

Northwest Atlantic



Fisheries Organization

Serial No. N2058

NAFO SCS Doc. 92/9

SCIENTIFIC COUNCIL MEETING - JUNE 1992

Canadian Research Report for 1991

SECTION I.       Scotia-Fundy Region, by P. A. Koeller  
SECTION II.       Gulf Region, by J. S. Lock  
SECTION III.       Newfoundland Region, by M. M. Roberge  
SECTION IV.       Quebec Region, by J. D. Lambert and M. Bérubé

SECTION I.       -       Scotia-Fundy Region

by

P. Koeller

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

**Subarea 4: Divisions 4V-W-X**

A. Status of the Fisheries

Nominal landings and TAC's from 1987 to 1991 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

Extensive observations were made for the World Ocean Circulation Experiment (WOCE), the Joint Global Ocean Flux Study (JGOFS), and the Ocean Productivity Enhancement Network's (OPEN) study on eastern Scotian shelf cod. Data collection and analyses were conducted in support of the Atlantic Fisheries Adjustment Program (AFAP) funded study of ocean climate in relation to fish stock dynamics. Analysis of groundfish survey and oceanographic data continued as part of ongoing research on the influence of the physical environment on survey catches.

b) Plankton studies

Another in a series of JGOFS expeditions focussed on carbon flux during the spring phytoplankton bloom in the NW Atlantic, and methodologies surrounding the measurement of primary productivity using satellites. Long term zooplankton monitoring studies, particularly in the deep basins of the Scotian Shelf, were initiated to determine climatic effects on secondary production (GLOBEC). A three year coastal monitoring program for harmful marine algae, especially those producing domoic acid, was completed and advances were made in understanding the physiology of domoic acid production by *Nitzschia pungens*.

c) Benthic studies

Work was initiated on the effects of trawling on the benthic habitat. A study on the impact of discarded or lost "ghost" gillnets on the groundfish population and benthos was also initiated. Research on the effects of aquaculture, particularly on the benthos below salmon cages, continued. Studies on the flux of contaminants between sediments and the water column, and the sublethal effects of contaminated sediments on selected benthic organisms, also continued.

d) Other environmental studies

In addition to those mentioned above, a variety of other environmental studies were conducted during the review year. These included: initial development of a habitat sensitivity mapping system; development of computer models to assist in habitat and environmental management, especially in relation to aquaculture site development; and continued monitoring and research on the effects of acid rain on freshwater fish production.

2. Biological Studies by Species

a) Cod

A renewed research effort on stock identification, migration, catch statistics collection, and sampling of the components of the Subdivision 4Vn and 4VsW cod stock complexes was made as a result of quota management problems associated with the cod migrations between Subdiv. 4T, 4Vn and 4VsW. Stock structure research based on otolith microstructure and shape analyses continued. Several larval surveys were completed as part of the OPEN program,

b) Haddock

Analysis continued on previous Subdiv. 4TVW haddock tagging studies. Haddock stock discrimination research using mitochondrial DNA analysis continued, including completion of a report on initial findings. An inshore survey in Subdiv. 4X was completed to develop an abundance index for areas not covered by groundfish trawl surveys due to rough terrain. Historical tagging data was analyzed to determine the usefulness of further closed areas for management of this depressed stock.

c) Pollock

A recruitment study using juvenile pollock data obtained from mackerel trap fishermen continued, including compilations and analysis of existing data. Another project involving fishermen obtained environmental and catch information from gillnetters to determine the factors influencing catchability and availability. Groundfish survey data analysis continued in an effort to determine changes in distribution by age which may be responsible for changing catch patterns. Length-based assessment techniques for this species were also investigated.

d) Flatfish and Atlantic halibut

Data analysis from a study of Atlantic halibut reproductive biology was completed. Work also progressed on reports on flatfish stock structure on the Scotian Shelf and on comparative study on the Atlantic and Pacific halibut.

e) Redfish

Other than continuing stock discrimination studies, little dedicated research on this species was conducted.

f) Silver hake

Differences in aging silver hake otoliths between Canadian and USSR technicians were resolved and work on radio-chemical aging techniques continued. Analysis on data collected during the Canada-USSR cooperative multidisciplinary research program continued. The cooperative juvenile survey was conducted again and results used for the first time in the analytical assessment. Analysis of data on trophic links between silver hake and other species also continued.

g) Herring

Acoustic surveys of spawning concentrations were attempted in the Bay of Fundy and on German Bank. Problems were encountered in surveying tightly aggregated, rapidly moving groups of fish, but there is some potential for surveys of this type if undertaken in close association with the fishing fleet. In addition to the annual Bay of Fundy larval survey, work progressed on modelling larval transport with respect to the hydrography in the region. SPA Tuning methods in eastern and western Atlantic herring assessments were compared and a report produced.

h) Large pelagics

Analysis of historical tagging data was completed. Swordfish and Bluefin tuna tagging and mark/recapture experiments were conducted, and biological information on age, size, fecundity and other parameters was collected during several research cruise.

i) Seals

A major research effort continued on the dynamics of seal populations, seal-sealworm-fish interactions, and seal diets and energetics.

j) Lobster

Data analysis continued on lobster larval surveys, including publication of a report on larval residence times in Nova Scotia bays. A prototype post-larval lobster collector was tested, and a cage study evaluated cannibalism of females by dominant females. The impact of scallop drags on commercial lobster stocks was evaluated. Several projects on lobster habitat in relation to population dynamics were conducted.

k) Scallops

RNA/DNA ratios were used to measure the year-round health of Bay of Fundy scallops. A study on the reproductive ecology of offshore deep-sea scallops was initiated. Analysis of morphometric data for stock identification studies continued and spatial variations in growth rates were examined.

l) Underutilized species

An exploratory cruise investigated the commercial potential of deep sea species on the continental slope using traps, trawls and longlines. Catches were composed of 21 species of deep-sea fish and the deep sea red crab. Catches of shrimp, although expected to be high, were nil. A detailed report was published.

m) Marine plants

Long-term studies were initiated to study competition between commercial and non-commercial species.

3. Gear and selectivity studies

Imposition of mesh size increases and revisions to management decisions on such changes required numerous analyses of mesh selection effects, especially with respect to the selectivities of square vs. diamond mesh cod ends. An experiment was also conducted to compare size selection of hooks and trawl nets when fishing the same population of fish.

4. Miscellaneous studies

A variety of non-specific studies designed to evaluate and/or improve currently used stock assessment models were conducted including: comparisons of N. Atlantic fishery management regimes subsequent to extension of jurisdiction; description of the development of regional overcapacity; development of biological and economic feedback control model; and consideration of biological reference points in a regional workshop. In addition to those mentioned above, several other special studies were conducted under AFAP funding: communication of fisheries science and management issues to fishermen; geographic distribution studies; survey trawl mensuration; and various biological studies including ichthyoplankton and juvenile surveys.

**Subareas 5 and 6**

A. Status of the Fisheries

Nominal landings and TAC's from 1987 to 1991 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

Analysis continued on data collected during the Georges Bank Frontal study.

b) Plankton studies

Observations were made for the GLOBEC climate study.

c) Benthic studies

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 clay particles such as are found in oil well drilling muds. Field work on the Bank collected data on the concentration and size distribution of naturally occurring particles just above the sea floor which constitute the food source for scallops.

d) Other environmental studies

2. Biological Studies by Species

a) Cod

A stock structure study on the relationship between 4X and 5Z cod was completed and a report produced.

b) Haddock

A study was conducted on the distribution and migration about the 5Zjm boundary. Another study was initiated using live fish to investigate the higher growth rates of the Georges Bank versus the Subdiv. 4X stocks. Preliminary preparations were completed on separating haddock stocks in the Georges Bank area using otoliths.

c) Pollock

Results given under Subdivisions 4-V-W-X also apply here.

d) Herring

A summary of recent work on the recovery of the Georges Bank stock indicated that the stock continues to show strong signs of recovery, but that geographical distribution is still very restricted relative to abundant years in the late 60s. Another adult/larval survey was conducted in the fall, this time expanded to include the northeast tip of the Bank. The futility of using acoustics to monitor this wide-ranging stock was confirmed. Long-term objectives for studies on the relationship between various biological parameters and stock recovery were finalized.

e) Large pelagics

Results given under Subdivisions 4-V-W-X also apply here.

f) Lobster

Analysis continued on offshore lobster distribution data for the Gulf of Maine. Information on inshore-offshore lobster was reviewed and a long-term research plan on the problem developed during a dedicated workshop. A reports on larval dispersion on Georges Bank was completed.

g) Scallops

Reports on the broadscale distribution and abundance of sea scallop larvae on Georges Bank and across the frontal zone on the Bank's northern flank were produced. Reports were also published on the faunistic assemblages of Georges Bank scallop beds and on the distribution and growth variability in juveniles.

