after skinning was considered desirable. Lactic acid was found to be useful for skinning the fish. About 5% body weight is lost by skinning. Skinned fish canned in oil appeared better on storage for 6 months while brine packed sample showed slightly oxidised flavour.

Elicate niger was found to yield an acceptable product when canned in the conventional style. Pre-cooking in steam at 10 psig for 1½ hours was necessary for maintaining the cooked drip below 5% when canned in oil. Tough texture and unpleasant flavour were noted in the product after 6 months of storage. Toughness of the canned product was found to be increased

Ready-to-serve fish curry packed in cans



Improved packaging — fish pickles packed in polythene bags

with the increase in length of frozen storage of raw fish.

Studies on the suitability of cans with lower tin coating of 5.6 GSM for clam and crab meat showed that the product became blakened immediately after canning indicating the necessity of a tin coating higher than 5.6 GSM in these cans.

It was observed that there was 2.45 to 2.50% loss of protein when the fresh prawn was blanched, and this varied from 1.75 to 4.05% when the prawn was iced. On canning there was a loss of 2.75 to 4.05% protein into the filling brine.

Fish curing

A survey on the handling, drying, packing, storage etc. of dry anchoviella has been initiated and data from Tuticorin, Kanyakumari, Quilon and Alleppey were collected on various aspects. The survey showed that the traditional method of drying the fish in sun by spreading over sand was followed in all the centres. The quality of dried fish was found to be far from satisfactory. Though the fish dried by this method is acceptable to Ceylon market, the same may not find markets in Singapore and other sophisticated markets.

Trials were conducted to improve the quality of dry anchoviella using chemicals and drying in hot air dryers. Alum treatment minimized the sticking of the fish to drying surfaces. Partial cooking was also attempted to remove part of the fat and reduce spoilage during drying. Storage studies showed that the control samples of dried fish steadily turned yellow and then brown, while in the partially cooked ones the changes were much slower. The colour of cooked and dried fish was better in the initial stage of storage.

Studies on the smoking of cured Jew fish, shark etc. were carried out. The shelf life and the organoleptic and bacteriological quality of the cured fish could be enhanced by smoking and drying of the fish. Good quality smoked products could be prepared from fresh barracuda landed by FORV Sagar Sampada. Smoking gave attractive colour, improved odour and enhanced shelf-life of the salted|cured fish. Insect attack could also be partially controlled by smoking.

Detailed studies on browning of dried| cured fish and its prevention were carried out. Oxidation of fat in the fish appeared to be the reason for browning in dried | cured fish. An antioxidant formulation containing BHA & BHT in propylene glycol was tested for minimising the browning. This formulation was found to prevent discolouration for a considerable period.

Salt minces

Salt minces prepared from *Scianid* spp. were subjected to storage studies at two temperatures viz. $30 \pm 2°C$ and $22 \pm 2°C$ for a period of seven months. Minces stored beyond this period were found to be unacceptable to consumers. The study showed that the sample stored at $22 \pm 2°C$ was superior to the one stored at the higher temperature.

Salt minces prepared from *Arius dussumieri* and whiting (Shillago Sihama) were packed in polythene paper covers and stored at the above two temperatures. The storage studies are in progress.

Microbial and chemical analysis of the above mentioned salted minces revealed

that from most parameters the values were less for lower temperature compared to higher temperatures. The peroxide value showed no significant difference between the two temperatures though TVB and TMA values were very much high for the samples stored at 30 ± 2°C.

Preliminary studies have shown that prawn flavour could be successfully imparted to the fish meat by using certain flavour enhancing chemicals. Minced meat treated with flavouring agents was comparable to prawn meat as adjudged organoleptically by taste panel members.

Nutritional evaluation of red, white and whole meat from skip jack tuna was carried out and amino acid analysis and PER values were determined.

Fishes like *Priacanthus, Psenes indicus,* leather jacket and other unused species obtained from deep sea (from the research vessel Sagar Sampada) were converted to fish meal. Nutritional evaluation of powder prepared from *Priacanthus* was completed. Study on the yield and physico chemical characteristics of fish sauce prepared from lantern fish, barracuda and two tiny deep sea fishes is in progress.

Studies on the preparation of meat substitutes from fish was continued. Texturised meat was prepared from different species of fish like jew fish, barracuda, horse mackerel etc. It was observed that all these raw materials could serve as good source for preparation of texturised meat.

By-products

Separation and identification of chemical constituents of frog galls were continued. Detailed investigations showed that taurine and methionine derivatives of lithocholic acid and dehydro-lithocholic acid were the major constituents of frog galls. Aqueous fraction was also identified for its amino acid contents.

Fat was extracted from the birds fed on chitin diet and those fed on commercial diet brought from a poultry farm. Cholesterol content in liver, kidney, muscle and serum was estimated and it was observed that there was a decrease in cholestrol content in the group fed on chitin diet.

A flavouring agent prepared from fresh tiny prawns was stored in sealed metalised polyester | LDPE bags at ambient temperature. It was observed that the product did not deteriorate in quality for two years of storage.

Analysis of protein powder isolated from *P. indicus* (Naran) waste has shown that the amino acid composition of protein was similar to that of protein extract from *M. dobsoni* (Poovalan) and *P. stylifera* (Karikadi) waste.

Feeding trials in broiler chicken (coff broiler) using feed containing 0.5% chitin were done. Batches of 500 birds were subjected to the studies. This diet reduced the feed conversion ratio and feed consumption per bird significantly compared to the birds fed on chitin free diet (control). Average live weight and dressed weight were increased and average wastage was decreased significantly. Cost-benefit was also worked out. Even after taking into account the selling price of chitin (Rs. 40|kg) it was found that incorporation of chitin at 0.5% level in the diet gave an additional profit of Rs. 1.25 per bird.

Feeding experiments in white leghorn showed that for layers chitin did not give any advantage.

Rat feeding experiments with chitin were in progress with a view to compare the results with those obtained on feeding poultry. Amino acid analysis and determination of PER and NPU of protein powders isolated from the waste of 'Karikkadi' and 'Poovalan' using mechanical and chemical means have been completed. PER and NPU of protein powders isolated by mechanical means were higher than that of the powders isolated by alkali treatment. Amino acid profile also supported this observation.

Investigations on the use of chitosan in dying of textile were undertaken. The properties of nylon twines dyed using reactive dyes after treatment with chitosan solution were observed. Cotton fabrics were screen printed with chitosan solution and dyed using different coloured dyes, resulting in excess dye uptake in the screen portions giving a two tone effect with deeper shade at chitosan portions. Chitosan application in textile industry is also underway through a Bombay based firm which reported the efficiency of chitosan.

Treatment of prawn shells with 3% NaOH at room temperature for 24 hours was found effective in bringing down the residual protein below 2%. Adoption of this method in chitin production for deproteinisation would save fuel cost and investment on heating arrangement required otherwise.

Experiments on the removal of Hg from solutions of higher concentration (upto 100 ppm) by passing through chitosan column were undertaken with encouraging results. A simple process has been developed to minimise the reduction of viscosity of chitosan solution in acetic acid during storage, though the results are to be confirmed and optimum conditions are to be worked out. A process has also been developed to elute mercury absorbed by chitosan using sodium chloride. Study was continued on the uses of chitosan in chromatographic experiments. To study the capacity of chitosan to absorb metal ions, different ppm level mercuric chloride solutions were passed through chitosan filled columns and the residual mercury content in the elute was estimated by a mercury analyser.

Speciality products

A process was developed for the preparation of speciality products such as wafers from the press liquor of prawn waste and squilla. For the preparation of wafers, direct use of the press liquor alone was not feasible. A mixture of press liquor and prawn meat in suitable proportions could give a product of appealing colour, good swelling property and organoleptic acceptability.

Lantern fish, barracuda and two other deep sea fishes collected from FORV Sagar Sampada were minced, mixed with common salt in 3:1 ratio and stored in screw capped polythene bottles at room temperature to study the yield and quality of the sauces produced from them. Initial analysis of the fish and the sauces after storage has been carried out.

A flavouring agent was developed from tiny prawns and its market acceptability is being explored.

Technology for the production of squilla protein powder has been developed and the protein powder obtained has a pale

pink to brown colour. Storage study of this product is under way.

Whole skinless squids treated with sodium propionate and sodium sorbate in different concentrations of 0.1, 0.25, 0.5, 0.75 and 1% as antifungal agents were dried to a moisture content of 12-13% and stored along with control in ambient as well as refrigerated temperatures. The treated as well as control samples were free from fungal agents. Browning was observed in all samples but it was more in samples stored at ambient temperature. Further experiments are to be continued.

Packaging

Thermal efficiencies of corrugated polypropylene board master cartons at ambient temperatures from 38 to 40°C were studied by following the rates of melting of ice packed in them. Fish packed with 1:1 ice with and without pre-chilling and held at 10°C remained in acceptable condition for 52 and 48 hours respectively. When the containers were given insulation with 25 and 12 mm thick expanded polystyrene slabs and the above experiment repeated without prechilling at ambient temperatures, the fish remained acceptable for 56 and 48 hours, final temperatures recorded being 2 and 9°C respectively. PP corrugated cartons filled with frozen blocks of fish and stored at —20°C became brittle after two months and failed in drop tests. A new design of corrugated fibre board master carton was made to hold 12 Nos. of unit cartons of 2 kg. of frozen fish with a view to minimising the packaging costs.

Consumer size packages of salted and dried tuna, ray, mackerel, shark and seer smeared with 0.1% level of calcium propionate and sodium benzoate separately in pouches of PE/MXXT cellophane were stored at ambient temperatures. Brown discolouration was found to occur in these products due to oxidation. BHA at 0.1% level was tried in the fish in the case of further experiments. BHA treated samples continued to be in good condition even after six months of storage. Observations are being continued. Studies on bulk packing of salted and dried shark were initiated. Dried samples were dusted with 0.1% calcium propionate and packed in different packing materials like HDPE circular woven sacks, HDPE traditional sacks, multilayer paper cartons and jute bags lined inside with PE film and stored along with controls for observation of the changes in quality.

Freshly caught live clams, bulk packed (20 kg) in corrugated fibre board master cartons of size 53 cm. x 53 cm. x 30 cm. with cubicle to hold individual clams in layer, remained in live conditions for 3 to 4 days at 18 to 20°C. Field trials are to be taken up shortly by air-lifting live clams in such containers to Japan.

Pouches made of 85 micron nylon| surlyn film and metallised polyester coextruded with LDPE-MDPE gave encouraging results when used to pack fish pickles with effective sealing and good grease resistance. Fish curry was sealed in pouches of (1) both sides PVDC coated cellophane laminated with LDPE, (2) 300 gauge LDPE and (3) 85 micron nylon | surlyn films, frozen and held in frozen storage with a view to substituting metallic can in which the product got badly tainted with lacquer flavour. Samples packed in the first film remained in better condition organoleptically after 3 months, even though slight delamination was observed due to

poor grease resistance property of LDPE. Samples of multi-layer flexible pouches received from a Bombay firm and metallised polyester | LDPE-HDPE received from a Delhi firm are being evaluated for packing fish pickles.

Quality control

A study was carried out for comparison of the existing method for deduction of coliforms and *E. coli* with the MPN technique which is in vogue in develped countries. Fortyone samples of raw fish, 60 samples of water and 22 ice samples were tested as per the existing method as well as the MPN technique. More data will be collected to reach a conclusion.

Dry matter content of prawn was determined from samples of prawn meat, frozen and unfrozen; and of unfrozen headless shell on prawns and frozen headless prawns. The dry matter was 14.4% in shrimp meat and 20.2% in headless prawns. Direct correlation existed between size and dry matter content but no such relation was observed between species and dry matter. The highest loss of dry matter was found to occur during icing and washing after peeling. Actual loss of dry matter was insignificant during 1, 2 or 3 days of storage respectively in the case of small, medium and large whole prawns in ice. Reduction in dry matter in the initial stages was due to water absorption and in the later stages it was due to dissolution of dry matter in the water. Attempts were made to reduce the loss of dry matter in whole prawns during ice storage by pretreatment with chemicals. K_2 HPO_4 was found to act positively.

Thawing loss from uniced or unwashed prawn meat was found to be nil initially compared to 6% in the washed ones. During storage of six months, the values rose to 6 and 18.2% respectively in the two samples, indicating that in frozen prawn meat the water imbibed prior to freezing plays an important role in thawing losses and development of toughness.

Physical, biochemical and sensory quality parameters were studied in 120 samples of frozen prawns (meat and headless) collected from the industry in comparison to controls prepared in the laboratory. Headless samples were better than peeled ones in all characteristics. In the latter samples, pH. ranged from 7 to 8, water extractable nitrogenous constituents were low to very low and flavour scores ranged from 4 to 6 on a 10 point scale. Direct correlation was observed between levels of water extractable nitrogen and the flavour scores.

