Northwest Atlantic Fisheries Organization

Serial No. N2172 NAFO SCS Doc. 93/6

SCIENTIFIC COUNCIL MEETING - JUNE 1993

Canadian Research Report for 1992

SECTION I. Scotia-Fundy Region, by P. Boudreau
SECTION II. Newfoundland Region, by M. M. Roberge
SECTION III. Quebec Region, by J-D. Lambert
SECTION IV. Gulf Region: not available

SECTION I. - SCOTIA-FUNDY REGION

by

P. Boudreau

Department of Fisheries and Oceans, Science Sector, Scotia-Fundy Region
Bedford Institute of Oceanography, P. O. Box 1006
Dartmouth, Nova Scotia, Canada B2Y 4A2

Subareas 2 and 3

A. Special Research Studies

1. Environmental Studies

Bedford Institute of Oceanography

Labrador and Newfoundland Shelves: Six satellite-tracked ice-beacons were deployed on the pack ice off the coast of Labrador to monitor ice drift, ice growth and ice decay of the pack ice as it drifts southwards to and over the Newfoundland Shelves. Salinity and temperature profiles of the water column underneath the pack ice and ice properties of the pack ice were collected at the sites where beacons were deployed by helicopter. Ice drift rates are also obtained by satellite imagery when two clear consecutive images are available.

Labrador Sea: Fifty-five full-depth CTD stations were occupied in the central Labrador Sea and over the continental shelves of Greenland and Labrador. This is the third of five planned annual repeats of World Ocean Circulation Experiment (WOCE) Hydrographic Program Line AR7/W between Greenland and Hamilton Bank, Labrador. Discrete measurements of dissolved oxygen, nutrients, chloroflurocarbons (CFC's), alkalinity and total carbonate were also obtained. Discrete measurements of natural halocarbons were made by a group from University of Göteburg and tritium/helium^3 samples were collected for Lamont Geophysical Observatory.

Subarea 4: Divisions 4V-W-X

A. Status of the Fisheries

Nominal landings and TAC's 1988-92 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 studies

Scotia-Fundy scientists continue to participate in activities related to the World Ocean Circulation Experiment (WOCE), the Joint Global Ocean Flux Study (JGOFS) and the Ocean Productivity Enhancement Network (OPEN) studies. Analysis of groundfish survey and oceanographic data continue as part of ongoing research on the influence of the physical environment on survey catches.

b) Plankton studies

Several coastal monitoring stations were established to measure long-term trends in phytoplankton abundance and species composition as well as associated physical and chemical variables. Advances were made in understanding the bloom dynamics of toxic phytoplankton and the conditions which cause algae to produce toxins. The long term monitoring of zooplankton populations in basins on the Scotian Shelf was continued and extended into the Gulf of Maine to determine effects of climate change on zooplankton populations.

c) Benthic studies

Experimental studies in the Minas Basin of the Bay of Fundy indicated that otter trawls did not have a major impact on intertidal organisms which were dominated by polychaete worms. Equipment has been developed and baseline data collected to conduct a similar trawling impact experiment on the Grand Banks in 1993 where a more diverse benthic community exists.

d) Other environmental studies

A variety of studies were carried out: development of a habitat sensitivity mapping system, continued refinement of numerical models to assist in habitat and environmental management (especially in relation to the impacts of aquaculture on coastal habitat), bioenergetics of marine mammals and contaminant fluxes in marine food webs.

2. Biological Studies by species

a) Cod

Studies in otolith structure continues. Otolith shape has been demonstrated to be an effective discriminator of populations with different growth rates (such as 4Vs and 4T cod). Studies on cod *recruitment* in relation to oceanographic parameters continues under the OPEN project. Also under OPEN, efforts at genetic fingerprinting (heritability) for cod has been very successful. Polymorphisms of the requisite degree of resolution have been obtained such that local stocks of cod can for the first time be reliably and easily distinguished. The effect of parent size, on the success of egg fertilization and subsequent larval survival of cod was also studied.

b) Haddock

Data suggest that cod and haddock stocks in 4X and neighbouring areas undergo parallel recruitment variability; the result of periodic and not random fluctuations in survival conditions.

c) Flatfish and Atlantic halibut

Studies continue on the lipid composition of halibut eggs, larvae and food organisms. A series of *experiments was performed on newly fertilized* halibut eggs to determine the influence of light intensity and salinity on water-hardening. These data will be analyzed and a manuscript written in the next year.

d) Redfish

Studies continue on redfish taxonomic and population inter-relationship. They are focusing on using *analysis of rapidly evolving* DNA segments including satellite sequences in the nuclear genome and a 300 base pair repeat sequence that was identified during the work on mitochondrial DNA sequence variation.

e) Silver Hake

Cooperative research on silver hake continues between Canada and Russian counterparts.

f) Herring

Long-term research programs on density dependent factors such as growth and fecundity initiated in 1991 were continued in 1992. Gonad samples were again collected in 1992. Work on growth and

length-at-age as indicators of stock status is encouraging and progressing well. Several more years of data collection will be required before benefits of this research become apparent.

g) Seals

Work continues on preparing a photographic otolith atlas of fish species in the NW Atlantic. The atlas could then be used by researchers analyzing seal stomach contents, as well as by archaeologists analyzing middens, and geologists analyzing sediment cores. Due to existing sample collections, otoliths of 56 species have already been collected.

h) Lobster

Laboratory studies were conducted on various aspects of lobster biology including: factors regulating molt synchrony and vertical migration in larvae; mating strategies of mature lobsters; and temperature regulation of egg production. Field research on Bay of Fundy lobsters continued with evaluations of postlarval settlement magnitude, and the use of hatchery-reared juveniles for manipulative field studies. Fine scale seasonal distance and depth movements of lobster in a Nova Scotia Bay were measured by a tagging and trapping study. Fishermen's catches of undersized lobster were found to be poor predictors of legal catches the following year. A new study, designed to assess pre-recruit indices as predictors of lobster abundance was initiated. Lobster productivity and mean annual surface temperature were found to be correlated. Morphometric lobster larval studies supported a two-population concept, Gulf of St. Lawrence and Scotian Shelf/Gulf of Maine, for Maritime lobster stocks.

i) Scallops

A study on the seasonal variation in the weight of the adductor muscle in Bay of Fundy scallops continued. Preliminary results show a much greater variation than has been previously reported. Studies on the seasonal variations in the RNA/DNA ratio are continuing. Genetic markers were discovered which allow for the distinguishing between Icelandic and Sea scallop meats, a potential forensic tool.

