Northwest Atlantic Fisheries Organization

Serial No. N384

NAFO SCS Doc. 81/IX/23

ANNUAL MEETING - SEPTEMBER 1981

Canadian Research Report for 1980

by

E. J. Sandeman
Department of Fisheries and Oceans, Research and Resource Sciences
P. O. Box 5667, St. John's, Newfoundland, Canada

and

J. S. Scott
Department of Fisheries and Oceans, Marine Fish Division
St. Andrews, New Brunswick, Canada

and

J. Boulva
Department of Fisheries and Oceans, Fisheries Research Branch
P. O. Box 15500, Quebec City, Quebec, Canada

This report was compiled from information provided by various federal government agencies of the Department of Fisheries and Oceans in the Atlantic Region and by the Ministere de l'Agriculture, des Pecheries et de l'Alimentation of the Province of Quebec.

Section I for the Newfoundland Region was submitted by E. J. Sandeman, Section II for the Quebec Region by J. Boulva, Section III for the Maritimes Region and Section IV for Seals by J. S. Scott

SECTION I - NEWFOUNDLAND

Subareas 0 and 1

A. Status of the Fisheries

1. Catches

a) Shrimp. Canadian landings of shrimp from these subareas in the 1980 totalled 2637 t.

b) Other species. No species of fish or invertebrates were landed from these subareas in 1979.

B. Special Research Studies

1. Biological Studies

a) Atlantic Salmon: A total of 16 sets of drift nets at various positions off the coast of West Greenland from latitude 67°11' to latitude 64°06' were made between 4 August - 29 August, 1980 from the research vessel "A. T. Cameron".

A total of 623 adult Atlantic salmon were caught. The estimated proportion from scale character analysis of North American salmon in research vessel catches in West Greenland area was 58.0%; of these,

4.2% were identified as being of hatchery origin. Concurrently, 978 salmon were sampled in the fish plants to compare to the research vessel sampling. The estimated proportion from scale character analysis of North American salmon in commercial catches in the West Greenland area was 47.7%; of these, 5.5% were identified as being of hatchery origin.

b) Biological observers were placed aboard twenty vessels with fishing activity in Subareas 0 and 1 during 1980. These were domestic and foreign vessels as well as foreign vessels licensed to fish the Canadian allocation of shrimp in Davis Strait.

2. Gear and Selectivity Studies, Including Studies of Fishing Operations

(a) Atlantic Salmon: Investigations were carried out on the growth of Atlantic salmon from August to November to determine the appropriate mesh size to be fished and quota required to maintain mortality in the event that a later fishing season was conducted at West Greenland. A technique has been developed utilizing the catch in two sizes of mesh (when both have been fished concurrently with equal effort) to reconstruct the population of Atlantic salmon exposed to the gear at West Greenland. Salmon escaping the gear were then identified by comparing the actual catch to this population. The escapement mortality losses (those fish that die from injuries sustained during their exposure to the net) were estimated at 10%.

Subarea 2

A. Status of the Fisheries

1. Cod

Canadian landings were almost 28,500 t, up substantially from 18,000 t landed in 1979 and only 11,400 t landed in 1978. The difference between 1979 and 1980 landings was mainly attributable to an increase in the Div. 2J inshore and offshore landings of 5,800 and 4,800 t respectively. Canadian landings in Div. 2G and 2H were small, amounting to less than 100 t. The offshore fishery amounted to 52% of the total landings in Subarea 2, about the same as in 1979 and up from 41% in 1978 and 12% in 1977. The increase in offshore landings in recent years reflects the expansion of the Canadian offshore fleet into more northern areas.

2. Redfish

Canadian landings were 3,600 t, down substantially from 16,200 t landed in 1979. These landings were entirely from Div. 2J. This dramatic decrease in landings is a reflection of a significant decrease in Canadian fishing effort attributed to poor market conditions for redfish which existed over the year.

3. Other Groundfish

Canadian landings of the combined flatfish species were 1,300 t, down from 3,400 t in 1979. This difference was almost entirely the result of a decrease in Div. 2J Greenland halibut landings. Greenland halibut landings in Div. 2H were up from only 30 t in 1979 to over 200 t. Landings of other groundfish species were about 110 t in 1980.

4. Capelin

Landings of capelin remained at a low level.

5. Herring

Landings of herring remained at a low level.

6. Atlantic Salmon

Landings were about 850 t in the commercial fishery and 11 t in the recreational fishery. The commercial harvest was the highest on record.

7. Arctic Char

Landings of Arctic char in ICNAF Subarea 2 during 1980 were 204 t; a decrease of 4% from 1979. The decline was partially due to a diversion of fishing effort from charr to salmon. In addition, one area remained closed to commercial fishing and quotas were imposed in three bays.

8. Shrimp

The Subarea 2 shrimp fishery was subject to a total quota restriction of 6150 t in 1979; 4800 t of which was in the Cartwright and Hopedale channels. Total landings in 1980 were approximately 4135 t.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic studies. There has been a large amount of data collected off Labrador recently as a result of oil-drilling activity. Anywhere from 40 to 75 current meter moorings were deployed by the industry and a large number of CTD transects were made, possibly over 200. Unfortunately, most of this data will not be available in the public domain for several years, but as it becomes available, it will be archived in MEDS. This level of activity is expected to continue for at least two more years.

The NAFC research vessels occupied the Seal Island (Hamilton Bank) section in early August as a continuation of this time-series. A second voyage occupied five transects from Hamilton Bank to Cape Chidley in October, collecting chlorophyll and nutrient profiles as well as CTD information.

As always, a temperature profile was made for every fishing station occupied for biomass estimates.

b) Other environmental studies. Sediments were collected at various offshore stations along the Labrador coast for evaluations of hydrocarbon degrading and "total" bacterial populations. The "total" bacterial counts are of special value for workers interested in primary productivity.

Offshore Labrador Biological Studies (OLABS 1980), an Industry/Community/Government undertaking designed to assist in the environmental assessment of oil and gas development off the coast of Labrador, collected information on the distribution of plankton, benthos and larval fish in great detail in the inshore region to the west of the Labrador Banks.

