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Section I. Scotia-Fundy Region (Div. 4VWX, Subarea 5)

by

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Subarea 4: Divisions 4V-W-X

A. STATUS OF THE FISHERIES

1. Groundfish General. Total nominal catches decreased by 21% to 155,032 MT. The decrease was due mainly to reduced landings of cod and mixed species but was spread over all major species except Atlantic halibut.
2. Cod. Landings decreased by 7% to 66,944 MT, 43% of total groundfish catches in the area. This is slightly higher than the proportion in 1987 (41%). The decrease was most severe in 4Vs (14%) but was spread over the whole of the central and northeast Scotian Shelf (4VW). There was a slight increase in 4X.
3. Haddock. Nominal landings decreased 11% to 14,736 MT. This was mainly due to an 18% reduction in catches from 4X which obliterated increases from the rest of the Scotian Shelf.
4. Flatfish. Catches fell by 20%. The fall was spread through all species except Greenland halibut, a minor component, but mainly in the northeast part of the Scotian Shelf (4VWX). The major impact was from American plaice, witch flounder and winter flounder.
5. Redfish. Catches fell by 20% to 13,202 MT. The effect was felt in all areas of the Scotian Shelf (4VWX) but mainly in 4X and 4Vn.
6. Pollock. Catches decreased by 6% to 38,552 MT. The decrease was shown in all subdivisions.
7. Other Groundfish. Total landings from the area were down 36% to 9,665 MT. Again, the reduction was shown by all species and in all subdivisions.
8. Scallop (*Placopecten magellanicus*). Landings were approximately 29,800 MT round weight, an increase of nearly three times those of 1987. A major contributor was the Bay of Fundy (4X) where landings from the Digby area were the highest on record, based on two good year classes.
9. Herring. Total nominal catches were 166,842 MT, an increase of 28% from 1988. This was almost wholly due to a 30% increase from 4X, constituting 92% of the total landings.

10. Mackerel. Nominal landings increased by 15% from 1988 to 6,063 MT, 58% from 4X.
11. Swordfish. Thirty-nine long-line vessels reported landings totalling 1431.5 MT, gutted, head-off, about 2.5 times the 1987 landings. The average weight was 76.5 lbs, compared with 69.3 in 1987, and reversing the decreasing trend in average weights since at least 1983. The harpoon fishery landed 39.7 MT with an average weight of 152 lbs.
12. Atlantic Salmon. Total nominal landings for 1988 were 19.1 MT, a 5% decrease from 1987. This was a grilse-only retained sports fishery: there was no commercial fishery permitted.
13. Squid (*Illex illecebrosus*). Reported landings were 11 MT round weight.

B. SPECIAL RESEARCH STUDIES

Environmental Studies

(a) Hydrography.

Examination of groundfish distributions in relation to bottom environmental conditions on the Scotian Shelf (4VWX) continued.

(b) Plankton.

The second annual survey was carried out to study the relationships between early life history stages of cod and haddock, zooplankton biomass and macrozooplankton abundance, and to assess the influence of the tidal front off Nova Scotia (4VWX) on them.

2. Biological Studies.

(a) General. The annual groundfish research program on the Scotian Shelf continued with the regular summer (July) survey, which was extended to cover the Canadian portion of Georges Bank. The annual March survey of the whole of Georges Bank, the two herring larval surveys (March, October), the 6th annual acoustic survey of overwintering herring in Chedabucto Bay (4W) and the joint Canada/U.S.S.R silver hake survey (November) were also completed.

Monitoring and biological sampling of commercial catches both at sea and landing places continued.

(b) Cod. Image analysis procedures were used for digitization of 9,600 otolith perimeters for Fournier analysis of shape data in a cod stock structure study.

A time series of daily growth rates was obtained through digitization of daily increment widths in otoliths representing over 400 individuals. The series will be analysed in conjunction with frequency distribution of birth dates for identification of year class strength and prediction of recruitment to the fisheries.

(c) Haddock. Returns of 70 fish from a tagging of 12,000 on Western Bank (4W) suggest a general east and north movement in summer, corroborating earlier work. Collections of haddock for stock discrimination were made from various areas for meristic, morphometric (truss measurement) and electrophoretic studies.

(d) Herring. In continuing work on stock identification, 2 years data from 8 spawning stocks were analysed for meristics, morphometrics, parasites and mitochondrial DNA. Studies continued on transboundary herring along the coasts of Maine and New Brunswick (5Y,4X) and on analysis of factors affecting the weir fisheries, including historic weir performance and interaction with marine cage-aquaculture.

(e) Redfish. An age validation study showed good correlation between radiochemical assays of otolith core samples and annular ages, with some disparities at older ages. It confirmed that redfish on the Scotian Shelf (4VWX) attain ages of up to at least 75 years.

(f) Atlantic halibut. Studies of undersized, and line caught v. trawl caught halibut, on the central Scotian Shelf (4WX), showed that the undersized fish released by trawl fishermen had extremely high mortality rates and that survival of line caught fish was much higher than in trawl caught fish of retainable sizes.

A sampling program involving collection of gonads by longline fishermen was initiated in an attempt to define spawning grounds on the Scotian Shelf (4VWX). A survey of intestinal parasites was completed.

(g) Mesopelagic fishes. A two year study of distribution and abundance of meso pelagic fishes off the Scotian Shelf (4VWX) was initiated.

(h) Scallop (*Placopecten magellanicus*) Research cruises were again carried out in the Bay of Fundy (4X) and Scotian Shelf (4WX) to inventory commercial-sized stocks.

Subareas 5 and 6

A. STATUS OF THE FISHERIES

1. Groundfish General.

Total nominal landings increased 9% to 23,014 MT, wholly from Div. 5Z. Landings of all major species except pollock increased. Cod alone constituted 58% of the catches.

2. Cod. Catches increased 3% to 12,743 MT

3. Haddock. Catches increased by 24% to 5,943 MT due to increased effort on Georges Bank (5Zc).

4. Pollock. Nominal landings decreased by 26%, following the general decrease in pollock catches in Subareas 4 and 5. The decrease is attributed to reduced effort, not problems with the stock(s).

5. Other Groundfish. These constituted only 4% of total landings. All species except yellowtail flounder showed increases.

6. Scallop (*Placopecten magellanicus*). Landings totalled 36,000 MT round weight, a 37% decrease from 1987.

7. Herring. No herring were landed from Subarea 5.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies.

(a) Hydrography

A field study of circulation, mixing and hydrography at the tidal front on northeastern Georges Bank was conducted between June and October, in association with biological and fisheries studies. Seven current meter moorings and two thermistor chain moorings were deployed. Fifteen drifter-tracking experiments were carried out each involving 2-11 satellite- or LORAN-tracked drifters, or 16-19 radar-tracked drifters. Totals of 459 CTD profiles, about 1770 nutrient samples and over 100 hours of Batfish hydrographic tows were obtained during three survey periods. Approximately 1200 turbulence profiles were taken at the mooring sites with the instrument EPSONDE. Other observations included velocity profiles with the Acoustic Doppler Profiler; surface temperature, salinity and fluorescence; and wind and air-sea flux observations in the frontal region.

(b) Plankton

A study of the distribution of zoo- and ichthyo-plankton distributions and of retention and/or dispersion on Georges Bank was initiated.

2. Biological Studies.

(a) Herring.

A survey for adult and larval herring on Georges Bank (5Z) (October 30-November 11) included a comparative fishing experiment with the U.S. Results from 1986 and 1987 surveys

produced evidence of resurgence of the spawning group.

(b) Scallop (*Placopecten magellanicus*)

A research cruise was carried out on Georges Bank (5Zc) to inventory commercial-sized stocks. A survey for larval scallops was completed in October.

SEALS

Subareas 2, 3 and 4

A. STATUS OF THE FISHERY

Harp Seals. Preliminary figures for the seal hunt on the Front show a total of 45,410 taken, 63% of the quota and a 28% increase from 1987. In addition 33,868 were taken in the Gulf. The number of vessels engaged in the Front fishery increased by 30% to 57.

Hooded Seals. Total harvest was 824 compared with 1362 in 1987, a drop of 40%.

B. SPECIAL RESEARCH STUDIES

Grey Seals. Long term monitoring of the Sable Island (4W) pup production continued. Of 8593 pups born, 7725 were tagged, representing the number surviving to the end of lactation, and 868 died during the nursing period.

A 5-year program on the ecology and population dynamics of grey seals and the sealworm parasite, *Pseudoterranova decipiens* was initiated. Geographical and temporal trends and prevalence of infection in the seals and in American plaice as an indicator species are being investigated.