Work continued on a scallop spat settlement project which explores linkages between settlement and oceanographic circulation, and other ecological processes which affect successful benthic recruitment.

j) Underutilized species

A report on the results of a survey for commercial concentrations of small arctic surfclams on the Eastern Scotian Shelf was published. Studies on the age-at-maturity and reproductive cycle are underway. A study comparing molecular and palaeotologically derived evidence in taxonomy of Mactridae and Pectinidae has been completed with results to be published this year.

k) Atlantic salmon

A comprehensive five-year Atlantic salmon management plan, instituted in Canada in 1984, was re-implemented for 1990-1994. The original version prohibited commercial salmon fishing in the Maritime Provinces, and quotas (1990-1991) and closure (1992) were subsequently brought to insular Newfoundland. Recreational landings were restricted to one-seawinter (<63 cm) Atlantic salmon (grilse) and regional seasonal creel limits were further restricted in 1992 from 10 to 8 fish. Recreational catch estimates for 1992 in the Scotia-Fundy Region indicate a retained one-seawinter harvest of 7,184 fish. This number is a substantial improvement over the 4,355 one-seawinter harvest in 1991. Estimated release of multi-seawinter salmon (>63 cm) in 1992 in Nova Scotia was 1,804 fish, a decrease from 2,020 fish in 1991.

3. Gear and selectivity studies

4. Miscellaneous studies

Work continued on both shell morphology and comparative biology of Mytilus edulis and M. trossulus . A study of paternal inheritance of mitochondrial DNA in Mytilus using is also ongoing.

Subarea 5 and 6

A. Status of the Fisheries

Nominal landings and TAC's from 1988 to 1992 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 studies

Department of Fisheries and Oceans participated in GLOBEC Scotian Shelf/Gulf of Maine Modelling Project workshops at *Dartmouth College, Hanover, NH, USA and the Skidaway Institute of* Oceanography, Savannah, GA, USA. This work has developed vertical migration algorithms which have assisted in the completion of particle tracking model runs for cod, haddock and scallop eggs and larvae on Georges Bank.

b) Plankton studies

c) Benthic studies

Work continues on determining the potential sublethal effects of drilling wastes on the growth and reproduction of the sea scallop (see scallop report below).

d) Other environmental studies

2. Biological Studies by species

a) Haddock

Results show seasonal shifts in species distribution which are repeated annually and could be *important to bilateral management of this transboundary stock.*

b) Cod

Analysis of Georges Bank cod growth rates in relation to sexual maturation and exploitation has been carried out.

c) *Pollock*

Collaborative work with National Marine Fisheries Service scientists is ongoing and currently 21 years of survey data, both Canadian summer, spring and fall and American spring and fall, have been extracted and combined using ORACLE and plotted. Preliminary results indicate that age may be a factor in pollock distribution; as well a possible inshore/offshore migration of juvenile pollock was noted. Data are now ready for final analysis.

d) Scallops

Laboratory experiments using flumes to simulate flow conditions on Georges Bank continued to indicate that sea scallops are very sensitive to low concentrations of suspended drilling wastes. A second research cruise to Georges Bank provided more information on the flow dynamics of the benthic boundary layer, where contaminants concentrate and scallops feed.

3. Gear and selectivity studies

4. Miscellaneous studies

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. 1992 values are preliminary estimates.

Stock		Nominal Catches ('000 t)					TAC's ('000 t)				
		1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
Cod											
	4Vn (M-D)	9	8	5	5	4	8	8	8	10	10
	4VsW	38	37	30	34	25	38	35	35	35	35
	4X	19	20	24	28	26	14	13	22	26	26
	5Zjm	21	14	21	20	17	13	8	-	15	15
Haddock											
	4TVW	5	9	7	5	6	0	7	6	-	-
	4X	11	7	7	10	10	12	5	5	-	-
	5Zjm	6	4	5	6	6	8	8	n/a	5	5
Pollock											
	4VXW5Z	43	43	37	39	34	43	43	43	43	43
Redfish											
	4VWX	18	17	17	17	24[1]	30	30	30	n/a	
	4RST+3Pn4Vn(J-M)	52	53	60	60						60
	3Ps4Vs4Wfgj+3Pn4 Vn(J-D)	11	15	15	20						26
	4WdehkIX	3	2	2	2						9
Flatfish											
	4VWX[2]	7	8	7	5[3]	4[3]	14	14	14	14	14
Herring											
	4Vn	3	2	5	5	n/a	4	4	4	4	n/a
	4WX	160	129	141	122	100	151	151	151	151	151
Scallops											
	4VWX (offshore)	0.1	0.9	0.7	0.6	0.5	n/a	n/a	n/a	n/a	n/a
	5Zc	4.3	4.7	5.2	5.8	6.2	5.4	4.7	5.2	5.8	n/a
Lobster											
	4VWX (inshore)	14.7	15.6	19.4	19.6	14.6	n/a	n/a	n/a	n/a	n/a
	4VWX (offshore)	0.3	0.3	0.5	0.5	0.5	0.7[4]	0.7[4]	0.7[4]	0.7[4]	0.7[4]
	5Ze (offshore)	0.2	0.1	0.1	0.1	0.1					

[1] Management units under review in 1992.
[2] Plaice, Yellow and Witch - unspecified flatfish species not included
[3] Change in reporting of unspecified species - no longer apportioned by statistical districts
[4] 4VWX (offshore) combined with 5Ze (offshore)

SECTION II. - NEWFOUNDLAND REGION

by

M. M. Roberge

Department of Fisheries and Oceans, Northwest Atlantic Fisheries Centre
P. O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1

SUBAREAS 0 AND 1

A. Status of the Fisheries

Nominal landings from 1989 to 1991 for fish harvested from Subareas 0 and 1 are given in Table 1.