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)				
	1987	1988	1989	1990	1991	1987	1988	1989	1990	1991
<b>Cod</b>										
4Vn (M-D)	10	9	8	5	5	9	8	8	8	10
4VsW	46	38	37	34	33	44	38	35	35	35
4X	19	19	20	23	27	18	14	13	22	26
5Zjm	17	20	15	21	21	13	13	8	n/a	n/a
<b>Haddock</b>										
4TVW	4	5	8	7	5	0	0	6.7	6	n/a
4X	14	11	7	7	10	15	12	5	5	n/a
5Zjm	6	6	4	5	6	8	8	8	n/a	5
<b>Pollock 4VWX</b>	46	43	43	37	39	43	43	43	43	43
<b>Redfish 4VWX</b>	24	18	17	17	17	30	30	30	30	n/a
<b>Flatfish 4VWX</b>	9	7	8	9	11	14	14	14	14	14
<b>Herring</b>										
4Vn	3	3	2	5	5	4	4	4	4	4
4WX	130	160	129	141	122	127	151	151	151	151
<b>Scallops</b>										
4VWX (offshore)	0.4	0.1	0.9	0.7	0.6	n/a	n/a	n/a	n/a	n/a
5Zc	6.8	4.3	4.7	5.2	5.8	6.8	5.4	4.7	5.2	5.8
<b>Lobster</b>										
4VWX inshore	14.7	14.7	15.6	19.4	20.0	n/a	n/a	n/a	n/a	n/a
4VWX offshore	0.4	0.3	0.3	0.5	0.5	0.7	0.7	0.7	0.7	0.7
5Ze offshore	0.2	0.2	0.1	0.1	0.01	combined with 4VWX				

1991 catch statistics are provisional

1991 5Z haddock quota represents Canadian quota only

SECTION II. - Gulf Region

by

J. S. Loch, Regional Director

Science Branch, Department of Fisheries and Oceans  
P. O. Box 5030, Moncton, New Brunswick, Canada E1C 9B6

A. STATUS OF THE FISHERIES:

1. Southern Gulf Cod (4TVn):

The Total allowable catch was 48,000 tonnes in 1991. Provisional landings were 42,102 tonnes. France was allocated 1,600 tonnes and a catch of 1588 tonnes was reported. The Canadian winter fishery in 4Vn landed 6651 tonnes, however, a further 4487 tonnes were estimated to have been caught in 4Vs. Fixed gear landings were the lowest in the period 1965-90. The standardized Otter trawl catch rate decreased over 1990. Research survey estimates (age 3+) also declined over 1991. The mean population biomass appears to have decreased since the mid 1980's. Fishing mortalities on the stock have been reduced in recent years to 0.25-0.30 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 1991 totalled 4,703 tonnes representing a decrease of about 900 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 1991 was 5,500 tonnes with provisional catches totalling 4,106 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 to 1991. This fishery has been relatively stable with a catch of 5,000-6,000 tonnes since 1965. The peak catch of 14,039 tonnes reached in 1981 was thought to be 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 1991 was 3,500 tonnes with provisional catches totalling 461 tonnes. Landings have averaged about 800 tonnes since 1982. Close to 100% of the catch is taken near Newfoundland in Division 4R during the summer fishery.

5. Southern Gulf Herring (4T):

The total allowable catch by gillnet and purse seine fisheries was 86,900 tonnes in 1991. 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 have been stable since 1985. Catch rates by index fishermen supplemented commercial catch rates in the catch rate model. Spring CPUE in 1991 was significantly

higher than 1990 but not different from 1986-1989. 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 1991 for Canada was 467 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. Results of the assessment indicate that the overall exploitable biomass is between 10 and 23% of the 1973 level.

7. Atlantic Salmon:

The 1991 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; quotas 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 1991 were 54% above 1990 returns and 27% above the previous 5 year mean. 1 SW returns were 27% below 1990 and 37% above the previous 5 year mean. In the Restigouche River, MSW returns were 18% below 1990 and 34% below the previous 5 year mean. 1 SW returns were 42% below 1990 but 49% 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 57% and 22%. 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 1991 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 below 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 from the Miramichi River in 1991 was similar to previous years but the catch in the Margaree River was half of the 1990 catch. The fishing mortality rates are high in both rivers and new recruits constitute a major portion of the catch.

9. Gulf Lobster (4RT):

Gulf lobster landings exhibited settling trends following an 11% decrease in landings from the previous year to 21,109 tonnes\*. Landings in 4TR are nevertheless at a high level compared to a twenty year average of 13,453 tonnes with a low of 9,170 tonnes in 1975. Fishing effort has been relatively stable over the past two decades and increased landings are attributed to favorable recruitment. The Gulf lobster fishery has traditionally been a recruitment fishery with high exploitation rates. (\*Preliminary)

Monitoring the effects of lobster carapace size increase in the Cape Breton Island Fishery Area 26B is an ongoing priority. Analysis of sea sampling, tagging and landing data collected prior to, during and after the carapace size increase were compiled in a CAFSAC report. Data acquisition will continue through a post carapace increase tagging program to evaluate movement and growth in Area 26B. A study of pre-recruits to the fishery will be conducted through a trawling program in Area 26B. Sea sampling will continue throughout

the Gulf of St. Lawrence (New Brunswick, Prince Edward Island, western Cape Breton and western Newfoundland) to provide an updated lobster data base on the status of the lobster biomass. The lobster data base is routinely utilized to provide biological advice concerning stock management decisions.

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. A reference total allowable catch (TAC) of 26,000 tonnes was introduced in 1984. 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 tonnes. For the 1990 fishery, an overall quota of 7000 tonnes was set in order to accelerate the rebuilding of the stock and promote long term stability. Individual boat quotas 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 tonnes were reported for 1990. A two year management plan was put in place for the 1991 and 1992 fishery. The overall quota was set at 10,000 tonnes and was to be reviewed after the 1991 fishing season. Total landings of 10,019 tonnes were reported in 1991. 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 and to 30.7 kg/trap haul in 1991.

The Prince Edward Island snow crab fishery was initiated on an experimental basis in 1985 and is now composed of 29 fishermen. Catches have dropped from 1239 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 southwestern Gulf with a closure due to a high percentage of newly molted crab in the catches for a total of 747 tonnes. In 1990, a global quota of 500 tonnes was set for this fishery. However, as opposed to the mid-shore fleet, no boat quota was established. A total of 546 tonnes of crab was landed for the season. In 1991, a global quota was set at 600 tonnes and total landings reached 615 tonnes. 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 haul in 1990 and increased again to 33.4 kg/trap haul in 1991.

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 quotas. Over the past four years, the same TAC level of 1338 tonnes 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 and to 80 kg/trap haul in 1991. The annual TAC of 674 tonnes set for Zone 18 since 1988 was caught. The catch rates have been on a decreasing trend from 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. In 1990, the fishery took place in the spring and in the fall. The catch reached 139 tonnes in the spring and 523 tonnes was recorded



for the fall season. For the 1991 season, a quota of 200 tonnes was set for the spring. A total of 187 tonnes was landed. For the first time, a quota of 674 tonnes was set for the combined fishery of the fall 1991 and spring 1992.

11. Southern Gulf Scallop (4T):

Landings of giant sea scallop were estimated at less than 200 tonnes of adductor muscles in 1991 (preliminary data). Since 1975, annual landings have ranged between 160 and 370 tonnes. The overall sea scallop catches in the southern Gulf have decreased as compared to 1990, suggesting low recruitment and/or overfishing in some fishing areas.

12. Northern Gulf Scallop (4R):

Landings of Iceland scallop in the Strait of Belle Isle (Newfoundland) have decreased from 276 tonnes of adductor muscle in 1985 to 6 tonnes in 1990 (1991 landings were not available). This decrease was accompanied by a decrease in the number of fishing vessels. The overall decrease could not be explained with the available data.

B. SPECIAL RESEARCH STUDIES IN 1991:

1. Environmental Studies:

Hydrographic studies - Temperature profiles were collected at 302 stations and salinity profiles at 195 stations during the groundfish cruises. Surface and bottom temperature were collected at 48 stations during an August 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. A study to determine the quantity of 4T cod captured in the 4Vs winter fishery, and its annual variation, was initiated. Spatial pattern of cod in 4T and its covariation with cod abundance was analyzed for the period 1971-1990 using data from September groundfish surveys.

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. The 1990 mean catch per tow during the research survey was the highest since 1983. This increase was attributed to strong year classes from 1984 to 1988.

c) White Hake: A study of areas of juvenile concentration ('nursery areas') was initiated in 1991. Three methods were employed: analysis of historical research vessel data, survey of

inshore areas in the southern Gulf with a small vessel (5m) and experimental trawl, and by monitoring the by-catch of inshore smelt and tomcod fishermen. A technical report documenting techniques for sampling and methods for determining the age and growth of white hake was published (September 1991). Coordinated correspondence with participants in the Groundfish Index Fisherman Program.

- d) Herring: The index fisherman program, in operation since 1986, was continued for a sixth year. The annual acoustic cruise for southern Gulf herring continued with a recent hydroacoustic system. Several studies continued on the distribution and biology of juvenile herring in the Gulf. The distribution of juveniles throughout 4T was determined in December. Surveys confirmed that the Bay of Chaleur is an important area for juvenile herring throughout the year, including winter. A logbook program on the bycatch in smelt bagnets in the Restigouche estuary was established to develop an index of juvenile abundance and inshore sampling was carried out in late summer. 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. Data is being collected from this fishery.
- 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, Humber River 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; morphometrics and meristics, forecasting pre-season and in-season MSW returns.
- g) Gaspereau: Assessments were not conducted in 1991 on gaspereau. Sampling continued as usual and assessments will be conducted in 1992.
- h) Winter Flounder: Predation by winter flounder on herring spawn was studied during the autumn herring spawn at Fisherman's Bank, eastern PEI. The spatial distribution and abundance of

flounder on Fisherman's Bank were analyzed in relation to egg deposition. Preliminary estimates of the daily ration of winter flounder were made near Fisherman's Bank in 1991. This aspect of the study will be continued to fully assess the impact of flounder feeding on herring spawn.

