Northwest Atlantic Fisheries Organization

Serial No. N5517 **NAFO SCS Doc. 08/12**

SCIENTIFIC COUNCIL MEETING - JUNE 2008

Canadian Research Report for 2007

PART A - Newfoundland and Labrador Region

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PART A

SUBAREAS 0 AND 1

A. Status of Fisheries

Nominal landings from 1992 to 2007 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, Div. 1B has been included in the management area with Div. 0A and Div. 1A. In 2006, Scientific Council advised for 2007 a TAC of 13,000 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 2007 were approximately 4000 t, fully utilizing it's allocation of the quota. In 2007, about 1900 t were taken by single otter trawls, 400 t by double otter trawls, 1400 t taken with gillnets and 60 t taken by longline. Length compositions in the catches have been stable in recent years.

[1] Following the submission of updated stock information from the designated species experts, this document was compiled by the Centre for Science Advice (CSA) Office, Newfoundland and Labrador Region. Refer to the end of the document – Acknowledgement Section - for a complete list of contributing authors.

SUBAREA 2

A. Status of Fisheries

Nominal landings from 1992 to 2007 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 remains closed since 1998. Approximately 5857 salmon were retained or hooked and released in the recreational fishery. Preliminary information on subsistence fishery catches indicated that about 26.5 t of salmon were harvested in 2007.

b) *Arctic charr* – Subarea 2

Commercial landings of Arctic charr from north Labrador in 2007 were approximately 28 t, a decrease of 28% over 2006, but somewhat comparable to the average landings over the past decade. The decline in 2007 was largely due to reduced effort. Over the past 34 years (1974 – 2007), more than 2800 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 2004, 2005, and 2006 are: 8.6 t, 11.9 t, and 7.0 t, respectively and are believed to be underestimates of the full extent of subsistence harvesting. Data for 2007 are presently unavailable.

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 1992.

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. Over this time catches ranged from 4200 to 8500 t. In April 2003 the whole stock area was closed indefinitely to directed commercial and recreational fishing. Monitoring by means of limited fishing by a small number of fish harvesters at specific sites (sentinel surveys) continues. Most of the catch from 2003-2005, which ranged from about 600 t to 1300 t, was by-catch from the gillnet fishery for winter flounder in shallow inshore waters (<25 fathoms).

During 2006, a pilot-scale inshore fishery using vessels <35 ft was reopened and fishers were each permitted to harvest 3000 lb of cod. The landings in 2006 totaled 2679 t, including 380 t in the recreational fishery, 159 t in the sentinel surveys, and 45 t of by-catch. The fishery continued in 2007, but fishers were permitted to harvest 2500 lb of cod. Reported total landings from the 2007 stewardship fishery were 2364 t. This included 2192 t taken as directed catch and 172 t as by-catch. In addition, 182 t were landed in the sentinel surveys. Two estimates of landings from recreational fisheries in 2007 were available. One suggested a recreational catch that was comparable to the stewardship fishery catch; the other suggested the recreational catch was much lower (371 t). Until recreational catch is determined, total catch is uncertain. The offshore portion of the stock area remained closed to directed fishing in 2006 and 2007.

The 2J3KL cod stock was assessed in March-April 2008. Since 2005, the inshore and offshore areas have been assessed separately. Total mortality in the offshore was extremely high during 1996-2003 and has been a major impediment to stock recovery. However, total mortality has declined substantially since 2003 and the prospects for stock recovery have improved. Based on autumn and spring surveys, the average biomass of cod in the offshore over the last 3 years is 4-5% of the average during the 1980's. Survey biomass has been increasing since 2003. The recent increase in offshore biomass is mostly due to improved survival and the continued growth of the 2002 year-class, and the appearance offshore after 2005 of the 2000-2001 year-classes.

Recruitment in the offshore has been weak since the 1989 year-class and has subsequently varied without trend.

In the inshore northern area (2J and northern 3K), sentinel catch rates were low in 1995-2004, increased in 2005, and are currently above the average of the time series. Stewardship fishery catch rates in 2006-07 were slightly higher than in earlier fisheries during 1998-2002. In the inshore central area (southern 3K and northern 3L), sentinel catch rates have generally increased since 2002 and are currently above the average of the time series. Stewardship fishery catch rates in 2006-07 were higher than in earlier fisheries during 1998-2002. In the inshore southern area (southern 3L), sentinel catch rates have remained stable since 2003, but are below the average of the time series. Stewardship fishery catch rates in 2006-07 were similar to those in earlier fisheries during 1998-2002. Catch rates in the inshore northern area and inshore southern area have been lower than those in the inshore central area since 2002, suggesting lower cod densities in these areas.

The inshore northern area is primarily dependent on seasonal immigration of fish, possibly from the offshore. Therefore it is recommended to minimize removals from this area. In the inshore central area the exploitable biomass has increased recently, as inferred from trends in catch rates. However, due to the weaker 2003-2006 year-classes, this increasing trend may not continue. The impacts on stock growth of fishing at specific catch levels could not be quantified. The inshore southern area is primarily dependent on seasonal immigration of fish, the magnitude of which cannot be predicted. Therefore, the effect of removals of various levels cannot be estimated. There is a risk that fishing inshore will impede stock growth offshore. The level of risk is difficult to quantify, but exploitation rates inshore are currently low and offshore biomass is increasing

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

This stock has been under moratorium since 1994. 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. Bycatch 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 bycatch in the Greenland halibut fishery. Bycatch of plaice, mainly from the Greenland halibut fishery in Div. 3K decreased from 60 t in 2006 to 23 t in 2007. There is also some bycatch of plaice in the shrimp fishery in this area (average 2006-2007 is 22 t). Up until 2003, the composition of the American plaice by-catch in the Greenland halibut fishery was composed mainly of sexually mature females but the size composition of the bycatch has not been updated since then.

e) *Redfish* – Subarea 2 + Div. 3K

This stock has been under moratorium to directed fishing in the Canadian EEZ since 1997. Prior to this, there had not been a persistent directed effort on this stock since 1990, when 2400 t was landed. Landings declined to 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 1800 t in 2001, to 5400 t in 2003 then declined to about 5000 t in 2004 and 2005. A provisional estimate for 2006 suggests catch declined to 1800 t. The increases beginning in 2001 were from non-Canadian directed fisheries occurring in the NAFO Regulatory area (NRA) utilizing large midwater trawls. It is assumed these catches were from the pelagic stock of redfish that resides primarily in the Irminger Sea between Greenland and Iceland. Canadian (NL) landings since the moratorium are primarily by-catch from Greenland halibut fisheries and had been less than 40 t annually from 1997 to 2003. Landings increased to 169 t in 2004, were between 135 t to 220 t to 2006 and declined to 29 t in 2007. 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 steadily increased from 240 t in 2004 to 420 t in 2006.

f) *Witch flounder* - Div 2J3KL

There has been no directed fishing on this stock since 1994. In 2007, by-catch in other fisheries from the Newfoundland region amounted to 22 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 Division 3L. The fall 1998-2007 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 1100 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 Division 3L. The estimates have remained the same since then. The stock size remains extremely low.

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

The Canadian (NL) catch of Greenland halibut in 2007 in Subarea 2 and Div. 3KLMNO was approximately 5100 t, a reduction of over 1000 t from catch levels of 2005 and 2006 (6300 t and 6600 t, respectively).

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 to 2006 have exceeded the rebuilding plan TAC by 27%, 22% and 27%, respectively.

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 amongst 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 (Shrimp fishing area 4), Hopedale and Cartwright Channels (2HJ) (Shrimp fishing area 5), and Hawke Channel (2J) + 3K (Shrimp fishing area 6).

Between 1998 and 2002, annual catches of approximately 8000 t were taken in 2G from 8320 t TACs. The 2003 TAC was increased to 10,320 t and included a 1125 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 2802 t was set for the 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 - 2008 seasons. Approximately 13,000 t of northern shrimp were taken during the 2003-2004 management year while approximately 10,000 t were taken in each year over the 2004 – 2007 period. Preliminary data indicate that the TAC will be achieved during the 2007-2008 season.

Historically, the fishery has been concentrated north of 60^{o}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^{o}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. Since 2002, standardized catch rates have varied about the long-term average. Large vessels had model CPUE indices of 2000 kg/hr during 2006 and 2007.

Autumn 1999 was the last time that the Canadian Government conducted a bottom trawl research survey in 2G. However, during the summer of 2005, the 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 focus upon gathering data necessary for shrimp stock assessments.

The Northern Shrimp Research Foundation – DFO research survey fishable biomass index has ranged between 66,000 t and 119,000 t since 2005. Recruitment trends are unknown as the time series is only three years in length and the confidence intervals about the estimates overlap. Exploitation rates indices ranged between 8% and 15% during 2005-2007. Current status appears positive from fishery catch rate indices and survey exploitation rate indices.

TACs in Hopedale and Cartwright Channels (2HJ) doubled from 7650 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 2500 t allocation for northern shrimp science research. During that year, the fishing season changed to April 1 – March 31, and an additional interim quota of 9787 t was set for the period January 1 – March 31, 2004. Thus the 2003-2004 fishing season was 15 months long and had a 33,084 t TAC. The 2003-2004 fiscal year TAC (23,300 t) was maintained for the 2004-2008 seasons. Approximately 23,000 t of shrimp were caught annually since the 2003-2004 season. Preliminary data indicate that the TAC will be achieved during the 2007-2008 season. Standardized catch rates within Hopedale and Cartwright Channels increased from 1992 (714kg/hr) through to 2001 (1993/hr) and have since remained high with an average catch rate of 1800 kg/hr. Most model catch rates since 1996 were statistically similar ($P>0.05$) to 2007 (1800 kg/hr) while indices previous to 1997 were generally lower than the 2007 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. Surveys of the whole of SFA 5 were completed in only three (2001, 2004, 2006) of the last eight years. Survey biomass indices (total, fishable and female) after 2000 have been somewhat higher than before 2000. Recruitment in the short-term, while uncertain, appears average. Longer-term prospects are unknown. The resource continues to be distributed over a broad area while the 2006-2007 exploitation rate index was 15%. Recent catches have had no observable impact on the resource. Current status remains positive.

