Northwest Atlantic Fisheries Organization

Serial No. N6315 **NAFO SCS Doc. 14/014**

Scientific Council Meeting - 2014

Canadian Research Report for 2013 Newfoundland and Labrador Region

Submitted by

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SUBAREAS 0 AND 1

A. STATUS OF FISHERIES

Nominal landings from 2004 to 2013 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 2012, Scientific Council advised for 2013 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 2006 declined gradually to 3,400t in 2009. Subsequently, catch has ranged between 3,600 t to 3,900 tons. Overall, catch by gear and by month remained about the same in 2013.The catch was approximately 3,750t in 2013 with about 57% taken by otter trawlers (1210 t with single trawls and 920 t with twin trawls) and the remainder by gillnets (1,620 t).The fisheries occurred from May to September with about half the catch being taken in 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 2004 to 2013 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 2013 preliminary recreational catch, including retained and hooked-and-released fish, was 7,484 salmon, 24 % more than the previous 6 year mean (2007-2012). Preliminary subsistence fisheries catches of Atlantic Salmon for 2013 were 37 t , 7 % higher than the previous 6 year mean (2007-2012) of 34 t.

Two of the four assessed rivers in Subarea 2 achieved conservation spawning requirement in 2013. There has been an increasing trend in the abundance of large Labrador salmon since 2010. A notable increase of large salmon in 2013 is well above (107%) the previous six-year mean.

b) Arctic Charr–Subarea 2

Commercial landings of Arctic Charr from north Labrador in 2013 were 25 t, more than twice as high as landings in 2012 when only 11 t were reported caught, and the highest reported catch since 2007. This is equivalent to about 15 thousand Charr caught in terms of numbers of fish. 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 show upwards of 10,000 Charr may be caught 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 estimates have ranged between 250 kg to 500 kg annually. More recent data have not been compiled.

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).

During 2006-13, a pilot-scale inshore stewardship fishery was open. Fishers were each permitted to harvest an annual amount ranging from 3,000-3,750 lb of Cod during 2006-2012 and this was increased to 5,000 lb during 2013. 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 2006-13. There was no direct estimate of recreational fishery landings for 2009-13; however, analysis of tag returns suggests that removals from recreational landings were equivalent to about 50% of reported stewardship fishery removals during those years. In 2013, reported landings were 4,299 t which included

4,001 t in the stewardship fishery, 275 t in the sentinel surveys, and 23 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 2010-13. 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 (GHL) gillnet and otter trawl fisheries. From 2007 to 2012, the total reported landings of American Plaice were between 10-23 tons annually. In 2013, catch increased to 100 tons, the result of by-catch from otter trawl fisheries in Div. 2J.

Based on observer data, estimates of American Plaice bycatch discarded from Canadian Shrimp fisheries in the Div. 2G to Div. 3K area have ranged from 27 t to 34 t from 2007-2009. More recent data have not been compiled.

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 2004-2013 with the 2013 catch at 66 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 2013 (<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 followed by a decline to 65 t in 2009. More recent data have not been compiled.

f) Witch Flounder-Division 2J3KL

There has been no directed fishing on this stock since 1994. In 2013, bycatch in other fisheries from the Newfoundland Region was 182 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 1998-2013 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 2013 in Subarea 2 and Div. 3KLMNO was approximately 6,400 t, similar to the amount landed in the previous year.

Over 1995-2003, indices from the majority of the surveys generally provided a consistent signal in stock biomass. Results since 2004 shows greater divergence which complicates interpretation of overall status, but generally suggest stability in stock biomass over 2008-2012.

In September 2003 at its annual meeting, the Fisheries Commission implemented a fifteen year rebuilding plan for this stock. In September 2010, following the recommendations of WGMSE, the Fisheries Commission adopted a harvest control rule which used trend information from various surveys to determine the TACs for each of 2011-2014. This management approach has been extended to 2017.

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 the annual 8,320 t TAC. In 2003 the 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 2004-05 to 2007-08 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 2004-05 to 2008-09 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 further increased to 14,971 t for the 2013-14 management year. Data, though preliminary for 2013-14, indicates that the quotas in 2012-13 and 2013-14 were 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 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 and 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 market 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 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. In 2013 the fishable biomass index decreased to 151,000 t. 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. In 2013 the SSB index decreased to 94,000 t.

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 11% since 2006-07. SSB index was assessed to be in the Healthy Zone, within the IFMP PA Framework, and it is anticipated that the 2013/14 exploitation rate will be close to 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. TACs 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 TACs for the 1997-99 management 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 from January 1-December 31 to April 1-March 31, and an additional interim quota of 9,784 t was set for the period January 1-March 31, 2004. Hence 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 2013-14 seasons however the TAC was reduced to 20,970 t was set for the 2014-15 fishing season. Catches varied between 20,500 t and 25,300 t each year between 2004/05 and 2012/13. Preliminary data indicate that 22,300 t of shrimp were taken from a TAC of 23,300 t during the 2013-14 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.

The DFO research survey in 2H was conducted annually from 1996-1999, again in 2001, then bienally from 2004-2008 before resuming an annual schedule from 2010-2013. For this reason, biomass and exploitation rate indices are not available for each year.

Current status within SFA 5 is less positive than in previous years. 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 to 2012, however it decreased by 48% to 76,000 t in 2013. SSB index increased from 40,000 t in the 1996-99 period to 96,000 t in 2001, decreased to 63,000 t in 2012 and further decreased, by 30%, to 44,000 t in 2013.

The exploitation rate index within SFA 5 varied between 15-20% from 2002 to 2013/14, with the preliminary 2013/14 index at 15%. SSB is in the Healthy Zone of the IFMP PA framework and if the 2014/15 TAC of 20,970 t is taken in, the exploitation rate index would increase to 28%, well above any previous level in the time series.

