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Canadian Research Report for 1997

Newfoundland Region

by

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SUBAREAS 0 AND 1

A. Status of the Fisheries

Nominal landings from 1990 to 1997 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Shrimp* - Div. 0B

Catches for *Pandalus borealis* in 1997 increased to 5,670 t against a TAC that was increased, experimentally, to 5,250 t for the 1997-1999 multi-year management plan. The apparent quota overrun likely includes some *P. montagui* catch that should have been included against the 3,800 t TAC for *P. montagui* in the area west of 63°. The reported catch for *P. montagui was* 2,445 t. Both standardised and unstandardised catch rates were the highest over the 1988 to 1997 period. The status of the resource remains uncertain as fluctuations in catches and catch rates are not considered to be valid indicators of overall stock conditions and may reflect oceanographic conditions - presence of ice, sudden shifts in water masses, or strong tides – that are believed by fishermen to affect shrimp distribution. The mixed fishery *for P. borealis/montagui* and the absence of a time series of research vessel trawl surveys further confounds the assessment of the distribution and abundance of both species.

b) *Greenland Halibut* - 0B+1B-F

The Greenland halibut stock in Subarea 0 + 1B-F is part of the stock distributed in Subarea 2 and 3. Canadian catches for 1997 declined to approximately 1,700 t. Recent scientific information on this stock is limited as the last complete survey was conducted in 1986. NAFO Scientific Council and the Canadian Fisheries Resource Conservation Council (FRCC) recommended that the 1997 and 1998 TAC should not exceed 11,000 t.

SUBAREA 2

A. Status of the Fisheries

Nominal landings from 1990 to 1997 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Atlantic salmon.*
Catches in the commercial fishery totalled 47 t in 1997. This figure excludes approximately 5,146 salmon retained or hooked and released in the recreational fishery.

b) *Arctic charr.*

Landings of Arctic charr in northern Labrador increased substantially to approximately 34 t in 1997 from landings of only 14.7 t in 1996. Declines in catches in 1996 were primarily attributable to a concomitant decline in effort,

lowest level of effort recorded since 1974. Effort increased in 1997 with the introduction of a community-based license system and catches was approximately equal to that of the early 1990's.

c) *Shrimp* – 2G, Hopedale and Cartwright Channels (2HJ), and Hawke Channel (2J) + 3K.

The shrimp fishery in Subarea 2 is divided into three management areas - 2G, Hopedale and Cartwright Channels (2HJ), and Hawke Channel (2J) + 3K. Catches in 2G for 1997 remained stable at 5,217 t. Fishing effort declined in 1997 from increases in 1995 and 1996. The fishery has been concentrated north of 60°N in an area noted for producing high catch rates of large, high-quality shrimp. Both standardised and unstandardized catch per unit effort (CPUE) analyses show an increase in 1997, but are likely overestimated due to the use of double trawls, from declines noted in 1995 and 1996. The spawning stock remains healthy as evidenced in continued high catch rates for female shrimp.

Catches in Hopedale and Cartwright Channels (2HJ) doubled to 15,102 t in 1997 from 7,383 t in 1996. Fishing effort approximately parallels the same trends over time as catch. In recent years however, effort has decreased while catches have increased. In the 1990s effort has expanded throughout the area and the timing of the fishery has shifted from a summer-fall fishery to mainly a winter-spring operation. Both standardised and unstandardized CPUE series show approximately the same trend – a decline to the mid 1980s, a substantial increase in 1986 followed by stability to the early 1990s, and an increase since that period. The introduction of double trawls in 1997 is not considered to be an important factor in the interpretation of these results. The resource in this area remains healthy with commercial catch rates of both male and female components stable over the 1980s and increasing in recent years.

