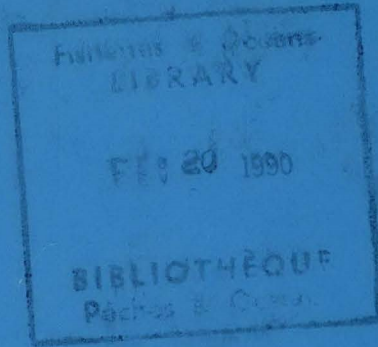


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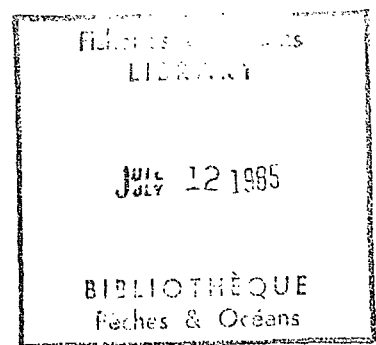


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ANNUAL REPORT
OF THE
DEPARTMENT OF FISHERIES AND OCEANS
FOR THE YEAR ENDING
MARCH 31, 1984



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Minister of
Fisheries and Oceans

Ministre des
Pêches et des Océans

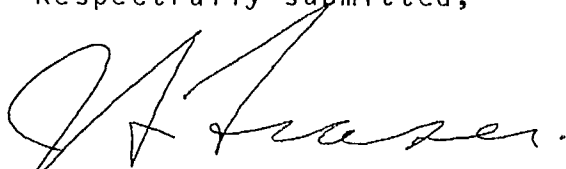
Ottawa, Canada
K1A 0E6

To Her Excellency the Right Honourable
Jeanne Sauv , P.C., C.C., C.M.M.,
C.D., D.H.L., D.S., D.L.

May it please Your Excellency

I have the honour herewith, for the information of Your
Excellency and the Parliament of Canada, to present the
Annual Report of the Department of Fisheries and Oceans
for the fiscal year ended March 31, 1984.

Respectfully submitted,



John Fraser



Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

Deputy Minister

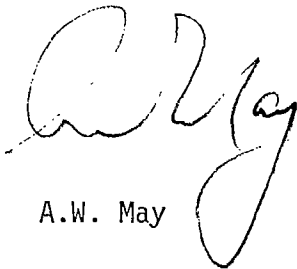
Sous-ministre

The Honourable John Fraser
Minister of Fisheries and Oceans
Ottawa, Ontario

Dear Mr. Minister:

I have the honour to submit the Annual Report of the Department of Fisheries and Oceans for the fiscal year ended March 31, 1984.

Respectfully submitted,



A.W. May

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INTRODUCTION

Under the Department of Fisheries and Oceans Act, the duties, powers and functions of the Minister of Fisheries and Oceans include sea coast and inland fisheries; fishing and recreational harbours; hydrography and marine sciences; and, the coordination of the policies and programs of the Government of Canada respecting oceans.

The department is composed of four main organizational components: Atlantic Fisheries, Pacific and Freshwater Fisheries, Fisheries Economic Development and Marketing, and Ocean Science and Surveys. A separate group handles the department's responsibility for small craft harbours.

The objectives of the Department of Fisheries and Oceans (DFO) are to ensure:

- the comprehensive husbandry and management of Canada's fisheries resource base, through the protection, rehabilitation and enhancement of individual fish stocks and the aquatic habitat upon which these resources depend;
- the "best use" of fisheries resources, through a variety of measures affecting when, where, how and by whom these resources are harvested, processed and marketed to obtain optimal socio-economic benefits;
- an adequate hydrographic survey and chart production program to enable hydrographic charts and other publications to be produced for safe navigation in Canadian waters;
- the acquisition of the necessary knowledge base pertaining to oceanic processes and environments to support activities related to defence, marine transportation, the exploitation of offshore energy resources, and the management of the fishery resource and its aquatic habitat;
- the provision of a national ocean information service; and,
- the provision and administration of a national system of harbours in support of commercial fishing vessels and recreational boating.

Operations of the department, which is highly decentralized, are carried out from Ottawa and regional offices and research establishments throughout Canada. A summary of the activities in fiscal year 1983-84 follows.

Fisheries Management

The Fishing Industry

For the sixth consecutive year, Canada maintained its position as the world's leading exporter of fish in terms of dollars. The value of Canadian fish-product exports totalled \$1.57 billion in 1983, a 3-percent decrease from 1982. The United States, taking 60 per cent of Canada's exported fish products, remained the most important market, followed by the European Economic Community and Japan.

Commercial landings in Canada amounted to 1.34 million tonnes in 1983, a 5-percent decrease from the previous year. Landed value was down by 2 per cent to \$874 million. Market value was \$2 billion, up 4 per cent from 1982.

On the Atlantic coast, landings remained relatively unchanged at 1.1 million tonnes valued at \$621 million. Product value showed an increase of 4 per cent with \$1.5 billion on the market.

Landings on the Pacific coast increased by 14 per cent to 182,800 tonnes valued at \$202 million. The market value of fishery products increased by 10 per cent to \$513 million due to an increase in the production of canned Pacific salmon.

Commercial freshwater landings amounted to 50,000 tonnes, a decrease of 13 per cent over 1982, worth \$51 million. Production showed a decrease of 8 per cent with a market value of \$105 million.

Financial difficulties facing the fishing industry on both coasts continued throughout 1983. Increased costs coupled with little improvement in the real selling price of fish products, resulted in a severe cost-price squeeze adversely affecting the financial performance of the fishing

industry, particularly the large integrated offshore groundfish companies.

Atlantic Fisheries

The Atlantic Fisheries Service mandate is to provide effective management of the fishery resources of Atlantic Canada. Management tools used to ensure an orderly, sustainable harvest of fisheries resources include licensing regimes, resource allocation plans and regulatory controls to properly conserve and allocate a limited resource among competing users. As well, a full surveillance and enforcement program ensures respect for harvesting privileges and protects the resource from unlicensed fishing.

Resource management initiatives included continuation of the revision of the licensing system. Vessel registration was streamlined by adopting a three-year registration program. Policies were developed for licence transfer, replacement guidelines and licence utilization. The streamlining of domestic and foreign quota-monitoring systems was begun. For mixed fisheries, combinations of catch quota, by-catch regulations, closures and fleet suballocations were used to effectively monitor and limit fishing effort.

The principal mechanism for determining the sharing of the available harvest among competing user groups is the resource allocation plan. The first major plan for allocating fish stocks to the Canadian fleet was the 1977 Atlantic Groundfish Plan. Since then, the process has been extended each year and by 1983 covered virtually all species including snow crab, shrimp, tuna and Atlantic salmon. A major long-term (10-year) plan was established for the herring purse seine fleet.

In 1983, on an informal, voluntary basis, enterprise allocations were maintained as part of the Groundfish Management Plan for the largest companies participating in the offshore fishery. This continued to require close monitoring and evaluation. Enterprise allocations were seen as a tool for allocating shares of fish in other sectors and in other fisheries.

Plans were made for the establishment of a departmental region for Quebec, effective April 1, 1984, consequent on the resumption by the Government of Canada of management responsibility for Quebec's marine fisheries, except for anadromous, catadromous and freshwater species.

Compliance with regulatory controls was achieved through air and surface surveillance, the presence of observers on board vessels, the collection of stock and catch data, information programs and prosecution of violators.

In 1983, as in 1982, Portuguese vessels were licensed to purchase semi-processed cod (green salted and split frozen) from Canadian processors ("over-the-wharf" sales). The majority (71 per cent) of purchases were made from Scotia-Fundy-based processors where purchases totalled 10,968 t, a significant decrease from 1982 purchases of 18,964 t. In Newfoundland ports, the Portuguese purchased 4,222 tonnes compared with 9,988 tonnes in 1982.

In the Newfoundland Region, approximately 6,250 t of cod were purchased under the Direct Sales Program, with 47 per cent being purchased along the Labrador coast. A significant portion (39 per cent) of direct sales was made up of wet-split cod. This was brought about by having foreign vessels tied up at a wharf close to a plant wherever possible. The fish was cleaned and split by local plant employees which added to the Canadian labour content on shore.

In the Scotia-Fundy Region, direct "over-the-side" sales of herring in the Bay of Fundy continued in 1983 with 16,626 t delivered by Canadian fishermen to foreign vessels.

The major thrusts in Atlantic fisheries technological development were in the areas of Quality Improvement, Cost Reduction/Productivity Improvement, Resource Utilization and Development, and Product Development/New Products, for a total cost of \$7.45 million. These initiatives were carried out in the five eastern Canadian provinces by the department's Gulf, Scotia-Fundy, Newfoundland and Quebec regional offices.

Specific quality-related development programs included the development of suitable containers for the small open boats used extensively in Newfoundland, as well as evaluating the feasibility of using boxes on larger vessels; evaluation of various types of fish-hold linings; promotion, development and demonstration of longline/autolining systems; development of alternative methods of holding crab live aboard vessels; and development of onboard handling systems to demonstrate mechanical methods of bobtailing and/or throat cutting of groundfish on gillnet and longline vessels.

The Task Force on Atlantic Fisheries identified cost reduction and productivity improvements as priority areas for development. Programs have been aimed primarily at reducing fishing costs through vessel and gear improvement (e.g. the potential for developing new methods to analyse propulsion systems has been explored and data acquired from various trials such as bollard pulls). Information concerning propellers and steering systems was also examined. Energy-saving equipment not currently in wide use on smaller vessels (e.g. nozzles, controllable and two-pitch propellers, fuel heaters, sails, etc.) was evaluated as to its potential in this

fleet. A program to disseminate information on energy matters was mounted and work continued on the utilization of waste heat both onboard vessels and onshore. Numerous projects were also carried out to demonstrate more energy-efficient fishing methods and deck equipment.

Exploratory crab, squid and scallop surveys were undertaken to locate new fish stocks or fishing areas which might be harvested using new techniques. Developmental activities were also undertaken with a view to maximizing the use of existing resources.

Product development programs included testing of a mobile blast freezer which provides increased freezing capacity in areas experiencing exceptionally high landings during peak period; a mechanized salting system which transports and evenly applies predetermined amounts of salt to split fish and re-cycles the unused salt; and fibreglass drying trays and racks.

As part of the Government of Canada's strategy to develop marine fisheries in the Province of Quebec, as recommended by the Atlantic Fisheries Task Force, a comprehensive development plan of more than \$138 million over a five-year period was put in place to revitalize the fishing industry in Quebec and bring it into the mainstream of the Atlantic fishery. Most of the expenditures in 1983/84 concerned the establishment of the proper administrative framework to implement the program and to initiate construction of the infrastructure.

The Special Recovery Capital Projects Program (SRCPP) was implemented in 1983/84 and involved the initiation or acceleration of a number of capital projects selected for their potentially important contributions to Canada's economic and regional development requirements. The Atlantic fisheries development component

of the program totals \$43.9 million. In 1983/84, \$3.5 million was expended for the construction of bait storage depots, ice-making, unloading and salting facilities, and industrial water and power facilities. Construction was also started on two marine service centres.

Substantial funds for fisheries projects were made available through two job creation initiatives. Implemented in 1982/83, the two-year Job Creation Program under Section 38 of the Unemployment Insurance Act saw a total allocation of \$28 million to Atlantic fisheries for implementation of projects for unemployed Canadians in fishing communities throughout Quebec and Atlantic Canada. The program resulted in the creation of approximately 3,950 jobs and 51,000 workweeks. Under the New Employment Expansion and Development Program (NEED), projects totalling \$10.8 million were implemented in Newfoundland, Quebec, Nova Scotia, New Brunswick and Prince Edward Island as a means of employing people who had exhausted all available unemployment insurance benefits or were receiving social assistance. Through the NEED Program, approximately 2,245 people were employed for a total of 35,000 workweeks.

The Coastal Labrador Fisheries Development Program is a five-year, \$13.5 million program designed to achieve increased efficiency in the harvesting, landing, processing and storage of fish. The overall objectives will allow for increased volume, quality and financial returns from fish landed and thereby enhance the quality of life for coastal residents. The program experienced its most successful season of activity during 1983/84. The Management Committee approved a total of 29 single projects which involved various communities along the coast. The program elements under which expenditures accrued are: ice making and storage (\$320,000); fish holding and cold storage (\$1,250,000); community

stages and unloading facilities (\$730,000); utility servicing (\$30,000); fish processing and handling (\$675,000); vessel servicing (\$14,000); and program management (\$381,000).