Bacterial quality of commercial frozen cooked lobsters was found to be good especially when cooking and freezing were done in the same premises. Though cooking reduced the counts, the same increased during the cooling and cleaning stages depending on the sanitary and hygienic conditions. The yield of whole cooked rock lobsters was nearly 95% and that of tails from sand lobsters was 36%. Quality defects were very less in raw rock lobsters whereas 8 to 14% of the raw sand lobster tails were discoloured. *Vibrio cholera* was absent in all samples.

Bacterial quality of commercial boiled and frozen clam meat showed much variation. Coagulase positive staphylococci and faecal streptococci were present in 44.6 and 93.6% of the samples respectively. Sand content varied from 0.025 to 1.39% on wet weight basis. Though boiling

reduced the counts, increases occured during post boiling processes.

The influence of draining time, temperature of water used for thawing and the extent of thawing on the net weight of prawns in block frozen shrimps was studied. It was noted that the net weight became constant after 25 to 30 mts. of draining and the difference in net weight between 2 and 30 mts of draining was nearly 4%. Lower temperature of water caused reduced net weight but the effect was insignificant. Though partial thawing gave higher net weight, it is difficult to practise.

The effect of delay in icing on quality and shelf-life was studied on board FORV Sagar Sampada. With *Aeanthurus* sp. it was found that a delay of six hours caused 50% reduction in quality and shelf life. Intellectron Fish Tester was used to assess progressive spoilage of *Acanthurus* sp. and *Nemepterus* sp. in ice. Readings were also obtained for fresh *Epinephelus* sp., *Alutera* sp. and *Geterin* sp. The average values of the fresh fish were 56 for *Nemepterus* and *Acanthurus* 50 for *Epinephelus*, 35 for *Geterin*, and 61 for *Alutera*.

RESEARCH CONTEMPLATED

1. Continued survey on handling, drying, storage and packing of anchoviella on the west coast
2. Standardization of the treatment of antioxidant formulation to prevent discolouration in dried|cured fish.
3. Production of smoked fish using commercially cured fish and its test marketing
4. Studies on smoking of miscellaneous fish
5. Studies on the sun drying of small prawns
6. Variables in the production process affecting the properties of chitin and chitosan for different uses
7. Use of chitin and chitosan in animal feeds
8. Physico-chemical aspects of the uptake of heavy metals and organic materials by chitin and chitosan
9. Studies on the protein isolates from squilla and other chitinous waste and shark liver oil
10. Investigations on corrugated fibreboard master cartons and waxed duplex board unit cartons
11. Development of bulk packages for salted and dried fishery products
12. Field trials on transportation of live clams
13. Development of synthetic pouches for packing fish pickles and curry
14. Development of retort pouches from indigenous films to preserve fish products.
15. Prevention of loss of dry matter from prawns
16. Quality control of lobster and clam processing
17. Effect of delayed icing on quality and shelf-life
18. Comparison of thawing losses from prawns frozen in 90 minutes and 180 minutes freezers
19. Applicability of Intellectron Fish Tester in quality assessment

2.1.6. ENGINEERING DIVISION

SCIENTISTS ASSOCIATED

S. Ayyappan Pillai, Dr. T. K. Sivadas, K. Sreedharan Namboodiri, P. K. Chakraborty, P. N. Joshi, K. Ramakrishnan, K. Vijayabharathi.

CHIEF FINDINGS

An electrocution box has been developed for stunning frogs as a humane method of killing frogs for the frog leg processing industry. The box made of fibre glass reinforced plastic could stun 400-500 *frogs per batch.*

The commercial model of the fish pump was operated in the sea.

An Universal Marine Telemeter has been developed for simultaneous acquisition of 15 *nos. of underwater hydrodynamic and environmental parameters using a single instrument and a single cable.*

The Freezer Temperature Monitor and Alarm developed by the Institute was operated by the Marine Products Export Development Authority (MPEDA) for estimating the efficiency of freezer units in different parts of the country.

The Electronic Boat Log developed at the Institute was successfully operated on board a Departmental vessel.

RESEARCH IN HAND

An electrocution box was developed for stunning frogs for the frogleg processing industry as a humane method of killing frogs. The box, developed at the instance of the MPEDA, can stun 400-500 frogs at a time and is made of fibreglass reinforced plastic. An electronic timer has also been developed to stun the frogs for three minutes, after which the power supply is cut off automatically. All measures have been taken to protect the operator from getting electric shock during the period. Field trials carried out with the equipment have been quite successful. As per the directives of the MPEDA, almost all the processors have procured the equipment for use in their factories.

Field trials were carried out with the commercial model of the fish pump. On direct pumping, water along with mud, jelly fish and shells was pumped out which were colleced by a jetter net. The pump was also used to pump out fish from the cod end of a trawl net. The fish so caught comprised of pomfrets, seer, squid etc.

Effect of ionisation on the electrodeposition of smoke on fish surface was studied by installing an electronic ioniser inside the electro-thermal smoke kiln. A marginal improvement in the settling of smoke was noticed.

Designing of a commercial solar dryer based on raised platform drying principle was undertaken. Studies have also been undertaken on standardisation of solar drying parameters.

Trials were continued with the propellor nozzle to collect more exhaustive data.

Modifications were being effected in the deep freezer already developed to attain a temperature of —40°C.

An Universal Marine Telemeter has been developed for simultaneous acquisition

of fifteen underwater hydrodynamic and environmental parameters by using a single instrument and a single cable instead of several instruments on board the vessel. It is an integrated design enabling simultaneous acquisition of all relevant parameters making the related investigations easier, more effective and faster. The instrument was operated on 9 V dry cells. The various parameters of the trawl system which can be measured using this instrument are 1) trawl depth, 2) underwater tension, 3) temperature at trawl depth, 4) salinity at trawl depth, 5) angle of attack of otter boards, 6) net-flow, 7) towing speed, 8) solar radiation at trawl depth, 9) mesh distortion, 10) sideways tilt of otter boards, 11) warp load, 12) fore and aft tilt of otter boards, 13) catch load, 14) resistance to motion of otter board and 15) temperature inside cold storage of ship.

The Freezer Temperature Monitor and Alarm developed by the Institute was operated by the MPEDA as part of their subsidy scheme for estimating the efficiency of several freezer units in different parts of the country. The special features of the instrument are that 1) temperature can be sensed from a remote point through a long cable from inside the frozen block, 2) sensor is very small (40 mm long and 8 mm dia.) and rigged to withstand pressure and other adverse environmental factors, 3) meter allows monitoring of temperature from several remote points at a central place along with their printing and recording and 4) it is found ideal for measuring temperature in the range of —40°C to + 40°C with an accuracy of ± 0.1°C.

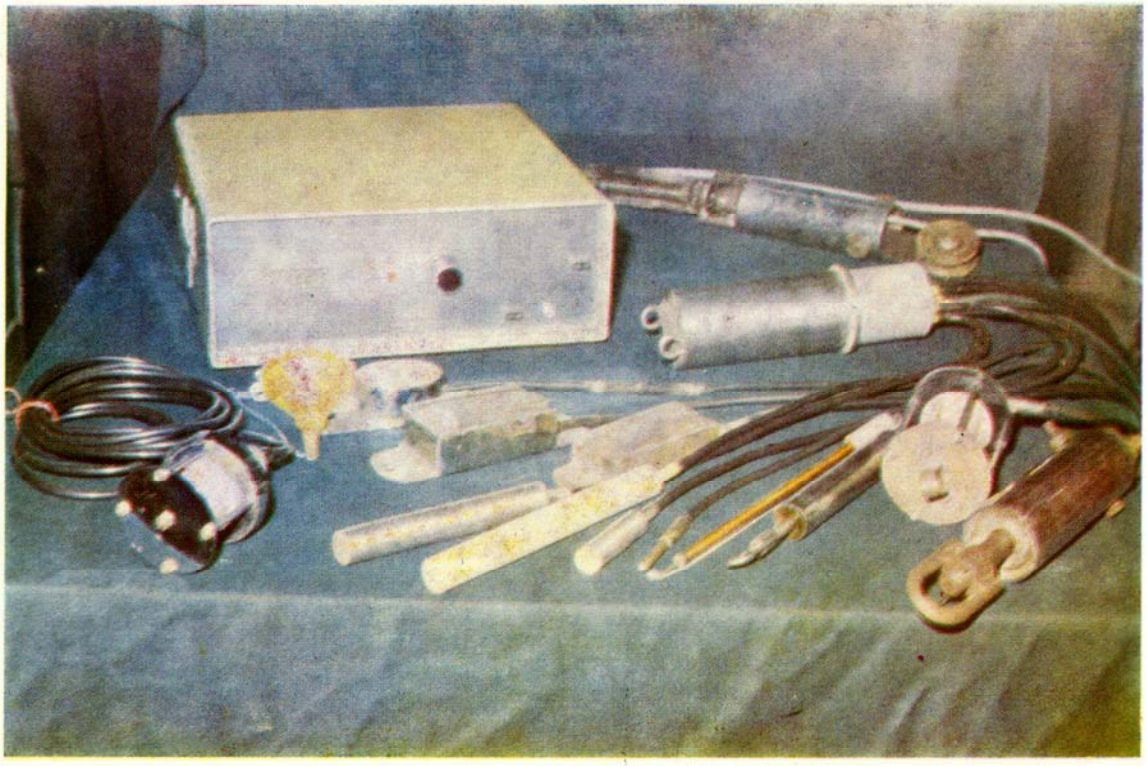
The performance of the Electronic Boat Log operated on board a Departmental vessel was found to compare well with that of the imported instrument Walkers Excelsior IV Log. The added advantages of this indigenously developed instrument are 1) direct and instantaneous measurement, 2) greater accuracy, 3) easy handling and operation and 4) facility to keep the read out unit on the bridge.

The transmitter of the buoy telemetry system is being developed for transmission of data from the buoy.

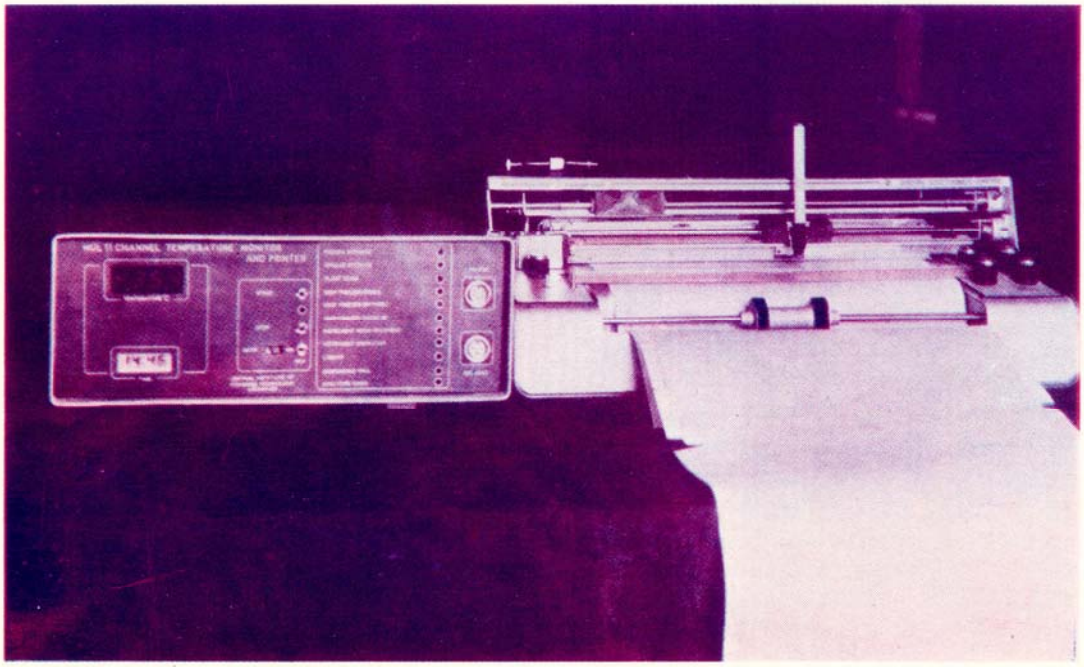
Work was continued on the development of the solar radiation monitor and integrator. The spectral response of various sensors was studied to find out their suitability for measuring the photosynthetically active radiations.

