

International Commission for



the Northwest Atlantic Fisheries

Serial No. 5254

ICNAF Sum. Doc. 78/VI/20

ANNUAL MEETING - JUNE 1978

CANADIAN RESEARCH REPORT, 1977

Section I. Subareas 2 and 3

by

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Government agencies involved: Department of Fisheries and the Environment:
Fisheries and Marine Service; Department of Energy, Mines and Resources:
Atlantic Geosciences Centre. Harp and hood seals are dealt with in Section
III.

Subarea 2

A. STATUS OF THE FISHERIES

1. Cod

The landings from the Labrador coastal fishery were almost 3500 tons, about 10% lower than the 1976 level. There were 488 tons of cod recorded from the Canadian offshore fishery.

2. Other groundfish

Landings of 2700 tons of redfish, 5 tons of witch and 407 tons of Greenland halibut were recorded from the Canadian offshore fishery. This total (3112 tons) was about the same level as the 1976 Canadian total of these same groundfish species other than cod (3236).

3. Capelin

Landings remained at low levels.

4. Herring

Landings remained at a low level (< 1000 tons) in 1977.

5. Salmon

The salmon landings in ICNAF Subarea 2 during 1977 were 598 metric tons, a decrease of 10% over 1976. It is encouraging that the high landings of the past 4 years are being maintained.

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6. Char

The Subarea 2 commercial catch of Arctic char in 1977 totaled 210 metric tons; an increase of 45% over 1976. This increase was, in part, the result of a redistribution of fishing effort in northern Labrador. Effort, however, continued to increase in the heavily-exploited areas adjacent to Nain, Labrador.

7. Shrimp

The new fishery which was started in 1976 in depressions of the Labrador Marginal Trough was continued in 1977 with landings of 2629.6 metric tons being taken in Div. 2J.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. A program was initiated to study the Labrador Current from Hudson Strait to Belle Isle Strait. Four current meter moorings were laid in October across Nain Bank to the outer slope. These will be recovered during the summer of 1978. Thirteen temperature, salinity, oxygen and nutrient sections between Hudson Strait and Belle Isle Strait were occupied across the Labrador Shelf out to the outer slope.

The section off Seal Islands, Labrador, was occupied in early August and, except for the two most seaward stations, surface and 10-meter temperatures over the Labrador Shelf were lower than those of 1976 and considerably lower than the 1951-71 average.

The volume of cold water less than 0°C extended farther seaward but not as deep in the inshore area where bottom and lower layer temperatures were much higher than those of the previous year and slightly higher than the recent average.

In the seaward stations where the deep water was related to the West Greenland Current, especially in the upper and intermediate depths, temperatures were higher in 1977 which suggests that the inflow of the warmer Irminger Current was much stronger than in the previous year.

2. Biological Studies

a) Cod. Monitoring of the coastal fishery was continued in 1977. Catches were somewhat lower than in 1976. The average lengths observed in the trap and gillnet fisheries were 52 cm and 81 cm, respectively.

A random-stratified survey cruise was conducted in November 1977. Cod in the range 49-52 cm were predominant.

An analysis of cod livers and gonads for their efficacy as bioenergetic indices has begun with samples collected in November 1977 in Div. 2J. Percent water in liver is very constant, 66.1 ($\pm .12$)%, over all lengths. The condition factor (KL), calculated as liver weight over fish weight, is 7.23 ($\pm .41$)%, while the KF condition factor, calculated as fish weight over length cubed, is 1.14 ($\pm .019$)%. Relating residual variance in liver indices to lipid constituents, environmental and morphophysiological parameters is expected to produce a more precise bioenergetic index than any in the literature. Comparison with data from the 1950's is anticipated.

b) Redfish. Over the last few years the general production model has been used to generate advice on possible TAC levels in Subarea 2 and Div. 3K. Irregularities existing in the current catch effort data did not allow updating of the general production model.

c) Flatfish. All flatfish stocks in Subarea 2 overlap with Subarea 3, thus assessments results are dealt with under the latter subarea.

