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Canadian Research Report for 2008 Newfoundland and Labrador Region

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SUBAREAS 0 AND 1

A. Status of Fisheries

Nominal landings from 1999 to 2008 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 2007, 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 2006 were approximately 4,000 t, fully utilizing it's allocation of the quota, then declined to 3,700 t in 2007 and 3,300t in 2008. In 2008, about 2,100 t were taken by single otter trawls, 400 t by double otter trawls and 800 t by gillnets. Length compositions in the catches have been stable in recent years.

SUBAREA 2

A. Status of Fisheries

Nominal landings from 1999 to 2008 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 6,683 salmon were retained or hooked and released in the recreational fishery. Preliminary information on subsistence fishery catches indicated that about 36 t of salmon were harvested in 2008. Four of four assessed stocks achieved conservation spawning requirements in 2008.

[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.

b) *Arctic charr* – Subarea 2

Commercial landings of Arctic charr from north Labrador in 2008 were approximately 18 t, a decrease of 38% over 2007. The decline was largely due to reduced effort. Over the past 35 years (1974–2008), more than 2,870 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. Harvests from subsistence fisheries are largely unknown, but can be substantial in some years.

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 2006-08, 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 and 3,300 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. 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. 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 in 2007 is uncertain. In 2008, total landings were 4,162 t including 3,089 t in the stewardship fishery which includes 121 t of bycatch and 818 t in the recreational fishery; in addition 254 t were landed in the sentinel surveys. The offshore portion of the stock area remained closed to directed fishing in 2006-08.

The Div. 2J3KL cod stock was assessed in March-April 2009. Since 2005, the inshore and offshore areas have been assessed separately, but new information from tagging and telemetry studies in 2007-08 indicates that a large proportion of cod in the offshore migrated inshore in summer 2008; the inshore catch is comprised of a mixture of inshore and offshore fish. Based on autumn DFO research vessel (RV) trawl surveys, offshore abundance and biomass indices have been increasing since 2003; spawning stock biomass (SSB) has been increasing since 2005. The average abundance, biomass, and SSB of cod in the offshore over the last 3 years are 8% of the average during the 1980's.

Most of the autumn offshore RV survey abundance (50%) and biomass (75%) 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 the prospects for stock recovery have improved. 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 2000-01 year-classes; recruitment remains weak. Winter acoustic surveys in 2007 and 2008 found a dense aggregation of cod in a traditional over-wintering area along the shelf edge in southern 3K. The aggregation in 2008 was much larger than was observed in 2007, and included approximately 20% mature fish. Exploitation of offshore cod in the inshore was estimated at 6%. 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 (6% based on tagging) 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). Standardized catch rates in the sentinel fishery were calculated for each inshore region. In the northern area, catch rates with gillnets (5½ inch

mesh) were low in 1995-2004, increased in 2005, and are currently above the average of the time series. In the central area, catch rates have generally increased since 2002 and are currently above average. In the southern area, catch rates have remained stable since 2003 but are marginally below average. Catch rates with line-trawls are variable but show an increasing trend since 2003 in the central area. Recruitment information from catch rates of small fish using small mesh gillnets indicate that the 2003 and 2004 year classes are weaker than those produced during 2000-02. During 2008, mean exploitation rates from tagging studies ranged from 3-7% among inshore central and southern areas. However, recruitment information suggests that exploitable biomass in inshore areas in 2009-10 is likely to be similar to 2008-09. In the inshore southern area, catches are partly dependent on seasonal immigration of fish from Subdiv. 3Ps where the stock is declining. Future removals may therefore rely more heavily on cod from the offshore of Div. 3KL. In the inshore northern area, catch rates are lower than those in the central area suggesting lower cod abundance in the northern area. Fisheries in this area depend on seasonal immigration of fish, possibly from offshore regions, including Div. 2J where offshore biomass remains low.

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 decreased from 60 t in 2006 to 23 t in 2007 and further decreased in 2008 to 13 t. 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. Prior to this, there had not been a persistent directed effort on this stock since 1990, when 2400 t was landed. Canada (NL) landings declined to less than 9 t in each year from 1992-1999 and were between 22-221 t for the period 2000-08 with the most recent two 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 increased rapidly from 1800 t in 2001 to a range of 5,000–5,400 t from 2003 to 2005. The catch has since fluctuated between 1,000–3,000 t. A provisional estimate for 2008 suggests catch was about 2,000 t. The increases, beginning in 2001 from non-Canadian fisheries, were taken 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. 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. The most recent years discard estimates have steadily increased from 260 t in 2004 to 460 t in 2006 with a decline to 330 t in 2007.

f) *Witch flounder* - Div 2J3KL

There has been no directed fishing on this stock since 1994. In 2008, bycatch in other fisheries from the Newfoundland region amounted to only 8 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 1998-2008 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 4,700 t, a slight reduction of the 2007 catch levels (5,100 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 and 2009 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% and 42% 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 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). The resource in these Shrimp Fishing Areas (SFA's) is assessed on a two year basis. The last formal assessment was completed during March 2008, with the next scheduled assessment due in March 2010.

