Agenda Item 5.4
For information

Council

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Revised Report of the ICES Advisory Committee

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NORTH ATLANTIC SALMON STOCKS*

Introduction

Main tasks

At its 2017 Statutory Meeting, ICES resolved (C. Res. 2017/2/ACOM21) that the Working Group on North Atlantic Salmon [WGNAS] (chaired by Martha Robertson, Canada) would meet at invitation at Woods Hole, Massachusetts, USA, 4–13 April 2018 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organization (NASCO).

The sections of the report which provide the responses to the terms of reference are identified below.

Question		Section
1	With respect to Atlantic salmon in the North Atlantic area:	sal.oth.nasco
1.1	provide an overview of salmon catches and landings by country, including unreported catches and catch and release, and production of farmed and ranched Atlantic salmon in 2017[1];	
1.2	report on significant new or emerging threats to, or opportunities for, salmon conservation and management[2];	
1.3	provide a review of examples of successes and failures in wild salmon restoration and rehabilitation and develop a classification of activities which could be recommended under various conditions or threats to the persistence of populations[3];	
1.4	provide a compilation of tag releases by country in 2017; and	
1.5	identify relevant data deficiencies, monitoring needs and research requirements.	
2	With respect to Atlantic salmon in the North-East Atlantic Commission area:	sal.27.neac
2.1	describe the key events of the 2017 fisheries[4];	
2.2	review and report on the development of age-specific stock conservation limits, including updating the time-series of the number of river stocks with established CLs by jurisdiction;	
2.3	describe the status of the stocks, including updating the time-series of trends in the number of river stocks meeting CLs by jurisdiction;	
2.4	provide catch options or alternative management advice for the 2018/19–2020/21 fishing seasons, with an assessment of risks relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding[5]; and	
2.5	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	
3	With respect to Atlantic salmon in the North American Commission area:	sal.21.nac
3.1	describe the key events of the 2017 fisheries (including the fishery at St Pierre and Miquelon)[4];	
3.2	update age-specific stock conservation limits based on new information as available, including updating the time-series of the number of river stocks with established CLs by jurisdiction;	
3.3	describe the status of the stocks, including updating the time-series of trends in the number of river stocks meeting CLs by jurisdiction;	
3.4	provide catch options or alternative management advice for 2018–2021 with an assessment of risks relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding[5]; and	
3.5	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	
4	With respect to Atlantic salmon in the West Greenland Commission area:	sal.2 127. wgc
4.1	describe the key events of the 2017 fisheries[4];	
4.2	describe the status of the stocks[6];	
4.3	provide catch options or alternative management advice for 2018–2020 with an assessment of risk relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding[5];	
4.4	update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

* Version 2: In May 2018, an error was detected in the data presented on the nominal catches by country (Table 7). These values have been corrected in this version.

[1] With regard to question 1.1, for the estimates of unreported catch the information provided should, where possible, indicate the location of the unreported catch in the following categories: in-river; estuarine; and coastal. Numbers of salmon caught and released in recreational fisheries should be provided.
[2.] With regard to question 1.2, ICES is requested to include reports on any significant advances in understanding of the biology of Atlantic salmon that is pertinent to NASCO, including information on any new research into the migration and distribution of salmon at sea and the potential implications of climate change for salmon management.
[3.] with respect to question 1.3, NASCO is aware that the WGERAAS final report is being prepared and will be submitted to ICES in 2017.
[4.] In the responses to questions 2.1, 3.1 and 4.1, ICES is asked to provide details of catch, gear, effort, composition and origin of the catch and rates of exploitation. For home water fisheries, the information provided should indicate the location of the catch in the following categories: in-river; estuarine; and coastal. Information on any other sources of fishing mortality for salmon is also requested. For 4.1 ICES should review the results of the recent phone surveys and advise on the appropriateness for incorporating resulting estimates of unreported catch into the assessment process.
[5.] In response to questions 2.4, 3.4 and 4.3, provide a detailed explanation and critical examination of any changes to the models used to provide catch advice and report on any developments in relation to incorporating environmental variables in these models.
[6.] In response to question 4.2, ICES is requested to provide a brief summary of the status of North American and North-East Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions 2.3 and 3.3.