The fishery in Hawke Channel (southern Div. 2J) + 3K began in 1987 with landings of approximately 1800 t. Catches increased to more than 7800 t in 1988 and ranged between 5500 and 8000 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 (<=500 t; LOA<=100'). 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 7653 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 2004-2008 fishing seasons. TACs have been reached in most years; however, due to market constraints, small vessels have not always taken their entire allocations. Between 72,000 t and 77,800 t were taken each fishing season between 2004-2005 and 2007-2008.

Large vessel (>500 t) CPUE remained at a high level since 1995 while the small vessel (< 500 t; LOA<100') CPUE has increased significantly since 2003. The 2007 model CPUE indices for the large and small vessel fleets were 1385 and 51 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 autumn biomass indices averaged 627,200 t (about 146 billion animals) during the 2003-2007 period. The resource in this area remains healthy with high biomass/ abundance of male and female components. Since 2000, most of the biomass has been attributed to female shrimp. The female spawning stock biomass index increased from an estimated 182,000 t (22 billion animals) in 1997 to 440,800 t (59 billion) in 2007. Males within 11.5 mm – 16 mm carapace length, primarily age 2, are used as a recruitment index. Recruitment indices in 2006 and 2007 were the highest in the time series. Recruitment and female biomass are expected to support the fishery over the next four years.

The resource continues to be distributed over a broad area and, over the past two years, exploitation rate indices were about 11% of survey fishable biomass. Recent catches have had no observable impact on the resource. Current status remains positive. At the current TAC the 2008/09 exploitation rate index is expected to be 11-15%. Any modest change in TAC is expected to have a proportional change in the exploitation rate index.

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 shrimp fishing fleets.

i) *Snow crab* – Div. 2J3KLNO

Landings increased by 5% from about 43,400 t in 2006 to 45,500 t in 2007, due primarily to an increase in Div. 3K. Fishery performance is monitored through analyses of commercial logbook data and observer program data. Div. 2J CPUE from logbook data increased from its lowest level in 2004 to about the long-term average in 2007. Both offshore and inshore Div. 3K CPUE increased sharply from 2005-2007 to approach the highest levels previously observed. CPUE increased inshore in Div. 3L from 2004-2007 to the long-term average. Offshore, CPUE has declined steadily since 2000 in Div. 3L to the lowest level since 1991, whereas it changed little during 2004-2006 in Div. 3NO before decreasing in 2007. The exploitable biomass index, which is estimated from the fall multi-species bottom trawl survey**,** declined between 1998 and 2003. This index agrees with CPUE in indicating that biomass has increased in the north (Div. 2J3K) from 2003-2007 but continued to decline in the south (Div. 3LNO). The pre-recruit index for greater than 75 mm new-shelled adolescent males also declined during 1996-2002, and remained low until it increased during 2006 and 2007. Recruitment has increased since 2004 in Div. 2J and since 2005 in Div. 3K. Recruitment remains promising for Div. 3K but is expected to decrease in the next several years in Div. 2J. Recruitment is expected to increase in offshore Div. 3L in the short term, while prospects for inshore Div. 3L and for Div. 3NO are uncertain. Long-term recruitment prospects are unknown.

j) *Iceland scallop* – Div. 2HJ

Inshore aggregations were again fished in 2007, with nominal catches estimated at 40 t, round, down from 686 t the previous year. 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 analyses, while biological characteristics information was updated from commercial landings from two north Labrador stock complex areas in 2007 and represented the 31st continuous year of sampling these populations. Following long term declines 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. Funding obtained from an International Polar Year (IPY) program on charr (*Climate variability and change effects on charr in the Arctic*) resulted in enhanced sampling in 2007. Over the next several years data obtained from this program will be used in a comparative manner with information from other regions of Canada to: investigate the response of charr to variability in thermal regimes; identify food web relationships of charr; examine contaminant levels in samples of resident freshwater and anadromous charr; assess the genetic and morphological variation among populations of Arctic charr.

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 and cod and has recently been updated for Greenland halibut.

c) 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. 2G. Biological and oceanographic data were collected to assess the distribution and abundance of the shrimp population in this division. By 2007, sufficient data had been collected to begin using the NSRF-DFO joint survey data in shrimp assessments. The Zonal Advisory Process (ZAP) meeting held in St. John's during March 2008 made use of this dataset.

SUBAREA 3

A. Status of Fisheries

Nominal landings from 1992 to 2007 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 2007 recreational harvest, including both retained and hooked-and-released, was 16,934 fish.

b) Capelin – Subarea 2 + Div. 3KL

Inshore capelin catches in Subarea 2 + Div. 3KL are taken during the inshore spawning migration. Catches decreased slightly from 29,800 t in 2006 to 29,360 t in 2007. 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 4900 t in 2003, declining to 600 t by 2006. In 2007 about 130 t were caught by Canada (NL). Estimates of age 3 recruits indicate all recent recruitment has been weak. Low spawner biomass, low recruitment and high fishing mortality, point to poor prospects for this stock in the medium term. This stock is currently well below B_{lim}. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

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 remained constant at 15,000 t for the 2001/2002 –2005/2006 fishing seasons, but was reduced to 13,000 t for the 2006/07 season. 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 2007 is 10,600 t. The most recent assessment (October 2007) indicated considerable uncertainty in the absolute size of the stock. The outlook about the short-term productivity is not optimistic, as several 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 1000 t in each year. Catch declined steadily since 2003. In 2007 catch by Canada NL was approximately 459 t. Catch in 2006 was 485 t by NL. Catch has been mainly as by-catch in the cod and witch flounder directed fisheries.

The Canadian survey in spring 2006 was incomplete and data on abundance and biomass could not be updated. The survey in 2007 indicated a similar stock size as in 2005. There has been a slight increase since 1993 in both biomass and abundance indices, but over the last 3 surveys average biomass is only 22% and abundance 30% of the 1983-1987 averages from the survey.

e) *Witch flounder* - 3Ps

Landings from this stock over the last 20 years have fluctuated between 300 t and 1000 t annually. In 2007 the catch from the Newfoundland region was 110 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-1990s. Geographic distribution has not changed appreciably since 1983 except during the early to mid 1990s when fish disappeared from the 51-100 fathom 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 2007 and 2008 were 15,500 t in each year. Annual spring and fall multi-species bottom trawl surveys have been conducted since 1971 and 1990 respectively. 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, the majority of the Canadian directed fishery for yellowtail flounder did not take place due to a dispute in the industry. Canadian catch in 2007 was 3673 t. In 2008, NAFO Scientific Council will be carrying out a full assessment of the resource.

g) *American plaice* – 3LNO

The last full assessment for American plaice in Div. 3LNO was in 2007 and is not due to be assessed again until 2009. Bycatch in 2006 was 2800 t, which was lower than in previous years, due to the fact that the Canadian quota of yellowtail was not filled. This bycatch was mainly taken in the NAFO regulatory area (NRA). Canadian bycatch of American plaice in 2007 was 430 t, up from 92 t in 2006. Canadian RV surveys indicate either a slight increase or plateau in mean numbers per tow and mean weight per tow since the 1990s but still low compared to historic levels. The Spanish Div. 3NO survey also shows an increase in American plaice. The 2007 assessment included the Spanish Div. 3NO survey in the VPA analyses which showed that population abundance and biomass declined fairly steadily from the mid 1970's. Biomass has increased slightly in the past few years. F increased fairly steadily from 1995 to 2000 but has generally been declining since then. Since 2001 the SSB has increased slightly to 36,000 t in the current year (B_{lim} for this stock is 50,000 t). Recruitment has been steadily declining since the 1989 year-class. Based on overall indices for 2007, there is nothing to indicate a change in the status of 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 UNIT 2 were last reviewed in November 2001 and updated in 2004.

Total Canadian catches have declined steadily from 27,000 t in 1993 to 8000 t in 2002, matching reductions in TACs. From 2002-2005 the TAC has been stable at 8000 t while catches declined from about 7500 t in 2003 to 6400 t in 2005. In 2006 the TAC was increased to 8500 t and maintained at that level in 2007. Catch remained at the 6400 t level in 2006 and declined to about 6000 t in 2007. About 1000 t of the 2007 catch was taken by

Canada (NL) fisheries. The shortfall in the TAC from 2005-2007 was due to industry processing problems in Newfoundland and Labrador Current management regulations include a closure related to peak spawning in May and June, and a minimum size restriction at 22 cm.

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 but increased in the early 1990s. Between 1996 and 2000 Canadian catches have alternated between levels of about 8000 t and 2500 t based on market acceptability for redfish near the Canadian 22 cm size limit. From 2001-2004, the Canadian catch averaged about 3400 t, increased to 5400 t in 2005 but has declined steadily to about 1100 t in 2007. Canada (NL) has accounted for more than 95% of the catch since 2001. 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. 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.

i) *Witch flounder* – Div. 3NO

There has been no directed fishing on this stock since 1994. Bycatch in 2007 (NL region) was 21 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 the beginning of the time series. Both the spring and fall RV indices have generally increased since the mid-90s but in the past three-four years, have declined. All indices for this stock are extremely variable, possibly due to seasonal movement of witch into and out of deep water and survey timing/coverage.

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 evidence was presented in 1995 indicating that the stock encompasses 3NOPs. Since then the sock has been assessed within 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 was approximately 5000 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 was 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, 2005, 2006 and 2007). Following a very large 1999 year class, the stock has been declining sharply due to an increase in fishing pressure and low recruitment. The stock is currently at or near a historic low.

k) *Thorny skate* – Div. 3LNOPs

Before the mid-1980s, non-Canadian fleets landed several thousand metric tonnes (t) of skate (mainly thorny) annually. An average of about 5000 t was discarded annually by the Canadian fleet during the 1980s and early 1990s, while only a few hundred tonnes per year were recorded in Canada's landings statistics during that period. Although often kept by non-Canadian fleets, skates were taken only as bycatch until the mid-1980s. In 1985, EU-Spain targeted skate in a non-regulated fishery in the NRA. Bycatches 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 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 for all countries until recently, when annual catches declined.