2. Biological Studies

a) Cod. Biological sampling of the commercial fishery included the examination for age of over 3,000 specimens from the inshore and offshore fisheries. The predominant age groups were 5, 6 and 7 years. Detailed observations were made on about 700 specimens during research vessel cruises to the area. About 5,000 cod were tagged on Belle Isle Bank in March, 1980.

b) Redfish. A research cruise in the fall to Div. 2J collected data on the distribution and abundance of redfish, the distribution of anal fin ray counts with depth and the incidence of infection by Sphyrion lumpi. Samples of length frequencies and otoliths were taken from both the research and commercial catches to determine the age distribution.

c) Flatfish. All flatfish stocks in Subarea 2 overlap Subarea 3, thus assessments are dealt with under the latter Subarea. Data on the distribution and abundance of flatfish were collected during autumn research vessel cruises. Approximately 9,000 Greenland halibut were tagged in Divisions 2H and 2J.

d) Grenadier. A study of the relationships between total length and anal fin length showed a high correlation between these two measurements.

As a result of this analysis and the tendency for grenadier to have incomplete tails, NAFO adopted the anal fin length as the standard length measurement for grenadier.

e) Capelin. An acoustic survey in Div. 2J3K in October-November 1980 found few capelin suggesting that this stock is still at a relatively low level. An analytical assessment provided a somewhat more optimistic outlook for the stock. This analysis suggested that the strength of the incoming 1978 year-class is stronger than the 1975-1977 year-classes but still relatively weak.

f) Atlantic salmon. Atlantic salmon caught in the commercial fisheries were sampled for size, age and sex ratio.

g) Arctic char. Catch and effort statistics were compiled from the northern Labrador commercial Arctic char fishery. Landings from eight fishing areas were sampled to provide information on age and size composition of stocks for assessment purposes. The collection of biological samples and tagging studies were carried out in northern sections of coastal Labrador during August, 1980. Research was continued to clarify the extent of seasonal and annual movements of char and to determine the degree of annual commercial exploitation.

h) Shrimp. A research vessel survey in July 1980 completed a biomass survey using a Sputnik 1600 shrimp trawl in the major areas where commercial concentrations occur. A total of 204 sets were made with the greatest catch 1114 kg being obtained in the Hopedale Channel. Catches in the Cartwright Channel ranged to 503 kg and were still lower in the Hawke Channel.

An intensive observer program on commercial vessels allowed the collection of much useful data from this source.

i) Whales. An aerial survey of whales on the inshore and neashore S.E. Labrador coast (to 55°00'N) was completed during August 1980. Assessments of humpback, fin, and pilot whale stocks are forthcoming.

Subarea 3

A Status of the Fisheries

1. Cod

Canadian landings were just over 166,000 t, about the same as in 1979. Inshore landings showed an increase of 5,300 t, however, this was offset by a decrease in offshore landings of some 6,500 t. About 69% of the total landings in this Subarea were from the inshore sector of the fishery.

2. Redfish

There was a drastic reduction in Canadian landings from 37,600 t in 1979 to only 17,100 t in 1980. There were decreases in all Divisions, however, the largest reductions occurred in Div. 3K, 3O and 3M with landings down 6,200 t, 4,900 t and 4,800 t respectively. The decreases reflect an overall reduction in Canadian fishing effort for redfish in this Subarea during 1980.

3. Flatfish

These were once again the principal species taken by the Canadian offshore fishery in Subarea 3. Total Canadian landings of the combined flatfish species were about 101,900 t, down slightly from 104,100 t in 1979. American plaice landings amounted to 56,000 t, an increase from 53,700 t landed in 1979. This increase was partly attributable to a 1,400 t increase in Div. 3LNO quota in 1980. Landings were up in Div. 3K, 3L and 3N, however decreases occurred in Div. 3O, 3Ps and 3Pn. The most significant decrease was in Div. 3O, from 4,700 t in 1979 to 1,900 t in 1980. About 10% of all American plaice landings in this Subarea were inshore. Canadian yellowtail landings were 12,400 t, down significantly from 18,800 t in 1979. This was a direct result of decreased fishing effort for that species in Div. 3LNO during 1980. Witch landings were 2,900 t, down from

4,000 t in 1979. Greenland halibut landings amounted to just over 30,200 t, up 12% from 27,000 t landed in 1979. Offshore landings did not change significantly, with most of the increase occurring inshore. Inshore landings were down by 1,900 t in Div. 3K however, this decrease was more than compensated for by a 4,500 t increase in Div. 3L. Inshore landings amounted to 88% of the total Greenland halibut landings in this Subarea.

4. Other Groundfish

Canadian landings were just over 6,600 t. This was mainly composed of wolffish (2,000 t), hake (1,250 t) and skate (1,100 t).

5. Capelin

Approximately 14,000 tons of capelin were landed inshore in Div. 3L in 1980, a slight increase over 1979. Landings in other divisions in Subarea 3 were low. The inshore catches were registered during the inshore spawning migration, female capelin are preferred to satisfy the Japanese roe market.

6. Herring

Herring landings from eastern Newfoundland (Div. 3KL) were 12,500 t and 2,000 t from southern Newfoundland (Div. 3P). These landings represent a decline of 56% for Div. 3KL and 47% for Div. 3P from the 1979 catch levels. These declines were a result of quota reductions in 1980 which reflected the poor recruitment pattern currently being observed in SA 3 herring stocks.

7. Mackerel

Mackerel landings in SA 3 declined to 6,100 t in 1980 from a level of 14,000 t in 1979.

8. Squid

Total catch for squid in 1980 was 36,000 metric tons (preliminary data). This was down 58% from the previous years catch of 86,000 MT. Decline in catch was largely due to a reduction in fishing effort resulting from both a severe decline in prices paid to fishermen as well as a labor dispute within the fishing sector during the inshore season. Decline in ex-vessel price was due to a decrease in foreign market demand for Canadian Illex. Real squid abundance was high except along the South Coast of Newfoundland.

9. Atlantic salmon

Landings were about 1069 t in the commercial fishery and 50 t in the recreational fishery. There was an increase in large salmon from previous years. About average adult counts on 11 fishways indicated above average spawning escapements throughout insular Newfoundland.

