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Canadian Research Report for 2014 Newfoundland and Labrador Region

Submitted by

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SUBAREAS 0 AND 1

A. STATUS OF FISHERIES

Nominal landings from 2005 to 2014 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 2013, Scientific Council advised for an increase in TAC from 13,000 t to 16,000 t for 2014 for Greenland Halibut in Div. 0A+1AB and not to exceed 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 Canadian (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 3,400 t in 2009 and has fluctuated thereafter between 3,600 t to 3,900 t. Overall, catch by gear and by month remained about the same in 2014. The catch was approximately 3,570 t in 2014 with about 57% taken by otter trawlers (774 t with single trawls and 1,276 t with twin trawls) and the remainder by gillnets (1,518 t).The fisheries occurred from July to September with about half the catch being taken in July.

[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 2005 to 2014 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 2014 preliminary recreational catch, including retained and hooked-and-released fish, was 6,652 salmon, 13 % less than the previous 6 year mean (2008-2013). Preliminary Aboriginal fisheries catches of Atlantic Salmon for 2014 were 34 t, 5.5 % less than the previous 6 year mean (2008-2013) of 36 t.

One of the four assessed rivers in Subarea 2 achieved conservation spawning requirement in 2014. There has been an increasing trend in the abundance of large Labrador salmon since 2010. However, there was no change in the number of large salmon in 2014 compared to 2013 but 2014 returns were 75% higher than the previous 6 year mean (2008-2013).

b) Arctic Charr–Subarea 2

Commercial landings of Arctic Charr from north Labrador in 2014 were 22 t, down about 12% from 2013, but twice as high as landings in 2012. This is equivalent to about 13 thousand Charr caught in terms of numbers of fish. Commercial landings have been sporadic in recent years driven largely by effort directed towards the commercial 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–Divisions 2GH, Divisions 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 2004-09 estimates have ranged between 250 kg to 5,200 kg annually (Orr et al. 2010). 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 2006-14, 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 and 2014. 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 2014, reported landings were 4,583 t which included 4,290 t in the stewardship fishery, 275 t in the sentinel surveys, and 18 t taken as bycatch. The offshore portion of the stock area has remained under moratorium since 1992.

Bycatch of cod occurs in shrimp fisheries in 2J3KL and from 2007-09 estimates have ranged between 1.3 t to 16.2 t annually (Orr et al. 2010). More recent data have not been compiled.

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 Research Vessel (RV) survey. Generally recruitment has been impaired when the survey spawning stock biomass (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 bycatch 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 t annually. In 2013, catch increased to 100 t, the result of bycatch from otter trawl fisheries in Div. 2J, but decreased to 9 t in 2014.

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 (Orr et al. 2010). 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 Exclusive Economic Zone (EEZ) since 1997 although there had not been a persistent directed effort on this stock since 1990, when 2,400 t was landed. Canadian (NL) landings were between 22-221 t for the period 2005-2014 with the 2014 catch at 48 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 NAFO's Regulatory Area (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 2014 (<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 (Orr et al. 2010). More recent data have not been compiled.

f) Witch Flounder-Divisions 2J3KL

There has been no directed fishing on this stock since 1994. In 2014, bycatch in other fisheries from the Newfoundland and Labrador Region was 178 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. In the mid-2000s, the survey distribution expanded somewhat, and has continued to be found in broader areas in Div. 3L and 3K. 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 low.

g) Greenland Halibut-Subarea 2 + Divisions 3KLMNO

The Canadian (NL) catch of Greenland Halibut in 2014 in Subarea 2 and Div. 3KLMNO was approximately 7 223 t.

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 the Working Group on Greenland Halibut Management Strategy Evaluation (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, each referred to as a shrimp fishing area (SFA): 2G (SFA 4), Hopedale and Cartwright Channels in 2HJ (SFA 5), and Hawke Channel in 2J + 3K (SFA 6). The resource within these SFAs is normally assessed on a biennial basis, with updates provided in interim years. The last formal assessment was completed during February 2015. The next formal assessment is scheduled to be completed during February 2017, with an interim monitoring report to be completed in March 2016.

Resource status of Northern Shrimp in Shrimp Fishing Areas (SFAs) 5 and 6 was updated based on DFO fall multi-species trawl survey data (1996-2014). Resource status for Northern Shrimp and Striped Shrimp in SFA 4 was updated based on Northern Shrimp Research Foundation (NSRF)-DFO summer trawl survey data (2005-14). Trawl survey data for SFAs 4-6 provided information on shrimp distribution, length frequencies, and biomass. Trends in fisheries performance were inferred from total allowable catch (TAC), commercial catch to date, fishery catch per unit effort (CPUE) and fishing patterns.

Data from SFAs 5 and 6 indicate that shrimp constitutes an important part of the diet of many groundfish species. In recent years the fraction of shrimp in the diets has declined, while another key forage species, Capelin, has been increasing. Relevant data from SFA 4 are lacking. In SFA 6, total biomass of fishes that are potential shrimp predators has increased. As a consequence, their consumption of all types of food was estimated to have tripled since the late 1990s, and has remained around that level since 2010. Estimates of total predation on shrimp peaked in 2011 and have since declined to be around twice the level of the mid-2000s. Future trends will depend on the trajectory of predator biomass and availability of alternative prey, like Capelin.

SFA 4 (NAFO DIVISION 2G)

A very small fishery took place in SFA 4, with a TAC of 500 t that was never taken, in the late 1970s and expanded greatly in the late 1980s. The TAC increased from 2,580 t in 1989 to 5,200 t in 1995 and 9,320 t in 1998. In 1998, 2,184 t of the TAC was allocated to the area south of 60°N to promote spatial expansion of the fishery. The 2003 TAC was increased to 10,320 t. In 2003 the management year changed from January 1-December 31 to April 1-March 31, and an additional interim quota of 2,802 t was set for the period January 1-March 31, 2004. The 10,320 t TAC was maintained through to 2007/08. By 2009/10, the regulations were changed such that the vessels no longer had to fish a portion of their catch in southern SFA 4. The TAC was set at 11,320 t for the 2008/09 to 2010/11 management years and increased to 13,018 t in 2012/13. In 2013/14 and 2014/15 the TAC was set at 14,971 t. Commercial catch increased from approximately 10,000 t from 2005/06-2011/12 to about 15,000 t in the past two years and the TAC has been taken in 2014/15. While the fishery is open year round, ice conditions in SFA 4 typically only allow access from early summer to late fall or early winter.

