Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

MARITIME REGION
TECHNOLOGY BRANCH

ACTIVITY REPORT

APRIL 1977 — MARCH 1979

FISHERIES AND OCEANS CANADA
FISHERIES AND MARINE SERVICE
- MARITIME REGION -
TECHNOLOGY BRANCH

Activity Report - April 1977 to March 1979

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April 1, 1979

To: H. Douglas Johnston
Director General
Fisheries Management Maritimes

From: E. Graham Bligh
Director, Technology Branch

During the period 1977 and 1978 a number of factors have had a profound impact on Canadian fisheries; among these one can list:

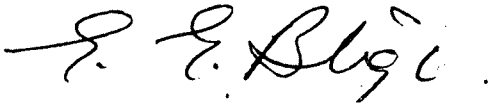
- the 200 mile limit
- increased costs
- resource scarcity
- a new federal policy for Canadian commercial fisheries
- environmental quality regulations
- food safety and nutrition, the necessity to examine these
- non-traditional fishing grounds, species and markets.

Not only have these altered our fisheries strategies, but in every instance there has been created a need for increased and more precise technology. I believe that the current demand for fisheries technology in Canada, and indeed in a number of other countries, is at an all-time high.

The Government of Canada, in response to demands from the fishing industry, first established the Halifax Laboratory in 1924, to carry out research related to the harvesting and processing of fish in the Atlantic area. The Technology Branch today consists of 79 people, whose names are appended to this report, who serve the fishing industry in the areas of fishing technology, process technology and seafood science. You will note that many of the projects summarized in this report are of a very practical nature, reflecting our orientation to meet the immediate needs of industry. You will also note that a significant number of projects are carried out with the physical and financial cooperation of industry.

Looking into the future, we anticipate an increasingly close working relationship with the industry through the newly-established Fish Processors' Advisory Committee and Fishermen's Advisory Committee meetings, and mutual collaboration with provincial and other federal fisheries technological units through the Canadian Atlantic Fisheries Technological Advisory Committee and the National Industrial Development Committee.

I am proud to present this summary of the activities of the Technology Branch for the two-year period beginning April 1, 1977.



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INTRODUCTION BY THE DIRECTOR

In 1924, the Fisheries Technology Laboratory was established in Halifax at the request of the fishing industry, to investigate problems associated with the utilization of fish as seafoods and other marine products. Although we have been reorganized into the Technology Branch, Fisheries Management Maritimes, service to the fishing industry is still our major role. We have now added to our team the former Industrial Development Branch, Ottawa; the Technical Services Group from Maritimes Inspection, and the Seafood Consultant. Our capability for research and development, aimed at improving the harvesting, handling, processing and marketing of fisheries resources, has thus been expanded and enhanced.

Even though the Branch deals with the commercial fishing industry, we are also responsible to the public as consumers of fishery products and to provincial governments for scientific and technical information. Cooperation and good coordination in this area is essential for effective fisheries development to take place in the Region. The Branch must also respond to the Department on national and international matters related to fish capture and utilization.

In response to the increasing technological needs of fishermen and the fishing industry, current programs emphasize:

- *the solution of commercial problems and improved communication with industry;*
- *the continuing improvement of fishing vessels, harvesting methods and equipment;*
- *more effective utilization of present landings and greater use of underutilized species;*
- *enhancing the quality and economic position of seafoods;*
- *promoting the wholesomeness, safety and nutritional value of seafoods.*

The programs of the Technology Branch are managed by the following four divisions:-

Industrial Development Division

Relocation of this group to Halifax has permitted better integration with other technological activities. Key personnel remain, however, in the other Regions to expedite programs and to insure that regional needs are properly met.

This Division has national responsibility for the development and demonstration of new and improved vessels, fishing methods and equipment, and to provide advisory and technological services related to the primary fishing industry.

Activities are related to:

- *more versatile and improved vessels and gear handling equipment;*
- *new and improved fishing methods and gear;*
- *vessel and gear modifications to improve safety, efficiency, and flexibility;*
- *harvesting and handling methods for underutilized species;*
- *electronic aids for navigation, searching, and capture of fish;*
- *cooperative projects with industry and provinces;*
- *providing technical assistance and promoting technology transfer.*

Resource Utilization Division

Under the leadership of Dr. Lloyd Regier provides industry (secondary and tertiary sectors) and government with technology and scientific information for more effective utilization of landings and improved economic returns from fishery resources.

Programs deal with:

- *preservation and storage of fish and fishery products;*
- *minimizing processing waste and improving product yield;*
- *adding value and improving processing technology;*
- *improving the image and quality of fish and shellfish products;*
- *new and improved processing and handling equipment;*
- *developing commercial uses for underutilized resources;*
- *consumer consultant services and product evaluation;*
- *technological assistance and pilot plant demonstration.*

Chemistry Division

Headed by Dr. John Uthe, the Division has a national program related to the greater use of fish as human food, emphasizing its wholesomeness, safety and nutritional value, and examining fish and shellfish as sources of commercial chemicals and by-products.

Projects involve:

- *nutrients in seafoods and labelling information;*
- *information promoting the greater use and safety of fish as food;*
- *investigating the presence of undesirable substances in fishery products;*
- *developing improved uses for fish oils;*
- *the use of fishery products in animal feeds;*
- *providing a national reference center on marine oils and seafood contaminants;*
- *underutilized resources as sources of commercial chemicals and by-products.*

Program Coordination

The overall scientific programming for the Branch is coordinated by Mr. Alan McIver who is also responsible for program planning and through liaison with industry, the Department, and outside agencies, evaluates program impact and the needs of clients.

Program Support Services

Miss Jean Rattray and her staff manage special facilities including aquaria for live-holding of fish and shellfish, refrigerated laboratories and low-temperature storage rooms; and provide in-house administrative and technical services.

With the extension of Canadian Fisheries jurisdiction to 200 miles, there is greater need for Canadian fisheries technology than ever before. In addition to the fore-mentioned programs, the Technology Branch has played an active part in the administration and direction of a major part of the Fisheries Rehabilitation Program. The particular programs carried out were:

- *Commercial pilot project for a grenadier fishery;*
- *Freezer trawler charter for silver hake, squid, argentine and shrimp;*
- *Inshore fisheries development in the Maritime Provinces;*
- *Northern fishing incentives;*
- *Offshore mackerel fishery;*
- *Gulf capelin fishery development;*
- *Vessel handling of Gulf shrimp;*
- *Inshore squid fishery development.*

The burden for the administration of these projects was shared by the Divisions listed above, with no additional staff.

E. Graham Bligh, Director
Technology Branch

BRANCH RESOURCES

1977-78

DIVISION	MY	Operating (000)	Capital (000)
Management & Support Services Director's Office	3	28	1
Property Maintenance, Aquaria Management & Technical Services Chief - I.J. Rattray	7	311	3
Industrial Development Chief - T.J. Hayes	14	932	10
Resource Utilization Chief - L.W. Regier	28	244	28
Chemistry Chief - J.F. Uthe	27	172	53
TOTAL - REGULAR	79	1687	95

Special Activities

Rehabilitation Program

Inshore Quality Enhancement	580,000
Offshore Mackerel	180,000
Freezer Trawler Feasibility Studies	800,000
	$1,560,000

A= Allotted
S= Spent

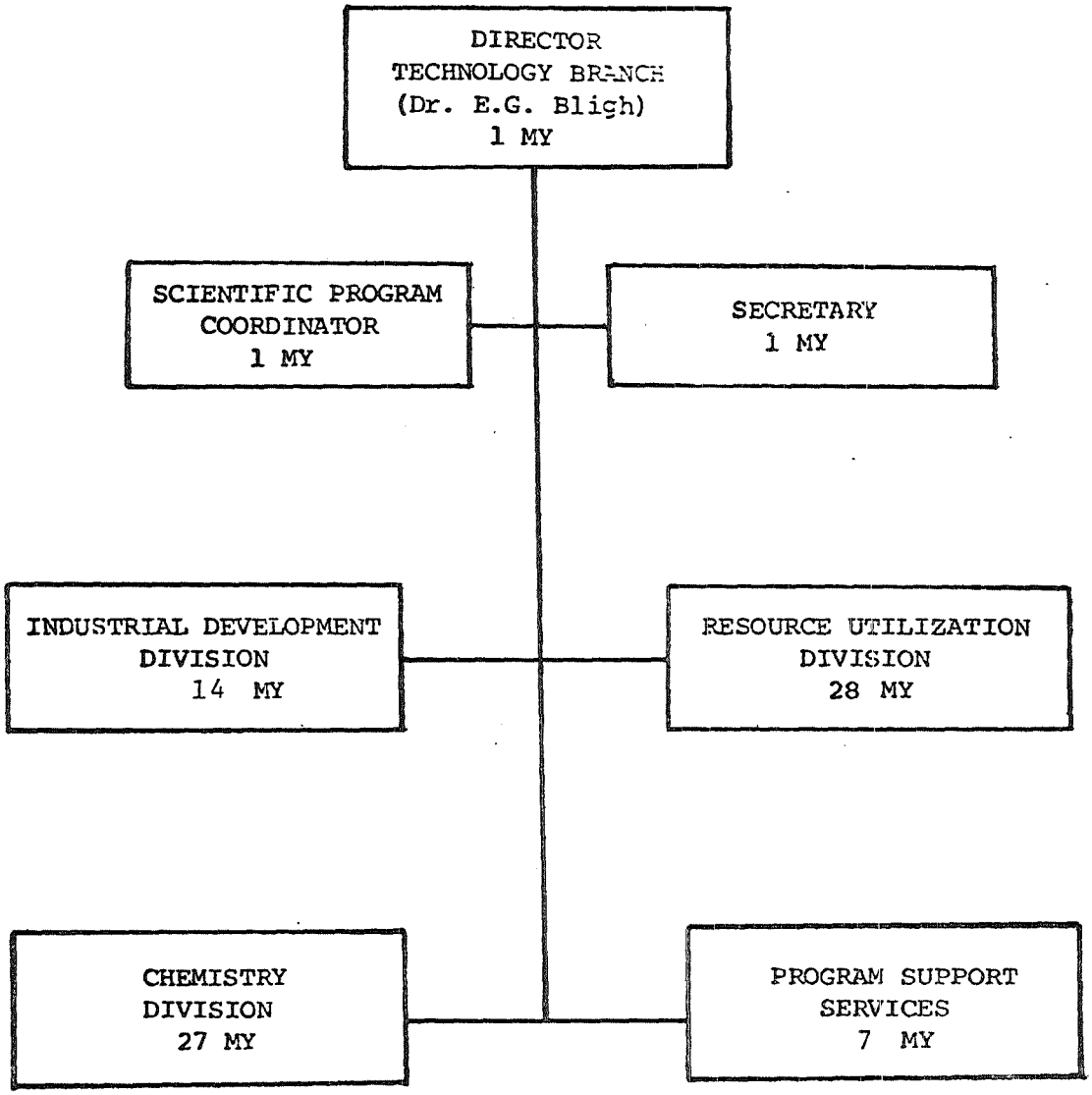
BRANCH RESOURCES

1978-79

DIVISION	MY		Salaries	Operating (000)	Total	Capital (000)
Management & Support Services	4	A	107	22		-
Director's Office		S	110	22		-
Property Maintenance, Aquaria Management & Technical Services	7	A	129	324		19
Chief - I.J. Rattray		S	120	320		13
Industrial Development	14	A	379	837	(V21)	2
Chief - T.J. Hayes		S	349	831		2
Resource Utilization	29	A	575	91		15
Chief - L.W. Regier		S	572	89		11
Chemistry	25	A	542	160		45
Chief - J.F. Uthe		S	579	155		50
	79	A	1732	1434		81
		S	1730	1417		76
Students A & S					27	
Extended Jurisdiction		A			10	(Vessel
		S			10	Charter)

Special Activities

		Operating	Grants & Contributions	Capital
Capelin	A	146	360	1
	S	85	348	1
Squid	A	70	25	5
	S	64	19	2
Shrimp	A	5	90	
	S	1	75	
Ports (Demonstration)	A	75		25
	S	57		15
Bay of Fundy Marketing Info	A	19		
	S	-		


DIRECTOR
TECHNOLOGY BRANCH
(Dr. E.G. Bligh)
1 MY
SCIENTIFIC PROGRAM
COORDINATOR
1 MY
SECRETARY
1 MY
INDUSTRIAL DEVELOPMENT
DIVISION
14 MY
RESOURCE UTILIZATION
DIVISION
28 MY
CHEMISTRY
DIVISION
27 MY
PROGRAM SUPPORT
SERVICES
7 MY

Scientific Program Coordination & Technology Transfer

The successful communication to industry and other agencies of the results of the activities of the Technology Branch is an essential part of fisheries development. Various channels were employed in relating Branch activities to the needs of fishermen, fish processors, governments and their agencies as well as the general public.

1. Fishermen

(a) In 1977-78 communication by the Technology Branch with fishermen has been primarily through demonstration fishing. Results of experiments, such as automated longlining, pair trawling, etc., are quickly communicated to the general fishing community via the media, circulars, special publications and film. Examples include "Shift to the North", a report on the results of exploratory fishing in the northern waters off Labrador and films, such as "Quality Begins Onboard" and the slide/sound program on the Technology Branch.

(b) The World Fishing Exhibition was held in Halifax, August 31-September 7, 1977 and was attended by 25,000 registered participants representing 41 countries. A fishermen's forum was organized by the Technology Branch, in conjunction with this. The program was well attended by fishermen and recent advances in fisheries technology were discussed, films shown and questions answered. The 65' multi-purpose "MV BLUE HAKE", the 93' automated longlinger "CLARA and LINDA", and the seiner/trawler "MV BRANDAL" gave demonstration cruises to interested fishermen.

