International Commission for the Northwest Atlantic Fisheries

Serial No. 3866
(D.a. 74)

ICNAF Summ. Doc. 76/VI/23
Corrigendum

ANNUAL MEETING - JUNE 1976

CANADIAN RESEARCH REPORT, 1975

Corrigenda

Subarea 5 (page 10)

1. Groundfish general

Total nominal landings were 9,055 metric tons, an increase of 35% from 1974 and 20% above the 1973 landings.

3. Haddock

Landings of haddock (1,433 metric tons) were more than twice those of 1974 (664 metric tons).

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ANNUAL MEETING - JUNE 1976

CANADIAN RESEARCH REPORT, 1975

Section I. Subareas 1, 2 and 3

by

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Government agencies involved: Department of 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 1

A. STATUS OF THE FISHERIES

There was no Canadian commercial fishery in this subarea.

B. SPECIAL RESEARCH STUDIES

2. Biological Studies

a) Atlantic salmon. During August staff of the Newfoundland Biological Station participated in biological sampling of Atlantic salmon in West Greenland. Using set nets, 37 salmon were caught by the *Tornak* while 499 were caught by driftnet by the Danish research vessel *Dana*. St. John's staff shared in the sampling for length, weight, sex, maturity, scales, liver, heart, muscle and blood specimens. The purpose of the program was: determination of size and age composition of Atlantic salmon in West Greenland during 1975, and comparison of results obtained from the discriminant analysis of scale characteristics and blood serum transferrin patterns for determining the relative proportions of North American and European salmon in the West Greenland area.

Subarea 2

A. STATUS OF THE FISHERIES

1. Cod

The landings from the Labrador coastal fishery were about 2900 tons, an increase of 61% above the 1974 level of 1800 tons but still 39% below the 1973 level of 4750 tons. No Newfoundland landing was recorded from offshore.

2. Other groundfish

A small landing of two tons of redfish and four tons of Greenland halibut was also reported in the coastal fishery. Landings of other groundfish totalled 2.6 thousand tons compared to 4.5 thousand tons in 1974.

3. Capelin

Landings remained at low levels in 1975 (< 10 tons).

4. Mackerel

Landings remained at the 1974 level (15 tons).

5. Herring

Landings increased from nil in 1974 to 738 tons in 1975, reflecting improved market conditions.

6. Atlantic salmon

The coastal fishery by set gillnets along the shore yielded a catch of 624 tons, a decrease from 1974 (635 tons).

7. Arctic char

The commercial fishery by set gillnets along the shore yielded a catch of 105 tons, a decrease from 1974 (149 tons).

8. Squid

Nil landings as in previous year.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. The section off Seal Island, Labrador, was occupied in August. The volume of cold water associated with the Labrador Current extended farther seaward but not as deep at the shoreward stations as in 1974. This resulted in bottom temperatures in the Hawke Channel and on the western slope of Hamilton Inlet Bank being higher than in 1974.

2. Biological Studies

a) Cod. Monitoring of the coastal fishery was continued in 1975. Catches were small. The usual temperature stations at 50 metres were occupied. In the trap catches, fish aged 5-7 years were most abundant while most of the gillnet catches consisted of fish of ages 8 and older.

Sampling of the catches of a Canadian otter trawler fishing in February in Div. 2J showed that the 1968 year-class was dominant. The cod sampled were all in the pre-spawning condition.

A cruise to the area by the *A. T. Cameron* in November was hampered by stormy weather and mechanical difficulties. Catches were small.

b) Redfish. General production models previously used to estimate MSY for redfish in Subarea 2 and Div. 3K indicated that the stock is in a depressed state. Indications are that improved recruitment is entering the fishery and the 1976 TAC was set at the same level as in 1974 and 1975 (30,000 tons) to allow the stock to slowly rebuild.

c) Grenadiers (Subareas 2 + 3). Information on distribution and relative abundance of roundnose, roughhead and common grenadiers was obtained from research vessel catches during 1958-73. Roundnose grenadiers were most plentiful in deep water on the continental slope in ICNAF Div. 3K, 2J and off the northern third of Labrador at bottom temperatures of 3.5 to 4.5°C. Largest catches were obtained at depths greater than 500 metres. Largest research catches of roughheads were obtained along the eastern edge of the Grand Bank (Div. 3L and 3N) at depths of 180 to 500 metres and bottom temperatures of 2.0 to 3.5°C. Maximum catch rates of roughhead grenadiers were considerably less than maximum catch rates of roundnose grenadiers. Catches of common grenadiers were very small in all areas fished, generally less than 5 kg per 30-minute set, at bottom temperatures from 3.0 to 5.0°C.

d) Capelin. An acoustic survey of Hamilton Bank by the research vessel *A. T. Cameron* in November 1975 indicated dispersed concentrations of capelin consisting of a mixture of maturing and immature capelin.

e) Shrimps. A research vessel cruise and exploratory fishing showed commercial quantities of *Pandalus borealis* at several locations in the Hawke Channel.

f) Atlantic salmon. A program of commercial sampling was continued to provide quantitative descriptions on seasonal sizes and age patterns of salmon taken by commercial fisheries in the northern Labrador area.

g) Arctic char. Management investigations of the commercial Arctic char fishery in northern Labrador continued with the installation of a 250-foot temporary counting fence on the Fraser River in 1975.

