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CANADIAN RESEARCH REPORT, 1978

by

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STATISTICAL AREA 0 AND SUBAREA 1

A. STATUS OF FISHERIES

1. Catches

No landings of fish and invertebrates were reported for 1978.

B. SPECIAL RESEARCH STUDIES

1. Biological Studies

a) Shrimp. A contract was undertaken with MacLaren Marex Inc. in 1978 to assess the potential for pink shrimp in areas north of Subarea 2. This survey did not reveal commercial concentrations of shrimp outside the limits of the traditional 0 + 1 fishery.

b) Salmon. During a research vessel trip to the West Greenland area in August 1978, a total of 606 adult Atlantic salmon were caught. The estimated proportion from scale character analysis of North American salmon in the West Greenland area was 37.5%; of these, 5.0% were identified as being of hatchery origin.

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SUBAREA 2

A. STATUS OF THE FISHERIES

1. Cod

Canadian landings were almost 10,700 tons, up significantly from about 4100 tons in 1977. This change was composed of an increase in the Div. 2J inshore and offshore fisheries of 2400 and 4200 tons respectively. The offshore fishery accounted for 44% of the total catch, as compared to only 12% in 1977. This increase in offshore landings reflects the expansion of the Canadian offshore fleet into the northern areas.

2. Redfish

Canadian landings were almost 10,200 tons, up from 2700 tons in 1977. Landings were almost totally from Div. 2J with < 1% landed from Div. 2H. This dramatic increase in landings again reflects the increase in Canadian offshore fishing effort in northern areas.

3. Other groundfish

Canadian landings of the combined flatfish species were almost 1300 tons as compared to just over 500 tons in 1977. This total was composed of 28 tons of American plaice, 17 tons of witch and 1230 tons of Greenland halibut. Greenland halibut landings were up 750 tons over the 1977 level. Landings of other groundfish species were about 30 tons.

4. Capelin

Landings of capelin remained at a low level (< 10 tons).

5. Herring

Landings remained at a low level (< 1000 tons) in 1978.

6. Salmon

The provisional salmon landings in ICNAF Subarea 2 during 1978 were 384 tons, a decrease of 36% over 1977. This decline is partially attributable to decreased sea survival.

7. Arctic char

Landings of Arctic char in ICNAF Subarea 2 during 1978 were 248 tons; an increase of 18% over 1977.

8. Shrimp

The second year of concentrated fishing effort in the Labrador Marginal Trough resulted in total landings of 3710 tons for 1978 in Div. 2H and 2J.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. Surface temperatures over the Labrador Shelf early in August were similar to those of 1977. The volume of cold water associated with the Labrador Current was much less, with temperatures considerably higher than in the previous year.

Bottom and lower layer temperatures extending from Hawke Channel over Hamilton Inlet Bank to the eastern slope were much higher than in 1977 and generally higher than for the past 10-12 year period.

The program, initiated in 1977, to study the Labrador Current was continued. Of the four current meter moorings laid across Nain shelf and slope in October 1977, the two eastern ones in deeper water were recovered and replaced by an array of six moorings placed between the 600 m and 3000 m isobath in January 1978. Seven temperature, salinity, oxygen, and nutrient sections extending seaward from the ice edge were run from Fogo Island to Nain Bank in February. The moorings off Nain were recovered in July. Only two of the eight were recovered intact, two were lost completely, and four were partially recovered. The losses are attributed to large icebergs. A long-term mooring program to monitor the flow of the Labrador Current was begun in October 1978 with the laying of three current meter moorings across Hamilton Bank. These moorings are necessarily short to avoid the icebergs and so will only measure the near-bottom current.

Analyses of data from the vicinity of Hudson Strait continue relative to nutrient addition to the Labrador Current.

2. Biological Studies

a) Cod. As in previous years, the inshore fishery was monitored. The 1978 inshore catch in Div. 2J was over 70% higher than the 1977 catch of 3460 tons. The average lengths observed in the trap and gillnet fishery were 54 cm and 73 cm respectively. The Canadian offshore catch for the 2J-3KL stock increased by a factor of three over 1977. Data obtained from this fishery were used for assessment purposes.

Research cruises in this area included one in Div. 2GH and three others covering Div. 2J-3KL and which included Div. 2J.

Biological studies on the 2J-3KL cod stock were continued involving the detailed examination for weights and volumes of whole fish and various organs from approximately 1250 fish. An additional sample of 170 fish was taken from Div. 2GH. A total of 2050 stomachs were collected from Div. 2J-3KL and a further 350 from Div. 2GH. These data were taken during five research cruises plus an inshore sampling trip to 2J-3KL.

About 4500 cod were tagged on Belle Isle Bank (Div. 2J-3K) during February-March with an additional 1500 juvenile cod being tagged in Trinity and Bonavista bays (Div. 3L).