The fishery in Hawke Channel (southern Div. 2J + 3K began in 1987 with landings of approximately 1,800 t. Catches increased to more than 7,800 t in 1988 and ranged between 5,500 and 8,000 t from 1989 to 1993. The first multi-year management plan for 1994-1996 set the annual TAC at 11,050 t for the Hawke Channel, St. Anthony Basin, east St. Anthony, Funk Island Deep, and three exploratory areas on the seaward slope of the shelf. Catches increased to 11,000 t in each of those three years. Based upon analyses of commercial fishery and research vessel data, the 1997 assessment concluded that the resource was healthy and exploitation low. The TAC for 1997, the second three-year management plan, was raised to 23,100 t and an inshore fishery component implemented as a first step in increasing exploitation. The preliminary catch estimate for 1997 was about 21,200 t. Fall multispecies research vessel surveys in 1995, 1996, and 1997 showed that shrimp were widely distributed and abundant throughout the area. Abundance was dominated by the 1993 and 1994 year classes. The data suggest that the 1995 and the 1996 year classes are weaker than either the 1994 or 1993. Catch rates in the 1997 fishery were the highest observed and despite the increased catch exploitation remains low and the resource remains healthy at unprecedented high levels.

d) *Cod* – 2GH, 2J3KL.

The catch from Div. 2GH has been negligible since 1990 and based on the 1996 DFO Stock Status Report the abundance of this stock is assumed to be low. The next regional review of stock status is proposed for 2000.

The northern cod moratorium has been in effect since July 1992 for cod from Div. 2J3KL. Reported catches come from bycatch and sentinel surveys in 1997. There is evidence of removals in excess of legal fisheries and the sentinel surveys, but the magnitude of these reductions cannot be estimated.

e) *American Plaice* – 2+3K

There was no directed fishery on this stock in 1997. Analyses of data from annual fall multispecies research vessel trawl surveys indicate that recruitment, abundance, and total and spawning biomass are low. Low exploitation rate on this stock suggests that fishing mortality cannot be responsible for the observed decline in this species.

f) *Redfish* – 2+3K

There was no directed fishery in 1997 for the Subarea 2 +3K stock. Results from fall multispecies research vessel surveys suggested that population biomass indices in both areas are at extremely low levels.

g) *Snow crab – 2J*

Catches increased marginally to 3,166 t in 1997 from 3,090 t in 1996. Fishery performance is monitored in the three management areas through analyses of commercial logbook data, observer program data, and dockside monitoring. CPUE's decreased in the north and south by 29% and by 49% respectively due primarily to the discovery of new fishing grounds in the offshore areas and expansion in 1997 to determine the northern extent of commercial fishing grounds.

B. Special Research Studies

1. Environmental Studies

a) *Hydrographic studies*

Field surveys and field sheet production were conducted for inshore areas of southern Labrador (2J) by the Canadian Hydrographic Service at Makkovik, Black Tickle, Windy Tickle, and Postville. Quality control baseline data was collected in the Voisey's Bay area (Div. 2H) in support of the nickel mine/mill development. New charts, chart inserts, or chart patches were produced for Punchbowl, St. Lewis Inlet, Sango Bay, and Williams Harbour.

b) *Oceanographic studies.*

Temperature profiles were taken at each fishing station during annual research vessel surveys in Div. 2GHJ. CTD profiles were collected along the standard NAFO transect line across Hamilton Bank (Seal Island Line in Div. 2J) and several other stations on the Labrador Shelf. Oceanographic observations were presented and referenced to the long-term (1961-1990) mean. The 1997 cold-intermediate layer (CIL) was 38 % below normal on the Seal Island transect while minimum CIL core temperatures were above normal continuing a trend established in 1995. Air temperatures at Cartwright (2J) show a decline from the higher levels of 1996 but are still higher than the low values of the early 1990's. Bottom temperatures were above normal in many locations, particularly the deeper portions of the Northeast Newfoundland Shelf.

2. Biological Studies

a) *Groundfish and Shellfish*

Biological and oceanographic data from fall multi-species research vessel surveys were collected from Div. 2GHJ to conduct distribution and abundance studies and detailed biological sampling. Juvenile and adult cod densities and distributions and acoustic properties mixed cod, arctic cod, capelin, and shrimp were studied in Div. 2J.

b) *Arctic charr.*

Samples were obtained for food and feeding and age, sex, and length distributions from commercial landings from 12 northern Labrador fishing areas. Analyses of sampling data demonstrated a decline in mean weight of charr, particularly for the Nain and Voisey stock units. These observations are consistent with growth overfishing and it was hypothesised that the trend is attributable to the long-term selective pressure of the Labrador commercial gill net fishery for Arctic charr.