B. Special Research Studies

1. Environmental Studies

a) Hydrographic studies Extensive oceanographic work was conducted in SA3 in 1980, including numerous current meter, satellite-tracted drifters, and CTD observations. Most of the standard sections were occupied and some, such as the 47°N line (Flemish Cap) were occupied repeatedly. Table 1 lists the sections occupied by Northwest Atlantic Fisheries Centre. The annual hydrographics cruise of NAFC was not as successful in 1980 as other years, and the southern transects were not occupied in early August as usual.

During the biomass surveys of the Grand Bank, extra hydrographic observations were made, and surface and bottom salinities as well as a temperature profile were collected at every station for some 300 stations. This data has been submitted to MEDS.

As part of the Flemish Cap experiment, oceanographic stations on the grid and associated sections were occupied in February, April, May and July.

Table 1. Oceanographic sections occupied by NAFC (Nfld.) in 1980.

Section	Date	Ship	Stns.	Notes
Flemish Cap (NW-SE)	Jan 21-22/80	GADUS 30	8	
Flemish Cap (47°00'N)	Jan 4-6/80	GADUS 30	11	
	July 19-22/80	ZAGREB 4	22	CTD
	April 2-6/80	GADUS 35	32	CTD chlorophyll nutrients
	April 13-14/80	GADUS 35	17	CTD chlorophyll nutrients
	May 18-20/80	GADUS 37	17	CTD chlorophyll nutrients
Bonavista Triangle (SW)	Aug 5/80	ZAGREB 4	9	CTD
Bonavista Triangle (SE)	Aug 5/80	ZAGREB 4	5	CTD chlorophyll nutrients
Seal Island	Aug 8-9/80	ZAGREB 4	6	CTD
White Bay	Aug 10/80	ZAGREB 4	4	CTD
Flemish Cap (44°00W)	July 22-23/80	ZAGREB 4	5	CTD chlorophyll plankton
	April 12/80	GADUS 35	7	CTD
	May 20-21/80	GADUS 37	7	CTD nutrients
44°30'W	July 23-24/80	ZAGREB 4	6	CTD
	April 11-12/80	GADUS 35	7	CTD
	May 21-22/80	GADUS 37	7	CTD nutrients
45°00'W	July 24-25/80	ZAGREB 4	7	CTD
	July 29-30	ZAGREB 4	11	CTD
	April 10-11/80	GADUS 35	7	CTD nutrients
	May 22-23/80	GADUS 37	7	CTD nutrients
	May 28-29/80	GADUS 37	10	nutrients
45°30'W	July 25-26/80	ZAGREB 4	7	CTD
	April 9/80	GADUS 35	7	CTD
	May 23-24/80	GADUS 37	7	CTD nutrients
	May 29-30/80	GADUS 37	7	CTD nutrients
46°00'W	July 26-27	ZAGREB 4	7	CTD
	April 7-8/80	GADUS 35	7	CTD
	May 24-25/80	GADUS 37	7	CTD nutrients
	May 26-27/80	GADUS 37	15	CTD nutrients
Flemish Cap (46°30'W)	July 28/80	ZAGREB 4	6	CTD
	April 6-7/80	GADUS 35	7	CTD
	May 25-26/80	GADUS 37	7	CTD nutrients
48°00'W	July 29/80	ZAGREB 4	1	CTD

b) Plankton Studies. On the Grand Bank, a series of four major transects and several shelf-break transects were occupied approximately monthly for nutrients, primary productivity, chlorophyll, phytoplankton, zooplankton, and fish eggs and larvae. This program is in support of oil drilling obligations, and continued from April to December. It is supplemented by current and sediment studies, particularly over the "Hibernia site", 46°45'N; 48°45'W.

The Flemish Cap grid was occupied to collect plankton and ichthyoplankton on three occasions, April to July.

c) Other Environmental Studies. A special study of the role of submarine canyons in the physical and biological dynamics of the eastern Grand Bank was made in June. Current and CTD observations supplemented studies of the benthic fish and invertebrate communities down to 1000 meters, plankton, and midwater fishes communities.

2. Biological studies

a) Cod. Sampling of the commercial fishery both inshore and offshore was extensive in 1980. About 16,000 age determinations were made. In all areas, most of the catches were composed of fish between 3-8

years. The dominant age in the trap catches was usually 5 years although in Division 3K, 4 year-old cod were most abundant. In otter trawl catches 6 year-olds were most abundant except in Divisions 3NO where 5 year-olds predominated. Six year-olds dominated in the gillnet catches.

During research vessel cruises to the various areas, about 5,000 specimens were examined in detail. Close to 10,000 cod stomachs were either examined in the field or brought to the laboratory. About 6,000 cod were tagged in various areas in Subarea 3 in 1980.

b) Redfish. Several research surveys were conducted throughout Subarea 3 collecting information on the abundance of redfish, the length and age distribution, the distribution of anal fin ray counts and the occurrence of infection by Sphyrion lumpi. A fixed station survey was undertaken in Div. 3O in recognition of the difficulty of fishing randomly over very irregular bottom. The commercial catch was sampled for length and age composition for assessment purposes.

c) Flatfish. As in previous years, the emphasis has been on the improvement of the data base for the various flatfish stocks aimed at more precise stock assessment and a better understanding of the biology of flatfish species.

- American plaice - For Subarea 2+3K, 3M and 3Ps the recommended TACs remained at the 1980 levels of 6,000, 2,000 and 5,000 tons respectively. For the Divisions 3LNO stock the recommended TAC was increased from 47,000 t to 55,000 t for 1981.

- Yellowtail - The recommended TAC for 1981 was increased to 21,000 t from the 1980 level of 18,000 t.

- Witch - The assessment of 3 witch stocks in Subarea 2J3KL, 3NO and 3Ps indicated no change in the advised TACs at 8,000, 5,000 and 3,000 tons respectively.

- Greenland halibut - There are indications that recruitment to this stock has been quite strong during the past several years. An assessment in 1980 indicated that the TAC could be increased to 55,000 t in 1981 from the 1980 level of 35,000 t. A total of 10,500 Greenland halibut were tagged in Division 3K.

