10.3 Atlantic salmon from North America

Advice for 2015 to 2018

ICES advises that when the MSY approach is applied, fishing should only take place on salmon from rivers where stocks have been shown to be at full reproductive capacity. Furthermore, because of the different status of individual stocks within stock complexes, mixed-stock fisheries present particular threats. The management of a fishery should ideally be based on the individual status of all stocks exploited in the fishery.

Management advice in the form of catch options is only provided for non-maturing 1SW and maturing 2SW salmon, as the maturing 1SW component is not fished outside of homewaters. In the absence of any fishing, there is less than 75% probability in 2015 to 2018 that the numbers of 2SW salmon returning to the six regions of North America will be above the management objectives (conservation limits for the four northern areas, rebuilding objectives for the two southern areas) simultaneously for the six regions. Therefore, in line with the objectives agreed by NASCO, there are no mixed-stock fishery options on 1SW non-maturing salmon and 2SW salmon in North America in 2015 to 2018.

The Framework of Indicators (FWI) was updated in support of the multi-year catch advice and the potential approval of multi-year regulatory measures. The FWI can be applied at the beginning of 2016, with the returns or return rate data for 2015, to evaluate the appropriateness of the advice for 2016, and again at the beginning of 2017, with the returns or return rate data for 2016, to evaluate the appropriateness of the advice for 2017.

Stock status

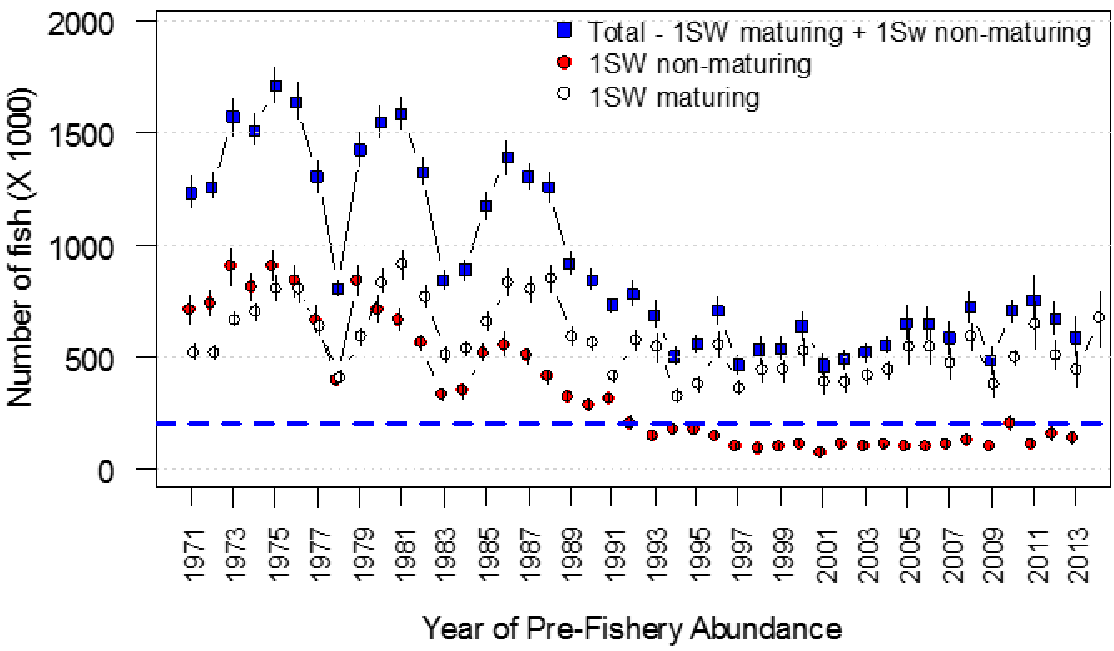

Figure 10.3.1 Estimated (median, 5th to 95th percentile range) pre-fishery abundance (PFA) for 1SW maturing, 1SW non-maturing, and total cohort of 1SW salmon for North America. The dashed blue horizontal line is the corresponding sum of the 2SW conservation limits for NAC, corrected for 11 months of natural mortality.