Research Contemplated

1. Trials and standardisation of the mechanical device for cooking prawns
2. Further studies on development of prawn washing machine
3. Design and development of a pressure cooling device for retort pouches
4. Computer control of D.C. motor for development of electric propulsion
5. Studies on development of new devices and techniques to harness solar and bio-gas energy
6. Development of ship borne data acquisition system and automatic algae counter
7. Development of depuration tank with ultra violet radiation system for biological cleaning of bivalves.



Universal Marine Telemeter - Versatile data acquisition device developed at CIFT



Multi-channel Temperature Monitor and Printer developed at CIFT.

2.1.7. EXTENSION, INFORMATION & STATISTICS DIVISION

PERSONNEL ASSOCIATED

Dr. P. N. Kaul, M. K. Kandoran, H. Krishna Iyer, K. Krishna Rao, A. K. Kesavan Nair, Mary Thomas, P. N. R. Kaimal, G. R. Unnithan, S. Balasubramaniam, V. Annamalai, R. Thiagarajan, R. G. Nair.

CHIEF FINDINGS

The mean extent of trial of an improved design of lobster trap by 45 fishermen was 26.46. The cost of local traps and the number of seasons used were found to have significant negative association with the extent of trial.

Data collected on the economic aspect of boat|net combination in fishing have shown that increase in HP of engine or size of the net have given higher returns from fishing operations with trawlers.

The optimum number of annual boat days for Kerala coast on the basis of economics of operation of trawlers and availability of fish was estimated to be 4,51,800.

RESEARCH IN HAND

Study on the extent of adoption of improved lobster traps developed at CIFT was completed. Anaylsis of the data showed that mean extent of trial of the improved design of lobster traps by 45 fishermen who were supplied with such traps on subsidy was 26.46. The cost of lobster traps and the number of seasons used were found to have significant negative association with the extent of trial. The correlation between the annual catch by indigenous trap and extent of trial seemed to approach significance at 5% level and this relationship was also negative in sign. These variables accounted for 59% of the variance in the extent of trial. The remaining variables studied did not have any significant relationship with the extent of trial.

The survey on the extent of adoption of the new and improved technologies transferred through training courses was conducted. Impact of motorisation of indigenous fishing craft was studied in different fishing villages in Kerala. Data collection on adoption of improved quality control practices in fish processing factories was also continued.

Taking the returns as the criterion, data were obtained for different combinations of boat size|net size|HP of the engine. Seasonal variation in the returns was observed to be high. However, the general trend in returns was one of increase with increase in HP|size of the net. The ranges of logarithmic mean values for different HP and net size were as follows:

HP	*Range*	*Net size*	*Range*
60	2.80—3.29	18.0 m	2.55—3.23
65	2.81—3.34	19.5 m	2.76—3.25
68	2.43—3.34	21.0 m	2.65—3.39
68	2.43—3.34	24.0 m	2.91—3.39
90	2.97—3.34	27.0 m	2.70—3.51

The optimum number of boat days for Kerala coast on the basis of economics of operation and availability of fish was estimated to be 4,51,800. They were allocated to different maritime districts of the State on the basis of demersal catch and prawn catch separately and the optimum number

of trawlers for each district was also estimated. These estimates were arrived at under the assumption that the annual number of fishing trips per boat is 180 and the profit over capital cost is 15%. The estimates arrived at are given in the following table:

District	Optimum number of boat days on the basis of demersal catch	Optimum number of trawlers on the basis of demersal catch	Optimum number of boat days on the basis of prawn catch	Optimum number of trawlers on the basis of prawn catch
Trivandrum	27,360	152	2,520	14
Quilon	1,89,000	1,050	1,51,740	843
Alleppey	36,540	203	72,720	404
Ernakulam	71,460	397	90,360	502
Trichur	6,300	35	4,860	27
Malappuram	34,200	190	24,840	138
Calicut	34,200	190	35,640	198
Cannanore	52,740	293	69,120	284
Total for Kerala	4,51,800	2,510	4,51,800	2,510

The scientists of the Statistics Section rendered assistance in the design of experiments and analysis and interpretation of data collected under various research projects on harvest and post-harvest technology of fish.

RESEARCH CONTEMPLATED

1. Adoption of innovations developed at CIFT
2. Economic aspect of boat|net combination in fishing
3. Survey on the utilisation of export oriented fish and by-catch
4. Design of experiments and analysis and interpretation of data for research projects of the Institute.

2.2. VERAVAL RESEARCH CENTRE

SCIENTISTS ASSOCIATED

Dr. P. G. Viswanathan Nair, K. K. Solanki, N. Subramonia Pillai, M. R. Boopendranath, K. V. Mohanrajan, Anil Agarwal, M. R. Raghunath, A. Ramachandran and T. V. Sankar.

CHIEF FINDINGS

Field trials of 25 m. high opening trawls with 10, 20 and 30 m. bridle lengths have shown that by rigging with 20 m. bridle, the efficiency of the gear could be increased by 22.35% and 13.34% respectively from that of the nets with 10 and 30 m. bridles.

Preliminary analysis of catch data of nylon, H.D.P.E. yarns and H.D.P.E. twisted twines indicated economic feasibility of introducing H.D.P.E. yarn as gill net material for hilsa, pomfret, silver bar and pellona species.

Washing shark fillets in a suspension of jack bean meal and water reduced the urea content of fillets. Soyabean powder was also found to be effective in reducing urea from shark meat.

Drip loss from frozen ghol fillets was seen to be around 10% of the weight of fillets.

Fish mince canned with vegetables remained in acceptable condition for more than six months. 'Kati' mince made into small cubes and canned in tomato juice was adjudged to have good organoleptic qualities.

RESEARCH IN HAND

Comparative field trials were carried out for standardising the optimum bridle length for high opening trawls developed at the Research Centre. Twenty one comparable observations were made with 10, 20 and 30 m. bridle lengths and the analysis of the data indicated 20 m. bridle length as optimum with an increased efficiency by 22.35 and 13.34% respectively over 10 and 30 m. bridle length. Field trials are to be continued for statistical confirmation of the results. Demonstration of mid water trawling was conducted in collaboration with State Fisheries Department for popularising the proven technology. Preliminary field trials with gill nets of Nylon, H.D.P.E. yarns and H.D.P.E. twisted twines were continued and 29 observations made. Results indicated an overall reduction of nearly 17% in total catch with only a marginal reduction of nearly 1.5% in the catch of the quality fishes like hilsa, pomfret, seer, silver bar and *Pellona* species for gill nets of H.D.P.E. yarns than that of Nylon. H.D.P.E. twisted twines on the other hand have shown a reduction of nearly 47% for both total catch and quality fish. This trend clearly indicated the economic feasibility of introducing H.D.P.E. yarns as gill net materials considering the efficiency in catching quality fishes.

Survey of shark long line along Saurashtra coast has been conducted. Washing shark fillets with a suspension of jack bean meal for 30 minutes reduced the urea level by about 50% of the original quantity. Washing with soyabean powder in water was also almost as effective as treatment with jack bean meal. Washing with cold water for longer periods and salting and desalting also were effective, though not to the same extent as the other treatments. Fillets thicker than 2.5. cm. required prolonged treatment. Loss of nutrients during these treatments was insignificant. Organoleptic quality of treated products was better than that of control samples.

It has been determined that thaw drip from frozen fillets of ghol was in the range of 9-10%. Studies have shown that there was no significant increase in the thaw drip after the first few weeks of storage at -20°C.

Canning trials were continued of fish mince with vegetables in various combinations. The canned products remained in good condition for more than six months. The appearance of the product depended to a great extent on the fish and vegetable used.

Mince from 'Kati' made into small cubes had a very good appearance.

Studies were also continued on drying of squids. Trials conducted for preparing dried squid have shown that the brown discolouration started in dried squids within five to six days of storage, if the product was kept at room temperature. Treatment with bisulphite was not effective in preventing this discolouration. Freshness of the raw material had a strong influence on the appearance of the dried product. No significant colour change was observed if the product was stored at sub-zero temperatures.

RESEARCH CONTEMPLATED

1. Standardisation of bridle length for large mesh demersal trawl
2. Demonstration and popularisation of proven trawling technique in collaboration with State Fisheries Department
3. Evaluation of efficiency of polypropylene as material for gill nets in collaboration with Gujarat Filaments Ltd., Baroda and G.F.C.C. of Ahmedabad
4. Studies on shark long line from M.V. Saraswathi of CIFE, Bombay
5. Studies on methods to minimize drip loss from frozen ghol fillets
6. Effects of pre-processing condition on lipid deterioration and development of discolouration in pomfrets and hilsa
7. Microbiological quality of fish at different stages of processing
8. Feasibility studies on solar dryer for drying important varieties of fish
9. Studies on drying of squid
10. Studies on technological problems associated with production of intermediate moisture products

2.3. KAKINADA RESEARCH CENTRE

SCIENTISTS ASSOCIATED

Dr. C. C. Panduranga Rao, G. Narayanappa, S. V. S. Rama Rao, Sib Sankar Gupta, Subrata Basu, D. Immam Khasim Saheb, R. Chakraborty, A. V. V. Satyanarayana, R. Mangayya Naidu.

CHIEF FINDINGS

Field trials of CIFT and BOBP high opening trawls have shown equal efficiency.

Preliminary results indicated utilization of 15-20% *of the total drag of the gear system by otter boards in demersal trawling.*

Field trials with nylon and HDPE gill nets of different mesh sizes have shown that 110 *mm. mesh size was optimum for nylon gill net for crabs.*

The advantages of isinglass for use in breweries have been brought out. Method was developed for storage of fish in modified atmosphere consisting essentially of air and carbondioxide. The fish dried in the solar tent drier was rated to be organoleptically superior to fish dried in the traditional method.

RESEARCH IN HAND

Field trials with CIFT and BOBP high opening trawls were conducted at different depths and their efficiency was found to be equal. More experiments have been proposed to be carried out.

Resistance studies on trawling system for fuel saving were taken up. Field trials of 20 m. bulged belly trawls with 1300 x 100 mm. otter boards have shown that 15-20% of the drag of trawl system was constituted by otter boards. Trials are also under way with 25 m. bulged belly, 30 m. six seam and rope trawls. Design and fabrication of trawls were taken up to study the relation of wing heights.

Studies were also conducted of equal and unequal panel midwater trawls of 10 m. H.R. with 1200 x 600 mm. vertical curved otter boards, 20 m. sweep lines and 20 kg. depressors. Electronic equipments like net height meter, depth meter and tension guage were used to monitor data. Results indicated that on an average, vertical height of unequal panel was 3.13 m. and equal panel, 3.8 m.

Survey of shark long line along North Andhra and Orissa coasts was taken up. Both hand lines and long lines were found to be employed along the coasts of Kakinada. Waltair and Orissa. Gear identical with 3-5 mm. dia, synthetic lines as main line and No. 1 and 2 hooks were used.

Studies on gill nets for crab with nylon and HDPE with 110 and 150 mm. mesh size have shown that 110 mm. meshed nylon gill nets were most effective for crab fishing.

Studies on optimum number of fishing boats were taken up. Data regarding number of trawlers and catch landed during 1985-86 was collected.

In order to study the storage of fish in modified atmosphere, trials were conducted using small size mullets packed in polythene packets in an atmosphere of 60% CO_2 and 40% air and stored at 8°C. Initial data showed that fish in modified atmosphere recorded longer shelf life of about 48 hours more than that of the control.

Prawns (*P. indicus*) both headless and head on, were dipped in sodium metabisulphite solution on board the fishing vessel and stored in chilled sea water at -2°C to study the effect in controlling blackening in prawns. It was observed that the control samples developed blackening within a few days of storage while the treated ones were free from such defect even after 15 days of storage.

The emulsifying capacity of different extracts of blood clam meat was studied and was compared with different beef extracts, so as to determine their suitability for manufacture of products like sausage.

Trials were carried out to find the effect of potassium sorbate along with other humectants on water activity (aw) of dried (sundried) fish cake. It was found that 'aw' was lowered considerably with higher doses of potassium sorbate.

Experiments were conducted with different varieties of fish to study the efficiency of solar tent dryer in comparison with the traditional method of drying on (ground level) cement platforms. It was observed that the inside temperature of the tent dryer was 14-18°C higher than the ambient temperature. Fish dried in the solar tent drier were seen to be much better than that dried by traditional method, as revealed by TBC, TVN and organoleptic tests.

