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Canadian Research Report for 2017 Newfoundland and Labrador Region

Submitted by
B. Healey and E. Parrill [1]

SUBAREA 2

A. STATUS OF FISHERIES

Nominal landings from 2008 to 2017 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. Estimates of recreational catches for Newfoundland and Labrador have been highly variable since 2005 (total catch range of 38,900 to 76,100 salmon). The 2017 preliminary recreational catch for subarea 2, including retained and hooked-and-released fish was 7,252 salmon, 5.6% less than the previous 6 year mean (2011-2016). Estimated Labrador Aboriginal and subsistence fisheries harvest was inferred from logbook returns (56% return rate) at 13,600 salmon in 2017 (7,200 small, 6,400 large), which was 4% less than the previous six-year mean (2011-16) of 14,100 salmon (9,000 small, 5,100 large).

Three of the four rivers assessed in Subarea 2 were below their limit reference point, whereas the most northerly river was above its upper stock reference point.

b) Arctic Charr–Subarea 2

Commercial landings of Arctic Charr from north Labrador in 2016 were approximately 29 t and about 16% higher than 2015 and were the highest reported landings since 2006. This is equivalent to almost 17 thousand Arctic 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 a fixed amount of charr that the local fish plant was willing to process (~25 t). In addition to the commercial fishery, estimates of subsistence fishery harvests of Arctic charr have averaged about 9,400 fish annually during the past 10 years (2007 – 2016), ranging from a low of 5,400 charr in 2007 to 13,000 reported caught in 2012.

[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.

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. Bycatch 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 cod stock (Div. 2J3KL) was closed to directed commercial fishing in 1992 but has been subjected to ongoing stewardship (weekly landings) and recreational fisheries in the inshore since 2006. In 2017, the management approach for the stewardship fishery was similar to 2016 with an extended season (149 days), weekly landing limits and a 1 year management plan. There were some changes, however, including: the removal of the requirement to fish within Canada's Territorial Sea (beyond the 12 nautical mile limit) and the season was extended to include June 12-30 and July 30-November 30.

Recreational fishers were permitted a maximum catch of five fish per day per person, or 15 fish per boat per trip when three of more people were fishing together.

Total reported landings in 2017 were about 12, 707 t compared with 4,435 t in 2015 (from the stewardship fishery, not including small amounts of bycatch). There are no requirements to report recreational landings and therefore landings from this source are largely unknown. However, tagging data was also used to provide information on the magnitude of the recreational fishery. Recreational catch based on tagging returns has been estimated at 25% of the stewardship fishery landings during 2016-17.

d) *American Plaice–Subarea 2 + Division 3K*

This stock has been under moratorium since 1994. The 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) surveys. 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 2010-16. 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 2016, the total reported landings of American Plaice were between 3-23 t annually with the exception of a 100 t catch in 2013 resulting from bycatch from otter trawl fisheries in Div. 2J.

Based on observer data, estimates of American Plaice bycatch discarded from Canadian shrimp fisheries in the Div. 2G to Div. 3K area have ranged from 27 t to 34 t from 2007-2009 (Orr et al. 2010). More recent data have not been compiled.

e) *Redfish–Subarea 2 + Division 3K*

Redfish in Subarea 2 + Division 3K underwent a full assessment in 2016. Results indicated that redfish biomass in Subarea 2 + 3K increased from 2003-2011. Biomass during 2011-2015 declined to approximately half of the pre-collapse (1978-1990) levels. Recruitment (abundance of redfish <15cm) since 2000 was above the long term average with a time-series high in 2014. Fishing mortality has been low (<1%) since 2006. The fishery remains under moratorium and average annual removals from bycatch landings and discards in the shrimp and Greenland Halibut fisheries since 2006 has been 500 t. In the absence of a limit reference point (LRP) it was not possible to determine the zone within the Precautionary Approach (PA) framework that SA2 +3K redfish currently reside in. Due to marginal increases in both abundance and biomass RV survey indices from 2004 – 2011 and a subsequent period of declining indices from 2011-2015 it was recommended that an adaptive and cautious management approach be applied to any reopened fishery.

From 1978 to present, redfish removals were comprised of reported landings by Canada and non-Canadian fleets, and reported bycatch landings and discards by Canadian and non-Canadian fleets. Discards in the shrimp and Greenland halibut fisheries, which emerged in the 1980s, were estimated from catch rates derived from the fishery observer data scaled to the total landings. From 1980 to 1996, discards ranged between 14 t to 700 t annually, averaging 240 t per year. Since the moratorium in 1997, estimates of discards ranged between 20 t and 600 t annually, averaging 300 t per year. During 2017, discards were estimated at 104 t.

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 2016 (<10 t) except for 74 t reported by Lithuania in 2011 and 39 t by Russia in 2015. It is assumed a portion of increased catches in the NRA were from the pelagic stock of redfish that resides primarily in the Irminger Sea between Greenland and Iceland. In 2017, landings were 104 t.

f) Witch Flounder-Divisions 2J3KL

There has been no directed fishing on this stock since 1994. In 2017, bycatch in other fisheries from the Newfoundland and Labrador Region was 97 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 since 2003, but the stock size remains low.

g) Greenland Halibut-Subarea 2 + Divisions 3KLMNO

The Canadian (NL) catch of Greenland Halibut in 2016 in Subarea 2 and Div. 3KLMNO was approximately 5,359 t. Length frequency and otoliths were collected for calculation of catch-at-age.

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. However, significant reductions in resource status in SFA 6 have led to more frequent stock assessments. The last formal assessment was completed during February, 2018 and the next formal assessment is scheduled to be completed during February 2019.

Ecosystem conditions in the Newfoundland Shelf (2J3K) are indicative of an overall low productivity state, with both total shellfish and total finfish biomass showing declines since the early-mid 2010s. Current total biomass is at similar levels to those observed in the mid-1990s. However, shellfish make up a much lower proportion of the biomass.

Predation, fishing and environmental forcing are correlated with subsequent shrimp production, although the precise linkage with environmental variables remains unclear. The build-up of shrimp until the mid-2000s occurred during a period of favourable environmental conditions and reduced predation. Shrimp per-capita net production has declined since the mid-1990s, and is expected to remain around current low values for the next 2-3 years. Shrimp is an important forage species, particularly when there is scarcity of high energy prey such as capelin. Shrimp predation mortality in the near future is expected to remain relatively high unless abundance of alternative prey increases. Given current predation pressure on shrimp, fishing pressure could now be more influential on stock declines in SFA 6 than it was in the past.

SFA 4 (NAFO Division 2G)

The TAC increased from 5,200 t in 1995 to 8,320 t in 1998. From 1998 until 2008/09 a portion of the TAC was allocated to the area south of 60°N to promote spatial expansion of the fishery, during which time the TAC was increased about every four years. TAC was unchanged from 2013/14 to 2016/17 and was increased by 5% to 15,725 t in 2017/18. The 2017/18 TAC has been fully taken.

Large-vessel standardized CPUE varied without trend near the long-term mean (1989-2016/17). Several factors including changes in management measures and species composition of catches (i.e. catches of both Northern and Striped shrimp in the same area) confound the interpretation of fishery performance in this area. Over 2005 to 2017 the fishable biomass index averaged 114,000 t and in 2017 was 82,700 t; a 13% decrease from 2016. Over 2005 to 2017 the female SSB index averaged 70,100 t and in 2017 was 55,600 t. The exploitation rate index was about 15% for 2014-2016 and was 19.4% in 2017/18. The confidence intervals surrounding the 2017/18 exploitation rate index are very wide, particularly the upper interval. The upper confidence interval for the exploitation rate index is based on the lower confidence interval of the fishable biomass index, which is the lowest in the time series in 2017. For this reason the upper confidence interval of the 2017/18 exploitation rate index is very high.