SUBAREA 3

A. Status of Fisheries

Nominal landings from 1990 to 1997 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Squid* – Subarea 2+3.

Following a peak catch in 1979 of 88,800 t, Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5,000t during the thirteen-year period 1983 to 1995. Catches increased during the most recent two years to 11,600 t in 1997. Increases in catches in 1996 and 1997 were due to improvement in the oceanographic regime and increase in squid abundance at the northern extreme of their range.

b) *Atlantic salmon* – Subarea 3+4

A moratorium on the Canadian commercial fishery has been in place since 1992. Landings at St. Pierre (Div. 3Ps) totalled 1.5 t in 1997. The recreational harvest including both retained and hooked-and-released was 40, 605 fish on insular Newfoundland. Declines in returns to rivers in Newfoundland were observed generally throughout the area.

c) *Shrimp* – 3M.

The international fishery in Div. 3M, which began in 1993, continued in 1997. Canadian vessels caught 785 t in 1997 compared to 3724 t in 1993.

d) *Iceland scallop.*

Iceland scallops are fished in Div. 3LN and Div. 3Ps. The fishery in 3LN commenced in 1993 on aggregations over the eastern Grand Bank (3L) and the Carson and Lilly canyons (LCC) and has expanded to the northeast of LCC in Div. 3LN in 1995 between 45°30'N and 46°30' N, to a new aggregation in Subdiv. 3Nf in 1996, and to exploratory areas in 3LN outside of these four "boxed" TAC zones.

In Eastern 3L only 5 t were taken from a TAC of 1,000 t. Overall mean catch rates and meat counts were low and the area is now considered marginal for the fleet.

Catches in the LCC box were 2, 842 t from a TAC of 3,000 t in 1997. Catch rates have declined 20% since aggregations were first exploited. Continuous exploratory movements of the fishing fleet to maintain or improve catch rates likely obscure real changes in CPUE. Individual meat-weight frequency shows a significant improvement from those of 1995 and 1996 suggesting that new aggregations were fished.

Fishing effort in Div. 3LN was concentrated south of 46° N. Approximately 211 t of the 3,000-t allocation was taken in 1997. In season catch rate declined 35% from 194 lb./tow to 125 lb./tow. Annual catch CPUE has declined 40% from the level recorded in 1995 and the total number of days expended and removals in this area by the commercial fleet have declined in each of the last three years.

In Div. 3Nf, catches declined significantly from 3,483 t in 1996 to 228 t in 1997 from a TAC of 800 t. Overall reductions in CPUE were 40 % from 1996. Total number of days fished declined to 68 days in 1997 from 833 days in 1996. Meat weights are among the lowest anywhere in the four "boxes" and may have contributed to the reduced effort.

Exploratory fishing outside of the TAC areas occurred from the Virgin Rocks, along the eastern edge of Grand Bank between the LCC and Kettle Canyon, and from nearshore aggregations off the Avalon Peninsula of Newfoundland. Approximately 690 t were caught within these areas.

The fishery in each of these areas appears to be driven by exploitation of an accumulated virgin biomass consisting largely of cohorts of old, possibly well separated year classes with little potential for further growth. No significant larval settlement or recruitment has been detected. The directed removals from high density scallop aggregations and resulting incidental mortality results in rapid declines in commercial scallop abundance and reduced settlement and recruitment potential.

The fishery in 3Ps commenced in 1989 on St. Pierre Bank and is managed in two zones - the transboundary stock co-managed by France (70%) and Canada (30%) on the northern edge of the Bank and a large-area Canadian Zone. In 1997, only one Canadian vessel fished in the transboundary area, catching only 7 t of the 630 t allocation. Much of these aggregations have been severely impacted by starfish predation and catches have declined dramatically since

peaking at nearly 6,000 t in 1992. Over 50 vessels are actively participating in the Canadian Zone fishery over a large geographic area. Substantial effort diversion occurs when nearshore aggregations are discovered. Currently, there are five aggregations or boxes being actively exploited. Total catches from these areas combined in 1997 were 7,567 t.

