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Submitted by

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SUBAREAS 0 AND 1

A. STATUS OF FISHERIES

Nominal landings from 2003 to 2012 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 Division 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 2011, Scientific Council advised for 2012 a TAC of 13,000 t for Greenland Halibut in Div. 0A+1AB and 14,000 t for Div. 0B and 1C-1F.

The Canadian Greenland Halibut fishery occurs in Division 0A in the north (Baffin Bay) and Division 0B in the south (Davis Strait). Catches in offshore 0+1 have been at the TAC levels since 2000. The Canada (NL) fishery only occurs in Div. 0B and catches from 2003 to 2006 were approximately 4,000 t, fully utilizing its allocation of the quota. Catch since 2009 declined gradually to 3,400t in 2009. Since then, catch has ranged between 3,400 t to 3,900 tons. The 2012 catch was approximately 3,600t with over half taken by otter trawlers (620 t with single trawls and 1440 t with twin trawls) and the remainder by gillnets (1,512 t).The 2012 fisheries occurred from June to November with a substantial portion of the catch (61 %) being taken by August.

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

SUBAREA 2

A. STATUS OF FISHERIES

Nominal landings from 2003 to 2012 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 for Atlantic Salmon in Subarea 2 has remained closed since 1998. The 2012 recreational catch, including both retained and hooked-and-released, was 6,759 salmon, 11 % less than last year and 7 % more than the previous 6 year mean. Preliminary information on subsistence fishery catches indicated that about 54 t of Atlantic Salmon were harvested in 2012, 32 % higher than the 2011 harvest of 41 t.

Only one of the three assessed rivers in Subarea 2 achieved conservation spawning requirement in 2012. The abundance of large salmon has remained particularly low since the 1980s (mean 1980-89 was 114,490 large salmon: mean 1990-2012 was 31,412 large salmon).

b) Arctic Charr–Subarea 2

Commercial landings of Arctic Charr from north Labrador in 2012 were only 11 t, a decline of over 50 % from the previous year when 24 t of Charr were harvested. Commercial landings have been sporadic in recent years driven largely by how many individuals participate in the fishery, and limited periods of time when the local fish plant is open to process Charr. In addition to commercial fisheries, recent surveys of Inuit domestic harvests from subsistence fisheries along the north coast of Labrador can approximate about 10,000 Charr annually.

c) Cod–Division 2GH, Division 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. By-catch 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 with annual catches ranging 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).

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During 2006-12, a pilot-scale inshore stewardship fishery using vessels <35 ft was open and fishers were each permitted to harvest 3,000 lb (2006), 2,500 lb (2007), 3,300 lb (2008), and 3,750 lb (2009-12) of Cod. There was also a recreational fishery that was open for a few weeks during summer and fall and fishers were allowed 5 fish per trip or 15 fish per boat per day. Total reported landings ranged from 2,500 t to 4,400 t during 2006-12. There was no direct estimate of recreational fishery landings for 2009-12; however, analysis of tag returns suggests that removals from recreational landings >50 % of reported stewardship fishery removals during those years. In 2012, reported landings were 3,305 t which included 2,991 t in the stewardship fishery, 273 t in the sentinel surveys, and 41 t taken as by-catch. The offshore portion of the stock area has remained under moratorium since 1992.

d) American Plaice–Subarea 2 + Division 3K

This stock has been under moratorium since 1994. This status of the stock was updated in 2012 and a limit reference point (LRP) established. Total mortality due to all causes, including fishing, has been decreasing on more recent cohorts. An empirical biological LRP was determined from examining stock recruit data from the RV survey. Generally recruitment has been impaired when the survey SSB index is below 70,000 t and therefore this was chosen as the LRP. It may be necessary to re-evaluate the LRP once more data are available at higher SSB (as SSB approaches the LRP). The 2009 estimate of survey SSB indicates that the stock is at 24 % of the LRP. This is the most recent SSB estimate for this stock as ageing data has not been completed for 2010-12. It was not possible to determine an upper reference point or a removals (F-based) reference point for this stock. The main source of by-catch of American Plaice in SA 2+3K since 2000 has been in the Greenland Halibut gillnet and otter trawl fisheries. In 2011 and 2012, the total reported landings of American Plaice were 17 t and 11 t, respectively.

e) Redfish–Subarea 2 + Division 3K

This stock has been under moratorium to directed fishing in the Canadian EEZ since 1997 although there had not been a persistent directed effort on this stock since 1990, when 2400 t was landed. Canadian (NL) landings were between 22-221 t for the period 2003-12 with the 2012 catch at 103 t. Canadian (NL) landings since the moratorium in the Canadian EEZ are bycatch primarily from Greenland halibut fisheries. Reported landings from other countries fishing in the NRA with large midwater trawls increased rapidly from 1,800 t in 2001 to a peak of 5,400 t in 2005. The catch declined to 1,100 t in 2006 and rose again to 3,100 t in 2007. The fishery has been virtually non-existent from 2008 to 2012 (<10 t). It is assumed increased catches in the NRA were from the pelagic stock of Redfish that resides primarily in the Irminger Sea between Greenland and Iceland.

Based on observer data, estimates of Redfish bycatch discarded from Canadian Shrimp fisheries in the Div. 2G to Div. 3K area since 1980 have ranged from 14 t in 1983 to 665 t in 1990. There has been a steady increase in discards from 260 t in 2004 to a peak of 460 t in 2006 with a decline to 240 t in 2008. More recent data have not been analysed.

f) Witch Flounder-Division J3KL

There has been no directed fishing on this stock since 1994. In 2012, bycatch in other fisheries from the Newfoundland Region was 94 t. Canadian fall surveys since the late 1970s indicated that Witch Flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s, they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope in Div. 3L. The fall 1998-2010 surveys indicate no change in this distribution pattern. For the three divisions combined, the biomass index declined from about 65,000 t in 1984 to 1,100 t in 1995, the lowest in the time series. Mean weight per tow decreased from a maximum of near 6 kg/tow in 1984 to a low of 0.23 kg/tow in 1995. The small increase in biomass index and mean weight per tow observed between 1995 and 1996 was almost exclusively a result of inclusion of the deeper strata surveyed in Div. 3L. Estimates of biomass and abundance have increased slightly since 2003, but the stock size remains extremely low.

g) Greenland Halibut-Subarea 2 + Division 3KLMNO

The Canadian (NL) catch of Greenland Halibut in 2012 in Subarea 2 and Div. 3KLMNO was approximately 6,200 t, unchanged from the catches in 2011. Canadian catches in recent years have been about 25 % of the overall removals.

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. TACs in 2008-10 have been set at 16,000 t. The total catches estimated by Scientific Council over 2004 to 2009 exceeded the rebuilding plan TACs considerably, with the over-runs ranging from 22 % to 47 %. In September 2010, following the recommendations of WGMSE, the Fisheries Commission adopted a harvest control rule which uses trend information from various surveys to determine the TACs for each of 2011-14.

h) Shrimp–Subarea 2 + Division 3K

The Northern Shrimp (*Pandalus borealis*) fishery in Subarea 2 and the northern portion of Subarea 3 is divided into three management areas: 2G (Shrimp fishing area 4), Hopedale and Cartwright Channels (2HJ) (Shrimp fishing area 5), and Hawke Channel (2J) + 3K (Shrimp fishing area 6). The resource within these Shrimp Fishing Areas (SFA's) is normally assessed on a biennial basis. The last formal assessment was completed during February 2013. The next formal assessment is scheduled to be completed during February 2015 with an interim monitoring report produced in March 2014.

SFA 4 (NAFO DIVISION 2G)

Between 1998 and 2002, annual catches of approximately 8,000 t were taken in 2G from 8,320 t TACs. The 2003 TAC was increased to 10,320 t and during that year the Canadian Shrimp fishing industry requested and was granted a change in season, from a calendar year (January 1–December 31) to a fiscal year (April 1–March 31). An additional interim quota of 2,802 t was set for the January 1–March 31, 2004 period. Thus the 2003-04 fishing season was 15 months long and had a 13,122 t TAC. The 2003-04 (April 1–March 31) TAC (10,320 t) was maintained for the 2004-08 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 2004-07 period. The TAC was increased to 11,320 t in 2008-09 and was maintained at that level through to 2011-12. Approximately 10,500 t was taken in each of these management years. The TAC was increased to 13,018 t for the 2012-13 management year and preliminary data indicate that this quota was taken.

Historically, the fishery has been concentrated north of 60°N in an area noted for producing high catch rates of large, high-quality shrimp. During 1998, a separate quota was created for the area south of 60°N to reflect the existence of high concentrations of shrimp along the shelf slope. The new quota resulted in a southward shift in fishing effort. Participants of the 2012 Northern Shrimp assessment felt that there were several confounding influences that affect catch rates in this area. These include:

changes in management decisions:

In 1998, 2,184 t of the TAC was allocated to the area south of 60°N to promote spatial expansion of the fishery. By 2009/10, the regulations were changed such that the vessels no longer had to fish a portion of their catch in southern SFA 4.

changes in seasonality:

Prior to 2002, the fishery occurred during the spring and summer. After 2001, the fishery switched to summer fall fishery with an increased amount of fishing during the winter.

changes in fishing pattern due to searching:

At various meetings, fishers indicated that some years there may have been more searching along the Labrador shelf edge. Searching may have extended into the shallower water.

changes in market conditions:

Northern and striped shrimp (*Pandalus montagui*) are now similar in value therefore fishers are no longer trying to avoid areas of high *P. montagui* concentrations.

For these reasons, it was felt that CPUE had limited value as a tool to monitor fishery performance within SFA 4.

Canadian Government conducted a bottom trawl research survey in 2G each autumn from 1996 to 1999. During the summer of 2005, the Northern Shrimp Research Foundation and the Government of Canada (DFO) began a series of 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.

