

ANNUAL REPORT 1968



**CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
ERNAKULAM
COCHIN-II**

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

ERNAKULAM, COCHIN-11

ANNUAL REPORT FOR THE YEAR 1968

ADMINISTRATIVE & GENERAL

The Institute continued to make its impact felt by vigorously pursuing all its research activities and by disseminating its findings to the fishing and fish processing industries of the country and thereby assisting their all round development. The salient features of the progress made in the investigations under the different projects are given in the respective sections below.

Initiation of a programme of irradiation preservation of fish at the Veraval Substation and Bombay Unit in collaboration with the Bhabha Atomic Research Centre, Bombay was one of the noteworthy events in the year under report. At the headquarters laboratories investigations on biochemical and bacteriological characteristics of fresh and processed fishery products continued to yield useful information throwing more light on various fundamental aspects of fish processing technology.

Among some of the problems which were successfully solved during the year may be mentioned the near perfect control of belly bursting in oil sardines during storage in ice and freezing, transportation of fresh fish in ordinary rail wagons to Calcutta and complete prevention of thaw drip loss in frozen prawns and froglegs by simple chemical treatments details of which are dealt with in this report. Investigations on freezing of different tropical fishes, standardisation of canning procedures for various fishes, causes and prevention of blackening in canned prawns, dehydration of fish and prawns in the tunnel and drum dryers, identification of the pigments in prawns, freeze-drying of fish and fishery products, electrical measurements of moisture and salt in dehydrated fishery products and utilisation of cheap varieties of fish in the form of fish soup powder, fish hydrolysate etc., as detailed in this report, yielded encouraging results. Work on storage characteristics of fish protein concentrate in various containers and pharmacologically active constituents in frog oil was taken up and is progressing satisfactorily. Preshipment inspection of frozen and canned prawns and frozen froglegs exported from the country continued to be carried out by the Institute and necessary export fitness certificates were issued. Close contact was maintained with the fish processing industry by frequent visits to the primary and final processing plants, examining the sanitary conditions prevailing there, helping the processors by technical advice and demonstrations to maintain strict hygienic conditions and thereby

enabling them to turn out the best products which could compete with other sophisticated fishery products in any of the world markets.

Amongst achievements on the Craft and Gear side could be mentioned the development of an instrument fabricated and tested for measuring the angle of attack of the otter boards attached to trawl net. The measurement will enable the fishermen to determine the force of water acting on the otter boards during operations. A prototype of an instrument for the continuous measurement of the variations in dimensions of the net meshes during operation has been fabricated. The design of a combination winch suitable for the 17.53 M. (57'-6") steel boats being constructed under the Government of India, was completed. Studies carried out have revealed that four seam nets were not only equally effective on comparison with two seam nets in inshore waters, but also obtained better catch in offshore waters.

The scientific staff of the Institute continued their visits of the fish processing factories for giving technical advice and demonstrations. Drawings of different types of trawl nets, otter boards, winches, tunnel dryers, etc. were supplied to interested parties on request.

Dr. A. N. Bose who was the Director of the Institute from 1961 resigned his post here in July 1968 to rejoin the Jadavpur University. Shri G. K. Kuriyan, Fishery Scientist (Craft and Gear) assumed charge of the current duties of the post of Director from July 1968.

The Director continued to serve on the following scientific and allied bodies.

1. Chairman of Fish and Fish Products Sectional Committee (AFDC 27) of the Indian Standards Institution.
2. Member of the Central Fisheries Research Committee, Ministry of Food, Agriculture, Community Development & Co-operation.
3. Member of the Scientific Research Committee, Fisheries Technological Research Station, Calicut.
4. Member of the Advisory Committee, Export Inspection Agency, Cochin.
5. Chairman of the Textile Materials for Fishing Purposes Sectional Committee (TDC 42) of the Indian Standards Institution.
6. Member of Working Party on Sardine and Mackerel Resources.
7. Member of the Board of Studies and Faculty of Fisheries of the University of Calicut.
8. Member of the Kerala State Advisory Board on Fisheries.

The following officers also served on various Committees as mentioned below:

Dr. V. Krishna Pillai, Fishery Scientist (Processing) - Member, Dried Fish Products Subcommittee of the Indian Standards Institution.
Shri Dines Roy Chaudhuri, Quality Control Officer - Member, Canned Fish Products Subcommittee of the Indian Standards Institution.
Shri R. Balasubramanyan, Junior Fishery Scientist (Craft and Gear) -

Member, Marine Corrosion Subcommittee of the Metals Committee of the C. S. I. R.

Shri M. Velu, Junior Fishery Scientist (Craft and Gear) - Member Marine Engineering and Shipbuilding Sectional Committee of the Indian Standards Institution.

Besides the officials of Government Departments, scientific workers from research institutes, trainees from State Fisheries Departments and other institutions, students and persons connected with fishing and fish processing industries visited the Institute. The Institute was also visited by Shri Anna Sahib P. Shinde, Minister of State for Food and Agriculture, Government of India and Mr. Roy I. Jackson, Chief of the Fisheries Division, FAO of the United Nations, Rome. The Public Accounts Committee of the Lok Sabha also visited and inspected the working of the Substation at Veraval.

Shri R. Balasubramanyan, Junior Fishery Scientist and Head of the Craft Materials Section of the Institute was awarded a Bronze Medal at the Second International Congress on Marine Fouling and Corrosion held in Athens, Greece during September 1968, in appreciation of a technical paper (mentioned elsewhere) contributed from the Section.

The Budget Estimate and the actual expenditure during the fiscal year 1968-69 are given in the table below:

	Budget Sanction	Actual expenditure
		Non-Plan
Pay of officers	3,00,000	3,03,367.43
Pay of Establishment	4,50,000	4,38,731.29
Allowances	4,30,000	4,60,220.24
Other charges	3,00,000	4,96,557.29
		Plan
Pay of Officers	6,000	4,326.06
Pay of Establishment	50,000	40,044.85
Allowances	49,000	26,400.93
Other charges	10,50,000	2,02,555.40

PROCESSING DIVISION

CHEMISTRY SECTION

Chief findings:

Fructose-1:6-diphosphate aldolase and AMP-deaminase enzymes could be extracted and concentrated from fresh oil sardine muscle. The freeze-dried preparations rapidly lost their activity at -10°C . Total nucleotides in headless *M. dobsoni* stored in contact with ice decreased rapidly parallel to the loss in flavour. In both *M. dobsoni* and *P. stylifera* held in ice, nucleotide dephosphorylation occurred to the extent of 40 to 73% in 17 days. Significant decreases in the levels of acid and molybdate labile P were observed in oil sardines during ice storage. Adenine nucleotides increased appreciably in sardines iced for 4 and 8 days followed by freezing and frozen storage. Gas chromatographic analysis of fatty acids of lipids of Cybium and Caranx showed relatively smaller

quantities of poly-unsaturated acids in the former than in the latter. In *M. dobsoni* phospholipids consisting of cephalin, phosphatidyl serine and their corresponding lyso derivatives constituted 40% of the total lipids. The phenolase enzyme prepared from *P. indicus* by fractionation on DEAE cellulose column showed UV absorbancy maximum at 275m μ . Pyrophosphates and tripolyphosphates inhibited denaturation in extracted proteins. Stability of sarcoplasmic proteins of sardine decreased with increasing temperature and decreasing pH.

a) Biochemical changes during storage of fish at different temperatures :

Fructose-1:6-diphosphate aldolase in the sarcoplasmic protein fraction of fresh sardine muscle was separated and concentrated. The aldolase activity of the muscle in the frozen fish decreased regularly at -10°C , although at a slower rate than ATP-ase activity. AMP-deaminase extracted and purified from sardine muscle deaminated AMP rapidly and ADP much more slowly. The preparation lost its activity in five days at 0°C and rapidly when freeze-concentrated and stored at -10°C . Effect of Ca and Mg ions on its activity was also studied.

b) Flavour bearing compounds in fish and prawns :

Changes in total and individual nucleotides in *M. dobsoni* stored in and out of contact with ice were studied. Rapid fall in total nucleotides occurred in prawns kept in contact with ice. Significant increase in the concentrations of adenine nucleotides were observed in sardines frozen fresh and after storage in ice for four days and then stored at -23°C for 6 months. Molybdate and acid labile P decreased gradually in *M. dobsoni* during ice storage. Resorcinol active substances showed slow decrease and ratio of barium acetate non-precipitable ribose to total acid soluble ribose showed rapid increase in ice storage. In both *P. styliifera* and *M. dobsoni* nucleotide dephosphorylation occurred to the extent of 40 to 73% in 17 days of storage in ice.

c) Studies on fish lipids :

Fatty acid composition of triglycerides and phospholipids of Cybium and Caranx were studied by gas-liquid chromatography. Palmitic, oleic, C_{18:4}, C_{20:5} and C_{22:6} acids predominated in Caranx while C₁₄ acids occurred in lower amounts, the first two accounting for 50% of the total acids. Poly-unsaturated acids were less predominant in Cybium. Major groups of lipids of *M. dobsoni*, *P. indicus*, *P. styliifera*, *M. affinis* and *M. monoceros* were fractionated. Cephalin, phosphatidyl serine and their lyso derivatives accounted for 40% of the total lipids of *M. dobsoni*.

d) Enzyme systems in fish and prawns :

The phenolase enzyme isolated from *P. indicus* and purified on DEAE cellulose column showed maximum UV absorbancy at 275m μ . The peak absorbancy in the visible region was suppressed by addition of cysteine. The cathoptic activity in the muscle of oil sardine and *M. dobsoni* at the optimum pH range on different substrates was in the order caesin > haemoglobin > egg albumin. The skeletal muscle of sardine showed slightly greater activity than belly muscle.

e) Studies on fish proteins :

Pyrophosphates and tripolyphosphates inhibited the course of denaturation in proteins extracted from sardines and prawns. Ortho and hexametaphosphates did not have any protective effect on proteins held in 2% NaCl. While acetates enhanced denaturation, citrates and glucose showed significant protective effect on the proteins. Stability of sarcoplasmic proteins of sardine muscle decreased with increasing temperature and decreasing pH. In the case of *M. affinis* and *M. dobsoni*, good separation was obtained in their sarcoplasmic proteins on electrophoresis on agar gel when borate buffer at pH 8.6 was used. During ice storage of the prawns, the electrophoretic pattern remained unchanged even though their intensities faded with increasing period of storage.

All the items of work in this section are still on hand and will be continued in the ensuing year. The scientific workers in the section are :

Shri M. Rajendranathan Nair,	Jr. Fishery Scientist
Smt. Susamma Jacob,	Asst. Fishery Scientist
Shri K. Gopakumar,	Asst. Fishery Scientist
Shri P. D. Antony,	Research Assistant
Shri K. Devadasan,	Research Assistant

BACTERIOLOGY SECTION

Chief findings:

The surface and bottom layers of seawater contained more bacterial load than the middle layer and bottom mud at the same point. Among pure cultures of pseudomonas, vibrio, achromobacter and flavobacterium frozen in different substrates, the third one was the most resistant to freezing and prawn and sardine homogenate substrates gave the maximum survival rates irrespective of the bacterial genus. Forty seven per cent of the strains isolated from canned prawns were gram positive spore-formers and 12% thermophilic spore-formers. Majority of the strains isolated from swabs, water and other environments in canning factories were gram negative rods. Twenty per cent were thermophilic and no clostridium species were encountered. No difference could be observed between whole prawns stored in CTC ice and control upto 6 to 8 days. Sardines dipped in 50 ppm. CTC and stored in ordinary ice did not show any difference from the control till the 10th day of storage. 6.9m μ / g of CTC was absorbed by the fish during the treatment which fell to 0.6m μ / g in 10 days of storage. A 5% suspension of prawn muscle in 2 ppm CTC solution destroyed 50% of the antibiotic in 4 hours. Eighty to 90% of the bacteria on fresh sardines were sensitive to 5 ppm CTC in the seawater agar medium while 97% destruction was observed when 10 ppm of the antibiotic was used. Trypticase soy agar in distilled water was found to support bacterial growth best of three different media tried.

a) Bacteriology of fresh, iced and frozen fish:

Effect of environmental conditions on the nature of bacterial flora of fresh prawns was investigated. For this purpose offshore seawater samples collected from surface, middle and bottom layers and prawns from the same area were analysed. Mud samples gave the lowest bacterial loads while the surface or bottom layers showed the highest counts. Data collected so far did

not indicate any correlation between environmental flora and those on the prawns and the work is to be continued.

Studies on the seasonal variations of the bacterial flora on different parts of the body of oil sardine were continued. Pure cultures of pseudomonas, vibrios, achromobacter and flavobacterium in different substrates like seawater peptone and sardine and prawn homogenates showed that the third strain was the most resistant to freezing and sardine and prawn homogenate substrates gave the maximum survival rates irrespective of the bacterial genus. Ninety to 100% reduction of viability was observed when strains with initial concentrations ranging from 2.1×10^4 to 2.1×10^8 were frozen showing that the phenomenon was independent of the initial concentration.

b) Bacteriology of canned prawns:

Out of 913 strains of bacteria isolated from canned prawns and related environments, 47% were gram positive spore-formers and 12% were thermophilic spore-formers. Two hundred and fifty nine strains of bacteria were isolated from swab, water, ice and raw materials at different stages of processing, majority of which consisted of gram negative rods. Twenty two per cent of them were thermophilic in nature. All the gram positive spore-formers isolated from both the sources were classified to the species level. No Clostridium species were encountered.

c) Antibiotics in preservation of fish:

In the case of whole prawns stored in CTC ice, no difference in bacterial and organoleptic qualities was observed between the treated and control till 6 to 8 days of storage. Blackening started on the sixth day in both cases. Sardines dipped in 50 ppm CTC and stored in ordinary ice showed little organoleptic difference between the treated and control till the 10th day of storage. $6.9m^{\mu}/g$ of CTC was absorbed during the treatment which fell to $0.6m^{\mu}/g$ during the 10 days of storage.

A 5% suspension of prawn muscle in 2 ppm CTC solution destroyed 50% of the CTC in 4 hours at room temperature. Effect of cooked meat and shells of prawns on the rate of destruction of the antibiotic was also studied. CTC at 5% level in seawater agar medium destroyed 80 to 90% of the bacteria from fresh sardines. Ninety seven per cent destruction was observed when 10 ppm of the antibiotic was incorporated.

d) Comparison of media for total plate counts:

Media containing beef extract and peptone, ordinary seawater agar compounded in full strength seawater and the same in 75% seawater used to determine total bacterial counts in fresh, frozen and cooked frozen prawns did not show any significant difference. However, trypticase soy agar in distilled water generally gave higher counts with both types of frozen prawn samples. A preponderance of gram positive organisms was observed among the bacteria isolated by these media.

All the items of work in this section will be continued during the coming year also. The scientific workers in the section are:

Shri K. Mahadeva Iyer	—	Jr. Fishery Scientist
Smt. T. C Karthiyini	—	Asst. Fishery Scientist
Shri V. Narayanan Nambiar	—	Research Assistant
Shri P. K. Surendran	—	Research Assistant

PROCESSING SECTION

Chief findings:

Partially frozen sardine blocks packed in 2.5 cm. thermocole insulated plywood box and stored at 5 to 10°C. remained in fair condition for 6 days while the same packed in plain plywood boxes remained in this condition only for 3 days. The keeping periods for fully frozen sardines under the same conditions were 7 days and four days in insulated and plain containers. Fully frozen kilimin blocks stored at 5 to 8°C. without any container thawed in two days and remained in edible condition for another two days. Similar results were obtained in the case of frozen baracuda, seer fish slices and whole tuna. Dip treatment of oil sardines in 15% brine for 30 minutes prior to freezing was effective in controlling belly bursting in all size grades of sardines and all seasons tried. Dry ice was effective for supplementary cooling of already chilled fish during long distance transportation.

Dip treatment in a 16% solution of sodium tripolyphosphate and sodium dihydrogen phosphate in the ratio 3:1 at the rate of 90 ml/kg. of material prior to freezing prevented thaw-drip and cooking losses completely in frozen prawns and froglegs. Individually frozen oil sardines were more prone to protein denaturation and rancidity development than block frozen ones. Frozen storage life of the latter decreased with increasing period of pre-process storage in ice. A sharp fall in salt soluble N and myosin contents occurred in frozen lactarius by two weeks of frozen storage. In frozen stored peeled and deveined prawns, sarcoplasmic protein N did not show any appreciable change upto five months, salt soluble N and myosin progressively decreased and drip volumes increased with frozen storage. Frozen and stored crab meat showed marked changes in colour and flavour after four months of storage though no appreciable change was observed in the chemical characteristics. Changes in these were observed only after 8 months of storage.

Freshwater fishes like catfish and mullets could be canned in oil to give satisfactory products. Presence of water higher than 10% of the oil in canned mackerel and sardines caused quick development of rancidity and blackening of the can. Concentrations of blanching brine and blanching time were the most important factors affecting the drained weights in canned prawns. Even though icing and freezing of prawns prior to canning and overblanching of prawns improved their texture immediately after canning, on subsequent incubation both treated and control samples behaved similarly. The fat content in different species of prawns varied from 5.5 to 7.5% and had no influence on sloughening of the meat after canning. No hydrogen sulphide could be detected in filled brine when its pH was 6.8 or less whereas significant levels of the compound were present when the pH was 7.0 or above. Addition of chelating agents like EDTA could not prevent blackening due to copper in canned prawns while discoloration due to iron could be controlled by chelating agents at and above neutral pH.