Subarea 3

A. STATUS OF THE FISHERIES

1. Cod

Total Newfoundland landings were 57.5 thousand tons, about the same level as in 1974. Ice conditions in the northern areas again hampered fishing operations of the inshore small boat fishery, from which most of the catch originated.

2. Redfish

The Newfoundland redfish catch was 15.3 thousand tons, an increase of 91% from the 1974 catch. This increase occurred in all divisions of Subarea 3 and reflected an increase in redfish effort.

3. Flounders

These were the principal species taken by the Canadian trawl fishery in Subarea 3 and also formed an important part of the coastal small boat fishery. Newfoundland landings of American plaice totalled 37.4 thousand tons, a 9% decline from the 1974 level. Newfoundland yellowtail landings were 18.8 thousand tons, a 9% increase from 1974. Newfoundland witch landings were 3.7 thousand tons, a 42% decline from 1974, and Greenland halibut landings, mainly from the coastal fisheries, were 8.1 thousand tons, a 39% increase from 1974. The total flatfish landings of 68 thousand tons in 1975 were only 4% below the 1974 landings, although the 1974 landings were 28% below the 1973 landings. The similarity in flatfish landings in 1974 and 1975 was a result of similar catch rates in the two years. Although most of the trawler fishery was suspended in 1975 for three months because of labour problems, this probably had no more effect on landings than the short period of suspension in 1974 because in 1975 the suspension was in the January-March period when catch rates are lower, whereas in 1974 the suspension was in the summer months when catch rates are higher.

4. Capelin

Landings decreased from 15.2 thousand tons in 1975 to 4.6 thousand tons in 1975, mainly due to reduced effort.

5. Mackerel

Landings increased from 1.9 thousand tons in 1974 to 4.0 thousand tons in 1975, mainly due to increased effort.

6. Herring

Landings increased from 18.3 thousand tons in 1974 to 32.2 thousand tons in 1975, mainly due to increased effort particularly on under-exploited stocks of herring along eastern Newfoundland.

7. Atlantic salmon

The commercial fishery which is entirely by fixed gear along the coast yielded 1282 tons in 1975, an increase from 1974 (1229 tons).

8. Squid

Landings increased from 621 tons to 3200 tons taken in the inshore fishery. Landings were limited by demand in freezer plants.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. The regular pattern of hydrographic sections from eastern Labrador to the southern Grand Bank was occupied during July-August 1975. The volume of cold water below 0°C was generally less for both the 1969-73 average and that occurring in 1974. Temperatures in the intermediate layers and near bottom were higher than in 1974 but similar to those of the 1969-73 average.

2. Biological Studies

a) Cod. Monitoring of the coastal and offshore fisheries was continued in 1975. In the trap fishery the bulk of the catches was composed of cod of ages 4 to 6 years. In the other inshore gears the younger ages were important but older fish, particularly of the 1968 year-class (7-year-olds), were also present. Catches by the offshore fleet in Div. 3L and Subdiv. 3Ps were made up mainly of 4- to 8-year-old fish. In Div. 3N the dominant year-class in the otter-trawl catches was that of 1971. In this division there was also a good number of cod of 7 years and older, caught mainly as by-catch.

Catches of pair-trawlers in Div. 3L and 3M consisted mostly of 4- to 6-year-old fish, and in Div. 3N of 4- to 5-year-olds.

As in recent years, research catches by the *A. T. Cameron* on the Grand Bank and on St. Pierre Bank were small.

b) Haddock. Research vessel cruises indicated no improvement in the very low level of this population.

c) Redfish. Results of a comparative day-night fishing survey in Subdiv. 3Ps revealed consistent substantial differences in mean numbers and weights of redfish caught per standard day and night set. The results also indicated that fish of intermediate ages (8 to 14 years) exhibit proportionately greater movement off bottom during the night. These results cast serious doubt, for any species exhibiting pronounced diurnal variations in availability, upon estimates obtained by random 24-hour stratified fishing. Estimates of numbers and biomass could be seriously biased by year-to-year or cruise-to-cruise changes in fishing pattern and nonproportional allocation of day and night sets among strata.