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, within the 1997-99 Management Plan, as a first step toward increasing the exploitation of an abundant resource. 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 2004-05 to 2007-08 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 seemed to improve in 2011, therefore the 2012/13 TAC was increased to 60,245 t in the 2012/13 management year and was maintained at that level in 2013/14. Due to renewed concerns pertaining to resource health, the TAC for 2014/15 was reduced to 48,196 t. Preliminary data indicate that 58,700 t of shrimp were taken during the 2013/14 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 decreasing to 316,000 t by 2012 and further decreasing to 212,000 t in 2013. The trend in female spawning stock biomass index reflected the trend in the fishable biomass index decreasing to 139,000 t t in 2013. Both biomass indices are at the lowest levels in their respective time series.

The exploitation rate index varied around 15% from 1997 to 2013/14, with the preliminary 2013/14 index at 19%. The SSB is slightly below the midpoint of the Cautious Zone of the IFMP PA framework. If the 2014/15 TAC of 48,196 t is taken the exploitation rate index will increase to 23%, the 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 45% since 2008, to 1,380 t. The TAC has not been taken in the past 3 years. CPUE declined steadily by half from 2008 to 2011, was unchanged in 2012, and increased in 2013. The exploitable biomass, as indicated by the post-season trawl survey, declined steadily from 2006 to 2011 and has changed little since. Recruitment declined from 2006 to 2011 and changed little since; prospects are uncertain in the short term (2-3 years). The post-season trawl survey pre-recruit index has changed little since 2005. A recent warm oceanographic regime suggests weak recruitment in the long term. The exploitation rate index increased steadily from 2007 to 2012 before decreasing in 2013.The pre-recruit fishing mortality rate index was at its highest level since 2004 during 2011and 2012 but decreased by more than half in 2013. The percentage of the catch handled and released in the fishery decreased from 35% in 2012 to 20% in 2013, implying a decrease in pre-recruit mortality.

j) Iceland Scallop–Division 2HJ

Inshore aggregations were again fished in 2009, 2010, 2011, 2012 and 2013, with nominal catches estimated at 17 t ,16 t, 19 t,16 t and 20 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 (including footgear) that will reduce the trawl gear footprint and thus the environmental impact on the seabed. Specific stages in the project involve, 1) design and computer simulation of innovative trawl gear protoypes (carried out in 2011), 2) flume tank testing of physical trawl models (completed in 2012), and 3) construction and field testing of full-scale trawl prototypes (completed in 2012).

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 2013 and represented the 37th 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. However, as noted in recent years 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) Multispecies Trawl Surveys

Biological and oceanographic data from fall multi-species research vessel surveys were collected from Div. 2HJ in 2013 to support stock assessment, distribution and abundance studies, and detailed biological sampling were conducted on traditionally important commercial species (eg. cod, American plaice, Greenland Halibut, redfish, shrimp, crab). Depending upon the species sampling occurs for length, age, growth, maturity stage, condition, stomach contents analyses. In addition, sampling for lengths and weights were conducted on a suite of other species to support ecosystem monitoring.

d) Shrimp

In 2005, the first of a series of trawl surveys which continued in 2013 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.

From 2010-2012, NL Region sent Northern Shrimp samples to Tromso, Norway as part of an international stock discrimination project. One hundred specimens were 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 Newfoundland and Labrador shelf areas appeared much more genetically similar to one another. The identification of distinct genetic populations might allow for a better understanding in the assessment and management of the various Northern Shrimp stocks. A research document has been written, and peer reviewed, with the results of the study and will be published through the technical series of DFO publications this year.

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. A similar study but of broader scale was conducted in Div. 2HJ in 2013.

f) Atlantic Salmon

The stock composition and exploitation of Atlantic Salmon in food, social and ceremonial fisheries in coastal Labrador was evaluated using genetic mixture analysis and individual assignment with a microsatellite baseline (15 loci, 11,575 individuals) encompassing the species western Atlantic range. Mixture analysis accuracy to regional reporting groups was >90%. Together, fishery samples (2006-2011; 1772 individuals) clustered tightly with neighbouring populations, and both Bayesian and maximum likelihood mixture analyses indicate that 85-98% of the harvest are of Labrador origin. Estimates of fishery associated exploitation were highest for Labrador salmon (4.3-9.4% per year) and generally < 1% for other regions. Individual assignment of fishery samples indicates that non-local contributions to the fishery (e.g., Maritimes, Gaspé Peninsula) were rare and occurred primarily in southern Labrador, consistent with discrete migration pathways through the Strait of Belle Isle.

SUBAREA 3

A. STATUS OF FISHERIES

Nominal landings from 2004 to 2013 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 2 has remained closed since 1992. The 2013 preliminary recreational harvest, including retained and hooked-and-released fish, was 36,725 salmon, 9 % greater than the previous 5 year mean (2008-2012).

Six of the nine assessed rivers in Subarea 3 achieved conservation spawning requirement in 2013. The three rivers that did not achieve conservation have had large areas of habitat made accessible and the area of habitat utlilized by Salmon is unknown.

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 22,317 t in 2012 to 23,755 in 2013 representing 4% overrun of the 2013 TAC. No assessment information is available for 2013. The most recent assessment (held January 2013) included survey data to May 2012 and biological data to 2011. During this assessment several indicators were examined that showed that many of the biological and behavioural changes first observed in the early 1990s continued to persist in 2011. 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 prospect 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 Cod stock has been under moratorium to all directed fishing, both inside and outside the NAFO Regulatory Area, since February 1994 and this continued into 2013. 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 2004-2012. The provisional 2013 value reported to NAFO based on monthly catch reports is 1,052 t. Canada (NL) landings ranged from 444 t to 818 t between 2002-2005, and from 26 t to 247 t between 2006-2012. Canadian catches in 2013 totalled 223 t, taken primarily in the 3NO yellowtail fishery.

The 2013 assessment of 3NO Cod reported that the spawner biomass had doubled since 2010. However, the 2013 estimate of 25,000 t is still less than half of B_{lim} (60,000 t).

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 3,100 t in 2013. Although there has been some fluctuation in the TAC, the decline in landings has been primarily due to economic considerations. 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.