Prawns dried in the drum after dipping in saturated brine for five minutes kept in sound condition for 12 weeks. Two of the main pigments in prawns were identified to be xanthophyll and astacene. The optimum tray loading was

found to be 1kg./900 cm² for salted fish in the tunnel dryer. Moisture contents in dried fish could be measured accurately by electrical methods. Conductivities of dried fish could be correlated with their salt contents and hence the latter could be directly measured electrically. Freeze-dried, peeled and deveined prawns and fish salad preparations remained without any appreciable change in chemical and organoleptic characteristics even after two years of storage.

The oil-binding capacities of cooked prawns, pallikora, mackerel, sardine and kilimin meats were 16.0%, 12.0%, 9.0%, 5.2% and 3.4% by weight respectively. Fifty eight per cent of the cooked meat of jew fish and 49% of that of kilimin were solubilised by 0.1% pancreatin at pH 7.6 in 24 hours. Homogenised fresh prawns treated with pepsin at pH 1.5 overnight followed by pancreatin at pH 7.6 yielded a hydrolysate which on concentration gave a product with good flavour and odour and completely soluble in water.

a) Preservation and transportation of fishery products:

Experiments under simulated conditions of transportation using different fishes in partially frozen and fully frozen state in blocks in insulated and plain containers and at different temperatures were carried out and the results are tabulated below:

Fish used	Container	Temperature of storage	Storage life in days	Final temperature
1) Sardines partially frozen (-3 to -4°C)	A	5 to 10°C	6	2 to 3°C
	B	-do-	3	
2) Fully frozen sardines (-15°C)	A	-do-	7	1°C
	B	-do-	4	...
3) Kilimin fully frozen (-17°C)	No container	5 to 8°C	4	...
4) Baracuda partially frozen (-3°C)	A	4 to 7°C	5	...
	B	-do-	3	...
5) Seer fish fully frozen slices (-15°C)	A	2 to 5°C	6 to 7	...
	B	-do-	4 to 5	...

A: 2.5 cm. thermocole insulated plywood box.

B: Plain plywood box.

Similar studies with tuna showed that its black meat which contained larger amount of fat deteriorated faster than red meat.

Sardines (fat content 8 to 11% DWB) stored at -1 to -1.5°C, 0 to 1°C, and 6 to 8°C in sealed polythene bags remained in edible condition for 13 to 16, 4 to 5 and 2 days respectively. Similar studies with seer fish are in progress.

Treatment of oil sardines with 15% brine for 30 minutes prior to freezing or storage in ice was effective in controlling the belly bursting in all size grades of the fish in all seasons and under different conditions of storage. No chemical or organoleptic difference could be detected between the treated and control samples during the first four weeks of frozen storage. After this period, the treated samples showed slightly higher peroxide values and was organoleptically inferior to the control, probably due to the salt absorbed accelerating development of rancidity.

Dry ice could not be used as a substitute for ordinary ice for chilling fish because freezer burn was caused by direct contact of fish with it. Secondly its cooling capacity was only double that of ordinary ice which made it comparatively uneconomical and thirdly, it could not effectively chill fish layers thicker than 7.5 cm. because the surface layers got frozen in the case of thicker layers. However, laboratory experiments clearly indicated that dry ice could be successfully used for supplementary cooling of already chilled or frozen fish during long distance transportation in insulated vans.

b) Studies on freezing of fishery products:

Prawns: Peeled and deveined prawns were held in ice upto 7 days and samples frozen at intervals of 0, 1, 3, 5 and 7 days. During frozen storage ∞ -amino N showed a sharp increase upto two months and then remained steady. Sarcoplasmic protein N did not show any appreciable change upto five months while salt soluble N and myosin showed progressive decrease. Even though drip volume increased gradually, drip constituents showed a gradual fall corresponding to the number of days of pre-process storage in ice.

Whole cooked and frozen prawns from fresh uniced material remained in organoleptically fair condition even after six months of frozen storage even though moisture, water extractable N, non-protein N, and ∞ -amino N decreased gradually.

Polyphosphate treatment: A dip treatment of peeled and deveined prawns and froglegs in a solution of a mixture of sodium tripolyphosphate and potassium dihydrogen phosphate prior to freezing retained their drained weights and volumes on thawing by preventing the drip losses and shrinkage, chemical characteristics also showing no appreciable change. The treated samples had better consumer appeal than the controls. Repeated dips in the same solution of the chemicals with replenishments could reduce the cost of treatment by half i. e., to Rs. 20/- per 100 kg. A further modification of the application of these chemicals by treating 100 kg. of raw material with 90 ml. of a 16% solution of the two chemicals in the ratio 3:1 could reduce the cost of treatment without impairing the other beneficial effects. This treatment worked well with peeled and deveined prawns stored in ice for various periods, but did not show any advantage with whole and headless prawns.

Sardines: Individually frozen and stored sardines showed more rancidity and denaturation of proteins than block frozen ones. Sardines held in ice and frozen after 0 & 1, 3 and 5 days and stored showed their maximum shelf lives to be 20, 13 and 2 weeks respectively.

Seer: Round slices and fillets cut from seer fish were stored in ice upto 7 days and samples frozen at intervals and stored. Peroxide values of the fillets were higher than those of the slices but no appreciable difference in the degree of denaturation of proteins was observed between the two samples.

Total protein and non-protein nitrogen in the drip showed a gradual increase as the days of storage advanced. On the fourth day of storage of the raw material in ice, its pH fell below 6.0 with simultaneous development of chalkiness.

Lactarius: The fish held in ice for 0, 1, 3, 5 and 7 days were individually frozen and stored. During ice storage peroxide values increased only slightly but salt soluble and sarcoplasmic protein nitrogen decreased by 4% and 6% respectively. These changes were much more sharp during frozen storage for two weeks.

Crab: Marked changes in colour and flavour of frozen crab meat were observed after four months; but no appreciable change in moisture, total N and sarcoplasmic protein N occurred during the period. After 8 months, salt soluble N, sarcoplasmic protein N and ATP-ase activity of myosin showed considerable decrease.

Mussel: Almost similar results as in the case of crabs were obtained in experiments on iced and frozen storage of mussels.

Tuna: Red and black meat of tuna were studied for their biochemical properties prior to starting freezing studies with them.

Mechanised peeling table: A mechanised peeling table with arrangements for moving raw prawns to the peelers and removing peeled meat and shell portions away from them mechanically, was fabricated and some trial runs were taken successfully.

Electrical resistance thawing: 50 mm. thick kilimin blocks weighing 1.75 kg. were thawed in the unit fabricated in the laboratory in 25 minutes. Peeled and deveined and headless shell-on prawn blocks 30 x 15 x 5 cm³ weighing 2.67kg. were thawed by pre-heating in running water for 20 minutes followed by application of 35 V A/C 50 C/S for 30 minutes.

A calorimeter was designed and fabricated for measuring enthalpy of frozen fish. The enthalpy of peeled and deveined frozen prawn block was found to be 0.09 KWH/kg and that of headless frozen prawn 0.094 KWH/kg.

c) Canning of fishery products :

Standardisation of canning procedures: Catfish was brined in 15% brine for 15 minutes after dressing and cleaning, packed in cans and subjected to pre-cooking at 0.35 kg/cm² pressure for 30 to 35 minutes. Cook-drip was drained off, filled with hot refined vegetable oil, exhausted, sealed and sterilised at 0.84 kg/cm² pressure for one hour.

Mullet was canned following the same procedure except that the brining time was increased to 22 minutes. The products are under storage studies.

Cans of sardine and mackerel with different amounts of water in the filling oil were prepared by pre-cooking the fish for different durations using unlaquered cans and incubated at 37°C. Development of rancidity and can blackening were much quicker when the filling medium contained more than 10% water.

Pre-process storage of prawns in ice: With a view to finding out the maximum period upto which prawns could be stored in ice prior to canning without materially affecting the quality of the canned product, different species of prawns were held in ice in headless and peeled and deveined form, canned as usual and the quality of the products studied in detail.

Drained weight in canned prawns: Concentration of blanching brine and blanching time affected the drained weight of canned prawns to a much higher extent than factors like acidity and volume of filling brine, cooling time of blanched prawns and sterilisation time.

Sloughening in canned prawns: Icing and freezing of prawns prior to canning as well as overblanching of the prawns improved the texture of the products immediately after canning. However, after 40 to 50 days of incubation at 37°C. both control and treated ones behaved similarly. Lipid contents of connective tissues in different varieties of prawns varied from 2 to 10% DWB and total lipids from 5.5 to 7.5%. The effects of these on the rate of sloughening of canned prawns on storage are being studied.

Blackening in canned prawns: The amount of volatile sulphur compounds (VSC) released as H_2S into the filled brine of canned prawns at pH values 3.6 to 8.7 was only 0.03 to 3.8 mg% H_2S which is insignificant when compared to the total sulphur present in the muscle (800 to 900 mg%). Below pH 6.8 no H_2S could be detected in the filled brine, whereas at and above pH 7.0 significant levels of the compound were encountered accompanied by black discoloration of can interior. On the other hand in the case of material blackening the main causative factor was found to be copper.

Quantity of acid to be added to filling brine: The quantities of citric acid to be added to filling brine in order to maintain an acid level of 0.1% in filled brine after blanching the material in 7% brine containing 0.2% citric acid have been worked out for prawns kept in contact with ice for different periods. Biochemical changes occurring in such products during storage are being studied.

d) Dehydration of fish and shell fish:

Prawns: Prawns dried in the drum dryer after dipping in saturated brine for five minutes to a moisture content of 21% (salt: 6.5% DWB) kept in sound condition at room temperature for seven weeks. After 12 weeks the product showed slight yellow discoloration but was still free from fungus.

Two of the pigments extracted from fresh prawns and separated by column chromatography on alumina were identified to be xanthophyll and astacene by their spectral characteristics. Washing the extract of the pigments with alkali to remove fatty acids and transferring of the pigments to alcohol to remove triglycerides prior to chromatography gave the best separation with the minimum tailing and diffusion.

Other fish: By making use of the accelerated technique of drying in the tunnel (under constant relative humidity but phased temperatures) small size split open and salted fish could be dried to 25 to 30% moisture levels in 10 to 12 hours and medium and large size fishes in 16 to 18 hours.

Electrical measurement of moisture in dried fish: Experiments on electrical measurement of moisture in heavily salted sardines and cooked and dried prawns at different moisture levels showed that moisture contents above 33% could not be measured accurately by this method. Salt contents did not affect the measurements. Capacitance values increased with packing density and decreased with particle size. An instrument based on these principles is under fabrication.

Electrical measurement of salt in dried fish: Salt contents in prawns, kilimin and sardines dried to different moisture levels were determined by measuring their conductivities using platinum electrodes. The results were in fair agreement with values obtained by chemical methods and were not affected by different moisture levels in the samples.

Design of dryers: A solar dryer (black roof dryer) with a capacity of 50 kg/batch was designed and its cost of fabrication calculated.

Freeze drying: Several batches of peeled and deveined prawns were freeze dried and changes occurring in protein and non-protein fractions during the different stages of processing studied in detail. A number of freeze dried salad preparations from fish developed by the Institute were reported to be acceptable to the Defence Purchase Organisation and some other parties. All these products remained without any appreciable change in organoleptic or chemical characteristics for more than two years.

e) Speciality products from fish and shell fish:

Shrimp extract from local dry prawns: Locally available dry prawns were powdered, treated with 0.05% papain at pH 5.5 for one hour at 60°C. followed by 0.2% pancreatin at pH 7.5 at 40°C. for two hours, final pH adjusted to 6.8 and concentrated. The product was sealed in 8 oz. cans and sterilised.

Emulsifying capacity of cooked fish meat: The fat-binding capacity of cooked fish meat was determined by blending known amounts of fat with known amounts of cooked fish meat, holding the blends at 70°C. for 30 mts

centrifuging and extracting the liberated fat. The bound fat was then found by difference. The results were :

Prawn	—	16.0%
Pallikora	—	12.0%
Mackerel	—	9.0%
Sardine	—	5.2%
Kilimin	—	3.4%

Browning in fish flour carbohydrate systems: Storage studies of fish flour-glucose mixture at various moisture levels showed maximum browning at 30% moisture. Further experiments showed that relative humidity did not affect the browning phenomenon which was largely dependent on the nature of carbohydrate used.

Protein supplementary foods from trash fish: 58% of the cooked meat of jew fish and 48% of that of kilimin were solubilised by hydrolysis with 0.1% pancreatin at pH 7.6 for 24 hours.

Utilisation of stale prawns: Rejected prawns from freezing factories could be hydrolysed by pepsin at pH 1.5 overnight followed by pancreatin at pH 7.6. The hydrolysate on concentration gave a product with characteristic odour and flavour and completely soluble in water.

Recovery of proteins from blanch liquor: The blanch liquor from prawn canning factories was acidified with 1 to 2 ml. of orthophosphoric acid per litre, boiled, cooled and filtered through a filter press. The pasty mass of proteins obtained had a moisture content of 80.9%, NaCl 3.9%.

Breaded prawns: The moistening and peeling off of the batter coating on frying and canning of breaded prawns could be controlled by drying the fried product under vacuum for 30 minutes before canning.

Researches completed: Work on blackening of canned prawns and standardisation of canning techniques has been completed. A new scheme on changes in micro-constituents of fishery products during different stages of canning and subsequent storage is contemplated for immediate attention. Changes in free amino acids, minerals and sulphur compounds will be studied. Improvements in canning techniques for prawns and sardines and perfection of a method for canning froglegs in oil and brine also will be taken up.

All other items of work will be continued during the ensuing year also. The scientific personnel handling these items of work are:

Dr. V. K. Pillai	—	Fishery Scientist
Shri D. R. Chaudhuri	—	Quality Control Officer
Shri T. K. Govindan	—	Jr. Fishery Scientist
Shri C. V. N. Rao	—	Asst. Fishery Scientist
Shri K. K. Balachandran	—	Asst. Fishery Scientist
Shri Cyriac Mathen	—	Asst. Fishery Scientist

Shri S. Ayyappan Pillai	—	Asst. Fishery Scientist
Shri P. K. Chakraborty	—	Asst. Fishery Scientist
Shri P. A. Perigreen	—	Asst. Fishery Scientist
Shri V. Venugopalan	—	Research Assistant
Shri M. Nandakumar	—	Research Assistant
Shri A. Vasantha Shenoy	—	Research Assistant
Shri P. R. Girija Varma	—	Research Assistant
Smt. P. L. Chinnamma	—	Research Assistant

BY-PRODUCTS SECTION :

Chief findings:

Fish protein concentrate (FPC) could be prepared from whole fish by treatment with hydrogen peroxide, cooking, pressing and extraction with alcohol followed by hexane-alcohol mixture. Moisture and TBA values of FPC stored in canvas bags and bitumin coated gunny bags increased during storage. Chitin could be isolated from prawn shell waste eliminating the step of drying and extraction with acetone. Non-saponifiable matter occurred to the extent of only less than 1% in frog oil.

a) Preparation of fish protein concentrate:

Whole miscellaneous fish could be used for preparation of fish protein concentrate by mincing them with equal weights of water, treating with 0.5% hydrogen peroxide at room temperature for two hours, cooking with 0.5% acetic acid at 80°C for 30 minutes, adjusting to pH 5.5, pressing and extracting the press cake with alcohol followed by hexane-alcohol mixture. Essential amino acids in the product were determined. Storage studies of the product in different containers showed that moisture and TBA values increased in samples stored in canvas bags and bitumin coated gunny bags.

b) Fish ensilage:

The ensilage prepared by the process developed by this Institute kept without any appreciable change for more than nine months. Feeding trials with the product are progressing satisfactorily.

c) Bacteriological peptone:

Treatment with ferric chloride prevented precipitate formation when the peptone prepared in the laboratory was used to prepare agar medium in seawater. Amino acid composition of the product was studied at various stages of preparation of the product with a view to studying and preventing the loss of tryptophane, tyrosine and lysine so as to avoid addition of caesin.

d) Prawn shell waste:

Chitin could be isolated from prawn shell waste avoiding the step of drying and acetone extraction previously followed. Experiments for preparing chitosan and an infant feeding composition from chitin are progressing.

e) Frog oil:

With a view to isolating and identifying the pharmacologically active principle in frog oil, the blubbers of frogs were extracted with chloroform-methanol and analytical characteristics of the oil studied. Non-saponifiable matter was only less than 1% in the samples. Fatty acid composition of the oil is being studied by gas liquid chromatography.