Female SSB index in 2017 was in the Healthy Zone within the IFMP PA Framework with a 56% probability of having been in the Cautious Zone and a 3% probability of having been in the Critical Zone. Given the relatively wide and asymmetric confidence intervals, there is a >50% chance the current SSB index is not in the healthy zone. The point estimate, however, falls just above the boundary between the cautious and healthy zones (i.e. the USR).

SFA 5 (Hopedale and Cartwright Channels)

TAC was increased by 10%, to 25,630 t, from 2015/16 to 2016/17. It is expected that the 2016/17 TAC will be taken. Standardized large-vessel CPUE over the last five years has varied without trend at relatively high levels.

Over 1996 to 2017 the fishable biomass index averaged 136,000 t and in 2017 was 140,000 t; a 31% increase from 2016. Over 1996 to 2017 the female SSB index averaged 66,500 t and in 2017 was 55,700 t; a 3% increase from 2016**Error! Reference source not found.**. The low biomass index in 2013 was likely due to year-to-year variation in survey sampling (i.e. a year effect), rather than low shrimp biomass. The exploitation rate index has varied without trend with a median value of 15% from 1997–2017/18. If the TAC is fully taken in 2017/18 then the exploitation rate index will be 20.6%.

Female SSB index is in the Healthy Zone within the IFMP PA Framework, with a 12% chance of being in the Cautious Zone. If the 22,000 t TAC is maintained and taken in 2018/19, then the exploitation rate index will be 15.7%.

SFA 6 (Hawke Channel + NAFO Division 3K)

The TAC was set at 11,050 t in 1994 and increased to 23,100 t in 1997 as a first step towards increasing the exploitation of an abundant resource. Most of the TAC increases from 1997 onwards were allocated to the small-vessel fleet. The TACs, and subsequently the catches, increased significantly to a maximum of 85,725 t in 2008/09–2009/10 after which TAC reductions were applied periodically. TAC was reduced by 42%, to 27,825 t, from 2015/16 to 2016/17 and further, by 63%, to 10,400 t in 2017/18; however it is uncertain if the TAC will be fully taken based on the portion of the catch taken as of the assessment and on verbal communication with harvesters. As of the February 2, 2018 CAQR, 78% of the TAC had been taken. The annual commercial CPUE declined considerably in recent years to the lowest levels in two decades.

Over 1996 to 2017 the fishable biomass index averaged 407,000 t and in 2017 was 87,300 t; a 16% decrease from 2016 and the lowest level in the time series. Over 1996 to 2017 the female SSB index averaged 254,000 t and in 2017 was 52,700 t; a 19% decrease from 2016 and the lowest level in the time series. The exploitation rate index ranged between 5.5% and 21.5% from 1997 to 2017/18, and has averaged 17% in the last five years. If the TAC is fully taken in 2017/18 then the exploitation rate index will be 10%.

The female SSB index is currently in the Critical Zone of the IFMP PA Framework with greater than 99% probability. The IFMP states that the exploitation rate should not exceed 10% (corresponding to a 2018/19 TAC of 8,730 t) while the female SSB index is in the Critical Zone.

i) Snow Crab–Divisions 2HJ

Most of the landings are derived from Div. 2J in all years. Landings have remained at 1,700 t for the past four years while effort has remained at its lowest level in two decades. CPUE has remained near the decadal average in recent years, reflecting trends throughout the division. The exploitable biomass index has changed little during the past decade with the exception of a 2014 spike. Recruitment into the exploitable biomass has changed little during the past decade with the exception of a 2014 spike. The 2017 trawl and trap surveys suggest recruitment will remain unchanged in 2018. The exploitable biomass has consisted largely of incoming recruits for the past six years (75%), with few old-shelled crab. This suggests high mortality of large adult male crab. Total mortality in exploitable crab has been at or near its highest level in recent years. The exploitation rate index has been above the long-term average for the past two years. Status quo removals in 2018 would maintain the two-year average exploitation rate index at a relatively high level.

j) Iceland Scallop–Divisions 2HJ

Inshore aggregations were fished in 2009, 2010, 2011, 2012, 2013, 2014 ,2015, with nominal catches estimated at 17 t , 16 t, 19 t, 16 t, 20 t, 6 t , and 8 t round, respectively and 5 t round in 2016 and 2017. The fishery for these years was prosecuted in 2J only, 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 2017 to support stock assessment, distribution and abundance studies, and detailed biological sampling were conducted on important commercial species (eg. cod, American Plaice, witch flounder, Greenland Halibut, redfish, Thorny Skate, shrimp, crab) as well as a suite of indicator species under the Ecosystem Research Initiative of the NL Region. A total of 68 successful sets were conducted in Div. 2H between 98m-640m and 114 sets in 2J between 133m – 1399m. 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.

Analyses of maturity data is conducted regularly on Greenland Halibut and other species and are presented as required to the annual meeting of NAFO Scientific Council during assessments.

b) Arctic Charr

Biological information obtained from sampling commercial landings in the north Labrador Arctic charr fishery terminated following the 2014 season along with other research programs. This ended a long-term program focused on Arctic charr that began in the early 1970s. Discussions are currently underway to consider options to resume a Science program on Charr in this area. A genetic study on Arctic charr is currently underway, with samples from 30 locations throughout Labrador collected in 2017 and being analysed. The results will be used to evaluate stock structure, explore the stock composition of mixed stock harvests, and better understand climate change impacts on Charr in the region.

c) Snow Crab

A trap survey for Snow Crab was conducted in the northern portion of Div. 2J and Div. 2H in the summers of 2013-2017. 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 the Nunatsiavut Settlement Area. The fixed-station survey covered areas to the north, west, and south of the Makkovik Bank. Small-meshed pots were also incorporated into the study to capture females and small males.

d) Atlantic Salmon

The stock composition of Atlantic salmon harvested in three fisheries in the northwest Atlantic was evaluated using genetic mixture analysis and individual assignment with a microsatellite (Northwest Atlantic) and single nucleotide baseline (SNP, range wide). Estimates of stock composition and individual assignment were derived using Bayesian mixture analysis and samples spanning 2015-2017 from each of three fisheries. A total of 398 individuals collected from the Saint Pierre and Miquelon fishery were analyzed and estimates of stock composition showed consistent dominance of three regions (Gulf of St. Lawrence, Gaspe Peninsula, and Newfoundland) and an increasing proportion of Newfoundland individuals in the samples over the three-year period. In the West Greenland harvest, 1,806 individuals were analyzed with the microsatellite panel over the three years. North American contributions were largely from Labrador, the Gulf of St. Lawrence, and the Gaspe Peninsula. SNP based analysis of 989 individuals for 2017 identified 74% as North American and region of origin estimates were again dominated by Labrador, the Gulf of St. Lawrence, and the Gaspe Peninsula. Finally, a total of 1,486 individuals were analyzed from the Labrador Food, Social and Ceremonial (FSC) fishery. In contrast to the other fisheries, here the mixture estimates suggest the harvest is dominated by a single region, with Labrador representing on average 98.9% of the harvest. Two individuals of USA origin were detected in 2017 in southern Labrador. This work illustrates how genetic analysis of these mixed stock Atlantic salmon fisheries in the northwest Atlantic can directly inform assessment and management efforts. Analysis of these three fisheries will continue in 2018.