(c) Technological development is a two-way process, and efforts were made to establish a Maritime Fishermen's Industrial Advisory Committee as an on-going forum for the exchange of requests and information. Since there is no single body representing the fishermen, the most successful efforts have been discussions between Technology Branch representatives and fishermen through meetings convened under the auspices of the Area Managers. Frank and meaningful discussion of technological needs, and the means of meeting them have resulted.

2. Fish Processors

(a) A Maritime Fish Processors' Advisory Committee was initiated with representation from all three Maritime Provinces. The work of the Branch was generally endorsed by the industry representatives indicating their desire to have more input into proposals and priorization of projects.

(b) Practical assistance has been given to industry through financial assistance, and in-plant technical advice.

(c) The results of the various studies on the catching and processing of fish carried out during 1977-79 by the Technology Branch are published in the Technical Report and Industry Report Series of the Fisheries and Marine Service (See Appendices I and II). In addition and of particular value to the fishing industry are the New Series Circulars: up-to-date summary

reports in layman's language on the most recent technological advances of the Branch. A by-monthly "Maritimes Technology Up-Date" was also published in 1978, highlighting the current research and activities of the Technology Branch, alerting the industry to new developments and techniques.

3. Federal and Provincial Agencies (National and Atlantic)

A Canadian Atlantic Fisheries Technological Advisory Committee (CAFTAC), comprised of Fisheries technological representatives of all Atlantic federal and provincial governments, provides a semi-annual forum for a Federal/Provincial review of all governmental Technological programs planned for the coming year, encouraging cooperation and minimizing unnecessary duplication of effort. Sub-committees of this Committee reviewed process and product technology and fleet development.

The National Industrial Development Committee is chaired by Dr. E.G. Bligh and has representation from Industrial Development groups from all the Federal Fisheries Regions across Canada. It meets twice annually to review, formulate and coordinate fisheries development projects and to provide input to the National program. It also provides a project reporting mechanism to the Directors General and advises on program priorities and budget allocation.

4. Scientific Community (other technological establishments, universities, etc.)

(a) Reporting to the scientific community, in addition to the Circulars, Technical and Industry Reports, is through publication in scientific journals, such as that of the Fisheries Research Board.

(b) The scientific community is also informed of the developments at the "Halifax Laboratory" through the presentation of papers at conferences and working committees.

The Technology Branch is an active participant in the International Commission for the Exploration of the Sea (ICES), an international forum for the discussion of the north Atlantic and its associated fisheries. Other conferences of particular note are the Canadian Institute of Food Science and Technology (CIFST) and the Atlantic Fisheries Technological Conference (AFT). The latter was held August 28-31, 1977, immediately preceding the World Fisheries Exhibition. It formed the scientific and technological focus for the exhibition, and hosted an international cast of speakers and participants.

5. General Public and Consumers

To maintain an awareness of technological development and enable the Branch to respond to the needs of the general public and consumers, an advisory service is maintained through the publishing of periodic press releases and media interviews.

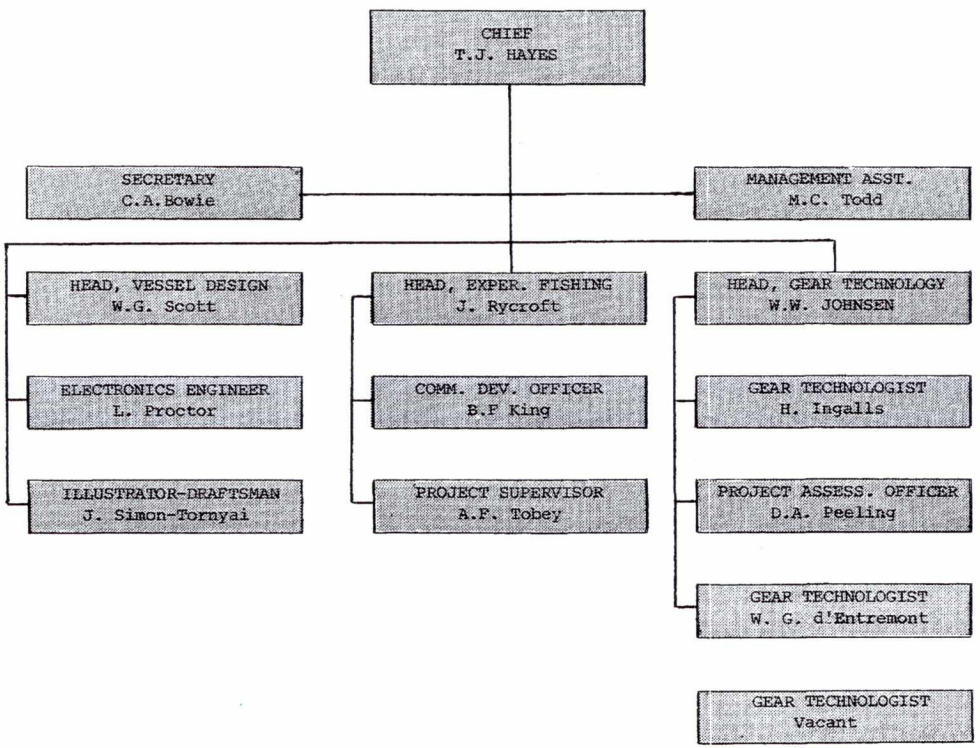
A seafood consultant on staff also responds to requests for specific information pertaining to the preparation and consumption of fish.

A 10-minute slide presentation on the activities of Technology Branch was prepared and has been extensively used in acquainting scientists, visitors and the general public with the activities of the Technology Branch in the Maritimes Region.

INDUSTRIAL DEVELOPMENT DIVISION

T. Hayes, Chief

INDUSTRIAL DEVELOPMENT DIVISION



INDUSTRIAL DEVELOPMENT DIVISION

The Technology Branch, Halifax, is the focus for the Fisheries National Industrial Development programs. Projects directed or sponsored under this and Regional Industrial Development programs across Canada are reported in an "Industrial Development Quarterly Review". A national committee, which plans, selects and manages the projects, meets twice annually. This program is responsible to the Assistant Deputy Minister and the National Directors General's Committee.

During 1977/78, the Division was directed by the Branch Director, Dr. E. G. Bligh. In May 1978 a suitable candidate, Mr. T. Hayes, was appointed. During the period 1976-May 1978, in spite of adjustment to the new work location, etc. considerable progress was made by the group. The responsibilities of the Division fall under the following headings:

The Demonstration Fishing Section (J. Rycroft, Head) is primarily concerned with the demonstration of new and improved fishing techniques and the development of non-traditional fishing grounds and fishing techniques for non-traditional fish species such as grenadiers and argentines.

The Fishing Electronics and Instrumentation Section (L. Proctor) is primarily concerned with the development of appropriate electronics for improving the location of fish relative to the fishing vessel, gear design and the catching ability of vessels.

The Fishing Vessel Development Section (W. Scott) gives naval architectural support to the other sections in gear placement and hull selection for developmental fisheries. New designs and fishing concepts are explored and their suitability to Canadian vessel development assessed.

The Fishing Gear Development Section (W. Johnsen) provides technical advice to the design of deck layout for specialized or multi-purpose fishing and in the development of new fisheries and new fishing techniques.

PROJECT SUMMARIES

INDUSTRIAL DEVELOPMENT DIVISION

(List of Contents)

Midwater Trawling For Shrimp - J. Rycroft

Bottom trawling for shrimp in the Gulf of St. Lawrence has been inefficient; requiring long trips and resulting in large by-catches of small redfish. The objective of this project was to refine the equipment and techniques of catching shrimp by means of pelagic and semi-pelagic trawls to permit vessels to fish during the hours of darkness and at other times when the shrimp migrate from the bottom and to reduce the catch of immature redfish.

As a result of work carried out in 1977 midwater shrimp trawling shows great promise for the harvesting of pink shrimp. By using a tickler chain system on the midwater trawl, sizable catches could be made both day and night, effectively doubling a fishermans catch during the normal length of trip. Also the shrimp caught are of a much larger size compared to shrimp from ground trawlers, resulting in a higher quality being landed.

In 1978 fishing trials were completed at the end of September with commercial grounds in the Canso, Louisbourg, North Anticosti and Sept-Isles areas fished during the charter period. Tows of up to 2,500 lb of pink shrimp with insignificant by-catches of small redfish have been realized with the newly designed shrimp midwater trawl. There was a high degree of collaboration in this project with provincial fisheries in the Atlantic region. A report has been published of the work in 1977 and is in preparation on the 1978 studies.

Shrimp Beam Trawl - J. Rycroft, W. Scott

It was decided to introduce a modified Dutch beam trawling method to the Gulf of St. Lawrence shrimp fishery since there are indications this method may also reduce the by-catch of juvenile fish.

British Columbia type beam trawls were used initially. Following fishing trials, these required considerable modification to suit Gulf bottom peculiarities. Catches were comparable to those of similar vessels (65-85 ft.) which used conventional bottom trawls. However, there was a considerable saving on fuel as beam trawls require less towing power.

Hydraulic Rope Reel Project

Since seining was introduced to Scotland, the handling of ropes has been one of the most labour intensive aspects of the technique. To overcome this problem a method was subsequently introduced which utilized hydraulic rope reels. With this modern method in mind, the Industrial Development Division embarked on a project to introduce hydraulic rope reels to Atlantic Canada.

Hydraulic rope reels have many advantages over conventional methods of handling ropes such as: a) they are fully automatic, no kinks or foul ropes while shooting which contributes to crew safety, b) twenty-five per cent less wear on ropes than traditional method, c) additional fishroom space and it also enables the boat to work in ice conditions. The chartered vessel spent many days of demonstration to the fishing industry to see the reels under working conditions and as a result skippers and shipbuilders have been very impressed. It is understood that there has been a number of serious enquiries from existing boat owners and skippers in the process of building new vessels. Owing to the wide range of vessel size and capacity of rope required by individual skippers, reels are manufactured in various sizes to each owners requirement.

Electrical Stimulation of Scallops and Fin Fish - L. Proctor

It was considered desirable a) to determine whether electrical stimulation could be used in conjunction with a lighter drag to harvest scallops (Placopecten magellanicus) thereby increasing the catch and minimizing the high incidental damage to scallops left in the path of the drag, and (b) to determine the effectiveness of electrical stimulation in the harvesting of lake trout.

The primary purpose of the construction of this equipment was to determine its effectiveness on scallop. The experiments were carried out with scallops in a test tank. The animals responded in a random manner, with some rising, some shooting sideways, and others just spinning. The rise was a few centimeters only and was considered insufficient to warrant construction of equipment for sea trials.

An additional use of the equipment was found in the creation of a barrier field to allow trout to be herded. The experiments showed that trout were stimulated and would move ahead of an electrical fence. Trials are planned in trout lakes.

Fleet Development - Vessel Design and Conversions Stability Studies - W.G. Scott

The purpose of this project is to produce in concert with the Provinces, consultants and industry conceptual designs for new fishing vessels and their systems, and to conduct stability and design studies to ensure adequacy and safety of vessel alterations.

Under a shared cost project with the Province of Nova Scotia 52' 6" steel vessel is well under construction. The project is on schedule with excellent steel workmanship. Delivery is expected by the end of 1978.

Several conversions, stability and design analyses are in progress:

(a) Marie France - rope reel installation;

(b) Standard 65' vessel - chilled seawater installation;

(c) Assessment of 42' vessel for seining;

(d) New Brunswick 72' vessel - onboard shrimp processing line;

(e) Stability of standard 58' Newfoundland longlining vessel to adapt to the autoline system(with Newfoundland Regional Industrial Development)

(f) Proposal under review to develop designs for Fundy and other regional herring food fishermen, a 55-60 day boat and a 70-80, 4-5 day boat.

Rope-Wing Trawl -

Continued development of a trawl employing ropes in lieu of twine meshes in the forward sections for increased efficiency and fuel economy.

The Atlantic Western ICR bottom trawl has undergone initial fishing trials aboard MV "Brandal", with a two hour tow yielding 40,000 lb. of pollock, haddock, cod and flounder. Indications are that this trawl may become the world's first successful rope wing bottom trawl.

Mechanized Longlining

Demonstration of mechanized longlining to the Canadian fishing industry for reduced labor costs.

The conversion of the 93' MV "CLARA and LINDA" from manual to automated longlining using the Mustad Autoline System has been successfully completed. Sea trials have demonstrated the effectiveness of the system with 80,000 hooks being fished, however, in spite of the technical success of the gear and good catches, continued development is desirable to develop the full potential of the system.

52'-6" Steel Vessel (Shared Cost with Owner & N.S. Fisheries) - W. Scott

The vessel was delivered toward the end of March and following some (expected) work up trials is now commercially fishing with reported success. Arrangements are in hand to (i) compile a report on the design and construction and to ready the drawings for issuance to interested parties, (ii) initiate a documentary arrangement whereby the data on commercial fishing performance, including costs and earnings, will be recorded for analysis.

Technical Information System for Fishing Vessels - W. Scott

The Branch was assisted by the Nova Scotia Research Foundation in the development of a design for a technical information system and it is hoped that work to accumulate data for this can be carried out this year.

Demonstration Fishing for Sandlaunce

Harvesting this species on a continuous basis would provide a new source of raw material for Canadian (Atlantic) based fish meal plants and other industrial outlets.

This project suffered a great deal owing to constant engine breakdowns on the vessel "BICKERTON PRIDE". The largest catch was approximately 180,000 lbs of sandlaunce. It is considered that a restricted summer fishery would be possible to utilize this species for fishmeal. A great deal of time was spent searching for sandlaunce concentrations and obviously this would be reduced considerably if perhaps ten vessels were used in a "fleet" operation.

