

1994 and '95 in Review

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The years 1994 and '95 were ones in which significant changes occurred in the organization and funding of the research and survey programs carried out at the Bedford Institute of Oceanography (BIO), the Halifax Fisheries Research Laboratory (HFRL), and the St. Andrews Biological Station (SABS). These changes were mainly driven by a major "Program Review" of federal programs in Canada. In addition, a merger of the Canadian Coast Guard with the Department of Fisheries and Oceans (DFO) on April 1, 1995, resulted in other changes, one of which was a decision to combine DFO's Scotia-Fundy and Gulf Regions into a single organization, the Maritimes Region. In the Department of Natural Resources, a major re-focusing of programs occurred and the Atlantic Geoscience Centre was renamed Geological Survey of Canada (Atlantic). In Environment Canada, the decision was taken to transfer both the Marine Wildlife Conservation Division and the Environmental Quality Laboratory from BIO to other locations.

Note that in the case of the coverage of DFO programs and achievements in this *Science Review*, the activities of staff at the Gulf Fisheries Centre, Moncton, New Brunswick are only partially included because the new DFO Maritimes Region was not established until the latter part of the review period.

Staff

A number of key staff changes occurred within the laboratories during the 1994-95 biennium. In January 1995, Mr. Stephen B. MacPhee, Regional Science Director, DFO, Scotia-Fundy Region, was transferred to DFO Headquarters, Ottawa to assume the position of Director-General, Canadian Hydrographic Service. He was replaced on an acting basis by Dr. James A. Elliott, Director, Physical and Chemical Sciences Branch. During 1995, John S. Loch, Regional Science Director, DFO, Gulf Region, was named as the new Regional Science Director for Maritimes Region, to take up the position as of 1 April, 1996. Subsequently he was named Regional Science Director of the new Maritimes Region. Within DFO the situation as at the end of this reporting period, i.e., December 31, 1995, was one of transition; the reader is referred to the Appendix, "Organization and Staff," which provides the situation as at April 1, 1996, by which time the new organization had become established. Among the changes that will be noted in DFO is the disappearance of the organizational units Biological Sciences Branch and Physical and Chemical Sciences Branch as a result of a process of "delayering."

Michael Keen, Director, Atlantic Geoscience Centre, 1977-88



Family, friends and former colleagues gathered on Tuesday, January 11, 1994, for a brief ceremony at the Bedford Institute of Oceanography to pay tribute to Dr. Keen's lifetime of achievements, and to mark the formal naming of Michael Keen Canyon. This undersea feature cuts the edge of the continental shelf east of the Grand Banks of Newfoundland, at the south end of the Flemish pass between Beothuk Knoll and Flemish Cap. Ranging in depth

¹ Note that Dr. D.B. Prior was the Director of the Geological Survey of Canada (Atlantic) during the review period, but he resigned in 1996 to take up an appointment with Texas A & M University, and was replaced on an acting basis by Dr. K.D. McAlpine.

from 1000 metres in the north to 3200 metres in the south, it is about 50 kilometres long and features a cross section comparable to that of the Grand Canyon at its deepest point.

Awards and Presentations

The following were among the awards and presentations involving staff of the laboratories:

- Dr. Ken Mann, Scientist Emeritus of the Habitat Ecology Division of DFO at BIO, received the American Society of Limnology and Oceanography (ASLO) "Lifetime Achievement Award" in 1994. He was the first recipient of this award that is to be presented annually to a scientist who has demonstrated long-term commitment to the field of aquatic sciences.
- Dr. Peter Jones, a marine chemist with DFO at BIO, was awarded an honorary doctorate degree of the University of Göteborg, Sweden in October 1994 in recognition of his work on the chemical conditions of the Arctic Ocean.
- Dr. Charlotte Keen, Geological Survey of Canada (Atlantic), was awarded the 1994 George P. Woolard award of the Geological Society of America in recognition of her outstanding contributions to the understanding of the development of continental margins. In 1995 she was awarded the Tuzo Wilson medal of the Canadian Geophysical Union.
- Dr. Peter Hacquebard, Scientist Emeritus with the Geological Survey of Canada (Atlantic) at BIO, was the first recipient of the Walter Bell Silver Medal, which was awarded at the Walter Bell Memorial Symposium on Paleobotany and Coal Science held May 28 - June 1, 1995, in Sydney, Nova Scotia.