The 2013 assessment of 3Ps Cod indicated that the stock is above the limit reference point ($B_{Recovery}$). The report of the assessment meeting concluded: "Over 2009-2013, SSB has increased considerably. The 2013 estimate is approximately twice the level of the LRP, and is near the (1983-2013) time series maximum. The probability of being below the LRP in 2013 is very low (<0.01). "

d) American Plaice-Division 3Ps

The status of this stock was last updated in 2014 with data to 2013. Biomass in 2013 is estimated to be 60% below Blim (40% BMSY) and therefore the stock is in the Critical Zone. The probability of being below Blim is high (0.97). Current median fishing mortality is estimated to be 20% of Flim and the probability of being above Flim (FMSY) is low (0.05). Although fishing mortality is low, the stock has declined since 2010. Projections of stock size were conducted under current productivity conditions at various catch levels from 2014 to 2016. Five scenarios were considered (zero catch, current catch, current catch + 15% and current F). Although there was growth under all scenarios, the stock remained well below Blim in all cases. Additional projections determined that annual catches of 1000 t or more will result in stock decline.

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 200 t and 1,000 t annually. The catch from the Newfoundland region averaged 210 t in the past 3 years. 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 2012 was estimated to be 1.8 times B_{msy}, well above the level of the mid-1980s. Annual spring and fall multi-species bottom trawl surveys have been conducted since 1971 and 1990 respectively. Evidence from the commercial fishery and various surveys indicates that the range of this stock has increased along with stock size since the mid-1990s. Fishing mortality 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 2013 was 7,900 t. Scientific Council noted that this stock is well above B_{msy}, and recommended any TAC option up to 85 % Fmsy for 2014 and 2015 (25.0 t and 22.9 t respectively). The TAC for 2013 was 17,000 t and Canadian catch was 7,920 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 and 2012, Scientific Council could not derive an estimate of total catch to utilize in the assessment of this stock in 2012. During the previous assessment, in 2011, Scientific Council concluded that: the stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below Blim. The limit reference point 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 (Unit 1-3). 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 Unit 1 and Unit 2 corresponds to a single biological population of each species and recommended these Units should be combined for assessment purposes. The last assessments for these stocks was evaluated at a limit reference point meeting for stocks wholly or bilaterally managed by Canada held in October 2011(DFO 2012, Duplisea et al. 2012) 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 2013, whereas catches have fluctuated between 2,500 t to 6,700 t from 2006-2012. The Canadian catch in 2013 was about 1,960 t with about 192 t 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 where otter trawling is feasible regarding bottom topography. 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 75 t in 2013. Canada (NL) has generally accounted for more than 95 % of the Canadian catch since 2001 but reported 0 tons in 2013. 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 3 t and 94 t since 2001. The 2013 catch was 62 tons, taken in the Yellowtail flounder directed fishery. There were some signs of improvement in stock status, based on 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 annual reported landings were 777 t during the period 2008-2012. Preliminary 2013 Canadian landings for NAFO Div. 3NO and Subdiv. 3Ps are 301 t. The current TAC for White Hake in 3NO for 2014 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 2013-14. The TAC for Subdiv. 3Ps in the EEZ was maintained at 1,050 t by Canada.

Average STATLANT landings for 2008-12 were 5599 t in NAFO Divisions 3LNO, and 653 t in Subdivision 3Ps. Preliminary Canadian landings for 2013 are 129 t in NAFO Divisions 3LNO, and 165 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 28,000 t. Due to declines in resource indices, the TACs have been steadily decreasing with the 2014 TAC being set at 4,300 t during the 2013 Fishery Commission meeting. Preliminary catch records indicate that 10,100 t of shrimp were taken from a 12,000 t TAC in 2012. Preliminary catch records, as of February 2014, show that the 2013 catch was 7,721 t. As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 5,400 t in 2002 to 20,100 t in 2008 but have since decreased to 8,000 t in 2012. Preliminary catch records show that Canadian vessels had taken 6,100 t of shrimp in 2013.

Catches by other contracting parties increased from 700 t in 2000 to 7,700 t in 2006 and between 2007 and 2012 have ranged between 2,100 and 7,600 t. Preliminary data indicate that non Canadian vessels took 1,600 t of Northern Shrimp in 2013 while they took 2,100 t by the same period in the previous year.

Canadian Fleet

Small vessel CPUE (2000–2013) 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 then increasing slightly to 290 kg/hr in 2013. The 2001 catch rate index was similar to the 2002 and 2010-2013 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 2011-2013 values. The 2012 CPUE index was 408 kg/hr. The Logbook data from 2013 were insufficient to produce a standardized CPUE model.

International fleet

The Statlant 21B 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 most recently peaked at 13,300 t in 2009 but declined by 51% to 6,500 t in 2012 before increasing to 6,600 in 2013. Effort most recently peaked in 2009 and has since declined by 33%. CPUE declined by half from 2008 to 2011 and increased slightly since 2012. The exploitable biomass, as indicated by the post-season trap and trawl surveys, declined by more than two thirds since 2008. 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 70% since 2008. A recent warm oceanographic regime suggests weak recruitment in the long term. The trawl survey-based exploitation rate index was at its highest level since 2004 in 2010-2011. It decreased in 2012 before increasing again in 2013. The pre-recruit fishing mortality rate index increased from 2007 to 2011 but decreased in 2012 before increasing again in 2013. The percentage of the catch handled and released in the fishery decreased from about 20% in 2012 to about 10% in 2013, implying a decrease in pre-recruit mortality.

In Div. 3K inshore, landings declined by 34% from 2,900 t in 2009 to 1,900 t in 2012 and 2013. Effort increased by 70% from 2008 to 2011 before declining by 40% to 2013. CPUE declined by more than half from 2008 to 2011, and increased over the past two years. The exploitable biomass, as indicated by the post-season trap survey, decreased from 2007 to 2009 and has since fluctuated. Recruitment prospects are poor in the short term (2-3 years). The post-season trap survey pre-recruit biomass index decreased by more than half in 2013 to its lowest level in the time series. The post-season trap survey-based exploitation rate index has changed little throughout the time series. Data are insufficient to estimate the pre-recruit fishing mortality rate index.

