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Canadian Research Report for 2005

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PART I. NEWFOUNDLAND AND LABRADOR REGION

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SUBAREAS 0 AND 1

A. Status of Fisheries

Nominal landings from 1991 to 2005 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) ***Greenland Halibut* – Subarea 0 + 1** (except Div. 1A inshore)

The Greenland halibut resource within Subarea 0+1 is considered to be part of a common stock distributed in Davis Strait and south to Subarea 3. The resource within the area, with the exception of Div. 1A inshore, is managed jointly by Canada and Denmark (Greenland), with the TAC being split equally. Since 2000, NAFO Scientific Council has provided separate TAC advice for offshore areas of Div. 0A+1A based on the unresolved relationship with the remaining areas and in 2003, the Scientific Council advised that Div. 1B be included in the management area with Div. 0A and Div. 1A. In 2004, Scientific Council advised for 2005 a TAC of 8 000 t for Greenland halibut in Div. 0A+1AB and 11 000 t for Div. 0B and 1C-1F. Catches in offshore 0+1 have been at the TAC levels since 2000. Canada (NL) catches from 2003 to 2005 were approximately 4 000 t, fully utilizing it's quota. In 2005, about 1 900 t was taken by otter trawls, 1 500 t taken with gillnets and 600 t taken by longline. Recent scientific information on this stock is limited. The most recent surveys were completed in Div. 0A and 1A in areas not previously surveyed. Based on these surveys, the Scientific Council advised that the TAC in Div. 0A and Div. 1A off shore + Div. 1B for 2006 should not exceed 13 000 t. In addition, considering the relative stability in biomass indices and CPUE rates, for Greenland halibut in Div. 0B and 1C-1F the TAC for 2006 should not exceed 11 000 t.

b) ***Shrimp* - Div. 0AB**

Between 1991 and 1996, the *Pandalus borealis* quota in Div. 0A was set at 8 500 t. Between 1997 and 2001 the quota varied between 7 650 and 9 350 t. The quota increased to 12 040 t during 2001, to 14 167 t during 2002 and subsequently to 18 417 t during 2004. The 2004 quota will remain in effect through 2005. Annual catches of 4 800-7 500 t were made between 1991 and 1994 and have since fluctuated between 500 and 7 500 t. The 2005 take was 7 508 t.

Catches of *Pandalus borealis* in Div. 0B increased from about 2 800 t in 1988 to 3 000 t in 1989, but had declined to 100 t by 1993. The 1994 catch was less than 500 t. Annual catches increased to over 3 600 by 1995 and more than 5 000 t over the 1997-1999 period. Subsequently, annual catches have fluctuated between 4 200 and 6 000 t. The 2005 catch was 6 333 t, 87% of which was taken west of 63°W.

Recent catches for the species have been estimated, in part, from the mixed fishery data for *P. borealis/montagui* in the area east of Resolution Island but their accuracy is questionable. *Pandalus borealis* taken in the immediately adjacent areas of Hudson Strait, Ungava Bay and NAFO Div. 2G were included in the catches reported for Div. 0B. TAC's remained at 3 500 t from 1989 to 1996 but were increased experimentally to 5 250 t for 1997 and 1998. In 1999, an additional 3 500 t were provided for the area north of 63°N as an incentive for the offshore fleet to return to grounds not fished extensively since 1995. However, just over 100 t were taken within this area in 1999. In 2000, the additional 3 500 t were not included in the quota report, and accordingly the catch was not counted against the TAC for the south (5 383 t). In 2001, the additional 3 500 t were included in the quota report as an exploratory quota east of 63°W. This quota for *Pandalus borealis* was maintained in 2003 and 2004 while a new exploratory quota of 2 000 t was allotted for *P. montagui*. The exploratory quota for *P. montagui* was to be fished within the Nunavut Settlement Area (NSA). The total catch of *P. montagui* in 2005 was 2 248 t.

CPUE models are not produced for this management area because their utility would be compromised by changes in resource management plans and fishing patterns, as well as the high degree of overlap in distribution of *Pandalus borealis* and *P. montagui*.

B. Special Research Studies

1. Biological Studies

a) *Shrimp*

In 2005, the first of a series of trawl surveys was conducted by the Northern Shrimp Research Foundation in partnership with DFO in Div. 0B. Biological and oceanographic data were collected to assess the distribution and abundance of the shrimp population in this division.

SUBAREA 2

A. Status of Fisheries

Nominal landings from 1991 to 2005 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) **Atlantic salmon – Subarea 2**

The commercial fishery remained closed for 2004. Approximately 9 700 salmon were retained or hooked and released in the recreational fishery. Preliminary information on food fishery catches indicated that about 32 t of salmon were harvested in 2005.

b) **Arctic charr – Subarea 2**

Commercial landings of arctic charr from north Labrador in 2005 were approximately 22 t, an increase of 20% over 2004. While catch rates have remained moderately high in the three primary stock complex areas over the past several years, only one stock was fished in 2005. Over the past 32 years (1974-2005), more than 2 700 t of charr have been harvested from a limited section of the north Labrador coast, and attests to the capacity of this area to produce fish. Preliminary information on the amount of charr harvested for subsistence (food) purposes in 2003, 2004, and 2005 are: 9.6 t, 13.7 t, and 17.2 t, respectively, and are believed to be underestimates of the full extent of subsistence harvesting.

c) **Cod – Div. 2GH, Div. 2J3KL**

The cod stock in Div. 2GH has been under a moratorium with respect to directed fishing since 1996. Landings (directed or by-catch) by Canada (NL) have been extremely low (<1 t) since 1991.

The northern (Div. 2J+3KL) cod stock was closed to directed commercial fishing in 1992. A small directed commercial fishery was reopened in the inshore only during 1998-2002. In April 2003 the whole stock area was closed indefinitely to directed commercial and recreational fishing. Monitoring by means of limited fishing by fish harvesters at specific sites (sentinel surveys) continues. Reported landings during 2005 were approximately 1 060 t of by-catch from commercial fisheries and 160 t from the sentinel surveys, for a total of 1 220 t. Most of the by-catch came from the gillnet fishery for winter flounder in shallow inshore waters. The 2005 catch comprised a range of ages, with ages 5-7 predominant.

The 2J+3KL cod stock was assessed in April 2006. The stock as a whole is at a very low level. In the offshore, the 2005 research bottom-trawl surveys during both spring (3L only) and autumn indicate that the biomass remains at 1-2% of the levels in the 1980s. Prospects for recovery in the offshore remain very poor because of very low recruitment (related at least in part to low spawner biomass) and extremely high mortality. In the inshore, the biomass of populations in the central area (Trinity Bay to Notre Dame Bay), as determined by sequential population analysis, increased from the start of the series in 1995 to a peak in 1997 (4+ biomass) or 1998 (SSB), but declined by more than 50% by 2003 as a result of fishing mortality, high natural mortality on adults, and weak recruitment. The biomass has increased during the most recent three years as a result of reduced fishing mortality and improved recruitment, and is currently (1 January 2006) about mid-way between the peak in 1997-1998 and the low in 2003.

d) **American plaice – Subarea 2 + Div. 3K**

This stock has not been assessed since 2003 but research vessel surveys indicate that the stock of American plaice in Subarea 2 + Div. 3K remains at a very low level. There was no directed fishery on this stock in 2005. By-catch has increased from an average of 13 t during 1994-1999 to an average of 100 t per year from 2000 to 2002, due mainly to by-catch in the Greenland halibut fishery. By-catch by Canada Newfoundland in 2005 was 29 t. The composition of the American plaice by-catch in this fishery is composed mainly of sexually mature females.

e) **Redfish – Subarea 2 + Div. 3K**

This stock has been under moratorium to directed fishing since 1997. Prior to this, there had not been a persistent directed effort on this stock since 1990, when 2 400 t was landed. Landings declined to 280 t in 1991, were less than 19 t in each year from 1992-1997 and were between 120 - 190 t for the period 1998-2000. Catch increased rapidly from 1,800 t in 2001, to 5 400 t in 2003 then declined to about 5 000 t in 2004 and 2005. The increases beginning in 2001 were from non-Canadian directed fisheries occurring in the NAFO Regulatory area (NRA) utilizing large mid-water trawls. It is assumed these catches were from the pelagic stock of redfish that resides primarily in the Irminger Sea between Greenland and Iceland. This stock is managed by the Northeast Atlantic Fisheries Commission (NEAFC). In recent years mid-summer trawl-acoustic surveys of this Irminger Sea population, conducted by member countries of NEAFC, have measured a portion of the concentration within the 2J3K boundary in the NAFO Regulatory area. Canadian landings since the moratorium are by-catch from Greenland halibut fisheries and have been less than 40 t annually. In 2004 catches increased to 169 t then declined marginally in 2005 to 137 t. Based on observer data, estimates of redfish by-catch discarded from shrimp fisheries in the Div. 2G to Div. 3K area since 1980 have ranged from 14 t in 1983 to 665 t in 1990. In recent years, discard estimates have increased from 60 t in 2000 to 252 t in 2004. Results from research vessel surveys in Div. 2J and 3K suggest the resource was at a historically low level in 1994. The survey biomass index increased by a factor of six from 1994 to 1998 and has averaged about 34 000 t to 2003, increased to 63 000 t in 2004 and was 85 000 t in 2005. The average of the index from 2001-2005 was only 8% of the index averaged from 1981-1990, a period over which the index began to decline. There has been an improvement in recruitment from the 1997, 1998 and 2000 year-classes (fish less than 19 cm), although these are considered poor in comparison to year-classes

of the early 1970s. Prior to the 1990s a substantial portion of the stock was comprised of fish greater than 30 cm (fish 15 years and older). Since 1994 these older fish are not well represented in the survey abundance even though exploitation is assumed low. This stock remains at a low level. Since 2001 there has been improvement in recruitment, although the average biomass index is only about 8% of what it was in over the 1980s.

f) **Witch flounder - Div 2J3KL**

There has been no directed fishing on this stock since 1994. In 2005, by-catch in other fisheries from the Newfoundland region amounted to 41 t. Canadian fall surveys since the late 1970s indicated that witch flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s, they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope in Div. 3L. The fall 1998-2005 surveys indicate no change in this distribution pattern. For the three Divisions combined, the biomass index declined from about 65 000 t in 1984 to 1 100 t in 1995, the lowest in the time series. Mean weight per tow decreased from a maximum of near 6 kg/tow in 1984 to a low of 0.23 kg/tow in 1995. The small increase in biomass index and mean weight per tow observed between 1995 and 1996 was almost exclusively a result of inclusion of the deeper strata surveyed in Div. 3L. The estimates have remained the same since then. The stock size remains extremely low.

g) **Greenland halibut -Subarea 2 + Div. 3KLMNO**

The Canadian catch of Greenland halibut in 2004 in Subarea 2 and Div. 3KLMNO was reported to be approximately 5 000 t. This is lower than the catches taken in the recent past, mainly due to quota reduction under the Fisheries Commission rebuilding plan (FC Doc. 03/13). In 2004, the total catch taken by otter trawl and gillnets (depths <400 fathoms) decreased considerably compared to 2003. However, gillnet catches in deeper waters (>400 fm) were approximately twice that taken in 2003. The catch at age in 2004 was dominated by the 1997 and 1996 year-classes (seven and eight year olds, respectively), which combined accounted for 61% of the catch numbers and 47% of the catch weight.