All the items of work are to be continued in the coming year also. The scientific workers handling the work are:

Shri P. Madhavan — Asst. Fishery Scientist
 Shri M. Arul James — Asst. Fishery Scientist
 Shri P. K. Ismail — Research Assistant
 Shri A. G. Radhakrishnan — Research Assistant

QUALITY CONTROL SECTION:

Chief findings:

Treatment of freshly cut froglegs with brine containing sodium hypochlorite brought down bacterial load to safe limits. The simplified process developed by the Section has been adopted by most of the leading exporters of frog-legs with great success. The major sources of contamination of the product were found to be unclean surfaces, utensils etc. and bacteriologically unsound water and ice used in some of the cutting centres and factories.

a) E. coli in frog-legs:

Washing of the freshly cut frog-legs in salt solution containing sodium hypochlorite, peeling, dressing, wrapping and freezing under strict hygienic conditions not only removed E. coli but brought down the total bacterial counts below 10,000/ g. The treatment did not cause any detectable change in organoleptic and chemical qualities during frozen storage.

b) Factory sanitation:

Peeling sheds, freezing factories and canning factories and their materials were surveyed during the period for sanitational aspects and a total of 490 utensils, 96 water samples and 72 ice samples were studied in detail. The results are indicated in the following table:

	Number surveyed	Material	Standard Plate Count (S. P. C.)	Faecal streptococci	E. coli
Freezing factories	30	Utensils/cm ²	5 to 8.6 x 10 ⁶	0 to 310	0 to 375
		Water/ml	5 to 3800	0 to 20	0 to 10
		Ice/ml	20 to 6.1 x 10 ⁴	0 to 30	0 to 13
Canning factories	25	Utensils/cm ²	100 to 3.0 x 10 ⁶	0 to 20	0 to 40
		Water/ml	0 to 50	0	0
		Ice/ml	10 to 180	0	0
Peeling sheds	24	Utensils/cm ²	3.1 x 10 ² to 8.9 x 10 ⁶	0 to 400	0 to 300
		Water/ml	140 to 2300	0 to 120	0 to 110
		Ice/ml	30 to 1180	0 to 80	0 to 30

Besides, 172 samples of raw prawns and 105 samples of frog-legs at different stages of processing from different processing factories were studied for their biochemical and bacteriological qualities.

c) Assistance to the industry:

13 samples of bleach liquor, 28 samples of water, 30 samples of canned prawns, 15 samples of canned fishes, two samples of dried turtle meat and two samples of dried prawn powder received from different processors were analysed and results communicated to the concerned parties.

d) Numerical scoring system for ice-stored prawns:

Work was initiated with a view to developing a numerical scoring system for assessing the loss in quality during icing using *M. affinis* and *M. dobsoni* and correlating the same with biochemical indices of spoilage. It was observed that changes in chemical indices of spoilage were reflected in organoleptic quality also.

The work of the section will be continued in the coming year also. The scientists associated with the section are:

Dr. V. K. Pillai	—	Fishery Scientist
Shri D. R. Chaudhuri	—	Quality Control Officer
Shri T. S. Gopalakrishna Iyer	—	Asst. Fishery Scientist
Shri H. Krishna Iyer	—	Asst. Fishery Scientist

PRE-SHIPMENT INSPECTION:

During the year under report, 14,319 metric tons of frozen prawns, 1,890 tonnes of canned prawns and 381 tonnes of frozen frog-legs were inspected under the scheme of pre-shipment inspection throughout the country. Detentions due to non-conformity to standards amounted to 1.8%, 2.3% and 0.33% respectively of the first, second and third commodities.

Consequent to the introduction of bacteriological standards for cooked frozen prawns from 15-1-1968, 2,920 samples of the product were examined in detail for bacteriological quality. Samples from all batches of canned prawns inspected were also subjected to bacteriological tests. Bacteriological defects (due to understerilisation, seam defects etc.) were found to be the major causes of rejection in canned prawns.

The scientific workers in this scheme are:

Dr. V. K. Pillai	—	Fishery Scientist
Shri D. R. Chaudhuri	—	Quality Control Officer
Shri T. S. Gopalakrishna Iyer	—	Asst. Fishery Scientist

besides the normal staff attached to the Scheme which includes one Senior Inspection Officer, twenty Inspection Officers and three Analysts.

CIFT SUBSTATION, VERAVAL:

Chief findings:

Shelf life of gutted and gilled hilsa during storage in ice was extended by more than six days over the control by treatment with an antibiotic. The skin of hilsa contained 20 to 30% of fat and the liver yielded 10% by its weight of oil containing 1500 I. U/g of vitamin A. Laminated and dried Bombay duck treated separately with 0.1% B. H. T. or NDGA remained free from yellow discoloration and consequent spoilage even after nine months of storage as against 2 to 3 months in the case of the control. Samples of commercially dried Bombay duck stored below 70% R. H. got dehydrated while those stored above 70% absorbed moisture and got attacked by fungus in periods inversely proportional to the level of R. H. Fresh Bombay duck could be preserved in ice in prime condition for five days and in satisfactory edible condition for the next 10 days. Silver pomfrets and black pomfrets iced for 3 days gave fairly good products on canning while hilsa gave only a satisfactory product after the same length of holding in ice. Smoking prior to canning or curing was found to be highly suited for almost all important food fishes of the locality.

- 1) Improvements in the methods of handling, preservation and transport of commercially important fish and shell fish:

A new line of investigation on radiation pasteurisation of fish and shell fish was initiated towards the fall of the year in collaboration with the Bhabha Atomic Research Centre, Bombay. Consignments of fish were sent to Bombay, irradiated, brought back to Veraval and further studies made.

Shelf life of gutted and gilled hilsa and its fillets in ice was extended by more than six days over the control by treatment with an antibiotic. The skin of hilsa contained 20 to 30% DWB of fat while its liver yielded 10% oil containing about 1,500 I. U/g. of vitamin A. Fat content of roe increased with maturity of the fish.

The red muscle of black pomfret contained higher amount of fat than white muscle. The fat extracted from red muscle was dark brown and showed higher peroxide, free fatty acid and lower iodine values than the fat from white muscle.

Pseudomonas, micrococcus, *brevibacterium*, *corny bacterium* and *achromobacter* were the organisms commonly met with in the seawater and fish of the locality. Detailed investigations on their occurrence in slime, muscle, guts and seawater and effect of icing on changes in the flora were carried out.

- 2) Investigations on economic utilisation of elasmobranch fish:

An unusually big shark, 6 m. long stranded at Veraval coast was processed. The skin measuring 4.2 m. x. 1.7 m. and weighing 85 kg. was tanned into leather. Experiments on utilising the flesh by salting and drying as well as by converting into edible flour were carried out.

- 3) Improvements in the methods of handling and preservation of Bombay duck:

Laminated and dried Bombay duck treated separately with 0.1% of BHT or NDGA remained free from yellowish brown discoloration and consequent spoilage even after storage for nine months while the controls got spoiled in 2 to 3 months. Samples of commercially dried Bombay duck got attacked by fungus within 7 to 8 days, 25 days, 50 days and 100 days when stored at 100%, 90%, 80% and 70% R. H. respectively. Below 70% R. H. the samples got dehydrated and rancid. Samples stored in containers without airtight lids got attacked by insects and spoiled in three months while those in airtight containers remained in good condition for more than six months.

Fresh Bombay duck could be preserved in ice in prime condition for five days and in satisfactory edible condition for the next 10 days. This gradation in quality was also reflected in the laminated and dried products prepared out of them. Several experiments were conducted at Jafrabad with a view to fixing up the minimum possible concentration of BHT and NDGA required to prevent discoloration of the laminated and dried Bombay duck during storage.

4) Standardisation of canning techniques for commercially important fishes:

Squid paste with and without addition of citric acid and spices and crab meat with and without 0.45% citric acid and 0.01% NDGA were canned and their storage characteristics are being studied.

Loss of weight by pre-cooking at 0.35 kg/cm² pressure for 15 minutes was found to be 15, 17 and 20% in black pomfret, silver pomfret and hilsa respectively. Silver and black pomfrets iced for 3 days yielded fairly good products on canning while hilsa gave only a satisfactory product after the same length of storage. The longer the pre-process storage in ice the higher was the loss of nitrogenous constituents in the canned products. Smoked eel fillets were canned after different periods of smoking and drying and quality changes of the products on storage are being studied. Canned Bombay duck paste remained in good condition for six months.

5) Smoke curing as a means of preservation for fish:

Eel fillets gave a product with good consumer appeal on smoke curing and drying. Other fish like dhoma, shark fillets, squid, hilsa, skate and ray also yielded similar results. Smoking of Bombay duck with and without guts gave products with golden yellow colour and palatable flavour which were much less prone to insect attack than control samples. Smoked and dried products were generally found to be very susceptible to fungus attack. Dipping the fish in 5% sorbic acid or potassium sorbate solution for one minute prior to smoking and sprinkling of finely powdered salt, sorbic acid, potassium sorbate, sodium propionate and their mixture on smoked samples were very effective in controlling fungus attack for considerable periods of storage.

All these items of work will be continued in the coming year. The scientific workers associated with the work are:

Shri R. Venkataraman — Fishery Scientist
Shri M. K. Kandoran — Asst. Fishery Scientist

Shri L. D. Kamdar	—	Research Assistant
Shri K. K. Solanki	—	Research Assistant
Smt. C. R. Raje	—	Research Assistant

CIFT UNIT, BOMBAY

Chief findings:

Eel fillets could be stored in ice in acceptable condition for four days. A highly acceptable wafer with good retention of available lysine could be prepared from low grade fish. Fresh peeled and deveined prawns could be stored in acceptable condition at 0°C for more than 30 days after a low dose of gamma irradiation.

1) Freezing and cold storage of fish:

Storage life of eel fillets in ice was found to be four days. On the other hand fillets from trawler caught ghol could not be preserved for more than two days in ice.

2) Utilisation of low grade fish:

Wafers with high retention of available lysine could be prepared from low grade fish by kneading the cooked fish meat with equal amount of cooked starch moulding into required shape and drying.

3) Irradiation of seafoods:

A combined programme of work on this subject was initiated during the period of report in collaboration with the Bhabha Atomic Research Centre. Fresh peeled and deveined prawns irradiated with low doses of gamma rays from Co 60 kept in acceptable condition for more than 30 days at 0°C.

4) Preshipment inspection:

704.6 tons of frozen prawns, 27.8 tons of canned prawns and 118.6 tons of frozen froglegs were inspected and certified during the period of report. Fifty samples of cooked frozen prawns and 1,320 samples of canned prawns were analysed for bacteriological quality under the scheme.

5) Technical assistance:

Ninety three samples of frozen froglegs and 9 samples of cooked frozen prawns voluntarily offered by the industry consequent to complaints from foreign importers were examined for total bacterial contamination, salmonella and E. coli. Besides, a close watch was maintained on the sanitary conditions in the processing factories and necessary guidance given whenever required.

All these items of work will be continued during the ensuing year. The scientific workers engaged in these investigations are:

Shri P. V. Kamasastri	—	Jr. Fishery Scientist
Shri K. K. Balachandran	—	Asst. Fishery Scientist

CIFT UNIT, CALICUT:

Chief findings:

Dipping of salted fish in natural vinegar containing small quantities of BHA and rinsing the salted fish in solutions of sodium propionate or sodium benzoate before drying prolonged the shelf life of the products considerably. Incorporation of the latter two compounds in salt used for curing fish along with an antioxidant was also effective in retarding fungus and 'red' attack in the products. Subjecting masmin to temperatures of 115°C for 15 minutes and sealing in polythene bags could effectively control insect infestation in the products. Brownish discolouration of cured products was more pronounced in the case of fatty fishes and the phenomenon was accelerated by cupric ions. Even though application of liquid smoke was easier than kiln smoking, the product from the former was inferior. Frozen blocks of sardines packed in thermo-cole insulated plywood boxes could be transported in sound condition from Calicut to Howrah in refrigerated railway wagon upto Madras and ordinary wagon thereafter.

1) Improvements in curing techniques:

A dip treatment of salted fish in natural vinegar containing small quantities of BHA before drying was able to keep the products free from fungus, 'red' and general putrefaction for considerable lengths of time. The method was found to work equally well with commercially cured samples which were given a dip in the above preservative and dried. In the normal curing process, when the salted fish was rinsed in dilute solutions of sodium propionate or sodium benzoate instead of water before drying, the products were found to withstand the above types of spoilage remarkably well. Incorporation of either of these compounds in the solid form along with an antioxidant in salt used for curing fish considerably simplified the application of the preservative yielding the same degree of beneficial effects.

Subjecting masmin to temperatures of 115°C for 15 minutes destroyed all insect infestation in the egg and larval forms, so that sealing of the treated products in polythene bags or other containers without chance of further contamination, could keep them free from spoilage due to insects for quite a long time.

High fat contents of fish were found to be predominantly responsible for the brownish discolouration occurring in the cured products. This could be substantially controlled by incorporating BHA or ditertiary butyl quinone in the curing salt to the extent of 1 in 2000. Cupric ions were found to accelerate this phenomenon of browning.

Experiments on salting and direct sealing of salted fish in polythene bags were carried out with a view to simplifying the curing process. Ordinary bazaar salt was found unsuitable for the purpose as it promoted rapid growth of fungus and 'red'. Heat sterilised refined salt preferably with chemical preservative like sodium benzoate gave good results.

2) Smoke curing of commercially important fishes :

Procedure for smoke curing of all the important commercial fishes was drawn up. Even though application of liquid smoke was easier than kiln smoking, the product from the former method was inferior.

3) Bacteriological study of cured fish :

Thirty one samples of commercial cured fish were examined bacteriologically and data collected so that they could be used for formulation of bacteriological standards for the products in quality control programme.

4) Transportation of fish :

Frozen blocks of sardines packed in 2.5 cm. thick thermocole insulated plywood boxes, transported in refrigerated wagons upto Madras, iced on the top of the material and forwarded in ordinary rail wagons to Howrah reached the destination in fine partially thawed condition when they could be marketed as fresh fish. Treatment of the sardines with 15% brine for 30 minutes prior to freezing effectively controlled the bursting of bellies usually occurring on freezing and thawing of sardines.

5) Preshipment inspection :

510.8 tons of frozen prawns and 109 kgs. of frozen froglegs were examined during the period of report. 1.53% of the former had to be detained due to non-conformity to standards.

6) Assistance to industry:

A demonstration of the application of mixed preservative to cured fish was carried out at Tuticoria at the instance of the Fish Exporters' Chamber. The fish processors of the locality were given technical assistance in maintaining hygienic conditions in the processing plants.

Researches completed

The work reported under project on smoke curing of fish was concluded during the period of report. All the other items of work will be continued during the coming year. The research workers associated with these projects are:

Shri A. P. Valsan	—	Asst. Fishery Scientist
Shri T. S. Unnikrishnan Nair	—	Research Assistant

SUMMARY

The two enzymes aldolase and AMP-deaminase which were isolated from sardine muscle and concentrated lost their activity rapidly when stored at -10°C . The flavour bearing nucleotides in prawns disappeared rapidly when they were stored in contact with ice. 40 to 73% of the nucleotides got dephosphorylated in 17 days of storage in ice. Loss of phosphorous compounds was also observed in the case of oil sardines stored in ice. Gas chromatographic

analysis of fatty acids of *Cybium* and *Caranx* showed relatively smaller quantities of poly-unsaturated acids in the former than in the latter. In one species of prawns phospholipids formed 40% of the total lipids. Spectral characteristics of phenolase enzymes isolated from prawn muscle were studied. Polyphosphates inhibited denaturation in extracted proteins. Sarcoplasmic protein fraction of oil sardine was less stable at higher temperatures and lower pH levels.

Surface and bottom layers of seawater contained higher bacterial loads than the middle layer and bottom mud at the same point. Among several pure strains of bacteria and substrates studied, *Achromobacter* was the most resistant to freezing and sardine homogenate substrate gave maximum survival rates. Nearly half the number of bacterial strains isolated from canned prawns were gram positive spore-formers while majority of those from factory environments were gram negative rods. Treatment with CTC exhibited its beneficial effects only after 6 to 10 days of storage in ice in the case of prawns and sardines. The antibiotic absorbed during the treatment disappeared almost completely on storage in ice. 80 to 90% of the bacteria on fresh sardines were sensitive to 5 ppm of CTC in the plating medium. Trypticase soy agar in distilled water supported bacterial growth best among several media tried.

Partially frozen sardine blocks packed in 2.5 cm thermocole insulated and plain plywood boxes and stored at 5 to 10°C remained in acceptable condition for 6 and 3 days respectively. The corresponding figures for fully frozen sardines were 7 and 4 days. Dip treatment of oil sardines in 15% brine for 30 minutes prior to freezing controlled belly bursting in all size grades and seasons studied. Dry ice was found to be effective in supplementary cooling of frozen or already chilled fish during long distance transportation in insulated containers.

Dip treatment in a 16% solution of sodium tripolyphosphate and potassium dihydrogen phosphate in the ratio 3:1 prior to freezing prevented thaw drip and cooking losses completely in frozen prawns and froglegs. Frozen storage life of sardines decreased with increasing period of pre-process storage in ice. Frozen and stored crab meat showed marked changes in colour and flavour in four months.

Methods were worked out for canning of cat fish and mullets. Presence of more than 10% of water in the filling medium caused quick development of rancidity and can blackening in sardine and mackerel. Hydrogen sulphide formation in canned prawns was completely prevented by maintaining a pH of 6.8 or less in the filling brine.

Dipping of prawns in saturated brine for 5 minutes prior to drying in the drum dryer prolonged the shelf life of the dried product. Two of the pigments present in prawns were isolated and identified as xanthophyll and astacene. Electrical measuring methods were developed for quick determination of moisture and salt in dried fish products. Freeze dried raw fish and prepared foods remained in good condition for two years.

Oil-binding capacities of different cooked fish meats were found out. Treatment of both fresh and cooked fish meat with pancreatin effected a high degree of hydrolysis yielding a product suitable for conversion into a number of speciality products.

Work on storage characteristics of fish protein concentrate in various containers and pharmacologically active compounds in frog oil was taken up and is progressing satisfactorily.

Treatment of freshly cut froglegs with brine containing sodium hypochlorite brought down all bacterial organisms to safe limits. Sanitary conditions in processing factories and peeling sheds were continuously surveyed and necessary technical assistance rendered to the processors for maintaining strict hygienic conditions. Preshipment inspection of frozen and canned prawns and frozen froglegs continued to be carried out by the Institute and necessary export fitness certificates issued.

At the Veraval Substation, a new programme of work on irradiation preservation of fish was initiated in collaboration with the Bhabha Atomic Research Centre, Bombay. Work on antibiotics in preservation of fresh fish, antioxidants in preservation of laminated and dried Bombay duck and optimum relative humidity for storing dried Bombay duck were continued and satisfactory progress recorded. Maximum possible storage life of silver and black pomfrets in ice prior to canning was found to be 3 days. Smoking prior to canning yielded very palatable products in the case of many of the local fishes.

