Northwest Atlantic Fisheries Organization

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SCIENTIFIC COUNCIL MEETING - JUNE 1991

Canadian Research Report for 1990

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Section I. Scotia-Fundy Region

by

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Subarea 4: Divisions 4V-W-X

A. Status of the Fisheries

Nominal landings and TAC's from 1986 to 1990 for major stocks currently being assessed in the Scotia-Fundy Region are given in Table 1.

B. Special Research Studies

1. Environmental Studies

(a) Hydrographic

Physical oceanographic observations were obtained in support of ice forecasting and continuing climate studies. Several projects exploring the relationships between hydrographic features and fish distribution continued, including the joint Canada-USSR field study concentrating on Silver hake, and ongoing Canadian studies on the influence of the physical environment on survey catches.

(b) Plankton

A major JGOFS (Joint Global Ocean Flux Study) cruise was undertaken to study the dynamics of the spring phytoplankton bloom in the open waters of the North Atlantic. In climate-related research, planning centred on including process models of phytoplankton production into global-scale numerical ocean circulation models. Research was initiated to confirm the existence of extremely abundant, but presumably non-living, sub-micron marine particles. Advances were made in understanding the physiology of domoic acid production by Nitzschia pungens, and inshore monitoring programs for harmful marine algae continued. Previous findings of extraordinarily abundant zooplankton populations in basins on the Scotian Shelf were extended through analysis of data collected by various means (multi-frequency acoustics, electronic bug counter, net catches, etc.) under contrasting conditions.

(c) Benthic Studies

Habitat related research included work on inshore clam habitat management, and the impacts of aquaculture on the benthos below salmon sea cages. Research activities on benthic/pelagic exchanges continued.

2. Biological Studies by Species

(a) Cod

Plans were completed for a major ecological study on the Eastern Scotian Shelf (4VsW). The research involves DFO and university personnel within several research programs, including the Eastern Shelf Program (ESP), spearheaded by DFO Scotia-Fundy, and the Ocean Production and Enhancement Network (OPEN), involving university and government researchers, in a comprehensive, multidisciplinary, multi-institutional approach to the biological and fisheries problems surrounding cod in the area.

(b) Haddock

Further results from the Southwest Nova Scotia Fisheries Ecology Program on the population dynamics of haddock were published. Work on alternate assessment methods and regulatory procedures (mesh size, closed area, overcapacity) was largely directed at the haddock fishery. Results of mitochondrial DNA analyses for Northwest Atlantic haddock populations were published. Haddock stock assessments utilized the ADAPT methodology of SPA calibration developed in the region and adopted for many assessments on the Atlantic coast. Another pelagic juvenile haddock survey was conducted in Subdivision 4X.

(c) Pollock

Analysis continued on previous exploratory acoustic cruises to determine the feasibility of acoustic stock assessments. A recruitment study continued by obtaining information from mackerel trap fishermen in St. Margaret's Bay on juvenile pollock catches. A ROV was used in an attempt to determine pollock movements in relation to tidal cycles, food organisms, etc.

(d) Flatfish and Atlantic Halibut

Various analyses were completed, including working papers describing halibut stock structure and abundance, flatfish migrations, and comparisons of Atlantic and Pacific halibut biology.

(e) Redfish

The completion of an age validation study resolved a longstanding controversy regarding redfish longevity. Work continued on redfish stock structure using genetic (mitochondrial DNA) and morphometric (gas bladder musculature) methods.

(f) Silver Hake

The joint Canada-USSR research program to investigate the role of ocean features on commercial silver hake catches continued with a cruise in June. Initial results suggest that S. hake do respond to changes in bottom temperature and prey densities. Feeding studies of 0-group juveniles were published, and indicated that S. hake are cannibalistic in the early juvenile stages. Work also continued on determining feeding rates in relation to prey abundance in the deep basins.

(g) Herring

A number of continuing herring surveys were successfully

completed, including the larval surveys in the Bay of Fundy and Georges Bank, and the acoustic biomass survey in Sydney Bight. The purse seine log book program continued. A number of stock identification/movement studies are on-going, including examination of the Bay of Fundy, Georges Bank and 4T/4Vn linkage. Results of previous studies on vertical movements of larvae, acoustic surveys, and stock identification were analysed and published.

(h) Large Pelagics

Participation in ICCAT increased as the large pelagic research program initiated last year continued to develop. The program has relied heavily on industry involvement, especially for commercial sampling, research vessel surveys and hook selectivity studies.

(i) Seals

The Bulletin on the International Sealworm Workshop published during the year represents a synthesis of knowledge of seal population dynamics and interactions with fish and sealworms. Field programs included grey seal production estimates on Sable Island and the harbour seal survey in the Bay of Fundy. The seal energetics program concentrated on examining growth processes during the first year of life. Seal-sealworm interaction studies continued.

(j) Lobster

A review of offshore lobster larval distribution and oceanography along with other aspects of lobster biology, including a synthesis of all available information, suggested possible relationships between the inshore and offshore lobster populations during a special workshop on the topic. Considerable effort was put into examining the habitat effects of salmon aquaculture on the lobster fishery. Assessment related research on various aspects of lobster biology in specific management areas were carried out.

(k) Scallops

Diel vertical migration of sea scallop larvae over an offshore bank and in a shallow bay were described. Gene sequencing of the sea scallop has resulted in the description of the 18s rRNA gene, a first for molluscs. A graphic age-based ADAPT model using index ages was implemented and graphic tuning software was developed to enhance assessments.

(l) Marine Plants

Rockweed assessment indicated severe overharvesting in parts of western Nova Scotia and the Annapolis Basin. An experimental study showed that commercially important species rarely frequent the extensive, intertidal rockweed zone of SW Nova Scotia. The ecological impact of Maritime marine plant harvesting practices was reviewed - evidence points to the resilience of these macrophytes species.

3. Gear and Selectivity Studies

Measurements continued during standard groundfish surveys and experimental surveys to measure the performance characteristics of the Western IIA survey trawl. Considerable effort was put toward improving groundfish survey results through routine mensuration during regular survey sets and other aspects of quality control. Additional experimental work and data analyses on the selectivity of square vs. diamond mesh netting for various species were carried out and results used in formulating mesh size regulations. An extensive review of lobster and crab trap efficiency and selectivity was completed.

Subareas 5 + 6

A. Status of the Fisheries

Nominal landings and TAC's from 1986 to 1990 for major stocks currently being assessed in the Scotia Fundy Region are given in Table 1 above.

B. Special Research Studies

1. Environmental Studies

(a) Hydrographic Studies

The Georges Bank Frontal Study, which includes an important physical oceanographic component, entered the data analysis and synthesis phase. Results are expected to be published next year.

(b) Plankton Studies

Plankton data obtained previously during the Georges Bank Frontal Study continued to be analysed. Work on scallop and lobster larvae associated with this project was published. Another plankton survey was conducted on the bank to monitor the apparent resurgence of the herring stock. A new program on recruitment processes for Gulf of Maine gadids will concentrate on early life history, particularly as revealed through otolith microstructure and laboratory rearing studies.

(c) Benthic Studies

Research on the sublethal effects of drilling wastes on scallops and benthic habitat in the Georges Bank area continued.

2. Biological Studies by Species

(a) Cod

An assessment using the new 5Zjm management unit was completed. Results of cod interactions between 4X and 5Y suggest substantial movement only within the Bay of Fundy. Additional stock interaction studies on Georges Bank were planned.

(b) Haddock

An assessment was completed and results supported the use of the new 5Zjm management unit. A formulation of the ADAPT methodology was implemented which incorporated information from the three available survey series and weighted their contribution according to how well each fit the SPA results.

(c) Herring

In addition to the larval survey monitoring stock resurgence, an experimental acoustic survey was conducted for herring and groundfish on the northeast slope. No herring and few groundfish echos were observed, although both were caught in trawl sets. It was concluded that the October survey time and the bottom discriminatory ability of the acoustic gear were unsuitable. Research in the area was consolidated and enhanced in anticipation of assessment and management requirements for the resurging herring stock.

(d) Scallops

Field work for a 2 yr study on Georges Bank juvenile scallops was completed with a study on juvenile settlement. The ability to analyze survey data and incorporate it into assessments was substantially enhanced through software improvements and enhancements.

Section II. Gulf Region

by

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A. STATUS OF THE FISHERIES:

1. **Southern Gulf Cod (4TVn):**
The Total allowable catch was 53,000 tonnes. Provisional landings were 49,000 tonnes. France was allocated 1,360 tonnes and a catch of 917 tonnes was reported. The winter fishery (4Vn) represented 19% of the landings. Fixed gear landings were the lowest in the period 1965-90. The standardized Otter trawl catch rate decreased slightly over 1989. Research survey estimates (age 3+) also declined over 1989. The mean population biomass appears to have been stable since 1984 and at the highest level since the mid 1950's. Fishing mortalities on the stock have been reduced in recent years to 0.2-0.25 from 0.3-0.7 previously.

2. **Southern Gulf American Plaice (4T):**
The annual total allowable catch for this fishery has been 10,000 tonnes since 1977. Provisional landings in 1990 totalled 4,600 tonnes representing a decline of 400 tonnes from 1989. The proportion of the total landings taken by directed effort has increased from 21% in the early 1980's to over 50% at present. Catch of small fish continues to be a problem with up to 50% by weight of the catch being discarded. The abundance index from research vessel surveys suggest that stock biomass has declined substantially since the late 1970's to become relatively stable since 1984. The recent catches from 4,500 to 9,000 tonnes are thought to be close to the $F_{0.1}$ level.