Since 2010, large vessel standardized CPUE fluctuated above the long term mean. Fishable biomass index has been relatively stable since 2010, and was 134,000 t in 2014. Female SSB index has changed little since 2010 and was 89,800 t in 2014. Prospects for recruitment to the fishable biomass are uncertain. Since 2010, the exploitation rate index has shown an increasing trend, and reached 11.2 % by 2014/15. Female SSB index was assessed to be in the Healthy Zone, within the Integrated Fisheries Management Plan (IFMP) Precautionary Approach (PA) Framework.

SFA 5 (HOPEDALE AND CARTWRIGHT CHANNELS)

The TAC doubled from 7,650 t in 1994-96 to 15,300 t over the 1997-2002 period. In 2003, the TAC increased to 23,300 t, the management year changed from January 1-December 31 to April 1-March 31, and an additional interim quota of 9,787 t was set for the fifteen month 2003/04 management year; hence 2003/04 had a 33,087 t TAC. The TAC of 23,300 t was maintained through to 2013/14. In 2013 the resource status appeared to decline and the TAC was set at 20,970 t for 2014/15. Commercial catch had been about 23,000 t over the past five years and it is expected that the 2014/15 TAC of 20,970 t will be taken.

Standardized large vessel CPUE increased over the last 4 years. Fishable biomass index has been relatively stable since 2010, and was 116,000 t in 2014. Female SSB index has changed little since 2010, and was 60,000 t in 2014. Climate-driven changes (e.g., time of phytoplankton bloom) and increases in predation suggest low recruitment to the fishable biomass in the medium term. The exploitation rate index has varied without trend and averaged 18% since 2010. Female SSB index was assessed to be in the Healthy Zone within the IFMP PA Framework. If the 20,970 t TAC is maintained and taken in 2015/16, then the exploitation rate index will be 18.1%.

SFA 6 (HAWKE CHANNEL + NAFO DIVISION 3K)

The TAC was set at 11,050 t in 1994 and increased to 23,125 t in 1997 as a first step towards increasing the exploitation of an abundant resource. Most of the increase was reserved for development of the small vessel fleet. The TAC more than doubled between 1997 and 1999, increased to 61,632 t in 2002 and then to 77,932 t in 2003. An additional interim quota of 7,653 t was set for the fishing season January 1, 2003-March 31, 2004. Thus the 2003/04 management period was fifteen months long and had an 85,585 t TAC. As a result of the seasonal bridging program, the 77,932 t TAC for 2007/08 was increased by 2,000 t. The TAC was increased to 85,725 t in 2008/09 and maintained through 2009/10. The 2010/11 TAC was reduced to 61,632 t and further to 52,387 t in 2011/12. Resource status improved during 2011 and subsequently the TAC for 2012/13 was increased to 60,245 t and maintained through 2013/14. The TAC was reduced in 2014/15 to 48,196 t and will likely be taken. Commercial catch has been about 60,000 t over the past four years.

Large vessel standardized CPUE has varied without trend since 2010 while small vessel CPUE has been increasing. Fishable biomass index declined from 421,000 t in 2011 to 216,000 t in 2013, the lowest in the time series, and increased slightly to 233,000 t in 2014. Female spawning stock biomass (SSB) index declined from 250,000 t in 2011 to about 136,000 t in 2013 and 2014, the lowest level in the series. Climate-driven changes (e.g., time of phytoplankton bloom) and increases in predation pressure suggest low recruitment to the fishable biomass in the medium term. The exploitation rate index ranged between 5.6 % and 22.3 % from 1997 to 2014/15, and has averaged 18.3 % in the last five years. The 2014/15 exploitation rate index will be 22.3 % if the TAC is taken. Female SSB index, at its lowest level in the time series, was assessed to be below the midpoint of the cautious zone within the IFMP PA Framework. If the 48,196 t TAC is maintained and taken in the 2015/16 season, the exploitation rate index will be 20.7 %.

i) Snow Crab–Divisions 2HJ

Most of the landings are derived from Div. 2J in all years. Landings were at their lowest level in two decades in 2013 but increased by 25 % to 1,740 t in 2014. Effort has been at its lowest level in two decades during the last two years. CPUE has increased since 2012. The exploitable biomass has increased since 2011, as reflected by continued improvement in the post-season trawl survey index. Recruitment has increased since 2011. Short-term (2-3 year) recruitment prospects are uncertain due to variability in the pre-recruit biomass index. The pre-recruit fishing mortality index has increased over the past ten years to above the median level. The exploitation rate index increased steadily from 2007-2012 but decreased to a moderate level in the past two years. Maintaining the current level of fishery removals would further reduce the exploitation rate in 2015.

j) Iceland Scallop–Divisions 2HJ

Inshore aggregations were again fished in 2009, 2010, 2011, 2012, 2013 and 2014 with nominal catches estimated at 17 t ,16 t, 19 t,16 t, 20 t, and 6 t round, respectively. 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) Multispecies Trawl Surveys

Biological and oceanographic data from fall (Div. 2HJ) multi-species research vessel surveys were collected in 2014 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, Thorny Skate, shrimp, crab) as well as a suite of indicator species under the Ecosystem Research Initiative of the NL Region. 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. In 2014, the CCGS Alfred Needler was completely out of commission and to mitigate part of this loss there was no coverage of Div. 2H greater than 750 m, no coverage of Div. 3NO and additional days required to allow CCGS Teleost time to work a core offshore areas in Div. 2HJ3KL.