- Juvenile Flatfish Studies - Studies have been initiated to locate and estimate the abundance of juvenile flatfish with the emphasis on the Grand Bank being directed towards yellowtail.

d) Capelin. An acoustic survey in Div. 3LNO in June 1980 and the results from an analytical assessment suggested that the capelin stocks in this area were still at a low level. A survey for pre-recruit capelin was conducted in October 1980.

e) Herring. Surveys to determine distribution and abundance of herring larvae in Fortune Bay (Subdiv. 3Ps) were carried out in June, August, September, October, December and February. Overall abundance appeared very low. Experiments on diurnal catchability of larvae were carried out and environmental data were collected during each survey. The goal of the project is to determine at which stage in the early life history we can reliably predict recruitment of a particular year-class.

f) Squid. In February-March a survey was conducted toward studying the distribution of larval and juvenile squid in the Gulf Stream. From a pre-recruit survey in June on the Grand Bank a predictive index of inshore abundance was determined. Inshore catch effort and CPUE were collected throughout the season. Samples were taken from the commercial catch at regular intervals to study changes in size, sex composition and maturity. Water temperature was monitored at Holyrood and the tagging program was intensified.

g) Atlantic salmon. A weekly survey of 28 commercial fishermen gave accurate estimates of effort and local sales of salmon. Two research cruises were carried out to determine migration routes of salmon and

for stock identification. In total, 485 salmon were tagged and released, another 173 were sampled for size, age, and sex. Commercial sampling occurred at Burgeo and at Twillingate. Blood and gonad samples were also collected from salmon at St. Anthony and off the Grand Banks. These samples when analyzed for plasma vitellogenin will provide information on the number of maturing salmon in these areas.

h) Whales. An aerial survey of whales in the inshore and nearshore eastern Newfoundland areas (47°48'N) was completed during August 1980. Assessments of humpback, fin and pilot whale stocks are forthcoming.

A census of whales on the Grand Bank during June and July 1980 was accomplished using the research vessel Gadus Atlantica (during a research cruise for capelin). Assessments of humpback numbers in this area are forthcoming.

i) sampling of foreign and Canadian offshore catches

A total of 3628 samples representing 880,227 lengths and 18,943 ages were taken from the catches of foreign and Canadian offshore fisheries as follows:

	Samples	Lengths	Ages	Shell Widths	Meas.
Cod	1,639	372,439	13,164		
Shrimp	1,385	385,449			
Plaice	212	41,496	2,295		
Witch	75	18,123	578		
Yellowtail	25	4,464	290		
Turbot	99	20,464	940		
Redfish	50	10,789	690		
White Hake	44	12,097	568		
Pollock	8	751	116		
Haddock	17	2,992	258		
Squirrel Hake	2	293	44		
Silver Hake	4	1,023			
Scallops	9			3,265	
Roundnose Grenadier	11	2,671			
Porbeagle	22				702
Blue Hake	9		117		789
Shark	14				107
Bigeye Tuna					272
Alborcore Tuna					22
Blue Fin Tuna					2
Yellowfin Tuna					3
Swordfish					9

About 19,205 sets were observed with 4,281 observed days fished. This represents a 65% coverage of the various foreign fisheries and about 25% on Canadian vessels. The coverage was for Subareas 0, 1, 2 and 3 with limited coverage in 4.

Subarea 4

A. Status of the Fisheries

1. Cod

Newfoundland landings totalled almost 60,000 t, up 38% from 43,600 t landed in 1979. Landings from Div. 4R amounted to 85% of the landings in this subarea. There was an increase in Div. 4R inshore landings from 22,700 t in 1979 to 28,500 t and an increase in offshore landings from 14,400 t to 1979 to 22,200 t in 1980.

2. Haddock

Newfoundland landings were 1,950 t, up from just over 500 t in 1979. This difference was almost entirely the result of an increase in landings in Div. 4W to 1,500 t from only 50 t in 1979.

3. Flatfish

Newfoundland landings totalled 6,600 t, down from 9,800 t landed in 1979. Most of this difference was due to decreased turbot and witch landings (down 2,200 t and 1,350 t respectively).

4. Redfish

Newfoundland landings were around 3,850 t, down slightly from 4,000 t landed in 1979. Landings from Sub div. 4Vs and 4Vn amounted to 77% of the total landings, with Div. 4R landings amounting to 18%. There were no significant changes between 1979 and 1980 landings for any Division within this Subarea.

5. Other Groundfish

Newfoundland landings were about 1,100 t, composed mainly of pollock, hake, catfish and skate.

6. Herring

Herring landings from Div. 4R increased by 9% from 1979 reaching a level of 20,100 t in 1980.

7. Mackerel

Newfoundland mackerel landings in Div. 4R increased from 500 t in 1979 to 1,000 t in 1980.

8. Atlantic salmon

Landings were about 172 t in the commercial fishery and 76 t in the recreational fishery. There was an increase in large salmon from previous years.

B. Special Research Studies

1. Biological Studies.

a) Cod. Sampling of the commercial fishery in the eastern part of the Gulf of St. Lawrence was continued in 1980. In the trap fishery 5 year-old cod were predominant. In the otter trawl fishery 5 and 6 year-olds were prevalent while in the gillnet fishery cod of ages 7 and 8 were most abundant. In addition to the 3,000 age interpretations of cod from the commercial fishery, about 1,100 cod were examined in detail as the result of research surveys.

b) Redfish. One survey (Beothic Venture) was undertaken in July and August to determine the distribution of young redfish. Acoustic trials were made to evaluate the feasibility of using this method to estimate the abundance of redfish populations. Redfish assessments were completed during groundfish surveys in September and January-February.

c) Atlantic salmon. Smolt and adult migrations were monitored on Western Arm Brook and Highlands River. A record smolt migration on Western Arm Brook indicated an above average grilse harvest in Area 4R (401) for 1981. New methods of estimating production of juvenile salmon in Newfoundland rivers are being devised.