3. **Southern Gulf White Hake (4T):**
The total allowable catch for 1990 was 5,500 tonnes with provisional catches totalling 3,730 tonnes. Precautionary TAC's of 12,000 tonnes were set from 1982 until 1986. Concerns that precautionary TAC's allowed the stock to be exploited at about twice the $F_{0.1}$ level in recent years were confirmed, thus the TAC was reduced to 9,400 tonnes for 1987 and again to 5,500 tonnes for 1988 and 1989. This fishery has been relatively stable with a catch of 5,000-6,000 tonnes since 1965. The peak catch of 14,000 tonnes reached in 1981 was due to recruitment of several strong year classes. Population numbers and biomass have declined in recent years in response to apparent lower recruitment and high fishing mortality, especially on young fish.

4. **Northern Gulf Witch Flounder (4R + 4S):**
The total allowable catch for 1990 was 3,500 tonnes with provisional catches totalling 1,000 tonnes. Catches have remained stable at this level since 1982. Close to 100% of the catch is taken near Newfoundland in Division 4R. Catches are thought to be below the long term sustainable yield.

5. **Southern Gulf Herring (4T):**
The total allowable catch by gillnet and purse seine fisheries was 86,900 tonnes in 1990. The fishery continues to be supported by several strong year classes. Above average recruitment since 1979 has allowed the stock to rebuild strongly from its levels in the late 1970's. CPUE's based on a fixed week model indicated a moderate rise in fall CPUE, continuing the trend since the early 1980's. Catch rates by index fishermen supplemented commercial catch rates in the catch rate model. Spring CPUE declined slightly but not significantly. Biomass of both spring and fall spawners is roughly an order of magnitude higher than at the beginning of the decade.

6. **Atlantic Bluefin Tuna (SA 3-6):**
Canada's share of the west Atlantic total allowable catch for 1990 was 573 tonnes. This TAC was set by ICCAT as part of an overall western Atlantic quota of 2,660 tonnes. The same allocations have been in place since 1983. The reported nominal landings for Canada was 550 tonnes as compared to 1989 landings of 573 tonnes. The Canadian rod and reel plus the tended line catch rate series have been used for age calibrations of the older fish (16+ years) in the stock assessment.

7. **Atlantic Salmon:**
The 1990 management plan for Atlantic salmon in the Gulf Region was a continuation of the five year plan initiated in 1984. Major restrictions on harvest included: the closure of commercial fisheries in New Brunswick, Nova Scotia, Prince Edward Island and in certain localized areas in southeast Newfoundland; quotes on all other areas of Newfoundland; mandatory release of all multi-sea-winter (MSW) salmon by anglers in all areas; and prohibiting the landing of salmon from non-salmon gear. In the Miramichi River, MSW returns in 1990 were 63 % above 1989 returns and 37 % above the previous 5 year mean. 1 SW returns were 20 % above 1989 and 11 % above the previous 5 year mean. In the Restigouche River, MSW returns were 10 % below 1989 and 17 % below the previous 5 year mean. 1 SW returns were 24 % above 1989 but 14 % below the previous 5 year mean. Total returns to the Restigouche River are calculated from angling catch alone, and are not considered accurate. Target spawning requirements were exceeded in the Miramichi River by 45 %- but missed in the Restigouche River by between 45% and 0% In Prince Edward Island there were above average returns of 1SW and MSW salmon. In Gulf Nova Scotia spawning requirements were exceeded. In western Newfoundland, adult salmon escapements in 1990 at counting fences and fishways were average or below average. Commercial landings of 1SW and MSW salmon were below previous 5 year landings, in large part because of quota restrictions. Recreational catch of 1 SW was similar to previous 5 year average.

8. **Gaspereau (4T):**
Gaspereau are intensively harvested in the Miramichi River, New Brunswick, and in the Margaree River, Nova Scotia. The catch of 1,789 tonnes from the Miramichi River in 1990 was equal to the average for the past five years, as was the catch of 1,016 tonnes from the Margaree River. The fishing mortality rates are high in both rivers and new recruits constitute over 60% of the catch.

9. **Gulf Lobster (4RT):**
Landings in 1990 were estimated at 23,538 tonnes, and this level of landings is unprecedented in the past 35 years. Landings in the previous three years were as follows: 23,236 tonnes in 1989, 21,300 tonnes in 1988, and 20,300 tonnes in 1987. The increase in landings since 1975 has occurred without changes in fishing effort (number of fishermen, traps, licenses and length of season). The increases and stability of landings are attributed to favourable recruitment. The Gulf lobster fishery has been traditionally a recruitment based fishery.

10. **Southern Gulf Snow Crab (4T):**
The southern Gulf of St. Lawrence snow crab fishery is composed of four management units: the southwestern Gulf, Prince Edward Island and two fisheries off the western coast of Cape Breton Island.

The southwestern Gulf fishery began in 1966 and expanded rapidly with landings of 31,585 tonnes in 1982. Annual landings then fluctuated between 24,000 and 26,000 tonnes until 1986. Total landings dropped to 11,782 tonnes in 1987 and increased slightly to 12,355 tonnes in 1988. In 1989, the fishery was closed after six weeks due to a high incidence of white crab in the catch for a total catch of 7882 t. For the 1990 fishery, the managers proposed an overall quota of 7000 t in order to accelerate the rebuilding of the stock and

promote long term stability. Individual boat quotes were put in place and the landings were monitored closely by a group of weight masters. Also, the management plan anticipated an automatic closure of the fishery when more than 20 % of the catch at sea was composed of soft shelled crab. Total landings of 6950 t was reported for 1990. A reference total allowable catch (TAC) of 26,000 tonnes was introduced in 1984. Catch rates (kg/trap haul) decreased continuously from 57.3 in 1985, 55.7 in 1986, 26.2 in 1987, 23.2 in 1988 and 22.1 in 1989 and then increased to 27.3 kg/trap haul in 1990.

The Prince Edward Island snow crab fishery was initiated on an experimental basis in 1985 and is now composed of 30 fishermen. Catches have dropped from 1,239 tonnes in 1986 to 457 tonnes 1987 and then increased to 666 tonnes in 1988. In 1989, the fishing season was the same as the southern Gulf with a closure due to high percentage of newly molted crab in the catches for a total of 747t. In 1990, a global quota of 500t was set for this fishery. However, as opposed to the mid-shore fleet, no boat quota were established. A total of 546 t of crab was landed for the season. Catch rates declined from 53 kg/trap haul in 1985 to 32.6 in 1986 and 18.3 in 1987. Catch rates have then increased to 31.1 kg/trap haul in 1988 and to 47.5 kg/trap haul in 1989 but decreased to 24.8 kg/trap in 1990. The total exploitation rate was estimated to be between 56.6 and 75.5%.

Two inshore fishery zones were established on the western coast of Cape Breton Island: Area 19 was established in 1978 and Area 18 became exclusive to inshore fishermen in 1984. Each zone is managed under individual boat quota. Over the past three years, the same TAC level of 1338 t for zone 19 was caught. The catch rates which were decreasing continuously from 96 kg/trap haul in 1982 to around 30 kg/trap haul in 1987 have increased back to around 47 kg/trap haul in 1990. The annual TAC of 674 t set for zone 18 since 1988 was caught. The catch rates have been on a decreasing trend form 64 kg/trap in 1987 to 50 kg/trap in 1990. Throughout the history of the fishery, white (soft shelled) crab have been a problem in zone 18. The fishery is presently in the process of being shifted to a spring season in order to avoid this problem.

11. Southern Gulf Scallop (4T):
Landings of sea scallop were estimated at approximately 250 tonnes in 1990. Since 1975, annual landings have ranged between 160 and 370 tonnes. The overall sea scallop fishery in the southern Gulf has been stable for the last 5 years.

12. Northern Gulf Scallop (4R):
Landings of Iceland scallops in the Strait of Belle Isle (Newfoundland) are viewed as stable if current effort levels are maintained.

B. SPECIAL RESEARCH STUDIES IN 1990:

1. Environmental Studies:
Hydrographic studies - Temperature profiles were collected at 302 stations during the groundfish cruises and at 35 stations during a July juvenile cod survey in the southern Gulf of St. Lawrence.

Sediment samples (500ml/station) were collected at 150 stations in the southwestern Gulf of St. Lawrence from snow crab fishing grounds. In Bonne Bay, Newfoundland, temperature, dissolved oxygen level, and salinity were measured by CSTD probe between late April and August. Plankton sampling (surface and vertical tows) and measurements of suspended carbon were conducted at depth strata of 10m from late April to August.