Data on the distribution and abundance of flatfish in Div. 2J were collected during a random-stratified survey. Additionally, information was collected from this division during a research cruise in collaboration with the Federal Republic of Germany. Data on Greenland halibut from Div. 2G and Statistical Area 0 were obtained on a cruise of the French research vessel CRYOS. These data added substantially to our knowledge of the flatfish species in Subarea 2.

d) Grenadier. Research and commercial samples were obtained from ICNAF Subarea 2 and Div. 3K during 1977. Frozen whole fish were supplied from a research survey from 2+3K for subsequent biological scrutiny. Two main concerns are currently under investigation: obtaining a reliable index of length to alleviate the broken/regenerated tail problem and the interpretation of the ages of grenadier.

e) Capelin. Few spawning and post-spawning capelin were detected in July during an inshore survey of the south Labrador coast. Small concentrations of capelin were recorded during an offshore survey in late October in Div. 2J.

f) Herring. A survey of southern Labrador by a chartered purse-seiner during August 1977 failed to detect commercial concentrations of herring. Biological sampling indicated a dominance of summer-spawners.

g) Salmon. During a research vessel trip to the Labrador Sea in October 1977, a total of 231 salmon were caught from 7 stations. The estimated North American proportions in the Labrador Sea were 58.3% from discriminant function analysis of scale characteristics. This was corroborated by blood transferrin analysis but with slightly varying results. Unfortunately, scale samples were not collected at Greenland during 1977. A sampling program for the Newfoundland commercial fishery continues to provide quantitative information on size, age and sex ratios of salmon in various areas of the fishery. During 1977, 447 salmon were sampled at Nain, Labrador, for pectoral length, scales and gutted weight (head off) and 976 salmon were sampled from the southern Labrador fishery.

h) Char. Catch and effort statistics were obtained from the commercial Arctic char fishery in northern Labrador. Both catch and effort surpassed the 1976 totals, and have increased by more than two-fold since 1975. Commercial sampling of char was carried out to provide quantitative information on size and age compositions in various areas of the fishery. Mortality estimates were derived and optimum levels of exploitation were determined from yield-per-recruit assessments on various stocks.

Subarea 3

A. STATUS OF THE FISHERIES

1. Cod

Total Canadian landings were 117,000 tons, about 30% above the 1976 landings. About 85% of the total catch was from the inshore fishery. The inshore landings were about 20% higher than in 1976 while the offshore landings were about 140% higher.

The increased cod catch in the inshore fishery was probably a result of both increased effective effort, since ice conditions did not hamper fishing operations in the inshore fishery, and increased availability of cod to the inshore gears. The increased catch in the offshore fishery represents a shift in Canadian trawler effort to the northern areas.

2. Redfish

Canadian redfish landings totaled 33,900 tons, 7% less than the 1976 landings of 36,500 tons. This higher catch in 1976 and 1977 than in years immediately prior to this reflected the diversion of effort from the Gulf of St. Lawrence fishery in 1976.

3. Flatfish

These were once again the principal species taken by the Canadian trawler fishery in Subarea 3 but also formed an important part of the coastal boat fishery. Canadian landings of American plaice totaled 53,500 tons, about 5% less than 1976 landings. Canadian yellowtail landings were 11,500 tons, about 1300 tons above the 1976 landings because of the increased TAC for yellowtail in Div. 3LN0 (12,000 tons as compared to 9000 tons in 1976). Witch landings were 12,400 tons, about 75% higher than in 1976, with increases in Div. 3K, Div. 30 and Subdiv. 3Ps (total of 7300 tons higher) and decreases in Div. 3L, 3N and Subdiv. 3Pn (total of 1900 tons lower). The general increase in landings represents a shift in fishing of the Canadian offshore fleet to previously unfished species such as witch. Greenland halibut landings were 17,600 tons, 95% higher than in 1976. This was because of increased landings in the inshore (+ 3800 tons) and offshore (+ 2200 tons) fisheries in Div. 3K and the inshore fishery (+ 2500 tons) in Div. 3L. The increased offshore catch in Div. 3K reflects increased effort in the northern area of Subarea 3 in 1977. The total flatfish landing of 95,400 tons was 15% higher than in 1976 because of the increased witch and Greenland halibut landings, with plaice and yellowtail landings remaining about the same as in 1976.

4. Other groundfish

Landings of other groundfish totaled 7200 tons, about the same level as in 1976.

5. Capelin

Landings increased from 9400 tons in 1976 to approximately 13,300 tons in 1977. Most of the catch was from the fishery on beach-spawning capelin.

6. Herring

Herring landings along eastern Newfoundland (Div. 3KL) were 24,000 tons, the same level as in 1976. Herring landings along southern Newfoundland (Div. 3P) declined to 4000 tons in 1977, down from 4600 tons in 1976.

7. Salmon

The salmon landings in ICNAF Subarea 3 during 1977 were 1142 metric tons, a 4% decrease from 1976. This drop is due to a slight decrease in effort.