Studies of milk (energy) intake and subsequent growth, composition and energy density of milk, mass transfer from mother to pup, and pup growth, body composition in early, middle and late lactation in mother/pup pairs, and pattern of weight change in post weaning, fast, and initial feeding in pups were started. Trials of an anti-helminthic drug (Ivermectin) and a chemosterilant (LNG) were carried out to combat the sealworm problem.

Harbour seals. The distribution of births during the breeding season and total pup production continue to be monitored. Investigations into the cost of reproduction and lactation, and on patterns of feeding were continued.

SECTION II - Newfoundland Region

by

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SUBAREAS 0 AND 1

A. Status of the Fisheries

1. Shrimp. Canadian landings of shrimp from Division 0A in 1988 totalled 5,881 t (preliminary), slightly less than 1987 landings. A new fishery developed in Division 0B where approximately 2,800 t were taken in 1988.
2. Other species. There were scallop landings from Cumberland Sound, Subarea 0. No other species of fish or invertebrates were landed by Canada from these Subareas in 1988.

B. Special Research Studies

1. Environmental Studies

- a) Baffin Bay/Davis Strait (Bedford Institute). Five moorings with fourteen current meters and three pressure gauges in a line across Davis Strait at 66°15'N that were deployed in the summer of 1987 were recovered. Five replacement moorings were deployed. Ninety-three CTD stations were occupied in the region of 65°-68°N.

2. Biological Studies

- a) Atlantic salmon. A total of 521 salmon was sampled at the fish plant in Godhaven, 2,946 in Sisimiut; 3,550 in Nuuk, 3,650 from Paamiut, and 388 from Narssaq in centimeter length groups; including detailed measurements of fork length, gutted weight, and of these 2,600 were scale-sampled. This project provides an annual assessment of the proportion of North American and European fish caught at West Greenland. Also, 111 salmon were detected with micro tags. Microtags were from Canada, USA, Scotland, Ireland, Iceland, and England.

In total, 374 tissue samples were collected for electrophoretic analysis. The results of this analysis will be used to develop a database of known-origin salmon for discriminant analysis.

- b) Observer Program. Canadian observers participated in several trips fishing shrimp in Davis Strait (0+1) during 1988. A total of 609 fishing days and 3,240 sets was observed, with a total of some 250,000 shrimp measured.

SUBAREA 2

A. Status of the Fisheries

1. Cod. Canadian landings were 59,000 t, up from 55,800 t landed in 1987. The majority of these landings were from Div. 2J with only 400 t landed from Div. 2H. Landings from the inshore sector accounted for 17,100 t compared to 16,400 t from this sector in 1987. Offshore landings were 41,900 t compared to 39,400 in 1987.
2. Redfish. Canadian landings were 400 t, down from 2,600 t landed in 1987 and 2,900 t landed in 1986. These landings were almost exclusively from Div. 2J with only 5 t landed from Div. 2H.
3. Greenland halibut. Canadian landings were 1,800 t, down substantially from 7,700 t landed in 1987 and 5,700 in 1986. Landings were primarily from Div. 2J with only 56 t recorded from Div. 2G and 2H. The inshore fixed gear fishery accounted for 1,530 t, or 85% of the landings from this Subarea.
4. Other groundfish. Canadian landings of all other groundfish species totalled only 140 t in 1988.
5. Capelin. Landings of capelin remained at a low level.

6. Herring. Landings of herring remained at a low level.
7. Atlantic salmon. Commercial landings of Atlantic salmon in Subarea 2 during 1988 were 356 t, compared to 482 t in 1987. Landings of large salmon (212 t) decreased by 35% from 1987. The recreational harvest totalled 9.1 t.
8. Arctic charr. Landings of Arctic charr in Subarea 2 during 1988 were 89 t, a decrease of 17% from 1987. The continued decrease in fishing effort is a major factor associated with reduced landings again in 1988. Assessments were carried out on three major stock units representing ten subareas.
9. Shrimp. The Subarea 2 shrimp fishery was subject to a total quota restriction of 6,800 t in 1988, 4,000 t of which were in the Hopedale Channel. Total landings were approximately 11,000 t.

B. Special Research Studies

1. Environmental Studies

- a) Oceanographic studies. The Seal Island section in 2J was occupied in August and again in November in 1988. Temperature profiles were taken at each fishing station occupied in the subarea.
- b) Labrador Shelf (Bedford Institute). The offshore ice over Labrador Shelf in 1988 was thinner than normal and caused a reduction in ice beacon deployments to seven from the planned twelve deployments. The beacons collect ice drift data used to study the atmosphere and oceanographic contribution of the ice drift. A prototype ice-water temperature profile beacon on landfast ice at Makkovik collected successfully data for a three month ice-growth season. Its data are transmitted in real time via satellite Argos data link and used to study ice growth and oceanic heat fluxes. During the ice-beacon deployments with a helicopter, temperature and salinity profiles of the water column under the ice are collected and used to obtain the variability of oceanic heat content available for melting the pack-ice.

2. Biological Studies

- a) Cod. Biological sampling of the commercial fishery included observations from both the inshore and offshore sectors. From research vessels, distribution and abundance studies were carried out and detailed biological sampling was conducted. A second complete stratified-random survey was conducted in Divisions 2GH (August 16-September 9) and provided samples and biomass estimates.
- b) Flatfish. Data on distribution and abundance of American plaice, Greenland halibut, and witch were collected during groundfish surveys of NAFO Div. 2G, 2H and 2J in 1988. Researchers continue to use data from shrimp surveys in Div. 2H and 2J in efforts to develop a recruitment index for Greenland halibut.
- c) Capelin. An acoustic survey in Div. 2J3K in October 1988 resulted in a biomass estimate of 2,439,000 t, the highest estimate since the series began. The 1986 year class dominated.
- d) Atlantic salmon. A total of 3,081 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.
- e) Arctic charr. A total of 2,571 samples was obtained for age determination of Arctic charr in commercial landings from thirteen northern Labrador fishing areas. Approximately 18,000 fish were sampled for length distribution from the same areas. Tagging studies were continued to clarify the extent of seasonal and annual movements and to determine the degree of annual commercial exploitation. Information on sex distribution of charr caught in the fishery was obtained and stomach samples obtained for evaluation of food and feeding habits.
- f) Shrimp. A research vessel survey which was conducted in July, 1988 completed a biomass survey using a Sputnik 1600 shrimp trawl in the major areas where commercial concentrations occur. A total of 179 sets was made with the greatest catch (887 kg) being obtained in the Hopedale Channel. Catches in the Cartwright Channel ranged to 490 kg. Information from this survey was used to estimate shrimp abundance which, in turn, will be used to update CAFSAC advice on total allowable catches for 1989. In addition, Canadian observers participated in several commercial trips fishing shrimp off Labrador and northeast Newfoundland (Subarea 2 and Div. 3K) during 1988. A total of 1,019 fishing days and 5,171 sets was observed, with a total of some 460,000 shrimp measured.

SUBAREA 3

A. Status of the Fisheries

1. Cod. Canadian landings were 235,200 t, up from 211,600 t landed in 1987. The inshore sector accounted for 108,200 t, compared to 96,500 t landed inshore in 1987. Landings from Div. 3K and 3L accounted for

77% of all cod landings in this Subarea with landings from Subdiv. 3Ps accounting for another 11%. Inshore landings from Div. 3K and 3L were 83,100 t, up significantly from 62,600 t landed inshore in 1987, while offshore landings were also up at 98,000 t compared to 83,700 t in 1987. Inshore landings from Subdiv. 3Ps were 19,600 t, down from 26,700 t in 1987, while offshore landings were 6,000 t to 6,500 t landed in 1987.