Under the Southeast New Brunswick Fisheries Development Program, approximately \$550,000 was expended in 1983/84. This five-year, \$2.7 million joint DFO/DREE program forms part of the \$10 million economic development initiative for southeast New Brunswick approved by Cabinet in early 1981. The main elements of the program are the upgrading of processing facilities to inspection standards; improving infrastructure related to harvesting, handling, holding and distribution in support of the Quality Improvement Program; assisting commercial aquaculture operators to utilize the latest technologies for rearing and harvesting shellfish, salmonids and other species; and, in consultation with fishermen and processors, providing for education and training programs.

The Prince Edward Island three-year, \$7 million Comprehensive Fisheries Development Plan was implemented in fiscal year 1981/82 as part of the \$39 million Federal Development Strategy for PEI. In 1983/84, approval was given by Treasury Board to increase the value of the program by \$2 million, for a total of \$9 million, and to extend the program by one year into 1984/85. Projects in 1983/84 concentrated on resource development, processing, infrastructure, harvesting and implementation/training for a total expenditure of \$3.4 million.

Pacific and Freshwater Fisheries

Major emphasis during the year was devoted to the development of a Pacific Fisheries management policy. Although the policy has not been finalized, the decision to

publish the plans for management and utilization of major species complies with one of the recommendations made by Peter Pearse in his report Turning the Tide: A New Policy for Canada's Pacific Fisheries.

Discussion on the recommendations made by Dr. Pearse proceeded during 1983-84. The Minister's Advisory Council (MAC) had requested the opportunity to review and discuss the Pearse Report during 1983. MAC's comments on the Pearse recommendations were studied by the department and several additional meetings were held to further explore industry viewpoints.

To deal with an increasing workload, additional resources were made available to the Pacific Region during the year. The new resources were used largely to improve enforcement, habitat management and research programs and the assessment and collection of data.

Landings were above average for Pacific salmon fisheries. Due to lower prices for all species and the fact that two-thirds of the salmon landed were lower-priced pinks, the landed value for the year was \$107 million.

The herring roe fishery in 1983 was highlighted by a satisfactory seine fishery in the Gulf of Georgia. Landed value of the herring fishery from all sources was \$48.9 million, the highest it has been since 1979, with approximately 40,000 tonnes landed. The landed value of all other species totalled \$39 million.

The enforcement program produced, for the first time, an analysis of compliance rates for various fisheries and displayed a high profile which resulted in an increased deterrent effect.

A Native Affairs Branch for the Pacific Region was formed in 1983 to foster

cooperation between native Indian organizations and the department, and to ensure that native people are consulted on fishery management matters affecting them. Fishery liaison officers will be hired in Nanaimo, Prince Rupert and New Westminster.

Fisheries development projects were undertaken in the areas of gear development, vessel development and safety, exploratory fishing, handling and processing improvements and mariculture.

Gear development studies included an investigation of the relative selection of three different gillnet mesh sizes (12.4, 14.0 and 14.9 cm) for chinook salmon in the Fraser River. Various types of bottom trawl gear were monitored, including their characteristics and the responses of the fish. Fuel consumption and ways of decreasing it were also studied. Model testing of fishing vessel hulls and trawl gear was conducted to develop means of reducing hull and gear resistance.

Exploratory fishing with gillnets was conducted for offshore flying squid. Excellent performance results were achieved with prototype equipment for scanning and detecting defective seams in sealed salmon cans.

Following an experimental system, preparations were made to develop a commercial prototype tank system for the live holding of prawns. Work continued on technology for spawn-on-kelp harvesting, feasibility of restoring herring runs utilizing windrow spawn collected from the beaches, and developing commercial abalone culture techniques.

The Salmonid Enhancement Program (SEP) initiated in 1977 with the objective of doubling salmonid catches in the Pacific Region, completed its final year of Phase I and received a new \$44 million funding

mandate for a transition phase for fiscal years 1984/85 and 1985/86.

In the final year of Phase I, the output of juvenile salmonids continued its upward trend as new facilities came on line and egg takes were expanded at older facilities. A total of 393 million juvenile salmonids were released from SEP facilities in 1983 with expected returns from these releases estimated at 5.4 million adults. An additional 0.8 million sockeye adults are estimated to be produced from the fertilization of 12 lakes in 1983.

The largest single investment in SEP was the \$9.6 million Kitimat facility designed to restore and enhance several salmonid stocks in the Kitimat area. The facility was completed during the year on budget and the first egg takes undertaken included 1,271,300 chinook eggs which were primarily from the progeny of a pilot facility which has been operated by SEP for several years.

Three new pilot chinook facilities on the Fraser River system (at Spius, Clearwater and Shuswap) and three new community economic development projects (at Port Hardy, Powell River and Terrace) were completed utilizing approximately \$2.08 million in special economic recovery funds.

Approximately \$3.6 million was spent to contract 26 community development projects in operation in 1983/84. They employed about 175 people on a full-time or part-time basis.

The number of volunteers spending time enhancing salmonids continues to grow. This year, 8,891 people of all ages worked on 146 volunteer projects.

In the Western Region, the year's major activity related to: freshwater fish habitat problems of national importance; fisheries rehabilitation and resource development in support of regional fisheries; fish and

marine mammal management concerns in the Arctic; and, regional commercial fishing concerns.

Field Services from Inuvik to Frobisher Bay continued to implement direct enforcement programs. Emphasis was placed on working with fishermen and marine mammal hunters to reduce wastage of resources caused by poor fishing and hunting practices and improper handling of the catch.

The restricted entry policy for the Great Slave Lake commercial fishery continued in 1983/84, as did consultations with fishermen to develop and improve the current management plan. The Great Slave Lake commercial fishery continued to be monitored. Plant sampling included collection of whitefish so that samples for length, weight and age of fish from each administrative area were taken three times per year.

Monitoring of the Beaufort Sea beluga harvest continued in 1983 to obtain data on catch/effort, hunting loss and efficiency of techniques.

Studies to assess the status of these various populations were initiated to develop a sound management plan. Observers monitored the narwhal hunt at both Pond Inlet and Arctic Bay, and collected data on harvest, catch/effort, hunting loss and efficiency of techniques.

The beluga hunt in the Pangnirtung area was monitored and biological samples obtained. Preliminary investigations of biochemical techniques for aging and stock identification were initiated.

Aerial population censusing and monitoring of the narwhal hunt by Repulse Bay, Hall Beach and Igloodik hunters were undertaken to provide a sound biological rationale for the harvest of quotas by those communities.

Fisheries development activities included stock and market assessment for Beaufort Sea herring, projects to promote the utilization of unused or wasted fisheries resources and the application of innovative gear and equipment. Energy conservation projects were undertaken on both vessels and engines. Work was begun on the design and construction of a small mobile walleye hatchery and rearing system.

In the Ontario Region, the Sea Lamprey Control Centre at Sault Ste. Marie continued its drive to control the parasitic sea lamprey. As a result, lake trout, whitefish and other salmonids are being rehabilitated in the Great Lakes and a thriving recreational fishery has developed in many areas. During 1983, 32 chemical treatments were made to streams to detect larval lamprey, and trapping studies were conducted in another 10 tributaries to assess adult spawning runs. Barrier dams which will permanently restrict access to spawning areas used by sea lamprey were built in two locations following the signing of the Canada/Ontario Barrier Dam Agreement in 1983.

Fisheries development projects undertaken with the Province of Ontario included the testing of various trapnets, and exploratory fishing for pink salmon and crayfish. As well, an American eel aquaculture project was started on the shores of Lake Ontario.

The region made an effective contribution to job creation through participation in the New Employment Expansion and Development (NEED) program of Employment and Immigration Canada. Projects in support of enhanced cage aquaculture for trout, toxicological research and the effects of lampricide on other stream life were undertaken, providing employment for approximately 30 people and useful results for program managers.

Negotiations with native people in Ontario and the provincial government were

resumed to develop a native fishing agreement. The purpose of the negotiations is to clarify access to fishery resources for the 22 per cent of Canada's native people who live in Ontario.

Agreements for further control of phosphates in the Great Lakes were put in place. Levels for most measured contaminants are declining. Habitat improvements, in conjunction with lamprey control, are returning large parts of the Great Lakes to a more productive condition and the outlook for development of a revitalized fishery in the lakes is encouraging.

The headquarters Operations Branch continued its function as liaison between the regions and headquarters. Considerable work was undertaken with regard to the recommendations arising from the Pearce Report, the Canada/U.S.A. Pacific Salmon Treaty, and the Salmonid Enhancement Program.

In 1983, the headquarters Native Affairs Branch became the Arctic Operations and Native Affairs Branch responsible for coordinating advice on fisheries management in the Arctic (an area where comprehensive land claims have assumed great importance) and native affairs. Branch personnel participated in negotiations leading to an Agreement-in-Principle with the Council of Yukon Indians (CYI) and a Final Agreement with the Committee of Original Peoples' Entitlement (COPE), both ratified by Cabinet. Implementation committees, involving both branch and regional personnel, were formed to prepare for the transition which ultimately will spread right across the Arctic as settlements are concluded with the Dene/Métis and the Inuit of central and eastern Arctic.

Branch personnel participated in land claim negotiations with the Nishga Tribal Council

in British Columbia and, together with regional staff and the Department of Indian Affairs and Northern Development, worked on an approach to the overall settlement of the fisheries aspect of B.C. native land claims following Cabinet approval of this policy initiative. In support of this and other activities, progress was made on the expansion of native fisheries data bases across the country.

Inspection

The National Fish Inspection Program is aimed at ensuring that Canadian and imported fish and fish products, destined for both domestic and export markets, comply with Canadian and importing country grade, handling, identity, process, quality and safety requirements. Fish and fish products were inspected on board vessels, at unloading sites, on transport vehicles, and during processing and storage. Handling, holding, transportation and processing facilities were inspected to ensure compliance with construction, equipment and operating requirements, and good manufacturing practices.

Enforcement action was taken to prevent the marketing of tainted, decomposed or fraudulently-labelled fish and fish products, and to ensure that all fish and fish products entering inter-provincial or export trade were processed in registered plants.

Intensive monitoring of salmon cannery quality verification systems continued to ensure the safety of Canadian canned salmon on domestic and foreign markets. Quality verification included automatic screening of all cans of salmon for weight and vacuum.

A Metal Container Defects Identification and Classification Manual was published for use by quality control and inspection

personnel involved in assessing canned products.

Industry demand for certification of domestically-produced products for export increased again due to the requirements of importing countries and buyers.

Imports for the year totalled 69,843 tonnes, a slight increase from the previous year. Of the imports inspected, 739 lots totalling 2,538 tonnes were refused entry into Canada. This is a 75-per-cent increase in rejections over the previous year mainly due to an increasing percentage of unacceptable quality, seam defects and non-sterile canned fish products.

The Inspection Program continued implementation of the department's Quality Improvement Program in line with the recommendations of the Task Force on Atlantic Fisheries.

The inspection of fishing vessels continued throughout the year, as did work to allow for the linkage of vessel certification to vessel licensing. Enforcement of the new schedules respecting vessels and unloading, holding and transportation also continued.

As a result of further testing and evaluation of the final product grade standard for groundfish, changes were made and an official document was circulated to the industry. In response to concerns expressed by the Fisheries Council of Canada, the department commissioned two studies to evaluate: a) the impact on production of mandatory use of Canadian grade standards for fresh and frozen groundfish products and canned crab, and b) the marketing impact of mandatory product grade standards for Canadian groundfish and canned snow crabmeat. The results were discussed in early 1984 at an industry seminar sponsored by the Federal-Provincial Atlantic Fisheries Committee. The seminar provided for

discussion of the implementation plans for dockside and final product grading.

Point-of-sale grading projects were conducted at: Bonavista Peninsula and Fogo Island in Newfoundland; Petit de Grat, Canso, Port Morion and Pictou in Nova Scotia; Shippigan, New Brunswick; and Miminegash and Red Head in Prince Edward Island. These projects demonstrated clearly the value of using the department's dockside grading system. Changes have been made to the dockside grade standard as a result of pilot projects and the Report of the Task Force on Atlantic Fisheries.

The Inspection Branch provided staff expertise for seven workshops on quality control programming for the fishing industry.

The branch concluded participation in the third of a three-year agreement between Canada and Brazil on a program to familiarize Brazilian fish inspectors with the Canadian inspection program.

At the request of the Thailand canned seafood industry and the Thailand Department of Fisheries, inspection specialists visited that country to evaluate the processing industry and hold a workshop on canned seafood processing to assist in upgrading product quality.

Fisheries Research

Research programs provide the knowledge necessary for optimal management and development of Canada's fisheries resources. Research includes a variety of fields such as population dynamics, ecology, statistics, aquaculture, fish health, nutrition, toxicology, physiology, genetics, etc. The results constitute the basis of scientific advice provided to fisheries managers, national and international fisheries agencies and the private sector.