e) *Capelin* - Subarea 2 + Div. 3KL

Inshore capelin catches in Subarea 2 + Div. 3KL are usually taken during the inshore spawning migration. Female capelin is preferred to satisfy the Japanese roe market. The 1994 and 1995 inshore catches were only 100 t as test fishing indicated that female capelin were too small to meet the size criteria established in the management plan. In 1996 and 1997, the management plans did not include a size criterion. Catches declined from approximately 26 t in 1996 to 9 t in 1997 largely attributable to smaller sized capelin that did not meet market requirements. Evaluation of resource status was determined by a mathematical model incorporating seven partially overlapping series of indicators – an aerial survey index, purse seine catch rate index, trap catch rate index, fall multispecies research vessel survey bycatch, Russian 2J3K fall commercial catch rate index, and egg deposition index. The aerial survey and egg deposition index provided the only information on the 1995 yearclass and the 1997 mature biomass. The aerial survey index was lower than the 1996 estimate and was the fourth highest in the series and higher than all but the 1987 estimate from the 1980's. Egg densities were the second highest in the series. Commercial catch rate data for 1997 were not considered to be indicative of stock status because the fishery was contracted both spatially and temporally. Numerous sources of uncertainty and concern about whether the individual indices are now providing reliable indicators of stock status exists regarding the status of this resource.

f) *Snow crab* – 3K, 3L, and 3Ps.

Resource status in Div. 3KL was determined from inshore trap/trawl surveys, fall multispecies research vessel trawl surveys, and commercial fishery logbook and observer data. Catches in 3K increased to 14,830 t in 1997 from 14,185 t in the seven management areas. Catch rates in three of the four inshore areas were reduced over 1996 levels due to a general decline in resource availability, an increase in the incidence of soft-shelled crabs, and an increase in the incidence of Bitter Crab Disease (BCD). CPUE for the offshore was stable although reports from fishermen suggested that nearshore fishing grounds had lower catch rates than in 1996 particularly in areas where BCD-infected crabs were located. Discarding at sea of diseased crabs may indicate a significantly higher incidence of BCD than dockside monitoring would indicate. A test fishery was conducted to evaluate the commercial feasibility of fishing deeper than 550m.

Catches in 3L increased to 22,185 t in 1997 from 16,847 t in the previous year in the 12 management areas. Trends in CPUE were highly variable in 1997 with a stable or slightly declining CPUE in inshore areas and an increasing CPUE in offshore areas.

Catches in 3Ps also increased in 1997 to 4,753 t from 3,052 t in 1996 in the 5 management areas. CPUE remained relatively stable with the exception of Area 11X, an area known as the "Mossy Hole," where the catch rate approximately doubled over the 1996 level to 13.6 kg/trap from 6.3 kg/trap.

g) *Cod* – 2J3KL, 3NO, and 3Ps.

Moratoria on directed cod fisheries remained in place in 1997 for Div. 2J3KL (since July 1992) and Div. 3NO (beginning in 1995). Resource status was determined from data from commercial bycatch, spring research vessel bottom trawl surveys, fall multispecies research vessel bottom trawl surveys, inshore sentinel surveys, new offshore sentinel surveys, inshore acoustic surveys in specific bays, pre-recruit surveys, and a new and intensive fall acoustic survey of the inshore from White Bay to St. Mary's Bay (3KL). Additional data on the consumption of cod by harp seals up to 1995 were also analysed but require further analysis to reconcile consumption estimates with estimates of population numbers. Biomass remains at less than 10% of the long-term average with no significant indications of recruitment and is coupled with increased natural mortality. Age at maturity has declined since 1991 and while weight at age has increased in recent years, it is still low compared with peak values in the 1970's.

Biomass estimates for 3NO cod from Canadian spring stratified-random surveys in Div. 3LNO and 3NO in the fall were conducted in 1997and will be tabled at the June 1998 meeting of the NAFO Scientific Council.