2. Biological Studies:

a) Cod: Commercial fishery (catch and weight at age; and catch per unit effort) and research survey data were used in the assessment of the 4TVn (Jan.-Apr.)

cod stock. A survey to determine juvenile cod abundance and distribution in Miramichi Bay was conducted during early August. Factors associated with a recent decrease in growth rate continue to be the main topic of study.

b) Plaice: The input data for the assessment of American plaice in area 4T came from commercial fisheries data and a research vessel survey. The discarded catch was estimated and included in the catch at age. Commercial catch at age showed more older fish than other plaice stocks. Research vessel mean number per tow showed a decline since 1979. A stable level of mean catch per tow has been observed in the last three years.

c) White Hake: Commercial catch samples, research vessel surveys, and commercial catch and effort data were used for the stock update. A study was completed to investigate the stock structure of white hake in the southern Gulf. Two components were identified, one stock restricted to water less than 200m, and the other in the deep water of the Laurentian Channel.

d) Herring: The index fisherman program, in operation since 1986, was continued for a fifth year. The annual acoustic cruise for southern Gulf herring continued with a new hydroacoustic system. An acoustic survey of the southern edge of the Laurentian Channel failed to detect the fall migratory pathway of the 4T herring. Several studies continued on the distribution and biology of juvenile herring in the Gulf. The distribution of juveniles throughout 4T was determined in July and in December. Surveys confirmed that the Bay of Chaleur is an important area for juvenile herring throughout the year, including winter. The possibility of using the bycatch in smelt bagnets in the Restigouche estuary as an index of juvenile abundance was pursued, and a sampling design for ice-free months was elaborated. Investigations on spawning of herring continued with emphasis on application of geostatistical methods for biomass estimation and on the role of winter flounder as egg predators.

e) Atlantic Bluefin Tuna: A stock update and review was carried out at the annual the annual ICCAT meetings. Sampling of individual fish, at local fishing ports, is the only source of biological data for tuna in the traditional Canadian fishery. In 1987, an offshore longline fishery was begun using larger vessels. This new data source is now being utilized in assessments.

f) Atlantic Salmon: Advice on the status of Atlantic salmon stocks was provided for the following rivers and areas: Restigouche and Miramichi Rivers, New Brunswick; Margaree River, Nova Scotia and western Newfoundland. Biological advice was based on monitoring adult and smolt runs at several index river sites; sampling angling, commercial and Native fisheries; summarizing all catch and effort data; and conducting electrofishing surveys throughout headwater areas. Specific research was conducted on the following topics: stock identification based

on scale characteristics; run timing and exploitation rates of early versus late-running salmon; forecasting preseason and inseason MSW returns.

g) Gaspereau: Assessments of the 1990 gaspereau fisheries of the Margaree and Miramichi rivers were completed. The catch at age was structured using samples from the fishery in the Margaree and the Miramichi Rivers, weighted by daily catch from logbook reports. Sequential population analysis was completed. Collection of biological characteristics of gaspereau from other rivers in the Gulf of St. Lawrence was continued.

h) Winter Flounder: The functional and numerical response of winter flounder to herring spawn were estimated at spawning grounds. Gastric evacuation times will be estimated in laboratory experiments. The overall importance of feeding on herring spawn to the production of winter flounder will be investigated.

i) Lobster: On the western coast of Cape Breton Island, the incremental carapace size increases for the pilot program have been completed. Data on life cycle and population characteristics of lobster in the area were collected before, during and will be collected after the carapace size increases. Analysis of the effect of minimum carapace size increases on lobster population structure and fisheries yield is in progress.

Minimum carapace size increase programs have been initiated in lobster fisheries in northern New Brunswick and the Northumberland Strait areas of New Brunswick, Nova Scotia and Prince Edward Island.

Sea sampling of commercial lobster catches was conducted throughout the Gulf of St. Lawrence from Baie des Chaleurs to western Newfoundland in order to provide management advice for specific local adjustments of fishery regulations and resource monitoring projects.

j) Snow Crab: Biological characteristics of the snow crab populations were monitored by sea sampling aboard commercial vessels during the 1990 fishing seasons. Soft shell crab was also closely monitored in several fisheries as part of the management plan in order to avoid exploiting this portion of the stock. In he southwestern Gulf of St. Lawrence, the supplementary sampling of the snow crab fishery was conducted aboard chartered vessels after the fishing season in order to monitor the incidence of postmolt crab. Stock assessments of all areas were presented based on data derived from fishermen's logbooks and processors' sales slips. Initial biomass and exploitation levels were estimated using Leslie analysis of catch/effort trends. A post-season trawl survey was conducted on all major fishing grounds in the southwestern Gulf of St. Lawrence fishery to provide information on the biomass levels and density

distributions of commercially-sized terminal molt males and potential molters.

Studies were conducted: growth increment, frequency of molting at size and duration of each molt stage, factors determining normal and terminal molting, geographic distribution of crabs in relation to different biological categories; pre-recruit size composition; and abundance. Studies on reproduction were continued and focused on: the reproductive contribution of pre-terminal and terminal molt males relative to primiparous and multiparous females, the monitoring of the reproductive cycle; and, the reproductive potential of male and female crabs. The tagging of pre-terminal and terminal molt crab as well as postmolt males was continued in order to study growth, seasonal movements, and mixing of crabs between fisheries. Studies of size composition and characteristics of snow crab couples and oceanographic parameters were conducted on a relatively unfished snow crab population in Bonne Bay, Newfoundland, by diving, trawling and experimental fishing. A study was conducted on age determination of snow crab carapaces using radioisotopic techniques.

k) Scallop: A Technical report, presenting an historical review (1923 to 1989) of the giant scallop catch and effort statistics in the southern Gulf of St. Lawrence, was published (March, 1991). A survey was conducted in the Northumberland Strait (July, 1990) to calibrate a scallop dredge (Labrador dredge), using an underwater video camera and 70 mm still cameras. Analysis of survey results remains ongoing.

RESEARCH PROGRAMME IN THE NAFO AREA FOR 1991

1. Provide scientific advice on the major fishery stocks through the Canadian Atlantic Fisheries Scientific Advisory Committee and ICCAT.

2. Conduct fishery resource assessments on the population status of the following stocks: cod, American plaice, witch flounder, white hake, herring, bluefin tuna, Atlantic salmon, gaspereau, lobster, snow crab and scallop. Study the migration of groundfish stocks.

   Specific plans for assessing and supporting the assessment of stocks are:

   a) Cod: Determine the distribution and abundance of cod pre-recruits from surveys; investigate causes of change in cod growth; examine trends in feeding habits of cod; initiate study to calculate an energy budget for cod; initiate study to develop an index fisherman program for sector of fleet <50 feet long.

   b) American plaice: Reconstruct the entire catch at age using semi-annual age-length keys where possible; use research vessel population estimates and the results of observational studies to quantify discards; initiate detailed analysis of abundance and distribution from research vessel surveys; initiate analysis of geographic variation using meristic, morphometric, biochemical, genetic, and parasitological characteristics.

   c) Witch flounder: Analyze available catch effort data, RV indices of abundance and catch data. Investigate use of length based models for assessment purposes.

d) White hake: Identify areas of juvenile concentrations by analyzing historical RV data, surveying nearshore areas with a small vessel and trawl, and monitoring the catches of inshore smelt and tomcod fishermen. Continue involvement with the Index Fishermen Program and Analyze catch and effort data for the white hake fishery.

e) Herring: Juvenile herring will be sampled throughout the year: Inshore areas will be covered monthly during the growth season; the December research survey will map and sample juveniles throughout 4T and estimate their abundance; smelt bagnets will be sampled regularly during winter on the Restigouche estuary to monitor juvenile abundance; and bottom and pelagic trawls will be used simultaneously on Chaleur Bay to determine geographic and vertical distribution of juveniles in late winter (April).

Investigations on spawning herring will continue with a purpose of determining whether or not egg deposition can be used as a recruitment index. In addition, the effects of predator by flatfish on herring eggs is being investigated.

f) Bluefin Tuna: Analyze catch/effort data from Canadian logbooks and assist in the international stock assessment. Attempt to relate offshore longline catches to SST data available from satellite imagery. Review available data from the International Observer Program.

g) Atlantic Salmon: Major stock assessments will be done for the Miramichi, Restigouche, Margaree and Humber Rivers utilizing angling catch and effort data, counting fences and electrofishing surveys. The accuracy of field spawner surveys will be tested by conducting surveys on populations of known sizes. Assumptions inherent in mark-recapture methods (reporting rate and random distribution of marked vs unmarked fish) will be tested in small tributaries above counting facilities. Estuerine use of salmon parr and smolts will be investigated. Preseason forecast models will be developed.

h) Gaspereau: Research emphasis will be placed on Miramichi and Margaree stocks. Sampling programs for other New Brunswick rivers and for coastal fisheries of Gulf Nova Scotia are to be continued.

i) Lobster: The emphasis of monitoring the effects of lobster carapace size increases will be on the Cape Breton Island fishery. Data analysis is in progress to determine the significant biological effects of minimum carapace size increases, Analysis of the lobster population characteristics of Malpeque Bay, Prince Edward Island is in progress. This information will be used to establish local fishery regulations. Sea sampling will be continued throughout the Gulf of St. Lawrence (New Brunswick , Prince Edward Island, western Cape Breton Island and western Newfoundland to compile information on population and the fishery.

j) Snow Crab: Continuation of studies on growth (growth increment, frequency of molting for different size class and duration of molt stages), reproduction (contribution of pre-terminal and terminal molt males relative to primiparous and multiparous females), reproductive cycle of males and females, mating behaviour, and stock delineation (tagging and trawling). The monitoring of the fishery (biological characteristics and incidence of postmolt crab) will continue aboard commercial fishing vessels and a post season trawl survey will be conducted in order to estimate biomass of different biological categories of crab and to study biological characteristics of crab populations. Observations will continue in Bonne Bay, Newfoundland, by diving, trawling and experimental fishing in order to build a time series

of data and also to understand recruitment dynamics on an unexploited population.

k) Scallop: Collect, compile and present the information on the 1990 Icelandic scallop fishery in the southern Gulf of St. Lawrence. Present a historical review (1984 to 1990) of the Iceland scallop catch and effort statistics in the northern Gulf of St. Lawrence (Strait of Belle Isle).