At the Bombay Unit, it was observed that eel fillets could be stored in ice in acceptable condition for four days. Fresh peeled and deveined prawns could be stored in acceptable condition at 0°C. for more than 30 days after a low dose of gamma irradiation.

The Calicut Unit of the Institute observed that dipping of salted fish in natural vinegar containing small quantities of antioxidant or dilute solutions of sodium propionate or benzoate before drying considerably prolonged the shelf life of the products. Subjecting masmin to 115°C. for 15 minutes and sealing in polythene bags effectively controlled insect infestation commonly met with in such products. Incorporation of small quantities of antifungal compounds and antioxidants in curing salt was very effective in retarding fungal growth and brownish discolouration usually occurring in cured fatty fishes.

CRAFT & GEAR WING

GEAR WING

Project I: Gear Materials:

Research completed and chief findings

a) Cotton:

Specifications worked out for cotton twines of 10, 20 and 30 count yarns of different degrees of twists were accepted by Indian Standards Institution under the following captions.

1. Cotton twines for fish net, Part I - Twines for gill nets.
2. Cotton twines for fish net, Part II - Twines for trawl nets.

Part I includes twist specifications, strength and knot strength values for soft and medium twisted twines of specifications 20/2/2 to 20/20/3 and 40/2/2, 40/2/3 and 40/3/3. In part II, data for hard and extra hard twisted twines of sizes 10/5/3, 10/6/3 and 10/7/3/ and 20/2/2 to 20/20/3 are incorporated.

b) Tannin:

The effectiveness of a combination treatment of $\frac{1}{2}$ catch + $\frac{1}{2}$ bark for the preservation of cotton fish net twines was assessed. While selecting the bark, the functional group of tannin present in it was also determined. While pot. dichromate is a better fixative for the pyrogallol tannin bark, copper sulphate + ammonia is more effective for barks belonging to catechol tannin group. Acidification reduces the effectiveness of pot. dichromate fixation.

c) Nylon.

Subsequent to the acceptance of specifications worked out in CIFT for nylon trawl twines by ISI, M/s. Garware Nylons have started the production of these samples. The twines were tested at this Institute and found to possess a tenacity of 4.4 and 3.75 gms. per resultant denier in the dry and wet conditions.

One modification effected in the manufacture of nylon is the reduction in the number of filaments from 34 to 24. Twines with these compare well in properties with existing samples of 34 filaments. The reduction in the number of filaments has (to a certain extent) increased the abrasional resistance of the twines.

Research in hand

a) Strength of webbing:

Strength of webbing varied with the type of material, specification of twine, and also the size of mesh. To arrive at a generalised empirical formula for strength of webbing of a given specification, webbings fabricated with cotton twines of 20/5/3, 6/3, 8/3, 10/3 and 12/3 were tested. The size of webbings was 20 cm. (1 mesh) depth and 1 - 5 meshes length. The studies are to be continued incorporating more specifications of twines and changing the number of meshes in depth.

b) Polyethylene monofilament.

A new synthetic material which is gaining popularity in the fishing industry is polyethylene monofilament. The samples available with the trade were analysed and it was found that these monofilament yarns when twisted offered good scope as materials for fish nets. Detailed investigations were, therefore, undertaken with a monofilament yarn of the following particulars.

Denier 240; strength 0.92 kg; stretch 36%

Samples of specification 3 x 3, 5 x 3, 6 x 3 and 8 x 3 were twisted and properties studied. More samples are being twisted in order to work out the correlation between the number of yarns and twist so that the required standards can be drawn. The studies would be further extended to include yarns of different thicknesses as well.

Future work

1. Strength of webbing of nylon and cotton to work out correlation between strength of webbing, twine size, mesh size etc.
2. Twist standards for polyethylene twisted monofilaments.

Persons associated:

Smt. K. Radhalakshmi	— Asst. Fishery Scientist
Smt. P. J. Cecily	— Research Assistant

FISHING METHODS SECTION

Project II Trawl Fishing

Research completed and chief findings

a) High opening trawls:

All along the Kerala coast trawling was initially conducted for the capture of mostly shrimps and thus the designs of shrimp trawls which have more emphasis on the horizontal opening have been developed. But the increase in trawling by small vessels and consequent decrease in the yield per unit effort necessitated the introduction of an alternate gear for trawling. Thus the designing of trawls with high vertical opening has also to be taken up so that the bottom as well as the column fish fauna could be exploited to advantage by the increasing number of mechanised vessels. The results of experiments carried

out in this direction during the previous years resulted in the development of the design of the bulged belly type of trawl with overhang.

b) Long wing trawl for shrimps :

The design of shrimp trawls of conventional type have been developed satisfactorily in the previous years. But for the small vessels to use a net covering larger area, the long wing trawl was introduced. Operations were successfully carried out with 29.26 M (96') long wing trawl from a 9.75 M (32') fishing boat.

c) Escapement studies :

The catch composition of prawns in the trawl landings was found to be comparatively low. So investigations have been carried out to ascertain the rate of escapement of prawns from the trawl during the operations. The magnitude of escapement of prawns through the different parts of the trawl was assessed by collecting the escaped prawns in the different pockets provided at the various parts of the trawl. It was found that the escapement was about 23% through the belly and 63% through the cod-end.

d) Studies on otter board :

Investigations carried out with different shaped otter boards to assess the efficiency of each type showed that horizontal curved otter boards produced better shearing force, though the construction cost was slightly higher.

Research in hand:

a) High opening trawl :

The programme of work proposed last year on the assessment of the size of overhang piece for bulged belly trawl was taken up and pursued. For this purpose, three nets of similar size and shape, but with different lengths of overhang, were designed and constructed and comparative operations were carried out to assess their efficiencies. Seventy two hauls were made with these nets. The preliminary analysis of the collected data indicated that the net 'B' with 30 meshes for the overhang was comparatively better than the other two nets. The experiments are to be continued for the entire season for collecting more data.

Based on the above findings a larger net of similar design, but of heavier construction suitable for operation from the offshore fishing vessel 'Pratap' was designed and fabricated. The net is of size 21.33 M (70') and the initial operations with this net indicated that it compared well with that of the 15 M Russian trawl though it is premature to decide conclusively. The net is put under field trials.

b) Escapement studies :

Earlier attention was concentrated to assess the escapement through the main body of a trawl net. During this year experiments were carried out to work out the escapement of prawns through the lateral sides of the net. Necessary pockets were provided on the side pieces and the studies are in progress.

c) Studies on otter board.

A 'V' form otter board has been designed for operation from small and medium size fishing boats. The board is under construction which when completed will be used for comparative operations with the horizontal curved board.

d) Pelagic trawl:

A prototype design of 11.75 M midwater trawl was constructed for operation from medium size vessels with different riggings.

Research contemplated :

1. High opening trawls :

After the commissioning of the new 50' boat, it is proposed to undertake experimental operations to arrive at the effective scope-ratio of warp length required for conducting trawling operations at different speeds of towing and at deeper waters.

2. Long wing trawls :

It is proposed to carry out operations with 29.26 M long wing trawl from different classes of vessels of higher size group by correspondingly strengthening the construction of the trawl and by using different methods of rigging.

3. Mid water trawl :

Soon after the commissioning of the new 50' boat it is proposed to carry out operations with the mid water trawl, so that the design of the gear, in relation to the different methods of rigging and different speeds of towing suitable for the local fishery may be perfected.

4. Underwater instruments :

Instruments fabricated for taking the different parameters of trawls while in operation are to be put under field trials so as to effect modifications if necessary.

Persons associated :

Shri G. K. Kuriyan	— Fishery Scientist
Shri K. A. Sadanandan	— Jr. Fishery Scientist
Shri S. Gopalan Nayar	— Asst. Fishery Scientist
Shri R. S. Nair	— Asst. Fishery Scientist
Shri T. K. Sivadas	— Asst. Fishery Scientist
Shri M. Mukundan	— Research Assistant
Shri K. N. Kartha	— Research Assistant
Shri G. Jagadeesan	— Research Assistant
Shri C. P. Varghese	— Research Assistant
Shri Syed Abbas	— Research Assistant

Project - III :Designs of gill nets :

Research completed and chief findings:

a) Buoyancy weight relationship :

Studies conducted on the buoyancy weight relationship of seer drift nets of specifications of nylon 210/6/3, 210/8/3, 210/9/3 and 210/12/3 twines and of hung length 25 M. and fishing height 10 M. showed the following buoyancy weight relations as appropriate for the different modes of operation.

Material of fabrication	Mode of operation	Buoyancy at head rope	Buoyancy at bridle length adjusted for operations	Weight at foot rope
1. 210/6/3	Surface drift	840 gm.	1125 gm.	1170 gm. (weight in air)
-do-	Mid-water drift	840 gm.	1125 gm.	1170 -do-
-do-	Bottom drift	840 gm.	1125 gm.	1170 -do-
2. 210/8/3	Surface drift	840 gm.	1125 gm.	1170 -do-
-do-	Mid-water drift	840 gm.	1125 gm.	1170 -do-
-do-	Bottom drift	840 gm.	1125 gm.	1170 -do-
3. 210/9/3	Surface drift	840 gm.	1125 gm.	1170 -do-
-do-	Mid-water drift	840 gm.	1125 gm.	1170 -do-
-do-	Bottom drift	840 gm.	1125 gm.	1170 -do-
4. 210/12/3	Surface drift	980 gm.	1125 gm.	1170 -do-
-do-	Mid-water drift	980 gm.	1125 gm.	1300 -do-
-do-	Bottom drift	980 gm.	1125 gm.	1300 -do-

7.6 cm (3") dia. and 15.2 cm (6") dia. aluminium floats were used at the head rope and bridle rope respectively for adjusting the buoyancy and iron rings of 6.3 mm ($\frac{1}{4}$ ") thick and 15 cm dia. have been used for adjusting the weight at the foot rope.

b) Lunar periodicity and effect of tide in seer gill net fishing

Analysis of the seer catch from night fishing trips during the two fishing seasons 1966-67 and 1967-68 showed the potential days for seer fishing to be 7 days before and 7 days after new moon. During the period, surface operations yielded better catch. So also low tide operations were particularly effective for the capture of seers.

Research in hand

a) Selective action of mesh size and mesh size-twine size relationship in the seer drift net :

Investigations initiated during the previous year with 16 different designs of seer gill nets made of four different specifications of nylon twine viz. 210 D 6/3, 8/3, 9/3 and 12/3 of mesh sizes 70 mm, 75 mm, 80 mm and 85 mm bar have been continued during this year. Fifty three fishing voyages were conducted

for the study. Twenty four valid operations were completed. The results obtained are as follows :

Catch rate in different designs of shots

	Design of shots		Total catch No.	Weight (kgs.)	Average weight of fish (kgs.)
1.	210 D. 6/3	70 mm bar	4	9.75	2.44
2.	-do-	75 mm bar	4	13.50	3.88
3.	-do-	80 mm bar	6	27.00	4.50
4.	-do-	85 mm bar	4	14.50	3.63
5.	210 D. 8/3	70 mm bar	7	37.70	5.39
6.	-do-	75 mm bar	4	16.45	4.10
7.	-do-	80 mm bar	3	13.75	4.58
8.	-do-	85 mm bar	1	5.75	5.75
9.	210 D. 9/3	70 mm bar	0	—	—
10.	-do-	75 mm bar	9	44.00	4.88
11.	-do-	80 mm bar	9	37.00	4.11
12.	-do-	85 mm bar	5	26.00	5.20
13.	210 D. 12/3	70 mm bar	6	25.25	4.21
14.	-do-	75 mm bar	8	43.45	5.45
15.	-do-	80 mm bar	8	46.00	5.75
16.	-do-	85 mm bar	2	13.00	6.50

Catch rate of shots made of different specifications of twines irrespective of mesh size

Specification of twines	Total No. of seers	Total weight in kgs.	Minimum weight of fish caught in kgs.	Maximum weight of fish caught in kgs.	Average weight of fish caught in kgs
210 D 6/3	18	64.75	0.75	9.5	3.60
210 D 8/3	15	73.65	0.75	8.5	4.90
210 D 9/3	23	107.00	3.00	6.5	4.65
210 D 12/3	24	127.70	3.00	9.2	5.32

Catch rate of shots of different mesh sizes irrespective of twines

Mesh size in mm bar	Total No. of seers	Total weight in kgs.	Minimum weight of fish caught in kgs.	Maximum weight of fish caught in kgs.	Average weight of fish caught in kgs
70	17	72.70	0.75	8.50	4.28
75	25	117.40	0.75	9.20	4.70
80	26	123.75	2.00	9.50	4.76
85	12	59.25	1.00	8.00	4.85

The catch consisted of seers ranging from 42 cms (0.75 kgs. weight) to 105 cms (9.5 kgs. weight). The dominant group were of 75 to 90 cms length having a weight of 4 to 7 kgs. The above results indicated that shots of thicker twines 210 D 9/3 and 12/3 were the most effective in capturing seers of commercially significant size range. Of the four different meshes tried 80 mm bar followed by 75 mm bar were observed to be more efficient than others. Of the sixteen different combinations, shot of 210 D 12/3 of 80 mm bar was particularly effective. More data are required to confirm the findings. The studies are being continued.

b) Spatial distribution of seer in gill net:

Spatial distribution of seers in seer drift nets operated in different depths varying from 0-30 M. revealed that in the surface strata of 0-15 M. depth, a congregation of about 90% of the catch was observed to be from the surface to 7.5 M. depth. Similar congregation of 64.1% of the total catch was observed in depths of 20-27.5 M. for the operations ranging from 15 to 30 M. The results gave clue for determining adequate fishing height of the gear. The studies are being continued to confirm the findings.

Research contemplated :

1. Effect of coloured gill nets for the capture of seers.
2. Attraction studies by means of (a) baits, (b) lights and (c) water sprinkling.
3. Periodicity of catch of seers during different hours of the night.
4. Utility of mechanical hauler for the operation of seer gill nets.

Persons associated :

Shri P. Sulochanan	—	Asst. Fishery Scientist
Shri Rajan Abraham	—	Research Assistant
Shri T. Joseph Mathai	—	Research Assistant

Project - IV: Line Fishing :

Research completed and chief findings

a) Standardisation of buffalo horn jigs of different specifications:

Buffalo horn being an indigenous material readily available at cheaper rate at all places, fishermen throughout the coastal area can afford to procure the material and fabricate the jigs. Experiments have been conducted with 9 different specifications of buffalo horn jigs viz. 10 cm, 12.5 cm and 15.0 cm lengths in three different weights viz. 50 gm., 60 gm., and 70 gm. specifications in order to ascertain the suitability of the lures of different specifications. The results indicated that buffalo horn jigs of 12.5 cm and 15 cm lengths and of weight 60 gm. having a contour of sardine fish which is the usual prey of the predator is particularly effective in capturing seers.

Research in hand:

1. a) Utility of wooden jigs as lure in trolling lines for the capture of seers.
b) Standardisation of different specifications of wooden jigs.
2. Standardisation of fish head jigs of different specifications.
3. Utility of electricity in the operation of trolling lines.

Research contemplated:

Suitability of metal jigs in trolling line for the capture of predatory fishes. Galvanised iron or nickel jigs are proposed for trials.

Persons associated:

Shri P. Sulochanan	—	Asst. Fishery Scientist
Shri N. Subramonia Pillai	—	Research Assistant
Shri R. S. Manohardoss	—	Research Assistant
Shri K. Sreedharan Namboodiri	—	Asst. Fishery Scientist

b) Long lines :

Studies were carried out under the following heads :

- a) Selective action of bait for sharks.
- b) Efficiency of different hooks.

Research in hand :

Long lines for sharks:

Different sizes of hooks from No. 3 to 6 were tried with different baits viz. soles, sardines, scianids, squids, prawns and crabs. The gear was operated both as set and drift in the bottom region to study the variations in the availability of shark.

A total of 42 operations were carried out both in vertical and horizontal long lines and a total number of 214 sharks were caught. Their lengths and weights ranged from 22 cm – 65 cm and 120 g. to 1.5 kg. respectively. The long line gear was operated in different depths viz. 10 – 20 M, 20 – 25 M and 25 – 30 M.

Among the baits soles and squids showed better catching efficiency and among the various hooks used No. 6 round bent hook showed better catching rate. The suitability of the baits and hooks for shark population existing in deeper waters is also to be ascertained and hence the study is being continued.

Research contemplated :

- 1) Tuna long line investigations :

Persons associated :

Shri P. Sulochanan — Asst. Fishery Scientist
Shri N. Subramonia Pillai — Research Assistant
Shri R. S. Manohardoss — Research Assistant
Shri M. Shahul Hameed — Research Assistant

Mobile Unit :

Research in hand :

1) The Directorate of Fisheries, Kerala, made a request that a scheme for the initiation of fishing gear investigations in the Malampuzha reservoir in Kerala State may be drawn up by this Institute for the joint implementation of the same by the Department of Fisheries Kerala and the mobile unit of this Institute. In order to draw up a detailed scheme a preliminary survey of the reservoir and its fisheries was undertaken by the unit. From the details gathered by the survey the present status of the fishery of the reservoir could be summarised as follows:

The indigenous fishery of the reservoir is composed of 18 species of uneconomic varieties of fishes. The present fishery is composed of exotic fishes which were introduced into the reservoir. The stocking of the reservoir commenced as early as 1951, previous to the completion of the dam. The reservoir has been stocked regularly from 1951 onwards with the following species of fishes.