In May, 1997, the Div. 3Ps commercial fishery was re-opened with a TAC of 10,000 t. Catches from the sentinel survey, a recreational fishery, bycatch, and Canadian and French commercial fisheries were about 9,000 t. Stock status was estimated from commercial landings in conjunction with abundance and biomass indices from Canadian (1978-1997) and French (1980-1991) research vessel trawl surveys. Other information for 1997 included an industry trawl survey on St. Pierre Bank, sentinel surveys (1995-1997), acoustic surveys in Placentia Bay and Fortune Bay, tagging experiments in Placentia Bay, and a new logbook for vessels less than 35 ft. to provide detailed information on catch and effort for the inshore fixed gear fishery. A reliable interpretation of stock status was impeded by severe problems of stock structure, seasonal migrations, variability in trawl survey estimates, and poor quality historical data on catch and effort. The 1989 and 1990 year classes have contributed to the growth of the spawning stock although recent recruitment has been poor. The Fisheries Resource Conservation Council has recommended an increase in the TAC for 1998 to 20,000 t consistent with the DFO Science Stock Status Report.

h) *Yellowtail flounder* – 3LNO

There was no directed fishery on this stock in 1997. Scientific Council and the FRCC have recommended a TAC of 4,000 t for 1998 to permit a limited directed fishery in 3NO following review of stock status at the June 1997 Scientific Council meeting which indicated that stock size has increased since 1994 but remains at a lower level than in the 1980s. In addition to the annual spring stratified-random groundfish survey in 3LNO and the fall multispecies bottom trawl survey, a joint DFO-Industry survey was conducted in 1997. The objective of this Fisheries Products International-DFO survey is to develop a commercial-type index of abundance and determine distribution of yellowtail flounder within a zone traditionally fished by commercial fleets.

i) *Redfish* – Unit 2 (3Ps4Vs, 3Pn4Vn-June to December, 4Wfgi) and 3O.

Redfish in the Canadian Atlantic have been reviewed on a zonal basis following redefinition of redfish management units in 1993 given substantial linkages between the various management units. Redfish were reviewed at a zonal meeting in October 1997.

Unit 2 landings in 1997 totalled approximately 9,200 t from a TAC of 10,000 t. Catches have declined steadily from 27,000 t in 1993 matching reductions in TACs. Stock status was determined from annual stratified random research vessel surveys and sampling of the commercial fishery. Commercial sampling suggested that the majority of the catch was comprised of fish between 28 cm to 33 cm, the bulk of which represents the early 1980's year class. The 1988-year class was also present in catches since 1994. Survey results indicated a bimodal length distribution consisting of the 1988 and 1994 year classes. The former is now becoming fully recruited to the fishery but its contribution will not likely be as great as that of the early 1980s year class.

Canadian catches of 30 redfish have increased dramatically from less than 200 t annually from 1983-91 to 7,000 t in 1996. Catches declined in 1997 to approximately 2,300 t. Resource status has been determined from a standardised catch rate index from commercial fishery data and spring and fall stratified random surveys in 3O. The spring survey index increased steadily from 1992 through 1996 but declined sharply in 1997. Stratum by stratum estimates indicate that the increases during the spring surveys occurred over a great deal of the area, although in the spring of 1996 only a few large sets were responsible for the observed increase. The fall survey index increased gradually from 1991 through 1993 but declined slightly in 1994 before increasing significantly in 1995. The index declined sharply in 1996 but the extent of the decline is unknown because four important strata were not sampled. The surveys catch fish in the 10 cm to 25 cm range whereas the commercial catch is mostly comprised of fish greater than 25 cm. Recent declines in the survey estimates may not be related to fishing and it is difficult to interpret these events in relation to stock status as a whole. There is also some concern that there has been little sign in the recent surveys of size groups smaller than 17 cm. In all surveys, the biomass indices in strata outside 200 miles were low compared to those inside.