The cod stock in Div. 2J-3KL continues to recover under stringent management at fishing mortalities below $F_{0.1}$.

b) Redfish. Several research cruises were carried out in Subarea 2 in 1978. First, a cruise aimed at determining the feasibility of using the random-stratified method of assessing the abundance of redfish species was carried out in Div. 2GH. Second, a random-stratified survey cruise was conducted. Redfish in the range of 23-24 cm for females and males were predominant in the catches.

Samples of the incidence of infection of redfish by Sphyrion lumpi were collected throughout the area as were samples aimed at stock discrimination.

c) Flatfish. All flatfish stocks in Subarea 2 overlap with Subarea 3, thus assessments are dealt with under the latter Subarea. Data on the distribution and abundance of flatfish in Div. 2G, 2H and 2J were collected during research vessel cruises. This was the first year that a comprehensive survey was carried out in 2G and 2H. Additional data on Greenland halibut were collected during a research cruise in collaboration with the German Democratic Republic.

d) Grenadier. Research and commercial samples were obtained from Subarea 2 and Div. 3K again in 1978. The general production model was used to assist in setting the TAC level. Studies continued in the areas of ageing and determination of a reliable anal fin length to total length ratio.

e) Sampling of catches by foreign countries. A total of 417 samples for lengths and ages were taken from the catches of foreign countries as follows: cod - 103, redfish - 4, witch - 1, Greenland halibut - 50, grenadier (mostly roundnose) - 26, capelin - 46, shrimp - 178, skate - 9. From these samples about 81,000 length measurements and 5500 otoliths were collected.

f) Capelin. The capelin stock in Div. 2J-3K in 1977 was assessed at approximately 700,000 tons by analysis of acoustic data. An acoustic survey was conducted in the same area in October 1978 and an estimate of stock biomass will be calculated in 1979.

g) Salmon. During a research vessel trip to the Labrador Sea area in September 1978, a total of 55 salmon were caught. The estimated North American proportions in the Labrador Sea were 61% from discriminant function analysis of scale characters. A sampling program for the Labrador commercial fishery continues to provide quantitative information on size, age and sex ratios of salmon in various areas of the fishery. During 1978, 1518 salmon were sampled at Nain, Labrador, for pectoral length, scales and gutted weight (head off) and 1535 salmon were sampled from the southern Labrador fishery as well.

h) Arctic char. Catch and effort statistics were obtained from the commercial Arctic char fishery in northern Labrador. A sampling program for the Labrador fishery continues to provide quantitative information on mortality and exploitation rates derived from size and age compositions of char in various areas of the fishery. During a research vessel trip to northern Labrador fiords in August 1978, a total of 1081 char were caught from five areas of which 300 were tagged and 781 frozen whole as specimens. Size, age and sex compositions, and meristic and morphometric analyses are being conducted.

i) Shrimp. The Labrador shrimp fishery was closely monitored in 1978. Trends in catch per unit effort suggest seasonal variation in shrimp abundance. A random-stratified survey was conducted in September-October 1978 providing information on shrimp distribution and biomass and the morphology of these areas. Shrimp were distributed over a much wider area in the 1978 survey than in November 1977.

j) Euphausiids (Subareas 2 and 3). Studies of whale functional morphology and energetics were used to verify samples of euphausiids taken by net and detected by sonar. Minimal concentrations required for economical feeding were greater than mean densities by two orders of magnitude and reflect a high degree of clumping.

k) Whales (Subareas 2 and 3). Functional morphology and energetic studies were conducted to provide realistic energy budgets for baleen whales, thus their demands upon commercial and non-commercial marine stocks.

Morphological studies provide an energetic explanation for body size lines in the Northwest Atlantic which in turn may be useful in stock differentiation.

l) Seals (Subareas 2 and 3). Studies of seal energetics are ongoing with respect to density-dependent changes in energy requirements for populations.

SUBAREA 3

A. STATUS OF THE FISHERIES

1. Cod

Total Canadian landings were about 137,000 tons, about 17% above the 1977 landings. Inshore landings remained about the same as in 1977, while offshore landings increased from 17,800 tons in 1977 to 37,800 tons in 1978. About 72% of the total catch was from the inshore fishery. Although offshore landings were down from 1977 levels in Div. 3M, Subdiv. 3Ps and Subdiv. 3Pn, this decrease was far more than compensated for by increases in all other Divisions. The increased offshore landings in Div. 3K (+ 6000 tons) and 3L (+ 4700 tons) reflect an increase in the Canadian offshore fishing effort in more northern areas.