2. Redfish. Canadian landings were 20,800 t, compared to the 1987 level of 21,800 t. Division 3K and 3L landings were 11,500 t, down from 15,200 t in 1987. Combined landings from Subdiv. 3Pn and 3Ps were 9,200 t, up from 6,400 t in 1987. Landings from other Divisions remained low.
3. Flatfish. Canadian landings of the combined flatfish species were 56,200 t compared to 70,900 t landed in 1987. American plaice dominated these landings at 31,400 t, down substantially from 39,600 t in 1987. Yellowtail landings were 10,700 t, down from 13,700 t in 1987. Greenland halibut landings were 6,700 t, down from 9,400 t in 1987, while greysole landings were 5,800 t compared to 4,900 t in 1987. Other flatfish landings in this Subarea included 700 t of winter flounder and 950 t of Atlantic halibut. While landings from the inshore sector amounted to only 22% of overall flatfish landings, about 94% of all Greenland halibut were landed by the inshore fixed gear sector.
4. Other groundfish. Canadian landings of other groundfish species were haddock (9,600 t), white hake (2,700 t), pollock (2,100 t), and wolffish (1,100 t). Some 2,500 t of lumpfish roe were also landed in this Subarea during 1988.
5. Capelin. Approximately 53,000 t of capelin were landed inshore in Div. 3L, 26,000 t in Div. 3K, and 3,400 t in Div. 3Ps in 1988. The inshore catches were taken during the inshore spawning migration. Female capelin are preferred to satisfy the Japanese roe market. The offshore catch in Div. 2J3KL was 17,000 t.
6. Herring. Herring landings from Newfoundland were approximately 19,200 t, 17,900 t from Div. 3KL and 1,300 t from Div. 3P. The commercial fishery did not catch the quota primarily due to poor market conditions.
7. Mackerel. Mackerel landings in Subarea 3 were about 4,300 t, compared to 10,000 t landed in 1987.
8. Squid. Total reported catch of squid in 1988 was 264 t (preliminary data). Early season catch rates on the southern Grand Bank were moderate. However, the fishery was again poor, the low catch being due to a natural absence of squid from commercial fishing areas.
9. Atlantic salmon. Landings were 420 t in the commercial fishery and 39 t in the recreational fishery. The commercial catch of large salmon (182 t) decreased by 49% from 1987.
10. Shrimp. The Div. 3K shrimp fishery located in the St. Anthony Basin was subject to a TAC of 1,500 t from May 1, 1988 to April 30, 1989. Catches to date from this area exceeded 1,200 t. An additional 2,300 t were taken in other areas within Div. 3K under exploratory fishing.
11. Scallops. Approximately 1,000 t sea scallop meats were landed from offshore 3P (St. Pierre Bank). Based on a single year class, this represents record landings from the area.

B. Special Research Studies

1. Environmental Studies

- a) Oceanographic studies. All of the standard sections in Subarea 3 (White Bay Line, Bonavista Triangle, Flemish Cap Section) were occupied August 1-15, 1988. The time series of Station 27 (4 km east of Cape Spear) was continued, the station being occupied 33 times in 1988.
- b) Plankton studies. Examinations of samples collected during August, 1987 on vertical distribution and diel variability of ichthyoplankton catches from oblique bongo tows in a Newfoundland coastal bay were completed. The same type of data will be collected in June and July, 1989. Summaries of ichthyoplankton caught during surveys carried out during 1982-86 have been tabulated. These include length frequencies of all fish larvae captured. Analysis is complete on the comparison of catches of larval capelin in 2 different gears, with an examination of biases in the calculation of population parameters derived using a standard gear.
- c) Ocean Circulation (Bedford Institute):
 - (3N) Southeast Shoal (Grand Bank).

A current meter mooring and a sea surface temperature buoy were deployed on the southern Grand Bank from April to September as part of a larval capelin study. An intercomparison of circulation and mixing on southeast Shoal and three other Northwest Atlantic banks was published. Reports on moored current and oceanographic measurements taken on Southeast Shoal in 1986 and 1987, and on historical oceanographic data analyses were also published.

- (3N) Integyre Exchange Experiment

An array of seven current meter moorings was deployed along 50°15'W running south from the 200-m contour to latitude 39°25'W to investigate the circulation and distribution of water properties over the southeast Newfoundland Ridge. Recovery is scheduled for January 1990. Oceanographic and trace element measurements were also carried out on the mooring deployment cruise.

- d) The oil industry continued ongoing oceanography observations on the Grand Banks (at a low level) in support of offshore exploratory drilling operations. Additional activities included ice and iceberg surveillance, geophysical site surveys, spill response field exercises.
- e) Temperature guided fishery project. A three-dimension correlation structure function was developed for Grand Banks sea bottom temperature. An inter-ship HF radio computer network was developed for the exchange of data and maps using the NAPLPS (aka Telidon) international standard and an innovative data compression technique. Extensive tests aboard two vessels were conducted in 1988.
- f) Centre for Cold Ocean Resources Engineering (C-Core), Memorial University:

- LIMEX

Motion data collected on the pack ice during the Labrador Ice Margin Experiment (LIMEX) of March, 1987 were analysed. A final report was submitted and the data used to verify a wave/ice interaction model developed for the Grand Banks. C-Core will be participating in two phases of the LIMEX '89 project, the investigation of ice wave interaction and the measurement of sea ice properties.

- Innovations in Acoustic Technology Offshore Conventional Optimization Acoustic Subseabed Interrogator (CO-ADI) Design and Fabrication

An extensive field simulation of the Conventional Optimization Acoustic Subseabed Interrogator (CO-ASI) took place in October, 1988. The data are presently being processed using a "Micromacs" processing system (hardware and software from Advance Geophysical of Denver, CO). Source characteristics and resolving capabilities of the system are meeting the target performance levels. A comprehensive optimization study of the sparker source is underway. Processing of the data collected in October will be completed by the spring, 1989. Field tests are scheduled for summer/fall, 1989 to verify the effectiveness of a working shallow water CO-ASI.

- Ice/Seabed Interaction

Ice scour research, supported by an NSERC strategic grant, continued to provide information on the mechanics of the scour process and its effects on the soils both above and below maximum scour depth. The second field trip to relict scours took place in mid-September, 1988 and the results indicate that, contrary to earlier ideas, soils are disturbed to some depth below the ice keel. Further work is directed to establishing the generality and significance of these preliminary indications. The ultimate goal of the research is to provide quantitative models of ice scour process for engineering design.

- Remote Sensing of Ocean Wave Conditions

The work performed to support wave remote sensing is in its final phase. The research is directed to finalizing new algorithms to extract wave conditions from the measured radar return. Numerical inversion of the equation for the principal components of the second order scatter provide the base for these techniques. The results show that the off patch scattering (third order) can be ignored and the measured radar return can be substituted from the radar data collected during the CASP (Canadian Atlantic Storms Program) field experiment correlate well with other wave data measured by wave buoys. The results are valid for a wider range of wave frequencies than was thought possible with earlier models. The new model will now be used to estimate the wave conditions for the radar data set provided by the British Department of Energy. These more recent data cover a broader range of incident ocean conditions than was available during CASP.

The algorithm is also being adapted for returns collected from a single monopole antenna mounted on a moving platform (drill rig or ship). This configuration gives a simple short range system, i.e. one capable of measuring the wave condition experiences right at the platform. An omnidirectional radar data set to test this version of the interpretation software was collected from the Department of National Defence research ship Quest, in April 1988.

The long term objective of the wave remote sensing program is to provide a wave interpretation capability for the various configurations of ground wave radars being considered for operational use. Configurations include:

- (a) the long range fixed coastal site radar (NRSL);
- (b) the portable shorter (~60 km) range narrow beam system (the OSCR system developed at the Rutherford Appleton Labs.);

- (c) the platform based omnidirectional radar, and;
- (d) the broad beam CODAR type systems.

- Environmental Survey

A report on an environmental survey of sea ice, iceberg, wave, and wind conditions on the Grand Banks was completed. This work was part of a comprehensive study on the behaviour of a proposed concrete semi-submersible to be used for oil production in ice-infested waters.

2. Biological Studies

- a) Cod. Sampling of the landings from the commercial fishery both inshore and offshore was continued in 1988. Using research vessels, surveys were carried out in all NAFO Divisions (except 3 M) to determine the distribution and abundance of cod. Biological sampling was extensive during these surveys and several thousand cod were tagged, inshore and offshore. Samples were collected from meristic studies in Div. 2J3K during winter and Div. 3L and Subdiv. 3Ps during spring.

Acoustic tracking of cod on their inshore migration provided observations on their diurnal behaviour in relation to feeding and temperature. Combined trawl and acoustic surveys were used to determine the distribution of cod off the east coast of Newfoundland during the shoreward migration in June.

Details of physical oceanography on cod and capelin schools were monitored continuously at an inshore location while movements of individual cod were tracked using acoustic tags.

- b) Redfish. Several research cruises throughout Subarea 3 (except Div. 3NO) were conducted yielding information on abundance and distribution. The collection and subsequent ageing of otoliths from both research and commercial catches, and the application of these to respective length frequencies yielded information about commercial catch at age as well as population structure. An acoustic cruise for redfish was carried out in Div. 3P during July-August.
- c) Flatfish. Distribution and abundance of flatfish were studied during fall random stratified surveys in the following NAFO Divisions and times in 1988: Div. 3K - fall survey; Div. 3L - spring, summer, and fall surveys; Div. 3N, 3O - spring survey; and Subdiv. 3Ps - winter survey. These surveys provide a major source of information for continued biological studies of flatfish. In addition, the following surveys provided valuable data on flatfish:
 - A gear trials experiment was conducted in the fall and provided valuable insights into the efficiency and behaviour of research vessel fishing gear particularly through the use of underwater cameras. Behaviour of fish near fishing gear and rates of escapement were also investigated and the results are being presented to the ICES Fish Capture Working Group.
 - In the fall of 1988 new studies into the behavioural ecology of A. plaice were initiated largely through laboratory experiments in controlled environments.
 - As a results of joint research efforts from the Newfoundland Region and Scotia-Fundy region scientific advice was provided through CAFSAC for the first ever management plan for Atlantic halibut in Canada.
 - A juvenile flatfish survey was conducted in Div. 3LNO in the fall of 1988. This survey is part of a time series directed at establishing a pre-recruit index for yellowtail aged 1-3 years. Information was also collected on the distribution and abundance of juvenile American plaice.

