

ANNUAL REPORT 1969



**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 1969

ADMINISTRATIVE & GENERAL

Steady progress was recorded in the research projects pursued in the Craft and Gear, Processing Divisions and Statistical Section of the Extension Division. Almost all of the research findings of practical importance to the trade were made known and useful to the industry through pamphlets, practical demonstrations and replies to queries. Exports of frozen froglegs and cooked frozen prawn continued without even a single case of rejection abroad during the year as a result of the direct guidance and technical help given to the industry by the Institute. As a result of similar service, problems like blackening and bacteriological defects in canned prawn could be successfully overcome during the year.

Details of the progress made in the various research projects are given under the respective sections. At the Headquarters laboratories particularly, investigations on biochemical and bacteriological characteristics of certain fishes and shell fish in fresh, ice-stored and frozen conditions yielded results of great practical value and importance. Efficient containers for transportation of fish could be made out of resin bonded fibreglass slabs enclosed in rexin cloth. Marine fishes like oil sardine, mackerel and seer and also clams, mussel and crabs and the fresh water fish *Tilapia* were examined for their freezing and frozen storage characteristics. The treatment with polyphosphate worked out earlier for prevention of thaw-drip loss in peeled and deveined frozen prawns was found to be quite beneficial in case of cooked prawns and frozen froglegs as well. A method worked out for increasing the yield on cooking prawn meat for canning is expected to bring down the cost of production of canned prawn. Design of a pilot plant for production of fish protein concentrate was completed based on the 'Wet Extraction Process'. Experiments in irradiation preservation of fish initiated last year showed that the ice storage life of fresh fish would be extended considerably by the technique.

Among the notable achievements of the fishing Craft and Gear Division could be mentioned the methods finalised for testing netting yarns, designs of two bulged belly type trawl nets for operation from small and medium sized fishing vessels, assessment made of the rate of escape of prawns through the different parts of a trawl net with a view to regulate the

mesh size, and the relationship worked out between the mesh size and twine size in gill nets for seer fishery. Further, design of a mechanical gill net hauler for operation of gill nets was completed. The suitability of different timbers as fishing boat building materials was studied. Arsenical compounds have been found to be toxic to marine organisms and hence suitable for treating cheaper secondary species of wood for boat construction. Design of a trawl winch for 18/20M. deep sea fishing boats (with larger wire capacity) was completed. A hand operated hydraulic motor for hydraulic control gear was fabricated. Field trials of a machine fabricated for dewatering of lakes were carried out successfully. Instruments for measuring the depth of operation of fishing gear, an underwater tension meter for measurement of resistance to motion of the net and instrument for measuring the variations in shape of the meshes of a net during fishing operations were also developed. So far as field trials on fishing gear and method investigations are concerned, the absence of fully manned fishing vessels of suitable sizes affected progress to some extent.

Fish processing factories and primary processing centres were visited regularly for giving technical assistance in maintaining factory hygiene, assessment of the sanitary conditions and demonstrations of the improved and new methods developed. Technical queries received from various organisations in different parts of the country were promptly answered. Design drawings of nets, mechanical fishing aids, fish dehydration units etc. developed by the Institute were supplied on request.

ADMINISTRATION

During 1969 Shri. G. K. Kuriyan, Fishery Scientist (Craft and Gear) continued to hold additional charge of the vacant post of Director. In this capacity he served on the following scientific and allied bodies.

1. Chairman of the Fish and Fish Products Sectional Committee AFDC: 27 of Indian Standards Institution.
2. Chairman of the Textile Materials for Fishing Purposes Sectional Committee TDC:42 of the Indian Standards Institution.
3. Convener of the Sub-committee on ISO Work on Textile Materials for Fishing Purposes, TDC 42:1 of the Indian Standards Institution.
4. Convener of the Frozen Fish Products Sub-committee, AFDC 27:2 of the Indian Standards Institution.
5. Member of the Central Fisheries Research Committee, Ministry of Food, Agriculture, Community Development & Cooperation.
6. Member of Working Party on Sardine and Mackerel Resources.
7. Member of the State Fishery Advisory Board, Govt. of Kerala.
8. Member of the Scientific Research Committee, Fisheries Technological Research Station, Calicut.

9. Member of the Tender Committee for Purchase of Marine Diesel Engines, Development (Fisheries) Dept. of Government of Kerala.
10. Member of the Board of Studies and Faculty of Fisheries of the University of Calicut.
11. Member of the Advisory Committee, Export Inspection Agency, Cochin.
12. Member of the Regional Panel of Experts for Hearing Appeals at Cochin-Export Inspection Agency, Cochin.
13. Member of the Sub-committee to consider matters relating to the import of trawlers by the Govt. of India.

The other Committees in which the Central Institute of Fisheries Technology was represented were:

1. Dried Fish Products Sub-committee of the Indian Standards Institution (by Dr. V. Krishna Pillai, Fishery Scientist (processing),
2. Marine Corrosion Sub-Committee of the Metals Committee of the C. S. I. R. (By Shri. R. Balasubramanyan, Jr. Fishery Scientist (Craft and Gear),
3. Marine Engineering and Ship building Sectional Committee of the Indian Standards Institution (By Shri. M. Vela, Jr. Fishery Scientist (Craft and Gear),

The work relating to the pre-shipment inspection of fishery products meant for export was transferred to the Export Inspection Council with effect from 1st May 1969 along with the services of 28 employees holding various posts under the Inspection Scheme. As requested by the Indian Institute of Foreign Trade, New Delhi, the services of Dr. V. Krishna Pillai, Fishery Scientist (Processing) were lent to that Institute for a period of 5 months from July to December 1969 in connection with the survey of the export possibilities of marine products. During this period Dr. Pillai also visited Canada, U. S. A. and Mexico.

SEMINARS, SYMPOSIA

Sarvashri R. Balasubramanyan, Junior Fishery Scientist (Craft and gear), K. Ravindran, Asst. Fishery Scientist (Craft and Gear) and A. G. Gopalakrishna Pillai, Research Assistant, participated in the seminar on Cashewnut Shell Liquid at Ernakulam organised and conducted by the Indian Institute of Foreign Trade and Cashew Export Promotion Council, Ernakulam. Two scientific papers were presented by the above workers which were discussed during the seminar. Shri. K. Ravindran Asst. Fishery Scientist (Craft and Gear) left for Belgium in September 1969

for higher studies on the award of a Government of India Educational Scholarship. Shri. M. Velu, Jr. Fishery Scientist (Craft and Gear) and Shri. S. Gopalan Nayar, Assistant Fishery Scientist (Craft and Gear) attended the Seminar 'On the Ecology and Fisheries of Fresh Water Reservoirs' organised by the ICAR at Central Inland Fisheries Research Institute, Barrackpore in November 1969. They also presented two technical papers.

VISITORS TO THE INSTITUTE

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. Visitors to the Institute during the year under report also include:

1. Shri. H. C. Linga Reddy, Hon. Minister for Fisheries & Ports, Government of Mysore.
2. Shri. Provas Roy, Minister for Fisheries, W. Bengal / accompanied by the Director of Fisheries, W. Bengal.
3. Shri. V. Satyanarayana Rao, Hon. Minister for Excise Prohibition and Fisheries, Govt. of Andhra Pradesh accompanied by Director of Fisheries, Andhra Pradesh.
4. Shri. H. V. Varthak, Minister for Fisheries, Food and Civil Supplies, Government of Maharashtra and Secretary, Dept. of Agriculture, Fisheries and Cooperatives, Government of Maharashtra.
5. Dr. D. B. Nag Choudhury, Member (Science and Technology), Planning Commission, Government of India, New Delhi.
6. F. James Levinson, Food Resources and Regional Development Division, USAID, Chanakyapuri, New Delhi-1.
7. Dr. Soubllet of the French Govt. Veterinary Service.
8. Dr. Yves B. Plessis, Director, Museum National De Paris, Laboratoires Des Pisces - Outre - Mer, 5 f. Sue Currier, F. t. Paris 5 c.

The Budget estimate and the anticipated requirements
during the fiscal year 1969-70

	Sanctioned Budget grant.	Anticipated actual expen- diture.
NON-PLAN		
	Rs.	Rs.
Pay of Officers	3,26,200	3,18,944
Pay of Establishment	5,19,400	3,53,172
Allowances and Honoraria	5,07,900	4,31,275
Other Charges	4,73,600	4,73,609
Total	18,27,100	15,77,000
PLAN		
Pay of officers	61,600	4,629
Pay of Establishment	1,45,600	24,531
Allowances and Honoraria	1,38,000	23,000
Other Charges	2,50,000	1,39,249
	5,95,200	1,91,409

PROCESSING DIVISION

CHEMISTRY SECTION

Chief findings:

The levels of lactate, pyruvate, creatine and various phosphorus containing fractions existing as ALP, MLP, ASF have been determined in oil Sardine and two species of prawns *M. dobsoni* and *M. affinis* stored in ice. The enzymic activity corresponding to aldolase and lactate dehydrogenase and α -glycerophosphate dehydrogenase has been tested, the lactate dehydrogenase being found to be slightly activated during initial stages of ice storage.

The pattern of change in concentrations of nucleotides, nucleosides and purine bases has been investigated in prawn held in chill storage. Qualitative and quantitative determinations of certain volatile sulphur and carbonyl compounds in fresh and ice-stored prawn *M. dobsoni* during cooking showed significant changes in the levels of mono and disulphides and acetaldehydes during ice storage.

Composition of phospholipids was worked out in different species of prawns *M. dobsoni*, *M. affinis*, *P. indicus* and *P. stylifera* and of fishes *Stromateus niger* and *Rastrelliger canagurta*. The distribution of major lipid

fractions in three fresh water fishes Tilapia, Barbus and Ophicephalus has been studied.

The proteolytic activity of crude enzyme from mackerel, prawns and oil sardine has been concentrated and fractionated by DEAE cellulose chromatography. The nature and mode of inhibition of various reagents on phenolase enzyme from prawn head juice purified by gel filtration on sephadex G-75 have been studied.

The electrophoretic pattern of muscle myogen in poly acrylamide gel has been studied in the different species of prawns. Myofibrillar proteins of these species have been fractionated on sephadex G-75. Extractability of soluble protein decreased with increasing concentration of acid added during extraction.

(i) Biochemical changes in fish and prawns held in ice.

Significant differences in the levels of hexose 6-phosphate and hexose 1:6 diphosphate have been observed in prawns *M.dobsoni* and *M.affinis* during ice storage. The α -glycerophosphate dehydrogenase activity was not changed appreciably in the case of sardine held in ice for 7 days. The changes in the levels of lactate, pyruvate, creatine and different phosphorus containing fractions existing as ALP, MLP, ASP have been followed in this fish and in the above species of prawns.

(ii) Studies on flavour principles in fish and shell fish.

Work on changes in nucleotides, nucleosides and purine bases in prawn muscle held in ice storage has indicated that the nucleotide concentration fell to about 3/4 of their original level during 12 days in the case of *M. affinis*. Nucleotide dephosphorylation occurred to a larger extent in *M. dobsoni* than in *M. affinis*. Nucleosides did not show any significant trend. Hypoxanthine content increased significantly. Carbonyl compounds increased several fold during 10 days of ice storage. The volatile sulphur compounds formed during cooking of the prawn meat were fractionated and it was shown that Hydrogen sulphide, mono and disulphides and mercaptans were the important compounds involved.

(iii) Investigation on fish lipids.

Fractionation of phospholipids has been worked out in the case of different species of prawns by a combination of column chromatography, thin layer chromatography and hydrolytic procedure. In the case of *M. affinis* phosphatidyl choline registered the highest amount followed by phosphatidyl serine and sphingomyelin. The composition of major lipids of fresh water fishes - Barbus, Tilapia and Ophicephalus has also been studied. Experiments were made to follow the changes in breakdown of

tryglycerides and phospholipids during ice storage of oil sardine. The FFA and I.V of fat at different stages of ice storage were also followed simultaneously.

(iv) Investigation on fish enzymes.

Activity of the proteinase enzymes occurring in prawns, *M. affinis* and *P. indicus* and fishes -Mackerel and oil sardine has been concentrated over DEAE cellulose column and the reaction studied with substrates - egg albumin, casein and haemoglobin. Active fractions containing the tyrosinase enzyme have been prepared from head juice of several species of prawns by elaborate purification procedure using column chromatography with celite, hydroxyl apatite, DEAE cellulose and sephadex G-75, followed by lyophilisation. The activity was screened by poly acrylamide gel electrophoresis in which only one major band was prominent. The purified fraction was used for studies on activation energy and on inhibitory action against various reagents.

(v) Studies on fish proteins.

The behaviour of different species of prawn during ice storage has been followed by disc electrophoresis on poly acrylamide gel employing Tris glycine buffer at pH8.6. The pattern remained almost identical with length of storage except for progressive decrease in intensity of the component bands. The comparative study of the amounts of the acid extractable protein in these species of prawns showed that the extractability of soluble protein decreased with increasing concentration of acid and was found to be maximum at 0.1 N. With lower amounts of linoleic acid added to the muscle extract the electrophoretic pattern of myofibrillar proteins of *M. monoceros* remained unaffected while with higher amounts, the mobilities of the band were found to be slightly affected.

RESEARCH IN HAND AND CONTEMPLATED

All the above items of work are still on hand and will be continued in the ensuing year.

The research workers associated with the Project are:

1. M. Rajendranathan Nair (Jr. Fishery Scientist)
2. Susamma Cherian (Asst. Fishery Scientist - Now on leave abroad)
3. K. Gopakumar (Asst. Fishery Scientist)
4. P. D. Antony (Research Assistant)
5. K. Devadas (Research Assistant)

BACTERIOLOGY SECTION

Chief findings.

Work on the comparative performance of media showed that Trypticase Soy Agar in distilled water gave maximum count for cooked frozen prawns. The method of drop plate was found to be better than the pour plate method for taking bacterial count.

The percentage reduction of the bacteria immediately after freezing was found to be independent of the initial concentration of the viable bacterial cells. Studies on the effect of prolonged storage temperature on the viability of cells showed that *Pseudomonas* strains were most viable after 4 months storage at -15°C in a substrate of prawn homogenate.

Routine examination of factory environments showed the absence of obligate thermophiles as well as anaerobes.