<i>Labeo fimbriatus,</i>	<i>Labeo kontius,</i>
<i>Barbus dubious,</i>	<i>Cirrhina cirrhosa,</i>
<i>Cirrhina reba,</i>	<i>Cirrhina mrigala,</i>
<i>Labeo rohita,</i>	<i>Mirror carp</i>
<i>Tilapia mosambica.</i>	

Commercial catch is mainly supported by *Tilapia mosambica*.

The fishing gear employed at present are nylon gill nets of the Rangoon net type. The mesh sizes of these nets vary from 55 mm to 95 mm bar with twine sizes, 210/1/3, 210/3/3, 210/6/3 and 210/9/3. On an average about 50 nets are operated daily.

The total catch for the last three years were as follows :

1965	—	4,275.92 kg.
1966	—	8,419.16 kg.
1967	—	15,122.25 kg.

Tilapia mosambica is the major commercial fishery of the reservoir and its share in the total catches is steadily increasing. The analysis of the morphometric data of tilapia landed by the nets has indicated that the size group falls between 250 mm and 450 mm.

From the survey conducted the following general conclusions can be drawn.

1. There is scope to undertake gear investigations in the reservoir and thereby intensify the exploitation of fishery wealth.
2. Because of the peculiar topographical conditions of the reservoir, the gear that could be operated are primarily restricted to the passive type.
3. Since the twine sizes of many nets in use are bigger than that are actually necessary, standards of twine sizes and mesh sizes for the nets have to be evolved particularly for tilapia.
4. Intensive fishing of tilapia appears necessary in order to maintain a steady growth of the species.
5. The effectiveness of the nets having greater entangling capacities like the trammel nets and frame nets for the capture of catla, rohu and mrigal is also worth investigating.

To achieve the objectives outlined above the following phased programme of investigations was drawn up. The project will be implemented in close association and collaboration with State Fisheries Department who have a Unit functioning at Malampuzha.

- Phase i — Improvement of existing gear.
- Phase ii — Fish attraction and electrical fishing.
- Phase iii — Trial operations of pelagic trawl.

The details of equipment, man-power etc. to be made available and the expenditure to be borne by the State Department were sent to the State Directorate along with the scheme.

2) At the request of the Directorate of Fisheries, Assam, a scheme for the fishing operations in Brahmaputra river was drawn up with complete details on the fishing gear and equipments necessary for conducting the exploratory fishing operations in the river system.

Research contemplated:

The actual implementation of the above two projects will be undertaken as soon as the gear and equipments are made available by the State Departments.

Person associated :

Shri S. Gopalan Nayar — Asst. Fishery Scientist

CRAFT WING

CRAFT MATERIALS SECTION:

Protection of wooden fishing boats against deterioration and prevention of metallic corrosion in fishing boats are the two major projects that were continued during the year 1968 under the Craft Materials Section. Under the first project, studies on cheaper boat building timbers after proper seasoning and preservative treatment, the utility of fibre-glass reinforced plastic as a sheathing material on the wooden hulls of fishing boats, design and formulation of an antifouling paint with organometallic compound as a toxic pigment were taken up in detail. Under the second major project corrosion of the different metallic fastenings was assessed.

Aluminium sheathing work on wooden hulls in place of the conventional copper sheathing has been perfected and at the request of the Madras Government Fisheries Department both demonstration and training work in this regard was undertaken at Madras during June 1968.

Lining of fish-holds in trawlers with fibre-glass reinforced plastic was followed by private boat builders as per the schedule worked out by this Section.

Project - I. Protection of fishing boats against deterioration:

Research in hand:

1) Boat building timbers:

In continuation to laboratory studies with treated timbers like Mango (*Mangifera indica*) and Haldu (*Adina cordifolia*) further work was carried out by actually using such treated timbers as deck planks and hatch covers in a 50' wooden trawler 'Sindhu Kumari' of the Department. 'Ascu' and creosote treated Mango and Haldu were cheaper by 50 to 60% when compared to untreated Teak and Aini, the conventional timbers. The wear and tear studies on such treated timbers showed encouraging results and this appeared to be yet another line wherein the present cost of wooden fishing boats could be considerably reduced. The preservatives, method of their application and installation work have been standardised. Though Mango wood is an all India timber, the availability of Haldu is also very encouraging from the following data:

Uttar Pradesh	6000 tons per annum
Mysore	3500 tons per annum
Gujarat	1500 tons per annum
Andhra	1000 tons per annum

Its availability is known in Madras and Kerala but exact quantities are not known.

2) Wood preservation:

Cut piece scantlings of seasoned Mango and Haldu woods were treated with 'Ascu' and creosote under hot and cold dip process and the desired impregnation was obtained as per CIFT schedule. 2 sets of hatch covers were fabricated and installed on the deck of 'Sindhu Kumari', the 50' departmental wooden trawler. The behaviour of these treated structures will be noted and compared with that of the untreated Venteak deck planks etc.

3) Marine wood borers:

Further studies and field observations on the pholadid wood borer *Martesia striata* were made. Their greatest resistivity and tolerance for changes in salinity of the living medium were recorded. Under a heavy population, the normal growth of martsesia was very much retarded. But rate of timber destruction was found to be highest. *Nausitora hedleli* continued to dominate the wood boring shipworms.

4) Fibreglass reinforced plastic for hull protection in wooden fishing boats:

In continuation of the fish-hold lining with FRP, sheathing of wooden hulls was taken up for actual field observations under service conditions. Two nos. of 14 feet plywood boats were completely sheathed with FRP using 450 gms./sq.m. of chopped strand mat of fibreglass (A-Glass) in 2 layers with Hylam polyester resin, catalyst and accelerator as per CIFT schedule. Titanium dioxide at 50 g. per kg. was incorporated for the desired tint. After 25 days of post curing at 28°C. to 31°C. the behaviour of the lining was put to vigorous tests and found to pass them satisfactorily. Similar procedure was adopted in lining about 15 sq. ft. of hull area both on the port and starboard side of the 50' trawler 'Sindhu Kumari'. After post curing, the surface was treated with etching primer and painted with one coat of zinc chromate primer and 2 coats of antifouling paint. This specially treated area will be compared with aluminium-magnesium alloy sheathing on the rest of the hull. A fish-hold hatch cover of Venteak wood has also been sheathed with FRP for observation. The present investigations have suggested the need for a surface mat of FRP with a view to obtaining a wrinkle free smooth surface particularly below waterline.

Research contemplated

The next phase of the project would be to build a prototype fishing trawler entirely out of fibreglass reinforced plastic material.

5) Studies on marine fouling organisms

Research in hand

Further attempts were made to rear the larvae of marine fouling organisms under laboratory conditions with a view to obtaining consistent yields of

larvae for toxicity studies. Adult oysters, bryozoans and calcareous tube worms were acclimatised and maintained under laboratory conditions by providing suitable algal food, aeration and antibiotics. Of the three animals tried, the calcareous tube worms bred under laboratory conditions producing free swimming larvae which subsequently settled on the walls of the aquarium tanks. The settled tube worms are carefully maintained to obtain a second generation. Bryozoans and oysters could not be induced to breed in the laboratory in spite of repeated attempts.

Research contemplated:

- 1) Studies on arsenical creosote as a wood preservative for marine structures:

Objectives: Arsenic fortified creosote is more toxic at a lower dosage than normal creosote and there are no health hazards. Arsenic possesses a chemical affinity for creosote. At 90°C. arsenic oxide chemically reacts with creosote forming large number of stable arsenical compounds which fix into the wood. The rate of leaching and toxicity of these compounds to foulers and borers in sea water have to be studied. The compounds are readily available in Indian market.

- a) Designing of suitable single pack wash primer using easily available indigenous raw materials:

The wash primer developed using Mowital as resin, phosphoric acid as etching ingredient and barium potassium chromate passed all the physical tests and raft tests which were reported earlier. For evaluating the service test, the formulation was applied on the aluminium hull of the newly built 50' trawler. Samples are to be sent to the paint industry after further service trials.

Research in hand:

- 1) Designing of a suitable antifouling paint using organometallic compound as toxic substances:

The investigations were undertaken with a view to formulate a new anti-fouling composition which could give a fouling free life for a minimum period of 2 years by incorporating organometallic compounds. The toxic characteristics of tributyl tin oxide were studied in detail. For determining the antifouling activity of the tributyl tin oxide when incorporated in paints and the type of matrix to be used in these compositions, 16 formulations were done and tested. In these compositions different types of matrix were used. Physical evaluation tests like resistance to erosion, resistance to alkali etc. gave satisfactory results for three samples out of the 16 formulations. Subsequent field tests of these sixteen formulations were done on wooden and asbestos panels. In the biological evaluation tests it was found that samples No. AF₁₄, AF₁₅, and AF₁₆ were free from fouling. Hence it was confirmed that the laboratory prepared limed rosin gave better results when compared with other types of matrices. The shelf life of the three satisfactory formulations was studied and found that all these formulations were not free from settling. The behaviour of the laboratory formulated antifouling paint on aluminium panels, primed with laboratory formulated wash primer were studied in the laboratory and found that

organic toxicant had no marked effect on the pre-treated aluminium panels with respect to corrosion. The leaching rate studies of the samples AF₁₄, AF₁₅ and AF₁₆ showed a value above 10 micro gm Sn/Sqcm/day whereas the critical leaching rate is only 1 micro gm Sn/Sqcm/day. Hence further formulations were made so as to reduce the leaching rate to the critical level.

2) Hydrographical studies at Cochin test site:

Regular hydrographic data at the selected test sites in the port of Cochin were collected in order to correlate the abundance of the marine organisms in the test site with that of the prevailing water temperature, salinity, dissolved oxygen, pH, turbidity and other dissolved salts.

Project II: Marine corrosion in fishing boats

Research completed:

1) Anodised aluminium for navigation lights:

This project aims at finding out a suitable indigenous alloy material to replace imported copper in the construction of navigation lights in fishing vessels.

Any material for use in the navigation light should withstand the salt spray, intermittent heating and cooling and carbon deposit attack. In the successful experiments INDAL M 57 S, an aluminium-magnesium alloy was subjected to the anodic treatment to produce oxide films of substantial thickness and abrasion resistance. The film was chromate sealed to impart resistance to marine corrosion.

Characteristics of the coatings:

The following special tests were performed:

- i. The coating withstood the VIP drop test. The time recorded was 26 seconds.
- ii. *Industrial atmosphere test:* The coating withstood a sulphur dioxide atmosphere containing 3% V/V of SO₂ at a relative humidity of 98%.
- iii. *Resistance to heat:* The film was not damaged when kept at 300°C. for two hours.

The following experiments were conducted with a view to subjecting the anodised aluminium panels to various corrosive attacks that would be experienced by the navigation lights in service.

- i) The test panels were subjected to 100 hrs. of 5% sodium chloride spray at a pressure of 20 lbs/in² at 30°C.
- ii) Panels coated with a thin layer of carbon from an oil lamp and subjected to 100 hrs. of spray.

- iii) An accelerated evaluation of the anodic film by the use of acetic acid-salt spray at pH = 3.0 and pressure = 20 lbs/in² for a period of 100 hrs.
- iv) Panels coated with a thin layer of carbon and kept at a temperature of 70-75°C. and exposed to condition as detailed under (iii).
- v) Panels exposed to 5% sod. chloride spray for 300 hours.

At the termination of the experiments the rate of corrosion and pitting etc. were observed. In certain cases copper panels were also exposed simultaneously for a comparative study.

The absence of any pitting corrosion in any of the above experiments and corrosion rates of 0.4 mils/yr and 0.7 mils/yr observed in acetic acid spray and carbon coated panels exposed to the same spray suggested that anodised aluminium can be safely used in the construction of navigation lights. Ancillary spray tests also confirmed its suitability.

2) Anticorrosive paint for ships bottom:

Since steel is the basic material of construction of large size trawlers its protection in a highly corrosive medium such as sea water is important. The principal method of protection of steel hulls of the sea going vessels is by the use of paint coatings which has been found effective, technically reliable and economically feasible. The present study deals with the development of an anticorrosive paint formulated with a commercially available cashewnut shell liquid condensation product marketed under the trade name SILIX.

The details of a successful formulation are given below:

Ingredients	Weight % in dry film
Silix	25.3
Phenolic resin	3.2
Linseed-rosin	3.2
Lead sulphate	21.0
Iron oxide	21.0
Aluminium powder	15.8
Talc	10.5

White spirit, turpentine and naphtha were added to adjust viscosity and naphthenates as driers and anti-skinning agents. The characteristics and performance of the coating are presented in the following table:

- 1. Viscosity (Ford cup No.4, 100 ml) sec: — 300-330
- 2. Drying time (hrs)
 - a) Surface dry — 6-10
 - b) Hard dry — 36-48
- 3. Scratch hardness (kg) — 1
- 4. Flexibility and adhesion — 6.25 mm dia rod

5. Resistance to:
 - a) Synthetic seawater — Satisfactory
 - b) 2% sodium carbonate — Satisfactory
 - c) Lubricating oil — Satisfactory
6. Salt spray test (5% sodium chloride, 120 hr) — No blistering and no corrosion underneath the paint film.
7. Aerated seawater — No corrosion
No blistering

The coating passed the standard tests prescribed for anti-corrosive paints and did not show any blistering or softening on cathodically protected steel structures (-780 mV with respect to saturated calomel electrode). The composition withstood the alkalinity normally encountered on cathodically protected steel hulls.

Research in hand:

- 1) Corrosion of metal fastenings in marine environment and by boat building timbers and evaluation of aluminized fastenings for use in boat building:

Metallic fastenings in contact with timbers break down due to corrosion. The timber is also affected at the place of contact. So boat builders have been using copper and brass fastenings which have become costly due to scarcity of material. Possibilities of using cheaper substitutes require detailed study. Work on these lines was initiated by using most common boat building timbers *Artocarpus hirsuta* (Anjili), *Lagerstroemia lanceolata* (Ventek), *Tectona grandis* (Teak) and *Terminalia paniculata* (Marudhu). As the presence of free acids, salts and sea-water permeating through the wood cause corrosion of metallic fastenings, these three aspects were studied. The acidity of the incubated saw dust samples by potentiometric titration, pH measurements and free acids by steam distillation were determined. The timbers can be arranged in the order Teak, Ventek, Anjili and Marudhu in the increasing order of acidity as per pH measurements. The total free acids were in the range of 0.1 to 1.2% expressed as acetic acid. The electrical resistance of wood at different moisture levels and the electrode potentials of metallic fastenings driven into the wood were measured. A maximum potential difference of 250 mV with respect to saturated calomel electrode was recorded between aluminium and brass. As this requires detailed study, further tests are in progress.

A series of laboratory tests are in progress with brass, galvanised iron, cadmised iron, mild steel and aluminium fastenings by driving into the wood. The respective metal cylinders machined for the purpose were driven into the wood and exposed to sea water. An analysis of four months corrosion data collected indicated that fastenings could be arranged as brass, cadmised iron, galvanised iron in the order of decreasing corrosion resistance in contact with boat building timbers like Teak and Ventek. Experiments with the fastenings

in direct contact with various other woods are being continued. In general the performance of cadmised and galvanised fastenings were found to be good and the former was comparable with brass in short term tests. The pH variations of the incubated samples of saw dust are under observation. The free acid set out as a result of prolonged incubation of the saw dust was determined by electrometric titrations. It was found that organic acids were present in wood as a complex buffer solution.

2) **Assessment of the suitability of spheroidal graphite austenitic cast iron for marine propellers:**

The object of the present study was to evaluate the suitability of Ni Resist—D2C grade ASG 3 SG iron for marine propellers for reasons of efficiency and economy over conventional manganese bronze propellers for fishing boats, aluminium sheathed wooden boats in particular.

The tests were conducted with the SG iron samples supplied gratis by the International Nickel Co. Inc., London through Nickel Information Bureau, Bombay which conform to IS:2749-1964. The principal ingredients were in the range specified below:

C	—	3.00% (Max)
Si	—	1.8 — 2.8%
Mn	—	1.8 — 2.4%
Ni	—	21 — 24%
Cr	—	0.5% (Max)
P	—	0.08% (Max)

The material was subjected to the following tests in particular:

- i) Total immersion corrosion tests in 3.5% sod. chloride solution for a period of 72 days.
- ii) Corrosion rate measurements at a protected potential of -780 mV with respect to saturated calomel electrode.
- iii) Corrosion in fast flowing seawater as experienced in a rotating disc equipment at a peripheral velocity of 7.2 metres/second.

The results of the above experiments attested the suitability of SG iron for the use of marine propellers. The electrode potential of the material was less noble than that of manganese bronze. Hence the aluminium sheathing on the hull will be subjected to less galvanic corrosion in the case of SG iron propellers. The physical properties such as tensile strength, proof stress, elongation, hardness etc. appear to be favourable.

Research contemplated:

Field trials with SG iron propellers and economics.

Persons associated:

Shri R. Balasubramanyan	— Jr. Fishery Scientist
Shri K. Ravindran	— Asst. Fishery Scientist
Shri N. Unnikrishnan Nair	— Research Assistant
Shri A. G. Gopalakrishna Pillai	— Research Assistant

MECHANICAL ENGINEERING SECTION :

Development of mechanical fishing accessories, testing of engines, development of mechanical equipments for eradication of aquatic weeds, investigations on electrical fishing and designing of measuring and testing instruments required in fishing craft and gear research were carried out in the Mechanical Engineering Section during the year under review.

Chief findings :

Equipment for eradication of under-water weeds in medium and small size ponds upto 15 hectares in area were developed and successfully tested under field conditions.

A faster method of dewatering suitable for larger waters was devised and fabrication of this equipment was completed for field trials.

Design of a combination winch suitable for the 17.53 M (57' 6") steel boats being constructed under the Government of India scheme was completed.