Huntsman Award

The A.G. Huntsman Award for excellence in the marine sciences is administered by a private foundation based at BIO. It was first awarded in 1980, and up to the end of 1995, 17 persons had received the Huntsman Medal. One award was made during the period covered by this [Review](#), for 1994. The presentation and distin-



Dr. Boyle

guished lecture took place on Wednesday, January 18, 1995, at the Bedford Institute of Oceanography. Dr. Edward A. Boyle, Massachusetts Institute of Technology, Cambridge, Massachusetts was the recipient in the category of physical/chemical oceanography. He was selected for his fundamental work and leadership in developing an important discipline in marine geochemistry (paleo-oceanographic chemistry) that uses trace metal contents of foraminiferal shells to retrieve historical data on nutrients, productivity, and deep-water circulation of the oceans. The title of Dr. Boyle's distinguished lecture was, "The Ice Age Ocean Conveyor Belt: on, off, or somewhere in between."

Research and Survey Highlights

Examples of the research undertaken, together with some of the major events that occurred during the 1994-95 biennium, are outlined below by broad geographic region.

Gulf of Maine, Georges Bank, Bay of Fundy

Ascophyllum nodosum (rockweed), a fucoid alga, is the dominant intertidal seaweed of Atlantic Canada. It has been harvested for the past 33 years in southwestern Nova Scotia and southeastern New Brunswick. Halifax Fisheries Research Laboratory personnel undertook investigations to understand the relationship between

Ascophyllum canopy and associated macro-invertebrates. This study examined the abundance and diversity of invertebrates with respect to tide level and wave exposure, degree of canopy cover and underlying substratum. A 3D imaging technique was developed to provide a detailed, quantitative description of the habitat space created by the seaweed canopy. The effects of commercial harvesting on associated invertebrates, due to alteration of the canopy structure and density, were evaluated by comparative studies in commercially harvested beds as well as through manipulations of the canopy. The results are being used to develop rockweed management strategies to reduce or prevent negative impacts on the invertebrate community.

Research examining benthic changes around salmon mariculture sites in the Fundy Isles area of New Brunswick was undertaken during the review period. The aim of the project was to compare three different techniques for measuring benthic changes: organic carbon burial rates; benthic enrichment indices; and conventional grab sampling. Comparisons were made based on the results obtained and on the costs for each method. This project was a collaborative effort between the St. Andrews Biological Station and the Bedford Institute of Oceanography.

Among biological factors considered in fish stock evaluations, length-at-age is a useful indicator of how well individual fish are doing because it reflects the conditions the fish has experienced for feeding and growth, and can be obtained from many sources. For example, the new "sentinel" fisheries surveys conducted by the fishing industry may make contributions in this area soon, whereas several years may be needed before trends can be identified in catch rates. In most recent years, there are indications in a few stocks that biological factors may be improving. Compared to the early 1990s, since 1993 increases in length-at-age have been seen for eastern Georges Bank (5Z) haddock and some components of Northern cod. Traditional models used to predict abundance often do not take account of changes in important biological characteristics of fish stocks, such as length-at-age. As biologists expand

their studies and analyses, more of these biological factors are being included in the evaluation of stock status. This leads to evaluations which are more complex, but more biologically realistic.

A collaborative investigation was undertaken with scientists from the Woods Hole Oceanographic Institution and the University of Rhode Island to study vertical mixing and stratification, and their effect on the life history parameters of target species. The work was part of a joint Canada/US (GLOBEC) Global Ocean Ecosystem Dynamics program of the Northwest Atlantic and Georges Bank to examine the biological and physical processes affecting recruitment of important species.

One important source of new environmental information to be examined by the Georges Bank Environmental Review Panel (established to reconsider the issue of exploratory drilling on the bank), is a multidisciplinary research program on the fate and effects of drilling wastes that is being carried out at the Bedford Institute of Oceanography. With funding support from the federal Program on Energy Research and Development (PERD), DFO and contract scientists have been carrying out a number of closely coordinated field, laboratory, and modeling studies. These are addressing the physical oceanography and sedimentology of Georges Bank, the flocculation behaviour of drilling wastes, and the sublethal effects of drilling wastes on the sea scallop *Placopecten magellanicus*, which is the most important commercial species on Georges Bank.

