

Northwest Atlantic Fisheries Organization



Serial No. N2378

NAFO SCS Doc. 94/10

SCIENTIFIC COUNCIL MEETING - JUNE 1994

Canadian Research Report for 1993

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

SECTION I - Scotia-Fundy Region

by

Paul Boudreau, Senior Advisor
Biology Marine Assessment and Liaison Division
Department of Fisheries and Oceans, 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 1989-93 for major stocks currently being assessed in the Scotia-Fundy Region are given in Table 1.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic studies

Scotia-Fundy scientists continue to participate in activities related to the World Ocean Circulation Experiment (WOCE), the Joint Global Ocean Flux Study (JGOFS) and the Ocean Productivity Enhancement Network (OPEN) studies. Analysis of groundfish survey and oceanographic data has revealed strong interactions between fish and ocean conditions. These are being used to help in the interpretation of the survey abundance indices.

b) Plankton studies

A series of zooplankton stations were sampled using nets and multifrequency acoustic methods to measure zooplankton concentrations in regions dominated by different water masses in the areas of the Scotian Shelf and Gulf of Maine. This was a continuation of the study dealing with the effects of climate change on zooplankton populations.

c) **Benthic studies**

Equipment has been developed and baseline data collected for the first phase of a trawling impact experiment on the Grand Banks. A study site, located about 40 nm northeast of Hibernia, was selected because of its well-developed benthic fauna and relatively uniform sandy sediments. Additionally, sidescan sonar surveys had shown no evidence of recent trawling activity and the site is now officially closed to trawling.

Two ships took part in the study: CSS Parizeau and the CSS Wilfred Templeman. The study site was first surveyed by the Parizeau. The Wilfred Templeman then arrived and trawled three replicate experimental corridors with a standard otter trawl equipped with rockhopper foot gear. Each corridor is 7 nm long and trawled three times. Acoustic tracking and digital global position systems were used to help keep the trawl close to the intended lines. The trawl catch, both fish and invertebrates, was saved for subsequent analysis. After trawling, the Parizeau conducted sidescan surveys of the trawled corridors and collected biological samples from disturbed sediments in two of the three corridors.

It will take several years before this experiment will produce final results. Samples collected on this cruise are being analyzed and the data interpreted. Additional cruises are planned for July 1994.

d) **Other environmental studies**

Development of a habitat sensitivity mapping system continues. Extensive amounts of data and information has been compiled for Shelburne County, N.S. coastal area.

2. **Biological Studies by species**

a) **Cod**

Studies in otolith structure continue. Inductively-coupled plasma mass spectroscopy (ICPMS) of dissolved otoliths of 7 NW Atlantic cod stocks of known origin produced fingerprints that differed significantly among all but one of the stocks. A subsequent study based on a laser-based version of the same device also resulted in successful discrimination. As a result, work has begun on the stock mixing problem of the Gulf of St. Lawrence cod stock that migrates to the Scotian Shelf each winter. Inshore surveys in 4Vn have determined the location of spawning and nursery areas. This work, combined with the innovative otolith examinations is leading to new ideas on the 4TVnVs stock structure.

A model describing the interaction between 4VsW cod and grey seals has been developed. It shows that there could be a significant impact by this predator. Further work on the loss of the 4VsW cod spring spawning component was also conducted.

The effect of parent size on the success of egg fertilization and subsequent survival of cod was studied.

For groundfish in general, alternative methods of utilizing commercial catch and effort information to develop indices of abundance are being evaluated. Studies of the impact of trawl configuration on research survey estimates of abundance were initiated.

b) **Haddock**

Much of the work on the Scotian Shelf involved consultation with fishermen on the current status of the resources. As well, an examination of the haddock/temperature interaction was completed. Finally, work on the spatial dynamics of the 4X haddock resource was conducted.

c) **Flatfish and Atlantic halibut**

Work focused on improving the quality of the DFO collected catch/effort statistics that is presently hampering assessment efforts.

d) **Redfish**

Little work was done on the Unit 3 resource, besides assigning personnel to start compiling the basic data on the population.

e) **Silver Hake**

A review of the by-catch regulation used in this fishery was conducted. Also a comprehensive assessment uncovered a retrospective problem similar to that observed in other stocks. Collaboration with Russian scientists continues, but at a lower level due to funding difficulties.

f) **Herring**

Nothing to report.

g) **Seals**

As mentioned for cod, a model of the interaction between 4VsW cod and grey seals was developed. This model drew upon the information collected during the five-year SSIP initiative. Also, considerable progress was made on understanding the seal-sealworm link. These studies will be influential in decisions to control the seal herds in the coming years.

h) **Lobster**

Juvenile lobster studies continued in the Western Bay of Fundy area and other locations; SCUBA diving allowed the utilization of air-lift suction samplers. Rockhopper trawls in the upper Bay of Fundy indicated seasonal, berried female assemblages in shoal waters. Canadian scientists joined a USA study using submersibles to document offshore lobster population demography in Gulf of Maine Canyons. Base line studies documenting spatial abundance patterns of lobsters and sea scallops at proposed finfish aquaculture sites in the Bay of Fundy continued. A study of fine scale seasonal distance and depth movements of Lobster Bay lobsters continued as did a study to develop a pre-recruit index; a first attempt at predicting recruit abundance, using the index, was correct. A Canadian, USA and Netherlands team is attempting to unravel endocrine regulatory processes controlling molting and reproduction.

i) **Scallops**

Experimental sites for sea scallop culture research were established in Passamaquoddy Bay. Pearl, lantern and shibetsu nets at each site, were stocked with several thousand sea scallops. One site is a salmon farm; it will be used to evaluate the co-culture of scallop and salmon. The availability and distribution of scallop seedstock in the Fundy Isles is being assessed by the deployment of spat collection bags. Benthic scallop seedstock collectors were rejected in favour of a horizontal longline system that suspends bags 2-3 metres off-bottom. Several new materials were compared for efficiency in scallop spat collection. Levels and variability of toxins in suspension cultured scallops is being assessed.

