Northwest Atlantic



Fisheries Organization

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# Canadian Research Report for 2009<sup>1</sup> Newfoundland and Labrador Region

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# SUBAREAS 0 AND 1

# A. Status of Fisheries

Nominal landings from 2000 to 2009 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 2008, Scientific Council advised for 2009 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 and have been almost exclusively taken from Div. 0B. Canada (NL) catches from 2003 to 2006 were approximately 4,000 t, fully utilizing it's allocation of the quota, then declined gradually to 3,400t in 2009. Approximately 1,700 t was taken by twin otter trawls in 2009 which represents a four fold increase compared to 2008. The remainder of the catch was primarily taken by gillnets (1,100 t) and single otter trawls (430 t). In recent years, length compositions in the catches have been stable.

# SUBAREA 2

# A. Status of Fisheries

Nominal landings from 2000 to 2009 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 4,859 salmon were retained or hooked and released in the recreational fishery. Preliminary information on subsistence fishery catches indicated that about 30 t of salmon were harvested in 2009. Only one of four assessed stocks achieved conservation spawning requirements in 2009.

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<sup>&</sup>lt;sup>1</sup> Information pertaining to Iceland scallop, Sea Scallops, and Squid is from previous year (2008).

<sup>&</sup>lt;sup>2</sup> 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.

#### *b)* Arctic charr – Subarea 2

Commercial landings of Arctic charr from north Labrador in 2009 were approximately 16 t, a decrease of about 12% over 2008. Over the past 35 years (1974–2008), more than 2,890 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. Recent surveys of Inuit domestic harvests from subsistence fisheries along the north coast of Labrador can approximate about 10,000 charr annually.

## c) Cod – Div. 2GH, Div. 2J3KL

Although the cod stock in Div. 2GH has been under a moratorium on directed fishing since 1996, there was no reported catch since 1993. Bycatch of cod occurs in shrimp fisheries in 2GH and from 2004-07 has ranged between 250 kg to 500 kg annually.

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 4,200 to 8,500 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 2003-05, which ranged from about 600 t to 1,300 t, was bycatch from the gillnet fishery for winter flounder in shallow inshore waters (<25 fathoms).

During 2006-09, a pilot-scale inshore stewardship fishery using vessels <35 ft was open and fishers were each permitted to harvest 3,000 lb, 2,500 lb, 3,300 lb, and 3,750 lb of cod in each of those years. A recreational fishery was also open for a few weeks during summer and fall and fishers were allowed 5 fish per trip or 15 fish per boat per day. The reported landings were 2,679 t in 2006, and 2,364 t in 2007 although the 2007 estimate does not include recreational fishery landings. and, total catch in 2007 is uncertain. In 2008, reported landings were 4,162 t including 3,089 t in the stewardship fishery which includes 121 t of by-catch and 818 t in the recreational fishery; in addition 254 t were landed in the sentinel surveys. In 2009, reported landings were 2,832 t in the stewardship fishery, 216 t in the sentinel survey, and 50 t of bycatch. There was no direct estimate of recreational fishery landings; however, analysis of tag returns suggests that removals from recreational landings could be 64% of reported stewardship fishery removals. The offshore portion of the stock area remained closed to directed fishing in 2006-09.

The Div. 2J3KL cod stock was assessed in March 2010. Since 2005, the inshore and offshore areas have been assessed separately, but new information from tagging and telemetry studies in 2007-09 indicates that a large proportion of cod in the offshore migrated inshore in summer 2008 and 2009 and indicated that the inshore catch is comprised of a mixture of inshore and offshore fish. Based on a cohort analysis of the autumn DFO research vessel (RV) trawl survey, total biomass has increased (23% per year) since 2004. Spawning stock biomass (SSB) increased (83% per year) from 2004 to 2008, but the 2009 value was similar to 2008. Autumn survey abundance and biomass over the past three years are 9% of the average values for the 1980's; The corresponding value for SSB is 10%.

• Most of the autumn offshore RV survey abundance (32%) and biomass (64%) is concentrated adjacent to the Div. 3K/3L boundary. This region encompasses only 14% of the total surveyed offshore area of Div. 2J3KL, and in the 1980s contained <20% of survey abundance and biomass. Total mortality in the offshore was extremely high during 1996-2003 and has been a major impediment to stock recovery. Total mortality has declined substantially since 2003 and this has been an important factor in the recent increase in total biomass and SSB. The 2003 and 2004 year-classes are weaker than those produced in 1998-2002 and have now entered the SSB; consequently, the recent rate of stock growth is unlikely to continue in the short term. Subsequent year classes (2005 and 2006) are estimated at about the 1993-2007 average. The number of young fish (ages 2 and 3) in the offshore survey in the 1990s and 2000s has been consistently much lower than during the 1980s. Further stock growth will require an improvement in recruitment which has not been observed to date.</p>

Exploitation of offshore cod in the inshore was estimated at 6% in 2008 and 2% in 2009. Although status offshore has improved, the stock has not increased across much of its historical range and overall remains far below historical

biomass levels. Exploitation rates on offshore cod by inshore fisheries have been low enough to permit growth in biomass of some offshore components.

For assessment purposes the inshore was divided into three areas: 1) a northern area (2J and northern 3K); 2) a central area (southern 3K and northern 3L); and 3) a southern area (southern 3L). Sentinel catch rates suggest that exploitable biomass in 2009 was near the 1995-2009 average, but lower than in 2008 for the northern, central and southern inshore regions. In the inshore northern area catch rates are lower than those in the central area suggesting lower exploitable biomass in the northern area. Fisheries in this area depend on seasonal immigration of fish, possibly from offshore regions, including 2J where offshore biomass remains low. Therefore, it is recommended that removals from this area be minimized. During 2007-2009, mean exploitation rates from tagging studies were low and ranged from 3-10% among inshore central and southern areas. In the inshore central area, catches depend on resident inshore components and seasonal migrants from the offshore. Exploitable biomass in the central inshore area is likely to decrease further in 2010 even with no removals. The 2003 and 2004 year-classes are weaker than those produced in 2000 and 2002, and the 2002 year-class is moving out of the exploitable biomass. Therefore, if current levels of removals are maintained then exploitation rates in the central inshore area are expected to increase in 2010. In the inshore southern area, catches are partly dependent on seasonal immigration of fish from the offshore of 3KL, and from 3Ps where the stock is declining.

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

This stock has been under moratorium since 1994. This stock has not been fully 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, mainly from the Greenland halibut fishery has been low in recent years, being 10 t in 2008 and 2009. There is also some bycatch of plaice in the shrimp fishery in this area (average 2004-07 is 20 t). Until 2003, the composition of the American plaice bycatch in the Greenland halibut fishery was composed mainly of sexually mature females and 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 although there had not been a persistent directed effort on this stock since 1990, when 2400 t was landed. Canada (NL) landings were between 22-221 t for the period 2000-09 with the most recent three years less than 30 t annually. Canadian (NL) landings since the moratorium in the Canadian EEZ are primarily bycatch from Greenland halibut fisheries. Reported landings from other countries fishing in the NRA with large midwater trawls increased rapidly from 1800 t in 2001 to a range of 5,000–5,400 t from 2003 to 2005. The catch declined to 1,100 t in 2006 and rose again to 3,100 t in 2007. The fishery has been virtually non-existent in 2008 (10 tons) and a preliminary estimate is 0 t in 2009. It is assumed these catches were from the pelagic stock of redfish that resides primarily in the Irminger Sea between Greenland and Iceland. Based on observer data, estimates of redfish bycatch discarded from Canadian shrimp fisheries in the Div. 2G to Div. 3K area since 1980 have ranged from 14 t in 1983 to 665 t in 1990. There has been a stead increased in discards from 260 t in 2004 to 460 t in 2006 with a decline to 330 t in 2007. More recent years data were not available prior to the compilation of this report.