Thorny skate underwent a decline in the late 1980s to early 1990s followed by a slight increase in the late 1990s. Since then, abundance remained relatively constant at low levels. The current TAC for skates in 3LNOPs presently amounts to 14,550 t (13,500 t in 3LNO and 1050 t in 3Ps) which considerably exceeds the catch that would allow rebuilding of the stock. Reduced catches in recent years appear to have resulted in an increase in thorny skate biomass and abundance in the current year.

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 1800 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 6000 t, and fishing was restricted to Div. 3L, in water depths greater than 200 m. The catch in 2000 increased to 4900 t, 4300 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 5100 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 5400 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 – 2004, catches were 4869, 10 566, 6977, 11 947 and 12 622 t respectively.

In 2004, SC recommended a 2006 TAC of 22,000 t based upon 12% of the inverse variance weighted average fishable biomass from the most recent surveys. SC did not update this calculation, in 2005, due to the incomplete survey in autumn 2004. Catch data indicate that 14,000 t of shrimp were taken against a 13,000 t quota in 2005 while 24 000 t were taken against a 22,000 t TAC in 2006. Preliminary data indicate that 21,000 t had been taken against a 22,000 t TAC in 2007.

As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 4250 t in 2000 to 18,271 t in 2006. Preliminary data indicate that 18,312 t were taken by Canadian vessels in 2007. Catches by non Canadian nations increased from 619 t to 5744 t over this period. Preliminary data indicate that by October 2007, 2573 t had been taken against a non Canadian TAC of 3675 t.

Large (>500 t) and small (<=500 t; LOA<100') shrimp fishing vessel catches are taken from a broad area extending from the northeastern border with 3K south east along the 200-500 m contours to the NRA border. Large and small vessel catch rates were modeled in order to describe fishing activities.

Since 2000, small (<=500 t) and large (>500 t) shrimp fishing vessels catches have been taken from a broad area from the northern border with 3K south east along the 200 – 500 m contours to the NRA border. The area occupied by small and large vessels has been fairly stable over much of the time series with an increase in area fished after 2005. The area accounting for 95% of the autumn survey catches also showed stability with an increase after 2003. Relative stability with an increase in the past few years is reflected in the small and large vessel CPUE time series.

Due to a lack of data it was not possible to model small vessel CPUE during 2007. Small vessel CPUE (2000 – 2006) was modeled using month, year and size class (class 1 = <50' LOA; 50' LOA <=class 2< 60' LOA; class 3 => 60' LOA) as explanatory variables. The final model explained 91% of the variance in the data and indicated that the annual, standardized catch rates have increased significantly since 2004 with all estimates being significantly lower than the 2005 and 2006 estimates (P< 0.005; 662 kg/hr during 2005 and 586 kg/hr during 2006).

Large vessel catch rates were analyzed by multiple regression, weighted by effort, for year, month, number of trawls and vessel effects. The final model explained 76% of the variance in the catch rate data. Standardized catch rates for large Canadian vessels have been fluctuating around the long term mean since 2000 with the 2007 standardized catch rate index (2304 kg/hr) above average and similar to the catch rates for 2002 – 2004 and 2006.

The fact that the area fished by large and small vessels has increased over the past few years at a time when CPUE increased implying that the resource is healthy.

A standardized catch rate model was produced using data from Estonian, Greenlandic, Icelandic, Norwegian and Russian vessels fishing shrimp in the NRA. Ship and year were significant independent variables and produced a model that explained 72% of the variance. Catch rates increased by 109% from 506 kg/hr in 2001 to 1057 kg/hr in 2004 but then decreased by 40% over the next three years resulting in a 637 kg/hr catch rate during 2007. The 2007 model catch rate was lower than the 2003 and 2004 catch rates but similar to all others.

Catch data were also available from Spain for 2005 and 2006. The raw Spanish catch rates for these two years were 640 kg/hr and 763 kg/hr respectively.

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 63,000 t, the highest in the series. However, due to economic constraints, catches in subsequent years have dropped considerably (46,000 t in 2004 and 32,000 t in 2005) with preliminary NAFO catch statistics indicating that 16,000 t and 14,000 t of shrimp were caught in 3M during 2006 and 2007 respectively.

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 of effort diversion into shrimp and crab.

There was no fishery for Iceland scallop in Div. 3LNO in 2007, down from 347 t. in 2006.

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 remains entirely under Canadian jurisdiction.

Total removals from the Canadian zone have decreased from 5367 t, (round) in 1997 to 38 t in 2004. In 2007, 6 t of a total 3500 t TAC were removed, a decline from 2006. 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.

There had been very little effort by offshore vessels from 1997 to 2003 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. The decrease in effort and landings continued in 2007. A total of 359 t (round) was landed in Newfoundland.

A small amount, 9 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 5000 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 2500 t in 2004. Catches decreased to about 550 t in 2005 and then increased to about 6900 t in 2006. High catches in 1996-1997 and 2006 were associated with environmental warming and increase in squid abundance at the northern extreme of their range. The catch decreased sharply to only 230 t in 2007.

p) *Snow crab* – Subdiv. 3Ps

Landings in 3Ps declined by 59% (7600 t - 3100 t) during 2002-2006 before increasing by 27% to 3950 t in 2007. 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. Offshore CPUE has since remained at a low level whereas inshore CPUE increased slightly in 2006 and 2007. The offshore spring multi-species bottom trawl survey exploitable biomass index declined from 1999-2001, and has since remained unchanged. The offshore spring survey pre-recruit index increased in 2007 to its highest level since 1996. Recruitment is expected to increase in the short term in inshore and offshore areas. 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 2007 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 11 to 26, the second on CCGS Templeman from August 2 to 15 and the last on CCGS Hudson from November 18 to December 8. 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 2007 was similar to previous years (1999-2006). The timing of events on the Newfoundland Shelf (south of Seal Island) was generally similar to conditions observed in the early part of the program although the spring phytoplankton bloom was slightly early than in 2006 and considerably longer than in recent years. Satellite information indicates the onset of the spring bloom, at least since 2002, has become gradually earlier throughout the region of the Newfoundland Shelf and Labrador Sea. However, in 2007 there appeared to be a delay in the onset of the bloom in offshore as well as in the northern portions of the region.

There were a few notable trends in the observations from Station 27 and the oceanographic transects. At Station 27, the inventories of both nitrate and silicate showed a rebound from relatively low levels but overall phytoplankton abundance was near average, with the exception of the spring bloom. The reversal of the trend in deep (50-150 m) nutrient inventories is a marked event because levels recorded in 2006 were the lowest recorded since the inception of AZMP. Nitrate continues to be the primary limiting nutrient on the Grand Banks, and the Newfoundland and Labrador Shelf. The relationship between near surface concentrations of silicate and nitrate showed large changes in the rates of utilization of these nutrients during 2007 and previous years (1999-2006). The changes in nutrient utilization between 2007 and earlier years is unknown but may be associated with differences in phytoplankton community structure, water masses and mixing. Several of the major zooplankton taxa showed a general increase over the previous year, with *C. hyperboreus*, *Metridia* spp. and euphausids being at their most abundant levels in the time series. Because these are large species, the overall estimated biomass of zooplankton at Station 27 was the second highest on record.

Because of the increasing information available from AZMP, we are now able to provide model-based (GLM) estimates of abundance for a broader range of taxa for Station 27 (16 versus 12) and oceanographic sections (27 versus 7). There were no outstanding events in 2007 relative to the remainder of the time series, other than an overall high abundance of small copepods on the Grand Banks, and a generally low abundance among meroplankton, larvaceans and ostracods. There has been a general decrease in the abundance of *C. glacialis* and *C. hyperboreus* on the Grand Banks but *Metridia* spp. is at its highest level recorded. Most carnivorous zooplankton have shown a decrease in 2007 over the previous year, which in many species this reflects a longer term pattern since 2004-2005.

The pattern of variation in abundance of taxa abundant at Station 27 appear to reflect a mixture of the patterns on the Grand Banks and the Newfoundland Shelf. For example, the trend in the abundance of *C. glacialis* at Station 27 is consistent with the patterns on the Grand Banks whereas that of *C. finmarchicus* and *C. hyperboreus* are more consistent with the trends observed on the Newfoundland Shelf. 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 (Mathieu et al. 2003). 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 (Pepin et al. 2007). 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 are 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 interannual variation in both the magnitude and duration of the spring phytoplankton bloom. Combining the data from the oceanographic surveys, continuous sampling at fixed stations, and 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.

A notable advance in 2004 was in our ability to provide model-based quantitative analysis of interannual differences in the abundance of dominant zooplankton taxa at Station 27 and along the key oceanographic transects (Pepin et al. 2005). 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 substantial interannual variations in the abundance of zooplankton on the Shelf. The approach based on general linear models to determine the interannual variations in abundance of taxa from AZMP collections did raise some questions about the programs overall ability to accurately monitor zooplankton abundance and species composition. With the longer time series, it has now been possible to expand the number of taxa for which model-based estimates of abundance can now be obtained. In many instances, the confidence intervals remain large, limiting our ability to evaluate the degree of change over time with any certainty. Most notable is the lack of any statistically significant interannual variations in 16 of 25 taxa collected off Labrador (Seal Island section). This could be the result of having one a single observation per year (summer) in that portion of the region, which yields wide confidence intervals in model-based estimates of abundance. On the transects sampled two to three times per year, the number of taxa showing statistically significant variations during the 9 year series ranges from 13 to 17 of 27 taxa for which model-based estimates are available. Trend analysis may be a useful tool which in the future can be used to assess changes in the pelagic ecosystem.