Current status within SFA 4 remains positive. Biomass indices are at or near their highest levels over the short time series. Fishable biomass index increased from 62,000 t in 2005 to 180,000 t by 2009, decreased to 127,000 t in the next year before increasing to 191,000 t in 2012. Similarly, the female spawning stock biomass (SSB) index increased from 35,000 t in 2005 to 140,000 t by 2009, decreased to 71,000 t in 2010 then increased to 110,000 t in 2012.

Annual female total mortality oscillated between about 40-50 % over the period 1999–2008. The methods used required the discrimination of primiparous and multiparous females. Due to high numbers of ovigerous females this was not possible after 2008.

The exploitation rate has been between 6 and 9 % since 2006-07. SSB index was assessed to be in the Healthy Zone, within the IFMP PA Framework, and it is anticipated that the 2012/13 exploitation rate will be less than 10 %.

SFA 5 (HOPEDALE AND CARTWRIGHT CHANNELS)

Shrimp catches in Hopedale and Cartwright Channels increased from about 2,700 t in 1977 to 4,100 t in 1980, declined to 1,000 t in 1983 and 1984, increased again to 7,800 t in 1988, stabilizing at roughly 6,000 t during the 1989-93 period. TAC's for the 1994-96 management plan, which combined the two channels as a single management area, were increased to 7,650 t annually and catches subsequently increased, averaging 7,500 t during that period. Annual TAC’s for the 1997-99 plan were increased by 100 % to 15,300 t and catches were near 15,100 t each year. The 15,300 t TAC was maintained in the 2000-02 plan. In 2003, the TAC increased 52 % to 23,300 t. (In 2003, the fishing season changed to April 1-March 31, and an additional interim quota of 9,784 t was set for the period January 1-March 31, 2004. The 2003-04 fishing season was 15 months long and had a 33,084 t TAC. The 2003-04 management year TAC (23,300 t) was maintained for the 2004-05 to 2012-13 seasons. Catches varied between 22,600 t and 25,300 t each year between 2004/05 and 2011/12. Preliminary data indicate that 24,400 t of shrimp were taken from a TAC of 23,300 t during the 2012-13 management year. Please note that due to a seasonal bridging program initiated in 2007 a limited amount of shrimp not caught in one management year may be caught in the next.

Large vessel (>500 t) CPUE increased from 1992 to 2001 and has oscillated around this higher level since then.

Current status within SFA 5 remains positive. Fishable biomass index increased from around 90,000 t in 1996-99 to 184,000 t in 2001. The index has been around 150,000 t from 2004 onward. The 2012 estimate is 147,000 t. SSB index increased from 40,000 t in the 1996-99 period to 96,000 t in 2001 and has since decreased. The 2012 estimate is 63,000 t. SSB is in the Healthy Zone of the IFMP PA framework and if the current TAC is taken in 2013/14, the exploitation rate index would remain at 16 %.

SFA 6 (HAWKE CHANNEL + NAFO DIVISION 3K)

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 1989-93. The first multi-year management plan covered the period 1994-96 and established an annual TAC of 11,050 t for the Hawke Channel, St. Anthony Basin, east St. Anthony, Funk Island Deep and three exploratory areas on the seaward slope of the shelf. Catches increased to 11,000 t in each of these years. TACs were increased to 23,100 t in 1997 as a first step toward increasing the exploitation of an abundant resource within the 1997-99 Management Plan. Most of the increase was reserved for development of the small vessel fleet (<=500 t; LOA<=100'). TACs more than doubled between 1997 and 1999, increased slightly to 2002 and further increased to 77,932 t in 2003. An additional interim quota of 7,653 t was set for the period January 1–March 31, 2004 to facilitate an industry requested change in fishing season from January 1–December 31 to April 1–March 31. Thus the 2003-04 fishing season was 15 months long and had an 85,585 t TAC. TACs remained at the 77,932 t level for the 2004-08 fishing seasons, but were increased to 85,725 t for the 2008-09 and 2009-10 seasons. Due to concerns pertaining to resource health, TACs were reduced to 61,632 t and 52,387 t for the 2010-11 and 2011-12 fishing seasons respectively. Resource status in SFA 6 improved in 2011, therefore, the 2012/13 SFA 6 TAC was increased to 60,245 t for the 2012/13 management year. Preliminary data indicate that 58,300 t of shrimp were taken during the 2012/13 management year.

The large vessel CPUE increased between 1989 and 1997 and oscillated at a high level until 2006/07, thereafter it declined until 2009/10 but has since been increasing. The small vessel CPUE showed a similar pattern.

There is concern for the current status. Fishable biomass index increased from 310,000 t in 1997 to a peak of nearly 670,000 t in 2006 then declined steeply to 295,000 t in 2010, increased to 409,000 t in 2011 before returning to 316,000 t by 2012. The trend in female spawning stock biomass index reflected the trend in the fishable biomass index decreasing to 187,000 t in 2012, which is comparable to the beginning of the time series. The SSB is in the Cautious Zone of the IFMP PA framework for the third time in the four most recent years.

Total annual mortality increased from 34 % to 58 % after 2001. If the 60,245 t TAC is maintained through 2013/14 and taken the exploitation rate will increase to 19 %, the third highest level in the time series.

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–Division 2HJ

Most of the landings are derived from Div. 2J in all years. Landings decreased by 37 % since 2008 to 1,600 t. Meanwhile effort increased by 55 % to 2011 before decreasing by 23 % in 2012. The TAC has not been taken in the past 2 years. CPUE most recently peaked in 2008, then declined steadily by half to 2011, and was unchanged in 2012. The exploitable biomass, as indicated by the post-season trawl survey, declined steadily from 2006 to 2011 and was unchanged in 2012. Recruitment declined from 2006 to 2011, changed little in 2012, and is expected to remain low in the short term (2-3 years). The post-season trawl survey pre-recruit index decreased sharply in 2005 and has since fluctuated without trend. Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime. The exploitation rate index has increased steadily after 2007 to its highest level since 2004. The pre-recruit fishing mortality rate index has been at its highest level since 2004 during each of the past two years. The percentage of the catch handled and released in the fishery increased from about 10 % in 2008 to about 35 % in 2012 implying a potential increase in pre-recruit mortality. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013 but would likely result in high mortality on soft-shelled immediate pre-recruits.

j) Iceland Scallop–Division 2HJ

Inshore aggregations were again fished in 2009, 2010, 2011 and 2012, with nominal catches estimated at 17 t ,16 t, 19 t and 16 t, round, respectively, up from 13 t in 2008. 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) Benthic studies

DFO Science, Newfoundland and Labrador Region, are involved in a five-year project “Reducing Seabed Impacts of Bottom Trawls” with Fisheries and Marine Institute (Memorial University) and Industry (Vónin Ltd.). The primary goal is to develop, test and commercialize innovative bottom trawl fishing technology that will reduce the environmental impact on the seabed. Specific stages in the project involve, 1) design and computer simulation of new fishing systems (carried out in 2011), 2) flume tank testing of physical models, and 3) construction and field testing of full-scale prototypes.

b) 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 2012 and represented the 36th continuous year of sampling these populations. Following long term declines in mean weight of Charr harvested in north Labrador, current data continue to show that mean weight and mean-weight-at-age has stabilized in recent years, but direct comparisons may be problematic owing to limited periods of time when biological samples are now potentially available by comparison with earlier years. Ongoing investigations include studies on trophic ecology, environmental influences on growth, and thermal habitat use.

c) Groundfish and Shellfish

Biological and oceanographic data from fall multi-species research vessel surveys were collected from Div. 2HJ to conduct distribution and abundance studies and detailed biological sampling is used to conduct analyses of growth, maturity and condition.

Analysis of sexual maturity data is conducted regularly on American Plaice, Cod, and Greenland Halibut and reported in the stock assessments of these species.

A joint project under the Canada Spain Marine Science Collaboration Initiative entitled 'Analysis of Stock Reproductive Potential to promote sustainability of Greenland Halibut fishery' ran for the past 3 years with funding ending March 31 2012. Research related to this project is still ongoing with the aim of increasing our understanding of Greenland Halibut reproduction and integrating this increased understanding into stock assessments. Within this project work is being conducted on fecundity (application of the autodiametric method), maturity, sex ratio and growth. A study on distribution has been published which examined intrapopulation variation in temperature and depth distribution, and the biological changes in relation to changes in available temperature. On the Flemish Cap, variation in available temperature was limited, and changes in depth were related to changing age composition and the differential depth distribution with age/size. In other areas there was a larger decline in available temperature, and associated with this, Greenland halibut moved to deeper waters and occupied warmer temperatures than they had previously. Concurrently, growth declined and condition increased. This study shows that shifts in distribution may not result in maintenance of homogeneous environmental conditions, and that resulting biological changes will be difficult to predict. Work has begun to test the robustness of the Greenland halibut harvest control rule to different assumptions about reproductive potential.

d) Shrimp

In 2005, the first of a series of trawl surveys was conducted by the Northern Shrimp Research Foundation in partnership with DFO in Div. 2G. Biological and oceanographic data were collected to assess the distribution and abundance of the Shrimp population in this division. By 2007, sufficient data had been collected to begin using the NSRF-DFO joint survey data in Shrimp assessments. The Zonal Advisory Process (ZAP) meeting held in St. John's since March 2008 has been making use of this dataset.