In Div. 3LNO offshore, landings decreased by 11% from 24,500 t in 2006 to 21,900 t in 2009 and then increased by 20% to 26,300 t in 2013. Effort increased by 83% from 2000 to 2008 and has since declined by 32%. VMS-based CPUE declined to its lowest level in 2008, and has since increased steadily to its highest level in the time series. The indices of exploitable biomass from post-season trap and trawl surveys diverged during 2009 to 2011 with the trap index increasing and the trawl index declining. However both indices have since increased slightly. Biological data from several sources indicate that recruitment will likely decrease in the short term. A recent warm oceanographic regime suggests weak recruitment in the long term. The exploitation rate index decreased marginally in 2013. The pre-recruit fishing mortality rate index decreased from 2008 to 2011, increased in 2012 and changed little in 2013. The percentage of the catch handled and released in the fishery decreased from about 20% in 2008 to 9% in 2013, implying a decrease in pre-recruit mortality.

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 7,600 t in 2013. Effort increased from 2008 to 2010 and has since declined steadily. CPUE increased sharply since 2011 to its highest level. The post-season trap survey index suggests that the exploitable biomass increased steadily since 2008 to its highest level in the time series, with considerable variability among management areas. Recruitment has declined slightly since 2010, although there is considerable variability among management areas, and is expected to decline further in the short-term (2-3 years). The post-season trap survey pre-recruit biomass index decreased in 2013. The post-season trap survey-based exploitation rate index has changed little over the time series, with considerable variability among management areas. Data are insufficient to estimate a pre-recruit fishing mortality rate index.

In Subdiv. 3Ps offshore, landings almost doubled from 2,300 t in 2006 to a peak of 4,200 t in 2011, before declining by 16% to 3,500 t in 2013. Effort increased by 76% from 2008 to a record high level in 2013. CPUE increased from 2005 to 2009 and has steadily declined since, to about its previous lowest level. 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 rapidly to its lowest level in 2013. 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 rapidly from 2009 to their lowest levels in 2013. A recent warm oceanographic regime suggests weak recruitment in the long term. The spring trawl survey-based exploitation rate index more than doubled from 2009-2012, before doubling again in 2013. The pre-recruit fishing mortality rate index has increased steadily since 2009 to about its previous highest level.

In Subdiv. 3Ps inshore, landings more than tripled from 700 t in 2005 to 2,500 t in 2011 and remained at that level since. Effort declined substantially in 2005 and has since varied without trend. CPUE increased steadily from 2005 to 2010, changed little in 2011–2012, then decreased slightly in 2013. The exploitable biomass, as indicated by the post-season trap survey index, increased substantially between 2006 and 2010, changed little in 2011-2012, then decreased by half in 2013. Recruitment decreased substantially in 2013 and is expected to remain low in the short term (2-3 years). The pre-recruit biomass has been declining since 2007. The post-season trap survey-based exploitation rate index has changed little in the past six years. Data are insufficient to estimate a pre-recruit fishing mortality rate index.

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. There were no removals in 2013. 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 and in 2013 there was 4 t of Iceland Scallop removals, in 2010 and 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 then decreased to 1071 t in 2013.

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. There were no reported landings in 2013.

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 2013 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Makkovik Bank on the mid- Labrador Shelf. The first was conducted on the CCGS Teleost from April 10 to 29. The second survey on CCGS Teleost took place from July 9-28 and the last on CCGS Hudson from November 17 to December 8. This program was established to include biological and chemical oceanographic sampling at a fixed coastal site (Station 27) at biweekly intervals and along offshore sections at seasonal time scales. The main objectives are to establish the seasonal temporal and spatial distribution and abundance of plant pigments, nutrients, microzooplankton and mesozooplankton in relation to the physical environment. Physical, biological and chemical variables being monitored include temperature, salinity, dissolved oxygen, ocean currents as well as measures of primary and secondary production and biomass, species composition of phytoplankton and zooplankton and nutrients. The oceanographic monitoring program currently conducted on the Newfoundland and Labrador Shelf should allow an understanding of changes in ecosystem productivity and changes in ecosystem structure over time. Data from this effort are used to produce annual physical, chemical and biological state of the ocean reports and in studies relating environmental conditions to marine resources.

a) Physical Environment

Physical oceanographic studies were conducted on the Newfoundland and Labrador Shelf during 2013 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. Average sea surface temperatures over a wide area on the NL Shelf decreased from 1.6 SD above normal in 2012 to about 0.4 SD above normal in 2013 and near shore at Station 27 off eastern Newfoundland they were 1.1^{O}C (1.6 SD) above normal, similar to 2012. Bottom temperatures at Station 27 were 1 SD (0.4°C) above normal, nearly identical to 2012 values. Spring bottom temperatures in NAFO Div. 3P decreased to about 1 SD above normal in 2012-13 down from +2 SD in 2011 and in 3LNO they decreased to slightly less than 1 SD above normal. Fall bottom temperatures in 2J, 3K and 3LNO decreased from 2, 2.7 and 1.8 SD above normal in 2011 to 1.1, 1.2 and 0.2 SD above normal in 2012 and to 0.8, 0.5 and 0.1 above normal in 2013, respectively, a significant decrease in the past 2 years. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C along standard AZMP sections on the NL Shelf during the spring, summer and fall were below normal ranging from 0.7 to 1.5, 0.5 to 1.4 and 0.3 to 0.9 SD, respectively, implying a continuation of less cold shelf water than normal. In general, most environmental indices show a continuation of a warmer than normal trend throughout the NAFO area. During the past 2 years however, temperatures have decreased compared to the record warm conditions of 2011.

b) Nutrients and plankton studies

The inventories of nutrients are strongly influenced by seasonal biological processes operating throughout the upper water-column. Shallow (0-50m) and deep (50m-bottom) macronutrient inventories of nitrate and silicate show depleted levels at Station 27 and across AZMP Sections in 2013 and recent years. The inventories in the deep layer were substantially reduced representing almost a 40 % reduction below normal. A spatial gradient in the extent of depletion of deep nutrient inventories was also observed with lower levels along the northern sections while concentrations increased southward. The opposite trend was observed in shallow inventories, particularly for silicate levels with higher depleted levels along the southern sections while increasing northwards. Standing stocks of phytoplankton that depend on macronutrients to fuel the spring bloom were mostly below normal in 2013 across the standard sections except for the southeast Grand Bank that showed a marginal positive inventory.