Year-classes of the mid 1950's supported the fishery in Div. 3P from 1965 to 1974 and produced sustainable yield estimates of 20,000-23,000 tons. New year-classes of fish 8 to 12 years old in 1975, of moderate strength, began to appear in commercial bottom trawl catches during 1974 and 1975. Under stable conditions these recruits would probably provide a sustainable yield less than that of the mid 1950's year-classes. Declines in catch per hour fished, from 0.9 tons in 1965 to 0.5 tons in 1974, indicate a substantial reduction in abundance of the 1953-58 year-classes. Over the next several years the fishery will become dependent upon the 1964, 1965, 1966 and adjacent year-classes.

Updating of the assessments for the remaining stocks of redfish in Subarea 3 (Div. 3M, 3LN and 3O) resulted in recommended TAC's at the same level as in 1975.

Preliminary analyses of morphological data on the (*Sebastes fasciatus-mentella*) species complex utilizing both principal components and hierarchical cluster methods indicate that more than 95% of specimens could be assigned to the two types on the basis of four morphological characters: number of anal fin rays, angle of inclination of the third preopercular spine, number of gill rakers, and degree and nature of head spination. Preliminary examinations indicate that all specimens could be distinguished from the swimbladder musculature pattern, with the swimbladder muscle passing between the 3rd and 4th ventral ribs in *Sebastes fasciatus* (the shallow-water form) and between the 2nd and 3rd ribs in *Sebastes mentella* (the deep-water form).

Incidence of at least three species of larval nematodes in redfish is under investigation from material collected during research cruises from 1972 to 1974 from Subareas 2 to 4. The project is designed to assess the possible use of these parasites as biological tags to further delineate the stock interrelationships of redfish of the Canadian Atlantic area.

d) Flatfish - General. The main emphasis has been on the improvement of the data base and various parameters used in updating the stock assessments. Additionally work is proceeding on various phases of the life history of the different flatfish species aimed at a more complete understanding of their biology.

A study of the possible effects of non-reported by-catch of flatfish was carried out and indicated that, for plaice and yellowtail at least, the non-inclusion of these discards in stock assessments would lead to an under-estimate of stock size and may cause unexplained fluctuations in the fishery.

e) American plaice. An updating of the stock assessment for Div. 3LNO indicated a reduction in stock abundance, especially in Div. 3L. TAC was reduced from 60,000 to 47,000 tons. In Subdiv. 3Ps a first analytical assessment indicated a reduction in the TAC from 11,000 to 8000 tons in 1976. The TAC for the stocks in Subarea 2 + Div. 3K and 3M remained at the 1975 level.

f) Greenland halibut. A new assessment was prepared for Subarea 2 + Div. 3KL recommending total removals for 1976 at 30,000 tons which was about 25% lower than in 1975. Indications are that the removal level from the total stock should be kept low enough to provide a stock size that would maintain a viable inshore fishery. In addition studies on food and feeding, age and growth are continuing.

g) Witch. The first analytical assessment of witch in Div. 3NO was prepared with a TAC of 10,000 tons recommended for 1976. The TAC for witch in Div. 2J + 3KL and Subdiv. 3Ps remained at the 1975 level.

Studies on age and growth indicated that witch from the northerly localities grow faster and have a shorter life span than those from the south and as a result of the faster growth rate the fish in the northern stocks become sexually mature at an earlier age. Distribution studies indicated that witch were taken in depths from 185 to 365 metres and at temperatures from 2° to 6°C.

h) Yellowtail. An updating of the assessment of the Div. 3LNO stock including 1974 catch data and information from research surveys indicated a sharp reduction in population size especially in the fully-recruited age-groups. Fishing mortality rates in the latter age-groups appeared to be extremely high; additionally, recruitment prospects appeared to be poor. As a result of this and pending new indications from 1975 data it was recommended that the TAC be reduced to 10,000 tons for 1976 from the 1975 level of 35,000 tons. A study of the food of yellowtail indicated that polychaetes and amphipods were the main components. A comparison with American plaice food indicated that the greater selection of fish and echinoderms by the latter species was the principal difference.

i) Capelin. A stock discrimination program based mainly on meristics and biochemical characteristics was initiated in 1974. Studies were continued on spatial and temporal differences in age, growth and maturity of capelin.

j) Herring. The 1968 year-class continues to dominate age-composition of spring-spawners around the Newfoundland coast as well as in the southern Gulf of St. Lawrence. The 1969-71 year-classes are very weak whereas the 1972 year-class appears to be relatively strong in the southeastern Newfoundland and southern Gulf spring-spawners.