Through collaborative research (DFO, Dalhousie University and Institute for Marine Biosciences), a set of molecular DNA markers has been developed with which to examine the population genetics of sea scallops. Each of the three types of markers, cDNA probes, single-locus microsatellites, and RAPD markers, reveal a high level of genetic variability among individuals. Among the features of these markers, the microsatellites require only a small amount of DNA to produce a reaction: a protocol was developed which will allow individual scallop larvae (less than 0.02mm) to be genotyped. Local scallop hatcheries are currently using this technology for such

applications as determining the parental contribution of different spawning sets, the level of inbreeding in their stock and tracking the yield and growth performance of selected pedigrees.

St. Andrews Biological Station has been sampling phytoplankton populations in the Southwest Bay of Fundy since 1987. All algal species are monitored, with the main focus being those species that produce toxins or cause harmful effects. During 1988, domoic acid was detected in shellfish and plankton, the algal species implicated being the diatom, *Pseudo-nitzschia pseudodelicatissima*. Although *P. pseudodelicatissima* has been an annual occurrence, concentrations were considerably higher during 1988. Analysis of 1995 samples, however, showed similar densities. *P. pseudodelicatissima* numbers in excess of one million chains of cells/litre were observed on August 22 and August 29, 1995. The DFO Fish Inspection Branch was notified and sampling of soft-shell clams and blue mussels from the New Brunswick coast of the Bay of Fundy for domoic acid was initiated. Domoic acid was detected from shellfish extracts and, on September 1, the regulatory level of 20 ppm was exceeded. This resulted in the suspension of shellfish harvesting in the southwest Bay of Fundy.

The evolution toward co-management of fisheries will have considerable, and as yet unknown, impacts on science programs of DFO. In a novel project during the summer of 1995, staff from the herring team at the St. Andrews Biological Station gained experience in responding to the challenge of in-season management. While DFO staff have a long history of close cooperation with the Scotia-Fundy herring industry, this new experiment during the summer of 1995 involved working with the industry to respond to biological signals from the fishery in real time. The experiment resulted from concern and uncertainty regarding the status of the major 4WX herring stocks. The move improved the record of information from the fishery, e.g., a series of surveys of major spawning areas using commercial vessels documented the number, location and size of herring schools. Resulting in improved protection of components of the fishery, a similar management system was recommended for future years.

Scotian Shelf

A research project of BIO physical oceanographers completed the task of compiling geographic parameters such as average depth, width, length, volume and surface area for 104 inlets along the Atlantic coast of Nova Scotia and elsewhere. These parameters were used to sort inlets with similar characteristics into groups where the circulation and climatology may be similar. This will enable investigators to infer the circulation and stratification for inlets that have not yet been sampled but that are part of a group for which some studies exist; and also to help focus future field work on inlets for which more detailed information is needed.

In 1994, the Geological Survey of Canada (Atlantic), in the first year of a three-year program funded under the joint Nova Scotia Mineral Development Program, surveyed part of the Scotian Shelf to assess offshore sand and gravel deposits. The resource potential was confirmed using investigations with high resolution seismic and side scan sonar data. In addition, bulk samples were collected for material strength testing.

Ecosystem considerations of the eastern Scotian Shelf cod stock include reviews of grey seal predation. This was first done in 1993 using information on the composition of grey seal diets collected between 1989 and early 1993. The proportion of cod (mostly less than 4 years old) in these samples did not indicate a trend over the sampling period. Given the low and declining biomass of cod, it was considered likely that grey seals would reduce their predation on cod in favour of more abundant prey. However, samples collected from Sable Island between the summer of 1993 and January, 1996 show that the proportion of cod in the diet, although variable among samples, has shown no trend over the five years of sampling on the Island. The mean percentage of cod in the grey seal diet has remained at about 15%. Given that the grey seal population has continued to increase at the same rate as previously measured, the average estimate of consumption of 4VsW cod by grey seal is 17,700t in 1995; an increase of 12% over 1994. This increase in a significant cod predator is coincidental with an apparent period of low production and re-

production for cod, thus increasing the ecological pressure on the cod population.

For the past several years, DFO scientists have collected detailed temperature data from selected inlets along the Atlantic coast of Nova Scotia in support of aquaculture. The data are used in two ways. The first is to define the climate of the inlets to determine which species could be cultured; the second is to determine the flushing of the inlets by the waters of the adjacent continental shelf. The temperature recording instruments are tended on a six-month schedule, usually in May and November.