Squid Purse Seine - Canso Area, Nova Scotia

The goal of the project was to develop the inshore fishery for squid by the purse seine method during periods when they can not be caught by jigging.

In response to requests in the Canso area, a 42' Cape Island vessel was rigged with a 150 x 15 fathom purse seine mast, boom, winch and power block in an attempt to catch squid. However, due to a late start squid were no longer in the area this season. The gear works well and catches of up to twenty tons of mackerel were realized. Four similar nets have been ordered by other fishermen in the community, impressed with the results.

Stern Drum Seine (Lampara) - Glace Bay, Nova Scotia

The objective of the project was to introduce to a 44 ft. Cape Island boat, a lampara type seine rigged to catch herring, mackerel, capelin and squid. A lampara sine differs from conventional purse seines in as much as the bunt is in the center of the net and large meshes are employed in the wings. The net is set around fish and towed closed, the movement of the wings leading the fish into the bunt. The deck machinery consists of dual reels. The net wings ar are simultaneously hauled into separate reels and the bunt or bag is subsequently lifted on board in the same way as a trawl. Sonar is being installed to aid in fish location.

Capelin Fishery Development

A project is being organized to develop a viable capelin roe fishery combined with a fish meal operation, by developing off-shore catching capability by supporting construction of seines and by introducing to the small boat fishery the technique of pair midwater trawling.

The small boat technique has been introduced and completed successfully. Fishing operations are expected to begin at the start of the 1979 season. Assistance has alo been given to three larger seiners in New Brunswick for the construction of capelin seines to be used next season.

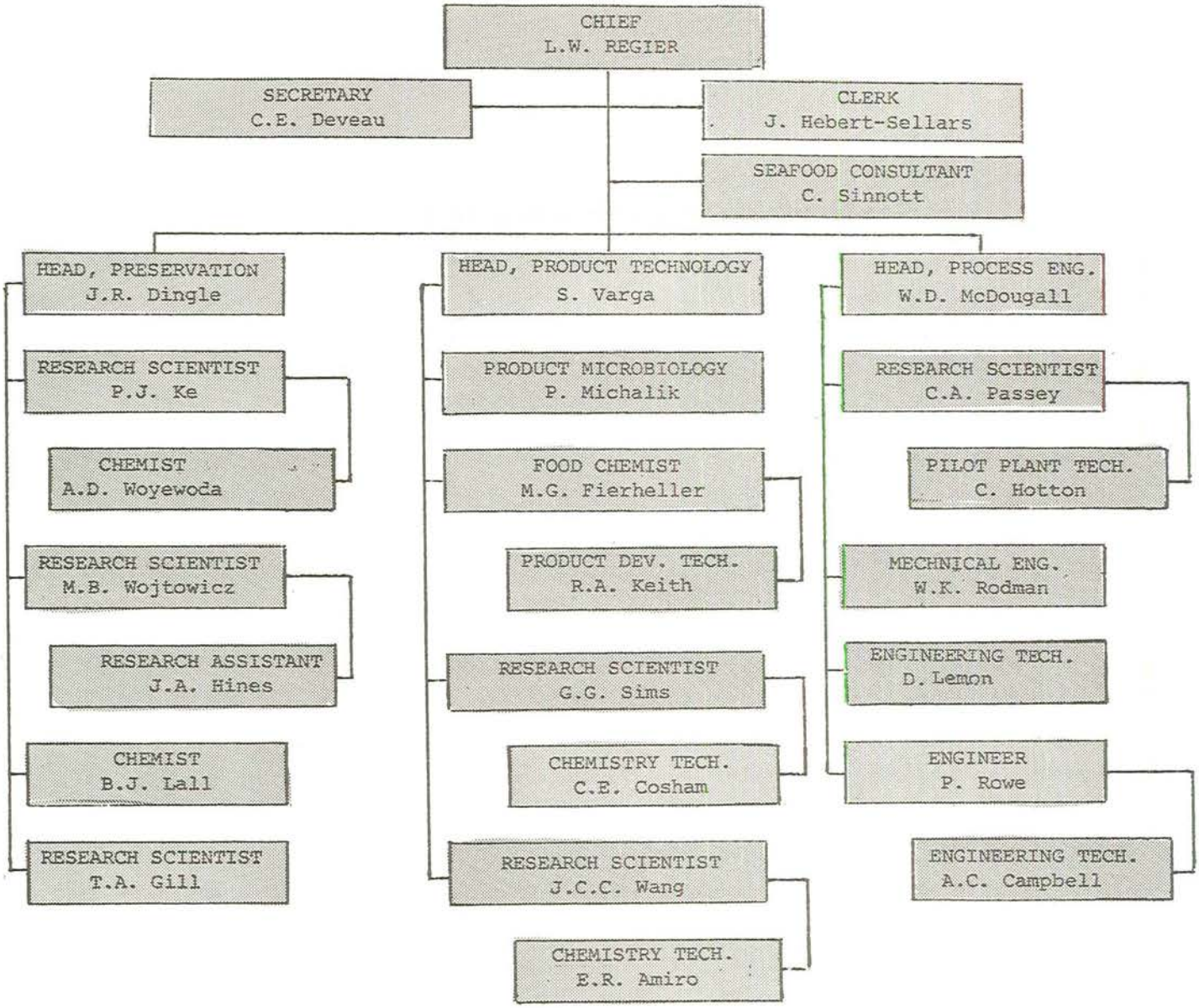
Safety Aboard Film

A twenty minute safety film to encourage safe fishing practices on board fishing vessels was co-sponsored with the Nova Scotia Fisheries Department. This film is now available through various agencies including the Fisheries Information Branch, Box 550, Halifax. The film has received an international award.

RESOURCE UTILIZATION DIVISION

L. W. Regier, Chief

RESOURCE UTILIZATION DIVISION



RESOURCE UTILIZATION DIVISION

The Resource Utilization Division provides the secondary and tertiary sectors of the fishing industry and government with scientific and technological information for more effective utilization of landings and to improve the economic returns from fishery resources. The activities cover a broad range of the spectrum that is research and development.

The Preservation Biochemistry Section primarily is concerned with the protein and lipid chemistry in fish and minced fish as related to methods of separation and preservation.

The Product Technology Section has special concern with product and process problems of current products and underutilized species and raw materials. Microbiological as well as chemical, physical and organoleptic factors are studied in laboratories and pilot plant.

The Process Engineering Section is involved in laboratory and pilot plant investigations on process and equipment development. Also development projects in industry are initiated,supported and monitored by this section.

The Seafoods Consultant provides service to consumers and is involved in promoting the increased use of fishery products in the food service industry. The consultant is also involved in organoleptic evaluation problems of the other sections.

RESOURCE UTILIZATION DIVISION (List of Contents)

The Frozen Storage Stability of Some Species of Marine Fish - J.R. Dingle

Investigation of the possible loss of protein quality due to formation of formaldehyde and the effect of lowering storage temperature on the rate of quality loss.

Argentine did not produce formaldehyde, and the minced flesh was stable over 35 days at 0°C.

Roundnose grenadier did produce formaldehyde and the minced flesh deteriorated fairly rapidly when stored at -10°C.

Cusk produced formaldehyde at a moderately rapid rate, and about twice as fast in mince as in intact fillets. The rate of deterioration of minced cusk decreased with decrease in temperature in a regular fashion. The rate of formation of formaldehyde and deterioration of quality at -17°C was only about one-third the rates at -10°; at -30°C no loss of protein solubility was detected in mince after 3.5 months.

Carefully handled redhake, gutted and stored in ice produced very little formaldehyde and showed no loss of protein solubility during 3-4 days after killing. Thereafter formaldehyde was produced but at a slower rate than had been found in commercially handled fish. Loss of protein solubility was much less than previously found for commercial fish and probably occurred mostly in the brown muscle. These results may reflect lack of tissue damage such as is caused by rough commercial handling.

Study of Possible Control Methods for Minimizing Deteriorative Changes Found in Various Fish Species - J. R. Dingle

Sodium bisulfite, at concentrationsup to 0.5% was tested as a possible sequesterant for formaldehyde to prevent deterioration of red hake at -10°C. Loss of protein solubility was retarded for about 3 days at an optium bisulfite concentration of 0.1%, but the treatment was totally ineffective over a longer time at any level. In fact, bisulphite strongly accelerated the formation of formaldehyde, but was able for a short time to sequester it before being overwhelmed.

Polyphosphate Treatment of Scallops - J.R. Dingle, B. Lall

The project was requested by the Fisheries Council of Canada, to determine if there is any advantage in the use of polyphosphate, and if so, to provide data satisfactory to the regulatory authorities.

Work on individually frozen unglazed scallop meats has not shown any difference in thaw-drip or cooking loss (boil-bag) between controls and meats containing not more than 0.5% tripolyphosphate.

Purificaton of TMAO-ase - T. Gill, R. Keith

The objective of this study is to isolate and purify the source of post mortem accumulations of dimethylamine (DMA) and formaldehyde (HCHO) in the tissues of Atlantic cod.

The material (presumed to be an enzyme) is bound to the insoluble portion of cod kidney homogenates but has been successfully solubilized in active form in the presence of the anionic detergent sodium dodecyl sulfate (SDS). SDS treatment at the 0.2% level resulted in activition of formaldehyde production by a factor of 2, suggesting that the activity is due to a membrane-bound enzyme with approximately 50% of its active sites occluded by membrane material *in vivo*. The enzyme is relatively stable at 20°C when stabilized with the antimicrobial agent sodium azide but rapidly deteriorates if not stabilized. It has a molecular weight larger than 300,000 daltons in detergent solution and has been partially purified by detergent gel filtraton. Present work involves the detergent removal and further purification with affinity and ion exchange chromatography.

Investigation of Fish Muscle Texture - T. Gill, R. Keith

The objective of this study is to develop reliable methods for the objective and subjective evaluation of fish texture as related to the chemical changes observed in species containing high levels of DMA-HCHO- producing material.

Progress to date includes the development of both objective and subjective means of fish texture evaluation. An experiment is nearly completed in which the chemical deterioration of frozen stored hake is being monitored by textural and chemical evaluation and compared with a control fish - frozen stored haddock. An electrophoretic method has been developed and used to monitor the molecular changes in the myofibrillar proteins as a result of HCHO formation. Work is continuing.

Rancidity Studies and Frozen Quality Preservation of Fatty Fish - P.J. Ke
A. Woyewoda

The studies have several objectives. The development and application of methods of defining the mechanism and characteristics of rancidity development in fatty fish; the development of information and data from which industry can select and apply processing and storage procedures to give maximum shelf life and quality to the consumer product and the development of analytical methods which are suitable for industrial quality control.

By modifying the Warburg apparatus a direct and simple technique for measuring the reaction rate of lipid oxidation has been designed. The reaction rate determined is comparable with that determined by other time-consuming procedures, but only 200 mg of sample is required to give most of the kinetic data in the whole course of lipid oxidation.

The kinetic characteristics and activation energy of oxidation of some monoenes and polyenes such as 18:4, 20:5 and 20:6 have been measured and determined. After mathematical treatment an empirical model system may be constructed for predicting the rate of oxidation for some marine fat products. Work is complete and a paper is in preparation.

A number of synthetic and natural antioxidants have been investigated for effectiveness using a rapid model oxidation system. Tertiary butyl hydroguinone

(TBHQ) has been shown to be the best antioxidant for preventing oxidation in marine oils by comparison with others. Investigations to improve the frozen storage quality of minced fatty fish have been studied using Atlantic mackerel which is highly susceptible to rancidity. The storage life of minced mackerel meat held at -18°C (0°F) can be extended to more than a year when vacuum-packaged in a plastic/aluminum foil pouch that is impermeable to oxygen. This is in sharp contrast to a storage life of only 2 weeks at -18°C (home freezer) and 6 weeks at -18°C with the most effective antioxidant (TBHQ) present, using ordinary non-vacuum packaging.

An improved meta-cresol purple (MCP) titrimetric method for determining the content of free fatty acids (FFA) has been developed. By using a multiple solvent system prepared from Bligh & Dyer's lipid-chloroform extract with iso-propanol and methanol, this procedure can be directly applied to various fish and fish products without completion of the time-consuming lipid extraction process. Work was complete and a paper on the method published in 1978.

Micro-determination of thiobarbituric acid (TBA) value by a rapid and direct method incorporating TCA and sulfite reagents has been developed. The described procedure has several advantages such as greater reproducibility, smaller sample size (20 mg) and superior miscibility and separation of the solvent systems and can be used for various unpurified and colored oil samples with an error less than 5%. Work is completed and a paper has been submitted for publication.

Squid Technology Program - P.J. Ke, A. Woyewoda

The goal of this program was to become familiar with the quality and processing characteristics of the species Illex illecebrosus, an underutilized resource in Atlantic coast waters.

Storage life trials were carried out (0° to 2°C) with accompanying chemical analyses of total volatile base, trimethylamine and free fatty acid (FFA) content of squid mantles as well as liver FFA. Samples were frozen periodically during the experiment for later taste panel correlation with chemical data. Mantle texture was evaluated with the Instron Universal Testing Instrument.

Hot water skinning of squid mantles and tentacles resulted in a partially cooked product (18-20% weight loss) which would be adaptable to further processing. Mechanical skinning of split squid mantles by a Trio fish skinning machine proved to be a satisfactory process and resulted in a 10 to 20% weight loss. Squid mantles dried after either hot water or mechanical skinning were not visually distinguishable. Drying trials to determine rates of drying and effects of chemical and physical treatments on color, rehydration characteristics and susceptibility to browning are underway.