TACs in 2002 and 2003 were above scientific advice and appear not to have been reached. In September 2003 at its annual meeting, the Fisheries Commission implemented a fifteen year rebuilding plan for this stock. It established TACs of 20 000, 19 000, 18 500 and 16 000 t, respectively, for the years 2004 to 2007. Subsequent TACs will be decided upon depending on the response of the resource to the reduced TACs. The total agreed catches for 2004 exceeded the rebuilding plan TAC by 27%.

The exploitable biomass (age 5+) was reduced to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, increasingly higher catches and fishing mortality since then accompanied by poorer recruitment has caused a subsequent decline. The current estimates are the lowest in the series. Recent recruitment has been below average, and fishing mortality has increased substantially in recent years.

h) **Shrimp – Subarea 2 + Div. 3K**

The shrimp fishery in Subarea 2 and the northern portion of Subarea 3 is divided into three management areas – 2G, Hopedale and Cartwright Channels (2HJ), and Hawke Channel (2J) + 3K.

Between 1998 and 2002, annual catches of approximately 8 000 t were taken in 2G from 8 320 t TACs. The 2003 TAC was increased to 10 320 t and included an 1 125 t allocation for northern shrimp research. In 2003, the Canadian shrimp fishing industry requested and was granted a change, in season, from a calendar year (January 1-December 31) to a fiscal year (April 1-March 31). An additional interim quota of 2 802 t was set forth January 1-March 31, 2004 period. Thus the 2003-2004 fishing season was 15 months long and had a 13 122 t TAC. The 2003-2004 (April 1-March 31) TAC (10 320 t) was maintained for the 2004-2005 and 2005-2006 seasons. Approximately 11 300 t of northern shrimp were taken during the 2004 calendar year while preliminary data indicate that catches were approximately 7 900 t in the 2005 calendar year.

Historically, the fishery has been concentrated north of 60°N in an area noted for producing high catch rates of large, high-quality shrimp. During 1998, a separate quota was created for the area south of 60°N to reflect the existence of high concentrations of shrimp along the shelf slope. The new quota resulted in a southward shift in fishing effort. Standardized catch per unit effort declined since 2001 to the long-term average in 2002. Large vessels had a model CPUE indices of 1900 kg/hr during 2004 and 2005. Current status appears positive from fishery data, but future prospects are uncertain as the assessment is based solely upon fishery data. Autumn 1999 was the last time that the Canadian Government conducted a bottom trawl research survey in 2G. However, during the summer of 2005, Northern Shrimp Research Foundation and the Government of Canada (DFO) began a series of at least five (5) collaborative annual research bottom trawl surveys in 2G. These surveys make use of a research Campelen 1800 shrimp trawl with a 12.7 mm codend liner and fish at depths between 100 and 750 m. These surveys are to focus upon gathering data necessary for shrimp stock assessments.

TACs in Hopedale and Cartwright Channels (2HJ) doubled from 7 650 t during 1994-1996 to 15 300 t over the 1997-2002 period. TACs have been taken in most years. In 2003, the TAC increased to 23 300 t and included a 2 500 t allocation for northern shrimp science research. In 2003 the fishing season changed to April 1-March 31, and an additional interim quota of 9 787 t was set for the period January 1-March 31, 2004. Thus the 2003-2004 fishing season was 15 months long and had a 33 087 t TAC. The 2003-2004 fiscal year TAC (23 300 t) was maintained for the 2004-2005 season. Approximately 26 000 t of shrimp were caught during the 2004 calendar year while preliminary data indicate that 20,000 t were taken in the 2005 calendar year. Standardized catch rates, within Hopedale and Cartwright Channels were relatively stable between 1986 and the early 1990s, increased from 1993 through to 1998 and then stabilized at a high level. Most model catch rates between 1997 and 2004 were statistically similar ($P > 0.05$) to 2005 (1700 kg/hr) while indices previous to 1997 were generally lower than the 2005 index ($P < 0.05$). High CPUEs are being maintained over a relatively broad area indicating that the stock is healthy.

Only the 2J portion of SFA 5 (Cartwright Channel) was surveyed over the history of the autumn multi-species surveys. Trends in indices and biological characteristics from SFA 5 and Cartwright Channel were broadly consistent; therefore, indices from Cartwright Channel are used as proxies for the entire of SFA 5. These analyses indicate that biomass and abundance have increased since 1998. Recruitment in the short-term while uncertain, appears average. Longer-term prospects are unknown. The resource continues to be distributed over a broad area and exploitation indices have remained low.

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 throughout 1989 - 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 these years. TACs were increased to 23 100 t in 1997 as a first step toward increasing the exploitation of an abundant resource within the 1997-1999 Management Plan. Most of the increase was reserved for development of the small vessel fleet (<65 ft vessels). TACs more than doubled between 1997 and 1999, increased slightly to 2002 and further increased to 77 932 t in 2003. An additional interim quota of 7 653 t was set for the period January 1-March 31, 2004 to facilitate an industry requested change in fishing season from January 1-December 31 to April 1-March 31. Thus the 2003 – 2004 fishing season was 15 months long and had an 85 585 t TAC. TACs remained at the 77 932 t level for the 2004-2005 and 2005-2006 fishing seasons. TACs have been reached in most years; however, due to market constraints, small vessels have not always taken their entire allocations. Approximately 72 000 t and 70 000 t were taken in the 2004 and 2005 calendar years, respectively.

Large vessel catch rates, within Hawke Channel + 3K increased throughout 1990-1997 and have since fluctuated above the long-term average while the small vessel CPUE index increased significantly in 2004. The 2005 model CPUE indices for the large and small vessel fleets were 1251 and 479 kg/ hr, respectively.

Autumn research surveys have been conducted since 1995 and indices of biomass/ abundance have been increasing since 1997. The lower 95% confidence intervals for the biomass indices averaged 538 000 t

(about 129 billion animals) during the 1999-2005 period. The resource in this area remains healthy with high biomass/ abundance of male and female components. Most of the 2005 biomass was attributed to female shrimp. The female spawning stock biomass index increased from an estimated 182 000 t (22 billion animals) in 1997 to 404,000 t (55 billion) in 2005. Males within 11.5 mm-16 mm carapace length, primarily age 2, are used as a recruitment index. The latest recruitment index, suggests that the 2003 year-class is weaker than average; however, strong residual female biomass is expected to maintain the fishery in the short-term. Medium term recruitment appears positive from the presence of a stronger than average 2004 year-class

Exploitation rate indices (ratio of nominal catch/ lower 95% confidence interval of biomass index) have remained below 15% over the past 6 years and the fishery continues to cover a broad area. Therefore, fishery related impacts could not be detected from the logbook, observer or the research data. The fact that catch per unit effort for large and small vessel fleets have been maintained at a high level, or are increasing, and they are able to take their quotas over broad geographic areas, throughout the year further suggest that the stock is healthy.

The mandatory use of sorting grates, low groundfish abundance and avoidance of problem locations have minimized by-catch. Recent studies estimated that low numbers of redfish and Greenland halibut have been caught by the shrimp fishing fleets.

i) ***Snow crab*** **– Div. 2J3KLNO**

Landings decreased by 19% in 2005 to 49 400 t from the 2003 value of 39 900 t due primarily to premature closure of the offshore Div. 3K fishery because of high levels of soft-shelled immediate prerecruits in the catch.. There were also decreases in TAC in 2005, primarily in Div. 2J. Fishery performance is monitored in through analyses of commercial logbook data, observer program data and dockside monitoring. Offshore CPUE from logbook data, which had been declining in the north (Div. 2J3K) since 1998, declined further in 3K but increased marginally in 2J in 2005. It generally remained at a high level in 3LNO relative to other areas, despite declining since 2003. The exploitable biomass index, which is estimated from the fall multi-species bottom trawl survey**,** declined between 1998 and 2003 and has since changed little. The pre-recruit index for greater than 75 mm new-shelled adolescent males also declined during 1996-2002, remained low in 2003, but increased in 2004, before decreasing again in 2005. Recruitment is expected to remain relatively low in the short term in all divisions except 2J while longer-term prospects are unknown.

j) ***Iceland scallop*** **– Div. 2HJ**

Inshore aggregations were again fished in 2005, with nominal catches estimated at 548 t, round. The fishery is prosecuted by inshore vessels, typically under 45 ft (14 m), L.O.A. Except for exploratory surveys for presence/absence, there have been no directed scientific missions into scallop aggregations along the Labrador coast.

B. Special Research Studies

1. Biological Studies

a) Arctic charr

Samples were obtained for food and feeding, age, sex and length distributions from commercial landings from four north Labrador Subareas. Sampling of the spring food fishery was also carried out. Following a long-term decline in mean weight of charr harvested in north Labrador, recent data show that mean weight and mean-weight-at-age has increased, or generally stabilized in recent years. Besides the long term effects of fishing on stock characteristics, analyses have identified a possible environmental component contributing to some of the variation in stock characteristics. In addition, analyses of food and feeding patterns have demonstrated major diet shifts occurring over an 18-year interval and have been related, in part, to changes in the size of charr in some areas. Diet studies

continued in 2004 and 2005, with samples obtained from various Subareas, while an analysis of latitudinal variation in fecundity was published.

b) **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.

Analysis of sexual maturity data is conducted regularly on American plaice. A project examining an alternative stock recruit model is ongoing for Div. 2+3K American plaice.

SUBAREA 3

A. Status of Fisheries

Nominal landings from 1991 to 2005 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) **Atlantic salmon - Subarea 3**

A moratorium on the Canadian commercial fishery has been in place since 1992. The 2005 recreational harvest, including both retained and hooked-and-released, was approximately 32 650 fish in insular Newfoundland.

b) **Capelin – Subarea 2 + Div. 3KL**

Inshore capelin catches in Subarea 2 + Div. 3KL are taken during the inshore spawning migration. Catches increased from 26 844 t in 2004 to about 28 026 t in 2005. Resource status has not been determined since 2000.

c) **Cod – 3NO and 3Ps**

The cod stock in Div. 3NO has been under moratorium to directed fishing since February 1994. Total catch since 1994 has increased from 170 t in 1995 to 4 900 t in 2003. Canadian catches over this time period increased from 60 t in 1995 to 800 t in 2003. Total Canadian landings in 2004 were about 480 t, with 440 t of this amount being caught by Canada (NL). In the last assessment of this stock (2003), fishing mortality averaged over 2000 to 2002 for ages 4 to 6 is 0.32. This level of fishing mortality is comparable to that in earlier time periods during which substantial fisheries existed. Estimates of recent year-class size indicate that recruitment has been very low since the 1990 year-class. Low spawner biomass, low recruitment and high fishing mortality point to poor prospects for this stock in the future. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass. Recent Canadian spring and fall research bottom trawl surveys confirm that the stock size remains at an extremely low level.