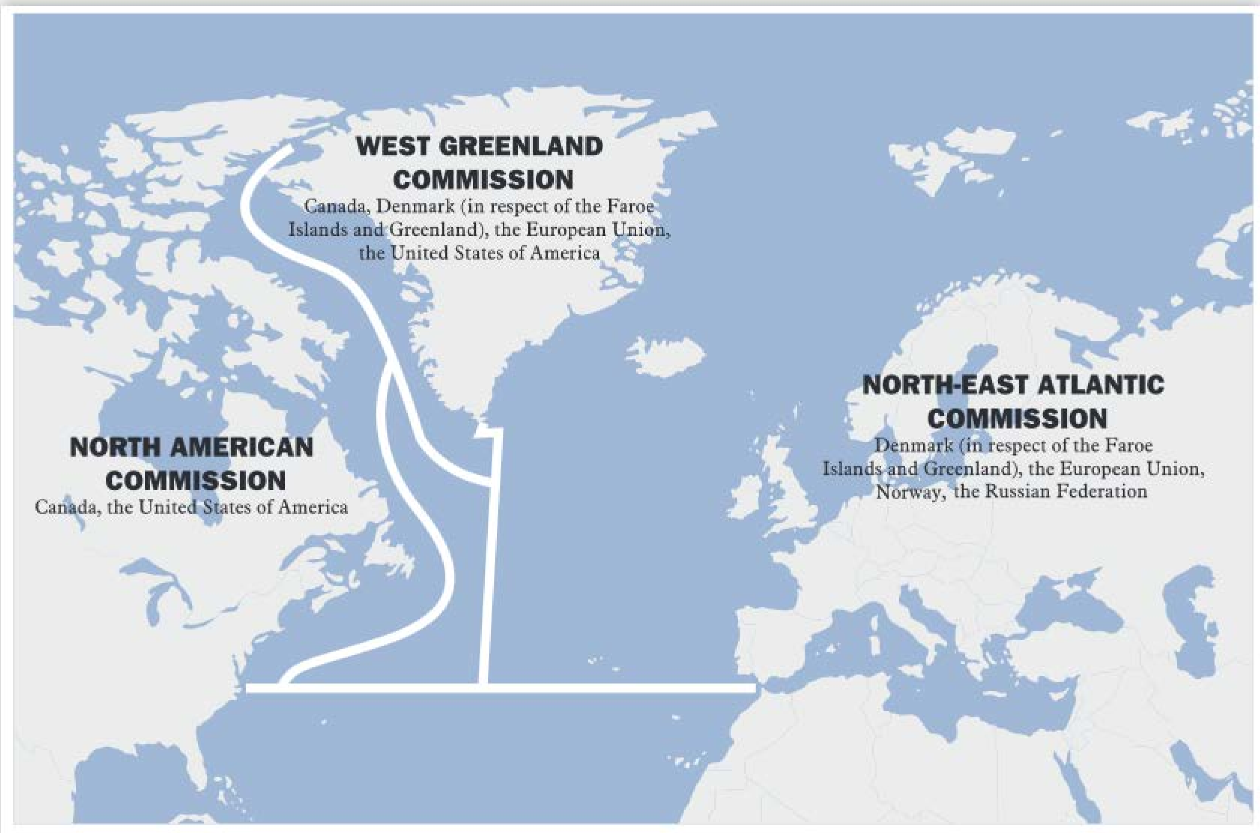
In response to the terms of reference, the working group considered 36 working documents. A complete list of acronyms and abbreviations used in this report is provided in Annex 1. References cited are given in Annex 2.

Please note that for practical reasons Tables 6–9 are found at the end, immediately before the annexes.