Marine strains of bacteria were found to be sensitive to CTC at 5.ppm level or even less. *Pseudomonas* and *Achromobacter* developed resistance to CTC more rapidly than the *Flavobacterium*.

(i) Comparative performance of media for plate count.

The three media: Trypticase Soy Agar in distilled water, Trypticase Soy Agar in sea water and ordinary sea water agar were employed to determine the total plate count in cooked prawns. The results showed that first medium gave highest count.

Pure strains of bacteria from marine and terrestrial sources drop plated on the above three media showed that each type of strain preferred a particular medium and that no single medium was satisfactory for all the types tested. A pathogen like *Salmonella paratyphi A* did not grow at all in the two sea water based media but grew well in medium based on distilled water.

Two types of organisms, one a *Bacillus* species (terrestrial) and a marine species were also employed for comparison of pour plating Vs drop plating techniques. Taking the pour plating as the standard procedure, the variations (observed in 11 trials) between the methods ranged from 0% to 31%. In general the count by drop plating was more than the count obtained by the pour plate method.

(ii) Effect of freezing on individual cultures of bacteria.

Work done on gram positive cocci and gram positive sporeformers showed that the percentage reduction in the viable count immediately after freezing was independent of the initial count before freezing. The result is in accordance with the results obtained with gram negative rods.

Strains of *Pseudomonas*, *Achromobacter* and *Vibrio* were frozen in the three substrates viz. sea water peptone, Sardine homogenate and prawn homogenate and kept at a temperature of -15°C for 4 months after which their viabilities were examined. The results showed that *Pseudomonas* are still viable after 4 months of storage at -15°C and among the three substrates prawn homogenate favoured the survival of these cultures.

(iii) Bacteriology of canned prawns.

About 72% of the total of 560 strains isolated from canned prawns were gram positive spore-formers. The rest constituted gram positive cocci, rods, gram negative rods, cocci and coccoids. The gram positive sporeformers were classified into species according to Bergey's Manual. Among the sporeformers 50% produced H₂S and 24% showed growth at 56°C. No obligate thermophiles or anaerobes were observed.

With a view to ascertain the probable source of contamination of canned prawns, samples of swabs, water and ice were analysed from canning factories. The species were similar to those found in the case of canned prawns. No obligate thermophiles were observed. Thermal resistance studies were carried out for some of the strains which grew at 56°C.

(iv) Use of Antibiotics for fish preservation

Studies were conducted to find out the extent of suppression of the growth of bacterial flora of fish in medium incorporated with 5ppm. of CTC. The percentage of suppression of the flora was found to vary from 70 to 90%

The sensitivity of strains to CTC was determined by the zone of inhibition and tube dilution methods. Of the six strains tested, all were sensitive at 5ppm level of CTC in nutrient broth. Variation in the extent of sensitivity was noticed with different strains. Pseudomonas and Achromobacter developed tolerance very rapidly whereas Flavobacteria were not so much prone to development of tolerance to CTC.

The studies on the destruction of residual CTC during cooking was found to depend upon the initial concentration of the antibiotic in the muscle and the cooking time. With a residual antibiotic at 3 ppm. level, complete destruction took place within 15 minutes cooking.

(v) Formation of B-vitamins by micro-organisms from fish.

Ninety four strains were tested for their capability to produce B-vitamins in the growth media. The following vitamins were estimated microbiologically viz. Thiamins, Riboflavin, Folic acid, Niacin, Pantothenic acid and B₁₂. No increase in the amount of any of these vitamins was noticed after growth by the respective strains.

Research in hand and contemplated.

All the above items of work will be continued during the next year.

The research workers associated with the project are:

1. K. Mahadeva Iyer (Jr. Fishery Scientist) (on deputation to Japan from July to Dec. 1969).
2. M. Arul James (Asst. Fishery Scientist)
3. T. C. Karthiayani (- do -)

4. V. Narayanan Nambiar (Research Assistant)
5. P. K. Surendran (-do-)

PROCESSING SECTION

Chief findings

Efficient containers for transportation of fish could be fabricated in different shapes by sandwiching resin bonded fibre glass slabs in between layers of rexin cloth. Frozen prawn blocks subjected to fluctuations of temperature prior to continuous storage at -15°C caused slight toughening of the texture in 11 months.

Preheating of frozen prawn blocks in running water prior to application of voltage in electrical resistance thawing reduced total thawing time to 30 minutes compared to 90 to 100 minutes when voltage was applied straight away.

Freeze-dried raw prawns sealed in cans were found to remain in good edible condition even after two years at atmospheric temperature.

The behaviour of oil Sardine during freezing and frozen storage was studied in relation to its fat content. Besides Sardines, a number of other tropical marine fishes like Mackerel and Seer, fresh water fishes like Tilapia and shell fishes like Clams, Mussel and Crabs have been examined for their freezing and frozen storage characteristics. The beneficial effect of Polyphosphate treatment was brought out in the case of frozen P & D prawns, cooked prawns and froglegs.

Blanching of prawns in whole condition for canning gave higher yields than blanching in peeled and deveined form. However, this procedure caused higher turbidity and pinkish colour in filled brine. Treatment of peeled and deveined prawns with potassium dihydrogen phosphate neutralised with citric acid gave a 7.5% increase of yield on canning over the control. Maximum period for which Tilapia could be held in ice prior to canning to give acceptable products was found to be four days. An equipment for direct reading of concentrations of blanching brine at its boiling point was designed and fabricated using electrical conductivity principle and is under extensive trials.

Acid as well as enzyme hydrolysis of fish and prawns could be successfully employed to yield soluble hydrolysates which could be used for a variety of products. Good quality edible protein could be isolated from the blanch liquor usually wasted from canning factories.

(i) Preservation and transportation of fishery products.

Detailed investigations were carried out using oil Sardines of different size grades and fat contents with a view to studying the seasonal variations

if any, in the phenomenon of belly bursting during freezing and thawing and the effect of brine dip treatment in controlling the same. Larger size grades of sardines having greater fat contents showed minimum belly bursting. Smaller sardines having lower fat contents contained larger amounts of stomach contents and were more prone to this phenomenon.

Containers of cylindrical (25 cm. dia X 45cm. ht) and cubical (35cm³) shapes were fabricated by sandwiching resin bonded fibre glass (RB2: 1.5 lb/cu.ft; 2.5 cm. thick) in between rexin cloth stitched to the shape. Capacity of the first was 12 kg. and the second 26 kg. When fish iced 1:1 was packed in them and stored at room temperature, they remained in acceptable condition for 40-44 hrs. and 44-48 hrs. respectively. When the fish was pre-chilled to 2-3°C and packed as before in the second container, the storage life was enhanced to 60 hrs.

A plastic insulated container obtained from M/s. Tropical Stored Products Centre, U. K. (Capacity: 5 kg. fish and 5 kg. ice) could hold sardines iced 1:1 in good condition at room temperature for 14-16 hrs. When the fish was pre-chilled to 1-3°C before packing, the storage life was increased to 18-20 hrs.

With a view to studying the effect of fluctuations in storage temperature on the quality, frozen P & D prawn blocks were held for 6 hrs. at room temperature, in insulated box and in walk-in-cooler before they were stored continuously at -15°C. A general trend of decreasing bacterial load was observed in all the samples. The sample stored in walk-in-cooler for 6 hrs. and then at -15°C showed the minimum bacterial load. Organoleptically, the test samples were slightly inferior to control samples with regard to texture.

(ii) Freezing of fishery products.

Necessary modifications were made in the design of the mechanised prawn peeling table and the same fabricated in the Institute's workshop. Noteworthy features of the table are that raw material is supplied to the workers and waste materials taken away from them by a conveyor belt system which is expected to effect substantial saving in labour. The equipment is undergoing trials in one of the Processing Factories in Cochin.

The possibility of avoiding the pre-heating step (in running water) for electrical resistance thawing of frozen fish blocks was studied. In the case of cooked frozen prawn block of 2.7 kg. and 4.5 cm thick, it took 90-100 minutes for complete thawing when 35 V A/C 50 C/S was straight away supplied to the frozen block. compared to 30 minutes in the combination process.

Sardines:-

The frozen storage characteristics of oil sardine landed in different months of the year with fat content varying from 16-38% (D.W.B) have been studied with particular reference to the changes in oxidative rancidity and protein denaturation. The ratio of development of FFA was higher with sardines of lower fat content belonging to the month of June. Sardines of September-October months had highest fat content and their frozen storage shelf life at -1°C was limited to 2 weeks.

Mackerel:

The storage characteristics of mackerel have been worked out. It was found that the fish which was held for more than 3 days in ice was not suitable for freezing as the frozen product had poor shelf life.

Seer:-

The frozen storage shelf life of the fish was studied in relation to its holding time in crushed ice prior to freezing. Rapid hydrolysis of the fat occurred during storage in ice and the shelf life was found to be limited to 4 days. The fish held in ice beyond 3 days was not found suitable for freezing.

Tilapia

The bacteriological, biochemical and organoleptic characteristics of eviscerated and beheaded Tilapia stored in ice were studied. Bacterial count decreased upto 5th day of storage and thereafter it increased rapidly. The material was organoleptically acceptable upto 10 days in ice.

Cooked Crab meat and Mussel meat:-

The effect of icing, cooking and freezing on cold storage characteristics of crab meat and mussel meat has been studied. The characteristic flavour was retained in the meat upto 6 days of ice storage prior to cooking and the frozen products prepared from 6 day iced material were acceptable till 8 months of storage at -1°C.

Clams:

Clams belonging to species *Villorita cornucopia* stored in ice beyond 6 days developed black discolouration of the meat. The frozen storage shelf life was 9 months for samples with pre-freezing ice storage period upto 6 days.

Polyphosphate treatment.

The use of polyphosphate treatment to improve the cooked yield of frozen fishery product was subjected to large scale trials in prawn processing plants in Cochin. The improvement in yield was found to be 8-15% for frozen P & D prawns and 10-15% for cooked prawns. The method was

extended to the freezing of froglegs in which the improvement in yield was noted to be 5-10%. The cost of treatment per ton of P & D prawn worked out to be about Rs. 160/-. Storage studies on P & D frozen prawns, cooked frozen prawns and frozen froglegs have shown that the beneficial effects of the treatment were retained during storage upto 6 months without adversely affecting the organoleptic quality.

iii Freeze-drying of fishery products.

Raw peeled and deveined prawns were freeze-dried in the fresh condition and after storage in ice for two days with a view to studying the effect of ice storage on the drying characteristics and chemical and organoleptic qualities of the dried product. All earlier samples of freeze-dried raw prawns, seer, kalava and prawn salads and prawn cake kept for studying the changes during storage were analysed and results recorded. No appreciable changes were observed during the period either in their chemical characteristics or organoleptic qualities.

iv. Canning of fishery products:

- a) Prawns:- With a view to studying the comparative yields by the different methods, whole and headless prawns were blanched and peeled; peeled as well as peeled and deveined prawns were blanched as usual and the four different samples canned. Maximum yield was observed with prawns blanched as whole and the minimum yield with P & D prawns. However, the product in the latter case was found to be relatively better with regard to appearance.

Treatments of peeled and deveined prawns before canning with sodium hexametaphosphate, disodium hydrogen phosphate, sodium pyrophosphate, sodium tripolyphosphate and the same neutralised with potassium dihydrogen phosphate and citric acid showed the maximum yield of 15% over the control in the case of disodium hydrogen phosphate and sodium pyrophosphate treated samples. However, the colour and appearance of the products in these cases were not satisfactory, as there were signs of bleaching. In the case of samples treated with sodium tripolyphosphate neutralised with Potassium dihydrogen phosphate and citric acid, a 7.5% increase of yield above control was obtained, with colour and appearance comparable to the control. This treatment did not necessitate any alteration in the quantity of citric acid to be added to the filling brine to give the titratable acidity of 0.1% in the final product.

Blackening in canned prawns:-

Since titratable acidity and pH of the filled brine are related to blackening of cans and the contents, the factors influencing them have been studied. The size of the can was found to influence acidity because the meat/brine ratio in 301 x 206, 301 x 307 and 301 x 109 cans is 1.5 while that in 401 x 411 can is 2.5 and consequently the latter type of cans requires nearly

1.5 times more of acid to maintain the acidity above 0.06%. All the species of prawns except *P. styliifera* behaved similarly with respect to titratable acidity while the smaller size prawns required more acid than the bigger type.

It has been found that 100 – 500 p.p.m. Na_2 EDTA added to filled brine had no beneficial effect while at a level of 0.1% or more blackening developed at neutral or alkaline condition and browning developed in low acid conditions by iron were considerably reduced. Can interior blackening was also retarded by DTA.

Gelling phenomenon in canned prawns:-

The factors influencing the gelling phenomenon of the filled brine in canned prawns held at low temperatures have been investigated. It was found that titratable acidity, NaCl and pH at levels usually encountered in canned prawns do not influence gelling. Total nitrogen in gelled samples invariably recorded very high values. Prolonged heating and higher temperatures of processing were found to yield brines which undergo gelling.

Sloughening in canned prawns:

P. indicus caught from river and from sea behaved differently in the degree of sloughening, the former variety being more susceptible. *M. affinis* on the other hand is more prone to sloughening than *P. indicus* (river variety). In all the species, however, the smaller size prawns are more resistant to this phenomenon.

b) Sardines: As a result of several treatments, it was observed that drying of precooked sardines for 40-45 minutes at 75°C prior to canning could prevent the softening of texture of product. The higher the fat content of the sardines, the shorter was the precooking time required.

c) *Barbus carmuca*:

Dipping of the dressed fish in 15% brine for 20 minutes, packing in cans and precooking for 40-45 minutes at 0.35 kg/cm², drying at 70°C for 30 minutes, filling with hot oil, exhausting, seaming and sterilising at 1.05 kg/cm² for 1 hr. gave a satisfactory product.

d) Tilapia : The maximum period for which tilapia could be held in ice prior to canning in order to yield acceptable product on canning was found to be 4 days.

e) Froglegs : Treatment of the legs with sodium tripolyphosphate improved its texture on canning in oil.

An apparatus for direct measurement of strengths of brine from 5 to 12% at its boiling point was designed and fabricated based on electrical conductivity principle and is undergoing trials under actual factory conditions.

v. Dehydration of fishery products:

Instant salting: A new item of work on instant salting and drying of fish was initiated. Seer fish flesh minced with salt, pressed and dried gave a stable product which did not disintegrate on cooking in water. Work is in progress to convert the cheaper varieties of trash fish into similar products.