Between 1998 and 2002, annual catches of approximately 8,000 t were taken in 2G from 8,320 t TACs. The 2003 TAC was increased to 10,320 t and included a 1,125 t allocation for northern shrimp research. In 2003, the Canadian shrimp fishing industry requested and was granted a change in season, from a calendar year (January 1 – December 31) to a fiscal year (April 1 – March 31). An additional interim quota of 2,802 t was set 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. Preliminary data indicate that 10,000 t of shrimp were taken during the 2007-08 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 2,000 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 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 2005-07. 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 and included a 2,500 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 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 2004-08 seasons. Approximately 23,000 t of shrimp were caught annually since the 2003-04 season. Preliminary data indicate that 23,700 t of shrimp were taken during the 2007-2008 season. Standardized

catch rates within Hopedale and Cartwright Channels increased from 1992 (714kg/hr) through to 2001 (1,993/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 2007 (1,800 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 2006-07 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 1,800 t. Catches increased to more than 7,800 t in 1988 and ranged between 5,500 and 8,000 t throughout 1989-1993. The first multi-year management plan for 1994-96 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 1997-99 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. TACs have been reached in most years; however, due to market constraints, small vessels have not always taken their entire allocations. Between 75,600 t and 80,700 t were taken each fishing season between 2004-05 and 2007-08.

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 1,385 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 2003-07 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 11.5–16 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 bycatch. Recent studies estimated that low numbers of redfish and Greenland halibut have been caught by shrimp fishing fleets.

i) *Snow crab* – Div. 2HJ3KLNO

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 the long-term average in 2008. Both offshore and inshore Div. 3K CPUE increased sharply from 2005-08 to the highest levels observed. CPUE increased inshore

in Div. 3L from 2004-08. Offshore, CPUE has declined steadily since 2000 in Div. 3L to the lowest level since 1991. In Div. 3NO CPUE has declined since 2002 to its lowest level in 2008. 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 increased in the north (Div. 2HJ3K) from 2003-07 but continued to decline in the south (Div. 3LNO). Biomass decreased in Div. 2HJ, remained high in Div. 3K, and remained low in offshore Div. 3L in 2008. 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 2006-08. 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. 2HJ. Recruitment is expected to increase offshore in Div. 3LNO in the short term, while prospects for inshore Div. 3L are uncertain. Long-term recruitment prospects are unknown.

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 2008 and represented the 32st 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 again in 2008. 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, cod, and 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.

d) Atlantic Salmon

A pelagic ecosystem survey of the northwest Atlantic was conducted in August 2008 using the CCGS Wilfred Templeman. 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 August 8 to 21, a total of 46 stations were sampled with the pelagic surface trawl. The survey covered an area extending from just south of 49°N to 56°N, 49°W to 55°W. Stations sampled were characterized by depths from 100 m to over 3,000 m and water temperatures (at 10 m depth) ranging from 7.7° to 14.4°C. Very few (N=15) of the targeted species, Atlantic salmon, were captured during the survey. Atlantic salmon were captured at 8 of the 46 stations (17%) and the majority (14 of 15 fish) were captured at stations north of 52°N. The stations with salmon catches were characterized by a wide range of water depths (about 250 m to >3,000 m depth) and temperatures (less than 10°C to over 13°C). Salmon were only captured during the daytime. The salmon ranged in size from 23 to 31 cm.

The most abundant catches (by weight and percent of stations) were Atlantic saury and common lumpfish. The most widely distributed invertebrate aquatic species was squid, predominantly shortfin squid. A total of 17+ fish species were captured and identified, a number of juvenile fish were retained for identification. The majority of the fish species sampled were at juvenile stages including several species of concern such as wolfish, Greenland halibut and redfish. Lanternfish (myctophids) were predictably captured only during night time sampling and only at stations with water depths >500 m. A total of seven invertebrate species groups were captured and sampled during the survey.