Inventory of Oceanographic Stations in the Northwest Atlantic

COUNTRY: CANADA YEAR: 1990

SHIP NAME	NAFO SUB AREA	NAFO STANDARD SECTION DATE SPAN	NAME	PARAMETERS (T.S.O2,ETC)	TOT. STNS	OTHER STATIONS SEASONS JFM	AMJ	JAS	OND	PARAMETERS T.S. O,2 ETC	TOT. STATS	TYPE STD OR BOTTLE
Lady Hammond	4T							X		T	155	
Lady Hammond	4T								X	T	83	
Navicula	4T							X		T	250	
Needler	4T								X	T	19	
Prince	4T							X		T	29	
Hart	4T							X		T	34	
Emy Serge	4T						X	X		T	248	
Prince	4T								X	T	36	
Navicula	4T							X		T	48	

Section III. Quebec Region

by

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1 Research report, 1990.

SUBAREA 4

A. Status of the Fisheries

DFO Nominal landings and TAC ('000 t) since 1987 for stocks currently being assessed in the Quebec region are as follows:

Species	Division	Nominal Landings (TAC)			
		1987	1988 [1]	1989 [1]	1990 [1]
Cod	4RS,3Pn	66 (80.3)	48 (73.9)	47 (76.5)	40 (58)
Greenland Halibut	4RST	11 (8.9)	7.5 (10.8)	5.0 (10.5)	2.4 (10.5)
Atlantic Halibut	4RST	0.3 (0.3)	0.3 (0.3)	0.2 (0.3)	0.4 (0.3)
Redfish	4RST	35 (50)	36 (56)	45 (57)	49 (57)
Herring	4R	17 (30.6)	18 (30.6)	18 (37)	17 (35)
	4S	1.4 (1)	0.9 (3.5)	0.5 (3.5)	0.6 (4)
Mackerel	S.A.2-6	76.6	79.3	71.7	62.5
Capelin	4R	0.9 (20)	4.9 (20)	1.1 (5.7)	5.8 (7.0)
	4S	0.1 (5)	0.1 (5)	1.1 (2.7)	0.1 (1.6)
	4T	0.1 (5)	0.1 (5)	0.1 (1)	0.1 (1.3)
Snow crab	4S,4Tpq	5.0	4.0	2.6	4.3
Shrimp	4RST	12.0 (13.1)	13.8 (14.1)	15.4 (15.1)	15.3 (15.8)
Lobster	4S,4T[2]	2.7	2.5	3.2	3.2
Scallop	4S,4T[2]	245	182	334	522

[1] Preliminary values.
[2] Except 4Tghij.

B. Special Research Studies.

1. Environmental studies

a) Hydrographic studies

b) Plankton studies (including eggs and larvae)

c) Benthic studies

d) Observations on ice conditions in Subareas 0 to 4

e) Other environmental studies

2. Biological studies by species

2.1 Demersal fish

2.1.1 Cod

An annual stock assessment of the 3Pn, 4RS cod stock is done and presented to CAFSAC. Annual landings have declined drasticaly in the last few years, most of this decline being attributable to the fixed gear sector. The advice for management of this ressource for 1991 was to stabilise the landings at no more than 35,000 t. The lowest TAC on this fishery since 1977. New research directed at better understanding of cod spawning and survival was initiated in 1990.

2.1.2 Redfish

The most recent assessment of the 4RST redfish stock has confirmed the presence of a pulse of recruitment that should reach a commercial size in 1990. An examination of stock structure of the 4RST, 3P and 4VWX redfish stocks is ongoing. There are some indications that considerable mixing may occur in the winter.

2.1.3 Greenland Halibut

The stock discrimination study that was initiated in 1989 should be terminated this year and presented to CAFSAC as the basis for delineating stocks for management purposes.

2.2 Pelagic fish

2.2.1 Herring

Two herring stocks are assessed in the Quebec region, herring from NAFO Div. 4R and from NAFO Div. 4S. Biomass estimates were done for the second year during a acoustic survey (Datasonics equipment) in November-December 1990. When aggregations of fish were detected, trawl sets were done to confirm species composition.

2.2.2 Mackerel

Assessment of the mackerel stock of the Atlantic coast was done and presented to CAFSAC. Abundance estimates are based on results of an egg and larvae survey that takes place in NAFO Div. 4T in summer.

A model aimed at explaining growth differences between both contingents of mackerel at age 0 that included thermal coefficient was developed. As well, a method to discriminate mackerel from both contingents on the basis of otolith shape was developed.

2.2.3 Capelin

Biological information including age/size structure from the commercial landings was presented to CAFSAC. Results from a stock discrimination study was completed and indicated that for management purposes, two stocks could be determined. One for the eastern part of the Gulf (NAFO div. 4S(east) and 4R) and another for the western part of the gulf (NAFO div. 4S (west) and 4T).

2.3 Invertebrates

2.3.1 Rock crab

Research activities in 1990 were aimed the study of growth, sexual maturity and fecundity of rock crab in Chaleur bay (NAFO div. 4Tnm). Some observations on spatial distribution during molt and reproduction were also done. This work was done in order to establish a management strategy of this ressource in the context of a commercial exploitation.

2.3.2 Snow Crab

From an unexploited population of the Saguenay fjord (NAFO Div. 4Tp), the age structure of snow crab, from shells was examined. Important differences were observed between morphometricaly immature and mature males. Laboratory work is ongoing to verify the inheritability of the size at maturity and to investigate the contribution of primiparous and multiparous females to the reproduction of the species.

The shoreward migration of the St. Margerite's bay snow crab was observed again in the spring of 1990. This migration involves mostly morphologicaly immature males and females for a molt and subsequent reproduction.

Information on stock structure for snow crab of the Saguenay fjord, the St. Lawrence estuary and the gulf of St. Lawrence based on phenotype and genotypes was pursued in 1990. Assessment of the snow crab ressource of the Quebec north shore was done and presented to CAFSAC.

2.3.3 Shrimp

Assessment of shrimp in the Gulf of St. Lawrence management units in 1990 was done. This resource is under a multi-year fishery management plan until 1993. Two surveys were undertaken in 1990. One estimated spatial distribution and biomass of shrimp in the Sept-Iles area (NAFO div. 4Siz). Another, a redfish, shrimp directed survey in the estuary and gulf was done for the first year.

A genetic comparison of various shrimp concentrations along the eastern coast of Canada was undertaken. Samples were collected from the Saguenay fjord, the estuary and gulf of St. Lawrence as well as from the Labrador. The purpose of this study is to verify the validity of the current management units.

Through the use of geostatistics, the spatial distribution of shrimp in the western part of the gulf of St. Lawrence was examined. Small and large scale estimates of biomass can thus be calculated.

The survival of larval shrimp by a condition index was derived in laboratory. Field trips should allow to verify various hypothesis brought forward.

2.3.4 Lobster

Work on molt frequency and growth increment by sex and size was maintained in 1990 at the Magdalen Islands (NAFO Div. 4Tf). A follow up of the commercial fishery was also done.

2.3.5 Scallop

Assessment of the Magdalen Islands, Gaspé and Québec north shore scallop stocks were done in 1990. Advice for management of these stocks were presented to CAFSAC. Repopulation of over-exploited banks by small scalops was done in 1990. Spat was collected by collectors placed in spring and retreived in the fall.

An exploratory video survey on the Quebec north shore alowed to determine biomass estimates of giant scallops.

2.3.6 Whelks

Work concerning the age determination, growth and size at sexual maturity were finalised in 1990. This allowed recommendations concerning a minimal size of captures to maintain the reproductive potential of the population.

2.4 Marine mammals

2.4.1 Seals

Research was conducted into the distribution, abundance, population dynamics, behavior and ecology of pinnipeds in the estuary and Gulf of St. Lawrence, and their interactions, both predatory and parasitological with commercial fisheries. In April of 1990 a research survey was conducted in the Svaalabad area to study the energetics of ringed seals. Analysis of the aerial survey of Greenland seals was done end presented to the mammal subcommittee of CAFSAC. Studies on the vocalisation and energetic transfers of grey seals was continued. In February and March of 1991, a aerial survey directed toward the estimation of the hodded seal herd was done.

2.4.2. Porpoise

A system to gather information on the porpoise by-catch in the Gulf of St. Lawrence was established. This involved collection and analysis of biological samples from porpoises taken in fishing gear. A survey to estimate numbers, distribution and movements of porpoises in the estuary and Gulf was undertaken.

2.4.3 Beluga whales

A volume containing some 20 articles on beluga biology was published. Autopsy of some 20 stranded beluga was done to estimate age, cause of death and pollutant loadings. A genetic analysis was undertaken to determine relations of the St. Lawrence population with others and to compare intra-population genetic variability.

2.4.4 Large whales

Stock identification of fin whales, based on length-weight relationships, external morphometrics and other parameters was attempted. A study of biological specimens of east coast killer whales was undertaken. Morphological and biological samples of stranded whales was done whenever they were reported. A aerial survey of the beluga whale population of the St. Lawrent estuary was conducted. Movements of beluga whales in Cunningham Inlet was investigated through the use of telemetry.

2.5 Marine plants

2.5.1 Ascophyllum

In order to establish a harvesting strategy that allows the algae to maintain its potential, experiments with varying frequencies and sizes harvested were conducted. The recommended harvest of 15 cm. every three years will be investigated in the median and long term.

3. Gear and Selectivity Studies, including studies of fishing operations.

4. Miscellaneous studies.

4. Environmental data for 1988 and Preceding years.

All available information will be forwarded directly to MEDS this year.

5. Tagging activities.

Section IV. Newfoundland Region

by

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SUBAREAS 0 AND 1

A. Status of the Fisheries

Groundfish. In Subarea 0, 6,194 t of Greenland halibut were landed in 1990.