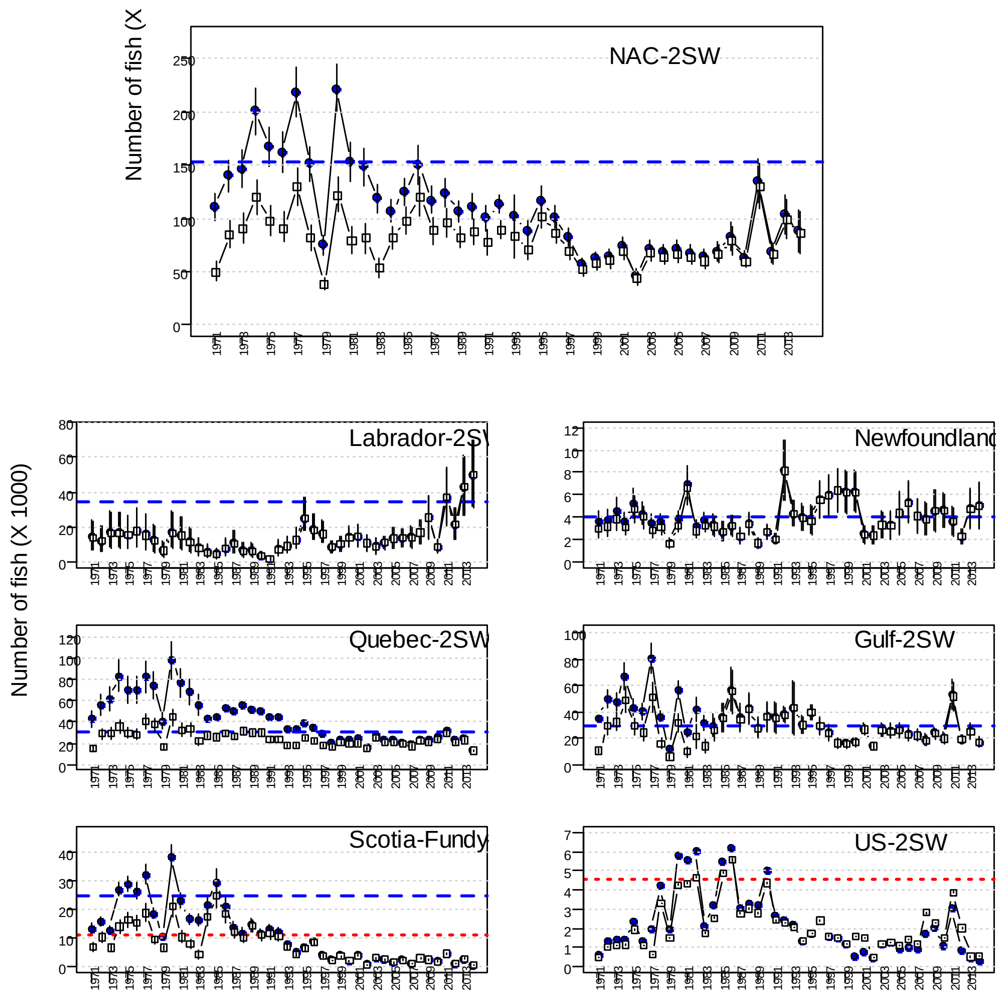

Figure 10.3.2 Estimated (median, 5th to 95th percentile range) returns (shaded circles) and spawners (open squares) of 2SW salmon for NAC overall and for each of the six regions. The dashed line is the corresponding 2SW CL; the 2SW CL (29 199 fish) is off scale in the plot for the USA. The dotted lines in the Scotia–Fundy and US panels are the region-specific management objectives. Returns and spawners for Scotia–Fundy do not include those from SFA 22 and a portion of SFA 23. For USA, estimated spawners exceed the estimated returns in some years due to adult stocking restoration efforts.

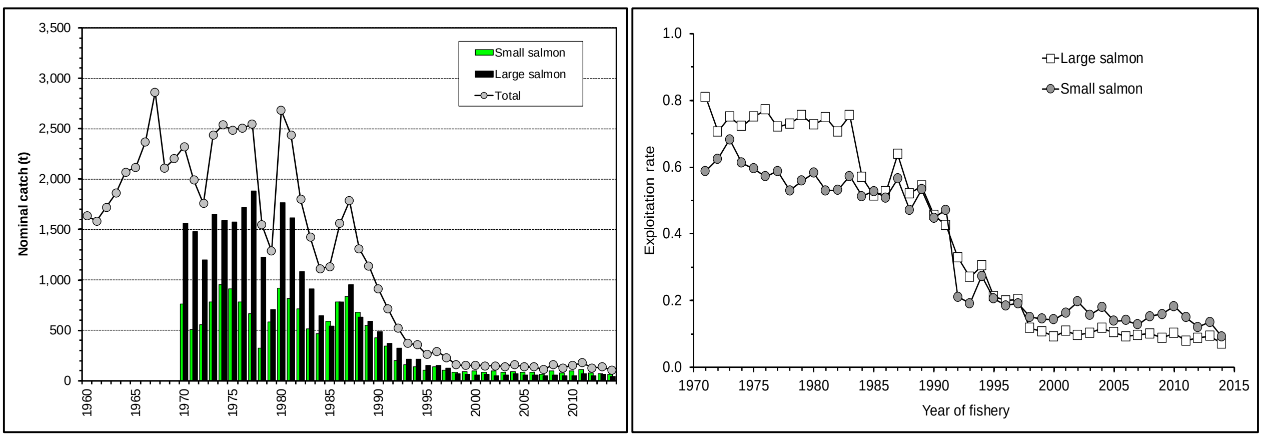

Figure 10.3.3 Left panel: Harvest (t) of salmon in Canada; combined catches in USA and St Pierre and Miquelon are ≤ 6 t in any year. Right panel: Exploitation rates in North America on small (mostly 1SW) and large (2SW, 3SW, and repeat spawners) salmon.

Stock status is presented for six regions (Figure 10.3.4) and overall for North America.

Recruitment (pre-fishery abundance (PFA), defined as the number of 1SW salmon on 1 August of the second summer at sea) estimates suggest continued low abundance of North American salmon (Figure 10.3.1). The total PFA in the Northwest Atlantic has oscillated around a generally declining trend since the 1970s, with a period of persistent low abundance since the early 1990s. This is largely driven by the decline in the non-maturing 1SW salmon.

In 2014, 2SW median spawner estimates for Labrador and Newfoundland were above the conservation limits (CL), while 2SW spawners were below the CL in all other regions and for the North American Commission overall (Figure 10.3.2). Particularly large deficits are noted in the Scotia–Fundy and USA regions. Egg depositions by all sea-ages combined in 2014 exceeded or equaled the river-specific CLs in 18 of the 66 assessed rivers and were less than 50% of CLs in 31 rivers (Figure 10.3.5).

Harvest (i.e. retained catch) of salmon decreased strongly from the early 1980s to the late 1990s, and has remained very low since then (Figure 10.3.3). Exploitation rates of both large salmon (2SW, 3SW, and previous spawners) and small salmon (mostly 1SW) remained relatively stable until 1984 and 1992, respectively, when they declined sharply with the introduction of restrictive management measures (Figure 10.3.3). Declines continued in the 1990s. In the last few years, exploitation rates have remained at the lowest in the time-series.