8. Squid

Inshore Newfoundland catches increased from 9895 tons in 1976 to 29,678 tons in 1977. Squid were unusually abundant in the inshore area in 1977 but the increased landings are more the result of increased effort because of much better prices to the fishermen.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. The Flemish Cap section from Woolfall Bank to the eastern slope of the Grand Bank was occupied in July (27th-30th); surface temperatures were similar to those of 1976 and the 1951-71 average; however, at the two most coastward stations and stations in the Flemish Channel, surface temperatures were well below the average and lower than any previously encountered including the unusually cold year of 1972.

In the deep water of the Flemish Channel, especially in the upper and intermediate layers, temperatures were higher than those of the previous year but similar to the 1951-71 average.

The volume of cold water less than 0°C was greater than in 1976 and extended in an unbroken core over the Grand Bank with temperatures below average and very similar to the lowest of the 1951-71 period. It is difficult to make comparisons in the southern Grand Bank area as our regular sections were replaced by newly-positioned ICNAF stations, observations of which were incomplete during 1977 due to the involvement with Search and Rescue operations.

During a trip of the C.S.S. DAWSON in October 1977 to the Flemish Cap, 46 stations were occupied to map zooplankton and oceanographic conditions as a contribution to the Flemish Cap Project. Among other results, it was noted a high production region existed in the shallowest waters and the northwest corner, and the Labrador Current did not flow around the east side of Flemish Cap. Attempts to collect 0 group cod were unsuccessful.

2. Biological Studies

a) Cod. Monitoring of the coastal and offshore fisheries was continued in 1977. Catches showed some improvement over 1976, especially in the northern subdivisions. Length frequencies for trap showed peaks in the 43-46 cm range, while gillnet catches were composed of larger fish. Otter-trawl catches generally were composed of fish with a peak in the length frequency of 50-55 cm.

The regular random-stratified research cruises on the Grand Bank and St. Pierre Bank were continued, and the first such survey of the Flemish Cap was completed in February 1977.

Survey cruises to the Grand Bank (Div. 3LNO) and St. Pierre Bank (Div. 3Ps) showed little change in cod abundance over previous years. A fall cruise on the French research vessel CRYOS produced catches which would indicate an increase in abundance of cod in Div. 3Ps.

A pilot study to prepare for an assessment of the impact of spawning capelin in Div. 3N has been analyzed. In June 1977, cod liver percent water was 53.6 ($\pm .66$)%, with cod under 30 cm apparently quite higher (62.6%). The condition factor (KL), liver weight over fish weight, was 2.21 ($\pm .10$)%, while the condition factor (KF), fish weight over length cubed, was .807 ($\pm .011$)%. These fish are, by comparison to the Div. 2J November 1977 results, energetically deficient during the capelin spawning period.

b) Haddock. Research cruises by Canadian research vessels again indicated that there was no improvement in the low population levels of recent years. Catches obtained during the fall (November) trip of the CRYOS on St. Pierre Bank did indicate some improvement in the population in this area.

c) Redfish. Division 3M length frequency data indicated better than average year-classes for 1963 and 1972. Both year-classes were evident in research cruises while the latter year-class also showed up in 1976 commercial catches. An update of the assessment recommended no change, however, in the TAC for 1977 from that set in 1976.

Division 3LN fishery which was traditionally a bottom-trawl fishery switched to midwater trawling in 1974 and back to the bottom trawl in 1975 and has continued to remain a bottom-trawl fishery in 1976. Monitoring the commercial fishery was maintained in 1977 with an emphasis on improving commercial sampling, thus improving the data base.

Division 3O redfish data are limited but from the simplified application of the Schaefer model the fishery appears to be underexploited.

Better than average year-classes which were expected in Div. 3P fishery in the late 1970's have not materialized nor is there any clear indication from length frequency data that better than average year-classes will be forthcoming. For the first time, ageing data have allowed for estimating the TAC by cohort analysis and this suggested that a TAC of about 18,000 tons might be appropriate.

d) Flatfish - general. The primary objective has continued to be the improvement of the data base leading to a refinement of the parameters necessary for stock assessment and a better understanding of the biology of the different flatfish species.

The use of stratified-random surveys as a means of estimating relative abundance of flatfish is being expanded. Indices of abundance from Grand Bank cruises in 1977 suggested that plaice and yellowtail are recovering somewhat from the low levels encountered during the 1973-75 period.

e) American plaice. An assessment of the stock in Subarea 2 and Div. 3K indicated that average catches of 6300 tons for 1966-76 produced fishing mortality levels near $F_{0.1}$, hence the recommended TAC was reduced from 8000 to 6000 tons for 1978. An updating of the assessment of the Div. 3LNO stock indicated that management at $F_{0.1}$ in 1978 (47,000 tons) should rebuild the stock to the pre-1970 levels by 1985 and permit removals of about 60,000 tons at that time. A new assessment of the stock in Subdiv. 3Ps indicated that this stock was being exploited above the $F_{0.1}$ level and it was recommended that the TAC be reduced from 6000 to 4000 tons in 1978.