Scientific advice is also provided in litigation matters, fish habitat and international negotiations.

DFO researchers assisted and worked closely with agencies such as the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC), the International Committee for Exploration of the Sea (ICES), the Northwest Atlantic Fisheries Organization (NAFO), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the International Whaling Commission (IWC), and the International North Pacific Fisheries Commission (INPFC). They also represented fisheries interests in organizations such as the Convention on International Trade in Endangered Species of wild fauna and flora (CITES), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Canadian Climate Program, and the Canadian Council for Ecological Areas. Researchers provided scientific advice in support of Canada's position in the USA/Canada Georges Bank dispute, presented before the World Court.

The department's research component comprises the Fisheries Research Directorate in Ottawa and seven branches in the regions. Results are reported in scientific publications, available on request.

The Fisheries Research Directorate in Ottawa serves as a national focus and is responsible for coordinating departmental initiatives, and communicating with senior management and regional research managers on matters pertaining to fisheries research at the national level. The directorate coordinates the department's fisheries research planning and review process, coordinates the transfer of fisheries technology to the private sector, directs the National Registry of Fish Diseases, and participates in the formulation of departmental policy on science-related issues. Information and

advice are provided to clients both in government and the private sector. Leadership was provided to the international collaborative aquaculture venture under technology growth and employment initiatives arising from the 1982 Versailles Summit of Heads of States and Governments. Leadership was also provided to the Atlantic Salmon Task Group established in response to the drastic reduction in Atlantic salmon, with the findings presented to the Atlantic Salmon Advisory Board.

In the Newfoundland Region, assessments of some 25 groundfish stocks under quota regulations were conducted and advice on Total Allowable Catches (TACs) for the 1984 fishing season was provided either through CAFSAC or NAFO. Toward this end, 14 cruises with large research vessels were conducted to collect biological samples and data from Canadian and foreign fisheries.

Cod studies indicated that changes in water temperature affected catch rates in certain inshore areas and that sand lance, crabs and euphysiids are important food for cod, with capelin contributing less (15 per cent) than formerly thought. The bio-economics study of the flatfish fishery on the Grand Banks, in collaboration with the Economics Branch, resulted in a flow chart for the economics model. Three distinct redfish species were identified on the basis of gasbladder musculature and a new methodology using a discriminant analysis technique.

Assessments of approximately 17 pelagic, shellfish and marine mammal stocks currently under quota regulation were conducted, and advice provided on TACs. Studies of pelagic fish identified the presence of large 1982 and 1983 year-classes along eastern Newfoundland. A strong homing tendency in herring was identified, which has significant implications for management strategies. By-catch of

juvenile cod and other species in capelin traps was shown to have a negligible impact on recruitment.

Invertebrate studies predicted inshore squid abundance on the basis of larval squid surveys on the Grand Banks and in the Gulf Stream, supplemented by environmental indices. Analyses of historical production and recruitment of a lobster population in eastern Newfoundland demonstrated that during the past decade lobster recruitment has increased substantially, despite increases in fishing effort.

Estimates of the current status of the harp seal population were shown to be highly reliable, enabling the provision of defensible advice on conservation measures. A systematic aerial survey of hooded seals at the 'Front' was carried out for the first time, the results of which will form an important component of the nature and strategy of future surveys.

An Atlantic salmon project was initiated to determine the potential salmon production of streams; surveys were conducted on 67 streams to identify suitable candidate sites. Staff was heavily involved in the Atlantic Salmon Task Group. Investigations into stock identification of salmon caught at West Greenland yielded techniques that classify stocks with a 98-per-cent efficiency; techniques based on scale patterns can separate hatchery and non-hatchery salmon caught on the Grand Banks. Investigations indicated that low catches at West Greenland are followed by low catches of large salmon in Canadian fisheries. A theoretical model for the evolution of precocious maturation in salmon was developed with the first quantitative analysis indicating decreases in the yield of males by 60 to 70 per cent. Modelling of the long-term data series on Atlantic salmon migrations at West River yielded novel inferences about growth and smolting of parr.

Advice was provided for the development of TACs on Arctic char in six stock areas. The commercial sampling program at Nain, Labrador, was extended to obtain additional information on sex ratios and maturation stages. Adult escapement to the Ikarut River increased by 80 percent over the previous year in the absence of a local commercial charr fishery in the Hebron Fiord. Tagging projects continued in the Nain and Hebron Fiord regions of the northern Labrador coast.

Salmon production on the Exploits River reached an annual 35,000 tonnes compared with the original 2,500 tonnes in 1980. A long-term salmon-stocking assessment design was completed for the Indian River project. A one-year, bio-engineering feasibility study on the salmonid enhancement potential of Barry's Brook, Gander Bay was completed. Methods were developed to increase the fry to fall-fingerling survival in a semi-natural early-rearing situation to greater than 50 percent.

In the area of fish habitat, protection guidelines were produced for urban developers in Newfoundland; world-wide demand for copies necessitated a second printing. Results from a field study of microhabitat preferences in juvenile and adult Atlantic salmon will be applied to determine minimum stream flow requirements. Continuing use was made of the Baie Verte oil-spill site to field-test a series of laboratory-developed, biochemical and histopathological indicators of stress in fish for potential monitoring of the effects of oil spills. The study produced the first evidence of the value of fish kidney enzymes in biological monitoring. Laboratory studies on serum corticosteroids in marine fish showed a lasting elevation of this stress indicator following long-term exposure to crude oil. Metal-binding proteins in the blue mussel were found to be markedly elevated upon exposure to low

concentrations of cadmium, supporting the belief that such proteins in bivalves could be useful indicators of heavy metal pollution.

Improvements in computer software enabled acquisition of hydrographic data to an accuracy limited only by the deep-sea reversing thermometers and salinometers. The Hydroacoustic Data Acquisition System was improved and used on five research cruises to provide fish abundance estimates.

An illustrated brochure giving a Newfoundland and Labrador perspective of acid rain was produced, as was a brochure on trap cod. The 46th annual conference of the American Society of Limnology and Oceanography was held at St. John's in June 1983 attracting 350 researchers.

With regard to the Canada/United States dispute over Georges Bank placed before the World Court for arbitration, Scotia-Fundy Region research staff made a significant contribution to the preparation of both the Canadian Counter-Memorial and the Reply to the United States' Counter-Memorial.

The Invertebrates and Marine Plants Division was integrated into the Halifax Fisheries Research Laboratory and reorganized to provide emphasis on scallop and lobster research. In addition to the ongoing assessments of several scallop stocks throughout the region, research was conducted on scallop larval ecology and recruitment variability. A series of papers was published on the stock structure, growth, fecundity and movement of lobsters, and new studies were initiated on lobster ecology and behaviour. Several joint research projects involving graduate students, the Marine Ecology Laboratory and Dalhousie University were undertaken on lobster, scallops and squid.

The problems of managing Atlantic herring in the northwest Atlantic were reviewed,

with particular emphasis on the Gulf of Maine/Scotian Shelf stock complex. A new hypothesis was presented on the timing of herring spawning. A five-year, multi-disciplinary fisheries ecology project, focusing on southwest Nova Scotia, confirmed a larval retention area on Brown's Bank, an association of juvenile haddock with jellyfish, and the existence of two major haddock concentrations in the 4X area. The acquisition of the new research trawler ALFRED NEEDLER, combined with important advances in database development and an improved International Observer Program is expected to result in improved biological analyses and assessments.

The salmon enhancement effort expanded on all fronts. Hatchery operations involved the production and distribution of 500,000 parr, 650,000 smolts and 300,000 other salmonids for restoring and expanding public salmonid fisheries. Over 400,000 juvenile salmon were provided to the aquaculture industry. Enhancement activities were undertaken on 11 rivers and opportunities for future work were identified on other rivers. Improvements and expansion, undertaken at several hatchery facilities, resulted in a 50 per cent increase in rearing capability.

Acid rain investigations showed positive results with both instream liming and headwater lake liming approaches. Lake liming, however, appeared to have higher efficiency and lower costs. The Westfield River study demonstrated salmon egg and fry survival to be seriously affected by low stream pH, with a resultant low production of salmon, and abnormally low returns to the river.

A new investigation into salmonids' immunity to furunculosis provided important insight into what causes this disease. The Fish Health Unit undertook an extensive program of diagnosis of fish disease

problems in the Maritime area. Three disease surveys were conducted, in addition to the novel diagnosis of edwardsiellosis in fish from Grand Lake, New Brunswick.

The first National Aquaculture Conference was held in St. Andrews. A number of major technology transfer projects in aquaculture were sponsored to assist the developing salmon sea cage industry, and several forms of assistance were provided to the developing European oyster industry in Nova Scotia.

In habitat research, much attention was devoted to offshore development and the branch made significant contributions to the Sable Island Venture Gas project. A report on Atlantic fish habitat programs was prepared outlining the priority fish habitat issues and organizational and resource requirements necessary for a proactive fish habitat management function in eastern Canada.

The St. Andrews Biological Station celebrated its 75th anniversary with an extended open house, a seminar exchange series with the Fisheries Research Branch in the Pacific Region, addresses by invited speakers, and workshops.

In studies of invertebrates, research on lobster yield confirmed that a slight increase in legal size could be beneficial. Geographic locations of fishing effort were determined from aerial surveys of lobster trap buoys. Observations on stock density dependence of biological parameters and on migrations were made by tagging (conventional and ultrasonic tags), and by underwater monitoring. Lobsters were monitored by underwater television to understand catchability and trap selectivity. A study was initiated on the electrophoretic discrimination of enzymes to identify sub-stocks of lobsters. Sea scallop research was directed to resource mapping and stock

assessment. Studies were initiated on scallop growth, maturation, and the space/time variations of biometrical parameters.

In groundfish studies, stocks of 4TVn cod, 4RST redfish and 4T plaice were assessed (codes identify NAFO areas). A four-week survey was carried out in early autumn to determine cod abundance and age composition, and to collect cod stomachs for a study of trophic relationships. A sealworm-in-cod monitoring survey was completed. Redfish studies included a survey of abundance and distribution of young and larval redfish, determination of maturity in sampled fish, comparison of age determinations by reading of otoliths and scales, and redfish species discrimination by meristic characteristics.

In pelagic studies, 4T herring stocks were assessed. Bluefin tuna catches were sampled and the data was used in contributions to the International Commission for the Conservation of Atlantic Tunas.

In studies of Atlantic salmon, eight index rivers were used to measure spawning escapement and predict recruitment in the Gulf Region. Data from the Western Arm Brook in Newfoundland was used to revise optimal spawning requirements. A stock recruitment relationship (between kelts and parr) was described for the Miramichi River. A study was completed to predict patterns of juvenile growth from smolt year-classes observed on Western Arm Brook. Scale discriminant analysis was used to determine river of origin for large salmon caught in the Nova Scotia sector of the Gulf of St. Lawrence. Tagging was used to identify native salmon from the commercial fishery in Nepisiguit Bay, New Brunswick.

Four hatcheries contribute to the Gulf salmonid enhancement program. Improved techniques for fry and smolt stocking were

developed in Nepisiguit, Bartholomew and Margaree rivers. Semi-natural pond rearing was developed to rebuild salmon stocks in PEI. Atlantic salmon seed stocks were provided in support of four resource development and enhancement projects. Studies were carried out in broodstock development, facility development, disease and diet research.

The declining Margaree and Miramichi gaspereau stocks were assessed by comparing their age structures to unexploited stocks.

The Fish Habitat Division initiated a study to develop a computerized Integrated Fisheries Information System on Habitat. The division also supported, through transfer of resources to the Scotia-Fundy Region, investigations into the levels of cadmium and arsenic in aquatic organisms in the Belledune area of New Brunswick.

In Quebec, research was conducted on the causes of eel mortality in freshwater. A number of projects were initiated including an improved understanding of the movement of fish populations and the study of species not commercially exploited. Staff also contributed to the training of Senegalese researchers in a cooperative program with the Canadian International Development Agency (CIDA).

In the St. Lawrence River, further observations were made on the behaviour and population structure of white whales frequenting the mouth of the Saguenay Fiord, while in the Gulf of St. Lawrence large numbers of young grey seals and hooded seals were tagged. In northern Quebec, the Inuit hunt for white whales in eastern Hudson Bay and southern Hudson Strait was monitored and sampled, and further observations were made on the behaviour of this species in estuaries. In the Arctic, the activities of ringed seals on their breeding grounds were studied using

radio telemetry, and further observations were made on the behaviour and underwater vocalizations of white whales at the edge of the fast ice and in a shallow estuary.