- i) Lobster: A minimum carapace increase program was initiated in Area 26A and is ongoing in Areas 23 and 25. Monitoring of the completed carapace increase program continued in Area 26B through sea sampling and trawling programs. A CAFSAC report on data collected to date on carapace increase has been prepared.

Sea sampling of commercial lobster catches in general was conducted throughout the Gulf of St. Lawrence from Baie des Chaleurs to western Newfoundland. This information is used to provide management with localized information on lobster stocks in dealing with adjustments to fishery regulations and resource monitoring of species.

- j) Snow Crab: Biological characteristics of the snow crab populations as well as the soft shell crab were monitored by extensive sea sampling aboard commercial vessels during the 1991 fishing seasons. As part of the management plan, the monitoring of soft shell crab was enhanced in order to protect the annual renewal part of the stock. In the southern Gulf of St. Lawrence, two major trawl surveys were conducted; the monthly trawl survey in Baie des Chaleurs for studying population dynamics of snow crab in an exploited population and the post-fishing season trawl survey on all major fishing grounds in the southern Gulf of St. Lawrence fishery to provide information on the biomass levels and density distributions of commercially sized terminal molt males and potential molters. Stock assessment of all areas were presented based on data derived from the post-season trawl survey and at-sea monitoring.

Studies were conducted both in aquarium and in the wild on the following subjects: 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, reproductive contribution of pre-terminal and terminal molt males relative to primiparous and multiparous females, the monitoring of the reproductive cycle of females, reproductive potential of both male and female crabs, recruitment mechanism and mechanism of mating by means of biochemical analysis of pheromone.

- k) Scallops: Reports presenting the status of the giant scallop fishery in the southern Gulf of St. Lawrence (1990 update) and the status of the Iceland scallop fishery on the western coast of Newfoundland (1990 update) were published (Manuscript reports, April 1992).

SCIENCE BRANCH - GULF REGION

RESEARCH PROGRAMME IN THE NAFO AREA FOR 1992

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; continue study to calculate an energy budget for cod; continue involvement in the index fisherman program for sector of fleet <50 feet long; continue study on extent of capture of 4T cod during 4Vs winter fishery and examine role of ice-cover on annual variation in these catches; continue analysis of cod spatial pattern and its effect on catchability; evaluate geostatistical methods of estimating cod abundance indices; investigate effects of systematic variation in trawl geometry on survey abundance indices.
- 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; collaborate with Development Branch in the assessment of gear modifications that will reduce the capture and discarding of undersized plaice.
- 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: Examine variability in the abundance and size of juvenile white hake in the Cascumpec/Malpeque Bay area, PEI (Location of white hake juvenile area identified in 1991.) Sampling will be conducted with trawls, beach seines and snorkeling to investigate day/night and high/low tide variability. Continue involvement with the Groundfish Index Fisherman Program.
- 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) 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. 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.

- g) 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. Assessments of 1991-1992 Miramichi and Margaree gaspereau fisheries will be provided. Logbook programs for other New Brunswick rivers and for coastal fisheries of Gulf Nova Scotia are to be continued.
- h) 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.
- i) Snow Crab: Continuation of studies on growth (growth increment, frequency of molting for different size classes and duration of molt stages), reproduction (contribution of pre-terminal and terminal molt males relative to primiparous and multiparous females), reproductive cycle of females, mating behaviour in relation to sex pheromone in aquarium and stock delineation (tagging, trawling, and genetic study in collaboration with DFO Quebec Region) in the southern Gulf of St. Lawrence. The monitoring of the fisheries (biological characteristics and monitoring of soft shell crab) as well as the monthly and post-season trawl surveys will be conducted in order to provide biomass estimation of different biological categories of crab and to study biological characteristics of crab populations.

### SECTION III - Newfoundland Region

by

M. M. Roberge

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

#### SUBAREAS 0 AND 1

#### A. Status of the Fisheries

Groundfish. In Subarea 0, 5,945 t of Greenland halibut were landed in 1991.

Shrimp. Canadian landings of shrimp from Division OA in 1991 totaled 6,788 t (preliminary), about 600 t more than 1990 landings. The fishery in Division OB produced about 1,100 t, compared to 1,575 t in 1990 and 3,200 t in 1989.

#### B. Special Research Studies

##### Biological Studies

- a) Atlantic salmon. A total of 1,755 salmon were sampled at the fish plant in Nuuk, 1,538 in Maniitsoq and 1,293 from Paamiut, in centimeter length groups; including detailed measurements of fork length, gutted weight, and of these 1,348 were scale-sampled. This project provides an annual assessment of the proportion of North American and European fish caught at West Greenland. Also, 37 salmon were detected with micro tags. Micro tags were from Canada, USA, Scotland, Ireland, Iceland, and England.

- b) Observer Program. Canadian observers participated in 14 trips which had fishing activity for shrimp in Davis Strait (0+1) during 1991. A total of 575 fishing days and 2,645 sets were recorded with a total of some 142,260 shrimp measured. (Preliminary)

#### SUBAREA 2

##### A. Status of the Fisheries

- Cod. Canadian landings were substantially lower in 1991 than in recent years. Inshore and offshore landings declined from 14,300 t in 1990 to 2,200 t and from 32,600 t to 635 t respectively. There were no reported catches from Div. 2G and 2H in 1991.
- Redfish. Canadian landings were extremely low, with 8 t landed, compared to 192 t landed in 1990. Landings in recent years have been almost exclusively from Div. 2J.
- Greenland halibut. Canadian landings were 3,150 t, compared to 3,800 t landed in 1990. Landings were primarily from Div. 2J and Div. 2H with less than 600 t landed from Div. 2G. The inshore fixed-gear fishery accounted for approximately 800 t in this Subarea in 1991.
- American plaice. Canadian landings of American plaice were down at <100 t, compared to 900 t landed in 1990. These landings were almost entirely by the offshore fishery in Div. 2J.
- Other groundfish. Canadian landings of all other groundfish species totaled 467 t in 1991.
- Capelin. Landings of capelin remained at a low level.
- Herring. Landings of herring increased substantially due to a fishery subsidy program.
- Atlantic salmon. Commercial landings of Atlantic salmon in Subarea 2 during 1991 were 86 t, compared to 179 t in 1990. Landings of large salmon (43 t) decreased 64% from 1990. The recreational harvest totaled 2.2 t.
- Arctic charr. Landings of Arctic charr in Subarea 2 during 1991 were 70 t, 30% less than in 1990. Severe ice conditions along the north Labrador coast contributed to decreased effort and poor landings in 1991.
- Shrimp. The Subarea 2 shrimp fishery was subject to a total quota of 11,220 t in 1991 (season May 1 to December 31), 4,760 t of which were in the Hopedale Channel. Total landings were approximately 10,300 t.

##### B. Special Research Studies

###### 1. Environmental Studies

- a) Oceanographic studies. The NAFO 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.

As part of the NCSP, several clusters of satellite-tracked surface drifters were deployed to monitor the surface currents on the continental shelf.

- b) Contaminant studies. A major program on the determination of levels of organochlorines, dioxins and heavy metals in codfish and Greenland halibut is continuing.

###### 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. A survey was conducted in Div. 2G and 2H during November to obtain biomass and abundance estimates as well as to collect biological information.
- b) Flatfish. Data on distribution and abundance of American plaice, Greenland halibut, and witch were collected during groundfish surveys of NAFO Div. 2J in 1991. The shrimp surveys in Div. 2H and 2J in 1991 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 1991 resulted in a biomass estimate of 59,000 t.
- e) Atlantic salmon. A total of 2,438 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.

- f) Arctic charr. A total of 2,147 samples was obtained for age determination of Arctic charr in commercial landings from twelve northern Labrador fishing areas. Approximately 18,100 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. Canadian observers participated in approximately 29 commercial trips fishing shrimp off Labrador and northeast Newfoundland (Subarea 2 and Div. 3K, 3Ps) during 1991. A total of 639 fishing days and 3,007 sets was observed, with a total of some 147,254 shrimp measured. (Preliminary)
- h) Exploratory surveys.
  - Crab. A 65-foot vessel was contracted to conduct an exploratory snow crab survey off outer Bonavista Bay, which is a northeast extension of the commercial grounds. Although catch rates varied considerably, several areas with high abundances of commercial-sized crabs were identified.