f) Yellowtail. An updating of the assessment using 1976 data suggested that the TAC could be increased from 12,000 tons to 15,000 tons in 1978, assuming an annual recruitment level of 60 million fish at age 5.

g) Greenland halibut. Biological studies indicated that most mature Greenland halibut in the northern areas (Subarea 2) are in deep water; however, a considerable proportion of the fishery is directed at immature fish in relatively shallow water. At present the stock apparently is being exploited at the $F_{0.1}$ level and hence it was recommended that the TAC remain at 30,000 tons for 1978.

h) Witch. Assessment of witch stocks in Div. 2J and 3KL, Div. 3NO and 3Ps indicated no change in the recommended TAC's for 1978 at 17,000, 10,000 and 3000 tons, respectively.

i) Grenadier. Research samples and frozen specimens were obtained from a charter cruise to Div. 3LNO. Investigations are being initiated in grenadier research in Subarea 3 using the approach described for Subarea 2.

j) Capelin. A survey for capelin larvae was conducted in Div. 3L in February. The offshore fishery on the spawning population on the Southeast Shoal (Div. 3N) was monitored in June during a research cruise of the A. T. CAMERON. The echo-integration system and an underwater camera were tested during a survey aboard the GADUS ATLANTICA in October 1977. Studies on stock discrimination and general biology of capelin were continued.

k) Herring. Recruitment prospects for fisheries along eastern and southern Newfoundland continue to be poor. Whereas strong year-classes appeared every 2-4 years in the 1960's, this pattern has changed during the 1970's, the last strong year-class occurring in 1968. The 1974 year-class has been the strongest to appear in the 1970's yet is less than 25% as strong as the 1968 year-class.

l) Mackerel. Sampling of the Newfoundland commercial fishery does not indicate the recruitment of any substantial year-classes; 75% of the catch was composed of fish 5 years of age and younger with the 1973 year-class dominant (35%).

m) Salmon. During June 10-July 20, 1977, 51 adult Atlantic salmon were tagged and released in the Fortune Bay area. Of the 13 recaptures, all of which were from Fortune Bay, 1 was angled and 12 were caught in the commercial fishery.

A sampling program for the Newfoundland commercial fishery continues to provide quantitative information on size, age and sex ratios of salmon in various areas of the fishery. During 1977, 1260 salmon were sampled at Goose Cove. These data, when analyzed with historical data, provide a means of detecting any changes in these biological characteristics.

Subsamples from the commercial fishery provided 197 blood and gonad samples from Goose Cove and 63 from Fortune Bay. These samples when analyzed for plasma vitellogenin will provide information on the percentages of maturing salmon caught in the commercial fishery. Studies in 1976 showed that an average of 79% of the females in five stocks were spawners of the year.

n) Squid. Standard biological sampling of the commercial catch at Holyrood, Conception Bay, from July to November was continued.

4. Miscellaneous Studies

a) Salmon. A survey conducted at St. Anthony collected data on the amount of salmon sold locally ("as local sales") and not through the plant. As these sales accounted for 30% of salmon landings in 1976, their importance to the total landings can be considerable.

Section II. Subareas 4 and 5

by

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The following report is compiled on the basis of information supplied by the Department of the Environment Biological Stations, St. Andrews, New Brunswick and St. John's, Newfoundland; the Marine Fish Division, Marine Ecology Laboratory and Atlantic Oceanographic Laboratory, Bedford Institute, Dartmouth, Nova Scotia; and by the Quebec Ministry of Industry and Commerce and Quebec Salmon Council, P. Q. Nominal fish landing data were supplied by the Department of Fisheries and Environment, Fisheries Information Branch, Maritimes Region.

Subarea 4

A. STATUS OF THE FISHERIES

1. Groundfish General

For the first time for several years, total nominal annual catches (Maritimes and Quebec) showed an increase over the previous year, rising by 8% to about 203,000 metric tons. Increased catches of cod, haddock and flatfishes more than compensated for a further decrease in redfish landings from the Gulf of St. Lawrence. Quotas were in effect on all major stocks and limited the landings of some species.

2. Cod

Landings from Maritimes and Quebec increased by about 21% from the 1976 level to almost 86,000 metric tons, constituting 42% of the total groundfish catch. Increased landings were shown in all Divisions except on the southeastern part of the Scotian Shelf (Divs. 4V_S-V_N) where landings were slightly below those of the previous year.