SUBAREA 3

A. STATUS OF FISHERIES

Nominal landings from 2007 to 2016 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 2017 preliminary recreational harvest estimate, including retained and hooked-and-released fish, was 17,982 salmon, 48 % less than the previous 5 year mean (2012-2016).

Eight of the eleven assessed rivers in Subarea 3 were below their limit reference point in 2017. The remaining three were above their upper stock reference point.

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. Landings in 2016 and 2017 were 27,708 t and 19,917 t, respectively, against a Total Allowable Catch (TAC) in Div. 2J3KL of 28,344 t. The Capelin assessment was held in March 2018 and included survey and biological data to December 2017. The two main indices of capelin abundance in the region [the spring (May) Div. 3L acoustic offshore survey and a larval index in Trinity Bay] were low. The acoustic abundance index has fluctuated markedly over time from a peak of 6 million t in the late 1980s to a low of 25,000 t in 2010. From 2013-2015, the acoustic abundance index showed some improvement peaking in 2014 at nearly 20% of the 1980s levels. The acoustic abundance index in 2015 showed larger than usual declines in the 2012 and 2013 year classes. No acoustic survey was conducted in 2016. The acoustic abundance index in 2017 was 70% lower than the 2015 acoustic index. The 2001-2017 capelin larval index is positively correlated with capelin abundance at age-2. The larval index has been low for the past four years (2014-2017), and year classes entering the fishery in 2018 and 2019 are expected to be small. The fall distribution of capelin in 2016 and 2017 were similar to the distribution patterns in the period of low capelin abundance in the 1990s and 2000s with the center of mass located in northern Div. 3L and few Capelin present in Div. 2J.

Fisheries productivity on the Newfoundland Shelf has declined since the early to mid-2010s. This decline was initially associated with a loss of shellfish and in the last two years includes declines in piscivores. Despite this decline in predators, the index of fish predation on capelin increased in 2016 and 2017.

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 2017. Total catch since 1994 increased from 170 t in 1995 to 4,900 t in 2003, and ranged between 500 t and 1,100 t for 2004-2016. The provisional 2016 value reported to NAFO based on monthly catch reports is 666 t. Canada (NL) landings ranged from 444 t to 818 t between 2002-2005, and from 26 t to 247 t between 2006-2017. Canadian catches in 2017 totalled 147 t, taken primarily in the 3NO yellowtail fishery.

The 2015 assessment of 3NO cod (i.e. the last full assessment of this stock) reported that the spawning biomass has increased considerably over the past five years but the 2015 estimate of 38,454 t still represents only 64% of Blim (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. The TAC for 2016/17 was set at 13,043 t. Total landings for 2016/17 totalled 6,282 t.. The majority of recent catches are taken by fixed gear (gillnet and line-trawl).

The 2017 assessment of 3Ps Cod indicated that the stock has declined since 2012, but showed an increase in 2017. Spawning stock biomass (SSB) is currently estimated to be 54% above the limit reference point (BRecovery). The probability of being below the LRP in 2017 is 0.03. Projected SSB shows a continuous decline, with a 70% risk of being below the LRP by 2020 under status quo mortality rates.

d) American Plaice-Subdivision 3Ps

Although approximately 50% lower than levels of a decade ago, there has been recent increase in Canadian (NL) landings. The 2016 catch was 168 t and 206 t in 2017.

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 Can (NL) catch averaged 317 t in the past 4 years with the 2017 catch at 277 t. The directed fishery is prosecuted by offshore otter trawlers and a nearshore Danish seine fleet. Survey stock size indices are highly variable, but have shown no overall trend. In the most recent years (2016, 2017), survey abundance and biomass have increased to values at or among the highest in the time series. 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. An interim limit reference point was adopted in 2017, with a proxy for BMSY adopted based on average survey biomass observed from 1983-1993, and BLIM set at 40% of BMSY. The stock is currently above the LRP, and has been in most years of the time series (1983-2017).

f) Yellowtail Flounder–Divisions 3LNO

Since the fishery for this stock reopened in 1998, stock size has steadily increased and in 2015 (the last full assessment of this stock) was estimated to be 1.8 times Bmsy, well above the level of the mid-1980s. Annual spring and fall multi-species bottom trawl surveys have been conducted since 1971 and 1990 respectively. Evidence from the commercial fishery and various surveys indicates that the range of this stock has increased along with stock size since the mid-1990s. Fishing mortality was estimated to be relatively low and the stock biomass relatively high. In 2006, the majority of the Canadian directed fishery for Yellowtail Flounder did not take place due to a dispute in the industry. Since then, Canadian catch has ranged from 4,000 t to 11,400 t, well below the TAC in each year and in 2017 was 6,508 t. Scientific Council noted that this stock is well above Bmsy, and recommended any TAC option up to 85 % Fmsy for 2016 and 2017 (26.3 t and 23.6 t respectively). The TAC for 2017 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 American plaice has been generally less than 3,500 t since 2007. Since the moratorium, the majority of bycatch is taken in the Canadian yellowtail fishery within Canada's 200-mile limit and in the skate, redfish and Greenland halibut fisheries in the NAFO regulatory area (NRA). In 2017, Canadian landings of American Plaice (as bycatch) were 223 t, compared to 750 t in 2016.

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 in 2010 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 2016 assessment for these stocks 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.

In the past two years, Can (NL) removals from this stock were 372 t and 329t. Industry reports that limitations in market conditions and management measures had a major effect on catches. 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 less than 35 t annually during 2012 to 2015 and only 21 t in 2016. In 2017, landings increased to 247 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 has progressively increased to 10,400 t for 2015-2016. Canada is allocated about 43 % of the TAC. The total catch averaged 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 generally increased its harvest since the reopening of the fishery. Landings in 2017 were 4177 t.

k) Witch Flounder-Divisions 3NO

There was no directed fishing on this stock from 1994 to 2014. The fishery reopened in 2015. Catches of 798t and 349t were reported in 2016 and 2017, respectively.

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 for NAFO Div. 3NO were 284 t during the period 2012-2016. Preliminary 2017 Canadian landings for NAFO Div. 3NO and Subdiv. 3Ps are 334 t and 308 t respectively. The current TAC for White Hake in 3NO for 2018 is 1,000 t and in Subdivsion 3Ps 500 t.

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 Skate) 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 2013-18. The TAC for Subdiv. 3Ps in the EEZ was maintained at 1,050 t by Canada.

Average STATLANT landings for 2012-16 were 3,406 t in NAFO Divisions 3LNO, and 476 t in Subdivision 3Ps. Preliminary Canadian landings for 2017 are 5 t in NAFO Divisions 3LNO, and 413 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 been slowly increasing.

n) Shrimp–Divisions 3LNO

This shrimp stock is distributed around the edge of the Grand Bank, mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 6,000 t TAC. Annual TACs were raised several times between 2000 and 2009 reaching a level of 30,000 t for 2009 and 2010. The TAC was then reduced annually until no directed fishing (ndf) was implemented in 2015 to 2017. Preliminary catch records, as of February, 2018, confirm that no fishing had taken place in 2017. As per NAFO agreements, Canadian vessels took most of the catch during each year prior to 2015. Canadian catches increased from 10,300 t in 2004 to 18,900 t in 2008 before declining with reduced TACs. 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 ranged between 2,100 and 7,600 t.