Despite major changes in fisheries management two to three decades ago, and increasingly more restrictive fisheries measures since then, returns have remained near historical lows. Many populations, particularly those in the southern regions, are currently threatened with extirpation. The continued low abundance of salmon stocks across North America, despite significant fishery reductions and generally sustained smolt production, strengthens the conclusions that factors acting on survival in the first and second years at sea are constraining abundance of Atlantic salmon.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a risk level (probability) of 75% for attainment of management objectives simultaneously in all regions has been agreed for the provision of catch advice on 2SW salmon exploited at West Greenland (as non-maturing 1SW fish) and in North America (as non-maturing 1SW and 2SW salmon). For the North American Commission, the management objectives are the 2SW CLs in the four northern regions (Labrador, Newfoundland, Quebec, Gulf), to achieve a 25% increase in regional returns relative to a baseline period (average returns in 1992–1996) for the Scotia–Fundy region, and to achieve 2SW adult returns of 4549 or greater for the USA. A framework of indicators (Table 10.3.2) has been developed in support of the multi-annual catch options.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northwest Atlantic they range from the Connecticut River (USA, 41.6°N) northward to 58.8°N (Quebec, Canada). Juveniles emigrate to the ocean at ages of one to eight years (dependent on latitude) and generally return after one or two years at sea. Long-distance migrations to ocean feeding grounds are known to take place, with adult salmon from both the North American and Northeast Atlantic stocks migrating to West Greenland to feed in their second summer and autumn at sea. Recent genetic information has demonstrated that fish from North America were also exploited in the historical Faroes fishery; further details are provided in Section 10.1.10.

Environmental influence on the stock

Environmental conditions in both freshwater and marine environments have a marked effect on the status of salmon stocks. Across the North Atlantic, a range of problems in the freshwater environment play a significant role in explaining the poor status of stocks. In many cases river damming and habitat deterioration have had a devastating effect on freshwater environmental conditions. In the marine environment, return rates of adult salmon have declined through the 1980s and are now at the lowest levels in the time-series for some stocks, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions and predator fields of salmon at sea are considered to be the main contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

Three groups exploited salmon in Canada in 2014: Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. The dramatic decline in harvested tonnage since 1980 (Table 10.3.3 and Figure 10.3.3) is in large part the result of the reductions in commercial fisheries effort, with closure of the insular Newfoundland commercial fishery in 1992, closure of the Labrador commercial fishery in 1998, and closure of the Quebec commercial fishery in 2000. All commercial fisheries for Atlantic salmon remained closed in Canada in 2014. In the recreational fishery, approximately 39 500 salmon (about 23 000 small and 16 500 large) were caught and released, representing about 59% of the total number caught (including retained fish). France (Islands of Saint-Pierre and Miquelon) reported a total harvest of 3.8 t in the professional and recreational fisheries in 2014 (Table 10.3.3). There are no commercial or recreational fisheries for Atlantic salmon in USA (Table 10.3.3).

	Canada				St Pierre & Miquelon	USA
	Commercial	Aboriginal	Labrador resident	Recreational		
2014 reported nominal catch (t)	0	53.0	1.6	51.0	3.8	0
% of NAC total	-	48	1	47	3	-

Effects of the fisheries on the ecosystem

The current salmon fisheries probably have no or only minor influence on the marine ecosystem. However, the exploitation rate on salmon may affect the riverine ecosystem through changes in species composition. There is a limited knowledge on the magnitude of these effects.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Recreational catch statistics for Atlantic salmon are not collected regularly in Canada and there is no mechanism in place that requires anglers to report their catch statistics, except in Quebec. The reliability of recreational catch statistics could be improved in all areas of Canada. Estimates of abundance of adult salmon in some areas, in particular Labrador, are based on a small number of counting facilities raised to a large production area.

Scientific basis

Assessment type	Run-reconstruction models and Bayesian forecasts, taking into account uncertainties in the data.
Input data	Nominal catches (by sea-age class) for commercial and recreational fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	There are no salmon discarded in the fisheries.
Indicators	Framework of Indicators used to indicate if a significant change has occurred in the status of stocks in intermediate years where multi-annual management advice applies.
Other information	Advice subject to annual review. A stock annex was developed in 2014 and updated in 2015.
Working group	Working Group on North Atlantic Salmon (WGNAS) (ICES, 2015).

Reference points

Reference points for the North American regions are based on the conservation limits for 2SW salmon. The management objective for Scotia–Fundy is based on an increase of 25% in returns of 2SW salmon from the mean return in the base years 1992 to 1996. For USA, the management objective is to achieve 2SW adult returns of 4549 or greater.

Country and Commission area	Stock area	2SW Conservation limit (number of fish)	Management objective (number of fish)
	Labrador	34 746	34 746
	Newfoundland	4 022	4 022
	Gulf of St. Lawrence	30 430	30 430
	Quebec	29 446	29 446
	Scotia–Fundy	24 705	10 976
Canada Total		123 349	
USA		29 199	4 549
North American Commission		152 548	

Outlook for 2015 to 2018

PFA forecasts for non-maturing 1SW salmon in 2014 to 2017 are derived from the abundance of lagged spawners and a productivity parameter by region for the six regions of North America (Figure 10.3.6). The estimated productivity (PFA divided by lagged spawners) was highest in most regions prior to 1990 (PFA year) and then decreased in all regions, reaching the lowest values during and after the 1990s (Figure 10.3.7).

The regional contributions to the overall NAC PFA are presented in Figure 10.3.8. For 2011 to 2013, the proportions of the estimated PFA originating from Labrador, Quebec, and Gulf have been approximately 34–54%, 20–33%, and 23–29%, respectively. These values are in broad agreement with the results of genetic stock identification of samples from the West Greenland fishery (see Section 10.1.12.3).

MSY approach

ICES considers that to be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from rivers where stocks have been shown to be at full reproductive capacity. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats.

The probability that the returns of 2SW salmon to the six regions of North America will meet or exceed the management objectives in 2015 to 2018 in the absence of any fishing is provided in Table 10.3.1. In all years, there is a zero probability of simultaneous attainment of all objectives. Therefore, in line with the management objectives agreed by NASCO, there are no mixed-stock fishery options on 1SW non-maturing salmon and 2SW salmon in North America in 2015 to 2018.

Additional considerations

Fisheries on mixed stocks pose particular difficulties for management, as they cannot target only stocks that are at full reproductive capacity. The management of a fishery should ideally be based on the status of all stocks exploited in the fishery. Conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity. Fisheries in estuaries and, especially, rivers are more likely to meet this requirement.