Since 2010, NL Region has been sending Northern Shrimp samples to Tromso Norway as part of an international stock discrimination project. One hundred samples have been collected from each of 2G, 2H, 2J, 3K 3L and 3M. Analyses have thus far shown that shrimp from the Western Atlantic are distinct from the Eastern Atlantic and that shrimp from 3M are distinct from 3L. The identification of distinct resources will allow for better assessment and management of the various stocks.

e) Snow Crab

A trap survey for Snow Crab was conducted in Div. 2H in the summers of 2009, 2010 and 2012. The surveys, conducted by the Torngat Joint Fisheries Secretariat with in-kind support from DFO, were performed to quantify the distribution and abundance of commercial-sized males in Div. 2H. The fixed-station survey covered the area between the Makkovik and Nain Banks using commercial crab gear. Small-meshed pots were also incorporated into the study to capture females and small males.

f) Atlantic Salmon

Approximately 1600 Atlantic Salmon from the subsistence harvest in coastal Labrador are currently being analyzed for river of origin using 15 microsatellite loci. These samples include tissue collected in 2011 and existing scale samples from previous years (2006-2010). Genetic samples from 15 rivers in coastal Labrador have been collected (2010 and 2011) and will be used to examine spatial population structure in Labrador. Salmon baseline data collected by Fisheries and Oceans will be integrated into the Canadian Atlantic Salmon genetic database being coordinated by Laval University. Standardization and integration of the regional components of the Canadian baseline is currently underway. Once the standardized baseline is available, analysis of fishery composition will occur.

SUBAREA 3

A. STATUS OF FISHERIES

Nominal landings from 2003 to 2012 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) Atlantic Salmon-Subarea 3

The commercial fishery for Atlantic Salmon in Subarea 23 has remained closed since 1992. The 2012 recreational harvest, including both retained and hooked-and-released, was 34,684 Salmon, 1 % less than last year and 8 % greater than the previous 5 year mean.

Three of the nine assessed rivers in Subarea 3 achieved conservation spawning requirement in 2012. These three rivers are on the northeast coast of Newfoundland. South Newfoundland Atlantic Salmon (*Salmo salar* L., 1758) were assessed to have declined by 37 % for small salmon and 26 % for large Salmon from 1994 to 2007 and on this basis were designated Threatened in November 2010 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010).

b) Capelin–Subarea 2 + Division 3KL

Inshore Capelin catches in Subarea 2 + Div. 3KL are taken primarily by purse seines, tuck seines, and Capelin traps during the inshore spawning migration. Catches increased from 20,104 t in 2011 to 22,317 t in 2012 representing 98 % of the 2012 TAC. The most recent assessment (October 2010) examined several indicators that showed that biological and behavioural changes first observed in the early 1990s continue to persist. The mean size of mature Capelin in 2011 was similar to 2010 and slightly higher than the mean size in 2009, the smallest in thirty years. The spawning biomass is comprised of two and three year-old fish instead of three and four-year olds. Condition has declined since the early 1990s. Capelin are spawning three to four weeks later than observed in the 1980s. Capelin in most areas are not undertaking diurnal vertical migrations, instead remaining near the bottom. The offshore distribution of capelin in the fall of 2011 and 2012 has expanded northwards into Div. 2J, reminiscent of historic distribution patterns. In the spring of 2011 and especially in 2012 Capelin distribution was widespread over the bank, closer to the coast, and extended to the south, more typical of patterns observed in the 1980s. There are no recent estimates of abundance available for the entire stock, however an acoustic survey covering Div. 3L in May, 2012 estimated abundances to be an order of magnitude lower than the 1980s. The abundance estimate from the May, 2012 acoustic survey was higher than in 2010 and similar to estimates from 2007 to 2009 but still an order of magnitude lower than observed in the 1980s. Five recruitment indices covering the year classes since 2003 are relatively coherent and indicated that prospects for recruitment in 2012 were average. Predation pressure on Capelin has likely increased in recent years due to population increases in Capelin predators and declines in other forage species such as Shrimp.

c) Cod–Division 3NO and 3Ps

The 3NO stock has been under moratorium to all directed fishing, both inside and outside the NAFO Regulatory Area, since February 1994 and this continued into 2012. Total catch since 1994 increased from 170 t in 1995 to 4,900 t in 2003, and ranged between 600 t and 1,100 t for 2004-2011. The provisional 2012 value reported to NAFO based on monthly catch reports is 725 t. Canada (NL) landings ranged from 444 t to 818 t between 2002-2005, and from 108 t to 247 t between 2006-2010. Canadian catches in 2011 and 2012 were 44 and 26 t respectively. These catches were primarily taken in the 3NO yellowtail fishery.

For the 3Ps Cod stock, after the extension of jurisdiction in 1977 catches averaged around 30,000 t until the mid-1980s when fishing effort by France increased and total landings reached about 59,000 t in 1987. Catches then declined gradually to 36,000 t in 1992. A moratorium was imposed in August 1993 after only 15,000 t had been landed. Although offshore landings fluctuated, the inshore fixed gear fishery reported landings around 20,000 t each year up until the moratorium. Since the moratorium, TACs are established bilaterally shared between Canada (84.4 %) and France (St. Pierre and Miquelon, 15.6 %). The fishery reopened in May 1997 with a TAC of 10,000 t. In 2000 the management year was changed to begin on 1 April. TACs under this revised management year schedule have ranged from a high of 15,000t to 11,500 t in for the 2012/13 management year. In the 2009/10 season, 78 % of the TAC was landed. At the end of the 2011/12 season, just over half (52 %) of the 11,500 t TAC was taken. Canada (NL) calendar year landings have shown a steady reduction from 10, 600 t in 2007 to 4,300 t in 2012. The majority of recent catches are taken by fixed gear (gillnet and line-trawl).

The level of total removals is uncertain. It is likely that historical landings have been biased both upwards (e.g., due to misreporting of catch by area and/or species) and downwards (e.g., due to discarding). In addition, commercial catch accounting procedures pre- and post-moratorium are radically different, with current measures likely to provide improved estimates of removals. In assessing stock status, it would be useful to better understand the accuracy of total removals, especially in the post-moratorium. Estimates of recreational fishery landings have not been available since 2006.

The 2012 assessment of 3Ps Cod indicated that the stock is above the limit reference point ($B_{Recovery}$). The report of the assessment meeting concluded: “Over 2009-2012, SSB has increased considerably. The SSB was estimated to be below the LRP during 2008 and 2009. The 2012 estimate is 64 % above the LRP, and the probability of being below the LRP in 2012 is very low (0.01). “

d) American Plaice-Division 3Ps

The status of this stock was last updated in 2012 and limit reference points determined from a Bayesian Surplus Production model. From 1994 to 1998 the catch was 400 t or less. Catch then increased substantially. During 2001 to 2003 the catch was greater than 1,000 t in each year.

Catch declined steadily since 2003 and was about 500 t per year from 2006 to 2009. Catch in 2010 was 402 t by NL. This stock has been under moratorium since September 1993 and catch has been mainly as bycatch in the Cod and Witch Flounder directed fisheries. Since 2006 catch has been about 500 t in most years.

Estimated stock size has been increasing slowly since 1993, however, current biomass is 50 % of Blim (40 % Bmsy) and therefore the stock is in the critical zone as defined by the DFO PA framework. The probability of being below Blim is high (0.94). Current fishing mortality is estimated to be 64 % of Flim (Fmsy). The probability of being above Flim is 0.2.

e) Witch Flounder-Division 3Ps

A TAC was first established for this stock in 1974 at 3,000 t, which remained in effect until 1988 when it was reduced to 1,000 t. It was further reduced to 500 t in 1996 and 1997 but was increased again to 650 t for 1998 and has remained at that level since then. Landings from this stock over the last 20 years have fluctuated between about 300 t and 1,000 t annually. In 2009 and 2010, the catch from the Newfoundland region was about 450 t each year, and in 2011 decreased to 175 t. The directed fishery is prosecuted by offshore otter trawlers and a nearshore Danish seine fleet. However, in recent years it appears to be a mixed American Plaice and Witch Flounder fishery by otter trawlers. Although survey stock size indices since 1983 have been highly variable, the survey biomass index during recent years suggests that the biomass is on average about 75 % of the 1983-90 average when catches were around 800 t. The age and size structure observed in this stock since the early 1980s also appeared to have remained stable with little change in growth pattern. Aging has not been conducted on Witch Flounder in this region since the mid-1990s. Geographic distribution has not changed appreciably since 1983 except during the early to mid 1990s when fish disappeared from the 51-100 fathom depth zone, coincident with extremely cold sea bottom water temperatures. In recent years the distribution appears to be returning to a more normal pattern.

f) Yellowtail Flounder–Division 3LNO

Since the fishery for this stock reopened in 1998, stock size has steadily increased and in 2011 was estimated to be 1.7 times Bmsy, well above the level of the mid-1980s. Annual spring and fall multi-species bottom trawl surveys have been conducted since 1971 and 1990 respectively. Evidence from the commercial fishery and various surveys indicates that the range of this stock has increased along with stock size since the mid-1990s. Fishing mortality was estimated to be relatively low and the stock biomass relatively high. In 2006, the majority of the Canadian directed fishery for Yellowtail Flounder did not take place due to a dispute in the industry. Since then, Canadian catch has ranged from 4,000 t to 11,400 t, well below the TAC in each year and in 2011 was 3,947 t. Scientific Council noted that this stock is well above Bmsy, and recommended any TAC option up to 85 % Fmsy for 2011 and 2012 (25.0 t and 22.9 t respectively). The TAC for 2012 was set to 17,000 t and Canadian catch was 1795 t. Scientific Council also noted that bycatch of Cod and American Plaice in the Yellowtail fishery needs to be considered in determining the TAC for yellowtail flounder.

g) American Plaice–Division 3LNO

Catches from this stock were generally in the range of 40,000 to 50,000 t per year throughout the 1970s and 1980s, before declining to low levels in the early 1990s. There has been no directed fishing on this stock since 1993. American Plaice is taken as by-catch in several fisheries; the majority of this by-catch is taken in the NAFO regulatory area (NRA). Canadian (NL) by-catch of American Plaice in 2011 and 2012 was 450 t and 267 t, respectively, caught primarily in the

Yellowtail Flounder fishery which in recent years has not fully taken the TAC. In 2011, STACFIS only had STATLANT 21A available and therefore total estimates of catch could not be derived. The SSB estimated from a Virtual Population Analysis (VPA) has been gradually increasing since the mid-1990s and was estimated at 34,000 t in the 2012 assessment. The B*lim* for this stock is 50,000 t.