There is reason for concern about the status of the Northern Shrimp resource within NAFO Divisions 3LNO. In Canadian surveys, there was an overall increase in both the spring and autumn biomass indices to 2007 after which they decreased by over 90% to the lowest levels in the time series in 2016. EU-Spain survey biomass indices for Div. 3LNO, within the NRA only, increased from 2003 to 2008 followed by a 93% decrease by 2012 and remaining near that level through 2017. The Canadian research vessel spring Div. 3LNO SSB index decreased by 97% between 2007 and 2016. The Canadian RV autumn SSB index showed an increasing trend to 2007 but decreased 93% by 2015 and has remained at a low level. SSB indices remain below B_{lim} for the fourth consecutive year.

Exploitation and mortality rate indices were increasing from 2007 to 2013, despite decreasing catches during that period, but dropped drastically in 2014. In 2016 the risk of the stock being below B_{lim} is greater than 95%. Given prospects of poor recruitment in recent years, the stock is not expected to increase in the near future.

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

In Div. 3K, landings declined by 66% since 2009 to a time-series low of 5450 t in 2017. Effort has been maintained near a two-decade low for the past five years. CPUE has been low for the past seven years reflecting trends in most management areas. The post-season trawl survey exploitable biomass index increased in 2017 from a historic low in 2015-2016. Although the post-season trap survey(s) index has remained near a historical low for the past three years slight improvements were seen in some nearshore management areas in 2017. Recruitment increased from time-series lows in both the post-season trawl and trap survey(s) from 2016 to 2017. The 2017 trawl and trap surveys suggest recruitment should increase in 2018. The exploitable biomass has consisted largely of incoming recruits throughout the time-series (50-75%), with few old-shelled crab. This suggests high mortality of large adult male crab. Total mortality in exploitable crab has been at or near its highest level in recent years. The exploitation rate index has been at a decadal high during the past two years. Status quo removals in 2018 would decrease the exploitation rate, with the two year average index being below the time-series median level.

In Div. 3LNO offshore, landings declined by 26% from 2016 to 18,050 t in 2017, the lowest level in two decades. Effort expanded rapidly from 1992 to the mid-2000s and has oscillated at a similar level since. Overall CPUE most recently peaked near a time-series high in 2013 and has since declined by 41% to its lowest level since 1992. Substantial declines have occurred in all management areas in recent years, although catch rates remain relatively high in the central portions of the division. The exploitable biomass index remains at or near time-series lows in both the trawl and trap surveys. Overall recruitment into the exploitable biomass has been at or near time-series lows in both the trawl and trap surveys in the past two years. This reflects low levels throughout all management areas. No major increases in the exploitable biomass are expected in 2018. Total mortality in exploitable crab has been steadily increasing since 2009 to be at or near its highest level in most recent years. The exploitation rate index increased by a factor of five from 2014 to 2017. Status quo removals in 2018 would maintain the two year average exploitation rate index at a historic high.

In Div. 3L inshore, landings declined by 29% from a historical high in 2015 to 6000 t in 2017. Effort has nearly doubled since 2013 to a historical high in 2017. Overall CPUE has declined by 56% since 2013 to its lowest level in 28 years. There have been strong declines throughout the division in recent years. The post season trap survey exploitable biomass index has declined by 73% since 2012, reaching a time-series low in 2017. The 40% overall change from 2016 to 2017 reflects declines to time-series lows in all management areas. Overall Recruitment has steadily declined for the past three years to a time-series low in 2017. Recruitment indices from DFO and CPS trap surveys in all management areas were at or near their lowest levels in 2017. No major improvements in biomass available to the fishery are expected in the short-term. The overall trap survey-based exploitation rate index has increased from 2013 to a time-series high in 2017. Maintaining status quo removals would increase the two-year average exploitation rate index to an exceptionally high level in 2018, with all management areas reaching or remaining near time-series highs. The scenario of a depleted exploitable biomass coupled with low recruitment prospects and high exploitation rate indices suggests minimal potential for improvements in the short term.

In Subdiv. 3Ps, landings declined from a recent peak of 6,700 t in 2011 to a time-series low of 1,200 t during the past two years. Effort has declined by 44% since 2014 to be near its lowest level in two decades. The TAC has not been taken in eight years. CPUE has steadily declined since 2009 to a record low in the past two years, reflecting precipitous declines throughout the major fishing areas of the Subdivision in recent years. The in-season trawl survey exploitable biomass index was at a time-series low in 2016 but improved slightly in 2017. However, the post-season trap survey index suggests considerable improvements in the exploitable biomass throughout the major fishing grounds. Overall recruitment into the exploitable biomass has been at its lowest observed level in recent years but increased slightly in 2017. Prospects for recruitment into the exploitable biomass in 2018 have improved from the lowest levels experienced in recent years. Survey data of pre-recruit abundance suggest improving prospects for the next few years. In 2017, total mortality in exploitable crab was high but the exploitation rate index declined sharply to a relatively low level. Assuming the exploitable biomass remains at the current level, status quo removals would result in an exploitation rate index near the long-term median in 2018. Discards comprised half the catch in the past two years. This is concerning as fishing under elevated mortality levels on small and pre-recruit crab could impair reproductive capacity or yield from forthcoming recruitment.

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 again no removals in 3LNO between 2013 and 2016. 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 2015, 2016, and 2017 removals were 45 t , 375 t and 527 t respectively. From 2012 to 2014 removals averaged 3 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 Iceland Scallops in the trans- boundary area was last updated based on DFO resource survey in September 2017.

q) Sea Scallop–Subdivision 3Ps

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. In 2014 and 2015, landings remained relatively the same at 1,158 t and 1,126 t respectively and have since decreased slightly to 883 t in 2016 and 846 t in 2017. The resource status of this area was last updated based on DFO resource survey in September 2015.

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 13-year period 1983- 1995. They increased from 1995 to approximately 12,700 t in 1997 before declining sharply to about 800 t in 1998 and 20 t in 1999. They remained low (approximately 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 from 2013 to 2015, but approximately100 t were landed in 2016 and 313 t were landed in 2017.

B. SPECIAL RESEARCH STUDIES

1. Environmental Studies

Physical oceanographic observations are routinely collected during marine resource assessments and research surveys in the Newfoundland and Labrador Region. The Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2017 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southwest St. Pierre Bank to Beachy Island d on the mid-Labrador Shelf. The spring survey was conducted on the CCGS Teleost from April 6 to 23, 2017. The summer survey on CCGS Teleost took place from July 8-28, 2017 and the fall survey on the chartered vessel Fugro Discovery from November 11 to 20 and from December 9 to 16, 2017. 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 2017 in NAFO Div. 2J and 3KLNMOP. The results were based on physical observations collected on the NL Shelf from Nain Bank to the Southern Grand Bank and on St. Pierre Bank from the AZMP and fisheries assessment surveys.