Management framework for salmon in the North Atlantic

The advice generated by ICES is in response to terms of reference posed by the North Atlantic Salmon Conservation Organization (NASCO), pursuant to its role in international management of salmon. NASCO was set up in 1984 by international convention (the Convention for the Conservation of Salmon in the North Atlantic Ocean), with a responsibility for the conservation, restoration, enhancement, and rational management of wild salmon in the North Atlantic. Although sovereign states retain their role in the regulation of salmon fisheries for salmon originating in their own rivers, distant-water salmon fisheries, such as those at Greenland and Faroes, which take salmon originating in rivers of another Party, are regulated by NASCO under the terms of the Convention. NASCO now has six Parties that are signatories to the Convention, including the EU which represents its Member States.

NASCO's three Commission areas, the North American Commission (NAC), the West Greenland Commission (WGC), and the North East Atlantic Commission (NEAC) are shown in the map below. The islands of St Pierre and Miquelon are not part of the NAC, but France (in respect of St. Pierre and Miquelon) participates as an observer to NASCO. The mid-Atlantic area is not covered by any of the three NASCO Commissions but, under Article 4 of the NASCO Convention, NASCO provides a forum for consultation and cooperation on matters concerning the salmon stocks in this area.



Management objectives

NASCO's objective is:

"..to contribute through consultation and co-operation to the conservation, restoration, enhancement and rational management of salmon stocks… taking into account the best scientific evidence available…".

NASCO further stated that "the Agreement on the Adoption of a Precautionary Approach states that an objective for the management of salmon fisheries is to provide the diversity and abundance of salmon stocks", and NASCO's Standing Committee on the Precautionary Approach interpreted this as being "to maintain both the productive capacity and diversity of salmon stocks" (NASCO, 1998).

NASCO's Action Plan for Application of the Precautionary Approach (NASCO, 1998) provides an interpretation of how this is to be achieved:

- "Management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets".
- "Socio-economic factors could be taken into account in applying the precautionary approach to fisheries management issues".
- "The precautionary approach is an integrated approach that requires, *inter alia*, that stock rebuilding programmes (including as appropriate, habitat improvements, stock enhancement, and fishery management actions) be developed for stocks that are below conservation limits".

Reference points and application of precaution

Atlantic salmon has characteristics of short-lived fish stocks; mature abundance is sensitive to annual recruitment because there are only a few age groups in the adult spawning stock. Incoming recruitment is often the main component of the fishable stock. For such fish stocks, the ICES maximum sustainable yield (MSY) approach is aimed at achieving a target escapement (MSY $B_{escapement}$, the minimum amount of biomass left to spawn). No catch should be allowed unless this escapement can be achieved. The escapement level should be set so there is a low risk of future recruitment being impaired.

For salmon, this approach has led to defining river-specific conservation limits (CLs) as equivalent to MSY $B_{escapement}$. 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 differences in status of individual stocks within stock complexes, mixed-stock fisheries present particular threats.

In many jurisdictions CLs are now defined using stock and recruitment relationships and the corresponding CLs are not updated annually. In the other jurisdictions where such relationships are not available, stock–recruitment proxies are used to define the CLs and these may vary from year to year as new data are added. NASCO has adopted the CLs as limit reference points (NASCO, 1998). CLs are used in reference to spawners. When referring to abundance prior to fisheries in the ocean (pre-fishery abundance, PFA) the CLs are adjusted to account for natural mortality, and the adjusted value is referred to as the spawner escapement reserve (SER).

Management targets have not yet been defined for all North Atlantic salmon stocks. Where there are no specific management objectives, the MSY approach shall apply:

- ICES considers that if the lower bound of the 90% confidence interval of the current estimate of spawners is above the CL, then the stock is at full reproductive capacity (equivalent to a probability of at least 95% of meeting the CL).
- When the lower bound of the confidence interval is below the CL, but the midpoint is above, then ICES considers the stock to be at risk of suffering reduced reproductive capacity.
- Finally, when the midpoint is below the CL, ICES considers the stock to suffer reduced reproductive capacity.