- d) Capelin. Data from acoustic surveys conducted in the offshore areas of Div. 3L were used to provide TAC advice, through NAFO, for 1989. The inshore fishery was monitored by a comprehensive logbook survey and an aerial survey was conducted during the inshore spawning migration. The strong 1983 year class made a higher than normal contribution (for 5-yr-olds) to the spawning biomass. The 1986 year-class was determined to be as strong as the 1983 year-class.

Two cruises to the Southeast Shoal were completed in 1988. On the first trip (DAWSON, September) seventy-one stations were sampled with MINIBIONESE. In a November trip (LADY HAMMOND) detailed information was collected on the vertical and horizontal distribution of capelin larvae relative to oceanographic features.

- e) Herring. Surveys to determine vertical distribution and abundance of herring and capelin larvae were conducted in Trinity Bay in August and September. An acoustic survey was conducted to estimate herring abundance in bays of northeastern Newfoundland during October-December.
- f) Scallops. A two-week research survey was undertaken to assess the state of sea scallop stocks on St. Pierre Bank (Subdiv. 3Ps). Two hundred and twenty-five one-mile survey sets were completed in two target areas. Sea scallop biomass was estimated to be about 2,000 t (meats). Observer participation was provided to a factory trawler fishing for Iceland scallops on the Grand Banks (NAFO Div. 3LNO)

- g) Squid. From a pre-recruit survey in June on the Grand Bank a predictive index of inshore abundance was determined. At Holyrood, squid samples were collected when available, catch-effort data were collected using squid traps, and water temperature was monitored.
- h) Crabs. Studies on biological aspects of a shallow-water spring breeding migration of snow crabs were continued at Bonne Bay in western Newfoundland. Studies investigating the effect of water temperature on yearly recruitment were continued. A photographic survey for snow crab was attempted during May in Conception Bay, but was unsuccessful due to the loss of the photographic vehicle.
- i) Lobster. Long-term monitoring of the fishery of various aspects of population biology and dynamics were continued at three inshore Newfoundland sites.
- j) Atlantic salmon. Long-term research studies continued to develop a model which could be used to estimate salmon production capacities of streams, optimal egg deposition and stock and recruitment relationships. A total of 1,876 Atlantic salmon caught in the commercial fisheries was sampled for size and age distribution.
- k) Seals. A total of 825 jaws, 677 stomachs, 163 ovaries and uterus, 30 foeti, and 142 penis and testes were collected in 1988. Additionally, 119 tissue samples (blubber, heart, liver, and muscle) were collected for a collaborative research project with Vic Huang of Efamol Research Institute on the lipid biochemical profiles in seal tissues.

Results of experiments on the determination of optimal photographic conditions for aerial surveys of harp and hooded seals have been analyzed.

Preliminary results from 2,805 harp seal stomachs indicate that frequency of occurrence of food items are as follow in decending order: capelin, arctic cod, shrimp, euphausiid, squid, amphipod, redfish, rock cod, sand launce, cod and herring.

Historical data on bounty and tag returns from grey and harbour seals collected at Newfoundland have been returned from Quebec and Scotia-Fundy regions and verified. The data have been encoded and a computer file suitable for inclusion in the Inter-Regional Grey Seal Data Base has been prepared.

A paper on by-catch of seals, whales and sea birds in fishing gear was presented to the World Symposium on Fishing Gear and Fishing Vessel Design, in conjunction with J. Lien (MUN) and R. Elliot (CWS).

- l) Whales. A total of 5 harbour porpoises, 2 white-sided dolphins, and 1 blue whale was examined. Morphometric measurements were obtained and samples from the smaller cetaceans were obtained for determination of parasite loads and toxic chemicals levels.

A publication "Right whale (*Eubalaena glacialis*) sightings in waters off Newfoundland and Labrador and the Gulf of St. Lawrence (1978-87)" has been accepted by the Canadian Field-Naturalist.

- m) Multispecies. Laboratory experiments were undertaken into the influence of variations in food availability on the susceptibility of larval fish to predation. A review of studies on early life history characteristics in fish was completed to assess the sensitivity of fish eggs and larvae to fluctuations in biotic and abiotic features of the environment.
- n) Newfoundland Institute for Cold Ocean Science (Memorial University). Field investigations were undertaken on primary productivity in coastal bays (primarily Conception Bay). General emphasis is given to the fate of primary production especially microbial decomposition and adjection of materials away from the site of production (COPE-Cold Ocean Production Experiment). There were further studies of the movement of adult capelin in relation to the upwelling/downwelling cycle and related predator interactions. Additional work is being undertaken of faunal boundaries on the Grand Banks using the extensive Fisheries and Oceans trawl surey data base.

SUBAREAS 2 AND 3

A. Special Research Studies

1. Environmental Studies

- a) Oceanographic and related studies. Ships of opportunity XBT programs were continued using the vessels CAPE ROGER and the LEONARD J. COWLEY. Temperature profiles were taken at each research fishing station occupied during 1988. Six month temperature recorders were provided to researchers in conjunction with the DFO long-term Temperature Monitoring Program. Field trials of

the Applied Microsystems STD-12 and the Seacat Profiler on the groundfish ottertrawl were also undertaken.

- b) Hydrography. The C.S.S. MAXWELL and hydrographic staff were involved in inshore sounding surveys from May 16 to November 4. Detailed information for the updating of navigation charts was collected along the NE Newfoundland and southern Labrador coasts.
- c) Bedford Institute. Thirteen moorings placed on the Labrador shelf and slope in 1987, including five pressure gauges, and twenty-three current meters were recovered in mid-summer. These were replaced by two moorings on Hamilton Bank and four on Nain Bank. Fifty-two CTD stations were occupied in a line from St. John's, Newfoundland to Flemish Cap to the Central Labrador Sea and down the Hamilton Bank line.

2. Biological Studies

- a) Assessments. Assessments of some 25 groundfish stocks presently under catch quota regulations were conducted and refined and advice on TACs for the 1988 fishing season was provided either through CAFSAC or NAFO. Further assessments were conducted of 17 pelagic-shellfish-marine mammal stocks, the marine phase of mixed Atlantic salmon stocks originating from Nfld., Labrador, Quebec and Maritime rivers, three Arctic charr stock complexes and other commercial and potentially commercial species.
- b) Research vessel cruises. Fifty offshore and inshore research vessel cruises were undertaken in 1988 utilizing DFO-owned vessels (WILFRED TEMPLEMAN, MARINUS, SHAMOOK, LADY HAMMOND) and the GADUS ATLANTICA (on long-term charter) (Table 1).
- c) Commercial sampling. Sampling of foreign and Canadian offshore catches by the Canadian Observer Program continued in 1988. A total of 6,006 samples representing some 1,333,530 length measurements and approximately 13,353 otolith pairs were collected from the catches of foreign and Canadian offshore fisheries. A total of 7,902 days and 28,672 sets was observed. Coverage in 1988 was high for 2J3KL cod, whereas in other areas approximately 20% coverage of Canadian vessels was maintained. The foreign activity inside the 200 mile limit was completely covered. High levels of coverage were also maintained on RSPP and other types of charter trips. Analysis of production on factory and wetfish trawlers was continued and the study of discarding practices for the domestic offshore fleet was examined closely.
- d) Cod. Tagging data on cod from Divisions 2 and 3 have been analyzed to assess how movement varies with age of fish, year of tagging, and place of tagging. Analyses were conducted of the Canadian otter trawl catch rate series for cod in NAFO Div. 3NO for alternate methods of determining directed fishing effort. Major improvements were accomplished relative to the 2J3KL cod data base to permit a greater variety of assessment treatments. This included expansion of catch-at-age matrices and adjusting survey data to account for omitted strata.
- e) Cod-capelin interactions. Discussions with Norwegian scientists laid groundwork for a bilateral workshop on cod-capelin interactions, to be held in 1989.
- f) Parasitology. Results of the survey of sealworm in cod stocks around Newfoundland have been submitted for publication. The findings indicate that abundance of sealworm in cod caught along the south coast of Newfoundland are two to three times higher than during the 1950's. Elsewhere sealworm abundances were still low and similar to those reported previously. Electrophoretic analyses of samples of sealworm (conducted by Prof. Lia Paggi and coworkers at the University of Rome) has revealed two, and possible three, distinct species of sealworm in Canadian waters. The species causing problems for the industry has been designated Type B until a full morphological description of all species is prepared.
- g) Groundfish. Analyses commenced to quantify the variation in biomass by size category, as compared to by species, for groundfish taken in research surveys from 1971 to the present.
- h) Flatfish. Papers were prepared on historic biomass levels of G. halibut from USSR surveys; the distribution of G. halibut in relation to temperature; and the distribution of witch in Subdiv. 3Ps with changes in age, growth and sexual maturity since exploitation began in the early 1950's