Analysis of maturity data is conducted regularly on Cod, American Plaice, 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) 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).

c) Arctic Charr

Biological characteristics information was updated from commercial landings from two north Labrador stock complex areas in 2014. Following long term declines in mean weight of Charr harvested in northern Labrador, current data continue to show that mean weight and mean-weight-at-age have stabilized. In recent years investigations have focused on trophic ecology, environmental influences on growth, and thermal habitat use of juvenile Arctic Charr. However, the end of the 2014 fishery marks the termination of Arctic Charr studies in north Labrador that began in 1974.

d) Shrimp

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 was published through the technical series of DFO publications, in 2014, outlining the study and results.

e) Snow Crab

A trap survey for Snow Crab was conducted in Div. 2H in the summers of 2009, 2010 and 2012-2014. 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 of Atlantic Salmon harvested in three fisheries in the northwest Atlantic was quantified using genetic mixture analysis and individual assignment with a microsatellite baseline (15 loci, 12409 individuals, 12 regional groups) encompassing the species western Atlantic range. A total of 353 individuals collected from the Saint Pierre and Miquelon fishery (2004, 2011-2014) were analyzed and estimates of stock composition showed consistent dominance of three regions, Gulf of St. Lawrence, Gaspe Peninsula, and Newfoundland. Together these account for > 70 % of annual harvest and this was stable over the decade examined. In the West Greenland harvest, we analysed 2336 individuals from 2011-2014 of which 342 were identified as European in origin. North American contributions were largely from Labrador, the Gulf of St. Lawrence, and the Gaspe Peninsula. Preliminary comparison with historical samples (1968, 1978, 1988, and 1998) again suggests stability in the dominance of these groups. No evidence of spatial or temporal trends in mixture composition was apparent. Finally a total of 771 individuals were analyzed from the Labrador aboriginal food, social and ceremonial (FSC) fishery during the period 2012-2014. In contrast to the other fisheries, here the mixture estimates suggest the harvest is dominated by a single region with ~95% of the catch originating from central Labrador. Minor components were also allocated to Northern Labrador / Ungava and Newfoundland (<4 %). Again this is consistent with previous analysis conducted for the period 2006-2011 which estimated 96.0% of the harvest originating from central Labrador. Regional and size group comparisons of stock composition indicated elevated contributions of central Labrador in Salmon Fishing Area (SFA) 1B (4-7%) and in small salmon (~8%).

SUBAREA 3

A. STATUS OF FISHERIES

Nominal landings from 2005 to 2014 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 3 has remained closed since 1992. The 2014 preliminary recreational harvest, including retained and hooked-and-released fish, was 19,418 salmon, 41 % less than the previous 5 year mean (2009-2013).

Two of the seven assessed rivers in Subarea 3 achieved conservation spawning requirement in 2014. Three of the rivers that did not achieve conservation have had large areas of habitat made accessible and the area of habitat utilized by Salmon is unknown.

b) Capelin–Subarea 2 + Divisions 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. Preliminary landings in 2013 and 2014 were 23,755 t and 23,173 t, respectively, against a Total Allowable Catch (TAC) in Div. 2J3KL of 22,771 t. The most recent Capelin assessment (held February 2015) included survey data and biological data to May 2014. During this assessment several biological indicators were shown to be returning to levels last recorded prior to the collapse of the stock in the early 1990s.

The mean lengths and weights of spawning Capelin sampled from the commercial fishery catch in 2013 and 2014 were the largest recorded since 1990, reflecting a higher proportion of age 3 spawners in landings. In the last two years an increasing proportion of the stock are delaying first maturation from age 2 to age 3.

From the early 1990s through 2010 spawning times had been delayed by as much as four weeks. Peak spawning at index sites at Bryants Cove and Bellevue Beach from 2011-2014 have occurred in early to mid-July, only two weeks later than in the 1980s. Fall Capelin distribution over the last two years has been further north and west than during the last two decades and spring distributions have shifted coastally from the shelf break. While they are still exhibiting less vertical migration than in the 1980s, during the last three years they have shifted into areas of shallower bottom depths.

There are no recent estimates of abundance available for the entire Capelin stock, however an abundance index derived from an acoustic survey conducted annually in Div. 3L estimated abundances in 2014 to have increased four-fold from the 2000-2012 period, although still only 25 % of the values observed in the 1980's.

Four recruitment indices covering the year classes since 2003 were generally coherent until 2012, but have since diverged. The most recent estimates of the 2012 and 2013 cohorts in the acoustics survey were both the highest since 1996. These cohorts are expected to comprise the majority of spawners in 2015 and 2016. Survival of larvae produced in 2011 and 2012 has been 2-3 times better than that of any cohort since 2003. This two year period corresponds to one of increased zooplankton production and improved condition and feeding in adult Capelin. However, stomach fullness indices from the spring acoustic survey indicate that feeding in 2014 was among the poorest in the time series.

Ecosystem estimates of consumption of Capelin by fish have increased in the last two years, which is consistent with observed improvements in Capelin abundance indices.

c) Cod–Divisions 3NO and Subdivision 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 2004-2014. The provisional 2014 value reported to NAFO based on monthly catch reports is 674 t. Canada (NL) landings ranged from 444 t to 818 t between 2002-2005, and from 26 t to 247 t between 2006-2014. Canadian catches in 2014 totalled 196 t, taken primarily in the 3NO yellowtail fishery.

The 2013 assessment of 3NO cod (i.e. the last full assessment of this stock) reported that the spawner biomass had doubled since 2010. However, the 2013 estimate of 25,000 t was 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 15,000 t to 11,500 t for the 2013/14 management year. Total landings for 2013/14 totalled 4,629 t, marking the fifth consecutive year that the TAC has not been taken. Reasons given for not taking the complete TAC have included reduced availability of fish, poor market conditions, and the closure of a processing facility in St. Pierre. 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 2014 assessment of 3Ps Cod indicated that the stock has increased since 2009 and is currently estimated to be 60 % above the limit reference point (BRecovery). The probability of being below the LRP in 2014 is very low (~0.01).

d) American Plaice-Subdivision 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 1,000 t or more will result in stock decline. Canadian catch in 2014 was 46 t.

e) Witch Flounder-Subdivision 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 202 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–Divisions 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 2014 was 6,800 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 2014 was 17,000 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– Divisions 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 and the TAC has been set at 0 since 1995. Bycatch of plaice in the Canadian yellowtail fishery increased in 2013 compared to 2011 and 2012 due to increased effort and a resolution to the market dispute. The majority of catch was taken in the NAFO regulatory area (NRA) in the skate, redfish and Greenland halibut fisheries. To estimate catch for 2011-2013 for Div. 3N, information on effort from NAFO observers and logbook data was used where possible with the assumption that CPUE has not changed substantially from 2010. A Virtual Population Analysis (VPA) was carried out using the ADAPTive framework with a reasonably good fit (0.31). Spawning stock biomass has been gradually increasing since the mid-1990s and in 2014 was 36,000 t, still below the Blim of 50,000 t set for this stock (72 % of Blim). Recruitment has been generally poor since the 1986 year class, although numbers of recruits from 2003-2008 are higher than 1995-2002. A retrospective pattern indicates instability in estimates of SSB and recruitment and these are revised downward as data is added.

h) Redfish–Unit 2 (3Ps4Vs, 3Pn4Vn-June to December, 4Wfgi)

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. The fishery management year was changed in 1999 from a calendar year basis to an April 1 – March 31 (following year) basis.