For catch advice on the mixed-stock fishery at West Greenland (catching non-maturing one-sea-winter (1SW) fish from North America and non-maturing 1SW fish from Southern NEAC), NASCO has adopted a risk level (probability) of 75% of simultaneous attainment of management objectives in seven geographic regions (ICES, 2003) as part of an agreed management plan. NASCO uses the same approach for catch advice for the mixed-stock fishery, affecting six geographic regions for the North American stock complex. ICES notes that the choice of a 75% risk (probability) for simultaneous attainment of six or seven stock units is approximately equivalent to a 95% probability of attainment for each individual unit (ICES, 2013).

There is no formally agreed management plan for the fishery at the Faroes. However, ICES has developed a risk-based framework for providing catch advice for fish exploited in this fishery (mainly multi-sea-winter (MSW) fish from NEAC countries). Catch advice is provided at both the stock complex and country level and catch options tables provide the probability of meeting CLs in the individual stock complexes or countries, and in all the stock complexes or countries simultaneously. ICES has recommended (ICES, 2013) that management decisions should be based principally on a 95% probability of attainment of CLs in each stock complex/country individually. The simultaneous attainment probability may also be used as a guide, but managers should be aware that this will generally be quite low when large numbers of management units are used.

NASCO 1.1 Catches of North Atlantic salmon

Nominal catches of salmon

In this document, catches are equivalent to harvest, with the exception of the recreational fishery where catch and release is referred to. For clarity, detailed Tables 6–9 are provided at the end of the report.

Reported total nominal catches of salmon in four North Atlantic regions from 1960 to 2017 are shown in Figure 1. Nominal catches reported by country are given in Table 6. Catch statistics in the North Atlantic include fish farm escapees, and in some Northeast Atlantic countries also ranched fish.

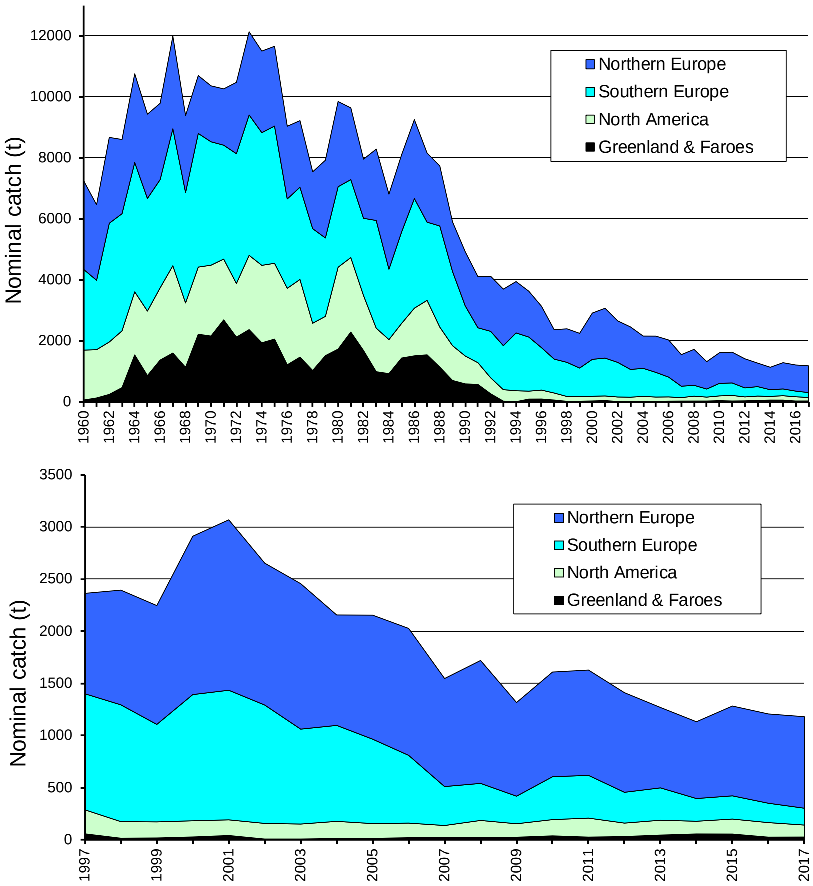


Figure 1 Total reported nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960–2017 (top) and 1997–2017 (bottom).