A coastal marine ecosystem study was continued in southeastern Baffin Island. Studies of the effects of petroleum and petroleum-dispersant mixtures on bacteria were undertaken in conjunction with the Baffin Island oil spill project.

At the new DFO Research Centre on Fish Ecology at Rimouski, studies were pursued on the importance of lagoons for fisheries resources. A water temperature recording system was established in the St. Lawrence estuary and gulf. Observations were carried out in the Mingan archipelago as part of a long-term study on the impact on marine fauna of variations in outflow from adjacent rivers in association with hydro-electric projects. In collaboration with researchers from Quebec universities, research projects on the whelk and on the survival of larvae of commercial species such as crab, lobster and mackerel were undertaken. A comprehensive guide on aquaculture in Quebec was completed.

As part of the effort to establish a national fish habitat management policy, an information and awareness campaign was launched concerning the conservation, restoration and enhancement of fish habitat in Quebec. Preliminary work was undertaken on an atlas of fisheries resources and their habitats. It will serve to denote zones according to their particular sensitivity or productivity, and should help in making decisions regarding development projects.

The fourth year of a study on the effects of acid rain was completed, which demonstrated clearly that the fish habitat is altered by acid deposits in lakes in several regions of Quebec and in salmon rivers on

the north coast of the St. Lawrence, particularly in the spring when the eggs are hatching on the spawning grounds. The problem is aggravated by the fact that the hatching often occurs in tributaries at the head of rivers, where the flow is reduced and consequently the springtime acid shock is more severe.

In the Ontario Region, development of an ultratrace organic analytical laboratory was initiated to study compounds such as tetrachlorodibenzodioxin (TCDD) entering the Great Lakes. Some preliminary analyses were conducted.

Work continued for the International Joint Commission (IJC) in the development of Great-Lakes-specific water objectives and in the biological component of the international surveillance program on Lake Ontario. Analyses of fish and sediments from the Maitland region of the St. Lawrence River confirmed the presence of high levels of methyllead compounds. Investigation of this occurrence continued, in collaboration with provincial agencies and Health and Welfare Canada, to establish consumption guidelines and to determine the source and pathways of this compound in this region of the river. Studies confirmed that the reduction rate of most contaminants is slowing down, as would be expected in an exponential decline after the major reductions in contaminant loadings achieved during the 1970s.

The bio-index sampling program on Lake Ontario continued for the third year. Weekly samplings of the epilimnion were taken at four stations and analysed for nutrients and plankton community structure. The data are evaluated against the standard surveillance program with a view to a future modification of the sampling strategy.

Investigations continued on methods of determining the health of fish populations in the Great Lakes with emphasis on white

sucker and lake trout. White suckers with tumours were prevalent, particularly in areas of higher urban and industrial density. Work on the aquatic ecosystem of the Bay of Quinte consisted largely of the preparation of a major document for publication in 1984. It describes the bay's ecosystem and interprets changes that have occurred as a result of major nutrient control and their impact on the fishery.

Work continued on the departmental acid rain program with major investigations on the calibrated Turkey Lakes watershed, surveys of the impact of acidification on trace metals in Georgian Bay, and the coordination of the headwater-lake national survey project.

On behalf of the IJC sub-committee on dredging, and for the Ontario Small Craft Harbours Branch, research was conducted on the toxicity of dredge spoil on the primary production of natural phytoplankton communities. This technique, using elutriated water from dredged sediment, proved to be highly sensitive with a wide range of potential applications. Methodology is currently being developed to identify the major groups of contaminants causing toxicity to the phytoplankton communities.

In the Western Region, monitoring of mercury levels in the Southern Indian Lake reservoir showed the continued decline of mercury concentrations in whitefish toward pre-impoundment levels. Mercury levels in piscivorous fish, pike and walleye, did not show similar declines. Research into the causes of mercury pollution in new reservoirs indicated that the flooding of terrestrial vegetation tends to enhance mercury bioaccumulation by drastically increasing rates of methylation of natural-occurring mercury. An investigation of the effect of rapid shoreline erosion triggered by reservoir creation showed that considerable deposition of fine-grained clay

particles had occurred on known pre-impoundment whitefish spawning areas.

Laboratory and whole ecosystem studies on the effects of Long Range Transport of Air Pollutants (LRTAP) on freshwater fish habitat were continued at the Experimental Lakes Area (ELA). The research showed that sulfuric acid caused greater lowering of the epilimnion pH than did nitric acid.

Lake trout and white suckers, acidified with sulfuric acid since 1976, again failed to reproduce, and their condition showed marked decline over the past two to three years. Microbiological studies indicated that sulfate reduction in the sediments continued to provide internal neutralizing capacity. Ongoing investigations at the ELA included heavy metal, radioisotopic and paleolimnological studies, and pilot studies for a whole ecosystem experiment with aluminum contamination.

Fish from lakes affected by the metal smelter in Flin Flon, Manitoba were found to be more resistant to cadmium toxicity and to have considerably higher levels of the metal-detoxifying protein, metallothionein. Fish from this area were surveyed for contamination with cadmium, mercury, copper, zinc, lead, selenium and arsenic. Other field investigations revealed that zooplankton is extremely sensitive to cadmium in slightly acidic lakes; that aluminum in low concentrations induces morphological alterations in desmids; and that sediment microbes reduce nitrate and sulfate to buffer lakes affected by atmospheric emissions from fossil fuel combustion.

Several observed responses of rainbow trout to moderately acidic water showed potential for use as stress indicators. A depressed attractant response to food extract observed in acid-exposed laboratory fish may help to explain the profound decrease in condition factor in lake trout from Lake 223.

The Fisheries Rehabilitation Pilot Project on Dauphin Lake continued in cooperation with the Province of Manitoba. Research focused on intensive surveys of fish and invertebrate communities, the first year of a five-year walleye stocking program, and the ongoing assessment of habitat deterioration resulting from land use practices.

In cooperation with private industry, development and testing continued on a pilot commercial fish production system to utilize sources of low-grade water heat. Effects of density, ration, size and temperature were investigated to determine optimal culture conditions for Arctic charr. An Arctic charr brood stock was established at the Rockwood Experimental Fish Hatchery.

The region continued to expand its fisheries research thrust in the Arctic. Work continued on the development of biochemical techniques for differentiating stocks of Arctic fish and marine mammals. Application of this work was pursued on certain whitefish aggregations as well as on available marine mammal material. In collaboration with the National Energy Program, projects were initiated to improve techniques for remote censusing and underwater detection of marine mammals, and for assessing the extent and physiological impacts of petroleum pollution on these animals.

The Chemistry Research and Analytical Services section provided some 58,000 chemical analyses to other projects and conducted several research projects on the analytical chemistry of metals, pesticides, oils, dioxins and other pollutant materials. Field and laboratory studies were carried out to describe the environmental dynamics of several chlorinated dioxins. Laboratory experiments were completed to define the responses of larval fish and aquatic plants to several oils and oil-dispersant mixtures, under various exposure conditions.

A significant contribution was made to the departmental review of the Beaufort Sea Hydrocarbon Production Proposal, including technical reviews, the development of the department's position statement, and intervention at public hearings. The second phase of a two-year program to describe the physical and chemical characteristics of Tuktoyaktuk Harbour and its importance as a fish habitat was completed.

Ongoing Arctic fish stock assessment programs included the monitoring of various Arctic charr, rainbow trout and lake trout sport fisheries for catch/effort, exploitation potential and stock population parameters. Harvesting of certain beluga and narwhal stocks was monitored and various population parameters were measured. Assessment of Foxe Basin walrus population was initiated. The fourth year of a five-year program to assess the status of the lake trout sport fishery in the Keewatin was completed.

In the Pacific Region, studies continued on the development of a vaccine to counteract furunculosis, a bacterial disease which causes high losses in cultured juvenile salmon and trout. Promising results were obtained with a vaccine consisting of killed cells of a bacterium not related to the furunculosis bacterium. A survey of the disease status of adult pink salmon at various locations along the Fraser River was initiated in relation to the potential hazards to Fraser River salmon stocks, as a result of the CNR twin tracking proposal. Following an outbreak of PKD (proliferative kidney disease) in September, salmon from the Puntledge River Salmon Hatchery on Vancouver Island were closely monitored. This is the first known occurrence of the disease in Canada.

A survey of 1982 escapements of certain sockeye stocks revealed the presence of the parasite Myxobolus neurobii in most samples from south-east Alaska and its total

absence in samples from northern British Columbia. Further studies were initiated to establish the potential of this parasite as a biological tag for distinguishing these two important sockeye stocks, and the potential of using parasites as biological tags for distinguishing Pacific ocean perch stocks. The latter is particularly significant since Pacific ocean perch cannot be tagged by conventional methods. Two species of the myxozoan parasite Kudoa were found in Pacific hake. Inshore stocks appear to carry only a relatively harmless species, while offshore stocks carry both benign and destructive types. This discovery could lead to fuller utilization of stocks of Pacific hake in Georgia Strait.

To diversify the roe herring fishery and protect spawning grounds from fishing operations, experimental impoundment in sea pens of maturing adult herring was conducted for a third year. Herring, held in quantities of up to 38 tonnes for three to six weeks past normal spawning times, produced roe that was well-received by industry. The high survival and excellent roe yield indicate favourable benefit/cost ratios.

Genetic and hormonal manipulation of sex ratios and sexual maturation of coho salmon showed that artificially sterilized fish grow larger, live longer, remain in saltwater and maintain their bright silver colour.

Thirteen lakes were treated by aerial application of fertilizer to enhance production of food organisms and consequent growth and survival of juvenile sockeye salmon. Fertilization of Great Central Lake on Vancouver Island is expected to produce a successful Barkley Sound sockeye salmon fishery. Monitoring and assessment of the effects of logging and forest management practices on stream ecology continued at Carnation Creek on Vancouver Island. Data suggested that clear cutting could increase coho smolt production in the short term, but that

logging-induced physical changes could, in the long run, result in decreased salmon productivity.

A new Salmon Stock Assessment Unit undertook a systematic reconstruction of profiles of salmon runs in all areas of coastal British Columbia for the past 10-15 years, and completed comprehensive stock assessments of sockeye, chum and pink salmon. Studies indicate that coho are attracted to water previously conditioned by siblings, as opposed to water conditioned by unrelated coho. This represents the first demonstration of kin recognition in fish. The cooperative program on chum salmon stock identification initiated in 1981 continued. This represents the first use of electrophoretic analysis for real-time fishery management.

Methods were developed for spawning weathervane, Japanese and sea scallops, but difficulty was encountered in rearing larvae to the metamorphosis and settlement stage.

In groundfish studies, stocks were assessed and biological and TAC advice was provided for management of the fisheries. A survey of Pacific cod in Hecate Strait indicated below-average recruitment for 1982 and 1983 cohorts, and a low abundance of the total stock over the next two years. The annual trawl survey of juvenile sole abundance in Hecate Strait was completed, as was an English sole tagging experiment to investigate stock delineation, abundance and increment.

Alaskan recoveries of sablefish tagged as juveniles at inshore locations in Canada suggest much greater transboundary movement than previously indicated from the tagging of adults in Canadian offshore areas. Results of a survey of rockfish distribution and abundance in the Dixon Entrance-southern Alaska area indicated the majority of the biomass on trawlable bottom in the 54°-55°N area to be

concentrated in the immediate boundary area. Surveys in the deeper waters off Queen Charlotte Sound did not reveal any separate stocks of Sebastes alutus outside the normal range of bathymetric movement of the Goose Island and Mitchell's Gullies stocks.

An analysis of the abundance, movement and diet of dogfish in Hecate Strait indicated a return to the levels believed to have existed before the intensive dogfish-liver fishery in the 1940s. A Canada/U.S. cooperative hydroacoustic and trawl survey examined a segment of offshore migratory Pacific hake stock entering Canadian waters off southwest Vancouver Island and a management plan was developed.

A three-day open house, held in September 1983 to mark the 75th anniversary of the Pacific Biological Station at Nanaimo, attracted more than 8,500 visitors.

In late 1983, the Fisheries Development Division was transferred to the Fisheries Research Branch, while continuing to work closely with the Field Services Branch in the planning and implementation of projects. In addition to projects funded under the Fisheries Development Act, the division had responsibility as scientific authority for a number of projects funded under the Unsolicited Proposals Program, the Program for Industry/Laboratory Projects, and the National Energy Program.

The Technological Services Division was transferred to the Fisheries Research Branch in late 1983 with responsibility for research on various aspects of product quality before reaching the processing plant.

A treatment was formulated to prevent skin discolouration of Pacific ocean perch during storage. Ways of extending the storage life of cod fillets through pasteurization, while giving a semi-cooked product, were also studied.