Shrimp. Canadian landings of shrimp from Division 0A in 1990 totaled 6,116 t (preliminary), over 1,000 t less than 1989 landings. The new fishery in Division 0B produced about 1,600 t, compared to 3,200 t in 1989.

B. Special Research Studies

1. Environmental Studies

a) Baffin Bay/Davis Strait (Bedford Institute): Five current meter moorings and three pressure gauges in a line across Davis Strait at 66°15'N that were deployed in the summer of 1989 were recovered. This ends the three-year mooring program in this area. CTD Stations (117) were occupied in the region from 65°N to 70°N.

2. Biological Studies

a) Atlantic salmon. A total of 2,501 salmon were sampled at the fish plant in Nuuk, 1,146 in Maniitsoq and 1,239 from Paamiut, in centimetre length groups; including detailed measurements of fork length, gutted weight, and of these 1,208 were scale-sampled. This project provides an annual assessment of the proportion of North American and European fish caught at West Greenland. Also, 54 salmon were detected with micro tags. Micro tags were from Canada, USA, Scotland, Ireland, Iceland, and England.

In total, 315 tissue samples were collected for electrophoretic analysis. The results of this analysis will be used to develop a database of known-origin salmon for discriminant analysis.

b) Observer Program. Canadian observers participated in 13 trips fishing shrimp in Davis Strait (0+1) during 1990. A total of 411 fishing days and 2,130 sets were recorded with a total of some 119,416 shrimp measured.

Note: Sampling methodology was changed in 1990 to obtain more detailed data on maturity stages as well as size composition.

SUBAREA 2

A. Status of the Fisheries

Cod. Canadian landings were 32,600 t, compared to 56,000 t landed in 1989. Most of these landings were from Div. 2J with 200 t landed from Div. 2H and 2,600 t from Div. 2G. Landings from the inshore sector accounted for 14,400 t, down from 22,000 t landed from this sector in 1989. Offshore landings were 32,600 t compared to 33,800 t in 1989.

Redfish. Canadian landings remained low, with just over 200 t landed, compared to 70 t landed in 1989. Landings in recent years have been almost exclusively from Div. 2J.

Greenland halibut. Canadian landings were 3,800 t, compared to 2,500 t landed in 1989. Landings were primarily from Div. 2J with less than 600 t landed from Div. 2H and 400 t from Div. 2G. The inshore fixed-gear fishery accounted for 45% of all landings in this Subarea in 1990.

American plaice. Canadian landings of American plaice were down at 900 t, compared to 3,200 t landed in 1989. These landings were almost entirely by the offshore fishery in Div. 2J.

Other groundfish. Canadian landings of all other groundfish species totaled 403 t in 1990, of which 250 t was rock cod.

Capelin. Landings of capelin remained at a low level.

Herring. Landings of herring remained at a low level.

Atlantic salmon. Commercial landings of Atlantic salmon in Subarea 2 during 1990 were 181 t, compared to 289 t in 1989. Landings of large salmon (122 t) decreased 37% from 1989. The recreational harvest totaled 5.3 t.

Arctic charr. Landings of Arctic charr in Subarea 2 during 1990 were 100 t, similar to those of 1989. While effort declined again in comparison with 1989, catch rates and overall abundance of charr appeared higher than in the past several years.

Shrimp. The Subarea 2 shrimp fishery was subject to a total quota restriction of 10,580 t in 1990/91 (season May 1 to April 30), 4,400 t of which were in the Hopedale Channel. Total landings were approximately 9,500 t.

B. Special Research Studies

1. Environmental Studies

a) Oceanographic studies. The NAFC current meter program on Hamilton Bank was continued. Temperature profiles were taken at each fishing station occupied in the subarea. The Seal Island transect was occupied during summer and fall.

b) Contaminant studies. A major program has been initiated to study levels of organochlorines, dioxins and heavy metals in codfish.

2. Biological Studies

a) Cod. Biological sampling of the commercial fishery included observations from both the inshore and offshore sectors. From research vessels, distribution and abundance studies were carried out and detailed biological sampling was conducted. Stomachs were collected from Div. 2J in autumn.

b) Flatfish. Data on distribution and abundance of American plaice, Greenland halibut, and witch were collected during groundfish surveys of NAFO Div. 2J in 1990. The shrimp surveys in Div. 2H and 2J in 1990 can again be used in the development of a recruitment index for Greenland halibut.

c) Redfish. An autumn groundfish survey in Div. 2J provided information on abundance, distribution and parasite infestation from biological samples collected.

d) Capelin. An acoustic survey in Div. 2J3K in October 1990 resulted in a biomass estimate of 96,339 t.

e) Atlantic salmon. A total of 7,605 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.

f) Arctic charr. A total of 2,125 samples was obtained for age determination of Arctic charr in commercial landings from twelve northern Labrador fishing areas. Approximately 16,500 fish were sampled for length distribution from the same areas. Information on sex distribution of charr caught in the fishery was obtained and stomach samples obtained for evaluation of food and feeding habits.

g) Shrimp. A research vessel survey which was conducted in July, 1990 completed biomass surveys in Hopedale and Hawke Channels using a Sputnik 1600 shrimp trawl. A total of 126 sets was made with the greatest catch (937 kg) being obtained in the Hopedale Channel. Biomass estimates from both areas were the lowest obtained for several years. In addition, Canadian observers participated in 39 commercial trips fishing shrimp off Labrador and northeast Newfoundland (Subarea 2 and Div. 3K) during 1990. A total of 761 fishing days and 3,366 sets was observed, with a total of some 276,402 shrimp measured.

Note: Sampling methodology was changed in 1990 to obtain more detailed data on maturity stages as well as size composition.

h) Exploratory surveys.

- Crab. A 65-foot vessel was contracted or 25 sea days to conduct an exploratory snow crab survey off Makkovik, Northern Labrador; an area covering 6,100 square miles which is a northward extension of commercial grounds identified by previous surveys. With the exception of a small area off Cape Harrison, no commercial quantities of crab were realized.

SUBAREA 3

A. Status of the Fisheries

Cod. Canadian landings were 201,600 t, down from 204,100 t landed in 1989. Landings by division were: 3K - 54,400 t, 3L - 104,000 t, 3N - 4,600 t, 3O - 7,000 t, 3Ps - 26,300 t, and 3Pn - 5,300 t. The inshore sector accounted for 60% of these landings, at 120,300 t, compared to 101,800 t landed inshore in 1989. Inshore landings from Div. 3K and 3L were 98,250 t, up from 76,600 t landed inshore in 1989, while offshore landings were 60,100 t, down from 79,300 t landed in 1989. Inshore landings from Subdiv. 3Ps were 20,100 t, down from 22,300 t in 1989, while offshore landings were 6,200 t, compared to 5,300 t landed offshore in 1989.

Redfish. Canadian landings were 14,300 t, up from 1989 levels of 13,200 t. Div. 3K and 3L landings were 2,900 t, down from 3,700 in 1989. Combined landings from Subdiv. 3Pn and 3Ps were 11,200 t, compared to 9,500 t in 1989. Landings from other Divisions remained low.

Flatfish. Canadian landings of the combined flatfish species were 47,200 t, compared to 54,200 t in 1989. American plaice dominated these landings at 27,500 t, compared to 32,000 t in 1989. Yellowtail landings were 5,100 t, down from 5,400 t landed in 1989. Greenland halibut landings were 6,500 t, down from 9,300 t in 1989, while greysole landings were 6,900 t, compared to 6,200 t in 1989. Other flatfish landings included 400 t of winter flounder and 790 t of Atlantic halibut. While landings from the inshore sector amounted to only 20% of all flatfish landings, about 84% of all Greenland halibut were landed by the inshore fixed-gear fishery.

Other groundfish. Canadian landings of other groundfish species were: haddock - 4,500 t, white hake - 3,400 t, pollock - 1,800 t, and wolffish - 580 t. Some 1,200 t of lumpfish roe were also landed inshore in this Subarea during 1990.

Capelin. Approximately 47,000 t capelin were landed inshore in Div. 3L, 32,000 t in Div. 3K, and 1,100 t in Div. 3Ps in 1990. The inshore catches were taken during the inshore spawning migration. Female capelin are preferred to satisfy the Japanese roe market. The offshore catch was 57,300 t for Div. 2J3KL and 3,537 t for Div. 3O.

Herring. Herring landings from Newfoundland were approximately 8,500 t, 7,800 t from Div. 3KL and 700 t from Div. 3P. The commercial fishery did not catch the quotas, primarily due to poor market conditions. The limited market available was for purse seined herring in excess of 300 g. The presence of substantial numbers of smaller herring, primarily of the 1987 year class, mixed with larger commercial size fish, led to reduced landings.

Mackerel. Mackerel landings in Subarea 3 were about 1,200 t, compared to 1,900 t landed in 1989.

Squid. Total reported catch of squid in 1990 was 3,750 t (preliminary data). The poor fishery, for the eighth consecutive year, was due to a natural low abundance of squid in commercial fishing areas.

Atlantic salmon. Landings were 319 t in the commercial fishery and 28 t in the recreational fishery. The commercial catch of large salmon (167 t) decreased by 12% from 1989.

Shrimp. The Div. 3K shrimp fishery located in the St. Anthony Basin was subject to a TAC of 1,600 t from May 1, 1990, to April 30, 1991. Catches to date from this area exceeded 500 t. An additional TAC of 2,000 t was set for other areas within Div. 3K. Catches to date were less than 500 t.