B. Special Research Studies

1. Biological Studies

a) *Atlantic salmon.* A total of 1,589 salmon was sampled at the fish plant in Narisaq, 2,748 in Maniitsoq and 2,018 from Paamiut, in centimetre length groups; including detailed measurements of fork length, gutted weight, and of these 1,612 were scale-sampled. This project provides an annual assessment of the proportion of North American and European fish caught at West Greenland. Also, 81 salmon were detected with micro tags from 7,883 salmon examined. Micro tags were from Canada, USA, Scotland, Ireland, Iceland, and England.

SUBAREA 2

A. Status of the Fisheries

Nominal landings from 1989 to 1991 for fish harvested from Subarea 2 are given in Table 1. Additional information on the status of the fisheries is as follows:

a) *Atlantic salmon.* Landings of large salmon (115 t) increased by 167% over 1991. The recreational harvest totalled 5.8 t.

b) *Arctic charr.* Severe ice conditions along the north Labrador coast, again, contributed to decreased effort and poor landings in 1992. An experimental in-river fishery at Saglek Fiord harvested 2.2 t of Arctic charr in 1992.

c) *Shrimp.* The Subarea 2 shrimp fishery was subject to a total quota of 11,220 t in 1992 (season January 1 to December 31), 4,760 t of which were in the Hopedale Channel.

d) *Capelin.* Landings of capelin remained at a low level.

e) *Redfish.* Landings in recent years have been almost exclusively from Div. 2J.

f) *Cod.* Landings were almost nil; northern cod moratorium was in effect in July 1992 for cod from 2J3KL.

g) *Greenland halibut.* Landings were primarily from Div. 2G and 2J with less than 200 t landed from Div. 2H. The fixed-gear fishery accounted for approximately 400 t.

B. Special Research Studies

1. Environmental Studies

a) *Oceanographic studies.* Northwest Atlantic Fisheries Centre current meter program on Hamilton Bank was continued. Temperature profiles were taken at each fishing station occupied in the subarea. As part of the Northern Cod Science Program, several clusters of satellite-tracked surface drifters were deployed to monitor surface currents on the continental shelf.

2. Biological Studies

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

b) *Atlantic salmon.* A total of 1,903 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.

c) *Arctic charr.* A total of 2,209 samples was obtained for age determination of Arctic charr in commercial landings from 12 northern Labrador fishing areas. Approximately 17,350 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.

d) *Shrimp.* Canadian Observers participated in approximately 40 commercial trips fishing shrimp off Labrador and northeast Newfoundland (Subarea 2 and Div. 3K, 3Ps) during 1992. A total of 2,004 fishing days and 9,336 sets was observed, with a total of some 756,205 shrimp measured. (Preliminary)

e) *Capelin.* An acoustic survey in Div. 2J3K in October 1992 resulted in a biomass estimate of 32,000 t.

f) *Flatfish.* Data on distribution and abundance of American plaice, Greenland halibut and witch flounder were collected during groundfish surveys of Div. 2J in 1992. Shrimp surveys in Div. 2H and 2J in 1992 can again be used in the development of a recruitment index of Greenland halibut.

g) *Redfish.* An autumn groundfish survey in Div. 2J in 1992 provided information on abundance, distribution and parasite infestation from biological samples collected.

SUBAREA 3

A. Status of Fisheries

Nominal landings from 1989 to 1991 for fish stocks are given in Table 1. Additional information on the status of the fisheries is as follows:

a) *Squid.* Total catch of squid in 1992 is expected to be low, generally, comparable to that of the previous year. The poor fishery, for the tenth consecutive year, was due to a natural low abundance of squid in commercial fishing areas.

b) *Atlantic salmon.* There was a moratorium on the commercial fishery. The recreational harvest was 20 t.

c) *Shrimp.* The Div. 3K shrimp fishery was subject to TACs totalling 3,655 t from January 1, 1992, to December 31, 1992.

d) *Scallops.* The offshore fishery for Iceland scallops continued into 1992 with a nominal catch 5,350 t shellstock (1,300 t for vessels less than 65' and 4,050 t for larger vessels).

e) *Clams.* The fishery for the Arctic (Stimpson's) surf clam (*Mactromeria polynnyma*) on the Grand Banks (3N) continued into 1992. Of the 20,000 t TAC, 11,154 t was taken. Most of the Canadian effort has moved away from the Banquerea Bank to the eastern Grand Banks of Newfoundland (unit 319).

f) *Capelin.* Inshore capelin catches were taken during the inshore spawning migration. Female capelin are preferred to satisfy the Japanese roe market. The offshore fishery was closed in 1992.

g) *Herring.* Herring landings decreased in 1992 due primarily to a reduction fishing effort.

h) *Cod.* Canadian landings were down substantially in 1992. The northern cod moratorium was in effect in July 1992 for cod from 2J3KL; reported Canadian catch (2J3KL) was 23,796 t, of whicih 5,000 5 was estimated to be from the inshore 'recreational' fishery.