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. Further work continued on the biological basis for management units for two species (*Sebastes fasciatus* and *S. mentella*) and a final Canadian workshop concluded that a review based on genetics, morphometrics and otolith chemical signature suggests that Units 1 and 2 corresponds to a single biological population of each species and recommended these Units should be combined for assessment purposes. An assessment was held in February 2010 (see http://www.dfo-mpo.gc.ca/CSAS/Csas/publications/sar-as/2010/2010_037_e.pdf) which evaluated *Sebastes mentella* and *S. fasciatus* separately in the area covered by the combined management units of Unit 1 and Unit 2.

For the UNIT 2 portion (primarily Div. 3P4V) of the combined stock UNIT1&2, total Canadian catches have declined steadily from 27,000 t in 1993 to 8,000 t in 2002, matching reductions in TACs. From 2002-05 the TAC has been stable at 8,000 t while catches declined from about 7,500 t in 2003 to 6,100 t in 2005. In 2006 the TAC was increased to 8,500 t and maintained at that level to 2012, whereas catches have fluctuated between 2,500 t to 6,700 t from 2006-2011 and were about 6,500 t in 2012. About 300 t of the 2012 catch was taken by the Canada (NL) fleet. Current management regulations include a closure related to peak spawning in May and June, and a minimum landing size restriction at 22 cm.

Canada has had limited interest in a fishery in Div. 3O because of small sizes of Redfish encountered in areas more suitable for otter trawling. Canadian landings were less than 200 t annually from 1983 to 1991 but increased in the early 1990s. Between 1996 and 2000 Canadian catches 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 100 t in 2011. The Canadian catch of 3O Redfish in 2012 was <1 t. Canada (NL) has generally accounted for more than 95 % of the Canadian catch since 2001. From 1974-2004, Div. 3O was under TAC regulation set by Canada within its jurisdiction, while catches were unrestricted in the NAFO Regulatory area of Div. 3O. Since 2004, NAFO Fisheries Commission has set the TAC for Div. 3O Redfish at 20,000 t.

i) Witch Flounder-Division 3NO

There has been no directed fishing on this stock since 1994. Canada (NL) bycatch has ranged between 11 t and 94 t since 2001. There were some signs of improvement in stock status, notably the increases in Canadian autumn survey indices in 2008-2010, but there is considerable uncertainty, and more recent survey estimates have been lower. Recent work has focused on trying to estimate reference points under the precautionary approach.

j) White Hake–Division 3NOPs (Division 3NO in NRA)

Prior to 1995, White Hake was taken as bycatch in other demersal fisheries on the Grand Banks. Average estimated catch during 1985-90 was approximately 5,000 t. Annual catches in a new directed (Canadian) fishery on the Grand Banks, starting in 1995 and encompassing Div. 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. STATLANT average reported catch was 1,074 t over 2007-11. Preliminary 2012 STATLANT catch for 3NOPs is 282 t. The current TAC for White Hake in 3NO for 2013 is 1,000 t, although inseason adjustments are possible for this stock.

The dominant feature of the White Hake abundance indices was the peak abundance observed over 1999-2001. Following the very large 1999 year class, the stock declined to a lower level comparable to levels observed prior to the recruitment pulse. The survey indices for this stock remain at a low level relative to the 1999-2002 peak period.

k) Thorny Skate–Division 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. A TAC of 5,000 t for divisions 3LNO and 1,000 t for Subdivision 3Ps were adopted by Canada in 1995. In 1996, the TAC was raised to 6,000 t for Div. 3LNO and 2,000 t for Subdiv. 3Ps. In 1997, the TAC was reduced to 1,950 t for Div. 3LNO and 1,050 t for Subdivision 3Ps. The Canadian fishery includes otter trawl, gillnet and longline gear while the non-Canadian catches are taken by otter trawl.

Outside Canada's 200-mile limit, catch was unregulated until September 2004, when the Fisheries Commission of the Northwest Atlantic Fisheries Organization (NAFO) set a TAC of 13,500 t for 2005-2009 in Div. 3LNO. This quota was lowered by NAFO to 12,000 t for 2010-11; then to 8,500 t for 2012. The TAC was further reduced to 7,000 t for 2013. The TAC for Subdiv. 3Ps in the EEZ was maintained at 1,050 t by Canada.

Average STATLANT catch for 2006-11 was 6,949 t in 3LNO, and 947 t in Subdivision 3Ps.

Thorny Skate underwent a decline in the late 1980s to early 1990s followed by a slight increase in the late 1990s. Since then, abundance indices have remained relatively constant at low levels.

l) Shrimp–Division 3LMNO

Catches increased dramatically since 1999, with the beginning of a regulated fishery. Over the period 2002-09, catches increased from 6,960 to 27,914 t. Due to declines in resource indices, the TACs have been steadily decreasing with the 2013 TAC being set at 8,600 t during the 2012 Fishery Commission meeting. Preliminary catch records indicate that 14,046 t of shrimp were taken from a 19,200 t TAC in 2011. By October of 2012, 8,561 t of shrimp had been taken, down from the 11,434 t taken by the same time in the previous year. As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 5 402 t in 2002 to 20,147 t in 2008 but have since decreased to 8,246 t in 2011. Canadian vessels had taken 7,867 t of shrimp by October 2012 down from the 8,945 t taken by this time last year.

Catches by other contracting parties increased from 661 t in 2000 to 7,703 t in 2006 and between 2006 and 2011 have ranged between 3,844 and 7,703 t. Preliminary data indicate that non

Canadian vessels took 694 t of Northern Shrimp by October 2012 while they took 2,489 t by the same period in the previous year.

Canadian Fleet

Small vessel CPUE (2000–2012) was modeled using year, month and size class (class 1 = <50' LOA; 50' LOA <=class 2<60' LOA; class 3 => 60' LOA) as explanatory variables. The model standardized data to 2001, class 3 and July values. The logbook dataset that was used in this analysis accounted for between 60 % and 95 % of the catch within any one year. The final model explained 82.2 % of the variance in the data and indicated that the annual, standardized catch rates increasing from near 300 kg/hr over 2000–2002 to 570 kg/hr by 2005 before gradually decreasing to 250 kg/hr by 2012. The 2001 catch rate index was similar to the 2002 and 2010-2012 indices while being significantly lower than all intervening indices.

Seasonality among the large vessel fleet has varied greatly over the years. The data were analyzed by multiple regression using data standardized against data from 2001, single trawls, the vessel with the longest history and December data. 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 40 % and 100 % 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 between 2004 and 2008, increased in 2009 but have since been decreasing. The 2001 standardized catch rate index (1,356 kg/hr) was similar to the 2003, 2005-09 and 2010 values but significantly higher than the 2011 and 2012 values. The 2012 CPUE index was 459 kg/hr.

International fleet

The Statlant21B data was used to create a standardized international fleet CPUE model. Most of the data were from Faroese vessels that were tonnage class 6 (1,000–1,999.99 t) therefore the model was produced for these vessels only. The model accounted for 72 % of the variance in the data and was standardized to 2001 and December. The index for 2001 was statistically similar to indices for 2002 and 2003 while all others were significantly higher. The catch rate was 77 kg/hr, in 2001, fell to 33 kg/hr during 2003 and then rose 566 kg/hr by 2004 and has been near or above the long term mean (366 kg/hr) until 2010 when the catch rate increased to 669 kg/hr. There were no trends in the residuals around parameter estimates; however, there was an anomalously high catch in May 2002.

Catch rate data provided by researchers accounted for 1–45 % of the non Canadian catch in any one year and it was felt that these percentages of the entire catch were not high enough to construct a meaningful standardized CPUE model. The data were therefore used to create an unstandardized international CPUE series. Unstandardized international indices increased from 381 kg/hr in 2001 to 2,035 kg/hr in 2004, decreased to 570 kg/hr in 2005, remained near that level in 2006 before increasing to 1,264 kg/hr by 2009 and subsequently dropping to 640 kg/hr by 2011 and remaining at that level in 2012. It is not clear how representative these commercial catch rates are of the international fishery in the 3L NRA since in any one year there may be data from only one or two countries.

m) Snow Crab–Division 3KLNOPs

In Div. 3K offshore, landings peaked at 12,600 t in 2009 but decreased by 52 % to 6,000 t in 2012. The TAC was not achieved in the past 3 years. Effort peaked in 2009 and has since declined by 31 %. CPUE declined by half from 2008 to 2011 and changed little in 2012. The exploitable biomass, as indicated by the post-season trap and trawl surveys, declined by more than half from

2008 to 2011 and was unchanged in 2012. Recruitment declined after 2008 and prospects remain poor in the short term (2-3 years). Post-season pre-recruit biomass indices from both trap and trawl surveys have decreased by about 55 % after 2008. Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime. The trawl survey-based exploitation rate index increased sharply from 2008 to 2010 and changed little in 2011 before decreasing in 2012. The pre-recruit fishing mortality rate index increased from 2007 to 2011 but decreased in 2012. The percentage of the catch handled and released in the fishery increased from about 7 % in 2008 to about 20 % in 2012 implying a potential increase in pre-recruit mortality. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate but would likely result in high mortality on soft-shelled immediate pre-recruits in 2013.

In Div. 3K inshore, landings increased from 2,200 t in 2005 to 2,900 t in 2009, but decreased by 34 % to 1,900 t in 2012. The TAC was not taken in the past 4 years in 2 of the 3 management areas. Effort increased by 70 % from 2008 to 2011 before decreasing by 19 % in 2012. CPUE increased sharply from 2005 to a record high level in 2008, then declined by more than half before increasing slightly in 2012. The exploitable biomass, as indicated by the post-season trap survey, decreased from 2007 to 2009 and since changed little but there is considerable variability among management areas. While uncertain, recruitment prospects appear to have changed little and there is considerable variability among management areas. The trap survey-based exploitation rate index changed little between 2011 and 2012. Data are insufficient to estimate the pre-recruit fishing mortality rate index. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013. However, it would likely result in high mortality on soft-shelled immediate pre-recruits in some management areas in 2013.