Annual sea-surface temperature (SST based on infrared satellite imagery) trends on the Newfoundland and Labrador Shelf, while showing an increase of about 1°C since the early 1980s, were mostly below normal during 2017, driven largely by very cold spring conditions. In 2017, the annual bottom (176 m) temperature/salinity at the inshore monitoring site (Station 27) was below normal by -0.6/-1.5 standard deviations (SD), respectively. Observations from the summer AZMP oceanographic survey indicated that the area of cold-intermediate-layer (CIL <0°C) water overlying the northeast Newfoundland and southern Labrador shelf increased over 2016 to about 1 standard deviation above normal, implying more extensive cold winter chilled water throughout the region. The spatially averaged bottom temperature during the spring in 3Ps remained slightly above normal, a significant decrease over the 33-year record high in 2016. In Divs. 3LNO spring bottom temperatures were about normal. The spatially averaged bottom temperature during the fall in 2J and 3K show an increasing trend since the early 1990s of about 1°C, reaching a peak of >2 SD above normal in 2011. Oceanographic data from the fall 2017 multi-species surveys in NAFO Divisions 3LNO indicate bottom temperatures were about 1.2 standard deviations (SD) below normal. In Divisions 2J and 3K fall bottom temperatures continued to decrease from the record high in 2011 to about normal conditions in 2017.

b) Nutrients and plankton studies

In general, shallow (0-50 m) inventories of nitrate, a limiting nutrient in ocean primary production, were near the 1999-2015 average across Newfoundland and Labrador AZMP Sections in 2017, with the exception of notably higher concentration on the southeast Grand Banks. The deep (50-150 m) inventories of nitrate, an index of nutrient availability to fuel the base of the marine food chain in the subsequent spring bloom, were near or below normal, which represents a decline from 2016. The chlorophyll a (0-100 m) inventories inferred from the seasonal oceanographic surveys, which provide an index of phytoplankton biomass in the water-column, were below normal on the Grand Banks and near normal on the Labrador Shelf.

Satellite ocean colour observations from 11 subregions off Newfoundland and Labrador indicated that both total production (magnitude) and peak intensity (amplitude) of surface phytoplankton spring blooms were below normal throughout the and the NL shelves in 2017 for a third consecutive year. Positive productivity indices (magnitude and/or amplitude) were only observed in the Labrador Sea. Spring bloom timing was early on the Labrador Shelf but delayed in the Labrador Sea and on the Grand Banks, while bloom duration was near normal across the entire area.

Total copepod abundance declined in 2017 but stayed near or above normal. Although non-copepod zooplankton abundance remained above normal throughout the area, it showed a ~50% decrease on the Grand Banks compared to 2016. The abundance of Pseudocalanus spp., a small key functional copepod group, declined in all AZMP sections, except for the southeast Grand Banks, but remained mostly above normal. The abundance of the large grazing copepod Calanus finmarchicus, an important prey to a variety of different life stages of fish, declined on the Labrador shelf shifting from above to below normal between 2016 and 2017. Abundance remained below normal on the northeast Newfoundland Shelf, and above normal on the Grand Banks. Zooplankton biomass, which seemed to be primarily driven by *C. finmarchicus* abundance, remained well below normal throughout the area for a third consecutive year.

2. Biological Studies

a) Multispecies Trawl Surveys

Biological and oceanographic data from fall (Div. 3KLNO) and spring (3LNOP) multi-species research vessel surveys were collected in 2017 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. In 2017, the annual spring survey completed a total of 179 sets in 3LNO (Div 3L was not fully completed) and 179 in 3Ps (Rideout and Ings, 2018). During the fall survey, a total of 621 successful sets were conducted in Divs. 2J3KLNO. Depending upon the species, sampling occurs for length, age, growth, maturity stage, condition, stomach contents analyses. In addition, sampling for lengths and weights were conducted on a suite of other species to support ecosystem monitoring. Analysis of maturity data is conducted regularly on cod, American Plaice, Yellowtail Flounder, Greenland Halibut and other species and are presented to the annual meeting of NAFO Scientific Council during assessments of cod in Div. 3NO, American Plaice in Div. 3LNO, Yellowtail Flounder in Div. 3LNO, Greenland halibut in SA2+Div. 3KLMNO as needed.

b) Capelin

In 2017, there was a spring (May) offshore acoustic survey in Div. 3L. This survey targets the immature, non-migratory portion of the capelin stock and produces an abundance index. In 2016 and 2017, acoustic data was 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 are ongoing. In 2016 and 2017, recently emerged larvae into the Bellevue Beach inshore area of Trinity Bay were monitored. In 2016 and 2017, inshore larval surveys were conducted in August and September to map capelin larval abundance and dispersal in Trinity Bay, Div. 3L.

c) Atlantic Salmon

Research examining aspects of the trophic ecology of Atlantic Salmon using stable isotopes continues. Variation in adult Atlantic Salmon run timing was 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 were associated with overall warming conditions on the Newfoundland and Labrador Shelf.

d) Shrimp

Population models are being developed within the next 3 years, which may be used to determine reference points and evaluate how the stock is expected to change under different environmental conditions.

Research on larval drift and dispersal has been completed for SFAs 4-6 and Divisions 3LMNO. The research includes a simulated release of 100 larvae from 100 sites in a biophysical model. The larvae are then permitted to drift and disperse for 85 days, approximately the period it takes for larvae to settle, and vertically behave as larval shrimp in the water column. Two subsamples of the results were presented; one demonstrated that most larvae hatched in Div. 3L end up in Div. 3M and the other demonstrated that most larvae that settle in Div. 3L originate in areas north of that division. Results are pending publication.

Preliminary research from a study on estimating age from eye stalks of shrimp is ongoing. More information is to follow once the study is concluded and results become final. There does not appear to be a strong relationship between number of growth rings and length of shrimp in NAFO Div. 2J3KLNO.

e) Snow Crab

Long-term trap surveys in White Bay (3K), Notre Dame Bay (3K), Bonavista Bay (3L), and Conception Bay (3L) were continued in 2016. 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 (BCD) in NL Snow Crab. A similar survey was initiated in Fortune Bay (3Ps) in 2007 and was continued in 2016. Similar surveys were initiated in Fortune Bay in 2007, and Trinity Bay and St. Mary's Bay in 2013. These continued in 2017.

A post-season trap survey, conducted by Snow Crab harvesters, which began throughout most of 2J3KLNOPs in 2004 was continued in 2017.

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. After experiencing low abundances during the 2004-2007 period, annual abundances of age 1 in this cod nursery/rearing area have increased substantially in the subsequent 9-year period (2008-2017). The degree to which these observations reflect broader coast-wide phenomena and offshore stock biomass are being investigated.

Genetic and genomic analysis of Atlantic cod in the region continued in 2017. Recent work has suggested a coastal population in Gilbert Bay Labrador is highly discrete, genetically isolated, adaptively unique and genetic tools were developed to identify the presence of this stock in coastal fisheries. Analysis in 2018 is targeting genomic diversity within Northern cod primarily associated with the genomic basis of differences in migratory behaviour and resolving genetic impacts of population decline and selective harvest.

SUBAREA 4

A. STATUS OF FISHERIES

Nominal landings from 2007 to 2016 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 preliminary estimate of the 2017 recreational harvest, including retained and hooked-and-released fish, was 17,053 salmon, 11% less than the previous 5 year mean (2012-2016).

In 2017, two of the four assessed rivers in Subarea 4 were above their upper stock reference point while one river was below the limit reference point and one river fell in the cautious zone between the two reference points.

b) Snow Crab–Div. 4R

In Div. 4R3Pn, landings have steadily declined since a recent peak in 2013. Meanwhile, effort has remained at a low level. CPUE has declined since 2013 to below the long-term median, reflecting trends throughout all major fishing areas. The trap survey exploitable biomass index most recently peaked in 2012 and has since declined to a time-series low in 2017, reflecting trends in all surveyed areas. Recruitment into the exploitable biomass has been very low for the past four years. Survey data from 2017 suggest no improvements are expected in 2018. The overall exploitation rate index has increased since 2013, reflecting trends in all surveyed areas. Status quo removals would elevate the two-year average exploitation rate index to an exceptionally high level in 2018, with all surveyed management areas reaching new time-series highs. The scenario of a low exploitable biomass and CPUE, coupled with an approaching pulse of pre-recruit crab in CMA 12EF suggests that excessive fishing in 2018 could be detrimental to yield in subsequent years due to associated high soft-shell mortality.

c) Iceland Scallops–Div. 4R

In 2013 removals from the Strait of Belle Isle (Div. 4R) 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. In 2016 and 2017, landings decreased, to 192 t and 115 t, respectively, the lowest since 2008. The TAC remains at 1000 t (round). 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 last updated for the Strait based on a survey in August 2007.

d) Sea Scallops–Div. 4R

The Sea Scallop removals in 4R increased between 2010 and 2012 from 27 t to 66 t (round), but has since decreased in the last few years to 104 t (round) in 2017.