A study in Subareas 4Xs and 4Xr on the seasonal variation in somatic and reproductive tissue weights was completed and another on RNA/DNA variation in adductor muscle

continued. Genetic markers for distinguishing scallop stocks is ongoing in conjunction with Dalhousie University and National Research Council researchers. These include RAPD primers, microsatellite DNA and cDNA probes and mitochondrial DNA variation. A Fourier analysis of shell shape amongst stocks was completed and domoic acid uptake and depuration rates in sea scallops was determined experimentally.

j) **Clams**

Scientists working with the local soft shell clam industry, determined that digging does not affect clam growth, but frequent digging appears to increase bottom roughness. A relationship between clam size and clam siphon diameter was developed, allowing video technology to be used for rapid assessment of clam bed biomass and size structure. The enhancement effects of beach-placed artificial barriers on soft shell clam biomass is being evaluated. Relaying clams from high density, faecally contaminated Grand Manan Island beach to a clean beach with a lower density holds promise as an enhancement tool.

k) **Underutilized species**

Green sea urchin standing stock estimates were made along the Fundy coast east to Point Lepreau. In addition, growth, reproduction and movement studies were initiated. Another study revealed a link between jaw morphometrics and the nutritional state of the green sea urchin. Field and laboratory research (with University of New Brunswick personnel) was initiated on sea cucumber demography in the Quoddy Region of the Bay of Fundy.

l) **Atlantic salmon**

A comprehensive five-year Atlantic salmon management plan, instituted in Canada in 1984, was re-implemented for 1990-1994. The original version prohibited commercial salmon fishing in the Maritime Provinces, and quotas (1990-1991) and closure (1992) were subsequently brought to insular Newfoundland. Recreational landings were restricted to one-seawinter (<63 cm) Atlantic salmon (grilse) and regional seasonal creel limits that were further restricted in 1992 were maintained in 1993.

Recreational catch estimates for 1993 in the Scotia-Fundy Region indicate a retained one-seawinter harvest of 4,303 fish. This number is only 60 percent of the 1992 regional harvest and similar to the 1991 harvest of 4,355 fish. The estimated number of released multi-seawinter salmon (>63 cm) in 1993 in the Scotia-Fundy portion of Nova Scotia was 1,383 fish. This is a 32 percent decrease from 1992 catch of 1,800 fish, and together the reductions reflect the trend in the region of lower returns of salmon to Scotia-Fundy rivers. Some local closures of rivers occurred for the third year in a row as a result of poor returns to those rivers.

3. **Gear and Selectivity Studies**

a) **Longline**

The first comprehensive study of the Nova Scotian Longline fishery was completed. Part of this included an examination of longline selectivity. This study is an encyclopedia of information on this fishery and will be an invaluable future reference.

4. **Miscellaneous Studies**

Work continued on both shell morphology and comparative biology of *Mytilus edulis* and *M. trossulus*. Work has revealed that on a percent shell volume basis, *M. trossulus* contains significantly less meat, and is slower growing than *M. edulis*. Examination of shells of both species has shown that identification by shell morphology (shell length:shell height ratios) alone, is possible

in most adults where the length to height ratios are extreme. To date we have learned the seasonal spawning of the two species is almost identical as is time to metamorphosis of laboratory-reared animals. A study of paternal inheritance of mitochondrial DNA in *M. edulis* using is also ongoing.

Subarea 5 and 6

A. Status of the Fisheries

Nominal landings and TAC's from 1989-93 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

DFO scientists collaborated with U.S. scientists in the development and application of three-dimensional numerical models for circulation on the continental shelf. The models use realistic bathymetry on a finite-element grid that allows high resolution in target areas and inclusion of important neighbouring regions. Forcings in the models include tides, wind, density gradients and boundary inflows that are being specified from historical databases. The models are being used to investigate a variety of problems, ranging from fish egg and larval drift, to the fates of drilling discharges, to climate-change scenarios.

Current focus is on application to the Georges Bank region, using a model with simplified (harmonic) time variability and specified density gradients (diagnostic method). Recent progress includes the computation of six climatological bi-monthly mean flow fields for the Bank, resolving the important seasonal variation in its three-dimensional circulation. The flow fields allow quantitative evaluation of the relative importance of retention mechanisms such as the clockwise gyre and loss mechanisms such as wind-driven drift in the near-surface region. Another recent thrust has been the use of the harmonic model to investigate the importance of wind stress to observed interannual variations in the distribution and abundance of cod eggs and larvae on the Bank. The model results suggest that enhanced loss rates from the Bank associated with strong northeastward winds in April 1982 were a factor in poor recruitment of that cod year-class.

b) Plankton studies

The long term monitoring of zooplankton population in basins on the Scotian Shelf was continued and extended into the Gulf of Maine to determine effects of climate change on zooplankton populations.

c) Benthic studies

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

d) Other environmental studies

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

2. **Biological Studies by Species**

a) **Haddock**

The distribution and migration of cod and haddock in relation to the Canada-USA boundary were examined and possible management implications were explored. Modelling of circulation (see Hydrographic Studies above) is continuing to enhance our understanding of recruitment.

b) **Cod**

See Haddock report above.

c) **Pollock**

Nothing to report.

d) **Scallops**

A multiagency study on scallop feeding was carried out under the OPEN study. The objective was to measure short-term variations in the horizontal and vertical flux of particulate matter in the water column and to study the feeding and digestion responses of sea scallops to natural fluctuations in the food supply. The feed supply was measured *in situ* using sequential sampling sediment traps to quantitatively collect faecal material produced by animals held at 1.5 m above the seabed. A video camera was mounted on one of the traps to record scallop feeding behaviour.

3. **Gear and selectivity studies**

Nothing to report.

4. **Miscellaneous studies**

Nothing to report.

Table 1. Summary of Nominal Canadian catches and TAC's for major stocks assessed by the Scotia-Fundy Region in Subdivisions 4VWX and Subarea 5 for the last 5 years. 1993 values are preliminary estimates.

Stock	Nominal Catches ('000 t)					TAC's ('000 t)				
	1989	1990	1991	1992	1993	1989	1990	1991	1992	1993
Cod										
4Vn (M-D)	8	5	5	4	1	8	8	10	10	2
4VsW	36	34	32	30	3	35	35	35	35	11
4X	19	23	27	26	16	13	22	26	26	15
5Zjm	4	9	10	11	8	8	13	15	15	-
Haddock										
4TVW	7	7	5	6	1	7	6	-	-	-
4X	7	7	10	10	7	5	5	-	-	-
5Zjm	3	3	5	4	4	8	-	5	5	-
Pollock										
4VXW5Z	40	36	39	33	21	43	43	43	43	
Redfish										
4VWX	17	17	17	24 ¹		30	30	n/a		
4RST+3Pn4Vn(J-M)	53	60	60	77	44				67	67
3Ps4Vs4Wfgj+3Pn4 Vn(J-D)	15	15	20	18	15				20	20
4WdehkIX	3.2	2.3	2.0	2.4	5.1				10	10
Flatfish										
4VWX ²	8	7	5	4	3	14	14	14	14	14
Herring										
4Vn	2	5	5	n/a	n/a	4	4	4	n/a	n/a
4WX	129	141	122	143	100	151	151	151	151	151
Scallops										
4VWX (offshore)	0.9	0.6	0.6	1.0	1.0	-	-	-	-	n/a
5Zc	4.7	5.2	5.8	6.2	6.2	4.7	5.2	5.8	-	n/a
Lobster										
4VWX (inshore)	15.6	19.4	19.6	14.6	14.1	-	-	-	-	n/a
4VWX (offshore)	0.3	0.5	0.5	0.5	0.5	0.7 ³	0.7 ³	0.7 ³	0.7 ³	0.7 ³
5Ze (offshore)	0.1	0.1	0.1	0.1	0.1					

¹ Management units under review in 1992.