Most catches (91%) in North America now take place in rivers or in estuaries. Fisheries are principally managed on a river-by-river basis and, in areas where retention of large salmon is allowed, are closely controlled. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located in bays, generally inside the headlands. The coastal fishery in St. Pierre and Miquelon (SPM) is a mixed-stock fishery which catches salmon from stocks in Canada and USA; there are no salmon-producing rivers in SPM.

Genetic investigations have provided new information regarding the stock origin of the salmon caught in the estuarine and coastal fisheries at Labrador and in SPM. Samples collected in both fisheries have been assessed against a recently developed North American genetic baseline for Atlantic salmon, which allows assignment to twelve regional groups. The results are provided in Section 10.1.12.

The returns of 2SW fish in 2014 decreased in four geographic areas relative to 2013 and increased in Labrador and Newfoundland (Figure 10.3.2). Three regions (Labrador, Quebec, and Gulf) contributed 93% of the total 2SW returns to North America. 2SW returns were the lowest on record for Quebec, Scotia–Fundy, and USA and among the lowest in Gulf, but the highest on record for Labrador. Total estimated returns of 1SW salmon to North America in 2014 were the highest on record (Figure 10.3.9). Returns increased relative to 2013 in four regions (Labrador, Newfoundland, Quebec, and USA), but decreased in Gulf and Scotia–Fundy.

Data and methods

The returns for individual river systems and management areas for both sea-age groups were derived from a variety of methods. These methods included counts of salmon at monitoring facilities, population estimates from mark–recapture studies, and applying angling and commercial catch statistics, angling exploitation rates, and measurements of freshwater habitat. The 2SW component of the large returns was determined using the sea-age composition of one or more indicator stocks.

Returns are the number of salmon that returned to the geographic region, including fish caught by homewater commercial fisheries, except in the case of the Newfoundland and Labrador regions, where returns do not include landings in commercial and food fisheries.

Estimates and forecasts of the pre-fishery abundance for the non-maturing 1SW salmon (PFA) are derived using a Bayesian framework.

To date, 1082 Atlantic salmon rivers have been recorded in eastern Canada and 21 rivers in eastern USA, where salmon are or have been present within the last half century. Conservation requirements in terms of eggs have been defined for 45% (485) of the 1082 rivers in Canada. For over 59% of the rivers with defined conservation requirements, these are less than 1 million eggs, which translates roughly into 200 to 300 spawners, depending on life-history type. Conservation requirements are less than five million eggs for 91% of the rivers. Assessments were reported for 66 rivers in 2014.

Uncertainties in assessments and forecasts

The unreported catch for Canada is estimated at 21 t in 2014, mostly from illegal retentions in fisheries directed at salmon. No unreported catch estimate has been provided for St Pierre and Miquelon.

Comparison with previous assessment and catch options

In 2012, ICES provided forecasts of the regional productivity parameters and PFAs. The regional PFA values in 2011 to 2013 estimated in this year’s assessment were higher than the forecast for Labrador, whereas the opposite occurred for all the other regions. Due to the large uncertainty associated with the forecast values, the estimated PFA values for 2011 to 2013 were within the 95% confidence intervals of the forecast values. The previous advice provided by ICES (ICES, 2012) indicated that there were no mixed-stock fishery catch options on the 1SW non-maturing salmon component for the 2011 to 2014 PFA years, and this year’s assessment confirms that advice.

Assessment and management area

The advice for the North America Commission is based on the management objectives agreed by NASCO for the six geographic areas of North America (Figure 10.3.4).

Sources of information

ICES. 2012. Atlantic salmon from North America. *In* Report of the ICES Advisory Committee, 2012. ICES Advice 2012, Book 10, Section 10.3.

ICES. 2015. Report of the Working Group on North Atlantic Salmon (WGNAS), 17–26 March, Moncton, Canada. ICES CM 2015/ACOM:09. 332 pp.