RESEARCH CONTEMPLATED

1. Field trials with different designs of high opening trawls of CIFT and BOBP

2. Studies on resistance of different components of trawling system on fuel saving

3. Inter-relationships between different parts of trawl

4. Studies on vertical distribution of fish in relation to area of trawl mouth

5. Studies on escapement reaction of fish in bottom trawls

6. Studies on optimum trawling speed in inshore | off-shore waters

7. Studies on mid-water trawling and multi-locational testing of long line for sharks

8. Studies on transportation of live fish

9. Preservation of commercially important fishes by modified atmosphere storage techniques and by cryogenic freezing

10. Studies on commercial use of isinglass

11. Development of new products like fish cube and fish sausage using miscellaneous varieties of mixed minced meat and study of their hydration characteristics

12. Laboratory and on–board studies on use of sodium metabisulphite for prevention of blackening in prawns

13. Preservation of local varieties of dried fish

14. Studies on the efficiency of different humectants and antimycotic agents in the formulation of intermediate moisture fish cake

15. Evaluation of different types of solar driers and improvements thereon

2.4. BURLA RESEARCH CENTRE

Scientists Associated

A. A. Khan, M. Mukundan, J. Sita Rama Rao, S. K. Bhattacharya, J. K. Bandyopadhyay, A. K. Chattopadhyay and Percy Dawson.

CHIEF FINDINGS

Field trials at Derjong reservoir indicated that the population of major carps was insignificant and the reservoir was teeming with weed fishes. Gill nets of 20-35 *mm. mesh bar were recommended for the exploitation of weed fishes.*

Presence of glazing water enhanced the storage life of Labeo calbasu *to* 31 *days.*

Pickle prepared from the fresh water mollusc (Vivipara bengalensis), *a cheap source of protein, could be kept well for* 190 *days at room temperature.*

The shelf life of smoked fish prepared by the traditional method could be extended upto 8 *months by maintaining proper hygienic conditions.*

Research in Hand

Mid water trawling with 8.5 mm. equal panel nets using 1 : 2, 1 : 2.5 and 1 : 3 scope ratio was taken up to study optimum scope ratio for reservoir mid water trawling. The catch consisted mainly of *G. chapra, R. cotio, Sciaenids, A. coilea, R. chrysea, Mystus* sp. etc.

Field trials at Derjong reservoir indicated that major carp fishery was insignificant. Exploitation of weed fishes with 20-35 m. mesh bar was recommended.

Studies have also been taken up on the possibility of utilizing cheap indigenous insulating materials for transportation of iced fish.

Dehydrated consumer products have been developed from the minced meat of fresh water fish using different ingredients. Storage studies are in progress.

Improved smoked product from *G. chapra* was developed after pre-treatment with turmeric solution following the traditional smoking methods.

Preliminary studies have been initiated to study the anti-microbial properties of some commonly available medicinal plants of the region that can be used as anti-microbial agents in production of cured | smoke dried products.

RESEARCH CONTEMPLATED

1. Studies on mid water trawl to assess availability of fishes during different hours of the day at different seasons
2. Field trials with improved gear at Hadgarh and Mandira reservoirs
3. Effect of light of various intensity and colour on attraction of fish
4. Introduction of newer fishing gear materials for reservoir fishing
5. Storage characteristic of frozen and dehydrated minced meat of fresh water fish and mollusc with or without pre-treatment and development of consumer products from the minced meat
6. Use of medicinal plants in cured | smoke dried products
7. Production of improved smoke dried products by cold and hot smoking
8. Studies on spoilage characteristics of frozen fresh water fish.

2.5. BOMBAY RESEARCH CENTRE

SCIENTISTS ASSOCIATED

Dr. M. Arul James, H. K. Beri, S. P. Damle and D. K. Garg.

CHIEF FINDINGS

It was observed that 'chor-bombil' could be frozen and stored for a maximum period of 30 *weeks at* —18°C. *Beyond this period, acceptability sharply declined with indications of spoilage.*

Pre-chilled pomfret packed with dry ice in the ratio 17 *kg of fish to* 3 *kg of dry ice retained its freshness for* 48 *hours*

RESEARCH IN HAND

Detailed investigations were carried out on the less commercially utilized fishes like perches, Carangids, flat fishes, Bill etc. which comprised 30% of the total marine catches of Maharashtra. Fresh samples of chor-bombil (*Saurida* sp.) were collected for freezing and storage studies. The maximum shelf life of frozen chor-bombil at —18°C was observed to be 30 weeks. On further storage, signs of spoilage were observed. The bacterial flora during frozen storage was found to be more of the proteolytic type.

In addition to the above, studies on the organoleptic evaluation of the quality of fish was carried out. Another variety of fish, Kateri bangda (*Megalopsis cordyla*) which is at present under-utilised, though

landed in substantial quantities, was also taken up for freezing studies.

Studies were initiated on the changes in bacterial quality and freshness of fish packed with dry ice during air transport. Pre-chilled pomfret retained its freshness for 48 hours when packed with ice in the ratio 17 kg of fish to 3 kg of ice.

Quality of fish at the fish landing and processing centres of Maharashtra coast was studied using various bacteriological parameters such as total viable plate count and presence of faecal coliforms including *E. coli*, coagulase positive *Staphylococci*, *Salmonella*, *V. parahaemolyticus*, *V. cholerae* and *Clostridium perfringens*. Faecal coliforms including *E. coli* were found in 80% of the fish samples collected; coagulase positive *Staphylococci* in 30% and *V. parahaemolyticus* in 22% of the samples. *Vibrio cholerae* 0 group type I was not detected in the water sample used for making ice, though non-agglutinable *V. cholerae* was detected in the same. *Salmonella* was detected in 12% of the samples.

The sanitary conditions of the two landing centres surveyed in Bombay were observed to be very poor.

RESEARCH CONTEMPLATED

1. Further studies on various aspects of preservation and utilisation of less utilized fishes of Maharashtra coast
2. Study on feasibility of ice and frozen storage of fish
3. Studies on proximate composition of various low priced and less utilized fishes
4. Bacteriology of fresh and spoiling fish and biochemical changes induced by bacterial action
5. Changes in qualitative aerobic microflora of various fishes during ice storage

2.6. CALICUT RESEARCH CENTRE

SCIENTISTS ASSOCIATED

T. S. Unnikrishnan Nair, V. Muraleedharan, K. George Joseph, N. Kalaimani.

CHIEF FINDINGS

Mussel marinades retained their good taste, flavour and texture for a storage period of three months.

A quality product could be prepared from cat fish roes by marinading.

Insects collected from different smoked and dried samples were identified.

Dried mussel meat packed in air-tight containers were free from infestation even after 12 months.

Commercial samples of dried anchoviella and silver belly subjected to heat treatment at 100°C for 15 minutes and later packed in polythene bags were free from infestation even after about 16 weeks. There was also no noticeable physical change due to heating of the samples.

RESEARCH IN HAND

Experiments were continued on marinading of mussel meat. Mussel marinades were observed to retain their taste, flavour and texture for a period of three months after which the meat showed some amount of softening.

A few experiments were conducted on curing of cat fish with particular reference to its tendency for crumbling. However, experimental samples prepared with different salt contents and varying durations of salting and drying did not show any sign of crumbling during storage although discolouration and rancidity development were noted in the samples to a large extent.

Attempts were also made to prepare spiced marinades from mussel meat, incorporating powdered cinnamon bark and cloves, at 0.2% w|w level. The rest of the process was the same as for marinading the meat. Here too, the shelf life of the product was about 3 months after which certain degree of softening of the meat was observed. The spiced marinade was good in all respects except for a slightly dull appearance which is attributable to the dispersion of the powdered spices in the medium.

Studies were continued on the seasonal variation in the yield and composition of mussel meat. The samples were also subject to detailed chemical analysis and assessment of bacteriological quality. Studies conducted so far indicated variation in the yield as well as proximate composition. Standard plate counts were generally very low and micro-organisms of public health importance like *E. coli, Faecal streptococci,* coagulase positive *Staphylococci,* coliforms and *Salmonella* have not been encountered so far.

Dried mussel meat packed in airtight glass bottles (wax sealed) and sealed polythene bags of 300 and 400 gauge thickness were found to be free of insects even after 12 months. Periodical analyses are being carried out to find out the effect of moisture on the incidence of infestation in the product.

Roes of catfish collected from different landing centres were subjected to different methods of processing and preservation. In one method, the eggs were dried, crushed and powdered. The powder had a sweet flavour and kept well for more than four months in air-tight bottles. Incorporation of this powder in other foods for enrichment is to be attempted. In another method, attempts were made to prepare marinades of cat fish roes. Marinading in fresh condition was not found possible as there was complete leaching of proteins and consequent coagulation of the whole mass. But a satisfactory product could be obtained by first blanching the roes in 5% brine for five minutes and then preserving it in a mixture of 3% acetic acid (pH 5.5). The product had very good appearance, flavour and other organoleptic qualities.

Samples of dry salted fish, curing salt and salt discarded after curing were collected from curing yards at Beypore, Parappanangadi and Tanur and stored in glass bottles for development of 'red' and fungus. Isolation and identification of these organisms is to be taken up.

Pickle cured sardines stored in different types of containers like cement barrel, plastic drum, wooden barrel and glazed porcelain jar were analysed at intervals for important physical, chemical and bacteriological factors. After four months storage, the samples were heavily infested with red halophiles, blow flies and maggots. Experiments are to be continued taking precautions to prevent infestation. A new series of experiments were also initiated with dressed sardines salted in the ratio 1 : 3

and closely packed in a plastic container. Physical and chemical observations are being carried out periodically.

Samples of sun-dried anchoviella collected from Tuticorin were subject to detailed bacteriological analysis. Total bacterial count, counts of *E. coli, Faecal streptococci,* coagulase positive *staphylococci* and coliforms were determined and the samples analysed for presence of red halophiles. Out of the fourteen samples analysed, only one showed presence of 'red' while fungal attack was observed in all the samples.

A case of tail and fin rot in *Chanos chanos* reared in polythene lined ponds on a beach was referred to the Centre by the Calicut Centre of Central Marine Fisheries Research Institute. Detailed bacteriological and culture studies of the strains isolated from these cultured fishes have been undertaken. Data so far gathered have been compiled and are being processed for classifying the bacterial strains.

Commercial samples of dried anchoviella and dried silver belly were given heat treatment at 100°C, 110°C, 120°C for 5, 10 and 15 minutes respectively. Control samples were kept without heat treatment. About 100 gms. each of the heat treated samples were then immediately cooled and packed in 400 gauge polythene bags and sealed air-tight. The packed samples were observed periodically for incidence of infestation and analysed for chemical factors. It was observed that samples subjected to heat treatment at 110°C and 120°C were somewhat brittle making handling difficult. 100°C was then selected as the temperature of treatment and duration, 15 and 30 minutes. The heat treated samples were then packed in polythene bags. Both the sets of samples remained free of insect infestation even after a storage period of 16 weeks, although the samples were affected with red halophilic bacteria after about 12 weeks. This leads to the conclusion that exposure of the dried samples to 100°C for 15|30 minutes does not destroy the red halophiles, necessitating treatment with a preservative like calcium propionate before packing and sealing in containers. Samples treated for 30 minutes showed a slight physical change.

With the active co-operation and assistance of Dr. M. Mohanasundaram, Professor and Head, Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, insects collected from smoked and dried samples were identified. They are *Dermestes oter* over wet cured sardines and smoked cat fish, *Stegobium panicium* over dried mussel meat and smoked cat fish, and *Suidesia nesbetti* over dried mussel meat and dried anchoviella. It was for the first time that *Stegobium panicium* was recorded over dried mussel meat.

Samples of dry fish were collected from different curing centres and dry fish markets for studying the extent of infestation in these products. Out of the 50 samples collected, a few were found to be infested with insects. The samples are being subjected to detailed analysis.

Research Contemplated

1. Development of hard dried fish products, smoked and dried products from elasmobranchs and cat fishes and speciality products from cat fish eggs and sardine roes

2. Further studies on isolation and identification of fungi and red halophiles in cured products
3. Detailed studies on mediterranean type of cured products
4. Study of storage life pattern of dried fish products without insect infestation and study of optimum factors like time of storage, moisture etc. and their relation to insect infestation
5. Heat treatment of products to extend storage life.

2.7. GOA RESEARCH CENTRE

Scientists Associated

T. Joseph Mathai, R. S. Manoharadoss, V. Vijayan and M. Syed Abbas.

CHIEF FINDINGS

Field trials with nylon gill nets of different twine and mesh sizes showed that mackerel gill nets of nylon 210\|1\|2 with 50 mm. bar mesh was the optimum gear.

Tapered jibs have shown better efficiency than straight jibs for bulged belly trawl.

Research in Hand

Studies on encircling mackerel gill nets was continued. Twenty observations were made from a motorised canoe fitted with 8 HP out board Engine. Results of the field trials with mackerel gill nets of different twine and mesh size have shown gill nets of nylon 210\|1\|2 with 50 mm. mesh bar as optimum gear.