The cod stock in Subdiv. 3Ps was placed under moratorium in August 1993. Stock assessments estimated a growing spawner biomass and the fishery reopened in 1997 with a TAC of 10 000 t, which was increased to 20 000 t in 1998 and to 30 000 t in 1999. From 2000 onwards the TAC has covered the period 1 April to 31 March. Although the 2000/2001 TAC was reduced to 20 000 t based on stock assessment results which indicated that spawner biomass was declining, the transition in the TAC year resulted in a calendar year catch of 25 100 t in 2000. The TAC has remained constant at 15 000 t for the 2001/2002-2005/2006 fishing seasons. The Canada (NL) share of the TAC is 84.5%, the remainder is allocated to France (SPM). A preliminary estimate of Canada (NL) catch in 2005 (to October) is 7 000 t. The most recent assessment (October 2005) indicated considerable uncertainty in the absolute size of the stock, and estimated that spawner biomass is declining. The outlook about the short-term productivity is not optimistic, as relatively poor year-classes enter the fishery. Concern continues regarding the low age at maturity in this stock and the high exploitation rates in a portion of the stock area (Placentia Bay).

d) **American plaice - 3Ps**

The last assessment of this stock was carried out in October 2005. This stock has been under moratorium since September 1993. From 1994 to 1998 the catch was 400 t or less. Catch since that time has increased substantially. During 2001 to 2003 the catch was greater than 1 000 t in each year. Catch declined somewhat in 2004 to just over 800 t. Catch in 2005 was 742 t by NL. Catch has been mainly as by-catch in the cod and witch flounder directed fisheries.

There has been a slight increase since 1993 in both biomass and abundance indices in the DFO RV survey but current biomass is only 20% and abundance 26% of the 1983-87 average.

Catch to survey biomass ratios indicate that exploitation rate has been increasing since the mid-1990s. Levels of the last few years are similar to those in the early to mid-1980s when there was a directed fishery on this stock.

Catches at recent levels are contributing to the lack of recovery.

e) **Witch flounder - 3Ps**

Landings from this stock over the last 20 years have fluctuated between 300 t and 1 000 t annually. In 2005 the catch from the Newfoundland and Maritime regions was 490 t. The main directed fishery is prosecuted by offshore otter trawlers complemented by a nearshore Danish seine fishery. However, in recent years it appears to be a mixed American plaice and witch flounder fishery by otter trawlers. Although survey stock size indices since 1983 have been highly variable, the survey biomass index during recent years suggests that the biomass is on average about 75% of the 1983-90 average when catches were around 800 t. The age and size structure observed in this stock since the early 1980s also appeared to have remained stable with little change in growth pattern. Aging has not been conducted on witch flounder in this region since the mid-90s. Geographic distribution has not changed appreciably since 1983 except during the early to mid 1990s when fish disappeared from the 51-100 fath. depth zone coincident with extremely cold sea bottom water temperatures. In recent years the distribution appears to be returning to a more normal pattern. No measurable change in recruitment has been observed over the past 20 years.

f) **Yellowtail flounder – 3LNO**

Since the fishery for this stock reopened in 1998, stock size has continued to increase and the TACs recommended for 2005 and 2006 were 15 000 t in each year. In addition to the annual spring stratified-random survey in 3LNO and the fall multi-species bottom trawl survey, joint DFO-Industry surveys have been conducted since July of 1996. The objective of these Fisheries Products International-DFO surveys is to develop a commercial-type index of abundance and to determine distribution of yellowtail flounder within a zone traditionally fished by commercial fleets. The last such survey was conducted in 2004. Evidence from the commercial fishery and various surveys indicates that the range of this stock has increased along with stock size since the mid-1990s. Fishing mortality is estimated to be relatively low and the stock biomass relatively high. In 2006 NAFO Science Council will be carrying out a full assessment of the resource.

g) **American plaice – 3LNO**

In 2005, there was a full assessment of this stock. Catches from this stock were generally in the range of 40 000 to 50 000 t per year throughout the 1970s and 1980s, before declining to low levels in the early 1990s. There has been no directed fishing on this stock since 1993. The TACs in 1995-2004 have been set at 0. Catch in rose in 2003 to 8 700 t though there was much variation around catch estimates. It was lower in 2004, at 6 100 t. Canadian NL catch in 2005 was 1 451 t. The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid-1970s. Biomass has increased slightly in the past few years. *F* increased fairly steadily from 1995 to 2000 but declined somewhat in 2004. *F* has been

slightly lower since then. Average F on ages 11-14 in 2004 was 0.22, higher than in 2002, but lower than average *F* in 2003 (0.25) consistent with the increase, then decline in catch. Since 2001 the SSB has increased very slightly to 23 000 t in the current year. This is still only 11% of the level in the mid-1960s and 17% of the level in the mid-1980s. Recruitment has been steadily declining since the 1989 year-class and there have been no good year-classes since then. No good recruitment is seen below an SSB of 50 000 t, the B_{lim} for this stock.

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

Redfish in the Canadian Atlantic within Div. 3P4RSTVWX were redefined into three management units in 1993. Redfish in UNIT2 was last reviewed in November 2001 and updated in 2004.

Total Canadian catches have declined steadily from 27 000 t in 1993 to 8 000 t in 2002, matching reductions in TACs. Since 2002 the TAC has been stable at 8,000 t and catches remained near that level to 2004. Unit 2 Canadian landings in 2005 totalled approximately 6000 t and about 1 900 t was caught by Canada (NL). Current management regulations include a closure related to peak spawning in May and June, and a minimum size restriction at 22 cm. The most recent Department of Fisheries and Oceans (DFO) surveys (conducted from 1994-1997, 2000 and 2002) indicates relative stability over the time period to 2002. A corresponding survey index conducted by industry (from 1998-2001, 2003 and 2005) is variable but indicated a decline between 2001 and 2003 to the lowest in the time series followed by a large increase in 2005. The 2005 fishery was dominated by exploitable year-classes born after 1980, most notably the 1988 year-class. Current information suggests the 1988 year-class is not as strong as the 1980 that has already produced about 15 years of yield. There appears to be improved recruitment to the stock from the 1994, 1998 and 2003 year-classes but their absolute size is unknown. Biological characteristics suggest the 1988, 1994, 1998 and 2003 year-classes are predominantly *S. fasciatus*, a shallower water species, and the strong 1980 year-class is predominantly *S. mentella*, a deeper water species. The strength of year-classes of *S. mentella* since the 1980 year-class is apparently very weak, yet it continues to be a significant portion of the fishery.

Canada has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in areas suitable for trawling. Canadian landings were less than 200 t annually from 1983-1991. In 1994, Canada took 1 600 t due to improved markets related to lobster bait, but declined to about 200 t in 1995. Between 1996 and 2000 Canadian catches have alternated between levels of about 8 000 t and 2 500 t based on market acceptability for redfish near the Canadian 22cm size limit. From 2001-2004, Canada has averaged about 3 400 t, with Canada (NL) accounting for more than 95% of the catch. The 2005 Canadian catch was about 5 600 t. From 1974-2004, Div. 3O was under TAC regulation set by Canada within its jurisdiction, while catches were unrestricted in the NAFO Regulatory area of Div. 3O. In 2004, NAFO Fisheries Commission adopted TAC regulation for Div. 3O redfish at 20 000 t for 2005, 2006 and 2007. Assessment of this stock has been primarily based on research data due to variable commercial indices and fleets prosecuting different areas of the stock. It is difficult to reconcile year to year changes in the indices, but generally, the Canadian spring survey biomass index suggests the stock may have increased since the early 1990s, fluctuated over 100,000 t from 1994 to 1999 and declined to 2002. The index shows an increase in 2003 and a larger increase in 2004 that was influenced by one large set in a stratum that represented 40% of the biomass index. The Canadian autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002 but suggests stability to 2004. RV surveys do not adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion of the fishery, which makes it difficult to interpret survey estimates in relation to what is happening to the stock as a whole. The fishery since 1998 appeared to target the relatively strong 1988 year-class that has grown sufficiently to exceed the small fish protocol of 22 cm. There is concern that there has been little sign in recent surveys of size groups smaller than 17 cm despite using a shrimp trawl, which is very effective at catching small fish.

i) **Witch flounder – Div. 3NO**

There has been no directed fishing on this stock since 1994. By-catch in 2005 (NL region) was 49 t. The data for Div. 3NO combined suggest an overall declining trend in stock size with the estimates for the

spring 1998 survey at the lowest level observed since 1984. Since then, all indices have generally increased but remain variable. The spring survey estimates for 2005 are lower than those for 2004.

j) **White hake – Div. 3NOPs** (Div. 3NO in NRA)

The initial (2003) Fisheries Commission (FC) request for advice on white hake was specific for Div. 3N and 3O to the exclusion of NAFO Subdiv. 3Ps, formerly included in the stock management area for the Canadian assessment. In 2004, the FC subsequently requested scientific advice for the management of white hake in Div. 3NO. FC, by specifying advice for Div. 3NO implicitly set the stock management unit as 3NO. However all evidence indicates that the stock encompasses 3NOPs.

Prior to 1995, white hake was taken as by-catch in other demersal fisheries on the Grand Banks. Average estimated catch during 1985-1990 averaged ~5 000 t. Annual catches in a new directed (Canadian) fishery on the Grand Banks, starting in 1995 and encompassing Divs. 3NO and Subdiv. 3Ps, averaged 460 t. However, in 2001 and 2002, a >10 fold increase in the catch of white hake Div. 3NO attributable to EU-Spain, EU–Portugal and Russia in the NAFO Regulatory Area. Given this large increase in catches in 2003, the FC of NAFO requested specific information on fishing mortality, abundance and distribution, reference points and conservation measures, size of fish and delineation of fishery areas with respect to white hake. That advice, to the extent of the available data was summarized in Kulka *et al*. (2004 and 2005). Most the increase in catch was attributable to a very large 1999 year-class. For the past 6 years, the stock has been declining due to an increase in fishing pressure and low recruitment. Only about 5% of that year-class remains and the stock is at or near a historic low.

k) **Thorny skate – Div. 3LNOPs**

Before the mid-1980s, non-Canadian fleets landed several thousand metric tons (t) of skate (mainly thorny) annually. An average of about 5 000 t was discarded annually by the Canadian fleet during the 1980s and early 1990s, while only a few hundred tons per year were recorded in Canada's landings statistics during that period. Although often kept by non-Canadian fleets, skates were taken only as by-catch until the mid-1980s. In 1985, EU-Spain targeted skate in a non-regulated fishery in the NRA. By-catches of thorny skate in other fisheries outside 200 miles (primarily Greenland halibut, *Reinhardtius hippoglossoides*) have also contributed significantly to skate catches. In 1993 and 1994, experimental fishing resulted in the first significant directed skate landings appearing in Canadian statistics. In 1995, Canada established a regulated skate fishery inside its 200-mile-limit with gear and by-catch policies, a licensing system, and Total Allowable Catch (TAC). The Canadian fishery includes otter trawl, gillnet and longline gear while the non-Canadian catches are taken by otter trawl. In 2000, Russia commenced a directed fishery for thorny skate. Catches have averaged about 11 000 t, all countries combined over the last 7 years.