The seasonal development of various biological oceanographic indices at Station 27 have shown some reduction in the extent of biological productivity over time. The duration of the spring bloom inferred from the optical indices has gradually declined since monitoring has began in 1999 indicating a reduction in the standing stocks of phytoplankton into 2013. High frequency sampling of particulate matter obtained from *in-situ* chlorophyll *a* fluorescence and discrete pigment inventories within the upper 100 m, shows a nearly identical constriction of the temporal trend over time in phytoplankton standing stocks at Station 27 resulting in a substantial reduction in duration of the spring bloom in 2013, in contrast to the normal conditions.

Satellite ocean colour observations from 11 sub-regions off Newfoundland and Labrador indicated that the magnitude of surface phytoplankton blooms detected was generally weak in 2013 relative to previous years, particularly from the northern Labrador Shelf down to the Avalon Channel. The only exceptions occurred on the Flemish Pass/Cap and southeast Shoal where surface chlorophyll *a* concentrations was comparable with the long-term trend. In addition, surface blooms occurred somewhat later in the northern sub-regions and across the northeast Shelf while areas on the Flemish Pass/Cap occurred earlier in 2013. Overall, the amplitude (peak intensity) and magnitude of the spring bloom was below normal across most of the NL sub-regions in 2013 compared to the standard climatology (1999-2010). Peak timing of the spring bloom was substantially delayed on the northern Labrador and northeast Shelf in contrast to early timing on the Flemish Pass and Cap. The initiation of the spring bloom was delayed on the southern Labrador and northeast Shelf resulting in reduced duration. The other sub-regions showed consistent timing indices with the exception of Hibernia that initiated substantially earlier resulting in a long duration bloom.

Zooplankton, important prey in energy transfer to higher trophic levels such as fish and larger invertebrates, has remained relatively abundant for the past decade based on the NL seasonal oceanographic surveys. Copepod (dominant species) abundance has generally slowly increased from the start of monitoring although the standing stocks over the northern sections have remained lower in recent years while above average along the southern sections into 2013. Calanoid copepods which dominate in terms of biomass and energy reserves, has remained stable and abundance has generally been above average over the Grand Bank and Flemish Cap in recent years while somewhat more limited on the southern Labrador Shelf. The abundance of non-copepod taxa increased substantially in 2013 across the NL Sections.

2. Biological Studies

a) Multispecies Trawl Surveys

Biological and oceanographic data from fall (Div. 3KLNO) and spring (3LNOP) multi-species research vessel surveys were collected in 2013 to support stock assessment, distribution and abundance studies, and detailed biological sampling were conducted on important commercial species (eg. cod, American Plaice, Greenland Halibut, redfish, Yellowtail Flounder, White Hake, Thorny Skate, shrimp, crab). Depending upon the species sampling occurs for length, age, growth, maturity stage, condition, stomach contents analyses. In addition, sampling for lengths and weights were conducted on a suite of other species to support ecosystem monitoring.

Analysis of 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 cod in Div. 3NO, American Plaice in Div. 3LNO, Yellowtail Flounder in Div. 3LNO, Greenland halibut in SA2+Div. 3KLMNO as needed.

b) Capelin

Monitoring larval emergence from beach sediments and from bottom spawning sites was discontinued in 2013, however monitoring of recently emerged larvae in the Bellevue Beach area of Trinity Bay is on-going. An ongoing offshore acoustic survey initiated in the spring of 1999 to monitor Capelin distribution, behaviour, and feeding habits in Div. 3L continued in 2013. Inshore surveys were conducted in August and in September of 2013 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 began in 2013 and is ongoing.

c) Atlantic Salmon

Research examining aspects of the tropic ecology of Atlantic Salmon using stable isotopes is ongoing. Recent studies have noted potential differences in the interpretation of stable isotope signatures depending on the respective growth zones of scales that have been analysed.

d) Shrimp

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

Northern Shrimp samples from 2GHJ3KLM have been sent to Norway as part of an international effort to determine whether genetics can be used to separate shrimp, from various parts of the northern hemisphere, into genetically distinct populations. From 2010-2012, NL Region sent Northern Shrimp samples to Tromso, Norway as part of an international stock discrimination project. One hundred specimens were 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 Newfoundland and Labrador shelf areas appeared much more genetically similar to one another. The identification of distinct genetic populations might allow for a better understanding in the assessment and management of the various Northern Shrimp stocks. A research document has been written, and peer reviewed, with the results of the study and will be published through the technical series of DFO publications this year.

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 2013. Similar surveys were initiated in Trinity Bay and St. Mary's Bay in 2013.

A post-season trap survey, conducted by Snow Crab harvesters, which began throughout most of 2J3KLNOPs in 2004 was continued in 2013.

f) Cod

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 2004 to 2013 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 2013 recreational harvest, including retained and hooked-and-released fish, was 19,486 salmon, 14 % less than the previous 5 year mean (2008-2012).

Two of the three assessed rivers in Subarea 4 achieved conservation spawning requirement in 2013.

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, and increased to 300 t in 2013. Effort increased by almost a factor of 7 since 2010. The TAC has not been taken since 2002. VMS-based CPUE declined from 2004 to its lowest level in 2009 before increasing to its highest value in the time series in 2013. The exploitable biomass remains low relative to other areas. Recruitment prospects are uncertain in the short term (2-3 years). A recent warm oceanographic regime suggests weak recruitment in the long term. Data are insufficient to calculate the exploitation rate and pre-recruit fishing mortality rate indices.