SUBAREA 3

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

Nominal landings from 1999 to 2008 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 2008 recreational harvest, including both retained and hooked-and-released was 23,429 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 29,360 t in 2007 to 28,200 t in 2008. 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. Mature capelin are smaller and the spawning biomass is comprised of two and three year-old fish instead of three and four-year olds. Capelin are spawning four weeks later. The offshore distribution of capelin remains similar to what has been observed since the 1990s. Moreover, capelin are not undertaking diurnal 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, 2008 had estimated abundances that are 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 2007, the total catch was 845 t. In 2008, about 230 t were caught by Canada (NL), up from 123 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_{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 Canadian share of the TAC is 84.5%, the remainder is allocated to France (SPM). The Canadian catch in 2008 was 10,000 t. The most recent assessment (February and March 2009) indicated considerable uncertainty in the absolute size of the stock. However, it was noted that total biomass from DFO RV surveys indicates a decline since 2004. The 2008 biomass estimate is less than 50% of the average for 1997-2008. The survey spawning stock biomass (SSB) is in decline and is near the lowest levels observed. The report of the assessment meeting recommended: "Survey SSB has been decreasing in recent years and in 2008 was just above the limit reference point. If management is to be consistent with the Precautionary Approach, catches should be reduced compared to recent levels, and greater priority should be given to increasing SSB." 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 since that time has increased substantially. During 2001 to 2003 the catch was greater than 1,000 t in each year. Catch declined steadily since 2003. In 2008 catch by Canada NL was approximately 470 t. Catch in 2007 was 524 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 average biomass is only 30% and abundance 50% of the 1983-87 averages from the survey. There was a large increase in abundance in the 2008 survey which increases the average from 30% to 50% of 1983-87.

e) Witch flounder - 3Ps

The first total allowable catch (TAC) was 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 2008, the catch from the Newfoundland region was 298 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 steadily increased and in 2008 was estimated to be 1.7 times B_{msy}, 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 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 was still low in 2007 at 3,673 t, but in 2008 catches increased to 10,216 t (TAC of 15,500 t). Scientific Council noted that this stock is well above B_{msy}, and recommended any TAC option up to 85% F_{msy} for 2009 and 2010 (24.8 t and 22.8 t respectively). The TAC for 2009 was subsequently set to 17,000 t.

g) American plaice – 3LNO

The last full assessment for American plaice in Div. 3LNO was in 2007 and will be assessed this year, in 2009. 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 2007 was 3,600 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 2007 was 435 t and 878 t in 2008. Catch will likely increase in the near future, due to revised NAFO regulations allowing for increased bycatch levels. Canadian RV surveys indicate either an increase or plateau in mean numbers per tow and mean weight per tow since the 1990s; however, especially in Div. 3N and Div. 3O, the percentage compared to historic levels has been increasing. 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 1970s. 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 assessed in November 2001 and updated in 2004.

Total Canadian catches have declined steadily from 27,000 t in 1993 to 8,000 t in 2002, matching reductions in TACs. 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 2008. Catch remained at the 6,400 t level in 2006, declined to 3,800 t in 2007 and 3,100 t in 2008 . About 740 t of the 2007 catch was taken by Canada (NL) fisheries. The shortfall in the TAC from 2005-07 was due to corporate restructuring and a labour dispute in the Canadian fishing industry. 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 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 catch 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. In 2004, NAFO Fisheries Commission adopted TAC regulation for Div. 3O redfish at 20,000 t for 2005, 2006 and 2007. From 2005-08, total catch from all countries has ranged between 4,200 t – 5,500 t with the exception of 2006 when about 12,600 t was taken.

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 2008 was 46 t. Spring RV estimates for Div. 3NO combined suggest the spring 1998 survey was at the lowest level observed since the beginning of the time series in 1984. From 1998-2003, indices increased, with the most recent data points down again slightly. The fall RV index shows a somewhat different trend with increases in recent years, and the 2008 value has been the highest in the time series. 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)

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 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 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 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 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, but that 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 18,300 t in 2006. Preliminary data indicate that 19,600 t were taken by Canadian vessels in 2008.

Catches by non Canadian nations increased from 600 t to 5,700 t over this period. Preliminary data indicate that by October 2007, 5,100 t had been taken against a non Canadian TAC of 3,898 t.

Canadian fleet catch rates

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 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 2% of the total available habitat of the entire time series while similar indices for the autumn survey and small vessel fisheries occupied less than 4% of the total available habitat.

The small vessel fleet fishes shrimp mainly during the spring and summer months, while seasonality of the large vessel fleet varies over time.

Due to a lack of data it was not possible to model small vessel CPUE during 2008. Small vessel CPUE (2000–2007) 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 logbook dataset that was used in this analysis accounted for between 74.5% and 93.4% of the catch within any one year. The final model explained 86% of the variance in the data and indicated that the annual standardized catch rates were increasing in 2005 with a gradual decrease to near the long term mean (431 kg/hr) since. The 2005 and 2006 catch rates were significantly higher than the 2007 index (454 kg/hr). The 2007 index was similar to the 2004 value but significantly higher than values previous to 2004. No clear trends were found in the plots of residuals.