3. Gear and Selectivity Studies

- a) Comparative fishing trials of moored monofilament longlines (feather-hooks vs. baited hooks). A comparison of the catching efficiency of feather hooks and baited hooks for Atlantic cod was conducted in Newfoundland during August and September, 1988. A total of 46,100 hooks was fished for a period of 42 days. Total codfish catch for the project was 17,293 kg of which 9,935 kg (57%) were caught on feather hooks and 7,385 kg (43%) on baited hooks. There was an equal number of feather hooks and baited hooks fished (23,050 each) during the project. The average catch per feather hook was 0.43 kg; the average catch per baited hook was 0.31 kg.

- b) Selectivity of Nordsea groundfish trawl. A cruise was mounted in October, 1988 (Grand Bank) to evaluate selectivity of a Nordsea Trouser Trawl, fitted alternately with 155 cm square mesh or diamond. Escapement beneath the footgear was measured by attaching three mini trawls attached to the footgear and lying under the main trawl. Fish mainly under 30 cm escaped beneath the footgear, as well as some large fish. Selection curves derived from the Trouser Trawl showed that more smaller cod were escaping through 144 mm square mesh codend in comparison with diamond mesh codend.

4. Miscellaneous

- a) Shell hardness gauge for snow crab. Shell hardness studies using the Pacific Transducer (PT) durometer continued. With the PT durometer, there was a significant positive relationship between durometer units (related to hardness) and claw meat yield ($p > 0.001$, $r^2 = 0.53$, $n = 17$). The bottom of the claw was the preferred position since spines are missing on this region. Repeated measurements with gauges softened the claws so only one reading per claw should be taken. Of the three gauges tested (7, 10, 13 lbs of force), the 7 lb. gauge was easiest to use, softened claws the least after repeated measurements, and cracked the fewest claws. On a scale of 0 to 100 durometer units, a value of 72 (bottom of claw, 7 lb. gauge) is recommended as a cut-off for removing soft shell crabs from the catch. Surprisingly, hard shelled "morphometrically immature" males will also be excluded since their claws remain flexible even after the males may actually benefit the fishery since some scientists have postulated that these crabs are not yet fully grown nor mature.
- b) Parasite detection and removal. Canpolar Incorporated continued their work on a parasite detection system as part of a major effort toward solving this problem for the fishing industry. A pre-production prototype was successfully developed followed by a complete review of work to date. Efforts are now underway to develop a commercial prototype.
- c) Remote vessel tracking. The work undertaken during the year focused on design, development and testing of a ship-board housing for a modified Data Hail H.F. Link from fishing vessels to a shore-based monitoring system. The purpose of the project was to develop a self contained environmentally sound, tamper proof unit that could be rapidly installed on fishing vessels operating within Canada's 200 Economic Zone.

The system will provide DFO monitors with timely information on vessel positions and activities. An acceptable unit has been fabricated and tested under laboratory conditions and will be commercially tested at sea in the very near future.

TABLE 1
NEWFOUNDLAND REGION
RESEARCH VESSEL CRUISES 1988

Vessel	Area of Operation	Type of Survey	Operating Days	Trip #
NFLD-BASED VESSELS				
WILFRED TEMPLEMAN	3PsN	Groundfish	January 26 - February 15	68
	3L	Groundfish	April 5-11	69
	3LNO	Groundfish	April 18 - May 9	70
	3L	Groundfish	May 11-24	71
	3PsO	Squid	May 27 - June 9	72
	2J3KL	Oceanography	August 1-15	73
	3Ps	Scallops	August 18-24	74
	3LNO	Juvenile flatfish	August 25 - September 19	75
	3K to Labrador Sea	Salmon	September 17 - October 6	76
	3LN	Gear trials	October 10-21	77
	3L	Groundfish	October 26 - November 13	78
	Conception Bay	Current meter recovery	November 14	79
SHAMOOK	Conception & Trinity Bays	Cod tagging	March 10-31	137
	Conception Bay	Oceanography	April 5-13	138
	Bonne Bay	Crab	April 18-29	139
	Conception Bay	Oceanography	May 2-13	140
	off St. John's	Crab	June 2-22	141
	Conception Bay	Cod acoustic tagging	June 27 - July 11	142
	2J (inshore)	Cod sampling	July 20 - August 15	143
	3Ps	Cod, pollock tagging	August 22 - September 20	144
	Conception Bay	Oceanography	September 23-29	145
	Conception Bay	Crab	October 3-14	146
	3KL (inshore)	Pelagic acoustic	October 18 - December 8	147
MARINUS	Conception Bay	Crab	February 15-26	105
	Conception Bay	Oceanography	March 1-9	106
	Placentia Bay	Toxicology	May 2-5	107
	Conception Bay	Crab	May 6-15	108
	Placentia; St. Mary's Bay	Capelin tagging	May 19 - June 22	109
	Conception Bay	Oceanography	July 29 - August 5	110
	Bonavista Bay	Crab	August 8-24	111
	Conception Bay	Crab	August 27 - September 2	112
	Conception Bay	Cod acoustic tagging	September 6-20	113
	Conception Bay	Bottom sampling	October 11-14	114
	3KL (inshore)	Pelagic acoustic	October 18 - December 8	115
MAXWELL	Notre Dame Bay	Hydrography	May 16 - June 12	-
	Trinity and Conception Bays	Hydrography	June 20-26	-
	Bonavista Bay	Hydrography	July 4-27	-
	Southern Labrador	Hydrography	August 2-27	-
	St. Anthony	Hydrography	August 28 - September 4	-
	Notre Dame Bay	Hydrography	September 12 - October 27	-
	Bonavista Bay	Hydrography	October 28 - November 4	-
CHARTERS (includes trips* manned by Quebec personnel)				
CHARTERS (includes trips* manned by Quebec personnel)				
GADUS ATLANTICA	*4RST3Pn	Groundfish	January 11-29	148
	2J3K	Groundfish	February 3-22	149
	3Ps	Scallops	April 28 - May 10	150
	3L	Capelin acoustic	May 13 - June 1	151
	3KL	Cod acoustic	June 3-19	152
	3NO	Capelin acoustic	June 21 - July 4	153
	2HJ3K	Shrimp	July 6-24	154
	3P	Redfish acoustic	July 28 - August 14	155
	2GH	Groundfish	August 16 - September 9	156
	3Ps	Scallops	October 4-7	157
	2J3K	Capelin acoustic	October 7-25	158
	2J	Groundfish	November 3-15	159
	2J3K	Groundfish	November 16-29	160
	3K	Groundfish	November 30 - December 4	161

RESEARCH VESSEL CRUISES 1988 (cont'd)

Vessel	Area of Operation	Type of Survey	Operating Days	Trip #
LADY HAMMOND ¹	Conception Bay 3LOPs	Crab Capelin tagging	April 26 - May 5 May 6-23	184 185
<u>AERIAL SURVEYS</u>				
FIXED WING AIRCRAFT	Trinity & Conception Bays	Capelin	June 15 - July 6	-

¹Scotia-Fundy based long-term charter.

Section III. Gulf Region

by

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A. STATUS OF THE FISHERIES

1. Southern Gulf Cod (4TVn):

The total allowable catch was 54,000 tonnes. Provisional landings were 52,000 tonnes. France was allocated 1,200 tonnes, however, no catch was reported. The winter fishery (4Vn) represented 14% of the landings. Fixed gear landings were the lowest since 1976. The standardized otter trawl catch was reported. The winter fishery (4Vn) represented 14% of the landings. Fixed gear landings were the lowest since 1976. The standardized other trawl catch rate decreased slightly over 1987, however, it is still among the highest observed since 1966. Research survey estimates (age 3+) are the third largest in the series after 1985 and 1986. The mean population biomass appears to have been stable since 1984 and at the highest level since the mid 1950's. The 1984 year-class is estimated to be the second largest since 1971. Fishing mortalities on the stock have been reduced in recent years to 0.2-0.25 from 0.3-0.7 previously.