² Plaice, Yellow and Witch - unspecified flatfish species not included

³ 4VWX (offshore) combined with 5Ze (offshore)

SECTION II - Newfoundland Region

by

M. M. Roberge

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

SUBAREAS 0 AND 1

A. Status of the Fisheries

Nominal landings from 1989 to 1993 for fish stocks are given in Table 1.

B. Special Research Studies

1. Biological Studies

- a) *Atlantic salmon*. No sampling program was conducted in 1993 due to the buyout of the Greenlandic fishery by Atlantic salmon conservationists; only a small local consumption fishery remained.
- b) Sampling of commercial shrimp catches by the Canadian Observer Program continued in 1993.

SUBAREA 2

A. Status of the Fisheries

Nominal landings from 1989 to 1993 for fish stocks are given in Table 1. Additional information on the status of the fisheries is as follows:

- a) *Atlantic salmon*. Total landings of salmon (99 t) decreased by 47% from 1992. The recreational harvest totalled 3.3 t. Licensed effort in the commercial salmon fishery in 1993 was reduced due to a buyout program offered by DFO.
- b) *Arctic charr*. Landings of Arctic charr in northern Labrador totalled 38 t in 1993, a decline of 48% from the previous year. Declines in catches were matched by a reduction in effort which declined to the lowest level recorded since 1974.
- c) *Shrimp*. The shrimp fishery had a total quota of 11,320 t in 1993 (season January 1 to December 31), 4,273 t of which were in the Hopedale Channel. An exploratory fishery, established in 1992, was continued in 1993 with a quota of 1,700 t.
- d) *Capelin*. Landings of capelin remained at a low level.
- e) *Cod*. Landings were almost nil; the northern cod moratorium has been in effect since July 1992 for cod from Div. 2J3KL; the recreational (handline) fishery was discontinued February 1994.
- f) *Greenland halibut*. Landings of Greenland halibut decreased 38% from the previous year.

B. Special Research Studies

1. Environmental Studies

Oceanographic studies. NAFC current meter program on Hamilton Bank was continued. Temperature profiles were taken at each fishing station occupied in the subarea. As part of the NCSP, several clusters of satellite-tracked surface drifters were deployed to monitor surface currents on the continental shelf. CTD profiles were collected along the standard NAFO transect across the Hamilton Bank (Seal Island Line) and several other stations on the Labrador Shelf.

2. Biological Studies

- a) *Cod*. From research vessels, distribution and abundance studies were carried out and detailed biological sampling was conducted in Div. 2J. Stomachs were collected from the Div. 2J autumn survey.
- b) *Atlantic salmon*. A total of 362 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.
- c) *Arctic charr*. A total of 1,774 samples was obtained for age determination of Arctic charr in commercial landings from 14 northern Labrador fishing areas. Approximately 13,600 fish were sampled for length distribution from the same areas. Information on sex distribution of charr caught in the fishery was obtained, along with stomach samples for evaluation of food and feeding habits.
- d) *Shrimp*. Sampling of commercial shrimp catches by the Canadian Observer Program continued in 1993.
- e) *Flatfish*. Data on distribution and abundance of American plaice, Greenland halibut and witch flounder were collected during groundfish surveys of Div. 2J in 1993.

Data on sexual maturity and spawning were collected from Greenland halibut caught in the deepwater gill net fishery off Labrador and northern Newfoundland.

SUBAREA 3

A. Status of Fisheries

Nominal landings from 1989 to 1993 for fish stocks are given in Table 1. Additional information on the status of the fisheries is as follows:

- a) *Squid*. Total catch of squid in 1993 was low, generally, comparable to that of the previous year. The poor fishery, for the eleventh consecutive year, was due to a natural low abundance of squid in commercial fishing areas.
- b) *Atlantic salmon*. There was a moratorium on the commercial fishery. The recreational harvest was 24 t.
- c) *Shrimp*. The Div. 3K shrimp fishery was subject to TACs totalling 3,724 t from January 1 to December 31, 1993. An exploratory fishery was also established in eastern 3K, with an initial quota of 1,700 t. A new, international fishery in Div. 3M began in 1993. The quota for Canadian vessels was 4,000 t and catches totalled 3,724 t.
- d) *Iceland scallop*. Due to the restrictions to fishing in the new French zone in 3Ps, the nominal catch declined dramatically. Some of the effort displaced from 3Ps shifted eastward to the Grand Banks of Newfoundland (Div. 3LNO). An estimated 456 t were landed in 1993, up from 19 t round in 1992.
- e) *Clams*. The Grand Bank (3N, Unit Area 319) fishery for the Arctic (Stimpson's) surf clam (*Mactromeris polynyma*) on the Grand Banks (3N) continued into 1993. The total allowable catch of 20,000 t TAC was taken.
- f) *Capelin*. Inshore capelin catches were taken during the inshore spawning migration. Female capelin are preferred to satisfy the Japanese roe market. The 1993 inshore TAC was 34,490 t and catches were about 37,000 t. The offshore fishery was closed in 1993.
- g) *Herring*. Landings in 1993 were approximately 6,000 t, 77% of which was taken from White Bay, Notre Dame Bay, Bonavista Bay and Trinity Bay. There was little fishing effort due to the low price of herring.
- h) *Cod*. Canadian landings were down in 1993. The northern cod moratorium has been in effect since July 1992 for cod from Div. 2J3KL; reported Canadian catch (2J3KL) was mainly from a 'recreational' fishery which was closed effective February 1994.
- i) *Flatfish*. Total landings of flatfish decreased 41% from 1992; the largest decrease was in landings of Greenland halibut (74%) and American plaice (32%).
- j) *Redfish*. Landings decreased from 1992 by 21%; however, they were higher than those reported in years prior to 1992.

B. Special Research Studies

1. Environmental Studies

- a) *Contaminants.* Contaminant levels were determined in yellowtail flounder from the offshore.

Data were assembled on organic and metallic contaminant levels in nearshore Newfoundland organisms, water and sediments. The information is being presented in a desktop mapping format for ease of geographic reference. A regional assessment of contaminants is being prepared.