2. Redfish

Canadian landings totalled 37,600 tons, 9% above the 1977 level and about the same as in 1976. There were decreases in landings in Div. 3LMNO and Subdiv. 3Ps (a total decrease of about 10,600 tons). However, these decreases were more than offset by a dramatic increase in Div. 3K landings to 14,100 tons, up from only 800 tons in 1977. There was also a 24% increase in Subdiv. 3Pn landings. The increased landings in Div. 3K again represent a shift in the Canadian offshore fishing effort to northern areas.

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 101,100 tons, up 5% over 1977 landings. Canadian landings of American plaice totalled about 56,000 tons, up slightly from 54,100 tons landed in 1977. A significant increase in American plaice landings in Div. 3LO was offset by a decrease in Div. 3KN, Subdiv. 3Ps and 3Pn landings. Canadian yellowtail landings were 16,300 tons, up 39% from 11,700 tons in 1977 because of an increased TAC for yellowtail in Div. 3LNO. Witch landings showed a decrease from 12,200 tons in 1977 to 4650 tons, with decreases in all Divisions except Div. 3N. Greenland halibut landings were about 23,600 tons, up 33% from 17,800 tons landed in 1977. This change was primarily a result of increased inshore landings in Div. 3K (+ 5000 tons) and in Div. 3L (+ 500 tons). Inshore landings amounted to 87% of the total Greenland halibut landings in 1978.

4. Other groundfish

Canadian landings of other groundfish were about 5300 tons in 1978.

5. Capelin

Approximately 9800 tons were landed in 1978.

6. Herring

Herring landings along eastern Newfoundland (Div. 3KL) were 24,200 tons, the same level as in 1977. Herring landings along southern Newfoundland (Div. 3P) declined to 2500 tons, down from 4000 tons in 1977.

7. Mackerel

Mackerel landings by Newfoundland increased from 7900 tons in 1977 to 1400 tons in 1978.

8. Salmon

The provisional salmon landings in ICNAF Subarea 3 during 1978 were 594 tons, a decrease of 48% over 1978. This decline is partially attributable to decreased sea survival, restrictions to the commercial fishery to increase spawning recruitment and a reduction of the salmon by-catch in herring and mackerel gear.

9. Squid

Total catch in 1978 was 44,300 tons of which 5000 tons were caught offshore (Div. 3O) by foreign trawlers. The bulk of the catch was landed by the inshore fishery. The catch is up from the 30,000 tons landed in 1977. Higher inshore and offshore effort, extended wharfage processing facilities by foreign trawlers and new markets, i.e. dried squid, may have accounted for the increased catch in 1978.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. In the Grand Bank-Flemish Cap area, surface temperatures especially in the inshore area were higher than in 1977.

The volume of cold water below 0°C which usually forms an unbroken core from the Avalon Channel to the eastern slope of the Grand Bank was divided into an inshore and offshore stream with bottom and lower layer temperatures on the western slope and top of Grand Bank well above those of 1977.

In the deep water adjacent to the seaward slope of the Flemish Cap, temperatures were slightly higher than in the previous year.

Except for the 20-30 meter water column (where temperatures were lower than in 1977), temperatures from surface to bottom over the central and southern Grand Bank were generally higher than the previous year.

Sections of temperature, salinity, and oxygen were run from Cape Farewell to Flemish Cap and from Flemish Cap to St. John's in the first half of April 1978.

2. Biological Studies

a) Cod. Monitoring of the coastal and offshore fisheries was continued in 1978. In general, catches showed considerable improvement over 1977 with the exception of those for Subdiv. 3Ps where there was some decline. This was particularly evident in the trap and gillnet fishery.

The average lengths for the trap fishery were: 48.5 cm (Div. 3K), 47.0 cm (Div. 3L), 44.5 cm (Subdiv. 3Ps). Those for gillnet were: 69.0 cm (Div. 3K), 69.5 cm (Div. 3L), and 64.0 cm (Subdiv. 3Ps).

Research vessel cruises in Div. 3K and 3L have already been mentioned in the previous section. A research survey was conducted in each of Div. 3N and 3O, while two surveys were carried out in each of Subdiv. 3Ps and 3Pn and Div. 3M. Data obtained from the Div. 3N, 3O and 3Ps cruises indicate that there was little improvement in 1978 in these stocks which were previously in a depressed condition. Commercial catches did show improvement in Div. 3NO. Research vessel surveys to the Flemish Cap (Div. 3M) have confirmed the presence of a strong 1973 year-class.