b) *Oceanographic studies* - Subareas 2 and 3

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2007 in NAFO Divs. 2J and 3KLNO. These studies were based on observations from the southern Labrador Shelf to the Southern Grand Bank on the Newfoundland Shelf. The North Atlantic Oscillation index for 2007 was slightly above normal at 0.3 SD, as a consequence, outflow of arctic air masses to the Northwest Atlantic was stronger than in 2006 resulting in a broad-scale cooling of air temperatures throughout the Northwest Atlantic from West Greenland to Baffin Island to Labrador and Newfoundland. Sea-ice extent and duration on the Newfoundland and Labrador Shelf increased slightly but remained below average for the 13th consecutive year. At Station 27 off St. John's, the depth-averaged annual water temperature decreased from the record high observed in 2006 to about normal. Annual surface temperatures at Station 27 also decreased from the 61-year record of 1.7°C above normal in 2006 to 0.2°C above normal in 2007. Bottom temperatures decreased from 0.8°C above normal in 2006 to 0.4°C above normal in 2007. Annual surface temperatures on Hamilton Bank and the Flemish Cap were 0.5°C above normal and on St. Pierre Bank they were about normal. Upper-layer salinities at Station 27 were above normal for the 6th consecutive year. The area of the Cold-Intermediate-Layer (CIL) water mass on the eastern Newfoundland Shelf during 2007 was below normal for the 13th consecutive year and the 14th lowest since 1948. Bottom temperatures during the spring of 2007 remained above normal on the Grand Banks but were below normal on St. Pierre Bank. During the fall they were significantly above normal in NAFO Div. 2J and 3K and most of 3L, but were below normal in the shallow areas of 3NO. The area of bottom habitat on the Grand Banks covered by sub-zero water decreased from >50% during the first half of the 1990s to near 15% during 2004-06 but increased to near-normal at about 30% in 2007. In general, water temperatures on the Newfoundland and Labrador Shelf decreased from 2006 values but remained above normal in most areas. Notable exceptions were on St. Pierre Bank during spring

where temperatures were below normal and in northern areas of NAFO Div. 2J and 3K where bottom temperatures were significantly above normal during the fall of 2007.

c) Multi-disciplinary studies - Subareas 2 and 3

A study describing physical oceanographic conditions in NAFO Division 3P during 2007 and its potential influences on the distribution and abundance of Atlantic cod (*Gadus morhua*) was carried out. The data show anomalous cold periods in the mid-1970s and from the mid-1980s to the mid-to-late-1990s with temperatures up to 1°C below average and up to 2°C below the warmer values of the late 1970s and early 1980s. Temperatures in deeper water off the banks during all years show significant variations, but remained relatively warm with values in the 3°-6°C range, compared to much colder values (often <0°C) on St. Pierre Bank. Beginning around 1996 temperatures on St. Pierre Bank begin to moderate and by 2000 they reached the highest values since the late 1970s. During 2001-03 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. On St. Pierre Bank bottom water with temperatures <0°C covered <10% of the total area during the warm years of 1999, 2000, 2004 and 2005. During the spring of 2007 however, near-bottom temperatures decreased to below normal values in many areas particularly on St. Pierre Bank, where the area of <0°C water increased to more than 50% of the total area. 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, cod tend to prefer the warmer (2°-6°C) portion of the available habitat with a slightly warmer preference based on weight than on total numbers. Finally, variations in the estimated abundance and biomass of cod from the RV surveys in strata with water depths generally <100 m are significantly correlated with bottom temperatures, indicating a potential climate effect on cod distribution in this area.

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 and Greenland halibut 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. Updates on the ageing problems have been presented to NAFO SC in June 2005 and 2006.

A study is ongoing into reproduction in Greenland halibut. The study will use histology and quantification of vitellogenin to verify the maturity status of large female Greenland halibut that are classed as juveniles by macroscopic examination of the gonad.

b) Seals

Multi-disciplinary studies on harp, hooded, and grey seal population dynamics and seal-fish interactions continued in 2007. The Atlantic Seal Research Program (ASRP), initiated in 2003, ended in March 2006 but a number of the projects continued into 2007 to ensure completion of analyses. 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.

Consumption of prey by seals in NAFO Divisions 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 nearshore and offshore areas of NAFO Divisions 2J3KL was collected during 2007. The current status of data on the potential impact of seals on fish stocks, primarily Atlantic cod, was reviewed at an

international workshop held in November 2007. A second workshop will be held in fall 2008 to review modelling exercises designed to improve our understanding of seal-fisheries interactions.

Two putative populations of hooded seals occur in the North Atlantic. The Greenland Sea population pup and breed on pack ice near Jan Mayen while the Northwest Atlantic population is thought to pup in the Davis Strait and off southern Labrador. A study of the stock structure of hooded seals was carried out using micro-satellite profiling and mitochondrial DNA sequencing. The study found no significant genetic differences between breeding areas, nor evidence for cryptic nor higher level genetic structure in this species. The Greenland Sea breeding herd was genetically most distant from the Northwest Atlantic breeding areas; however, the differences were statistically non-significant. The data therefore suggest that the world's hooded seals comprise a single panmictic genetic population.

Current methods of diet analysis in marine mammals, particularly hard part analysis (HPA), have biases that will affect the accuracy of species and frequency of prey in estimated diet. Using polymerase chain reaction (PCR) amplification of specific prey DNA, we developed a method that will compliment HPA and improve the detectability of prey. Species-specific PCR primers for Atlantic cod, Arctic cod (*Boreogadus saida*) and capelin (*Mallotus villosus*) were designed and used with DNA extracted from the stomach contents of 31 harp seals (*Pagophilus groenlandicus*) to amplify specific prey DNA. Amplification results were then compared to hard part analysis (HPA) that is assumed to represent the most recent meal. For Atlantic cod, there were stomachs (n=11) where hard parts were found, but DNA was not amplified, suggesting that cod may be over represented in the diet proportions. While PCR amplification occurred in 17 stomachs, including all stomachs with Arctic cod hard parts (n=12), hard parts were missing from several stomachs which amplified DNA (n=5). Capelin DNA was also amplified in all stomachs with hard parts, but was amplified in a number of stomachs (n=9) without hard parts, illustrating the difficulty in finding small otoliths in HPA.

The importance of some areas of the Grand Banks and the south coast of Newfoundland for the aggregation of marine mammals is a long-recognized phenomenon. The quality of areas of marine mammal concentration and associated functions are assessed against criteria developed to identify Ecologically and Biologically Significant Areas (EBSAs). Based on this criteria 11 areas were identified: 1) Newfoundland southwest coast, 2) Southeast Shoals, 3) Tip of the Buren Peninsula, 4) Cape St. Mary's, 5) Merasheen Islands, 6) Woody Island and area, 7) Placentia Sound, 8) Eastern Avalon Coast, 9) Southern Whale Bank, 10) Carson Canyon, and 11) Sackville Spur (east and west).

International Governance Program

In order to determine movements and habitat use by northwest Atlantic hooded seals, a cooperative project between DFO and the Greenland Institute of Natural Resources was initiated in 2004. The primary objective of this project was to deploy satellite-linked time depth recorders on both young and adult hooded seals to monitor annual movements and diving behaviour. The data obtained will be used to identify critical habitat for hooded seals and insight into the role this species plays in the northwest Atlantic ecosystem, provide data critical to understanding the role seal consumption is having on the population dynamics of commercial fish species, and improve the management of Greenland and Canadian hunts through a better understanding of the movements of hooded seals. In addition, these transmitters also provide oceanographic data (temperature and salinity profiles) that is being used to develop and/or improve oceanographic models for the north Atlantic. Four young hooded seals (bluebacks) were tagged on the whelping grounds off the coast of Newfoundland in March 2006. Adults were live captured on the Denmark Straits moulting grounds during July 2007 (n=7). These data will supplement data collected during earlier deployments off Greenland and at the whelping grounds.

As part of the International Governance Program, Canada participated in an international survey to estimate abundance of cetaceans across the North Atlantic during summer 2007. A total of 107,000 km of surveys, covering an area of 5 million km^2, from the eastern Barents Sea to the east coast of Canada, was covered by 7 vessels and 5 aircrafts. Another 9800 km of line were covered by observers on 3 fishery surveys in adjacent waters. Over 4000 cetacean sightings from 22 species were recorded. Fin whales, minke whales, humpback whales, white-beaked dolphins, and belugas were the 5 species providing the higher numbers of sightings. The survey was also coordinated with similar surveys in the European Atlantic and the northeastern USA to provide

the most complete synoptic survey of the north Atlantic to date. Abundance estimates will be derived using standard line transect methods, double platform analysis and spatial modeling, depending on data availability. The final goal is to provide combined estimates for several species for the entire north Atlantic.

c) Capelin

A comparative study to determine factors governing capelin survival during egg development and larval emergence from beach sediments and from bottom spawning sites in Trinity Bay continued in 2007. Samples of adult capelin were collected in 2007 at spawning sites in Labrador, Div. 2J; the east coast of Newfoundland, Div. 3KL; the Southeast Shoal, Div. 3NO; the Gulf of St. Lawrence, Div. 4S; and the Scotian Shelf, Div. 4W as part of a genetic study on capelin biodiversity. An ongoing offshore acoustic survey initiated in the spring of 1999 to examine capelin distribution, behaviour, and feeding habits in Div. 3KL resumed in 2007 after missing 2006. However, due to the exceptionally heavy ice conditions in spring 2007 survey area coverage was incomplete. Fall and winter inshore surveys were conducted in 2007 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. Two surveys in the final year of a two-year study of bottom spawning habitat and distribution of mature capelin and sand lance on the Southeast Shoal, Div. 3NO, were conducted in June and in July, 2007.

d) Salmon

A study, funded under the International Governance on High Seas program, was initiated to examine long term variability in the trophic ecology of Atlantic salmon. Analyses of stable isotope signatures of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$) were carried out using scale samples of one-sea-winter (1SW) salmon from 9 Canadian and 1 north European river (Tana). Differences were found in $\delta^{13}C$ and $\delta^{15}N$ signatures among rivers, as well as among years within rivers. Significant trends over time, however, were evident in only a few situations. In addition, isotopic signatures were largely invariant in relation to variations in abundance or to various environmental measures characterizing ocean climate conditions in the north Atlantic.