Newfoundland landings totalled 25,000 tons, about the same level as in 1976. A 5,000 ton (26% increase in landings from the north-east Gulf of St. Lawrence (Div. 4R) was offset by a similar decrease in landings from the remainder of the Gulf of St. Lawrence and of Cape Breton (Divs. 4S-T-V_N).

The increased cod landings from the Gulf of St. Lawrence result from restriction on the redfish fishery, diverting effort to cod.

3. Haddock

Landings were 30% higher than in 1976, totalling about 23,000 metric tons, 11% of total groundfish landings. The bulk of the landings and the major increase was from the Browns Bank area (Div. 4X), reflecting continued improvement of the 4X haddock stock. Landings from the middle of the Scotian Shelf (Div. 4W) reversed the trend in recent years, more than doubling to almost 3,000 metric tons.

4. Flatfish

Total nominal landings (Maritimes & Quebec) of combined flatfish species increased by 16% over the 1976 level to almost 32,000 metric tons, of which about 60%, mostly American plaice, were taken in the Gulf of St. Lawrence (Divs. 4R-S-T). Increased landings were shown in all parts of the Scotian Shelf (Divs. 4V_S-W-X) more than compensating for a slight fall in landings from Sydney Bight (Div. 4V_N). American plaice constituted about 50% of total flatfish landings, increasing from the 1976 level by 6% to over 15,000 metric tons, and together with an increase in "mixed flatfish", more than made up for a slight decrease in witch, yellowtail and turbot landings.

Newfoundland landings were about 5,200 metric tons, 47% below the 1976 figure. Significant decreases were recorded in witch in Div. 4R and in both plaice and witch in the southern Gulf of St. Lawrence (Div. 4T) and the northeast part of the Scotian Shelf (Divs. 4V_S-V_N). TAC restrictions and reduced bycatch from the restricted redfish fishery probably contributed to the decrease.

Atlantic halibut landings decreased by about 8% from the 1976 level to 783 metric tons.

5. Redfish

Redfish landings (Maritimes & Quebec) decreased by almost 30% from the 1976 level to about 24,000 metric tons. The decrease was almost wholly due to a fall in landings from the Gulf of St. Lawrence (Div. 4R-S-T) where landings fell from about 29,000 tons in 1976 to 17,000 tons in 1977, mainly due to TAC restrictions in the fishery to protect the declining stock. On the Scotian Shelf (Divs. 4X-W-V_S), there was an improvement of 31% in the landings to about 7,000 metric tons and in Sydney Bight (Div. 4V_N) landings increased by 85% to 3,600 metric tons.

Newfoundland landings totalled about 5,100 metric tons compared to about 15,000 metric tons in 1976, again due to TAC restrictions in the Gulf of St. Lawrence (Div. 4R-S-T).

6. Pollock

Landings rose by about 3% over the 1976 level to 21,700 metric tons, about the same level as in 1975. The bulk of the landings (64%) were from Div. 4X where a decrease of 25% from the 1976 landings was compensated for by an increase in landings from the remainder of the Scotian Shelf (Divs. 4W-V_S).

7. Other Groundfish

Landings by Maritimes and Quebec increased by about 8% over the 1976 level to 15,800 metric tons while those from Newfoundland remained at about the same level as in 1976 at 500 tons. White hake constituted 47% (4,000 metric tons) of the landings, mostly from the southern Gulf of St. Lawrence (Div. 4T), up 6% from 1976 and reversing the decreasing trend since 1973. Cusk (over 3,000 metric tons) made up 20% of landings and showed a slight increase over 1976. Silver hake landings¹ were negligible at 9 metric tons, down 70% from 1976, and skate were down 56%, while the remainder of the group all showed slight increases.

8. Sea Scallops (Placopecten magellanicus)

Landings (Maritimes and Quebec) totalled 7,057 metric tons whole weight, a decrease of 45% from 1976. Catch decreases occurred on Browns Bank (Div. 4X) and in the Gulf of St. Lawrence (Div. 4T) whereas catches in inshore waters in the Bay of Fundy increased.

¹ Landings of silver hake (and squid) by non-Canadian vessels under joint venture arrangements with Canadian companies are not included here.

9. Herring

Total nominal landings (Maritimes & Quebec) of herring from Subarea 4 were 178,788 metric tons, a 2% increase over 1976 landings. Landings from southwest Nova Scotia were up 9% at about 114,000 metric tons, while those from the central part of the Scotian Shelf (Div. 4W) fell by 38% to about 19,000 metric tons. In the southern Gulf of St. Lawrence (Div. 4T), landings increased by 12% to 35,000 metric tons, continuing the improvement shown in 1976, while in the northeast Scotian Shelf (Div. 4V_n) landings increased by 28% to about 11,000 metric tons.