Icelandic catches have traditionally been separated into wild and ranched, reflecting the fact that Iceland has been the main North Atlantic country where large-scale ranching has been undertaken, with the specific intention of harvesting all returns at the release site and with no prospect of wild spawning success. The release of smolts for commercial ranching purposes ceased in Iceland in 1998 but ranching for angling fisheries in two Icelandic rivers continued into 2017 (Table 6). Catches in Sweden are also separated into wild and ranched over the entire time-series. The latter fish represent adult salmon originating from hatchery-reared smolts that have been released under programmes to mitigate hydropower. These fish are also exploited very heavily in home waters and have no possibility to spawn naturally in the wild. While ranching does occur in some other countries, it is on a much smaller scale. The ranched components in Iceland and Sweden have therefore been included in the nominal harvest.

Table 1 Reported catches (in tonnes) for the three NASCO commission areas for 2008–2017.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NEAC	1533	1162	1414	1419	1250	1080	954	1083	1041	1038
NAC	162	129	156	182	129	143	122	144	140	115
WGC	26	26	40	28	33	47	58	57	27	28
Total	1721	1318	1610	1629	1412	1270	1134	1284	1208	1182

The provisional total nominal catch for 2017 was 1182 t, the second lowest in the time-series. NASCO requested that the nominal catches in home water fisheries be partitioned according to whether the catch is taken in coastal, estuarine, or in-river fisheries (Table 2).

Table 2 The 2017 nominal catches (in tonnes) for the NEAC and NAC commission areas.

Area	Coastal		Estuarine		In-River		Total
	Weight	%	Weight	%	Weight	%	Weight
NEAC 2017	340	33	32	3	665	64	1038
NAC 2017	13	11	33	29	69	60	115

Coastal, estuarine, and in-river catch data aggregated by commission area are presented in Figure 2. In Northern NEAC, a decreasing proportion and weight of the nominal catch was taken in coastal fisheries until 2013, followed by a modest increase since then to 2017. There are no coastal fisheries in Iceland, Denmark, or Finland. At the beginning of the time-series about half the catch was reported from coastal fisheries and half from in-river fisheries, whereas since 2008 the coastal fisheries catches represent only around one third of the total. In Southern NEAC, catches in coastal and estuarine fisheries have declined dramatically since 2006. While coastal fisheries have historically made up the largest component of the catch, these fisheries have declined the most, reflecting widespread measures to reduce exploitation in a number of countries. Since 2007, the majority of the catch in this area has been reported from in-river fisheries. In NAC, two thirds of the total catch has been reported from in-river fisheries; the catch in coastal fisheries has been relatively small in any year (13 t or less).