Thorny skate underwent a decline in the late 1980s to early 1990s followed by a slight increase in the late 1990s. Since then, abundance has remained relatively constant near the lowest historic level. An average exploitation rate of 10% (equivalent to an average catch of 11 200 t) over the past 7 years has resulted in a flat biomass trajectory. Although stable in recent years, skate continues to be near a historic low population size. Average index of biomass over that 7 year period was 112 000 t. The current TAC for skates in 3LNOPs presently amounts to 14 550 t (13 500 to in 3LNO and 1 050 t in 3Ps) which considerably exceeds the current 11 100 t average catch. The results of the production model suggest that a catch <12 000 t would be required to allow rebuilding of the stock.

l) **Shrimp – Div. 3LMNO**

Subarea 3 has been divided into two shrimp management areas – Div. 3LNO and 3M. The 3LNO shrimp stock is distributed along the edge of the Grand Banks mainly in Div. 3L. The fishery began in 1993 and catches were approximately 1 800 t. Exploratory fishing from 1996-1999 resulted in catches ranging from 179 to 795 t. In 2000, the NAFO Fisheries Commission implemented a TAC of 6 000 t, and fishing was restricted to Div. 3L. The catch in 2000 increased to 4 900 t, 4 300 t of which was caught by Canada. The remainder of the catch was taken by vessels from 7 other countries.

STACFIS estimated that the 2001 fishery took approximately 10 600 t, with Canada taking just over 5 100 t. However, reliable catch reports were not available for all countries in 2001. Similarly, estimates of catch in 2002 were not available for all countries. However, STACFIS noted that the total catch in 2002 was likely lower than that estimated for 2001, but that there was considerable uncertainty with estimates of catch in both years. Canadian vessels caught 5 400 t of shrimp in 3L during 2002.

During November 2002, Scientific Council (SC) noted that there had been a significant increase in biomass and recruitment in Div. 3LNO shrimp since 1999. Applying a 15% exploitation rate to the lower 95% confidence interval of biomass estimates, averaged over the autumn 2000-2001 and spring 2001-2002 surveys, resulted in a catch of approximately 13 000 t. Accordingly, SC recommended that the TAC for shrimp in Div. 3LNO in 2003 and 2004 should not exceed 13 000 t. Over the period 2000-2003, catches were 4 900, 10 600, 7 000 and 12 000 t, respectively. Preliminary data indicate that ~13 000 t of shrimp were taken in 3L each year during 2004 and 2005.

In 2004, SC advice of 22 000 t for 2006 was based upon 12% of the inverse variance weighted average fishable biomass from the most recent surveys. SC did not update this calculation due to the incomplete survey in autumn 2004.

During 2001, large (>500 t) and small (<65 ft) shrimp fishing vessel catches were taken from a broad area extending from the northeastern border with 3K south east along the 200-500 m contours to the NRA border. The area fished contracted as large quantities of big shrimp were discovered in the northeastern corner of 3L, near the 3K border, and at the NRA border. The distribution of fishing activity is much lower than the distribution of the stock, therefore, the catch rate models should not be used as a proxy for shrimp biomass and abundance. Large and small vessel catch rates were modeled in order to describe fishing activities.

The fishery for northern shrimp at Flemish Cap began in the spring of 1993 and has since continued with annual catches (as estimated by STACFIS) fluctuating between 25 000 and 54 000 t between 1993 and 2002. The 2003 catch was 62 000 t, the highest in the series. Preliminary NAFO catch statistics indicate, 43 000 t of shrimp were caught in 3M during 2004 while only 12 000 t of shrimp were caught in 3M during 2005. Vessels from as many as 16 nations have participated in this fishery since its beginning.

The use of a sorting grid to reduce by-catches of fish is mandatory for all fleets in the 3LNO and 3M fisheries. By-catch of groundfish has been quantified, and consists primarily of redfish and Greenland halibut.

m) **Iceland Scallop – Div. 3LNOPs**

The 3LN Iceland scallop fishery commenced in 1992. Aggregations over the eastern Grand Bank (3L) were first commercialized. In 1994, the fishery expanded into the Lilly and Carson Canyons (LCC) and subsequently (1995) into the northeast of LCC between 45°30' N and 46°30' N. In 1996 a new aggregation was located and rapidly fished down. Nominal landings have declined throughout, partially because ofeffort diversion into shrimp and crab.

A total of 128 t were removed from the LCC box in 2005, the first since 2001. Elsewhere, over the Grand Bank (Div. 3LNO), there were 5 t removed, again the first commercial activity since 2000.

The Iceland scallop fishery on 3Ps commenced in 1989. It encompasses the trans-boundary stock, along the northern edge of St. Pierre Bank, co-managed by France (70% of annual TAC) and Canada (30% of TAC), and the remainder of 3Ps that remains entirely under Canadian jurisdiction.

Total removals from the Canadian zone have decreased from 5 367 t, (round) in 1997 to 38 t in 2004. In 2005, 1 986 t of a total 3 500 t TAC were removed. There has been no directed effort for Iceland scallops in the trans-boundary area since 1998, however, the resource status of this area was updated based on a joint Canada-France survey in September 2005.

n) **Sea scallop – Subdiv. 3LPs**

The sea scallop fishery on St Pierre Bank commenced soon after its discovery in 1953. The area has been fished by both Newfoundland inshore vessels and larger Maritimes (Nova Scotia) based offshore vessels. Occurring as they do towards the northern extreme of its distribution, sea scallops here have not been able to withstand continued heavy exploitation. The fishery is typically characterized by a disproportionate dependence on sporadic recruitment of a single or a few intermittent and sometimes, well-spaced year-classes. Figures shown in Table 1 represent only landings in Newfoundland ports and do not include removals from the area but landed in Nova Scotia.

Since 1997 there has been very little effort by offshore vessels with most of the landings coming from inshore beds. In 2003 there was sign of a large recruited year-class, with 647 t (round) removed. In the following two years, there was a significant increase in effort and landings by both inshore and offshore fleets. In 2005 a total of 1 999 t (round) was landed in Newfoundland, while an additional 256 t was removed but landed in Nova Scotian ports.

A small amount, 18 t, was removed by inshore vessels in Div. 3L.

o) **Squid – Subarea 3**

Following a peak catch in 1979 of about 88 800 t, the Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5 000 t during the thirteen-year period 1983 to 1995. They increased since 1995 to about 12 700 t in 1997 before declining sharply to about 800 t in 1998 and about 20 t in 1999. They remained low, at about 300 t, in 2000, decreased to only about 20 t in 2001 and increased to about 600 t in 2003. Catches increased further in 2004 to approximately 2 000 t, but decreased to about 500 t in 2005. Increases in catches in 1996 and 1997 were associated with environmental warming and increase in squid abundance at the northern extreme of their range.

p) **Snow crab – Subdiv. 3Ps**

Landings in 3Ps declined by 58% (7 600 t-3 200 t) during 2002-2005 due to reductions in TACs. Inshore CPUE declined from 2001-2005 by 70%, whereas offshore CPUE declined by 75% from 1999 to its historical low in 2005 due to an apparent reduction in the abundance of commercial-sized males. No exploitable biomass index is available as there are insufficient fishery- independent data from this area. Recruitment appears to have been stable in recent years and is expected to increase over the next 3 years. Longer-term prospects are unknown.

B. Special Research Studies

1. Environmental Studies

Physical oceanographic observations are routinely collected during fish assessment and research surveys in the Newfoundland and Labrador Region. The Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2005 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Hamilton Bank on the southern Labrador Shelf. The first was conducted on the CCGS Teleost from April 30 to May 9, the second from July 16 to August 3 and the last from November 26 to December 14. This program was established to include biological and chemical oceanographic sampling at a fixed coastal site (Station 27) at biweekly intervals and along offshore sections at seasonal time scales. The main objectives are to establish the seasonal temporal and spatial distribution and abundance of plant pigments, nutrients, microzooplankton and mesozooplankton in relation to the physical environment. Physical, biological and chemical variables being monitored include temperature, salinity, dissolved oxygen, ocean currents as well as measures of primary and secondary production and biomass, species composition of phytoplankton and zooplankton and nutrients. The oceanographic monitoring program currently conducted on the Newfoundland and Labrador Shelf should allow an understanding of changes in ecosystem productivity and changes in ecosystem structure over time. Data from this effort are used to produce annual physical, chemical and

biological state of the ocean reports and in studies relating environmental conditions to marine resources.

a) **Plankton studies**

Overall, the seasonality of chemical and biological variables at Station 27 and along the major AZMP sections in 2005 was similar to previous years (1999-2004). The timing of events on the Newfoundland Shelf (south of Seal Island) was once again similar to conditions observed in the early part of the program but in contrast to 2001 when the onset of the spring phytoplankton bloom was delayed. However, satellite information indicates that the relative delay in the onset of the spring bloom remained as one moved further north.

There were a few notable trends in the observations from Station 27 and the oceanographic transects. At Station 27, the integrated seasonally-adjusted chlorophyll inventory along with many zooplankton species (*C. finmarchicus, C. glacialis, C. hyperboreus, Metridia* spp., *Oithona* spp., euphausiids and larvaceans) were are their lowest levels since the start of AZMP. Few of these trends were statistically significant, largely as a result of the considerable sampling variability. Also, the deep (0-150 m) inventories of nitrate and silicate remained low relative to that observed in 2000. However, the trends observed at Station 27 were in marked contrast with those observed along the oceanographic transects. With the exception of the decline in the seasonally-adjusted deep (50-150 m) silicate inventory along the Flemish Cap transect, none of the standard oceanographic variables (integrated chlorophyll, surface and deep nitrate and silicate inventories) showed significant trends during the period 2000-2005. Values in 2005 were generally near the overall mean since the inception of AZMP. In addition, most of the seven major copepod taxa along the Flemish Cap, Bonvasita Bay and Seal Island transects were either at or near their maximum seasonally-adjusted means, in contrast to the patterns at Station 27. Zooplankton abundance along the Southeast Grand Banks showed few clear trends, and none were statistically significant.

Discrepancies between the patterns of seasonally-adjusted means for oceanographic variables and major zooplankton taxa between Station 27 and the oceanographic transects is in marked contrast with the relatively large decorrelation scales found in temperature and salinity. One possible explanation is that the decorrelation scale is relatively small (10s of kms) for chemical and biological variables collected by the AZMP because local coastal processes are highly dynamic in contrast to broad oceanographic bio-physical interactions that govern the patterns of abundance further on the shelf. An analysis of the correlation between observations at Station 27 and transect stations taken during oceanographic surveys shows that the average correlation, based on the seven dominant copepod taxa, is highest for the nearshore stations along the Bonavista Bay and Flemish Cap transects, after which it drops rapidly as one moves offshore. There is no correlation with conditions at the deep water offshore stations, and a nearly inverse relationship with conditions along the Seal Island transect. The high concentration of copepods in offshore waters may therefore have a strong influence on the mean abundance estimated from the GLM analysis.