Stock discrimination studies, based mainly on external tagging, continued in 1974. Preliminary analyses of tag returns suggest substantial although irregular migrations from area to area.

k) Mackerel. Commercial sampling and tagging studies continued in 1975. More recent year-classes, particularly the 1973 year-class, have replaced the 1967 year-class as the dominant age-group in the Newfoundland area. Winter kills (December) of mackerel were again reported in the Notre Dame Bay area (3K).

l) Atlantic salmon. During May 20-June 23, 27 large Atlantic salmon and 38 grilse were tagged and released from commercial trap and set nets in Trinity Bay, eastern Newfoundland (Div. 3L). All 4 recaptures of large salmon were from the Newfoundland commercial fishery. Of 4 returns from grilse, 3 were from the Newfoundland commercial fishery and 1 was from Nova Scotia.

During May 24-June 25, 34 large salmon and 418 grilse were tagged and released in Placentia Bay, southern Newfoundland (Subdiv. 3Ps). Of 7 recaptures of large salmon, 6 were from the Newfoundland commercial fishery and 1 was from Quebec. Of 91 recaptures of grilse, 81 were from the Newfoundland commercial fishery, 7 from Newfoundland rivers and 3 were from New Brunswick.

A program of commercial sampling was continued to provide quantitative descriptions on seasonal size and age patterns of salmon taken by commercial fisheries in various areas, in particular to allow estimation of one- and two-sea-winter salmon in catches and variation in proportion with time.

A co-operative research project with Memorial University of Newfoundland, Marine Sciences Research Laboratory, has been instituted to examine the feasibility of separating maturing 1-sea-year salmon and those which will remain at sea a further year before maturing. Parameters being examined are: quantity and type of gonadotropin(s) in blood plasma and pituitary gland, quantity of vitellogenic (egg) protein in blood plasma, gonadal development as revealed by histological and histochemical examination and quantity in the plasmas of steroids most likely to be implicated in gametogenesis.

m) Pink salmon. From a series of egg plantings during the early 1960's from British Columbia to North Harbour River, St. Mary's Bay, Newfoundland, a small stock of natural spawning fish was established. The runs appear to be maintaining themselves at a very low level. The total number reported in 1975 was 103 distributed as follows: 46 in North Harbour River, 21 in the commercial fishery and 36 observed in other rivers. These were the progeny of 60 adults which spawned in 1973 and a subsequent fry run of 35,000 during the spring of 1974.

n) Squid. Standard biological sampling of the commercial catch was continued.

CANADIAN RESEARCH REPORT, 1975

SECTION II. SUBAREAS 4 and 5

by

J.S. Scott

Research in Subareas 4 and 5 reported here was carried out by the Department of Environment, Biological Station, St. Andrews, New Brunswick; St. John's, Newfoundland; the Arctic Biological Station, Ste. Anne de Bellevue, Quebec; the Marine Ecology Laboratory and Atlantic Oceanographic Laboratory, Bedford Institute, Dartmouth, Nova Scotia; and by the Quebec Ministry of Industry and Commerce.

Subarea 4

A. STATUS OF THE FISHERIES

1. Groundfish general

Total nominal catches (Maritimes and Quebec) decreased by about 5% from 1974 catches to about 204,000 metric tons. Reduced catches of all major species, except haddock, American plaice and pollock, contributed to the decrease.

2. Cod

Landings by Maritimes and Quebec (66,000 metric tons) were down about 8% from the 1974 level but still constituted the highest individual proportion (32%) of the total groundfish catch: Scotian Shelf catches (Divs. 4X-W, Subdiv. 4Vs) remained at about the same level as in 1974 (28,000 metric tons), but those from the Gulf of St. Lawrence (Divs. 4R-S-T) fell by 13%.

Newfoundland landings, mainly from the Gulf of St. Lawrence (Divs. 4R-S-T), again increased by about 11% to over 23,000 metric tons of which about 16,000 metric tons came from the northeast Gulf of St. Lawrence (Div. 4R).

3. Haddock

There was a 30% increase on haddock landings from the 1974 level, to over 17,000 metric tons, of which about 16,000 metric tons were taken in Div. 4X (TAC 15,000 tons). Landings from the central part of the Scotian Shelf (Div. 4W, Subdiv. 4Vs) were 48% higher than in 1974 at 1,600 metric tons, but there are no indications from the commercial fishery of a significant increase in stock abundance.

4. Flatfish

Total landings (Maritimes and Quebec) of combined flatfish species fell from the 1974 level by 2% to 27,000 metric tons but were still above the 1973 landings. The percentage decrease in total landings was fairly uniform through all Divisions and was mainly due to a decrease in witch flounder catches which showed an overall decrease of about 35% to 4,000 metric tons. American plaice constituted 48% of the flatfish landings, showing a 7% increase over 1974 landings. There was a 50% increase in Greenland halibut landings to 1,200 metric tons, almost wholly from the Gulf of St. Lawrence (Divs. 4R-S-T).