SUBAREA 2 + 3 + 4

A. STATUS OF FISHERIES

Nominal landings from 2007 to 2017 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 Total reported landings for Newfoundland (Div. 3KLP4R) 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 2,910 t in 2017. 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. Nominal effort (based on active fishers, trap limits & fishing days) decreased by 45 % from 2006 to 2015 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 index logbooks on commercial catch and effort. In addition, mandatory DFO 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. Based on the index (2004-2015) and mandatory DFO logbooks (2010-2015) CPUE (number of lobster caught/number of traps hauled) has increased gradually over the last decade.

b) Marine Mammals

2017 Research Projects:

1. Grey seal tagging (Stenson, Lawson, Hammill, Sheppard, Goulet)

A study of the movements of grey seals in southeast Newfoundland and the French territories of St. Pierre and Miquelon was initiated in 2017. Satellite transmitters were deployed on 15 adult seals live-captured on Miquelon. The transmitters collected data on seasonal distribution and diving behaviour of seals that summer along the south coast of Newfoundland, the Scotian Shelf, and potentially, on the Grand Banks. They also collected oceanographic data to improve climate models in this area. This study is a collaborative project between Canada and France.

2. Data Layers (Lawson, Goulet)

To assess and monitoring cetacean Species at Risk, and other marine mammals, baseline data on the occurrence and distribution of cetaceans in potential development areas are required urgently to facilitate the design of industrial monitoring programmes and impact assessments. In this final year of a three-year project we compiled and developed geo-referenced databases on human activities and environmental features in Canada that will be included as complimentary data-layers within marine mammal and sea turtle geo-referenced databases. This will facilitate DFO's efforts to operationalize the risk-based framework for assessing cumulative impacts of marine development projects on marine mammals and sea turtles in Canada (particularly SARA-listed species), and provide important support for other undertakings, such as COSEWIC and SARA assessments, requiring a comprehensive and accessible set of biological, environmental, and risk data. The geo-referenced databases and corresponding GIS maps created will be available for use with the risk framework currently being completed, and by DFO, Environment Canada, and other internal government users via a web-based interface to be developed during the project. These existing biological and physical data will be used to model the distribution, and when possible, the seasonal density of marine mammals and sea turtles in Canada's three oceans. Results will be used to delineate areas of seasonal aggregation and to visualize and to quantify the degree of geographic and seasonal overlap between human activities and areas of aggregation for marine mammals. This will highlight areas of particular conservation concern. This analysis will also be used to evaluate the performance of habitat suitability analysis to address the paucity of seasonal density data for mammals, sea turtles, and their prey; the primary focus will be on obtaining data for Species at Risk. The project has compiled data for the Atlantic, Arctic, and Pacific Canadian waters.

3. Sightings and survey data for marine megafauna (Lawson, Stenson, Buren, Sheppard, Goulet, Stockwood and colleagues from DFO Quebec and Maritimes)

To understand the distribution and abundance of cetaceans in the northwest Atlantic, DFO conducted a second large-scale aerial survey of Atlantic Canadian shelf and shelf break habitats extending from the northern tip of Labrador to the U.S border off southern Nova Scotia in August and September of 2016. Using three fixed-wing aircraft DFO achieved almost the same coverage as DFO's comparable large-scale marine megafauna survey in 2007 (TNASS); poorer weather and an extended NATO naval exercise meant that DFO completed 92.6% of their planned lines in 2016, versus 99.0% in 2007. During this 2016 Northwest Atlantic International Sightings Survey (NAISS) observers in survey aircraft collected data on the identity, group size, position, and behaviour of large and small cetaceans, plus environmental covariates. Almost twice as many cetaceans (841 sightings of 8,660 animals) were sighted in the Labrador and Newfoundland areas as in 2007 (584 sightings of 3,691 animals), although there were fewer large whales (fin, humpback, minke); white-beaked dolphins were the most encountered and numerous cetacean. Most of the additional 2016 sightings were collected on the Labrador and Newfoundland NE coasts. The two Skymaster teams amassed slightly fewer cetacean sightings in the Gulf of St. Lawrence, Scotian Shelf and Bay of Fundy (1,035 sightings of 4,449 animals) than they did in 2007 (1,217 sightings of 7,803 animals) despite greater effort in both Scotian Shelf and Bay of Fundy in 2016. Using Distance sampling approaches to estimate species abundance and derive detectability bias corrections for the common cetaceans, it appears that the abundance of cetaceans in eastern Canadian waters, particularly white-beaked dolphins, is larger than almost a decade ago.

4. Acoustic monitoring (Lawson, Sheppard)

To assess and monitoring cetacean Species at Risk, other marine mammals, and anthropogenic noise, DFO NL has been deploying long-term, autonomous underwater acoustic recorders around Newfoundland and Labrador. These recorders collect data across a broad frequency spectrum, and for periods up to one year in both nearshore and offshore locations. In addition to the data layers project and the visual survey, described above, these acoustic data will facilitate DFO's efforts to understand habitat use by marine mammals throughout the year, as well as the potential manmade stressors arising from underwater noise exposure from seismic exploration and commercial shipping.

5. Harp and hooded seal pup production survey (Stenson, Lawson, Gosselin, Buren, Sheppard, Goulet, Hammill, Mosnier, Lang, den Heyer)

Visual and photographic surveys were carried out off Newfoundland and Labrador, and in the Gulf of St Lawrence, during February and March 2017 in order to assess the pup production of the Northwest Atlantic populations of hooded and harp seals. Fixed wing and helicopter reconnaissance surveys identified the locations of multiple whelping concentrations in the southern and northern Gulf, as well as off southern Labrador (referred to as the 'Front'). Fixed-wing aircrafts carried out systematic strip-transect photographic surveys of each whelping areas. Visual survey and staging data were collected from ship and land-based helicopters. Preliminary results indicate that harp seal pup production in the southern Gulf during 2017 was much lower than previous surveys although there it appears that some of these animals may have moved to the Front. Results from this survey will be integrated with information on reproductive rates, estimates of ice related mortality and harvest information to estimate total abundance of these populations.

6. Ocean Productivity (Buren, Stenson, Lawson)

A project aimed at characterizing spatial and temporal variability, long-term trends, and the influence of environmental conditions (e.g., ice cover, SST, etc.) on energy content of key forage species in the northwest Atlantic was continued. In collaboration with University partners we are determining energy contents of important prey species through bomb calorimetry and proximal compositional analyses. This project is ongoing and will continue until March 2019.

7. A Predictive Model of the Environmental Regulation of Capelin (Buren, Lewis)

A project aimed at determining how environmental conditions affect the overall productivity of capelin, and at developing statistical models to provide short- and long- term forecasting models of capelin abundance. Results from this project will improve the provision of advice for the management of capelin, and predators that rely on them as an important food source (e.g. northern cod and harp seals). This project is ongoing and will continue until March 2020.