A project to transfer the Canadian Shelf Climate Database to a more formal relational database management system was completed in 1994. The database, consisting of over 425,000 profiles and 9 million observations, is the most comprehensive assembly of temperature and salinity observations available for the Canadian east coast. The conversion has made it much easier for scientists to extract and analyze the data and has reduced the effort required to maintain and update the database.

BIO marine chemists completed a mission to the Scotian Shelf in the fall of 1994, the purpose of which was: (1) to study processes controlling the transport of organic carbon and particle-associated chemicals (which include most contaminants) in the ocean; (2) to further investigate the environmental effect of drill waste dispersion around the Rowan Gorilla III oil rig (Cohasset Field, Sable Island Bank); and (3) to collect samples for a monitoring program aimed at predicting the influence of environmental conditions on fish stocks on the Scotian Shelf.

Scientists from the St. Andrews Biological Station, together with colleagues from Australia and the United States, worked with fishermen from the St. Margarets Bay Tuna Association in Nova Scotia in a field study during mid-August 1995. This study examined the use of external archival tags (miniature data loggers) on bluefin tuna.

The Canadian Hydrographic Service at BIO, together with other partners, has carried out high resolution multi-beam surveys

for projects in the Atlantic coastal zone area. Using the vessels *FCG Creed* and *DOL-PHIN*, the work included mapping corridors for underwater communications cables from Nova Scotia to Newfoundland, and from Nova Scotia to the edge of the Scotian Shelf for transmission overseas. Another survey was performed for the Sable Island Offshore Energy Project to provide data in support of undersea pipeline routes.



FCG Creed

The Arctic surfclam, *Mactromeris polynyma*, is a large clam (75-125 mm), similar in appearance to the more common Atlantic surfclam. The main distinguishing feature is that most specimens have a purple color in the foot and mantle that turns red upon cooking, similar to lobster and shrimp. It is found in both the Atlantic and Pacific oceans in medium to coarse sand bottom. In the Atlantic there are commercial fisheries on Banquereau Bank and the Grand Banks. The fishery on Banquereau Bank started with developmental surveys conducted by DFO scientists in 1980-83. After a three-month test fishery, a commercial fishery was managed with a TAC/EA program and limited entry. It is now conducted by 3 large (60 m) freezer processors using hydraulic dredges. The fishery targets clams in the 10-15 year old age range for the sushi and surimi market in Japan. The value of this fishery increased from zero in 1985 to approximately \$35 million in 1993, and created jobs for 480 persons.

Biological and physical oceanographers from BIO collaborated in a research program directed at assessing effects of changes in climate (past, present and future) on physical and ecological processes

on the Scotian Shelf. Studies included a field program to identify and characterize supply sources of zooplankton to the Scotian Shelf (e.g. Gulf of St. Lawrence, Labrador Current and The Shelf Basins) and the development of a model based on newly collected and historical data.

In early 1994 a new group was established comprising fishermen and scientists with the objectives of improving communication between members of the two professions, sharing information and ideas, and jointly launching research projects on problems of mutual interest. Known as the "Fishermen Scientists Research Society," it initially covered the Eastern Shore area of Nova Scotia. In the August 10, 1994 issue of the *Globe and Mail*, an article under the heading "Conservation: fishermen are gathering valuable data about cod and haddock stocks for a former antagonist - federal scientists," the federal Fisheries Minister, Brian Tobin, was quoted as saying: "It has looked to me many times that the fishermen were on one team and DFO was on the other; and each team spent a great deal of its time trying to figure out how to outwit the other....Now we have fishermen and scientists working on the same team."

Gulf of St. Lawrence

In July 1994, GSC (Atlantic) participated in an expedition on the *Edwin Link* in the Saguenay Fjord, Québec. One purpose of the mission was to use a submersible to investigate the age of several turbidite channels discovered about a year previously near the mouth of the North Arm of the fjord. The observations indicate that the channels were not formed as a result of the 1988 Chicoutimi earthquake, but may be related to a major collapse of fjord basin sediments that is believed to be associated with a large earthquake that occurred in this area in 1663. A second purpose of the expedition focused on observations of sea floor communities in the North Arm and their recovery in response to the cessation of industrial waste discharge (pulp mill organic waste) in the early 1970s. Visual observations did not detect any anoxic bottom areas in the middle part of the arm or any indications of sulphur bacteria colonies.