An analysis of the protein, fat and moisture content of chum salmon in the south was conducted and compared with data from Japan, Amur River and Yukon River. The chemical changes in pink salmon at various stages of their pre-spawning migration were analyzed as a "before" study in relation to the proposed railroad twin tracking along the Fraser and Thomson rivers.

Electrophoretic analyses were conducted in support of a genetics study and as a means of verifying the species origin of frozen fillets for the Fish Inspection Branch. A sampling showed that the highest incidence of the problematic soft texture in the flesh of arrowtooth flounder occurred in February-March. Changes in the quality and yield of herring roe during impoundment, transportation and storage were evaluated.

A feasibility study on the use of refrigeration powered by waste heat from engine exhaust indicated that it is economically viable for seiners and other large vessels. A compact, high-capacity freezer and fish-handling system was developed for use on seiners. Also investigated were refrigerated seawater systems that can be temperature-controlled at higher-than-freezing temperature of the medium. Ways of increasing the rate of freezing ocean perch in blocks packed to Japanese specifications were studied, as were the design and fabrication of a portable 15 cm airlift pump gentle enough for transfer of live herring.

Field trials of a 1.1 m³ self-contained, prawn-holding tank demonstrated successful live-holding for several months and a procedure using oxygen-enriched atmosphere enabled the transportation of live prawns out-of-water for 12 hours. A study showed that the prawn hepatopancreas is an excellent indicator of the general condition of live prawns held for extended periods.

Studies revealed that a 0.22 micron filter is as effective as ultraviolet irradiation for depuration of oysters, while another showed that magnesium chloride is effective for inducing gaping in oysters and other molluscs which facilitates shucking. An examination was conducted on 150 marine plant species as potential sources of commercial polymers, and the effects of mechanical factors and gel-preparative procedures on texture characteristics of agar gels.

Fish Habitat Management

A discussion paper on fish habitat management policy was released in September 1983 for public review and comment. This document, which stimulated substantial debate across Canada, outlined an objective, goals and series of strategies for the department's fish habitat management program, along with a suggested guide to the application of the policy.

On the east coast, a task force completed a comprehensive review of fish habitat management in the Atlantic zone. The resulting seven-volume report is designed to serve as a blueprint for improvements. Under contract to the department, consultants completed a plan for fish habitat management in southwestern New Brunswick. After 12 years of assessment, review and expressions of concern by fishermen and the federal government, the Pittston Company decided to withdraw its application to construct an oil refinery at Eastport, Maine, near the Canadian border.

A four-year national program studying the effects of acid rain on Canada's fishery resources was concluded and steps were taken to extend it. Data and advice were contributed to Statistics Canada and Environment Canada for the preparation of a report on the state of the environment.

A series of public meetings was organized in British Columbia inviting comment on a departmental discussion paper concerning the implications to fisheries of Alcan's Kemano Completion Project. In addition, public hearings commenced on CN's twin track proposal. Finally, a commission of inquiry was established in the Yukon to review draft federal guidelines for placer mining.

Regulations and Enforcement Branch

The department administers 15 federal acts and approximately 60 sets of regulations. The Regulations Unit formulates, drafts and interprets the majority of these acts and regulations to provide the federal government and five delegated provincial departments with the legal basis for their fisheries management plans.

During the year, 43 amendment packages, including a complete rewrite of the British Columbia (general) regulations, were promulgated out of approximately 70 that were processed by the unit.

Attention was given to the problem of streamlining and expediting the regulatory process. The department's internal processing procedures, following receipt in the Regulations Unit - National, were improved and clarified. Consultations continued with the Department of Justice to institute procedures to accelerate the passage of submissions.

A project to revise and consolidate most of the Atlantic tidal water fisheries regulations into one set was undertaken. An innovative approach to defining fishing areas by using geographic coordinates in combination with maps, rather than the traditional method of employing narrative descriptions, was started. This method will also be employed in the Atlantic fishery regulations consolidation.

The unit's national function also includes internal distribution of all fisheries-related acts and regulations. In this role, more than

31,000 items were distributed. An in-house computerized mailing system was implemented which permits total local control on an as-needed basis while significantly reducing costs.

The Regulations and Enforcement Unit issued licences to 277 foreign vessels resulting in the collection of \$2.998 million. Following bilateral discussions, fishing plans in Canadian waters were implemented for approximately 12 nations.

Thirty ministerial forfeitures and approximately 75 licence suspensions were processed during the year. The developmental aspect of surveillance was started in various projects such as the Electronic Identification program, National Telecommunications-Radio study, the LTA (lighter than air) program, HF data terminal trials and the UHF multi-plex portable radio.

During 1983-84, a new training approach for fishery officers was adopted due to the increasing complexity of the fishery officer's responsibilities over the past years (e.g., extension of jurisdiction, increased illegal fishing, habitat concerns). Eleven officers from three regions took part.

The two-year program, coordinated on a national basis, begins with a six-week national orientation course dealing with the department's role in such areas as resource and habitat management, and enforcement. Recruits also receive training in the organization of government, basic supervisory skills and first aid. A six-week regional orientation course follows, during which new officers learn various aspects of the department's business. The regional portion is coupled with work assignments which are supervised by senior fishery officers who, in turn, have undertaken training in on-the-job coaching skills. The final, formal portion of the program, in the second year, consists of five weeks of concerted enforcement training provided by the RCMP in Regina.

Fisheries Economic Development and Marketing

Economic Development

Fisheries management policies for the Atlantic and Pacific coast fisheries continued to evolve as a result of the in-depth reviews of the Task Force on Atlantic Fisheries and the Commission of Inquiry on the Pacific Fisheries Policy which were completed in 1982.

The policy initiatives have resulted in substantial progress in the Atlantic fisheries management program and its response to the financial crisis facing the industry. The major processors were regrouped into three restructured companies supported by significant federal government equity investments. The legislation to provide for this investment was approved by Parliament in November 1983 under the Atlantic Fisheries Restructuring Act. The departmental response to government policy initiatives aimed at aiding the industry includes: the development and application of guidelines for "over-the-side" and "over-the-wharf" sales; establishment of enterprise quotas for the offshore fishing companies and, on an experimental basis, for some smaller fishing vessels; the resumption of federal jurisdiction over the Quebec marine fisheries; and, regulatory amendments to the Unemployment Insurance Act changing the unemployment insurance benefits available to fishermen.

Pacific fisheries policies were analyzed extensively to assess the social and economic implications of the Commission of Inquiry recommendations. Extensive analysis was carried out on the implications of alternative approaches to addressing the resource and economic difficulties facing the British Columbia fisheries.

Other socio-economic research activities made an important contribution to the

greater understanding of the impacts of fish plant closures and the potential alternatives to plant closures, and the damages inflicted on recreational fishing by acid rain.

The Canadian Sport Fisheries Conference, sponsored by the department and held in February 1984, fully recognized the value and importance of sport fishing to Canadians and the economy. The conference, in consultation with provincial, territorial and regional licensing and management agencies, established a basic framework and agreement on the overall goals and programs for the future of the sport fisheries.

Economic assistance, through price stabilization and support programs was provided by the Fisheries Prices Support Board (FPSB) under the authority of the Fisheries Prices Support Act. During the year, the Board was authorized to implement a "buy-sell program" for cod fillet blocks and purchased 942,480 kg of this product from processors at a cost of \$2.4 million. By March 31, 1984, the Board had sold back to the industry, at cost, 226,167 kg and held the balance in inventory. Fishermen received deficiency payments totalling \$725,000 for their seal pelts sold during the year because of depressed markets for seal skins. The Board also purchased canned mackerel valued at \$920,000 to help meet the food fish requirements of the Canadian International Development Agency (CIDA) for food aid and development programs. Sales to CIDA totalled \$970,000 from existing and new inventories. The FPSB prepares an Annual Report which is tabled in Parliament and in which more details are provided on the above programs. This unit also provided analytical advice to senior management and administrative support

and liaison services to the Freshwater Fish Marketing Corporation and the Canadian Saltfish Corporation.

Additional economic assistance included provision of guarantees for more than \$16 million in loans to 872 fishermen through chartered banks and other designated lenders under the Fisheries Improvement Loans Act; insurance, under the Fishing Vessel Insurance Plan, of 8,224 vessels valued at \$306 million with \$6.1 million collected in premiums and claims totalling \$7.5 million, resulting in a deficit of \$1.4 million; and, \$7.2 million for the construction, modification or conversion of 744 Atlantic fishery and 67 inland fishing vessels less than 22.91 m in length, in conformity with the Fishing Vessel Assistance Program.

At the request of the Foreign Investment Review Agency, the Economic Programs group reviewed all applications from foreign investors interested in the fisheries, and advised FIRA on the compatibility of the proposals with national fisheries policy.

Other activities included the publication of the results of a survey on the economic performance of British Columbia fish processing plants, surveys relating to the economic performance of B.C. fishing vessels and on the contribution of fishing earnings to household incomes and the collection of data on the importance of the fishery to communities in the Scotia-Fundy region as input into the preparation of Canada's case relating to the delimitation of the Maritime boundary in the Gulf of Maine/Georges Bank area.

Marketing

The Marketing Directorate is the focal point for the department's marketing function. It plans, develops and implements policies, strategies and programs to help market

Canadian fish and fishery products and enhance the viability of the fishing industry in a manner consistent with domestic and world-wide marketing opportunities.

To fulfill this mandate, an integrated "sea to table" approach has been developed including market intelligence and early-warning system to improve marketing efficiency; market-related product costing and production-planning systems; implementation of pilot market-extension projects aimed at developing new business; improved organizational structures for marketing; and, consumer education and promotion of fish and fishery products.

The Marketing Directorate consists of: Marketing Intelligence and Planning Branch; Marketing Programs and Extension Services Branch; and Promotion Branch.

Over the past year, the Market Intelligence and Planning Branch provided extensive market analyses, research studies, outlooks/forecasts and business-oriented advice to industry and government. The branch assisted the FPSB with detailed technical analyses and evaluations of price support requests. Assistance and market analyses were also provided to the fishing industry, the department and crown corporations such as the Freshwater Fish Marketing Corporation and the Canadian Saltfish Corporation. Major initiatives undertaken included industry-wide species-market forecasts and action plans. The advancement of the species-marketing concept involving pre-season, in-season and post-season meetings continued to generate strong interest in industry and government.

Major activities of the Market Intelligence and Planning Branch included development of marketing plans and strategies and up-to-date marketing intelligence on a species/product/market basis; short-, medium- and long-term market forecasts and the provision of early-warning systems;

and, development and improvement of the existing market intelligence system and database on a computerized basis.

Market bulletins on groundfish, pelagics and shellfish were published and disseminated to industry, governments and fishermen.

Regular marketing advice was provided to companies, associations and the Canadian Association of Fish Exporters to apprise them of opportunities and problems. Marketing advice was provided to fisheries managers, as was input into the commercial aspects of bilateral agreements. Annual market forecasts for Atlantic coast species were provided to industry and governments via "road show" presentations in St. John's, Halifax and Moncton. Pacific coast species forecasts were presented to a joint meeting of the B.C. Seafood Exporters Association and the Fisheries Association of B.C. Long- and short-term market forecasts were provided as input into the Pacific coast restructuring Cabinet document.

Special marketing missions were undertaken during the year, including the Caribbean and Japan. A detailed study was completed on the farmed salmon industries in Norway and Scotland. The branch also published a report on the United States imitation crab market, and participated in the Canada-Scandinavia Groundfish Consultations in Iceland.

The main focus of the Marketing Programs and Extension Services Branch is the development and implementation of pilot projects and programs to improve market performance, market returns and product competitiveness.

A pilot project was undertaken to help industry improve product profitability. It resulted in the development of a micro-computer-based production-planning and product-costing system called "MICO PLAN". This system provides essential

information for making marketing decisions based on a least-cost/best-selling price approach. During the year, the system was installed in seven fish plants in British Columbia, New Brunswick, Newfoundland, Nova Scotia and Quebec. Provincial governments, private consultants and other organizations have expressed keen interest in actively promoting the installation of the system. A study was also undertaken to determine the effect of size and quality of cod and flatfish on processing yields and productivity with the results expected to be published in 1984/85.

A DFO/Air Canada Fresh Fish project was started to maximize opportunities for the movement of fresh fish by air. Consultative meetings were held with industry and other interested groups on the Atlantic coast. Developments in 1983/84 included major gains in the volume of fresh fish moved by air, particularly in Newfoundland; new combination air/truck routes for key distribution points; favourable revisions of rate schedules by Air Canada; and, assistance in the development and testing of improved processing techniques and packaging.