Studies were also continued on a meristic and morphometric study of cod. Approximately 300 fish were examined from Div. 3M, 220 from Div. 3NO and 110 from Subdiv. 3Ps. Fish from Subdiv. 3Pn were also examined as part of the total stock of Subdiv. 3Pn and Div. 4R. Approximately 1000 cod stomachs were collected on research cruises to Subarea 3 other than Div. 3KL and many observations of the same were made at sea.

b) Haddock. Haddock populations on the Grand Bank and St. Pierre Bank remain at low levels. Catches from research vessel cruises and from the commercial fishery have been very small or negligible. There is no indication of a successful year-class survival from either area.

c) Redfish. Random stratified research cruises were conducted throughout Subarea 3 aimed at assessing the abundance of redfish in the area. Diel study of the vertical movement by redfish in the water column was carried out to determine the effect of variation in catches between day and night on estimating relative abundance by the random stratified method. Preliminary results indicate that the variability associated with diel movement is insignificant compared to the variability in size of catches made within periods of light or periods of darkness. As in Subarea 2, samples were collected both to estimate the incidence of infection of redfish by Sphyrion lumpi and for stock discrimination.

d) Flatfish. 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 has continued to be a primary objective.

Preliminary data from random stratified surveys indicate an increase in the abundance of plaice and yellowtail and Greenland halibut. For plaice and Greenland halibut the increase in abundance was especially noticeable in the recruiting age-groups.

e) American plaice. An assessment of the stock in Subarea 2 and Div. 3K indicated the current fishing is probably at the $F_{0.1}$ level, hence the TAC was recommended to remain at 6000 tons in 1979. For Div. 3LNO stock the catch projection for 1979 was for 43,000 tons corresponding to fishing at $F_{0.1}$. However, in view of the evidence of increased abundance from research vessel surveys, the same TAC of 47,000 tons as for 1978 was recommended. For Subdiv. 3Ps plaice, the TAC was recommended to remain at 4000 tons. The TAC for Div. 3M was reduced from 4000 to 2000 tons on the basis of research vessel data. A study of the breeding biology of American plaice with particular reference to temporal variation in such functions as size and age at maturity has been undertaken.

f) Yellowtail. Based on indices of increased abundance and excellent correlations of estimates from cohort analyses with research vessel data, the recommended TAC was 18,000 for 1979.

g) Witch. Assessments of witch stocks in Div. 2J and 3KL and in Subdiv. 3Ps indicate no change in the recommended TACs for 1979 at 17,000 and 3000 tons respectively. For Div. 3NO a new assessment suggested that a TAC of 10,000 in effect for 1978 and for several previous years was perhaps too high. Although the Assessments Subcommittee recommended that it remain at this level, the TAC was later reduced by the Commission to 7000 tons. Studies are in progress to elucidate stock boundaries of different witch stocks in Subarea 3.

h) Greenland halibut. An assessment of the stock in Subarea 2 and Div. 3KL indicated that the level of fishing for 1979 should remain at the 1978 level with the TAC set at 30,000 tons; however, recruitment levels appear to be improving. Biological studies indicated that the distribution of Greenland halibut is closely related to depth with large fish located in the deepest water. Studies on stock discrimination in this species are in progress and hopefully advice on the management areas for Greenland halibut for the whole ICNAF Area should be forthcoming in the near future.

i) Sampling of catches by foreign countries. A total of 655 samples for lengths and ages were taken from the catches of foreign countries as follows: cod - 192, redfish - 23, American plaice - 48, witch - 7, yellowtail - 23, Greenland halibut - 17, grenadier (mostly roundnose) - 171, capelin - 98. Other species - 76. These samples resulted in 121,000 length measurements and 13,700 otoliths being collected.

j) Capelin. A survey in Div. 3L in January for capelin larvae was unsuccessful because of bad weather. An acoustic survey in Div. 3LNO in June was attempted but an abundance estimate could not be calculated because no concentrations were located.

A sequential capelin abundance model for the 3NO stock was developed. This model estimated the biomass of capelin back in time to the start of the fishery. The biomass of this stock was relatively constant in the early years of the fishery but has declined in recent years.

Studies on stock discrimination and general biology of capelin were continued.

k) Salmon. During May 1978, 97 adult Atlantic salmon were tagged and released along the south coast of Newfoundland. Of the 19 recaptures, 8 were caught in the commercial fisheries and 11 were angled in rivers in the Maritimes and Quebec.

During June 1978, 35 adult Atlantic salmon were tagged and released in the Fogo-Twillingate area of the northeast coast of Newfoundland. Of the 11 recaptures, 7 were caught in the local commercial fishery and 4 were angled.

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 1978, 783 salmon were sampled at Goose Cove. These data, when analyzed with historical values, provide a means of detecting any changes in these biological characteristics.

Subsamples from the commercial fishery and research tagging provided 100 blood and gonad samples from Goose Cove and 13 from tagged fish at Fogo-Twillingate and the south coast that were of known river origin. These samples when analyzed for plasma vitellogenin will provide information on the percentages of maturing salmon caught in the commercial fishery.