B. Special Research Studies

1. Environmental Studies

a) Existing biophysical and socio-economic resource information for the western coastline of the Island of Newfoundland, and the marine area adjacent to it, was collected and converted to a common, digital format suitable for display by computerized desktop mapping software. The information will be presented in desktop mapping software. The information will be presented in a manner which readily permits evaluation of the relative sensitivity and accessibility of different portions of the coastline. The project will be completed in the second quarter of 1993.

b) Hibernia Management and Development Company. HMDC performed a geotechnical and detailed bathometric study in the summer of 1992 over the Hibernia oil field on the northeastern Grand Banks. Benthic samples were collected on an opportunistic basis during the program. The samples were analyzed to give an initial indication of natural variability amongst benthic faunal populations associated with varying substrates, and to determine whether potential indicator species for the purposes of effects monitoring were present.

c) Centre for Cold Ocean Resources Engineering (C-CORE), Memorial University of Newfoundland.

- Acoustic marine mammal alarm prototype was developed by the Seabed Geotechnics Group and the Whale Research Group at MUN. The alarm was designed to prevent incidental entrapment of marine mammals in fixed fishing gear. The alarm was tested and found to be effective.

- Ground Wave Radar ship trials carried out by Remote Sensing Group and Northern Radar. Operating in the ground wave mode, the radar is the first long range fully steerable system to be built and has the potential of becoming a reliable coastal surveillance device. It is capable of detecting vessels targets out to 400 km from shore of a sector of 120 degrees centred at 121 degrees (true) from Cape Race. Remote operation of the system is now possible from C-CORE's facilities in St. John's for display on a "FLAG" system developed by ULTIMATEAST Data Communications Limited.

- Hydraulically-operated Crab Sampler, clamshell design, was developed and tested by the Marine Minerals Research Group in the fall of 1990 to collect better and larger samples from a coarse-grained or compacted seabed, than could be obtained with present sampling equipment. A second generation sampler was developed with Atlantic Canada Opportunities Agency (ACOA) and NSERC support. This duel bucket sampler, proved to be extremely successful and of significant commercial potential.

- C-CORE, in collaboration with Gametic Technologies incorporated, was awarded a contract to evaluate the utility of airborne multispectral scanner (MSS) imagery for monitoring environmental effects. The study was carried out in St. John's harbour, and in Humber Arm, Corner Brook. The objective of the study was to establish a rule base from which water quality parameters can be derived using MSS imagery.

- C-CORE and CORETEC Incorporated worked on the development of the only fully operational Sea, Ice and Iceberg Forecasting System (IIFS).

2. Biological Studies

a) *Cod.* Sampling of the landings from the commercial fishery, both inshore and offshore, was continued in 1992. Using research vessels, surveys were carried out in spring and autumn, in all NAFO Divisions (except 3M) to determine the distribution and abundance of cod. Biological sampling was extensive during these surveys and approximately 8,600 cod were tagged, inshore and offshore. Stomachs were collected from Div. 3LNO during spring and from Div. 3KL during autumn.

b) *Scallops.* A stratified random survey was completed on St. Pierre Bank to determine the fishable biomass of Icelandic scallops (*Chlamys islandica*). Nine strata within the 55-90 m isobaths were surveyed.

c) *Squid.* Commercial squid samples were acquired, whenever available, at one inshore site (Holyrood), where water temperature was also monitored.

d) *Crabs.* New methods for estimating population size, exploration rate and catchability coefficient were applied, for the second consecutive year, to a small crab stock.

An investigation into the incidence and distribution of Bitter Crab Disease on the commercial fishing grounds was initiated. Three standard time-series research cruises, aimed at determining resource status off St. John's and in Bonavista Bay and Conception Bay, were carried out.

e) *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.

f) *Whales.* A study of the biology of harbour porpoise was continued. A sample of over 90 porpoise caught in fishing gear was examined and morphometric, age, reproductive and stomach content data were obtained.

Biological information and tissue samples were obtained from stranded and incidently 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 modelling and levels of aromatic hydrocarbon pollutants were continued.

g) *Scallops.* An exploratory survey was conducted in Div. 3Ps in the area around Cape St. Mary's to determine the abundance of Iceland scallops (*Chlamys islandica*). Of 34 sets (one mile tows with 3.6 m [12'] offshore rake), only two sets had catches in excess of 50 kg and four sets had in excess of 40 kg.

A test fishery was conducted by five commercial inshore and one offshore fishing vessels on selected areas of St. Pierre Bank (3Ps) and the Grand Banks (3L). Results indicate that there are potential commercial concentrations in a number of locations.

h) *Shrimp.* A research vessel survey, conducted in July 1992, used a combination of bottom trawling, and pelagic sampling to study the details of vertical distribution of shrimp in Cartwright and Hawke Channel (Div. 2J).

i) *White Hake.* In June, a test fishery was conducted by five commercial vessels fishing gill nets in Subarea 3O. Results indicate that there is a potential for a seasonal commercial fishery in depths greater than 165 m. During this test fishery by-catch of cod fish was generally less than 10%.

j) *Capelin.* An acoustic survey conducted during May 1992 resulted in a biomass estimate of 206,000 t which was approximately double the 1991 estimate but much lower than the estimates between 1985 and 1990 (2.6 (1987) to 7.0 (1990) million t). Abundance indices were derived from logbook and aerial surveys, which have been conducted since the early 1980's. Factors governing capelin survival during egg development and larval emergence from beach sediments were continued in 1992. Primary sampling sites were Arnold's Cove, Placentia Bay; Chapel's Cove, Conception Bay; Bellevue Beach, Trinity Bay; Eastport, Bonavista Bay; and Hampden, White Bay.