Production and Characterization of Salt Minced Fish - B. Woytowicz

The project requires the collection of information the chemical changes during storage to select and establish quality criteria for salt minced fish (SMF); improvement of the previously elaborated production technique and application of it, modified if required, to a wider range of raw materials including under used species and filleting wastes.

Minced cod, argentine and herring have been studied to date. A satisfactory product has been made from minced cod fillets but other species especially the fatty ones, have presented difficulties. The use of low cost raw materials (flesh separated from fish frames) was tested on a pilot plant scale and the stability of the product is being investigated. A detailed investigation of the production process for such species as silver hake, argentine, and herring is underway.

Non-protein nitrogen, dimethyl amine, ammonia, peptides, tyrosine value and products of non-enzymic browning reaction all increase in SMF during ripening and storage. The rates depend on storage conditions and on the degree of brine saturation and temperature during salting. Data on the swelling and water holding capacity of the final product were collected to establish quality criteria for SMF. It was found that the addition of the antioxidant BHT and sodium sulfite and the use of air-tight packaging gave an extended shelf life to salt minced whiting stored at 35°C.

Factors (temperature, pH, salt concentration, etc.) limiting the activity of some enzymes in salted fish were studied. In most cases high salt concentrations suppressed enzyme activity but not proteolytic enzymes. Activity depends on the species and on completeness of evisceration before mincing Lipase (e.g. in herring) is normally active during pickling but is inactive below pH 5.

A previously (1977) proposed procedure for washing minced flesh (separated from "frames" and "V-cuts") at modified pH before salting was tested on laboratory and pilot plant scales. Both chemical analysis and organoleptic testing of salted products stored up to 8 months at 5°, 20° and 35°C) indicated improvement of quality and promising stability of salt minced fish produced from raw materials discarded after filleting fish.

An associated study on activity of fish enzymes during washing at different pH's, indicates that at lower pH values acid proteases (cathepsins) are strongly activated and remain in the washed fish solids, causing accelerated spoilage (proteolysis). Minced fish washed at low pH should be immediately frozen or salted.

The Quality of Salted Herring Produced in Wooden and Plastic Barrels - S. Varga, P. Michalik & T. Gill

The recent introduction of polyethylene barrels for the processing of pickeled herring gave rise to some complaints that lower quality herring were produced when compared to herring cured in conventional wooden barrels. A study requested by the fishing industry was carried out to test the validity of these complaints.

Samples from lots of herring salted in plastic and wooden barrels stored at 1°C and 10°C were periodically withdrawn and examined for eating quality, chemical and microbiological characteristics. No detectable differences were found in the quality of herring cured in plastic or wooden barrels held at the same temperature. Samples from barrels stored at 1°C had a significantly longer storage life and were of better qualty than those stored at 10°C.

Assessment of High Temperature Plate Count Method to Determine the Bacteriological Quality of Soft Shelled Clams - S. Varga, R. Dobson, R. Earle

In shellfish depuration studies it is important to have knowledge of the bacteriological loading of the shellstock being harvested and early knowledge of initial loading on a lot by lot basis. The bacteriological techniques presently used requie 48 hrs to establish the initial bacterial loading. The Elevated Temperature Coliform Plate Count (ETCPC) technique of Hefferman and Cabelli, 1967, allows determination of bacterial loading within 24 hrs. It was recommended that the relative performance of the ETPC and standard MPN methods be verified.

The ETPC method was found to under estimate,by about 10%,the densities of faecal coliforms found by the standard MPN procedure. Hence, the faecal coliform standard used in the assessment of the sanitary quality of clams would require adjustment when using the ETPC procedure. The work has been incorporated in a paper published in 1977 in the Journal of Food Protection.

Growth and Control of Halophilic Micro-organisms in Salt Minced Fish - S. Varga G.G. Sims, P. Michalik

The objective of this study was to examine the biological stability of salted minced fish. The results of investigaton have shown that the nature of processing of salted minced fish can be such that the product may be practically free of halophilic microorganisms. As a consequence, salted minced fish may be shelf stable at high storage temperatures (35-40°C). However, when the product is contaminated with red bacteria, it spoils faster than the traditional salt fish under the same storage conditions.

It has alo been shown, that incorporating 0.3% of sorbic acid into the curing salt will result in a biologically stable product at ambient storage temperatures. The concentration of sorbic acid residue in the freshened product was about 0.1% which is lower than allowed in many other foods.

If the product is to be preserved by drying,the moisture content must be reduced to 20-22% to protect the product against the growth of salt tolerant organisms.

"Vacuum" Preservation of Fresh Fish - S. Varga, P. Michalik, R. Keith, L. Regier

At the request of the Maritime Fish Processing industry tests of fish held under "hypobaric" conditions were conducted to determine if this method of storage would extend the shelf life of fish similar to that of fruits and vegetables for which the technique was developed."Hypobaric" storage is a procedure where food is held in a chamber at controlled low temperatures and the atmosphere held at reduced pressure and saturated with water vapour is continuously vented from the chamber.

Groups of fish held under these conditions at 30, 31 and 32°F were sampled at intervals and assessed for eating quality and the rate of protein and lipid deterioration. The results have shown that the degradation of protein and especially of lipids was slowed and the rate of change of eating quality and the growth of microflora retarded. Fifteen trials on lean and fatty fish have been completed. The method extended the storage life of lean fish by 30-40% and the storage life of herring 50-100%. The economic usefulness of the procedure will have to be determined.

The Effect of EDTA on the Storage Life of Commerciall Treated Wet Fish Fillets - S. Varga, G.G. Sims, P. Michalik, C. Sinnot, L. Regier, N. Peacock

The fish processing industry has expressed a desire for the availability of an additive which would extend the shelflife of wet fish fillets intended for distant markets. Earlier laboratory trials have shown that ethylenediamine tetraacetic acid (EDTA) was useful for this purpose and a study was undertaken to confirm this finding under commercial condtions.

In a joint study with National Sea Products Ltd., 100 lb lots of untreated (control) fillets and fillets treated with a solution of Na_2HEDTA in a tumbler mixer, were placed in 10 lb polyethylene plastic boxes which were placed in 100 lb plastic lined master containers and generously iced. The containers were shipped and held under commercial storage conditions at 30-40°C until spoiled. The stored fillets were sampled at regular intervals, analysed for EDTA residue, TMA nitrogen and total volatile base and examined for organoleptic and microbiological quality.

It was found that wet fish fillets taken from 3-4 day old iced and gutted fish and treated with Na_2H EDTA to a mean residue level of 300 ($\pm$100 ppm) under commercial conditions had an average of a 45% longer storage life than untreated fillets stored under the same conditions. The treatment of wet fish fillets to give a 300 ppm EDTA residue with $\pm$100 ppm range is possible with existing procedures.

Mechanical Deshelling of Molted and Unmolted Specimens of Atlantic Snow Crab, *Chionoecetes opilio* - G. G. Sims, C. Cosham, W. Anderson

This project was designed to assess the suitability of Atlantic Snow (queen) crab for mechanical deshelling operations and to compare the meat yield from molted and unmolted specimens.

The percentage yields of various components of these specimens and of various minced meats (from a Baader 694 mechanical separator) were determined. The total recovered meats from the molted and unmolted specimens (using a combination of hand and mechanical operations were 42% and 35% respectively. The mechanically deshelled snow crab meats were acceptable to the taste panel and the undesirable solid contents were substantially lower than recommended tolerance limits. Proximate composition of these meats were also established.

A Simple and Rapid Procedure for the Determination of Total Blood Pigments in Fish Muscle - J. C. C. Wang

The amount of hemoprotein in fish products is a primary quality factor. The limitations of most of the reported procedures for the quantitative determination of heme compounds are the frequently found turbidity in the extract and the amount of residual heme compounds left in the muscle tissue. It was thus desirable to develop an improved analytical procedure for the quantitative determination of total heme content in fish muscle.

A simple and rapid method using a mixture of acetone, water and hydrochloric acid as a solvent to extract and measure heme pigment has been developed. The acetone/water (hydrochloric acid ratio was shown to be critical; maximum extraction being obtained with a ratio of 80:18:2(v/v), due allowance being made for the moisture present in fish muscle. This work has been completed and the result is being prepared for publication.

The Development of Rancidity in Cooked Breaded Mussels - J.C.C. Wang

Assistance was requested by the Resource Development Division, Nova Scotia Department of Fisheries to help investigate the problem of rancidity development in individual quick frozen (IQF) precooked breaded and battered mussel meats.

The quality deterioration of IQF mussel meat and its breaded and battered product was characterized as "stale" or "rancid fish" off odour. The extent of fat oxidation taking place in the product as measured by the thiobarbituric (TBA) test and organoleptic score gave the products a rather short storage life. The maximum period during which the mussels can be stored appears to be about 3 to 4 months. A rise in TBA value was observed for the cooking oil used in the preparation of the product but not the batter and breading. A negligible TBA value was detected in mussel juice. The development of rancidity in IQF breaded and battered muscle meat appears to be derived mainly from the frying oil employed but is slower than in the raw muscle.

Experimental Canning of Atlantic Snow (Queen) Crab - A.B. Dewar, G.G. Sims

In response to a request from industry, arising from excessive smut formation in their canned queen crab product, several treatment groups were canned at the Halifax Laboratory. The main objective is to make comparisons between the traditionally used can and a "new" drawn can which also has a different protective lacquer. As this "new" can is also different in size, some of the canning specificatons are also being checked (i.e. heat penetration, drained weights). The first withdrawal of sample has been examined and three further examinations are scheduled.

Salt, Sugar and Fat Migration in Cured Herring - G.G. Sims, S. Varga, C. Cosham

The purpose of the study is to establish the penetration rates of the active curing agents and to monitor changes in the proximate composition of sugar cured and salt cured herring during storage.

The penetration rates of salt and sugar into sugar and salt cured herring are being established. Any migration of fat out of the fish is also being estimated. During the storage of these samples, peroxide values, free fatty acid content and proximate composition changes are being determined. Seven samplings have been made and it is expected the next sampling will be the final one.

Promotion of Seafood - C. Sinnott

It has been an objective to promote the utilization of seafood by providing information on all areas related to seafood cookery, buying, storing, recipes, serving suggestions, etc. to key groups such as the food service industry, consumers, retailers and schools.

Three seafood seminars, held in Truro, Sydney and Kentville, have been presented to food service industry personnel. Topics covered in the seminars include quality recognition and maintenance, buying and storing through to cookery and garnishing.

Promotion of Seafood - C. Sinnott (continued)

A seafood reception featuring Maritime products was held in New York for the food service industry and retail trade. Home economists from the federal and provincial departments of fisheries attended.

Seafood was promoted to consumers through various articles on the subject which have appeared in local newspapers and magazines. Six radio interviews have been done with various stations and a half hour television show for ATV on conversion to metric measure.

Talks on seafood cookery and on sensory quality evaluation were presented to Acadia and Mount Saint Vincent Universities respectively.

Convenience Food Catering For Vessels - C. Sinnott, L. Proctor

A study was undertaken to determine the acceptability of planned convenience food menus based on foods currently servied on board "CGS Cygnus".

An eight day lunch and dinner convenience food menu was drawn up by staff of Foremost Foods, Inc. under contract to the Technology Branch with participation by the Consumer Consultant for the trial period February 26 to March 6, 1977.

Individual evaluations obtained from the crew indicated that convenience food provisioning is feasible. Advantages are lower food costs, better inventory control, reduction in storage space requirements, less spoilage and wastage and the capability of producing full course meals regardless of weather conditions. Three follow-up demonstration luncheons, for interested owners of small vessels were held in Halifax, Grand Falls, Nfld. and St. John, New Brunswick.

Development of a Scallop Shucking Machine - W.D. McDougall, K. Rodman, W. Gionet

The purpose of this project is to design and construct a prototype commercial scale scallop shucking machine based on earlier experimental work carried out by this laboratory and to test the machine under laboratory and commercial scale conditions. The development of a successful shucking machine would offer industry an alternative to hand shucking.

The test results of the prototype laboratory scale machine demonstrated that the mechanical shucking techniques being developed were feasible, but further design changes and testing were required for commercial demonstration and utilization. A new and improved clamping device with commercial scale loading rate capability was designed and built. Subsequently the machine was completely redesigned and is presently in the final stages of construction.

Scallop Washing and Chilling Aboard Vessel - W. McDougall, K. Rodman

It is desired to improve the washing and chilling of scallops aboard the vessel with a view to improving the landed quality, especially reduction of the sand content and thus to increase the earnings of vessel, crew and plants.

Two washes were built by Atlantic Bridge Co. of Lunenburg, N.S. to Technology Branch specifications, one manual and the other mechanically operated. The manually operated washer required the hand-dumping of each shucking basket (30 lb) into the washer basket which was then manually shaken

a few times, and subsequently dumped into a chilling tank.

The rotating drum type mechanical washer has an integral internal helix which effects the continuous discharge of washed meats into the chill tank. This machine requires manual loading only. Wash water is sprayed onto the meats as they are conveyed to the chiller. The performance of the drum type washer has been very satisfactory and is being used commercially.

The manual washer failed to provide adequate washing due mainly to the manual effort required.

Mechanization of Herring Bloater Production - W. McDougall, R. Davis, P. Rowe

This study is designed to increase the profitability of this traditional product by the use of a mechanical tunnel type smoker dryer to decrease drying time, improve drying and handling techniques and product quality.

A pilot scale smoker dryer has been built and is in operation. Several batches of traditional cure type bloaters have been successfully produced with an overall reduction in drying time from about 6 to 8 weeks for the conventional natural draft smoke house to about 2 weeks for the wind tunnel dryer. A report including some indication of operating costs is being prepared.