1) Squid. A June stratified-random survey on Grand Bank yielded pre-season biomass estimate and predictive index of inshore abundance. Standard biological sampling of the commercial catch was conducted at five Newfoundland inshore locations. Monitoring of CPUE, effort, hydrographical parameters was done on a regular basis. Tagging operations were conducted in Conception Bay and the validation of ageing study was initiated.

SUBAREA 4

A. STATUS OF THE FISHERIES

1. Groundfish General

Total nominal annual catches (Maritimes and Quebec) fell slightly (1.4%) from the 1977 level to about 200,000 metric tons. Cod and haddock catches increased but were not sufficient to compensate for reduced landings of redfish and flatfish. Quotas were in effect on all major stocks and limited the landings of cod and haddock in particular.

Under developmental charter arrangements, foreign nations landed catches of various groundfish species, concentrating mostly on squid.

2. Cod

Landings (Maritimes and Quebec) continued to increase, by about 3% from the 1977 level to just over 88,000 metric tons and constituted 44% of the total groundfish catch. Catches in the Gulf of St. Lawrence (Divs. 4R-S-T-Vn) fell by about 20% but the fall was more than compensated for by increases on the Scotian Shelf (Divs. 4V-W-X).

Newfoundland catches increased by 68% to more than 43,000 metric tons, mostly from the northeast Gulf of St. Lawrence (Div. 4R) although catches from northeast of Cape Breton (Div. 4Vn) increased from 200 metric tons in 1977 to more than 3,000 metric tons in 1978.

3. Haddock

Landings, mostly from the Scotian Shelf, increased by about 30% to nearly 30,000 metric tons, 15% of total groundfish landings. Landings were almost wholly from the Scotian Shelf and from the Browns Bank area (Div. 4X) in particular which yielded 85% of the total. Landings from the 4W haddock stock continued to increase, by about one third, to almost 4,000 metric tons indicating further improvement of the condition of the stock.

4. Flatfish

Total nominal landings (Maritimes and Quebec) of combined flatfish species (except halibut) fell by 23% to about 24,000 metric tons, almost wholly due to reduced catches in the Gulf of St. Lawrence (Divs. 4R-S-T). The reduction was shown by all species except yellowtail flounder which increased slightly. Catches on the Scotian Shelf remained at about the same level as in 1977. American plaice again constituted about 50% of total flatfish landings.

Newfoundland landings recovered from the fall in 1977 and were over 8,000 metric tons, 63% above the 1977 total. They consisted mainly of plaice, witch and Greenland halibut from the northeast Gulf of St. Lawrence (Div. 4R).

Atlantic halibut landings increased by 64% to just over 1200 metric tons, largely from the Scotian Shelf (Divs. 4-Vs-W-X) and almost half the landings from Div. 4X alone.

5. Redfish

Redfish landings (Maritimes and Quebec) continued to decrease, the total falling by 34% to about 16,000 metric tons. The decrease was mainly from the Gulf of St. Lawrence and Sydney Bight (Divs. 4R-S-T-Vn) where landings fell by 54% to just over 9,000 metric tons. On the Scotian Shelf (Divs. 4Vs-W-X) there was a slight (5%) fall in landings mainly due to decreases in the southern part of the Shelf (Divs. 4W-X) which were counteracted by increased landings on the northwest part (Div. 4Vs), the only area which showed an improvement.

Newfoundland catches were slightly (8%) greater than in 1977, mostly from the northeast Scotian Shelf (Div. 4Vs), reflecting restrictions on the Gulf of St. Lawrence (Divs. 4R-S-T) fishery.

Japan caught 780 metric tons under developmental charter arrangements.

6. Pollock

Landings again rose, exceeding the 1977 level by about 1% at 22,000 metric tons. Almost the whole of the landings were from the Scotian Shelf (Divs. 4Vs-W-X) and mainly from the Browns Bank area (Div. 4X) which supplied 68% of the total catch. There was a slight decrease in landings from the central part of the Scotian Shelf (Div. 4W) which was counteracted by an increase from the northeast part of the Shelf (Div. 4Vs). Landings from the Gulf of St. Lawrence were negligible.

Seventy-eight metric tons of pollock were taken by Japan under developmental charter arrangements.

7. Other Groundfish

Landings by Maritimes and Quebec increased by 17% over the 1977 level to almost 20,000 metric tons and Newfoundland catches increased by 36% to 680 metric tons. White hake increased to over 9,000 metric tons, constituting 48% of the landings, about the same proportion as in 1977, while cusk (25%) and "unspecified" (18%) contributed the bulk of the remainder. Silver hake landings increased from 6 metric tons in 1977 to 163 metric tons in 1978, not including landings by non-Canadian vessels under joint venture arrangements with Canadian companies.