Thorough ecological studies are being undertaken in selected rivers (the Highlands River and Western Arm Brook in 1980), so that by measuring a number of ecological parameters, predictive models can be derived for estimating juvenile salmon production and survival of year classes, related to various factors.

d) Whales. An aerial survey of whale abundance was completed along the west coast of Newfoundland during summer 1981.

Subarea 5

A. Status of the Fisheries

1. Groundfish

Newfoundland landings amounted to 130 t. These landings were all from Subdivision 5Ze and consisted primarily of cod and haddock.

2. Redfish

Newfoundland landings in Subdivision 5Ze amounted to 360 t.

SECTION II - QUEBEC

Subarea 4

Government agencies involved: Department of Fisheries and Oceans, Québec Region: Fisheries Research Branch (DFO); Direction générale des pêches maritimes, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation, Gouvernement du Québec (DGPM).

A. STATUS OF THE FISHERIES

(See Section III)

B. SPECIAL RESEARCH STUDIES

1. Environmental studies

a) Plankton studies. DFO- Sampling for species composition of fish eggs and larvae was carried out in the St.Lawrence estuary in winter and along the north shore of the Gulf in May. A study of interactions between larvae of St.Lawrence estuary species was continued.

b) Other environmental studies. DFO- The fish community of the intertidal marsh of Kamouraska, in the St.Lawrence estuary, was sampled throughout summer and fall. Species occurrence, abundance and diversity have been assessed. Qualitative data on the diet of the most abundant species are also available.

2. Biological studies

a) Lobster. DFO- Various short programs were carried out at the Magdalen Islands, including: a survey of the distribution of larvae around the islands; a study of the timing of hatching and extrusion of young larvae; selectivity of lobster traps in view of finding an optimal spacing for the laths; observations on a possible second late summer molt.

DGPM- Results of tagging studies at the Magdalen Islands indicate dispersion from tagging sites, but no evidence was obtained of directed migratory movements. Growth data were also obtained from the tagging studies. Studies of lobsters seasonally present in the lagoons of the Magdalen islands were carried out and suggested more rapid growth in the lagoons than in coastal waters.

b) Crabs. DFO- Underexploited resources of snow crab were located in the estuary and western Gulf of St.Lawrence (Subareas 4T-4S). Growth studies of snow crab, using physiological characteristics, tagging and size frequencies were initiated. A study of catch statistics and biological samples from the snow crab fishery in the south-western Gulf of St.Lawrence has indicated a marked improvement of recruitment in recent years, which seems strongly dependent on cod abundance in preceding years. Distribution, abundance and biological characteristics of snow crab on the fishing grounds have been surveyed.

DGPM- Exploratory fishing was carried out to identify underexploited concentrations of snow crab along the lower north shore of the Gulf (Division 4S) and in the lower estuary of the St.Lawrence (4T). Yields in some areas were as high as 26-38 kg/trap/day.

c) Shrimp. DGPM- Direct assessment of shrimp biomass north of Anticosti (4S) indicated an increase from the 1979 assessment. Vertical distribution in relation to light conditions was investigated using a specially-constructed sampling device. Shrimps were found to be concentrated in a layer 1-5 m deep near the bottom during daylight, but to be dispersed over a greater depth range at night.

d) Herring. DFO- An intensive study of development and mortality of herring eggs and larvae was initiated in the St.Lawrence estuary. A study of survey methodology and distribution of juvenile herring was carried out in the western Gulf (4T) in collaboration with Maritimes region, using a small purse seiner in October. Adult herring were sampled from commercial catches in the Gaspé peninsula (4T) and on the north shore of the Gulf (4S). Surveys of the inshore fisheries (questionnaires, aerial surveys) provided information on abundance trends. Historical data were compiled and analyzed for trends in biological characteristics associated with abundance changes.

DGPM- Catch sampling from traps in the Magdalen islands was continued, as was analysis of data collected in 1975-1979.

e) Capelin. DFO- Catch sampling and beach sampling were carried out in Chaleur Bay (4T), the St.Lawrence estuary (4T), and the north shore of the Gulf (4S). A stock definition study was begun, based on multivariate analysis of morphometric and meristic date from capelin from the same areas.

f) Smelt. DFO- A study of stock definition and basic population dynamics (growth, maturation, fecundity, feeding, parasites, etc.) was continued, covering Chaleur Bay, the St.Lawrence estuary, and the north shore of the Gulf.

g) Greenland halibut. DGPM- A survey cruise north of Anticosti (4S) in October provided a biomass estimate; larvae and juveniles were also taken on this cruise. Some 600 individuals were tagged during the cruise. Intensive catch sampling was performed throughout the season, particularly for a study of maturity stages. Mature, pre-spawning fish were present in the catches in November.

h) American plaice. DGPM- Discards of flatfish from Québec trawlers were studied in the area off the Gaspé peninsula and Miscou (4T) from August onward. Discards accounted for 13-59% by weight of captures, and 28-77% by number.

i) Witch flounder. DGPM- Analysis of historical data (1976-1979) on witch in Divisions 4R and 4S suggested that stocks of western 4S and of 4R are separate.

3. Gear and selectivity studies

DGPM- Trials of a Lofoten trawl, suitable for use by 20 m trawlers on hard bottoms, were continued in 1980.

SECTION III - MARITIMES

Subarea 4

A. STATUS OF THE FISHERIES

1. Groundfish General

Total nominal catches (Maritimes and Quebec) increased by 18% from the 1979 level to 310,500 metric tons (MT). Increases were shown by all categories. Quotas were in effect for all major stocks, affecting haddock landings in particular.

Newfoundland landings totalled 73,000 MT, 28% over the 1979 level.

2. Cod

Landings (Maritimes and Quebec) continued to increase, by 12.5% over the 1979 level, to 153,000 MT. This constituted 49% of total groundfish, a slight decrease from 1979 (52%). Compared to the previous year, landings were up in all areas except 4W, where there was a 25% decrease; this was more than compensated for by an increase in Subdiv. 4Vs landings from 14,000 MT in 1979 to 26,000 MT in 1980.