In Div. 4R inshore, landings declined by 80% from 930 t in 2003 to a historical low of 160 t in 2010 and have since more than tripled to 600 t in 2013. Effort declined by 69% from 2004 to 2010 and doubled in 2011 before declining by 34% to 2013. The TAC has not been taken since 2002. CPUE increased sharply since 2010 to a record high level in 2013. The exploitable biomass, as indicated by the post-season trap survey index, fluctuated from 2006 to 2010,was three times as large in 2011, and changed little in 2012 before decreasing in 2013. Recruitment prospects are unfavourable in the short term (2-3 years). The trap survey pre-recruit biomass index more than doubled in 2009 and changed little until it decreased substantially to remain below pre-2009 level during 2012-2013. The post-season trap survey-based exploitation rate index decreased in 2012 and changed little in 2013. Data are insufficient to estimate a pre-recruit fishing mortality rate index.

c) Iceland Scallops–Div. 4R

The nominal catch from the Strait of Belle Isle (Div. 4R) in 2013 increased to 378 t fro 295 t (round) in 2012 against a TAC of 1,000 t. Landings in 2011 after almost doubled to , 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 and 2013 were 15 t, 27 t, 48 t, 66 t and 2 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 2004 to 2013 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. They 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 27% in 2011 to 1,900 t before increasing by 16% to 2,200 t in 2013. Landings had been increasing in Subdiv. 3Ps up to 2010 but had a sharp decline in 2011 and have increased slightly since. Landings in Div. 4R had a recently peaked in 2008 but have since declined to the values of the late 1990s. Landings in Div. 3K and 3L have declined to record low levels. Landings in all divisions combined, Div. 3KLPs4R, have increased slightly from 2010 to 2013. 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) decreased by 31% from 2008 to 2012 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 in captured lobsters 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. 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 landings or CPUE. CPUE has changed little over the time period for which data are available (2004-13).

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 2013.

Obtaining accurate estimates of fecundity are critical for estimating the population dynamics of a species. Estimates of late term pregnancy rates, fecundity and abortion rates of Northwest Atlantic harp seals were obtained from samples collected off the coast of Newfoundland and Labrador. No new data were available for young seals. The declining , but highly variable, reproductive rates reported previously have continued with the pregnancy rate of mature females falling to the lowest level since data was first collected in the 1950s, occurring in 2010 and 2011 (<0.3). Using a fixed dispersion beta regression model to explore the importance of a variety of biological and environmental conditions, we found that fecundity rates were influenced by both density dependent and independent factors. While the general decline in fecundity is a reflection of density dependent processes associated with increased population size, including the late term abortion rates captured much of the large inter-annual variability. Changes in the annual abortion rate could be described either by a model that incorporated ice cover in late January or a model that incorporated ice cover and capelin biomass obtained from the previous fall as a proxy for prey availability. Using these models, we predicted the 2012 fecundity rate to be 0.44 or 0.54, depending upon the model used which is lower than the estimate (0.643) obtained from the small sample of reproductive tracts.

Photographic and visual aerial surveys were conducted off Newfoundland and in the southern Gulf of St. Lawrence to determine pup production of Northwest Atlantic harp seals in 2012. Readings and analysis of the surveys was completed in 2013 and presented for peer review. Repeated surveys of three whelping concentrations were carried out between 27 February and 16 March. Visual surveys in the southern Gulf resulted in pup production estimates ranging from 117,600 (SE=31,800) to 137,300 (SE=48,400) animals, after correcting estimates for pups born after the surveys were flown. Photographic estimates varied from a low of 71,300 (SE=9,000) from a survey flown on 4 March to 111,500 (SE=20,000) pups from a survey flown on 2 March. The 4 March estimate is considered to be negatively biased because a significant number of pups appeared to be outside of the survey area. Mortality of pups may also have occurred between the two surveys. Excluding the 4 March survey, estimated pup production in the southern Gulf was 115,500 (SE=15,000) animals. Multiple photographic surveys of seals that pupped on ice that was originally in the Strait of Belle Isle and at the Front resulted in estimates of 74,100 (SE=12,400) and 601,400 (SE=66,900) pups, respectively. Combining the number of pups found in all three areas resulted in an estimated total pup production of 790,000 (SE=69,700, CV=8.8%). This estimate is approximately ½ of the number of pups estimated in 2008, likely due to lower reproductive rates in 2012. Only 15% of the pups were born in the southern Gulf where years with poor ice conditions have been increasing in frequency over the past decade. Ice conditions observed during 2012, were similar to those observed in 1969, 2010, and 2011 and are among the worst on record. This continuing trend of poor ice conditions has serious implications for survival of harp seal pups and the persistence of breeding seals in the southern Gulf of St Lawrence.

A population model was used to examine changes in the size of the Northwest Atlantic harp seal population between 1952 and 2014. The model 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 twelve 12 periodic estimates of pup production from 1952 to 20012, and to annual estimates of age-specific pregnancy rates data collected between 1954 and 2013. Pup production declined throughout the 1960s reaching a minimum in 1971, and then increased to a maximum in 2008. Pup production and total population size in 2012 are estimated to be 929,000 (SE=148,000) and 7,445,000 (SE=698,000), respectively. The maximum estimated population size, Nmax, was estimated to be 7.8 million animals in 2008. Projecting forward to 2014, the estimated pup production is 853,000 (SE=202,000) and total population size is 7,411,000 (SE=656,000). The population appears to be relatively stable, showing little change in abundance since the 2004 survey, although pup production has become highly variable among years. Data on age- specific reproductive pregnancy rates indicate that herd productivity has declined compared to the 1980s and early 1990s. However, relatively few reproductive samples have been obtained in recent years which contribute to our uncertainty surrounding the population estimate.

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
2013	90,703	0

The study examining the noise environment and marine mammal assemblages for candidate Valued Marine Ecosystems (VMEs) on the Grand Banks and NAFO Regulatory areas was continued. 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. Analysis of the recordings is underway.

In 2013, the two satellite tagging programs for ringed Seals along the Labrador coast were continued; one in collaboration with the Torngat Joint Fisheries Board and the other with the ArcticNet Nunatsiavut Nuluak Project. To date, there have been ten Seals tagged in the Torngat Program with the possibility of an additional three to be deployed in the spring of 2014. Thirteen Seals have been tagged in the Nunluak Project with data analyses and manuscript preparations 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 2013, research to identify and map Ringed Seal pupping habitat from RADARSAT-II imagery using a GIS-based model is ongoing. Effort was focused on the preparation of habitat maps for seven study areas along the coast of Labrador.