Aliasing of sampling and the onset of the spring phytoplankton bloom are likely to prevent an estimation of the annual mean phytoplankton standing stock from the oceanographic surveys. Estimates of annual mean phytoplankton standing stock or surface nutrient inventories along oceanographic transects based on GLM analysis are highly influenced by the magnitude of the spring phytoplankton bloom observed during our surveys. However, attempts to derive average annual values were strongly influenced by the stage of the spring phytoplankton bloom, as determined from the relative abundance of nutrients and phytoplankton. In some years (e.g., 2003), phytoplankton standing stock was low during the spring oceanographic surveys whereas the surface nitrate inventory was high, while the opposite was true in 2000. The two-week composite estimates of surface chlorophyll do assist in the interpretation of these patterns but a more temporally-resolved estimate of the seasonal variations in surface chlorophyll throughout the entire Atlantic Zone would assist in determining the degree of inter-annual variation in both the magnitude and duration of the spring phytoplankton bloom. Combining the data from the oceanographic surveys with satellite observations could enable us to obtain a three-dimensional view of the progression of phytoplankton dynamics throughout the Zone and thus provide a more accurate estimate of changes in standing stock.

The most notable advance in 2005 was in our ability to provide quantitative analysis of inter-annual differences in the abundance of dominant zooplankton taxa at Station 27 and along the key oceanographic transects. The analytical approach is somewhat simplistic and does not take into consideration of major shifts in the spatial distribution of species (this appears as part of the error). However, the approach has revealed significant inter-annual variations in the abundance of zooplankton on the Shelf. Data from Station 27 revealed that only 12 taxa were sufficiently abundant and frequent to allow appropriate inter-annual comparison in abundance patterns, which included copepods, gastropods, larvaceans and euphausiids. In contrast, only 7 to 8 species of copepods were sufficiently abundant and frequent on the shelf to allow effective and reliable intercomparison throughout the AZMP implementation period. Other groups, such as bivalves, gastropods, euphausiids and larvaceans were highly patchy in their distribution, making statistical intercomparisons unfeasible at this time. Longer time species of observations may be required before we can detect significant inter-annual variations in abundance based on the AZMP survey design and collection methods. We did investigate the potential to simply contrast seasonal and inter-annual variations in abundance without taking into consideration the spatial distribution of each species. This did allow a greater number of species to be included in the analysis but the complexity of the results requires further investigation at this time before we feel that we can comment on the overall trends.

b) **Oceanographic studies - Subareas 2 and 3**

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2005 in NAFO Div. 2J and 3KLNO. These studies were based on observations from southern Labrador Shelf to the Southern Grand Bank on the Newfoundland Shelf. At Station 27 off St. John's, the depth-averaged annual water temperature decreased slightly from the record high of 2004 to just over 0.5°C above normal, the 7th highest on record. Annual surface temperatures at Station 27 were identical to 2004, 1°C above normal, the highest in the 60 year record. Bottom temperatures were also above normal by 0.8°C, the 3rd highest in the 60-year record. Annual surface temperatures on Hamilton Bank were 1°C above normal, the 4th highest on record, on the Flemish Cap they were 2°C above normal, the 3rd highest and on St. Pierre Bank they were 1.7°C above normal, the highest in 56 years. Upper-layer salinities at Station 27 were above normal for the 4th consecutive year. The area of the cold-immediate-layer (CIL) water mass on the eastern Newfoundland Shelf during 2005 was below normal for the 11th consecutive year and the 5th lowest since 1948. The near-bottom thermal habitat on the Newfoundland and Labrador Shelf continued to warm in 2005, with bottom temperatures reaching a record of 2°C above average on Hamilton Bank off southern Labrador during the fall. Bottom temperatures on St. Pierre Bank were above normal during the spring of 2005, the highest since 2000 and the 6th highest in 36 years. The area of bottom habitat on the Grand Banks covered by sub-zero water has decreased from >50% during the first half of the 1990s to near 15% during the past 2 years. In general water temperatures on the Newfoundland and Labrador Shelf decreased slightly from 2004 values, but remained well above their long-term means, continuing the warm trend experienced since the mid to late 1990s. Newfoundland and Labrador Shelf water salinities, which were lower than normal throughout most of the 1990s, increased to the highest observed in over a decade during 2002 and have remained above normal at shallow depths during 2005.

An oceanographic assessment study was also conducted during the summer of 2005 on the Flemish Cap in NAFO Div. 3M. Oceanographic data from the summer of 2005 on the Flemish Cap were examined and compared to the long-term (1971-2000) average. The cold near-surface temperatures (0.5° to 2°C below normal) experienced over the Cap from 1993 to 1996 had warmed to 0.5°-1.5°C above normal by the summer of 1997, which increased further to 2°C above normal by the summer of 1999. Upper layer temperatures over the Flemish Cap during the spring of 2001 and the summer of 2002 generally showed a downward trend with temperatures decreasing to below normal values. During the summer of 2003, temperatures directly over the Cap were highly variable while adjacent areas showed significant positive anomalies and during 2004 and 2005 they increased to above normal values. Near bottom temperatures over the Cap during both 2004 and 2005 were >4°C, which was above normal by near 1°C over the shallow areas of the Cap. Salinities over most of the upper water column during the summer of 2002 to 2005 were generally saltier-than-normal (0.25-0.5). In the

deeper water (>100-m depth) salinities were about normal. In general, the colder-than-normal temperatures experienced over the continental shelf and on the Flemish Cap from the late 1980s up to the mid-1990s moderated by the summer of 1996 and continued to warm until 1999. During the summer of 2000 and into the spring of 2001 the observations indicate a reversal in the recent warm trend in some areas with water column temperatures decreasing to near normal values. However during the summers of 2003 to 2005 most areas of the water column again experienced an increase in both temperature and salinity. During 2004 and 2005 and throughout most of the 1990s and early 2000s summer chlorophyll levels in the upper 100-m of the water column over the Cap were higher compared to the adjacent Grand Bank. Dissolved oxygen levels were about normal for the region with super-saturated values in the near surface layers reaching 105%. Finally, during the summer of 2005, it appears that the circulation pattern around the Cap was again dominated by the southward flowing Labrador Current, however there appeared to be a slight increase in the northward component compared to the previous year, indicating a slight strengthening of the gyre circulation.

c) **Multi-disciplinary studies - Subareas 2 and 3**

A study was conducted in NAFO Subdiv. 3Pn and 3Ps during 2005 relating possible influences of oceanographic conditions on the distribution and abundance of Atlantic cod (*Gadus morhua*). Oceanographic data from NAFO Div. 3P during the spring of 2005 are examined and compared to the previous year and the long-term (1971-2000) average. Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid-1990s. Beginning in 1996 however, temperatures moderated, decreased again during the spring of 1997 and returned to more normal like values during 1998. During 1999 and 2000 temperatures continued to increase, reaching the highest values observed since the late 1970s in some regions. During 2001-2003, however, temperatures cooled significantly to values observed during the mid-1990s with the average temperature during the spring of 2003 the coldest in about 13 years. Temperatures during both 2004 and 2005 warmed considerably over 2003 values to 1°C above normal in some areas. The areal extent of <0°C bottom water during 2003 increased to the highest in about 13 years but decreased during 2004 and 2005 to <10%, the lowest since 1988. The areal extent of bottom water with temperatures >3°C has remained relatively constant at about 50% of the 3P area during the past decade. On St. Pierre Bank bottom water with temperatures <0°C essentially disappeared during the warm years of 1999 and 2000, reappeared again during 2001 to 2003 and disappeared again during 2004 and 2005. In general, temperatures during the past two years increased significantly over values observed during 2001-2003. The most evident trend in the numbers of cod caught per set during the multi-species surveys was the high number of zero catches in the <0°C water on St. Pierre Bank and regions to the east of the Bank, mainly from 1985 to 1998 but also from 2001 to 2003. During 1999 and 2000 larger catches became more wide spread over St. Pierre Bank as cold (<0°C) water disappeared from the area. In general, during most surveys the larger catches occurred in the warmer waters (2°-6°C) along the slopes and areas to the west of St. Pierre Bank. In 2004 there was no observed shift in the distribution of cod over St. Pierre Bank and there were many low or zero catches in the warm deeper waters off the banks compared to most years. During the spring of 2005 however there was an increase in the number of non-zero catches on St. Pierre Bank and an apparent increase in the size of the catches in deeper waters with temperatures >2°C. Finally, variations in the estimated abundance and biomass of cod from the RV surveys in strata with water depths <92 m are significantly correlated with bottom temperatures for that depth range.

A study on the spatial distributions and abundance of northern shrimp was also carried out for NAFO Div. 3LNO. The study examined variations in the thermal habitat and shrimp distribution and abundance for NAFO Div. 3LNO during spring surveys from 1998-2005 and for autumn surveys from 1995-2004. The data indicates that the highest numbers of shrimp are generally found in the 2°-4°C temperature range during the spring with lower numbers in water with temperatures <2°C and >4°C. During the fall most shrimp are found in a colder temperature range of 1°-3°C. Cumulative frequency distribution of the number of shrimp caught and temperature indicates that <5% of the catches are associated with temperatures <1°C in the spring and up to 30% are associated with temperatures <1°C in the fall. About 90% of the shrimp were caught in the 2°-4°C temperature range during the spring,

while only about 50% appeared in this temperature range during the fall. In terms of available thermal habitat, about 30% of the surveyed region was covered with water in the 2°-4°C-temperature range during the spring, while about 40% was covered by water in this temperature range in the fall. In 2004 the average spring bottom temperature increased significantly over 2003 to >2°C, the highest since the early 1980s but decreased to slightly <2°C in the spring of 2005. An apparent shift in the shrimp distribution towards colder temperatures further upon the Grand Bank and towards the inshore regions occurred during the fall and as a result, a greater proportion (30%) of the catch shifted into the 0°-1°C temperature range. Very low numbers of shrimp were found in temperatures <0°C and >4°C during both spring and fall. Shrimp catches were mostly zero in all surveys in the shallow waters (<100 m) of the southeast Grand Bank, where temperatures generally range from 2°-7°C. In general, during the spring most of the large catches were found in the warmer water along the slopes of Div. 3LN, while in the fall, larger catches were found in most areas of Div. 3L including the inshore areas of the bays along the east coast of Newfoundland. During the spring of 2005 most of the shrimp catches (>70%) were found in temperatures >3°C with an apparent increase in the overall catches over the previous year. Preliminary results indicate that the larger shrimp are associated with temperatures >3°C while smaller shrimp on average are found in temperatures <2°C. The total number of shrimp in sets dominated with small shrimp shows a general association with bottom temperature with the higher numbers occurring in years with low bottom temperatures while the opposite seems to be the case for larger size shrimp.