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

There has been no directed fishing on this stock since 1994. In 2009, bycatch in other fisheries from the Newfoundland region was 45 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 1998-2009 surveys indicate no change in this distribution pattern. For the three divisions combined, the biomass index declined from about 65,000 t in 1984 to 1,100 t in 1995, the lowest in the time series. Mean weight per tow decreased from a maximum of near 6 kg/tow in 1984 to a low of 0.23 kg/tow in 1995. The small increase in biomass index and mean weight per tow observed between 1995 and 1996 was almost exclusively a result of inclusion of the deeper strata surveyed in Division 3L. Estimates of biomass and abundance have increased slightly since 2003, but the stock size remains extremely low.

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

The Canadian (NL) catch of Greenland halibut in 2008 in Subarea 2 and Div. 3KLMNO was approximately 5,700 t, a slight increase compared to the 2008 catch levels (4,700 t).

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 are to be decided upon depending on the response of the resource to the reduced TACs. The 2008 - 2010 TACs have been set at 16,000 t. The total catches estimated by Scientific Council for 2004 to 2007 have exceeded the rebuilding plan TAC by 27%, 22%, 27%, 42%, and 32% 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 although fishing mortality has declined since the rebuilding plan was implemented, it remains relatively high.

## h) Shrimp – Subarea 2 + Div. 3K

The Northern Shrimp (Pandalus borealis) 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). The resource within these Shrimp Fishing Areas (SFA's) is normally assessed on a biennial basis. The last formal assessment was completed during March 2010; however, due to concerns pertaining to the resource within Shrimp Fishing Area 6, the next scheduled assessment will be during March 2011.

Between 1998 and 2002, annual catches of approximately 8,000 t were taken in 2G from 8,320 t TACs. The 2003 TAC was increased to 10,320 t and during that year the Canadian shrimp fishing industry requested and was granted a change in season, from a calendar year (January 1 – December 31) to a fiscal year (April 1 – March 31). An additional interim quota of 2,802 t was set for the January 1 – March 31, 2004 period. Thus the 2003-04 fishing season was 15 months long and had a 13,122 t TAC. The 2003-04 (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 2003-04 management year while approximately 10,000 t were taken in each year over the 2004–2007 period. The TAC was increased to 11,320 t in 2008/09 and was maintained at that level during 2009/10. Preliminary data indicate that 10,700 t of shrimp were taken during the 2009-10 season.

Historically, the fishery has been concentrated north of 60oN 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 60oN to reflect the existence of high concentrations of shrimp along the shelf slope. The new quota resulted in a southward shift in fishing effort. CPUE has increased since 2004/05 and is now well above the long term mean. Since 2006/07, the standardized large vessel (>500 t) catch rates have been above 2000 kg/hr with the 2009/10 catch rates above 3000 kg/hr.

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 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 181,000 t since 2005. The recruitment index increased from 2005 to 2008 and has changed little in 2009. Exploitation rates indices ranged between 6% and 16% during 2005-09. Current status appears positive from fishery catch rate indices and survey exploitation rate indices.

TACs in Hopedale and Cartwright Channels (2HJ) doubled from 7,650 t during 1994-96 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. During that year, the fishing season changed to April 1 – March 31, and an additional interim quota of 9,787 t was set for the period January 1 – March 31, 2004. Thus the 2003-04 fishing season was 15 months long and had a 33,084 t TAC. The 2003-04 fiscal year TAC (23,300 t) was maintained for the 2004-09 seasons. Approximately 23,000 t of shrimp were caught annually since the 2003-04 season. Preliminary data indicate that 24,900 t of shrimp were taken during the 2009-10 season. It is important to note that since 2007, a season bridging program has been in place allowing offshore licence holders to fish up to 250t of their total combined subsequent year quotas in the period March 1-30, or fish up to 250t of their previous year quotas in the period April 1-30. Standardized catch rates within Hopedale and Cartwright Channels increased from 1992 (737 kg/hr) through to 2001 (2,080 kg/hr) and have since remained high with an average catch rate of 1,800 kg/hr. Most model catch rates since 1996 were statistically similar (P>0.05) to 2009 (1,700 kg/hr) while indices previous to 1996 were generally lower than the 2009 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 four (2001, 2004, 2006, 2008) of the last ten years. SFA 5 fishable biomass indices declined by 16% from 2006 to 2008. Fishable biomass in Cartwright Channel, surveyed every year, decreased by 40% in 2009; however, broad confidence intervals in 2009 indicate uncertainty. Recruitment in the short-term, while uncertain, appears average. Exploitation rate index was 20% in 2008, slightly above the long term mean.

The fishery in Hawke Channel (southern Div. 2J) + 3K began in 1987 with landings of approximately 1,800 t. Catches increased to more than 7,800 t in 1988 and ranged between 5,500 and 8,000 t throughout 1989-1993. The first multi-year management plan covered the period 1994-96 and established an annual TAC of 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 1997-99 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 7,653 t was set for the period January 1 – March 31, 2004 to facilitate an industry requested change in fishing season from January 1 – December 31 to April 1 – March 31. Thus the 2003-04 fishing season was 15 months long and had an 85,585 t TAC. TACs remained at the 77,932 t level for the 2004-08 fishing seasons, but were increased to 85,725 t for the 2008-09 and 2009-10 seasons. TACs have been reached in most years. Between 75,600 t and 80,700 t were taken each fishing season between 2004-05 and 2007-08. Quota monitoring statistics indicate that 75,000 t and 45,100 t were taken in 2008-09 and 2009-10 respectively. These shortfalls were due to operational (i.e., weather, mechanical problems etc.) and commercial (price of shrimp) constraints.

The SFA 6 large (>500 t) vessel CPUE remained at a high level between 1995 and 2006 after which it decreased to 2009. The small vessel (<100 ft) CPUE increased to 2003, remained high until 2007 and then decreased to 2009. The 2009 model CPUE indices for the large and small vessel fleets were 1,000 and 375 kg/ hr respectively.

Biomass indices (total, fishable and female spawning stock) from fall multi-species surveys generally increased from 1997 to peak levels in 2006 but have since decreased by 50%. The present catch levels may not be sustainable given the declining biomass. If the current TAC is taken in 2010/11, the exploitation rate index would increase to between 20 and 37% (based on an 85,725 t TAC and 2009/10 fishable biomass 95% confidence intervals).

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

## *i)* Snow crab – Div. 2HJ3KLNO

A commercial TAC was first established in Div. 2H in 2008. Prior to this, the fishery was of an exploratory nature. Stock assessments for Div. 2H snow crab began in 2008. Landings declined by 55% from 190 t in 2007 to 90 t in 2009, while effort decreased by 40%. The exploitable biomass has decreased in recent years. The post-season trawl survey exploitable biomass index doubled between 2004 and 2006, but decreased by 66% to 2008. There was no trawl survey in 2009, but a trap survey conducted by the Torngat Joint Fisheries Secretariat during the summer of 2009 captured few commercial-sized crabs. Recruitment has decreased since 2004 and is expected to be low over the next several years. The effect of maintaining the 2009 level of removals on the exploitation rate in 2010 is unknown.