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 2014, whereas catches have fluctuated between 1,960 t to 6,700 t from 2006-2013. The Canadian catch in 2014 was 2770 t with 533 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.

i) Redfish – Division 3O

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 t in 2012 and 2013 and 34 t in 2014. 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.

j) Redfish – Divisions 3LN

The directed fishery in 3LN was under moratorium from 1998 to 2009 then re-opened in 2010 with a TAC of 3,500 t which increased to 6,000 t for 2011-2012 then to 6,500 t for 2013-2014. Canada is allocated about 43 % of the TAC. The fishery yielded an average of 21,000 t from 1960-1985 then escalated rapidly to 79,000 t in 1987 then fell steadily to a minimum of 450 t in 1996. Catches were generally low, fluctuating between 450 t and 3,000 t during the moratorium years to 2009. Canada has increased its harvest from 113 t in 2009 to 1,446 t in 2014; it only exploited its full allocation in 2013 at 2,730 t.

k) Witch Flounder-Divisions 3NO

There has been no directed fishing on this stock since 1994. Canada (NL) bycatch has ranged between 2 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 2011-2013, but there is considerable uncertainty. Recent work has focused on trying to estimate reference points under the precautionary approach and developing a model. A 1,000 t quota has been adopted for 3NO Witch Flounder and is slated to begin in 2015.

l) White Hake–Divisions 3NO and Subdivision 3Ps (Divisions 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 521 t during the period 2009-2013. Preliminary 2014 Canadian landings for NAFO Div. 3NO and Subdiv. 3Ps are 397 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 low levels relative to the 1999-2002 peak period.

m) Thorny Skate–Divisions 3LNO and Subdivision 3Ps

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 2013-15. The TAC for Subdiv. 3Ps in the EEZ was maintained at 1,050 t by Canada.

Average STATLANT landings for 2009-13 were 5,047 t in NAFO Divisions 3LNO, and 431 t in Subdivision 3Ps. Preliminary Canadian landings for 2014 are 97 t in NAFO Divisions 3LNO, and 291 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.

n) Shrimp–Divisions 3LMNO

Catches increased dramatically since 1999, with the beginning of a regulated fishery. Over the period 2004-09, catches increased from 13,200 t to 26,000 t. Due to declines in resource indices, the TACs have been steadily decreasing with the 2014 TAC being set at 4,300 t, and a moratorium put in place for 2015, during the 2013 and 2014 Fishery Commission meetings. Preliminary catch records, as of August 2014, show that the 2014 catch was 1,700 t. As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 10,300 t in 2004 to 18,900 t in 2008 but have since declined. Catches by other contracting parties (outside the 200 mile limit) increased from 2,900 t in 2004 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 7 t of Northern Shrimp by September 2014, while they took 170 t by the same time in the previous year.

There is reason for concern about the status of the Northern Shrimp resource within NAFO Divisions 3LNO. The spring female spawning stock biomass (SSB) index decreased by 91% from 2007 to 2014 while the autumn SSB index decreased by 91% from 2007 to 2013. The autumn 2013 SSB was below the $B_{lim.}$ Both, the spring and autumn 3LNO total biomass indices dropped drastically from 2007 to 2012 and increased slightly in 2014. There were also slight increases in spring fishable biomass and age 3 abundance during modal analysis. It is important to note that the spring 2014 indices of biomass and abundance have increased, however these levels are still near the lowest sets of indices over the time series. Exploitation and mortality rate indices have been increasing since 2007 even though catches have been decreasing during this period.

o) Snow Crab–Divisions 3KLNO and Subdivision 3Ps

In Div. 3K offshore, landings declined by half since 2009 to 6,100 t in 2014, their lowest level in two decades. Meanwhile, effort has declined by a third. CPUE declined by half from 2008 to 2011 and has since changed little, remaining near a historic low level. The post-season trawl and trap survey exploitable biomass indices have both declined steadily since 2008 to be at or near their lowest levels. Recruitment has been poor since 2009. Recruitment is expected to remain low in the short term (2-3) years. The post-season trawl and trap survey pre-recruit biomass indices have both declined since 2008 to their lowest levels. The pre-recruit fishing mortality index has varied at a moderate level since 2009. The exploitation rate index increased from 2008-2010 and has since changed little. Maintaining the current level of fishery removals would result in a continued high exploitation rate in 2015.

In Div. 3K inshore, Landings declined from 2,900 t in 2009 to 1,750 t in 2014, due to declines in Crab Management Area (CMA) 3D (Notre Dame Bay) and 3C (Green Bay) where TACs were not taken in most of the past 5 years. Overall, effort has declined since 2011. CPUE has remained low during the past four years in CMAs 3C and 3D, whereas it remained high in CMA 3B (White Bay). The CPS (Collaborative post-season) trap surveys indicate that the exploitable biomass has remained low in CMAs 3C and 3D in the past 4 years. The DFO trap survey indicates the exploitable biomass in CMA 3B has remained high. Recruitment has been low during the past 3-4 years in CMAs 3C and 3D. Recruitment peaked at its highest level in 2012 in CMA 3B but has since declined. Recruitment is expected to remain low in the short term in CMAs 3C and 3D and to continue to decline in CMA 3B. In the last two years, the post-season trap survey-based exploitation rate index has changed little in CMA 3D, has declined in 3B and has increased sharply in 3C. Data are insufficient to estimate the pre-recruit fishing mortality index. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate overall in 2015 with continued high exploitation in CMA 3C.

In Div. 3LNO offshore, Landings have remained near their highest level, at about 26,000 t, in the past 3 years. Effort declined considerably from 2011-2013 but increased slightly in 2014. CPUE increased from 2009-2013 and changed little in 2014. The indices of exploitable biomass from spring and fall trawl and trap surveys decreased, to differing degrees, in 2014. Recruitment has declined since 2012. Recruitment is expected to decline further in the short term (2-3 years). The pre-recruit biomass indices spring and fall trawl and trap surveys have declined since 2010. The exploitation rate index has changed little over the last four years. The pre-recruit fishing mortality index has remained relatively low since 2008. Maintaining the current level of fishery removals would likely increase the exploitation rate in 2015.