While the large vessel fleet has been fishing throughout the entire year over the entire 2000–08 catch time series, it appears to have changed from a winter spring to autumn in one year and winter in the next year fishery. However, most of the data came from the winter and spring, therefore, large vessel catch rates were analyzed by multiple regression using data from the winter and spring months only. The model was weighted by effort, for year, month, number of trawls and vessel effects. The observer dataset used in this analysis accounted for between 47% and 96% of the catch within any one year. The final model explained 70% 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 2008 standardized catch rate index (1,846 kg/hr) near the long term average (1,798 kg/hr) and similar to the catch rates for 2002 and 2004-07 indices. There were no trends in the residuals around parameter estimates.

The fact that the area fished by large and small vessels has increased over the past few years, while the CPUE remained near the long term average, implies that the resource is healthy.

International fleet catch rates

A standardized catch rate model was produced using data from Estonian, Greenlandic and Icelandic vessels fishing shrimp in the NRA. Ship, month and year were significant independent variables and produced a model that explained 76% of the variance. The number of trawls used had an insignificant influence upon model outcome. Unfortunately, the data used in this model accounted for between 1% and 29% of the catch within any one year, therefore the results are thought to be less reliable than they were for the Canadian large and small vessel fleets. Catch rates fluctuated along the long term mean over the short time series. The 2008 model catch rate index was similar to all but the 2004 index. The 2004 value was significantly higher than the 2008 value. The model did not include Norwegian or Spanish data as the vessels from both countries changed each year. There were no trends in the residuals around parameter estimates. The unstandardized catch rates for the non-Canadian vessels were highly variable by country and year.

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 14,200 t and 10,200 t of shrimp were caught in 3M during 2007 and 2008 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) *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.

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 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.

o) *Squid* – Subarea 3

Following a peak catch in 1979 of about 88,800 t, the Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5,000 t during the thirteen-year period 1983 to 1995. They increased since 1995 to about 12,700 t in 1997 before declining sharply to about 800 t in 1998 and about 20 t in 1999. They remained low, at about 300 t, in 2000, decreased to only about 20 t in 2001 and increased to about 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.

p) *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 2008 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 20 to May 5, the second on CCGS Templeman from July 4-19 and the last on CCGS Hudson from November 22 to December 5. 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 2008 was similar to previous years (1999-2007). 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 later than in 2007 and considerably shorter than in recent years. Satellite information indicates the onset of the spring bloom, at least since 2005, has become gradually later throughout the region of the Newfoundland Shelf and adjacent slope.

In 2008, there appears to have been a change in the balance between nitrate and silicate inventories throughout much of the region. There has been a notable increase in the inventory of silicate in both surface (0-50 m) and deep (50-150 m) layers whereas the inventories of nitrate have either remained close to previous levels or decreased slightly throughout much of the region. Overall phytoplankton abundance, measured in terms of chlorophyll concentration generally declined in 2008 relative to previous years, with many observations approaching the lowest levels recorded since the start of AZMP. Nitrate continues to be the primary limiting nutrient on the Grand Banks, and the Newfoundland and Labrador Shelf. However many of the observations from 2008 showed that the concentration of nitrate relative to that of silicate was generally at the lower limit of the range of previous observations. There is generally a strong correlation in the interannual variations in nutrient and chlorophyll inventories throughout much of the region although the weakest variations have occurred in the deep nitrate inventories.

The overall abundance of *C. finmarchicus*, *C. glacialis*, *C. hyperboreus*, *Acartia* spp, *Pseudocalanus* spp., and *Sagitta* spp. at Station 27 was at or near the lowest values recorded since the start of AZMP. The low abundance of these taxa reflected some changes in the seasonal cycle at the site, and the combined low abundance of many large copepods resulted in the lowest estimated biomass on record. Although the general patterns in abundance at Station 27 were reflected in the southeastern Grand Banks section, the correspondence with interannual patterns of variation along other sections was mixed. The abundance of the three *Calanus* species was generally near average levels throughout much of the region. The pattern of variation at Station 27 may reflect changes in the influx of offshore species along the inner branch of the Labrador Current.

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 2008 relative to the remainder of the time series, other than a generally low abundance of meroplankton, larvaceans and ostracods. There has been a general decrease in the abundance of *C. glacialis*, *C. hyperboreus* and large nauplii on the Grand Banks section, but *Metridia* spp. was more abundant than the

long term average. Most carnivorous zooplankton remained at relatively low levels in 2008. In many species this reflects a longer term pattern since 2004-05.