In 1994 and 1995, Halifax Fisheries Research Laboratory staff worked with the *Chondrus* buyers and harvesters to design an experimental harvest for *Furcellaria fastigata* off western Prince Edward Island, "The World's Capital of Irish Moss". The purpose of the study was to determine the impact of drag raking on *Furcellaria* regrowth and recruitment.

Towards the end of the review period there was increasing scientific activity by DFO staff in association with the submerged wreck of the *Irving Whale* oil barge off the north coast of Prince Edward Island, and its planned recovery. Among projects undertaken, snow crabs collected in the vicinity of the wreck of the *Irving Whale* and at a control site were analyzed for polychlorinated biphenyls (PCBs). The results were used to develop a baseline for assessing the consequences of recovering the submerged wreck, which contained PCBs in the oil heating system.

Grand Banks, Labrador Sea

A team of DFO scientists undertook field observations of the Labrador ice pack off Cartwright, Labrador. Poor weather conditions made helicopter operations difficult and although ice conditions were heavy, swells moving through the ice pack broke up the large floes making it difficult to locate safe landing sites. Despite these difficulties, data on ice thickness and type were collected both on the ice and through an airborne electromagnetic ice thickness sensor during three different overpasses of the ERS-1 satellite from which SAR imagery was obtained. These data have allowed the development and validation of algorithms to estimate ice thickness and type from the satellite SAR missions. In addition, beacons were set at various locations across the ice pack and temperature and salinity

profiles of the water column obtained at each location. These data were used to test and validate ice-ocean models that predict the movement, and formation and decay, of the ice pack off Labrador.

During the summer of 1994 CSS *Hudson* completed the occupation of the World Ocean Circulation Experiment (WOCE) repeat section across the Labrador Sea. This year, the eastern end of the section was free of ice so that stations could be occupied right onto the east Greenland shelf. On the Labrador side, ice was encountered as the vessel crossed the 400 metre isobath, thus terminating the transect at the inshore edge of the offshore branch of the Labrador Current. This section measures the amount and characteristics of oceanic convection that has taken place in the Labrador Sea during the previous winter. The Labrador Sea is the source region of one of the components of the thermohaline overturning cell of the North Atlantic and may be responsible for observed interdecadal variability in North Atlantic waters and climate.

The Geological Survey of Canada (GSC) Atlantic has recently designed and put into operation a coastal information system to manage and distribute coastal geomorphologic data. This project, using commercial GIS software, was initiated through in-kind cooperation with the Government of Newfoundland and Labrador, and is now continuing via in-kind and financial support from Environment Canada and the Province of Nova Scotia. GSC scientists have mapped the coastline for 22 national topographic series map sheets (at a scale of 1:50,000) and plan to continue mapping throughout the Atlantic Provinces in collaboration with provincial and federal departments.



BRUTIV Vehicle

During June 24 to July 3, 1995, the CSS *Hudson*, working together with the CSS *Wilfred Templeman*, carried out the fourth and final mission in the trawling impact experiment being conducted on the Grand Banks of Newfoundland. This year's program included a further sampling, by the *Parizeau*, of the experimental corridors trawled in 1994, in order to again evaluate what effects could still be discerned one year after the second trawling event. After the *Parizeau* completed this sampling, the *Wilfred Templeman* re-trawled the experimental corridors in the same manner as in 1993 and 1994. The *Parizeau* then carried out post-trawl sampling in the same manner as before. Successful modifications to the BRUTIV vehicle permitted its first use since 1993 in providing video imaging of trawled and untrawled corridors. The data from this and earlier missions in the series will provide quantitative information on the immediate, short-term, and longer-term effects of otter trawling in benthic marine environments.

Arctic

Geological and geophysical investigations in Hudson Strait and Ungava Bay were carried out in October and November, 1993 by GSC (Atlantic) in collaboration with researchers from Centre Géoscientifique du Québec, Université du



Irving Whale



CCGS Louis S. St. Laurent at the North Pole

Montréal, and University of Colorado. Cruise objectives were: delineation of the late Quaternary geology and history of the region, and acquisition of data relating to global climate change; and collection of gravity and magnetic field data in Ungava Bay.