Newfoundland landings totalled 60,000 MT, a 39% increase over 1979. Most of the increase is attributable to increased offshore landings in Div. 4R, constituting 83% of the Newfoundland total, and a fourfold increase in Subdiv. 4Vs from 1,300 MT in 1979 to 5,500 MT in 1980.

3. Haddock

Landings, almost wholly from the Scotian Shelf (Divs. 4V-W-X), increased by almost 50% over the 1979 level to over 41,000 MT (13% of total groundfish). Increases were shown by all Divs. but particularly by Div. 4W where landings were almost five times the 1979 level, indicating improvement of the 4VW stock.

Newfoundland landings increased three times to 2,000 MT, almost all from Div. 4W.

4. Flatfish

Total nominal landings (Maritimes and Quebec) of combined flatfish species (except Atlantic halibut) increased by 10% to 36,000 MT, 11.6% of total groundfish landings. Increased catches on the Scotian Shelf (Divs. 4W-X, Subdiv. 4Vs) from 10,000-12,000 MT more than compensated for a slight decrease in landings from the Gulf of St. Lawrence (Divs. 4R-S-T) and Sydney Bight (Subdiv. 4Vn). Increases over 1979 levels were shown by all species except American plaice and Greenland halibut, although the nominal decrease in American plaice catches may result from a high proportion of the catches being included under "mixed flatfish." Landings in this category more than doubled to over 5,000 MT.

Newfoundland landings totalled about 6,500 MT, only 66% of the 1979 landings. The decrease was almost wholly due to reduced catches of Greenland halibut, down 56% from 1979, and witch flounder, down 37%, most of the reduction from Div. 4R.

5. Redfish

Redfish landings continued to show a slow recovery from the recent decline. Landings in 1980 were up 18% from 1979 at over 21,000 MT with the increase distributed almost equally between the Gulf of St. Lawrence area (Divs. 4R-S-T, Subdiv. 4Vn) and the Scotian Shelf (Divs. 4W-X, Subdiv. 4Vs).

Newfoundland catches (4,000 MT) remained at about the same level as in 1979.

6. Pollock

Pollock landings (Maritimes and Quebec) continued to rise, increasing by 13% over the 1979 level, to 30,000 MT, about 10% of total groundfish landings. As usual, almost the whole catch was from the Scotian Shelf (Divs. 4W-X, Subdiv. 4Vs) with 66% coming from the Browns Bank area (Div. 4X). There was a 25% decrease in catches from Subdiv. 4Vs but this was more than compensated for by a 64% increase from Div. 4W. Landings from the Gulf of St. Lawrence (Divs. 4R-S-T) were negligible.

Newfoundland landings totalled 446 MT, down 20% from 1979 and almost wholly from Subdiv. 4Vs.

7. Other Groundfish

Landings by Maritimes and Quebec increased by 31% to 27,000 MT. Newfoundland catches were 500 MT, down 50% from 1979 to about the 1978 level. Catches on the Scotian Shelf (Divs. 4W-X, Subdiv. 4Vs) were up about 10% and from the Gulf of St. Lawrence (Divs. 4R-S-T) up about 50%. Common hake catches increased by 52% to 17,000 MT, constituting about 63% of "other groundfish." About 13,000 MT were from the southern Gulf of St. Lawrence (Div. 4T), an increase of 61% from 1979. Landings of cusk decreased slightly to 4,000 MT and wolffish landings increased by 42% to 2500 MT. Silver hake landings were negligible.

8. Sea Scallops (*Placopecten magellanicus*)

Landings totalled 24,355 MT round weight, an increase of 113% over the 1979 level. This was due to continued increase of landings from Div. 4X (22,061 MT), up 131% from 1979. New scallop concentrations were exploited in the Lurcher Shoal area and fall landings from within the 6-mi summer closure zone off Digby, Nova Scotia, were well above average. Landings increased 11% in the Northumberland Strait (Div. 4T) to 1702 MT round weight.

Newfoundland landings of Iceland scallops more than doubled from the previous year to 1052 MT, all from Div. 4R.

9. Herring

Total nominal catches (Maritimes and Quebec) were 141,000 MT, an increase of 7% over the 1979 level. Landings from Div. 4X were up about 14% at 82,867 MT, constituting 59% of the total catch. Landings from the central part of the Scotian Shelf (Div. 4W) more than doubled to 12,000 MT, recovering to about the 1978 level and compensating for reduced landings in the southern Gulf of St. Lawrence (Div. 4T) where there was a decrease of 17% to about 40,000 MT.

Newfoundland landings, almost wholly from the northeast Gulf of St. Lawrence (Div. 4R), were about the same as in 1979 (20,000 MT).

10. Mackerel

Landings in 1980 were at the same level as in 1979 (15,000 MT). Increased catches in the southern Gulf of St. Lawrence (Div. 4T), where 57% of the landings were made, compensated for slight reductions in other Divisions.

11. Tuna

Total Canadian landings of Atlantic bluefin tuna amounted to 324 MT in 1980, an increase from 245 MT reported in the previous year.

The trap net catch of bluefin in the St. Margaret's Bay area yielded 47 MT, a slight increase from 31 MT reported in 1979 but still substantially lower than catches reported in preceding years.

The rod and reel fishery in the Gulf of St. Lawrence yielded 259 MT, a slight increase from 214 MT reported in the previous year. An additional 18MT was reported taken by other gear types. Catches in the Chaleur Bay area increased substantially, from 30 MT in 1979 to 83 MT in 1980 and catches off Prince Edward Island increased from 129-155 MT; however, catches in the St. Georges Bay area decreased from 55 MT in 1979 to 21 MT, largely due to a poor late-season run of bluefin in this area. Seasonal mean weights in the Chaleur Bay and Prince Edward Island areas remained the same in 1980 as in 1979, while seasonal mean weight in the St. Georges Bay area decreased from 493 to 413 kg, due to the poor late-season run. This decrease in the St. Georges Bay area, together with a decrease in seasonal mean weight in the St. Margaret's Bay catch due to the appearance of much younger fish, resulted in the reversal in a trend of annually increasing mean weight observed in the Canadian bluefin catch over the last decade.