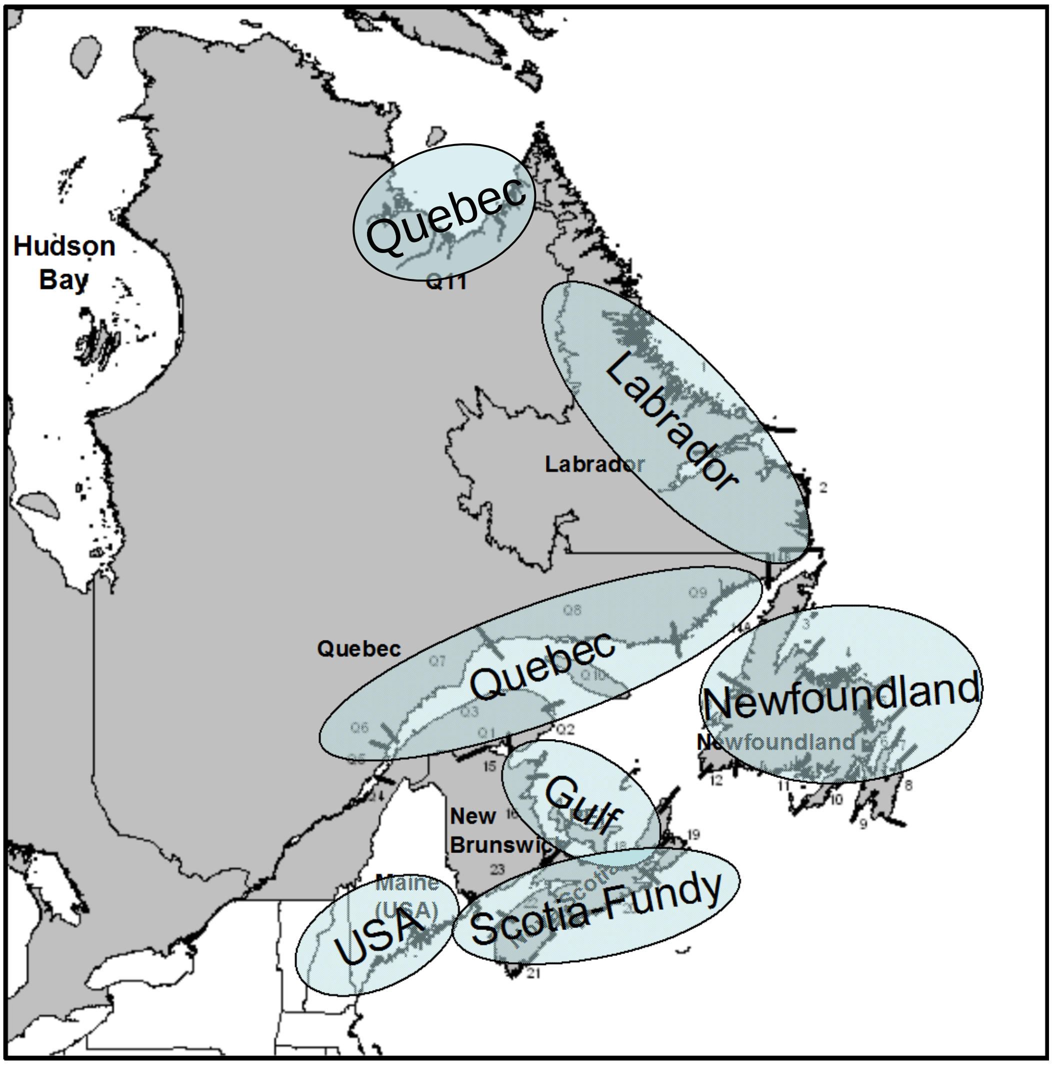

Figure 10.3.4 Regional groupings of Atlantic salmon in the North American Commission.

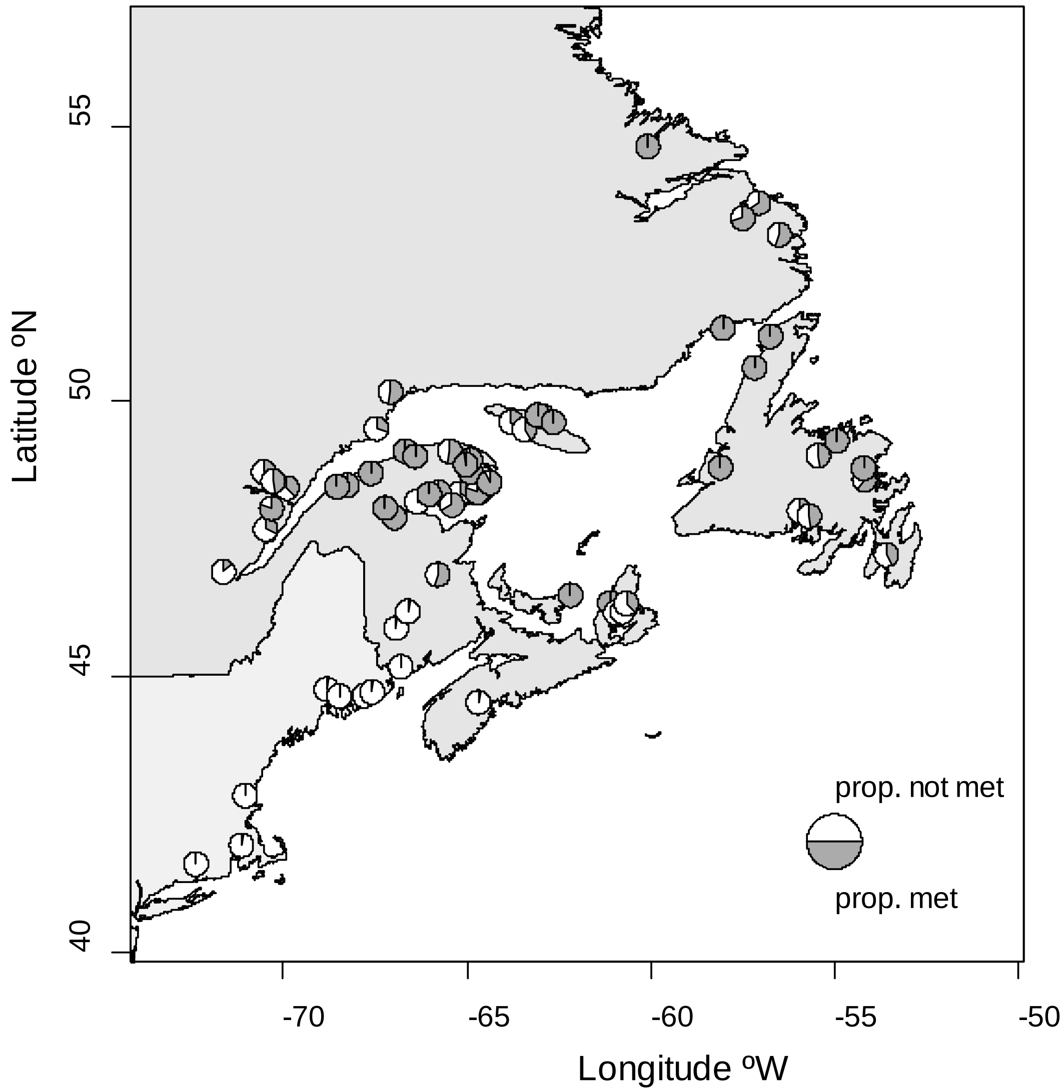

Figure 10.3.5 Proportion of the conservation egg requirement attained in the 66 rivers of the North American Commission area assessed in 2014.