Studies on mid water trawl were continued with 10.3 m. large mesh unequal panel mid water trawl with 50 m. bridles at different speed. Catch at 1200 Engine rpm. was 41% and 165% more than that of 1100 and 1300 rpm. respectively.

Twenty observations undertaken durinb the year on the effect of tapering jibs on bulged belly trawls have shown better efficiency of tapered jibs over straight jibs.

Research Contemplated

1. Multi-mesh | multi-purpose gill nets
2. Introduction of Chinese dip net
3. Studies on stick held dip net
4. Platform trawls for pelagic fishes
5. Effect of speed on mid water trawling
6. Studies on separator trawl
7. Studies on tapering jibs.

3. INTRODUCTION OF RETORTABLE POUCHES

Dr. E. G. Silas, the then Director, CMFRI, inaugurated a programme on Test Marketing of Sardines Processed in Retortable Pouches at CIFT on 24.6.85. Shri P. K. Sadanandan, Vice President, Seafood Exporters' Association of India, received the first consignment of processed sardines. Sh. Amitabh Kant, IAS, General Manager, MATSYAFED, presided over the function. Dr. Keith D. Jeffs, Directotr, KM Packaging Services Ltd., U.K. gave a talk on "Technology of Retort Pouch Processing". The test marketing of these packs represent an important step in a carefully organised programme of work at the Institute, which, it is hoped, will ultimately lead to establishment of retort pouch production facilities at Cochin.

4. EXTENSION AND INFORMATION

Replies to technical queries

About 400 technical queries received from those connected with the fishing industry, both from within the country and outside, were replied to during the period under report.

Processes for preparation of various fishery products developed at CIFT were in continuous demand from user agencies and research institutions. Printed pamphlets were furnished to these agencies on the preparation of fish pickles, fish soup powder, wafers, shark fin rays and chitosan.

Technical advice was rendered to fish processors on canning of different types of fish. To some of the public sector units, suitable guidelines were given on the setting up of fish meal plants, canning factory, can making units, frozen fish storage, ice plant and fresh fish storage.

Some of the fish processing units were advised on the permissible limits of mercury (Hg) in fish for human consumption. A large number of user agencies were supplied with chlorine level indicator paper for use in their processing plants. A quantitative estimate of the percentage of waste on account of drip losses in processed shrimp was furnished to some of the parties. Processes for preparation of deodorant and antiseptic ointment were made available to the processing factories and other interested parties.

Artisanal fishermen also evinced keen interest in making use of the modern research results. Quite a few of them obtained from this Institute the methods for preservation of traditional fishing craft and information on protective paint coatings.

Technical advice was given to parties on the minimum and maximum horse power of the engine that could be fitted in different types of fishing vessels and appropriate size of trawls for these vessels.

Publications

A comprehensive account of the technologies so far developed by the Institute was brought out entitled, "Technologies Developed at CIFT". Other publications brought out for extension work are the following.

1. Production of fish wafers
2. Production of fish soup powder
3. Production of fish pickles.

Supply of designs and publications

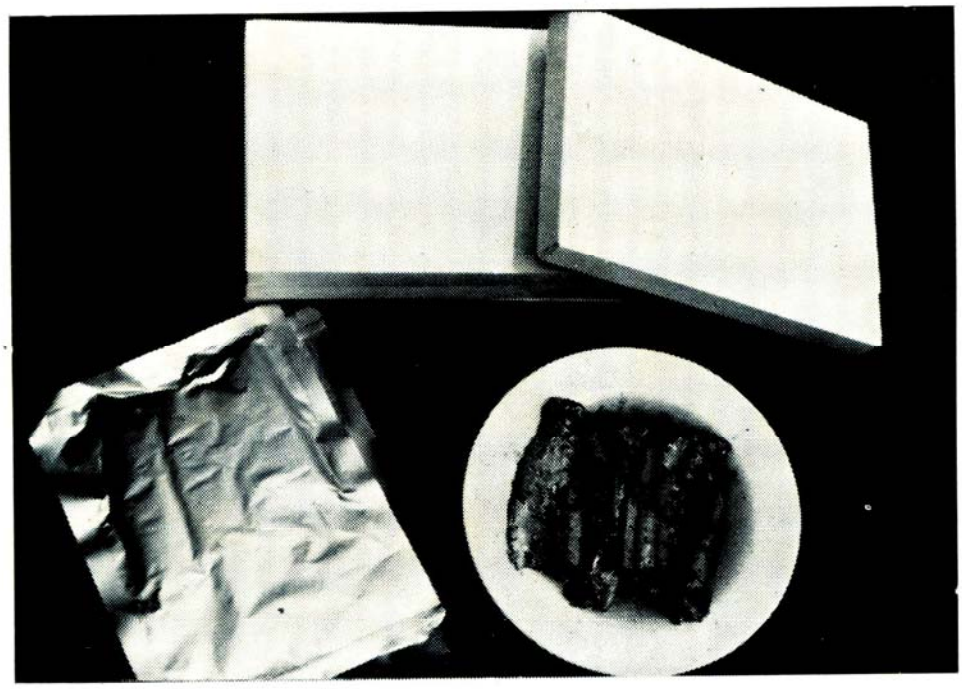
Designs and publications were issued during the year to those who requested for the same as detailed below.

Designs	*Number issued*
Rotary drum dryer	3
Tunnel dryer	10
Fish trap	2
25 ft. fishing vessel	1 set
30 ft. trawler	2 sets
32 ft. trawler	4 sets
36 ft. trawler	4 sets
42 ft. fishing vessel	1 set
50 ft. combination vessel	5 sets

Radio/TV feature

A malayalam feature programme on the Institute was telecast from Trivandrum TV centre on 1st August 1985.

At the inauguration of the programme on test marketing of sardines processed in retortable pouches. 'l' to 'r' — Shri M. R. Nair, Dr. E. G. Silas, Shri Amitabh Kant, Dr. Keith D. Jeffs, Shri P. K. Sadanandan & Dr. K. Gopakumar.



Sardines packed in pouches.

5. TRAINING/DEMONSTRATION

Training programme on Instrumentation and Methodology in Fishing Gear Investigations was held at CIFT during 24-30 April 1985. Thirty three participants from 8 states including Universities, Research Departments and Corporations participated in the programme.

A training-cum-demonstration programme on chlorination of water was held at Bombay in collaboration with MPEDA Regional office. Similar programmes were also held at Calcutta and Madras.

Training on production of dried fish, fish wafers and pickles was conducted as detailed below at the request of the Alleppey Diocesan & Charitable and Social Welfare Society Regd. for the benefit of local fishermen.

Place	*Period*
Vadakkal	8 & 9 October 1985
Kattoor	10 & 11 October 1985
Arthunkal	14 & 15 October 1985
Saudi	17 & 18 October 1985

Training programmes were also held at Krishi Vigyan Kendra, Narakkal during October 1985 and March 1986, on preparation of fish wafers, soup and pickle for the benefit of local fisherwomen.

In-plant training on "Refrigeration and Air Conditioning" was held for the post diploma students of Government Polytechnic, Kalamassery, Cochin.

Under a scheme drawn up in collaboration with MATSYAFED on gainful employment for coastal fisherwomen, training programmes were initiated to transfer various technologies developed at CIFT. Initially a twenty day programme was organised at Cochin in March 1986.

Demonstration-cum-practical training programmes were conducted by the Burla Research Centre at the request of the State Fisheries Department, Orissa, for members of Bimsy Fishermen Co-operative Societies of Thebra and Lachipalli on development of pickled products from fish and mollusc and on the improved method of sun drying of fish. Proper methods of handling and packing of fresh water fish were also explained.

At Calicut, a demonstration was organised on the methods of preparation of fish and prawn pickles.

Ad-hoc training imparted

Subject	*Place*	*Duration*	*No. of trainees*
In-plant training in Refrigeration & Air Conditioning	Cochin	3 months	3
Quality control	Cochin	2 weeks	7
aspects of fish and	Cochin	1 month	3
fishery products	Cochin	2 months	1

Subject	*Place*	*Duration*	*No. of trainees*
Microbiological	Cochin	2 weeks	3
methods in fish	Cochin	1 month	1
processing	Calicut	3 weeks	1
	Bombay		2
	Veraval		3
Bacteriological	Cochin	3 weeks	1
aspects of fish	Bombay		1
Detection of *Vibrio*	Cochin	1 week	1
cholerae in fish	Cochin	2 weeks	1
Preparation of mussel pickle	Calicut		1
Production of fish	Cochin	2 weeks	4
flakes, pickles and shark fin rays	Cochin	1 month	5
Fishing gear technology	Cochin	4 days	4

6. EXHIBITION AND FILM SHOWS

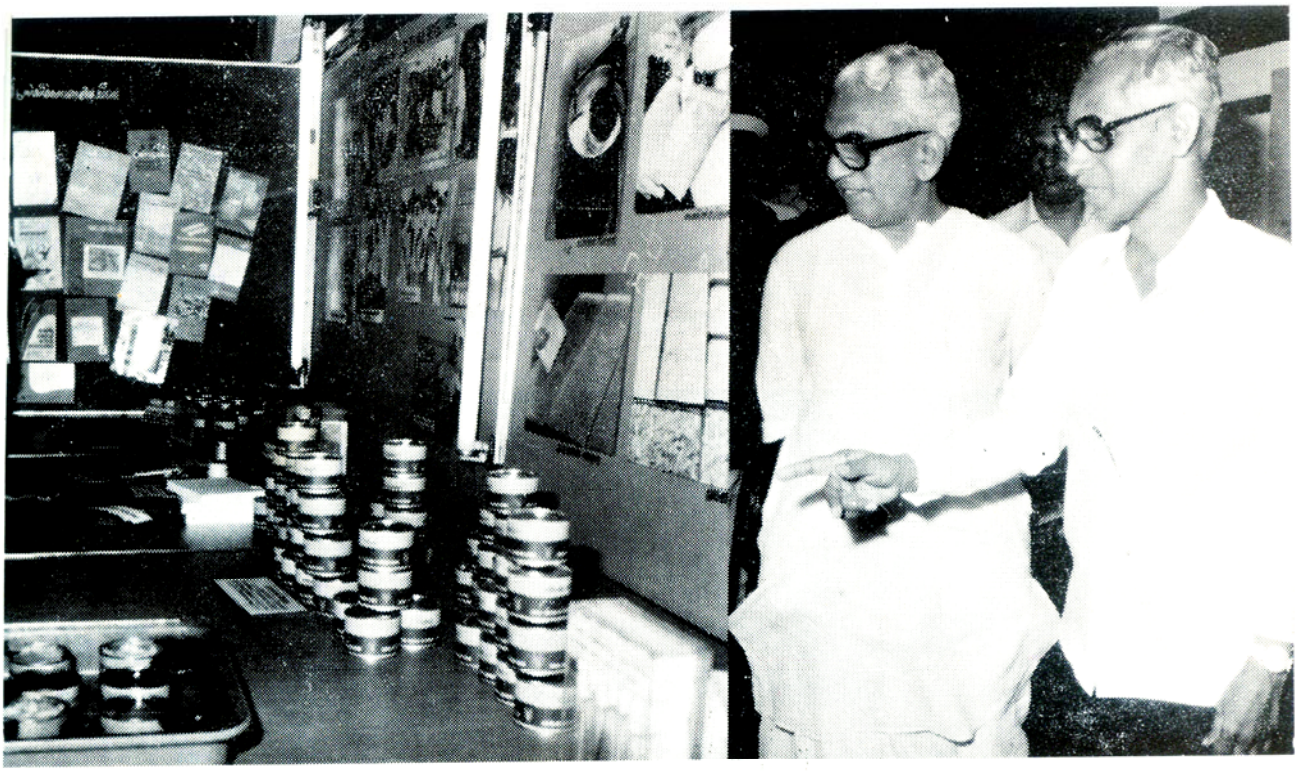
The Institute actively participated in three exhibitions during the year. These included the Fisheries Carnival-Matsya Mela 1985 organised by the Kerala State Co-operative Federation for Fisheries Development Ltd. (MATSYAFED) at Trivandrum from 17-19 May 1985, the Indian National Congress Centenary Exhibition held at Cochin from 15 December 1985 to 31 January 1986, and the exhibition held at Trivandrum in connection with Tourism Festival and Silver Jubilee Celebrations of Agri-Horticultural Society, Trivandrum during 4-12 January 1986. At the 'Matsyamela' it secured the award for the best pavilion among Central Govt. stalls. The Institute was also awarded a shield in the Congress Centenary Exhibition for securing the second prize among pavilions in the Educational and Research Group.

Samples of processed products were sent to ICAR for display at the Agricultural Research Sector of Science and Technology Exhibition at Moscow and India Exhibition at Doha in February 1986. Exhibits were also sent for display at the International Trade Fair held at New Delhi during November 1985. The Institute also sent samples to a few exhibitions conducted in Cochin.