Pigments in prawns: Cold saponification of the pigment with methanolic potash was found necessary for proper separation of the pigments in chromatographic column, since some of them were obviously in the ester form. The epiphase on separation of activated A 1203 column gave two distinct bands of yellow shades. Rechromatography of the hypophase on deactivated A 1203 resulted in separation of red zone and yellow zone.

Rapid determination of salt in dried fish: A rapid method for measuring salt content in dried fish was developed using a glass electrode responsive to sodium ions only in conjunction with a standard reference electrode. The potential developed was read on a high impedance voltmeter. The principle used was to dry a 10g. sample under infra red lamp, homogenise the dried material with 50 ml. water and measure the sodium ion activity.

Another apparatus for the same purpose was designed and constructed based on electrical conductivity method.

Mechanised fish cleaner: The fish cleaner fabricated earlier was suitably modified and successfully used for deshelling cooked and dried prawns. Prawns cooked in brine and dried got de-shelled better than those cooked in steam and dried.

vi. Technology of speciality products.

Prawn and fish hydrolysates: Fresh, partially spoiled and canned prawns were utilised for this study and sulphuric and hydrochloric acids used as hydrolysing agents under pressure. After hydrolysis the excess acid was neutralised and the hydrolysate dried in vacuum dryer. It could be used as such as a flavouring agent or as a base for protein supplementary foods. Hydrochloric acid gave better yields compared to sulphuric acid. In both cases, the peptone contents in the hydrolysate were more in the first two hours. The method worked equally well with cooked trash fish meat.

Hydrolysis of minced kilimeen meat with papain (0.25%) and pancreatin (0.1%) was studied. Significant difference in yields was observed in the case of the two enzymes. In the case of pancreatin, a pH of 7.6

was required for optimum hydrolysis. Protein breakdown was more with papain than with pancreatin.

Proteins from blanch liquor: The blanch liquor, usually wasted from canning factories, was acidified with orthophosphoric acid and boiled to coagulate the proteins. On filtration through a filter press, an orange coloured, creamy residue was obtained which was dried in hot air and extracted with ethanol to remove the carotenoid pigments and odour-bearing compounds. The final product was colourless and odourless.

Shrimp butter: The protein paste obtained from above was blended thoroughly with vanaspati and preservatives to yield a butter like product which could be used as breadspread and which had a storage life of two months in the refrigerator.

Instant meals: Preliminary trials to prepare an instant meal from cooked rice and prawn in tomato sauce in the frozen condition gave encouraging results.

Protein supplementary foods: The hydrolysate obtained from fish was mixed with cocoa, malt extract and vanilla (flavouring) and vacuum dried when a wholesome hygroscopic product completely soluble in water was obtained. Work is in progress to standardise this product.

Emulsifying capacity of fish meat: A gradation in surface tension with respect to oil content in blends with proteins was noticed which is being followed up as a criterion to study the emulsifying capacity of fish proteins.

RESEARCH IN HAND AND CONTEMPLATED

Work on all the items described above will be continued during the ensuing year.

Research workers associated with the investigations are:-

Dr. V. K. Pillai	(Fishery Scientist)
D. R. Chaudhuri	(Quality Control officer)
T. K. Govindan	(Jr. Fishery Scientist)
C. V. N. Rao	(Asst. Fishery Scientist)
K. K. Balachandran	(- do -)
Cyriac Mathen	(- do -)
Ayyappan Pillai	(- do -)
P. A. Perigreen	(- do -)
P. K. Chakraborty	(- do -)
V. Venugopalan	(Research Assistant)
M. Nandakumaran	(- do -)
A. Vasanth Shenoy	(- do -)
P. R. Girija Varma	(- do -)
P. L. Chinnamma	(- do -)

BY - PRODUCTS SECTION

Chief findings

Storage studies on F P C obtained from kilimeen showed that canvas bag or bitumin coated gunny bag can be used for at least a year without appreciable damage. Method for obtaining colourless and odourless F P C from sardine press cake has been worked out. Hydrogen peroxide in dil. sodium bicarbonate solution has been found effective in removing the colour of sardine press cake. A fresh design of F P C pilot plant based on "Wet Extraction Process" was completed incorporating a charcoal tower also for deodourisation of alcohol.

Attempts were made to prepare bact. peptone from prawn shell waste and the results so far obtained in this respect are encouraging. Compositions for obtaining starter, breeder and concentrate varieties of poultry feed have been formulated and samples of these have been prepared and analysed.

Two useful products, viz. shrimp protein extract and chitosan have been prepared and conditions to isolate these products worked out. Attempts to obtain synthetic resins from sardine oil were also made.

(i) Studies on F P C

During the year under report storage studies on FPC prepared from kilimeen (whole fish) by the method developed in the laboratory have been made by keeping the samples packed in various containers like canvas bag, bitumin coated gunny bag, aluminium foils, sealed bottles and polythene bags at room temp. It has been found that the colour, odour and taste as well as the overall appearance did not change appreciably during the storage period of 12 months. A slight yellowing was, however, observed in the samples packed in polythene bag and colourless bottles.

Experiments were also carried out to prepare colourless and odourless F P C from sardine press cake. Treatment of the sardine press cake with hydrogen peroxide in dil. sodium bicarbonate before extraction was found to give a satisfactory product. Optimum conditions for the treatment have been worked out.

Pilot Plant:

A modified design of FPC plant based on the wet extraction process was prepared. The plant includes a charcoal tower to be used for deodourisation of alcohol used for extraction. Design report incorporating all technical informations and data of the process, process machinery, design calculations, flow sheet and layout of the plant etc. was prepared.

(ii) Prawn shell waste.

Prawn shell waste was mixed and hydrolysed using papain under controlled conditions. A fairly good yield of peptone was obtained. The peptone was found to support growth of bacteria, but the quality was not strictly comparable to DIFCO Peptone.

A simple and economical method of isolating proteins in the form of a paste containing about 35% moisture and 12% nitrogen from prawn shell waste has been worked out. Samples obtained have been analysed and were found to compare well with that obtained from abroad. The extract which is in the partially hydrolysed form has characteristic prawn flavour. The samples have been sent to foreign countries for consumer acceptance tests. Attempts were also made to isolate protein hydrolysates from shell waste. Chitin isolated from shell waste has been converted into a product which when dissolved in dilute organic acids yielded very viscous solutions resembling those of sodium alginate. The usefulness of the product in textile, pharmaceutical and food industries is being examined.

(iii) Poultry feed.

Three different varieties viz, starter, breeder and concentrate, of poultry feed were prepared by mixing sardine meal, prawn shell powder, tapioca waste and rice bran. The composition for different varieties was fixed according to the ratio given by the Kerala Veterinary Research Institute. On proximate analysis, it was found that the samples had the required composition recommended by K. V. R. I.

(iv) Alkyd Resins from Sardine Oil.

Heat bodied sardine oil was polymerised by treating it with glycerine and phthalic anhydride at a temperature above 240°C. When the reaction is allowed to proceed to completion, a rubber like resin insoluble in mineral oil is obtained. Under controlled conditions the reaction yields a viscous product. Attempts are now being made to study the properties of these products and their practical applications.

Research workers associated with the investigations are:

P. V. Prabhu	(Asst. Fishery Scientist)
M. Arul James	(Asst. Fishery Scientist)
P. Madhavan	(Asst. Fishery Scientist)
P. K. Ismail	(Research Assistant)
A. G. Radhakrishnan	(Research Assistant)

QUALITY CONTROL SECTION

Chief findings

Further studies have been made on coagulase positive staphylococci bringing out their incidence in cooked frozen prawns, frozen froglegs, raw prawns, fresh crabs and in water, ice and utensils used for the processing work. Attempts were also made to study their chance of survival during freezing and frozen storage and their behaviour towards disinfectants and antiseptics. Technical assistance was rendered to prawn processing factories and demonstrations made to them on phosphate treatment, preparation of bacteriologically sound froglegs and on prevention of blackening in canned prawns.

i. Studies on coagulase positive staphylococci.

Incidence of coagulase positive staphylococci was surveyed in several samples of cooked frozen prawns, frozen froglegs, raw prawns, fresh crabs, utensils, water and ice samples. It has been found that 5% of the utensils, cooked prawns and fresh crabs showed the incidence of the organism.

The organism when inoculated to cooked prawns and brain-heart infusion broth and subsequently frozen survived to the extent of 90%. However almost complete destruction of the organism took place after 7 months of frozen storage.

The cleaning schedule developed by the Institute was shown to be very effective in destroying the organisms completely from surfaces of utensils and equipments. Chlorine solution at a concentration of 0.3-0.5 ppm. was found to be capable of destroying the organisms in one minute. With 'Detol' a concn. of 0.6% was found necessary to obtain the desired effect.

ii. Factory sanitation and technical assistance.

As in previous years, close contact with the processing industry was maintained during the year under report and technical assistance rendered to them wherever necessary. The scientific staff of the section made regular visits to processing factories and primary processing centres and appraised them on inplant sanitation, maintenance of drained weight in frozen prawns, prevention of blackening in canned prawns etc. In this connection 30 freezing factories, 20 primary processing centres and 10 canning factories were surveyed from where 367 utensils, 53 water and 52 ice samples were analysed for sanitary aspects. Results of analyses with remedial measures were communicated to the parties for proper and timely action. Demonstration and technical assistance were given to seven processors regarding phosphate treatment and to two of them regarding prevention of blackening.

During the year 93 canned prawns, 29 canned tuna, 12 frozen froglegs, 4 ambergris, 1 prawn powder, 9 water samples and 2 bleach liquor samples were analysed for quality.

Research workers associated with the investigations are:

Dr. V. K. Pillai, Fishery Scientist
D. R. Chaudhuri, Quality Control Officer.
Cyriac Mathen, Assistant Fishery Scientist.
T. S. Gopalakrishna Iyer, Asst. Fishery Scientist.

C. I. F. T., SUB-STATION, VERAVAL

Chief findings

Irradiation of prawns, Bombay duck and silver pomfret at the dosage of 0.25 M rad extended the ice storage life of these species considerably. Combination process like cooking followed by irradiation ensured the maximum storage life for prawns. The drip formation which was enhanced as the result of irradiation could be effectively controlled by brine treatment prior to irradiation. However the irradiated fish developed brown discolouration at a faster rate than the respective controls.

Canning of seer fish indicated that the initial moisture content has got some effect on the drip loss. A suitable method was worked out for canning smoked eel fillets.

The insect growth in commercially dried Bombay duck could be controlled by packing the material in air tight containers. Sorbic acid and potassium sorbate were found effective in preventing fungus growth in smoked eel fillets. High quality fish flour could be prepared from squid meat.

Constant contact was maintained with the fish processing industry and necessary technical guidance was given to the concerned parties to solve various problems in fish processing and to improve the quality of fish products.

i. Improvements in the methods of handling, preservation and transport of commercially important fish and shell fish.

Commercially important fish and shell fish like prawns, Bombay duck and silver pomfret were irradiated at 0.25 M rad at B. A. R. C, Trombay, Bombay by a source of cobalt-60 and their storage life in ice compared with that of unirradiated fish was studied. It has been noted that prawns in three forms, headless, peeled and deveined. and peeled and deveined after blanching, which were subjected to irradiation could

be held in good condition in ice for 15,17 and 23 days respectively. Total bacterial counts in the above irradiated samples were 3.07×10^4 , 1.859×10^4 and 1.32×10^4 per gram in the above order whereas very high counts were recorded in the control samples.

The shelf life in ice storage of irradiated whole and gutted Bombay duck were found to be 15 and 22 days with total bacterial counts of 9.832×10^4 and 4.789×10^4 per gram respectively. It was also noted that brine treatment prior to irradiation considerably reduced the drip loss during ice storage period of Bombay duck.

Irradiated silver pomfret could be stored for at least 14 days in good condition with a total bacterial count of 1.592×10^5 per gram. However slight discolouration and rancid odour developed in the fish during storage.

ii. Standardisation of canning techniques of commercially important varieties of fish and shell fish.

It was found that the loss of precook drip and processing drip during the canning of smoked eel fillets was related to the moisture content of the fillets. Whereas a higher moisture content gave very soft and juicy products a lower moisture content gave tough and unpalatable canned products. An optimum moisture content was therefore worked out for the smoked fillets and was fixed to be around 50% so as to give products retaining sufficient juiciness and satisfactory odour and flavour over 10 months of storage period. Treatment of fresh fillets with 15% brine for 15 minutes gave sufficient salt in final canned product. For maintaining the moisture content of 50% in smoked fillets, it is however necessary that the fillets should be precooked in a perforated steel tray, skin removed and then filled in cans for further processing.

The body and leg meat of fresh crabs procured from Jamnagar were canned separately with the incorporation of NDGA and citric acid and the storage behaviour of canned products studied.

iii. Smoke curing as a means of preservation and utilisation of important varieties of fish.

It was found that citric acid and acetic acid (both upto 2% in solution) and propionic acid (upto 1%) when used as dipping solutions for brined eel fillets prior to smoking did not confer any protection against mould attack in the final products. Potassium sorbate and sorbic acid on the other hand were very effective even at 0.5% and 1% levels in inhibiting the mould growth.

iv. Improvements in the methods of handling, processing and preservation of Bombay duck.

The commercial samples of Bombay duck stored in glass bottles without airtight sealing were found to be infected with insect growth, the corresponding samples stored in sealed glass bottles and cans being free from the infestation. The irradiated Bombay duck which had been dried were also free from such defect when the dried control samples got infected with insect growth within 2 months of storage.

v. Investigations on the economic utilisation of miscellaneous trash fish.

Attempts were made to prepare fish flour and sausages from trash fish like dhoma, lactarius, cuttle fish etc. and the prepared samples were periodically analysed for storage characteristics.

Research workers associated with the investigations are:-

R. Venkataraman, Fishery Scientist (P)
M. K. Kandoran, Asst. Fishery Scientist,
K. K. Solanki, Research Assistant.

C.I.F.T. UNIT, BOMBAY.