The zone of impact of St. John's harbour effluent on the surrounding fisheries ecosystem is being investigated. Nutrient levels, faecal bacteria, coliforms and toxic metal species are being investigated during an annual cycle from the harbour mouth to oceanographic Station 27.

- b) *Canada-Newfoundland Offshore Petroleum Board.* The environmental Studies Research Fund (ESRF), which is financed by levies on holders of exploration and production licenses in Canada's offshore areas, initiated a study during 1993 to assess the relative capabilities of different remote sensing systems for the purpose of ice detection in support of offshore petroleum exploration and production. The study is scheduled for completion in 1994.

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

- Ground wave radar - Canadian coastal surveillance network: This initiative, proposed by Northern Radar and its partner Canadian Marconi Company (CMC), is to develop a fully operational network of GWR systems providing long-range, continuous coverage of the Exclusive Economic Zone. The systems will be capable of detecting and tracking vessels, icebergs and low-flying aircraft and taking measurements of surface currents and sea-state. Two experiments were conducted during the fall of 1993 and used to develop a detailed upgrade plan for Northern's Cape Race site. The first experiment was completed during September 1993 and the second trial during November.
- The Cape Race GWR system has been operating for the past three years on a near-continuous basis, performing many experiments and demonstrations. Enhancements made to the system improve the ability to automatically detect and track targets and perform environmental measurements over a broad range of conditions. GWR systems are capable of measuring surface currents, sea-state and surface winds. The continued research in these areas has two objectives: to develop a routine oceanographic monitoring capability using GWR technology, and to demonstrate application of these measurements to problems in search and rescue, fisheries research and, in port, coastal and marine engineering.
- SEAPROBE (Seabed Environmental Acoustic PROBE): A program involving acoustic studies of seabed properties and dynamics with environmental applications is being carried out by C-CORE with funding from the Natural Sciences and Engineering Research Council (NSERC). The unique qualities of high resolution non-linear acoustic signals are being used to investigate sediment settling, erosion and transport phenomena and their implications for contaminant migration in the marine environment.
- Effects of ice keel scour on benthic communities: Scouring sea ice and icebergs disturb seabed, destroying fauna and flora that live on and in the sediment. Ice keel scour also exposes previously buried sediments containing chemicals and nutrients which attract benthic organisms. The interrelationship between the destructive and beneficial effects of ice keel scour on marine food webs, and ultimately on commercial fish species, is not known.

As part of a collaborative effort, studies were initiated on the effect of ice scour on marine benthic flora and fauna by ice keel scour. This is an integrated biological, geological and geotechnical study. Preliminary data have been collected.

2. Biological Studies

- a) *Cod.* Sampling of the landings from the commercial and recreational (where commercial closures were in effect) fisheries, both inshore and offshore, was continued in 1993. Using research vessels, surveys were carried out in spring and autumn, in all NAFO Divisions (except 3M) to determine the distribution and abundance of cod. Biological sampling was extensive during these surveys and cod were tagged, inshore and offshore. Stomachs were collected from Div. 3LNO during spring and from Div. 3KL during autumn.

- b) *Scallops*. A stratified random survey was completed on St. Pierre Bank to determine the biomass of Iceland scallops (*Chlamys islandica*) along the northern edge of St. Pierre Bank (187 sets over 188 mi²). It is estimated that a significant reduction (49%) in the biomass had occurred between 1990 (\bar{x} = 36,000 t) and 1993 (\bar{x} = 18,400 t). Due to boundary resolution, approximately 85% of the biomass now lies in the French zone.
- c) *Squid*. Commercial squid samples were acquired opportunistically from two localities in Trinity Bay. No other samples could be acquired.
- d) *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.
- e) *Seals*. Sampling of seals to provide data on age structure, reproductive parameters, stomach contents and morphological condition continued.

A series of studies designed to provide information on the role of pinnipeds in the Northwest Atlantic ecosystem continued. These studies include research on the abundance, diet and distribution of harp and hooded seals. A study of seasonal movements and diving behaviour in free-ranging seals using satellite-telemetry has been expanded.

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

- f) *Whales*. Ongoing studies on ice entrapments of blue whales, entanglements of whales in fishing gear, detectability of fishing gear by cetaceans, the use of alarms to reduce incidental catches of harbour porpoise, photo-identification of cetaceans, food selection using stable isotope analysis and population modelling continued. Biological information and tissue samples were obtained from stranded and incidentally entrapped cetaceans.
- g) *Scallops*. Commercial fishing trials for Iceland scallops (*Chlamys islandicus*) were undertaken over a wide area of the Grand Banks. Twelve inshore vessels, ranging from 13 to 20 m participated on an intermittent basis. Landings amounted to 1.1 million pounds (round weight). It is anticipated that approximately 20 inshore vessels will fish the area in 1994.
- h) *Capelin*. An acoustic survey normally conducted during May was discontinued. Div. 3L was surveyed as part of a larger survey covering Div. 2J3K and Div. 3L during September and October. An aerial survey index and catch rates of traps for 1993 were at or near historical levels. Factors governing capelin survival during egg development and larval emergence from beach sediments were continued in 1993. Primary sampling sites were Arnold's Cove, Placentia Bay; Chapel's Cove, Conception Bay; Bellevue Beach, Trinity Bay; Eastport, Bonavista Bay; and Hampden, White Bay.
- i) *Herring*. The research gill net index fisherman program was continued for the fourteenth year as an index of herring abundance. A controlled field experiment was conducted in Conception Bay during May, June and September to examine the relationship between target strength and fish length for herring. A relationship derived from these experiments was used to calculate biomass estimates from acoustic surveys conducted from 1988 to 1993. An acoustic biomass estimation survey was conducted during November-December in Bonavista Bay-Trinity Bay.
- j) *Redfish*. Several groundfish research surveys conducted throughout Subarea 3, primarily in the spring and fall of 1993, provided information on the abundance, distribution and parasite infestation (*Sphyrion lumpi*). The collection and subsequent ageing of otoliths from both research and commercial catches, and the application of these to respective length frequencies yielded information about commercial catch-at-age as well as population structure.
- k) *Flatfish*. Distribution and abundance of flatfish were studied during random stratified surveys in 1993: Div. 3K - fall survey; Div. 3L, 3N and 3O - spring and fall surveys; Div. 3P - spring survey.

A survey was conducted in June 1993 to tag primarily juvenile American plaice and yellowtail flounder. The effort was conducted within Canadian waters in Div. 3LN and in the NAFO Regulatory area of Div. 3N. There were 5,953 fish tagged, 2,005 of which were juvenile American plaice, 1,860 juvenile yellowtail flounder and 2,088 adult American plaice.

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

A juvenile flatfish survey was conducted in Div. 3LNO in early fall of 1993. 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.