Newfoundland landings, almost all American plaice and witch flounder, were 4,400 metric tons, a decrease of 24% from 1974.

Atlantic halibut landings continued to decrease and were down 12% from 1974, at 750 metric tons, mainly from the southwest part of the Scotian Shelf (Divs. 4W-X).

5. Redfish

The decrease in redfish landings (Maritimes and Quebec) from 1973 to 1974 continued with a further decrease in 1975 to about 54,000 metric tons, a fall of 11% from the 1974 level. Approximately 90% of the landings were from the Gulf of St. Lawrence (Divs. 4R-S-T). Newfoundland landings totalled about 26,000 metric tons, an increase of 51% over 1974 landings, die to increased effort. There is no evidence of strong new year-classes to support the stocks.

6. Pollock

Total landings of pollock showed a small (1.6%) increase over the 1974 landings, at 22,000 metric tons. The bulk of the landings (81%) were from the southwest part of the Scotian Shelf (Div. 4X). Landings from this area were slightly down (5%) from 1974, but this was more than compensated for by an increase in landings from the middle part of the Shelf (Div. 4W). In view of the increased effort aimed at pollock, in place of cod and haddock, the decrease in landings from the major stock in 4X may indicate that the stock cannot support heavier exploitation.

7. Other groundfish

Landings by Maritimes and Quebec were down about 10% from those of 1974 at 1,700 metric tons and those by Newfoundland down 28% at 600 metric tons. Approximately 50% of the "other groundfish" was white hake, landings of which decreased by 25% from the 1974 level.

8. Scallops

Sea scallop (*Placopecten magellanicus*) landings (Maritimes and Quebec) from the Scotian Shelf (Divs. 4V-W-X) totalled 4,633 metric tons whole weight, an increase of 56% over the 1974 landings.

9. Herring

Total nominal landings (Maritimes and Quebec) from Subarea 4 decreased by 1% from those of 1974 to 189,000 metric tons. Landings from southwest Nova Scotia (Div. 4X) increased by 1.5% to 126,500 metric tons, and from Div. 4W by 10% to about 26,000 metric tons. The southern Gulf of St. Lawrence (Div. 4T) fishery landed over 27,000 metric tons, an improvement over the 1974 landings (23,000 metric tons) but still below the 1973 level. Landings from the northeast Scotian Shelf (Div. 4V) remained at about 9,000 metric tons, approximately 60% of the 1973 level.

10. Mackerel

Mackerel landings in Subarea 4 (excluding Div. 4R) continued to decrease, with a fall of 31% from the 1974 level to 9,650 metric tons. Much of the decrease was due to lower catches in the southern Gulf of St. Lawrence (Div. 4T) which yielded less than 22% of the total as compared with 48% in 1974. There was a reduction of effort in the mackerel fisheries because of poor market conditions.

11. Tuna

Total landings of tuna in 1975 were approximately 9,000 metric tons live weight. The St. Margaret's Bay (Div. 4X) trap fishery yielded 141 metric tons, a decrease of 55% from the 1974 landings, with an average weight of 319 kg. Catches in the sports fishery also declined, by 47%, to 193 metric tons, the lowest figure for the past 3 years.

12. Atlantic salmon

Total landings, including those from commercial and sports fishery, but excluding those from the Newfoundland fishery in the eastern Gulf of St. Lawrence (Div. 4R), were 296 metric tons, only 64.7% of the 1974 total and lower than the 1973 catch (324 metric tons). The commercial catch (199 metric tons) decreased by 14%; the angling catch (96 metric tons) fell by 58%.

The Newfoundland coastal set-net fishery yuelded 161 metric tons, up 15 metric tons from 1974.

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

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

a) Hydrography. Seasonal physical oceanographic surveys, including T-S and current measurements, were carried out in the Gulf of St. Lawrence (Divs. 4R-S-T) and T-S measurements made along the Halifax section (Div. 4X).

Estuarine and coastal embayment studies continued, with physical oceanographic measurements in Georges Bay (Div. 4T), St. Margaret's Bay (Div. 4X), and suspended sediment studies in the Northumberland Strait (Div. 4T).

Temperature profiles (XBT) were taken during research cruises in the Gulf of St. Lawrence (Divs. 4R-S-T), the Laurentian Channel and Banquereau Bank area (Div. 4V). Hydrographic charting surveys were conducted in the Gulf of St. Lawrence and over the Labrador Shelf.