Chief findings

Experiments on irradiation of fresh headless shrimps have been conducted with the collaboration of B. A. R. C, Trombay, Bombay. It was noted that mild doses at 0.1 and 0.2 M rads with or without brine treatment failed to prevent melanosis in the headless prawns during subsequent ice storage. Irradiation however gave promising results in inhibiting insect infestation in dried Bombay duck. The irradiated products could be even packed in cardboard containers for long term storage.

The Unit conducted demonstration of the improved methods of processing of froglegs to the trade which were adopted by the industry with benefits.

i. Collaboration work with B. A. R. C.

The experiments on application of irradiation to improve the storage life of headless prawns in ice were conducted under collaboration with B. A. R. C., Bombay. It has been found that mild doses at 0.1 and 0.2 M rads with or without brine treatment could not prevent melanosis in headless prawns during subsequent ice storage. The usual spoilage indices were considerably low in the case of irradiated samples. Dried Bombay

ducks subjected to low doses of radiation were free from insect infestation for longer periods at normal storage temperatures unlike the control samples. The irradiated products could be packed in cardboard containers.

Research workers associated with the investigations are:-

P. V. Kamasastri, Junior Fishery Scientist (P)

K. K. Balachandran, Asst. Fishery Scientist (P)

C.I.F.T: UNIT, CALICUT

Chief findings

Treatment of cured fish with mixture of preservatives consisting of 3% Sodium propionate and 0.05% BHA in refined salt was proved to be highly successful in controlling the spoilage due to fungus, 'red', rancidity and general deterioration for longer periods of storage.

It was shown that impurities in salt especially Cu^{++} used in curing catalyse the oxidation of lipids and thereby enhance the development of brownish discolouration in cured fish. Sterilised and refined salt fortified with 0.5% Sodium benzoate and 0.05% BHA could be used for direct salting and packing of cured fish. The products prepared by this method were free from excessive rancidity, discolouration and off flavour.

A survey had been conducted on the bacteriological quality of commercially cured fish products. The fertiliser value of self brine from curing yards has been evaluated and attempts have been made to recover the salt in a solid form retaining the nutritive factors.

i. Improvement in curing technique.

Since lipid oxidation was found to be the main cause for browning, the effect of adding antioxidants to the salt for curing was tried in a series of experiments. It has been noted that BHA at a level of 1 part to 7,500 part of meat gave satisfactory results in the preparation of cured mackerel. Controlled experiments have also shown that Cu^{++} when incorporated to pure salt used for curing catalysed the browning reaction and development of rancidity.

ii. Simplified method of curing and direct packing.

The bazar salt and the refined salt used in earlier experiments were found unsuitable for direct curing as the products very soon got infested with fungus and 'red'. The use of sterilised refined salt overcame these defects. Best results were however obtained where sterilised refined salt was fortified with 0.5% Sodium benzoate and 0.05% BHA. This method substantially improved the storage life by warding off fungus and

'red' besides the development of discolouration and off flavour. To keep down the softening of the tissue, the cured products in packed state had to be maintained at 85°C for 30 minutes.

The survey on the bacteriological quality of cured fish products has been continued during the year and a total of 113 samples analysed for chemical and bacteriological characteristics.

iii. Use of self brine as fertiliser.

Samples of self brine collected from different curing sheds were subjected to solar evaporation so as to obtain a solid residue retaining all the nutritive factors. The average yield of the solid was found to be about 37% with a high nitrogen content. The fertiliser value of the recovered salt has been assessed in several batches of preparation.

iv. Assistance to industry.

Technical assistance was continued to the processing industry. Samples of water, bleaching powder, fish meal etc. offered for analysis have been examined in detail and results communicated to the parties concerned. The methods of minimising the thaw drip in frozen product have been suggested to the industry. The method worked out by the Unit to control the insect infestation in 'Mas Min' was passed on to the Lacadive Administration for large scale trials.

Research workers associated with the investigations are:-

- A. P. Valsan, Asst. Fishery Scientist (P)
- T. S. Unnikrishnan Nair, Research Asst.

CRAFT AND GEAR DIVISION

Gear section

Project-I-Gear Materials.

Chief findings.

Investigations on strength of nylon and cotton webbings in relation to size of twine, number of meshes and type of knot, initiated during the previous year, were completed. Materials under test were cotton twines of specifications 20^S/3/3 to 20^S/12/3 and nylon 210D/3/3 to 210D/15/3 with number of meshes ranging from 1 to 5 and with meshes having a total length of 20 cms. Nylon webbings were made with double trawl knot and that of cotton with single trawl knot. The strength per mesh, per number of yarns for cotton worked out to be 0.52 and 0.62 kgs. in the dry and wet condition respectively. The corresponding value for nylon is 1.24 and 1.05 kgs. A nylon net is therefore 2.38 times (dry) and 1.7 times (wet) stronger than a cotton net of similar specifications.

The section prepared basic standards for "Methods for test for netting yarns" and sent to ISI for finalisation.

a) Cotton.

As a continuation of the work on standardisation of twist of varying hardness, studies were pursued to evolve standards for cotton ropes. Ropes of specifications 20/30/3 to 20/150/3 in soft and hard lays and in the ZSZ construction were prepared. Similarly those in the ZZS construction are under preparation. Further, the studies also envisage preparation of thicker ropes by cabling thinner ones. In this process, the twists have to be effectively controlled at 3 stages of construction namely, strand twist, twine twist and rope twist. The two methods of lay viz. ZZSZ and ZSZS are also to be tried.

b) Polyethylene monofilament.

More samples from different manufacturers were received by the section during the period under review, for detailed studies. Analysis of the data showed that the material possesses a tenacity of 2.0 to 4.0 gm/denier. Percentage of stretch varied from 20-60. Samples with low extension values are suitable for gill nets for reservoirs. The basic yarn used by different manufacturers varied from 180-460 denier and there was no uniform standard of twist for the different samples. The relationship between twist and specification of samples of different construction was studied to form the basis for twist standards for twisted monofilaments. The constant in the relation on outer twist $K \times \frac{1}{\sqrt{\text{den.}}} \times \frac{1}{\sqrt{\text{no.of yarn}}}$ is kept as 1140 and samples are being prepared.

Research in hand and contemplated.

1. Standardisation of twist for cotton ropes.
- ii. Twist standards for twisted polyethylene monofilaments.

Persons associated

1. Smt.K.Radhalakshmi, Asst.Fishery Scientist.
2. Smt.P.J.Cecily, Research Assistant.
3. Sri.Vergheese Paul Research Assistant.

Project II: Improvements in the designs of trawls

Chief findings.

a) High opening trawls.

The studies carried out during the previous year have resulted in the development of a bulged belly type trawl of head rope length 15m (50 ft), suitable for operation from smaller classes of fishing vessels. The design is particularly efficient for the exploitation of bottom as well as column fish fauna.

The programme of work on the assessment of the size of overhang piece for the above design of trawl was pursued and completed.

The calculated value for the optimum length of overhang is 37 meshes of length 1.9m. The experimental nets tried were therefore:

- (i) Net without overhang.
- (ii) Net with 30 meshes overhang and having a length of 1.5m and

- (iii) Net with 60 meshes overhang and having a length of 3 m.

The catch data for a total of 164 hauls of 124.5 hours duration were collected and analysed. Of the total catches landed by the three nets under experiment, 41.3% was landed by the net with 30 meshes overhang, 36.2% by net without overhang and 22.5% by net with 60 meshes overhang. This would indicate that the net with 30 meshes overhang was functioning properly and in turn might have engulfed the majority of fishes that attempted to escape upwards. The net with lengthy overhang, on the other hand, recorded the minimum catch probably due to the sagging of the head rope resulting in a decrease of fishing height.

The significance of variation of the output of the three nets, for prawn, fish and total catch was also analysed statistically. The analysis of variance for prawn catch showed that the between net variation was significant at 5% level indicating that the rate of output of the three nets was different. A comparison of the mean logarithmic catch of the three nets showed that the net with 30 meshes overhang always had a higher output for prawn, fish and total catch than the other two.

b) Long wing trawls

The 29.26 M (96 ft) long-wing shrimp trawl earlier designed for operation from smaller classes of vessels, was operated from 9.75 m (32ft) OAL. fishing vessels. Results of initial trials warranted certain modifications in the design to ensure better efficiency in commercial operations. Accordingly, modifications were effected to the shape of the wing. More weight was added to the foot rope and the hanging ratio and rigging pattern were also changed. As a direct outcome of these changes, the catch rate increased and the catch per hour recorded was 45 kgs. for prawns and 30 kgs. for fish. The results are being incorporated in a scientific paper for publication.

c) Escapement studies

To assess the quantity of escapement of prawns through the lateral parts (side seams) of a four seam trawl and thereby to regulate the mesh size, experiments were conducted with a 13.7 m four seam cotton trawl net by the pocket method. The analysis of the data collected indicate the rate of escapement at the forward part of the gear to be 8%. The escapement through the anterior and posterior parts of the side seam, adjacent to the belly was noticed to be 24 and 50% respectively. At the throat of the gear, an escapement rate of 18% was recorded.

The studies have been completed and the results are being incorporated in a technical paper.

d) Multipurpose trawls

Trial operations were conducted with the prototype design of 11.75 m multipurpose trawl net, designed for operation at bottom, column and surface waters. Simple adjustments in the combination, rigging and operational techniques were also tried in order to effectively fish at the various strata depending on abundance of fish.

As the landing of prawn and bottom fishes were found on the increase during the period, the gear was rigged for bottom operations and few trials were taken. The gear was further provided with detachable 5.5 m long wings, and the weight on the foot rope was increased from 10 kgs to 25. A total of 319 kgs. of fish and prawns was landed for 11 hrs. of towing. The catch per hour of prawns alone was worked out as 27 kgs. The preliminary results show the suitability of the gear for bottom operations.

Research in hand

a) High opening trawl.

The 15 m bulged belly type trawl net evolved at the Institute for the exploitation of bottom as well as column fauna have been taken up for further investigations and improvements. Ten important parameters have been taken up for intensive research. The resistance offered by the different components of the gear, estimation of the relation between horizontal and vertical openings in relation to the length of warp released and towing speed, effect of heavy and light foot ropes, effect of hanging coefficient, flow pattern inside and outside the net, estimation of the rate of escapement of the catch through different parts of the net, effect of additional wings, effect of weight of otterboards, suitability of the 'V' form otter boards and the effect of impulse current on the catches are the main subjects of study initiated during the period under review.

b) Multipurpose trawl

The prototype design of 11.75 m multipurpose trawl net is to be operated for studying the following aspects.

1. Suitability of the gear for bottom operations, by making simple adjustments in the combination, rigging and operational techniques.
2. Suitability of the gear for operations along the column and pelagic layers.
3. Estimation of the towing resistance, working depth, horizontal spread, vertical spread, flow characteristics etc.

Research contemplated**1) High opening trawls**

More systematic studies are contemplated during the ensuing season using the bigger and heavier high opening trawl already designed and constructed for operation from medium size vessels.

2) Long wing trawls.

Systematic fishing operations with a bigger design of the long wing trawl are envisaged from medium classes of fishing vessels.

Persons associated:-

1. Shri. G. K. Kuriyan	Fishery Scientist - Project Coordinator.
2. Shri. K. A. Sadanandan	Jr. Fishery Scientist.
3. Shri. S. Gopalan Nayar	Asst. Fishery Scientist.
4. Shri. R. S. Nair	Asst. Fishery Scientist.
5. Shri. K. Sreedharan Namboodiri	Asst. Fishery Scientist.
6. Shri. T. K. Sivasdas	Asst. Fishery Scientist.
7. Shri. M. Mukundan	Research Asst.
8. Shri. K. N. Kartha	Research Asst.
9. Shri. C. P. Verghese	Research Asst.
10. Shri. Syed Abbas	Research Asst.
11. Shri. R. S. Manohardoss	Research Asst.
12. Shri. V. Vijayan	Research Asst.

Project - III: Improvements in the designs of gill nets.

Research work completed: Nil

Research in hand**a. Selective action of mesh size and mesh size - twine size relationship.**

Investigations initiated earlier with seer drift nets of 4 different mesh sizes viz. 70 mm, 75 mm, 80 mm, and 85 mm bar made of four different specifications of nylon twines viz. 210 D 6/3, 210 D 8/3, 210 D 9/3 and 210 D 12/3 have been continued during this year. Of the total number of 48 valid operations in three series programmed for the study, two series of 32 and 4 valid operations of the third series have been completed.

A preliminary analysis of the catch data of these nets for two complete series of 32 valid operations have been carried out and the findings in general are as follows:

Table showing efficiency indices of shots of 4 different mesh sizes irrespective of twine size.

Mesh size of shots in mm bar	Total area of nets operated.	Total No. of seers.	Total Wt. in Kgs.	Mini - mum Wt. of fish caught.	Maximum Wt. of fish caught.	Average Wt. of fish caught.
70	1000 sq. m.	20	87.5	0.75	8.50	4.38
75	1000 sq. m.	33	155.75	0.75	9.20	4.72
80	1000 sq. m.	29	139.50	2.00	9.50	4.81
85	1000 sq. m.	14	70.05	1.00	8.00	5.00

From the average weight of fishes landed in shots of different mesh sizes, it was observed that although the fishes landed in shots of largest mesh size (85 mm bar) were of relatively larger sizes, the frequency of the dominant size group was less and correspondingly the total output was also less in comparison with the shots of smaller mesh sizes. Shots made of 75 mm bar landed the maximum catch of 33 nos. weighing 155.75 kgs. as these shots were able to cover up the dominant size range better than the nets of other mesh sizes.

Catch rate of shots made of different specifications of twines irrespective of mesh sizes.

Specification of twines.	Total area of net per operation.	Total No. of Seers.	Total Wt. in Kgs.	Minimum Wt. of fish caught.	Maximum wt. of fish caught.	Average Wt. of fish caught.
210 D 6/3	1000 sq.m.	20	73.00	0.75	9.50	3.65
210 D 8/3	- do -	15	73.65	0.75	8.50	4.91
210 D 9/3	- do -	27	127.85	3.00	7.80	4.74
210 D 12/3	- do -	34	178.25	2.90	9.20	5.25

The nets made of thickest twines viz. 210 D 12/3, landed the maximum number of fishes - 34 numbers giving the maximum output of 178.25 kgs. This is about 2.44 times more than that of the total landings of seers from nets made of thinnest twines in the lot, 210 D 6/3.