A stratified random survey for Greenland halibut was conducted in Div. 3KLMN in the winter of 1994 to investigate stock abundance and biomass and collect data on population dynamics and stock structure.

3. Gear and Selectivity Studies

- a) *Fixed gear selectivity.* An eel fyke net selectivity project was conducted from four locations. A 127 mm rubber band was placed around the guiding funnel in each fyke net, stretched tight to close off the funnel and tied. Catches with the rubber band were compared to the catches when the rubber band was removed. The results indicate that the rubber band significantly reduces the proportion of the by-catch that enters the end of the fyke net and it increases the proportion of by-catch that remains in the forward section of the net, where the probability of survival is generally higher. Overall, it appears that the use of the rubber band, as a by-catch reduction device, is effective.

A cod trap selectivity project was carried out during the summer of 1993. Two modified Newfoundland cod traps, two long shore cod traps and a small mesh control trap were monitored for 30 fishing days. The results indicate that increasing the mesh size in the drying twine from 92 mm to 102 mm will reduce the amount of small cod retained. Only 3.2% of the fish caught in the cod traps with 102 mm mesh in the drying twine were 41 cm or under while the traps with 92 mm mesh in the drying twine retained 21.5% small fish (41 cm or under). The mean length of cod retained in traps with the larger mesh drying twine was approximately 3 cm greater than the mean length of cod retained in the traps with the smaller mesh drying twine. Selectivity curves developed clearly demonstrated that the traps with the 102 mm drying twine retained fewer small fish with no increase in the loss of larger fish.

- b) *Mobile gear selectivity.* To assess lastridge rope hanging ratios, an otter trawl selectivity study was carried out from a 16.6 m commercial fishing vessel for 17 fishing days. The primary objective of the project was to test the effectiveness of shortened lastridge rope on otter trawls as a method to reduce the catch of small (<41 cm) cod. A standard 300 mesh otter trawl was modified by installing a 40 mm vertical panel which extended from the center of the headrope and footrope, back to a trouser codend. For three phases of the experiment, one leg had 130 mm mesh with lastridge rope hung at 72%, 80% or 85%, while the other leg had a 141 mm mesh with a 43 mm mesh liner. The fourth phase compared a 130 mm mesh with lastridge ropes hung at 80% to the 141 mm mesh counterpart of a twin codend. The codend with lastridge ropes hung at 72% had the lowest percentage of small fish (1%) and the shortest selection range (5.6 cm). Lastridge ropes hung at 80% had an average of 3% small fish, and a selection range of 7.6 cm. Ropes hung at 85% had an average of 4% small fish, and a selection range of 7.3 cm. The 142 mm mesh without lastridge ropes retained 8% small fish. An underwater video camera was used to observe the trawl with lastridge ropes hung at 72% and 80%. Small fish were observed escaping through the meshes with little difficulty.

A cod/plaice separator trawl project was carried out during two 10-day fishing trips to 3NO in June and December 1993. A traditional flounder trawl was modified to accommodate Nordmore grates with horizontal and vertical bar spacings of 51 mm to 203 mm. A retainer bag was placed over the fish outlet to measure escapement. The most positive results were obtained with the 127 mm bar spacing; 88% of the cod were excluded with a combined plaice and yellowtail loss of 8%. Following trip #1 industry outfitted 20 vessels with these grates and continued using them until the year end. Reports of grate performance have been mostly positive, with a significant decrease in cod by-catch.

Nordmore grates with bar spacings of 22 mm, 25 mm and 28 mm were tested during 54 fishing days on a northern shrimp trawler from January to March 1993. Direct comparisons of a commercial shrimp trawl and an experimental trawl with the Nordmore grates were made. The 22 mm grate was also tested using a retainer bag over the fish outlet to measure shrimp loss. Results indicated a significant reduction in all by-catches, especially cod and redfish. When the retainer bag was used, 2 out of 14 sets produced shrimp losses of 35% and 43%. These coincided with a severe reduction in grate angle as indicated by Scanmar sensors. Shrimp trawlers fishing northern shrimp are now required to use Nordmore grates with bar spacings of 28 mm or larger. Some fishermen use the grate at all times and report that, in addition to groundfish reduction, it works well as a groundshark excluder.

SUBAREAS 2 AND 3

A. Special Research Studies

1. Environmental Studies

- a) *Hydrography.* Hydrographic staff were involved in inshore sounding surveys. Detailed information for the updating of navigation charts was collected along the northeastern Newfoundland coast and Labrador.
- b) *Oceanographic and related studies.* Ships-of-opportunity XBT programs were continued using the surveillance vessel CAPE ROGER. Temperature profiles were taken at each research fishing station occupied during 1993. In addition, over 50 thermographs were deployed by researchers in conjunction with the DFO long-term Temperature Monitoring Program. CTD data were collected using a SeaBird SeaCat Profiler on the groundfish otter trawl.

Five physical oceanographic cruises were conducted to collect CTD, oxygen and plankton profiles along the standard NAFO transects and additional stations, as well as the vertical profiles of the ocean currents along the cruise track.

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

2. Biological Studies

- a) *Assessments.* Assessments of some 25 groundfish stocks presently under catch quota regulations were conducted and refined for advice on TACs for the 1993 fishing season was provided either through DFO 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, two Arctic charr stock complexes and other commercial and potentially commercial species.
- b) *Fisheries Resource Conservation Council.* The Fisheries Resource Conservation Council (FRCC) was created in December 1992 as a means of integrating fishing industry experience and scientific advice in the resource assessment process. The Council is to review assessments of Atlantic groundfish stocks and recommend total allowable catches (TACs) and other conservation measures. In 1993, the Council concentrated on reviewing stock assessments and conducting public hearings primarily on the state of Atlantic groundfish stocks, including stocks within the NAFO divisions. It recommended basic directions with respect to Science priorities (e.g. use of information from fishermen and commercial fisheries in stock assessments, collection of commercial fishery data through test fisheries, involvement of fishermen in scientific research), research initiatives (e.g. cause of groundfish resource declines, efficiency of surveys, optimal fish sizes for harvesting and benefits of area closures, understanding of Unit 1, 2 and 3 redfish and Greenland halibut in Div. 0+1 and Div. 2+3KLMN, as well as in Cumberland Sound and adjacent areas) and research integration (e.g. ecosystem approach to fisheries management, multidisciplinary team approach).
- c) *Cod.* Combined trawl and acoustic survey was undertaken to determine the distribution of cod off the east coast of Newfoundland during the shoreward migration in June, as well as to determine the depth and temperature of cod concentrations near the coast prior to, and during, the inshore migration of cod.
- d) *Capelin.* An acoustic survey in Div. 2J3KL in September-October 1993 resulted in a biomass estimate of 45,500 t. This survey was expanded during 1993 to include NAFO Div. 3L.
- e) *Research vessel trips.* Sixty-one offshore and inshore research vessel trips were undertaken in 1993-94 utilizing DFO-owned vessels (Newfoundland-based: WILFRED TEMPLEMAN, MARINUS, SHAMOOK; Scotia-Fundy based: ALFRED NEEDLER, PARIZEAU, MATTHEW; GADUS ATLANTICA, PETREL V and ZANDVOORT (charters).
- f) *Commercial sampling.* Sampling of foreign (inside the Canadian zone) and Canadian offshore catches for all commercial fish and invertebrate species by the Canadian Observer Program continued in 1993.