8. Can we detect changes in Arctic ecosystems? (Stenson, Buren, Ferguson)

This is a large scale project, funded by the Natural Environment Research Council (UK), and led by researchers from multiple British Universities. The Arctic Ocean is already being heavily impacted by climate change. It is warming faster than any other ocean region and as it absorbs fossil fuel emissions, it is gradually acidifying. To understand how Arctic ecosystems will evolve in response to multiple stressors, it is crucial to evaluate the effects of ongoing change. Often these questions are tackled by studies that focus on a specific ecosystem in one location and document the various components of the food chain. However the Arctic is diverse, with a wide range of environments that are responding to unique stressors differently. We require a new approach that can provide information on Arctic ecosystems from a pan-Arctic perspective over decadal timescales. To effectively monitor changes to pan-Arctic ecosystems requires tracers that focus on key ecosystem components and provide quantitative information on ecosystem structure, providing information for management and conservation of ecosystem services. We will focus simultaneously on the base of the food chain, controlled by the activity of marine phytoplankton, and key Arctic predators, harp and ringed seals. Seals are excellent candidates to monitor the food web due to their pan-Arctic distribution and foraging behaviour, which means they are exposed to the changing environment. This project will provide information on past changes to Arctic ecosystems, but also put in place an approach that can be used to monitor future changes and aid in the management and conservation of ecosystem services. This project is ongoing and will continue until July 2020.

9. Comparative diet analysis of four sympatric ice seal species (Buren, Stenson)

A comparative diet analyses of Arctic and sub-Arctic seals in the Newfoundland Region was presented at the 22nd Biennial Conference on the Biology of Marine Mammals. Overlap in resource utilization can potentially indicate the existence of interspecific competition. Several species of seals coexist in waters off Newfoundland and Labrador (Canada), including the most abundant marine mammal in the North Atlantic, the harp seal. Harp and hooded seals are migratory and move into the southern Newfoundland-Labrador Shelf during winter and spring to feed and build up energy stores for whelp and moult, while bearded, and ringed seals inhabit coastal waters year-round. Hooded seals are found primarily along the shelf edge, while the other three species occur on the shelf itself. To assess the potential for niche overlap and interspecific competition for food resources we compared the diets of these four species using data obtained since 1985. There was a distinct separation in the diet of two species; the diet of bearded seals was dominated by invertebrates and benthic organisms, while that of hooded seals was comprised mostly of flatfish, redfish, and other prey species associated with deep water. However, the diets of ringed and harp seals was composed mainly of forage fish (Arctic cod, and capelin), with important contributions of amphipods and zooplankton. Furthermore, the length frequencies distributions of fish consumed by both seal species are similar. The differential use of space may separate the niches of harp and ringed seals. However, similarity in diets suggests that they might be feeding on similar areas. Hooded and bearded seals occupy each a particular niche in the Northwest Atlantic ecosystem. Ringed and harp seals, however, share a similar niche, at least during winter and spring when the latter move into the area, and may therefore be competing for food resources. Given the large size of the harp seal herd this competitive interaction might have a significant impact on the dynamics of the ringed seal population.

10. Environmental influences on harp seal reproduction (Stenson, Buren)

A study on environmental influences expressed via condition on harp seal reproduction was presented at the 22nd Biennial Conference on the Biology of Marine Mammals. Harp seals are the most abundant marine mammal in the north Atlantic. They are top predators, and as such, are important indicators of changes in their ecosystem. Since the 1950s, pregnancy rates of Norwest Atlantic harp seals have declined while inter-annual variability has increased. A previous study has shown that while the general decline in fecundity is a reflection of density-dependent processes associated with increased population size, the large interannual variability is due to varying rates of late term abortions which are related to changes in capelin abundance (focal forage species of the system). We hypothesize that the impact of changing prey availability influences reproductive rates through changes in body condition and growth. To test this hypothesis we compared reproductive rates to growth rates and body condition of harp seals collected off the coast of Newfoundland Canada over the past four decades. Comparing lengths weights of seals among decades indicated that growth rates and asymptotic weights of harp seals have decline significantly since the 1980s. The average body condition of females prior to pupping varied greatly among years, although the condition of pregnant females did not change among years. Annual pregnancy rates were positively correlated with improved condition while abortion rates declined rapidly with only slight improvements in condition. Also, average blubber depth, another index of energy stores prior to pupping, was highly correlated with annual pregnancy rates. These data indicate that changes in abundance and environment influence reproductive rates in harp seals through changes in body condition and suggest that females must maintain a certain level of body condition if they are to complete their pregnancy successfully

11. Biological sampling of Marine Mammals (Stenson, Buren, Lawson, Goulet)

Multi-disciplinary studies on the population dynamics, fisheries interactions, and the impact of climate change on marine mammals were continued in 2017. The ongoing programme of collections involving sealers, fishermen 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) and stranded or by-caught cetaceans in the region. These data facilitate the long-term monitoring of distribution, reproductive status, diets, and the growth and condition of marine mammals during a period of significant ecological change.

B. SPECIAL RESEARCH STUDIES

1. Miscellaneous Studies

a) Atlantic Salmon population genetics in Atlantic Canada

Resolving population structure of Atlantic salmon in threatened or understudied regions remains a priority. Several recent genetic and genomic studies in Atlantic Canada have revealed both river-scale and regional population structure of Atlantic salmon, which are directly informing the design of conservation units and allowing the estimation of river and region-specific exploitation. At the regional scale, recent analysis has revealed new evidence of climate associated structure within Labrador with evidence that populations within Lake Melville are discrete from coastal populations. Ongoing work is using a large genomic database to refine conservation units (i.e. COSEWIC) throughout Atlantic Canada.

The consequences of aquaculture escape events for wild populations are also being examined within Atlantic Canada. Specifically, we are examining the consequences of a large escape event in 2013 for wild populations of Atlantic Salmon in a southern Newfoundland fiord using targeted genomic tools. We report for the first time the unambiguous, widespread detection of first- and second-generation wild-aquaculture hybrid salmon and pure aquaculture offspring (i.e. 35% hybrids, 17/18 rivers within 75 km). Results indicate that levels of hybridization were higher in smaller populations, and higher in the lower stretches of watersheds below obstructions. Monitoring of this cohort over time suggests declines in the proportions of hybrids detected consistent with reduced survival of individuals with domestic ancestry in the wild. Monitoring of levels of hybridization and the presence and abundance of escapees will continue in southern Newfoundland in 2018-2019.

b) Sentinel Studies

The Sentinel Surveys, initiated in October 1994, were continued in 2017. Data collected were tabled at the Regional stock update in the spring of 2018 for Div. 2J3KL cod, and the 3Ps cod Regional Stock Assessment in October 2017. 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 2017. There were 3, 602 (1, 796 in Div. 3KL and the remainder in Subdiv. 3Ps) cod tagged and released with Floy tags; in addition, detections of acoustically tagged cod released inshore in 3KL during 2010-2017 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 and retrieved in December 2014. 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 generally low (<6 %) during 2011-2016 but increased to ~8% in 2017. For cod in Subdiv. 3Ps, the most recent exploitation rates are for 2016 when tagging was conducted only in Fortune Bay. Exploitation rates were estimated between 12 and 19% among cod ranging in length from 50 to 85 cm, but higher exploitation rates (21-27%) were calculated for larger cod (> 65 cm). The distribution of tag returns did not give any indication of significant exploitation of 3Ps cod in adjacent stock areas (3KL/3Pn-4R).