Scallops. Landings of sea scallop (Placopecten magellanicus) in 1990, again based predominantly on the 1982 year-class, receded further to 153 t meats, down from 305 t the previous year. Average meat count (as-landed) was 21.9/500 g.

An offshore fishery for Iceland scallops (Chlamys islandica) by vessels less than 65 ft (LOA) commenced in Div. 3Ps during 1990. Approximately 35 t of meats were removed.

Clams. The fishery for the Arctic (Stimpson's) surf clam (Spisula polynnyma) on the Grand Banks (3LNO) continued in 1990. Approximately 50% of the 20,000 t TAC was taken.

B. Special Research Studies

1. Environmental Studies

a) Oceanographic studies. The NAFO transects, Bonavista line and White Bay line were occupied. The time series of Station 27 (4 km east of Cape Race) continued, the station being occupied 41 times in 1990.

As part of the Northern Cod Science Program (NCSP), a major oceanographic program was launched whereby current meter/thermistor chain moorings were deployed on the NE Newfoundland Shelf. Comprehensive CTD/current mapping was also carried out in July and November. Two oceanography cruises were conducted in Conception Bay to conduct an extensive CTD/current mapping of the Bay.

b) Contaminant studies. Preliminary information has been obtained on polycyclic aromatic hydrocarbon and petroleum hydrocarbon residues in various marine mammals.

c) Oil industry (Environmental Studies Revolving Fund). Four studies dealing with both the physical and biological environment are currently underway. The projects focus on the Grand Banks, a frontier oil and gas development area. In addition, a study of fishery/oil industry interaction was completed.

- Oil spill model:

  A model has been produced establishing the impact of a major oil spill on the Grand Banks on codfish and American plaice populations. The losses are indicated to be negligible (<5 tonnes).

- Tainting of commercial species of Grand Banks groundfish:

  The risk of tainting commercial fish species will always be an issue in the event of an oil spill on fishing grounds. Studies are being initiated on the tainting potential of contaminated sediments for groundfish species.

- Iceberg trajectory model - real time verification:

  An operational iceberg trajectory forecasting model, developed for the Grand Banks, is being subjected to independent testing. The objective is to examine the model in an operational forecasting environment in order to assess its capabilities as an iceberg management tool for industry. The Canada-Newfoundland Offshore Petroleum Board is carrying out this study in two phases, the first involves model setup and initial trial runs and the second will be the operational trials.

- Repetitive mapping survey - east coast:

  This study, being carried out in conjunction with the oil industry, PERD and the Geological Survey of Canada, involves the use of side-scan sonar to repetitively map iceberg scours of known age on the northeast Grand Banks. This will help determine the rates of scour and rates of degradation of a scour.

d) Centre for Cold Ocean Resources Engineering (C-Core), Memorial University.

- The sea ice environment:

  LIMEX. Labrador Ice Margin Experiment Program is directed to advance the knowledge of physical environment associated with the ice-covered ocean. This year's program conducted ice thickness and ice melting studies from the BAFFIN. The research advanced the understanding of ice deterioration and ablation process in the Marginal Ice Zone.

  Sea ice/iceberg forecast system. The Integrated Sea Ice/Iceberg Forecast System (IIFS) Project is proceeding with the emphasis on checking the performance of the three main models: iceberg trajectory, iceberg ensemble drift and sea ice edge drift. The immediate goal is to develop software for a menu-driven user-friendly interface, color graphics displays and plotting capabilities.

  In situ sea-ice properties. Under NSERC Co-op R&D research is being conducted to study how wave action in the ice cover depends on ice strength. the objective is to develop instrumentation to conduct in situ ice strength measurements. In April 1990 a filed trial comparing different testing methods was carried out on landfast sea ice.

  Ice growth and melting. Initiated development of an acoustic device to measure variations in ice thickness during the 1990 winter. The unit was field tested in April however due to ice conditions encountered only a short time series of readings were obtained and the results were inconclusive. Further work is planned for 1991.

- Geophysical/geotechnical sediment property correlation:

  Interactive marine acoustic probe (IMAP): Research activities in marine geophysics continue to focus on the development of an intelligent stationary acoustic probe, the IMAP formerly referred to as the ASI. The IMAP probe is a geophysical tool designed to measure the properties of the sub-seabed with unprecedented resolution in time and space. . Two field programs were conducted in 1990. The first program investigated and eliminated the electrical interference with the acoustic signal that hindered previous data collection. The second program investigated the scientific acoustic imaging of the system.

  Ice/seabed interaction. Ice scour research, supported by an NSERC strategic grant, continues to provide information on the mechanics of the scour process and its effects on the soils both above and below maximum scour depth.

- Remote sensing of ocean wave conditions:

  The task of extracting ocean wave conditions from narrow beam radar return has been completed and

tested. New algorithms were developed, based on earlier fundamental research carried out by the radar group at C-CORE and the Engineering Faculty at Memorial University of Newfoundland. The new technique is superior to earlier interpretation schemes that have been tested at the Centre. The solution is numerically efficient and is being implemented as a module in the data processing software of the Northern Radar Cape Race facility.

Work is ongoing to develop ocean wave interpretation algorithms for broad beam, compact GWR systems. The basic formulations, and a preliminary interpretation algorithm have been developed. More effort will be required to further refine the techniques, and to develop improved software.

- Geographical Information Systems (GIS) (new initiative):

The new program is developing a GIS-based system which will examine multivariate spatial relationships between ocean-related variables and seabed features and properties. The spatial model for iceberg scouring on the Grand Banks will synthesize iceberg information, sea ice coverage data, wave and current regimes, iceberg scour data, surficial geology, bathymetry and other complementary environmental data. GIS was also used to study the fisheries in the vicinity of the Significant Hydrocarbon Discovery Areas (SDAs) and to look at stratification of commercial catch rate data.

- Seabed contaminants (new initiative):

This work has two components, development of technology and site studies. The development of technology has centered around a 3D Sub-bottom Imager which is a stationary, high resolution acoustic imaging system capable of imaging sedimentary units on a scale of centimetre thicknesses. Site tests of contaminated mud comprising the upper meter of the lakebed sediments have shown the system to be superior to a conventional echosounder tested at the same site. A dedicated system is currently being constructed.

2. Biological Studies

a) Cod. Sampling of the landings from the commercial fishery both inshore and offshore was continued in 1990. Using research vessels, surveys were carried out in all NAFO Divisions (except 3 M) to determine the distribution and abundance of cod. Biological sampling was extensive during these surveys and approximately 7,000 cod were tagged, inshore and offshore. Stomachs were collected from Div. 3LNO during spring and from Div. 3KL during autumn. Samples were collected for meristic studies in Div. 2J3KL and Subdiv. 3Ps during winter.

b) Redfish. Several groundfish research surveys conducted throughout Subarea 3 provided information on abundance, distribution and parasite infestation (Sphyrion lumpi). An acoustic survey was conducted in Div. 3P/4RST/4VWX during July-August and provided information on abundance and distribution to address the issue of populations for management purposes. Two bottom trawl surveys, directed specifically for redfish were conducted in Div. 3LN in January and Div. 3L in August. The collection and subsequent ageing of otolith from both research and commercial catches, and the application of these to respective length frequencies yielded information about commercial catch at age as well as population structure.

c) Flatfish. Distribution and abundance of flatfish were studied during fall random stratified surveys in the following NAFO Divisions and times in 1990: Div. 3K - fall survey; Div. 3L, 3N and 3O - spring and fall surveys; and Subdiv. 3Ps - winter survey. These surveys provide a major source of information for continued biological studies of flatfish. In addition, the following surveys provided valuable data on flatfish:

- New studies into the behavioral ecology of A. plaice were continued, largely through laboratory experiments in controlled environments.

- As a result of joint research efforts from the Newfoundland Region and Scotia-Fundy Region scientific advice was provided through CAFSAC for the management plan for Atlantic halibut.

- A juvenile flatfish survey was conducted in Div. 3LNO in the fall of 1990. This survey is part of a time series directed at establishing a pre-recruit index for yellowtail aged 1-3 years. Information was also collected on the distribution and abundance of juvenile American plaice.

d) Capelin. Calibration problems with acoustic system prevented a biomass estimate being made from the 1990 Div. 3L survey. The inshore fishery was monitored by a comprehensive logbook survey and an aerial survey, using an imaging spectrometer, was conducted during the inshore spawning migration. Factors governing capelin survival during egg development and larval emergence from beach sediments was initiated in 1990 at Arnold's Cove, Placentia Bay and Bellevue, Trinity Bay.

e) Herring. Two hydroacoustic biomass estimation surveys were conducted in 1990, one from Fortune Bay to St. Mary's Bay (Jan-Feb) and one from White Bay to Trinity Bay (Oct-Nov). the results of these surveys formed the basis of scientific advice on the status of these stocks. A research gill net index fisherman program was continued for the eleventh year as an index of herring abundance. A controlled field experiment was conducted in Trinity Bay to determine a target strength-fish length relationship for herring.

f) Scallops. A 12-day cruise (250 sets) was conducted for sea scallops in Div. 3Ps. There was no evidence of a large-scale settlement. The fishery will continue to depend on the residual biomass from the 1982 year class.

A random-stratified survey (275 sets) was completed in 3Ps to determine fishable biomass of Icelandic scallops. Ten strata within the 55-180 m isobaths were surveyed. Some fishing was directed outside of the primary target area.