3. Miscellaneous

- a) *Northern Cod Science Program.* As part of the Atlantic Fisheries Adjustment Program (AFAP), research initiatives continued for the fourth year on northern cod (Div. 2J3KL) under the Northern Cod Science Program (NCSP). NCSP initiatives were established to address the science recommendations of the Northern Cod Review Panel which conducted an independent review of the state of the northern cod stock and published a report in February 1990. Resources were assigned to study cod ecosystems dynamics, improve communication, collaboration and education and to take advantage of new technologies in cod research and assessment.

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

Table 1. Summary of preliminary catches for stocks within the Newfoundland Region, 1989-1993.

Subarea	Species	Division	Catch (t)				
			1993	1992	1991	1990	1989
O + 1	Greenland halibut	O	2,561	8,200	5,945	6,194	
	Shrimp	OA	5,501	7,493	6,788	6,116	7,200
		OB	106	1,250	1,100	1,575	
2	Cod	(Offshore)			635	32,600	56,000
		(Inshore)	13		2,200	14,300	22,000
	Redfish			1	7	192	70
	Greenland halibut		1,119	1,800	3,200	3,800	2,500
	American plaice			<10	80	900	3,200
	Other groundfish			100	467	403	
	Arctic charr		38	74	70	100	100
	Shrimp		12,114	11,100	10,300	9,500	
	3	Cod		<u>23,573</u>	<u>56,600</u>	<u>159,200</u>	<u>201,600</u>
3K			544	1,756	42,800	54,400	
3L			3,384	22,600	74,500	104,000	
3N			326	580	1,500	4,600	
3O			3,391	6,600	6,500	7,000	
3Pn			2,411		6,500	5,300	
3Ps			13,517	24,600	27,300	26,300	
Redfish				17,481	22,200	16,100	14,900
<u>Flatfish</u>			<u>23,755</u>	<u>40,300</u>	<u>45,500</u>	<u>47,200</u>	<u>54,200</u>
American plaice			8,015	11,800	27,000	27,500	32,200
Yellowtail			6,280	6,800	7,400	5,100	5,400
Greenland halibut			3,919	15,100	4,000	6,500	9,300
Greysole			5,420	6,600	5,700	6,900	6,200
Atlantic halibut			120		560	790	
<u>Other groundfish</u>							
Haddock			763	1,200	1,600	4,500	
Pollock			472	264	1,300	1,800	
Capelin		3L	23,000	3,000	21,400	47,000	
		3K	12,000	17,400	19,800	32,000	
		3Ps	2,000	50	80	1,100	
Herring			6,100	7,000	18,200	8,500	
Mackerel			5,100	1,300	800	1,200	1,900
Squid			100	923	1,720	4,440	
Shrimp	3K	4,363	3,600	500	>1,000		
Sea scallops (meats)			67	59	153	305	
Iceland scallops		500	5,530	70	35		
		(shellstock)	(shellstock)	(meats)	(meats)		
Clams	3N	20,000	11,254	7,200	10,000		
2 + 3	Capelin	2J3KL	0	0	450	57,300	
	Atlantic salmon	2J3KPs	126	213	353	498	

SECTION III - Québec Region

by

S. Hurtubise and J.-D. Lambert

Maurice Lamontagne Institute, Department of Fisheries and Oceans
850 Route de la mer, P. O. Box 1000, Mont-Joli (Québec) Canada G5H 3Z4

1. RESEARCH REPORT, 1993

A. Status of the fisheries

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

Species	Division	Nominal landings (TAC)				
		1989	1990	1991 ¹	1992 ¹	1993 ¹
Atlantic halibut	4RST	0.3 (0.3)	0.4 (0.3)	0.3 (0.3)	0.2 (0.3)	0.1 (0.3)
Capelin	4RST	10.0 (10.1)	6.5 (27.4)	7.4 (20.0)	9.5 (22.0)	10.5 (10.8)
Cod	3PN4RS	47.0 (76.5)	37.0 (58.0)	32.0 (35.0)	29.0 (35.0)	18.0 (18.0) ²
Greenland halibut	4RST	5.0 (10.5)	2.4 (10.5)	2.3 (10.5)	3.4 (10.5)	2.7 (4.0)
Herring	4R	17.4 (37.0)	16.9 (35.0)	19.4 (35.0)	15.3 (35.0)	15.1 (35.0)
	4S	0.9 (3.5)	0.5 (3.5)	0.1 (0.4)	0.1 (0.4)	0.1 (0.4)
Mackerel	S.A. 2-6	74.2	66.0	53.9	38.3	31.3
Redfish	4RST,3PN4VN	52.5	61.9	59.5	77.4 (67.0)	51.1 (60.0)
Lobster	4S,4T ³	3.2	3.3	3.5	3.8	3.6
Scallop	4S,4T ³	2.4	3.6	2.0	2.7	2.1
Shrimp	4RST	15.4 (15.1)	15.3 (15.8)	16.3 (16.6)	12.7 (16.6)	15.5 (16.6)
Snow crab	4S,4T ³ pq	2.6	4.5	4.7	4.6	5.3
Soft shell clam	4S,4T ³	0.6	0.6	0.5	0.4	0.3
Whelk	4S,4T ³	0.1	0.3	0.8	0.8	0.6

¹ preliminary values.

² established in August 1993, the initial TAC was 35,000 t.

³ 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.

The objective of the study was to determine if both redfish species (*S. fasciatus* and *S. mentella*) spawn in the Gulf of Saint Lawrence. Genetic variability at the liver malate dehydrogenase locus was used to identify the larvae of both species collected at different sampling sites during the summer 1991 and 1992. Results show that both species spawn in the Gulf of Saint Lawrence. However, they do not spawn simultaneously and they may use different spawning sites.

iii) Cod juvenile survey

A survey for pelagic cod juveniles was conducted in the northern Gulf of St. Lawrence (NAFO Div. 4RS) in October 1993 to locate likely areas of settlement and potential nursery grounds. The survey gear was an 8m² Rectangular Midwater Trawl (RMT-8) without an opening and closing device. Because of the limited amount of ship time (9 days), the size of the area and bad weather, only 39 sets could be completed. Juvenile cod were caught over most of the surveyed area with highest densities along the Quebec lower North Shore east of Beaugé Bank and near the southwest coast of Newfoundland. Age determination from otoliths indicates that fish from this last area were the oldest (mode = 96 days), in keeping with the currently perceived sequence of spawning events for northern Gulf cod. None of the area north of 50°30' N could be investigated.