2. Southern Gulf American Plaice (4T):

The annual total allowable catch for this fishery has been 10,000 tonnes since 1977. Provisional landings in 1988 totalled 6,700 tonnes representing a decline of 1,000 tonnes from 1987. The proportion of the total landings taken by directed effort has increased from 21% in the early 1980s to over 50% at present. Catch of small fish continues to be a problem with up to 50% by numbers of the catch being discarded. The abundance index from research vessel surveys suggest that stock biomass has declined substantially since the late 1970s to become relatively stable since 1984. The recent catches from 6,000 to 9,000 tonnes are thought to be close to the $F_{0.1}$ level.

3. Southern Gulf White Hake (4T):

The total allowable catch for 1988 was 5,500 tonnes with provisional catches totalling 3,800 tonnes. Precautionary TAC's of 12,000 tonnes were set from 1982 until 1986. Concerns that precautionary TAC's allowed the stock to be exploited at about twice the $F_{0.1}$ level in recent years was confirmed, thus the TAC was reduced to 9,400 tonnes for 1987 and again to 5,500 tonnes for 1988. This fishery has been relatively stable with a catch of 5,000-6,000 tonnes since 1965. The peak catch of 14,000 tonnes reached in 1981 was due to recruitment of several strong year classes. Population numbers and biomass have declined in recent years in response to lower-recruitment.

4. Southern Gulf Herring (4T):

The total allowable catch by gillnet and purse seine fisheries was 78,900 tonnes in 1988 with provisional catches totalling 71,400 tonnes. The fishery continues to be supported by several strong year classes, particularly those of 1979 and 1980. Above average recruitment since 1979 has allowed the stock to rebuild strongly from its levels in the late 1970's. CPUE's based on a fixed week model indicated a moderate rise in fall CPUE, continuing the trend since the early 1980's. Catch rates by index fishermen supplemented commercial catch rates in the catch rate model. Spring CPUE also increased modestly. Biomass of both spring and fall spawners is roughly an order of magnitude higher than at the beginning of the

5. Atlantic Bluefin Tuna (SA 3-6):

Canada's share of the West Atlantic total allowable catch for 1988 was 573 tonnes as in previous years. This TAC was set by ICCAT as part of an overall western Atlantic quota of 2,660 tonnes. The same allocations have been in place since 1983. The reported nominal landings for Canada was 440 tonnes as compared to 1987 landings of 80 tonnes (466 fish). The traditional fishery by Canadian rod and reel plus tended line landed 86% of the fish while an experimental offshore longline fishery landed 62 tonnes. The Canadian rod and reel plus the tended line catch rate series have been used for age calibrations of the older fish (16+ years) in the stock assessment.

6. Atlantic Salmon:

The 1988 management plan for Atlantic salmon in the Gulf Region was the final year of a five year plan initiated in 1984 to conserve stocks. Major restrictions on harvest included the closure of commercial fisheries in New Brunswick, Nova Scotia, Prince Edward Island, and in certain localized areas in southeast Newfoundland; mandatory release of all multi-sea-winter (MSW) salmon by anglers in all areas; and prohibiting the landing of salmon from non-salmon gear. In Gulf area of New Brunswick, there were average to above average returns of one-sea-winter (1SW) and MSW salmon in 1988. Multi-sea-winter salmon returns to the Miramichi River were less than forecasted as was the case in 1987 as well. Angling catches of 1SW salmon were above average in most areas. In the Restigouche River, New Brunswick, angling catches of 1SW salmon in 1988 were the highest ever recorded (6,776 fish). In Prince Edward Island and Gulf Nova Scotia, there were above average returns of 1SW and MSW salmon. In western Newfoundland, adult salmon escapements in 1988 at counting fences and fishways were below average in northern areas, but above average in the south. Recreational landings of 1SW and MSW salmon were above 1987 landings while commercial landings were similar to 1987.

7. Gaspereau (4T):

Gaspereau are intensively harvested in the Miramichi River, New Brunswick, and in the Margaree River, Nova Scotia. The catch of 1,357 tonnes from the Miramichi River in 1988 was lower than in 1987, but average for the past five years whereas the catch of 1,666 tonnes from the Margaree River was almost double the previous five year average for that fishery. The fishing mortality rates are high in both rivers and the landings in the past 2 years have been sustained by a strong year-class in both fisheries.

8. Gulf Lobster (4RT):

Overall landings in 1988 were estimated at 21,300 tonnes representing the highest recorded annual landings in the past 35 years. Landings in the previous three years were, as follows: 1987-20,300t, 1986-15,449t, 1985-17,721t. The relative stability and gradual increase of landings since 1975 has occurred without changes in fishing effort (the number of fishermen, traps, licenses and length of season). The increases and general stability of the landings are attributed to favorable recruitment. The Gulf lobster fishery has traditionally been a recruitment based on fishery which should be viewed as stable with existing catches and effort.

9. Southern Gulf Snow Crab (4T):

The southern Gulf snow crab fishery is composed of four management units: the southwestern Gulf, Prince Edward Island, and two fisheries off the western coast of Cape Breton.

The southwestern Gulf fishery began in 1966 and expanded rapidly with landings of 31,585 tonnes in 1982. Annual landings then fluctuated between 24,000 and 26,000 tonnes until 1986. Total landings dropped to 11,782 tonnes in 1987 and increased slightly to 12,355 tonnes in 1988. Catch rates (kg/trap haul) decreased continuously from 57.3 in 1985, 55.7 in 1986, 26.2 in 1987 and 23.2 in 1988. A reference total allowable catch (TAC) of 26,000 tonnes was introduced in 1984, and a fishing season was in place from 1986 to 1988 subject to the reference TAC. Initial biomass for 1988, using various analytical methods, was estimated between 13,365 and 20,770 tonnes which represented an exploitation rate between 60 to 92 percent.

The Prince Edward Island snow crab fishery was initiated on an experimental basis in 1985 and is now composed of 30 fishermen. Catches have dropped in the same proportion as for the southwestern Gulf fishery from 1,239 tonnes in 1986 to 457 tonnes in 1987 and 666 tonnes in 1988. Catch rates declined from 53 kg/trap haul in 1985 to 32.6 in 1986 and 18.3 in 1987. Catch rates have increased to 31.3 kg/trap haul in 1988 due to increased fishing effort. The estimated total exploitation rate exceeded the target level (50-60%) in 1988.

The 1988 total allowable catches for the two management areas off western Cape Breton (Areas 18 and 19) were 674 tonnes and 1,338 tonnes respectively. Total landings of 669 tonnes and 1,337 tonnes were recorded for Areas 18 and 19 respectively. Catch rates in Area 18 have declined from 62 kg/trap haul in 1982 to 31.4 kg/trap haul in 1985, but increased back to over 60 kg/trap haul in 1987 and 1988. In Area 19, catch rates declined continuously from 96 kg/trap haul in 1982 to 30.3 kg/trap haul in 1987, but increased to 58.7 kg/trap haul in 1988. Present TAC's appear to ensure stabilization of the fisheries in these two areas.

10. Southern Gulf Scallop (4T):

Landings of sea scallop were estimated at approximately 250 tonnes in 1988. Annual landings since 1972 have ranged between 200 to 350 tonnes. The overall sea scallop fishery in the southern Gulf is stable except in some localized areas. The northeastern Gulf Icelandic scallop stock is also viewed as stable if current effort levels are maintained.

B. SPECIAL RESEARCH STUDIES:

1. Environmental Studies:

Hydrographic studies - Temperature profiles were collected at 164 stations during the fall groundfish cruise and at 56 stations during a July juvenile cod survey in the southern Gulf of St. Lawrence.

2. Biological Studies:

a) Cod: Commercial fishery (catch and weight at age, and catch per unit effort) and research survey data were used in the assessment of the 4Tvn (Jan.-Apr.) cod stock. A survey to determine juvenile cod concentrations was conducted in Baie des Chaleurs and waters of northeastern New Brunswick during July. Lab analysis of stomach contents from samples collected in 1987 was completed. An investigation of age distribution at length among years was made. Factors associated with a recent decrease in growth rate are being investigated.

b) Plaice: The input data for the assessment of American plaice in area 4T came from commercial fisheries data and a research vessel survey. Commercial catch at age showed more older fish than other plaice stocks. Research vessel mean number per tow showed a decline since 1979. A stable level of mean catch per tow has been observed in the last three years.

c) White Hake: Commercial catch samples, research vessel surveys, and commercial catch and effort data were used for the stock assessment. Analysis was completed on seasonal movements of hake and other demersal species. These studies indicate the need to identify the stock structure of white hake in the southern Gulf.

d) Herring: The index fisherman program, in operation since 1986, was used for the first time in the stock assessment. The fifth annual acoustic cruise was completed using randomized parallel transects. This survey design allows confidence limits to be placed on biomass estimates derived from the surveys. Several studies were begun on the distribution and abundance of juvenile herring in the Gulf with the long-term objective of establishing an index of pre-recruit abundance which would allow year-class size to be estimated.

before the class enters the fishery. Juvenile studies included by-catch questionnaires and logbook programs for mackerel and smelt fishermen, a summer cruise to Shediac Valley and the Bay of Chaleur, and a cruise in December to the Bay of Chaleur.