In Div. 2J, landings increased by 60% from 2005-2008 and remained unchanged in 2009, while effort increased by 28%. CPUE increased from 2004-2008 to the long-term average, but decreased in 2009. The exploitable biomass has decreased in recent years. The post-season trawl survey exploitable biomass index peaked in 2006 and has since declined steadily. Recruitment has recently declined and is expected to remain low in the short term. The post-season trawl survey pre-recruit index decreased sharply in 2005 and has since fluctuated without trend. The exploitation rate index and the pre-recruit fishing mortality index both declined sharply from 2003-2005. While the pre-recruit index has remained low since that time, the exploitation rate index continued to decline to 2007 before increasing to 2009. Maintaining the 2009 level of removals while the biomass is declining would likely increase the exploitation rate in 2010.

# *j) Iceland scallop* – Div. 2HJ

Inshore aggregations were again fished in 2008, with nominal catches estimated at 13 t, round, down from 40 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 2009 and represented the 32<sup>nd</sup> continuous year of sampling these populations. Following long term declines in mean weight of charr harvested in north Labrador, recent data continue to show that mean weight and mean-weight-at-age has 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 and 2008. Collaborative studies with other researchers in Canada have resulted in recent publications on latitudinal variation in growth of charr and an analysis of changes in growth patterns in response to fluctuating environmental conditions.

# b) Groundfish and Shellfish

Biological and oceanographic data from fall multi-species research vessel surveys were collected from Div. 2HJ to conduct distribution and abundance studies and detailed biological sampling.

Analysis of sexual maturity data is conducted regularly on American plaice, cod, and Greenland halibut and reported in the stock assessments of these species.

The utility of using 0-year old and 1-year old cod abundance at a site on the northeast coast of Newfoundland in calculating a pre-recruit index of year-class strength shows some promise and continues to be evaluated.

A joint project under the Canada Spain Marine Science Collaboration Initiative entitled 'Analysis of Stock Reproductive Potential to promote sustainability of Greenland Halibut fishery' has been initiated and will run until 2012. This project aims at increasing our understanding of Greenland halibut reproduction and integrating this increased understanding into stock assessments.

## 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 since March 2008 has been making use of this dataset.

## *d) Atlantic Salmon*

A pelagic ecosystem survey of the northwest Atlantic was conducted in September 2009 using the CCGS Alfred Needler. An experimental pelagic trawl was used to characterize the abundance and distribution of pelagic fish within the upper 10 m of the water column. A key species targeted during the survey was Atlantic salmon. Oceanographic data and plankton samples were also collected at the majority of the stations. Science personnel for the survey were from DFO Science (Gulf, Maritimes, and Newfoundland and Labrador), from US NOAA, from the province of Quebec, and from the Torngat Joint Fisheries Board Labrador. During September 8 to 30, a total of 21 stations were sampled with either the pelagic surface trawl or surface gillnets. The survey covered an area extending from just south of 50°N to 58°N, 49°W to 60°W. Stations sampled were characterized by depths from 100 m to over 3,000 m and water temperatures (at 10 m depth) ranging from 0° to 14°C. An adequate number (N=92) of the targeted species, Atlantic salmon, were captured during the survey. Salmon were captured during the night and day. The salmon ranged in size from 25 to 75 cm.

The most abundant catches (by weight and percent of stations) were lantern fish (Myctophids) and common lumpfish. The most widely distributed invertebrate aquatic species was squid. The majority of the fish species sampled were at juvenile stages including several species of concern such as Greenland halibut and redfish.

## e) Snow Crab

A trap survey for snow crab was conducted in Div. 2H in the summer of 2009. The survey, conducted by the Torngat Joint Fisheries Secretariat with in-kind support from DFO, was performed to quantify the distribution and abundance of commercial-sized males in Div. 2H. The fixed-station survey covered the area between the Makkovik and Nain Banks using commercial crab gear. Small-meshed pots were also incorporated into the study to capture females and small males. The results of the survey were used in the assessment of Div. 2H snow crab in 2009.

# SUBAREA 3

# A. Status of Fisheries

Nominal landings from 1999 to 2009 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 2009 recreational harvest, including both retained and hooked-and-released was 23,991 fish.

*b)* Capelin – Subarea 2 + Div. 3KL

Inshore capelin catches in Subarea 2 + Div. 3KL are taken during the inshore spawning migration. Catches decreased from 29,220 t in 2008 to 23,190 t in 2009. The most recent assessment (November 2008) examined several indicators that showed that biological and behavioural changes first observed in the early 1990s continue to persist. The mean size of mature capelin in 2009 was the smallest in thirty years. The spawning biomass is comprised of two and three year-old fish instead of three and four-year olds. Capelin have been spawning four

weeks later than observed in the 1980s. In 2009, spawning was six weeks later. The offshore distribution of capelin remains similar to what has been observed since the 1990s. Capelin in most areas are still not undertaking diurnal vertical migrations, instead remaining near the bottom. There are no recent estimates of abundance available for the entire stock, however an acoustic survey covering Div. 3L in May, 2009 estimated abundances similar to the last two years, although still considerably lower than those observed in the late 1980s.

## c) Cod - 3NO and 3Ps

The cod stock in Div. 3NO has been under moratorium to directed fishing since February 1994. Total catch since 1994 has increased from 170 t in 1995 to 4,900 t in 2003, and declining to 600 t by 2006. In 2008, the total catch was 921 t. In 2009, about 158 t were caught by Canada (NL), down from 230 t the year before. The total biomass and spawning biomass are estimated to be at extremely low levels. There is some indication of an increase in recruitment but it is too early to determine if the 2006 and 2005 year classes are larger than other recent cohorts. This stock is currently well below B<sub>lim</sub>. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

The 2009 TAC for the cod stock in Subdiv. 3Ps is 11,500 t (fishing season runs from 1 April 2009 to 31 March 2010). This stock is jointly managed by Canada and France (in respect of St.Pierre et Miquelon). The most recent assessment (September 2009) of stock status indicated considerable uncertainty in the recent biomass trends in this stock. The report of the assessment meeting concluded: "Estimated survey SSB from a cohort model decreased in recent years and in 2009 was above the limit reference point (LRP). However, the probability that the SSB in 2009 was below the LRP varied from 20% to 40% depending on assumptions regarding the catchability of different age fish by the survey. Cohort analysis of the DFO RV survey data indicated that SSB has declined by 13% per year over 2004-09. It is too early to assess the effect on SSB of the recent reduction in TAC to 11 500 t for the 2009/10 management year. However if the management goal is to ensure growth in SSB, then a further reduction in TAC would increase the probability of growth." The outlook about the short-term productivity is not optimistic, as several relatively poor year classes enter the fishery. The 2006 year-class is estimated to be much stronger relative to other recent cohorts and should fully recruit to the fishery by 2011.