12. Swordfish

The total Canadian catch of swordfish in 1980 was estimated to be 1885 MT, a decrease from 2970 MT reported in the previous year. Of this total, 1794 MT were taken by longline while the remainder was taken by other gear types, principally harpoon. The majority of this catch was transshipped to U.S. vessels at sea. A total of 1126 MT was taken in Subarea 4.

13. Atlantic salmon

Total landings, including both commercial and sport fisheries, but excluding those from the Newfoundland fishery in the eastern Gulf of St. Lawrence (Div. 4R), were 498 MT, more than double the 1979 landings (216 MT). The increase was derived from greatly improved landings in both the Maritimes and Quebec and from both commercial (286 MT) and angler (212 MT) catches.

The Newfoundland set net fishery in Div. 4R yielded 172 MT, a 59% increase from 1979.

The ban on commercial fishing in New Brunswick and the Gaspē continued but has been partially lifted, with imposition of a quota system for 1981.

14. Squid

The squid fishery on the Scotian Shelf and in the Gulf of St. Lawrence (Divs. 4T-V-W-X) yielded reduced catches in 1980 (1204 MT), falling to 25% of the 1979 level. The greatest reductions were on the Scotian Shelf in Divs. 4W-X where catches (558 MT) were about 12% of the 1979 level.

Under developmental charter arrangements Japan caught 496 MT, almost all from Div. 4X, and Portugal caught 917 MT (355 - Div. 4W, 562 - Div. 4X).

Subarea 4

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

(a) Hydrography. Studies in St. Georges Bay (Div. 4T) show the Bay as strongly stratified in summer, with diminution of the clockwise gyre with depth in the upper layer, and an outflow in the lower layer.

The Bay of Fundy ecological study conpleted its fourth (final?) year of field work with emphasis shifting from ecological and chemical surveys to consideration of important environmental processes that influence the structure and dynamics of marine ecosystems in the Bay. The data base covers all seasons, including heavy ice conditions. Quantification of strong chemical and biological gradients in the water column along the axis of the basin is related to suspended particulate matter load.

(b) Plankton studies. The vertical flux of zooplankton, phytoplankton, particulate matter and dissolved nutrients, and salinity were measured in coastal waters in Chedabucto Bay (Div. 4W) and St. Georges Bay (Div. 4T) over a 26-h L-D cycle and vertical profiles obtained. Nutrient and gas exchange across sediment-seawater interface was measured with in situ chambers placed on the sea bed. Comparison of benthic nutrient regeneration with existing dissolved nutrients in the water will indicate potential importance of benthic regeneration for the overlying pelagic-planktonic community.

The Scotian Shelf Ichthyoplankton Programme (SSIP) continued, with year-round coverage of the area for the second year. Eight cruises, totalling 1152 stations, were completed. Refinement of gear, the surface pumping system, and interfacing with computer was continued. Special patch studies were made of silver hake larval distribution.

Three larval herring survey cruises were carried out in the Bay of Fundy, including testing of telemetry operations, and three in the southern Gulf of St. Lawrence.

A herring spawning bed in Miramichi Bay (Div. 4T) was delineated and number of eggs, egg viability, and stage of development, and relationship with depth contours and algal distribution estimated.

Distribution of lobster larvae in St. Georges Bay (Div. 4T) is strongly influenced by cloud cover, a higher proportion (95%) occurring in the top 30 cm on overcast days than on sunny days (74%). The larvae are also associated with floating eelgrass.

(c) Benthic Studies. The Bay of Fundy (Div. 4X) mudflat study has been expanded to include: study short-term variations and effect of changes in light intensity in epibenthic primary production and respiration; examining light/photosynthetic relationships of the resident phytoplankton population; investingating the flux of dissolved and particulate materials between mudflat and seawater; studying energetics of the dominant prey organism Corophium voltator; studying the origin of organic carbon and food chain relationships; investigating bioturbation processes and effects.

2. Biological Studies

(a) General. The annual groundfish research programme continued with three seasonal surveys (March, July, October) on the Scotian Shelf-Bay of Fundy (Divs. 4V-W-X) and one cruise (September) in the southern Gulf of St. Lawrence (Div. 4T). An annual fall (November) survey of juvenile silver hake was initiated.

Monitoring and biological sampling of commercial catches both at landing places and at sea (observer programme) continued.

Monitoring of incidence of pseudobranch tumors in cod and of the fungus Ichthyophonus hoferi in yellowtail flounder continued.

An extensive groundfish tagging programme was carried out on the Scotian Shelf (Divs. 4V-W-X) and southern Gulf of St. Lawrence (Div. 4T), including, besides the principal species cod and pollock, haddock (141), plaice (2734), and small numbers of miscellaneous species.

(b) Cod. Tagging experiments continued with 6586 released in the southern Gulf of St. Lawrence and 6686 on the Scotian Shelf.

Studies of reproductive physiology showed the influence of feeding on fecundity and timing of maturation. Food habits study utilized collections of 3500 stomachs from commercial fishermen and research cruises. The contents will be analyzed for seasonal and geographic variation in cod diet.

Experiments were carried out on digestion rates of various prey species.

(c) Haddock. Distribution of 0-group haddock on the Scotian Shelf in October was plotted and examined in relation to known spawning areas and stock delineation. A study of haddock parasites was completed. A study of the biological and environmental factors influencing haddock stocks was initiated.

(d) Pollock. Tagging experiments were carried out with young pollock, 3000 at Canso (Div. 4W), 2735 in south Nova Scotia (Divs. 4W-X), 4384 in Bay of Fundy (Div. 4X), and 2577 off Halifax (Div. 4W), a total of 12,696. Recoveries showed dispersion throughout Scotian Shelf and to northeast edge of Georges Bank (Div. 5Z). Field collection of material for parasite studies was completed.

(e) Herring. Distribution numbers and lengths of herring gill nets in the coastal fishery in the southern Gulf of St. Lawrence were determined by aerial photography. Meristic studies were made to delineate stocks in the southern Gulf of St. Lawrence and to examine year-class variation in the Bay of Fundy (Div. 4X). A trial acoustic survey based on distribution of commercial catches was made to evaluate the herring stock off Chedabucto Bay (Div. 4W).