#### SUBAREA 3

##### A. Status of the Fisheries

- Cod. Canadian landings were 159,200 t in 1991, down substantially from 202,000 t in 1990. Landings by Division were: 3K - 42,800 t, 3L - 74,500 t, 3N - 1,500 t, 3O - 6,500 t, 3Ps - 27,300 t, and 3Pn - 6,500 t. Landings declined for both the inshore and offshore sectors with landings for both being approximately equal in 1991. Inshore landings from Div. 3K and 3L declined from 98,000 t in 1990 to 58,000 t in 1991, while offshore landings in 1990 and 1991 were similar at about 60,000 t. Inshore landings in Subdiv. 3Ps increased from 20,100 t in 1990 to 21,300 t in 1991, while offshore landings declined slightly from 6,200 t in 1990 to 6,000 t in 1991.
- Redfish. Canadian landings were 15,700 t, an increase of 800 t from the 1990 landing of 14,900 t. Div. 3K and 3L landings were 570 t, down from 2,900 in 1990. Combined landings from Subdiv. 3Pn and 3Ps were 15,100 t, compared to 11,650 t in 1990. Landings from other Divisions remained low.
- Flatfish. Canadian landings of the combined flatfish species were 45,500 t in 1991, compared to 47,200 t in 1990. American plaice dominated these landings at 27,000 t, compared to 27,500 t in 1990. Yellowtail landings were 7,400 t, up from 5,100 t landed in 1990. Greenland halibut landings were 4,000 t, down from 6,500 t in 1990, while greysole landings were 5,700 t, compared to 6,900 t in 1990. Other flatfish landings included 900 t of winter flounder and 360 t of Atlantic halibut. Landings in the offshore sector dominated most flatfish fisheries in 1991.
- Other groundfish. Canadian landings of other groundfish species were: haddock - 1,600 t, white hake - 773 t, pollock - 1,300 t, and wolffish - 490 t.
- Capelin. Approximately 21,400 t capelin were landed inshore in Div. 3L, 19,800 t in Div. 3K, and 80 t in Div. 3Ps in 1991. The inshore catches were taken during the inshore spawning migration. Female capelin are preferred to satisfy the Japanese roe market. The offshore catch was 450 t for Div. 2J3KL.
- Herring. Herring landings from the Newfoundland Region were approximately 18,000 t in 1991, up from 8,500 t in the previous year. The increased landings were due to subsidy programs to processors and fishermen which made it economically viable to catch and process herring.
- Mackerel. Mackerel landings in Subarea 3 were about 800 t, compared to 1,200 t in 1990.
- Squid. Total reported catch of squid in 1991 was about 2,000 t (preliminary data). The poor fishery, for the ninth consecutive year, was due to a natural low abundance of squid in commercial fishing areas.
- Atlantic salmon. Landings were 267 t in the commercial fishery and 18 t in the recreational fishery. The commercial catch of large salmon (130 t) decreased by 28% from 1990.
- Shrimp. The Div. 3K shrimp fishery was subject to TACs totalling 2,091 t from May 1, 1991, to December 31, 1991. Catches from this area were about 500 t.
- Scallops. Sea scallop (*Placopecten magellanicus*) landings in 1991 receded to 59 t meats, down from 153 t in 1990. Average meat count (as landed) was 22.5/50 g.
 

The offshore fishery for Iceland scallops by vessels less than 65 ft (LOA) that commenced in 1990 continued into 1991 with a nominal catch of approximately 70 t meats.
- Clams. The fishery for the Arctic (Stimpson's) surf clam (*Macrcomeria polynynna*) on the Grand Banks (3N) continued into 1991. Approximately 36% of the 20,000 t TAC was taken. Most of the effort continues to be confined to unit area 319.

## 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 1991.

The Northern Cod Science Program (NCSP) oceanographic initiative was continued in 1991 whereby current meter/thermistor chain moorings were deployed on the NE Newfoundland Shelf. Comprehensive CTD/current mapping was also carried out in May, June, July and November. Two oceanography cruises were conducted in Conception Bay to conduct an extensive CTD/current mapping of the Bay. BIO also deployed 12 current meter moorings as part of the CASP II and Ice project.

Petroleum operators undertook waverider and moored current meter measurements during two drilling programs on the northeast Grand Banks in 1991: from July 15 to September 2, and from September 12 to October 2. Ice conditions in the area also were monitored during these programs.

- b) Contaminant studies. Tissue samples were collected from 3Ps for polycyclic aromatic hydrocarbon (PAH) analysis.
- c) Oil industry (Environmental Studies Revolving Fund). Three studies dealing with both the physical and biological environment are currently underway. The projects primarily focus on the Grand Banks, a frontier oil and gas development area.

- Tainting of commercial species of Grand Bank groundfish:

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

- Characterization of iceberg pits on the Canadian Eastern Continental Shelf:

These pits are formed as a result of iceberg groundings. A detailed description of their distribution, physical characteristics and probability of occurrence will be provided by this study, with particular emphasis upon Grand Bank region.

- Environmental sensitivity atlas for coastal and offshore western Newfoundland:

This study will draw together in a common, digital format, existing biophysical and socioeconomic resource information for the region. Areas also will be evaluated as to their relative sensitivity and accessibility.

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

- The sea ice environment:

Sea Ice/Iceberg Forecast System. The Integrated Sea Ice/Iceberg Forecast System (IISF) Project continued in 1991 with efforts concentrated on the integration of the three components of the program: enhancement of ice forecast models, database stored and update all information needed to run forecast models, and electronic mapping for display of both the input data and ice forecasts. The ice edge drift module of the integrated ice forecast model will be upgraded to incorporate the effects of ice melting, wave radiation pressure and floe-to-floe contact forces on ice edge drift.

In situ sea-ice properties. Under NSERC Co-op R&D research continued 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.

Iceberg/structure interaction. Work commenced on the planning and design of a series of iceberg bit impact tests. Field tests are to be conducted in the summer of 1992. Work is also continuing on the COGLA studies for large-scale ice forces on vertical structures. Field and laboratory testing programs on fractal characteristics of sea ice are currently underway.

Oil in ice. A new study was initiated to theoretically investigate how spilled oil will behave in cold, and in particular, in ice-covered waters. The objective is to formulate the equilibrium thickness as the oil layer spreads over the surface. The analysis will investigate how the various ice types influence the way the oil spreads and is incorporated within the ice cover.

- 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. The primary objective of the IMAP program in 1991 was



to analyze, evaluate and exhibit acoustic and geotechnical groundtruthing data collected at Terrenceville, Newfoundland, during the fall of 1990 and to produce a final interpretation or acoustic core product. A three-dimensional, layer-by-layer presentation of the interpreted acoustic data was produced.

In cooperation with University of Sherbrooke, C-Core worked to advance the theoretical aspects of intensity mapping and producing energy flow models for complex structures undergoing deformation.

Ice/seabed interaction. Ice scour research 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:

Shore-based ground wave radar system. Algorithms have been developed to extract information on wave and current conditions from a portable GWR system (COGAR). Work is currently in progress to modify the wave and current measurement algorithms for the Cape Race GWR system. This system will be capable of mapping the radial component of the surface current as well as RMS wave height and the non-directional ocean wave spectrum.

Ocean wave conditions interpretation. Techniques for extracting ocean wave conditions for the radar returns from a narrow beam pulsed system have been completed and tested. These techniques are currently being adapted for use in the Cape Race GWR system. Work is also ongoing to develop ocean wave algorithms for broad beam, compact GWR systems.

- Bio-acoustics:

An acoustic device has been developed which can be attached to fixed fishing gear to minimize incidental entrapments of marine mammals without hampering fishing performance. Extensive field investigations were undertaken in Newfoundland waters in 1991 and showed that the alarm system significantly reduced the number of collisions between humpback whales and codtraps.

2. Biological Studies

- a) Cod. Sampling of the landings from the commercial fishery both inshore and offshore was continued in 1991. Using research vessels, surveys were carried out in all NAFO Divisions (except 3M) to determine the distribution and abundance of cod. Biological sampling was extensive during these surveys and approximately 15,000 cod were tagged, inshore and offshore. Stomachs were collected from Div. 3LNO during spring and from Div. 3KL during autumn.
- 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. 3P4RV during August and provided information on abundance and distribution to address the issue of populations for management purposes. A bottom trawl survey, directed specifically for redfish, was conducted in Div. 3LNO in August. 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.
- c) Flatfish. Distribution and abundance of flatfish were studied during fall random stratified surveys in the following NAFO Divisions and times in 1991: 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 studies provided valuable data on flatfish:

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

A juvenile flatfish survey was conducted in Div. 3LNO in the fall of 1991. 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. An acoustic survey conducted in May 1991 resulted in a biomass estimate of 146,000 t. Because this survey has hampered by ice, it was repeated during late June and early July and the biomass estimate was 116,000 t. Calibration problems during the 1990 survey were solved and the estimate from this survey was 6.9 million tons. 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 continued in 1991 at Arnold's Cove, Placentia Bay and Bellevue, Trinity Bay.
- e) Herring. The research gill net index fisherman program was continued for the twelfth year as an index of herring abundance. A controlled field experiment was conducted in Conception Bay in September to examine the relationship between target strength and condition factor for herring. *In situ* target strength research was conducted in Bonavista Bay in October. There were no hydroacoustic biomass estimation surveys conducted in 1991.

- f) Scallops. Preliminary use and evaluation of an acoustic ground discrimination technique over Div. 3Ps showed that it may be effective in delineating benthic assemblages containing scallops. Groundtruthing was by simultaneous use of the PHANTOM 500 (ROV).