Landings from western Newfoundland (Divs. 4R-S) increased by 30% to 13,000 metric tons.

Quota control of herring fisheries restricted landings but the change from mainly processing for fish meal to mainly using for food resulted in a great increase in landed value of the fish.

10. Mackerel

Total mackerel landings increased by 38% over the 1976 level to over 14,000 metric tons. Landings from the Gulf of St. Lawrence (Divs. 4R-S-T) were slightly lower at 2,600 metric tons, but this and a 55% decrease in landings from the Atlantic coast of Cape Breton (Div. 4V_n) to 1,400 metric tons were more than compensated for by a fourfold increase from the central part of the Scotian Shelf (Div. 4W) to almost 5,000 metric tons and a 73% increase from southwest Nova Scotia (Div. 4X) to over 5,000 metric tons.

11. Tuna

Total landings of bluefin tuna amounted to 972 metric tons. The commercial (trap) catch in the St. Margaret's Bay area (Div. 4X) was 368 metric tons, more than double the 1976 catch (168 metric tons). Weights were obtained from 918 fish ranging from 184 to 541 kg, averaging 388.1 kg compared to 369.2 kg in 1976. The sport fishery yielded about 300 metric tons, down 12% from the 1976 level. Almost the whole of the angling catch, 294 metric tons, came from the southern Gulf of St. Lawrence (Div. 4T) while the remainder was taken off eastern Nova Scotia (Divs. 4W-X).

12. Atlantic salmon

Total landings, including those from commercial and sports fisheries but excluding those from the Newfoundland fishery in the eastern Gulf of St. Lawrence (Div. 4R) were 501.7 metric tons, an increase of 27% over the 1976 total. The commercial catch, 216 metric tons, increased by about 10% over the 1976 catch, while the angling catch, 285 metric tons, was 43% greater than in 1976.

The Newfoundland coastal set-net fishery yielded a catch of 213 metric tons, an increase of 31% over 1976. The increase was mainly due to a shift in ice patterns and higher sea survival than in recent years.

The ban on commercial fishing in New Brunswick and the Gaspé Peninsula (Divs. 4X-T) continued.

Subarea 4

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

(a) Hydrography. A physical oceanographic survey covering Browns Bank and Northeast Channel (Div. 4X), including release of drift bottles and seabed drifters and measurement of salinity, temperature and depth profiles, was carried out in support of a study of offshore lobsters.

The observational program to study the dynamics at the continental shelf break was concluded in December. Ten current meter moorings had been maintained throughout the year at the shelf break due south of Halifax. Hydrographic surveys of the area were performed three times during the year. A remarkably persistent warm-core eddy was observed in the area for 4-5 months.

(b) Plankton Studies. In studies of the distribution and abundance of fish eggs and larvae in St. Georges Bay (Div. 4T), capelin eggs were found off beaches on the west side of the Bay and observations were made of physical processes in dispersion of a patch of mackerel eggs.

Annual larval herring surveys in the Bay of Fundy (Div. 4X) have continued and have been expanded to include a summer survey in addition to the fall and late winter surveys.

Preliminary results of a new, long-term ichthyoplankton survey programme on the Scotian Shelf (Divs. 4V-W-X) indicate very different distribution patterns, species interrelationship; abundance indices and spawning times from those previously found in the Gulf of St. Lawrence (Div. 4T). Analysis of the results of the 10-year ichthyoplankton survey programme in the Gulf of St. Lawrence have been published in a series of Technical Reports. Studies on the temporal and spatial patterns of zooplankton in the Bay of Fundy (Div. 4X) have continued.

In Bedford Basin (Div. 4X), studies of size fractionation of phytoplankton production, of distribution, composition, growth and physiological condition of natural assemblages, and of vertical and horizontal distribution of microzooplanktons have continued. A study of vertical and horizontal distribution of zooplankton was carried out at the edge of the Scotian Shelf (Div. 4W) in May.

(c) Other Environmental Studies. Completed studies of levels, behaviour and dynamics of heavy metals in the sediments of the St. Lawrence and Saguenay fjord indicate that very little of the anthropogenic inputs of Hg, Zn, Pb, V and Ni have reached the open Gulf except from local sources in Chaleur Bay, Northumberland Strait and the Bay of Islands, Newfoundland. Elsewhere, the elemental concentrations are at or near natural levels.

Bi-weekly collection of plankton, including juveniles and eggs of commercially important pelagic fishes from St. Georges Bay (Div. 4T) are being analysed for DDT and PCBs plus metabolites and the results will be used to construct models of organochlorine dynamics in marine pelagic food webs.