Of the sixteen different combinations of shots tried, the maximum output was observed to be for the shot made of nylon 210 D 12/3, 75 mm bar mesh landing the maximum number of fishes weighing 61.25 kgs. The results indicate the superiority of seer gill net made of nylon twines 210 D 12/3 and of mesh size 75 mm bar.

The studies are being continued to further confirm the above findings. Of the 3rd series of 16 more operations planned for the study, 4 valid operations have been completed and the studies will be completed by carrying out 12 more valid operations.

b) Spatial distribution of seer in gill nets

Recording of spatial distribution of seer in gill nets has been continued during this year. Of the total number of 196 fishes caught their distribution in depths of 0-30 m. have been studied. More data are required to interpret the distribution in relation to the fishing height of the net used or in relation to the mode of operation of the gear.

Research contemplated

1. Effect of coloured nets in the capture of seers.

The gear required for the experiments has been fabricated and arrangements are being made to get them dyed in 4 different shades.

2. Utility of mechanical hauler for the operation of seer gill net.

A mechanical hauler has been designed and it is proposed to fabricate a prototype for trials.

Persons associated.

Shri. K. A. Sadanandan, Jr. Fishery Scientist-Project
Coordinator.

Shri. P. Sulochanan, Asst. Fishery Scientist.

Shri. T. Joseph Mathai, Research Asst.

Shri. Rajan Abraham, Research Asst.

Shri. M. Velu, Jr. Fishery Scientist.

Project IV: Lines

Chief findings.

a) Utility of wooden jigs as a lure in trolling lines.

In search for cheaper substitutes, investigations on the utility of wooden jigs were taken up during the year. Jigs made out of rose wood in 9 different specifications were tried as lures for trolling lines. Though this artificial bait was found to be effective in luring seer, much loss of fish was recorded due to the jigs breaking.

b) Standardisation of fish head jigs of different specifications.

Studies on the standardisation of jigs made of lead in the form of fish head was also carried out during the year under review. Two series of 18 valid operations have been completed for the study, with three different specifications of fish head jigs viz. of 50, 60 and 70 gram wts. These lures were tried by attaching feathers. The jigs having 60 grams weight were observed to be more effective than those of the other two specifications. The rate of catch per lure, per day was observed to be upto 50 numbers for the jigs with 60 grams weight while that for the jigs of 50 grams and 70 grams was only 24 numbers each.

Research in hand

a) Studies on the utility of metal jigs (Galvanised iron) as lures in troll lines for the capture of seers.

Six different specifications of galvanised iron jigs in two different lengths viz. 12.5 cm and 15.0 cm and in three different weights viz. 50, 60 and 70 grams have been fabricated. Trial operations are to be carried out.

Research contemplated.

Fishing for kalava has been reported to be a profitable proposition in the field of off-shore fishing (40 to 50 fathom range). The preliminary

attempts made in these lines were by employing large vessels. Attempts will be made to study the economic feasibility of employing medium sized vessels for the fishery and to standardise gear and accessories required.

Persons associated :-

Shri. P. Sulochanan - Asst. Fishery Scientist - Project
Coordinator,

Shri. N. Subramania Pillai - Research Asst.

Shri. R. S. Manohardoss - Research Asst.

Project : Studies on fish behaviour.

Research in hand

Experimental fishing operations were conducted with a chinese dip net at the station in Thevara for three months, from October to December 1969. Altogether 78 operations were completed. These operations were undertaken as a preliminary for assessing the species distribution of the locality, their behaviour and preference to the conventional gas lamp used by the local fishermen, and the effect of duration of operation on the quantity and quality of the catch. Simultaneously the environmental and biological factors related to the catch were also studied. Data on the variation in temperature, distribution of illumination, oxygen content, salinity, turbidity and plankton were collected. Biological data on the length, weight, sex and stomach contents of the common species caught are also being collected.

Research contemplated.

The next phase of this project is to be carried out by replacing gas lamp with electric lights including fluorescent lamps underwater and above water. Necessary arrangements are being made to set up a current generator at the fishing site for this purpose.

Persons associated

Dr. K. P. P. Nambiar, Pool Officer - Project Leader.

Shri. N. Sreedharan Nomboodiri, Asst. Fishery Scientist.

Shri. T. Joseph Mathai Research Asst.

Shri. N. Unnikrishnan Nair, Research Asst.

Shri. R. Krishnaswami, Research Asst.

CRAFT SECTION

The craft section continued to handle project studies pertaining to the protection of wooden fishing boats against deterioration and prevention of metallic corrosion. Studies on antifouling paints proved the versatility of tributyl tin oxide as a more effective toxic pigment than the conventional

cuprous oxide. Tin oxide incorporated surface coatings exhibited considerable resistance to marine wood borers also. New materials in the fibreglass sheathing and a new variety of marine quality aluminium alloy were located and recommended. More wooden boat hulls have been sheathed with fibreglass reinforced plastic in lieu of the imported copper sheets. 5 more new antifouling compositions, samples of which were procured from the local market were put to assessment tests in the laboratory. The second prototype of the Institute's cheaper version of the 15.24 meter wooden combination vessel 'Sindhu Kumari', was launched during August 1969.

Project-1. Protection of fishing boats against deterioration.

Research in hand

a) Boat building timbers.

Raderimachera xylocarpa ('onthi' - Tamil, 'Vedankorana' - Malayalam) and *Terminalia bellerica* - ('Tani' - Tamil - Telugu, 'Thanni' - Malayalam) were the two new species of wood examined for their utility in boat building. While the studies on the former are incomplete, the latter species appears to be as heavy as and stronger than Teak, Aini, Venteak. However its retention of shape is only as good as Venteak thus requiring careful seasoning before use. It is hard and tough, generally straight grained, seasons well with care, easy to work with and fairly durable and also treatable. It is good for use below water for keel and back bone assembly like the other species of Terminalia.

During actual field trials the behaviour and performance of treated woods like Mango (*Mangifera indica*) and Haldu (*Adina cordifolia*) as deck planks and hatch covers were extremely good when compared to the costlier untreated timbers like Teak, Aini, Venteak and the like. Treated woods were free from white ants attack and fungal infection. The metallic fastenings were free from corrosion. There was no splitting except negligible warping.

b) Wood preservation.

1) Studies on arsenical creosote as a wood preservative.

As there is no satisfactory wood preservative for use under marine conditions available in Indian market and the normal creosote requires high dosage, studies on arsenical creosote were taken up during the year under report. Arsenic oxide chemically reacts with creosote at 90°C forming stable arsenical compounds. These can be used for treating cheaper secondary species of wood like Mango and Haldu and there are no health hazards.

Circular and rectangular panels of Haldu and Mango were treated with the preservative at 90°C both by brush application and hot dip.

The circular panels were put in running sea water for 36-256 days. The panels were subjected to leaching rate studies in the laboratory after aging in sea water for various periods. Creosote was extracted in solvent ether. The study showed very good holding power of the preservative in the wood and aging has very little effect on the loss of preservative from the wood by leaching. The rectangular panels were subjected to field test for five months and the panels treated by hot-dip gave better protection against borer attack. Copper, G. I, Aluminium and MS panels were immersed in the preservative fortified with sodium chloride and treated with the respective saw dust and the quantitative nature of corrosion is being studied. Boat building fastenings were driven into treated timbers for observing the quantitative nature of corrosion. Treated panels are also being subjected to accelerated leaching rate studies for predicting their performance under service conditions. The study is in progress.

(2) Tributyl tin oxide as a wood preservative.

A special surface coating composition was formulated incorporating tributyl tin oxide in ordinary kerosene. 2% TBTO in kerosene when applied by brush to wooden test panels of Mango and Haldu and subjected to continuous immersion in sea water was found to resist all marine organisms. After 157 days of continuous immersion the treated wooden test panels revealed negligible fouling (below 1% surface covering) and negligible attack by ship-worms as well as Martesia, Sphaeroma and Limnoria (ranging from 0.6% to 3% internal timber damage) while the untreated controls were damaged considerably. Further studies are being continued.

(3) Aluminium alloy in fishing boats.

Apart from Indal M 57S, a marine quality aluminium-magnesium alloy of the Indian Aluminium Co, samples of aluminium alloy sheets of specifications Hindal 5082 and 5086 produced by the Hindustan Aluminium Corporation Ltd were examined and found suitable for hull sheathing work in lieu of the imported copper sheets.

The new material had the following characteristics.

	Hindal 5052	Rolled sheets	Hindal 5086
Magnesium	2.20 - 2.80%		3.5 - 4.5%
Iron	0.45		0.5
Manganese	0.10		0.20-0.70
Zinc	0.20		0.25
Chromium	0.15 - 0.35		0.05 - 0.25
Copper	0.10		0.10
Aluminium	remainder		remainder

Ultimate tensile strength in kg/mm ² - 17-30	24-38
depending on hardness	depending on hardness
Yield strength in kg/mm ² - 9 - 25	12-28
Hardness in brinell number - 47-73	50

Performance of these new sheathing materials is under further study.

(4) Fibreglass sheathing.

During further studies with fibre-glass reinforced plastic sheathing for wooden hulls of fishing boats, the possibility of using woven roving glass fibre and surfacing mat either with polyester resin or epoxy resin was examined. While 2 layers of FRP chopped strand mat is stronger and tougher, single layer of woven roving with a layer of surface mat gives a smooth finish at a reduced rate of expenditure. However, both surfaces require antifouling paints.

The experimental test window of FRP sheathing of the hull of 'Sindhu Kumari' - the 50' departmental wooden trawler, continued to be stable under continuous immersion with negligible 'fouling'. There has been no borer attack. No sign of delamination is noted. More number of wooden fishing boats are going in for this new sheathing material.

c) Studies on marine fouling.

1. Design of suitable single pack wash primer using easily available indigenous raw materials.

The laboratory formulated wash primer developed from Mowital, phosphoric acid and barium potassium chromate was applied on the aluminium hull of the newly built 15.24 meter wooden trawler for evaluating the service performances. The evaluation will be taken up during the next dry-docking of 'Sindhu Kumari'.

2. Designing of a suitable antifouling paint using organometallic compound as toxic substance.

Eleven formulations were made so as to minimise the leaching rate to that of critical level based on the previous sixteen formulations using tributyl tin oxide. All these formulations passed satisfactorily the physical tests like resistance to acid, resistance to alkali and resistance to erosion. The initial leaching rate studies of all these formulations were made and it was found that one composition gave satisfactory leaching rate in sea water.

Initial leaching rate of the sample is:

1.624 mgms/sq.cm/day

The leaching rate after 30 days: = 1.582/mgms/sq. cm/day.
The leaching rate after 60 days = 1.598 mgms/sq. cm/day
- do - 90 days = 1.588 - do -

As the leaching rate of the samples was more or less the same the satisfactory sample was applied on mild steel test panels and aluminium test panels with and without primer. The painted panels without wash primer were corroded in this test. Thus it is essential that the antifouling paint containing TBTO should be applied on panels only after applying wash primer first.

Subsequent field tests of these eleven formulations were done for 10 months. It was noted that out of these, the one that gave satisfactory leaching rate was absolutely free from fouling under continuous immersion. The commercial antifouling paints so far tested at this laboratory have revealed only 5-7 months effective life. Further evaluations of the sample are underway.

Research contemplated.

1. Studies on arsenical creosote as wood preservative.
Present studies have to be pursued further.

Project II

Marine corrosion in fishing boats.

Research in hand

1. Corrosion in metal fastenings in marine environment and by boat building timber and evaluation of aluminised fastenings for use in boat building.

The corrosion studies of the cadmised iron, brass, anodized aluminium and aluminium fastenings in the test blocks of various types of boat building timbers in sea water were continued. The studies on the pH variations of the incubated saw dust samples in sea water and the volatile and non-volatile acid content determinations were also continued. It is observed from all these studies so far completed that the cadmised iron fastenings stand the corrosion of salt water and organic acids present in the wood better than uncoated plain steel and zinc coated steel. Zinc and cadmium coated steel fastenings were found to be compatible with the common boat building timbers. They did not suffer appreciable corrosion and the coatings were intact. It was noted that incubated saw dust samples were found to contain weak acids mainly in the buffered conditions. Further observations of these experiments are underway.

Research contemplated

Present studies will be continued.

2. Hydrographical studies at the CIFT test te.

Regular hydrographic data from the selected test site in the Cochin backwaters were collected in order to correlate the abundance of the marine wood boring and fouling organisms and corrosive factors of the water mass. The study involves measurement of water temperature, salinity dissolved oxygen, pH, turbidity and other dissolved salts. The lowest salinity is recorded in July with a value of 1.2 ‰ and the max. is 35.2 ‰ in March. Dissolved oxygen ranges from 3.1 ml/L to 6.7 ml/L. Turbidity, surface water temp., pH, bicarbonate and relative humidity recorded only very little variation during the year.

Persons associated.

1. R. Balasubramanyan, Jr. Fishery Scientist – Project Coordinator.
2. K. Ravindran, Asst. Fishery Scientist.
3. N. Unnikrishnan Nair, Research Asst.
4. A. G. Gopalakrishna Pillai, Research Asst.

MECHANICAL ENGINEERING SECTION

Testing of engines, development of mechanical fishing accessories, development of cheaper stern gear using indigenously available material, development of machine for eradication of aquatic weeds, designing and testing of electrical fishing gear and development of various measuring and testing instruments required for fishing gear research were carried out in the mechanical engineering section during the year under review.

Chief findings.

Field trials of the machine fabricated for dewatering of lakes and bheels of larger sizes were carried out successfully. Fabrication of hand operated hydraulic motor for hydraulic control gear has been completed. Installation of Kirloskar RVM engine has been completed and trials are underway. Fabrication of a stern tube using aluminium alloy has been completed. Design of trawl winch for 18/20m deep sea fishing boats with larger wire rope capacity has been completed. Field trials of the electrical shrimp trawl using low volt direct current have been carried out and it has been proved that the prawn catch is more when 36 V direct current is applied. An instrument for the measurement of the depth of operation of fishing gear has been designed. An underwater tension meter and a mesh size meter have also been fabricated.

Research completed.

a) Development of mechanical accessories for fishing boats.

- 1) Development of trawl winch suitable for 18/20m deep sea fishing boat.