- e) Atlantic Bluefin Tuna: A stock update and review was carried out at the annual ICCAT meetings. Sampling of individual fish, at local fishing ports, is the only source of biological data for tuna in the traditional Canadian fishery. However, in 1987, an offshore longline fishery was begun using chartered Japanese vessels. This new data source will be utilized in future assessments.
- f) Atlantic Salmon: Advice on the status of Atlantic salmon stocks was provided for the following rivers and areas: Restigouche and Miramichi Rivers, New Brunswick; Margaree River, Nova Scotia; and western Newfoundland. Biological advice was based on monitoring adult and smolt runs at several index river sites; sampling angling, commercial and Native fisheries; summarizing all catch and effort data; and conducting electrofishing surveys throughout headwater areas. Specific research was conducted on the following topics: stock identification based on morphometric and meristic characteristics; run timing and exploitation rates of early versus late-running salmon; comparison of the freshwater production rate of native Atlantic salmon and introduced brown trout; effect of sea age on the reproductive potential Atlantic salmon; utilization of estuaries by juvenile salmon; and spatial and temporal variability in the run-timing of anadromous stocks within the Gulf of St. Lawrence.
- g) Gaspereau: Assessments of the 1988 gaspereau fisheries of the Margaree and Miramichi rivers were completed. The catch at age was restructured using samples from a commercial trap in the Margaree River and index trapnet in the Miramichi River, weighted by daily catch from logbook reports. Sequential population analysis, using revised natural mortality rate values, was completed. Collection of biological characteristics of gaspereau from other rivers in the Gulf of St. Lawrence was continued.
- h) Lobster: The experimental carapace program in Cape Breton was in the third year of a four year incremental minimum legal carapace increase study. The biological effects of this program are being monitored during and after the increases. The baseline monitoring involves sea sampling of commercial lobster catches to obtain biological and fisheries related parameters. Lobsters were tagged in 1988 at three sites in the increase zone. The data collected from the recaptures will be used to determine growth parameters and movement.

Sea sampling of commercial lobster catches was conducted throughout the Gulf from Baie des Chaleurs to western Newfoundland. This information will be used for providing management advice for location specific adjustments to fishery regulations and resource monitoring.
- i) Snow Crab: Biological characteristics of the snow crab populations were monitored by sea sampling aboard commercial vessels during the 1988 fishing seasons. Assessments of all areas were presented based on data derived from fishermen's logbooks and processor's sales slips. Initial biomass and exploitation levels were estimated using Leslie's analysis of catch/effort trends. A post-season trawl survey was conducted on all major fishing grounds in order to estimate biomass recruitment, distribution, and biological characteristics of snow crab populations.

Studies were conducted on growth included growth increment, frequency of molting at size and duration of each molt stage, factors determining normal and terminal molting, geographic and vertical distribution of crabs in relation to molt stages and seasons, pre-recruit size composition and abundance. Studies on reproduction were continued and focused on the reproductive contribution of pre-terminal and terminal molt males relative to primiparous and multiparous females, the monitoring of the reproductive cycle and potential of both male and female crabs, and observations of successful spawning of multiparous females without molting. The tagging of pre-terminal and terminal molt crabs was continued in order to study growth, seasonal movements, and mixing of crabs between fisheries. Studies of size composition and characteristics of snow crab couples and oceanographic parameters were conducted on a relatively unfished snow crab population in Bonne Bay, Newfoundland, by diving, trawling and experimental fishing. A study was conducted on age determination of snow crab carapaces using isotopes.

- j) Scallop: The stock status of the southern Gulf sea scallop fishery in 1988 was evaluated using data from a sea sampling program, questionnaires distributed to fishermen and landing statistics. An inventory of the different types of fishing gear currently in use was completed. A manuscript presenting an overview of scallop catches since 1940 was initiated. Port sampling and landing statistics were used to assess the northeastern Gulf Icelandic scallop

SECTION IV - Quebec Region

by

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This report summarizes the research of various laboratories
in Quebec, which are identified as follows:

MLI - Maurice-Lamontagne Institute, Mont-Joli (DFO)
MAPAQ - Direction de la Recherche Scientifique et Technique,
Quebec Provincial Government.

1 Research report, 1988.

SUBAREA 4

A. Status of the Fisheries

DFO Nominal landings and TAC ('000 t) since 1985 for stocks currently being
assessed in the Quebec region are as follows:

Species	Division	Nominal Landings (TAC)			
		1985	1986	1987 ₁	1988 ₂
Cod	4RS,3Pn	87 (100)	80 (92.1)	66 (80.3)	48 (73.9)
Greenland Halibut	4RST	2.4 (5)	6.5 (5)	11 (8.9)	7.5 (10.8)
Atlantic Halibut	4RST	0.163	0.273	0.3 (0.3)	0.3 (0.3)
Redfish	4RST	28 (50.6)	33 (55.6)	35 (50)	36 (56)
Herring	4R	14.4 (10)	21.4 (17)	12 (30.6)	18 (30.6)
	4S	0.5 (1)	0.6 (1)	0.8 (1)	0.9 (3.5)
Mackerel	S.A.2-6	70.8	63	76.6	79.3
Capelin	4R	2.2 (20)	3.3 (20)	0.8 (5)	N.A.
	4ST	0.5 (5)	0.7 (5)	0.1 (2)	N.A.
Snow crab	4S,4T _{pq}	5.8	5.3	5.0	4.0
Shrimp	4RST	8.8 (14.5)	9.5 (12.1)	12.0 (13.1)	13.8 (14.1)
Lobster	4S,4T ₃	2.1	2.3	2.7	2.5
Scallop ₄	4S,4T ₃	1.3	1.2	2.0	1.4

₁ Preliminary values.

₂ Preliminary values when available.

₃ Except 4Tghij.

₄ Round weight.

B. Special Research Studies.

1. Environmental studies

a) Hydrographic studies

MLI A study of the circulation, oceanography and hydrography of the Jacques Cartier Strait (COHJAC, NAFO division 4Sx, 4Sy) initiated in 1987 was maintained in 1988. As part of this program, 35 temperature and salinity profiles were done, 4 current meters and 2 tidal gauges were set in October 1987 and were recuperated in May 1988. Eggs and larvae of important commercial species (cod, shrimp) were found and it is hypothesized that this area may be an important retention site.

MAPAQ A survey of environmental conditions initiated in 1984 continued in 1988 near La Tabatière on the Lower North Shore (NAFO division 4Sw) of the Gulf of St-Lawrence. It included the use of 9 thermographs in 6 shallow waters locations near the coast. Data were also taken every week or two, from June through October in 3 areas for determination of temperature and salinity in the first 14 meters of water. At the same time chlorophyll A, particulate inorganic and organic matters were determined at 1, 5 and 9 meters.

b) Plankton studies (including eggs and larvae)

MLI The spatial distribution, and factors controlling the transport and survival of larval shrimp in the Gulf of St. Lawrence was investigated. This involved laboratory rearing of ovigerous females until hatching of the eggs and subsequent testing of the effect of various concentrations of food on survival.

c) Benthic studies

d) Observations on ice conditions in Subareas 0 to 4

e) Other environmental studies

2. Biological studies by species

MLI General: The centralization of reference collections of biological specimens was undertaken and a computerized data bank is currently being established. Basic data essential for various stock assessments have been collected by the port sampling section which is also responsible for the age determinations. An observer program collects information (length frequency, otoliths, effort) on a set by set basis for the national fleet. Finally, three random stratified groundfish surveys are carried out each year. The surveys in January and August being directed toward groundfish and the September survey directed toward shrimp.

2.1 Demersal fish

2.1.1 Cod

MLI The ecological status of cod in the north of the Gulf of St. Lawrence as a predator was investigated in respect to its relationship with capelin and the adjoining cod stock (2J, 3KL). An assessment on the 3Pn, 4RS cod stock was presented to CAFSAC as part of the yearly stock assessment process. The influence of the ice edge on catchability of cod, based on results of winter groundfish surveys were analyzed and presented to NAFO (September 1988).