Analysis of surface sediments for hydrocarbon content and composition indicates their derivation from biogenic terrestrial sources and slight alteration of hydrocarbon composition at abandoned exploratory drilling sites.

A bimonthly study of concentrations and distribution of nutrients in St. Georges Bay (Div. 4T) was carried out from May to December.

Studies of the effects of the 1970 oil spill in Chedabucto bay (Div. 4W) have continued. Comparison of populations of the clam Mya arenaria from oiled and non-oiled lagoons indicated that the recovery potential of M. arenaria in oiled sediments is low and the oiled populations remain under continuous stress six years after the oil spill. Clams contained up to 200 µg/gm hydrocarbon in their tissues. The bivalves are unable to degrade petroleum aromatic hydrocarbons, which accumulate in their tissues and may be transferred unaltered into the food chain.

Suspended and sedimented particulate carbon, nitrogen chlorophyll a and pheopigments were measured at various depths throughout the year at Bedford Basin (Div. 4X) as a possible means of predicting residence time of dredged bottom material in the water column during dumping operations.

2. Biological Studies

(a) General. Annual groundfish research survey cruises were completed on the Scotian Shelf (Divs. 4V-W-X) in July and in the southern Gulf of St. Lawrence (4T) in September. A survey of haddock stocks on the Scotian Shelf (Divs. 4W-X) was carried out in March. Annual larval herring surveys were completed in the Bay of Fundy (Div. 4X) in March and November.

Monitoring and biological sampling of commercial catches continued. An observer program involving the stationing of trained personnel to study bycatches in foreign vessels engaged in the silver hake fishery was initiated.

(b) Cod. Analysis of the southern Gulf of St. Lawrence (4T-V_n) migratory cod stock has been increasingly associated with incorporating environmental influences on production and using simulation modelling to predict the future status of the stock. The models have reached a stage which provides reliable predictions of recruitment.

The occurrence of mouth neoplasms in cod, which had been observed in previous years, was not substantiated in 1977. It is intended to study the effects of the neoplasm on growth and fecundity.

(c) Haddock. The spring survey of the spawning haddock populations in the Emerald-Browns-Georges Banks area (Div. 4W-X, 5Z) is being maintained to monitor the effect of closures of the fishery in recent years on the abundance of spawning haddock and to follow the eggs and larvae as they drift and settle. Data indicate increases in the spawning population since the spring fishery closure in the Browns area (Div. 4X).

The prevalence of gas bladder disease in haddock decreased markedly in 1977 in the Emerald Bank area (Div. 4W). The incidences in spring and fall were 9.1% and 4.0% respectively, compared with 40.0% and 12.2% respectively in 1976, 36.7% in autumn 1975 and 70-80% prior to 1975. Concurrent studies indicate a southerly movement of the infection.

(d) Flatfish. Previous assessments of Scotian Shelf American plaice, witch, yellowtail and winter flounder have lumped these species together. For the first time, Div. 4V plaice and 4VW witch stocks were assessed separately for setting of TAC's. Yellowtail stocks have been drastically depleted to below the level where they can support a directed fishery.

An assessment of the Gulf of St. Lawrence (Div. 4T) American plaice stock attempted for the first time to consider the effects of a 30-40% discard level (by weight). A simulation model is being developed, incorporating a stock/recruitment relationship.

(e) Herring. More than 73,000 tags were applied to herring, most in the Bay of Fundy area (Div. 4X). After two unsuccessful attempts in 1975 and 1976, 3,500 herring were tagged in the Sydney Bight area (Div. 4V_n). Recoveries from previous tagging confirmed that Bay of Fundy herring moved freely across the Bay with populations migrating to Chedabucto Bay (Div. 4W) and the Gulf of Maine (Div. 5) areas during winter. A small tagging experiment in Chedabucto Bay confirmed the return migration, recoveries being made in the Bay of Fundy and Gulf of Maine.

A summer survey of herring larval distribution revealed a concentration in the Bay of Fundy at the same time as production off southwest Nova Scotia, probably implying very rapid transport of larvae from the spawning area.

(f) Mackerel. In addition to ichthyoplankton studies, stomachs and gonads were collected for study of species interactions and fecundity.

(g) Capelin. A first assessment of capelin in the Gulf of St. Lawrence shows that four stock components may be present, representing a standing stock biomass in the order of 160,000 metric tons.

(h) Bluefin Tuna. Data from catch statistics from commercial and sports fisheries and from port samples are being combined to produce estimates of length at age and growth rates.