In Div. 3L inshore, landings have increased gradually since 2010 to a historical high of 8,000 t in 2014 while overall effort has declined. CPUE has been near its highest level for the past three years but there has been considerable variability among management areas. The post-season trap survey index suggests the overall exploitable biomass has increased steadily since 2008 to its highest level in the time series. Most management areas have experienced increases in recent years. Overall recruitment has declined gradually since 2010, although there is considerable variability among management areas. Recruitment is expected to decline further in the short-term (2-3 years). The post-season trap survey pre-recruit biomass index decreased in the past two years. 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 index. Maintaining the current level of fishery removals would likely decrease the exploitation rate in 2015.

In Subdiv. 3Ps offshore, landings declined from a peak of 4,200 t in 2011 to 2,700 t in 2014. Meanwhile, TACs have not been taken and effort has increased to a record high level. CPUE has steadily declined since 2009 to a record low in 2014. The exploitable biomass, as indicated by the spring trawl and fall trap survey indices, has been at its lowest level during the past two years. Both trap and trawl surveys indicate recruitment has declined since 2009. Recruitment is expected to remain low in the short term (2-3 years) as pre-recruit biomass indices from both trap and trawl surveys declined rapidly from 2009 to their lowest levels in 2013-2014. The exploitation rate index has been at or near its highest level during the past two years. The pre-recruit fishing mortality index has increased steadily since 2010 to its highest level in 2014. Maintaining the current level of fishery removals would result in a continued high exploitation rate in 2015.

In Subdiv. 3Ps inshore, landings remained at 2,500 t from 2011-2013 but decreased to 2,200 t in 2014. Effort has increased steadily since 2010. CPUE remained at a high level from 2010-2012 but has declined sharply in the past two years. The exploitable biomass, as indicated by the post-season trap survey index, declined since 2012 to its lowest level in eight years. Recruitment declined substantially in the past two years to its lowest level. Recruitment is expected to remain low for at least 2-3 years. The pre-recruit biomass index declined by more than half from 2007-2011 and has since changed little. The post-season trap survey-based exploitation rate index changed little from 2008-2013 but nearly doubled in 2014. Data are insufficient to estimate a pre-recruit fishing mortality index. Maintaining the current level of fishery removals would result in an increase in the exploitation rate in 2015.

p) Iceland Scallop–Divisions 3LNO and Subdivision 3Ps

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 and 2014. 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 2013 there was 4 t and in 2014 there was 1 t of Iceland Scallop removals, in 2012 there was 2 t then 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.

q) 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 1,190 t (round) respectively then decreased to 1,071 t in 2013 and 1,158 t in 2014.

r) 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 or 2014.

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 2014 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 11 to 29. The second survey on CCGS Teleost took place from July 9-28 and the last on CCGS Hudson from November 15 to December 7. 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 2014 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.

Annual sea-surface temperatures (SST) based on infrared satellite imagery remained above normal in most areas across the Newfoundland and Labrador Shelf in 2014, however, values have declined from record-highs observed in 2012. The annual bottom (176 m) water temperature at the inshore monitoring station (Station 27) was below normal in 2014 by -0.6 SD, a significant decrease from the record high in 2011. The cold-intermediate layer (CIL; volume of < 0° C) in 2014 was at its highest level since 1985 on the Grand Bank during the spring and the highest since 1991 off eastern Newfoundland during the summer. Spring bottom temperatures in 3Ps remained above normal by about +0.5 SD but were slightly below normal on the Grand Banks by -0.3 SD. Fall bottom temperatures in 2J and 3K decreased from 2 and 2.7 SD above normal in 2011 to 0.7 and 0.3 above normal in 2014, respectively, a significant decrease in the past 3 years.

b) Nutrients and plankton studies

The inventories of nutrients are strongly influenced by seasonal biological processes operating throughout the upper water-column. In general, shallow (0-50m) macronutrient inventories of nitrate (principal limiting nutrient) were near the 1999-2010 average across AZMP Sections in 2014. The deep inventories of nitrate, an index of nutrient availability to fuel the base of the marine food chain in the subsequent spring bloom, were consistently negative across the northern Sections down to the southern Grand Bank. Nitrate inventories in the deep layer (50-150m) continue to decline across the Grand Bank, northeast Newfoundland and Labrador Shelf in 2014, ongoing since 2008. The chlorophyll *a* inventories inferred from the seasonal oceanographic surveys, which provide an index of phytoplankton biomass throughout the water-column, were generally below normal throughout the survey area in 2014. The trend in chlorophyll *a* inventories have remained lower since 2011 with gradual increasing levels into 2014 but still below the long-term climatology.

Satellite ocean colour observations from 11 sub-regions off Newfoundland and Labrador indicated that the magnitude and peak intensity (amplitude) of surface phytoplankton blooms detected was generally weak in 2014 similar to conditions observed in the previous year. The initiation and duration of the spring bloom was

delayed and reduced in 2014 across the Newfoundland and Labrador Shelves. Peak timing of the spring bloom was somewhat variable across the different sub-regions with mostly delayed production.

The abundance levels of different functional mesozooplankton taxa varied across the AZMP Sections in 2014. The zooplankton abundance anomalies for a key small grazer and dominant copepod, *Pseudocalanus spp*., were substantially higher again in 2014 similar to the pattern observed in the previous year with the largest changes observed over the Flemish Cap (3LM). These small epipelagic, subarctic copepods represent an important preferred prey to many early life stages of gadoid fish and invertebrates. In contrast, the abundance of a dominant large grazing copepod (*Calanus finmarchicus*) were lower throughout the Newfoundland and Labrador Shelves in 2014. In general, the total number of copepod taxa increased from 2013 levels with larger proportions of smaller subarctic and temperate taxa in 2014. The non-copepod taxa, characterized by carnivorous zooplankton, gelatinous invertebrates, and meroplankton, have increased substantially in recent years throughout the Grand Bank and northeast Newfoundland Shelf.