During the spring of 2007, Atlantic salmon smolts (N = 62) and kelts (N = 30) were tagged with acoustic transmitters and released from Conne River, Newfoundland, during April and May to determine movements and migration patterns throughout the Bay d'Espoir fiord, and obtain insight into the initial survival and residency time of both life history stages. This work built on tracking carried out in 2006. A total of 34 Vemco VR2 receivers were positioned at various locations throughout Bay d'Espoir while manual tracking was also carried out in areas proximate to where fish were initially released. Of the 30 kelt that were tagged and released all were subsequently accounted for. Five (5) kelt returned to the general area of the mouth of Conne River after an absence of 60 – 84 days. The remaining kelt spent an average of 10.6 days (range = 2 to 2 days) in Bay d'Espoir before exiting the fiord. With respect to smolts, 53 of 62 (85%) provided tracking information. Smolts were found to use several routes to exit the fiord with an average residency time of 17 days, slightly longer than in 2006. Results from both years suggests that many smolts are successfully able to migrate to the outer margins of the Bay d'Espoir fiord.

e) Shrimp

A baseline of pathology is being constructed from past research survey datasets. This study has just begun and is a joint project between Environmental Sciences and Science within NL Region

SUBAREA 4

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

Nominal landings from 1992 to 2007 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) *Atlantic salmon* – Subarea 4

A moratorium on the Canadian commercial fishery has been in place since 1992. The 2007 recreational harvest, including both retained and hooked-and-released, was 15,313 fish.

b) *Snow Crab* – Div. 4R

Landings in 4R declined by 71% during 2002-2006 (1850 t - 540 t) and changed little, at 550 t, in 2007. The commercial catch rate has remained at a lower level than in other divisions. Fishery independent data are insufficient to assess offshore resource status. It is not possible to infer trends in the offshore exploitable biomass from commercial CPUE data because of recent changes in the spatial distribution of fishing effort. The inshore biomass has recently declined. Both CPUE and post-season trap survey catch rates have declined sharply since 2005. Recruitment prospects are unknown.

c) *Iceland scallops* – Div. 4R

The nominal catch from the Strait of Belle Isle (4R) in 2007 is estimated at 284 t (round) against a TAC of 1000 t. 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 1992 to 2007 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 1800 t in 2000, from a long-term high of 3200 t in 1992. Preliminary figures indicate increases in recent years, to 2100 t in 2002 and 2300 t in 2003, followed by a decrease in 2004, to 1900 t. Landings then increased to about 2600 t in 2005 and remained the same for 2006. A preliminary value for 2007 landings is 2500 t. Landings continue to increase in LFA 11 in Subdivision 3Ps, and in LFAs 13A, 13B and 14A in Division 4R, but have declined precipitously in LFA 10 in Subdivision 3Ps, as well as LFA 4 in Division 3K. 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 2007. Data collected were tabled at regional stock assessments in the autumn of 2007 for 3Ps and the spring of 2008 for 2J3KL cod. Sites in 2J3KL, 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

age 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) Cod tagging and telemetry

A tagging program was restarted and telemetry studies were initiated in inshore cod in 2J3KL in 2006. Approximately 6200 cod were tagged and released with Floy tags along with an additional 150 cod implanted with ultrasonic transmitters. A series of arrays of receivers were deployed along a 350 km area of the inshore to monitor cod movement patterns and survival over the next two years. The objectives are to obtain estimates of exploitation and population size to improve the assessment of this stock; and to study migration patterns and survival rates. In addition, 164 cod with surgically implanted transmitters and 1100 cod with Floy tags were released in the offshore of 3K during March 2006; the objective is to determine if the remnant offshore stock is continuing to migrate to the inshore during summer. Tagging and telemetry were continued in 2007 with release of a further 3800 tagged cod. In addition, 2200 cod with Floy tags and 150 with surgically implanted ultrasonic transmitters were released in the offshore of 3K during March 2008.

c) Stock Definition of Redfish in Units 1 and 2 – Subareas 3 and 4

The issues of redfish population structure, more specifically the interaction between management Unit 1 and Unit 2, were presented during workshops held at the Maurice Lamontagne Institute in February, 2006 and September, 2007. A science advisory report representing the advice and conclusions from the 2007 workshop will be available on the CSAS website (http://www.dfo-mpo.gc.ca/CSAS/) in late June 2008.

d) Hydrographic Surveys

The Canadian Hydrographic Service (CHS) priorities for Subareas 2, 3 and 4 for 2007-2008 were several sites throughout Newfoundland and Labrador.

CCGS Matthew

As in previous years, the Canadian Coast Guard Hydrographic survey vessel CCGS Matthew conducted hydrographic surveys at various locations throughout Newfoundland and Labrador. During the 2007 survey season surveys were completed at Grey River, Seal Cove Hermitage Island Cape Freels, Fogo Island, Cartwright, Labrador, Makkovik Bank, Labrador and Northern Labrador.

Connaigre Bay
A multibeam acoustic survey was completed at Grey River on the south coast of Newfoundland to verify charted depths. This unplanned survey was in response to the grounding of the cruise ship Polar Star in the entrance to Grey River.

Seal Cove and Hermitage Island
This survey was a multibeam acoustic survey of uncharted areas in the vicinity of the Hermitage Island. Uncharted areas in the approaches Seal Cove and a survey of an uncharted wharf at the same location was also completed.

Cape Freels
A joint CHS and DFO Newfoundland Science Branch survey to conduct a multibeam survey off the coastal areas of Cape Freels, Newfoundland. Information from this survey will be used to study demersal capelin spawning grounds. This survey was a continuation of surveys started in 2006 and significantly expanded the area of coverage.

Fogo Island

The existing chart for the north side of Fogo Island, Notre Dame Bay, contained several areas delineated as uncharted or not charted to modern survey standards. A number of request were made from clients to provide modern charting for these areas. The survey of Fogo Island provided state of the art hydrographic information required to update the charts north of Fogo Island.

Cartwright Labrador
This survey was a continuation of a survey commenced in 2006 to investigate a number of client reported uncharted features such as shoals, rocks, reefs and poorly charted islands in the vicinity of Cartwright, Labrador. Information from this survey will be used to update the charts in the area.

Makkovik Bank
A joint Canadian Hydrographic Service (CHS), National Research Council of Canada (NRCAN) survey to conduct a multibeam acoustic survey of Makkovik Bank, Labrador. The survey returns will be used to update nautical charts and to investigate geo-hazards required for planning gas pipeline routes across Makkovik Bank.

Northern Labrador
During 2007, a multiyear multibeam acoustic survey to establish new shipping routes along the Labrador coast from Nain to Cape Chidley was completed. Routes were also established into ports and fjords as required to link near shore coastal routes with deeper offshore water. A series of new charts are now in production for use by mariners required to navigate this area. Prior to this project northern Labrador was uncharted or charted to reconnaissance standards only.

Canadian Survey Launch William R. Curran

The annual W. R. Curran Revisory Survey, funded from the High Risk Charting Project, operated at several sites throughout Newfoundland and Labrador during the 2007 survey season.

These surveys were necessary for the updating of new and revised nautical charts and Sailing Directions publications and in response to ISO Quality Management System Client Feedback Reports. The following survey projects were undertaken during the 2007 survey season.

Chart No.	Risk Class	Location	Type Survey	Proposed Product
4851	Class B	Trinity Bay Southern Portion	Single beam acoustic and side scan survey of Bull Arm.	New edition of chart.
4852	Class B	Smith and Random Sounds	Investigation of uncharted rock Hickman's Harbour	Notices to Mariners Action
4591	Class C	Halls Bay and Sunday Cove	Shoal investigation, South Brook.	Notices to Mariners Action
4863 ATL 101	Class B	Bacalhao Island to Black Tickle	Single beam acoustic and side scan survey of Black Island Tickle.	Sailing Directions Diagram or Chart inset
4652 ATL 109	Class A	Humber Arm, Meadows Point to Humber River	Single beam acoustic and side scan survey, Public Wharf Corner Brook.	Sailing Directions Diagram and New Edition of Chart
4862	Class B	Carmanville and Bacalhao Island to Fogo Island	Investigation of uncharted rocks and shoals at Cobbs's Arm Notre Dame Bay	Notices to Mariners Action

Annual Sailing Directions Revisory Survey

The annual Sailing Direction Revisory survey gathered hydrographic data from many sites throughout Newfoundland and Labrador. This data is used in revising and updating the Sailing Directions publications ATL 101, 102, 103, 109 and 120 for Newfoundland and Labrador.

An integral part of the Sailing Directions Revisory Survey is chart dealership inspections. These inspections assured that CHS chart dealers are selling the most recent edition of charts to clients, an important marine safety consideration.

Seven (7) chart dealership inspections were conducted at various locations throughout the Island portion of Newfoundland and Labrador. A new chart dealership was also established at St. Anthony Labrador.

During 2007 a new edition of the Sailing Directions Publication ATL 102, Cape Bonavista to Ferryland Head was started. This new edition was 95% completed and will be published in 2008.

Table 1: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 1992-2007. (Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.)