## *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 then increased substantially. During 2001 to 2003 the catch was greater than 1,000 t in each year. Catch declined steadily since 2003 and was just over 500 tons from 2006 to 2008 Catch in 2009 was 509 t by NL. Catch has been mainly as bycatch 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. There has been an increase since 1993 in both biomass and abundance indices, but over the last 3 surveys (2007-2009) average biomass is less than 30% and abundance 50% of the 1983-87 averages from the survey. After a large increase in 2008 there was a large decline in survey indices to 2009.

# *e)* Witch flounder - 3Ps

A TAC was first established for this stock in 1974 at 3,000 t, which remained in effect until 1988 when it was reduced to 1,000 t. It was further reduced to 500 t in 1996 and 1997 but was increased again to 650 t for 1998 and has remained at that level since then. Landings from this stock over the last 20 years have fluctuated between about 300 t and 1,000 t annually. In 2009, the catch from the Newfoundland region was 450 t. The directed fishery is prosecuted by offshore otter trawlers and a nearshore Danish seine fleet. 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 steadily increased and in 2009 was estimated to be 1.6 times Bmsy, well above the level of the mid-1980s. 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 was 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 was still low in 2007 at 3,673 t, and in 2008 catches increased to 10,216 t (with a TAC of 15,500 t). Scientific Council noted that this stock is well above Bmsy, and recommended any TAC option up to 85% Fmsy for 2010 and 2011 (25.5 t and 23.5 t respectively). The TAC for 2010 was set to 17,000 t. Scientific Council also noted that bycatch of cod and American plaice in the yellowtail fishery needs to be considered. In 2009, Canadian catch was only 5 414 t.

## *g) American plaice* – 3LNO

Catches from this stock were generally in the range of 40,000 to 50,000 t per year throughout the 1970's and 1980's, before declining to low levels in the early 1990's. There has been no directed fishing on this stock since 1993. Bycatch from all countries in 2008 was 2,515 t, which is on par with bycatch in recent years. This bycatch was mainly taken in the NAFO regulatory area (NRA). Canada (NL) bycatch of American plaice in 2008 was 878 t and increased to 1,077 t in 2009. Catch will likely increase further in the near future, due to revised NAFO regulations allowing for increased bycatch levels.

## *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 Based on subsequent studies a number of workshops on the biological basis for redfish management units were held in 2006 and 2007, more specifically the interaction between management Unit 1 (4RST, 3Pn4Vn January to May) and Unit 2 for two species (Sebastes fasciatus and S. mentella). The final workshop concluded that a review of the biological data (genetics, morphometrics and otolith chemical signature) suggests that Units 1 and 2 corresponds to a single biological population of each species and recommended these Units should be combined for assessment purposes. An assessment meeting was planned for November 2009 but was postponed to February 2010. The terms of reference required that the scientific data should be re-analyzed taking into consideration the presence of two species each of which is showing population substructure, and to evaluate separately the status of the stock of Sebastes mentella and the stock of S. fasciatus in the area covered by the combined management units of Unit 1 and Unit 2 to the extent possible.

For the UNIT2 portion of the combined management UNIT1&2, total Canadian catches have declined steadily from 27,000 t in 1993 to 8,000 t in 2002, matching reductions in TACs. From 2002-05 the TAC has been stable at 8,000 t while catches declined from about 7,500 t in 2003 to 6,400 t in 2005. In 2006 the TAC was increased to 8,500 t and maintained at that level in 2009. Catch remained at the 6,400 t level in 2006, declined to 4,800 t in 2007, 3,300 t in 2008 then increased to 5,900 t in 2009. About 2,300 t of the 2009 catch was taken by Canada (N) fisheries. The shortfall in the TAC from 2005-07 was due to corporate restructuring and a labour dispute in the Canadian fishing industry. Subsequent shortfalls have been due to market conditions. Current management regulations include a closure related to peak spawning in May and June, and a minimum landing 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 8,000 t and 2,500 t based on market acceptability for redfish near the Canadian 22 cm size limit. From 2001-2004, the Canadian catche averaged about 3,400 t, increased to 5,400 t in 2005 but has declined steadily to about 200 t in 2008. Canada (NL) has accounted for more than 95% of the Canadian 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. Since 2004, NAFO Fisheries Commission has set the TAC for Div. 3O redfish at 20,000 t. Catch for all countries was about 4,000 t in 2008. Catch by Canada NL in 2009 was about 250 t.

#### *i*) Witch flounder – Div. 3NO

This stock was last fully assessed in 2008. There has been no directed fishing on this stock since 1994. Canada (NL) bycatch has ranged between 21 t to 94 t since 2003 and in 2009 was 41 t.

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

Prior to 1995, white hake was taken as bycatch in other demersal fisheries on the Grand Banks. Average estimated catch during 1985-1990 was approximately 5,000 t. Annual catches in a new directed (Canadian) fishery on the Grand Banks, starting in 1995 and encompassing Divs. 3NO and Subdiv. 3Ps, averaged 460 t. However, in 2001 and 2002, a >10-fold increase in the catch of white hake Div. 3NO was attributable to EU-Spain, EU–Portugal and Russia in the NAFO Regulatory Area. Following a very large 1999 year class, the stock has declined to a lower level comparable to levels observed prior to the recruitment pulse. The stock is currently at a low level.

*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 5,000 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 bycatch 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 1,050 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 a slight increase in thorny skate biomass and abundance in recent years.

## *l)* Shrimp – Div. 3LMNO

Subarea 3 has been divided into two shrimp management areas – Div. 3LNO and 3M. The Div. 3LNO shrimp stock is distributed along the edge of the Grand Banks mainly in Div. 3L. The fishery began in 1993 and catches were approximately 1,800 t. Exploratory fishing from 1996-99 resulted in catches ranging from 179 to 795 t. In 2000, the NAFO Fisheries Commission implemented a TAC of 6,000 t, and fishing was restricted to Div. 3L, in water depths greater than 200 m. The catch in 2000 increased to 4,900 t, 4,300 t of which was caught by Canada. The remainder of the catch was taken by vessels from 7 other countries.

STACFIS estimated that the 2001 fishery took approximately 10,600 t, with Canada taking just over 5,100 t. However, reliable catch reports were not available for all countries in 2001. Similarly, estimates of catch in 2002 were not available for all countries. However, STACFIS noted that the total catch in 2002 was likely lower than that estimated for 2001, however, there was considerable uncertainty with estimates of catch in both years. Canadian vessels caught 5,400 t of shrimp in Div. 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 2000-01 and spring 2001-02 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 4,900, 10,600, 7,000, 12,000 and 12,600 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 21,600 t had been taken against a 22,000 t TAC in 2007 while 24,700 t were taken against a 25,000 t TAC in 2008. Subsequently, during 2009 the TAC was increased to 30,000 t.

As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 4,200 t in 2000 to 21,200 t in 2008. Preliminary data indicate that 20,500 t were taken by Canadian vessels in 2009 against a Canadian TAC of 25,324 t. Catches by non Canadian nations increased from 600 t to 5,700 t over this period. Preliminary data indicate that by October 2009, 4,400 t had been taken against a non Canadian TAC of 4,676 t.

## **Canadian fleet catch rates**

Since 2000, small ( $\leq$ =500 t) and large (>500 t) shrimp fishing vessel 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 the resource and Canadian fisheries has been increasing over the time series. However, the percent area occupied by the large vessel fishery and the resource as determined from spring survey data was less than 4% of the total available habitat over the entire time series while similar indices for the autumn survey and small vessel fisheries occupied less than 8% of the total available habitat.