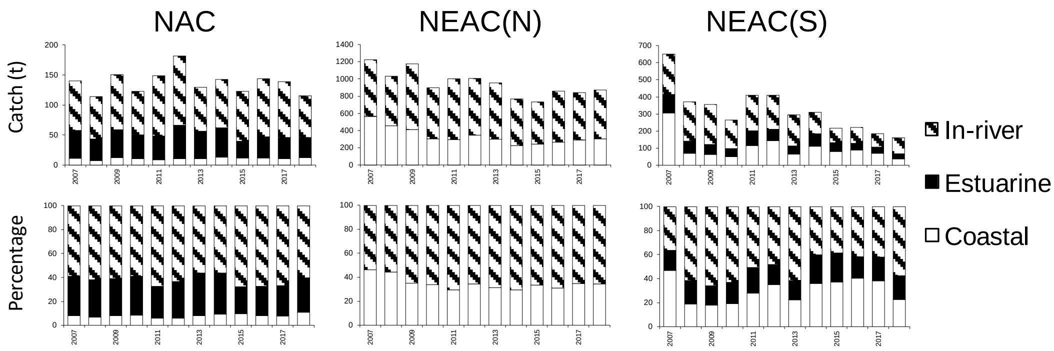


Figure 2 Nominal catches (tonnes; top panels) and percentages of the nominal catches (bottom panels) reported from coastal, estuarine, and in-river fisheries for the NAC area, and for the Northern (NEAC(N)) and Southern (NEAC(S)) NEAC areas, 2006–2017. Note that scales of vertical axes in the top panels vary.

There is considerable variability in the distribution of the catch among individual countries (Figure 3 and Table 7). In most countries the majority of the catch is now reported from in-river fisheries, and across the time-series the coastal catches have declined markedly. However, nominal catches from in-river fisheries have also declined in many countries as a result of increasing use of catch-and-release in angling fisheries.