In Div. 3LNO offshore, landings decreased by 11 % from 24,500 t in 2006 to 21,900 t in 2009 but since increased by 20 % to 26,200 t in 2012. Effort increased by 80 % from 2000 to 2008 and has since declined by 23 %. VMS-based CPUE declined to its lowest level in 2008, but has since increased steadily to above the average of the series. The trawl survey index of exploitable biomass declined from 2009 to 2011 and changed little in 2012. The index from the trap survey, which tends to capture older-shelled crabs relatively better than new-shelled crabs in this area, peaked two years later in 2011 and changed little in 2012. Recruitment has recently peaked and will likely decrease in the short term (2-3 years). Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime. The exploitation rate index increased during the past two years following a sharp decrease from 2008 to 2010. The pre-recruit fishing mortality rate index decreased from 2008 to 2011 but increased in 2012. The percentage of the catch handled and released in the fishery decreased from about 20 % in 2008 to 12 % in 2012, implying a potential decrease in pre-recruit mortality. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

In Div. 3L inshore, landings increased by 19 % from 6,100 t in 2005 to 7,300 t in 2010, and have since changed little, at 7,400 t in 2012. Effort increased by 24 % from 2008 to 2010 but has since declined by 22 %. CPUE increased sharply in 2012 to its highest level since 1995, after varying about the long term average for the previous 5 years. The post-season trap survey index suggests that the exploitable biomass increased in 2012 to its highest level in the time series. Recruitment has recently peaked and is in decline, although there is considerable variability among management areas. Short-term (2-3 years) prospects are uncertain. The trap survey-based exploitation rate index changed little in 2012 but there was considerable variability among management areas. Data are insufficient to estimate a pre-recruit fishing mortality rate index. Maintaining the current level of fishery removals would likely result in a decrease in the exploitation rate in 2013.

In Subdiv. 3Ps offshore, landings almost doubled from 2,300 t in 2006 to a peak of 4,300 t in 2011, before decreasing by 14 % to 3,700 t in 2012. Effort increased by 57 % from 2008 to 2011 before decreasing slightly in 2012. CPUE increased from 2005 to 2009 and has gradually declined since. The exploitable biomass, as indicated by both the spring trawl survey and the post-season trap survey indices, increased steadily from 2006 to 2009 before declining sharply from 2009 to 2011 and changed little in 2012. Recruitment has recently declined and is expected to decline further in the short term (2-3 years). Pre-recruit biomass indices from both trap and trawl surveys declined sharply from 2009 to 2011 and changed little in 2012. Long-term recruitment prospects are unfavourable due to a recent warm oceanographic regime. Exploitation and pre-recruit fishing mortality rates, as indicated by spring trawl survey indices, decreased from 2007 to 2009 but increased sharply to 2011 and changed little in 2012. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

In Subdiv. 3Ps inshore, landings peaked at 3,500 t in 1999, declined to 700 t in 2005, then more than tripled to 2,500 t in 2012. Effort declined from 2005 to 2010 and increased by 36 % to 2012. CPUE increased steadily from 2005 to 2010, its highest level since 1996, and has since changed little. The exploitable biomass, as indicated by the post-season trap survey index, increased substantially between 2006 and 2010 and has since changed little. Recruitment has recently decreased. The index of pre-recruit-sized males has recently decreased, suggesting a further decline in recruitment in the short term (2-3 years). The post-season trap survey-based exploitation rate index changed little during 2008 to 2011 but increased in 2012. Data are insufficient to estimate a pre-recruit fishing mortality rate index. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

n) Iceland Scallop–Division 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 no fishery for Iceland Scallop in Div. 3LNO from 2009-11. In 2012 there was a removal of 11 t in 3LN. 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. Since 1992 it has been 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 2012 there was 2 t of Iceland Scallop removals, in 2010 & 2011 there were no removals, in 2009, only 2 t of a total 3,500 t TAC were removed, less than the 5 t taken in 2008. 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 DFO resource survey in September 2009.

o) Sea Scallop–Subdivision 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. Landings almost doubled in 2010 to 842 t (round) from 432 t in 2009 which was an increase from the 293 t landed in 2008. Landings increased again in 2011 and 2012 to 920 t and 1190 t (round) respectively.

There were 9 t (round) of Sea Scallops removed by inshore vessels in Div. 3L in 2010.

There were no Sea Scallop landings from Div. 3L in 2011 or 2012.

p) Squid–Subarea 3

Following a peak catch in 1979 of about 88,800 t, the Subarea 3 catch declined regularly to 5 t in 1983. Catches remained lower than 5,000 t during the thirteen-year period 1983 to 1995. They increased since 1995 to about 12,700 t in 1997 before declining sharply to about 800 t in 1998 and about 20 t in 1999. They remained low, at about 300 t, in 2000, decreased to only about 20 t in 2001 and increased to about 2,500 t in 2004. Catches decreased to about 550 t in 2005 and then increased to about 7,000 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 has since remained low, declining steadily from about 520-640 t in 2008-09 to about 100 t in 2010 and only about 20 t in 2012.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

Physical oceanographic observations are routinely collected during marine resource assessment and research surveys in the Newfoundland and Labrador Region. The Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2011 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Nail Bank on the mid- Labrador Shelf. The first was conducted on the CCGS Teleost from April 11 to 30. The second survey on CCGS Teleost took place from July 9-27 and the last on CCGS Hudson from November 19 to December 09. 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) *Physical Environment*

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2012 in NAFO Div. 2J and 3KLNOP. The results were based on physical observations collected on the NL Shelf from Makkovik Bank to the Southern Grand Bank and on St. Pierre Bank from the AZMP and fisheries assessment surveys. At Station 27, the depth-averaged annual water temperature decreased to 0.4°C above normal from the record high of 1°C in 2011. Annual surface temperatures at Station 27 increased to 1°C above normal while bottom temperatures (176 m) decreased to 0.4°C down from the record high of 1.3°C in 2011. The annual depth-averaged salinities at Station 27 were below normal for the 4th consecutive year. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf (Bonavista Section) during 2012 increased to slightly below normal from the record low value in 2011, implying a continuation of warm conditions. On the Grand Bank the CIL was about normal during the summer of 2012. Spring bottom temperatures in NAFO Div. 3Ps and 3LNO during 2012 were above normal by an average of about 1°C a moderate decreased over 2011 conditions. During the fall, bottom temperatures in 2J, 3K and 3LNO decreased by about 1-2°C from 2011 values, a significant decrease. The volume of CIL (<0°C) water on the NL shelf during the fall was close to normal.

b) *Plankton studies*

The extent of nitrate uptake in the upper water-column was noticeably higher at Station 27 in 2010-12 compared to previous years. In recent years, the annual mean upper water-column (<50 m) nitrate inventory at Station 27 has decreased by more than 50 % from the start of the program. The monthly <50m nitrate inventory anomalies were also consistently negative for almost all sampling months during 2010-12. The deep (50-150m) inventories of nitrate at Station 27 continue to show a downward trend in 2011 and 2012 compared to earlier years, with levels only slightly above the record-low observed in 2010.

The seasonal development of phytoplankton blooms at Station 27 was substantially earlier in recent years from the April-May to March-April period. Integrated chlorophyll a levels at Station 27 were below normal conditions in 2011–2012 and were at the lowest level observed in the time-series at ca. 50 % of the long-term average. The annual mean anomalies of the monthly values of integrated chlorophyll a in 2011 were the lowest observed in the time-series and remained below average in 2012. MODIS satellite imagery over the Newfoundland and Labrador Shelves indicated weaker spring and autumn blooms compared to previous years. In general, the surface blooms occurred later, were less intense and in many cases shorter in duration. Metrics describing the seasonal dynamics of the production cycle based on satellite imagery have shown considerable variability over time with some coherent trends observed among the sub-regions during certain years.

The abundance of small copepods along ocean sections show divergent trends with a number of species that increased during 1999-2012, and another group of species that have declined steadily.The abundance of *C. finmarchicus* has increased in recent years with the highest levels being recorded along the southern Grand Bank section in 2011 and the Flemish Cap section in 2012. The abundance of *Calanus glacialis* and *Calanus hyperboreus* has shown long-term declines in abundance on the Flemish Cap and southeast Grand Bank starting in 2001, and shorter term declines on the Bonavista Bay and Seal Island section since 2009. Copepodite biomass at Station 27 in 2011-12, based on the abundance of 8 dominant taxa, has demonstrated in consistent decline over time since the record high levels observed in 2009. Analysis of yearly patterns in abundance reveals dramatic shifts in phenology of ecologically-important copepod species such as *C. finmarchicus* and *Pseudocalanus spp.* have occurred at S27 starting approximately in 2005, when the fall cohorts increases in relative abundance.

2. Biological Studies

a) Groundfish

Biological and oceanographic data from spring (3LNOP) and fall (3KLNO) multi-species research vessel surveys were collected to conduct distribution and abundance studies and detailed biological sampling were used to conduct analyses of growth, maturity and condition.

Analysis of sexual maturity data is conducted regularly on Cod, American Plaice, Yellowtail Flounder, Greenland Halibut and other species and are presented to the annual meeting of NAFO Scientific Council during assessments of American Plaice in Div. 3LNO, Yellowtail Flounder in Div. 3LNO, Greenland halibut in SA2+Div. 3KLMNO as needed. Research on Greenland Halibut age and growth is ongoing, using bomb radiocarbon dating to validate an ageing method.