Design of a trawl winch suitable for 18/20m deep sea fishing boat was completed. This consists of two main warp drums and an auxiliary drum. The main drums can hold 400m of 12mm wire rope and the auxiliary drum can hold 400m of 8mm wire rope for operation of a trawl net.

b) Testing of engines.

A Kirloskar RVM series sea water cooled engine (RVM 6) has been installed in the test boat Fishtech No. 6 for evaluation trials. Preliminary trials have been completed. Fishing trials are underway.

c) Dewatering of lakes and bheels.

Field trials of the rotary type of machine fabricated for eradication of underwater weeds in larger water areas have been completed. Based on the trials, final drawings of the machine with suitable modifications and improvements such as self propulsion arrangements have been finalised. Arrangements are being made to fabricate the final version of the machine for trials.

d) Development of hydraulic control gear for fishing boats using indigenous components.

Fabrication of the reversible hand operated pump has been completed. A laboratory set up of steering gear using this pump and a hydraulic ram have been fabricated for trials.

e) Development of cheaper stern gear.

The anodized aluminium stern tube has been fabricated and arrangements are being made to carry out laboratory and field trials.

f) Electrical fishing.

Experiments to develop an electrical shrimp trawl using low volt direct current from batteries have been completed. The statistical analysis of the data showed that the mean catch of *Metapenaeus affinis* and *M. dobsoni* with current were significantly higher than without current; the significance was high in *M. affinis* compared to that of *M. dobsoni*.

g) Measuring and testing instruments.

1) Depth telemeter.

An instrument for the measurement of the depth of operation of fishing gear has been developed. The instrument has got the additional advantages over the one developed previously at the Institute in that this is more sensitive and has larger ranges of operation. The ranges can be altered with simple adjustments in the instrument. The main features of the instrument are:

- a) range of operations 0-100 M
- b) accuracy ± 1 M
- c) Wt. of the transducer in air 550 gms.

2) Underwater tension meter.

An electronic telemetering underwater tension meter has been developed for the measurement of the resistance to motion of the net alone. The following are the important features of the instrument.

- a) range of operation 0-300 kg.
- b) accuracy ± 2 kg.
- c) Wt. in air of transducer 2.3 kg.

3) Mesh size meter.

An electronic instrument has been developed with solid state components for the remote measurement of the variations in shapes of the meshes of a fishing net during operation. The following are the important features of the instrument.

- a) range - 230 mms to 410 mms.
- b) Accuracy - $\pm 1\%$
- c) Wt. of the transducer in air - 25 gms.

Research contemplated

1) Development of mechanical fishing accessories.

As mechanical drives have certain drawbacks particularly in the larger boats work has been taken up to develop in collaboration with Central Mechanical Engineering Research Institute, Durgapur, a suitable hydraulic motor which is not indigenously available at present. Preliminary information has been supplied to CMERI in order to work out design details of a hydraulic motor.

2) Testing of engines and accessories.

Field trials of Kirloskar RVM series sea water cooled engines are being carried out and is expected to be completed shortly. Testing of Kirloskar RVM4 engine will be taken up as soon as trials of RVM6 engine are completed.

3) Development of stern tube.

As copper alloys as well as stainless steel are becoming scarce in our country, work has been taken up to develop stern gear consisting of aluminium alloy stern tube, mild steel propeller shaft with suitable rubber sleeving and spheroidal grained cast iron propeller. The stern tube has already been fabricated and testing will be taken up shortly.

4) Development of machine for eradication of aquatic weeds-machine for eradication of floating weeds.

Floating aquatic weeds, like submerged ones, also present a formidable problem and development of equipment for eradication of floating weeds has been taken up on the basis of trials conducted with the experimental set up.

5) Electrical fishing.

Studies on the reaction of prawns to impulse current were conducted in the laboratory. The fabrication of the gear for conducting fishing trials with impulse current is in progress.

6) Testing and measuring instruments.

Work on the development of a remote measuring instrument of the vertical opening of trawl nets, an underwater flow meter for the measurement of the flow of water around the trawl net and an electronic warp tension meter for measurement of the load in the trawl warps is in progress. Similarly work on development of a rudder position indicator for small and medium vessels and a boat speed indicator as well as construction of an electronic device for luring fish is well underway.

Persons associated :

M. Velu, Jr. Fishery Scientist - Project Coordinator.

K. Sreedharan Namboodiri, Asst. Fishery Scientist.

T. K. Sivadas, Asst. Fishery Scientist.

R. Krishnaswamy, Research Assistant.

V. Vijayan, Research Assistant.

CIFT SUB-STATION, VERAVAL

Fishing Gear Branch.

Project - I. Investigations on trawl nets.

a) Investigations on otter trawls

Researches completed and chief findings.

- 1) Comparative catch efficiency of 13.7m four - seam and 29.26m long wing trawl.

The investigations started earlier were continued and completed during the period under report. A total of 60 hauls of 40 hrs. 18 minutes total duration were made, landing 1438 kgs. of prawns and 3480 kgs. of fish. The average catch per hour of 13.7m four seam trawl and 29.26m long wing trawl works out to 181 kgs and 63 kgs. respectively.

- 2) Comparative catch efficiency of rectangular flat and rectangular curved otter boards.

The studies initiated earlier were continued and completed during the period under review. The net used for the studies was a 13.7m four seam one. A total of 73 paired hauls of 97 hours 20 minutes were made during the course of the investigations, landing 6900.65 kgs. of prawns and 14,146.35 kgs. of fish. The catch per hour using rectangular curved otter board was found to be 227 kg. compared to 205 kg. for rectangular flat boards.

- 3) Investigations with 15.8m six seam trawl.

Studies initiated during previous year to assess the effectiveness of 15.8m modified six seam nylon trawl were continued. A total of 100 hauls of 75 hours duration were made during the entire period. The average catch per hour of prawn and fish works out to 31 kg. and 210 kg. respectively.

- 4) Standardisation of an otter trawl for operation from a medium sized vessel.

For the first time a 15.2m OAL boat designed and constructed at the Institute is put for operation along this coast. With a view to recommending a suitable gear for this vessel field investigations were conducted employing three trawl nets viz. 13.7m four seam, 15.8m six seam, and 18.3m four seam trawl. The details of the gear employed and the catch landed are as follows:

Gear employed	13.7 m trawl	15.8 m trawl	18.3 m trawl
Otter board	1.15 m x 0.63 m	same	same.
Total no. of hauls made	35	35	35
Total duration of hauls	23 hrs. 20 mts.	23 hrs. 20 mts.	23 hrs. 20 mts.
Total catch (kgs)			
Prawn	12.10	31.73	70.90
Fish	2287.90	5424.27	4996.10
	2300.00	5456.00	5067.00

Persons associated.

S. D. Deshpande	Jr. Fishery Scientist.
H. N. Mhalathkar	Asst. Fishery Scientist.
S. V. S. Rama Rao	Research Asst.

Research contemplated.

Project II on gill net investigations in Veraval area will be resumed during the ensuing year.

Persons associated:

T. M. Sivan, Asst. Fishery Scientist.
H. N. Mhalathkar, Asst. Fishery Scientist.

Technical assistance.

The scientific and technical staff rendered assistance to several private parties regarding the gear and its accessories. In addition, on request from M's. Sunshine Sea Food Co (Pvt) Ltd, Bombay, information regarding the lobster landings and its potentialities along the North West Coast was furnished.

CIFT SUB-STATION, KAKINADA.

During the year under review, studies were continued under major research projects viz. 1) Trawl fishing. 2) Improvement in the design of gill nets and 3) Line fishing. Steady progress was maintained in all of them.

I. Trawl fishing

The investigations on this project were undertaken under two heads, namely shrimp trawling and fish trawling.

i. Shrimp trawling.

The investigations on the design and operational aspects of shrimp trawl on the East Coast initiated in June 1967, were continued. Extensive trials with long wing trawl were undertaken. Comparative fishing trials with two seam net were also undertaken.

Research in hand and chief findings.

a) Investigations on 29.26 m long wing four seam net.

This new shrimp trawl design was extensively operated in both half year periods, to study its effective working along this coast. The net was operated off Kakinada beyond Hope Island in March 1969 and off Uppada between June to October within the depths of 10 to 40 m.

The analysis of the catch data has indicated that the net has worked satisfactorily with good percentage of shrimp in the catch. The catch during the first half was better compared to the second half.

b) Studies on the comparative efficiency of 29.26 m long wing four seam trawl and 18.26 m two seam trawl.

Comparative fishing experiments were conducted with the two types of nets in both the first and second half of the period under report. Horizontal curved otter boards with 20 m single sweep wire were used in the fishing operations.

The results are as follows:

Period	Comp. hauls/ trawling time	Catch in kgs.					
		29.26 m net.			18.26 m net		
		Prawn	Fish	Total	Prawn	Fish	Total
1. First half year (April-June)	12/12.0	22.62	58.20	80.82	8.83	62.30	71.13
2. Second half year (July to October)	14/14.0	7.14	27.78	34.92	3.23	23.92	27.25
3. Entire year	26/26	14.29	41.84	56.13	5.69	40.73	46.42
4. Last year	10/10	14.00	19.60	33.60	13.50	32.70	46.40

Main findings.

- i) The catch rate in general was found to be better in the new four seam net during the year.
- ii) The catches of the first half year were better compared to the second half.
- iii) 29.26 m net was found to be superior in catch rate of prawn, which is nearly 2.5 times more than that of the two seam net.

Research work contemplated.

- i. During the period under review, due to the cyclonic weather only few comparative hauls could be made under the different investigations. Hence the experiments will be continued for confirmation of the results.

Persons associated.

1. A. V. V. Satyanarayana, Jr. Fishery Scientist.
2. G. Narayanappa, Research Asst.
3. D. A. Narasimha Raju, Research Asst.

ii Fish trawling.

Research completed and chief findings.

a) Investigations on optimum buoyancy on head rope and buoyancy/weight ratio.

This investigation initiated in 1968 was continued and completed during the year under review. The experiments were conducted with a 16.14 m net with 0.55, 0.75 and 0.95 buoyancy/weight ratios.

The main finding ie. higher catch rate with 0.75 buoyancy/weight ratio, obtained previously was confirmed by the results of this year also. In view of this it may be concluded that 0.75 buoyancy/weight ratio is optimum for a fish trawl to yield good results along this coast. Based on the work of fish trawl project at this sub-station the following recommendations can be made.

1. The new design of the four seam net evolved and developed at the Institute can be introduced on a pilot scale in this area as this design has given encouraging results. This will also enable collection of more data for possible improvements.
2. The results of the experiments on a) utility of kite and gusset and other means for greater vertical opening and increasing the catch of fish trawl b) on the optimum buoyancy/weight ratio for a fish trawl and c) exploratory fishing operations in deep waters (50-100 m) off kakinada, can be passed on to the industry as the results are conclusive.

Persons associated.

1. A. V. V. Satyanarayana, Jr. Fishery Scientist.
2. G. Narayanappa, Research Assistant.
3. D. A. Narasimha Raju, Research Assistant.

Research in hand

a) Studies on otter boards.

A new research project study on otter boards in trawl was initiated during the period under report. The main objective of the study is to investigate the comparative performance of different shaped otter boards ie. horizontal curved, vertical curved and V-shaped boards in trawling. The designing and fabrication of the otter boards was completed during the period under report.

b) Preliminary experiment with double trawl net.

An experiment on trial basis was taken up with double trawl nets having three panels mounted one above the other for the possible discriminative fishing for the capture of bottom and near bottom fishes along this area. A suitable 10.97 m cotton trawl has been designed and fabricated. Trial operations were conducted and interesting results were obtained.

Research contemplated.

The investigations on otter boards and double trawl net will be continued. Persons associated.

A. V. V. Satyanarayana, Jr. Fishery Scientist.

G. Narayanappa. Research Asst.

II - Improvement in the designs of gill nets.

The investigations on seer gill nets and shark drift nets initiated earlier were continued and completed.

a) Seer gill nets.

Research work completed and chief findings.

Experiments on the optimum mesh size, twine size and size of fish, the effect of coloured netting on catch and catch variation with phase of moon and depth of operation initiated in 1968 were pursued and completed. The chief findings of the investigations can be summarised as follows:

- i. The 50 mm bar mesh units of nets are equally effective for the three species of seer viz. *Scomberomorus guttatum*, *S. commersoni* and *S. lineolatus*. Among the three species, the 50 mm bar mesh size is more effective for *S. guttatum*.
- ii. Nets made of Kapron yielded better catch, mostly *S. guttatum*.
- iii. White coloured nets are more effective for *S. guttatum*.
- iv. Deeper areas (21 - 40 m) are more productive for *S. guttatum* while inshore areas seem to be productive for *S. commersoni*.
- v. Regarding spatial distribution it was found that seers were available upto 1-4 m depth of netting with concentration between 2-3 m.

Observations on the catches of local gill net boats were continued. The data collected on analysis showed the percentage composition of the different species of seer as follows:

<i>S. guttatum</i>	39.4 %
<i>S. commersoni</i>	44.2 %
<i>S. lineolatus</i>	16.4 %

Persons associated.

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

b) Shark drift nets.

5 Units of 63.5 mm bar mesh nets were operated along with seer gill nets. The catches were mainly composed of *Carcharius melanopterus*, and *C. sorakowah*, which composed about 47 % in the total catches in the surface operations. The share of these species in bottom drifting operations was only 9 %.

Persons associated.

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

Research in hand.

A project to evolve a suitable gill net for *S. commersoni*, *S. lineolatus* and shark was initiated during the second half of the year under report. 18 gill nets having 55, 65, 75, 85 and 105 mm mesh bar, of nylon 210 D / 6 / 3, 210 D / 7 / 3, 210 D / 8 / 3, 210 D / 9 / 3 and 210 D / 10 / 3 with a hung area of 180 sq. m. have been designed and fabricated.

Research contemplated.

Actual experimental part will be undertaken in the next year to collect data on the various items under study.

Persons associated:

J. Sitarama Rao	Research Asst.
P. Dawson	Research Asst.

CIFT SUB-STATION, BURLA

I. Gill net for inland fishery.

Chief findings.

The productive fishing grounds were found to be in the upper reaches during the first and last quarters of the year and in the middle reaches during the second quarter. Majority of fishes were caught in 3-6 m from the surface.