2. Biological Studies

a) Multispecies Trawl Surveys

Biological and oceanographic data from fall (Div. 3KL) and spring (3LNOP) multi-species research vessel surveys were collected in 2014 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) as well as a suite of indicator species under the Ecosystem Research Initiative of the NL Region. 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. In 2014, the intensity of the spring survey was reduced due to mechanical issues with the CCGS Alfred Needler and the CCGS Teleost was deployed in 3PLNO to mitigate most of the shortfall. In the autumn survey, the CCGS Alfred Needler was completely out of commission and Div. 3NO and deep water in Div. 2H (>750m) was not covered. In addition, additional days were required in January 2015 to allow completion of Div. 3L, including the deep water area from 732 m to 1500 m which had not been accomplished since.

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 is ongoing.

c) Atlantic Salmon

Research examining aspects of the tropic ecology of Atlantic Salmon using stable isotopes continues. 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. Variation in adult Atlantic Salmon run timing were found to vary over time with evidence showing that the median date of return has advanced by almost 12 days over a 35-year interval going back to the late 1970s. Temporal changes in run timing are associated with overall warming conditions on the Newfoundland and Labrador Shelf.

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 was published through the technical series of DFO publications, in 2014, outlining the study and results.

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 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 latitudes 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 2014. 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 2014. Similar surveys were initiated in Trinity Bay and St. Mary's Bay in 2013 and continued in 2014.

A post-season trap survey, conducted by Snow Crab harvesters, which began throughout most of 2J3KLNOPs in 2004 was continued in 2014.

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 2005 to 2014 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 2014 recreational harvest, including retained and hooked-and-released fish, was 16,393 salmon, 13 % less than the previous 5 year mean (2009-2013).

All three of the assessed rivers in Subarea 4 achieved conservation spawning requirement in 2014.

b) Snow Crab–Div. 4R

In Div. 4R offshore, data are insufficient to assess resource status.

In Div. 4R inshore, landings have increased from a historical low of 155 t in 2010 to about 600 t in 2013-2014. Effort has been stable for the last three years. CPUE has been near an all-time high for the last three years. The exploitable biomass index peaked in 2011 and has since declined to its previous level. Recruitment has declined since 2011 to its lowest level. Recruitment prospects are unfavourable in the short term (2-3 years). The trap survey index of pre-recruit-sized males peaked in 2009 and has since declined to its lowest level. The post-season trap survey-based exploitation rate index decreased in 2012 and has since changed little. Data are insufficient to estimate a pre-recruit fishing mortality index. Maintaining the current level of fishery removals would result in an increase in the exploitation rate in 2015.

c) Iceland Scallops–Div. 4R

The nominal catch from the Strait of Belle Isle (Div. 4R) in 2013 increased to 378 t from 295 t (round) in 2012 against a TAC of 1,000 t then decreased slightly in 2014 to 310 t. Landings in 2011 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 2010, 2011, 2012, 2013 and 2014 were 27 t, 48 t, 66 t, 2 t and 6 t (round) respectively.

SUBAREA 2 + 3 + 4

A. STATUS OF FISHERIES

Nominal landings from 2005 to 2014 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 to approximately 2,150 t in 2014. In Subdiv. 3Ps landings increased up to 2010 to 1,228 t but had a sharp decline in 2011 to 916 t and have averaged close to 980 t in the last few years. Landings in Div. 4R peaked in 2008 at 1,400 t but have since declined to approximately 900 t in the last couple of years. Landings in Div. 3K and 3L have declined to record low levels of 50 t and 80 t respectively. Landings in all Divisions combined, Div. 3KLP4R, have decreased slightly from 2,600 t in 2010 to approximately 2,100 t in 2014. The reported landings have become spatially concentrated. The contribution of the most productive Lobster fishing area (LFA 11 which is within Subdiv. 3Ps) 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. In addition, mandatory logbooks were implemented in 2010. At-sea sampling data which has been collected from at least

one Lobster Fishing Area (LFA) in each Division clearly show a sharp drop in captured lobsters at minimum legal size (MLS) and few large lobsters surviving beyond MLS, 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 which is likely due to the protection provided for ovigerous (egg-bearing) and v-notched females. Mean catch rates of pre-recruit Lobsters show little annual variation which suggests there is no apparent relationship between these catch rates and future commercial landings or CPUE. Based on the commercial (2004-2013) and mandatory logbooks (2010-2012) CPUE (number of lobster caught/number of traps hauled) has changed little since 2004.

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) 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, seal-fisheries interactions, and the impact of climate change continued in 2014.

As the northern hemisphere continues to warm, declines in sea ice seriously impact species that rely on ice for reproduction and/or feeding. Northwest Atlantic Harp Seals feed and give birth on ice along the southern edge of the seasonal pack ice. Unfortunately, little is known about the impact of climate change on ice-dependent species in sub-Arctic areas, even though the associated ecosystem changes are likely to be most rapid along the southern edge of the ice. Although climate change has been shown to affect Harp Seals directly through increased mortality of young, it may also impact indirectly through changes in prey and subsequent reproductive rates. Estimates of late-term pregnancy and premature birth rates of Northwest Atlantic Harp Seals were estimated from samples collected between 1954 and 2014 off Newfoundland, Canada. Since the early 1980s, pregnancy rates have declined while inter-annual variability increased with late term pregnancy rates among mature females varying from <0.3 to >0.86. Using a beta regression model to explore the importance of a wide variety of biological and environmental conditions and pregnancy rates to 2013, we found that while the general decline in pregnancy is associated with increased population size, by including the rate of premature births we captured much of the large inter-annual variability. Changes in premature birth rates were described by a model that incorporated mid-winter ice cover and capelin biomass. It is likely that ice cover is a proxy for ecosystem changes in overall prey abundance. Harp Seals appear to respond to relatively small variations in environmental conditions when they are at high population levels. If the observed changes in climate continue, the Northwest Atlantic Harp Seal population will mostly likely be negatively impacted by the general warming trend and reduced ice coverage predicted.

The impact of Harp Seal predation on Atlantic Cod in 2J3KL was investigated using a bioenergetics–allometric model. The model was used to determine the relative contributions of seal predation, Capelin abundance and fishing on the lack of recovery and dynamics of the northern (2J3KL) cod stock. Biomass dynamics were best explained by a combination of fisheries removals and Capelin availability, whereas seal consumption was found not to be an important driver of the northern cod stock. Prey availability was linked to reduced somatic condition during the 1990s and 2000s. Evidence suggests that cod may be experiencing depensatory dynamics, but not related to a 'predator pit effect'. Our study further suggests that trophic control is bottom-up, and that a depressed Capelin stock could be a serious impediment for cod rebuilding.