The variation in abundance of dominant taxa at Station 27 appears to reflect a mixture of the patterns on the Grand Banks and 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 (Ouellet 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 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 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 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. Integration of data from the oceanographic surveys, continuous sampling at fixed stations, and satellite observations would allow 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 major shifts in the spatial distribution of species, which appear 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 raised questions about the program's overall ability to accurately monitor zooplankton abundance and species composition. With the longer time series, it is now possible to expand the number of taxa for which model-based estimates of abundance can 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 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 ten year series is greater than for the Seal Island section because we are in a better position to characterize the full seasonal pattern of variation for many taxa.

Trend analysis may be a useful tool which in the future can be used to assess changes in the pelagic ecosystem. There are broad patterns of correlation in the interannual variability among taxa on the Newfoundland Shelf and Grand Banks. The patterns of variation may reflect differences in the dependency on onshore transport of some species (e.g., *C. finmarchicus*, *C. glacialis*, *C. hyperboreus*) from overwintering areas for the Newfoundland Shelf, whereas interannual variations in temperature may play a more significant role on the dynamics of lower trophic levels on the Grand Banks. With only ten years of data, our ability to detect long term patterns of variations is considerably more limited than can be afforded by longer series, such as the CPR which demonstrates substantial decadal variations (Head and Pepin 2009). However, the data from the Atlantic Zone Monitoring Program are

beginning to provide insight into the dominant processes that may be affecting interannual patterns of variations on the continental shelf.

b) Oceanographic studies - Subareas 2 and 3

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2008 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 2007-08 was above normal (~0.5 standard deviation (SD) in 2008) and as a consequence, outflow of arctic air masses to the Northwest Atlantic was stronger than in 2006. This resulted in a broad-scale cooling of air temperatures throughout the Northwest Atlantic from West Greenland to Baffin Island to Labrador and Newfoundland relative to 2006. Sea-ice extent and duration on the Newfoundland and Labrador Shelf increased in 2008 but remained below average for the 14th consecutive year. As a result of these factors, local water temperatures on the Newfoundland and Labrador Shelf generally cooled compared to 2006 but remained above normal in most areas in 2008, continuing the warmer than normal conditions experienced since the mid-to-late 1990s. Salinities in general on the NL Shelf, which were lower than normal throughout most of the 1990s, increased to the highest observed since the early 1990s during 2002 and have remained mostly above normal during the past 7 years. In particular, at Station 27 off St. John's, the depth-averaged annual water temperature decreased from the record high observed in 2006 to about normal in 2007 and to about 1 SD above normal in 2008. Annual surface temperatures at Station 27 also decreased from the 61-year record of 1.7°C (3 SD) above normal in 2006, to about normal in 2007 and to 1 SD (1°C) above normal in 2008. Bottom temperatures at Station 27 remained above normal for the 13th consecutive year. From 2004-06, they were >2.5 SD above normal but decreased to about 1 SD above normal in 2007-08. Upper-layer salinities at Station 27 were above normal for the 7th consecutive year. Annual surface temperatures on Hamilton Bank were 1.8 SD above normal, 1.3 SD above normal on the Flemish Cap and near normal on St. Pierre Bank. Bottom temperatures on Hamilton Bank were normal, ~2 SD above normal on the Flemish Cap and ~1 SD below normal on St. Pierre Bank. The area of the Cold-Intermediate-Layer (CIL) water mass on the eastern Newfoundland Shelf during 2008 was below normal for the 14th consecutive year and the 5th lowest since 1948. The average temperature and salinity during the summer of 2008 along the Bonavista section has remained significantly above normal by 2.4 and 3.3 SD, respectively. Bottom temperatures during the spring of 2008 remained slightly above normal on the Grand Banks (3LNO) but were below normal on St. Pierre Bank (3Ps). During the fall they were above normal in NAFO Div. 2J and 3K and slightly below normal in 3LNO. The area of bottom habitat on the Grand Banks covered by <0°C water during the spring decreased from near 60% in 1991 to <5% in 2004 but increased to near-normal at about 30% in 2007-08. In conclusion, water temperatures on the Newfoundland and Labrador Shelf decreased from 2006 values but remained above normal in most areas during 2007-08. A composite climate index derived from several meteorological, ice and oceanographic time series indicate a continuation of warm-salty conditions with 2008 ranking 6th warmest in 59 years of data.

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.

b) Marine Mammals

Multi-disciplinary studies on harp, hooded, and grey seal population dynamics and seal-fish interactions continued in 2008. A number of studies initiated under the Atlantic Seal Research Program (ASRP) were completed. 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 up to 2007 and analysed. The data and

estimates of consumption of Atlantic cod were presented for peer review at an international workshop held in November 2008. Preliminary results of a model exploring the impact of harp seal predation and capelin abundance on population dynamics of Div. 2J3KL cod indicated that cod recovery may be restricted by ecosystem productivity (as defined by capelin abundance) rather than predation.