The small vessel fleet fishes shrimp mainly during the spring and summer months, while seasonality among the large vessel fleet has varied greatly over the years; however, most of the data came from the winter and spring; therefore large vessel catch rates were analyzed by multiple regression using data collected from January – June of each year. The large vessel (>500 t) CPUE model was weighted by effort, for year, month, number of trawls and vessel effects. The observer dataset used in this analysis accounted for between 33% and 94% of the catch within any one year. The final model explained 68% of the variance in the catch rate data. Standardized catch rates for large Canadian vessels have been fluctuating around the long term mean since 2004 with the 2009 standardized catch rate index (2058 kg/hr) slightly above the long term average (1840 kg/hr) but similar to the catch rates for 2002 and 2004 - 2008 indices.

Due to a lack of data it was not possible to model small vessel CPUE up to and including 2009. Small vessel CPUE (2000 - 2008) was modeled using month, year and size class (class  $1 = <50^{\circ}$  LOA; 50' LOA <=class  $2<60^{\circ}$  LOA; class  $3 => 60^{\circ}$  LOA) as explanatory variables. The logbook dataset that was used in this analysis accounted for between 57.2% and 93.8% of the catch within any one year. The final model explained 87.4% of the variance in the data and indicated that the annual, standardized catch rates increasing from near 350 kg/hr over 2000 – 2002 to 676 kg/hr 2005 with a gradual decrease to 502 kg/hr in 2007 remaining near that level in 2008. The 2007 catch rate index was similar to the 2008 index (529 kg/hr), while the 2005 and 2006 indices were significantly higher than the 2008 value with all others being significantly lower.

Spatial analyses from the small and large vessel fisheries do not provide consistent signals. The small vessel fishery covers a larger portion of the resource whereas the large vessel fleet has always fished near the 200 Nmi limit and along the northwestern border between 3L and 3K. For this reason, the small vessel fleet information may provide a better indicator of resource status than the large vessel fleet. The distribution of small vessel catches may be providing an early warning that the fishery may be contracting. It is important to note that the biomass estimates from small vessel data has been decreasing over the past few years.

## **International fleet**

A standardized international fleet CPUE model is not presented here as the percent catch data accounted for in the international dataset ranged from 1 - 54% and in most years was less than 25% of that year's catch. Unstandardized international indices increased ranged from 381 kg/hr in 2001 to 1,344 kg/hr in 2004 but decreased to 744 kg/hr in 2005 and remaining near that level until 2009. The 2009 catch rate index was 671 kg/hr; however, the data accounted for only 20% of the total catch and was limited to data from only Estonia and Greenland. It is not clear how representative these commercial catch rates are of the international fishery in the 3L NRA.

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 12,900 t and 4,500 t of shrimp were caught in 3M during 2008 and 2009 respectively.

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

## *m)* Snow Crab – Div. 3KLNOPs

In Div. 3K offshore, landings more than doubled from 6,000 t in 2005 to 13,000 t in 2009. Effort changed little since 2005 until it increased by 70% in 2009. Both landings and effort have returned to pre-2005 levels. CPUE increased sharply from 2005 to a record high in 2008, but decreased sharply in 2009. The exploitable biomass has decreased substantially since 2007. Post-season exploitable biomass indices from both trap and trawl surveys increased in 2006 and to 2007, respectively. Both indices then remained at high levels until decreasing abruptly in 2009. Recruitment decreased in 2009 as reflected by the sharp decrease in the post-season exploitable biomass while landings increased little. Recruitment is expected to be further reduced for 2010, while longer term prospects remain uncertain. The trawl survey exploitation rate index increased slightly in 2009 following a decline since 2006. The pre-recruit fishing mortality index decreased sharply in 2006 and changed little until more than doubling in 2009. Maintaining the 2009 level of fishery removals would likely result in an increase in the exploitation rate and high mortality on soft-shelled immediate pre-recruits in 2010.

In Div. 3K inshore, landings increased by 33% from 2,700 t in 2005 to 3,600 t in 2009. Effort declined from 2004 to 2008 and increased by 42% in 2009. CPUE increased sharply from 2005 to a record high in 2008 but decreased in 2009. The exploitable biomass decreased in 2009. The collaborative fall trap survey exploitable biomass index changed little during 2004-2008 before decreasing substantially in 2009. Recruitment decreased in 2009 as reflected by the decrease in the post-season exploitable biomass while landings increased little. Recruitment is expected to decrease further in 2010 and longer term prospects are uncertain. The trap survey-based exploitation rate index changed little since 2005. Data are insufficient to estimate pre-recruit mortality rates. Maintaining the 2009 level of fishery removals would likely increase the exploitation rate in 2010.

In Div. 3LNO offshore, landings have remained at 22,000-25,000 t since 2000. Effort increased steadily from 2000-2007 and has changed little since. CPUE declined steadily from 2000-2008, to the lowest level since 1991, and was unchanged in 2009. The exploitable biomass has recently increased. The exploitable biomass index from the trawl survey declined steadily from 2001-2007 but has since more than doubled. The trap survey index declined steadily from 2004-2008 but increased in 2009. Both post-season surveys indicate that recruitment has been increasing and is expected to increase further over the next two to three years. Both the exploitation rate index and the pre-recruit fishing mortality rate index peaked in 2008 and decreased in 2009. Increased removals would not likely increase the exploitation rate in 2010.

In Div. 3L inshore, landings have increased by 15% since 2005, totaling 7,000 t in 2009. Effort decreased by 23% from 2005-2008, but increased by 11% in 2009. CPUE increased by 53% from 2004-2008 before decreasing slightly in 2009. The post-season trap survey index indicates the exploitable biomass has declined gradually since 2006. Overall, recruitment prospects have recently improved, but there is considerable spatial variability. The trap survey-based exploitation rate index changed little from 2005-2007 but has since increased. Data are insufficient to estimate pre-recruit mortality rates. Maintaining the 2009 level of fishery removals would likely result in little change in the exploitation rate but could increase mortality on soft-shelled immediate pre-recruits in some areas in 2010.

In Subdiv. 3Ps offshore, landings have increased by 57% since 2006, totaling 3,600 t in 2009. Effort decreased by 26% in 2008, to its lowest level since 2001, and was unchanged in 2009. CPUE has increased by 72% since 2007 and is approaching the long-term average. The exploitable biomass has recently increased. The pre-season trawl survey exploitable biomass index increased since 2007 while the post season trap survey index more than doubled since 2004. Recruitment has recently increased as reflected by an increase in biomass while landings increased. Recruitment prospects remain promising for the short-term following 2010. Since 2005, the pre-season trawl survey

pre-recruit index has steadily increased while the post-season trap survey index has varied without trend. Exploitation and pre-recruit mortality rate indices based on trap and trawl surveys have both decreased since 2007. The pre-recruit index is at its lowest level since 1996. Fishery removals could likely be marginally increased in 2010 without increasing the exploitation rate.

In Subdiv. 3Ps inshore, landings more than doubled from 700 t in 2005 to 1,900 t in 2009 while effort declined slightly. CPUE more than doubled since 2005 to exceed the long-term average. The exploitable biomass appears to have peaked. The post-season trap survey exploitable biomass index increased substantially from 2006-2008 but decreased slightly in 2009. Recruitment has decreased for 2010 but longer-term prospects remain promising. The post-season trap survey pre-recruit biomass index peaked in 2007 and has since decreased to remain above the 2004-2006 level. The post-season trap survey-based exploitation rate index fluctuated without trend during 2005-2009. Maintaining the 2009 level of fishery removals would likely result in a slight increase in the exploitation rate in 2010.