B. Special Research Studies

1. Environmental Studies

a) *Hydrographic Studies*

Field surveys using 100% multibeam bottom coverage were conducted for St. John's harbour and approaches, Come-by-Chance/Whiffen Head, and Marystown harbour. Paper and electronic charts were produced. New charts were

published for Twillingate (3K) and new sailing direction diagrams (SDD) were produced for Musgrave Harbour, Summerford, Lumsden, and St. John's.

b) *Plankton studies*

A study of the influence of small scale turbulence on the feeding of larval fish and the partitioning of the contribution of biological and physical processes to the rate of loss of ichthyoplankton were conducted in Bonavista, Trinity, and Conception bays. Data on ichthyoplankton composition, development, and mortality; current measurements of plankton drift and dispersion; and data on estimates of prey selection and ingestion rates of ichthyoplankton were collected.

c) *Oceanographic studies*

Oceanographic observations from St. Pierre Bank (Div. 3Ps), Grand Bank (Div. 3LMNO), Northeast Newfoundland shelf (3K), and Southern Labrador Shelf during 1997 were presented and referenced to the long term (1961-1990) mean. Temperatures recorded off St. John's Harbour at Station 27 during 1997 were above normal during the winter months, below normal throughout the spring and summer in upper layer and near normal throughout the year from about 100 m to the bottom. The summer upper layer salinities were normal, the first time since 1990. Temperatures on St. Pierre Bank warmed during 1996, but decreased again to below normal values in 1997. During the summer of 1997 the area of sub-zero cold intermediate layer (CIL) water off Bonavista and Hamilton Bank was below normal continuing a trend established in 1995. Across the Grand Bank the CIL was above normal compared to near normal conditions in 1996. Bottom temperatures on Hamilton Bank and the Grand Bank during the fall of 1996 increased significantly over previous years and were up to 0.5 °C above normal over many areas. During the fall of 1997 bottom temperatures were still above normal over many areas, particularly on the offshore portion of the Northeast Newfoundland Shelf, while bottom temperatures on St. Pierre Bank (3L) continued below normal. In general, during 1997 oceanographic conditions were above normal over many areas, the exception being the coastal regions in the upper water column where temperatures were colder than normal during late spring and early summer.

2. Biological Studies

a) *Cod.*

A multispecies survey of pelagic juvenile fish (0-group cod and 0- and 1-group capelin) was conducted to measure pre-recruit abundance. Acoustic measurements of the distribution and abundance of fish in the top 100m of the water column at each fishing station was incorporated for the first time in 1997. The abundance of pelagic 0-group cod was found to be relatively low although cod were sampled throughout the 2J3KLNO survey area.

Food and feeding studies continued in 1997with investigations on kinds, quantities, and sizes of prey consumed by cod to determine the importance of various prey to migration, growth, and reproduction of the 2J3KL and 3Ps cod stocks.

Inshore-nearshore cod stock structure research continued in 1997. Tagging, acoustics, genetic, and morphometric data was collected to delineate the relationship between inshore and offshore stock components of 2J3KL and 3Ps cod stocks, the relationship and movements between the 3Ps and 3Pn4RS cod stocks, and identification of mixed stocks – 3Pn4RS, 3Ps, 4T, 4Vs - in the Gulf of St. Lawrence. Tagging studies in 3Ps and 3L were implemented using Brownie models to enable estimation of exploitation rate at the end of year one, survival rate, fishing mortality, and natural mortality. New methods were incorporated to estimate tag shedding rates and short –term tagging mortality. Blood and tissue samples were collected for genetic analyses with initial results suggesting genetic differentiation between Flemish Cap (3M) and offshore 3K cod and some differentiation between inshore and offshore cod aggregations.

A multi-year, multidisciplinary study on partitioning the total mortality of Atlantic cod stocks concluded in 1997-98. The project had five components to ascertain the degree of variability in the total mortality of cod that can be attributed to environmental and ecosystem factors and its relationship to fishing activity. The research components are: understanding changes in physiological condition of cod; evaluation of fishing effort, discarding, and reporting; evaluation of the impact of harp seals and minke whales; distribution and dynamics of pre-recruit cod; and comparative ecosystem dynamics studies to delineate the association between community structures and physical conditions in the North Atlantic.

b) Seals

A multi-disciplinary study on harp and grey seal-fish interactions continued its second year of research in 1997. The objectives of the program were to provide a contraceptive vaccine for sue on harp and grey seals, to develop a better understanding of seasonal distributions of seals, to determine current population size of grey seals, and to model seal predation on cod and population control methods.

c) *Capelin.*

Studies to determine factors governing capelin survival during egg development and larval emergence from beach sediments continued at one beach site in 1997. A multi-disciplinary pelagic juvenile fish survey on the Southern Labrador Shelf (Div. 2J+3K), the Northeast Newfoundland Shelf (Div. 3K), and the Grand Bank (3LNO) was conducted to provide pre-recruit indices for ages 0, 1, and 2 year old capelin. Studies of seabird ecology demonstrated significant relationships between capelin availability and abundance with diets and timing and success of breeding.