Exploratory fishing.

The study initiated earlier was continued and a total of 165 observations made from 11 fishing stations in the Mahanadi river course of the Hiracud reservoir. The data indicated that the upper reaches were more productive during the first and last quarters of the year and the middle reaches in the second quarter.

b) Spatial distribution of fish

Majority of the fishes viz. 71 % were caught in the depth range of 3-6 m from the surface water. In the 0 - 2 m depth, the movement of fish seems to be comparatively less and in depths beyond 6 m, the availability of fish was negligible.

c) Time of gilling of scale and cat fish.

The data gathered on the study tend to reveal the following:

Period	% composition of catch by weight.		
	Scale fish	Cat fish	Total
Sunset to midnight	20.52 %	18.23 %	38.75 %
Midnight to sunrise	27.00 %	34.25 %	61.25 %

d) Horizontal movement of fish.

During summer (March to May) 52 % (by number) of the fishes were found to be either ascending or descending and 48 % were either moving shore-ward or river-ward. In the post monsoon winter period 70 % were found to be either ascending or descending and 30% were moving either shore-ward or river-ward.

e) Optimum parameters of framing in frame nets.

The studies initiated earlier were continued during the year. The catch analysis of the different frame sizes of nets are furnished below.

Frame size in m	Catch in kg/1000 sq. m of net
1.00	3.113
1.25	4.869
1.50	4.585
1.75	7.504
2.00	4.044

f) Studies on trammel nets.

Investigations with this gear were continued during the year and the higher output was from the net with mesh size in the outer webbing which was five times greater than that of the mesh size in the inner webbing. This year's finding corroborates with the previous year's observations.

Research contemplated.

1. Effect of mesh size, twine size and hanging coefficient on the output of simple gill nets.
2. Relation of mesh size and frame size in frame nets.
3. Standardisation of the relation of inner and outer mesh sizes in trammel nets.
4. Standardisation of horizontal hanging and slackness of inner webbing in trammel nets.
5. Effect of twine size on the output of trammel nets.

Persons associated.

V. C. George, Asst. Fishery Scientist.

R. M. Naidu, Research Asst.

K. K. Kunjipalu, Research Asst.

CIFT UNIT, NANGAL.

Steady progress has been maintained in the different research projects undertaken at this unit during the period under review. Experimental and exploratory fishing investigations have been carried out in Gobindasagar with a view to locate potential fishing grounds for the commercial exploitation of the fishery resources of the lake as well as to assess the seasonal migration of the important species of fish in the reservoir. Studies on the mesh selectivity, comparative efficiency of different coloured gill nets, and on column gill nets initiated earlier were continued.

A brief review of the progress achieved under the different projects is indicated below:

Research in hand.

I Gill net for inland fishery.

a) Studies on the selective action of mesh size.

The preliminary investigations which were completed during the previous year has indicated that gill nets of mesh bar in the range of 45 mm to 55 mm, are effective for the exploitation of *Labeo diplostoma*, the major fishery of the reservoir. Based on this finding, gill nets of mesh sizes (bar mesh) 45 mm, 47.5 mm, 50 mm, 52.5 mm and 55 mm were operated from different centres in the upper and middle reaches of the reservoir and relevant data on the catches were gathered. The investigations are in progress.

b) Studies on the effect of coloured gill nets.

The studies initiated earlier were continued. The data gathered from the landings of the nets with different coloured twines did not show any appreciable variation between them. It was noted that the catches of the nets were also poor in general. The investigations were carried out using nets of 50 mm bar mesh size, fabricated with 34 s/6 Kapron twine, which is thicker than nylon twine of 210 D/2/3 specification. The poor catches of these nets may be attributed to this factor. Hence it is proposed to continue the study with nets made out of nylon 210 D/2/3 specification.

c) Investigations on column gill nets.

The investigations initiated earlier were intensified and continued during the year under review. Comparative fishing with column gill nets set 1 m below the surface of water and surface set gill nets were undertaken during the

summer period. The catch data on analysis tend to show an increase in the catch per unit area of column set gill nets. The studies are being continued to arrive at definite conclusions.

d) Exploratory fishing.

Exploratory fishing operations were continued in Gobindasagar reservoir to assist the Himachal Pradesh Fisheries Dept. in locating potential fishing grounds for the exploitation of the fishery potential of the reservoir. Operations were carried out in different localities of the reservoir during summer months; better landings were observed from the middle reaches of the reservoir; fish concentrations were very meagre from September to November. During December large fish concentrations were observed in the upper reaches of the reservoir. This may probably be due to the winter migration of fishes. One hundred and ninety eight fishing trips were undertaken during the year under report landing a total No. of 12115 fishes weighing 9897.5 kgs.

Persons associated.

N. A George	Asst. Fishery Scientist.
Om Prakash Pandey,	Reaearch Asst.
Anwar Ahamedkhan.	Research Asst.

CIFT UNIT, GOA

The following projects undertaken at the Unit were continued during the year under review.

- | | | |
|------------------|---|------------------|
| 1. Trawl fishing | — | Shrimp trawling. |
| 2. Line fishing | — | Troll lines. |
| 3. Gill netting | — | Seer gill net. |

Research in hand

a) Trawl fishing — "Shrimp trawls"

The project was initiated with a view to evolve a suitable design of shrimp trawl for commercial shrimp trawling in this area. During the course of the experiments four different designs of shrimp trawls viz. 12.93 m, two seam nylon trawl, 13.68 m four seam nylon trawl, 14.12 m four seam cotton and nylon trawl, and 16.76 m nylon trawl were operated for studying their comparative efficiencies. 13.68 m four seam nylon trawl was found to be relatively better than the other three. However, the observation requires further conclusiye experimental data.

b) Gill nets — Seer gill nets.

Seven units of gill nets of specifications nylon 210 D/5/3, 210 D/6/3 and 210 D/7/3 with mesh sizes 65, 70 and 75 mm bar were fabricated during the period under review. Fishing operations could not be initiated as the private boat from which the operations were to be made was out of order. The work will be continued during the ensuing season.

c) Line fishing — Trolling lines

Four types of jigs viz. white feather, buffalo horn, stainless steel and plastic designed at the Institute, were operated along with the imported spoon jig, which is being used by the local fishermen, to assess their comparative efficiency. Of the jigs tried, white feather jig was found to be more effective. The studies are in progress.

Purse seine.

Since purse seine is the most successful gear in this area for mackerel and sardine, this unit has undertaken designing of a suitable purse seine for mackerels and sardines. The work is in progress.

Research contemplated.

All the projects in hand will be continued.

Persons associated.

P. A. Appukutta Panicker	Jr. Fishery Scientist.
G. Jagadesan	Research Asst.
M. D. Verghese	Research Asst.
P. R. Senthivelan	Research Asst.

EXTENSION, INFORMATION AND STATISTICAL DIVISION

The Statistics Section of the Division made steady progress in the research projects undertaken by it in collaboration with the other sections of the Institute. The Extension and Information Sections continued activities in giving technical assistance to the fishery industry, State Fisheries Depts. 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 this Division are summarised below:

STATISTICS SECTION

Chief findings.

Significant correlations were obtained between the gross and drained weights of frozen prawns. The fluctuations in the gross weight of canned prawns were found to arise in a factory even during a single day's production. The experiments in connection with the development of a numerical scoring system for ice-stored characteristics of prawns were continued. The relationship of the exported quantities of frozen prawns with those of canned and dried prawns and frozen lobster tails was worked out. A preliminary analysis of the data regarding quantities of frozen prawns submitted for inspection at Cochin during the last four years has shown that during the month of November, the proportion of lots submitted for inspection was significantly less when compared to the other months.

1. Statistical studies on the drained weights of frozen and canned prawns.

Observations on drained and gross weights of frozen prawn blocks taken in the course of pre-shipment inspection have shown the following correlation coefficients.

	DF	Cor. coeff.	Significance.
Headless shell on	202	0.240	< 1% level
Peeled and deveined	248	0.550	< 1% level

These correlations can be taken advantage of for controlling the drained weights by controlling gross weights of frozen prawns.

Data collected from a canning factory to trace the fluctuations in gross weights of canned prawns have shown that significant fluctuations (in gross weights) could arise during the course of a single day's production also. This observation is from a follow-up study of an earlier result where the gross and drained weights of canned prawns were found to be significantly correlated.

Persons associated: K. Krishna Rao, Asst. Fishery Scientist (Statistics)
&
Dr. V. K. Pillai, Fishery Scientist.

2. Development of a numerical scoring system for characteristics of ice stored prawns.

Experiments to develop a numerical scoring system for evaluation of the organoleptic characteristics of ice stored prawns were conducted using the three species of prawns viz. *Metapenaeus affinis*, *M. dobsoni* and *Parapenaeopsis stylifera*. The study has to be extended for the species *Penaeus indicus* and *M. monoceros*.

Persons associated: H. Krishna Iyer, Asst. Fishery Scientist (Statistics)
and
Dr. V. K. Pillai, Fishery Scientist

Other studies.

A multiple regression of the exported quantity of frozen prawns in terms of the (exported) quantities of canned and dried prawns and frozen lobster tails (based on half yearly data for the years 1962-68) was worked out. The multiple regression was found to be $Y = 2.997 X_1 - 1.066 X_2 + 19.349 X_3 + 1676.287$ where Y, X_1 , X_2 and X_3 represent frozen, canned and dried prawns and frozen lobster tails respectively (all in terms of thousands of kilograms). The associated multiple correlation was 0.940 which was highly significant.

Treating April to the following March as a year, the percentages of quantities submitted for inspection at Cochin have shown that during the month of November, the quantity was significantly lower than during other months. The data for the last four years showed the average percentage during November as 5.83 % and this quantity gradually increased from December (7.48 %) to January (11.48 %) with irregular fluctuations during the rest of the year. As the quantity submitted for inspection is related to the quantity exported, these fluctuations are proposed to be followed for arriving at consistent month - wise figures.

Person associated: K. Krishna Rao, Asst. Fishery Scientist
(Statistics).

In addition to the above, the section also assisted the other sections of the Institute in carrying out statistical analysis of experimental results.

Extension and Information Section .

1. Technical assistance to the fishery industry and other interested parties.

i. Furnishing technical informations on queries received.

Technical queries received from the fishing, fish processing and related industries, State Fisheries Depts. and others interested in various aspects of the industry and results of investigation at the Institute were promptly attended to. A total of 480 queries were answered during the period. Of these, 210 queries were related to fishing craft and gear and 270 to different aspects of fish processing industry. The technical details furnished on fish processing technology included schemes for fish and prawn canning and freezing plants, frogleg freezing factory, prawn and fish dehydration units, fish body oil and fish liver oil extraction units, fishmeal manufacturing unit, layout drawings for different processing units, method for handling, preservation and transportation of fish over long distances including details of containers recommended for the purpose, handling, preservation and transport of clams, mussels and oysters, methods for canning, freezing and dehydration of different types of fish and shell fish and freezing of froglegs, specification of different types of can for fish canning, method for prevention of thaw drip loss in frozen prawns, methods for production of speciality products from fish, methods for preparation of ready-to-serve accelerated freeze dried fish products, specifications of tunnel freezer, cold storage and ice plant, details of different methods of curing including the improvements recommended, packages for canned, frozen, dehydrated and cured fish products, general information on the fishing and fish processing industry in India, etc. The technical details supplied with respect to fishing craft and gear included specifications of fish net twines, method of preservation of cotton twine nets by treatment with

tannin preparation, information on the common vegetable fish net preservatives, specifications of different types of floats used in the fishing industry, specifications of different equipments and machinery for a net making factory including details of twine testing equipments, use of the less expensive wood, Ventek, for boat building, details of the method of providing sheathing to wooden hulls of fishing boats with aluminium alloy and fibreglass reinforced plastic, use of indigenous resins as preservatives for wooden fishing boat, observations on the resistance of different types of timbers to marine borers and foulers, details of stern gear for marine engines of different H. P. suitable for different sizes of boats, approximate cost of construction of different sizes of fishing boats, methods for calculating depreciation of fishing boats, details of tension meter for measuring warp of trawl net, specification of trawl nets and otter boards for different sizes of trawlers, details of different machines and equipment for a marine engine service station etc.

ii. Technical assistance through personal discussion.

Besides the technical information and guidance given through correspondence, such assistance was also provided regularly to representatives of the fishery industry, new entrepreneurs etc. who called at the Institute for gathering information and advice on different aspects of the industry and innovations made by the Institute. Due attention has been paid in furnishing them with the information needed, arranging for their discussions with the concerned scientific workers, demonstrating the operation of the different equipments installed at the Institute etc. A total of 105 such parties called at the Institute during the period.

iii. Testing of materials and products.

Arrangements were made for testing samples of fish net twines, monofilaments and floats and samples of processed fish products received from different parties and the test reports and comments on quality and suggestions for improvement in cases of defects observed were furnished on request to the concerned parties. Test reports and comments thus furnished enabled the indigenous manufacturers and processors to turn out better quality materials and products.

iv. Visit to fish processing factories and conduct of demonstrations.

Six fish canning and freezing factories in Goa and Ratnagiri areas were visited for rendering technical assistance in maintaining good plant sanitation and propagation of the recent findings of the Institute in fish processing technology. Demonstrations were conducted on the cleaning schedule recommended by the Institute for the maintenance of sound factory hygiene and method for prevention of weight loss due to drip at the time of thawing frozen prawns and froglegs. The methods recommended by the Institute for handling, icing and storage of raw material, canning

and freezing different types of fish and shell fish, prevention of blackening of prawn meat and black discolouration of can interior in case of canned prawns, maintenance of bacteriological quality of canned prawn and cooked frozen prawns etc. were brought to the knowledge of the concerned persons in these factories.

v. Supply of booklets, design drawings of nets, mechanical fishing aids and fish dehydration plants.

Thirty complete sets of drawings of trawl nets and suitable otter boards for operation from different sizes of boats, three sets of drawings of anchors specially designed for fishing boats, thirty eight sets of drawings of trawl winches suitable for different sizes of boats, drawing of a torsion meter, drawing showing arrangement of sprayer and live bait tank for a pole and line fishing vessel, two sets of drawings for installation of engines in fishing boats, ten sets of drawings of the tunnel dryer of one tonne raw material capacity for dehydration of fish and nine of the rotary drum dryer of half tonne raw material capacity for production of fish meal and dehydration of prawns, all of the Institute's design, were supplied on request. Besides, nineteen copies of the booklet on 7.6m (25') fishing boat published by the Institute were also supplied on request. Drawing of a hydraulic winch suitable for a research vessel was also got specially prepared and supplied to the Kerala State Fisheries Department on request.

vi. Exhibitions.