2.1.2 Redfish

MLI The redfish stock from NAFO Divisions 4RST was assessed and projections of catches for the commercial fishery undertaken. The assessment is based on information from two yearly groundfish surveys as well as results of commercial catch per unit effort. A new program was initiated in 1988 and aims to monitor the redfish commercial fleet deployment and to monitor the bottom temperatures by attaching temperature recorders to the trawl.

2.1.3 Greenland Halibut

MLI No stock assessment was not done since the stock identification studies were not terminated this year.

2.2 Pelagic fish

2.2.1 Herring

MLI A post-doctoral fellow has investigated the energetic implications of the reproductive strategies by various stocks on larval survival and recruitment. Stock assessments for the herring stocks of NAFO Divisions 4R and 4S were done and presented to CAFSAC.

2.2.2 Mackerel

MLI Stock assessment of the mackerel stock (S.A. 2 to 6) was presented to CAFSAC. The assessment was based on results of a summer ichthyoplankton survey and commercial sampling and resulted in an estimation of increasing stock. A stock discrimination study was undertaken. Based on the shape of the otolith, it was found that the area of the first annulus was the most important factor in the discrimination of the two major spawning concentrations of the Northwest Atlantic stocks. The daily migration cycles of juvenile mackerel and mortality caused by adults was investigated in NAFO division 4T.

2.2.3 Capelin

MLI A brief review of the capelin fishery in 1987 was presented to CAFSAC. This included landings as well as results from the commercial sampling program.

2.3 Invertebrates

2.3.1 Snow Crab

MLI The various snow crab stocks present in the Quebec region were assessed as part of the regular mandate from CAFSAC. A tagging program was maintained in 1988 with the use of stainless steel micro tags injected through the shell and subsequent detection in the processing plants.

2.3.2 Shrimp

MLI An analysis of the factors influencing the vertical and horizontal distribution of shrimp was done using hydroacoustics on board a research vessel. A laboratory rearing of shrimp was attempted for the analysis of phototaxis. Stock assessments of shrimp from various management areas of the Gulf of St. Lawrence was done and presented to CAFSAC. These stock assessments are based on results from the catch and effort from the commercial fishery as well as results from shrimp directed research surveys. A study of shrimp growth from the Gulf and from Davis Strait was done in order to identify potential negative impacts of aggregation of samples from various areas for stock assessments.

2.3.3 Lobster

MLI A project on the factors that influence recruitment of lobster in the Magdalen Islands was done in 1988. The analysis aimed at relating the influence of fresh water runoff, water temperature and wind direction and intensity, to the landings of lobster in the area. The recruitment of lobster larvae was studied with the use of collectors. Assessments of the lobster populations in the Magdalen Islands, Gaspé, Anticosti and North Shore of Quebec were done and presented to CAFSAC. Advice on the impact of an increase of minimum landing size of lobster was presented to CAFSAC and to fishermen.

2.3.4 Scallop

MAPAQ On the Lower North Shore near La Tabatière (NAFO division 4Sw), in order to determine the moment of spawning, a sample of scallop gonads has been examined every week or two from June through October for the last 5 years. Collection of spat was made, and some aspects of the hanging methods of culture were studied. The survey of growing juveniles was continued and a second transfer of spats from the MAPAQ experimental hatchery in Magdalen Islands was made to determine the growth and survival rates of the spats.

An experiment of spat production from giant scallop (Placopecten magellanicus) was undertaken in 1988 at a nursery located in the Magdalen Islands (NAFO division 4Tf). From the 4 trials, a total of 500,000 post-larvae

of over 250 microns were produced. Massive mortalities were encountered after metamorphosis due to poor water quality in the three trials that took place in February. Parameters under study in these rearings were larval density and the use of antibiotics. The June production which yielded some 250,000 post-larvae over 250 microns was used for rearing in the natural habitat. The experimental nursery in the Magdalen Islands was established and a preliminary experiment of post-larvae rearing was conducted in 1988. In 60 days, the average size of post-larvae increased from 1.35 mm to 6.1 mm with a survival rate of 65%. In 1989, it is expected to produce over 100,000 juveniles at a size of 5 to 10 mm. The feasibility of rearing scallops under suspension in the lagoons of Magdalen Islands will also be investigated.

- MLI A stock identification study was done in order to separate the scallops from various management areas in Quebec (NAFO divisions 4Tf, 4Tm, 4Tn, 4Tw) based on variations in the degree of heterozygosity with age. Stock assessments of the scallop in the management areas were undertaken and presented to CAFSAC. These involve analysis of commercial sampling of shells to derive numbers at age and analysis of dredge sampling in various areas. An estimate of recruitment of scallop was initiated in 1985 and maintained by analysis of the spat collectors in Magdalen Islands. Early developmental parameters affecting fertilization success in scallop was initiated in order to predict and stabilize production to the fishery. Since a commercial fishery has developed on the lower north shore of Quebec, a exploratory fishing survey was undertaken in this area to increase the knowledge of the biology of this stock and to estimate its potential for commercial exploitation.

2.3.5 Mussels

- MAPAQ On the lower North Shore near La Tabatière (NAFO division 4Sw), collection of spat was made, and some aspects of the method of culture were studied in order to determine the growth rate of cultured mussels in this area.

For a second year, the rates of intoxication by the toxin producing algae, Protogonyaulax tamarensis were monitored in four areas in Bay of Gaspé (NAFO division 4Tn) in order to study the effect of local geography, depth and yearly changes on wild and cultured mussels.

In 1987, the feasibility of establishing a mussel culture in an open site of Baie de Plaisance (Magdalen Islands, NAFO division 4Tf) was pursued. In collaboration with INRS Océanologie, the habitat capacity for commercial rearing of mussel in Magdalen Islands was investigated. A new project on the feasibility of implementing the Swedish culture method in this area was investigated. This method is characterized by the use of a unique substrate for the collection of spat and for the rearing of mussels.

- MLI A simple model relating the limitation of growth of mussels by density, size and area was developed with the ultimate purpose of optimizing in situ rearing of this (and other) species. Another study aimed to maximize yield of in situ rearing was to investigate the most appropriate spatial distribution of racks in a shallow in Magdalen Island so that phytoplankton populations would not be seriously depleted by high densities of mussels. Microstructure of mussel shells were analyzed to establish an objective method of measuring daily growth.

2.3.6 Soft shell clams

- MLI The feeding behavior of soft shell clams in laboratory was studied in respect to the influence of burying into the sediment to the efficiency of food intake.

2.3.7 Whelks

- MLI Basic biological data on sexual maturity, growth and gear selectivity of whelks from 8 sites in Quebec were investigated in order to present management options for this resource. The implementation of log-books on the various vessels exploiting this resource resulted in only 1% answer rate and was thus terminated. An estimate of whelk biomass was done using bait as an attractant and following the area of reaction with the use of a underwater video camera.

2.4 Marine mammals

2.4.1 Grey Seals

MLI Information on grey seal diet, parasite burden, population age structures were obtained from Anticosti Island, Northumberland Strait and Les Escoumins. A mark-recapture and aerial photographic survey were conducted in St-Georges Bay to estimate Gulf pup production. Live capture techniques were developed for a habitat utilization study to begin in 1989-90.

2.4.2. Harp Seals

MLI Harp seal feeding was investigated in the Magdalen Islands in March 1989.

2.4.3 Beluga Whales

MLI Aerial photographic survey of belugas in the estuary to determine population size and distribution was completed in August 1988. Helicopter surveys of the estuary looked at winter distribution of beluga whales.

2.5 Marine plants

2.5.1 Ascophyllum

MLI The harvesting strategy that optimizes the long term yield of ascophyllum was studied by measuring the effect of the height of the cut on subsequent production.

3. Gear and Selectivity Studies, including studies of fishing operations.

MAPAQ An experiment using racks developed initially for the culture of mussels was undertaken in the Bay of Gaspé (NAFO division 4Tn) as a means of rearing scallops in suspension.

MLI A trial survey aimed to establish a joint redfish and shrimp research survey in the Gulf of St. Lawrence will be undertaken in September 1989, aboard the Alfred Needler. The sampling efficiency of the DIGBY scallop dredge was recorded by attaching a video camera to the gear and various sets were done on various bottom types. Results were used to interpret the fishing efficiency of the gear since it is used for stock assessments. Edited versions of the video were also presented to fishermen.

4. Miscellaneous studies.

MAPAQ The use of semi-industrial bait for longline fishery of cod as well as for traps in the snow crab and lobster fishery was tested in Chaleurs Bay (NAFO division 4Tn) in the summer of 1988. Results were very encouraging for the lobster fishery.

5. Environmental data for 1988 and Preceding years.

All available information will be forwarded directly to MEDS this year.