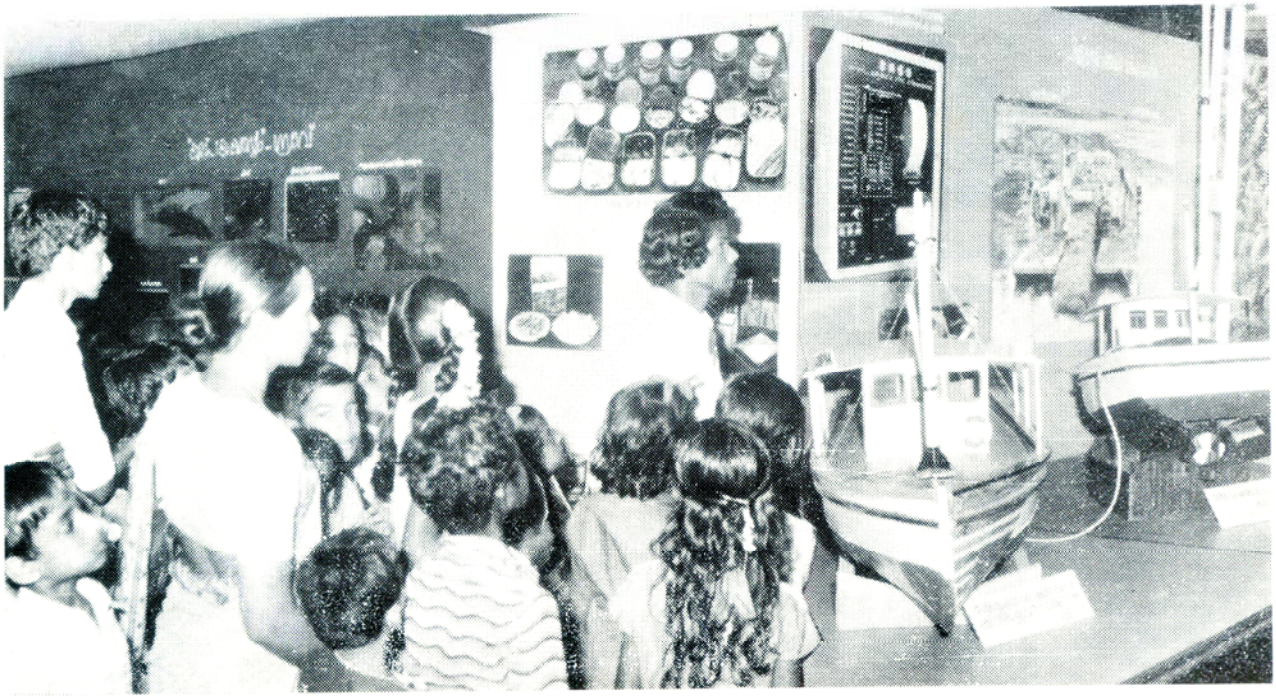
The Goa Centre of the Institute participated in an exhibition conducted at the ICAR Complex, Ela Farm during August 1985. The exhibition was held in connection with the training programme on multiple cropping and plant protection conducted for the farmers.

The Burla Centre also participated in a Fisheries Exhibition organised by the State Fisheries, Sambalpur Unit during February 1986. Various types of fishing gear and models of improved gear and processed fish products were exhibited.

Film shows were conducted in different places for the benefit of the fishermen, State Fisheries Departments, Educational institutions and others connected with the fishery industry.



At the "Matsyamela 1985" organised by MATSYAFED at Trivandrum — Shri M. R. Nair, Director, explains the various activities of the Institute to Shri K. Karunakaran, Chief Minister of Kerala



At the Congress Centenary Exhibition at Cochin — Visitors in the CIFT stall.

CIFT pavilion was adjudged best among Central Govt. stalls at the "Matsyamela 1985", *Shri K. Karunakaran, Chief Minister of Kerala, hands over the prize for the best stall.*

7. ANALYSIS OF MATERIALS PRODUCTS

Raw materials and products manufactured/processed indigenously were tested and results of analysis intimated to the concerned parties with suggestions for improvement wherever necessary. Particulars of materials/products tested are given below:

Material/product	*No. of samples*
Frozen fish and shell fish products	61
Dried fish and shell fish	19
Accelerated freeze dried products	21
Fish by-products	38
Fish speciality products	3
Fish oil	3
Packaging material	13
Water	48
Ice	30
Fishing craft materials	4
Marine engines	11
Outboard motor	2
Fishing gear materials	35
Corrugated fibre board master carton	13

8. TECHNICAL ASSISTANCE IN GENERAL

The Institute including its Research Centres continued to render technical assistance wherever needed.

At Cochin, technical guidance was given to fishermen in different centres on improved method of processing of dried anchoviella and other types of fish. Technical assistance was also given to parties producing fish pickles and fish wafers for improving the quality of the products.

At Goa, assistance was given to a private trawler owner in operation of the mid water trawl.

Technical know-how was supplied by the Calicut Centre on preparation of mussel meat pickle to a private party. The party has already started production and marketing of the product prepared as per method developed at CIFT. The Centre also analysed nine samples of water, 3 of fish feed, 5 of mud and one sample of fish meal and furnished reports.

The Burla Centre extended help to the local fishermen in selecting gear suitable for operation in the Hirakud reservoir.

At Veraval, about 195 samples of fish meal/dry fish and 10 samples of water were analysed during the year.

9. PUBLICATION

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George Joseph, K. & Unnikrishnan Nair, T. S. - Quality of certain ready-to-eat fish products of the domestic trade - *Fish. Technol.*, 23(1): 73, 1986.

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10. APPENDICES

APPENDIX - I

HEADQUARTERS

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
Willingdon Island, Matsyapuri P.O.,
COCHIN-682 029, KERALA

TLX No. 0885-440
Telephone: Office No. 6845 (10 lines)
Director (Per) No. 6880
Res. No. 361034

Telegram: MATSYAOUDYOGIKI OR
FISHTECH, COCHIN

DIRECTOR .. Shri M. Rajendranathan Nair

Scientists-in-Charge

1.	Craft Division	..	Shri R. Balasubramanyan (upto July 1985) Dr. K. Ravindran
2.	Gear Division	..	Shri P. A. Panicker
3.	Biochemistry & Nutrition Division	..	Dr. K. Devadasan
4.	Microbiology Division	..	Shri K. Mahadeva Iyer
5.	Processing & Packaging Division	..	Dr. K. Gopakumar
6.	Engineering Division	..	Shri S. Ayyappan Pillai
7.	Extension, Information & Statistics Division	..	Shri M. K. Kandoran

(APPENDIX - I Contd.)

RESEARCH CENTRES

Sl. No.	*Place*	*Address*	*Telephone/Telex*	*Telegram*	*Scientist-in-Charge*
1.	VERAVAL	Research Centre of CIFT, Bunder Road, Veraval-362265 Gujarat.	Tele: 20297 Telex: 0163-202 CIFT-IN	MATSYAOUDYOGIKI	Dr. P. G. Viswanathan Nair
2.	KAKINADA	Research Centre of CIFT, D.No. 2-11-1/4, Venkatanagar, Kakinada-533003 Andhra Pradesh	Tele: 4436 Telex: 0491-229 CIFT-IN	MATSYAOUDYOGIKI	Dr. C. C. Panduranga Rao
3.	BURLA	Research Centre of CIFT, Burla-768017, Sambalpur Dist., Orissa	Tele: 19	MATSYAOUDYOGIKI	Sh. A. A. Khan
4.	BOMBAY	Research Centre of CIFT, 162--B.P.T. Godown, Sassoon Dock, Colaba, Bombay-400005 Maharashtra	Tele: 213892 Telex: 011-2464 CIFT-IN	FISHPROCES (FT)	Dr. M. Arul James
5.	CALICUT	Research Centre of CIFT, Beach Road, West Hill, Calicut-673005, Kerala	Tele: 76607	CARE 'CADALMIN'	Sh. T. S. Unnikrishnan Nair
6.	GOA	Research Centre of CIFT, 2nd Floor, 'Shanta' 18th June Road, St. Inez., Panaji-403001, Gao	Tele: 5905	MATSYAOUDYOGIKI, PANAJI	Sh. T. Joseph Mathai

APPENDIX - II

List of Personnel in CIFT as on 31-3-1986

Headquarters: Cochin

SCIENTIFIC PERSONNEL

DIRECTOR

Shri. M. RAJENDRANATHAN NAIR

Scientist S-3

1. Dr. K. Gopakumar (S-4 Personal Grade)
2. Dr. T. K. Govindan
3. Shri P. V. Prabhu
4. Shri K. Mahadeva Iyer
5. Dr. K. Ravindran
6. Shri V. C. George
7. Dr. T. S. Gopalakrishna Iyer
8. Dr. K. Devadasan
9. Shri P. Madhavan
10. Shri P. Appukutta Panicker
11. Dr. T. K. Sivadas
12. Shri H. Krishna Iyer
13. Shri S. Ayyappan Pillai
14. Shri K. K. Balachandran
15. Shri K. Sreedharan Namboodiri
16. Shri M. K. Kandoran
17. Shri K. Krishna Rao
18. Shri Cyriac Mathen

Scientist S-2

1. Shri C. V. Narasimha Rao
2. Shri P. D. Antony
3. Shri P. K. Chakraborthy
4. Shri P. A. Perigreen
5. Shri A. K. Kesavan Nair
6. Shri K. A. Sadanandan
7. Shri P. R. Girija Varma
8. Shri A. G. Radhakrishnan
9. Dr. Chinnamma George
10. Dr. P. K. Surendran
11. Dr. K. G. Ramachandran Nair
12. Shri P. T. Mathew
13. Dr. Jose Stephen
14. Shri A. G. Gopalakrishna Pillai
15. Dr. N. Unnikrishnan Nair
16. Smt. A. Lakshmy Nair
17. Shri T. K. Sreenivasa Gopal
18. Dr. M. K. Mukundan
19. Shri H. N. Mhalathkar
20. Shri A. C. Joseph
21. Shri K. K. Kunjippalu
22. Kum. B. Meenakumari
23. Shri T. P. George
24. Shri K. N. Kartha
25. Smt. Mary Thomas
26. Shri A. Vasantha Shenoy
27. Shri P. N. Joshi
28. Shri P. K. Vijayan
29. Shri Jose Joseph
30. Smt. Nirmala Thampuran
31. Shri Francis Thomas
32. Shri S. Sanjeev
33. Dr. P. T. Lakshmanan
34. Shri P. Ravindranathan Nair

Scientist S-1

1. Shri P. N. R. Kaimal
2. Shri P. George Mathai
3. Shri K. Ramakrishnan
4. Smt. K. Vijayabharathy
5. Shri T. K. Thankappan
6. Shri G. Rajagopalan Unnithan
7. Smt. K. Ammu
8. Shri V. Narayanan Nambiar
9. Smt. K. V. Lalitha
10. Shri S. Balasubramaniam
11. Shri K. P. Antony
12. Dr. M. D. Varghese
13. Smt. R. Thankamma
14. Shri V. Annamalai
15. Shri A. C. Kuttappan
16. Shri R. Thiagarajan
17. Kum. Saly N. Thomas
18. Shri Praveen Puthra
19. Smt. Leela Edwin

TECHNICAL PERSONNEL

Technician T-8

1. Shri S. Gopalan Nayar .. Technical Officer (Fish.)
2. Shri K. S. Genesan .. Workshop Engineer

Technician T-7

1. Smt. P. J. Cecily .. Jr. Technical Officer
2. Shri M. S. Fernando .. Skipper

Technician T-6

1. Shri K. C. Purushothaman .. Editor-cum-Information Officer
2. Shri N. A. George .. Technical Officer (Fish.)
3. Shri T. M. Sivan .. Technical Officer (Fish.)
4. Smt. K. Radhalakshmy .. Technical Officer (Fish.)