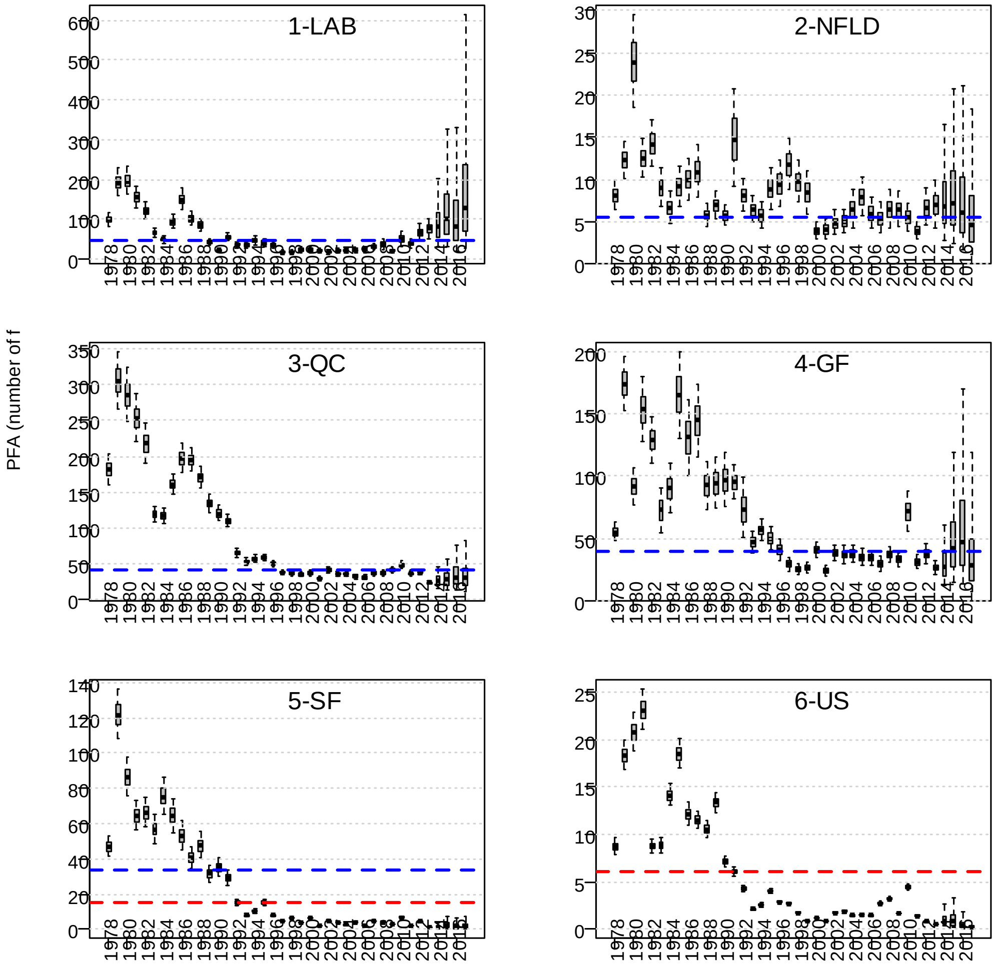

Figure 10.3.6 Estimated region-specific pre-fishery abundance (PFA) values of non-maturing 1SW salmon for the six regions of North America. The values for 2014 to 2017 are predicted based on lagged spawners and forecasts of the PFA to lagged spawners ratio. The dashed blue line is the corresponding 2SW conservation limit (adjusted for 11 months of natural mortality) for each region (out of range for US). For Scotia–Fundy and US the dotted red line corresponds to the 2SW management objectives (adjusted for 11 months of natural mortality). Boxplots are interpreted as follows: the dashed line is the median, the shaded rectangle is the inter-quartile range, and the dashed vertical line is the 5th to 95th percentile range.

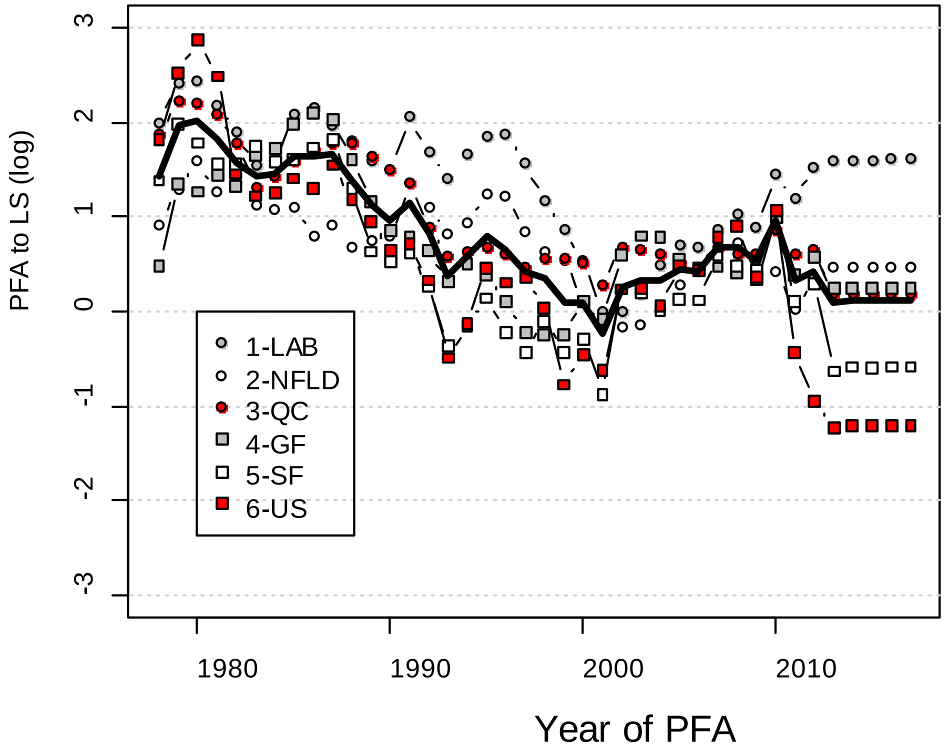

Figure 10.3.7 Region-specific productivity (in logarithmic scale, i.e. logarithm of PFA per lagged spawner) for non-maturing 1SW salmon. The values for 2014 to 2017 are forecast values. The bold line is the value for NAC overall.