3. Gear and Selectivity Studies

a) *Effect of environmental variability on catchability*

A multiyear project on the effect of environmental factors on trawl catchability of commercial groundfish species continued in 1997. Field and laboratory experiments have been underway in 1996 and 1997. Laboratory studies of the effect of temperature, size, and condition of both species on swimming performance, herding behaviour, and avoidance were conducted. Field experiments were conducted to measure trawl-induced behaviour reactions of American plaice and cod using underwater video and still cameras mounted on the trawl at different times of the year. Data on herding induced by the lower sweep lines and the use of restrictor ropes to constrain door spread, changes in fish avoidance behaviour between night and day were collected.

SUBAREA 4

A. <u>Status of the Fisheries</u>

Nominal landings from 1990 to 1997 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Snow Crab* – 4R

Catches in 4R totalled 969 t in 1997 up from 833 t in 1996. Evaluation of fishery performance was conducted through analysis of dockside monitoring, commercial logbook, and observer data. Catch rates were reduced from 1996 levels and remain relatively low compared to the snow crab fishery in Divisions 2J, 3K, 3L, and 3Ps.

b) Iceland *scallops* – 4R

The Iceland scallop fishery in the Strait of Belle Isle (4R) landed 1,205 t against a TAC of 1,200 t in 1997. Total effort and CPUE appear to have stabilised although fishing effort has been drifting southwards since 1991 onto aggregations first exploited in the 1970s and not exploited recently. Total level of effort is likely to decline given the large areal shifts fishing effort during 1996 and 1997 reflecting localised depletion, low catch rates from a research vessel survey in 1997 throughout the total area, the absence of evidence of recent significant recruitment, and the absence of pre-recruits.

SUBAREAS 2 + 3 + 4

A. <u>Status of the Fisheries</u>

Nominal landings from 1990 to 1997 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Lobster.*

Landings have declined to 2413 t in 1996 from long-term high of 3,207 t in 1992. This decline is part of a widespread pattern in Atlantic Canada. The fishery is monitored through a voluntary research logbook program and dockside sampling of commercial catches. Average seasonal catch rates vary considerably from year to year and are usually highest early in the season and decline rapidly as the season progresses. The fishery is characterised by high exploitation rates and size limits that are small in relation to growth rate and size at maturity. Yield per recruit and egg per recruit analyses demonstrate growth overfishing with potential substantial increases in yield through reduction in exploitation rates or an increase in size limits. Given high exploitation rates and variable recruitment, landings are expected to decline and become less stable than under a more moderate level of exploitation.

B. Special Research Studies

1. Biological Studies

a) *Redfish.*

A redfish fishery closure in Management Unit 1 (4RST and 3Pn4Vn [June to December]) for 1995 prompted the establishment of a multi-disciplinary research program on redfish which continued in 1997. The program examines the biology and fisheries of redfish to develop a better understanding of these species and to ensure sustainability of the fishery. The program concentrates on species identification and stock structure; improved stock assessment and management approaches; distribution in relation to environmental conditions; and recruitment studies.

2. Sentinel Surveys

The Sentinel Surveys, initiated in October, 1994, were continued in 1997 and data collected tabled at zonal stock assessments in the spring of 1998. Sites in 2J3K3L, 3Ps and 3Pn4Rs were sampled by inshore fish harvestors using traditional fishing gears based on historic fishing patterns. The objectives of the program are: to develop a reliable inshore catch rate, length frequencies, sex, maturity, and otolith series for use in resource assessment; to incorporate the knowledge of inshore fish harvestors in the process of resource assessment, to describe temporal and spatial inshore distributions; to establish a long-term physical oceanographic and environmental monitoring program of the inshore area; and to provide a source of biological material for other researchers for genetic, physiological, food and feeding, and toxicological analyses.