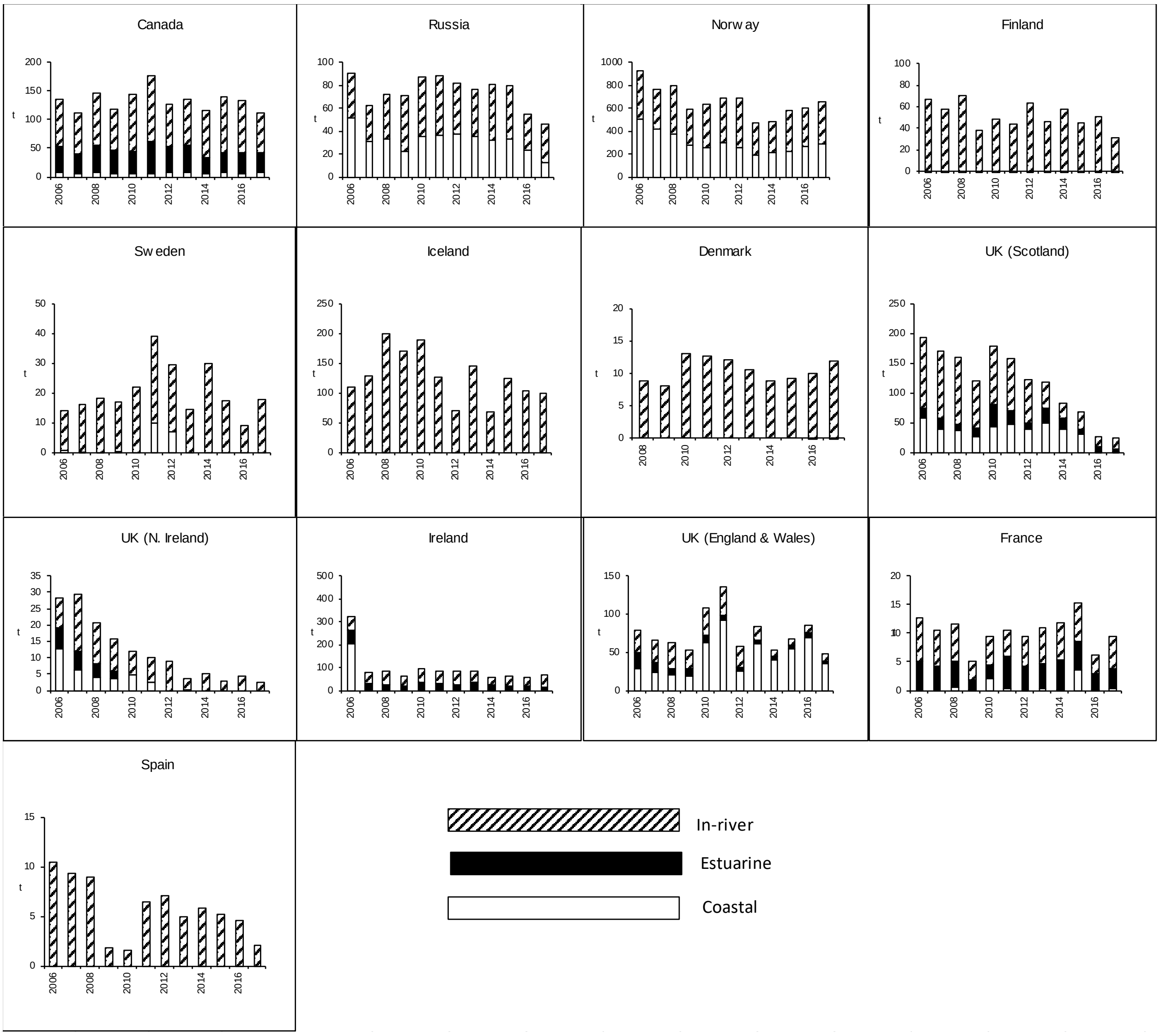


Figure 3 Nominal catch (tonnes) by country taken in coastal, estuarine, and riverine fisheries, 2006–2017 (except Denmark: 2008–2017). Note that scales on the *y*-axes vary. USA is not included because there has been no catch. 100% of the fishery at SPM and at West Greenland occurs in coastal areas. These catches are not shown.

Unreported catches

The total unreported catch in NASCO areas in 2017 was estimated at 353 t. No estimates were provided for Russia, France, Spain, or St Pierre and Miquelon in 2017. The unreported catch in the NEAC area in 2017 was estimated at 318 t, and that for the West Greenland and North American commission areas at 10 t and 25 t, respectively.

Table 3 Unreported catch (in tonnes) by NASCO commission area in the last ten years.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NEAC	433	317	357	382	363	272	256	298	298	318
NAC	-*	16	26	29	31	24	21	17	27	25
WGC	10	10	10	10	10	10	10	10	10	10
Total	443	343	393	421	403	306	287	325	335	353

* Data not available for Canada in 2008.

The 2017 unreported catch by country is provided in Table 8. Unreported catch data were not provided by category (coastal, estuarine, and in-river). Over recent years, efforts have been made to reduce the level of unreported catch in a number of countries.

Catch and release

The practice of catch and release (C&R) in angling fisheries has become increasingly common as a salmon management/conservation measure in light of the widespread decline in salmon abundance in the North Atlantic. In some areas of Canada and USA, C&R became widely applied as a management measure in 1984, and in recent years this has been introduced in many European countries, both as a result of statutory regulation and through voluntary practice.

The nominal catches do not include salmon that have been caught and released. Table 9 presents C&R information from 1991 to 2017 for countries that provide records; C&R may also be practised in other countries while not being formally recorded. There are large differences in the percentage of the total angling catch that is released. In 2017, it ranged from 15% in Sweden to 90% in UK (Scotland), reflecting varying management practices and angler attitudes among countries. Within countries, the percentage of fish released has increased over time. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller fish. Overall, more than 179 000 salmon were reported to have been caught and released in the North Atlantic area in 2017.

Farming and sea ranching of Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2017 was more than 1624 kt (Figure 4). The production of farmed salmon in this area has been over one million tonnes since 2009. Norway and UK (Scotland) continue to produce the majority of the farmed salmon in the North Atlantic (80% and 11%, respectively). With the exception of Canada (production in 2017 assumed similar to 2016) and Faroes, farmed salmon production in 2017 was above the previous five-year average in all countries. Data for UK (N. Ireland) since 2001 and data for the east coast of the USA are not publicly available; this is also the case for some regions within countries in some years.