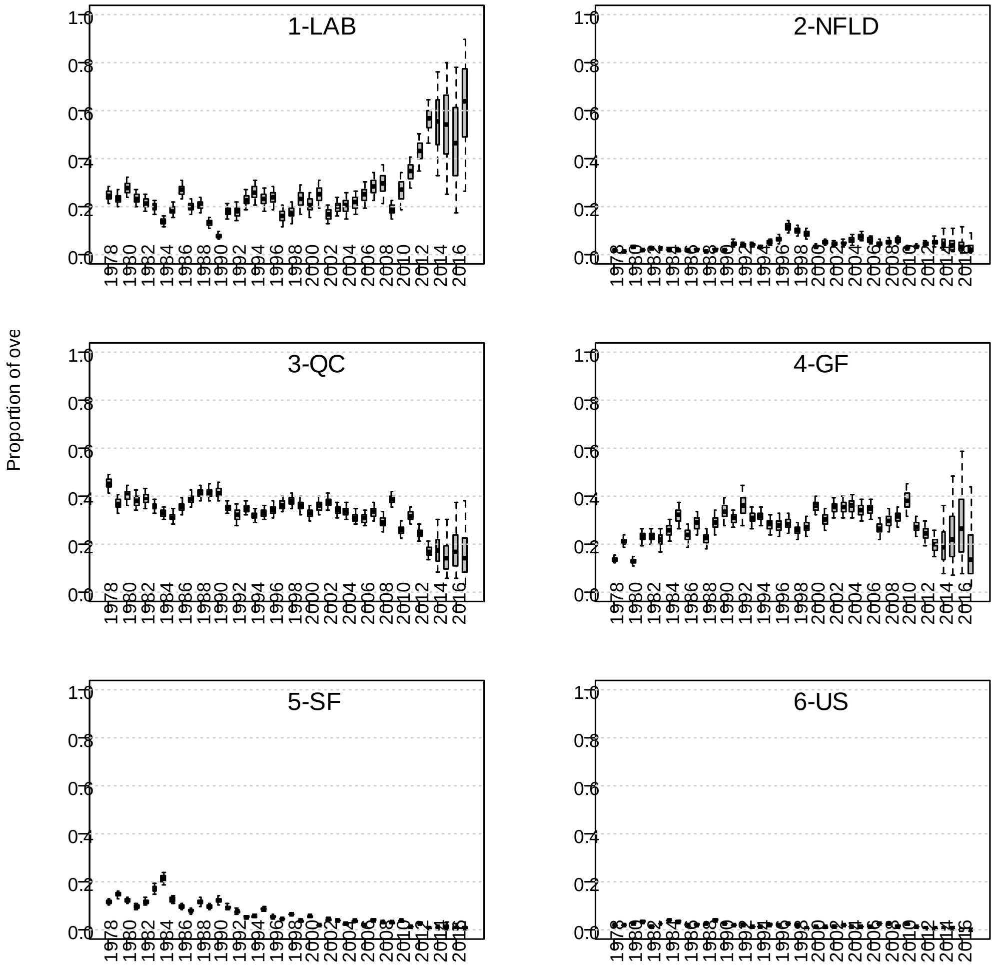

Figure 10.3.8 Proportion of PFA in each region relative to overall non-maturing 1SW PFA for NAC.

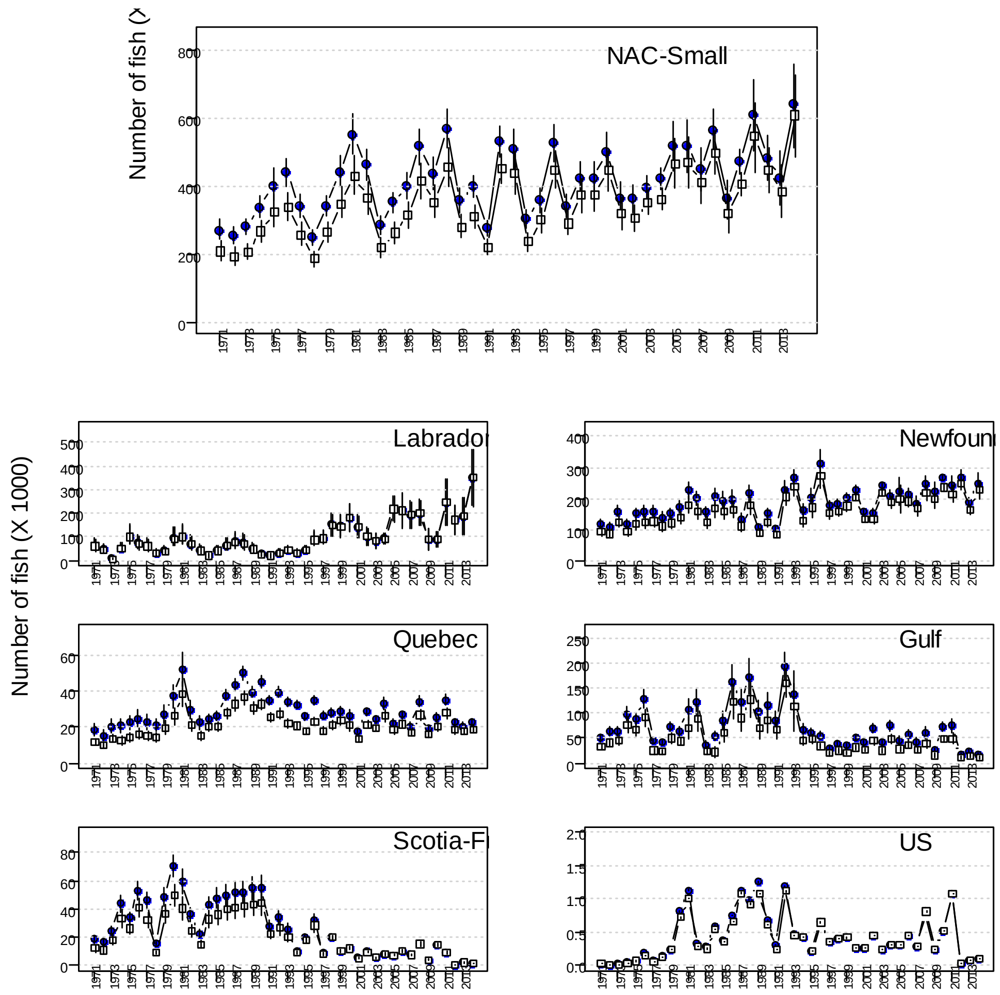

Figure 10.3.9 Estimated (median, 5th to 95th percentile range) returns (shaded circles) and spawners (open square) of small salmon for NAC and for each of the six regions. Returns and spawners for Scotia–Fundy do not include those from SFA 22 and a portion of SFA 23.