BIO marine chemists participated in an expedition aboard the Russian research vessel *Geolog Fersman* in the Barents and Kara Seas. During this cruise, the vessel discovered a sunken vessel believed to hold radioactive waste containing in excess of 200 Curies of 'Strontium-90 equivalent' according to the so-called "White paper" released by the Russian Federation in early 1993. DFO scientists participated in this cruise as part of a series of survey activities being carried out in cooperation with Russian, Norwegian and US agencies. Sediment samples were collected over a wide area and returned to BIO for analysis for radionuclides.

The CCGS *Louis S. St. Laurent*, with five scientific staff from Scotia-Fundy Science on board, reached the North Pole at 1200 hours Atlantic time on 22 August, 1994. It battled through heavy ice over the Lomonosov Ridge at 88°51'N, but finally made it to the pole. The *Louis S. St. Laurent* is the first Canadian ship to reach the North Pole and the event was celebrated with a High Arctic barbecue in addition to other ceremonies. DFO staff collected samples at the North Pole for the radionuclides

Cesium-137, Plutonium, Iodine-129, Americium, and Strontium-90. Also at the North Pole they found Eurasian Basin water with a maximum temperature of 1.5°C which is 0.7° higher than in the Makarov Basin. A scientist collecting conductivity, temperature and depth (CTD) profiles several miles from the ship and traveling by helicopter discovered an uncharted seamount near the Lomonosov Ridge.

BIO scientists completed a 1994 study on the summer distribution of sea ice meltwater and river run-off, and surface circulation, in Foxe Basin, Hudson Bay and Hudson Strait using the oxygen isotope method. It was found that the reduction of surface salinity in summer in Foxe Basin is predominately due to sea ice meltwater and that river run-off and sea ice meltwater contribute equally to the surface layer in northern Hudson Bay. Oxygen isotope data provided new information on the surface circulation in northern Hudson Bay and Foxe Basin.

Offshore and International

During 1994, GSC (Atlantic) scientist David Piper completed two months at sea as Co-Chief Scientist of Leg 155 of the Ocean Drilling Program. The drill ship *Joides Resolution* drilled 34 holes on the rapidly accumulating sediments 300-500 kilometres seaward of the mouth of the Amazon River. These provided, for the first time in an equatorial area, a record of ocean and continental climate change over the

past 60,000 years with a resolution of about ten years. Until now, the only proxy climatic records of similar resolution have come from the Greenland ice sheet. Such records allow an assessment of the processes leading to rapid climatic change and will eventually improve our predictive capabilities for changes in climate on the scale of decades.

DFO scientists participated on a five-week autumn 1994 cruise to the Labrador Sea and the Irminger Sea on the German Research Vessel *Meteor*. *Meteor* was carrying out a fall occupation of WOCE repeat sections AR7W and AR7E across the Labrador and Irminger seas from Labrador to Greenland to Ireland. BIO staff have been involved in occupying AR7W each spring since 1990; this fall occupation contributed to the better documentation of the winter transformations of water masses in this region.

Biological oceanographers from BIO completed a three-week mission aboard *CSS Hudson* to the northwestern Atlantic during the summer of 1995. The mission's primary objective was to map the broad-scale distribution of phytoplankton and zooplankton (and their physical-chemical environment): (1) on the Nova Scotian, Newfoundland and southern Labrador shelves; (2) in the Labrador Sea; and (3) in the open North Atlantic between Greenland and the Sargasso Sea.

Non-Site Specific

Software developed by the Canadian Hydrographic Service (CHS) is putting



The drill ship Joides Resolution



MV-CTD probe

Canada on the map in the field of information technology. CHS's Spatial Data Option (SDO), an extension of the Oracle database software, enables scientists to access and manage huge volumes of multi-dimensional data about a wide range of geographical subjects. Herman Varma, a CHS hydrographer at BIO, developed the ground-breaking technology. The software was then evaluated and implemented by a team at CHS in Ottawa. For the past several years the group has monitored the technology in a specialized testing laboratory set up by the Oracle Corporation in Hull, Quebec. The technology has gained international attention. CHS has met with interested hydrographic agencies, spatial data producers and users in related fields, such as genetics and the environment, from several countries. At least four leading GIS and desktop mapping suppliers have announced new products based on a close integration of SDO technology.