Salt Fish Drying Coordinated Heat Pump System - C. Passey

This project is a demonstration to industry of energy savings and increased productivity in salt fish drying through modification of conventional salt fish dryers by means of a proprietary coordinated Heat Pump System.

The system has demonstrated improved drying efficiency over systems currently in use. Enhanced product quality and productivity are also achieved.

The Technology Branch pilot plant fish dryer was modified to demonstrate the coordinated heat pump system. This dryer has been in operation since September 1977 and a variety of fish products have been successfully dried. The outside weather has ranged from sunny and cool, rainy and foggy, to snow and freezing rain. None of these weather conditions adversely affected the performance of the dryer system.

Caustic Skinning of Tuna and Mackerel - D. Lemon, R. Davis, K. Rodman

Caustic skinning of tuna would substantially reduce the hand labor in tuna processing plants and has a potential for increasing yield. Removing the skin from mackerel would provide a more uniform and visually appealing pack.

Laboratory experiments have confirmed the ability of hot caustic solutions to skin tuna and mackerel and led to the development of a continuous processing unit in which hot caustic may be sprayed on the fish. The caustic skinning machine was modified by laboratory personnel to provide for improved temperature control and caustic solution flow.

In a cost shared project with the Province of Nova Scotia, testing of the machine was carried out in a tuna processing plant. Foaming of the caustic solution has presented operating problems. Anti-foaming agents are being investigated.

Development of New Product Forms of Salt Minced Fish - C. Passey

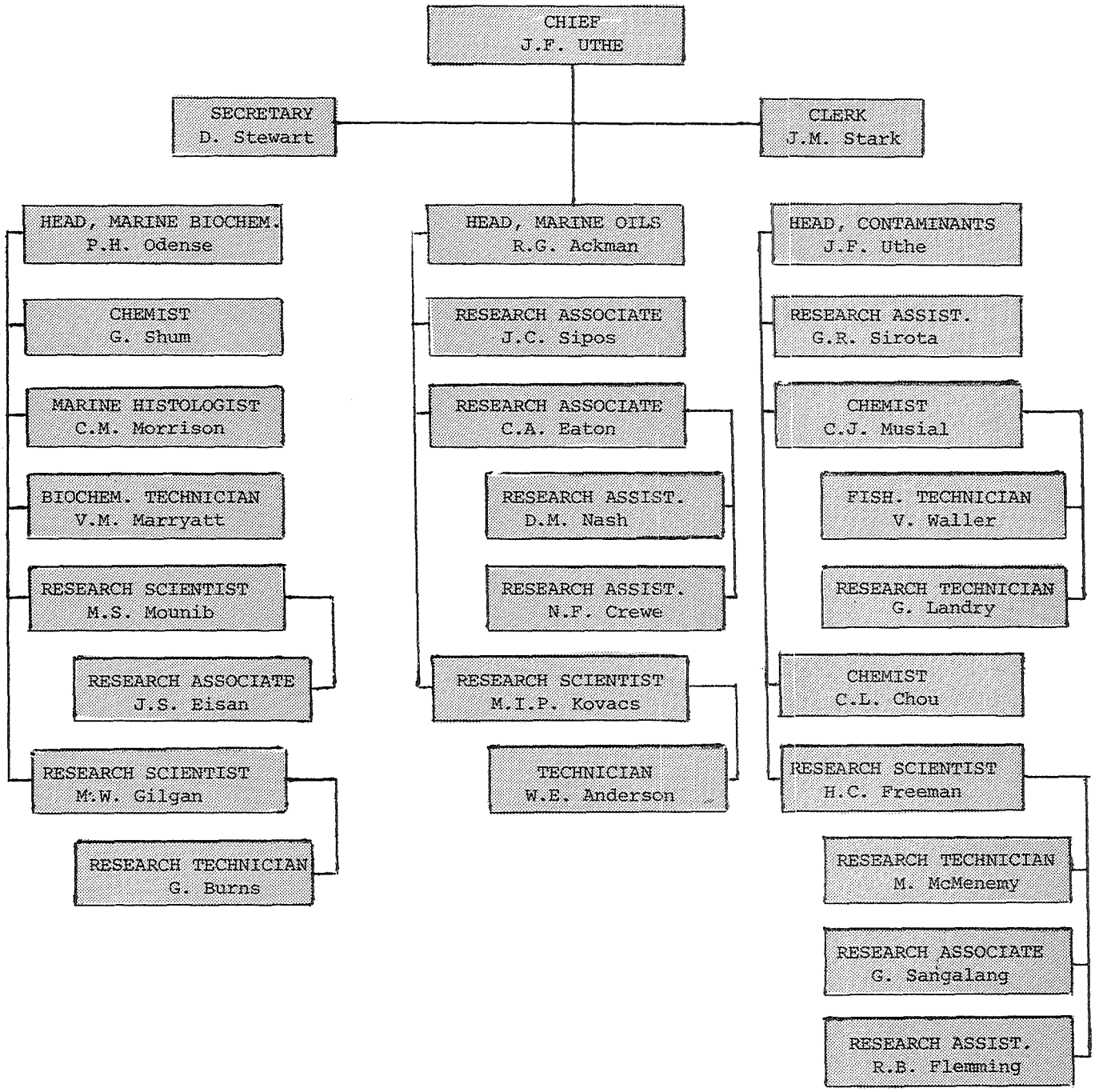
Using salt minced fish produced by the rapid salting technique developed earlier by the Technology Branch the vacuum filter cake obtained by dewatering the slurry was pressed into pound blocks (1 in. thick) in the laboratory. These blocks retained their shape during desalting and cooking operations and can be sliced into thin portions like "luncheon meat".

A low capacity laboratory scale vacuum filter press was designed, built and tested by our laboratory personnel with very satisfactory results. A larger capacity model is being designed and built under our laboratory supervision to produce a sufficient quantity for market testing.

C H E M I S T R Y D I V I S I O N

J. F. Uthe, Chief

CHEMISTRY DIVISION



CHEMISTRY DIVISION

The Chemistry Division is responsible for scientific assistance to the Canadian fisheries industry through three major scientific programs. Each program utilizes the latest in scientific knowledge in studying problems related to resource use by ensuring each scientist maintains his expertise by carrying out a degree of basic scientific research along with these applied efforts. The usual criterion of acceptability of both the basic and applied research in referreed scientific journals is accepted as evidence of the division's scientific excellence.

The three program areas of the division are:

Fish Contaminants - investigating the nature of chemical pollutants in commercial species and developing insights and methodologies for determining the dangers posed by such pollutants to both humans eating these fish and to the fish themselves. In addition the effects of processing and storage on the nature and levels of pollutants are determined.

Marine Biochemistry - investigating the histology, parisitology, biochemistry, enzymology and basic structure of marine species with emphasis on reproduction and hormonal control. In addition certain species of unutilized species are investigated as sources of unique chemicals.

Marine Oils - studying the analytical chemistry, composition and changes in fatty acids in the marine biosphere. Emphasis is placed upon the utilization and food safety aspects of marine oils. Effects of processing and oxidative changes in marine oils and products are investigated. The group is also responsible for developing cheap, rapid and accurate lipid analytical procedures for use in meeting nutritional labelling requirements.

The Division has national responsibility for research into both marine oil utilization and the nature of chemical contaminants in fishery products. In addition, the group fulfills Canada's committment to the International Council for the Exploration of the Sea's studies on Pollution Baseline Monitoring and Biological Effects Detection in the North Atlantic.

CHEMISTRY DIVISION (List of Contents)

Contaminant Levels In Commercial Fish Species - J.Uthe, G. Sirota
C. Chou, G. Shum & B. Flemming

In part to satisfy Canada's international committment to the International Council for the Exploration of the Sea (ICES) continuing studies are underway to determine the relationship between biological factors (age, size, sex, etc.) and contaminant levels in fish.

During the past year a study has been completed of a sample (60 individuals) of cod obtained in September, 1977 approximately 5 miles north of Prince Edward Island. Muscle and liver were analysed for PCB's, α-HCH, HCB, p,p'-DDT, Cu, Zn, Pb, Cd, Hg, Se and As. Multiple linear regression analysis of contaminant level, biological variables (age, length, weight, liver weight, percent fat) and tissue analysed showed the most significant predictors of a contaminant level in a tissue were not the biological variables as expected, nor the concentration of that contaminant in other tissue studied but levels of other contaminants. A repeat sampling is underway to determine if levels of contaminants are changing.

In the course of these studies a number of unknown chemicals have been demonstrated in cod livers. Certain of these materials are extremely inert suggesting a man made origin for them. In the past year hexachlorobenzene and α-HCH (a pesticidal by-product) have been identified and these are now routinely estimated.

Studies on Shellfish as Coastal Monitors of Environmental Pollution - C. Chou
J. Uthe

The objective is to determine if various stationary or non-migratory shellfish can be used to compare pollution levels and inputs from one geographical area to another.

During the past year the level of Cu, Zn, Ag, Se, As, Pb, Mn and Fe in individual lobster and rock crab digestive gland has been determined in animals from "polluted" (Bay of Chaleur, Halifax) and clean areas (Victoria Beach, N.S., North Lake, P.E.I.). Highly significant correlations between individual metal pairs were often found for certain areas but only in the case of copper and silver was a highly significant correlation ($\sigma \rightarrow 1.0$) observed for all areas studied. In spite of the high degree of interaction between silver and copper the quantitative relationship between these two elements varied significantly from area to area. The data suggests a biological role for silver, an element not known to be required biochemically. Absolute level of contaminants in each population varied from area to area and it was not possible to demonstrate a general increase in contaminant level in the more "polluted" area.

This work is being extended to shucked blue mussels and to date, no highly significant relationship between elements have been found, presumably due to mixing of all the animal's tissue for analysis.

Hexachlorobenzene In Fishery Products - C. Musial, J. Uthe

It was the purpose of this study to develop satisfactory methodology for determining this stable organochlorine compound in marine fishery products.

Hexachlorobenzene (HCB) is a contaminant widely distributed in the environment. Previous attempts to determine HCB in fishery products resulted in low and variable recoveries (approx. 7-20%). Refinement of methodology now enables us to measure HCB at parts per billion with much improved accuracy and precision (recovery of spiked samples = 74.5%, standard deviation = 4.6%).

Organochlorine Residues in 13-Year Old Smoked Canned Cod Livers - C. Musial, J. Uthe

Analysis of these samples would provide some estimate of the degree of contamination in the mid 1960's.

A sample of 13-year old canned smoked cod livers was analyzed for HCB, polychlorinated biphenyl (PCB) and organochlorine insecticides. PCB and HCB levels appeared to be about half present day levels but this was difficult to measure with certainty because the same contaminants were also found in the oil in which the livers were packed. Interestingly, p,p'-DDT was not found in the sample; however, its metabolites p,p'-DDE and p,p'-DDD were found. In a biological matrix, it is unusual to find DDT metabolites in the absence of the parent compound. Therefore, conversion may have occurred during canning and/or storage.

Nature of the Arseno-Organic Compound in Fish - H. Freeman, R. Flemming

Some of our east coast fish have arsenic levels many times higher than that considered safe for food by the World Health Organization. The Department of National Health and Welfare is interested in the isolation and characterization of this compound so they can assess its toxicity to the human.

Several hundred milligrams of an arseno-organic compound have been isolated and crystallized from flounder muscle. It has been partially characterized and has been found to be different from the arseno-betaine isolated from the Australian rock lobster. We have found that all east coast fish that are contaminanted with arsenic do not have the same arseno-organic compound. We have also shown that when 5 adult males consumed two consecutive meals of fish contaminated with arsenic that most of the arsenic was excreted in the urine within 48 hours after ingestion, in an unchanged form.

The Nature and Toxicity of Cadmium in Shellfish - C. Chou, G. Landry, J. Uthe

A method, employing both liquid chromatography and electroanalytical techniques for determining free divalent cadmium in shellfish material has been developed. The method has been applied to determine the chemical form of cadmium in shellfish (such as lobster). The initial study on lobster digestive gland shows that levels of free divalent Cd increase with storage and heating processes.

Cadmium exists as a bound form in scallop adductor muscle but in oyster meat the situation is different. Here about 50% of the total cadmium present exists in a free, unbound form. A feeding experiment with rats showed that cadmium in tomalley is much less available to the animals than the usual forms of cadmium used to experimentally determine allowable food tolerances.

Selenium/Mercury Relationship in Swordfish - H. Freeman, G. Shum

It was desirable to determine if sufficient selenium is present in swordfish to significantly lower the toxicity in the flesh of this species. Since selenium has been shown by others to ameliorate the toxicity of methyl mercury compounds to a number of different species. Swordfish have been shown to generally increase their muscle selenium levels as muscle mercury levels increase. With increasing levels up to 2.0 μg of Hg per gram, selenium increases result in a molar excess of selenium. The swordfish with greater than 2.0 μg Hg per gram have less than a molar equivalent of selenium (5% of the total number of fish caught but generally the larger specimens). The study is completed.

Selenium Methodology - H. Freeman, G. Shum

There was a need to develop a rapid, accurate method for determining selenium in fish tissue.

Utilizing atomic absorption spectroscopy, coupled with a graphite furnace and deuterium arc background correction, a method for selenium analysis was developed. It is fast, accurate and does not require either complicated sample preparations or complicated standardizations. The study is complete.