A test program was undertaken in consultation with the Fisheries Council of Canada, Atomic Energy Canada Limited and other government departments to assess the marketability of irradiated fish and seafood. The initial phase of the program, concept development and testing was undertaken. Future test marketing is dependent upon the final results of the initial phase expected in June 1984.

Other major activities included: a study on the marketing impact of final product grading in cooperation with industry; provision of marketing expertise to DFO inspection personnel on proposed quality enhancement programs; initiatives designed to help revitalize the Canadian sealing industry, including the exhibition of

Canadian-made quality seal fur products at international and domestic shows, the preparation of promotional material to assist seal fur product manufacturers, and the coordination of the government/industry Sealing Industry Revitalization Committee. Studies were also undertaken to assess the United States retail market for fresh fish, review Canadian fresh fish exports and fisheries trade, and analyse domestic consumption trends in meat and fishery products.

In addition, the branch provided recommendations, support and marketing advice to the Program for Export Market Development, FIRA, other federal and provincial departments and committees, and fish processors.

The Promotion Branch's major initiative was the development and initial implementation of a five-year, generic advertising campaign in support of fish and seafood products in the Canadian market. The program, recommended by the Task Force on Atlantic fisheries, is budgeted at \$7.2 million over a 5-year period for the domestic market and \$21.1 million in the United States. The campaign in the domestic market was launched in January 1984 with a 10-week, multi-media program which provided extensive exposure across Canada.

The branch also continued its promotion programs in Canada and abroad. The sixth November Fish and Seafood Month campaign focused the attention of Canadians on the variety and versatility of fish and seafood products. This was achieved through national newspaper advertising and a strong public and media relations program carried out by the branch and provincial food professionals.

The Fisheries Food Centre undertook a broad range of promotional initiatives in support of Canadian fish both at home and

in international markets. In Canada, the centre undertook the development and publication of several new recipe publications, including microwave cooking, low-calorie dishes and recipes for two people. Educational and promotional material was directed at consumers, media, food editors, schools and retailers. More than 40,000 requests were answered during the year.

Promotions staff coordinated and participated in major food shows and exhibitions in Canada, the United States, Europe and Japan. A successful Canada Fish Day promotion was also initiated to focus the attention on Canada's position as the world's pre-eminent exporter of fish and seafood products.

International

The International Directorate continued work related to the nine international fisheries commissions to which Canada belongs. In addition, considerable effort was devoted to the establishment of the new North Atlantic Salmon Conservation Organization (NASCO) which held its first meeting in Edinburgh, Scotland in January 1984. The directorate continued work related to the establishment and implementation of Canada's bilateral fisheries treaties, and pursued specific fisheries trade issues and opportunities.

Problems regarding implementation of the European Economic Community's obligations under the Canada-EEC fisheries treaty (LTA) were resolved. Under the agreement, Canada provides fixed allocations to the EEC until the end of 1987 in return for improved tariff treatment (in the form of tariff rate quotas) for certain Canadian fish products. The new arrangement contains a more acceptable limit on application of the agreed tariff reduction to Canada's major market (the

U.K.), unifies two tariff rates at the lower of the two, and allows a greater variety of product forms to benefit from the LTA.

Problems continued in fisheries negotiations with Spain, resulting in an impasse, with no allocation for Spain in the Canadian zone in 1983. The Spanish market for Canadian fish products remained largely closed, as in previous years.

Portugal, one of Canada's more important markets in 1982 (sales of \$70-75 million), was provided with surplus and non-surplus allocations in 1983 in keeping with government policy based on the recommendations of the Task Force on Atlantic Fisheries.

Fisheries consultations with Japan culminated in a ministerial visit to the country in 1984. Arrangements were made under which the Japanese fishing industry undertook to make its best efforts to increase Canada's exports to Japan by 50 per cent by 1986. Canadian fish exports to this nation stood at about \$200 million, making it Canada's second-largest market after the United States.

While Canada's bilateral fisheries relations with Cuba and the German Democratic Republic went smoothly with both countries fulfilling their purchase obligations, bilateral fisheries relations with Poland lagged behind. Negotiations with the USSR progressed towards a new fisheries treaty, which would include a commitment by the

USSR to purchase Canadian processed fish products for the first time.

The directorate continued its key role in achieving Canadian objectives in the Northwest Atlantic Fisheries Organization, with continued success in establishing conservation measures (in particular, safe total allowable catch limits) and Canadian allocations in the area beyond the 200-mile limit.

Little progress was made toward signature of the draft Pacific Salmon Treaty which had been initialled by negotiators in February 1983. Technical discussions to design fishing plans for the 1984 season failed to produce an agreement, although further consultations were foreseen.

Following ratification by Canada and the United States of the treaty to refer the Gulf of Maine boundary dispute to the International Court of Justice (ICJ), work continued on preparation of the Canadian case during the year with documents being submitted to the court, leading to the initiation of oral hearings in 1984. Pending the ICJ decision, consultations continued between the two countries on management of Georges Bank scallops.

At Canada's request, the General Agreement for Tariff and Trade Organization agreed to undertake a study of the problems in fisheries trade and the prospect for further liberalization. The OECD initiated a similar study.

Ocean Science and Surveys

The Ocean Science and Surveys (OSS) component of the department is responsible for national programs in hydrography and marine sciences and the coordination of ocean policies and programs. Its principal tasks are to produce navigational charts and associated publications covering the Canadian seacoast, navigable inland waters and ocean areas of interest to Canada; assist in the production of offshore natural resource maps and in the delimitation of marine boundaries; provide scientific data, information, advice and assistance concerning ocean-related problems and the safe, economically and environmentally sound utilization of marine resources; support the continuing scientific and technical development of industrial and academic capability in ocean sciences, services and related technologies in Canada; and, meet the needs of the marine community.

Oceanographic research and hydrographic field programs are directed from regional offices located at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia; the Institute of Ocean Sciences, Sidney, British Columbia; the Bayfield Laboratory for Marine Science and Surveys, Burlington, Ontario; and the Champlain Centre for Marine Science and Surveys, Quebec City, Quebec.

Two line programs and OSS headquarters are located in Ottawa. The Marine Sciences and Information Directorate is concerned primarily with the acquisition and dissemination of ocean-related data. The Canadian Hydrographic Service is concerned with hydrographic policy formulation, program coordination and national production. The OSS headquarters function is headed by the Assistant Deputy Minister, supported by a Special Scientific Advisor, the National Secretariat for the Canadian Committee on Oceanography, and a small Policy and Program Coordination Directorate which integrates and synthesizes various program elements and information.

Marine Sciences and Information Directorate

The Marine Sciences and Information Directorate (MSID) consists of the Scientific Information and Publications Branch (SIPB), Ocean Science Affairs Branch (OSAB) and Marine Environmental Data Service (MEDS).

MEDS continued its mandate of collecting, archiving and disseminating oceanographic data and information in response to national and international requirements and commitments.

The branch operated 40 wave-measuring stations, 33 of which were in support of offshore exploration for hydrocarbons.

Satellite wave buoys were placed at the Hibernia location, and in Queen Charlotte Sound and Hecate Strait on the Pacific coast. In addition, five satellite wave recorders were purchased for placement in the Beaufort Sea as part of the Northern Oil and Gas Action Program (NOGAP). MEDS also began to provide wave data in real time to both the Atmospheric Environment Service and private wave forecasters via the national weather circuits.

A major study on the state of knowledge of the wave climate along the east coast was completed and submitted to the Royal Commission on the Ocean Ranger Marine Disaster.

An automated technique for scrutinizing oceanographic data was implemented on a trial basis. The new format for the international exchange of measured wave data is in the process of being implemented jointly by MEDS and several private oceanographic consulting firms in Canada. The system for contouring and presenting oceanographic data has been improved substantially, permitting man/machine interactions in creating the maps.

A major study of MEDS computer hardware and office automation requirements was completed. The goal is to upgrade the facility, improve access to MEDS services via remote terminals, increase productivity and data throughput, and integrate office automation and data processing. Procurement was initiated and is expected to be completed in 1985/86.

Ocean Science Affairs Branch

The Ocean Science Affairs Branch (OSAB) provided a focus for various national and international matters related to oceanographic programs, the development of oceanographic policies for senior management, the provision of oceanographic information and advice, membership on interdepartmental committees and working groups, and the coordination and management of several national programs. Major areas of emphasis included the Energy Research and Development Program, arctic marine transportation issues, amendments to the Canada Shipping Act, the Northern Oil and Gas Action Program, Contingency Planning and the Environmental Assessment and Review of the Venture development project, and Beaufort Sea hydrocarbon development. The branch provided an OSS focus for the Unsolicited Proposal Program of the Department of Supply and Services, the Program for Industry Laboratory Projects, the Environmental Studies Revolving Fund,

the Departmental Science Subvention Program to Canadian Universities, the fund for research contracts in support of the Ocean Dumping Control Act, and departmental participation in the Natural Sciences and Engineering Research Council Post-Doctorate Fellowship Program. The branch provided the coordination for departmental remote-sensing requirements and the development of the fluorescent line imager.

On the international scene, input and personnel were provided to many ocean-related intergovernmental activities such as those of UNESCO, Intergovernmental Oceanographic Commission (IOC), London Dumping Convention, and Remote Sensing Advisory Group of the European Space Agency. The branch provided ocean science coordination for bilateral scientific and technical agreements with several countries.

Scientific Information and Publications Branch

The Scientific Information and Publications Branch (SIPB) is the department's national focal point for scientific and technical information (STI). It ensures that useful research and development information is published and made available. It cooperates with the Communications Directorate in making scientific results understandable to non-specialists, and plays an equally important role in information transfer by documenting and retrieving STI, in concert with DFO libraries, to ensure access to published information by numerous users.

As publisher, SIPB produced and distributed more than 12,000 printed pages, including the monthly Canadian Journal of Fisheries and Aquatic Sciences, the most highly cited publication of its kind in the world. The Proceedings of the Conference on Pollution in the North Atlantic Ocean were published

as the second Journal Supplement. Research results of more regional interest appeared in the seven national Report series coordinated by the branch and produced in the regions. Complementing the series, which are aimed primarily at a scientific audience, are the publications issued on behalf of the Canadian Hydrographic Service and aimed at mariners: Sailing Directions, Small Craft Guides, Tide and Current Tables, Water Levels, and the Proceedings of the Centennial Conference of the Canadian Hydrographic Service.

Through its function as the national focal point and input centre for the Aquatic Sciences and Fisheries Information System sponsored by FAO/IOC, SIPB afforded Canadians access to more than 125,000 on-line titles. Besides answering more than 6,500 requests for information, the branch signaled availability of current DFO literature through a bimonthly listing, SCITECH Publications, and its annual index. SIPB has installed a computer system and is now implementing applications to support its documentation and publications programs.

Canadian Hydrographic Service (CHS)

In the Arctic, a corridor survey through the Beaufort Sea was completed. This survey was started in 1981 and entailed extremely detailed work in the 10 nautical mile wide and 170 nautical mile long corridor. Hydrographic staff participated in the Canadian Expedition to Survey Alpha Ridge (CESAR) project off the northwest coast of Ellesmere Island and obtained reconnaissance data over an extensive area of the Arctic Ocean. CSS BAFFIN carried out surveys in Jones Sound while Coast Guard icebreakers concentrated on Wellington Channel and Freeman's Cove. In addition, CSS HUDSON obtained survey data in a number of fiords on Baffin Island. A

survey was carried out off Hall Beach in a search for the MV EDGAR JOURDAIN. On the Labrador Coast, work was done at Davis Inlet and the inside route from Davis Inlet to Nain was completed. A high priority project was also carried out at Fort Chimo, Quebec.

In Newfoundland, surveys were undertaken in Trinity Bay and the Strait of Belle Isle. On the coast of Nova Scotia, chart revisions were carried out between Liscomb and the eastern end of Northumberland Strait. High priority projects were undertaken at Liscomb and at Shediac and Richibucto in New Brunswick.

In Quebec, a major survey was begun in the Magdalen Islands and revisory surveys were done on the Richelieu River and at Port Cartier and Seven Islands.

The Coast Guard vessel SIR WILLIAM ALEXANDER was assigned to a survey of Eskimo Harbour and Approaches in the Belcher Islands, Hudson Bay.

On the St. Lawrence River, surveys were extended from the Johnstown International Bridge to below the Iroquois Lock, while surveys were continued in the North Channel of Lake Huron. Surveys of Lake Nipissing were completed and revisions were carried out over an area extending from the Detroit River to Valleyfield, Quebec and from Lake Ontario north to Petawawa. Revisions were also made at Hamilton Harbour and on seven charts along the Trent-Severn Waterway from Trenton to Lake Simcoe. On Lake Ontario, surveys of Whitby, Oshawa, Port Hope and Cobourg were conducted.