Information from tagging was also used in the integrated state-space assessment model for cod in Div. 2J3KL.

d) Hydrographic Surveys

The Canadian Hydrographic Service (CHS) conducted Revisory surveys in several areas of the island to update charts in production. Chart production is in progress for the Lake Melville area incorporating new data collected from CHS surveys and data from external sources collected in recent years. These charts will be released this year.

New charts were released in the Trinity Bay area, (Subarea 4) and in the Voisey Bay area (Subarea 2).

Annual Sailing Directions Revisory Survey

The 2017 Sailing Direction Revisory survey gathered hydrographic data to revise ATL 103, Newfoundland, Southwest Coast. A New Edition of ATL 120, Labrador, Camp Islands to Hamilton Inlet (including Lake Melville) was nearing completion with publishing projected for 2018/19. A New Edition of Sailing Directions ATL 109, Gulf of St. Lawrence (Northeast Portion) was commenced with publishing projected for 2019/20.

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.

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

All Canadian Hydrographic Service Sailing Directions publications are available in Print on Demand (POD) format.

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Rideout, R.M. and D.W. Ings. 2018. Temporal And Spatial Coverage Of Canadian (Newfoundland And Labrador Region) Spring And Autumn Multi-Species RV Bottom Trawl Surveys, With An Emphasis On Surveys Conducted In 2017 18/17, Ser. No. N6801.

Table 1. Summary of preliminary catches (t) for stocks within the DFO, Newfoundland and Labrador Region, 2007-2017. Note that unless otherwise specified, this table presents Newfoundland and Labrador landings only.

Subarea	Species	Division	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
2	Cod	2GH	0	0	0	0	0	0	0	0	0	0	0
	Shrimp*	2G (SFA 4)	16,068	14,677	15,050	14,958	14,969	13,847	10,441	11,134	10,656	9,682	10,009
		2HJ (SFA 5)	15,045	22,522	21,530	21,850	22,317	23,645	25,264	21,425	25,094	20,503	23,768
		2J3K (SFA 6)	8,161	25,143	48,722	46,340	59,032	58,327	59,685	61,501	45,099	75,080	80,736
	Snow Crab	2HJ	1,758	1,700	1,769	1736	1392	1606	1933	2131	2387	2549	2523
	Iceland Scallop	2HJ	5	5	8	6	20	16	19	16	17	13	40
	Arctic Charr	2J3KLPs+4R	16	29	25	22	25	11	24	11	16	18	28
	Atlantic Salmon****		39	39	42	38	37	54	41	36	30	36	27
2+3	Redfish	2+3K	104	16	5	48	66	103	74	61	28	20	29
	Greenland halibut	2+3KLMNO	5359	6089	6524	7223	6410	6176	6166	6529	5744	4701	5073
	American plaice	2+3K	3	1	4	9	100	11	18	22	10	10	23
	Witch	2J+3KL	97	53	187	178	182	94	143	160	45	5	22
	Cod*****	2J3KL	12778	9911	4314	4583	4299	3305	3139	2902	3098	3343	2546
	Grenadier	2+3	2	0	1	5	11	28	113	41	13	10	38
	Capelin	2J3KL (offshore)	19873	0	0	0	0	0	0	0	0	0	0
	Squid	2+3	313	104	0	0	0	17	90	100	643	516	228
3	Redfish	3LN	4177	3005	4139	1446	2730	920	1960	113	6	1	3
		3M	0	0	0	0	0	0	2	0		0	0
		3O	36	21	31	34	0	0	97	42	255	202	1054
	Yellowtail	3LNO	6,508	6248	5442	6800	7920	1795	3947	8056	5414	10216	3674
	American plaice	3LNO	223	750	436	748	1041	267	450	1154	1077	878	434
		3Ps	206	168	100	46	96	140	279	402	509	456	460
	Witch flounder	3NO	349	798	222	9	62	3	11	39	41	46	21
		3Ps	391	479	343	144	226	235	175	446	454	298	110
	Atlantic halibut	3	499	519	361	570	400	364	270	321	289	287	170
	Cod	3NO	58	136	130	187	223	25	39	103	158	231	123
		3Ps	5796	4964	4961	4378	3058	4254	5424	6737	7491	9636	10,599

	Haddock	3LNO	228	186	62	10	13	4	42	27	104	60	30
		3Ps	329	224	167	189	69	101	88	129	173	288	302
	Pollock	3Ps	582	357	190	305	148	335	186	319	287	616	1,042
	White hake***	3NOPs	294	363	205	397	301	264	239	559	748	1383	1,680
	Thorny skate***	3LNOPs	418	192	169	388	294	531	467	604	1334	1452	1639
	Capelin	3L	16,155	8890	11,380	9,808	12,423	11,645	12,023	11,927	13,326	15,176	16,321
		3K	3,762	16,619	13,640	13,365	11,332	10,672	8,081	3,544	9,853	13,043	13,036
	Shrimp*	3M	0	0	0	0	0	0	0	0	0	0	0
		3L	0	0	0	1,769	6,119	8,019	9,276	13,535	20,494	21,187	18,316
	Sea scallop	3KLNO	0	3	0	0	0	0	0	27	0	0	9
		3Ps	846	883	1,126	1158	1071	1,190	920	842	432	293	359
	Iceland scallop	3LNO	0			0	0	11	0	0	0	1	0
		3Ps	527	368	45	1	4	2	0	0	2	5	6
	Snow Crab	3K	5,509	5550	7182	7828	8519	8390	10,744	12,420	16,184	15,068	12,270
		3LNO	23,230	32,316	37,159	34,499	33,892	33,511	32,914	31,419	29,033	30,248	30,895
		3Psn	1,173	1188	2540	4904	6047	6225	6716	6026	5559	4523	3947
	Lobster	3K	77	76	121	50	63	66	61	96	107	134	120
		3L	95	92	113	81	81	84	75	111	98	109	83
		3Ps	1,088	1199	1100	940	1048	952	917	1228	1071	1171	1010
		3Pn	162	157	150	161	138	164	112	139	127	153	94
	Atlantic salmon**	2J3KLPs+4R	30	49	46	37	48	39	48	51	41	50	29
3+4	Redfish	3P+4V	329	372	71	533	192	295	907	2275	2265	1217	1402
4	Iceland scallop	4R	115	192	200	310	378	295	431	244	246	121	284
	Sea scallop	4R	10	7	4	6	42	66	48	27	15	0	0
	Lobster	4R	1,488	1354	1260	906	873	857	769	1022	1096	1404	1260
	Snow Crab	4R	524	694	776	850	891	742	596	188	268	365	558

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 February 2, 2018, 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 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 three main components of the science program include:

1) Science in support of straddling stocks and highly migratory species,
2) Science in support of understanding ocean variability and marine ecosystems,
3) 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.), and,

The following tables outline those IGS activities of interest to NAFO that were completed 2017/18, as well as those currently underway for 2018/19.

List of IGS Activities 2017-18 and 2018-19	
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
I. Bradbury	Temporal evaluation of regional contributions to Northwest Atlantic mixed stock Atlantic salmon fisheries
I. Bradbury	Population genomic analysis of Atlantic Halibut stock structure to inform trans-boundary management in eastern North America
I. Bradbury	Genomic based mixed stock analysis of Atlantic salmon fisheries in the North Atlantic
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. Kenchington/ K. Gilkinson/ V. Wareham	Identification and Mapping through Predictive Modelling of Coldwater Coral and Sponge Species in the Sub-Arctic/Eastern Arctic
Koen-Alonso/Pepin	Making the NAFO Roadmap for an Ecosystem Approach to Fisheries (EAF) operational: Incorporating ecosystem and multispecies information into fisheries management advice
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.