Semi-Automated Methyl Mercury Determination - G. Shum, J. Uthe

Current tolerances for mercury are based upon determination of total mercury. The assumption is made that the total mercury present is all present as methyl mercury; an assumption that is untrue for certain species (e.g. eels, crab). Currently, methyl mercury analyses are long and complicated. We have developed an atomic absorption procedure utilizing selective extraction of samples which enable us to determine only methyl mercury. Hopefully, this type of advance will allow regulatory agencies to set tolerances based upon methyl mercury.

Determination of Pathological Effects of Low Level Feeding of PCB's in Cod

H. Freeman, R. Flemming, J. Uthe, C. Musial, G. Sangalang

Cod in all areas of the North Atlantic are contaminated with polychlorinated biphenyls (PCB's). If this pollutant lowers the reproductive capacity of the cod it may well be a factor contributing to declining cod stocks. The purpose of this study is to determine if current levels (or levels slightly elevated above these) are having a deleterious effect.

Groups of male and female Atlantic cod were fed diets containing PCB's at doses of 1 to 50 μg/g of diet for 5 1/2 months. PCB treated fish showed testicular damage, an impaired sex hormone metabolism and an inhibition in sperm formation. Even at the lowest doses (1 μg/g food level) impaired spermatogenic development was noted. At the higher PCB doses there was no normal sexual maturation in the treated fish and testicular damage was documented. None of the control fish showed testicular abnormalities. Prominent structural changes were observed in the gills of treated fish. The degree of damage to the testes and gills was dose related. Fatty degeneration in the liver was observed in the livers from all PCB fed fish. The livers of some control fish also indicated some degree of degeneration suggesting that current PCB levels are already having a serious toxicological impact upon these fish.

PCB In Mink Feed - C. Musial, J. Uthe

Mink feed containing fish caught in the Shediac River, New Brunswick, and used by a mink rancher in Grand Digue, N.B., was tested for PCB content. Mink are particularly susceptible to PCB poisoning and therefore it is critical that the amount they derive from the diet be kept to a minimum. The PCB levels in the feed samples tested were very low; averaging 38 part per billion (whole food).

The Determination of the Toxicity of Great Lakes Coho Salmon as Food - H.Freeman

The purpose of the study was to determine whether or not contaminated coho salmon from the Great Lakes are fit for human food.

A comprehensive feeding study using 500 rats was carried out in collaboration with the Dept. of National Health and Welfare (NH&W),Ottawa. Different groups of rats were fed (1) a standard laboratory diet, (2) a control diet (3) the control diet plus 5% Pacific coho salmon, (4) the control diet plus 10% Pacific coho salmon, (5) the control diet plus 5% Lake Ontario coho salmon and (6) the control diet plus 10% Lake Ontario coho salmon. A complete chemical analyses for all expected contaminants was carried out on all diets. National Health & Welfare are carrying out a biochemical and histological assessment of the effects of the diets on rat tissues. We have determined the effects of the various diets on steroid hormone metabolism in each group and have found no effect on androgen synthesis, however a significantly altered adrenocorticosteroid hormone metabolism was observed in the rats on all fish diets. The alterations were dose dependent showing that something in the coho salmon leads to metabolic alterations in the animals in a manner consistent with severe stress being imposed on these animals.

Radioimmunoassays (RIA) for Plasma Hormones Determines the Sex of Immature Fish and Measures Stress Caused by Pollutants - H. Freeman, R. Flemming, G. Sangalang

Sensitive tests that werve to sex immature fish and detect the early effect of pollutants would aid investigations of fishery problems.

A sensitive RIA method was developed by which living sexually immature tuna, salmonids (trout) and Atlantic cod were sexed successfully (with greater than 90% accuracy) using only 2 drops of blood. This was done by determining the presence of a male sex hormone in the plasma since only male fish have high blood levels of androgen.

RIA methods are also being developed to determine the blood levels of the stress hormone, cortisol for use in monitoring the effect of stresses on living fish.

Contaminant Analysis and Toxicological Investigations - Miscellaneous Studies - C. Musial, J. Uthe, G. Sirota, B. Jessop

The objective of these projects was to investigate suspected contaminant problems and supply back-up analytical expertise to other Branches in this and and other regions (e.g. Resource Branch, Inspection Division, Environmental Protection Service (E.P.S.).

(1) In cooperation with EPS determined the toxicity of bis(tri-n-butyltin) oxide (TBTO) to 4th stage lobster larvae to obtain an estimate of the dose required to intoxicate canner and market size lobsters. TBTO is used extensively to treat traps in warmer Maritime waters (e.g. Northumberland Strait). We are attempting to develop adequate methodology for determining total tin and TBTO in water and tissues.

(2) Due to Food and Drug Administration (USA) notification in the Federal Register we have analysed a number of edible seaweed products for toxic elements. Levels of lead and cadmium exceeded 1 ppm while arsenic, mercury, selenium, zinc and copper are below levels of concern.

(3) In cooperation with the Resource Branch we are analysing striped bass from a number of Maritime rivers to see if there is any relationship between PCB levels and the reproductive failure observed with striped bass in the Annapolis River. The work is still in progress.

(4) In an attempt to determine whether aerial fallout is the major source of oceanic PCB input, a number of burbot and lake trout from Eastern Labrador were analysed. This led to the discovery of extremely high levels of PCB's in fish caught downstream from the Churchill Falls power development. EPS is assessing the problem of locating and eliminating the source of the contaminant. The high levels found prevented the assessment of the aerial fallout mechanism.

Studies of Pathological Effects of Heavy Metals on Fish and Shellfish - C. Morrison P. Odense

(1) Effect of Cadmium on Trout - Study of the sub-lethal and lethal effects of cadmium upon the tissues of trout under the light and electron microscope will aid the diagnosis of disease and in establishing safe levels of cadmium in the aquatic environment.

A study of the effects of cadmium on gill, kidney and liver tissue of brook trout under the light microscope has been completed. The fish were held in fresh water and exposed to various concentrations of cadmium over a range of temperatures. Trout have also been exposed to 5 ppm cadmium at 6° and 12°C and the gills of these fish examined with the light and scanning electron microscopes. Extensive changes were found at 12°C and the SEM proved to be a useful tool for checking whole gill filaments for focal damage to the gill lamellae. Study of kidney, liver and intestinal tissue from the above experiments will be examined at the electron microscope level to extend the original light microscope study.

(2) Effect of Lead on Spermatogenesis in the Sand Shrimp - Sub-lethal levels of a toxic substance such as lead may destroy a species reproductive capacity and thus destroy a species as effectively as an acute lethal dose of a toxicant. The object of this study was to define the sub-lethal effects of lead upon the process of spermatogenesis. Organic and inorganic forms of lead may have different effects and the level at which the harmful changes occur must be determined.

A paper describing the process of spermatogenesis in the sand shrimp is in press. Shrimp exposed to tri-methyl lead acetate at concentrations from 1 to 50 ppm have been fixed for electron microscopy. Tissues from treated shrimp will be compared with control tissues to determine the effects of organic lead salts on spermatogenesis.

Effects of PCB's on Some Enzymes in the Testes of Atlantic Cod - M.S. Mounib
J. S. Eisan

Experiments were carried out on the effect of adding a polychlorinated biphenyls (Arochlor 1254), from 1 to 50 ppm to the diet of Atlantic cod, *Gadus morhua*. The relative activities of malic (MDH), lactic (LDH), glutamic (GLDH) and isocitric (ICDH) dehydrogenases and aspartate (ASAT) and alanine (ALAT) aminotransferases in the testicular tissue were examined.

The presence of PCB's in the diet of cod resulted in varied responses: mitochondrial-MDH, supernate- and mitochondrial-LDH, and -ICDH, mitochondrial -GLDH, and -ASAT, and supernate -ALAT were not significantly affected by the presence of PCB. The relative activities of supernate-MDH in ripening testes and the supernate -ASAT in both unripe and ripening testes, were enhanced by PCB, whereas mitochondrial -ALAT in both groups of animals were depressed. These results indicate changes in the metabolism of the testicular tissue due to adding PCB to the diet of cod.

In Vitro Effect of Cadmium on Carbon Dioxide Fixing Enzymes in the Cod Testes - M.S. Mounib, J.S. Eisan

The goal of this study was to explore the effect of cadmium on this group of anabolic enzymes from the cod testes.

Our studies revealed that all four carbon dioxide fixing enzymes were affected by the *in vitro* presence of cadmium although their sensitivity to the heavy metal was different. NADP-malic enzymes were depressed at cadmium levels of 5 and 20 ppm, whereas propionyl CoA carboxylase depression required an even higher level of cadmium. These studies demonstrate the potential vulnerability of cod reproduction to the presence of cadmium. This project has been completed and the results are being prepared for publication.

In Vitro Effect of Cadmium on Some Dehydrogenases and Aminotransferases in Cod and Rabbit Testes - M.S.Mounib, J.S. Eisan

Studies were undertaken to investigate the *in vitro* effect of cadmium at levels between 0.1 and 1.0 u mole/3 ml on the relative activities of malic (MDH), lactic (LDH), glutamic (GLDH), and isocitric (ICDH) dehydrogenases, and aspartate (AsAT) and alanine (AIAT) aminotransferases, in the mitochondria and cytosol of cod and rabbit testes.

These experiments demonstrated that cadmium enhanced the relative activity of the mitochondrial MDH of cod and rabbit, probably because of an allosteric effect on the enzyme, although it depressed the relative activity of the cytosol MDH in these animals. The relative activities of the cytosol LDH of cod, the mitochondrial and cytosol GLDH of cod and rabbit, cytosol AsAT of cod and the mitochondrial and cytosol AsAT of rabbit were not significantly affected by the cadmium levels studied. On the other hand, the relative activities of all the other enzymes were depressed by the presence of cadmium, although they differed among themselves in their sensitivity to the heavy metal. The activity of the enzyme AIAT was completely obliterated in the mitochondria and cytosol of cod and in the cytosol of rabbit in the presence of 1 u mole of cadmium /3 ml. The project has been completed and the results prepared for publication.

Effects of Exposing Berried Female Lobsters to Cadmium - M.S. Mounib, J.S. Eisan

An investigation was undertaken to the effect of exposing berried lobsters close to their hatching time to different levels of cadmium.

It was found that only at a cadmium level of 10 ppm were the relative activities of the mitochondrial NAD- and the mitochondrial and cytosol NADP-malic enzyme significantly lower than those of control eggs. The relative activities of the remaining carbon dioxide fixing enzymes were not significantly affected by cadmium exposure at 10 ppm. When the cadmium treatment was stopped and the female lobsters with their remaining eggs were allowed to stay in non-polluted sea water until hatching was completed, the previous treatment of cadmium had no significant effect on the number of larvae produced. However, exposing the hatching larvae to cadmium levels of 1 ppm, 5 ppm and 10 ppm resulted in their death within 36 hrs. Also larvae exposed to cadmium levels of 50 ppb or 200 ppb died within one week. This investigation demonstrates that lobster eggs prior to hatching are more protected against the harmful effect of cadmium than the hatching larvae. This project has been completed and the results are being prepared for publication.

Biochemistry of Reproduction - Malic Enzymes as Indicators of Maturity - M.S. Mounib

To lay down a sound foundation for studying the effects of cadmium on malic enzymes, more information is required as to the way in which these enzymes are controlled in the testicular tissue of cod.

(a) Effects of ATP and fumarate on NAD- and NADP-malic Enzymes - Thus far, the results indicate that the relative activities of the mitochondrial NAD- and NADP-malic enzymes in cod testes were depressed by the presence of ATP, whereas they were promoted by fumarate. These findings support the contention that these enzymes are more active during the spawning process.

(b) Effects of Gonadotropic Hormones on NAD- and NADP-malic Enzymes - Mitochondria and cytosol were prepared from cod testicular tissue and the effects of adding gonadotrophic hormones (follicle-stimulating hormone (FSH) and luteinizing hormone (LH) to these fractions on the relative activities of NAD- and NADP-malic enzymes were determined. The results showed that the presence of either FSH or LH in the incubating medium caused an enhancement to the relative activities of both the malic enzymes in the mitochondria and in the cytosol of cod testes. Inasmuch as the FSH and LH are closely related to the process of ripening of fish, it would appear that the relative activities of malic enzymes could be used as indicies for determining the reproductive status of male cod.

A Bioassay for Evaluating Water Quality (Low in Cadmium) - M.S. Mounib

The goal was to develop a simple bioassay that is suitable for determining the safety of water for raising fish eggs.

After screening approximately twenty enzymes as possible candidates for a bioassay system, three namely, isocitric dehydrogenase, alanine aminotransferase and glucose-6-phosphatase gave encouraging results. The latter enzyme has been studied extensively in the eggs of cod, herring and salmon at different stages of development and in the presence of different levels of cadmium. Glucose-6-phosphatase in the eggs at all stages of development was found to be extremely sensitive to the presence of cadmium and hence a reliable indicator of the quality of water in the incubators.

Lobster Molt Hormone Studies - Effectiveness of Some Dose Forms - M.W. Gilgan, B.G. Burns

It was desired to determine if esters of ecdysterone, other than acetate would be more or less effective at inducing molting.

Apparently the acetates are the most successful simple ester available. The effectiveness of the treatment was apparently seasonal being least successful in the winter. The work has been completed.

Lobster Molt Hormone Studies - Hormone Metabolism - M. W. Gilan

Since the molt hormone derivative ecdysterone triacetate was so much more effective than the "natural" hormone, ecdysterone, we wished to determine how the two compounds were metabolized, stored and excreted by the lobster which might lead to an explanation of the difference.

The accumulation of labelled ecdysterone and its triacetate have been determined in several tissues of the lobster. Preliminary work was completed as to the nature of the radioactive materials in the tissues. The predominant compounds have been identified - ecdysterone, ecdysterone di- (only one of the three possible) and triacetates.