			Catch (t)															
Subarea	Species	Division	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	3,742	4,045	4,005	4,993	4,017	2,560	3,184	2,614	3,876	3,300	1,700	1,453	5,852	3,723	2,561	8,200
	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
		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
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	Shrimp*	2G (SFA 4)	9,839	10,084	10,247	9,644	13,020	8,393	8,116	7,529	7,884	8,051	5,217	5,160	5,104	3,982	2,723	2,706
		2HJ (SFA 5)	22,772	22,612	22,898	22,690	30,437	15,332	15,036	14,645	15,109	15,170	15,103	7,383	7,616	7,499	5,719	6,315
		2J3K (SFA 6)	72,196	75,673	75,129	77,776	71,227	59,912	52,554	63,175	51,202	46,337	21,246	10,923	10,914	10,978	8,035	6,609
	Snow Crab	2J	2,330	1987	1517	1,915	2511	3,521	3,738	3,685	5,416	4,098	3,183	3,102	3,189	2,978	2,275	1,529
	Iceland scallop	2HJ	40	686	672	495	528	272	218	230	685	1,295	1,027	360	167	340	401	103
	Arctic Charr	2J3KLPs+4R	28	40	22	19	19	21	33	47	41	38	38	16	30	31	38	74
	Atlantic salmon****		27	32	31.9	32	22.1	17.6	16.3	15.6								
2+3	Redfish	2+3K	29	221	135	167	22	34	40	30	3	3	4	2	1		2	9
	Greenland halibut	2+3KLMNO	5,073	6,307	6,644	4,877	6,620	6,291	8,238	10,637	4,124	4,081	5,877	5,891	3,229	2,928	4,899	6,933
	American plaice	2+3K	23	60	29	16	33	100	133	67	6	6	2	16	28	16	77	103
	Witch	2J+3KL	22	53	40	26	110	167	148	90	2	1	6	4	10	11	343	1,632
	Cod*****	2J3KL	2,546	2,679	1,330	643	971	4,196	6,887	5,376	8,525	4,501	877	1,874	413	1,313	8,967	26,073
	Grenadier	2+3	38	99	151	135	183	274	212	234	145	209	98	225	125	130	614	992
	Capelin	2J3KL (offshore)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Squid	2+3	228	6,879	548	2,525	1089	229	23	328	19	815	12,748	8,285	48	1,954	276	924
3	Redfish	3LN	3	1	2	0	9	47	40	33	5	7	19	0	0	0	46	657
		3M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3O	1,054	3,580	5,364	2,340	3,093	2,988	4,557	880	2,027	6,121	1,895	128	24	1,192	677	845
	Yellowtail	3LNO	3,674	177	13,268	12,577	12,705	9,959	12,238	9,422	5,540	3,536	1				6,265	6,369
	American plaice	3LNO	434	93	1,466	1,290	1,607	1,374	1592	623	269	204	71	47	65	59	7,454	9,663
		3Ps	460	485	745	731	883	1,014	877	609	542	405	213	112	80	112	723	2,380
	Witch flounder	3NO	21	94	49	49	62	27	13	12	3	3	18	26	0	0	3,971	4,093
		3Ps	110	182	483	540	529	517	450	332	507	452	259	250	273	429	956	1,012
	Atlantic halibut	3	170	251	255	303	399	369	315	182	124	165	152	101	107	36	138	114
	Cod	3NO	123	73	459	441	714	422	487	171	485	306	289	54	31	3	3,719	5,232
		3Ps	10,599	10,506	11,400	11,046	12,469	12,618	13,339	19,683	24,328	15,690	7,327	767	581	575	13,865	23,493
	Haddock	3LNO	30	23	44	18	67	183	86	69	50	14	190	28	9	0	675	598
		3Ps	302	128	219	123	137	111	102	162	98	191	69	118	48	20	86	251
	Pollock	3Ps	1,042	733	500	296	333	492	815	709	729	428	592	435	248	59	113	437
	White hake***	3NOPs	1,675	2,320	2,325	1,724	1,541	1,931	1,462	1,535	933	695	804	852	636	2,375	1,795	2,902
	Thorny skate***	3LNOPs	92	1,158	1,652	1,542	2,374	2,304	2,125	1,432	2,168	2,250	4,982	3,123	4,536	2,540	62	63
	Capelin	3L	16,321	15,431	15,534	15,706	13,270	8,639	13,898	12,041	11,403	19,809	3,560	16,840	100	890	23,480	3,160
		3K	13,036	14,368	12,194	11,138	4,067	1,553	5,022	4,066	7,254	10,225	9,230	8,920	30	70	13,525	19,350
	Shrimp*	3M	0	0	0	0	0	8	293	618	490	469	785	906	970	1,041	3,724	
		3L	18,312	18,147	11,184	10,613	10,008	5,417	4,986	4,111								
	Sea scallop	3KLNO	9	10	35	0	0	0	0	0	0	6	20	27	9	10	9	6
		3Ps	359	518	2,132	3,473	647	51	338	85	70	266	9	8	418	534	483	0
	Iceland scallop	3LNO	0	347	128	0	0	0	39	336	141	1,300	3,986	9,454	6,501	3,941	817	22
		3Ps	6	132	1,748	40	87	478	498	1,148	1,197	2,792	5,367	608	1,061	440	667	5,967
	Snow Crab	3K	12,270	10,717	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
		3LNO	30,895	30,717	29,649	30,717	31,638	30,032	28,172	26,773	32,725	23,533	22,185	16,656	13,790	12,237	8,979	6,652
		3Ps	3,947	3,099	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
	Lobster	3K	118	156	209	157	207	206	275	231	251	295						
		3L	82	111	112	73	116	128	124	126	158	146						

Note: Table indicates Newfoundland and Labrador landings only unless otherwise specified.

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

Please note that during 2003 industry requested and was granted a season change from a calendar year (Jan. 1 - Dec. 31) to Apr. 1 - Mar. 31.

Therefore all years subsequent to 2002 are Apr. 1 - Mar 31 for shrimp fishing areas 4, 5 and 6 only.

Please note that the values shown for 2003 - present will not agree with past values shown because in the past values were converted to calendar year catches.

Since 2007, all values will be according to the Apr. 1 - Mar. 31 management year for Shrimp fishing areas 4-6.

The 3L shrimp catches are taken according to a Calendar year (Jan. 1 - Dec. 31) and are recorded accordingly.

**** Subsistence Fisheries ***** Excludes recreational catch **** Subsistence Fisheries ***** Excludes recereational catch

Acknowledgements

The following staff of Fisheries and Oceans Canada (Newfoundland and Labrador Region) have contributed to the completion of this report: J. Brattey, F. Cahill, N. Cochrane, E. Colbourne, R. Collins, E. Dawe, B. Dempson, K. Dwyer, B. Healey, M. Koen-Alonso, J. Morgan, B. Nakashima, D. Orr, D. Maddock Parsons, P. Pepin, D. Power, M. Simpson, G. Stenson, C. Stirling, and J. Tillman.

PART B

SUBAREA 0

A. Status of the Fisheries

1. Shrimp

a) Division 0A

The shrimp fishery in 0A is based on *Pandalus borealis* fished east of 60°30'W which corresponds to the Canadian Shrimp Fishing Area (SFA) 1. The quota in 0A rose from 8,500t in the early 1990s to 18,417t in 2004 and remained at this level through 2007. Reported catches rose from a low of 517t in 1997 to 7,508t in 2005 (Table1). 2006 saw a significant decrease (45%) in reported catch of 4,127t. In 2007 there was an additional decrease by 53% to 1,945t. This decline in catch probably has more to do the increased operating costs than stock status; however, there have been reports from fishermen of reduced CPUE in the area. .

b) Division 0B

The 0B shrimp fishery is a mix of *Pandalus borealis* and *Pandalus montagui*. SFAs with corresponding quotas for each species are used to manage the shrimp fishing within 0B. Catches are reported by SFA. Since the SFAs do no correspond exactly to NAFO boundaries the catches are estimated from a combination of SFAs. For this report shrimp reported in SFA2 and 3 are reported as 0B catch in this report. This is appropriate when the distribution of the fishing effort is considered. The exception would be the portion of NAFO 2G from 60°30'N-61°N and 63°W-64°30'W which is also reported as SFA2 catch. Therefore the accuracy of the level as it relates to the NAFO Division can be questionable.

The quota for the area rose from 3,500t in 1996 to 9,150t in 2006 for *Pandalus borealis* and 1,200t in 1996 to 4,300t in 2002 for *Pandalus montagui* where it has remained since that time. Catches of *Pandalus borealis* in 0B have fluctuated between 3,220t to 6,333t from 1996 to 2005. The 2007 catch was 5717t. (Table 1). 89% of all *P. borealis* was caught in 2007 came from west of 63°W. 1,144t of *P. montagui* were caught in 2007, continuing the decline in catch from 2005 (2,600t). Catch rates in 0B remain at a high level.

2. Greenland Halibut

a) *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. From 1994 to 2005, the total allowable catch (TAC) for inshore fisheries in Subarea 0 was set at 1000 t with half of this (500 t) allocated to Cumberland Sound (Div. 0B). 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 has been unstable again since 2004 and in 2007 the ice conditions were so poor that the fishery lasted less than two 2

weeks with a catch of only 3 t. 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 t quota in the Division 0B offshore commercial fishery with the option to transfer surplus inshore quota to the offshore fishery. Catches in 0B have varied between 20 t and 1720 t from 1992-2006 (Table 2). In 2007, the TAC for Nunavut was 1500 t with 1227 t caught using otter trawl (single and twin trawls) and gillnet (Table 3).

A CPUE index for the offshore trawl fleet was updated in 2007. There have been frequent vessel changes in this fishery over the years and the catch from single and double trawl gear was often aggregated as "otter trawl" catch when this gear was first introduced to the fishery in the early 2000s. Very few of the vessels operating in the fishery in 2007 have been in the fishery for more than 3 years. A standardized catch rate is produced using a General Linear Model. The model was updated in 2007; two vessel/gear classes were removed due to fewer than 5 occurrences in the database while one vessel/gear class was added due to the introduction of two Class 5 vessels to the fishery in 2006. Also, catches (t) and hours fished with values less than 10 were removed. The overall CPUE index declined slightly in 2007 (Fig. 1) despite an observed increase in the un-standardized double trawl rate (Fig. 2) for catches taken in Jan and late fall (Table 3). The catch rates for vessels fishing both trawl gear during May-September (Table 3) declined from 2006 to 2007 and this decline influenced the overall estimate for 2007. The un-standardized catch rate index shows similar rates for single and double trawl catches in 2000 and 2002, this would not be expected and is likely due to the combining of catches from these two gear types in reported landings. Catch rates for the past 3 years are higher than those seen in the early 2000s and have returned to levels observed in the early-mid 1990s (Fig. 1).

A length frequency distribution for the Div. 0B catch (Can-CA and Can-NF) was prepared using observer data from the 2007 gillnet fleet (16% observer coverage) and trawl fleets (92% observer coverage) (Fig. 6). There was no observer coverage of the CAN-NF Div. 0B long-line fleet in 2007.

b) *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 3500 t, in 2003 it increased to 4400 t and for 2006 and 2007 it has been set at 6500 t. Catches were 2625 t in 2001 and increased to 6635 t in 2006 (Table 1). The total catch for 2007 was 6150 t (Table 2). Prior to 2006 a majority of the catch was caught using bottom otter trawl (both single and twin trawl gears have been used). Long-line gear was used in this fishery in 2002 and 2003. Approximately 50% of the 2006 and 2007 catch was caught using Gillnets which were first introduced into the fishery in 2004.