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. In 2007, a method using polymerase chain reaction (PCR) amplification of specific prey DNA (Atlantic cod, Arctic cod and capelin) was developed to compliment HPA and improve the detectability of prey. This preliminary study is being expanded to include a larger sample size and more prey species. The feasibility of using quantifiable PCR is also being examined.

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 is being 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. Individual seals were tracked for up to a year, although the average duration was slightly over 200 days. After moulting in July individuals travelled along the Greenland continental shelf to Davis Strait and Baffin Bay. During the winter mature seals moved south along the Labrador shelf to the breeding grounds off NE Newfoundland by March. Immature seals remained in the Davis Strait area until they returned to SE Greenland for moulting. Males and females showed slightly different movement patterns. Hooded seals feed primarily along the continental shelf slopes, diving to depths of more than 1,500 m. Ice and depth were found to be significant factors for identifying areas of high use. Young of the year hooded seals (bluebacks) left the pupping ice 2-3 weeks after weaning, wandering extensively across the North Atlantic prior to arriving at the moulting areas off Greenland. Diving capabilities developed quickly with seals reaching depths of 250 m within two months. Temperature profiles were obtained from all of the tags while only 1 provided salinity. These data significantly increased the information available on temperature at depth in this area and have been incorporated in an Operational Oceanographic model for the Northwest Atlantic (NOOFS), resulting in a significant improvement in the model predictions. These data have also been incorporated into international meteorological databases where they are being used by oceanographers to improve global oceanographic models.

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. The Canadian survey was a component of the multinational Trans North Atlantic Sightings Survey (TNASS) that extended from the northeastern U.S.A. to the U.K. The Canadian component included three initiatives that covered different geographic areas: 1) Labrador Shelf and Grand Banks, 2) Gulf of St. Lawrence and 3) Scotian Shelf. Abundance and distribution of mysticete species such as blue, fin, humpback, and minke whales, as well as large (sperm, pilot and killer whales) and small (white-beaked, common and Atlantic white-sided dolphins, and harbour porpoises) odontocetes, leatherback sea turtles, sunfish, and basking sharks were estimated. The most abundant species was the common dolphin (54,396; 95% CI: 35,580-83,192), with lower numbers of other small cetaceans (e.g., harbour porpoise: 4,955; 95% CI: 2,254-8,971). Pilot whales were the most abundant medium-sized species (5,612; 95% CI: 3,020-10,867), while there were an estimated 2,149 humpback (95% CI: 1,347-3,169), and 1,360 fin whales (95% CI: 825-2,241). These abundance estimates are negatively biased due to the lack of correction factors for availability and perception biases. Once corrected, the results will be integrated with concurrent data from other international components of the TNASS to produce the first estimate of abundance in the 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 2008. Samples of adult capelin were collected in 2008 at spawning sites on the east coast of Newfoundland, Div. 3KL; in 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 continued in 2008. Fall and winter inshore surveys were conducted in 2008 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. A research project was initiated in 2008 as part of DFO's Ecosystem Research Initiative (ERI) to assess the distribution and biology of forage fishes from an ecosystem perspective.

d) Salmon

During the spring of 2008, Atlantic salmon smolts (N = 30) and kelts (N = 8) 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. Smolts (N = 20) were also tagged and released from nearby Little River. This work built on tracking carried out in 2006 and 2007. A total of 28 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 8 kelt that were tagged and released all were subsequently accounted for. Three (3) kelt returned to the general area of the mouth of Conne River after an absence of 57–73 days. With respect to smolts, only 13 fish (43%) provided useful tracking information. Information compiled over the past three years shows that smolts use several routes to exit the fiord with no difference in migration routes among years. In addition, it was also found that the migration route of Conne River smolts differs from that of kelt.

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.

f) Cod

Processing has recently been completed on samples collected over a number of years for the estimation of fecundity. Samples are from all populations in Subarea 3. The fecundity length relationships will be published in a CSAS research document in 2009.

SUBAREA 4

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

Nominal landings from 1999 to 2008 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 2008 recreational harvest, including both retained and hooked-and-released, was 23,784 fish.

b) Snow Crab – Div. 4R

Landings in 4R have declined by 79% from 1,850 t in 2006 to 380 t in 2008. 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 2004. Recruitment is expected to change little over the next 2-3 years.