It would appear that the triacetate is effectively stored as such but that the ecdysterone, if it is truly stored at all, is first converted to polar compounds, presumed to be the conjugates, or to non-polar compounds presumed to be the dehydro-hormones which are then retained for a considerable time.

Starfish, Saponin Studies - M.W. Gilgan, B.G. Burns

Isolation of a large quantity of crude saponin was conducted to permit the isolation of the major components, particularly the asterone-saponin, and the determination of the structure of the aglycones released by enzymatic/alkaline hydrolysis.

The complex mixture of crude saponins isolated from the common starfish was fractionated but with much more than the anticipated difficulty partly due to repeated instrument failures but also because the principal method used was less successful than expected.

Since time was therefore limited only the principal asterone-saponin was examined in any detail. It was found that asterone could no longer be recovered from this material by acid hydrolysis when the parent saponin had been reduced with sodium borohydride, nor could the reduced form of asterone be recovered. It was concluded that asterone was not the natural aglycone of the saponin but rather produced from the aglycone by acid hydrolysis.

A Survey of the Occurrence of the Rodlet Cell in Marine Fish - P. Odense, C. Morrison

The rodlet cell known by a variety of names is widely distributed in fish species. It has been variously described as a parasite, an epithelial cell and a blood cell variant. The objective has been to establish its distribution in marine species, and to attempt to confirm the nature of the cell.

Most species examined possessed rodlet cells in epithelial tissues, e.g. gills, intestine, kidney. The distribution varies within a species which has led proponents of the parasite theory to claim this as evidence, however, others have found the number of rodlet cells may increase upon exposure of the fish to heavy metals, thus suggesting a function in detoxification of heavy metals. To date, we have established the ubiquitous nature of the cell in marine species and this has been published.

An Ultrastructural and Isoenzyme Study of the Sound Muscle of Haddock - C. Morrison
P. Odense

Hodder and Templeman have demonstrated a sexual dimorphism in the size of the haddock sound muscle. They suggested this could be used to sex fish which had lost their gonads when they were gutted prior to landing.

In a histological study of the muscles we found that the muscle may be classified as a rapid twitch type, necessary to vibrate the swim bladder to produce sound. There is a characteristic annular pattern of the myofibrils in the female haddock and a characteristic complex pattern of myofibrils in the male sound muscle. As the muscle develops from an immature size to the adult size, there is a change in LDH isoenzyme type reflecting the change in activity and function. A description of this work has been submitted for publication. At present the seasonal changes in muscle size are being followed in order to determine how the cytoplasmic reduction takes place to premit the muscle to shrink in the post spawning period.

Nature and Incidence of Some Abnormalities in Northwest Atlantic Fish - C. Morrison
P. Odense

It is intended to begin to correlate information about disease conditions and abnormalities among marine fish species, to examine the nature of these conditions and to determine if any of these abnormalities have any relation to environmental conditions such as coastal pollution.

A number of abnormalities have been identified in commercial fish species about which little is known.

Recent histological studies of pseudobranch tumor of cod suggest it is a benign tumor of epithelial origin. Preliminary surveys indicate the incidence of the tumor is about 5% in the Halifax inshore area, but only about 0.1% in fish from the Scotian Bank.

Redfish will be examined in an attempt to find any agent which may be responsible for the melanosis observed in some refish fillets.

A study on the incidence of cod worm was made in response to the major concern of the Canadian fish processing industry. An improved candling table was designed and tested. Acoustical detection methods and processing conditions lethal to the cod worm are also being studied.

Study of Isoenzyme Systems of Some Salmonids and Their Crosses - P. Odense

The purpose of the study was to determine whether or not the isoenzymes content of these fish can be related to the probable or actual success or failure of attempts to produce hybrids from these fish.

Some salmonids and their crosses which were produced at the International Salmon Research Center at St. Andrews, N.B. were sampled and their isoenzyme systems compared. The number of genetic loci which the species shared in common were determined. Species with a large number of loci in common produced successful crosses, other did not. Genetic distances between the salmonids can be estimated by this technique.

Resource Enhancement of Marine Oils and Lipids - R.G. Ackman, J. Sipos, D. Nash

This program is basically devoted to promoting regional resources by examining various species (e.g. capelin and squid) as sources of new commercial oils or specific lipids for fatty acids of commercial value.

Capelin has been investigated for oil content, quality and composition.

Oil will be produced incidentially to packing operations for dressed squid. The liver of Illex was found to contain 11% oil by extraction. This is only half that reported earlier for this species and seasonal or size variations are suspected. The oil was found to be close enough in composition to conventional fish oils to be substituted for them or it could be blended off in suitable proportions with other oils.

Supplies of a number of marine oils were made available to the University of Guelp for the trout nutrition evaluation studies financed there by the Departmental Subvention Program.

A survey of fifteen Nova Scotia seaweeds for fatty acid content revealed several specific components, in unusual purity. Some of these are usually minor constituents in most natural sources (e.g. palmitoleic acid). Also the proportion of lipid and fatty acid is two low in seaweeds to justify exploitation for these materials alone, they should be considered if the costs are

partially covered by the seaweed being harvested for other purposes.

Fatty acid composition data for many species of fish and shellfish was provided to the U.S. Department of Agriculture for their proposed major publication on food fatty acids. This included species not as yet widely exploited (e.g. sergested shrimps, sand launce, ocean quahaug).

Safety Aspects of Fish Lipids - R. G. Ackman, C.A. Eaton

The purpose of this project is to assess the health hazard of a number of natural components and artifacts in fish and fishery products.

A project on partial stripping of organochlorine residues from raw fish oils was explored jointly with the Zapata-Haynie Corp. of New Orleans and Campro of Mississauga, Ontario. In small scale tests, the patented Campro stripper was found to remove 90% of organochlorine residues without altering the oil in chemical characteristics. The objective, that of meeting the Department of Agriculture standards for individual feed components for poultry or pigs should be easily met without loss of nutrient value.

We have recently found that the muscle lipid of capelin can contain several percent of fatty alcohol which means a content of twice as much wax ester. This level is approaching that which can cause diarrhea in sensitive subjects. This may also be true of some stocks of mackerel, most herring however, seem to have quite low levels of fatty alcohols.

As part of a safety evaluation of processed fishery products two types of materials found in crude fish oils were followed throughout the partial hydrogenation process. The chlorinated hydrocarbons were found to be partially destroyed during hydrogenation and finally removed by the post hydrogenation deodorization step. Heavy metals were largely removed by conventional processing.

Partially Hydrogenated Marine Oils in Nutrition - R.G. Ackman, A. Eaton

These studies were undertaken to maintain the present market for marine oils in margarine and shortenings.

Largely because of the effect of rapeseed oil to produce heart muscle lesions in male rats health experts advised that docosenoic acids should be phased out of edible oils and fats in Canada, threatening the use of herring oil in this market because of its docosenoic acid content. By vigorously supporting research in Canada and elsewhere the marine lipid section was able to discourage premature implementation of this policy. A 6 month pilot study in which non-human primates were fed standard margarine stock produced from herring oil was successfully concluded in 1975 and on this basis a long term version of the study was begun in 1976. The fatty acid aspects of this study have been continuously monitored by this group and upon slaughter of animals at 6,12,18 24 and 30 months, detailed studies of the animal fatty acid biochemistry was undertaken. The histopathological evaluation shows that in terms of heart muscle lesions fish oils may be safely utilized.

Role of Docosenoic Acids in Human Metabolism - R.G. Ackman, A. Eaton

The examination of samples of human blood, depot fat and heart muscle for lipids and docosenoic acids was seen to usefully complement the primate feeding study already in progress.

Collaborative studies with Denmark have shown that in Greenland Eskimos, the diet and serum both have 22:1 levels, and that this is definitely associated with a dietary intake of unprocessed marine foods. The cardiac health of these people is known to be excellent.

An initial evaluation of sample of heart tissue and depot fats from human subjects in Canada where a moderate intake of docosenoic acids was expected and from subjects from the U.S.A. were no intake was anticipated showed surprisingly that docosenoic acids were present in both groups.

Lipid Composition of Formulated Fishery Products - M.I.P. Kovacs

The demand for accurate food composition data is fostered by labelling requirements, consumers groups, dieticians, doctors and others. Data for formulated fishery products is incomplete.

Samples of fresh, frozen and canned formulated products containing fish and shellfish were collected and have been analysed for sterols and for fatty acids. Gas-liquid chromatography data shows that the lipoxidase assay for polyunsaturated fatty acids is applicable with mixed marine oil/vegetable oil samples. Cholesterol was found to average 27 mg per 100 gram (4 oz.)portion, a relatively minor contribution if a daily intake of less than 300 mg is recommended.

Determination of Sterols in Fishery Food Products - M.I.P. Kovacs

An efficient micromethod has been developed for the extraction, saponification and subsequent gas-chromatographic determination of cholesterol. The method is also suitable for the determination of plant sterols such as brassicasterol, campesterol and β-sitosterol originating from ingredients of plant origin. It can thus be used with these sterols from cholesterol in the analysis of total sterols in modern convenience foods. The analysis has been found to be simple, sensitive, economical of time and solvents and is probably adaptable to a wide variety of food ingredients or products.

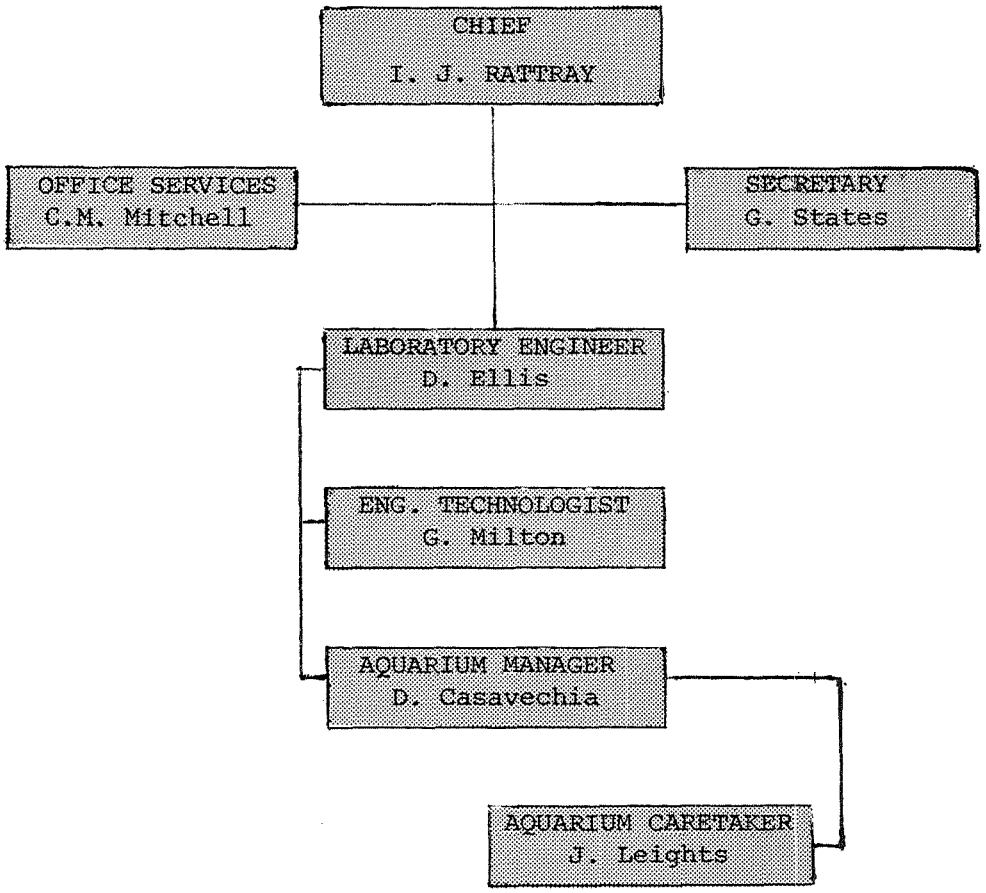
Sterols of Low Erucic Acid Rapeseed Oils - M.I.P. Kovacs

At the request of the Canadian Interdepartmental Codex Alimentaruis Committee the total sterol and proportion of sterol components were determined for a number of Canadian rapeseed oils (from Brassica napus or campestris). These oils represent a succession, starting in 1971, of plant breeding developments directed to the reduction of both erucic acid and glucosinolates. The overall effect appears to be a slight increase in total sterols and a slight decrease in the proportion of brassicasterol. Refractive indicies were also determined for all oils but no obvious chronological trend was apparent.

P R O G R A M S U P P O R T S E R V I C E S D I V I S I O N

I. J. Rattray, Chief

PROGRAM SUPPORT SERVICES DIVISION



PROGRAM SUPPORT SERVICES DIVISION

Over the past two years departmental reorganization has resulted in transfer of various responsibilities to the Regional Support Services office. The major areas affected were purchasing, finance, library, records and material management. Staff transfers to the regional office accompanied the change. In addition, administrative support positions have been established in each Division to carry out clerical, stenographic and typing duties which were previously performed in the Branch s central business office.

The Program Support Services Division not only experienced change within its organization but it has been the focal point for other major changes including - -

a) transfer from Ottawa and integration of the Industrial Development Division with the Technology Branch;

b) setting up and establishing procedures for inter-Service use of various specialized facilities, common rooms and services;

c) space changes to accommodate transfers and program changes.

Most of the major changes have now been completed, although a few problems such as the provision of reception services must be solved. In co-operation with officers of Fisheries Management much time was devoted to setting up procedures for administering cost-shared and other agreements, and, for management of funds assigned to fisheries development and rehabilitation projects.