## *n*) *Iceland Scallop* – Div. 3LNOPs

The Div. 3LN Iceland scallop fishery commenced in 1992. Aggregations over the eastern Grand Bank (Div. 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 virtually no fishery for Iceland scallop in Div. 3LNO in 2008, with only 1 t removed from 3L. Resource status was updated for the LCC based on a survey in August 2008.

The Iceland scallop fishery on Subdiv. 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 Subdiv. 3Ps remains entirely under Canadian jurisdiction.

Total removals from the Canadian zone have decreased from 5,367 t (round), in 1997 to 40 t in 2004. In 2008, 5 t of a total 3,500 t TAC were removed, similar to the 6 t taken in 2007. There has been no directed effort for Iceland scallops in the trans-boundary area since 1998. The resource status of this area was last updated based on a joint Canada-France survey in September 2005.

## *o)* 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 Scotian) 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 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. Landings decreased in 2006 and 2007. The decrease in effort and landings continued in 2008. A total of 293 t (round) was landed in Newfoundland, with only 2 vessels active.

No sea scallops were removed by inshore vessels in Div. 3L.

#### *p)* Squid – Subarea 3

Following a peak catch in 1979 of about 88,800 t, the Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5,000 t during the thirteen-year period 1983 to 1995. They increased since 1995 to about 12,700 t in 1997 before declining sharply to about 800 t in 1998 and about 20 t in 1999. They remained low, at about 300 t, in 2000, decreased to only about 20 t in 2001 and increased to about 2,500 t in 2004. Catches decreased to about 550 t in 2005 and then increased to about 6,900 t in 2006. High catches in 1996-97 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 and remained low, at 520 t in 2008.

*q*) Snow crab – Subdiv. 3Ps

Landings in 3Ps declined by 59% (7,600–3,100 t) during 2002-06 before increasing by 47% to 4,520 t in 2008. Inshore CPUE declined from 2001-05 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 remained at a low level until it increased by 48% in 2008 to remain below the long-term average. Inshore CPUE more than doubled since 2005 to the long-term average. The offshore spring multi-species bottom trawl survey exploitable biomass index declined from 1999-2001, and has since remained low. The offshore spring survey pre-recruit index increased in 2008 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 2009 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.

# 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 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.

A calibration curve for the autodiametric method of determining fecundity has been initiated for yellowtail flounder, American plaice and witch flounde. Fecundity samples are being collected from the spring survey in 3Ps and 3LNO and will be analyzed using this new, more efficient method. An attempt is being made to collect more samples for extending the calibration curves. This work is necessary before the new method can be used to estimate fecundity in these species.

## b) 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 2009. Samples of adult capelin were collected in 2009 at spawning sites on the east coast of Newfoundland, Div. L; southern Labrador, Div. 2J; in the Gulf of St. Lawrence, Div. 4RST; 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 continued in 2009. Inshore surveys were conducted in the fall of 2009 to map the abundance and dispersal of larval capelin in Trinity Bay, Div. 3L. A research project initiated in 2008 as part of DFO's Ecosystem Research Initiative (ERI), incorporated acoustic data collection into the fall bottom trawl

surveys of Div.2J3KLNO, along with enhanced sampling of the biology and feeding of forage fishes. This work continued in 2009.

c) Salmon

Information from three years of tracking studies have now been fully analysed whereby Atlantic salmon (*Salmo salar*) smolts (n = 181) from two rivers were surgically implanted with acoustic transmitters and released to determine migration route, residency time, and survival in a 50 km long estuarine fiord located on the south coast of Newfoundland. Data obtained from automated receivers placed throughout Bay d'Espoir indicated that migrating smolts used different routes to reach the outer areas of the fiord. The duration of time that smolts spent in the immediate river-estuary zone also differed between the two populations although the total time smolts were resident in the fiord was similar, and extensive. Many smolts were resident for periods of 4 to 8 weeks moving back and forth in the outer part of the fiord where water depths range from 300 – 700 m. Survival in the river-estuary zone was greater for smolts with prolonged residency in estuarine habitat, with the overall survival to the fiord exit moderately high (54 to 85%) indicating that the initial phase of migration did not coincide with a period of unusually high mortality.

d) Shrimp

A baseline of pathology is being constructed from past research survey datasets.

Northern Shrimp samples from 2J3KL have been sent to Norway as a part of an international effort to determine whether genetics can be used to separate shrimp from various parts of the northern hemisphere into stocks.

e) Snow Crab

Long-term trap and trawl surveys in White Bay (3K), Notre Dame Bay (3K), Bonavista Bay (3L), and Conception Bay (3L) were continued in 2009. These surveys collect information on biological and population parameters and are used in annual assessments of snow crab. The surveys have also been used for past and on-going research of the incidence and impacts of bitter crab disease in NL snow crab. A similar survey was initiated in Fortune Bay (3Ps) in 2007 and was continued in 2009.

f) Cod

A calibration curve for the autodiametric method of determining fecundity has been completed. Fecundity samples are being collected from the spring survey in 3Ps and 3LNO and will be analyzed using this new, more efficient method. It is hoped that these analyses will become a regular part of the spring research vessel survey sampling and that a time series of fecundity estimates can be established.

# **SUBAREA 4**

## A. Status of Fisheries

Nominal landings from 2000 to 2009 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 2009 recreational harvest, including both retained and hooked-and-released, was 15,213 fish.

*b)* Snow Crab – Div. 4R

In Div. 4R offshore, landings and effort have been variable in recent years after reaching historical lows in 2006. The TAC has not been achieved since 2002. CPUE has remained below the long-term average since 2003. The exploitable biomass is low as reflected by poor fishery performance since 2004. Recruitment has been low in recent

years while longer-term recruitment prospects are unknown. The effect of maintaining the current level of fishery removals on the exploitation rate is unknown.

In Div. 4R inshore, landings and effort have steadily declined since 2004, to historical lows in 2009. The TAC has not been achieved since 2002. CPUE has steadily declined since 2002 to its lowest level in 2009. Post-season trap survey catch rates show that the exploitable biomass has remained low since 2005. Recruitment is expected to remain low for 2010 but is expected to increase in the short term following 2010, however there is considerable spatial variability. Maintaining the current level of fishery removals would have an unknown effect on the exploitation rate but may increase mortality on soft-shelled immediate pre-recruits in some areas in 2010.

## *c) Iceland* scallops – Div. 4R

The nominal catch from the Strait of Belle Isle (Div. 4R) in 2008 is estimated at 111 t (round) against a TAC of 1,000 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. Resource status was updated for the Strait based on a survey in August 2007.

A total of 12 t was removed from areas south of the Strait.