Physical and chemical studies related to productivity in the Gulf of St. Lawrence during the past 5 years have shown that temperature ranges from -2 to 20°C. The lowest values occur both at the surface in winter and in the "cold layer" (-2-3°C) which in summer separates the sun-warmed surface layer in which is found the upper tail of the temperature range from the deep water of more constant temperature (4-7°C). This cold layer extends from 25 to 175m depending upon location and time of year, though it is nowhere as thick as these limits imply. The minimum within this layer is most frequently encountered around 75m. Its importance to the productivity of the Gulf lies in the fact that it effectively separates the photic zone from the nutrient-rich deep water during those months when insolation is not the limiting factor on phytoplankton growth.

Salinity ranges from 25 to 35°/oo, the low values have their origin in the freshwater input, principally of the St. Lawrence River, the high values in incoming waters from the North Atlantic Ocean (34-36°/oo).

Specific gravity. The specific gravity of the water column in the Gulf ranges from σ_t = 19-28, with 3/4 of the values between 25 and 28. Sigma-t correlates very strongly with temperature; 97% of the variation in σ_t can be accounted for by variations in temperature. This is in contrast to the waters of the Scotian Shelf where variations in σ_t are much more dependent (65%) upon variations in salinity. The same is true of the bottom water, a 30-50m thick layer overlying the sediments, in which temperature ranges from 1.2-4.2, salinity from 34-36 and 93% of the variation in specific gravity is attributable to variation in salinity.

Oxygen ranges from 2 to 10 $m\ell/\ell$, with most values in the class 7-8. Oxygen concentration decreases with depth, a minimum layer ($\leq 3m\ell/\ell$) occur between 150 and 350m, but in the deeper water, higher values (3-5) prevail.

Studies of particulate organic matter in the Gulf of St. Lawrence show that there is an export of one million tonnes or organic matter from the Gulf annually to the Atlantic Ocean through Cabot Strait.

b) Plankton studies. Studies of the Yarmouth upwelling (Div. 4X) were continued, with surveys for temperature, salinity, phytoplankton and chlorophyll with a towed porpoising body (BATFISH), and airborne remote sensing flights to detect surface chlorophyll.

Quantitative analysis of zooplankton samples from survey cruises is being made to investigate persistence, distribution and movement of selected local stocks of plankton in the Bay of Fundy.

The dynamics of slope water intrusions onto the Scotian Shelf will be studied from December 1975 to June 1977. The program will include joint experiments with biologists. Internal waves in the St. Lawrence estuary lead to intrusions of cold saline St. Lawrence water into Saguenay Fjord on flood tides giving strong mixing and high dissolved oxygen values in the deep layers of the Fjord. Storms passing through the Magdalen Shallows area of the Gulf of St. Lawrence have strong effects on the water currents and their thermo-haline structure.

c) Other environmental studies. Levels of mercury and other trace metals in Saguenay Fiord (Div. 4S) indicate that the fiord is heavily polluted with mercury, presumably of industrial origin.

A survey was made for presence of Bunker C oil on Chedabucto Bay beaches and in intertidal invertebrates and attached algae.

Measurements were made of levels of insecticides and heavy metals in liver and muscles of cod from Divs. 4X, 4W, 4Vn and 4T as part of a continuing program under the auspices of the ICES Working Group on Pollution Baseline and Monitoring Studies.

2. Biological Studies

a) General. Annual groundfish research survey curises were completed on the Scotian Shelf and in the southern Gulf of St. Lawrence (Divs. 4X-W-V-T) in July-August, in the southern Gulf of St. Lawrence (Div. 4T) in August-September and in the northern Gulf of St. Lawrence (Div. 4S) in July. A survey of groundfish populations and herring larval distribution was carried out in February in Divs. 4X-W. The annual groundfish egg and larval survey in the southern Gulf of St. Lawrence (Div. 4T) was completed in July-August and herring larval surveys in the Bay of Fundy and Gulf of Maine (Divs. 4X-5Y) in April and November.

Monitoring and biological sampling of commercial landings and studies of sampling methods and data treatment continued, and a special sampling program in cod, redfish and flatfish initiated in the northern Gulf of St. Lawrence (Divs. 4R-S). A method was developed to compensate estimated age compositions for errors in age reading and to reduce the effects of sampling variation.

Field trials were conducted to develop a survey design for hydro-acoustic counting methods for a large-scale groundfish inventory.

Simulation techniques, using data from 10 years of egg and larval surveys, were employed for prediction of long- and short-term implications of management decisions for stocks of cod, herring, plaice and mackerel in the southern Gulf of St. Lawrence (Div. 4T).

b) Cod. Commercial and research cruise data have provided a basis for improved estimates of growth patterns and mortality rates in the Sable Island-Banquereau Bank (Divs. 4W-Vn) stock complex. Analysis indicates mortality above that maximising yield per recruit for at least the past 6 years, a decline in mean age at recruitment in recent years and a substantial decline in stock abundance since 1970.