Laboratory studies for the development of an electrical shrimp trawl were completed. Based on these results an electrical shrimp trawl was developed and field trials were taken. Preliminary data collected indicated an increase of upto 40% in the catches of prawns by using electrical trawl nets.

Instruments for measuring the tilt and angle of attack of otter boards have been developed and tested under actual field conditions.

Research completed:

1) **Development of mechanical accessories for fishing boats:**

a) **Development of trawl winch for larger boats:**

Design of a combination winch suitable for the 17.53 M (57' 6") steel boats which are being constructed at present under the Government of India scheme was completed and detailed drawings were prepared.

b) **Development of equipment for mechanical spraying and for water circulation in live - bait tank for pole and line fishing:**

Fabrication of this equipment was completed and after preliminary laboratory trials was sent to Laccadives for field trials.

2) Testing of engines:

a) Testing of Kelvin engine :

Testing of Kelvin J4 engine was completed. Necessary modifications were suggested in a report furnished to the manufacturers.

3) Dewatering of lakes and bheels :

a) Submerged weeds:

Fabrication of a rotary rake for clearing submerged weeds faster has been completed and arrangements have been made for conducting field trials at a place near Ernakulam.

b) Floating weeds:

An equipment for removal of floating weeds such as water hyacinth, salvinia etc. has been fabricated and preliminary trials taken at the laboratory were successful. The equipment was sent to Kakki (Kerala) for field trials.

4) Electrical fishing :

Reaction studies on fresh water fishes were conducted using impulse current. Threshold values of impulse rate for narcotisation have been determined for most of the fresh water fishes.

A suitable method has been developed to eradicate unwanted fishes from nursery and fish ponds before stocking them with cultivatable fishes.

The first phase of the development of an electrical shrimp trawl has been completed and field trials were taken. Analysis of preliminary data collected showed an increase of about 40% in the catches. The investigations are being continued.

5) Measuring and testing instruments:

i) Development of instrument for measuring tilt of otter boards:

Simple instruments were developed for measuring tilt of otter boards both in the horizontal and vertical planes. The main characteristics of the instruments are given below:

a) Tilt meter: (to measure inclination in the vertical plane)

Range	—	—44° to + 44°
Accuracy	—	± 4°
Capacity to withstand pressure	—	15 kg/cm ²
Weight in air	—	415 gm.

b) Fore and aft tilt meter :

Range	—	—22° to + 22°
Accuracy	—	± 2°
Capacity to withstand pressure	—	15 kg/cm ²
Weight in air	—	550 gm.

ii) Angle of attack meter :

Measurement of the angle at which the otter board presents itself to the flow of water termed as "angle of attack", is necessary to calculate the force acting on the otter board during operation. An instrument for measurement of this angle has been fabricated and tested. Main features of this instrument are:

Range	—	0° — 90°
Accuracy	—	± 1°
Capacity to withstand pressure	—	15 kg/cm ²
Weight in air	—	400 gm.

Work in hand and future work:

i) Testing of engines and accessories:

All preliminary information required for testing Kirloskar RVM series water cooled engines have been collected. The engine is expected here shortly for installation and trials.

ii) Development of hydraulic control gear for fishing boats using indigenous components:

Work on this project was held up due to non-availability of a suitable hand operated, *reversible* pump. Design of suitable pump has been prepared and arrangements have been made to fabricate it.

iii) Fish hold refrigeration:

Design of brine chilling tank for laboratory trials has been completed. Arrangements are being made to fabricate this item.

iv) Dewatering of lakes and bheels:

Work to provide self propulsion arrangements for the equipment already developed and working out a method of reduction of the collected weeds before disposal to facilitate easy handling of the weeds collected on the barge will be taken up during the coming year.

v) Electrical fishing:

Impulse current has been found to be more effective in inducing reactions in shrimp. So the electrical shrimp trawl has to be perfected by using impulse current.

vi) Measuring and testing instruments:

a) Vertical mouth opening meter:

The development of a solid state electronic remote measuring instrument has been partially completed. The laboratory tests have proved the technical feasibility of an electronic net mouth opening meter which will be fabricated for further studies.

b) Under-water tension meter:

An electronic telemetering type instrument has been developed for the continuous measurement of the resistance to motion of the various parts of a fishing gear in the range 0 to 130 kg. A larger one with a range of 0 to 250 kg. is under development.

c) Mesh size meter:

A prototype of an instrument for the continuous measurement of the variations in dimensions of the net meshes during operation has been fabricated. This fully transistorized instrument has a range of 170 mm. to 300 mm. The prototype is being studied to perfect the same and to build a full scale instrument.

d) Electrical warp tension meter:

An electronic instrument for continuous measurement of the warp tension on board the vessel has been fabricated. Field trials have to be taken to study its working and to effect modifications.

Persons associated:

Shri M. Velu	—	Jr. Fishery Scientist
Shri K. Sreedharan Namboodiri	—	Asst. Fishery Scientist
Shri T. K. Sivadas	—	Asst. Fishery Scientist
Shri R. Krishnaswamy	—	Research Assistant
Shri M. D. Varghese	—	Research Assistant

CIFT SUBSTATION, VERAVAL

Fishing gear branch:

Project I: Investigations on Trawl Nets:

a) Investigations on otter trawls:

Studies initiated during previous year on 13.7 M. two seam and four seam trawls were continued and a total of 22 hauls were made during the year under report in addition to the 78 hauls made earlier.

Gear used	13.7 M two seam	13.7 M four seam
Otter boards size, weight	Rectangular flat 1.4 M x 0.63 M, 64 kg. each	Rectangular flat 1.4 M x 0.63 M, 64 kg. each
No. of hauls made	50	50
Total duration	25.5 hrs.	25.5 hrs

Catch details:

Prawn	788	881
Fish	3146	4213
	<u>3934</u>	<u>5094</u>

Catch/hour:	Two seam	Four seam
Prawn	31	34.5
Fish	123	165
	<u>154</u>	<u>199.5</u>

The above data revealed that the average catch per hour of prawns and fish is more by 30% in the case of four-seam trawl.

b) Effect of false-head-rope on the catch landed by 13.7 M four-seam trawl:

In order to assess the effect of false-head-rope on the catch landed by 13.7 M four seam trawl, studies initiated during previous year were continued and a total of 63 hauls of 41.5 hours total duration were made employing 13.7M four seam cotton trawl rigged with 1.4 M x 0.63 M rectangular flat otter boards.

On analysis of the data collected it has been revealed that due to the absence of varieties of fish which swim above the sea bottom the false-head-rope has not shown encouraging results.

Research in hand :

a) Comparative efficiency of 29.26 M long wing and 13.7 M four seam trawls:

Studies initiated to assess the comparative catch efficiency of 13.7 M four seam and 29.26 M long wing trawls were continued and a total of 120 hauls of 80 hours total duration were made and landed 819 kgs. of prawns and 14.762 kgs. of fish. The studies are in progress.

b) Investigations with 15.9 M six seam trawl:

With a view to study the effectiveness of 15.9 M modified six seam nylon trawl for operation along this coast, field trials were initiated during the last month of the year and in all 91 hauls of 74 hours 40 minutes total duration were made. The studies are in progress.

Persons associated :

Shri S. D. Deshpande	—	Jr. Fishery Scientist
Shri T. M. Sivan	—	Asst. Fishery Scientist
Shri V. Vijayan	—	Research Assistant
Shri S. V. S. Rao	—	Research Assistant

Project II Investigations on gill nets

a) Investigations on ghol-dara gill nets :

Ghol-dara gill net experiments were conducted at Jamnagar from a boat belonging to a fisherman from Maharashtra State. Nineteen units of gill nets (9 made out of Italian hemp and 10 out of Indian hemp twine) were operated along with 62 units belonging to the private fishermen. Five hauls were made during the period of 8 days. Particulars of the fishing operation etc. are given below:

Total number of dara caught in 10 units of Indian hemp twine	—	5
Total number of dara caught in 9 units of Italian hemp twine	—	7
Total number of dara caught in 62 units of the private fishermen	—	37

Since the data collected are inadequate for drawing any definite conclusions, it is proposed to continue these studies during the ensuing year.

b) Investigations on pomfret gill nets:

For comparative efficiency studies, pomfret gill nets following CIFT and local methods of mounting, fabricated out of nylon 210 D/3/3 having 14.6 cm. stretched mesh size, were operated from a private gill net boat along with the local gear.

During the course of these studies 33 fishing trips were made with 21 units (10 units with CIFT mounting, 11 units mounted following local method) operated along with 39 units of local gear and landed 4315 kg. of fish (3166 kg. - pomfret and 1149 kg. - other fish).

The following aspects were noted during the course of investigations:

- i) Percentage of gilling is more in CIFT method of mounting (about 60%).
- ii) Percentage of entangling is more in local type of mounting (about 70%).

Persons associated:

Shri P. Appukutta Panicker	—	Jr. Fishery Scientist
Shri V. Vijayan	—	Research Assistant

Project III Line fishing

Long lines for sharks

Main line of 17 units of long line gear was replaced by using a thicker cotton line of 10/101/4 specification. Another 14 units of long lines consisting of 350 hooks were prepared and kept ready for operation.

Persons associated:

Shri S. D. Deshpande	—	Jr. Fishery Scientist
Shri S. V. S. Rao	—	Research Assistant

Technical assistance:

The scientific and technical staff of the Substation rendered technical assistance to the interested fishermen in the local area in the different aspects of mechanised trawling like the correct rigging of boats, mounting of nets, selection of suitable otter boards for trawls, method of trawling etc.

CIFT SUBSTATION, KAKINADA:

During the year under review, studies were continued under three major research projects, namely (1) Trawl fishing, (2) Improvement in the design of gill nets and (3) Line fishing. Steady progress was achieved in all the experiments undertaken under various heads.

1 - Trawl fishing :

Work was taken up under two heads namely shrimp trawling and fish trawling.

(i) Shrimp trawling:

Studies on the design and operational aspects of shrimp trawls on the East Coast, initiated in June 1967 were continued. Experiments on comparative efficiency of long winged net of four seam type with two seam net and effect of reduced buoyancy on head rope of an otter trawl on prawn catch, taken up previously were pursued this year also. These experiments could not be carried out effectively as proposed, due to poor availability of prawns during July to December. In general, prawn fishing season was very bad at the centre in the year.

Research in hand:**(a) Comparative efficiency of different designs of shrimp trawls:**

29.26 M (96') long wing four seam and 18.25 M (60') two seam nets were operated within depth ranges of 10 to 15 M off Uppada during the first half of the year. Though the catch rate is more with two seam net, prawn content as well as its percentage composition is better with long wing net.

(b) Effect of reduced buoyancy on head rope of a shrimp trawl on prawn catch:

18.26 M two seam net was operated with 15 floats (11.83 kgs. buoyancy) and 11 floats (8.67 kgs. buoyancy) of 5" dia. on head rope as against constant lead of 18.00 kgs. (in air) on foot rope with the following results:

Prawn content showed increase with reduced buoyancy by nearly 5.00 kg. per trawling hour.

Future work :

Since the above experiments could not be completed to substantiate the main observations, the same will be continued in the next year. In these

experiments, a new long winged net of 29.26 M which was fabricated during the year with few modifications in jibs and mesh size, will be used.

Persons associated

Shri A. V. V. Satyanarayana — Jr. Fishery Scientist
Shri G. Narayanappa — Research Assistant
Shri D. A. Narasimha Raju — Research Assistant

(ii) Fish trawling

Experiments completed :

(a) Comparative efficiency of two seam and four seam trawl nets.

Based on the previous experiments on the relative utility of different methods to increase the vertical height in an otter trawl, a new design of four seam trawl with 18.3 M head rope was worked out to suit Fishtech No. 7, a 40' boat with 60 BHP engine. The above net was operated with a 18.26 M two seam net, which was already found effective as a fish trawl. These gear were tried in both inshore and offshore waters.

Chief findings:

Four seam net was not only found equally effective on comparison with two seam net in inshore water, but also obtained better catch in offshore waters. For the first time, this four seam net proved its efficacy in terms of catch as well as better variety of fish at the centre disproving the previous finding that two seam nets alone are suitable.

b) Potentialities and catch composition of offshore (deep) waters off Kakinada:

As the catch rate in the usual inshore fishing grounds during the first quarter was found low, an attempt was made to study the potentialities of new offshore grounds and the catch composition available there. In this process, fishing experiments were undertaken upto 100 M off this centre during the months of March to April.

During the period, the catch rate is found very high in offshore waters (deep) which was estimated to be nearly 5.5 times more than the catch rate of inshore waters.

The catch composition is significantly different in both the regions. The catch in deep waters was represented by Synagris sp., Psenus sp., Decapterus sp., Scianids and Soles; while the catch in inshore waters comprised of Lactarius sp., Synagris sp., Upenoids sp., Saurida sp., Caranx sp., Scianids and Soles.

The bulk of deep water catch consists of Synagris sp. (60%) where as Scianids (30%) form the major catch in the inshore waters.

Research in hand

The experiment on the optimum buoyancy on head rope and buoyancy/weight ratio for a fish trawl was taken up in the latter half of the year and pursued.

Initially the experiment was made using a 18.26 M two seam nylon net, with 11, 15 and 19 floats of 5" dia. on head rope and later on extended to a cotton net of same design, but with head rope length of 16.14 M. The ratio of buoy./wt. thus tried, were 0.5, 0.75 and 1.0 respectively. The results of the experiments are as follows.

i) 18.26 M net with	11 floats	15 floats	19 floats
Period of experiment		July to October	
Depth/Warp (m)		15 to 65/75 to 270	
Valid hauls/Tr. time		34/34 hrs.	
Catch/Tr. Hr. (Kg.)	83.4	93.7	69.7
ii) 16.14 M net			
Period of experiment		October to December	
Depth/W. L. (m)		18 to 45/130 to 220	
Valid hauls/Tr. time		16/16 hrs.	
Catch/Tr. Hr. (kg.)	53.6	70.0	63.2

The catch rate is found high with buoy/wt. ratio at 0.75 for both the nets experimented, which seems to be optimum for a fish trawl at this centre.

Future work:

The above experiment will be continued for confirming the results.

Experiments on the optimum trawling speed for a fish trawl and relative utility of horizontal curved and vertical curved otter boards are proposed.

Persons associated:

Shri A. V. V. Satyanarayana	—	Jr. Fishery Scientist
Shri G. Narayanappa	—	Research Assistant
Shri D. A. Narasimha Raju	—	Research Assistant

II Improvements in the designs of gill nets:

Under this, investigation on seer gill nets and shark drift nets, taken up previously, were continued.

(a) Seer gill nets

Work completed:

Forty nine observations at the local gill net landing centre, to study the predominant size group of seers and trend of seer fishery were made during

the year. On each observation day the data relating to the number of boats operated, the total catch, its composition, seer percentage, species composition and their size group were gathered. Seer fish constituted 33.5% of the total gill net catch, with peak catches in January to March, June and December. *Scomberomorus guttatum* (40%), *S. commersoni* (33%) and *S. lineolatus* (22%) are represented in seer catch.

The predominant size groups of *S. guttatum*, *S. commersoni* and *S. lineolatus* are 45-50 cm., 90-95 cm. and 85-90 cm. respectively and form 93, 70 and 85% of the total catch.

Research in hand:

Experimental fishing with the designed gear to study the optimum mesh size for commercially predominant size groups, selective action of twine, effect of colour of netting twine and catch variation with phase of moon and depth of operation, was conducted by making 68 fishing voyages in the year. 53 fishing trips for surface drifting and 15 trips for bottom drifting were made.

21.0% of the total catch is represented by seer. 50 mm. bar mesh size is equally effective for all three species of seers. 60 mm. bar is also effective for bigger species.

Nylon twine, having greater breaking strength, is found good for *S. commersoni*, whereas kapron obtained more catch of *S. guttatum*.

White coloured units are effective for *S. guttatum* and *S. lineolatus*, and blue and yellow for *S. commersoni*.

The depth ranges of 31-40 and 41-50 M are relatively more productive for *S. guttatum* and *S. commersoni* respectively.

The catch of *S. guttatum* is more after new moon, whereas that of *S. commersoni* is before full moon days.

Future work:

Based on the data already collected, suitable designs of seer gill nets are to be worked out for further experiments.

Persons associated:

Shri Y. Sreekrishna	—	Asst. Fishery Scientist
Shri J. Sitarama Rao	—	Research Assistant
Shri P. Dawson	—	Research Assistant

b) Shark drift nets:

Research in hand:

Five units of nylon 210/6/3 with 63.5 mm. mesh bar were experimented along with seer gill nets.

Chief findings:

Sharks constituted 19.3% at the landing centre on comparison with 20.7% and 44% of the experimented gear in bottom and surface drifting respectively. *C. melanopterus* is found to be the main catch in surface operation.

50-60 M. depth range is more productive for sharks with better catch rate before new moon and after full moon.

Future work:

The experiments on shark drift nets will be continued for confirmation. Based on preliminary findings suitable design for shark drift nets is to be worked out for experimentation as well as popularisation.

Persons associated:

Shri Y. Sreekrishna	—	Asst. Fishery Scientist
Shri J. Sitarama Rao	—	Research Assistant
Shri P. Dawson	—	Research Assistant

III Line fishing:**Research in hand:**

Long lining for sharks as planned previously, was undertaken by making 19 fishing trips during the year. Initially 3 units with 50 hooks of Nos. 4 and 5 were tried. Later on the length of branch line was reduced and hooks doubled in each unit. More trips could not be made due to repairs to boat, continued bad weather and non-availability of sharks in inshore waters.

Preliminary findings:

Sharks are not available in the inshore waters off the centre.

Future work:

The experiments will be attempted in the deeper waters from a big boat during the calm period of next season.