# **SUBAREA 2 + 3 + 4**

## A. Status of Fisheries

Nominal landings from 1999 to 2009 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 3,200 t in 1992. Reported landings increased to 2,100 t in 2002 and 2,300 t in 2003, and then decreased to 1,900 t in 2004. Landings increased to about 2,600 t in 2005, remained the same for 2006 and 2007, then increased to 3,000 t in 2008. A preliminary value for 2009 landings is 2,500 t. Landings have been increasing in Lobster Fishing Area (LFA) 11 in Subdiv. 3Ps, and in LFAs 12, 13A, 13B and 14A in Division 4R, but have declined precipitously in LFA 10 in Subdiv. 3Ps, as well as in LFA 4 in Division 3K. In 2007, reported landings in LFAs 4 and 10, as well as in LFAs 8 and 9 (in Div. 3L), declined to record lows. 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. At-sea sampling data from LFAs 5 (in Div. 3L), 10, 11 and 14 suggest that the catch consists largely of incoming recruits, and that annual survival of males is generally less than 0.2. Survival of females is higher. Sufficient data are 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 2009. Data collected were tabled at Regional stock assessments in the spring of 2010 for Divs. 2J3KL cod. Sites in Divs. 2J3KL, Subdiv. 3Ps and Divs. 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*

Tagging and telemetry studies on cod in Div. 2J3KL were continued in 2009. Approximately 4,300 cod were tagged and released with Floy tags; in addition acoustically tagged cod were released inshore in 3L during 2008 and 2009. A series of arrays of acoustic receivers were deployed along a 350 km area of the inshore to monitor cod movement patterns and survival. The objectives were to obtain estimates of exploitation and population size to improve the assessment of this stock; and to study migration patterns and survival rates. The tag reporting rate during 2009 was estimated at 57% (based on a high-reward tagging study). During 2009, estimates of exploitation (harvest) rate ranged from 3-10% for the cod released inshore and 2% for cod tagged offshore (but recaptured inshore). The tagging and telemetry study indicated that a substantial fraction of cod tagged offshore migrated to the inshore throughout Div. 3KL during summer 2008 and 2009, rendering them vulnerable to inshore fisheries. Telemetered inshore cod dispersed widely around the coast, with many returning to Smith Sound late in autumn; acoustically tagged offshore late in the autumn.

#### c) Hydrographic Surveys

The Canadian Hydrographic Service (CHS) priorities for Subareas 2, 3 and 4 for 2008-2009 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 2008 survey season, surveys were completed at the Approaches to Voisey's Bay and Makkovik Bank in Labrador. On the Island of Newfoundland hydrographic surveys were completed north of Fogo Island, in Bonavista Bay, Ramea Islands and Port Aux Basques.

#### Voisey's Bay, Labrador

A multibeam acoustic survey was completed in the approaches to the Voisey's Bay Mine Site and the community of Nain on the Coast of Labrador. These surveys were designed to widen shipping routes providing access to these two sites. Previous to this survey the areas adjacent to the shipping routes were uncharted. These uncharted areas were of concern to agencies responsible for Search and Rescue Operations and Environmental Clean Ups resulting from a marine incident. This work is scheduled to continue next season.

#### Makkovik Bank, Labrador

A multibeam acoustic survey was continued on the Makkovik Bank of Labrador. This work was a continuation of surveys started previously. The data collected will be used for navigation safety and to study geohazards along possible pipeline routes.

## Bonavista Bay

Multibeam surveys were completed in Bonavista Bay, Island of Newfoundland in conjunction with Natural Resources Canada (NRCAN). The data collected will be used by NRCAN for their work and by CHS for charting and navigational safety.

## Fogo Island, Island of Newfoundland

The existing navigation 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. A hydrographic survey was conducted at this site to complete outstanding hydrographic work which was not achievable last season due to inclement weather. In conjunction with this work, a multibeam acoustic survey was also completed in a deep trench area trending northeast along the north side of Fogo Island to the Funk Island. It is suspected that this trench may be an over wintering and/or spawning site for cod which migrate into shore near Fogo Island and the acoustic data will be used in support of scientific research.

## Ramea Islands

A multibeam acoustic survey was completed in the vicinity of the Ramea Islands on the south coast of the Island of Newfoundland. This survey was required to replace survey data from the 1800's which was the only source data for charts at this site.

#### Port Aux Basques

A multibeam acoustic survey was completed for the Port aux Basques harbour and approaches. This was a survey of opportunity completed while poor weather prevented hydrographic surveys of other priorities. Data from the survey will be archived in CHS databases and used to update the chart for this port when the next edition of the chart is produced. Concurrent with this survey was a multibeam acoustic survey in the approaches to Port Aux Basques to locate a shipwreck from World War 2. This survey was conducted in conjunction with the Canadian Department of National Defense. Poor weather prevented the completion of this survey and it is anticipated that it will be continued in the 2009 survey season.

#### 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 2008 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 2008 survey season.

Chart No.	Risk Class	Location	Type Survey	Proposed Product
4652	Class A	Corner Brook	Single beam acoustic survey of shoals of a wharf facility at Corner Brook.	New edition of chart.
4659	Class B	Fox Island River, Port au Port Peninsula	Hydrographic survey to gather new shoreline and sound a new route into the Port of Fox Island River.	Notices to Mariners Action.
4852 4843	SDD	Admiral's Beach	Single beam sounding survey required for production of a new Sailing Directions Diagram.	New Edition of Sailing Directions ATL 102.
4841	Class A	Argentia Harbour	Hydrographic revisory survey to update charted information as a result of changes to berths at this port.	Notices to Mariners.
4679	Class B	Port au Choix Harbour	A hydrographic survey of new navigational ranges and to complete a revisory survey of the port.	Updates chart inset for this port.

## 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, Cape Bauld to Cape Bonavista, ATL 102, Cape Bauld to Ferryland Head and ATL 103, Ferryland Head to Port Aux Basques.

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.

Six chart dealership inspections were conducted at various locations throughout the Island portion of Newfoundland and Labrador.

During 2008 a new edition of the Sailing Directions Publication ATL 102, Newfoundland, East and South Coasts was produced.

Efforts are now underway in the Canadian Hydrographic Service to produce Print On Demand (POD) Sailing Directions publications and it is expected that by next year some of the Sailing Directions publications for Newfoundland and Labrador will be available in POD format.

Subarea	Species	Division	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
	Greenland	SA 0 + 1A(offshore)+										
0+1	halibut	1B-F	3,363	3,348	3,742	4,045	4,005	4,993	4,017	2,560	3,184	2,614
	Shrimp*	0A					7,508	6,236	6,654	6,247	3,625	1,588
		0B					6,333	4,488	4,584	5,597	5,829	4,805
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	10,664	10,735	10,009	10,084	10,247	9,644	13,020	8,387	8,117	7,382
		2HJ (SFA 5)	24,883	21,658	23,768	22,612	22,904	22,785	30,437	15,339	15,116	14,694
		2J3K (SFA 6)	45,108	75,080	80,736	75,673	75,231	77,820	71,227	60,384	52,590	62,581
	Snow Crab	2HJ	2,555	2,387	2,330	1987	1517	1,915	2511	3,521	3,738	3,685
	Iceland scallop	2HJ		13	40	686	672	495	528	272	218	230
	Arctic Charr	2J3KLPs+4R	16	18	28	40	22	19	19	21	33	47
	Atlantic											
	salmon****			36	27	32	31.9	32	22.1	17.6	16.3	15.6
2.2	Dadfiah	2,21/	20	20	20	224	105	167	22	24	40	20
2+3	Greenland	2+3K	20	20	29	221	155	107	22	- 34	40	- 30
	halibut	2+3KLMNO	5.744	4.701	5.073	6.307	6.644	4.877	6.620	6.291	8.238	10.637
	American plaice	2+3K	10	10	23	60	29	16	33	100	133	67
	Witch	2J+3KL	45	5	22	53	40	26	110	167	148	90
	Cod*****	2J3KL	3,098	3,343	2,546	2,679	1,330	643	971	4,196	6,887	5,376
	Grenadier	2+3	13	10	38	99	151	135	183	274	212	234
	Capelin	2J3KL (offshore)	0		0	0	0	0	0	0	0	0
	Squid	2+3	640	515	228	6,879	548	2,525	1089	229	23	328
3	Redfish	3LN	6	1	3	1	2	0	9	47	40	33
		3M		0	0	0	0	0	0	0	0	0
		30	255	202	1,054	3,580	5,364	2,340	3,093	2,988	4,557	880
	Yellowtail	3LNO	5,414	10,216	3,674	177	13,268	12,577	12,705	9,959	12,238	9,422
	American plaice	3LNO	1,077	878	434	93	1,466	1,290	1,607	1,374	1592	623