Japan caught 46 tons of argentine under developmental charter arrangements.

8. Sea scallops (Placopecten magellanicus)

Landings totalled 6,422 metric tons whole weight, a decrease of 9% from 1977 landings. A catch decrease occurred on Browns Bank (Div. 4X) whereas

catches increased in both the Northumberland Strait (Div. 4T) and the Bay of Fundy (Div. 4X).

9. Herring

Total nominal catches (Maritimes and Quebec) from Subarea 4 were 194,921 metric tons, an increase of 9% over those of 1977. Landings from southwest Nova Scotia (Div. 4X) constituted 60% of the total, increasing 4% over the landings for 1977. Landings in the central part of the Scotian Shelf (Div. 4W) increased 24% to 23,452 metric tons while those in the southern Gulf of St. Lawrence (Div. 4T) increased by 32% to 46,331 metric tons. A decrease was shown in northern Cape Breton (Div. 4Vn) landings which fell by 39% to 6,723 metric tons.

Landings by Newfoundland, mainly from the northern Gulf of St. Lawrence (Div. 4R-S), amounted to 17,434 metric tons, a decrease of 14% from the 1977 level.

10. Mackerel

Catches decreased in all Divisions of the Scotian Shelf and Gulf of St. Lawrence except in north Cape Breton (Div. 4Vn). Total catches were 10,925 metric tons, a decrease of 24% from the 1977 level, and only slightly above the 1976 level.

11. Tuna

Total landings of bluefin tuna amounted to 671 metric tons, a decrease of 31% from the 1977 landings. The commercial trap fishery in St. Margaret's Bay (Div. 4X) yielded 221 metric tons. Weights were obtained for 530 fish ranging in size from 68-554 kg with a mean weight of 417.6 kg. The sport fishery yielded 208 metric tons, a decrease of 31% from 1977; almost the whole catch came from the southern Gulf of St. Lawrence (Div. 4T).

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 309 metric tons, a decrease of 38% from the 1977 total catch. The commercial catch (203 mt) was about the same as in 1977 but the angling catch (106 mt) was only 37% of the total angling catch in 1977, mainly due to a shortfall in the Quebec area.

The Newfoundland coastal set net fishery yielded a catch of 121 mt, a decrease of 40% over 1977. The decrease is partly attributable to decreased sea survival, restrictions to the fishery to increase spawning recruitment, and a reduction in the salmon by-catch in herring and mackerel gear.

The ban on commercial fishing in New Brunswick and the Gaspē (Div. 4X-T) has continued.

13. Squid

An important squid fishery has developed on the Scotian Shelf. Catches in 1978 totalled more than 6,500 metric tons, about 2/3 the 1977 figure. Catches by non-Canadian vessels under developmental charter arrangements totalled more than 15,500 metric tons, most (80%) taken by Japan on the Scotian Shelf (4Vs-W-X).

14. Capelin

Approximately 8,200 metric tons were landed on the west coast of Newfoundland from the Gulf of St. Lawrence (Divs. 4R-S-T) reflecting a developing interest in the Japanese capelin roe market.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

(a) Hydrography. Physical oceanographic surveys covering Browns Bank-Cape Sable area (Div. 4X), including release of drifters, temperature and salinity profiles, and one mooring with current meters were undertaken in support of a study of offshore lobsters.

A program of surficial geological mapping has been completed in the Bay of Fundy, eastern Gulf of Maine and the Scotian Shelf (Divs. 4V-W-X). For the Laurentian Channel and western Grand Banks of the Newfoundland area, the maps are in the final stages of production and preliminary copies have been placed on open file with the Geological Survey of Canada. The maps and reports describe the sediment type at the seabed and provide additional information on roughness of the seabed which may be useful to those engaged in fishing operations.

(b) Plankton Studies. The Scotian Shelf Ichthyoplankton Program (SSIP) was continued for its second year (Divs. 4V-W-X) and elaborated. Decisions on standard gear and tows to be used were made and arrangments for identification and counting of eggs and larvae were finalized.

Lobster larvae were sampled bi-monthly with a 3-tier neuston net at 13 locations within St. Georges Bay (Div. 4T) and two stations off Cape George for larval abundance, distribution and production studies.

Plankton samples were taken in the centre of St. Georges Bay monthly from January to April, and thereafter weekly, to study zooplankton life history and production cycles.

Annual larval herring surveys in the Bay of Fundy (Div. 4X) have continued, including seasonal surveys in summer, fall and late winter.

Two 24-hour studies of nutrient regeneration, primary production, currents and vertical migration of planktons were completed. Weekly measurements of sedimentation and particulate matter in glass-walled cylinders were carried out to collect settled material for organo-chlorine residue analyses, as part of a continuing study of production and transport of particulate matter through a coastal ecosystem.