Persons associated:

Shri A. V. V. Satyanarayana	—	Jr. Fishery Scientist
Shri J. Sitarama Rao	—	Research Assistant
Shri P. Dawson	—	Research Assistant

CIFT SUBSTATION, BURLA:**I - Gill nets for inland fishery:****Chief findings:**

The productive areas were observed to be in the upper reaches during the winter season shifting to the middle reaches during summer and monsoon seasons. Frame nets with 1.75 metre frame were found to yield the optimum

results. The optimum ratio of mesh sizes of inner and outer webbing in trammel nets was found to be 1:5. About 27% of the fishes were caught in the gear during the first half of the night and 72% during the second half of the night.

i) Exploratory fishing :

Exploratory fishing experiments have been conducted for 183 days from 13 stations along the Mahanadi course. The productive areas were found to be the upper reaches followed by middle reaches during the first quarter of the year, while the middle reaches were found to be productive in the second quarter. In the last quarter the upper and middle reaches have the same potentiality.

ii) Spatial distribution of fish:

Ninety five per cent of the total catch was obtained from depths of 0-6 metres, 33.2% from 0-2 metres, 42.8% from 3-4 metres and 18.2% from 5-6 metres depth. The fishes were generally confined to 3-6 metres with surface water temperature of 22-24°C and 27-30°C.

iii) Comparative studies on the various designs of gill nets:

As in previous years the output of frame net is about 100% more than that of the simple gill net. The average output of the nets is as below.

Gear	Catch in kg/1000 sq. m. of net
Simple gill net	1.853
Vertical lines net	2.715
Frame net	3.599

iv) Optimum parameters of framing in frame nets:

In conformity with previous year's observation the frame size of 1.75 metres was found to be the optimum. The average output of frame nets of different frame sizes is given below:

Frame size in metres	Catch in kg / 1000 sq. m. of net
1.00	2.844
1.25	4.229
1.50	3.764
1.75	6.235
2.00	3.232

v) Studies on trammel nets:

The output of trammel net with the mesh size of the outer webbing five times greater than that of the inner webbing has given the maximum output. The output of the nets is as below.

Net (Ratio of inner mesh size to outer mesh size)	Catch in kg/1000 sq. m. of net
1:3	4.052
1:4	3.712
1:5	6.229

vi) Studies on coloured nets:

Experiments with coloured nets, green, yellow, blue and white have shown a better output with green net followed by yellow. The catch per unit effort of the various coloured nets is as below:

Colour	Catch/unit effort
White	1.294
Blue	0.872
Yellow	1.503
Green	1.542

vii) Time of gilling of different species of fish:

The data collected tend to indicate that 27.42% of the total catch is caught during the first half of the night and 72.58% during the second half of the night. The percentage composition of the catch is as given below:

Period	Percentage composition of catch by weight	
	Scale fish	Cat fish
First half of night	7.52	19.89
Second half of night	31.06	41.51

Research contemplated:

- Effect of mesh size, twine diameter and hanging coefficient on the output of simple gill nets.
- Relation of mesh size and frame size in frame nets.
- Standardisation of the relation of inner and outer mesh size in trammel nets.
- Standardisation of horizontal hanging and slackness of inner webbing in trammel nets.
- Effect of twine thickness on the output of trammel nets.
- Initiation of the studies on beach seines.

Persons associated:

Shri V. C. George	— Asst. Fishery Scientist
Shri R. M. Naidu	— Research Assistant
Shri R. V. V. Satyanarayana Rao	— Research Assistant

CIFT UNIT, NANGAL:

During the year under report steady progress has been recorded in the research projects undertaken by this Unit. Investigations have been carried out

in Gobindsagar as well as in Nangal lake in order to find out the most effective fishing methods for the proper exploitation of such water areas. Studies on mesh selectivity have been continued in Gobindsagar and similar studies were initiated in Nangal lake with a view to arrive at the optimum mesh size for gill nets in exploiting the dominant species of fishes in the respective reservoirs. Preliminary investigations to evaluate the relative efficiency of different colours for gill nets in fresh water operations were continued during the year under report. Investigations on column gill nets were initiated in Gobindsagar with a view to assess the availability of fishes in the deeper zone of the reservoir.

A brief review of the progress recorded under different projects during the year under report is given below:

Research completed with chief findings:

I - Gill nets for inland waters:

a) Studies on the selective action of mesh size:

Mesh selectivity studies have been continued in Gobindsagar and similar studies were initiated in Nangal lake, an adjacent reservoir, with a view to arrive at the optimum mesh size for gill nets in exploiting the major fishery in the respective reservoirs. Ordinary gill nets of mesh bar ranging from 40 mm to 75 mm at an interval of 5 mm were operated at selected centres under identical conditions and the data on the length, girth and weight of fish caught from nets of each mesh size were collected separately. As *Labeo diplostoma* constituted the bulk of the landings from Gobindsagar and Nangal lakes, gill nets of mesh bar of the range 45 mm to 55 mm bar recorded considerably higher catch per unit area of webbing as compared to nets of other mesh size in both the reservoirs. The State Government agencies as well as private fishermen engaged in regular fishing in Gobindsagar and Nangal lakes are at present using only gill nets of mesh bar of the range 45 mm to 55 mm as the above mesh range have been conclusively proved to be most suitable for the commercial exploitation of these water areas.

b) Studies on the effect of coloured gill nets:

Preliminary investigations on the relative efficiency of different colour shades for gill nets in fresh water operations were initiated in Nangal lake. Four ordinary gill nets of 50 mm mesh bar dyed in 4 different shades, viz. blue, green, orange and yellow were operated along with an undyed net of the same specification under identical conditions and data on the species and size of fish caught in relation to the respective shade of nets were collected. No appreciable preference in respect of any particular shade could be noticed from the investigations in Nangal lake, as the catch per unit area of net operated from this reservoir was generally poor compared to that of Gobindsagar due to lack of sufficient fish population.

c) Exploratory fishing:

Investigations on exploratory fishing have been conducted in Nangal lake, an adjacent reservoir to Gobindsagar with a view to assess the productivity

of this lake as well as to locate potential fishing grounds as per request of the Punjab State Fisheries Department. Accordingly trial operations were carried out at various centres in the lake using ordinary gill nets of varying mesh size operated as surface set nets. During the course of the investigations it has been noticed that the catch per unit effort from this lake has been much lower as compared to that of Gobindsagar. The reason for this may be attributed apparently to limited fish population in this lake coupled with the prevalence of strong current and sudden fluctuation in the water level. Two hundred and fourteen fishing trips were undertaken landing a total number of 5546 fishes weighing 3816 kgs. The Punjab State Fisheries Department has started regular fishing operations in this reservoir for tapping the resources following the method suggested by this Unit.

Exploratory fishing investigations have also been resumed in Gobindsagar from the month of October with a view to advise the Himachal Pradesh Fisheries Department on the regular exploitation of this reservoir. Trial operations were carried out from different centres in the upper as well as middle reaches of the reservoir using gill nets of varying mesh size operated as surface set nets. Larger fish concentration has been observed in the upper reaches of the reservoir during the course of investigations. Sixty seven fishing trips were undertaken during the year under report landing a total number of 7555 fishes weighing 5528 kgs.

The result of the exploratory fishing investigations conducted in Gobindsagar has established the existence of a lucrative fishery in this reservoir and surface set gill nets can be successfully employed for the commercial exploitation of its major fishery by selecting suitable fishing grounds at different seasons. The abundance of submerged underwater obstructions restrict the scope for introduction of any dynamic gear at this stage. Fish concentrations have been observed mostly in the upper reaches of the reservoir specially in shallow marginal areas and small pockets and hence fishing has to be concentrated in such areas for economic results. The fishing methods developed by this Unit are being successfully adopted by the State Fisheries Agencies as well as private fishermen engaged in fishing in Gobindsagar. Here it is worth mentioning that prior to the establishment of this Unit at Nangal there were no fishermen population around Gobindsagar but now there are more than 200 fishermen actively engaged in fishing in Gobindsagar using our designs of nets and following the methods recommended by this Unit.

Research in hand and programme of future work:

a) Studies on the effect of coloured gill nets:

Studies on this aspect have been resumed in Gobindsagar towards the end of the year under report using gill nets of 45 mm mesh bar of kapron 200/12 dyed in the same colours and following the same method of operation. The studies are in progress and will be continued during the ensuing year.

b) Set nets and traps for inland waters:

Trial operation of a 5 metre Russian type inland trap net has been conducted in Nangal lake during the year under report with a view to assess the suitability of this gear for the exploitation of this water spread. The result was not encouraging in spite of continuous operations for 4 months which corroborate with earlier observations made in Gobindsagar, that this gear is not very effective for inland reservoirs. The reason for this may apparently be the absence of shoaling fishes in the reservoir. As such, experiments on this aspect have been discontinued from the month of July 1968.

c) Investigations on column gill nets:

Preliminary investigations on this aspect have been initiated in Gobindsagar towards the end of the year under report with a view to assess the availability of exploitable fishery in the column region of the reservoir. With the onset of winter, more fish concentration was observed near the surface and the catch from column nets was not encouraging. Hence it is proposed to resume the investigations during the summer months.

Persons associated:

Shri N. A. George	—	Asst. Fishery Scientist
Shri Om Prakash Pandey	—	Research Assistant
Shri Anwar Ahmed Khan	—	Research Assistant

CIFT UNIT, GOA

During the period under review the Unit has undertaken the following technical projects in the development of the fishing gear and methods.

- | | | |
|---------------------|---|----------------------|
| 1. Trawl fishing | — | Shrimp trawling. |
| 2. Line fishing | — | Trolling lines. |
| 3. Gill net fishing | — | Seer gill nets. |
| 4. Set net | — | Set net for mackerel |

As the pre-shipment inspection and quality control section is also attached to this Unit with an Inspection Officer, pre-shipment inspection is carried out by this Unit.

The details of the various projects and the progress of work in the other fields are as follows:

Research in hand and programme for future work:

I - Trawl fishing - "shrimp trawls":

The project was initiated with the objective of evolving suitable designs of shrimp trawls for commercial exploitation of the shrimp grounds and also of finding out the possibilities of commercial shrimp trawling in the hitherto unexploited deeper waters. The investigations are in progress in a systematic way after reorientation during this season. Regarding the suitability of the designs of gear, comparative catch efficiency studies were initiated with two

shrimp trawls of same head rope length of 13.68 m. but made of two different materials and of designs i. e. one of nylon, four seam type and other of cotton, two seam type.

II - Gill nets--"seer gill nets":

The project was initiated with the main objective of evolving rational designs of gill nets.

As reported in the previous report the rigging of the gear was completed by the end of March 1968.

III - Line fishing - "trolling lines"

During the year under report, the gear was made ready for the operations. The operations could be initiated only in the month of November 1968 as the Fishtech No. IV could be ready only by then. In all, six fishing trips were conducted during the same month. The artificial baits used were the buffalo-horn jigs, fish-head jigs and stainless steel jigs. Only one tuna weighing about 5.0 kg. was caught in the stainless steel jig. The experiments could not be pursued as the seer season almost came to an end by the end of November 1968. For want of data the investigations are to be pursued during the ensuing season.

IV - Set net, bag net and traps - "set net for mackerel":

The set net which was originally planned to be operated off Mangalore coast (Malpe) was shifted to this Unit during the end of December 1967. The project was taken up during the mackerel season of this year. The gear was operated successfully off Agwad Port. The mackerels do not seem to have approached the shore in the area as exemplified by the very poor catches of the local shore seines, "rampani", and successful operations of the purse seines in deeper waters. Catch data for some species of fish like seer, carangids, polynemus, clupeids, scianids etc. have been collected and the data are under processing.

Persons associated :

Shri H. N. Mhalathkar	—	Asst. Fishery Scientist
Shri K. K. Kunjipalu	—	Research Assistant
Shri P. R. Sentivelan	—	Research Assistant

SUMMARY

1. Horizontal curved otter board is comparatively more efficient than the other types viz. flat rectangular and hydrofoil, oval with single slit otter boards.
2. Four seam trawl nets were found equally effective both in inshore and offshore regions in bringing better catch when compared to two seam nets.

3. The buoyancy-weight relationship of nylon seer drift nets of different specifications appropriate for different modes of operations have been worked out.
4. The period of 7 days before and 7 days after new moon is best suited for seer fishing.
5. Buffalo horn jigs of 12.5 cm. and 15 cm. length and weight 60 gms. having a shape of a sardine fish is effective in capturing seer fish.
6. A successful formulation of an anti-corrosive paint using modified cashew nut shell liquid (CNSL) suitable for application to steel hulls of fishing boats has been developed.
7. Prototype of an equipment for eradication of under-water weeds in medium and small size ponds was fabricated and trials undertaken.
8. Design of a combination winch suitable for the 17.53 M. steel boats constructed under Government of India scheme has been completed.
9. Instruments have been developed for measuring the tilt and angle of attack of otter boards.
10. Gill nets of mesh bar of the range 45 mm. to 55 mm. are best suited for exploitation of fisheries in the Gobindsagar and Nangal reservoirs.

EXTENSION, INFORMATION & STATISTICAL WING

The Statistics Section of the Wing made further progress in the research projects undertaken by it in collaboration with other sections of the Institute. The Extension and Information Sections of the Wing continued activities in giving technical assistance to the fishery industry, State Fisheries Departments and other fishery interests, popularisation of the results achieved by the Institute, publication of the quarterly Fish Technology Newsletter, leaflets and information sheets. The activities of the Wing are summarised below.

STATISTICS SECTION

Chief findings:

With reference to pre-shipment inspection of frozen prawns, tightened tolerance limits for the quality characteristics which appear to be appropriate from the point of view of existing commercial practices, have been suggested to replace the tolerance limits prescribed in the present Indian Standard specification for the product. The results of pre-shipment inspection of frozen prawns from different factories over various periods have indicated that while off-condition of the product has caused major proportion of rejections, certain factories had relatively higher percentages of rejections due to other factors. The studies on evaluation of the service performance and economics of fishing vessels built to the designs prepared by the Institute have shown that vessels in the size group of 11 M. are more economical than those in 10 M. group.

1) Pre-shipment inspection scoring system for frozen prawns:

The need for revision of the present scoring system for frozen prawns which was drawn up by the Indian Standards Institution on lines for similar products in USA has been under investigation. The study was continued during the year with a view to revising the tolerance limits for the quality characteristics. Considering the existing commercial practices, the following tolerance limits are found to be more appropriate. These tolerance limits are being studied for their relative effect along with the existing ones considered in quality evaluation in the pre-shipment inspections at present.

Factor	Headless frozen prawns	Peeled and deveined frozen prawns
Deterioration	15%	20%
Discolouration	30%	30%
Black spot	25%	—
Broken and damaged pieces	5%	20%
Legs, veins etc.	5%	10%

2) A factory wise study of the results of quality control inspection of frozen prawns:

Results pertaining to different factories over different periods for the last 3 years have shown that the percentages of rejections due to different factors were as follows:

Off-condition or decomposition	—	89.04%
Short weight condition	—	4.92%
Excessive discolouration of the product	—	1.89%
Defective size-grading	—	1.82%
High percentage of broken pieces	—	1.89%
Heavy chlorine smell	—	0.44%

Thus, off-condition (decomposition) of the product was the most important single factor causing maximum rejections. In case of other factors, the performance of the different factories varied, some of them showing relatively higher proportion of rejections than others. After up-to-date tabulation of the data these results will be consolidated to arrive at the final conclusions.

3) Development of a numerical scoring system for characteristics of ice-stored prawns:

Experiments were conducted in the laboratory using two species of prawns viz. *Metapenaeus affinis* and *M. dobsoni*. Significant differences in *M. affinis* (stored in headless shell-on form) were brought out by storage in ice for 3, 7 and 11 days. Regarding *M. dobsoni* (stored in peeled and deveined form) appreciable change in flavour was experienced on the 2nd, 5th, 7th and 10th day of ice-storage. Significant difference in odour was experienced on the 2nd, 5th, 6th and 9th day of ice-storage and in texture on the 2nd, 3rd, 6th and

9th day of ice-storage. The descriptive expressions of spoilage in respect of flavour, odour and texture collected during the experiment were also compiled. The work has to be continued with other species of prawns and also to finalise the descriptive expressions of scoring mentioned above.

4) Evaluation of service performance and economics of fishing vessels:

The work on the project was continued during the year. The catch efficiency data collected from the selected trawlers for the study were consolidated and analysed. Analysis of data has revealed that the fishing boats of 11 M. class were better than boats of 10 M. class both from the considerations of catch per unit effort and the total effort per year. The catch per hour and the total effort per year for the 11 M. class were 1.5 and 1.45 times respectively of those of 10 M. class. The landings per year from the 11M. class were twice those of 10 M. class. The percentage return on capital from the 11 M. class was also higher. This study is proposed to be extended for larger sized trawlers in the size range of 13 to 30 M. operating along the Kerala coast.

The prawn catch per hour during the last four seasons from 1964-65 to 1967-68 did not show much variation.

Persons associated

Shri H Krishna Iyer — Asst. Fishery Scientist
Shri R. Rajendran — Research Assistant

5) Other studies:

Preliminary studies on control of gross weight in canned prawns:

With the aim of finding out whether the fluctuations in gross weights of canned prawns reflect changes in processing conditions in canning factories, a preliminary analysis of data pertaining to different factories and size grades was carried out to find out the nature of correlation between gross weights, drained weights and volume of brine in canned prawns. The results have shown that in many instances significant correlations exist among these factors. This information will be utilised in preparing control charts for gross weights of canned prawns in some of the canning factories.