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

The 1993 fishing season was conducted with many problems. The fishing season started late because of problems linked with enforcement, the fisheries were stopped many times because of small fish. The initial TAC for 1993 of 35,000 t was reduced at the end of August in accordance with a recommendation from FRCC to 18,000 t. This TAC was based on results of last year's assessment and corresponds to a fishery at the $F_{0.1}$ reference level. Landings for 1993 have been of 18,171 t. There are no directed nor sport fishery on the 3PN,4RS cod stock in 1994.

All available indices indicate a large decline in the last year. The mobile gear catch rates drop by 37% between 1992 and 1993. The population estimates, derived from the 1994 January groundfish research vessel survey, represent only 51% of those estimated in 1993. The population estimates from the summer groundfish survey drop by 65% between 1992 and 1993. Catch rates from the Index Fishermen decline in certain cases and maintain themselves in others.

For the first time, an illustrative calibration of the SPA was done incorporating results from both the summer and the winter surveys. This was done because the summer survey series is long enough to be of interest (4 years) and because the winter series will be discontinued in 1995. The 3+ population numbers would have gone from 546 million individuals in 1980 to as low as 95 million individuals in 1993 and the biomass of mature fish (7+) in 1993 could be as low as 10,000 t. Because of problems linked with the quality of the research vessel estimates, this calibration is not well adjusted and the most recent population estimates are not considered representative of the current situation. This analysis is presented for illustrative purpose only.

2.1.2 Redfish

The annual stock assessment for the Gulf of St. Lawrence redfish (4RST + 3PN4VN [Jan-May]) was presented to an Atlantic scientific groundfish committee. The landings 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 reach 77,000 t in 1992. The winter (Jan. to April) fishery in the Cabot Strait area was responsible of 50% of the catch during the last two years. The index of abundance from research vessel survey showed an important decline since 1991. A precautionary TAC of 30,000 t was recommended for 1994.

2.1.3 Greenland halibut

The status of Greenland halibut in the Gulf of St. Lawrence has not been assessed between 1988-1992 due to uncertainties regarding stock structure. Stock assessments performed in 1992 and 1993 led to the reduction of the TAC from 10,000 t to 4,000 t. Landings reached their maximum values between 1986-1988, but has remained below 4,000 t for the last three years. The index of abundance from research vessel surveys has been stable for the last two years. The recommended TAC for 1994 was kept at 4,000 t.

2.2 Pelagic fish

2.2.1 Herring

Herring stocks in NAFO division 4R were assessed by the Québec region. Since 1986, 4R herring landings have been between 15,100 t and 19,400 t. The proportion of the total catch taken by seiners versus the fixed gear sector has risen from 80% in 1985, to 98% in 1993.

Cohort analysis indicated a 2+ mid-year spring-spawner biomass of 46,300 t, the lowest estimate since 1973. The 5+ F for the spring-spawning stock in 1993 was estimated at 0.27. However, fishing mortality on older fish has been well above 0.3 since 1990. The abundance of the 1987 year-class is about one half that of either the 1980 or the 1982 cohorts. Our present perception of the state of this stock indicates that the fishing mortality is high and we do not foresee any reconstruction in the mid-term.

The cohort analysis results indicated that the autumn-spawning stock has not undergone as high an exploitation rate as the spring-spawning component in recent years. The analysis did not converge, the fully recruited F being well below 0.1 since 1985. The presence of the 1986 year-class was first manifest in the late fall fishery in 1990, and has been dominant since 1991, indicating a strong recruitment pulse into this stock. The autumn-spawning stock seems to be rebuilding.

If present exploitation patterns are maintained, i.e. the targeting of the spring-spawning component, the future of this stock is threatened in the short term. Several indices have suggested that spawning activity has already been affected by the reduced stock size. Fishing effort must therefore be reduced to a minimum on this component by eliminating any fisheries directed upon spring spawners. A reorientation of fishing effort towards the autumn-spawning stock could be supported by this component, at least in the short term.

2.2.2 Mackerel

Northwest Atlantic mackerel is a migratory, transboundary stock under the jurisdiction of both Canada and the United-States. In the beginning of the 1970's, foreign fleets landed up to 430,000 t annually. However, since the

extension of jurisdiction to 200 miles by Canada and the United-States, landings have fallen to substantially lower levels. At present, the stock is lightly exploited with a relatively high biomass.

The commercial catch at age showed that the 1982 year-class was particularly abundant, and was responsible for the increase in biomass during the 1980's. This cohort is now in decline, although the 1988 year-class has appeared strong and is now an important contributor to the commercial catch.

Abundance estimates from the annual Gulf of St. Lawrence egg survey have been variable over the time series, but nonetheless show that the spawning stock biomass from this northern component has been generally above 800,000 t between 1984 and 1993. Abundance indices last calculated by the Americans in 1991 from the spring groundfish survey along the east coast of the United States indicated that mackerel biomass was gradually increasing throughout the 1980's, reaching a maximum in 1990.

2.2.3 Capelin

Overall landings of capelin in the Gulf of St. Lawrence have been increasing for the last four years. Catch-at-age analyses suggest that female will contribute significantly to the Division 4R fishery at age 3 in 1994. An update of the fishery and the biological characteristics of the capelin in the Gulf of St. Lawrence has been published as an industry report. In 1994, an index-fishermen program will be implemented. An acoustic survey will be conducted during the shrimp-groundfish survey in August 1994. Finally, a study of the capelin stock structure on the basis of the types of parasites encountered in different regions will be initiated in 1994.

2.3 Invertebrates

2.3.1 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 (port and sea sampling, catch and effort statistics) is done throughout the fishing season to allow the assessment of snow crab present in the Estuary and off the Québec North Shore and the provision of scientific advice.

Recruitment surveys series was continued in 1993 in many areas of the northern Gulf of St. Lawrence. Results are promising for the construction of a mid(long) term recruitment index for this fishery. A closer research collaboration, starting in 1994, is planned with the industry and aims to develop a short term recruitment index in the future.