Tissue samples were collected from Div. 3Ps for polycyclic aromatic hydrocarbon (PAH) analysis.

g) Clams. One hundred percent observer coverage continued on the single foreign-flagged vessel fishing clams in Div. 3LNO. Observer coverage on domestic vessels was approximately forty percent. Nominal catch for 1990 was 10,036 t (round wt). Five experimental Arctic clam trips in Div. 3LNO (154 fishing days) were made, 131 samples taken and 37,478 lengths recorded. Detailed analyses were carried out on 17 samples consisting of 1,900 clams.

h) Squid. At one inshore locality (Holyrood), water temperature was monitored and commercial squid samples were acquired, whenever available.

i) Crabs. Studies on biological aspects of a shallow-water spring breeding migration of snow crabs were continued at Bonne Bay in western Newfoundland. Studies investigating the effect of water temperature on yearly recruitment were continued.

j) Lobster. Long-term monitoring of the fishery of various aspects of population biology and dynamics were continued at three inshore Newfoundland sites.

k) Atlantic salmon. Long-term research studies continued to develop a model which could be used to estimate salmon production capacities of streams, optimal egg deposition and stock and recruitment relationships. Approximately 1,800 Atlantic salmon caught in the commercial fisheries were sampled for size and age distribution.

l) Seals. Aerial surveys were conducted to estimate pup production of harp and hooded seals off NE Newfoundland and in the Gulf of St. Lawrence.

Monitoring of incidental catches of seals and whales in fishing gear was expanded. Experiments were conducted to determine the extent of biases inherent in traditional reporting methods.

Sampling of seals to provide data on age structure, reproductive parameters, stomach contents and morphological condition was continued. A study of the levels of hydrocarbon pollutants in marine mammals was also continued.

Harp and hooded seal tagging data have been updated and verified.

m) Whales. A study of the biology of harbour porpoise was initiated. An initial sample of 20 porpoise caught in fishing gear were examined and morphometric, age, reproductive and stomach content data were obtained.

Biological information and tissue samples were obtained from stranded and incidentally entrapped cetaceans.

Ongoing studies on ice entrapments of blue whales, entanglements of whales in fishing gear, detectability of fishing gear by cetaceans, photo-identification of cetaceans, food selection using stable isotope analysis, population modeling and levels of aromatic hydrocarbon pollutants were continued.

A series of studies designed to provide information on the role of pinnipeds in the Northwest Atlantic Ecosystem have been initiated. These studies include expanded research on feeding and offshore distribution of harp and hooded seals. A study of movements and diving behavior in free-ranging seals using satellite-linked telemetry has also been started. Studies of the energy requirements of captive harp seals and indicators of metabolic rates are also being supported under this initiative. Most of these studies were still being planned during 1990. Field work will commence in 1991.

n) Multispecies. Laboratory experiments on the susceptibility of larval fish to predation were conducted to assess size-dependent elements of the process. A review of size and temperature dependent development, mortality and survival rates was completed and contrasted with extensive information on recruitment variability to commercial fish populations. Work continues to assess the validity of size-dependent models to determine early life history production patterns.

o) Larval fish. Work on nearshore production processes in relation to larval fish survival, particularly capelin, was initiated. A study was undertaken to determine the factors that may influence the advection of larval fish in coastal areas (Conception Bay). Extensive ichthyoplankton sampling was undertaken in conjunction with CTD measurements and transect measurements of current speed and direction using an acoustic Doppler current profiler.

p) Exploratory surveys.

- Scallop. Two 35' to 45' vessels were contracted for 20 sea days each to carry out exploratory scallop surveys in Placentia and Fortune Bays. The areas surveyed were identified in consultation with Fishermen Committees. One potentially commercial bed of scallop was located in each Bay.

- Turbot. Survey operations using gill nets were conducted during July and August in water depths ranging from 600-1500 meters. Two 65' vessels were chartered, each for 12 fishing days. An area of 2,100 square miles was surveyed. Mesh sizes of 5.5, 6.5, 7.5 and 8.0 inches were investigated. Catch rates ranged from 64-125 lbs/net.

3. Gear and Selectivity Studies

a) Square mesh vs diamond mesh. A study was conducted to compare the effectiveness of square mesh vs diamond mesh. One ten day trip was completed on a 62 m vessel in November 1990. A second ten day trip is scheduled for mid March 1991.

SUBAREAS 2 AND 3

A. Special Research Studies

1. Environmental Studies

a) Oceanographic and related studies. Ships of opportunity XBT programs were continued using the vessels CAPE ROGER and the LEONARD J. COWLEY. Temperature profiles were taken at each research fishing station occupied during 1990. Six-month temperature recorders were provided to researchers in conjunction with the DFO long-term Temperature Monitoring Program. CTD data were collected using a SeaBird SeaCat Profiler on the groundfish ottertrawl.

b) Hydrography. The CSS MAXWELL and hydrographic staff were involved in inshore sounding surveys. Detailed information for the updating of navigation charts was collected along the northeastern Newfoundland coast.

c) Environmental monitoring/assessment. A major study has been initiated to determine if the levels of pollution found in the areas 2 and 3 are in sufficient concentrations and nature to effect genetic damage in marine mammals.

d) Bedford Institute.

- Labrador and Newfoundland Shelves. No helicopter-supported field survey was carried out in the early winter of 1990, they will start again in 1991. Ice drift data were only collected by satellite imagery covering the winter of 1989/90 when clear consecutive images were available.

- Labrador Sea. Thirty-one full-depth CTD stations were obtained in the central Labrador Sea and over the continental shelves of Greenland and Labrador with accompanying measurements of dissolved oxygen, nutrients and chloroflurocarbons (freons). Twenty-four of the stations make up the World Ocean Circulation experiment (WOCE) hydrographic line AR7/W between Cape Desolation, Greenland and South Wolf Island, Labrador. This line is part of Canada's contribution to this program and will be occupied at least once a year between 1991 and 1995.

- Northeast Newfoundland Shelf. An extensive survey of water properties (temperature, salinity) was conducted in the Newfoundland marginal ice zones in March. A current meter array was deployed about 160 km east of St. John's. Ice beacons were deployed on ice floes to measure ice drift. The work was coordinated with two overflights for remote sensing measurements (conducted by the Canadian Ice Centre).

2. Biological Studies

a) Assessments. Assessments of some 25 groundfish stocks presently under catch quota regulations were conducted and refined and advice on TACs for the 1990 fishing season was provided either through CAFSAC or NAFO. Further assessments were conducted of 17 pelagic-shellfish-marine mammal stocks, the marine phase of mixed Atlantic salmon stocks originating from Newfoundland, Labrador, Quebec and Maritime rivers, three Arctic charr stock complexes and other commercial and potentially commercial species.

b) Research vessel cruises. Fifty-seven offshore and inshore research vessel cruises were undertaken in 1990 utilizing DFO-owned vessels (WILFRED TEMPLEMAN, MARINUS, SHAMOOK, LADY HAMMOND) and the GADUS ATLANTICA (on long-term charter) (Table 2).

c) Commercial sampling. Sampling of foreign and Canadian offshore catches by the Canadian Observer Program continued in 1990. A total of 4,765 samples representing some 974,790 length measurements and approximately 12,382 otolith pairs was collected from the catches of foreign and Canadian offshore fisheries. A total of 9,097 days and 37,469 sets was recorded. Coverage in 1990 was high for 2J3KL cod, whereas in other areas approximately 20% coverage of Canadian vessels was maintained. The foreign activity inside the 200 mile limit was completely covered. High levels of coverage were also maintained on the Resource Short Plant Program (RSPP) and other types of charter trips. Analysis of production on factory and wetfish trawlers was continued and the study of discarding practices for the domestic offshore fleet was examined closely.

d) Cod. Combined trawl and acoustic survey was undertaken to determine the distribution of cod off the east coast of Newfoundland and during the shoreward migration in June, as well as to determine the depth and temperature of cod concentrations near the coast prior to and during the inshore migration of cod.

Adult cod were tagged in inshore areas during the summer-autumn and also the winter to determine migration patterns of summer feeding concentrations and of overwintering concentrations.

Researchers completed initial installation/testing of the new dual frequency 38/128 KHz Biosonics Dual Beam Echosounding System (with integration and in situ target strength capabilities), for new studies of cod distribution and onshore migration.

e) Parasitology. Stomachs of harbour, grey, hooded, bearded and ringed seals were collected (approx. 30-50 of each species) and the nematodes removed, counted and identified. Harbour and grey seals had large numbers (50-500) of sealworm (P. decipens Type B) and small numbers of other species. Hooded seals were infected with the nematode Phocascaris. bearded seals had large numbers of P. decipiens Type C which is not the same type as that causing problems in the commercial fishery (TypeB). Contracaecum spp. were also found in bearded seals and ringed seals. Species of Contracaecum and Phocascaris occur as larvae only in the viscera of fish and are therefore of no commercial or public health significance.

Turbot (Reinardtius hippoglossoides) and Arctic cod (Boreogadus saida) collected in 2G, 2H and 3K were examined for nematodes. Small numbers of larval Anisakis were found in both species, with some in the flesh of turbot. Larvae of Contracaecum osculatum Types A and B and Phocascaris sp. were common in the viscera of turbot and Arctic cod and the fish species appear to be important intermediate hosts in the transmission of these nematodes to seals. Small numbers of P. decipiens Type C were found in the viscera of turbot.

Electrophoretic analysis of nematodes from Canadian seals and fish (conducted jointly with Prof. Lia Paggi and coworkers at the University of Rome) continues. Most recent findings indicate the genus Contracaecum comprises two species, provisionally designated Types A & B, in Canadian seals. Type A occurs as an adult in bearded seals, with larvae in turbot, American plaice and Arctic cod. Type B occur in harp seals with larvae mainly in capelin and Arctic cod.