2. **Biological Studies**

a) Flatfish

Analysis of sexual maturity data is conducted regularly on American plaice, yellowtail flounder and other species. The yellowtail and American plaice analyses are presented to NAFO during the biannual assessment of Div. 3LNO American plaice and yellowtail flounder. Research on yellowtail age and growth is ongoing, using a variety of methods. The most recent analysis of age validation studies was presented to NAFO SC in June 2001.

A tagging program was begun on yellowtail flounder in Div. 3LNO in 2000. This is a co-operative project between DFO and Fishery Products International Ltd. This program is designed to run in May –June of each year from 2000 to 2004 inclusive. The objectives are to obtain estimates of exploitation and population size to improve the assessment of this stock; and to study movements and migrations, age and growth, mortality, and longevity of this species. These objectives will be accomplished by using two different tagging methods. In 2004, only 15 data storage tags were deployed along with the Petersen discs used in 2000-2004. This represents the last year of the tagging program.

A study into changes in fecundity in several flatfish species (and cod) has begun. This study will produce new estimates of fecundity and compare them with previous estimates. The potential use of proxies for fecundity will be examined. New estimates of reproductive potential will be produced and their utility for use in stock assessment examined.

b) **Seals**

Multi-disciplinary studies on harp, hooded, and grey seal population dynamics and seal-fish interactions continued in 2005. The Atlantic Seal Research Program (ASRP), initiated in 2003, was extended until March 2006. The objectives of the ASRP are to: 1) conduct surveys to estimate the abundance of the three seal species believed to be important groundfish predators; 2) determine seal distribution in relation to fish resource and provide current estimates of the diet of each species; and 3) evaluate the utility and test seal management tools, which might aid the recovery of Atlantic cod stocks (e.g. Seal Exclusion Zone, immuno-contraception). In addition, research is continuing on other aspects of seal biology and ecology (e.g. interannual changes in growth and reproductive status) in order to determine their role in the ecosystem of the Northwest Atlantic.

As part of the ASRP, analysis of the 2004 harp seal pup production survey was completed and the results presented for peer review. The total pup production of harp seals in 2004 was estimated to be approximately 991 400 pups (95% SE = 58 200). Pup production has not changed since the last estimate in 1999. This estimate was combined with data on reproductive rates and age specific removals to determine trends in total population since 1960. The harp seal population declined during the 1960s and reached a minimum of less than 2 million in the early 1970s. Since then it increased steadily until the mid-1990s and is currently at its highest level since the current time series began. Due to the large harvests in recent years, the population has been relatively stable since 1996. The estimated population size of northwest Atlantic harp seals for 2004 is 5.9 million (95% confidence interval 4.6-7.2 million). Differences between this estimate and the previous one is due to changes in the fitting of the population model and do not represent an increase in the population.

Visual and photographic surveys were conducted in March 2005 to estimate hooded seal pup production in the Northwest Atlantic. Over 6 000 photographs were obtained and are currently being examined. The results of these surveys are expected to be available in the spring of 2006 and will be incorporated into a hooded seal population model to estimate total abundance of the northwest Atlantic hooded seal population

Consumption of prey by seals in NAFO Div. 2J3KL is estimated by integrating information on individual energy requirements, population size, distribution, and diet composition. New information on the diet of harp and hooded seals in near shore and offshore areas of NAFO Div. 2J3KL was collected during 2005. Once analyses of these samples are completed, new estimates of consumption will be made available.

c) **Capelin**

A comparative study to determine factors governing capelin survival during egg development and larval emergence from beach sediments and from demersal spawning sites in Trinity Bay continued in 2005. Samples of adult capelin were collected in 2005 at spawning sites in Labrador, Div. 2J, and the east coast of Newfoundland, Div. 3KL, as part of a genetic study on capelin biodiversity. An ongoing offshore acoustic survey initiated in the spring of 2000 examined capelin distribution, behavior, and feeding habits in Div. 3KL. Seasonal inshore surveys were conducted in 2005 to map the abundance and dispersal of larval capelin and to track seasonal distributions of capelin, cod, and marine mammals in Trinity Bay, Div. 3L.

d) **Salmon**

A method was derived by which numbers of adult Atlantic salmon returning to fish ways or fish counting fences could be combined into separate regional indices (e.g. northeast coast, south coast, southwest coast, northwest coast), or a composite index of all Newfoundland. The approach uses data from all counting facilities in constructing the indices, even those where projects have now been terminated. Owing to the sequence of specific management measures, such as the 1984 salmon management plan followed by the closure of the commercial fishery in 1992, data could be analyzed with planned contrasts to evaluate the impact of the 1992 fishery closure on returns of salmon to Newfoundland rivers. Results of analyses showed that while indices of freshwater production have generally been maintained, marine survival rates remain low (2-10%) and highly variable. Overall, total stock size differs little from that prior to the closure of the Newfoundland commercial salmon fishery. Spawning escapements have increased by a factor of 2 or 3 in some rivers, but in other areas total returns are still lower on average than those prior to the fishery closure.

SUBAREA 4

A. Status of Fisheries

Nominal landings from 1991 to 2005 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) **Snow Crab – Div. 4R**

Landings in 4R declined by 54% during 2002-2005 (1 850 t-860 t). The commercial catch rate has remained at a lower level than in other divisions. Fishery independent data from this area are insufficient to assess resource status. It is not possible to infer trends in exploitable biomass from commercial CPUE data because of recent changes in the spatial distribution of fishing effort. Recruitment prospects are unknown.

b) **Iceland scallops – Div. 4R**

The nominal catch from the Strait of Belle Isle (4R) in 2005 is estimated at 442 t (round) against a TAC of 1 000 t. CPUE in 2005 increased by 9% from the previous year. The fishery here continues to be driven by the exploitation of an accumulated 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 in recent years. Fishing activity in high density scallop aggregations causes high collateral mortality to scallop spat and appears to have had a significant effect on recruitment dynamics in the area.

SUBAREA 2 + 3 + 4

A. Status of Fisheries

Nominal landings from 1991 to 2005 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) **Lobster**

Landings declined through the 1990s to 1 758 t in 2000, from a long-term high of 3 207 t in 1992. Preliminary figures indicate increases in recent years, to 2 059 t in 2002 and 2 256 t in 2003, followed by a decrease in 2004, to 1 900 t. In the majority of LFAs, landings remain low, following the recent downward trend, but landings continue to increase in LFA 11 in Subdiv. 3Ps, and in LFAs 13A and 13B in Div. 4R. The lobster fishery is monitored at several localized sites through at-sea sampling programs and co-operative arrangements with harvesters who complete voluntary logbooks on commercial catch and effort. Data suggest that the fishery is characterized by high exploitation rates and a small size limit relative to growth rates and size at maturity. Sufficient data is not available to assess the overall status of the resource at this time.

B. Special Research Studies

1. **Miscellaneous Studies**

a) **Sentinel studies**

The Sentinel Surveys, initiated in October 1994, were continued in 2005. Data collected were tabled at regional stock assessments in the autumn of 2005 for 3Ps and the spring of 2006 for 2J3KL cod. Sites in 2J3K3L, 3Ps and 3Pn4Rs were sampled by inshore fish harvesters 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 harvesters 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.

b) **Gear and selectivity studies**

Engineering sea trials of the performance of Campelen 1800 shrimp trawl and the Western IIa otter trawl used in bottom trawl surveys of Atlantic Canada

Sea trails were carried out the southern Gulf of St. Lawrence in depths of 20-120 m to measure the performance and geometry of both survey trawls with particular emphasis on trawl door stability in shallow waters, i.e. less than 40 m. In depths greater than 35 m the Western IIa trawl doors performed well but were very unstable at depths 20-35 m. The Campelen was only tested in depths of 20-40 m and its trawl doors were very stable at the lower depths.

c) **Hydrographic Surveys**

The Canadian Hydrographic Service (CHS) priorities for Subareas 2, 3 and 4 for 2004-2005 were several sites throughout Newfoundland and Labrador.

Frederick G. Creed Survey

Placentia Bay is designated as a priority area in terms of integrated management. Fisheries and Oceans Canada (DFO) has an integrated management team in place and local committee convened to discuss issues and make decisions related to management of Placentia Bay. The Smart Bay Initiative is complementary to this activity and will enhance the integrated management effort in Placentia Bay. The joint CHS/NRCAN Creed multibeam sea bed mapping of Placentia Bay, part of the Smart Bay Initiative, continued this season during June July and August. Multibeam surveys of Placentia Bay using the Frederick G. Creed are now completed, with remaining work being limited to launch surveys in shallow near shore areas which is planned for next season

As in previous years, the Canadian Coast Guard Hydrographic Survey vessel Matthew conducted hydrographic surveys at various locations throughout Newfoundland and Labrador. Surveys were conducted at St. John's, St. Anthony and Cartwright Labrador. A new multibeam acoustic system (EM710) was recently installed on the Matthew was successfully tested and used as part of this seasons activities. Unfortunately, due to down time as a result of unexpected mechanical problems with this vessel, planned surveys in northern Labrador, Makkovik Bank and at other sites were not completed as planned.

The W. R. Curran Revisory Survey, funded from the High Risk Charting Project, operated at several sites throughout Newfoundland and Labrador from July thru October (Table 1).

These surveys were necessary for the updating of new and revised nautical charts and Sailing Directions publications and in response to ISO Client Feedback Reports. The majority of these projects fell on high risk charts.

In addition to hydrographic surveys, High Risk Charting Project funds were used to install a shallow water side scan unit in the W. R. Curran. The installation of the shallow water side scan in the W. R. Curran provided for more effective surveys. Using the side scan permits the hydrographer to have a greater degree of confidence that no shoals or other hazards were missed between the single beam sounding lines of the W.R. Curran surveys.

Table 1. W. R. Curran Revisory Surveys.

Chart No.	Risk Class	Location	Type Survey	Proposed Product
4846	A	St. John's Harbour	Shoal investigation and position sewer pipeline	NTMs
4845	A	Bay Bulls Harbour	Harbour Revisory	New Ed.
4849	B	Harbour Grace Harbour	Harbour revisory, ruins and soundings	NTMs
4865	A	Lewisporte Harbour & Approaches	Harbour revisory, shoal investigation, shoreline	NTMS
4524		Botwood Harbour	Harbour Revisory, sounding	New Chart
4652	A	Corner Brook Harbour	Sounding	Sailing Directions. Diagram, New Inset
4663	C Special case (port of refuge)	Cow Head	Sounding	Sailing Directions Diagram
4851	C	Long Cove	Sounding, shoreline	Sailing Directions Diagram

Annual Sailing Directions Revisory Survey

The Sailing Direction Revisory survey gathered hydrographic information for use in revising and updating the Sailing Directions publications ATL 101, 102 and 109 for Newfoundland and Labrador. Hydrographic information was obtained for 175 sites. The provision of High Risk Charting funds for helicopter usage permitted access to many remote sites, especially along the isolate south coast of Newfoundland. The helicopter was also used to obtain over 300 aerial photographs necessary for new editions of Sailing Directions publications.