3. Gear and Selectivity Studies

A multi-year project on the impact of mobile fishing gear on benthic habitat and communities continued in 1997. Spatial and temporal mapping of benthos on the Grand Bank (3L), Western Bank (4W), and Banquereau Bank (4V) through grab sampling of macrofauna, meiofauna, organic carbon, and sediment for grain size analyses during spring groundfish surveys have been conducted. Experimental otter trawling was carried out in an area of the Grand Bank and on Western Bank. A hydraulic clam dredging experiment on Banquereau Bank was designed in 1997 and will be implemented in 1998.

Species	Division	Catch (t)							
		1997	1996	1995	1994	1993	1992	1991	1990
Greenland halibut	0		1453	5,852	3,723	2,561	8,200	5,945	6,194
Shrimp	0A	517	-	2,361	4,727	5,501	7,493	6,788	6,177
	0B	5670	3220	3,564	476	106	1,291	1,107	1,609
Cod	2GH	0	0	0	0	3	0	0	400
Redfish	2+3K	2	1	1	-	-	1	7	192
Greenland halibut	2+3	4,000	19,000	15,000	48,000	62,000	63,000	65,000	47,400
American plaice	2+3K	0	184	167	187	8,015	11,800	27,080	28,400
Shrimp	2G (SFA 4)	5,217	5,160	5,104	3,982	2,723	2,706	2,561	2,945
	2HJ (SFA 5)	15,102	7,383	7,616	7,499	5,719	6,315	6,118	5,360
	2HJ3K (SFA 6)	21,246	10,923	10,914	10,978	8,035	6,609	5,500	5,598
Snow crab	2J	3,166	3,090	3,178	2,978	2,275	1,529	989	645
Cod	2J3KL	500	350	330	1,309	3,938	24,356	120,135	204,900
	3NO	170	53	63	2	3,717	7,180	8,000	11,600
	3Ps	9,000	458	613	562	13,517	24,600	27,300	26,300
Greenland halibut			3,859	1,012	1,619	3,919	15,100	4,000	6,500
Yellowtail	3LNO		300	200	2,000	13,600	10,800	16,300	14,000
Witch flounder	2J3KL	6	10	6	10	340	2,300	4,000	3,600
	3Ps	280	230	300	400	1,000	1,100	1,000	1,000
	3NO	300	300	1,100	4,400	4,800	4,800	4,200	3,700
Atlantic halibut			92	194	35	120	-	560	790
American plaice	3Ps	100	600	100	100	800	2,300	4,400	4,800
	3LNO	900	600	7,000	17,300	12,600	33,900	32,500	43,400
Haddock	3LNO	240	72	65	20	763	1,200	1,600	4,500
	3Ps	20	93	40	10	100	500	500	1,500
Pollock	3Ps	280	244	309	189	472	264	1,300	1,800
Capelin									
	3L	3,600	16,800	83	1,000	23,000	3,000	21,400	48,000
	3K	5,500	8,900	57	100	13,000	18,000	20,400	51,900
Shrimp	3M	785		970	1,041	3,724			
Squid	2+3	11,652	8,285	48	1,954	276	924	1,719	4,440
Sea scallop	3Ps			564	1,299	1,438	676	1,279	1,559
Iceland scallop	3LNO	3,973	9,454	6,501	3,941	817	22	-	-
Crab	3K	14,830	14,185	12,245	11,039	9,760	7,295	7,675	4,253
	3LNO	22,185	16,847	13,790	12,237	8,979	6,652	6,394	5,211
	3Ps	4,753	3,052	1,853	1,590	704	121	176	596
Capelin	2J3KL (offshore)	0	0	0	0	0	0	450	57,300
Atlantic salmon	2J3KLPs			95	133	126	213	353	498
Iceland scallop	4R	1,205	1,204	1,497	2,294	1,914	1,169	412	79
Crab	4R	969	833	920	655	-	-	-	-