Table 10.3.1 Probabilities that the returns of 2SW salmon to the six regions of NAC will meet or exceed the 2SW objectives for the six regions in NAC and simultaneously for all regions in the absence of any fishing.

Region	2SW Objective	Probability of meeting 2SW objectives in the absence of fisheries (2SW return year)			
		2015	2016	2017	2018
Labrador	34 746	0.82	0.85	0.74	0.85
Newfoundland	4 022	0.64	0.64	0.55	0.41
Quebec	29 446	0.07	0.18	0.30	0.29
Gulf	30 430	0.19	0.49	0.56	0.32
Scotia–Fundy	10 976	0.00	0.01	0.01	0.01
USA	4 549	0.00	0.01	0.00	0.00
Simultaneous to North America		0.00	0.00	0.00	0.00

Table 10.3.2 Framework of indicators spreadsheet for the North American Commission and West Greenland Commission areas. For illustrative purposes, the 2014 value of returns or survival rates for the 23 retained indicators is entered in the cells corresponding to the annual indicator variable values.

	Catch Advice	**Catch option > 0 (Yes = 1, No = 0)**			**0**					
	Overall Recommendation									
	No Significant Change Identified by Indicators									
Geographic Area	River/ Indicator	**2014 Value**	Ratio Value to Threshold	Threshold	True Low	True High	Indicator State	Probability of Correct Assignment	Indicator Score	Management Objective Met?
USA	Penobscot 2SW Returns	174	7%	2,368	100%	100%	-1	1	-1	
	possible range				*-1.00*	*1.00*				
	Average		7%						**-1.00**	**No**
Scotia-Fundy	Saint John Return Large	46	1%	3,329	96%	100%	-1	0.96	-0.96	
	Lahave Return Large	41	14%	285	79%	85%	-1	0.79	-0.79	
	North Return Large	84	13%	626	96%	96%	-1	0.96	-0.96	
	Saint John Survival 2SW (%)	0.10	76%	0.131	96%	81%	-1	0.96	-0.96	
	Saint John Survival 1SW (%)	0.11	14%	0.763	88%	73%	-1	0.88	-0.88	
	Saint John Return 1SW	112	5%	2,276	88%	80%	-1	0.88	-0.88	
	LaHave Return 1SW	84	5%	1,679	95%	67%	-1	0.95	-0.95	
	possible range				*-0.91*	*0.83*				
	Average		19%						**-0.91**	**No**
Gulf	Miramichi Return 2SW	6,922	47%	14,695	100%	82%	-1	1.00	-1.00	
	Miramichi Return 1SW	7,475	18%	41,588	90%	68%	-1	0.90	-0.90	
	Margaree Return Large	1,812	52%	3,471	86%	56%	-1	0.86	-0.86	
	possible range				*-0.92*	*0.69*				
	Average		39%						**-0.92**	**No**
Quebec	Bonaventure Return Large	665	45%	1,493	81%	73%	-1	0.81	-0.81	
	Grande Rivière Return Large	86	19%	442	100%	82%	-1	1.00	-1.00	
	Saint-Jean Return Large	278	27%	1013	77%	100%	-1	0.77	-0.77	
	Dartmouth Return Large	408	54%	756	82%	79%	-1	0.82	-0.82	
	Madeleine Return Large	308	44%	693	93%	81%	-1	0.93	-0.93	
	Sainte-Anne Return Large	519	89%	584	88%	80%	-1	0.88	-0.88	
	Mitis Return Large	290	79%	369	89%	59%	-1	0.89	-0.89	
	De la Trinité Return Large	65	17%	385	84%	92%	-1	0.84	-0.84	
	Madeleine Return Small	274	46%	600	79%	82%	-1	0.79	-0.79	
	De la Trinité Return Small	235	25%	949	77%	100%	-1	0.77	-0.77	
	De la Trinité 1SW Survival	0.56	38%	1.49	78%	80%	-1	0.78	-0.78	
	De la Trinité 2SW Survival	0.09	17%	0.54	92%	73%	-1	0.92	-0.92	
	possible range				*-0.85*	*0.82*				
	Average		42%						**-0.85**	**No**
Newfoundland										
	possible range									
	Average								**NA**	**Unknown**
Labrador										
	possible range									
	Average								**NA**	**Unknown**
Southern NEAC										
	possible range									
	Average								**NA**	**Unknown**

Table 10.3.3 Total reported nominal catch of salmon in homewaters by country (in tonnes, round fresh weight), 1980–2014 (2014 figures include provisional data).

Year	Canada			USA	St. P&M
	Large	Small	Total	Total	Total
1980	1,763	917	2,680	6	-
1981	1,619	818	2,437	6	-
1982	1,082	716	1,798	6	-
1983	911	513	1,424	1	3
1984	645	467	1,112	2	3
1985	540	593	1,133	2	3
1986	779	780	1,559	2	3
1987	951	833	1,784	1	2
1988	633	677	1,310	1	2
1989	590	549	1,139	2	2
1990	486	425	911	2	2
1991	370	341	711	1	1
1992	323	199	522	1	2
1993	214	159	373	1	3
1994	216	139	355	0	3
1995	153	107	260	0	1
1996	154	138	292	0	2
1997	126	103	229	0	2
1998	70	87	157	0	2
1999	64	88	152	0	2
2000	58	95	153	0	2
2001	61	86	148	0	2
2002	49	99	148	0	2
2003	60	81	141	0	3
2004	68	94	161	0	3
2005	56	83	139	0	3
2006	55	82	137	0	3
2007	49	63	112	0	2
2008	57	100	157	0	4
2009	52	74	126	0	3
2010	53	100	153	0	3
2011	69	110	179	0	4
2012	52	74	126	0	3
2013	66	72	138	0	5
2014	41	65	106	0	4