A further step in the development of a moving vessel conductivity/temperature/depth (MV-CTD) probe, was accomplished during the review period. The stability of the MV-CTD fish was tested from the swath vessel, *Frederick G. Creed*, for the high towing speeds expected on container ships. It was towed in the wake of the vessel at a speed of 22 knots without any signs of instability. This is a joint development project

with a Dartmouth, NS company, Brooke Ocean Technology Ltd.

An experiment was undertaken to determine the effects of ambient temperature on cod egg development, hatching and larval yolk utilization. Temperatures ranged from 1°C to 8°C. A similar experiment was performed on haddock. The experiments were conducted at the St. Andrews Biological Station to investigate the potential aquaculture of these species, as well as for understanding their biology in the wild.

Tests were conducted by members of the St. Andrews Biological Station to determine the lethality of a pyrethrum formulation to larval stages of the American lobster. Pyrethrum is a group of naturally occurring compounds with high insecticidal activity, commonly referred to as pyrethrins. They are extracted from certain species of *chrysanthemum*. The formulation under investigation had been proposed as a treatment for sea lice infestations of farmed salmon.

The development of a moored instrumented platform for monitoring the concentration of particulate material around offshore petrochemical rigs continued during the review period. The platform includes sensors to monitor the concentration of bulk suspended particulates, a digital camera system to photograph flocculated material, as well as a current meter capable of measuring turbulence. The final platform will include a telemetry system to transmit its data either to a nearby rig or to shore via a satellite transmitter in a surface buoy.

In 1995, BIO scientists released an ocean data inventory system. This is an integrated software and database package that contains information on the current meter, thermograph and thermosalinograph holdings of Maritimes Region, DFO, from the waters of eastern Canada. The inventory contains information from over 4000 current meters and 2200 thermograph deployments. The package allows users to identify when and where moored time series information was collected and to display each record, as well as providing monthly statistics from these records.

Appointments

Staff were appointed to a variety of national and international memberships and positions during the review period, including the following:

- Mike Bewers, DFO at BIO, was appointed a member of the Joint Scientific and Technical Committee for the Global Ocean Observing System (GOOS).
- Allyn Clarke, DFO at BIO, was elected Vice-Chairman of the Joint Scientific Committee for the World Climate Research Programme (WCRP). He was also appointed a member of the Joint Scientific and Technical Committee for the Global Ocean Observing System (GOOS).
- Brian Nicholls, DFO at BIO, was appointed Chairperson of the Coastal Zone Canada Association at the first meeting of this new non-governmental organization.
- Mike Sinclair, DFO at BIO, was appointed Chairperson of the Scientific committee on Oceanic Research (SCOR) Working Group on the Impact of World Fisheries Harvests on the Stability and Diversity of Marine Ecosystems.
- Rob Stephenson, DFO at the St. Andrews Biological Station, was appointed Chairperson of the ICES Pelagic Fish Committee.

Conferences and Workshops

During the review period, the following conferences and workshops were among several held at, or sponsored in whole or in part by, the Regional facilities:

- Symposium on cod and environmental change—This special event was held at BIO in February, 1994 to review the situation of groundfish (with an emphasis on cod) in the waters of the east coast of Canada. The event was open to the public.
- Annual Meeting of the American Fisheries Society—The 124th Annual Meeting was held in Halifax in August, 1994. The Local Arrangements Chairperson was Peter Amiro of DFO's Diadromous



Minister of Fisheries Brian Tobin attending CZC'94

Fisheries Division. Over 1000 delegates attended this international event.

- Coastal Zone Canada '94—This international conference was held in Halifax in September, 1994. The conference was co-chaired by Brian Nicholls, DFO at BIO, and Larry Hildebrand of Environment Canada. 750 delegates attended from over fifty countries.
- Workshop on Modeling the Environmental Interactions of Mariculture—This workshop, organized under the auspices of the ICES Working Group on Environmental Interactions of Mariculture, was held at BIO in 1995. Over 30 researchers from eight countries participated.
- Aquatic Toxicity Workshop - This annual national workshop, the 22nd in the series, was held in St. Andrews in October 1995, and was hosted by the St. Andrews Biological Station.

Partnering and Technology Transfer

Partnering and technology transfer events and highlights during the review period included the following:

- In June, 1995, the Canadian Hydrographic Service at BIO, along with several local

agencies and businesses, participated in an "Ocean Information Technology Showcase." This event was held at the same time as the Halifax G-7 Summit meetings to promote Canada's competence in oceans-related technologies.