In addition to the above studies, the Section has assisted other sections of the Institute in designing of experiments and carrying out statistical analysis of the experimental results.

Persons associated:

Dr. V. K. Pillai — Fishery Scientist
Shri Dines Roy Choudhuri — Quality Control Officer
Shri K. Krishna Rao — Asst. Fishery Scientist
Shri H. Krishna Iyer — Asst. Fishery Scientist
Shri R. Rajendran — Research Assistant
Shri N. Balraj — Research Assistant

EXTENSION & INFORMATION SECTIONS:

I Technical assistance to the fishery industry and other fishery interests:

i) Furnishing technical information on queries received:

Furnishing information and advice on the technical queries received from the fishing and fish processing industries, State Fisheries Departments and other fishery interests on the various aspects of the industry and fishery technology was one of the main activities of the Section. A total of 546 queries were answered during the period. Of these, 329 queries related to different aspects of fish processing industry and 217 queries to matters pertaining to fishing craft and gear. The technical details furnished in respect of fish processing industry include schemes on prawn canning and freezing factories, frog leg freezing factory, prawn and fish dehydration units, fish meal manufacturing unit, units for extraction of sardine oil and shark liver oil, layout drawings for different fish processing factories, design and details of prawn peeling shed, methods for dry curing different types of fish, methods for dehydration of fish in tunnel dryer, methods for freezing and canning different types of fish, methods for different speciality products like prawn and fish pastes, fish flake, fish soup powder etc., details of processing products like shark fins, fin rays, fish maws, beach de mer, shark skin leather, printing ink, factice and ready mixed paint from sardine oil and details of the improved type of containers and methods for transport of fish over long distances. The technical details supplied with respect to fishing craft and gear include specifications of twines for fishing nets, estimates of cost of construction of different sizes of mechanised boats, details of the technique of providing sheathing to wooden fishing boats with aluminium-magnesium alloy and fibre-glass reinforced plastic (FRP), lining of fish-hold with FRP, method of application of indigenous resins on wooden fishing boats, observation on the performance of indigenous marine engines, specifications of equipment and machinery for net making plant, specifications of floats for deep sea fishing, suitable indigenous wood for use as stern bearings in boats, details on the use of *Venteak (Lagerstroemia lanceolata)* for construction of fishing boats, suitable trawl nets and otter boards for different sizes of boat, average catch data in respect of boats of different sizes etc.

ii) Facility provided for personal discussions.

Correspondence remained the important medium for transmission of the required technical information and advice to various parties all over the country. However, quite a good number of persons from the industry, new entrepreneurs etc. used to come to the Institute for gathering information and advice on different aspects of the industry, and the innovations made by the Institute. Such visitors have been given all facilities by furnishing them with the information needed, arranging for their discussion with the concerned scientific workers, demonstrating the working of the different equipments installed in the Institute etc. During the period a total of about 90 parties came to the Institute for personal discussions on the points of interest to them.

Facility was also provided to one Research Assistant from the Lime Shell Research Institute, Kumarakom, Kerala for training of one week in the Chemistry Section of the Institute in the methods of determination of nutritive value of shell fish with particular reference to clams.

iii) Testing of materials and products:

Arrangements were also made for testing of samples of gear materials like fish net twines, floats etc. and samples of processed fish products received from different parties and the test reports and comments furnished to the concerned parties which enabled the indigenous manufacturers and processors to improve upon the quality of the items turned out.

iv) Visits to fish processing establishments and conduct of demonstrations:

The processing factories and primary processing centres in Cochin area were visited regularly for follow-up action in respect of the cleaning schedule recommended by the Institute for maintaining sound hygienic conditions and other recommendations made towards processing standard quality products and also for studying the specific problems, if any, encountered by the processors. A total of 46 processing factories and primary processing centres in and around Cochin were visited regularly during the period. During the visits, particular attention was paid in giving specific suggestions for overcoming the cases of defects observed during the analysis carried out by the Quality Control Section of the Institute on the samples of raw material, ice and water and on the general sanitary conditions in the various establishments. Besides, demonstrations of the cleaning schedule were conducted in the factories and processing centres newly set up and where these had not been conducted earlier. Thirty six demonstrations were conducted during the period in 12 processing establishments. These have helped in educating the technologists and workmen engaged in cleaning in the concerned establishments, on the different steps in the recommended schedules of cleaning including determination of strength of bleaching powder or bleach liquor and chlorination of water to the desired levels for different purposes. The routine application of the methods of cleaning as recommended by the Institute in the processing establishments has resulted in maintaining satisfactory hygienic conditions. This has clearly reflected in the overall quality of the products turned out from the factories, especially in the bacteriological quality, which is generally of the standard, if not superior, to those required by the importing countries.

The method recommended by the Institute for anaesthetising live frogs before cutting off the legs for freezing and at the same time improving the bacteriological quality of the legs was once again brought to the notice of all the frog leg processors in the country stressing the necessity for routine adoption of the method in view of the quality of the finished product and the controversy that exists regarding the method of cutting of legs from live frogs without anaesthetising them and thus causing rigorous torture and struggle to the frogs.

The recommendations made by the Institute for prevention of blackening in canned prawns and loss in weight due to 'drip' in frozen prawns were also explained to the prawn processors in Cochin area, apart from furnishing the methods to all processors in the country.

Demonstrations on the application of a mixed preservative consisting of sodium propionate in refined salt for preservation of cured fish products were conducted for the benefit of the cured fish exporters at Tuticorin on the request made by the local Fish Exporters' Chamber. These demonstrations helped in impressing the fish curers on the striking benefits of the recommended method of preservation.

- v) Supply of design drawings of nets, trawl winches, fish dehydration plants etc:

Sixty three complete sets of drawings of trawl nets and suitable otter boards for operation from different sizes of boats and six drawings of trawl winches of different capacities, all designed by the Institute, were supplied on request. Besides, four drawings of the tunnel dryer of one tonne (raw material) capacity for dehydration of fish and 9 drawings of the rotary drum dryer of half tonne (raw material) capacity for dehydration of prawns and production of fish meal, both of the Institute's design, were also supplied.

- vi) Film shows and exhibition:

Eight film shows were conducted in the Fishermen and Staff Training centres and Regional Technical High Schools under the Kerala State Fisheries Department and two fish processing factories in Cochin area. The films on fishing methods, fish spoilage and control, different processing techniques etc. showed were very useful to the trainees, staff members of the organisations and local fishermen as could be known from the written appreciations received from the parties.

Different exhibits pertaining to the findings made by the Institute in fish processing technology were displayed in the exhibition conducted at the Jadavpur University, Calcutta in July 1968 in connection with a symposium organised by the University on food technology.

II Publications:

- i) Fish Technology Newsletter:

Four issues of the Fish Technology Newsletter, Vol. IX were published. A total of 29 notes on the results achieved by the Institute were published in these issues. They include notes on prevention of blackening in canned prawn, methods for canning dara fish and tilapia, preparation of fish soup powder, prevention of drip loss in frozen prawns, preparation of laminated Bombay duck, accelerated method for dehydration of fish in tunnel dryer, smoking of eel fish fillets, utilisation of frog wastes, efficiency of otter boards of different shapes, results of trolling operations in Cochin waters, details of angle of attack meter and tilt meter and a combination winch for 16.8/18.3 M. fishing boats.

ii) Leaflets and information sheets:

The following cyclostyled leaflets and information sheets were published.

1. Processing of cooked frozen prawns—hints on maintenance of bacteriological quality.
2. Insulated box for transport of iced fish over long distances.
3. Fibreglass reinforced plastic (FRP) for lining interior of fish-hold.
4. FRP for sheathing wooden hulls of fishing boats.
5. Fuel and fresh water tanks in fishing boats.
6. Speciality products from prawn and fish.
7. Fish soup powder from trash fish.
8. Shrimp extract.
9. Crab concentrate.
10. Fish maws.

Copies of the different leaflets and information sheets published so far were supplied to various parties on request. About 800 copies of these publications were supplied during the period.

The Note on Work and Activities of the Institute published earlier was revised and made up-to-date.

The scheme for a prawn canning factory of capacity 5000 cans (8 oz.) per day and that for a prawn freezing factory of capacity 2 ton finished product per day published earlier were also revised and made up-to-date.

The leaflet on Venteak as timber for construction of fishing boats published earlier was revised incorporating more details on the comparative properties of Teak, Aini and Venteak.

An article highlighting the recent findings of the Institute was prepared and sent for publication in the Journal 'Foreign Trade of India' published by the Ministry of Commerce.

A write-up on the set-up, activities and recent important findings of the Institute was prepared and furnished to Indian Council of Agricultural Research for inclusion in the proposed Directory on ICAR Institutes.

A list each of dealers in fishing gear and gear materials in India, dealers in marine engines and engine spares, dealers in materials for protection of hulls of wooden fishing boats and dealers in mechanical fishing accessories were prepared on the basis of available information and copies were sent to different State Fisheries Departments inviting additional information, if any, for inclusion in the lists. The lists are being revised on the basis of supplementary information received. Copies of the lists already prepared were supplied also to different parties on request.

III - Visitors to the Institute:

Besides the officials of Government Departments, scientific workers from Research Institutes, trainees from State Fisheries Departments and other Institutions, students and persons connected with fishing and fish processing industries, the Institute was also honoured by the visits of Mr. Anna Sahib P. Shinde, Hon. Minister of State for Food and Agriculture, Government of India and Mr. Roy I. Jackson, Chief of the Fisheries Division, FAO of the United Nations, Rome.

Persons associated:

Shri P. N. Ravindranatha Kaimal — Extension Officer
Smt. Mary Thomas — Research Assistant

PUBLICATIONS

The following publications were brought out during the year under report.

1. Appuraj, V. E. and Valsan, A. P. - Observations on inhibitory effect of sodium chloride on moulds met with in smoked fishery products, *Fish. Technol.*, 3 (2), 158, 1966 (issued in February 1968).
2. Balasubramanyan, R., Ravindran, K., Unnikrishnan Nair, N. and Gopalakrishna Pillai, A. G. - Protection against borers, foulers and corrosion through the use of aluminium alloy sheathing in marine environment, presented at the Second International Congress on Marine Corrosion and Fouling, Athens, Greece, Sept., 1968.
3. Studies on the pholadid marine wood borer *Martesia striata* (Linnaeus) presented at the Symposium on Mollusca organised by the Marine Biological Association of India, Ernakulam, January 1968.
4. and Unnikrishnan Nair, N. - Fouling by oysters and their prevention, *Ibid.*
5. Deshpande, S. D., Sivan, T. M., Kartha, K. N. and Rama Rao, S. V. S. - Comparative efficiency studies between two seam and four seam otter trawls, presented at IPFC 13th Session, 1968.
6., Rama Rao, S. V. S. and Kartha, K. N. - Certain observations on the effectiveness of rectangular and oval otter boards, *Ibid.*
7. and Kartha, K. N. - Experiments in fishing with shrimp trawls - on the standardisation of tickler chain, *Fish. Technol.*, 4 (2), 62-64, 1967 (issued in Oct. 1968).
8. Gopakumar, K. and Rajendranathan Nair, M. - Studies on fish lipids - I. Fatty acid composition of lipids of marine fishes as determined by gas-liquid chromatography, *Ind. Jour. Bioch.*, 4 (4), 229, 1967 (issued in April 1968).

9. Gopalakrishna Pillai, A. G. Ravindran, K. and Balasubramanyan, R. - On the designing and testing of an antifouling paint incorporating copper aceto arsenite, *Paintindia*, XVIII (7), 1968.
10. Gopinatha Kartha, T. D. and Roy Choudhury, R. L. - Trawling pull exerted by a trawler - a method of estimation from propeller dimensions and its comparison with sea measurements, *Fish. Technol.* 3 (2), 133, 1966 (issued in February 1968).
11. Govindan, T. K. - Application of technology in optimum utilisation of the fishery resources of India, - presented at the Symposium on the Living Resources of the Seas around India, Cochin, 7-10 December 1968.
12. Iyer, T. S. G. and Choudhuri, D. R. - Influence of ice on the bacteriological quality of processed fishery products, *Fish. Technol.* 3 (2), 113, 1966 (issued in February 1968).
13. Kaimal, M. N. N. and Madhavan, P. - Utilisation of sardine oil for industrial purposes - I. Factice for use as a filler in rubber compounding, *Res. and Ind.*, 12 (4), 251, 1967 (issued in June 1968).
14., Gopalakrishna Pillai, A. G. and Madhavan, P. - Utilisation of sardine oil for industrial purposes - II. Surface coating materials from sardine oil, *Ibid* 13 (1), 24, 1968.
15. Kamasastri, P. V., Ghadi, S. V. and Ramananda Rao, D. - Studies on storage characteristics of silver pomfrets (*Pampus argenteus*) transported to Bombay, *Fish. Technol.* 4(2), 71, 1967 (issued in October 1968).
16., Sham Narayan Doke and Ramananda Rao, D. - Some aspects of freezing and frozen storage of pomfrets, *Ibid*, pp. 78.
17. Kamdar, L. D., Kandoran, M. K., and Venkataraman, R., - Studies on shark liver oil and its residue, *Ibid*, 4 (1), 21, 1967 (issued in June 1968).
18. Kandoran, M. K., Valsan, A. P. and Unnikrishnan Nair, T. S. - Occurrence of deeper red colour in prawn pulp prepared from iced prawns, *Ibid*, 4(2), 85, 1967, (issued in October 1968).
19., Rao, S. V. S. and Valsan, A. P. - Studies on effect of impurities on the penetration of salt in the curing of fish, *Indian J. Fish.*, XI(1), B, 1, 1964 (issued in December 1968).
20. Karthiyani, T. C., and Mahadeva Iyer, K., - Quantitative and qualitative studies on the bacterial flora of fresh sardines, *Fish. Technol.* 4 (2), 89, 1967 (issued in October 1968).
21. Krishna Rao, K. and Pillai, V. K. - A study on the quality of prawns during processing in prawn freezing factories, *Ibid*, pp 98.
22. Krishna Iyer, H., Rajendran, R. and Roy Choudhury, R. L. - Comparative fishing ability and economic efficiency of mechanised trawlers operating along the Kerala Coast, *Fish. Technol* 5 (2), 71-80, 1968.

23. Kuriyan, G. K., - Fishing gear research at the Central Institute of Fisheries Technology, Fish. Technol., 5 (1), 1-4, 1968.
24. Madhavan, P. and Kaimal, M. N. N. - Utilisation of sardine oil, - Presented at the Seminar on Marine Oils, Oil Technologists' Association of India, Bombay, June 1968.
25. Mukundan, M., Satyanarayana, A. V. V. and Krishna Iyer, H. - On the relative efficiency of different shaped otter boards, Fish. Technol., 4(2), 53, 1967 (issued in October 1968).
26. Narayanappa, G. - On the relative catch efficiency of different shaped otter boards in bottom trawling, Fish. Technol. 5 (1), 15-20, 1968.
27., Raju, D. A. N. and Satyanarayana, A. V. V. - Certain observations on the trawling operations carried out in the inshore and deep waters off Kakinada - presented at IPFC 13th Session, 1968.
28., On the optimum length of single sweep wire for an otter trawl, *Ibid*,
29. Pillai, V. K., Quality control in better utilisation of fishery resources of India, presented at the Symposium on the Living Resources of the Seas around India, Cochin, 7-10, December 1968.
30. Ramananda Rao, D. and Kamasastri, P. V. - Utilisation of waste materials in the frog leg processing industry, Indian J. Fish X (1) B; 4-7, 1963, (issued in July 1967).
31. Rao, C. V. N., - Thermister thermometer for temperature measurements of frozen fish, Air Conditioning and Refrigeration in India, 5 (4), 24, 1968.
32., Some observations on handling of fresh prawns, Indian Food Packer, XXII (4), 32, 1968.
33., Balachandran, K. K. and Govindan, T. K., - Measurement of moisture in dry cured fish by infra red irradiation, Fish. Technol., 4 (1), 28, 1967 (issued in June 1968).
34. Ravindran, K., - Stray current corrosion of copper sheathing and keel cooling pipe of a 36' trawler, Fish. Technol. 4 (2), 96-100, 1968.
35. Sivadas, T. K., - A simple instrument for measuring depth of operation of fishing gear, Res. & Ind. 13 (2), 89-90, 1968.
36., - Instrument for the measurement of the fore and aft tilt of otter boards, Fish. Technol., 5 (1), 27-30, 1968.
37. Sreedharan Namboodiri, K. - Preliminary experiments on electrical fishing in fresh water, Fish. Technol. 3 (2), 133, 1966 (issued in February 1968).

38., - Impulse generator for electrical fishing, Fish. Technol. 4 (2), 65-70, 1967 (issued in 1968),
 39. Sulochanan, P. and Krishna Rao, K., - Vertical distribution of silver pomfrets (*Pampus argenteus*) in the bottom drift gill net off Veraval and Porbandar, Indian J. Fish., XI (1) B, 9, 1964 (issued in December 1968).
 40., George, V. C. and Naidu, R. M. - Experimental fishing in Hirakud Reservoir, Orissa (1965-67), Fish. Technol. 5 (2), 81-95, 1968.
 41. Valsan, A. P., - A simplified method of pickling mackerel using propionic acid, Indian J. Fish. X (1) B, 1, 1963 (issued in July 1967).
 42. Varghese, C. P., Vijayan, V. and Kuriyan, G. K. - On the comparative efficiency of conventional and bulged belly fish trawls, Fish. Technol. 5 (1), 9-14, 1968.
 43. Venugopalan V. and Govindan, T. K. - Utilisation of trash fish - I. Preparation of fish flakes., Fish. Technol. 4 (1), 35, 1967 (issued in June 1968).
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