Technician T-5

1. Shri M. S. Rajan .. Fishing Mate
2. Shri N. Sriharshan .. Engineer
3. Shri V. K. Ibrahim .. Head Draughtsman
4. Smt. T. T. Annamma .. Sr. Technical Assistant
5. Shri K. Vasudevan Nair .. Sr. Technical Assistant
6. Smt. Annamma Mathew .. Sr. Technical Assistant
7. Shri K. Bhaskaran .. Photographer-cum-Artist
8. Shri Varghese Paul .. Technical Assistant
9. Shri C. Chandrasekharan .. Superintendent (E & M)
10. Shri N. Vareethiah .. Glass Blower
11. Shri G. Mohanan .. Artist
12. Shri O. Subramanian .. Senior Welder

Technician T-4

1.	Shri P. Ravindranathan	.. Librarian
2.	Shri T. K. Sayed Ali	.. Technical Assistant
3.	Shri Shri A. Kassim Kunju	.. Technical Assistant
4.	Shri M. L. Anslem	.. Senior Draughtsman
5.	Shri R. Gopalakrishnan Nair	.. Technical Assistant
6.	Shri P. Sadanandan	.. Technical Assistant
7.	Shri M. K. Sasidharan	.. Technical Assistant
8.	Shri P. T. Sebastian	.. Technical Assistant
9.	Shri N. M. Vasu	.. Technical Assistant
10.	Shri V. Gaspar	.. Technical Assistant
11.	Shri Thomas J. Mammoottil	.. Technical Assistant

Technician T-II-3

1.	Shri P. S. Alias	.. Superintendent (Instrumentation)
2.	Shri B. Anandan	.. Foundry Assistant
3.	Shri G. Ramadas Kurup	.. Instrument Maker
4.	Shri M. M. Devasya	.. Sr. Library Assistant
5.	Shri C. R. Gokulan	.. Technical Assistant

Technician T-I-3

1.	Shri M. U. Vijayan	.. Senior Mechanic
2.	Shri T. K. David	.. Fitter
3.	Shri K. J. Augustine	.. Senior Turner
4.	Shri A. K. Jaisingh	.. Bosun
5.	Shri T. S. Bhaskara Menon	.. Senior Mechanic
6.	Shri K. E. Mani	.. Senior Mechanic
7.	Shri P. M. Joseph	.. Mechinist
8.	Shri A. R. Dharaneedharan	.. Media Assistant
9.	Shri K. K. Subramanian	.. Engine Driver
10.	Shri V. V. Johni	.. Senior Field Assistant
11.	Shri V. K. Ramachandran	.. Senior Lab. Assistant
12.	Shri E. K. Balakrishnan	.. Draughtsman
13.	Shri G. Ratnakaran Nair	.. Refrigeration Mechanic
14.	Smt. K. Sarasamma	.. Draughtsman
15.	Shri M. Shanmugavel	.. Refrigeration Mechanic
16.	Shri C. Rajendran	.. Refrigeration Mechanic
17.	Shri Jose Kalathil	.. Refrigeration Mechanic
18.	Shri K. V. Madhavan	.. Electrician
19.	Shri K. K. Pappukutty	.. Driver (Launch)
20.	Shri T. Gopalakrishnan	.. Metal Worker
21.	Shri P. A. John	.. Cockswain

Technician T-2

1.	Shri P. K. Damodaran	.. Senior Lab. Assistant
2.	Shri Shaju A. Averah	.. Draughtsman
3.	Shri P. A. Josi Augustine	.. Refrigeration Mechanic
4.	Shri C. C. Sivan	.. Welder-cum-Blacksmith
5.	Shri K. B. Thilakan	.. Junior Lab. Assistant
6.	Shri T. N. Manibhadran	.. Tindal
7.	Shri T. K. Vasudevan	.. Junior Lab. Assistant
8.	Shri T. K. Aravindakshan	.. Junior Lab. Assistant
9.	Shri T. K. Bhaskaran	.. Junior Lab. Assistant
10.	Shri P. N. Sudhakaran	.. Net Making Supervisor
11.	Smt. K. K. Sumathy	.. Junior Lab. Assistant

Technician T-1

1.	Shri V. V. John	.. Junior Lab. Assistant
2.	Shri A. A. Kunjappan	.. Field Assistant
3.	Shri K. K. Narayanan	.. Boilerman
4.	Smt. G. Usha Rani	.. Junior Lab. Assistant
5.	Kum. K. G. Sasikala	.. Junior Lab. Assistant
6.	Kum. K. P. Leelamma	.. Junior Lab. Assistant
7.	Smt. V. C. Mary	.. Junior Lab. Assistant
8.	Shri P. S. Raman Nampoothiri	.. Junior Lab. Assistant
9.	Shri Mathew A. K.	.. Electrician
10.	Shri P. T. Viswambharan	.. Electrician
11.	Shri Tommy Rebello	.. Boilerman
12.	Shri K. A. Gopinath	.. Vessel Oilman
13.	Shri K. D. Jos	.. Field Assistant

ADMINISTRATIVE PERSONNEL

1.	Shri M. P. Rajasekharan	.. Senior Administrative Officer
2.	Shri P. James Abraham	.. Administrative Officer
3.	Shri Varghese Paul	.. Asst. Administrative Officer
4.	Shri P. J. Joseph	.. Asst. Administrative Officer
5.	Shri T. Velayudhan Asari	.. Accounts Officer
6.	Shri S. P. Nair	.. Asst. Accounts Officer
7.	Smt. Jessy Joseph C.	.. Hindi Officer
8.	Shri S. Sadanandan	.. Asst. Admn. Officer (On deputation)

Superintendent

1.	Smt. T. N. Ambujakshi Amma	4.	Shri S. Naveenchandra Prabhu
2.	Shri P. A. Uthup	5.	Smt. K. A. Devaky
3.	Shri M. George Joseph	6.	Shri T. Gurumoorthy

Senior Stenographer

Shri K. J. Thomas

Assistant

1. Smt. Nafeesa Ali
2. Shri A. George Joseph
3. Shri T. M. Padmanabhan
4. Smt. N. K. Sulochana
5. Shri R. Anil Kumar
6. Smt. T. K. Sarala
7. Shri R. S. Shanmughan
8. Shri A. L. John
9. Smt. Alice M. Joseph
10. Shri M. Gopalakrishnan
11. Smt. M. S. Susanna

Stenographer

1. Smt. Mariamma Sadanandan
2. Shri K. Ravindran
3. Smt. N. K. Saraswathy
4. Smt. R. Vasantha

Senior Clerk

1. Shri M. T. Joseph
2. Shri V. N. Rajasekharan Nair
3. Shri A. K.Venugopal
4. Shri M. J. Sebastian
5. Smt. Annamma Varghese
6. Smt. C. G. Marykutty
7. Smt. N. Prabhavathy Amma
8. Shri C. Ravindran Nair
9. Smt.K. R. Gita Rani
10. Shri T. M. Ramraj
11. Shri G. Somappan
12. Shri K. Bhaskaran
13. Smt. M. Jully
14. Shri Y. Philipose
15. Shri M. A. Prasanna
16. Shri R. Viswanathan
17. Shri V. R. Kesavan

Junior Stenographer

1. Shri P. K. Raghu
2. Kum. S. Kamalamma
3. Kum. V. P. Vijayakumari
4. Kum. N. Leena
5. Shri K. V. Mathai

Junior Clerk

1. Smt. K. A. Nazeem
2. Shri P. K. Sreedharan
3. Smt. K. Gracy
4. Shri P. V. Venugopalan
5. Shri K. P. Velayudhan
6. Smt. T. K. Susannamma
7. Smt. P. C. Kamalakshy
8. Shri K. Rajappan Pillai
9. Smt. N. I. Mary
10. Shri P. K. Thomas
11. Smt. P. K. Thankamma
12. Smt. A. A. Cousallia
13. Shri K. K. Sasi
14. Shri P. Padmanabhan
15. Smt. A. R. Kamalam
16. Smt. T. K. Shyma
17. Smt. T. D. Usheem
18. Smt. V. S. Aleyamma
19. Shri V. S. Ambasuthan
20. Shri A. P. Gopalan
21. Smt. G. N. Sarada
22. Shri S. Radhakrishnan Nair
23. Shri K. B. Sabukuttan
24. Smt. P. A. Sathy
25. Shri P. Krishnakumar
26. Shri M. V. Danaseelan
27. Shri K. C. Baby
28. Shri C. K. Sukumaran

Telephone Operator-cum-Receptionist

Shri P. Bahuleyan

AUXILIARY PERSONNEL

1. Shri V. S. Augustine .. Senior Carpenter
2. Shri Philip Durom .. Senior Carpenter
3. Shri P. Joseph Paul .. Carpenter
4. Shri A. Gopalakrishnan Nair .. Staff Car Driver
5. Shri P. P. Paulose .. Staff Car Driver
6. Shri M. G. Narayanan Nair .. Driver
7. Shri V. P. Raphel .. Driver
8. Shri T. Neelakantan .. Projector Operator
9. Shri C. C. Gandhi .. Plant Attendant
10. Shri N. C. Bhaskaran .. Plant Attendant
11. Shri K. R. Kesavan .. Plant Attendant
12. Shri K. K. Lakshmanan .. Deck Hand
13. Shri T. Balan .. Deck Hand
14. Shri P. K. Pushpangadan .. Deck Hand
15. Shri T. K. Dasan .. Deck Hand
16. Shri T. K. Bava .. Deck Hand
17. Shri E. K. Chinnappan .. Deck Hand
18. Shri M. K. Asokan .. Deck Hand
19. Shri D. G. Rao .. Deck Hand
20. Shri E. R. Krishnan .. Cook
21. Shri M. Sankara Panicker .. Carpenter
22. Shri G. Jyothi Kumar .. Driver
23. Shri V. A. Sudhakaran .. Plumber

SUPPORTING STAFF

Supporting Staff Grade IV

1. Shri K. K. Radhakrishnan
2. Shri O. C. Lonan
3. Shri O. A. Krishnan
4. Shri E. S. Balachandra Pai

Supporting Staff Grade III

1. Shri E. S. Sreedharan
2. Shri P. A. Thomas
3. Shri K. Balakrishna Pillai
4. Shri P. J. George
5. Shri P. C. Sukumaran
6. Shri A. G. Vasu
7. Shri C. A. Subran
8. Shri K. K. Appachan
9. Shri K. X. Joseph
10. Shri T. T. Das
11. Shri M. K. Thevan
12. Shri P. M. Pakeer Mohammed

Supporting Staff Grade II

1. Shri K. Raghavan
2. Shri K. K. Madhavan
3. Shri S. Rajan
4. Shri T. V. Manoharan
5. Shri T. T. Velayudhan
6. Shri C. A. Krishnan
7. Shri P. A. Shanmughan
8. Shri K. N. Mukundan
9. Shri P. Gopalakrishnan
10. Shri P. D. George
11. Shri K. B. Bhaskaran
12. Shri K. K. Karthikeyan
13. Shri K. A. Kunjan

Supporting Staff Grade I

1. Shri T. T. Thankappan
2. Shri P. R. Unnikrishna Panicker
3. Shri R. Chellappan
4. Shri T. Kochukuttan Nair
5. Shri A. R. John
6. Shri C. N. Raghavan
7. Shri A. Ravindran Nair
8. Shri P. N. Sukumaran Nair
9. Smt. P. L. Rosilly
10. Shri T. K. Rajappan
11. Shri K. N. Velayudhan Kutty
12. Shri T. G. John
13. Shri O. K. Xavier
14. Shri T. Mathai
15. Shri P. T. Anthappan
16. Shri T. K. Viswanathan
17. Shri P. A. Sivan
18. Smt. C. G. Radhamony
19. Shri P. K. Somasekharan Nair
20. Shri N. Krishnan
21. Shri C. D. Parameswaran
22. Shri V. T. Sadanandan
23. Shri P. P. George
24. Shri A. V. Chandra Sekharan
25. Shri P. V. Raju
26. Shri M. Shanmughavelu
27. Shri E. Damodaran
28. Shri M. M. Radhakrishnan
29. Shri K. K. Karthikeyan
30. Shri K. D. Santhosh
31. Smt. C. Ammini
32. Shri K. Dinesh Prabhu
33. Shri P. P. Varghese
34. Shri P. T. Chandran

VERAVAL RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-3

1. Shri P. G. Viswanathan Nair .. Scientist-in-Charge

Scientist S-2

1. Shri K. K. Solanki
2. Shri K. V. Mohan Rajan
3. Shri N. Subramania Pillai
4. Shri M. R. Boopendranath
5. Shri Rajendra Badonia

Scientist S-1

1. Shri M. R. Raghunath
2. Shri A. Ramachandran
3. Shri T. V. Sankar

TECHNICAL STAFF

1. Shri K. J. Francis Xavier .. T-7 (Skipper)
2. Shri G. P. Vaghela .. T-II-3 (Tech. Asst.)
3. Shri J. B. Paradwa .. T-II-3 (Tech. Asst.)
4. Shri D. K. Ukhabhai .. T-II-3 (Tech. Asst.)
5. Shri S. R. Jethwa .. T-I-3 (Sr. Mechanic)
6. Shri Mohammed Jaffar .. T-I-3 (Engine Driver)
7. Shri N. J. Tandal .. T-I-3 (Driver Launch)
8. Shri M. M. Vara .. T-2 (Sr. Field Asst.)
9. Shri M. K. Kuttikrishnan Nair .. T-2 (Sr. Field Asst.)
10. Shri K. U. Sheikh .. T-2 (Jr. Lab. Asst.)
11. Shri D. R. Aparnati .. T-2 (Jr. Lab. Asst.)
12. Shri A. P. Joshi .. T-1 (Tindal)
13. Shri T. Gangadharan .. T-2 (Sr. Lab. Asst.)