The diving behavior of Northwest Atlantic Hooded Seals was investigated using satellite telemetry to determine important feeding areas. Many pinniped species perform a specific dive type, referred to as a 'drift dive', where they drift passively through the water column. This dive type has been suggested to function as a resting/sleeping or food processing dive, and can be used as an indication of feeding success by calculating the daily change in vertical drift rates over time, which reflects the relative fluctuations in buoyancy of the animal as the proportion of lipids in the body change. Northwest Atlantic Hooded Seals perform drift dives at regular intervals throughout their annual migration across the Northwest Atlantic Ocean. We found that the daily change in drift rate varied with geographic location and the time of year and that this differed between sexes. Positive changes in buoyancy (reflecting increased lipid stores) were evident throughout their migration range and although overlapping somewhat, they were not statistically associated with high use areas as indicated by

First Passage Time. Differences in the seasonal fluctuations of buoyancy between males and females suggest that they experience a difference in patterns of energy gain and loss during winter and spring, associated with breeding. The fluctuations in buoyancy around the moulting period were similar between sexes.

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
2014	54,830	7

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, and now includes deployments on the southern Labrador Shelf. In cooperation with research partner in St. Pierre and Miquelon (France), DFO deployed AURAL autonomous acoustic recorders in multiple locations to 1) characterize the acoustic environment of several VME and/or LOMA sites, and 2) use these data to characterize ambient noise levels and identify which marine mammal species are associated with identified VMEs/LOMAs, some of which are listed under SARA. Analysis of the recordings is underway, and DFO researchers in Newfoundland and Labrador have been working with colleagues in other Atlantic Canadian DFO labs, and with several private firms (Akoostix Inc., JASCO Ltd.) to coordinate acoustic collections and develop means to automate analyses. Further, an international effort with Canadian and American government, academic, and NGO researchers in underway to coordinate large-scale acoustic deployments in the western offshore and nearshore Atlantic in the next several years.

Part of the western Atlantic population of Leatherback Turtles forage in Canadian and international waters of interest to NAFO. Considered “Endangered”, the designation and protection of its critical habitat is a legal requirement. Several areas of higher use have been identified in eastern Canada using satellite telemetry and opportunistic data. In a recent study, sightings of Leatherback Turtle and Sunfish, obtained during a systematic aerial survey by DFO in nearshore and offshore areas of the Canadian Atlantic shelf areas, along with additional opportunistic turtle sightings, were used to 1) re-examine the seasonal occurrence and distribution of Leatherback Turtles in eastern Canada, 2) identify the relationships between their occurrence and habitat characteristics, and 3) predict spatial and seasonal evolution of potentially suitable areas. Data confirmed the presence of Leatherback Turtles off Nova Scotia during summer, but also highlighted the importance of the southern coast of Newfoundland for the species. Opportunistic sightings suggest a progressive seasonal shift, from southwest to northeast, of the main concentration of Leatherback Turtles, with use of southern Newfoundland waters extending until September. A Generalized Additive Model linking environmental characteristics and Leatherback observations suggests adding the Grand Banks and waters east of Anticosti Island in the northern Gulf of St. Lawrence to the potential habitat already defined. While our findings using direct observations help delineate habitat currently used by Leatherback Turtles, modelled predictions could trigger new studies in unexplored areas (such as offshore NAFO VMEs), and provide a basis for tracking the evolution of turtle habitat in the context of changing climate.

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 2014. Data collected were tabled at the Regional stock update in the spring of 2015 for Div. 2J3KL cod, and the 3Ps cod Regional Stock Assessment in October 2014. 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 2014. Approximately 6,268 (5,297 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 2010-2014 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 and ≤ 5 % during 2014. Among cod in NAFO Subdiv. 3Ps the exploitation rate in 2012 for cod tagged in Placentia Bay tended to increase with size of cod from 14 % among cod >50 cm at tagging to 22 % among those >60 cm. These exploitation rates are modest, but only 42 % of the TAC was taken. In 2013 harvest rates for cod tagged in

Placentia Bay were broadly similar among cod size groups ranging from 13-16 %; for those tagged in Fortune Bay the range was 14-22 %. However, only 35 % of the TAC was taken. If the entire TAC had been harvested in 2013 it is likely that harvest rates would have exceeded 30 % in both areas.

d) Hydrographic Surveys

The Canadian Hydrographic Service (CHS) conducted Hydrographic Surveys in the Goose Bay-Lake Melville-Groswater Bay area of Labrador (Subarea 2) in 2014. Surveys were conducted from shore based operations using three CHS survey launches. The launches were equipped with multibeam echo sounders and associated equipment. Tidal data was collected at several sites in the area. High Resolution Satellite imagery was obtained for the area as well. The data collected from the surveys will be used to produce new charts for the area. The new charts are in production and will also include data collected in 2012 and 2013. Charts will be constructed from modern survey data and will replace the existing charting in the area.

New charts were released in the Voisey Bay area (Subarea 2) and in the Bay of Islands area (Subarea 4)

Annual Sailing Directions Revisory Survey

The 2014 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), ATL 102, Newfoundland East and South Coasts and ATL 103, Newfoundland Southwest Coast. A New Edition of ATL 121, Labrador, Hamilton Inlet to Cape Chidley (including Button Islands and Gray Strait) was commenced with publishing projected for 2015.

An integral part of the Sailing Directions Revisory Survey is chart dealership inspections. These inspections assure 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.