B. SPECIAL RESEARCH STUDIES

1. Miscellaneous Studies

a) Atlantic Salmon population genetics along southern Newfoundland: the identification of designatable units (DUs) and farmed escapees

In 2010, COSEWIC designated Atlantic Salmon populations along southern Newfoundland (DU4) as threatened. As previous work had shown unusually high genetic differentiation throughout southern Newfoundland, the population structuring in the region was re-examined with extensive parr sampling (2008-2012) and both genetic and genomic analysis. Multivariate and Bayesian clustering support a hypothesis of two discrete groups with the dividing boundary located near the Burin Peninsula. Genomic analysis confirms that the groups represent populations that are both discrete and differ adaptively (relevant genes) and represent deep divergent lineages (mtDNA). This analysis is consistent with the presence of two DU's in southern Newfoundland and suggests that a re-assessment for the region is warranted.

Given recent reports of escaped farmed salmon along the south coast of Newfoundland, the potential to use both genetic and genomic tools for identifying farmed escaped Atlantic Salmon and subsequent hybridization was also evaluated. Using an existing baseline of regional wild populations and farmed Salmon (i.e. Saint John River strain), accurate identification (>99%) was possible both with a microsatellite panel (n=15) and targeted SNP (n=96) panels. The ability of both marker types to quantify the presence of hybridization using simulated hybrids was explored. The microsatellite panel was unable to successfully identify or classify hybrid individuals, however accurate identification of various hybrid classes (F1, F2 etc) was possible with the targeted SNP panels examined. To further demonstrate the application of genetic approaches for the identification of farmed escapees in southern Newfoundland, tissue samples from 64 suspected farmed escapees sampled from the wild following escapes in 2012 and 2013 were also analyzed. Individual assignment confirmed an aquaculture origin for 97% of these individuals. Individuals not of aquaculture origin were assigned to wild stocks either in, or adjacent to, their capture location. This work suggests that highly accurate escape and hybrid identification is possible using genetic and genomic tools for Atlantic Salmon in this region.

b) Sentinel Studies

The Sentinel Surveys, initiated in October 1994, were continued in 2013. Data collected were tabled at the Regional stock update in the spring of 2014 for Div. 2J3KL Cod, and the 3Ps Cod Regional Stock Assessment in October 2013. 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*

Ongoing tagging and telemetry studies on Cod in Div. 2J3KL and conventional (Floy) tagging on Cod in NAFO Subdiv. 3Ps were continued in 2013. Approximately 6,100 (2,300 in Div. 2J3KL and the remainder in Subdiv. 3Ps) Cod were tagged and released with Floy tags; in addition, detections of acoustically tagged Cod released inshore in 3KL during 2010-2013 were obtained from acoustic receivers. The receivers have been deployed along a 350 km area of the inshore since 2006 and additional receivers were deployed in the offshore during 2013. The objectives were to obtain estimates of exploitation and to study migration patterns and survival rates. Among Cod in Div. 2J3KL estimates of exploitation (harvest) rate were <6 % during 2011-2013. Among cod in SubDiv. 3Ps, average annual exploitation rates based on various size groups of cod tagged and released in Placentia Bay (3Psc) have been variable over 2009-2012. In 2011, estimates ranged from 7-14% but increased to 11-21% in 2012, even though the full TAC was not taken in either year.

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 2013 were several sites throughout Newfoundland and Labrador.

Survey Launch Harlequin

The CHS Survey Launch Harlequin is equipped with a multibeam echosounder and associated equipment. In 2013 the launch was used to conduct Hydrographic Surveys in Conception Bay, Fortune Bay – Hermitage Bay, and Burgeo. The surveys will be used to update CHS nautical charts and for ecosystem mapping applications.

Nuliajuk (Government of Nunavut Research Vessel):

The Nuliajuk is a government of Nunavut research vessel and is equipped with a multibeam echosounder. The CHS in collaboration with the Government of Nunavut, the University of New Brunswick and Memorial University utilized this vessel to conduct hydrographic surveys in Lake Melville, Labrador. The surveys will be used to update the chart and for ecosystem mapping applications.

Annual Sailing Directions Revisory Survey

The 2013 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 102, Newfoundland East and South Coasts. A New Edition of ATL 101, Newfoundland, Northeast and East Coast was released in 2013.

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.

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Table 1: Summary of preliminary catches for stocks within the DFO, Newfoundland and Labrador Region, 2004-2013. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

Subarea	Species	Division	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	3,747	3,571	3,871	3,862	3,363	3,348	3,742	4,045	4,005	4,993
	Shrimp*	0A									7,508	6,236
		0B									6,333	4,488
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	15,323	13,912	10,441	11,134	10,656	9,682	10,009	10,084	10,247	9,644
		2HJ (SFA 5)	22,337	24,529	25,264	21,425	25,094	20,503	23,768	22,612	22,904	22,785
		2J3K (SFA 6)	58,745	58,334	59,685	61,501	45,099	75,080	80,736	75,673	75,231	77,820
	Snow Crab	2HJ	1379	1606	1933	2131	2387	2549	2523	2139	1576	1,925
	Iceland scallop	2HJ	20	16	19	16	17	13	40	686	672	495
	Arctic Charr	2J3KLPs+4R	25	11	24	11	16	18	28	40	22	19
	Atlantic Salmon****		37	54	41	36	30	36	27	32	31.9	32
2+3	Redfish	2+3K	66	103	74	61	28	20	29	221	135	167
	Greenland halibut	2+3KLMNO	6410	6176	6166	6529	5,744	4,701	5,073	6,307	6,644	4,877
	American plaice	2+3K	100	11	18	22	10	10	23	60	29	16
	Witch	2J+3KL	182	94	143	160	45	5	22	53	40	26
	Cod*****	2J3KL	4,299	3,305	3139	2902	3,098	3,343	2,546	2,679	1,330	643
	Grenadier	2+3	11	28	113	41	13	10	38	99	151	135
	Capelin	2J3KL (offshore)		0	0	0	0	0	0	0	0	0
	Squid	2+3	0	17	90	100	643	516	228	6,979	548	2,525
3	Redfish	3LN	2730	920	1960	113	6	1	3	1	2	0
		3M	0	0	2	0		0	0	0	0	0
		3O	0	0	97	42	255	202	1,054	3,580	5,364	2,340
	Yellowtail	3LNO	7,920	1,795	3947	8056	5,414	10,216	3,674	177	13,268	12,577
	American plaice	3LNO	1,041	267	450	1154	1,077	878	434	93	1,466	1,290
		3Ps	96	140	279	402	509	456	460	485	745	731
	Witch flounder	3NO	62	3	11	39	41	46	21	94	49	49
		3Ps	226	235	175	446	454	298	110	182	483	540