ADMINISTRATIVE STAFF

1. Shri P. Vasudevan .. Assistant
2. Shri Veersingh .. Junior Clerk
3. Shri S. B. Purohit .. Junior Clerk
4. Shri M. M. Damodara .. Junior Clerk
5. Shri T. Viswanathan .. Junior Clerk

AUXILIARY STAFF

1.	Shri G. B. Tandel	.. Deck Hand
2.	Shri H. M. Kotiya	.. Deck Hand
3.	Shri G. R. Bhogte	.. Deck Hand
4.	Shri Malam Bachu Sidi	.. Deck Hand
5.	Shri G. L. Tandel	.. Cook

SUPPORTING STAFF

1.	Shri P. A. Abdul Rahman	.. SSG III
2.	Shri K. K. C. Fofandi	.. SSG II
3.	Shri G. M. Vaghela	.. SSG II
4.	Shri K. A. Massani	.. SSG II
5.	Shri N. N. Goswami	.. SSG II
6.	Shri Harbhajan	.. SSG I
7.	Shri B. M. A. Khoker	.. SSG I
8.	Shri D. P. Parmar	.. SSG I
9.	Shri D. B. Chudasama	.. SSG I
10.	Shri K. J. Damer	.. SSG I
11.	Smt. Chandrika C. Tank	.. SSG I
12.	Shri P. N. Chudasama	.. SSG I
13.	Shri H. V. Punjera	.. SSG I
14.	Smt. Gangaben Naran Chorwadi	.. SSG I

KAKINADA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-3

1. Dr. C. C. Panduranga Rao (S4-Personal Grade) .. Scientist-in-Charge
2. Shri Narayanappa

Scientist S-2

1. Shri Sibsankar Gupta
2. Shri S. V. S. Rama Rao
3. Shri Imam Khasim Sahib
4. Shri Subrata Basu

Scientist S-1

1. Shri R. Mangayya Naidu
2. Shri Rupshankar Chakraborty
3. Shri M. M. Prasad

TECHNICAL STAFF

1.	Shri A. V. V. Satyanarayana	.. Technical Officer - Fish (T-7)
2.	Shri A. Veeranjeneyulu	.. Technical Assistant (T-II-3)
3.	Shri Srihari Babu	.. Technical Assistant (T-II-3)
4.	Shri V. V. Ramakrishna	.. Technical Assistant (T-II-3)
5.	Shri K. V. Baladasan	.. Engine Driver (T-I-3)
6.	Shri Laxmanadu	.. Bosun (T-I-3)
7.	Shri Veera Raju	.. Tindal (T-I-3)
8.	Shri B. Ramaiah	.. Jr. Lab. Asst. (T-2)
9.	Shri Prakash Rao	.. Driver - Launch (T-1)
10.	Shri N. Venkata Rao	.. Field Asst. (T-1)
11.	Shri K. V. S. S. Kusuma Harnath	.. Technical Asst. (T-II-3)

ADMINISTRATIVE STAFF

1.	Shri N. Venugopal	.. Senior Clerk
2.	Smt. Satyanarayanamma	.. Jr. Stenographer
3.	Ch: Satyanarayana	.. Junior Clerk
4.	Kum. B. Hemalatha	.. Junior Clerk
5.	Shri Nirmala Raju	.. Junior Clerk

AUXILIARY STAFF

1.	Shri K. Sarangadharadu	.. Deck Hand
2.	Shri Karri Gangaraju	.. Deck Hand
3.	Shri G. Subba Rao	.. Cook

SUPPORTING STAFF

1.	Shri B. Suryaprakash Rao	.. SSG IV
2.	Shri Koppada Gandhi	.. SSG IV
3.	Shri Thirupathi Rao	.. SSG III
4.	Shri N. Gnanaranjana Rao	.. SSG III
5.	Shri C. Kamaraju	.. SSG II
6.	Shri V. Kamaraju	.. SSG II
7.	Shri K. Kameswara Rao	.. SSG II
8.	Shri Melladi Perraju	.. SSG II
9.	Shri G. Chinna Rao	.. SSG II
10.	Shri O. Heman	.. SSG II
11.	Shri Vasippilli Yelliah	.. SSG I
12.	Shri K. Appa Rao	.. SSG I
13.	Shri B. Sivanadham	.. SSG I
14.	Shri S. Chakram	.. SSG I
15.	Shri S. Appa Rao	.. SSG I
16.	Shri R. Ranga Swamy	.. SSG I
17.	Shri V. Venkata Ramana	.. SSG I

BURLA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Shri Anwar Ahmed Khan .. Scientist-in-Charge
2. Shri J. Sita Rama Rao
3. Shri S. K. Battacharya
4. Shri A. K. Chathopadhyay

Scientist S-1

1. Shri M. Mukundan
2. Shri Percy Dawson
3. Shri J. K. Bandhopadhyaya

TECHNICAL STAFF

1. Shri Baikunta Pradhan .. Technical Assistant (T-II-3)
2. Shri Gurudas Ram .. Tindal (T-I-3)
3. Shri P. M. Pattanayak .. Sr. Lab. Asst. (T-I-3)
4. Shri Radhu Pandey .. Driver - Launch (T-I)
5. Shri Sathrughan Kumara .. Tindal (T-1)
6. Shri Damodar Rout .. Jr. Lab. Asst. (T-1)
7. Shri Ashok Kumar Naik .. Mechanic (T-1)
8. Shri Rabinarayan Sahoo .. Driver - Launch (T-1)
9. Shri Binod Kumar Pande .. Technical Assistant (T-II-3)
10. Shri Asok Kumar Panigrahi .. Technical Assistant (T-II-3)

ADMINISTRATIVE STAFF

1. Shri Jatindra Kumar Mishra .. Assistant
2. Shri G. C. Adhikari .. Junior Clerk
3. Shri Udekar Pande .. Junior Clerk

AUXILIARY STAFF

1. Shri Narasingh Panda .. Driver

SUPPORTING STAFF

1.	Shri Gajendra Karali	.. SSG IV
2.	Shri K. C. Meher	.. SSG III
3.	Shri Laba Nag	.. SSG III
4.	Shri G. C. Meher	.. SSG II
5.	Shri Rathan Chand	.. SSG II
6.	Shri Sathrughan Seth	.. SSG II
7.	Shri K. C. Nayak	.. SSG II
8.	Shri Kirtan Kisan	.. SSG II
9.	Shri S. C. Meher	.. SSG II
10.	Shri Badrinarain Guru	.. SSG I
11.	Shri Thomas Topno	.. SSG I
12.	Shri Jaisingh Oram	.. SSG I
13.	Shri Satyarayan Mirdha	.. SSG I
14.	Shri P. K. Bhangaraj	.. SSG I
15.	Shri Premlal Pande	.. SSG I
16.	Shri Dibyalochan Pattanayak	.. SSG I
17.	Shri Godabari Mahanandia	.. SSG I
18.	Shri Surjananda Dishri	.. SSG I

GOA RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1.	Shri T. Joseph Mathai	.. Scientist-in-Charge
2.	Shri R. S. Manohardoss	

Scientist S-1

1. Shri V. Vijayan
2. Shri Sayed Abbas

TECHNICAL STAFF

1.	Shri A. B. Varghese	.. Bosun (T-I-3)
2.	Shri Koruthu George	.. Engine Driver (T-2)

ADMINISTRATIVE STAFF

1.	Shri A. B. Rodrigues	.. Senior Clerk
2.	Shri S. K. Dhabarde	.. Junior Clerk

AUXILIARY STAFF

1.	Shri M. Venkateswara Rao	.. Driver

SUPPORTING STAFF

1. Shri D. D. Naik	..	SSG III
2. Shri R. D. Padnekar	..	SSG II
3. Shri Vasudev G. Kubal	..	SSG II
4. Shri Menino Souza	..	SSG II
5. Shri P. S. Morajkar	..	SSG II
6. Shri C. B. Shirodhkar	..	SSG II
7. Shri V. P. Halernekar	..	SSG I
8. Shri Gopixenkar Chodankar	..	SSG I
9. Shri Chandrakanth Kolvalkar	..	SSG I

BOMBAY RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-3

1. Dr. M. Arul James	..	Scientist-in-Charge

Scientist S-1

1. Shri S. P. Damle
2. Shri Dinesh Kumar Garg
3. Shri H. K. Beri

TECHNICAL STAFF

1. Shri V. Gopalakrishna Pillai	..	Technical Assistant (T-II-3)

ADMINISTRATIVE STAFF

1. Shri Milind S. Bhatkar	..	Assistant
2. Shri Y. W. Mhadgut	..	Senior Clerk
3. Shri Smita K. Shirishkar	..	Junior Clerk

AUXILIARY STAFF

1. Shri B. B. Pinjari	..	Driver

SUPPORTING STAFF

1. Shri S. S. Salvi	..	SSG IV
2. Shri A. T. Waghmare	..	SSG III
3. Shri B. S. Tambe	..	SSG II
4. Shri B. N. Ghare	..	SSG I
5. Shri Vinod S. Salvi	..	SSG I

CALICUT RESEARCH CENTRE

SCIENTIFIC PERSONNEL

Scientist S-2

1. Shri T. S. Unnikrishnan Nair .. Scientist-in-Charge
2. Shri V. Muraleedharan
3. Shri N. Kalaimani
4. Shri K. George Joseph

TECHNICAL STAFF

1. Shri T. John .. Technical Assistant (T-II-3)
2. Smt. M. K. Sreelekha .. Junior Lab. Asst. (T-1)
3. Smt. Tara Karupalli .. Junior Lab. Asst. (T-1)

ADMINISTRATIVE STAFF

1. Shri M. Ravindran .. Senior Clerk
2. Shri M. Balan Nambiar .. Senior Clerk

SUPPORTING STAFF

1. Shri E. Gangadharan Nair .. SSG III
2. Shri C. M. Gopalan .. SSG III
3. Shri K. K. Lakshmanan .. SSG I

ON DEPUTATION

Sl. No.	*Name*	*Deputation with*	*Designation*
1.	Shri P. Sulochanan, Scientist S-2	Fisheries Survey of India. Cochin Base, Cochin.	Zonal Co-ordinator
2.	Shri Y. Sreekrishna, Scientist S-2	Central Institute of Fisheries Education, P.B. No. 7392, Kakori Camp, J.P. Road, Bombay-61.	Professor (Fisheries Technology)
3.	Shri C. Hridayanathan, Scientist 'S'	University of Cochin	Lecturer

APPENDIX - III

Details of budget provision and actual expenditure during the year 1985-86

	NON-PLAN			*PLAN*		
	Budget allotment for the year 85-86		*Expenditure during the year*	*Budget allotment 85-86*		*Expenditure during the year*
	Budget Estimates	*Revised Estimates*	(1985-86)	*Budget Estimates*	*Revised Estimates*	(1985-86)
I. Establishment charges						
i) Salary of officers	22,32,000	21,00,000	21,27,169.18			
ii) Salary of establishment	15,94,000	15,00,000	15,00,867.98			
iii) Dearness allowance	52,74,000	48,05,000	48,78,977.85			
iv) Interim Relief	3,77,000	7,50,000	7,67,693.45			
v) Overtime allowance	35,000	35,000	34,901.55			
vi) House rent allowance	4,79,000	4,25,000	4,58,272.89			
vii) City compensatory allowance	42,000	40,000	36,974.70			
viii) Other allowances	1,87,000	1,60,000	1,86,561.09			
ix) Bonus	—	5,95,000	3,11,840.50			
TOTAL ESTABLISHMENT CHARGES	1,02,20,000	1,04,10,000	1,03,03,259.19	Nil	Nil	Nil
Travelling expenses	2,70,000	2,70,000	2,68,729.58	2,00,000	50,000	75,563.45
Pension contribution	2,000	1,000	.—	—	—	—
Other charges	24,00,000	20,00,000	21,04,337.36	68,00,000	64,50,000	64,26,094.23
Grant-in-aid contribution	—	—	59,585.20	—	—	—
Fellowship, scholarships awards etc.	5,000	55,000	.—			
TOTAL	1,28,97,000	1,27,36,000	1,27,35,911.33	70,00,000	65,00,000	65,01,657.68