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

- g) Squid. Commercial squid samples were acquired, whenever available, at two inshore sites; at one of these sites (Holyrood), water temperature was monitored.
- h) 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.
- i) Lobster. Long-term monitoring of the fishery and various aspects of population biology and dynamics were continued at three inshore Newfoundland sites.
- j) 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.
- k) Seals. Monitoring of incidental catches of seals and whales in fishing gear was continued.

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 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.

- l) 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 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.

- m) Multispecies. Work continues investigating the transport of multispecies assemblages of larval fish into the nearshore regions. Results show that many species occur in Conception Bay but that there is relatively little evidence of prolonged retention in the region. Analysis was undertaken to determine whether mortality rates were dependent on organism size. Contrary to expectations, results clearly show that changes in abundance are independent of size. A study of larval fish production on the Grand Banks indicates that the accuracy of broad scale surveys of larval populations may be insufficient to detect variations in survival.
- n) Larval fish. Work on nearshore production processes in relation to larval fish survival, particularly capelin, continued. 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.
- o) Exploratory surveys.
- Scallops. A stratified random survey was conducted in Div. 3Ps on Green Bank (1100 m<sup>2</sup>) to determine the abundance of Iceland scallops (*Chlamys islandica*). Of 78 tows (one mile tows with a 3.6 m [12 ft] offshore rake), only 3 sets resulted in catches in excess of 50 kg. Extensive beds of Iceland scallops were not found in this area. Prospects for their commercialization would appear minimal.
  - Shrimp. A research vessel survey, conducted in July 1991, used a combination of bottom trawling, pelagic sampling and fisheries acoustics to study the vertical and horizontal distribution of shrimp in the St. Anthony Basin. Although the acoustic data could not be used to estimate biomass, some inferences on the vertical distribution were possible.

### 3. Gear and Selectivity Studies

- a) A detailed examination of gear selectivity and escapement of Iceland scallops (*Chlamys islandica*) was conducted with a 3.6 m (12 ft) offshore dredge. Paired tows with standard (uncovered) and covered offshore scallop dredges showed the shell height of 50% retention for a 7.6 cm (3 in) ring dredge with quadruple bottom links and triple top links was 69 mm.
- b) Fishing gear and gear handling experiments aimed at improving catch effectiveness and operational efficiency were conducted by four gillnetters (19.8 m LCA) in water depths ranging from 730 to 1370 m. The vessels directing for turbot also caught quantities of routhead grenadier.

### 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 1991. 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.

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 IGOS messages.

- b) Hydrography. 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 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 is continuing.

##### d) Bedford Institute.

- Labrador and Newfoundland Shelves. Sixteen satellite-tracked ice-bacons 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. Four beacons were deployed by the ice reconnaissance aircraft of Canadian Ice Centre while the rest (12) were deployed with helicopters. 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. Twenty-five full-depth CTD stations were occupied in the central Labrador Sea and over the continental shelves of Greenland and Labrador. This is the second of five planned annual repeats of World Ocean Circulation experiment (WOCE) Hydrographic Program Line A17/W between southern Greenland and Hamilton Bank, Labrador. Discrete measurements of dissolved oxygen, nutrients and chlorofluorocarbons (CFCs), alkalinity and total carbonate were also obtained. Near-surface currents were measured by a ship-mounted acoustic current profiler.

Discrete profile measurements of primary biological production from pumped samples were made by Biological Sciences Branch in support of the Joint Global Ocean Flux Study (JGOFS). Underwater temperature and chlorophyll measurements were obtained using the ship's seawater intake. Profile measurements of light attenuation and fluorescence were carried out with a developmental electronic system.

Discrete measurements of dissolved methyl chloride and bromoform were obtained by Dalhousie University in one of the first systematic marine surveys for these trace gases.

##### 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 1991 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. Sixty offshore and inshore research vessel cruises were undertaken in 1991 utilizing DFO-owned vessels (Newfoundland-based: WILFRED TEMPLEMAN, MARINUS, SHAMOCK; Scotia-Fundy based: AFRED NEEDLER, DAWSON) and the GADUS ATLANTICA and LADY HAMMOND (charter) (Table 1).
- c) Commercial sampling. Sampling of foreign and Canadian offshore catches for all commercial fish and invertebrate species by the Canadian Observer Program continued in 1991. A total of 4,674 samples representing some 917,723 length measurements and approximately 14,242 otolith pairs was collected from the catches of foreign and Canadian offshore fisheries. A total of 7,987 days and 32,669 sets was recorded. Coverage in 1991 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 various 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.
- e) Parasitology. The stomachs of six white-sided dolphins (Lagenorhynchus acutus) from offshore 2J, and the stomachs and intestines of approximately 61 harbour porpoises (Phocoena phocoena) from inshore 3L were examined for adult Anisakis and related nematodes. Many larval nematodes (mostly Contracaecum osculatum) were found but there were few adult Anisakis.

Stomachs of 13 grey seals (Halichoerus grypus) from 4R and 2H and 10 harbour seals from 2H were examined for nematodes. Grey seals harbored large numbers of sealworm (Pseudoterranova decipiens) and other species (Contracaecum osculatum); harbour seals had smaller numbers of the same species.

The viscera and flesh of 171 Atlantic cod (Gadus morhua) from 3Ps and 3Pn were examined by pepsin-HCL digestion and nematodes counted and identified. Cod were quite heavily infected with larvae of Anisakis and Pseudoterranova decipiens. The viscera harbored extremely large numbers of Contracaecum osculatum and Phocascaris sp.

Larval nematodes were collected from 134 American plaice (Hippoglossoides platessoides), 44 Greenland halibut (Reinhardtius hippoglossoides), 25 Atlantic cod, 18 witch (Glyptocephalus cynoglossus) and 43 other fish of various species from offshore areas in NAFO Div. 2H, 2J, 3K, 3L. Nematodes were measured then identified using allozyme electrophoresis. Discriminant function analysis revealed that, contrary to popular opinion, the larvae of the two most common nematode species (C. osculatum and Phocascaris) can easily be distinguished by a few simple morphometric measurements.

Nematodes were also collected from all tissues of 654 Atlantic cod from 3Q, 4R and 4T under a project conducted jointly with the Newfoundland provincial Department of Fisheries. Infection levels with Anisakis and sealworm (Pseudoterranova decipiens) were compared with those observed during a previous study conducted during 1985 and found to be similar. The efficiency of various methods of examining fish for nematodes was also investigated.

Miscellaneous samples of capelin (Mallotus villosus) from 3L, smelt (Osmerus mordax) from 3Ps, rock and Atlantic cod from western Greenland (1D) and plaice, yellowtail, herring and sculpins from inshore 3L were also examined and larval nematodes counted and identified.

- f) Flatfish. Papers were published on seasonal distribution of American plaice in Div. 3L, on trawl and codend selectivity of American plaice, and on the distribution of juvenile flatfish on the Grand Bank. As well, an extensive review of the biology and distribution of Greenland halibut in the Newfoundland area was prepared.

Surveys for Greenland halibut were conducted in August-September in the deepwater areas (up to 1000 m) along the Continental Slope from Subarea 0 to Div. 3N.

- g) Crab. A study investigating long-term movements of tagged Bonavista Bay snow crab was completed.
- h) Exploratory surveys.
- Turbot. Deepwater surveys (700-1000 m) were carried out from Davis Strait to Flemish Pass (Div. 0 to Div. 3M) on two charter vessels during August and September 1991. Catches of turbot were generally smaller in Div. 3L and 3M compared to other areas.

### 3. Gear Selectivity Studies

- a) Otter trawl selectivity study. During January and February 1991, two 10-day cruises were conducted in Subarea 3K. The purpose of the study was to investigate various ways and means of reducing the catch of juvenile cod fish in otter trawls. The first cruise investigated the effect of codend mesh size and shape on otter trawl performance. The second cruise investigated the selectivity of a rigid grid

(Sort-X system) installed into an otter trawl extension. Results indicate that 140 mm square mesh and 155 mm diamond mesh codends are much more selective than 130 mm diamond mesh. The 50 mm grid Sort-X system showed some promise; however, modifications to the system are necessary.

- b) Cod trap selectivity study. Data were obtained on the lengths of cod fish caught in various types and mesh size cod traps in six locations. Three Japanese cod traps were constructed with a small mesh retainer outside the traps to catch the fish which pass through the trap walls. Low catch rates were experienced in all areas during this study; 32-40% of the cod fish which entered the 102 mm mesh cod traps escaped. However, 81% of the escaped fish was under 40 cm.
- c) Hood size selectivity study. Data were obtained on the lengths of cod fish caught on various sizes of feather hooks used on longlines in three locations. The hook sizes studied from smallest to largest are as follows: #6/0-J, #15-J and #12/0-EZ baiter. Poor catch rates were encountered during the study. Results from the study indicated that the smallest hook (#6/0-J) caught the most fish and also the smallest average fish size.