	Atlantic halibut	3	400	364	270	321	289	287	170	251	255	303
	Cod	3NO	223	25	39	103	158	231	123	73	459	441
		3Ps	3,058	4,254	5424	6,737	7,491	9,636	10,599	10,506	11,400	11,046
	Haddock	3LNO	13	4	42	27	104	60	30	23	44	18
		3Ps	69	101	88	129	173	288	302	128	219	123
	Pollock	3Ps	148	335	186	319	287	616	1,042	733	500	296
	White hake***	3NOPs	301	264	239	559	748	1383	1,680	2,112	2,145	1581
	Thorny skate***	3LNOPs	294	531	467	604	1334	1452	1639	1,392	2,124	2,026
	Capelin	3L	12,423	11,645	12,023	11,927	13,326	15,176	16,321	15,430	15,230	15,694
		3K	11,332	10,672	8,081	3,544	9,853	13,043	13,036	14,368	12,166	11,157
	Shrimp*	3M	0	0	0	0	0	0	0	0	0	0
		3L	6,095	7,982	9,276	13,535	20,494	21,187	18,316	18,128	11,109	10,560
	Sea scallop	3KLNO	0	0	0	27	0	0	9	10	35	0
		3Ps	1071	1,190	920	842	432	293	359	518	2,132	3,473
	Iceland scallop	3LNO	0	11	0	0	0	1	0	347	128	0
		3Ps	4	2	0	0	2	5	6	132	1,748	40
	Snow Crab	3K	8519	8,390	10,744	12,420	16,184	15,068	12,270	10,717	8,685	16,460
		3LNO	33,892	33,511	32,914	31,419	29,033	30,248	30,895	30,717	29,649	30,717
		3Psn	6047	6225	6716	6026	5559	4523	3947	3099	3169	4720
	Lobster	3K	63	66	61	96	107	134	120	156	208	157
		3L	81	84	75	111	98	109	83	111	111	73
		3Ps	1,048	952	917	1,228	1,071	1,171	1,010	1,052	988	780
		3Pn	138	164	112	139	127	153	94	52	29	14
	Atlantic salmon**	2J3KLPs+4R	48	39	48	51	41	50	29	36	41	37
3+4	Redfish	3P+4V	192	295	907	2,275	2,265	1,217	1,402	2,439	1,918	3,428

4	Iceland scallop	4R	378	295	431	244	246	121	284	656	454	360
	Sea scallop	4R	4	66	48	27	15	0	0	0	0	0
	Lobster	4R	873	857	769	1,022	1,096	1,404	1,260	1,275	1,276	888
	Snow Crab	4R	891	742	596	188	268	365	558	514	856	1425
4	Iceland scallop	4R	378	295	431	244	246	121	284	656	454	360
	Sea scallop	4R	4	66	48	27	15	0	0	0	0	0

ACKNOWLEDGEMENTS

The following staff of Fisheries and Oceans Canada (Newfoundland and Labrador Region) have contributed to the completion of this report:

K. Dwyer	K. Gilkinson	D. Maddock Parsons
J. Brattey	D. Ings	C. Bourne
M. Simpson	B. Healey	D. Power
E. Couture, National Capital Region	E. Hynick	M. Robertson
E. Colbourne	G. Maillet	K. Skanes
E. Dawe	J. Manning	F. Mowbray
B. Dempson	J. Morgan	R. Rideout
G. Smith	G. Stenson	

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 2013/14, as well as those currently underway for 2014/15.

List of IGS Activities 2013-14 and 2014-15	
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 and 3LN redfish
P. Ouellet	Assessing the response of Northern shrimp (Pandalus borealis) populations to Climate Change and Variability
M. Koen-Alonso/P. Pepin	Robustness of regional ecosystem units on the Newfoundland Shelf and regional integration
P. Pepin /M. Koen-Alonso	Linking Bottom-up Projections of Ecosystem Production Potential for the Newfoundland and Labrador Shelves and Grand Banks with Environmental Drivers
M. Koen-Alonso	NAFO Roadmap multispecies modelling
M. Koen-Alonso	Multispecies dynamics in Northwest Atlantic marine ecosystems: Towards practical tools for multispecies management decisions.
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 Arctic Marine Ecosystems
E. Head	Ecosystem monitoring in the Northwest Atlantic using the continuous plankton recorder
E. Kenchington	Canadian Contributions to NEREIDA: Use of Benthic Data for EBFM and Assessment of SAI in the NAFO Regulatory Area
E. Kenchington/ K. Gilkinson/ V. Wareham	Identification and Mapping through Predictive Modelling of Coldwater Coral and Sponge Species in the Sub-Arctic/Eastern Arctic

E. Edinger/ K. Gilkinson/ V. Wareham	Biodiversity and Distributions of Corals and Sponges in the Eastern Canadian Arctic: Targeted Field Surveys and Sampling of Inaccessible and Previously Unfished Habitats using a Remotely Operated Vehicle.
K. Gilkinson/ E. Kenchington/ V. Wareham	Collection of In Situ Baseline Data on Sea Pen and Non-coral and Sponge VME in the NAFO Regulatory Area for Future Evaluation of Protection Measures