(f) Redfish. Monitoring of the commercial fishery for redfish in the Gulf of St. Lawrence (Divs. 4R-S-T) continued.

(g) Silver hake. Age and growth studies continued. Midwater trawling experiments in November showed the geographic distribution of juvenile silver hake in the central Scotian Shelf (Divs. 4W-X) and also showed diel changes in vertical distribution which may require modification of standard survey design for recruitment prediction.

(h) Bluefin tuna. Morphometric data and otoliths were collected for age and growth studies from 154 giant bluefin landed in Canadian ports in 1980.

Analysis of logbooks collected from the rod and reel fishery from 1975-80 indicated a decreasing catch per unit effort trend over 1975-79 and showed a very high correlation with abundance estimates from recent population analyses.

A total of 13 giant bluefin were tagged and released in Chaleur Bay in 1980. Two bluefin, tagged in Chaleur Bay in 1974 and 1975, were recaptured in the Gulf of Mexico in February and Chaleur Bay in August 1980, respectively. These data support hypothesized migration patterns in the west Atlantic.

(i) Swordfish. Tagging experiments resulted in tagging of 65 swordfish in the Cape Hatteras to Newfoundland Grand Banks area. Detailed studies of 313 fish were made for stock discrimination, age and growth, reproductive biology and behavior.

Analysis of log records indicates a slight decrease in catch per unit effort and mean size from 1979.

(j) Squid. Studies of biology, distribution and abundance continued, with emphasis on egg, larval and juvenile stages, including environmental

conditions associated with geographic and diurnal distribution of larval/juvenile and adult squid, spawning behavior, growth, and food and feeding patterns.

3. Gear and Selectivity Studies

Work on acoustic development continued with assembling and testing of a microprocessor at sea. The relationship of tilt angle and target strength was determined for capelin at controlled aspects.

Photographs of wild herring, by day and night, were obtained using the Bottom Referencing Underwater Towed Instrument Vehicle (BRUTIV). They showed coherent swimming patterns during the day but no uniform orientation at night.

Subareas 5 and 6

A. STATUS OF THE FISHERIES

1. Groundfish General

Total nominal landings from Divs. 5Y-Z increased by 64% from 1979 to about 24,513 MT, almost wholly from Georges Bank (Subdiv. 5Ze). Haddock catches, the main contribution, almost doubled and increases were shown by all major species.

2. Cod

Catches increased by 29% to 8227 MT with over 8000 MT from Georges Bank.

3. Haddock

Following the decrease in landings from 1978-79, landings increased by 92% to 10,226 MT in 1980.

4. Pollock

Landings increased by 85% to 5609 MT, recovering from the comparatively poor 1979 landings. About 90% of the catch was from the Georges Bank area, the remainder from the Gulf of Maine (Div. 5Y).

5. Other Groundfish

Catches of flatfish, mainly yellowtail flounder, American plaice, witch and winter flounder, more than doubled from 1979, to 238 MT, virtually all from Georges Bank.

6. Sea Scallop (Placopecten magellanicus)

Landings totalled 43,483 MT round weight, a decrease of 43% from 1979. This reflects lower abundance of recruits on Georges Bank with some Canadian effort moving to the Scotian Shelf. The absence of any scallop management agreement between Canada and the U.S. continues to frustrate implementation of an optimal management strategy.

7. Herring

No herring landings were reported from Subarea 5.

8. Swordfish

A total of 232 MT were taken in 1980, down almost 50% from 1979.

9. Bluefin Tuna

There was no Canadian purse seine fishery for tuna in Subarea 6 in 1980.

SECTION IV - SEALS

Subareas 2, 3, and 4

A. STATUS OF THE FISHERIES

The TAC for harp seals remained at 170,000, plus 15,000 for Greenland, Labrador, and the Canadian Arctic. Canada took 151,716, 8% higher than in 1979, of which 42,081 were taken by landsmen, the remainder by ships. The "Front" yielded 73% of the total northwest Atlantic catch, about 10% higher than in 1979.

The total catch of hooded seals was 13,053, of which Canada took 7346 (56%), an increase of 8% over 1979, all taken at the "Front."

B. SPECIAL RESEARCH STUDIES

Harp Seals

For the third year running, large-scale tagging of pups was carried out in the Gulf of St. Lawrence, near the Magdalen Islands: 2738 pups were single tagged and 894 double tagged. On the "Front" 4509 pups were tagged. Returns in 1980 from about 1900 double-marked 0-group seals indicates tag loss of 1.4%. About 20% of tags recovered by hunters were not returned.

Specimens were obtained from a landsmen's base in the St. Lawrence River for further studies of age-composition, reproductive rate, and feeding intensity.

A simulation model indicates that natural mortality rate of harp seals is about 0.095 with a range from 0.08-0.12 and an associated population size of seals one year-old and older in 1979 of about 1.5×10^6 with a range of $1.0\text{-}2.0 \times 10^6$ individuals.

A sample of 1879 jaws was used to investigate temporal changes in age and sex composition of catches. Age determinations were incorporated in recent population analyses.

Biases in age-reading were investigated, indicating that biases from single-age readings, particularly in the over-12 year olds, may have a significant impact on management advice for harp seals in the northwest Atlantic.

Tag mark-recapture data indicate that Gulf production was 118,502 (95% confidence levels 102,332-138,906), northern Front patch 182,247 (163,878-204,482) and southern Front patch about 45,000. Estimate of average pup production during the period 1977-80 is 410,559.

Morphometrics, tissue samples, and stomachs were collected from 140 "beater" seals for studies of growth and energetics.

Hooded Seals

Twenty pups were tagged in the Gulf of St. Lawrencs. Jaws of 588 seals were obtained from the commercial catch for ageing.

Grey Seals

The total live escapement from Sable Island, 3250 pups, were tagged in 1980. Poor ice conditions limited tagging of the Gulf of St. Lawrence ice breeding component to 160 pups.

Harbour Seals

Almost the total production of harbour seals on Sable Island, 323 pups, were tagged. Recoveries from 1978 and 1979 tagging indicate dispersal from the Island to the adjacent mainland of Nova Scotia and as far away as Cape Cod.