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 2008 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 then increased to about 2,600 t in 2005 and remained the same for 2006 and 2007. A preliminary value for 2008 landings is 3,000 t. Landings continued to increase in Lobster Fishing Area (LFA) 11 in Subdiv. 3Ps, and in LFAs 13A, 13B and 14A in Division 4R, but 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 was higher. 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 2008. Data collected were tabled at zonal stock assessments in the winter of 2009 for Subdiv. 3Ps and 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 2008. Approximately 5,400 cod were tagged and released with Floy tags; these included telemetred cod with surgically implanted acoustic transmitters (35 cod in the inshore and 147 cod in the offshore). 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 2008 was estimated at 63% (based on a high-reward tagging study). During 2008, estimates of exploitation (harvest) rate ranged from 3-7% for the cod released inshore and 6% 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, rendering them vulnerable to inshore fisheries. Telemetered inshore cod dispersed widely around the coast, with many returning to Smith Sound late in autumn.

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 for two species (*Sebastes fasciatus* and *S. mentella*), 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 can be found on the CSAS website (*http://www.dfo-mpo.gc.ca/CSAS/http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/SAR-AS/2008/SAR-AS2008_026_E.pdf*)

The workshop concluded based on genetic and morphometric studies that there is no difference between redfish from Unit 1 and Unit 2 although some genetic heterogeneity is detected within these management units. For both species, the scale at which genetic differentiation is observed appears to be much larger than current management units. The connectivity between Units 1 and 2 is most obvious for *S. mentella* but the population structure of *S. fasciatus* is more complex.

Given the difference observed in the biology, distribution, and population structure of *S. mentella* and *S. fasciatus*, it appears that managing redfish as one group as it is done presently may not be the most appropriate strategy. Therefore, it is proposed that the scientific data should be re-analyzed taking into consideration the presence of two species each of which is showing population substructure. A meeting is planned for November 2009 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.

d) 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 Funks. 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 Ramea Island on the south coast of the Island of Newfoundland. This survey was required to replace survey data from the 1800s which was the only source data for charts at this site.

Port Aux Basques

A multibeam acoustic survey was completed for the Port aux Basque area 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 River, Port au Port Peninsula	Hydrographic survey to gather new shoreline and sound a new route into the Port of Fox 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 101, Cape Bauld to Cape Bonavista 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.

Table 1: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 1999-2008.
Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

			Catch (t)									
Subarea	**Species**	**Division**	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	3,288	3,742	4,045	4,005	4,993	4,017	2,560	3,184	2,614	3,876
	Shrimp*	0A				7,508	6,236	6,654	6,247	3,625	1,588	2,046
		0B				6,333	4,488	4,584	5,597	5,829	4,805	5,132
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	9,682	9,839	10,084	10,247	9,644	13,020	8,393	8,116	7,529	7,884
		2HJ (SFA 5)	20,503	22,772	22,612	22,898	22,690	30,437	15,332	15,036	14,645	15,109
		2J3K (SFA 6)	74,506	72,196	75,673	75,129	77,776	71,227	59,912	52,554	63,175	51,202
	Snow Crab	2HJ	2,549	2,549	2,139	1,576	1,925	2511	3,521	3,738	3,685	5,416
	Iceland scallop	2HJ	13	40	686	672	495	528	272	218	230	685
	Arctic Charr	2J3KLPs+4R	18	28	40	22	19	19	21	33	47	41
	Atlantic salmon****		36	27	32	31.9	32	22.1	17.6	16.3	15.6	
2+3	Redfish	2+3K	20	29	221	135	167	22	34	40	30	3
	Greenland halibut	2+3KLMNO	4,691	5,073	6,307	6,644	4,877	6,620	6,291	8,238	10,637	4,124
	American plaice	2+3K	13	23	60	29	16	33	100	133	67	6
	Witch	2J+3KL	8	22	53	40	26	110	167	148	90	2
	Cod*****	2J3KL	4,162	2,918	2,679	1,330	643	971	4,196	6,887	5,376	8,525
	Grenadier	2+3	9	38	99	151	135	183	274	212	234	145
	Capelin	2J3KL (offshore)	0	0	0	0	0	0	0	0	0	0
	Squid	2+3	516	228	6,879	548	2,525	1089	229	23	328	19
3	Redfish	3LN	1	3	1	2	0	9	47	40	33	5
		3M	0	0	0	0	0	0	0	0	0	0
		3O	202	1,054	3,580	5,364	2,340	3,093	2,988	4,557	880	2,027