As in Div. 0B very few of the vessels operating in the fishery in 2007 have been in the fishery for more than 3 years. The General Linear Model used to standardize trawl catch rates for Div. 0B was applied to data from Div. 0A in 2008. Vessel/gear classes with fewer than 5 occurrences in the database were removed as were records where catches (t) and hours fished were less than 10. The overall CPUE index declined slightly in 2007 (Fig. 3). This decline could also be seen in the un-standardized catch rates for both single and twin trawl gears (Fig. 4). Trawl gear catch rates have been relatively stable over the past 7 years (Fig. 3).

The un-standardized CPUE for the 0A gillnet fleet has remained relatively un-changed over the last 3 years (Fig. 5).

Length frequency distributions for the Div. 0A catch was prepared using Newfoundland region observer data for the gillnet fleet (100% observer coverage) (Fig. 6). The trawl fleet length frequency samples were not available prior to the June SC meeting and will be included in the 2009 assessment.

c) *Subarea 0*

A summary of trawl codend and body mesh sizes are provided in Table 4 and gillnet mesh size and corresponding depths are given in Table 5. Details on the main by-catch species in the Greenland halibut fisheries for all of Subarea 0, not just C&A, are summarized in Tables 6 and 7 and include catch data on wolfish species that have been listed under the Canadian Species at Risk Act. The Greenland halibut catch recorded by observers for the 0A gillnet fishery (100% observed) differs from the landed catch estimates (Table 3) due to discarding (approx. 32 t) and differences in product weight to round weight conversion factors.

B. Special Research Studies

1. Environmental Studies

There was no oceanographic sampling within NAFO SA0 in 2007.

2. Biological Studies

a) Greenland halibut

There were no research surveys in SA0 in 2007. Greenland halibut were tagged in offshore areas of Div. 0A over a 3 day period in Oct. 2007 conducted in collaboration with the Greenland Institute of Natural Resources tagging project (see SCR 08/17, Fig. 12).

b) Shrimp

2007 was year 3 of the survey conducted 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 on each set taken during the survey.

A DFO multi-species research survey was conducted in SFA3 west of 66°W. While not strictly in NAFO 0B the survey supports the assessment of the fishing conducted in the division. The standard trawl survey produced abundance and biomass estimates for *Pandalus borealis* and *P. montagui*. Fecundity, length-weight and feeding habits of the shrimp were examined. Oceanographic parameters were recorded on each set taken during the survey.

Table 1. *Pandalus borealis* catch (t) reported by all Canadian vessels fishing from 1990-2007

Division	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
0A	1945	4127	7508	6236	6654	6247	3625	1588	2046	933	517	2623	2361	4727	5501	7493	6788	6177
0B	5717	6143	6333	4488	4584	5597	5829	4805	5132	5204	5670	3220	3564	476	106	1291	1107	1609

Table 2. Greenland halibut catch (t) in SA0 by Central and Arctic licensed vessels, 1992-2006.

Div.	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992
0A	6635	4268	3753	4142	3800	2625	320	0	42	203	329	0	0	0	0
0B[1]	1219	1240	208	800	918	1017	1043	1568	1720	1446	1417	407	0	20	1020

[1]Does not include catches from the inshore Cumberland Sound long-line fishery which has been managed separately from Div. 0B offshore since 2005.

Table 3. Summary of 2007 catch (t) for Greenland halibut by Central and Arctic licensed vessels

Division	Gear type	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
0A	Gillnet								613	1048	979	131		2771
0A	Single Trawl							69	72	72	231	237		681
0A	Double Trawl							98	521	835	1025	219		2698
Totals														**6150**
0B	Gillnet					11	30	56		72	19	43	19	250
0B	Single Trawl	41	157	43								13	229	483
0B	Double Trawl	246	188									8	52	494
Totals														**1227**

Table 4. Summary of trawl mesh size used in the 2007 Div. 0A and 0B fisheries (Data for Div. 0A not available).

Division	Codend Mesh (mm)	Body Mesh (mm)
0A		
0B	145, 146, 147, 148, 152	90, 91, 96, 100, 120, 130

Table 5. Summary of gillnet mesh sized used in the 2007 Div. 0A and 0B fisheries with corresponding depth fished.

	Mesh (mm)	Mesh (inches)	Depth Fished (m)
Division 0A	203	8”	371-1335
	205	8”	988-1258
Division 0B	203	8”	912-1242

Table 6. Catch and bycatch in the 2007 Division 0A Greenland halibut fishery, all regions not just C&A. Data are from observers with 100% coverage on all fleets. However, the trawl fleet samples were not available for this meeting.

Species	Trawl Catch (t)	Gillnet (Catch t)	Total Catch (t)	% of Total Observed Catch
Greenland halibut (R. hippoglossoides)		2995	2995	98
Greenland shark (S. microcephalus)		7	7	<1
Arctic skate (A. hyperborea)		28	28	<1
Skate sp. (Raja sp.)		17	17	<1
Roughhead grenadier (M berglax)		22	22	<1
Spiny crab (N. grimaldii)		11	11	<1
Northern wolffish (A. denticulatus)		0.198	0.198	
Striped wolffish (A. lupus)		0.015	0.015	

Table 7. Catch and bycatch in the 2007 Division 0B Greenland halibut fishery, all regions not just C&A. Data are from observers with 16% coverage on the gillnet fleet and 92% coverage on the trawl fleet.

Species	Trawl Catch (t)	Gillnet (Catch t)	Total Catch (t)	% of Total Observed Catch
Greenland halibut (R. hippoglossoides)	3234	289	3523	94
Greenland shark (S. microcephalus)	75	1	76	2
Roughhead grenadier (M. berglax)	9	12	21	<1
Redfish (Sebastes. Sp.)	11	0	11	<1
Spiny crab (N. grimaldii)	1	11	12	<1
Northern wolffish (A. denticulatus)	7.481	0.084	7.565	
Striped wolffish (A. lupus)	1.587	0.000	1.587	

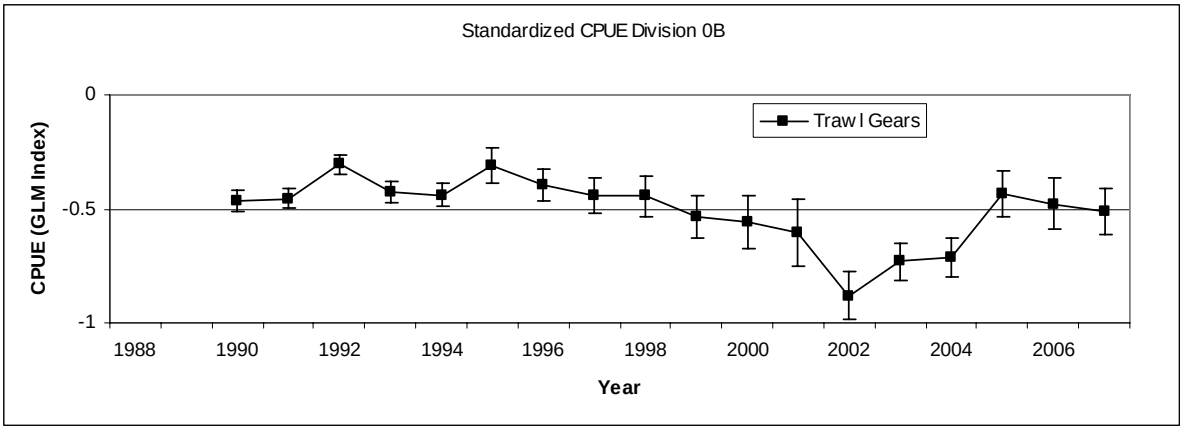

Figure 1. Standardized CPUE series for trawlers operating in Div. 0B (+/- S.E).

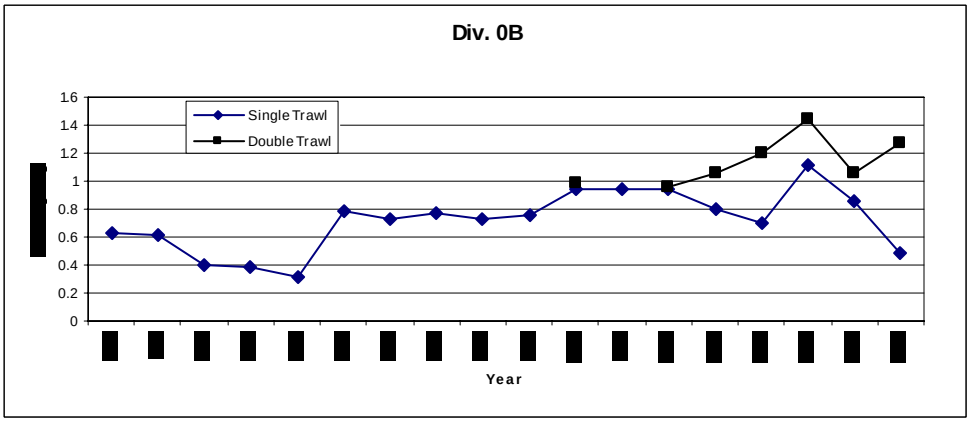

Figure 2. Div. 0B trawl fleets, un-standardized CPUE series.