Two chart dealership inspections were conducted at locations within 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, 2005-2014. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only

Subarea	Species	Division	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
0+1	Greenland halibut	SA 0 + 1A(offshore)+ 1B-F	3,568	3,747	3,571	3,871	3,862	3,363	3,348	3,742	4,045	4,005
	Shrimp*	0A										7,508
		0B										6,333
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	14,970	14,976	13,847	10,441	11,134	10,656	9,682	10,009	10,084	10,247
		2HJ (SFA 5)	17,273	24,637	23,645	25,264	21,425	25,094	20,503	23,768	22,612	22,904
		2J3K (SFA 6)	39,496	58,853	58,327	59,685	61,501	45,099	75,080	80,736	75,673	75,231
	Snow Crab	2HJ	1736	1392	1606	1933	2131	2387	2549	2523	2139	1576
	Iceland scallop	2HJ	6	20	16	19	16	17	13	40	686	672
	Arctic Charr	2J3KLPs+4R	22	25	11	24	11	16	18	28	40	22
	Atlantic Salmon****		38	37	54	41	36	30	36	27	32	31.9
2+3	Redfish	2+3K	48	66	103	74	61	28	20	29	221	135
	Greenland halibut	2+3KLMNO	7,223	6410	6176	6166	6529	5,744	4,701	5,073	6,307	6,644
	American plaice	2+3K	9	100	11	18	22	10	10	23	60	29
	Witch	2J+3KL	178	182	94	143	160	45	5	22	53	40
	Cod*****	2J3KL	4,583	4,299	3,305	3139	2902	3,098	3,343	2,546	2,679	1,330
	Grenadier	2+3	5	11	28	113	41	13	10	38	99	151
	Capelin	2J3KL (offshore)	0	0	0	0	0	0	0	0	0	0
	Squid	2+3	0	0	17	90	100	643	516	228	6,979	548
3	Redfish	3LN	1,446	2730	920	1960	113	6	1	3	1	2
		3M	0	0	0	2	0		0	0	0	0
		3O	34	0	0	97	42	255	202	1,054	3,580	5,364
	Yellowtail	3LNO	6,800	7,920	1,795	3947	8056	5,414	10,216	3,674	177	13,268
	American plaice	3LNO	748	1,041	267	450	1154	1,077	878	434	93	1,466
		3Ps	46	96	140	279	402	509	456	460	485	745
	Witch flounder	3NO	9	62	3	11	39	41	46	21	94	49
		3Ps	144	226	235	175	446	454	298	110	182	483
	Atlantic halibut	3	570	400	364	270	321	289	287	170	251	255
	Cod	3NO	187	223	25	39	103	158	231	123	73	459
		3Ps	4,378	3,058	4,254	5,424	6,737	7,491	9,636	10,599	10,506	11,400
	Haddock	3LNO	10	13	4	42	27	104	60	30	23	44
		3Ps	189	69	101	88	129	173	288	302	128	219
	Pollock	3Ps	305	148	335	186	319	287	616	1,042	733	500
	White hake***	3NOPs	397	301	264	239	559	748	1383	1,680	2,112	2,145
	Thorny skate***	3LNOPs	388	294	531	467	604	1334	1452	1639	1,392	2,124

	Capelin	3L	9,808	12,423	11,645	12,023	11,927	13,326	15,176	16,321	15,430	15,230
		3K	13,365	11,332	10,672	8,081	3,544	9,853	13,043	13,036	14,368	12,166
	Shrimp*	3M	0	0	0	0	0	0	0	0	0	0
		3L	1,769	6,119	8,019	9,276	13,535	20,494	21,187	18,316	18,128	11,109
	Sea scallop	3KLNO	0	0	0	0	27	0	0	9	10	35
		3Ps	1158	1071	1,190	920	842	432	293	359	518	2,132
	Iceland scallop	3LNO	0	0	11	0	0	0	1	0	347	128
		3Ps	1	4	2	0	0	2	5	6	132	1,748
	Snow Crab	3K	7,828	8,519	8,390	10,744	12,420	16,184	15,068	12,270	10,717	8,685
		3LNO	34,499	33,892	33,511	32,914	31,419	29,033	30,248	30,895	30,717	29,649
		3Psn	4,904	6,047	6,225	6,716	6,026	5,559	4,523	3947	3099	3169
	Lobster	3K	50	63	66	61	96	107	134	120	156	208
		3L	81	81	84	75	111	98	109	83	111	111
		3Ps	940	1,048	952	917	1,228	1,071	1,171	1,010	1,052	988
		3Pn	161	138	164	112	139	127	153	94	52	29
	Atlantic salmon**	2J3KLPs+4R	37	48	39	48	51	41	50	29	36	41
3+4	Redfish	3P+4V	533	192	295	907	2,275	2,265	1,217	1,402	2,439	1,918
4	Iceland scallop	4R	310	378	295	431	244	246	121	284	656	454
	Sea scallop	4R	6	42	66	48	27	15	0	0	0	0
	Lobster	4R	906	873	857	769	1,022	1,096	1,404	1,260	1,275	1,276
	Snow Crab	4R	850	891	742	596	188	268	365	558	514	856

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

*Shrimp catches are for Eastern Canada (i.e. taken by vessels from Newfoundland and Labrador, Quebec, and Nova Scotia).
Shrimp catches for shrimp fishing areas 4, 5 and 6 are as of January 30, 2015, and represent an Apr 1 – Mar 31 fishing year.
Please note that the values shown for 2003 - present will not agree with past values shown because in the past values were converted to calendar year catches.
The 3L shrimp catches are taken according to a Calendar year (Jan. 1 - Dec. 31) and are recorded accordingly.
**Recreational catch (retained only)
***Canadian catches only
**** Subsistence Fisheries
***** Excludes recreational catch for 2007 and 2009-2014

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

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

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

The four main components of the science program include:

Science in support of straddling stocks and highly migratory species,

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

The following tables outline those IGS activities of interest to NAFO that were completed 2014/15, as well as those currently underway for 2015/16.

List of IGS Activities 2014-15 and 2015-16	
Project Leader(s)	Title
I. Bradbury	Genetic determination of catch composition and stock exploitation of Atlantic salmon harvested in mixed stock fisheries in the northwest Atlantic
B. Healey	Migration and Distribution of Greenland Halibut & Atlantic Cod: Answering basic questions via modern tagging techniques
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
R. Rideout	A detailed examination of cod spawning in NAFO Subdivision 3Ps and a review of the use of spawning closures as a tool for the management of fish stocks.
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	Multispecies dynamics in Northwest Atlantic marine ecosystems: Towards practical tools for multispecies management decisions.
K. Azetzu-Scott	Ocean Acidification in the Arctic: drivers and impacts.
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
N. Ollerhead	Spatial analysis of commercial fishing effort and its relationship to Vulnerable Marine Ecosystems (VMEs) in Newfoundland-Labrador waters.