Facilities and Laboratory Services - Maintenance and operational control of the laboratories has increased in complexity. Major influencing factors arise out of -

a) the shared use of the facilities by a population estimated to have doubled and drawn from various Branchs of the Department;

b) an increase in emphasis on safety and health standards by both employer and employee;

c) the assignment to the Branch of 14,000 sq. ft. of additional laboratory space;

d) an enlarged demand for skilled services;

e) obsolesence of the main laboratory building.

In response to the foregoing several significant non-structural changes have been completed.

A new Maritimes Region Fisheries Centre is being considered for future construction at this site. Planning for this development has occupied an appreciable part of the time of this Division.

Extra hours, much pre-planning and the exercise of appropriate control measures have resulted in uninterrupted electrical and water services to specialized facilities on several occasions when complete breakdown was threatened due to factors such as age or extraordinary conditions connected with the elements.

As a result of a series of meetings with various industrial and municipal representatives procedures were developed and changes made to provide for protection and continuation of building services during sewer installation work on Lower Water Street.

A significant increase in requests for advise on techniques and equipment for holding live fish has been experienced. Requests originate locally as well as at an international level and are generated by such diverse groups as restauranteers, universities, other scientists, consultants, and, other levels of government.

A demand for development of plans and specifications for conversion of space to special purposes decreased considerably. However, there has been a significant increase in requests for technical services which the Division is unable to meet within its available resources. This demand is a reflection of the increased emphasis on development projects.

Energy Conservation - Considerable effort was put into energy conservation projects. The use of time clocks to control after hours ventilation, domestic hot water supply, and a programmed duty cycle for heating circulators has resulted in a savings of oil and electrical energy used for building operation. Less saving has been made in lighting and areas where control is more dependent upon the individual.

FISHERIES REHABILITATION PROGRAM

FISHERIES REHABILITATION

To stimulate long-term fisheries development of the Maritimes, the following projects were initiated and/or managed by the Technology Branch:

Northern Fishing Incentives

The decline of fish stocks in traditional fishing grounds has resulted in the need to exclude larger trawlers (100 ft (30 meters)) from fishing in such areas as the Gulf of St. Lawrence. To assist in developing an alternate fishery in non-traditional areas and for non-traditional species, a groundfish vessel dislocation program was instituted and trips were allocated through the offshore groundfish advisors committee. The major obstacles to be overcome are the aquisition of the technology and experience needed to operate in ice infested waters and the improvement of on-board fish storage capability.

Fifteen trips were allocated to the Maritime region for 1977, 13 trips of which were in September 77.

In February and March, 1978, 313 additional fishing days were undertaken by trawlers of United Maritime Fishermen, National Sea Products, and H.B. Nickerson & Sons. Altogether 8 million lbs of fish with a landed value of $667,000 were caught under this project in I.C.N.A.F. sub-areas 2GHJ and 3K.

Freezer Trawler Experiment - Frank King

This project was designed to evaluate the economics and feasibility of using a freezer factory trawler to fish non-traditional fish stocks in the Canadian Atlantic.

Early in 1977 the Department of Fisheries and the Environment entered into an agreement with National Sea Products Limited, the leading deep-sea fishing corporation as a possible component of Canada's future offshore fishing fleet.

Under this agreement, National Sea Products Limited chartered one of the most modern vessels of this type, the FRIEDRICH BUSSE, from Nordstern AG, Bremerhaven, West Germany. With departmental observers, Canadian Skippers and crew members onboard, the FRIEDRICH BUSSE, over a five-month period (May to October) fished on the Scotian Shelf, in the Labrador Sea, and as far north as the Arctic Circle in the Davis Strait.

Catch weights recorded during the duration (May 17-October 24, 1977) are are follows:

(Illex) squid	4,876.5 (MT)	shrimp	93.5 (MT)
silver hake	556.1	argentine	90.7
pollock	309.5	redfish	64
mackerel	288	turbot	38.8

fish meal 190

The venture was a financial success and a substantial profit was divided between National Sea Products Limited and the Federal Government. The major proportion of the catch was squid, taken on the Scotian Shelf. Shrimp and redfish were taken along with other species in the Labrador Sea.

Leaders in the industry learned much about the technology involved in deploying vessels of this type. There would be obvious problems in training Canadian crews for this kind of operation, but it was concluded that the efficient exploitation of non-traditional, as well as traditional species in distant waters would be facilitated with the addition of freezer factory trawlers to the Canadian deep-sea fleet.

A complete report (including financial data) is available and is entitled "Fishing With the FRIEDRICH BUSSE, by K. Brown, Sr., Fisheries and Marine Service Miscellaneous Special Publication #40: 20p.

The Catching and Processing of Roundnose Grenadier - D. Lemon

The objective of the project was to catch, process and market sufficient quantities of roundnose grenadier to determine whether these species could be profitably marketed.

The necessary processing equipment was installed in a local fish plant. Four trips were made to northern waters during which generally unsuccessful attempts were made to catch grenadier. Less than commercial quantities were obtained, due in part to the timing of the voyages, however, a sufficient quantity was obtained to permit modest processing trials. The project was terminated at the end of the year but results to date are inconclusive.

Development of Inshore Fisheries in Maritime Provinces

Quality Enhancement Program Fish Handling Centres - W. McDougall, (R. Davis K. Rodman)

By improving the handling, storage and unloading of fish from inshore fishing vessels at selected parts, it was hoped that improvements in efficiency and quality could be demonstrated resulting in the development of the inshore fishery.

Seven fishing centres, Murphy's Pond, Little Dover and Central Port Mouton in Nova Scotia, Stonehaven, Escuminac and Cape Richibucto in New Brunswick and Beach Point, P.E.I. were supplied with improved fish handling facilities.

Branch Engineers have designed and supervised the installation of buildings for housing fish handling equipment and for storing ice and iced fish. Fish handling equipment included provision for sorting, deicing, washing, weighing, boxing, icing and conveying. Unloading facilities included suitable cranes with hoists and in one instance a vacuum loading system.

Insulated wharf and boat boxes have been provided for storage and transporting fish in ice. Portable pumps for washing and boat clean-up have been supplied.

Substantially all facilities were in place March 31, 1977. Use of these facilities and further refinement will continue in 1978. Management and ownership of these facilities by the fishermen, plant operators or communities is being negotiated.

Offshore Mackerel Development - W.W. Johnsen

The purpose of this fishery was to determine whether the development of a Canadian offshore mackerel fishery was feasible.

Approval of funds for this project were delayed resulting in a late start for this experiment. Two stern ramp trawlers were chartered. Success was achieved late in 1977 but was limited by a poor offshore mackerel season.

The "BRANDAL" 136', 1250 HP owned by the Karlsen Shipping Co., Halifax, made the first catch of 110,000 lbs. of mackerel in 3 tows in November 1977, 3 to 10 miles south of Sable Island in 11 to 27 fathoms, using a Diamond XIV trawl scraping the sea bed.

Chilled sea water preservation proved superior to icing. Large catches emptied directly into wells greatly reduced time on deck, improved quality and reduced handling and towing to a minimum.

Landed mackerel was frozen round, as was squid caught at the same time, and sold for lobster and longline bait which was strongly in demand.

The "A.W. HENDRIKSEN", 150', 2400 HP, owned by H.B. Nickerson & Sons Ltd. operating from Canso, N.S. was rigged with a Polish rope wing mid-water trawl and stored the catch in ice. A Polish expert was hired to design and supervise the construction of the trawl and to instruct the skipper and crew in its use.

Three complete fishing trips were made with a total of 34 tows yielding 229,000 pounds of mackerel. Fishing was carried out from Sable Island to as far south as Cape Charles, Virginia.

The catch was processed as Individual Quick Frozen (I.Q.F.) round mackerel and I.Q.F. fillets and placed in cold storage awaiting sale by the company.

Although fishing for offshore winter mackerel, this year yielded some productive tows for both vessels, insufficient quantities were found to establish a fishery.

Capelin Fishery - W. Johnsen

The three large seiners previously assisted in obtaining capelin seines are ready for the spring capelin run. Two 64' 11" vessels were chosen to demonstrate harvesting methods for inshore vessels. Split combination winches and spooling gear has been ordered and will be installed. They have also obtained capelin stern drum seines and rope trawls. They will fish either method as conditions dictate. Two processing plants have been assisted in obtaining the necessary extra equipment to handle, sort and process capelin as a food product.

Squid Fisheries Development Program - P.J. Ke

The squid fisheries development program (1978-79) was started in early September, 1978 and completed in March 1979. The major investigations and projects on Atlantic squid, such as harvesting technology, gear and equipment tests, quality assurance, and process technology were all completed with the exception of the design and construction of a squid drier. This was held back due to the unusual change within the Technology Branch. The big problem in conducting this squid project was to obtain a supply of fresh samples, since we only had a few weeks left of the fishing season. Due to lack of time, our squid harvesting operation in the Canso area was not a success. The results and achievements have been briefly summarized as follows:

(1) The preliminary studies of various gear for squid harvesting was completed. Based on these findings, an extensive investi-

gation and tests, including automatic jiggers, are being conducted in 1979-80 for both inshore and offshore squid fisheries.

(2) Various experiments on squid processing technology were investigated. The optimum and standarized operations on freezing, thawing, skinning, drying, etc. were selected and recommended. A comprehensive technical report is in preparation. An audio visual technology training program is in preparation for making sun dried squid and developing the cottage squid industry for inshore fishermen. This extension project has been approved for inclusion in our 1979-80 Squid Development Program.

(3) A squid quality enhancement study was completed in our laboratory tests. The quality improvement in terms of both color and texture are quite successful. Squid of excellent grade can be kept for more than 2 days by handling in CSW or non-contact ice. In addition, some field experiments will be carried out in the squid study of this year.

(4) A systematic technique and method for evaluating and grading squid based on physical, organoleptic and chemical means has been developed. Tests on various quality of squid were conducted during the squid workshop in March 1979, with about 30 fish inspectors, and the co-relation of results were satisfactory. The recommended grades and methodology will be used for field inspection this year. A technical report of details is completed and an audio visual training kit is in preparation.

Shrimp Processing Aboard Vessel - W. McDougall

The objective of this project was to introduce equipment to produce salt-cooked frozen shrimp aboard existing Gulf of St. Lawrence shrimp vessels, and improve quality of landed shrimp and increase vessel and crew earnings.

Phase (1): The hold of the shrimp vessel "JEAN COLLETTE" has been insulated, for minus 25°C application, and fiberglass lined. A mechanical refrigeration chilling unit has been installed to provide chill temperatures in conjunction with ice. The chilling system and the improved insulation should be sufficient to maintain the quality for subsequent freezing onshore. A sorter, batch type cooker and mechanical grader have been installed to enable salt cooking and grading on board.

Trials will be carried out during 1979 to determine the effectiveness of the chilling, handling and storage systems.

Phase (2): Depending on the results of the chilling systems, it is planned to install a freezer system to provide for the finished salt cooked product aboard vessel.

APPENDIX I

WORLD FISHING EXHIBITION

August 31-September 7/77

The World Fishing Exhibition sponsored by the Federal, Provincial and Municipal governments was held in North America for the first time at Halifax, Nova Scotia from August 31 to September 7, 1977. This major exhibition of fishing gear and processing equipment was an outstanding success, attracting over 50,000 visitors representing more than 20 countries.

As Chairman of the Scientific Sub-committee of the World Fishing Exhibition, Dr. Graham Bligh invited the 22nd Atlantic Fisheries Technological Conference to be held August 28-31 immediately preceeding the World Fishing Exhibition adjacent to the exhibition grounds. Members of the Technology Branch staff chaired by Dr. Bligh organized the conference program. One hundred and fifty technologists from North America and other fishing nations attended the conference. The theme Global Fisheries Technology was addressed by a distinguished panel of international technologists with particular emphasis on the utilization of non-traditonal species and processing at sea. In addition to several well attended social functions, twenty-eight scientific papers on current fisheries technological investigations were presented.

Fishermens Forum - September 2-3, 1977

The fishermen's forum exposed more than four hundred fishermen and representatives of allied industries to the latest developments in fishing gear, technology and equipment accompanied by talks and visual presentations by Canadian, U.S. and European experts. This forum was organized by Technology Branch staff and moderated by Barry Fisher of Oregon. Three fishing vessels with gear and deck layouts developed by the Technology Branch were demonstrated.

Support to Fisheries in Other Countries (Visit of Peoples Republic of China delegations - May 30-June 15)

A delegation from China, headed by Lo Ou Feng, Director of Aquatic Product Research Institute of Kwang Tong Province was hosted by the Technology Branch. Their particular interest while in Halifax was to study mid-water trawling technology and various other Canadian fishing technologies. Detailed information was given and a trip on a stern trawler arranged. Visits were also arranged to view automated longlining equipment.

Fisheries Technology Training Course, Dakar, Senegal (Support to Fisheries in Developing Countries - October 6-19, 1977)

Together with other fisheries experts, Dr. E.G. Bligh, the Director and Dr. L. W. Regier, Head, Resource Utilization Division at the invitation of the Fisheries Division of F.A.O. participated as lecturers in a training course in fish handling, plant sanitation, quality control and fish inspection held in Dakar, Senegal, West Africa from October 6 to 19, 1977. The course was organized for and attended by the staff from fisheries agencies from fishing nations of several African and other countries.

APPENDIX II

PUBLICATIONS FOR 1977-78

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APPENDIX II

PUBLICATIONS & SUBMISSIONS

1978-1979

1. Freeman, H.C., G. Shum and J.F. Uthe. 1978. The Selenium Content in Swordfish (Xiphias gladius) in Relation to Total Mercury Content. J. Environ. Sci. Health, A13(3), 235.

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