Work continues on the autodiametric method of determining fecundity for Cod, Yellowtail Flounder, American Plaice and Witch Flounder and Greenland Halibut. Fecundity samples are being collected from the spring survey in 3Ps and 3LNO and will be analyzed using this new, more efficient method. There is sufficient data for calibration for Cod, Yellowtail Flounder and Greenland Halibut but work continues to collect more samples for extending the calibration curves for American Plaice and Witch Flounder. This work is necessary before the new method can be used to estimate fecundity in these species.

b) Capelin

Monitoring larval emergence from beach sediments and from bottom spawning sites in the Bellevue Beach area of Trinity Bay continued in 2012. An ongoing offshore acoustic survey initiated in the spring of 1999 to monitor Capelin distribution, behaviour, and feeding habits in Div. 3L continued in 2012. Inshore surveys were conducted in August and in September of 2012 to map the abundance and dispersal of larval Capelin in Trinity Bay, Div. 3L. Since 2008 acoustic data have been collected during the fall multispecies bottom trawl survey in Div.2J3KL, along with enhanced sampling of the biology and feeding of forage fishes. Analyses of these fall acoustic data will begin in 2013.

c) Atlantic Salmon

Differences in marine feeding ecology of three geographically distinct populations of Atlantic Salmon in the North Atlantic were examined using analyses of stable isotopes of carbon and nitrogen. Significant differences were found among populations and between different sea-age life history groups. Reported differences in marine feeding between populations from the Northeast and Northwest Atlantic were corroborated by stable isotope results. Additional investigations have focused on characterizing trophic position and shift in Salmon from freshwater to marine life-cycle phases. These studies are based on changes in stable isotope signatures among life stages (smolt, 1SW, and 2SW) from various Canadian populations that extend from New Brunswick and Nova Scotia to Labrador, with comparisons with Salmon obtained from the West Greenland area. Results show a high reliance on pelagic food webs in the marine environment.

Recreational Salmon catch statistics are incorporated into the annual assessments of stock status and are also used as part of a process to determine pre-fishery abundance of Salmon in the Northwest Atlantic. A recent study has examined changes in angler demographics over a 17-year period. Key findings identified changes in angler participation and demographics among different regions of Newfoundland and Labrador with a significant increase in the mean age of anglers. Return rates of angler catch logs, used in Salmon stock assessments, also declined over time and were found to vary by age, sex, and area of angler residence. The impact of identified changes on the interpretation of annual catch statistics is currently unknown.

Several new Atlantic Salmon genetic projects began in 2011 in Subarea 3, funded in part by the Genomics Research and Development Initiative. Population genetic data (microsatellite loci) is presently being collected (~50 rivers). This data will be used to examine spatial population structure and management units and preliminary analysis suggests significant spatial structuring on regional and local scales. This data will be used as part of a North American genetic baseline to analyze samples (collected in 2004) from several mixed stock harvests including the fisheries off Saint Pierre and Miquelon fishery and west Greenland. Genomic diversity associated with local adaptation is currently being explored for populations along Newfoundland's south coast using large panels (10,000's) of single nucleotide polymorphisms. All samples have been collected and analysis is underway.

d) Shrimp

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

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

In 2011, Northern Shrimp research with NL Region became involved in an International Governance Strategic Fund project to assess the response of Northern Shrimp (*Pandalus borealis*) populations to climate change and variability. This project has inter-regional collaboration with the Drs. Patrick Ouellet and Denis Charbot of the Maurice Lamontagne-Institute as well as international collaboration with Dr Piero Calosi of University of Plymouth in England. The objective of this project is to assess how the ongoing changes in ocean water temperatures (Climate Change) will affect the distribution, productivity and resilience of Northern Shrimp populations in the Northwest Atlantic, both inside and outside Canadian waters. Polar taxa or populations also have been shown to be highly stenothermal and limited in their abilities to adapt; therefore, we predict that the northern most Shrimp populations to be highly vulnerable to warming. This hypothesis is in opposition to the current popular suggestion that Shrimp abundance may increase at higher the latitude and/or expand further northward as warming continues.

e) Snow Crab

Long-term trap and trawl surveys in White Bay (3K), Notre Dame Bay (3K), Bonavista Bay (3L), and Conception Bay (3L) were continued in 2012. These surveys collect information on biological and population parameters and are used in annual assessments of Snow Crab. The surveys have also been used for past and on-going research into the incidence and impacts of bitter Crab disease in NL Snow Crab. A similar survey was initiated in Fortune Bay (3Ps) in 2007 and was continued in 2012. A mark-recapture tagging experiment was conducted during the Notre Dame Bay (3K) survey in 2011 and 2012.

A post-season trap survey which began throughout most of 2J3KLNOPs in 2004 was continued in 2012.

f) Cod

A calibration curve for the autodiametric method of determining fecundity has been completed. Fecundity samples are being collected from the spring survey in Subdiv. 3Ps and Div. 3LNO and will be analyzed using this new, more efficient method. This sampling has become a regular part of the spring research vessel survey in order to establish a time series of fecundity estimates.

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

SUBAREA 4

A. STATUS OF FISHERIES

Nominal landings from 2003 to 2012 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) Atlantic Salmon–Subarea 4

The commercial fishery for Atlantic Salmon in Subarea 4 has remained closed since 1992. The 2012 recreational harvest, including both retained and hooked-and-released, was 19,808 Salmon, 3 % less than last year and 11 % less than the previous 5 year mean.

Two of the three assessed rivers in Subarea 4 achieved conservation spawning requirement in 2012.

b) Snow Crab–Div. 4R

In Div. 4R offshore, landings declined by 83 % from 190 t in 2007 to a historical low of 30 t in 2010, but increased back to 190 t in 2012. Effort increased by a factor of four in 2011 following the historical low in 2010 and changed little in 2012. The TAC has not been taken since 2002. VMS-based CPUE declined from 2004 to its lowest level in 2009 before increasing to the average of the series in 2012. The exploitable biomass remains low relative to other areas. Recruitment prospects are uncertain in the short term (2-3 years). Long term recruitment prospects are unfavourable due to a recent warm oceanographic regime. Data are insufficient to calculate the exploitation rate and pre-recruit fishing mortality rate indices. The effect of maintaining the current level of removals on the exploitation rate in 2013 is unknown.

In Div. 4R inshore, landings declined by 80 % from 950 t in 2003 to a historical low of 190 t in 2010. They more than doubled to 450 t in 2011 and increased further to 550 t in 2012. Effort declined by 95 % from 2004 to 2010 and doubled in 2011 before decreasing substantially in 2012. The TAC has not been taken since 2002. CPUE declined by more than half from 2002 to 2007 and changed little to 2010 before more than doubling to 2012. The exploitable biomass, as indicated by the post-season trap survey, fluctuated at a low level from 2006 to 2010 but tripled in 2011 and changed little in 2012. Recruitment has recently increased and is expected to remain strong in 2013, but short-term (2-3 years) prospects are unfavourable. The post-season trap survey-based exploitation rate index decreased sharply in 2012. Data are insufficient to estimate a pre-recruit fishing mortality rate index. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate in 2013.

c) Iceland Scallops–Div. 4R

The nominal catch from the Strait of Belle Isle (Div. 4R) in 2012 dropped to 295 t (round) against a TAC of 1,000 t after almost doubling in 2011, 431 t (round) from the 2010 removals estimated at 244 t (round). There was 246 t removed in 2009, up from 111 t removed in 2008. 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.

d) Sea Scallops–Div. 4R

The Sea Scallop removals in 4R in 2009, 2010, 2011 & 2012 were 15 t, 27 t, 48 t and 66 t (round) respectively.

SUBAREA 0 + 2 + 3

In 2009 a three year project proposal was accepted under the International Governance Strategy (IGS). The objectives were to develop sampling protocols for Sponge collections on all research surveys for the Newfoundland and Labrador, and eastern Arctic Regions, as well as increase taxonomic expertise on Sponges.

Since the inception of the project, all research surveys conducted by the Newfoundland and Labrador Region have a standardized collection protocol in place for Sponges. Sea-going staff, including fisheries observers from the Newfoundland and Labrador Region, have been briefed on Sponge collections at sea.

To date over 1,500 Sponges have been sampled and processed with at least 80 species delineated. Species identification sheets are being developed for each species as well as a general identification guide to be used on local research surveys and by fisheries observers. In addition, information on Sponges processed from this region contributed significantly towards the Sponge Identification guide for NAFO Areas (Best *et al.*, 2010).

SUBAREA 2 + 3 + 4

A. STATUS OF FISHERIES

Nominal landings from 2003 to 2012 for fish stocks are listed in Table 1. Additional information on the status of the fisheries is as follows:

a) Lobster

Total reported landings for Newfoundland have remained relatively stable since the 1960s. Reported landings declined through the 1990s to 1,800 t in 2000, from a peak of 3,200 t in 1992. Reported landings increased to 2,300 t in 2003, and then decreased to 1,900 t in 2004. Landings averaged about 2,600 t from 2005 to 2010 with little variability but declined by 26 % in 2011 to 1,900 t before increasing by 11 % to 2,200 t in 2012. Landings had been increasing in Subdiv. 3Ps up to 2010 but had a sharp decline in 2011. Landings in Div. 4R had a recent peak in 2008 but have declined to the values of the late 1990s. Landings in Div. 3K and 3L have declined to record lows. Landings in all divisions, Div. 3KLPs4R, have shown slight increases in 2012. The reported landings have become spatially concentrated. The contribution of the most productive Lobster fishing area (LFA 11) to the reported landings has increased from less than 15 % in the early 1990s to around 45 % in the last three years. Nominal effort (based on active fishers, trap limits & fishing days) has decreased by 31 % since 2008, due to license retirements, fewer active fishers, shorter seasons, and trap limit reductions.