An acoustic survey in Div. 3NO during late June and early July resulted in a biomass estimate of 4,000 t.

k) *Herring.* The research gill net index fisherman program was continued for the thirteenth year as an index of herring abundance. A controlled field experiment was conducted in Conception Bay in June to examine the relationship between target strength and condition factor for herring. Acoustic biomass estimation surveys were conducted during January-February in Fortune Bay, Placentia Bay - St. Mary's Bay, and Conception Bay - Southern Shore, and during November - December in White Bay - Notre Dame Bay, and Bonavista Bay - Trinity Bay.

l) *Redfish.* Several groundfish research surveys conducted throughout Subarea 3, primarily in the spring and fall of 1992, provided information on the abundance, distribution and parasite infestation (Sphyrion lumpi). The collection and subsequent ageing of otoliths 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.

m) *Flatfish.* Distribution and abundance of flatfish were studied during random stratified surveys in the following Div and times in 1992: Div. 3K - fall survey; Div. 3L, 3N and 3O - spring and fall surveys; Subdiv. 3Ps - winter survey.

A survey was conducted in June 1992 to tag primarily juvenile American plaice and yellowtail flounder. The effort was conducted within Canadian waters in Div. 3LNO and in the NAFO Regulatory area of Div. 3N. There were 5600 fish tagged, 2,100 of which were juvenile American plaice and 2,700 juvenile yellowtail flounder.

Studies into the behavioral ecology of American plaice were continued, largely through laboratory experiments in controlled environments.

A juvenile flatfish survey was conducted in Div. 3LNO in the fall of 1992. 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.

3. Gear and Selectivity Studies

a) During January and February 1992, three 10-day cruises were conducted in Div. 3L. The objective was to investigate various ways of reducing catch of juvenile codfish in otter trawls; lastridge ropes shortened by 15% and 20%, 155 mm diamond mesh codends, 140 mm square mesh codends and a 50 mm grid Sort-X system were investigated. Results indicated increased selectivity with the 20% shortened lastridge ropes. Poor selectivity results were obtained from the Sort-X system.

b) In October 1992, two 10-day cruises were conducted in Div. 3LNO. The first cruise investigated the use of a horizontal panel to separate cod fish from flatfish. Two small mesh codends were used to retain all fish caught from above and below the panel. While some separation was achieved, this would not be practical in commercial fishing operations. The second cruise investigated the use of 178 mm square mesh codend to

release cod fish while directing for flounder. The results from this cruise are inconclusive due to a lack of codfish.

c) A cruise was carried out in February-March in Div. 2J3KL to investigate the use of the Nordmore grate to separate and release by-catch in the northern shrimp fishery. The results indicated that the grate became blocked with jelly fish, shark, and when fished in high concentrations, shrimp. As well, there was a loss of the larger more valuable shrimp. The effect of using the Nordmore grate in the northern shrimp fishery requires more study.

SUBAREAS 2 AND 3

A. Special Research Studies

1. Environmental Studies

a) *Hydrography.* Hydrographic staff were involved in inshore sounding surveys. Detailed information for the updating of navigation charts was collected along the northeastern Newfoundland coast.

b) *Oceanographic and related studies.* Ships-of-opportunity XBT programs were continued using the vessels CAPE ROGER. Temperature profiles were taken at each research fishing station occupied during 1992. 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 otter trawl.

An environmental data acquisition/transmission system (EDATS) was developed for installation on trawlers-of-opportunity. This system integrates data from automatic on-board weather stations, navigational data and data from XBT casts, transmits to AES and DFO computers in real time as MET and IGOSS messages.

2. Biological Studies

a) *Cod.* Combined trawl and acoustic survey was undertaken to determine the distribution of cod off the east coast of Newfoundland 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. Blood samples (385) from inshore and offshore areas were analyzed for "stock differentiation" using nuclear DNA gene probes.

b) *Assessments.* Assessments of some 25 groundfish stocks presently under catch quota regulations were conducted and refined for advice on TACs for the 1992 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.

c) *Research vessel cruises.* Sixty-six offshore and inshore research vessel cruises were undertaken in 1992-93 utilizing DFO-owned vessels (Newfoundland-based: WILFRED TEMPLEMAN, MARINUS, SHAMOOK; Scotia-Fundy based: ALFRED NEEDLER, PARIZEAU; GADUS ATLANTICA and LADY HAMMOND (charters).

d) *Commercial sampling.* Sampling of foreign and Canadian offshore catches for all commercial fish and invertebrate species by the Canadian Observer Program continued in 1992.

e) *Seals.* 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.

A series of studies designed to provide information on the role of pinnipeds in the Northwest Atlantic Ecosystem were continued. These studies include expanded research on feeding and offshore distribution of harp and hooded seals and a study of movements and diving behaviour in free-ranging seals using satellite-telemetry. Studies of the energy requirements of captive harp seals and indicators of metabolic rates are also being supported under this initiative.

3. Miscellaneous

a) *Northern Cod Science Program.* As part of the Atlantic Fisheries Adjustment Program (AFAP), research initiatives continued for the third year on northern cod (Div. 2J3KL) under the Northern Cod Science Program (NCSP). NCSP initiatives were established to address the science recommendations of the Northern Cod Review

Panel which conducted an independent review of the state of the northern cod stock and published a report in February, 1990. Resources were assigned to study cod ecosystems dynamics, improve communication, collaboration and education and to take advantage of new technologies in cod research and assessment.