For the Div. 4X cod stock, research vessel surveys indicate that fishing mortalities are about double the level giving maximum yield per recruit, with no indication of improved recruitment in the immediate future.

In the northeast Gulf of St. Lawrence (Div. 4R) gillnet catches were composed mainly of cod of 7-12 years of age, with 1967 and 1968 year-classes dominant. In the offshore fishery the 1970 year-classes dominant. In the offshore fishery the 1970 year-class was dominant and the bulk of the catch composed of age 4-7 fish.

A simulation study, based on detailed biological structure of the stock, produced the hypothesis that the southern Gulf of St. Lawrence (Div. 4T) cod stock was on the verge of recruitment failure. Exceptionally poor catches in 1974 give support to the hypothesis.

c) Haddock. Research vessel surveys indicate that the spawning stock size of Div. 4X haddock in 1974 was the lowest on record. It should increase in 1975 and 1976 with maturation of the moderately good 1971 and 1972 year-classes but will decline again in 1977 due to the weak 1973 year-class.

Investigations were initiated into the geographic distribution, incidence and intensity of infection of helminth parasites and of *Eimeria gadi* a potentially serious disease of the gas bladder of haddock of the Scotian Shelf (Divs. 4X-W-V).

d) Redfish. A general production model for the redfish stock of the Scotian Shelf (Divs. 4X-W-V) indicated that fishing effort exceeded the level required to give the MSY in the 1971-74 period and the stock was over-exploited. There is no evidence from survey data of strong recruitment in the immediate future and stocks are expected to be below average abundance in 1976.

In the Gulf of St. Lawrence (Divs. 4R-S-T) adult biomass declined substantially during 1972-75 to about 100,000 metric tons at beginning of 1976, apparently less than 25% of that present at the beginning of 1972. The 1966 year-class, anticipated to be about one-tenth of the very successful 1956 year-class, was virtually absent from 1974 and 1975 research surveys. Recruitment for the next 4 or 5 years is likely to be very poor, until the moderately good 1971 year-class recruits to the fishery.

e) Silver hake. Revision of estimated size compositions of Scotian Shelf (Divs. 4X-W) silver hake showed that most of the commercial catch is of 2-yr-old fish and that considerable numbers of 1-yr-olds are also caught. Almost all males and most females mature at age 2, the fishery exploiting a high proportion of pre-spawners.

f) Sea scallop (*Placopecten magellanicus*). Assessments of the Bay of Fundy (Div. 4X) and southern Gulf of St. Lawrence (Div. 4T) scallop fisheries indicate that low and declining landings result from fishing effort more than twice that needed to provide close to optimal yields.

Iceland scallop (*Chlamys islandica*). Stock(s) in the Jacques Cartier Strait (Div. 4S) appear to be comprised mainly of old individuals showing poor recruitment and slow growth (shell diameter 60-80 mm at 10 yrs.).

g) Herring. Analysis of recapture data from 1973 and 1974 tagging experiments on both sides of the Bay of Fundy (Div. 4X) indicates movements across the Bay in summer with dispersion in winter along the Maine Coast as far west as Cape Cod and northeast to the Chedabucto Bay area (Div. 4W). Lack of returns from the Sydney Bight area (Subdiv. 4Vn) suggests that herring in Sydney Bight are not related to south-west Nova Scotia or, probably, Chedabucto Bay fish.

Studies of herring fecundity in relation to fish weight, age, length, spawning group and area of capture were continued.

Studies of the relationships between the structure of hydrographic systems in the Bay of Fundy and the siting of herring spawning grounds, absolute size, and distribution of herring stocks have been initiated. Weir catches of juvenile fish in the Bay of Fundy are being studied as indicators of movements of fish groups and of the origin of the Bay of Fundy sardines.

h) Mackerel. Analysis of first year's growth and year-class size suggests a negative correlation between L_1 and year-class size at age 1.

Tagging returns further confirmed movement of mackerel from subarea 4 to subareas 5 and 6 during winter.

i) Tuna. Tag and recapture, and size frequency data, indicate that fisheries for giant bluefin tuna in the west Atlantic, north of Cape Cod, exploit a common population of mature fish. Catch trends, mean sizes and ages are similar in the northeast and northwest Atlantic.

Ageing data indicate that 19-24 yr-old fish dominated the 1975 Canadian catch with very few fish younger than 14 yrs (1961 year-class). Evidently a few cohorts have supported the Canadian inshore fishery over the last 10-12 yrs and few recruits have entered since the early 1950's. The population of giant fish is expected to continue to decline to about 10% of current stock levels in the next 4-10 yrs even with management practices giving protection to juvenile fish.

j) Swordfish. Biological data on swordfish stock off the Scotian Shelf (Div. 4V-W-X) were collected during experimental longline operations with chartered vessels.