Data on the occurrence of larval Anisakis simplex in the musculature of cod from Div. 2J, 3KL, 3NO, 3Pn and 3Ps are currently being analyzed and a manuscript is in preparation. Infected cod were found in all areas sampled, although the number of larvae per fish was low (generally <1.0).

f) Flatfish. Papers were prepared on biology and fishery of Atlantic and Pacific halibut; biomass estimates of flatfish from USSR surveys; distribution of juvenile and adult American plaice and yellowtail on the Grand Bank. In addition, several papers on flatfish were presented at NAFO Symposium in September and at the International Symposium on Flatfish Ecology in November 1990.

g) Crab. A study investigating the effect of shell condition on snow crab weight-length relationships was completed.

3. Gear and Selectivity Studies

a) Mesh selectivity in cod traps. A study was conducted to determine fish retention lengths in selected cod traps. It included the identification of optimum mesh and twine size in the drying portion and various other parts of the cod trap to facilitate the escapement of small cod. The study also undertook to monitor the behavior of cod during the hauling process with a view to identifying practical methods that could be engaged during the hauling process to facilitate the escapement of small cod.

Twenty-four cod traps were monitored in eight communities. Results indicated an escapement of 13% to 35% of small fish. Results varied among communities and trap mesh size.

b) Bio-acoustics. C-CORE is carrying out work, funded in part by the Canadian Centre for Fisheries Innovation, involving the development of acoustic devices which will be attached to fixed fishing gear to minimize incidental catches of marine mammals (whales in particular) without hampering fishing performance.

c) The stern deployment/retrieval and towed body handling system, which was developed for the GADUS ATLANTICA in 1989 to allow hydroacoustic work to be conducted in ice infested waters, was field tested in 1990. The system performed satisfactorily in ice covered areas, but handling and towing problems were experienced in areas with light ice coverage and in open ocean conditions. The problems were due to the increased vessel motion which was caused by swells greater than 2 m in height. A study is being carried out to determine the most effective method of upgrading the performance of the system.

4. Miscellaneous

a) Cod. During 1990, new research was initiated on northern cod (Div. 2J3KL) under the Northern Cod Science Program (NCSP). This program is a five year program of intensified research, collaboration and communications in direct response to recommendations from the Harris Northern Cod Review Panel. The biological research program focuses on many aspects of cod ecology including migration patterns, improved trawl surveys, impact of trawling on cod spawning and benthic communities, stock structure, chemical contamination, early life history, juvenile cod, cod food and feeding, predators and prey of cod and the influence of the environment on cod distribution and population dynamics. Significant progress has been made in the implementation of this program. In 1990 research cruises were conducted in hydroacoustic tracking of northern cod as they migrate inshore, determining larval cod distribution, tagging cod, increasing trawl survey coverage, assessing pre-spawning abundance of cod using hydroacoustics and in oceanography. In addition, considerable time was spent analyzing existing databases as a precursor to developing new research proposals and acquiring equipment and recruiting trained scientists and technicians for upcoming field seasons. New programs have been instituted to improve communications with fishermen, to increase collaboration with foreign scientists (Canada-Norway cod-capelin working group and ICES multispecies working group) and improving ties with university researchers.

b) Hydroacoustics. Investigate potential sources of variation observed in calibration measurements of the Hydroacoustic Data Acquisition System (HYDAS). The procedure used to acquire and analyze HYDAS calibration data in 1987 and 1988 was examined. Errors and weaknesses were identified in the procedure. These problems were corrected through the development of a new data acquisition and analysis technique.

Work is being carried out to enhance hydroacoustic technology. The primary goal during the next three years is the development of a standard target hydroacoustic calibration technique. The technique will include procedures for correcting echosounder TVG errors, conducting on-axis sensitivity measurements and measuring the equivalent beam angles of transducers mounted in towed vehicles.

c) Projects are underway to automate the Atlantic Observer Programs. Detailed Trip Report, automation of catch and effort data acquisition at sea and automation of editing are priorities.

catches/tacs

Table 1. *Summary of* Nominal catches and TAC's for major stocks assessed by the Scotia-Fundy Region in Subdivisions 4VWX and Subarea 5 for the last 5 years.

Stock	Nominal Catches ('000 t)					TACs set ('000 t)				
	1986	**1987**	**1988**	**1989**	**1990**	**1986**	**1987**	**1988**	**1989**	**1990**
Cod										
4Vn (M-D)	12	10	9	8	5	12	9	8	8	8
4VsW	52	46	38	37	34	48	44	38	35	35
4X	20	19	19	20	23	20	18	14	13	22
5Zjm	15	17	20	15	21	11	13	13	8	n/a
Haddock										
4TVW	17	4	5	8	7	17	0	0	6.7	6
4X	15	14	11	7	7	15	15	12	5	5
5Zjm	6	6	6	4	3	5	8	8	8	n/a
Pollock 4VWX	44	46	43	43	37	40	43	43	43	43
Redfish 4VWX	13	24	18	17	17	30	30	30	30	30
Flatfish 4VWX	8	9	7	8	9	14	14	14	14	14
Herring										
4Vn	5	3	3	2	5	4	4	4	4	4
4WX	102	130	160	129	141	98	127	151	151	151
Scallops										
4VWX	0.7	0.4	0.1	0.9	0.6	n/a	n/a	n/a	n/a	n/a
5Zc	4.9	6.8	4.3	4.7	5.2	4.3	6.8	5.4	4.7	5.2
Lobster										
4VWX inshore	14.1	14.7	14.7	15.6	18.7	n/a	n/a	n/a	n/a	n/a
4VWX offshore	0.6	0.4	0.3	0.3	0.5	0.7	0.7	0.7	0.7	0.7
5Ze offshore	0.2	0.2	0.2	0.1	0.1	combined with 4VWX				

1990 catch statistics are provisional

Table 2. Research vessel cruises, 1990.

Vessel	Area of Operation	Type of Survey	Operating Days	Trip #
NFLD-BASED VESSELS				
WILFRED TEMPLEMAN	3LNO	Redfish	January 16-29	90
	3P	Groundfish	January 31-February 20	91
	3KLNO	Groundfish	February 22-March 12	92
	3LN	Gear Trials	March 14-28	93
	3O	Groundfish	April 18-May 1	94
	3NO	Groundfish	May 4-16	95
	3L	Groundfish	May 18-June 5	96
	3LNO	Juvenile Flatfish	June 7-14	97
	3L	Redfish	August 7-20	98
	3NO	Juvenile Flatfish	August 23-September 5	99
	3LO	Juvenile Flatfish	September 7-27	100
	3L	Groundfish	October 27-November 19	101
	3NO	Groundfish	November 21-December 10	102
SHAMOOK	3LPs	Herring	January 15-March 2	160
	No operation due to ice		March 5-16	161
	Trinity Bay	Cod tagging	March 20-30	162
	Conception Bay	Oceanography	May 16-31	163
	Off St. John's	Crab	June 7-18	164
	Conception Bay	Oceanography	June 21-July 16	165
	2J (inshore)	Cod sampling	July 23-August 16	166
	Conception Bay	Oceanography	September 25-October 1	167
	3KL (inshore)	Herring	October 16-November 29	168
MARINUS	3LPs	Herring	January 15-March 2	127
	3LPs (inshore)	Capelin tagging	June 1-14	128
	Bonavista Bay	Crab	August 2-14	129
	Conception Bay	Oceanography	September 11-12	130
	3KL (inshore)	Herring	October 18-November 29	131
MAXWELL	St. John's	Hydrography	April 23-June 2	-
	Notre Dame Bay	Hydrography	June 3-July 4	-
	2J (inshore)	Hydrography	July 5-24	-
	Notre Dame Bay	Hydrography	July 25-August 10	-
	Conception Bay	Hydrography	August 11-22	-
	Notre Dame Bay	Hydrography	August 23-October 9	-
	Conception Bay	Hydrography	October 11-15	-
SCOTIA-FUNDY-BASED VESSEL				
DAWSON	3KL	Oceanography	May 29-June 6	-
	2J3KL	Oceanography	July 12-25	-
	3KL	Oceanography	October 31-November 6	-
CHARTERS (includes trips* manned by Quebec personnel)				
GADUS ATLANTICA	*4RST3Pn	Groundfish	January 10-30	177
	2J3K	Cod Acoustic	February 1-24	178
	St. John's, 3LPs	Acoustic trials	April 20-25	179
	3Ps	Scallops	April 25 - May 7	180
	3L	Capelin acoustic	May 9-28	181
	3L	Gear trials	May 29	182
	3KL	Cod acoustic	May 31-June 19	183
	Conception Bay	Acoustic calibration	June 21-26	184
	2HJ3K	Shrimp	July 7-25	185
	3P4RSTVW	Redfish acoustic	July 27-August 19	186
	3Ps	Scallops	August 21-September 4	187
	3Ps	Acoustic calibration	September 26-October 2	188
	2J3K	Capelin acoustic	October 3-29	189
	2J	Groundfish	October 31-November 15	190
	2J3K	Groundfish	November 16-December 3	191
	3KL	Groundfish	December 5-20	192
LADY HAMMOND[1]	3LO	Capelin tagging	May 4-13	210
	3LPs	Crab	May 14-22	211
	3K	Crab	May 23-31	212
	3KL	Capelin tagging	June 1-8	213
AERIAL SURVEYS				
FIXED-WING AIRCRAFT	Trinity & Conception Bays	Capelin	June 17-July 6	-

[1]Scotia-Fundy based long-term charter.