#### 4. Miscellaneous

- a) Cod. As part of the Atlantic Fisheries Adjustment program, research initiatives continued for the second year on northern cod (Div. 2J3KL) under the Northern Cod Science Program (NCSP). NCSP initiatives are to address the science recommendations of the Harris Panel report related to northern cod. There are five components of the NCSP, namely: Administration, Cod Ecosystem Dynamics, Communication, Collaboration and Education, Technology Advancement and Vessel Charter. In general terms, the broad objectives the program are to provide better biological advice to management on northern cod through enhanced assessment and ecological research activities, establishment of better communication links between DFO and its clients and advancement of technologies used in cod research and assessment. Highlights of the research activities in 1991 included an offshore hydroacoustic survey of pre-spawning concentrations of northern cod; various vessel surveys to study factors affecting the transport of cod eggs and larvae and the inshore migration of cod; several major aggregations of cod were located, mapped and tracked using scientific echosounders during May and June while the fish were moving from offshore to inshore waters; oceanographic cruises indicated that the cold intermediate layer was significantly larger than observed in 1989 and 1990; drifting buoys were deployed on southern Hamilton Bank off Labrador to simulate the drift of cod eggs and larvae.
- b) Hydroacoustics. Work is continuing to enhance hydroacoustic technology. The primary goal 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 will be operational in mid-1992, automation of catch and effort data acquisition at sea is also a priority. Data from the observers are used to address a wide variety of management questions raised by industry, the department and other agencies.

#### Section IV. Quebec Region

by

Jean-Denis Lambert and Marthe Bérubé

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

SUBAREA 4

A. Status of the Fisheries

DFO Nominal landings and TAC ('000 t) since 1988 for stocks currently being assessed in the Quebec region are as follows:

Species	Division	Nominal Landings (TAC)			
		1988 <sup>1</sup>	1989 <sup>1</sup>	1990 <sup>1</sup>	1991 <sup>1</sup>
Cod	4RS,3Pn	48 (73.9)	47 (76.5)	40 (58)	32 (35)
Greenland Halibut	4RST	7.5 (10.8)	5.0 (10.5)	2.4 (10.5)	2.1 (10.5)
Atlantic Halibut	4RST	0.3 (0.3)	0.2 (0.3)	0.4 (0.3)	
Redfish	4RST	36 (56)	45 (57)	49 (57)	60 (67)
Herring	4R	18 (30.6)	18 (37)	17 (35)	
	4S	0.9 (3.5)	0.5 (3.5)	0.6 (4)	
Mackerel	S.A.2-6	79.3	71.7	62.5	55.2
Capelin	4R	4.9 (20)	1.1 (5.7)	5.8 (7.0)	7.4 (18)
	4S	0.1 (5)	1.1 (2.7)	0.1 (1.6)	0.1 (3.3)
	4T	0.1 (5)	0.1 (1)	0.1 (1.3)	0.1 (3.3)
Snow crab	4S,4Tpq	4.0	2.6	4.3	4.7
Shrimp	4RST	13.8 (14.1)	15.4 (15.1)	15.3 (15.8)	
Lobster	4S,4T <sup>2</sup>	2.5	3.2	3.2	3.5
Scallop	4S,4T <sup>2</sup>	1.4	2.4	3.6	2.0

<sup>1</sup> Preliminary values.

<sup>2</sup> 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.

A summary presentation of different studies on the geographic distribution of larvae, juveniles of S. fasciatus and S. mentella in the Gulf of St. Lawrence was made to CAFSAC. Genetic variation patterns observed in the liver malate dehydrogenase locus was used to differentiate larvae and juveniles of the two species. There are discrepancies in the geographic distribution of larvae and juveniles of the two species, also the relative importance varies with depth. The commercial fleet showed that the current redfish fishery is concentrated almost entirely on S. mentella.

ii) Mackerel Egg Surveys.

DFO has been conducting surveys for mackerel egg abundance in the southern Gulf since 1979 in order to estimate spawning stock biomass. dt egg production method has been proposed to overcome the problem of lack of valid abundance index and a convergence with SPA. The index of total annual egg production obtained from the 1991 survey indicates a biomass of 1,960,000 t.

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. Landings for this stock reached a peak of 106,000 t in 1983 and have steadily declined to an historic low of 32,000 t in 1991. Most of this reduction is attributable to a rapid decline of fixed gear catches. The lowest catches were reported in 1990 and have increased by 22% to 11,000 t in 1991. The trap fishery is responsible for this increase, influenced by the strong incoming 1986 year class. The mobile gear fleet have decreased by 31% between 1990 and 1991. This is due to the decreased allocations for this fleet as the TAC was reduced from 56,000 t to 35,000 t all allocations for this gear sector were reached in 1991.

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 was completed in 1991. There are some indications that considerable mixing may occur in the winter.

2.1.3 Greenland Halibut

The stock discrimination study initiated in 1989 was completed in 1991. The genetic and parasites aspect were conceded. From both studies it is possible to conclude that exchanges among the stocks although extensive are taking place in the early phases of the life history and that the adults may not move intensively before the spawning migration.

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.

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 conducted in 91 are part of a multi-year research program aimed at the study of growth, sexual maturity and fecundity of rock crab in order to establish a management strategy of this resource in the context of a commercial exploitation. Observations on spatial distribution were done in the field as well as observations on molting in laboratory.

#### 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.

#### 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 five management units of the Gulf and to provide scientific advice. This resource is under a multi-year management plan until 1993.

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 an index fisherman program provide the data to follow up the commercial fishery. Research work involves observations on molting (frequency and growth increment) and the development of collectors for juveniles.

#### 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) is done on a routinely basis to assess the resource and provide scientific advice. Other means such as submarine video and acoustic gear were investigated to evaluate their potential to survey scallop in relation to the traditional dredge survey.



#### 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. Surf clams concentrations were sampled to determine the demographic structure of the resource and elaborate management strategies adequate to this slow growing species.

### 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 size harvested were conducted. The recommended harvest of 15 cm. every three years will be investigated in the median and long term.

### 2.4 Marine mammals

#### 2.4.1 Seals

Research was conducted into the distribution, abundance, population dynamics, behaviour and ecology of pinnipeds in the estuary and Gulf of St. Lawrence and their interactions with commercial fisheries. During April 1991, research on energetics of lactation in ringed seals continued on Svalbard. Results from surveys of harp and hooded seals, and information on seasonal changes in harp seal feeding have been analyzed and are ready for submission for publication. Studies on underwater vocalizations and mass transfer during lactation in grey seals have been completed. New work on mass loss of male grey seals during the breeding season, and during activity of lactating grey seals were initiated. Three satellite transmitters were placed on adult male hooded seals in the Gulf of St. Lawrence. During the summer, boat surveys were completed to examine the distribution of marine mammals in the proposed Saguenay Marine Park.

#### 2.4.2 Porpoise

Collection of by-catch porpoise carcasses was continued. Collaborative research was initiated to investigate the structure of the porpoise stocks in the Northwest Atlantic by genetic analyses and by study of contaminant profiles. A sighting survey was undertaken along the north coast of the Gaspésie.

#### 2.4.3. Beluga and Narwhal

Depth-recording satellite tags were placed on beluga in Cunningham Inlet and on narwhal in Tremblay Sound, and gave information on dive behaviour and movements over periods up to six weeks. Aerial surveys were carried out to determine distribution of these whales.

The carcasses of 12 beluga stranded in the St. Lawrence were examined and basic biological data was obtained.

Beluga in the St. Lawrence were photographed from the air at medium altitude with a high precision camera to estimate the length frequency structure of the population. Studies were also carried out of the effect of disturbance on the vocal and visible behaviour of beluga, as well as the winter distribution and movements in the lower estuary.

#### 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 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.

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.

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.

LIST OF SAMPLING DATA FOR 1990

ESPECES	DIV. NAFO	ENGIN	MOIS	ECH.	MESU.	GARDE
SPECIES	NAFO DIV.	GEAR	MONTH	SAMP.	MEAS	KEPT
MORUE FRANCHE ATLANTIC COD	2J	GNS	MAI-MAY	1	253	39
			SEP-SEP	1	260	37
	4R	LLS	MAI-MAY	1	250	55
JUI-JUL			1	251	54	
AOU-AUG			1	250	30	
OCT-OCT			1	250	48	
		OTB2	MAI-MAY	1	251	33
		OTM2	JUN-JUN	1	407	34
	4S	OTB2	MAI-MAY	1	250	36
GNS			MAI-MAY	1	259	29
			JUN-JUN	1	201	34
		JUI-JUL	5	1262	155	
LLS		JUN-JUN	2	500	95	
		JUI-JUL	2	521	109	
		AOU-AUG	1	250	38	
		SEP-SEP	1	250	44	
		OCT-OCT	2	513	72	
OTB1		JUN-JUN	2	500	51	
		AOU-AUG	2	502	56	
		OCT-OCT	1	250	35	
OTB2		MAI-MAY	5	1260	151	
		JUN-JUN	7	1799	209	
		JUI-JUL	2	528	64	
		AOU-AUG	3	773	91	
		SEP-SEP	2	520	59	
		OCT-OCT	4	1011	126	
		ST	MAI-MAY	1	250	30