In Bedford Basin, 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 at the edge of the Scotian Shelf (Div. 4W) was continued.

One research vessel and one chartered fishing boat participated in an international larval herring patch study on Georges Bank (Div. 5Z) and Nantucket Shoals areas in October-November.

2. Biological Studies

(a) General. The annual groundfish research survey program was expanded to include surveys of the Scotian Shelf in March and November as well as the usual July-August survey, so providing a basis on which to study seasonal distribution and abundance of groundfish. The standard groundfish survey cruise was carried out in the southern Gulf of St. Lawrence (Div. 4T) in September and a survey of haddock stocks on the central and southwest areas of the Scotian Shelf (Divs. 4W-X) was completed in March.

Monitoring and biological sampling of commercial catches and the observer program - stationing of trained observers on foreign vessles to study catches and by-catches - continued.

Studies of the incidence of cod worm in cod and of the fungus Ichthyoponus hoferi in yellowtail flounder were renewed.

Juvenile herring surveys were carried out in the Bay of Fundy (Div. 4X) in February and August to determine the distribution and possible origin of the young fish.

(b) Cod. In October 6,000 cod were tagged on Middle Bank (Div. 4W) from a chartered vessel, initiating a long-term program of tagging of various groundfishes including cod, haddock and pollock.

Canadian catches in Div. 4RS improved considerably over those of 1977. The greatest increase was in the gillnet fishery which produced fish with an average length of 65 cm. The average length from the trap fishery was 48 cm. Sampling for meristics and morphometrics was also conducted in Div. 4RS during two research cruises with approximately 300 being examined in detail. Approximately 450 stomachs were also collected.

(c) Haddock. The annual spring survey of spawning haddock populations in the Emerald-Browns-Georges Bank area (Div. 4W-X, 5Z) was carried out to monitor the effect of closure of the fishery in recent years and the movement of eggs and larvae after spawning. Data indicate a continuing increase in the spawning population since closure of the spring fishery.

(d) Pollock. In May, 1,000 juvenile pollock were tagged in the Chedabucto Bay area (Div. 4W). Tagging of larger fish was hindered by the problem of keeping them alive after trawling from deep water. The use of parasites as biological tags for pollock is being investigated.

(e) Herring. Approximately 45,000 herring were tagged in various areas including the Bay of Fundy (Div. 4X), southwest Nova Scotia (Div. 4X), Chedabucto Bay (Div. 4W) and in a new fishery off Prince Edward Island (Div. 4T). Returns from these taggings indicate a wide dispersal of herring from the tagging areas with no definite trends appearing to date.

(f) Redfish. Monitoring of redfish species in the Gulf of St. Lawrence (Div. 4R-S-T) was continued in 1978. Preliminary results indicate the 1971 year-class may not be as large as was estimated in 1977. The most predominant year-classes of young redfish were the 1971 and 1972 year-classes, and the 1958 and 1956 year-classes are by far the most dominant of the adult stock.

The implications of the small redfish by-catch in the shrimp fishery are presently under investigation. Research to date indicates that this by-catch removes only about 2% of the total biomass of the small redfish. Similar to other areas, samples are being collected on the Sphyrion lumpi problem and on stock discrimination particularly aimed at trying to resolve whether any significant quantities of redfish move out of the Gulf of St. Lawrence in the winter months.

(g) Witch. The first analytical assessment for the stock in Divs. 4R-S was prepared in 1978. Fishing at the $F_{0.1}$ level indicated a TAC of 3,000-4,000 tons; however, since there were many old individuals in the population, it was felt that a slightly higher removal level of 5,000 should be recommended. The TAC was thus increased from 3,800 tons in 1978 to 5,000 tons in 1979.

(h) Bluefin tuna. Detailed sampling of bluefin tuna catches was carried out for the Gulf of St. Lawrence (Div. 4T) rod and reel fishery, the St. Margaret's Bay (Div. 4X) impoundment fishery and the southern purse seine fishery. Length-frequency distributions and age-length keys were prepared, meristic and morphometric data collected and analysed and other physiological parameters relevant to seasonal growth measured.

Six bluefin were tagged and released and three recaptures were made from fish tagged in St. Margaret's Bay in 1975 and 1976 (Div. 4X); two near Prince Edward Island, and one from the Gulf of Mexico. One released in 1977 in Bay of Chaleur (Div. 4T) was recaptured in the same general area.

(i) Swordfish. Two tags were recovered from swordfish tagged in 1970 and 1975 respectively. The first was tagged and recovered in the Georges Bank (Div. 5Z) area; the other was tagged near LaHave Bank (Div. 4X) and recovered southwest of Nantucket Lightship.