2.3.2 Shrimp

Data collection from the commercial fishery (port sampling, catch and effort statistics) is done throughout the fishing season and a research survey is conducted every fall in the northern Gulf of St. Lawrence to obtain a relative index of abundance of the resource. The commercial and research data are analyzed to assess the status of shrimp in the four management units of the Gulf and to provide scientific advice. This resource is under a multi-year management plan until 1995.

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.

2.3.3 Lobster

Landing statistics and abundance indices obtained from commercial at-sea sampling and from the catch statistics from an index-fishermen program, provide the basis for the assessment of the status of the stocks and of the fishery. Research work involves estimations of pre-recruit abundance as well as observations of proportions molting a given year, in order to develop tools to forecast recruitment to the fishery in the coming years.

2.3.4 Scallop

A multi-disciplinary research program is conducted on the restocking of suitable grounds for scallop in Magdalene Islands. Research implies studies for the identification of adequate grounds for seeding, the collection and growth of spat, the dispersal of young scallops and predation.

Data collection from the commercial fishery (port and sea sampling, catch and effort statistics) is done throughout the fishing season and a research survey is conducted every summer to assess the resource and provide scientific advice.

2.3.5 Whelk

Data collection from the commercial fishery from the Gulf of St. Lawrence is done throughout the fishing season. These data are analysed and a research document is produced annually. In 1993, the research was oriented toward the study of length at maturity, in order to set a minimal length at catch for conservation purposes.

2.3.6 Other molluscs

A survey was conducted in the area of Sept-Iles (Québec North Shore) to determine the spatial distribution, density, demographic structure and recruitment of the Stimpson's surf clam. Furthermore, bottom type data have

been gathered from both, hydroacoustic system and a sample taken with a grab, to determine the relationship between the density of different mollusc species and the sediment type. An evaluation of the efficiency of an hydraulic clam dredge for the harvesting of the Stimpson's surf clam have been conducted.

2.4 Marine mammals

2.4.1 Seals

Seal research in Québec region continues to focus on seal/commercial fisheries interactions. During 1993, harp seal diet information from 247 animals was summarized and published. Thirty additional animals were collected on the whelping patch in March 1993, as part of a long term study to monitor interannual changes in diet and condition. In a joint study, led by DFO (Newfoundland), six satellite transmitters were deployed on female hooded seals on the whelping patch in March 1993. These animals were monitored until their moult in June off southeast Greenland. A study on energy transfer using radioisotopes between lactating females and their pups was also completed. Satellite transmitters were also deployed on three male grey seals on the whelping patch in the southern Gulf of St. Lawrence. Animals were monitored until April. Five transmitters were also deployed on adult females in September in the northern Gulf of St. Lawrence (Anticosti Island). Four of these animals were monitored until April 1994. One female was recaptured on Sable Island in January 1994, and the transmitter was recovered.

2.4.2 Beluga whales

- Aerial survey - visual at 1500' - of eastern Hudson Bay and James Bay.

Transects were east-west, ten nautical miles (n. mi.) apart in James Bay and five n. mi. apart in the eastern Hudson Bay. The survey was flown from 12-23 August 1993. Line transect methods were used, the depression angle for each observation giving its distance from the transect line. The observations were censored at 6000 feet from the line.

445 belugas were observed, 295 in James Bay and 150 in Hudson Bay. The effective strip width was 2000 feet on each side of the aircraft. The resulting estimates of visible whales were about 3400 (s. e. 1100) in James Bay and 1100 (s.e. 500) in eastern Hudson Bay.

- Satellite tagging - eastern Hudson Bay.

Six Argos PTTs were deployed on belugas in eastern Hudson Bay, at Little Whale River and at the Nastapika. They all gave data, the longest for seven weeks. Local movements were recorded, the furthest distance any beluga went was to the Belcher Island. All transmitters gave large amount of dive data, which is still being analysed.

- Aerial survey - Ungava Bay.

Visual aerial surveys were flown in Ungava Bay from 15 through 19 July and again from 24 through 29 August 1993. Sightings were very few. It is not possible to form a population estimate using standard methods. The evidence is that about twenty belugas may be present in or near the Whale River estuary.

- Belugas - St. Lawrence.

22 stranded naturally dead carcasses were examined. The mean age at death for fourteen of which the age was determined was 19 years (range 3 -33 years).

2.5 Parasitology

2.5.1 Greenland halibut (Reinhardtius hippoglossoides)

Results of "biological tagging" studies have shown that parasites can be readily used to separate fish taken from the Gulf of St. Lawrence from neighbouring collections from off Labrador and in the Saguenay Fjord (Arthur and Albert. 1994. Can. J. Fish. Aquat. Sci. 50: 2175-2181). Concurrent enzyme electrophoretic studies conducted at IML have shown that considerable genetic interchange occurs between fish from these three geographic areas. As parasitological studies show that adult Greenland halibut from these areas do not mix, this interchange must occur via movement of eggs or young fish.

A review of the parasites of this fish and their zoogeography on a world-wide basis has been completed (Arthur and Albert. In press. Can. J. Zool.).

Collections available in 1993 were inadequate to provide analysis of seasonal movements of Greenland halibut using parasites. Additional collections are being made in 1994 in an attempt to address this question.

2.5.2 Redfish (Sebastes fasciatus and S. mentella)

Redfishes of commercial size (>20 cm) were collected from the Gulf of St. Lawrence in August of 1992 and identified to species using malate dehydrogenase (MDH) electrophoretic mobility patterns and anal fin ray counts (AFCs). To see whether parasites might be used to identify these species more readily, a study of the parasite fauna was completed to determine what differences, if any, were present. Twenty three species of parasites were identified from the examination of 125 redfishes. Parasite data were analyzed using non-parametric discriminant analyses in an attempt to separate the two host species. However, separation was only partially achieved, most S. mentella being correctly classified (98 %) but with a relatively high percentage (34 %) of S. fasciatus being misassigned to S. mentella.

2.6 Marine plants

2.6.1 Ascophyllum

In order to establish a harvesting strategy that allows the algae to maintain its potential, experiments with varying frequencies to harvest and cutting heights are conducted. The effect of the recommended cutting height of 15 cm. every three years on biomass renewal is being investigated in the median and long term.

3. GEAR AND SELECTIVITY STUDIES

3.1 Mackerel gill net selectivity

Preliminary results show that the yield of each mesh size studied has changed throughout the season. For example, the largest meshes catch larger fishes at the beginning of the season. It also seems the spawning has an important effect on the selectivity. For a given length, a fish would be caught at spring, while its girth is maximal, by a given mesh size. Later in the season, this fish would not be caught by this same mesh size. This study is pursued in 1994 and the analyses will be completed by the beginning of 1995.

4. MISCELLANEOUS STUDIES.

5. TAGGING ACTIVITIES.