3. Gear and Selectivity Studies

Data fully decribing trawl dimensions and vector forces during 73 instrumented tows, representing over 30 types and rigging of groundfish trawls under various towing conditions, are available. Estimates of door spread are in good agreement with net and warp measurements. Net drag, measured at wing tips, is a close linear function of hydrodynamic pressure, with good separation between hydrodynamic and ground friction components of drag.

An apparatus was built to measure target strengths of live fish at different aspects, in relation to development of an echo-counting system.

Underwater noises produced by an offshore oil drilling operation in the Bay of Fundy (Div. 4X) were measured and ranges at which herring can probably detect the noises estimated: at the moderate ambient sea-noise level of -40 db, the noisiest operation may be detected at 74 km.

An obstacle avoidance system has been designed for the bottom-referencing underwater towed instrument vehicle (BRUTIV).

Planning and trials were made on high-headline trawls and on double-codend trawls for separation of redfish and shrimp.

Subarea 5

A. STATUS OF THE FISHERIES

1. Groundfish general

Total nominal landings were 5,659 metric tons, a decrease of 15% from 1974 and 31% below the 1973 landings.

2. Cod

Landings of cod increased over the 1974 level by 28% to 1,920 metric tons, almost all from Div. 5Z.

3. Haddock

Landings of haddock (1,433 metric tons) were more than twice those of 1973 (664 metric tons).

4. Pollock

Landings continued to improve, with a 32% increase over the 1974 level to 4,695 metric tons, of which 92% were from the Georges Bank area (Div. 5Z).

5. Sea scallop (*Placopecten magellanicus*)

Landings totalled 62,086 metric tons whole weight, a 25% increase over 1974. Major effort (95.8%) of the offshore fleet was on Georges Bank (Div. 5Z).

In June 1975 a regulation prohibiting the landing of scallop meats averaging more than 45 meats/lb was introduced.

6. Herring

Landings of herring increased by 25% from the 1974 level to about 5,000 metric tons, all from Div. 5Y.

7. Tuna

Landings from the mid-Atlantic Coast purse-seine fishery increased from the 1974 landings by 186% to 295 metric tons. The fish lengths ranged from 50-180 cm, within the range of the 1974 catch.

B. SPECIAL RESEARCH STUDIES

1. Biological Studies

a) Sea scallop. Sampling of catches for meat sizes and development of methods for analysis of meat-size data were continued.

Section III. Harp and Hood Seals

(Subareas 2, 3 and 4)

A. STATUS OF THE FISHERIES

	Harp Seals			Hood Seals		
Area	Young	Older	Total	Young	Older	Total
Gulf	7,550	9,102	16,652	11	8	19
Front	81,461	15,790	97,251	2,569	2,795	5,364
Total	89,011	24,892	113,903	2580	2,803	5,383

In 1975 the overall quota of harp seals remained at 120,000 for ships and the allowance for Canadian landsmen in waters north to Cape Chidley, Labrador, at 30,000. Canadian ships exceeded their quota (60,000) by 663 harp seals. Because of unusual ice conditions the Canadian landsmen exceeded its allowance and took 53,240 harp seals. Thus with the Norwegian catch of 60,161 the overall catch was 174,064 instead of the allowable catch of 150,000. The total catch of young-of-the-year was 140,629 with 133,079 of those taken at the Front.

B. SPECIAL RESEARCH STUDIES

1. Harp Seals

An ultra-violet photographic aerial survey was conducted in the Gulf (Subarea 4) on March 10. In a herd area of 519 km^2 the estimated pup production was 46,300+ 5,158 (95%CI). This technique appears to be well suited for counting exposed white-coat pups but substantial ground-truthing is essential where the ice is hummocky. The possibility that the single, concentrated, herd photographed did not comprise the total Gulf production in 1975 remains a major consideration to be examined in subsequent years.

Similar surveys were made at the Front on March 11 (northern patch) and March 15 (southern patch). The "best" estimate for pup production for the two patches was 79,658 but the confidence interval was extremely wide (with an upper limit of 145,775 pups) and the actual area of the herd somewhat uncertain. The greater variability in ice condition at the Front may result in a smaller portion of the pups being exposed to the camera and greatly increases the need for ground truthing.

Age analysis of samples taken for net fisheries on the southward migration was compared to similar data from 1970, 1971 and 1974. The year-classes of 1972, 1973, and 1974 (from which catches in excess of 200,000 young were taken) are generally more poorly represented than is that of 1968 (from which 155,000 young were taken). The 1972, 1973 and 1974 year-classes appear well represented (mean catches of young for those years were 110,000).

Recaptures of seals tagged or branded as young in the Gulf indicate a significant number appear at the point at age 1 but a high rate of return to the Gulf by age 3.