Table 1: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 2000-2009. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

Subarea	Species	Division	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
		3Ps	509	456	460	485	745	731	883	1,014	877	609
	Witch flounder	3NO	41	46	21	94	49	49	62	27	13	12
		3Ps	454	298	110	182	483	540	529	517	450	332
	Atlantic halibut	3	289	287	170	251	255	303	399	369	315	182
	Cod	3NO	158	231	123	73	459	441	714	422	487	171
		3Ps	7,491	9,636	10,599	10,506	11,400	11,046	12,469	12,618	13,339	19,683
	Haddock	3LNO	104	60	30	23	44	18	67	183	86	69
		3Ps	173	288	302	128	219	123	137	111	102	162
	Pollock	3Ps	287	616	1,042	733	500	296	333	492	815	709
	White hake***	3NOPs	746	1383	1,675	2,320	2,325	1,724	1,541	1,931	1,462	1,535
	Thorny skate***	3LNOPs	1322	1452	92	1,158	1,652	1,542	2,374	2,304	2,125	1,432
	Capelin	3L 3K	13,337 9,853	15,163 13,043	16,321 13,036	15,431 14,368	15,534 12,194	15,706 11,138	13,270 4,067	8,639 1,553	13,898 5,022	12,041 4,066
	Shrimp*	3M 3L	0 20,494	0 21,187	0 18,314	0 18,128	0 11,109	0 10,560	0 10,701	8 5,417	293 4,984	618 4,050
	Sea scallop	3KLNO 3Ps		0 293	9 359	10 518	35 2,132	0 3,473	0 647	0 51	0 338	0 85
	Iceland scallop	3LNO 3Ps		1 5	0 6	347 132	128 1,748	0 40	0 87	0 478	39 498	336 1,148
	Snow Crab	3K 3LNO 3Psn	16,184 29,033 5,560	15,068 30,248 4,523	12,270 30,895 3,947	10,717 30,717 3,099	8,685 29,649 3,169	16,460 30,717 4,720	16,502 31,638 6,113	16,352 30,032 7,637	15,288 28,172 7,843	15,390 26,773 7,917
	Lobster	3K 3L 3Ps	107 99 1067	135 109 1170	120 82 1,010	156 111 1,049	209 112 987	157 73 779	207 116 786	206 128 763	275 124 709	231 126 637

Subarea	Species	Division	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
		3Pn	127	153	94	52	29	14	22	11	25	17
	Atlantic salmon**	2J3KLPs+4R	34	50	29	36	41	37	40	39	39	30
3+4	Redfish	3P+4V	2,265	1,217	1,402	2,439	1,918	3,428	3,956	3,451	3,213	4,459
4	Iceland scallop	4R		121	284	656	454	360	275	252	638	1,084
	Sea scallop	4R		0	0	0	0	0	0	0	0	1
	Lobster	4R	1097	1405	1,260	1,276	1,280	888	1,125	950	985	747
	Snow Crab	4R	287	380	554	543	862	1,462	1,562	1,851	1,683	1,627

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.

\*\*Recreational catch

\*\*\*Canadian catches only

\*\*\*\* Subsistence Fisheries

\*\*\*\*\* Excludes recreational catch for 2007

## Acknowledgements

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# Appendix I: Research Projects of interest to NAFO conducted under the International Governance Strategy

The objectives if the International Governance Strategy (IGS) are to strengthen international governance of fisheries, support healthy ocean ecosystems and to protect Canada's economic and environmental interests. The IGS is now funded on an ongoing basis at \$22 million per year for the overall Strategy which includes **\$4 million for Science** and 15 million for enforcement in the NAFO Regulatory Area.

The IGS Science Program conducts scientific research to acquire, synthesize and interpret scientific data to better understand fisheries and their supporting ecosystems in support of decision-making (e.g., understanding fishing interactions with sensitive marine areas and species, reducing bycatch of non-target species, improving selectivity of fishing operations, conducting deep-sea fisheries responsibly). The outcomes of the IGS Science program will support objective international policy debates and standard-setting; and, to leverage science into relevant international studies (e.g., contribute to international scientific cooperation that informs RFMO decision-making).

The four main components of the science program include:

- Science in support of straddling stocks and highly migratory species,
- Science in support of protecting high seas marine habitat and communities (e.g., impacts of fishing, identification and characterization of Vulnerable Marine Ecosystems, including seamounts and unfished frontier areas, etc.),
- Ocean variability and marine ecosystems, and
- Program coordination and enabling functions.

The following tables outline those IGS activities of interest to NAFO that were completed 2009/10, as well as those currently underway for 2010/11.

List of IGS Activities 2009-10-11						
Project Leader(s)	Title					
P. Shelton/D. Miller	Developing precautionary harvesting strategies for high seas straddling					
	stocks: Management Strategy Evaluation for the NAFO Divisions					
	2J3KLMNO Greenland halibut stock.					
J. Morgan/Y.	Canada-Spain Marine Collaboration - Analysis of Stock Reproductive					
Lambert/E.Trippel	Potential to promote sustainability of Greenland Halibut fishery					
K. Gilkinson	Deep-sea sponge taxonomy and distribution					
W. Brodie	Understanding impacts of various fishing gears on VME and biodiversity.					
K. Gilkinson/E.	Delineating ecoregions in the NW Atlantic to support the development of					
Kenchington	MPA networks					
J. Lawson	Characterizing noise environment and marine mammal assemblages for					
	candidate VME on the Grand Banks and the NRA.					
B. Greenan	Connectivity and Uniqueness of Closed Areas in International Waters					
	Adjacent to Canada					
J. Loder	Ocean Climate Assessments and Indices for Ecosystem Issues in the					
	Offshore NW Atlantic					
K. Azetzu-Scott	Impact of Ocean Acidification on NW Atlantic Fisheries and Marine					
	Ecosystems					
E. Head	Ecosystem monitoring in the Northwest Atlantic using the continuous					
	plankton recorder					
E. Kenchington	Benthic surveys of VME in the NRA					
E. Kenchington	Defining encounter protocols in the NRA					
V. Kostylev	Detecting VMEs in the NRA using the habitat template approach					
E. Kenchington/K.	Participation in Nereida surveys onboard Miguel Oliver					
Gilkinson						