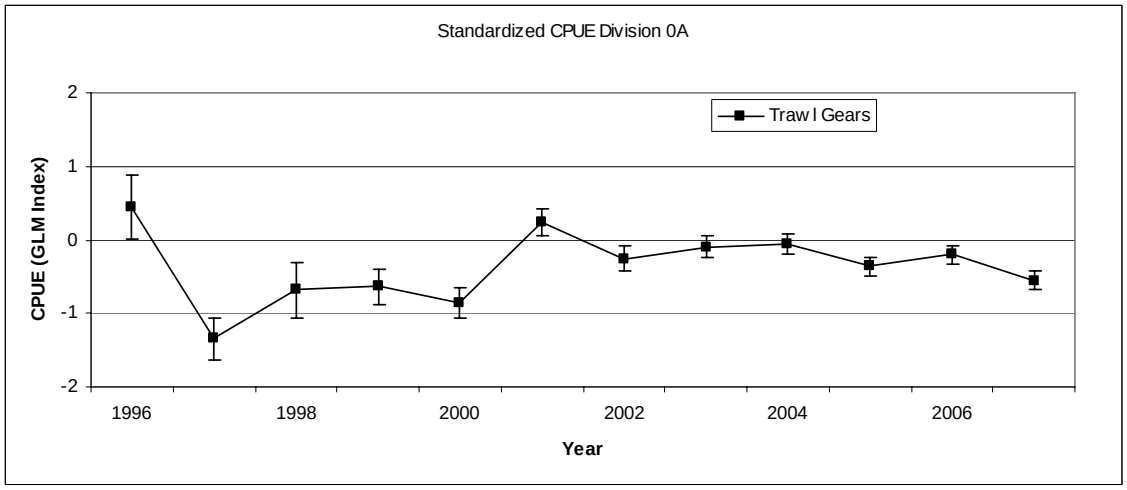

Figure 3. Standardized CPUE series for trawlers operating in Div. 0A (+/- S.E).

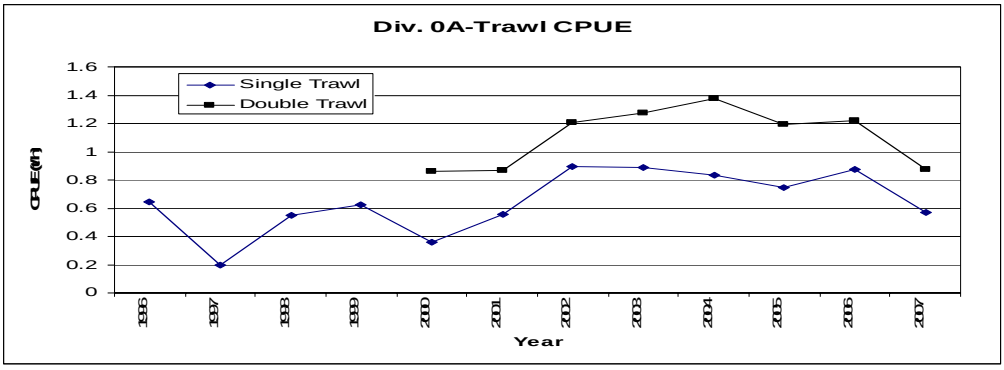

Figure 4. Division 0A trawl fleet, un-standardized CPUE series.

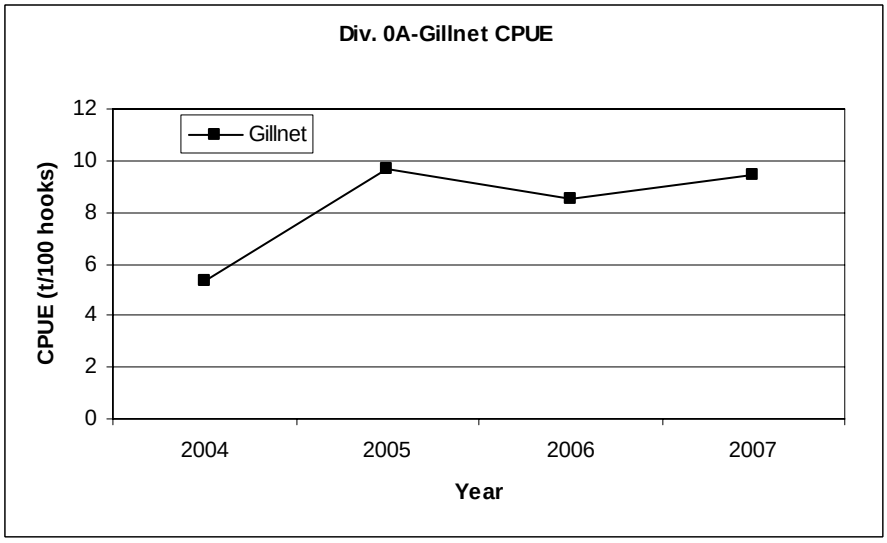

Figure 5. Division 0A gillnet fleet, un-standardized CPUE series.

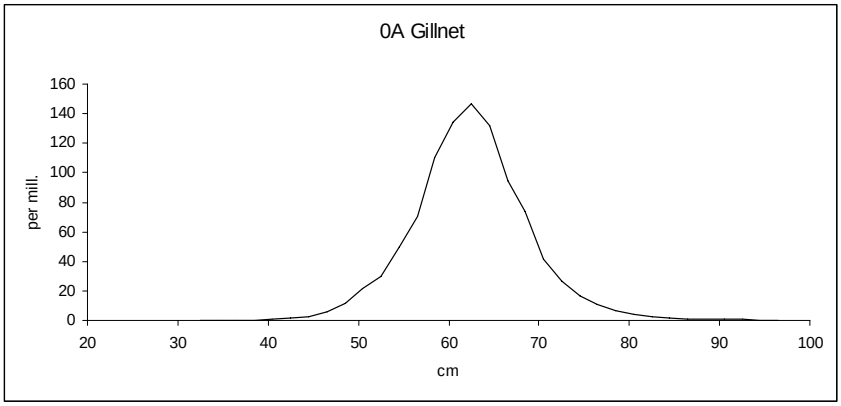

Fig.6a. Length distribution from the gill net fishery in Div 0A in 2007 in per mill ., 2 cm groups. Samples from the trawl fishery in Div. 0A were not available for this meeting but will be presented along with 2008 data at the next NAFO SC meeting.

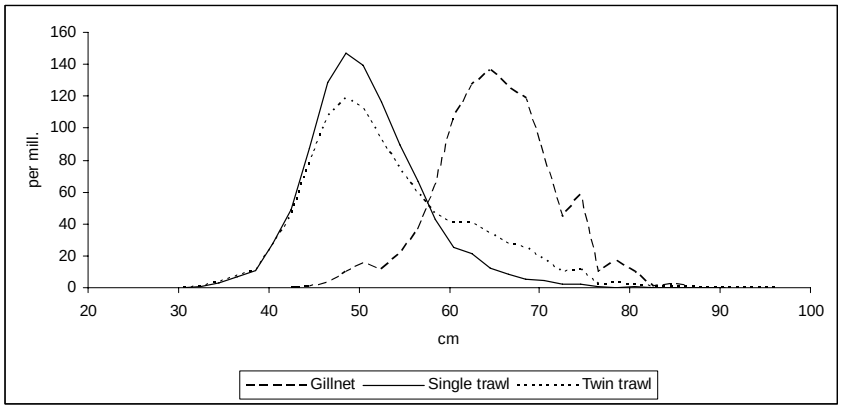

Fig.6b. Length distribution by gear from the fishery in Div 0B 2007 in per mill ., 2 cm groups.

Appendix I: Research Projects for the International Governance on the High Seas Program (2006-2008); DFO Newfoundland and Labrador Region

On April 29th, 2005, the Minister announced that the government will invest an additional $20 million over three years on initiatives to combat over-fishing and strengthen international fisheries governance on the Grand Banks.

Part of this initiative will focus on scientific research to increase knowledge of marine ecosystems, sensitive marine areas and species, and straddling and highly migratory fish stocks.

For the Newfoundland and Labrador Region, approximately $7.2M over 3 years, has been notionally allocated towards the new program which is primarily focused on 2 areas:

1. Sustainable Fisheries Technologies and Practices

   Focus will be research on fishing technologies and practices to better understand their effects on the environment. Areas of interest could include gear selectivity, reducing environmental impacts of fish harvesting and ecosystem impacts.

2. Research on Sensitive Areas and Species

   This component will aim at developing a better understanding of the ecosystems of the Labrador Sea, continental shelf and slope areas of the Region. Priority will be given to understanding the physical and biological components of this ecosystem. This may include projects examining the inter-relationships between the various commercial and non-commercial species, research on straddling resources (e.g. species that inhabit areas where the continental shelf extends outside Canada's EEZ) and highly migratory species, species interactions, studies on distribution and migration, development of conservation guidelines (e.g. PA) or identification of sensitive areas and species, e.g. corals.

The three year research projects for the International Governance on the High Seas Program concluded in March 2008. A summary workshop is being planned for the fall of 2008 and planning is currently underway for a similar program starting in 2008.

List of International Governance Proposals	
Project Leader(s)	**Title**
K. Gilkinson D. Hamoutene G. Veinott	The ecology of deep-sea corals of Newfoundland and Labrador waters: biogeography, life history, biogeochemistry, and role as critical habitat
N. Cadigan	Accounting for mis-reported catches in stock assessment models
J. Morgan J. Banoub	Improving our knowledge of the reproductive potential of Greenland halibut
D. Kulka	Ecology and life history of the skate complex (Rajidae) in the Northwest Atlantic
B. Dempson	Use of stable isotopes to assess long term changes in trophic ecology of Atlantic salmon (*Salmo salar*)
P. Pepin	To assess the roles of onshore transport and on-shelf production to annual cycle of *Calanus* spp. on the Newfoundland Shelf and Grand Banks
P. Shelton	Developing precautionary harvesting strategies for high seas straddling stocks
K. Dwyer S. Walsh M. Koen-Alonso	Improving the accuracy of stock assessment and the precautionary approach framework for grand bank yellowtail flounder using age-based analysis
D. Power	Temporal verification of stock structure and identification of strong year classes by species to investigate recruitment synchronization in Redfish based on genetic analysis of archived otoliths
J. Carscadden M. Koen-Alonso E. Colbourne G. Lilly P. Pepin F. Mowbrey G. Stenson E. Dawe	Comparison of Marine Ecosystems (NORCAN and ESSAS)
J. Payne J. Lawson	Effect of seismic energy on selected marine species of commercial importance or identified as Species at Risk
F. Mowbray J. Carscadden E. Hynick K. Gilkinson	Forage fish on the Southeast Shoal, an ecologically and geo-politically sensitive area of the Grand Banks
G. Stenson	Habitat use by hooded seal (*Cystophora cristata*) in the Northwest Atlantic
J. Lawson	Aerial survey of marine megafauna on the Continental Shelf from Baffin Island to the Scotian Shelf