Highlights of research activities in 1992 included:

- The procurement of new 38 kHz hydroacoustic technology as part of the three year 49 kHz to 38 kHz hydroacoustic technology conversion plan.
- A survey of the abundance and distribution of demersal juvenile cod was carried out in December 1992, covering the inshore and shelf waters of Division 3KL. A Cameplen 1800 shrimp trawl was used. Juvenile cod were widely distributed over the survey area but size distributions differed among areas.
- An analysis of reconstructed contents of harp seals collected in nearshore waters in 1991 indicated that arctic cod was the most important prey of these animals. Capelin, squid, herring, crustaceans,, and gadoid sp. were also important components.
- The second year of the NCSP Synchronous Events and Recruitment of Capelin initiative was completed whereby biological and environmental data on the reproductive tactics of capelin at six beach spawning sites were collected. This information will be used to examine the link between the timing/abundance of beach spawning capelin and variations in cod distribution and inshore cod catches.
- Satellite-linked time-depth recorders (SLTDRs) placed on hooded seals in the Gulf of St. Lawrence allowed researchers to follow the migration of these seals to their traditional moulting area off southeast Greenland.
- High resolution acoustic imaging trials carried out in mesocosms with muddy bottom indicated that burrow systems, buried sea urchins, mud stars, brittle stars, whelks, and clams showed up clearly. This new technology will be used in field work on the northern Grand Banks scheduled for 1992-1994.
- A Northern Cod Workshop was held in January 1993 to determine the possible cause of the decline in biomass and abundance of cod in recent years. Recommendations for research necessary to evaluate the different possibilities were produced. The NCSP will be funding most of this new work.
- Four sites were monitored on the northeast coast of Newfoundland using Japanese pelagic traps set in the nearshore. Inshore juvenile cod abundance (age 0-4) was monitored and samples were provided to other program researchers.
- The historical database of tagging information on northern cod consists of 220,190 fish which have been tagged and released over 250 different locations and covers virtually all coastal and shelf regions of Newfoundland and Labrador from 1933-1992.
- Short-finned squid have been shown to be predators of young-of-the-year Atlantic cod after July although squid stomach analysis showed presence of otoliths of other fish species, as well.
- The offshore to inshore migration of cod was followed in June and July using hydroacoustic technology working off an OPEN-chartered vessel and using other vessels to collect fish for detailed samples.
- NCSP-chartered LADY HAMMOND was involved in four trips to study the drift of cod eggs and larvae, two trips to track the offshore to inshore migration of cod, and one trip to observer oceanographic parameters in the area of the Bonavista Migration Corridor.

b) *Hydroacoustics.* Work is continuing to develop and enhance hydroacoustic technology through: 1) the development of a standard target calibration technique for use with transducers mounted in underwater towed vehicles and 2) conversion from 49 kHz to 38 kHz instrumentation.

Table 1. Summary of preliminary landings for fish harvested by NAFO Subarea 0, 1, 2 and 3, 1989-1992.

Subarea	Species	Division	Catch ('000 t) 1992	1991	1990	1989
0+1	Greenland halibut	0	8,200	5,945	6,194	
	Shrimp	0A	7,493	6,788	6,116	7,200
		0B	1,250	1,100	1,575	
2	Cod	(Offshore)	-	635	32,600	56,000
		(Inshore)	-	2,200	14,300	22,000
	Redfish		1	7	192	70
	Greenland halibut		1,800	3,200	3,800	2,500
	American plaice		<10	80	900	3,200
	Other groundfish		100	467	403	
	Atlantic Salmon		152	86	179	289
	Arctic charr		74	70	100	100
	Shrimp		11,100	10,300	9,500	
3	Cod		56,600	159,200	201,600	204,100
		3K	1,756	42,800	54,400	
		3L	22,600	74,500	104,000	
		3N	580	1,500	4,600	
		3O	6,600	6,500	7,000	
		3Ps	24,600	27,300	26,300	
		3Pn	-	6,500	5,300	
	Redfish		22,200	16,100	14,900	13,200
	Flatfish		40,300	45,500	47,200	54,200
	American plaice		11,800	27,000	27,500	32,200
	Yellowtail		6,800	7,400	5,100	5,400
	Greenland halibut		15,100	4,000	6,500	9,300
	Greysole		6,600	5,700	6,900	6,200
	Winter flounder		-	900	400	
	Atlantic halibut		-	560	790	
	Other groundfish					
	Haddock		1,200	1,600	4,500	
	White hake		-	773	3,400	
	Pollock		264	1,300	1,800	
	Wolfish		-	490	580	
	Capelin	3L	3,000	21,400	47,000	
		3K	17,400	19,800	32,000	
		3Ps	50	80	1,100	
		2J3KL (offshore)	closed	450	57,300	
		3O (offshore)	closed		3,537	
	Herring		7,000	18,200	8,500	
	Mackerel		1,300	800	1,200	1,900
	Squid		-	2,000	3,750	
	Atlantic salmon		-	267	319	
	Shrimp	3K	3,600	500	>1,000	
	Sea scallops (meats)		67	59	153	305
	Iceland scallops		5,530 *(shellstock)*	70 *(meats)*	35 *(meats)*	
	Clams		11,254	7,200	10,000	

SECTION III. - QUEBEC REGION

by

Jean-Denis Lambert

Institut Maurice-Lamontagne, Ministère des Pêches et des Océans
850 Route de la Mer, C. P. 1000, Mont-Joli, Quebec, Canada G5H 3Z4

1 Research report, 1992

SUBAREA 4

A. Status of the Fisheries

DFO Nominal landings and TAC ('000 t) since 1989 for stocks currently being assessed in the Quebec region are as follows:

Species	Division	Nominal Landings (TAC)			
		1989 [1]	1990 [1]	1991 [1]	1992 [1]
Cod	4RS,3Pn	47 (76.5)	40 (58)	32 (35)	32 (35)
Greenland Halibut	4RST	5.0 (10.5)	2.4 (10.5)	2.1 (10.5)	3.5 (10.5)
Atlantic Halibut	4RST	0.2 (0.3)	0.4 (0.3)	0.3 (0.3)	0.4 (0.3)
Redfish	4RST	45 (57)	49 (57)	60 (67)	60 (57)
Herring	4R	18 (37)	17 (35)	19 (35)	15 (35)
	4S	0.9 (3.5)	0.5 (3.5)	0.1 (4)	0.1 (4)
Mackerel	S.A.2-6	74.7	65.5	55.2	37.6
Capelin	4R	1.1 (5.7)	5.8 (7.0)	7.4 (18)	8.6 (18)
	4S	1.1 (2.7)	0.1 (1.6)	0.1 (3.3)	0.9 (3.3)
	4T	0.1 (1)	0.1 (1.3)	0.1 (3.3)	0.1 (3.3)
Snow crab	4S,4Tpq	2.6	4.3	4.7	4.5
Shrimp	4RST	15.4 (15.1)	15.3 (15.8)	16.3 (16.6)	12.7 (16.6)
Lobster	4S,4T[2]	3.2	3.2	3.5	3.8
Scallop	4S,4T[2]	2.4	3.6	2.0	2.7

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

B. Special Research Studies.

1. Environmental studies

a) Hydrographic studies

b) Plankton studies (including eggs and larvae)

i) Stock structure of Gulf Redfish.

Genetic variation patterns observed in the liver MDH locus are used to differentiate larvae of S. mentella and S. fasciatus. Project is under completion.

ii) Mackerel Egg Surveys.

The Department of Fisheries and Oceans has been conducting an annual survey of mackerel egg abundance since 1979 in order to estimate the Gulf of St.Lawrence spawning stock biomass. The total egg production method in 1992 gave an estimated biomass of 792,000 MT.

Estimation of the spawning stock size of Gulf of St.Lawrence mackerel is calculated according to the total egg production method. In the past, this method has been proposed to overcome the problem of a lack of valid abundance index. Female fecundity, one of the most important variable to insert in this method, is determinated as being the number of oocytes having a diameter greater than 140 µm just before the spawn. This definition of fecundity is inadequate for indeterminated serial spawner as the Atlantic mackerel and batch fecundity method has been proposed to redefine mackerel fecundity and calculate the biomass. As in 1991, a research survey was conducted in 1992 and the data are under analysis.

For the past three years, a correction for oversampled eggs at the surface with oblique plankton tow has been applied. A mean annual reduction of 20% was obtained. In 1993, the study describing the relationship between the egg vertical distribution and physical factors will be completed to refine the model.

iii) Cod juvenile survey

Beach seine and bottom trawl research surveys have been conducted in the northern Gulf of St. Lawrence since the fall of 1990 to provide basic information on the ecology of juvenile cod and assess their availability and susceptibility to capture. Preliminary results indicate that in early spring, 1-group cod were distributed in the region where a permanent intermediate cold water layer (< 0 °C) impinges on the bottom. They were in good general condition and there was no evidence for size-dependent winter mortality. Small cod (< 25cm) can be seriously undersampled by bottom trawls of the types used by regular Canadian research vessel surveys.

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

Landings for the 3Pn 4RS cod stock have plumetted to a historical low of 32,000 t in 1992, this being lower than the TAC of 35,000t. Most of the shortfall can be attributed to the fixed gear sector. The TAC for 1993 is 31,000 t and most of the catches should be constituted by two average year classes, those from 1986 and 1987. Subsequent year classes apear to be under average which may slow the recovery of this cod stock. Fishing mortality is estimated to be 0.34 in 1991 which is well above the target fishing mortality at $F_{0.1}$ of 0.2. Asside from the low recruitment observed for this cod stock in recent years, growth rates are very low which affect as well the overall productivity of the stock.

2.1.2 Redfish

The annual stock assessment for the Gulf of St.Lawrence redfish was presented to CAFSAC. The fishery increased steadily during the 1960's to reach a maximum of 130,000 t in 1973. Thereafter, landings declined sharply to a low 15,000 t in 1978 and have steadily increased to 60,000 t for the last two years. An examination of stock structure of the 4RST, 3P and 4VWX redfish stocks indicate that considerable mixing may occur in the winter. Therefore, CAFSAC identified new management units as been 4RST+3PN(Jan-May)+4Vn(Jan-May). The recommended TAC for 1993 is 60,000 t.

2.1.3 Greenland Halibut

The status of Greenland Halibut in the Gulf of St. Lawrence has not been assessed by CAFSAC for the last five years dues to uncertainties regarding stock structure. From a stock discrimitation study completed in 1992, CAFSAC concluded that exchanges among the stocks may take place in the early phases of the life history of the species, but the adult population of the Gulf may not emigrate to any great extent. Therefore Greeland Halibut in 4RST could be managed as a unit on yield per recruit, and the TAC recommended for 1993 is 4000 t.

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. An analytical assessment was not undertaken in 1991 as the last ADAPT formulation presented in 1990 result in non-converged population numbers and high values in the correlation matrix, and there was not sufficient change in the fishery data to provided this year to warrant the use of a VPA. Preliminary analysis of acoustic survey results for 1989-1990 were presented to CAFSAC. Fishery have reported landings that ranged from a low 3,000 t in 1969 to a peak of 27,000 t in 1973 mainly due to fluctuations in size of the purse seine fleet. Nominal catches in 1991 totalled 18,900 t up from 16,100 t in 1990.

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.

From the acoustic study it was demeonstrate that movements in the nearshore zone during the feeding migration are closely linked to the wind-forced advections of heated near-surface waters but mackerel can nevertheless be found in waters mush colder than hypothezed 7 C boundary.

A preliminary otolith L_1 was performed on previous collected commercial samples. Mean annual L_1 presented no significant difference for the period preceding the 200 miles juridiction where strong fishing effort was applied on the population. Significant differences were however noted after that period where the two lowest mean values corresponded to the strong year-classes of 1982 and 1988. These results suggest the presence of an inverse relationship between density and growth during the first year. It was also noted that length at one year old does not affect length at older ages. Examination of otolith L_1 could be used in futur to predict and verify the strength of a year-class.