3. Gear and Selectivity Studies

Measurements to determine the relationship between acoustic target strength, fish length and aspect were continued on herring and are to be expanded to include other fish such as haddock, redfish, silver hake, pollock, mackerel and squid. A cage for measuring target strengths and aspect was designed and constructed and target strengths of different-sized groups of herring measured.

Development of the bottom referencing underwater towed instrument vehicle (BRUTIV) continued. It now flies reliably and has taken pictures of fish.

SUBAREAS 5 AND 6

A. STATUS OF THE FISHERIES

1. Groundfish General

Total nominal landings from Divs. 5Y-Z increased over the 1977 level by 96% to 25,155 metric tons, largely from Georges Bank (Div. 5Z). Quotas were in effect on all major stocks and limited landings.

2. Cod

Catches increased by 49% to just over 9,000 metric tons, almost all of which came from the Georges Bank area (Div. 5Z).

3. Haddock

Catches increased more than threefold, to over 10,000 metric tons, almost entirely from Georges Bank (Div. 5Z).

4. Pollock

Pollock catches continued to increase, reaching 4,748 metric tons, 43% greater than the 1977 level. Georges Bank yielded 93% of the total, the same as in 1977.

5. Other Groundfish

Catches of flatfish, mainly American plaice, yellowtail and winter flounder more than doubled, to 298 metric tons, while unspecified groundfish totalled 209 metric tons, 31% above the 1977 level.

6. Sea Scallop (Placopecten magellanicus)

Catches totalled 97,959 metric tons whole weight, a decrease of 10% from the 1977 level. Fleet restrictions and effort control were implemented as in 1977. The Bay of Fundy scallop fleet was permitted to land scallops from Subarea 5 to an amount not to exceed 2.9% of the previous year's total Canadian scallop landings from that area (3,140 metric tons whole weight).

7. Herring

A total of 582 metric tons of herring was caught in Div. 5Y, whereas no catches were recorded in 1977.

8. Tuna

The purse seine fishery for juveniles off the U.S. coast yielded 241 metric tons, 80% of the 1977 level. A total of 1,307 fish were measured ranging in size from 55.3 to 186.8 cm with a mean length of 111.9 cm.

SEALS (SUBAREAS 2, 3 AND 4)

A. STATUS OF THE FISHERIES

The TAC for harp seals was set at 170,000, as for 1977, plus 10,000 to Greenland, Labrador and the Canadian arctic. Of this total, Canada took 145,469.

The TAC for hooded seals was 15,000 of which Canada's share was 6,000. Norway's 6,000 and the balance available to either country after March 26. Canada took only 4,189 of the total allowed.

B. SPECIAL RESEARCH STUDIES

Harp Seals

A total of 4,378 young harp seals was tagged in the Gulf of St. Lawrence and 5,000 on the Labrador coast using pink plastic "Roto tags" attached to the hind flipper. Estimates of production have been possible using randomised recaptures by landsmen following the main fishery.

Tagging showed a late lingering in the Gulf of many young harp seals, while those on the Front migrated north at the usual time. This difference was followed by a much greater appearance of Front-born than of Gulf-born animals in west Greenland, as judged by numbers of tagged animals killed there.

Age samples totalling 1,895 animals were collected from eight sampling sites together with a small collection of moulting seals from the Gulf of St. Lawrence in late March. The resulting pooled age frequency shows all year-classes from 1972 to 1977 to be in good abundance.

Large samples of ovaries and teeth showed a median age at first pregnancy in 1978 of 4.8 years as determined from females in late pregnancy. No significant change in rate of attainment of sexual maturity can be detected from 1976 to 1978.

Distribution of pelage patterns in whelped females in the Gulf of St. Lawrence and the Front showed no significant differences between the areas, in spite of more intensive hunting on the Front than on the Gulf. This evidence indicates considerable mixing between the two herds. Large scale tagging in 1978 should give some evidence on degree of homing by adult seals in 5-years' time. It is already known that immature seals show a large degree of cross-over.

Hooded Seals

Sixty-three young hooded seals were tagged with pink "Roto tags" in the Gulf of St. Lawrence. From previous tagging in the same area, there was one recovery in 1978 from east Greenland in August and one from the north shore of the Gulf of St. Lawrence net fishery in January.

Grey Seals

In January and February, 2,266 out of a total production of about 2,700 live grey seal pups were tagged on Sable Island (Div. 4W) so that they could be identified in the bounty kill. Comparison of tagged and untagged numbers found in the kill will enable total production to be estimated. About 1,000 pups were also branded with the letter 'S' so that tag loss can be estimated.

Harbour Seals

In May and June, 302 pups were tagged on Sable Island (Div. 4W) out of a total production of about 350 in order to estimate distribution and movement and eventually help in estimation of population size.