ESPECES	DIV. NAFO	ENGIN	MOIS	ECH.	MESU.	GARDE
SPECIES	NAFO DIV.	GEAR	MONTH	SAMP	MEAS	KEPT
	4T	OTB2	MAI-MAY	3	755	84
		GNS	MAI-MAY	1	251	28
			JUN-JUN	1	250	46
			AOU-AUG	2	537	88
			SEP-SEP	2	511	73
			OCT-OCT	2	510	73
		LHP	JUN-JUN	1	276	35
			JUI-JUL	1	257	51
			SEP-SEP	2	506	58
		LLS	MAI-MAY	1	251	47
			JUN-JUN	2	494	64
			JUI-JUL	3	779	107
			AOU-AUG	3	755	107
			SEP-SEP	5	1308	169
			OCT-OCT	3	759	86
		OTB1	MAI-MAY	2	518	53
			JUN-JUN	1	253	24
			JUI-JUL	1	253	24
			SEP-SEP	1	253	23
		OTB2	MAI-MAY	3	753	81
			JUN-JUN	9	2331	234
			JUI-JUL	8	2042	186
			AOU-AUG	5	1257	117
			SEP-SEP	2	502	56
			OCT-OCT	5	1257	145
		PTB	AOU-AUG	1	252	28
		SDN	MAI-MAY	2	500	60
			JUN-JUN	2	506	56
			JUI-JUL	2	509	47
			AOU-AUG	1	255	23
			SEP-SEP	2	507	52
			OCT-OCT	2	510	56
		SSC	AVR-APR	2	506	48
			MAI-MAY	8	2025	198
			JUN-JUN	3	775	82
			JUI-JUL	3	763	94
			AOU-AUG	5	1256	116
			SEP-SEP	2	501	50
			OCT-OCT	9	2267	234
MERLUCHE BLANCHE WHITE HAKE	4T	GNS	SEP-SEP	2	503	74
		LLS	JUI-JUL	1	250	34
			AOU-AUG	1	250	52
			OCT-OCT	1	253	27
SEBASTE ATLANTIQUE REDFISH	4R	OTB2	OCT-OCT	1	273	0
		OTM2	JUN-JUN	1	235	0
			JUI-JUL	1	268	0
			OCT-OCT	4	1085	0
			NOV-NOV	1	222	0
	4S	OTB2	JUI-JUL	2	516	0
		OTM2	MAI-MAY	1	272	0
			JUN-JUN	3	726	0
			JUI-JUL	1	253	0
			OCT-OCT	6	1383	0
			NOV-NOV	1	247	0
		ST	SEP-SEP	1	257	0

ESPECES SPECIES	DIV. NAFO NAFO DIV.	ENGIN GEAR	MOIS MONTH	ECH. SAMP	MESU. MEAS	GARDE KEPT
	4T	OTB2	JUI-JUL	2	519	0
			AOU-AUG	9	2271	0
			SEP-SEP	2	2	0
			OCT-OCT	1	251	0
		OTM2	MAI-MAY	1	276	0
			JUN-JUN	3	746	0
			JUI-JUL	3	736	0
FLETAN ATLANTIQUE ATLANTIC HALIBUT	4R	LLS	JUI-JUL	1	65	65
FLETAN DU GROENLAND	4S	GNS	JUN-JUN	1	250	34
			JUI-JUL	4	1047	135
			AOU-AUG	3	709	0
	4T	GNS	MAI-MAY	2	502	64
			JUN-JUN	1	254	34
			SEP-SEP	1	250	32
			OCT-OCT	2	501	66
		OTB2	AOU-AUG	1	250	48
PLIE CANADIENNE AMERICAN PLAICE	4S	LLS	OCT-OCT	1	250	27
		OTB1	SEP-SEP	1	250	37
		OTB2	JUI-JUL	1	256	27
			SEP-SEP	1	258	36
		ST	JUI-JUL	1	250	33
	4T	LLS	JUN-JUN	1	252	36
			JUI-JUL	1	179	30
			AOU-AUG	2	507	56
		OTB1	JUI-JUL	1	256	26
			SEP-SEP	1	267	29
		OTB2	JUN-JUN	2	510	63
			JUI-JUL	1		
			AOU-AUG	2	525	65
			OCT-OCT	4	1005	125
		SDN	JUN-JUN	1	265	28
			SEP-SEP	3	817	80
			OCT-OCT	3	761	89
		SSC	MAI-MAY	1	254	38
			JUN-JUN	1	270	42
			JUI-JUL	3	753	98
			AOU-AUG	4	1002	146
			OCT-OCT	2	515	69
PLIE GRISE WITCH FLOUNDER	4S	OTB2	JUN-JUN	1	253	34
PLIE ROUGE WINTER FLOUNDER	4T	GNS	SEP-SEP	1	254	24
HARENG ATLANTIQUE ATLANTIC HERRING	4S	GNS	AVR-APR	2	503	110
			MAI-MAY	7	1819	400
			JUN-JUN	2	536	110
		PS	AOU-AUG	1	255	55
			SEP-SEP	1	273	56

ESPECES SPECIES	DIV. NAFO NAFO DIV.	ENGIN GEAR	MOIS MONTH	ECH. SAMP	MESU. MEAS	GARDE KEPT			
CAPELAN CAPELIN	4T	GNS	AVR-APR	3	795	102			
			MAI-MAY	5	1257	168			
			JUN-JUN	5	1257	179			
			JUI-JUL	2	507	79			
			SEP-SEP	4	1015	158			
	4S	FPN	JUI-JUL	4	1041	75			
			FWR	JUN-JUN	2	509	27		
				JUI-JUL	2	533	34		
			MIS	MAI-MAY	5	1279	54		
				JUN-JUN	4	1110	48		
	4T	FWR	MAI-MAY	15	3924	179			
			JUN-JUN	4	1026	35			
		MIS	MAI-MAY	6	1573	59			
			JUN-JUN	3	727	44			
MAQUEREAU BLEU ATLANTIC MACKEREL	4T	GNS	JUN-JUN	5	1272	188			
			JUI-JUL	2	560	83			
			LX	AOU-AUG	7	1881	295		
				SEP-SEP	5	1268	163		
	OCT-OCT	1		253	27				
	4S	ST	AVR-APR	5	1250				
			MAI-MAY	6	1500				
			JUN-JUN	5	1250				
JUI-JUL			7	1750					
CREVETTE ROSE PINK SHRIMP	4S	ST	AOU-AUG	4	1000				
			SEP-SEP	4	1000				
			4T	ST	AVR-APR	1	250		
					MAI-MAY	2	500		
	4T	FPO	OCT-OCT	6	2748	0			
			CRABE DES NEIGES SNOW CRAB	4S	FPO	AVR-APR	2	702	15
						MAI-MAY	2	500	20
						MAI-MAY	2	547	21
JUN-JUN	2	500				53			
JUN-JUN	3	957				21			
JUI-JUL	2	500				20			
JUI-JUL	1	301				0			
SEP-SEP	1	250				19			
SEP-SEP	1	260				0			
OCT-OCT	2	500				22			
OCT-OCT	1	207				51			
4T	FPO	AVR-APR		5	2710	53			
		MAI-MAY	3	750	0				
		MAI-MAY	9	3042	125				
		JUN-JUN	3	750	0				
		JUN-JUN	4	2006	65				
HOMARD AMERIQUE AMERICAN LOBSTER	4T	FPO	MAI-MAY	16	7369	0			
			JUN-JUN	23	8866	0			
			JUI-JUL	10	3620	0			
PETONCLE GEANT GIANT SCALLOP	4S	DRB	OCT-OCT	1	1088	0			
			OCT-OCT	1	438	59			
			NOV-NOV	1	1074	0			
			NOV-NOV	1	492	51			

ESPECES	DIV. NAFO	ENGIN	MOIS	ECH.	MESU.	GARDE
SPECIES	NAFO DIV.	GEAR	MONTH	SAMP	MEAS	KEPT
	4T	DRB	AVR-APR	4	2968	47
			AVR-APR	1	3577	55
			MAI-MAY	4	3095	45
			JUN-JUN	3	2404	65
			JUN-JUN	2	3708	116
			JUI-JUL	4	3452	44
			AOU-AUG	5	4025	64
			AOU-AUG	3	2784	185
			SEP-SEP	6	4370	50
			SEP-SEP	1	720	60
			OCT-OCT	1	994	0
PETONCLE ISLAND ICELAND SCALLOP	4S	DRB	AVR-APR	1	874	31
			MAI-MAY	1	1190	0
			JUN-JUN	1	1031	0
			JUI-JUL	1	1028	0
			JUI-JUL	2	1730	60
			AOU-AUG	1	1036	0
			SEP-SEP	2	2159	0
			SEP-SEP	1	853	32
			OCT-OCT	1	1037	0
			OCT-OCT	1	924	26
BUCCIN WAVE WHELKS	4S	FPO	AOU-AUG	1	100	0
			SEP-SEP	6	600	0
			OCT-OCT	1	100	0
	4T	FPO	JUN-JUN	2	202	0

LIST OF SAMPLING DATA FOR 1991

ESPECES	DIV. NAFO	ENGIN	MOIS	ECH.	MESU.	GARDE
SPECIES	NAFO DIV.	GEAR	MONTH	SAMP	MEAS	KEPT
MORUE FRANCHE ATLANTIC COD	4R	LLS	MAI-MAY	2	506	128
			JUN-JUN	1	250	47
	4S	GNS	MAI-MAY	1	254	31
			JUN-JUN	2	525	62
			JUI-JUL	1	274	36
			AOU-AUG	4	1025	157
			SEP-SEP	4	1013	160
			OCT-OCT	1	291	48
		LHP	AOU-AUG	2	523	65
			SEP-SEP	1	252	34
		LLS	AVR-APR	1	250	37
			SEP-SEP	3	586	149
		OTB1	AOU-AUG	1	251	28
			JUN-JUN	3	868	91
			JUI-JUL	4	1037	121
			AOU-AUG	4	1011	109
			SEP-SEP	3	753	100
			OCT-OCT	1	250	31
		ST	AVR-APR	1	250	31
			MAI-MAY	1	250	27
	4T	GNS	JUN-JUN	4	926	138
			AOU-AUG	1	123	28
			SEP-SEP	2	478	68
			OCT-OCT	1	255	35
		LHP	JUI-JUL	1	258	13
			SEP-SEP	1	258	31
		LLS	MAI-MAY	2	503	79
			JUN-JUN	2	511	60
			JUI-JUL	3	757	107
			AOU-AUG	2	500	67
			SEP-SEP	4	1040	122
			OCT-OCT	8	2062	245