On the coast of British Columbia, the barge PENDER surveyed the following areas: Spiller Channel and Inlet, Bullock Channel, Briggs Inlet, Troup Passage, Return and Johnson Channels, Seaforth Channel, a portion of Milbanke Sound, Fisher Channel,

Cousins Inlet, Ocean Falls and Gunboat Passage. Spiller, Bullock and Briggs were previously unsurveyed and had no chart coverage.

A second party utilized CSS RICHARDSON. This vessel continued the surveys of the entrance to Quatsino Inlet which were started in 1982 and also carried out surveys of the Ridley Island grain and coal terminal. Revisions were made of the charts of Vancouver Harbour, Howe Sound and Prince Rupert to Stewart.

On the Atlantic Coast, six new charts were published and 56 new editions were released. In addition, six chart amendment patches were produced. Forty-eight of the new editions were for the production of Loran-C and Decca latticed charts.

Twelve new standard charts were produced in Pacific Region, in addition to 48 new editions and 13 reprints.

In Quebec, in preparation for the celebration of Jacques Cartier's explorations in Canada, a special commemorative chart was produced. Four new charts and eight new editions were also published.

In Central Region, 27 new editions were released, and in the Pacific Region nine new charts and 83 new editions were published. A total of 53 reprints encompassing all regions were produced. In addition, six General Bathymetric Charts of the Oceans (GEBCO) were reprinted.

In the eastern Arctic, 10 Anderaa tide gauges were deployed in Jones Sound/Baffin Bay. In Ungava Bay, a numerical modelling contract was let as part of a project to study the tidal power potential of the area. In Hudson Bay and at Little Current (North Channel, Lake Huron) radio telemetry gauges were established in support of survey operations and a teleannouncing

gauge was installed at Iroquois Lock to assist survey operations on the St. Lawrence River. A semi-permanent gauge for the purpose of determining mean sea level for the Geodetic Survey was deployed at Baychimo.

On the coast of British Columbia, records from 17 permanent, four temporary and two tsunami warning gauging sites were processed as required. Work proceeded on two Meteorburst systems. Data from last year's current survey in Chatham Sound have been analysed and the results used to update charts, Sailing Directions and other CHS publications.

Minor current surveys were carried out in Nakwakto Rapids and Sechelt Rapids in June and July.

A turbulence profiler to look at shallow water and continental shelf mixing processes was built according to existing designs and modified with a unique guard allowing it to be employed closer to the bottom. This profiler was used, with success, on two separate cruises in Hecate Strait.

Three major cruises were carried out in the Hecate Strait and on the west coast of the Queen Charlotte Islands. In May, 13 moorings were deployed on the west coast, and 20 moorings in Hecate Strait, giving a total of 83 current meters, 13 tide gauges, a thermistor chain and two weather stations currently in use. In September, all but three of these moorings were recovered and a total of 58 current meters were re-deployed. In October, attempts were made with M.V. PANDORA and PISCES to recover the missing moorings. One mooring was recovered while the search for the other was abandoned due to bad weather. Part of the third missing mooring was recovered by a fisheries patrol vessel.

The 1984 Tide Tables were released and new editions of all volumes of the bench

mark books were available in French and English. The new Canadian Tidal Manual was released in September. The new publication, Current Atlas Atlas des Courants, Juan de Fuca Strait to Strait of Georgia, received excellent reviews.

At Pacific Region, a towed acoustic sweeping system, designed specifically for the Beaufort Sea and adjacent waters, was completed and successfully deployed. The Targa "Bubblebox" bubble memory system was obtained and, used in concert with the Navbox vehicle position logger, was developed into a reliable, rugged system for collecting and storing survey data.

Significant progress was also made in the use of airborne laser bathymetry for inshore surveys. The Larsen 500 Lidar (Light Detection and Ranging) system was tested successfully in the Bruce Peninsula during the summer of 1983.

The DOLPHIN remote-controlled survey launch was completed and underwent open-sea evaluation off the southeast coast of Nova Scotia in late 1983. The data collected by Atlantic Region personnel as a result of these trials clearly demonstrated this semi-submersible vessel's ability to operate in heavy seas for prolonged periods with minimum effect from wave movement.

Preliminary tests of the Global Positioning System (GPS), conducted by Navigation Group personnel, showed its suitability as a positioning system for a future Arctic integrated marine navigation system.

In 1983/84, the following volumes of Sailing Directions and Small Craft Guides were published:

1. Sailing Directions, British Columbia, Volume II, Ninth Edition
2. Sailing Directions, Labrador and Hudson Bay, Fifth Edition

3. Sailing Directions, Newfoundland, Seventh Edition
4. Small Craft Guide, British Columbia, Volume I, Sixth Edition
5. Small Craft Guide, Rideau Waterway and Ottawa River, First Edition
6. Small Craft Guide, Saint John River, Third Edition
7. Small Craft Guide, British Columbia, Volume 2, Fifth Edition
8. Instructions nautiques, Arctique canadien, volume 1, troisieme édition
9. Instructions nautiques, Arctique canadien, volume III, troisieme édition
10. Instructions nautiques, Golfe et fleuve Saint-Laurent, cinquieme édition
11. Instructions nautiques, Terre-Neuve, septieme édition
12. Guide nautique, Baie Georgienne, premiere édition.

A total of 490,442 charts, 85,824 Tide Tables, 9,703 Sailing Directions and 4,865 Small Craft Guides were distributed. In addition, 1,499 Notices to Mariners were promulgated and hand amendments totaled more than 4,500,000.

In April 1983, CHS Headquarters hosted the Centennial Conference of the Canadian Hydrographic Service in Ottawa. The conference was well attended with participants from around the world. The Chartmakers - The History of Hydrography in Canada was published to coincide with the CHS centennial.

CHS continued to give training courses. Participants at the Hydrography I course included candidates from Pakistan and Jamaica.

Oceanography

Institute of Ocean Sciences (IOS)

The main programs at IOS during 1983/84 were in the fields of ocean chemistry, ocean physics and ocean ecology.

A study of the water circulation off B.C.'s north coast entered its second year. This project is being undertaken in preparation for possible offshore hydrocarbon exploration and to complement a fisheries research project in the same area.

Two ocean flux experiments --SEAFLEXES and PARFLUX -- were carried out. With funding assistance from the International Development Research Centre (IDRC), the SEAFLEXES program involved a cooperative study at Patricia Bay with participants from Shandong College of Oceanology, the 3rd Institute of the Chinese National Bureau of Oceanography, the Department of Oceanography at the University of British Columbia and IOS. The study investigated the pathways and fate of Prudhoe Bay crude oil premixed with a dispersant, and the biological effects of the dispersed oil and the dispersant alone on the planktonic and bacterial communities.

PARFLUX involved Woods Hole Oceanographic Institution and IOS. Three cruises were conducted to retrieve and relaunch automated sediment traps. Three seasonal peaks of particulate flux into deep ocean were observed in the time-series.

The Marine Carbon Research Centre at IOS, now in its fifth year, is focussing on the marine aspects of the global carbon dioxide (CO₂) cycle by conducting research, monitoring and modelling activities. The centre took a lead role in conducting the first Scientific Committee on Oceanic Research (SCOR) working group meeting on oceanic CO₂ monitoring. The meeting was called to map out a global strategy, to define the precision of measurements required for CO₂ signals and to review various national capabilities for international cooperation.

The CO₂ monitoring program at IOS continued. Research and modelling

activities concentrated on working up atmospheric CO₂ data from Ocean Station P, Alert and Sable Island to establish the trend of atmospheric CO₂ increase, characteristics of the seasonal cycle and long-term nautical variation.

Programs were initiated to examine oceanographic factors affecting sea-ice motion in the Beaufort Sea. Another one was established aimed at developing methods of forecasting oceanic variables. A field program was started to improve knowledge of the water properties and currents on the west coast of the Queen Charlotte Islands and the first phase of an international experiment (Australia Coastal Experiment) designed to test theories of continental shelf wave propagation was completed.

A study was initiated of the plankton ecosystems in Hecate Strait and Queen Charlotte Sound, an area where the biological oceanography is largely unknown. Among the findings was a layer of phytoplankton at a depth of about 20 metres that had escaped previous detection. The finding is also noteworthy because it was thought that tidal mixing in this area would be so rigorous that phytoplankton would be evenly distributed from top to bottom. Apparently, freshwater input to the region is sufficient to supply a near surface layer of low salinity water that resists complete mixing by tidal currents.

A five-year program studying the fine-scale (less than one kilometre) zooplankton pattern associated with the Fraser River plume in Georgia Strait was completed in May. The dominant zooplankton species (Neocalanus plumchrus) occurs in highest abundance around the outer margin of the brackish surface plume. The intensity of this aggregation varies both spatially and with tidal phase and appears to be associated with convergent circulation at the plume boundary.

The Ocean Ecology Division, in conjunction with other agencies, discovered an active hydrothermal vent on the Juan de Fuca Ridge. IOS involvement included microbiological studies in these extraordinary vent environments. The bacteria obviously play a key role in these communities, in which the basic energy supply for the support appears to be derived indirectly from the mineral-laden hot water emanating from the vents mediated via the bacteria, rather than from the normal process of photosynthesis.

Bayfield Laboratory for
Marine Science and Surveys
(BLMSS)

A major field experiment was conducted at the DFO Radar Research Facility on Baffin Island. Radars operating at four frequencies (3GHz, 9GHz, 16GHz, 35GHz) using both horizontal and vertical polarization were used to collect data on radar returns from a variety of ice types and features. Subsequent analysis showed that cross-polarized signals make it easier to detect icebergs and ice-cover. In order to circumvent the conflicting requirements of low operating frequency and the high resolving power needed to measure sea-ice thickness, research on a Step Frequency Radar was contracted which resulted in successful tests under simulated Arctic conditions.

Before the Bayfield Lab's oceanographic component was transferred to other DFO regions, field work continued in March and April on the final phase of a three-year oceanographic program in Barrow Strait.

Major vessels carried out a number of cruises in support of the multi-disciplinary surveys of NWRI and GLFRB in addition to ongoing hydrographic surveys in the Great Lakes. Data from these cruises is used to

assess long-term trends on water quality and eutrophication in the Great Lakes as well as trends and relationships of the biological community to nutrient loadings.

Fuel costs have been reduced by \$25,000 per season since CSS LIMNOS was re-engined in 1982.

Champlain Centre for Marine
Science and Surveys (CCMSS)

Oceanographers at the Champlain Centre for Marine Science and Surveys conducted extensive physical, chemical and biological research on the St. Lawrence Estuary, Gulf of St. Lawrence, Saguenay Fiord and coast of northern Quebec.

Research continued on the relationship between water circulation and zooplankton distribution in the St. Lawrence Estuary. In January, aboard the CSS HUDSON, the Physical Oceanography Division collaborated with the Bedford Institute of Oceanography to take a series of temperature and salinity measurements in the northern Gulf. The results of this mission, with other data, will enable researchers to determine the annual salinity variation cycle of these waters. A report was prepared on spring and summer conditions of this region.

Other measurement projects included an impact study on the waters of northern Quebec, following the move of the Grande Baleine hydroelectric complex to Hudson Bay.

Under the International Council for the Exploration of the Sea (ICES), the Chemical Oceanography Division organized an intercalibration exercise on measuring mercury concentrations in sea water.

Studies were undertaken on the behaviour and speciation of selenium and iodine that

occur when marine and continental waters meet in the St. Lawrence Estuary.

For the third consecutive year, the division participated in the SCOPE international research program on the chemical composition of the world's major rivers.

The group continued to study hydrocarbons found in Saguenay Fiord sediments as well as the blue mussel -- a marine pollution indicator.

Finally, data was published on the mercury contamination of the waters and shrimp of Saguenay Fiord. According to certain surveys, between 3.5 and 7.5 years were required to rid these waters of contamination.

The Biological Oceanography Division concentrated on phytoplankton and zooplankton studies. The division examined how zooplankton in the St. Lawrence Estuary utilizes its energy supplies. Also, studies continued on the effects of temperature, salinity and light on the algal growth of ice floes in the St. Lawrence River and Hudson Bay.

The division also examined bacteria, phytoplankton and zooplankton distribution in the St. Lawrence Estuary. Recent results show that the flow of freshwater and the rising and mixing of deep water have a definite influence on the estuary's productive capacities.

Bedford Institute of Oceanography (BIO)

The Bedford Institute of Oceanography (BIO), founded in 1962, is the largest centre of its kind in Canada. It ranks as one of the major oceanographic research institutes in the world in terms of size and scope of its programs.