Table 2. Sailing Directions Revisory Survey.

Ports visited	175
Navigational Aids positioned	8
Wharves positioned	38
Documents (Folded Copies) reviewed	254
Aerial Photos obtained (South Coast & St. Pierre Miquelon)	336
Chart Dealership Inspections	6
Other (Nav. Aid recommendation from clients)	1

An integral part of the Sailing Directions Revisory Survey is chart dealership inspection. These inspections assured that CHS chart dealers are selling the most recent edition of charts to our clients. Six (6) dealerships inspections were completed with reports forwarded to CHS Headquarters.

Tidal Maintenance Survey

The Canadian Hydrographic Service completed its annual tidal maintenance project in Newfoundland and Labrador during October. During this project all permanent tide gauge sites in the Region are visited and much need annual maintenance and upgrades completed.

Table 3: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 19912005. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

			Catch (t)														
Subarea	Species	Division	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	4,017	4,029	4,204	2,561	3,181	2,615	3,876	3,300	1,700	1,453	5,852	3,723	2,561	8,200	5,945
	Shrimp*	0A	7,508	6,236	6,654	6,247	3,625	1,588	2,046	933	517	2,623	2,361	4,727	5,501	7,493	6,788
		0B	6,333	4,488	4,584	5,597	5,829	4,805	5,132	5,204	5,670	3,220	3,564	476	106	1,291	1,107
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	Shrimp*	2G (SFA 4)	7,891	11,286	10,021	8,393	8,116	7,529	7,884	8,051	5,217	5,160	5,104	3,982	2,723	2,706	2,561
		2HJ (SFA 5)	19,987	26,568	16,534	15,332	15,036	14,645	15,109	15,170	15,103	7,383	7,616	7,499	5,719	6,315	6,118
		2HJ3K (SFA 6)	69,801	72,280	60,150	59,912	52,554	63,175	51,202	46,337	21,246	10,923	10,914	10,978	8,035	6,609	5,500
	Crab	2J	1,581	1,925	2,532	3,522	3,756	3,794	5,448	4,061	3,166	3,090	3,178	2,978	2,275	1,529	989
	Iceland scallop	2HJ	546	495	528	272	218	230	685	1,295	1,027	360	167	340	401	103	7
	Arctic Charr	2J3KLPs+4R	22	18	19	21	33	47	41	38	38	16	30	31	38	74	70
2+3	Redfish	2+3K	137	169	211	351	41	28	3	3	4	2	1		2	9	161
	Greenland halibut	2+3KLMNO	6,639	4,870	6,960	6,292	8,235	10,637	4,124	4,081	5,877	5,891	3,229	2,928	4,899	6,933	6,664
	American plaice	2+3K	29	17	34	100	132	67	6	6	2	16	28	16	77	103	494
	Witch	2J+3KL	41	28	111	166	151	92	2	1	6	4	10	11	343	1,632	2,430
	Cod	2J3KL	1,122	689	1,029	4,193	6,887	5,354	8,472	4,501	501	1,500	332	1,309	3,938	24,356	120,135
	Grenadier	2+3	153	133	185	272	212	234	145	209	98	225	125	130	614	992	365
	Capelin	2J3KL (offshore)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	450
	Squid	2+3	529	1,997	622	228	23	328	19	815	12,748	8,285	48	1,954	276	924	1,719
3	Redfish	3LN	4	1	9	48	24	32	5	7	19	0	0	0	46	657	362
		3M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
		3O	5,362	2,339	3,093	2,988	4,532	880	2,027	6,121	1,895	128	24	1,192	677	845	173
	Yellowtail	3LNO	13,138	12,575	12,702	9,958	12,240	9,425	5,540	3,536	1				6,265	6,369	6,257
	American plaice	3LNO	1,451	1,296	1,606	1,377	1594	622	269	204	71	47	65	59	7,454	9,663	22,510
		3Ps	742	731	881	1,011	877	607	542	405	213	112	80	112	723	2,380	3,982
	Witch flounder	3NO	49	49	52	26	12	4	3	3	18	26	0	0	3,971	4,093	2,457
		3Ps	484	542	530	518	450	332	507	452	259	250	273	429	956	1,012	1,056
	Atlantic halibut	3	272	317	398	365	317	183	124	165	152	101	107	36	138	114	231
	Cod	3NO	445	442	714	424	506	172	485	306	289	54	31	3	3,719	5,232	5,456
		3Ps	11,160	10,807	12,440	12,118	13,339	19,683	24,328	15,690	7,327	767	581	575	13,865	23,493	25,694
	Haddock	3LNO	44	21	69	183	88	70	50	14	190	28	9	0	675	598	708
		3Ps	223	129	137	109	99	163	98	191	69	118	48	20	86	251	263
	Pollock	3Ps	504	298	332	492	808	710	729	428	592	435	248	59	113	437	1,188
	Whitehake***	3NOPs	2,063	1,431	1,469	1,847	1,430	1,390	920	626	893	1,054	603	657	1,963	2,821	2,438
	Thorny skate**	3LNOPs	2,063	1994	3530	3,308	2195	1968	2,608	2,692	5,241	3,223	4,697	2,787	5,229	4,740	6,953
	Capelin	3L	15,393	15,706	13,270	8,639	13,898	12,041	11,403	19,809	3,560	16,840	100	890	23,480	3,160	22,310
		3K	12,633	11,138	4,067	1,553	5,022	4,066	7,254	10,225	9,230	8,920	30	70	13,525	19,350	20,000
	Shrimp*	3M	unavailable	0	0	8	293	618	490	469	785	906	970	1,041	3,724		
		3L	11,212	10,613	10,008	5,417	4,986	4,111									
	Sea scallop	3KLNO	16	0	0	0	0	0	0	6	20	27	9	10	9	6	13
		3Ps	1,992	3,472	647	51	338	85	70	266	9	8	418	534	483	0	167
	Iceland scallop	3LNO	126	0	0	0	39	336	141	1,300	3,986	9,454	6,501	3,941	817	22	-
		3Ps	1,986	36	87	478	498	1,148	1,197	2,792	5,367	608	1,061	440	667	5,967	755
	Crab	3K	8,685	16,460	16,502	16,352	15,288	15,390	21,470	16,788	14,830	14,190	12,245	11,039	9,760	7,295	7,675
		3LNO	29,649	31,029	31,627	30,032	28,172	26,773	32,725	23,533	22,185	16,656	13,790	12,237	8,979	6,652	6,394
		3Ps	3,169	4,720	6,113	7,637	7,843	7,917	7,909	6,615	4,753	3,047	1,853	1,590	704	121	176
	Lobster	3K	220	157	207	206	275	231	251	295							
		3L	119	73	116	128	124	126	158	146							
		3Ps	1,046	779	786	763	709	637	613	684							
		3Pn	30	14	22	11	25	17	25	25							
	Atlantic salmon**	2J3KLPs+4R	32	35	36	39	39	30	38	45	82	114	95	133	126	213	353
3+4	Redfish	3P+4V	1,893	3,435	3,040	3,289	2,506	4,439	4,726	4,101	3,825	4,566	3,978	7,594	9,350	4,635	6,628
4	Iceland scallop	4R	442	360	275	252	638	1,084	1,091	1,355	1,205	1,204	1,497	2,294	2,122	1,296	457
	Sea scallop	4R	0	0	0	0	0	1	0	0	0	0	2	37	0	0	3
	Lobster	4R	1,336	888	1,125	950	984	746	767	886							
	Crab	4R	862	1,462	1,562	1,750	1,675	1,640	1,612	1,064	969	833	920	655			

* Shrimp catches are for Eastern Canada (i.e. taken by vessels from Newfoundland and Labrador, Quebec, and Nova Scotia).
** Recreational catch.
*** Canadian catches only.

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PART 2. CENTRAL AND ARCTIC REGION

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SUBAREA 0

A. Status of the Fisheries

a) **Shrimp**

Shrimp in NAFO Subarea 0 is managed through quota allocations assigned to four Canadian Shrimp Fishing Areas (SFA). The extent of these management areas do not correspond exactly with NAFO boundaries. Quotas exist for both *Pandalus borealis* and *Pandalus montagui*. Nunavut's portion of the shrimp fishery in their adjacent waters has increased from 8.8% in 1996 to 31.45% in 2004 through special allocations to the territory of quota increases in the area.

Pandalus borealis:

SFA 0, NAFO 0A west of 60°30'W, is an exploratory shrimp fishing area with a quota of 500 t. Rarely do commercial vessels fish in the area and therefore generally no catch is recorded for the area.

SFA 1, NAFO 0A east of 60°30'W, quota has increased from 8 500 t in 1996 to 18 417 t in 2004 and remained unchanged for 2005. Catches of *P. borealis* in SFA 1 for 2002-2004 varied between 6 200 t and 6 700 t but 2005 had the highest catch, 7 508 t, ever recorded for the area.

SFA 2 contains all of NAFO 0B except for the portion of 0B west of 64°30'W. The total quota for SFA 2 rose from 3 500 t in 1996 to 10 750 t in 2002 and has remained unchanged since.

Only a small portion of SFA 3 lies in NAFO 0B, that is the area of 0B west of 63°W. Most of SFA 3 extends outside NAFO boundaries. No quota exists for *P. borealis* in SFA 3 for 2005.

Pandalus montagui:

Pandalus montagui are managed and reported as combined for SFA 2, 3 & 4. The quota for the combined area has also risen over the years to its current level of 6 300 t. Reported catches have risen over the past three years from 754 t in 2003 to 2 248 t in 2005. This is below the historic high of 3 751 t taken in 2001.

b) **Shellfish**

No reported harvest of shellfish reported in Nunavut for 2005.

c) **Arctic Charr**

Subsistence and commercial Arctic charr fisheries in the Baffin region (NAFO Subarea 0) are conducted in inshore lakes and rivers not in marine waters. Information on these fisheries can be found in the "Annual Summary of Fish and Marine Mammal Harvest Data for the Northwest Territories" published by Fisheries and Oceans Canada, Central and Arctic Region.

d) **Greenland Halibut – Division 0B**

Inshore: The Cumberland Sound fishery began in 1987 and is the only inshore fishery that has operated on an annual basis in Subarea 0. Prior to 2005 the total allowable catch (TAC) for inshore fisheries in Subarea 0 was set at 1 000 t with half of this (500 t) allocated to the Div. 0B Cumberland Sound since 1994. However, catches have not reached this level since the early 1990s. The fishery is exclusively a winter fishery (January to May) and the fishermen use long-lines set through holes cut in the land-fast sea ice. Sea-ice conditions can affect the success of the winter fishery by restricting access to deeper more productive areas and thereby curtailing effort. Catches were lowest in the late 1990s at less than 100 t with a slight increase in 2002 and 2003. However, the sea ice was unstable again in 2004 and 2005 and catches dropped to 63 t and 9 t, respectively (Table 1). Exploratory fishing was conducted in Cumberland Sound in the summer, open water season, in 1995 and 2002 but they were not successful in locating exploitable aggregations of Greenland halibut. Beginning in 2005 the Cumberland Sound inshore fishing grounds have been managed separately from the offshore with a TAC set at 500 t.