- The Geological Survey of Canada's marine program has improved its ocean and sea-floor mapping capability using digital techniques. A key factor has been the development of a new digital data logging system in collaboration with the private sector. GSC Atlantic contracted MUSE Research, an electronics company in Ontario, to build a shipboard acquisition and laboratory processing system which would serve GSC mapping missions for coastal and offshore resource and environmental applications. This project is one example of successful GSC technology partnering with the Canadian marine industry, which has resulted in commercial competitive systems such as AGCNAV (Xon Digital Communications Ltd.); ocean vibrocorer (Brooke Ocean Technology Ltd.); Arktos coastal survey vehicles (Watercraft Offshore Canada Ltd.); and swath mapping data correction (Applied Analytics Ltd.).

- In 1995, Focal Technologies Inc., Dartmouth, NS announced that sales of its optical plankton counter (OPC) surpassed the \$1 million mark. The OPC, an instru-

ment used to monitor and assess zooplankton in east coast waters, was developed by DFO at BIO during 1985-89 and the technology transferred to Focal during 1989-90. Among other optical-electronic products, Focal currently manufacture the OPC under DFO license. BIO continues to partner with Focal on co-developing new technology required for DFO monitoring program needs.

Visitors

As in previous years, the regional establishments received many special visitors from Canada and abroad. Of particular interest were the visits by the following:

- April 28, 1994—Vice-Admiral José Sarmiento Gouveia, Portuguese Hydrographer, visited BIO.
- August 12, 1994—Joint Government/Industry fish disease delegation from Australia visited the Halifax Fisheries Research Laboratory.
- August 15, 1994—Delegation of Cuban fisheries scientists visited the St. Andrews Biological Station.
- August 22, 1994—Dr. Stan Dromisky, M.P., visited BIO for discussions on the Canadian Environmental Protection Act (CEPA).
- October 24, 1994—Dr. Max M. Tilzer, Director, Alfred Wegener Institute for Polar and Northern Research, Bremerhaven, Germany, visited BIO.
- November 15, 1994—Rear-Admiral Garnett, Commander of Maritime Forces Atlantic, visited BIO.



Ocean Information Technology Showcase

- May 19, 1995—A party of 13 fisheries scientists from Indonesian universities and other institutes visited BIO.
- June 17, 1995—Mrs. Yeltsin (wife of the President of Russia) paid a private visit to BIO during the G7 Summit Meetings in Halifax, June 14-17.
- October 4, 1995—Mr. Arnaldo Macaya, former president of the Chilean Salmon and Trout Growers' Association, visited the St. Andrews Biological Station
- November 3, 1995—Prof. T.J. Lam, Department of Zoology, National University of Singapore, visited BIO.

Facilities and Support Services

The decision was taken during the reporting period to close down the Halifax Fisheries Research Laboratory facilities and to transfer the staff to the Bedford Institute of Oceanography, the Gulf Fisheries Centre, and the St. Andrews Biological Station. As at December 31, 1995, planning was actively proceeding towards this end. This decision was taken in order to consolidate Regional research programs at a smaller number of sites and because the facilities at the Halifax Fisheries Research Laboratory are in need of urgent and major renovation. As a cost-cutting measure, the decision was taken to work towards the gradual devolution of DFO's salmon hatcheries to external organizations and private industry. These hatcheries are part of the DFO Maritimes Region Science organization.

Publications

The establishments reach their respective clients and customers through a variety of means, including journal articles, reports and nautical charts. During 1994 and 1995, the published output of the establishments continued at a high level. Full details are provided in the Appendix of this Review entitled "Charts and Publications." Selected highlights are noted below:

Oceanographic Wall Chart #8 covering the Eastern Canadian Arctic, was published in March 1994. The chart illustrates both the surface circulation and salinity fields, as well as regions of permanent ice cover and iceberg calving areas along the west



coast of Greenland. Inset schematic diagrams depict important physical processes of the region. The chart was produced in English, French and three native dialects (Cree, Northern Quebec and Eastern Arctic Inuktitut).

A monograph on dinoflagellates co-authored by a team of geologists and biologists from government, industry and academia, led by Dr. Robert Fensome of GSC Atlantic at BIO, was awarded the Paleontological Society's 1995 Golden Trilobite Award in recognition of excellence in a paleontological publication.