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. A mandatory logbook has been in place since 2010. At-sea sampling data from at least one LFA in each division clearly show a sharp drop at legal size and few Lobsters achieving the second molt class, indicating that most of the exploitable biomass is caught in the year of recruitment to the fishery and annual survival of males is generally less than 0.2. The survival of females is slightly higher. Mean catch rates of pre-recruit Lobsters show little annual variation and there is no apparent relationship between these catch rates and future commercial reported landings or CPUE. CPUE has changed little over the time period for which data are available (2004-12).

b) Marine Mammals

An ongoing programme of collections involving sealers and DFO personnel from Newfoundland, Labrador and the Gulf of St. Lawrence continues to provide annual biological samples of Seals (Harp, Hood, Ringed, Bearded, and Grey) captured during the commercial hunt in the region. These data facilitate the long term monitoring of reproductive status, diets, and the growth and condition of Seals during a period of significant ecological change.

Multi-disciplinary studies on Harp and Hooded Seal population dynamics and Seal-fish interactions continued in 2012. Consumption of Atlantic Cod and Capelin by Harp Seals off the east coast of Newfoundland in NAFO Divisions 2J3KL was estimated by integrating information on the numbers at age, age specific energy requirements, seasonal distribution and diet of Harp Seals in the Newfoundland area. The impact of different diet determination methods was explored by estimating consumption based upon the proportion of Cod in the diet obtained using traditional hard part analysis, a multinomial regression approach and fatty acid signatures. Bioenergetic-allometric biomass dynamic models were constructed to determine if predation by Seals is an important factor controlling the population dynamics of Atlantic Cod or Capelin in the area. Overall, the best model to fit the data to explain abundance of Cod was one including Capelin and fisheries catches, but without Seal consumption. Based upon the results of this simple model, consumption of Cod by Harp Seals does not appear to be an important driver of Northern Cod during the study period. Instead, fisheries and availability of food appear to be the important drivers of the dynamics of this stock. Environmental factors such as ice cover appear to be more important in influencing the dynamics of Capelin stocks than Seal predation.

Annual estimates of late term pregnancy rates, fecundity and mean age of sexual maturity of Northwest Atlantic Harp Seals were obtained from samples collected off the coast of Newfoundland and Labrador between 1954 and 2010. Estimates of the total number of Seals in the Northwest Atlantic declined from 3.0 million in the 1950s to 1.8 million in the early 1970s, then increased steadily to approximately 7.5 million in 2010. Pregnancy rates among 3 year olds remained low (<10 %) throughout the time period while those of 4 and 5 year olds initially increased during the 1970s, but declined by the mid 1980s to levels similar to, or lower than, those seen in the 1960s. Pregnancy rates for 6-year-olds were low (<67 %%) since the mid 1990s when compared with earlier years when rates averaged around 80 %. Among the older Seals, pregnancy rates were high (80–90 %) until the mid 1980s, but then declined. Since then, pregnancy rates fluctuated greatly, but averaged around 60 %. Since 2008, pregnancy rates have declined significantly to less than 30 %. The proportion of mature females that give birth (i.e., fecundity rate) showed a similar trend, remaining relatively high until the mid 1980s and then declining. Recent fecundity rates have been highly variable, with years of low pregnancy rates being associated with high levels of late-term abortions.

Although the direction of the changes we have observed are consistent with a density dependent response to changes in population size, dramatic changes in the northwest Atlantic ecosystem have also occurred at the same time. A number of physical and biological factors were examined to determine which may have influenced pregnancy rates in Harp Seals. The overall decline in average fecundity appears to be a response to increases in population size. The interannual variation, however, is best explained by changes in the rates of late term abortions. In turn, the abortion rates appear to be influenced by early winter ice conditions and food availability, as indicated by Capelin abundance in the preceding fall surveys. This suggests that population dynamics of Northwest Atlantic harp seals is being influenced by a complex interplay of internal and external factors that include both physical and biological factors.

Photographic and visual surveys were carried out in March 2012 to determine pup production of Northwest Atlantic Harp Seals. The photographs are currently being read and the results of these surveys will be presented for peer review in the fall of 2013. They will be used to provide a current estimate of Harp Seal abundance.

The abundance of Northwest Atlantic Harp Seals was estimated using a population model that incorporated information on reproductive rates, reported removals, estimates of non-reported removals and losses through bycatch in other fisheries to determine the population trajectory. The model was fit to eleven periodic estimates of pup production from 1952 to 2008, and to annual pregnancy rate data collected between 1954 and 2012. Pup production declined throughout the 1960s reaching a minimum in 1971, and then increased to a maximum in 2008. Estimated pup production in 2012 was 1.5 million animals (95 % CI=1.0-2.1million); the total estimated population size in 2012 was 7.1 million (95 % CI=5.9 to 8.3 million). Fitting the model to both the aerial survey data and the reproductive rate data (age classes 8+ only), resulted in estimates of carry capacity (K) =10.0 million. Ice conditions, reproductive rates and removals from the Greenland harvest continue to be important factors affecting the dynamics of this population. Modifications to the assessment model have provided a means of estimating environmental carrying capacity assuming a certain functional relationship between total population size and juvenile survival, and between population size and reproductive rates.

Reconstructing historical population size provides useful information for management and conservation by providing an indication of abundance prior to exploitation. When combined with environmental variables, such estimates can also provide insights into how a species may respond to climate change. Harp Seals have been commercially exploited since the early 1700s, although significant catches did not begin until early in the 19th century. Catch data from historical records and recent harvests were incorporated into a surplus production model to reconstruct the dynamics of this population back to the late 18th Century.

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 is to deploy satellite-linked time depth recorders on both young and adult Seals to monitor annual movements and diving behaviour. In addition, these transmitters also provide oceanographic data that is being used to develop and/or improve oceanographic models for the north Atlantic. Data from this program have contributed to an understanding of the circulation of warm subtropical waters in a fjord in east Greenland. The importance of physiological factors such as depth, slope, temperature, ice and chlorophyll on determining habitat use in hooded Seals is being examined using first passage time analyses. A paper describing the results of this study has been accepted for publication.

A study to characterize the noise environment and marine mammal assemblages for candidate Valued Marine Ecosystems (VMEs) on the Grand Banks and NAFO Regulatory areas was initiated. DFO deployed two AURAL autonomous acoustic recorders in offshore locations (and several in nearshore locations for comparative purposes) to 1) characterize the acoustic environment of several VME and/or LOMA sites, and 2) use these data to identify which marine mammal species are associated with identified VMEs/LOMAs, some of which are listed under SARA. The deployment areas have never been monitored acoustically before, so information gathered in these areas is useful for comparative studies of biological and anthropogenic sources with adjacent and distant regions.

Adopted in 2003, the Atlantic Seal Management Strategy, formerly referred to as Objective Based Fisheries Management (OBFM), was the first plan to incorporate a precautionary approach in the management of marine species in Canada. It provides a framework that identifies precautionary and critical reference limits which define healthy, cautious and critical zones of abundance, along with management actions that are triggered when thresholds are exceeded to reduce potential damage to the resource. Currently, the precautionary and critical reference levels are defined as 70 % and 30 % of the maximum population size. To determine if the strategy meets the management objectives within the Precautionary Approach framework, a series of simulations (reported last year) were carried out to test the various components of the current approach. Canadian scientists are examining methods to apply a similar approach to the management of all marine mammals.

Reported Canadian commercial catches of harp and hooded seals

	Harp	Hood
2003	289,512	151
2004	365,971	389
2005	329,829	28
2006	354,867	40
2007	224,745	17
2008	217,850	5
2009	76,668	10
2010	69,101	0
2011	40,393	2
2012	69,189	1

In 2012, there are two ongoing satellite tagging program for ringed Seals along the Labrador coast; one in collaboration with the Torngat Joint Fisheries Board and the other with the ArcticNet Nunatsiavut Nuluak Project. There have been seven Seals tagged in the Torngat Program with an additional six tags to be deployed in the fall of 2013. Thirteen Seals have been tagged in the Nunluak Project with data analyses ongoing. Ringed Seals along the Labrador coast exhibit movement patterns that are consistent with other areas where tagging has been done on this species. Some Seals travelled several hundred kilometers as far north and west as Baffin Island and Ungava Bay and as far south as Notre Dame Bay in Newfoundland while others show very localized movements. Research examining the changing availability of Ringed Seal pupping habitat along the coast of Labrador is continuing. In 2012, the focus was on developing a GIS-based model using PCI Geomatica Software to identify, map and quantify available land fast ice habitat based on RADARSAT-1 imagery; analyses are ongoing.

B. SPECIAL RESEARCH STUDIES

1. Miscellaneous Studies

a) Atlantic Salmon License Stub Return System

Recreational Salmon catch statistics are incorporated into the annual assessments of stock status and are also used as part of a process to determine pre-fishery abundance of Salmon in the Northwest Atlantic. A recent study has examined changes in angler demographics over a 17-year period. Key findings identified changes in angler participation and demographics among different regions of Newfoundland and Labrador with a significant increase in the mean age of anglers. Return rates of angler catch logs, used in Salmon stock assessments, also declined over time and were found to vary by age, sex, and area of angler residence. The impact of identified changes on the interpretation of annual catch statistics is currently unknown.

b) Sentinel Studies

The Sentinel Surveys, initiated in October 1994, were continued in 2012. Data collected were tabled at Regional stock assessments in the spring of 2013 for Div. 2J3KL Cod. Sites in Div. 2J3KL, Subdiv. 3Ps and Div. 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.

c) Cod Tagging and Telemetry

Tagging and telemetry studies on Cod in Div. 2J3KL were continued in 2012. Approximately 4,500 Cod were tagged and released with Floy tags; in addition detections of 150 acoustically tagged Cod were released inshore in 3KL during 2010 were obtained from acoustic receivers. The receivers have been deployed along a 350 km area of the inshore since 2006. 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. During 2010-12, estimates of exploitation (harvest) rate ranged from 2-6 % for the Cod released and recaptured inshore.

d) Greenland Halibut

A new tagging study on Greenland Halibut was initiated in 2012, funded under Canada’s International Governance Strategy. This project uses a custom-designed capture box which is affixed to a bottom trawl in order to maximize fish survival. Work in 2012 was limited to the inshore areas, focused mainly on gear-trials and other experimentation. During this work, approximately 1,000 Greenland Halibut were tagged (using Floy t-bar tags) and released. A cage-experiment was conducted to assess short-term mortality due to capture and handling stress. In 2013, over 7,600 Greenland Halibut were tagged and released, primarily along the edge of the continental slope in Divs.3KL (southern portion of 3K; northern portion of 3L). A range of size groups were tagged, including pre-commercial sizes, which should lead to many years of potential recapture.