Offshore: Prior to 2005 Nunavut companies had a 500 ton quota in the Div. 0B offshore commercial fishery with the option to transfer surplus inshore quota to the offshore fishery. In 2005 the TAC for Nunavut was set at 1 500 t with 1 240 t caught using otter trawl (single and twin trawls) and gillnet (Table 2). A summary of the gillnet mesh size and corresponding depths fished is provided in Table 3. Standardized catch-per-unit effort was updated in 2005 for the Div. 0B trawl fleet (including Can-NF vessels) (Fig. 1). A length frequency distribution for the Div. 0B catch (Can-CA and Can-NF) was prepared using observer data from the 2005 gillnet fleet (8% observer coverage) and trawl fleets (100% observer coverage) (Fig. 2). There was no observer coverage of the CAN-NF Div. 0B long-line fleet in 2005.

e) **Greenland Halibut – Division 0A**

Since 1996 Nunavut companies have had exclusive access to an exploratory fishery license to harvest Greenland halibut in NAFO Division 0A and there is 100% observer coverage for this fishery on all gear types. Between 1996 and 2000 catches were less than 330 t. In 2001 the TAC was set at 3 500 t and had increased to 4 400 t by 2005. Catches were 2 625 in 2001 and increased to 3 753 t in 2004 (Table 1). A majority of the catch throughout the years has been with bottom otter trawl (both single and twin trawl gears have been used). Long-line gear was used in this fishery in 2002 and 2003. Gillnets were first introduced in 2004 with 15 t caught. The total catch for 2005 was 4 268 t of which 167 t were caught using gillnets (Table 2). A summary of the gillnet mesh size and corresponding depths fished is provided in Table 3. Length frequency distributions for the Div. 0A catch was prepared using observer data (Fig. 2).

Details on the main by-catch species in the Greenland halibut fisheries in Subarea 0 are summarized in Tables 4 and 5 and include catch data on wolfish species that have been listed under the Canadian Species at Risk Act.

B. Special Research Studies

1. Environmental Studies

None.

2. Biological Studies

a) **Shrimp**

A multi-year survey of NAFO 0B was begun in 2005 by the Northern Shrimp Research Foundation in partnership with DFO. The standard trawl survey will produce abundance and biomass indices of shrimp in this division. Oceanographic parameters were recorded during the survey however extent was limited due to equipment failures.

b) **Shellfish**

None.

c) **Nuclear DNA (Microsatellite) Analysis in Greenland Halibut**

Our research into the stock structure of Greenland halibut continued in 2005. Data from 2004 were analyzed and a manuscript is in preparation.

d) **Marine Mammal Studies**

Research on bowhead whales continued in Cumberland Sound (NAFO Div. 0B) in 2005. The research team applied satellite-linked tags to nine bowhead whales in early July. Only three tags provided data for more than a few days: 26, 55 and 200+ days. All three (juvenile) whales moved out of Cumberland Sound by the third week of July. Two of the whales moved north along the east coast of Baffin Island. One of the tags stopped reporting while in Home Bay in mid-August. Transmissions from the second tag were interrupted between Isabella Bay in the second week of August and northern Foxe Basin in early October. In mid-October, the second tagged whale began moving south, reaching Hudson Strait by the third week of November. The third whale moved south out of Cumberland Sound around the third week of July and reached Foxe Basin in early August. In mid-August, it moved through Fury and Hecla Strait and south into Committee Bay. By the third week of August, this whale was in southern Prince Regent Inlet. In late August and early September, it moved into Lord Mayor Bay in western Gulf of Boothia, where tag activity ended. This project will continue in 2006.

Our lab has also been studying beluga and narwhal stocks within Cumberland Sound for a number of years. There is an important subsistence harvest for these whales by hunters in the community of Pangnirtung. Cumberland Sound belugas are currently designated by COSEWIC as Threatened and a recovery strategy has been drafted. An aerial survey of Cumberland Sound belugas was completed in 2005.

There is a proposal to fly surveys off southeastern Baffin Island in July, August and September 2006 for walrus.

Research results are reported to the International Whaling Commission (IWC), the North Atlantic Marine Mammal Committee (NAMMCO) and the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga (JCNB).

Table 1. Summary of catch (t) for Greenland halibut by Central and Arctic licensed vessels, 1989-2004.

Div.	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992
0A offshore	3753	4142	3800	2625	320	0	42	203	329	0	0	0	0
0B[1] inshore	61	244	106	80	45	34	63	66	60	285	400	425	430
0B offshore	208	800	918	1017	1043	1568	1720	1446	1417	407	0	20	1020
Total 0B	269	1044	1024	1097	1088	1602	1783	1512	1477	692	400	445	1450

[1] A separate management area was created in 2005 for the 0B inshore fishery in Cumberland Sound. This catch is no longer counted against the 0B offshore quota.

Table 2. Summary of 2005 catch (t) for Greenland halibut by Central and Arctic licensed vessels.

Division	Gear type	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
0A	Gillnet	0	0	2.8	264.5	354.3	416	80.5	0	1118.1
0A	Single Trawl	0	0	6.2	246.5	380.6	440.5	238.5	0	1312.3
0A	Double Trawl	0	0	27.3	424.6	484.4	643	258.2	0	1837.5
Totals		0	0	36.3	935.6	1219.3	1499.5	577.2	0	**4267.9**
0B	Gillnet	57.3	0	17.8	32	29.1	23.2	4.6	3.3	167.3
0B	Single Trawl	13.2	0	0	4.8	9.6	0	48.8	62.9	139.3
0B	Double Trawl	222.3	0	0	256.4	94	0	43.6	317.3	933.6
Totals		292.8	0	17.8	293.2	132.7	23.2	97	383.5	**1240.2**

Table 3. Summary of gillnet mesh sized used in the Div. 0A and 0B fisheries with corresponding depth fished.

	Mesh (mm)	Depth Fished (m)
Division 0A	190	1155-1271
	203	704-1302
	208	1076-1244
Division 0B	196	839-1015
	203	1074-1097
	208	547-1130

Table 4. By-catch in the Div. 0A Greenland halibut fishery, gears combined. Data are from observers with 100% coverage on all gear fleets.

Species	Catch (t)	% of Total Catch
Greenland halibut (*R. hippoglossoides*)	4530	98
Greenland shark (*S. microcephalus*)	63	1
Jensen skate (A. *jenseni*)	16	<1
Arctic skate (*A. hyperborea*)	13	<1
Skate Sp. (*Raja* sp.)	7	<1
Northern wolffish (*A. denticulatus*)	.720	
Striped wolfish (*A. lupus*)	.020	
Spotted wolfish (*A. minor*)	.039	

Table 3. By-catch in the Div. 0B Greenland halibut fishery, gears combined (includes catch from CAN-NF). Data are from observers with 100% coverage on trawl fleets and 8% coverage on the gillnet fleet.

Species	Catch (t)	% of Total Catch
Greenland halibut (*R. hippoglossoides*)	3132	97
Greenland shark (*S. microcephalus*)	21	1
Roughhead grenadier (*M. berglax*)	10	<1
Spiny crab (*N. grimaldi*)	10	<1
Redfish (*Sebastes* sp.)	6	<1
Northern wolffish (*A. denticulatus*)	.553	
Striped wolfish (*A. lupus*)	.008	
Spotted wolfish (*A. minor*)	.332	

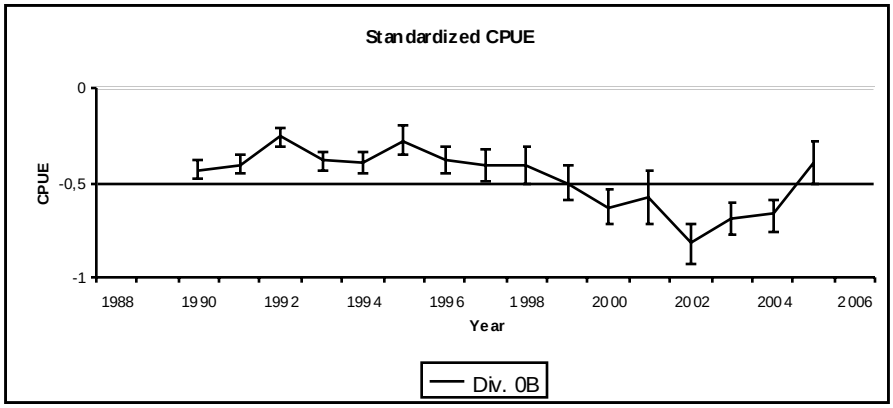

Fig 1. Standardized CPUE series from trawlers in Div. 0B with +/- S.E. Includes catch for vessels from both Central and Arctic Region and Newfoundland Region.

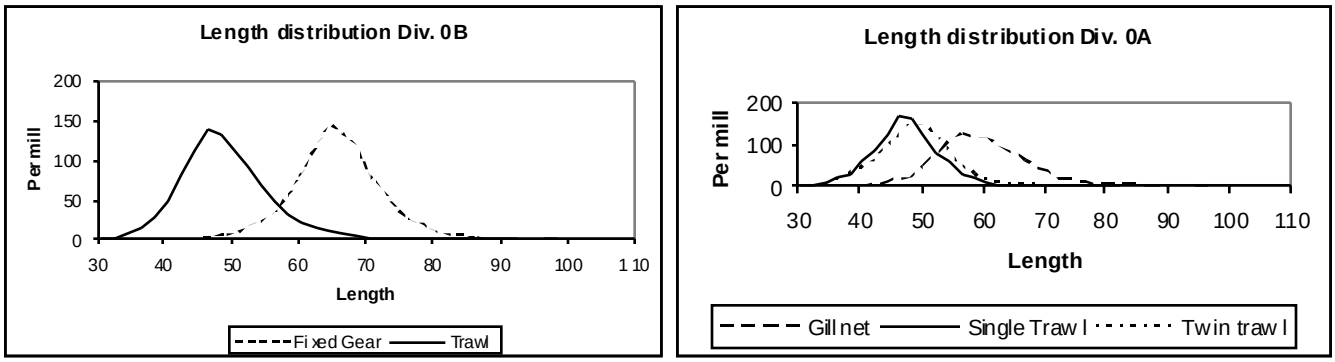

Fig. 2. Length frequency for the Greenland halibut catches from Div. 0B (left panel) fixed gear (gillnet only) and trawl gear (both single and twin trawl) for vessels from both Central and Arctic Region and Newfoundland Region and from Div. 0A (right panel) for three gear types, gillnet, single trawl and twin trawl.