2.2.3 Capelin

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 conducted in 92 provided data on geographical variability of growth, sexual maturity, fecundity and patterns of spatial distribution of rock crab. Data will serve to establish a management strategy of this resource, once the commercial exploitation begins.

2.3.2 Snow Crab

A multi-year research program was undertaken in 1990 on the inheritability of the size at sexual maturity of males and the size limit regulation as an adequate management tool for snow crab. Field and laboratory work is ongoing on growth, molting, reproduction and movement of snow crab and on genetic identification of stocks. The age structure is also examined from data and shells datation.

Data collection from the commercial fishery (at sea sampling and logbook compilations) is done on a routinely basis to allow the assessment of snow crab in the Estuary and Québec North Shore and the provision of scientific advice.

A recrutment survey serie was started in 1992 on the north shore of the Gulf of St. Lawrence estuary. Preliminary results were presented to the fishery representatives in 1993 in a way to predict short term recrutment to this fishery

2.3.3 Shrimp

Data collection from the commercial fishery (port sampling and logbook compilations) is done on a routinely basis and a research survey is conducted every fall in the northern Gulf of St.Lawrence to obtain a relative index of abundance of the resource. The commercial and research data are analyzed to assess the status of shrimp in the four management units of the Gulf and to provide scientific advice. This resource is under a multi-year management plan until 1994.

Current research is ongoing on the genetic discrimination of shrimp concentrations inside and outside the Gulf, the spatial organization of shrimp in relation to its ontogeny and the survival of larvae evaluated by a condition index.

2.3.4 Lobster

Monitoring of the landings (at sea sampling) as well as catch statistics obtained from index fisherman program provide the data to follow up the commercial fishery. Research work involves observations on molting (frequency and growth increment) and work on catchability of different types of traps.

2.3.5 Scallop

A multi-disciplinary research program is conducted on the restocking of suitable grounds for scallop in Magdalene Islands. Research implies studies on growth in relation to the density, the identification of adequate grounds and the collection and growth of spat.

Data collection from the commercial fishery (at sea sampling and logbook compilations and research survey) is done on a routinely basis to assess the resource and provide scientific advice.

2.3.6 Other molluscs

An acoustic survey was conducted in the area of Magdalene Islands to determine the spatial distribution of some species of bivalves. Stimpson's surf clams concentrations were sampled to determine the demographic structure of the resource and elaborate management strategies adequate to this slow growing species.

2.4 Marine mammals

2.4.1 Seals

Harp, grey, hooded and harbour seals are the four species of seals present in the Gulf of St. Lawrence. Only grey and harbour seals are year round residents. In 1989-90, grey seal pup production in Northwest Atlantic was estimated at 20 044 animals, with about 50% being born on Sable Island and 50% in the southern Gulf. From this the total northwest grey seal population was estimated at 112 249 animals. Last January, studies on the energetic of reproduction has been pursued and satellite transmitters have been attached to five females to follow their movements and activity until the moult in June. In August 1993, another five satellite transmitters will be attached to five female grey seals in the northern Gulf, and recovered in January 1994. For harp seals in 1990, the total

pup production of the northwest Atlantic was estimated at 577 600 animals (467 000 at the Front, 106 300 in the Gulf and 4 300 in Mecatina patch), from which a model gave a total population in the order of 3.1 millions. In March 1993, satellite transmitters were attached to 6 hooded seals in the Gulf. The information from the energetic work combined to the information on the movements and diving patterns from the satellite transmitters will be used in models to improve the assessment of seal predation on fish stocks.

2.4.2. Porpoise

In summer 1992, the characteristics of the gillnet fishery has been studied by following 22 fishermen in the Gaspe region. From 2000 sets, the incidence of harbour porpoise by-catch (440) was related to position, target species, net length, mesh size, water depth and fishing success. Biological samples from the animals caught in fishing gears were collected and analysed.

2.4.3 Beluga whales

In summer 1992, photographic aerial surveys were conducted in the St. Lawrence estuary. The purpose of these surveys was to estimate the total number of individuals and to determine the age structure of this population. That same summer, satellite transmitters were placed on two animals of the Hudson Bay. In 1993, in the eastern Hudson Bay and James Bay we will deploy satellite transmitters on 6 Beluga whales, fly one aerial survey and get samples from native hunting.

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.Lawrence estuary was conducted.

2.5 Parasitology

2.5.1 Greenland halibut (Reinhardtius hippoglossoides)

Studies are continuing on the use of parasites as " biological tags" for this fish. Results show that fish from the Gulf of St.Lawrence can be readily distinguished from those taken from adjacent waters off Labrador and from the Saguenay Fjord. The value of parasites to determine movmements of fish within the Gulf is being investigated.

2.5.2 Redfish (Sebastes fasciatus and S. mentella)

A study is in progress to determine the parasite fauna of redfish in the Gulf of St.Lawrence and, in conjunction with genetic analyses, to see if parasites can be used as easy means of distinguishing between these two closely related species.

2.6 Marine plants

2.6.1 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 is beeing investigated in the median and long term.

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

i) Mesh selection studies in the Gulf of St.Lawrence Greenland Halibut fishery.

In 1991 a major study of mobile gear selectivity and impacts of a mesh change was conducted in the Gulf of St.Lawrence. In total 12 vessels were involved in the experiment. Field work was completed at the end of November and preliminary results were presented to CAFSAC. In summary the study concluded that a mesh size increase would mean significant immediate decrease in CPUE. Further analyses are required to determine the long-term benefits of an increase in the mesh size.

ii) Mackerel gill net selectivity

In 1992, a mackerel fishery in Baie des Chaleurs (Québec) has been monitoring to study gill net selectivity. Fork length and different girth measurements have been taken to find the best model. In 1993, the effect of mesh size on the yield will be analysed.

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.