The objectives of this study are to evaluate and apply new capture techniques for tagging studies, gain further understanding on migration and distribution of this resource, and in future years, explore the potential of estimating exploitation rates.

e) Hydrographic Surveys

The Canadian Hydrographic Service (CHS) priorities for Subareas 2 and 3 for 2012 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 2012 survey season, hydrographic surveys were completed at Voisey Bay Labrador and on the Island of Newfoundland hydrographic surveys were completed in Bonne Bay.

Voisey Bay Labrador:

The *CCGS Matthew* and two survey launches, all equipped with multibeam acoustic echo sounders, conducted Hydrographic surveys in the Voisey Bay area. The data collection for that area is now complete and will be used to produce New Editions of charts 5048, 5049, 505, 5052 and 5070.

Bonne Bay , Island of Newfoundland:

The *CCGS Matthew* and two survey launches, all equipped with multibeam acoustic echo sounders, continued data collection which will be used to produce a new chart for Bonne Bay (chart 4881). This new chart will replace chart 4658 that was compiled from data from the 1890's. Chart 4881 will be compiled from multibeam data and will be to modern day standards.

Annual Sailing Directions Revisory Survey

The 2012 Sailing Direction Revisory survey gathered hydrographic data from selected sites throughout Newfoundland and Labrador. This data was used in revising and updating the Sailing Directions publications, ATL 109, Gulf of St. Lawrence (Northeast Portion) and ATL 120, Labrador, Camp Islands to Hamilton Inlet (including Lake Melville)

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. The inspections also provide an avenue to gather client feedback.

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

Efforts are now underway in the Canadian Hydrographic Service to produce Print On Demand (POD) Sailing Directions publications. Presently three of the Sailing Directions publications for Newfoundland and Labrador are available in POD format.

Table 1: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 2003-2012. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

Subarea	Species	Division	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	3,571	3,871	3,862	3,363	3,348	3,742	4,045	4,005	4,993	4,017
	Shrimp*	0A								7,508	6,236	6,654
		0B								6,333	4,488	4,584
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	13,849	10,441	11,446	10,656	9,682	10,009	10,084	10,247	9,644	13,020
		2HJ (SFA 5)	24,434	25,264	21,425	25,094	20,503	23,768	22,612	22,904	22,785	30,437
		2J3K (SFA 6)	58,280	59,685	61,501	45,099	75,080	80,736	75,673	75,231	77,820	71,227
	Snow Crab	2HJ	1,606	1933	2131	2,387	2,549	2,523	2139	1576	1,925	2511
	Iceland scallop	2HJ	16	19	16	17	13	40	686	672	495	528
	Arctic Charr	2J3KLPs+4R		24	11	16	18	28	40	22	19	19
	Atlantic Salmon****		54	41	36	30	36	27	32	31.9	32	22.1
2+3	Redfish	2+3K	103	74	61	28	20	29	221	135	167	22
	Greenland halibut	2+3KLMNO	6,176	6166	6529	5,744	4,701	5,073	6,307	6,644	4,877	6,620
	American plaice	2+3K	11	18	22	10	10	23	60	29	16	33
	Witch	2J+3KL	94	143	160	45	5	22	53	40	26	110
	Cod*****	2J3KL	3,305	3139	2902	3,098	3,343	2,546	2,679	1,330	643	971
	Grenadier	2+3	28	113	41	13	10	38	99	151	135	183
	Capelin	2J3KL (offshore)	0	0	0	0	0	0	0	0	0	0
	Squid	2+3	17	87	100	643	516	228	6,979	548	2,525	1089
3	Redfish	3LN	920	1960	113	6	1	3	1	2	0	9
		3M	0	2	0		0	0	0	0	0	0
		3O	0	97	42	255	202	1,054	3,580	5,364	2,340	3,093
	Yellowtail	3LNO	1,795	3947	8056	5,414	10,216	3,674	177	13,268	12,577	12,705
	American plaice	3LNO	267	450	1154	1,077	878	434	93	1,466	1,290	1,607
		3Ps	140	279	402	509	456	460	485	745	731	883
	Witch flounder	3NO	3	11	39	41	46	21	94	49	49	62
		3Ps	235	175	446	454	298	110	182	483	540	529

	Atlantic halibut	3	364	270	321	289	287	170	251	255	303	399
	Cod	3NO	25	39	103	158	231	123	73	459	441	714
		3Ps	4,254	5424	6,737	7,491	9,636	10,599	10,506	11,400	11,046	12,469
	Haddock	3LNO	4	42	27	104	60	30	23	44	18	67
		3Ps	101	88	129	173	288	302	128	219	123	137
	Pollock	3Ps	335	186	319	287	616	1,042	733	500	296	333
	White hake***	3NOPs	264	239	559	748	1383	1,680	2,112	2,145	1581	1538
	Thorny skate***	3LNOPs	531	467	604	1334	1452	1639	1,392	2,124	2,026	3823
	Capelin	3L	11,645	12,023	11,927	13,326	15,176	16,321	15,430	15,230	15,694	13,270
		3K	10,672	8,081	3,544	9,853	13,043	13,036	14,368	12,166	11,157	4,067
	Shrimp*	3M			0	0	0	0	0	0	0	0
		3L			13,535	20,494	21,187	18,316	18,128	11,109	10,560	10,701
	Sea scallop	3KLNO	0	0	27	0	0	9	10	35	0	0
		3Ps	1,190	920	842	432	293	359	518	2,132	3,473	647
	Iceland scallop	3LNO	11	0	0	0	1	0	347	128	0	0
		3Ps	2	0	0	2	5	6	132	1,748	40	87
	Snow Crab	3K	8,390	10,744	12,420	16,184	15,068	12,270	10,717	8,685	16,460	16,502
		3LNO	33,608	32,912	31,419	29,033	30,248	30,895	30,717	29,649	30,717	31,638
		3Psn	6,208	6,717	6,026	5,559	4,523	3,947	3,099	3,169	4,720	6,113
	Lobster	3K	66	62	96	107	135	120	156	209	157	207
		3L	84	75	112	99	109	82	111	112	73	116
		3Ps			1,232	1,071	1,170	1,010	1,049	987	779	786
		3Pn			138	127	153	94	52	29	14	22
	Atlantic salmon**	2J3KLPs+4R	46	48	51	41	50	29	36	41	37	40
3+4	Redfish	3P+4V	295	907	2,275	2,265	1,217	1,402	2,439	1,918	3,428	3,956

4	Iceland scallop	4R	295	431	244	246	121	284	656	454	360	275
	Sea scallop	4R	66	48	27	15	0	0	0	0	0	0
	Lobster	4R	875	769	1,023	1,097	1,405	1,260	1,276	1,280	888	1,125
	Snow Crab	4R	783	637	218	288	381	562	539	859	1,462	1,562
4	Iceland scallop	4R	295	431	244	246	121	284	656	454	360	275
	Sea scallop	4R	66	48	27	15	0	0	0	0	0	0

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 (January. 1-December 31) to April 1-March 31

Therefore all years subsequent to 2002 are April 1-March 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 April 1-March 31 management year for Shrimp fishing areas 4-6.

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

**Recreational catch (retained only)

***Canadian catches only

**** Subsistence Fisheries

***** Excludes recreational catch for 2007 and 2009-11

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APPENDIX I: RESEARCH PROJECTS OF INTEREST TO NAFO CONDUCTED UNDER THE INTERNATIONAL GOVERNANCE STRATEGY

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

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

The four main components of the science program include:

Science in support of straddling stocks and highly migratory species,

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

The following tables outline those IGS activities of interest to NAFO that were completed 2012/13, as well as those currently underway for 2013/14.

List of IGS Activities 2012-13 and 2013-14	
Project Leader(s)	Title
B. Healey	Migration and Distribution of Greenland Halibut & Atlantic Cod: Answering basic questions via modern tagging techniques
D. Stansbury	Genetic studies of Northern shrimp
P. Shelton/G. Dauphin	Recovery strategies for straddling stocks: 3LNO American plaice and 3NO cod
P. Ouellet	Assessing the response of Northern shrimp (Pandalus borealis) populations to Climate Change and Variability
W. Brodie	Understanding impacts of various fishing gears on VME and biodiversity.
M. Koen-Alonso/P. Pepin	Robustness of regional ecosystem units on the Newfoundland Shelf and regional integration
M. Koen-Alonso	NAFO Roadmap multispecies modelling
M. Koen-Alonso	NAFO Roadmap-stomach analysis
B. Greenan	Oceanographic support for the characterization of VMEs in the NAFO Regulatory Area
E. Kenchington/ M. Treble	Identification and characterisation of benthic VME in Baffin Bay and Davis Strait
K. Azetzu-Scott	Impact of Ocean Acidification on NW Atlantic Fisheries and Marine Ecosystems
E. Head	Ecosystem monitoring in the Northwest Atlantic using the continuous plankton recorder
E. Kenchington	Characterisation of VME in the NAFO Regulatory Area: Canadian contributions to NEREIDA
E. Kenchington	Defining encounter protocols in the NRA
K. Dwyer/S. Campana/M. Treble	Bomb radiocarbon dating of Greenland halibut otoliths to validate age