In experimental impoundment facilities at St. Margaret's Bay (Div. 4X), studies were made of feeding behaviour, ultrasonic telemetry of physiological parameters with simultaneous hydrographic measurements, and underwater photography. Cooperative studies were also made of nutrition, sex determination and contamination. Experiments involving tetracycline administration were conducted to validate Canadian ageing techniques.

Ten "giant" bluefin tuna were tagged and released for elucidation of migration patterns. Five tags from previous years were recovered.

3. Gear and Selectivity Studies

Measurements to determine the relationship between acoustic target strength, fish length and aspect were made on herring. Similar measurements previously made on cod have enabled an equation relating target strength to fish length and aspect of pitch to be calculated. Techniques are being investigated to reduce the unacceptably high variance in the results. Low values of target strength measured suggest that ambient sea noise is probably a limiting factor in detecting smaller fish.

Development of the bottom referencing underwater towed instrument vehicle (BRUTIV) entered its second phase with a new chassis and control system which should enable it to investigate changes in fish aspect at sea.

Cooperative research studies were carried out with:

- (1) Cuba, in an acoustic survey for location of silver hake and mesh selection experiments with silver hake.
- (2) USSR in mesh selection studies with silver hake.
- (3) Japan, in comparative fishing experiments with off-bottom trawls and a normal bottom trawl.

Subareas 5 and 6

A. STATUS OF THE FISHERIES

1. Groundfish General

Total nominal landings from Divs. 5Y-Z increased over the 1976 level by 68% to almost 13,000 metric tons, mainly due to improved landings of cod which constituted 48% of the total. Almost the whole of the landings were from the Georges Bank area (Div. 5Z).

2. Cod

Landings almost tripled the 1976 total to just over 6,000 metric tons, 99% coming from the Georges Bank area (Div. 5Z).

3. Haddock

Haddock landings, almost wholly from the Georges Bank (Div. 5Z), were about double the 1976 figure at almost 3,000 metric tons.

4. Pollock

Landings showed an increase of 60% over the 1976 level to about 3,300 metric tons, but still 30% below the 1975 level. The Georges Bank area (Div. 5Z) yielded 93% of the total catch.

5. Other Groundfish

Landings of flatfish, mainly American plaice and yellowtail flounder, totalled 116 metric tons while unspecified groundfish totalled about 160 metric tons.

6. Sea Scallop (Placopecten magellanicus)

Landings totalled 108,340 metric tons whole weight, an increase of 42% over 1976. Fleet size continued to be restricted and, in addition, trip and 4-month catch quotas of 112.9 and 677.3 metric tons whole weight respectively were imposed. Maximum trip duration was also restricted to 12 days.

7. Herring

No landings of herring were recorded, completing the rapid decrease in landings from Div. 5Y since 1975.

8. Tuna

The purse seine fishery for juvenile bluefin off the New Jersey coast of the United States yielded 298 metric tons, a decrease of 10% from the 1976 level of landings. A total of 732 fish were measured ranging from 44.5 to 163.6 cm, and averaging 116.3 cm.

Section III. Seals

Subareas 2, 3 and 4

A. STATUS OF THE FISHERIES

The TAC for harp seals was 170,000, 10,000 to the Arctic, the remainder to large vessels (97,000) and landsmen and small Canadian vessels (63,000).

The TAC for hooded seals was set at 15,000, divided between Canadian (6,000) and Norwegian (6,000) ships with the balance (3,000) available to either country after March 30, if not already taken.

Allocations of harp seals were closely attained at 154,000, excluding the arctic, but catches of hooded seals were only 12,000.

B. SPECIAL RESEARCH STUDIES

Harp Seals

A total of 1,230 young harp seals were tagged on the Gulf of St. Lawrence with green plastic "Rototags" attached to the hind flipper. A new method was devised to calculate production based on tagging large numbers of harp seals in both whelping areas. Knowing the relative survival rates and the relative number of animals whelping in the two areas, equations can be solved to derive total production and production in each area.

Age samples totalling 1,864 harp seals showed all year classes since and including 1972 to be in good condition. The 1977 year class is stronger than the 1976 as a result of good reproduction from the large 1968 year class. The latter has not yet been succeeded by strong parental year classes of 1972 and later.

Hooded Seals

Sixty-six young hooded seals were tagged in the Gulf of St. Lawrence. Recoveries at age 1 of two animals previously tagged ranged from northeast Newfoundland in February to southeast Greenland in June.

A whelping concentration of more than 10,000 adult hooded seals was again found in Davis Strait, considerably further west than usual because of a narrower ice-belt.

Grey Seals

As the first stage in a study of their distribution and movement, more than 2,000 grey seals were tagged on Sable Island (Div. 4W).