Yellowtail	3LNO	10,216	3,674	177	13,268	12,577	12,705	9,959	12,238	9,422	5,540
American plaice	3LNO	878	435	93	1,466	1,290	1,607	1,374	1592	623	269
	3Ps	455	460	485	745	731	883	1,014	877	609	542
Witch flounder	3NO	46	21	94	49	49	62	27	13	12	3
	3Ps	298	111	182	483	540	529	517	450	332	507
Atlantic halibut	3	286	170	239	255	303	399	369	315	182	124
Cod	3NO	230	126	73	459	441	714	422	487	171	485
	3Ps	9,636	10,642	10,602	11,400	11,046	12,469	12,618	13,339	19,683	24,214
Haddock	3LNO	62	30	23	44	18	67	183	86	69	50
	3Ps	285	301	132	219	123	137	111	102	162	98
Pollock	3Ps	602	1,041	733	500	296	333	492	815	709	729
White hake***	3NOPs	1,417	1,675	2,320	2,325	1,724	1,541	1,931	1,462	1,535	933
Thorny skate***	3LNOPs	1,888	92	1,158	1,652	1,542	2,374	2,304	2,125	1,432	2,168
Capelin	3L	15,163	16,321	15,431	15,534	15,706	13,270	8,639	13,898	12,041	11,403
	3K	13,043	13,036	14,368	12,194	11,138	4,067	1,553	5,022	4,066	7,254
Shrimp*	3M	0	0	0	0	0	0	8	293	618	490
	3L	19,606	18,312	18,147	11,184	10,613	10,008	5,417	4,986	4,111	
Sea scallop	3KLNO	0	9	10	35	0	0	0	0	0	0
	3Ps	293	359	518	2,141	3,473	647	51	338	79	71
Iceland scallop	3LNO	1	0	347	128	0	0	0	39	336	141
	3Ps	5	6	136	1,748	40	87	478	498	1,148	1,197
Snow Crab	3K	15,068	12,270	10,717	8,685	16,460	16,502	16,352	15,288	15,390	21,470
	3LNO	30,198	30,895	30,717	29,649	30,717	31,638	30,032	28,172	26,773	32,725
	3Ps	4,522	3,947	3,099	3,169	4,720	6,113	7,637	7,843	7,917	7,909
Lobster	3K	135	118	156	209	157	207	206	275	231	251
	3L	108	82	111	112	73	116	128	124	126	158
	3Ps	1,170	1,008	1,049	987	779	786	763	709	637	613

		3Pn	160	97	52	29	14	22	11	25	17	25
	Atlantic salmon**	2J3KLPs+4R	40	28	36	41	37	40	39	39	30	38
3+4	Redfish	3P+4V	740	1,014	1,439	1,918	3,428	3,956	3,451	3,213	4,459	4,726
4	Iceland scallop	4R	121	286	663	466	360	275	252	638	1,084	1,091
	Sea scallop	4R	0	0	0	0	0	0	0	0	1	0
	Lobster	4R	1,418	1,260	1,276	1,280	888	1,125	950	985	747	767
	Snow Crab	4R	381	554	543	862	1,462	1,562	1,851	1,683	1,627	1,597

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

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Appendix I: Research Projects for the International Governance Strategy; DFO Newfoundland and Labrador Region

The International Governance Strategy (IGS) has been renewed to strengthen international governance of fisheries, support healthy ocean ecosystems, protect Canada's economic and environmental interests and position Canada as a global leader in high-seas issues. The IGS has been funded on an ongoing basis at $7 million per year for the overall Strategy which includes $4 million for Science.

The IGS Science Program will conduct 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 that were completed in the Newfoundland and Labrador Region in 2008/09, as well as those currently underway for 2009/10.

List of IGS Activities 2008-09	
Project Leader(s)	**Title**
P. Shelton	Developing precautionary harvesting strategies for high seas straddling stocks: Management Strategy Evaluation for the NAFO Divisions 2J3KLMNO Greenland halibut stock.
J. Morgan	Effect of recent warm ocean temperatures on fish productivity
K. Gilkinson/E. Kenchington	Identification of Existing Information in known and predicted Vulnerable Marine Ecosystems (VME).
K. Gilkinson	In-situ habitat characterization within known VME.
W. Brodie	Understanding impacts of various fishing gears on VME and biodiversity.
K. Dwyer	Development of a Sequential Population Analysis model to assess stock status, biological and fishing mortality reference points necessary for the establishment of PA-compliant strategies for Grand Bank yellowtail flounder.

List of Proposed IGS Activities 2009-10	
Project Leader(s)	**Title**
P. Shelton	Developing precautionary harvesting strategies for high seas straddling stocks: Management Strategy Evaluation for the NAFO Divisions 2J3KLMNO Greenland halibut stock.
K. Gilkinson	Geology, biogeography, and conservation of deep-sea corals and sponges.
K. Gilkinson/E. Kenchington	Delineating ecoregions in the NW Atlantic to support the development of MPA networks.
K. Gilkinson	Benthic surveys of Orphan Knoll (and other candidate VME).
K. Gilkinson	Deep-sea sponge taxonomy and distribution.
W. Brodie	Understanding the impacts of various fishing gears on VME and biodiversity.
J. Lawson	Characterizing noise environment and marine mammal assemblages for candidate VME on the Grand Banks and the NRA.