ESPECES SPECIES	DIV. NAFO NAFO DIV.	ENGIN GEAR	MOIS MONTH	ECH. SAMP	MESU. MEAS	GARDE KEPT
		OTB1	MAI-MAY	2	553	52
			JUN-JUN	1	266	25
			OCT-OCT	1	258	20
		OTB2	AVR-APR	2	510	65
			MAI-MAY	11	2789	317
			JUN-JUN	6	1768	189
			JUI-JUL	4	1010	100
			AOU-AUG	5	1269	130
			SEP-SEP	5	1260	127
			OCT-OCT	5	1270	141
			NOV-NOV	1	250	28
		SDN	MAI-MAY	1	263	30
			JUN-JUN	1	275	36
			JUI-JUL	1	264	26
			AOU-AUG	1	250	24
		SSC	MAI-MAY	4	1027	110
			JUN-JUN	4	982	151
			JUI-JUL	5	1262	141
			SEP-SEP	1	141	22
			OCT-OCT	3	759	80
			NOV-NOV	1	253	28
MERLUCHE BLANCHE WHITE HAKE	4R	LLS	SEP-SEP	1	250	34
	4S	LLS	JUI-JUL	1	251	28
			AOU-AUG	2	501	58
	4T	GNS	JUN-JUN	2	504	70
SEBASTE ATLANTIQUE REDFISH	4R	OTB2	AOU-AUG	1	250	0
		OTM2	AVR-APR	6	1455	0
			MAI-MAY	4	921	0
			JUN-JUN	1	268	0
			SEP-SEP	4	839	0
			OCT-OCT	6	1502	0
			NOV-NOV	3	759	0
	4S	GNS	JUN-JUN	1	252	0
		OTB2	AOU-AUG	3	754	0
			SEP-SEP	1	283	0
		OTM2	AOU-AUG	3	819	0
			SEP-SEP	3	849	0
	4T	GNS	MAI-MAY	1	250	0
		OTB2	JUI-JUL	1	278	0
			AOU-AUG	2	492	0
			SEP-SEP	1	255	0
		OTM2	JUN-JUN	2	521	0
			JUI-JUL	8	2061	0
			AOU-AUG	1	262	0
	4V	OTM2	MAI-MAY	1	218	0
FLETAN ATLANTIQUE ATLANTIC HALIBUT	4R	LLS	MAI-MAY	2	207	178
FLETAN GROENLAND GREENLAND HALIBUT	4S	GNS	MAI-MAY	1	249	36
			JUN-JUN	2	510	74
			JUI-JUL	4	1028	177
		OTB2	AOU-AUG	1	252	33
		ST	JUN-JUN	2	507	88
			JUI-JUL	4	1004	156
			AOU-AUG	1	251	38
			SEP-SEP	1	252	29
	4T	GNS	AVR-APR	2	500	76
			MAI-MAY	2	506	90
			JUN-JUN	1	251	36
			AOU-AUG	1	251	35

ESPECES SPECIES	DIV. NAFO NAFO DIV.	ENGIN GEAR	MOIS MONTH	ECH. SAMP	MESU. MEAS	GARDE KEPT
PLIE CANADIENNE AMERICAN PLAICE	4S	GNS	JUI-JUL	1	256	29
			AOU-AUG	2	503	51
			SEP-SEP	2	507	59
		LLS	JUI-JUL	1	250	28
			AOU-AUG	1	250	32
			SEP-SEP	2	500	58
	4T	OTB2	OCT-OCT	1	251	35
		GNS	AVR-APR	1	252	28
			MAI-MAY	1	258	27
			JUN-JUN	3	760	83
		OTB1	MAI-MAY	6	1519	216
			JUN-JUN	1	254	26
		OTB2	JUI-JUL	3	755	92
			AOU-AUG	1	252	24
			OCT-OCT	1	250	42
		SDN	MAI-MAY	1	261	39
			OCT-OCT	1	252	28
		SSC	MAI-MAY	2	502	62
			JUN-JUN	3	769	99
			JUI-JUL	4	1008	137
			AOU-AUG	2	504	59
			OCT-OCT	1	251	44
PLIE GRISE WITCH FLOUNDER HARENG ATLANTIQUE ATLANTIC HERRING	4T	SSC	JUI-JUL	1	253	43
	4S	GNS	AVR-APR	1	251	55
			MAI-MAY	4	1155	220
			JUN-JUN	2	515	110
			AOU-AUG	2	513	110
		PS	SEP-SEP	1	258	55
			AOU-AUG	3	789	165
			OCT-OCT	1	273	55
	4T	FWR	MAI-MAY	1	263	49
			AVR-APR	7	1747	219
		GNS	MAI-MAY	6	1453	220
			JUN-JUN	2	500	63
			SEP-SEP	4	1009	154
			OCT-OCT	1	253	36
CAPELAN CAPELIN	4S	FPN	AOU-AUG	1	322	18
			MAI-MAY	2	502	26
		MIS	JUN-JUN	5	1299	65
			JUI-JUL	4	1006	40
		SSC	JUN-JUN	1	250	16
			JUI-JUL	1	257	14
	4T	FWR	MAI-MAY	1	244	15
			JUN-JUN	5	1315	82
		MIS	JUN-JUN	5	1265	62
MAQUEREAU BLEU ATLANTIC MACKEREL	4T	GND	JUI-JUL	1	257	40
			JUN-JUN	5	1265	190
		GNS	JUI-JUL	1	267	50
			AOU-AUG	3	754	93
		LX	SEP-SEP	1	251	26
			AOU-AUG	4	1031	152
			SEP-SEP	3	766	134
CREVETTE ROSE PINK SHRIMP	4S	ST	AVR-APR	6	1500	
			MAI-MAY	6	1500	
			JUN-JUN	7	1750	
			JUI-JUL	6	1500	
			AOU-AUG	6	1500	
			SEP-SEP	6	1500	
			OCT-OCT	3	750	
			NOV-NOV	1	250	



ESPECES	DIV. NAFO	ENGIN	MOIS	ECH.	MESU.	GARDE
SPECIES	NAFO DIV.	GEAR	MONTH	SAMP	MEAS	KEPT
CRABE DES NEIGES SNOW CRAB	4S	FPO	AVR-APR	2	624	33
			MAI-MAY	3	740	92
			MAI-MAY	2	500	0
			JUN-JUN	3	768	41
			JUN-JUN	2	270	20
			JUI-JUL	2	500	0
			AOU-AUG	2	510	17
			SEP-SEP	1	250	46
			SEP-SEP	1	250	0
	4T	FPO	AVR-APR	4	686	37
			AVR-APR	1	245	0
			MAI-MAY	9	4332	0
			MAI-MAY	3	750	0
HOMARD AMERIQUE AMERICAN LOBSTER	4S	FPO	JUI-JUL	2	23	23
			AVR-APR	2	784	
			MAI-MAY	13	7042	
			JUN-JUN	18	8756	
			JUI-JUL	16	6993	
PETONCLE GEANT GIANT SCALLOP	4T	DRB	AVR-APR	1	695	0
			MAI-MAY	2	2897	67
			MAI-MAY	3	1845	136
			JUN-JUN	2	1164	38
			JUN-JUN	4	2117	99
			JUI-JUL	3	2967	54
			JUI-JUL	3	2268	0
			AOU-AUG	3	1922	78
			SEP-SEP	1	1773	77
PETONCLE ISLANDE ICELAND SCALLOP	4S	DRB	MAI-MAY	1	458	30
			MAI-MAY	2	1220	0
			JUN-JUN	1	719	0
			JUI-JUL	1	413	33
			JUI-JUL	1	756	0
			AOU-AUG	1	701	32
			AOU-AUG	2	1367	0
			SEP-SEP	1	653	36
			SEP-SEP	1	759	0
			OCT-OCT	1	826	0
	4T	DRB	JUN-JUN	1	1937	0
			AOU-AUG	1	1176	0
			SEP-SEP	1	882	0
BUCCIN WAVE WHELKS	4S	FPO	AVR-APR	1	100	0
			MAI-MAY	5	500	0
			JUN-JUN	5	500	0
			JUI-JUL	7	700	0
			AOU-AUG	6	600	0
			SEP-SEP	4	400	0
			OCT-OCT	2	200	0
		MIS	JUN-JUN	1	100	0
	4T	FPO	JUN-JUN	2	200	0
			JUI-JUL	2	200	0
			AOU-AUG	3	300	0
			SEP-SEP	2	200	0
			OCT-OCT	1	100	0