Samples of different fish products and by-products prepared as per the methods worked out by the Institute and suitable informative write-ups were displayed in the Agricultural Exhibition at Alleppey through the Kerala State Fisheries Department. Models of different types of net, otterboard, synthetic material used for fishing, fish products and by-products prepared according to methods worked out by the Institute together with suitable informative write-ups were also displayed in the Agricultural Exhibition at Goa through the State Department of Fisheries. These models, products etc. thus displayed have enabled in popularising some of the more recent achievements of the Institute.

II Publications.

i. Fish Technology Newsletter.

Two issues of the Fish Technology Newsletter Vol. IX and one of Vol. X were brought out. A total of 21 notes on the results achieved by the Institute were published in these issues. They included method for preparation of fish protein concentrate, suitable cans for standard packs as required in importing countries, improvement of bacteriological quality of frozen froglegs, method for preparation of hydrolysed protein

from prawns. a simpler method for prevention of thaw drip loss in frozen prawns, method for preparation of laminated Bombay duck, method for maintaining the required acidity in canned prawn, results of investigation on the nutritive factors and ice storage behaviour of certain shell fishes, a method for preparation of squid rings, three drum combination winch for 16.8/18.3 m fishing boats, a simple instrument for measuring the tilt of otter boards, results of gill netting for seers off Kakinada and details of an equipment for removal of submerged water weeds.

ii. Leaflets and information sheets.

The following cyclostyled leaflets and information sheets were brought out:

1. Preparation of fish ensilage by fermentation method.
2. Mass min preparation.
3. Improved containers for transport of fresh fish.
4. Shark skin leather.
5. Urea in shark flesh - process for removal.
6. Canning of lactarius and tilapia.
7. Bacteriological peptone from trash fish.
8. Freezing of pomfrets.
9. Utilization of shark flesh as fillets.
10. Reglazing of frozen prawns-quality of water to be used.
11. On the quality of ice to be used in fish.processing factories.
12. Freezing of oil sardines.
13. Canning of small dara fish.
14. An accelerated method for dehydration of fish in the tunnel dryer.
15. Preparation of ready mixed paints from sardine oil.
16. Factice from sardine oil.
17. Frozen breaded fish sticks.
18. A simpler method for prevention of thaw drip loss in frozen prawns.
19. Fish protein Concentrate.
20. Production of dehydrated fish.
21. Printing ink base from sardine oil.
22. Fish paste from Bombay duck.
23. Long distance transport of fish.
24. Smoking of eel fillets.
25. An effective method for reducing belly bursting in oil sardines.
26. Frozen froglegs - improvement of bacteriological quality.
27. Maintenance of acidity in canned prawns.
28. Squid rings.
29. A new material for propellers in fishing boats - spheroidal graphite austenitic cast iron.
30. Cashewnut shell liquid as a surface coating material for fishing boats.

Copies of the different leaflets and information sheets so far published were supplied to visitors to the Institute and different parties on specific requests.

The scheme for a pilot plant for production of fish protein concentrate proposed for setting up in Cochin under the United States Agency for International Development was prepared and furnished to the organisations concerned with the project.

Notes, incorporating information on the different species of prawns taken for freezing, cost, percentage yield of meat, cost factors in the different stages of handling etc. in respect of a unit quality of material, on the use of ice in preservation of fish including cost of preservation and one highlighting the developments in and the present status of the fishery were prepared and furnished against specific requests.

A list incorporating addresses of dealers in fishing gear and gear materials in India, dealers in marine engines and engine spares, dealers in materials for protection of wooden hulls of fishing boats and dealers in mechanical fishing accessories prepared earlier and circulated among the various State Fisheries Departments are being revised on the basis of supplementary details being obtained from the State Depts.

In order to ascertain the capacities of different boat building yards, types of timber used for construction of fishing boats, approximate cost of different sizes of fishing boats, etc. a proforma was prepared and copies of the same sent to the different fishing boat building yards in the country. It is proposed to publish the consolidated information on the boat yards when the information asked for is received from the different yards.

In order to assess the performance of the Aluminium-alloy sheathing on wooden hulls of fishing boats, a proforma aimed at bringing out the performance in case of individual boats was prepared and copies sent to different boat building yards and Fisheries Departments in the States of Kerala, Mysore, Andhra and Madras inviting details as per the proforma on the observations made. Replies to these are being received.

With a view to ascertaining the number of fish dehydration plants, if any, in the country set up as per the project report and design of one tonne tunnel dryer prepared by the Institute and supplied to the Fisheries Departments of the maritime States in India and to assess the observations on the working of the plants the various State Fisheries Departments were contacted. Details of the plants, if any set up, are expected.

In view of the increased requirement of synthetic fish net twines in tune with the increased activities in fishing and introduction of more and more mechanised fishing boats, it was found necessary to assess the production

of twines of different synthetic materials in the country. Accordingly, a proforma aimed at bringing out the different types of synthetic twines, their specifications, quantity of production, installed capacity of the plants etc. was prepared and copies sent to the different twine manufacturing firms in the country inviting detailed information as per the proforma. Replies to these are being received.

SUMMARY

The levels of lactate, pyruvate, creatine and various phosphorus containing fractions were determined in oil sardines and two species of prawns. In case of prawns held in chill storage, the pattern of changes of nucleotides, nucleosides and purine bases has been investigated. Significant changes in the levels of mono and disulphides and acetaldehydes were noted in the prawn *M. dobsoni* during ice storage. The composition of phospholipids was worked out in pomfret, mackerel and 4 species of prawns. The proteolytic activity of crude enzyme from mackerel, oil sardine and prawn was concentrated and fractionated. Extractability of soluble protein in different species of prawn was found to decrease with increasing concentration of acid added during extraction.

Determination of total plate count by the 'drop plate method' was found to be better than the 'pour plate method'. Of the total of 560 strains of bacteria isolated from canned prawns, about 72% were gram positive spore-formers and the rest gram positive cocci, rods, gram negative rods, cocci and coccoids. The percentage suppression of bacterial flora of fish in medium incorporated with CTC at 5 ppm level was found to vary from 70% to 90%. *Pseudomonas* and *Achromobacter* were found to develop tolerance to CTC whereas flavobacterium was not much prone to development of tolerance. But of the 6 strains tested, all were sensitive to CTC at 5 ppm level in nutrient broth.

Large size grades of oil sardines having greater fat contents showed minimum of belly bursting during freezing and thawing. In containers of cylindrical and cubical shapes fabricated from resin bonded fibreglass placed in between rexin cloth stitched to the shape, fish iced in 1:1 ratio and stored at room temp. remained in acceptable condition for 40-44 hrs. and 44-48 hrs. respectively. A mechanised prawn peeling table was fabricated as per modifications made in earlier design. By improvement made in the technique of electrical resistance thawing, a cooked frozen prawn block of 2.7 kg. could be thawed in 30 minutes. Mackerel and seer held in ice for more than 3 days were not found suitable for freezing as the frozen material had poor shelf life. Eviscerated and beheaded tilapia was found to be acceptable organoleptically upto 10 days of ice storage. Crab meat and mussel meat stored in ice upto 6 days yielded cooked frozen products which could be stored in acceptable condition for 8 months at -1°C. Clams

stored in ice up to 6 days, was suitable for freezing and storage for 9 months. Frozen froglegs free from salmonella and E. coli could be produced by the method recommended by the Institute. Treatment of froglegs with polyphosphate was found to be effective in increasing the yield upto 5-10% on thawing the frozen material. The increase in the yield by the treatment was found to be 8-15% for frozen peeled and deveined prawns and 10-15% for cooked prawns.

An increase in yield of 7.5% could be achieved by treating peeled and deveined prawns for canning with sodium tripolyphosphate neutralized with potassium dihydrogen phosphate and citric acid without altering the colour and appearance of the treated material. Prolonged heating and higher temp. of processing was found to influence jellying of brine in canned prawn. Method was worked out for canning barbus carmuca. An apparatus for direct measurement of concentration of blanching brine was designed and fabricated.

Seer-fish flesh minced with salt, pressed and dried gave a stable product which did not disintegrate on cooking in water. The mechanised fish cleaner earlier developed was found to be useful in deshelling cooked and dried prawns.

A method was worked out for preparing protein concentrate from blanch liquor usually wasted from canning factories.

Canvas bag or bitumin coated gunny bag was found to be suitable for storage of fish protein concentrate for a minimum of one year. A new design of pilot plant for FPC based on 'wet extraction process' was completed. Methods were worked out for preparing shrimp protein extract and chitosan from prawn shell waste.

Sanitary conditions in processing factories and primary processing centres were continued to be surveyed and technical assistance rendered to the processors in maintaining strict factory hygiene and processing quality products. Demonstrations of the phosphate treatment of prawns, processing of bacteriologically sound froglegs and prevention of blackening in canned prawn were conducted in a few factories.

Preshipment inspection of frozen and canned prawns and frozen froglegs continued to be carried out and necessary export fitness certificates issued till 1st May 1969 from which date the scheme was transferred from the Institute.

At the Sub-station of the Institute at Veraval irradiation of prawns, Bombay duck and silver pomfret was found to be effective in extending the ice-storage life of the species considerably. A method was worked out for canning smoked eel fillets. Storage of commercially dried Bombay

duck in airtight containers prevented insect growth in the product. Good quality fish flour could be prepared from squid meat. Fungus growth in smoked eel fillets could be prevented by treatment with suitable preservative.

At the Bombay Unit, it was noted that irradiation at mild doses failed to prevent melanosis in headless prawns during subsequent ice-storage. Irradiation was however effective in inhibiting insect infestation in dried Bombay ducks.

The Unit at Calicut observed that treatment of cured fish with a preservative mixture of 3% sodium propionate and 0.05% BHA in refined salt was highly effective in controlling different types of spoilage. The fertilizer value of self brine from curing yards has been evaluated.

On the fishing craft and gear side, studies on the strength of webbing made out of nylon and cotton twine have indicated that a nylon net is 2.38 times stronger than a cotton net of similar specifications. Standards were drawn up for testing netting yarns for quality evaluation. Samples of polyethylene monofilament produced by indigenous manufacturers were subjected to detailed tests for the study of their basic characteristics and to assess suitability for different types of fishing gear.

Design of bulged belly type trawl net for operation from vessels in smaller size group was finalized. Study on the rate of escapement of prawns through trawl nets showed that at the forward part of the gear the rate of escapement is 8% and that at the anterior and posterior parts of the side seam adjacent to the belly 24% and 50% respectively. At the throat of the gear the escapement rate was 18%.

Investigation on the selective action of mesh size in gill nets with reference to seer fishery off Cochin has indicated that shots made out of 75 mm bar mesh landed the maximum catch. The twine size-mesh size relationship was also worked out in case of seer gill nets. Of the different types of jigs tried to determine their comparative efficiency for capture of seer fish, fish head jigs of 60 gms weight made out of lead were found to be the most efficient. The rate of catch per jig per day was observed to be up to 50 seers.

Studies on antifouling paints for application on fishing boats indicated the better efficiency of tributyl tin oxide as a toxic pigment than the conventional cuprous oxide.

Studies on different antifouling paints incorporating organometallic compound as toxic substance showed the better performance of a particular composition compared to all others including commercially available samples.

It is observed that cadmised iron fastenings resist the corrosion of salt water and organic acids present in wood better than the uncoated steel and zinc coated steel fastenings. Zinc and cadmium coated steel fastenings were also found to be compatible with common boat building timbers. They did not suffer appreciable corrosion.

Field trials of the machine fabricated for eradication of submerged aquatic weeds from lakes and bheels were carried out successfully and the design of the equipment was finalized. Fabrication of a hand operated hydraulic motor for hydraulic control gear was completed as also fabrication of a stern tube using aluminium alloy. A trawl winch was designed for operation from deep sea fishing boats in the size group of 18/20M. Field trials of an electrical shrimp trawl has indicated that the prawn catch could be increased significantly by applying 36 V direct current. An instrument to measure tension on warp underwater, another for measuring variations in mesh sizes while the gear is in operation and yet another instrument for the estimation of the depth of fishing gear in operation have been designed and successfully put to use.

In the Substation of the Institute at Veraval, a new otter trawl net for operation from medium sized vessel (15.2M) along the Saurashtra region of the Gujarat coast was developed and put to successful trials.

In the Substation at Kakinada, the optimum buoyancy for a trawl net and the buoyancy - weight relationship was worked out. A 29.26 M long wing four seam trawl net was found to be about 2.5 times more efficient than an 18.26M two seam net for prawn fishing. This design of the four seam net is recommended for operation along the Andhra Coast. It has been established that 50mm bar nylon gill nets are effective along the Kakinada coast for the capture of seers, especially *S. guttatum*.

Exploratory fishing conducted by the Substation at Burla in the Mahanadi river course of the Hirakud Reservoir showed that the upper reaches of the river are more productive during the first and last quarters of the year and the middle reaches in the second quarter.

In the Unit of the Institute at Nangal gill nets of the mesh bar in the range of 45mm to 55mm were found effective for the exploitation of *Labeo diplostoma*, the major fishery of the Gobindasagar reservoir. Exploratory fishing operations conducted in the reservoir showed that the middle reaches of the reservoir are more productive during summer months. During December large fish concentrations were observed in the upper reaches of the reservoir.

In the Goa Unit, fishing operations towards development of suitable trawl gear for the area were continued. Designing of suitable purse-seine for mackerel and sardine fishery was also taken up during the period.

The Institute continued giving technical assistance to the fishing and fish processing industries and propagation of the research findings. The fish processing factories and primary processing centres were visited regularly for survey of sanitary conditions and giving technical guidance in processing quality products. Demonstrations of the improved and new techniques developed were conducted in some of the factories. Technical queries received from different parties were answered. Publication of Fish Technology Newsletter was continued and a few cyclostyled information sheets were brought out on the important research findings.

PUBLICATIONS.

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

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