Scientific studies of the processes occurring near the air/sea boundary continue to be

important as concern increases for a better understanding of climatological trends, sea-ice and iceberg dynamics and thermodynamics, dispersal of oil on fish larvae, the effect of waves on offshore development, and the modelling of current and mixing to estimate design criteria for environmental impact.

The analysis of the wave charts prepared by the Meteorological and Oceanographic Centre continued and there are now 13 years of data in an in-depth statistical analysis of trends and variability for the north Atlantic. There is strong evidence of a significant trend toward increased wave intensity over most of North America during the past decade which raises serious concern for the validity of established values of wave design criteria for the offshore. The same data was used along with wave rider data to describe events leading up to and during the Ocean Ranger sinking. There is strong evidence of a crossing wave field, due to generation in the near and far field. A major effort was initiated to improve the capability to hindcast and potentially forecast waves by numerical modelling.

A new Gulf Stream variability experiment was started. Five moorings with four current meters each were laid in the Gulf Stream south of Nova Scotia. These current meters, combined with similar ones on three Woods Hole moorings along the southwestern edge of the array, will allow the eddy scale processes of the Gulf Stream to be mapped and analysed over the next two years. Hydrographic surveys in the region in May and November, as well as infrared photographs from satellites, have confirmed that the Gulf Stream has remained over the array. The results of this experiment should provide a better parameterization of the eddy scale process that probably mixes and transport heat, salt and other properties in the vicinity of the Gulf Stream.

Considerable success was made with regard to the study of the sedimentary record in the Saguenay Fiord. As a result, a remarkably precise simulation of the transport of natural and artificial radionuclides introduced to the drainage basin through atmospheric deposition was achieved. This model is being applied to other chemical components, particularly those of anthropogenic origin, to further investigate chemical transport in this basin. The nature of the sedimentary record in the Saguenay Fiord was also used to determine the sequence of natural episodic events during the last three centuries by the extrapolation of features of the 20th century chronological record.

The results of work in Baffin Bay were used to construct a model for the stoichiometric composition of regenerating biogenic material which appears to differ in Baffin Bay from other areas of the ocean that have been studied. During 1983, better quality carbonate measurements were obtained from Baffin Bay and will be used to test and refine the model further. Similar work conducted in the vicinity of Svalbard and in the Arctic Ocean was extended through the occupation of stations from the CESAR ice-camp. The nutrient maximum at approximately 120 metres, previously attributed to the composition of water flowing into the Arctic Ocean through Bering Strait, was shown to be a reflection of shelf processes and horizontal mixing processes in the Arctic Ocean itself.

BIO conducted a major cruise to the Sargasso Sea and another to the Arctic. A new high precision oxygen technique proved extremely useful in studies on photosynthetic oxygen production and respiratory uptake. Data obtained by this method allowed BIO to make important contributions to the controversy surrounding the question of the molar flux ratios of oxygen and carbon in the world's oceans. A new device for measuring the effect of

irradiance on photosynthesis has greatly simplified this measurement and a modification of this device has permitted the production of photosynthetic action spectra for natural populations.

Development of ECOLOG, the acoustic device for enumerating fish abundances and size distributions, reached the stage where it was considered a verified research instrument, and emphasis shifted to evaluating its survey utility in conjunction with the Marine Fish Division demersal fish surveys, as part of the South West Nova Program; developing a capacity for "real time" computing of results at sea; and, shifting attention from the instrument development per se toward the technology transfer requirements of transforming it into a "turnkey" device for management application in general.

Climate studies require data sets from a range of scattered sources and a major addition in 1983 was the acquisition of marine surface observations for the northwest Atlantic area (sea surface temperature, sea state, and meteorological observations) from the National Climatic Centre, North Carolina. This, along with other environmental and fish abundance data sets, helps in investigating relationships between environment and fish abundance. BIO research suggests that the southward increase in cod on the Labrador Shelf is linked through the food chain and advection to upstream physical processes operative within Hudson Strait. The yearly variation of cod is interpreted as arising from the variation of the nutrient supply, which is correlated with salinity. The freshwater discharge into Hudson Bay, which subsequently flows seaward through Hudson Strait and southward onto the Labrador Shelf, appears to suppress mixing and hence years of higher freshwater discharge would tend to decrease nutrient supply.

The Cumberland Basin ecosystem modelling project was implemented in 1983. A workshop in the Netherlands produced the first draft of a model which has been improved upon through cooperative work with Dutch and German scientists. A new field program was begun at Grand Pré, N.S., to collect detailed information on the dynamics of salt marshes. This project is also closely coordinated with other agencies such as St. Andrews Biological Station, Canadian Wildlife Service, and Acadia University.

Health of the Northwest Atlantic is the title of a report to the Atlantic Interdepartmental Committee on Environmental Issues, drafted jointly by DFO and Environment Canada, which describes the present state of marine environmental quality on Canada's Atlantic coast. It concludes that the quality is good compared to, for example, the Baltic or North seas, which suffer from pollution from industrialized western Europe. While there are hotspots of marine pollution, they are usually caused by isolated shore-based industries. The report predicts that pollutants such as DDT will probably decline over the next few decades due to tighter regulations. However, contaminants such as PCBs and some aromatic hydrocarbons are introduced through long-range atmospheric transport probably from the northeastern United States, and it is obviously much more difficult to control these or predict trends in their levels.

DFO scientists from the Marine Ecology Laboratory (MEL at BIO) and the Canadian

Hydrographic Service (CHS at BIO) participated in the second multidisciplinary and international voyage of HUDSON for Project SAFE (Sedimentology of Arctic Fiord Experiment) Sept. 19-Oct. 5. SAFE is a comprehensive study of the climatology, hydrography, physical oceanography, sediment dynamics, sedimentological history and animal-sediment relationships on Baffin Island fiords. Work in Cambridge focussed on its polyna, on the large turbidite channel found meandering along the fiord bottom, and on detailed seismostratigraphy of the thick stratified quaternary sediment ponded between three large sills. Shoreline work concentrated on sampling the raised glacio-marine deposits and on one actively calving tidewater glacier.

Work in Itirbilung Fiord focused on the actively erosive submarine channels that cross the main prodelta slope. The channels, floored by large 3-D megaripples, were examined by the DND DART submersible: unique macrobenthos facies were identified in and out of the channels. A one-month record of ocean currents and temperature, sediment flux and surface wind was collected with moorings placed in Cambridge and Itirbilung Fiord by helicopter.

In general, active processes were found to behave differently from warmer temperature fiords (e.g. B.C. west coast), to the extent that predictive oceanographic models of the latter now in use for environmental concerns will have little application in Arctic fiords.

Small Craft Harbours

The Fishing and Recreational Harbours Act provides the Minister of Fisheries and Oceans with the authority to develop, maintain and operate some 2,400 federally-owned fishing and recreational harbours. The Small Craft Harbours Directorate, through regional directors located at Vancouver, Winnipeg, Burlington, Quebec, Halifax, St. John's and Memramcook, carries out this mandate.

The program objectives are to develop effective and efficient regional harbour systems directed at ensuring maximum economic and social benefits to Canada from the use of the commercial fishery, and to provide assistance in the provision of harbour facilities to the recreational boating and sports fishing sector through:

- the upgrading and maintenance of harbours by providing adequate protection, berthage, water depth, launching facilities and other harbour infrastructure services to satisfy user needs; and,
- the operation and management of harbours, collection of revenues and provision of property services responsive to program needs.

The Marina Policy Assistance and Tourist Wharf Programs give the thrust to the recreational program by providing harbour facilities for recreational craft through cost-sharing agreements with other levels of government and the private sector.

Federally-owned harbours comprise properties and facilities valued at some \$2.0 billion which are administered by Small Craft Harbours, including some 2,900 leases, licences and agreements. The implementation of an on-site Harbour Management System, through either appointed harbour managers or municipal leases at more than 600 of the most active harbours, has resulted in a marked improvement in the standard of operation and management at these locations.

Of the \$36 million regular program budget for 1983/84, \$32 million was allotted to commercial fishing harbour projects and \$4 million to recreational harbour projects.

Approximately \$3.5 million in regular program funds were directed to joint funding of Canada Works projects with the Department of Employment and Immigration. This resulted in improved harbour infrastructures and significant

employment of local labour, particularly in eastern Canada.

In addition to the regular program budget, \$68 million (made available through the Special Recovery Capital Projects Program and Special Employment Initiatives) was devoted to projects throughout the Small Craft Harbours systems.

As a direct result of receiving this large increase in capital funding, major harbour construction projects were undertaken at Hartley Bay and Prince Rupert in British Columbia; Belle River, Cobourg, Cornwall, Leamington and Port Dover in Ontario; Cap Chat, Cap-aux-Meules, Grande-Riviere, Matane and Ste.-Thérese-de-Gaspé in Quebec; Caraquet, Dipper Harbour and Point Sapin in New Brunswick; Alder Point, Dennis Point, Falls Point, Neils Harbour, Glace Bay in Nova Scotia; Graham's Point, Miminegash, and North Lake in PEI; and Port aux Basques, Codroy, L'Anse au Loup,

Port au Choix and Trout River in Newfoundland. Many of these projects are of two years duration and will be completed in 1984/85. The major capital purchase of the B.C. Packers fishing harbour at Steveston, British Columbia was completed

in 1983/84. The main focus in future years will be in the area of harbour maintenance and upgrading through regular funds and active participation in employment stimulation and regional development exercises.

Vessel Management

A major fishing trawler was purchased for conversion to a fisheries research vessel for the Pacific Region. It is expected that the vessel will be in service in 1985-86.

Two 25-metre patrol vessels constructed at Metemban, Nova Scotia, were accepted for operations in Newfoundland and the Bay of Fundy area around Grand Manan.

The conversion of CAPE HARRISON, a 38-

metre patrol vessel, to meet the hydrographic program needs for Quebec is being carried out. The vessel will be operational in July 1984.

Major emphasis was placed on a program for training and retention of ships officers. Recruiting by private industry for offshore development is a cause of concern which, it is hoped, can be countered by enhanced training and career prospects in the DFO fleet.

Communications

The Communications Directorate is responsible for the Department's information and public relations programs. This function is carried out by staff operating out of headquarters and regional offices across Canada.

Communications program officers, working closely with regional information staff and headquarters creative services staff, provide communications advice and support to all major sectors of the Department. This includes the provision of services such as communications planning, publications, audio-visual and exhibit production, graphic design, French quality control and coordination of advertising. In addition the Directorate is responsible for the coordination of ministerial correspondence, arrangements for DFO-sponsored conferences and the Parliamentary Relations unit. It also administers the Access to Information Act and the Privacy Act for the Department.

During the year the headquarters Communications Directorate completed some 410 writing, publishing and graphics projects, including 129 publications and more than 150 press releases, speeches and backgrounders. Staff also produced a number of films and audio-visual packages for departmental clients and provided a range of services in support of special events such as the 75th Anniversary celebrations at the Pacific Biological Station, Nanaimo, B.C. and the St. Andrew's Research Station, St. Andrews, N.B. and an Open House at the Canada Centre for Inland Waters, Burlington, Ont.

Communications initiatives included regional newsletters informing the fishing industry of departmental policies and programs, annual regional reviews summarizing the major achievements for the year, communications programs utilizing slide shows, brochures and presentations on fishing technology improvements, news releases and media relations. Major projects included coordination of communications and media relations for the National Aquaculture Conference held in St. Andrews in July 1983, the announcement of the annual groundfish fisheries management plans, communications programs in support of the resumption by the federal government of responsibility for Quebec's marine fisheries, announcements of new management initiatives for the Pacific Salmon fisheries and also in support of the fish habitat manage-

ment program and acid rain research.

In the Ocean Science and Surveys sector, numerous communications activities were undertaken to celebrate the Centennial of the Canadian Hydrographic Service in 1983. An attractively illustrated book The Chartmakers: A History of Nautical Surveying in Canada 1883-1983 was produced through co-publication with the private sector and was highly successful. A film co-sponsored by the National Film Board Charting the Frozen Sea, was released in both languages. A range of audio-visual, publication, advertising and exhibit services were provided, including a major exhibit tracing the history of hydrography and charting in Canada which was developed for circulation across the country at all OSS establishments.

A special undertaking completed during the year was the Canadian Fish Cookbook. Attractively illustrated and providing detailed information on the handling and preparation of Canadian fish, together with recipes for all occasions, this co-publishing venture proved extremely popular with consumers.

Communications support through editorial and production services was also provided to the Marketing, International and Economic Development Directorates, as well as for various staff-related and other projects originating with Personnel and Finance and Administration directorates.