Worldwide production of farmed Atlantic salmon has been in excess of one million tonnes since 2001 and over two million tonnes since 2012. The worldwide production in 2017 is provisionally estimated at 2310 kt (Figure 4), an increase compared to 2016 and higher than the previous five-year mean. Production outside the North Atlantic is estimated to have accounted for one third of the total worldwide production in 2017, dominated by Chile (78%).

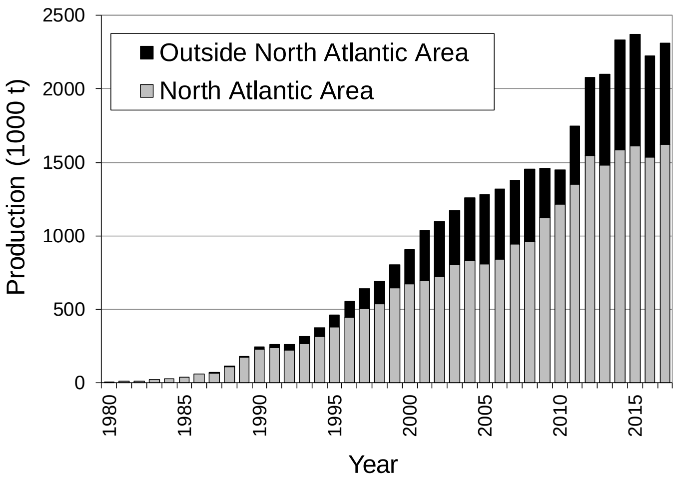


Figure 4 Worldwide production of farmed Atlantic salmon, 1980 to 2017.

The reported nominal catch of Atlantic salmon in the North Atlantic was in the order of 0.05% of the worldwide production of farmed Atlantic salmon in 2017.

The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2017 was 42 t, all taken in Iceland, Sweden, and Ireland (Figure 5), with the majority of the catch taken in Iceland (28 t). No estimate of ranched salmon production was made in Norway in 2017, where such catches have been very low in recent years (< 1 t), or in UK (N. Ireland), where the proportion of ranched fish has not been assessed since 2008.

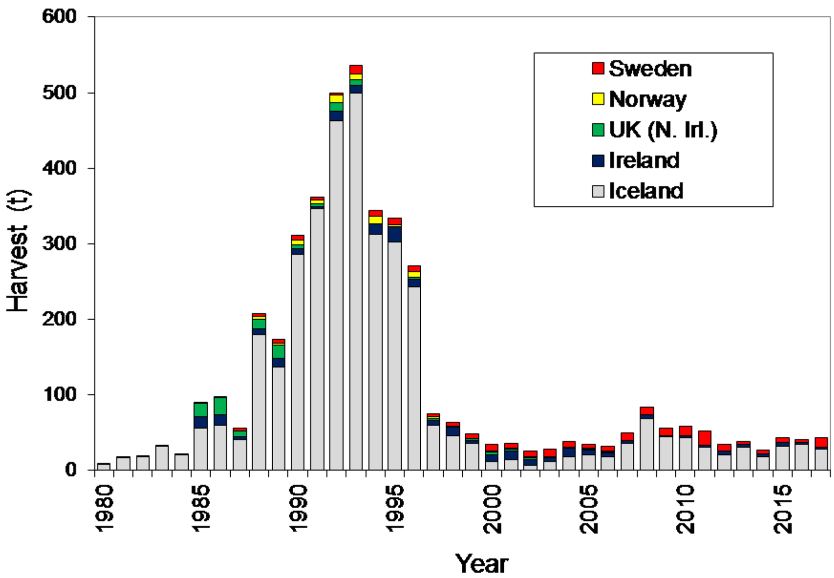


Figure 5 Harvest of ranched Atlantic salmon (tonnes round fresh weight) in the North Atlantic, 1980 to 2017.

NASCO 1.2 Significant, new, or emerging threats to, or opportunities for, salmon conservation and management

A number of topics related to this term of reference were considered by ICES (2018a) and a summary of these is presented below, sorted by threats to salmon stocks followed by opportunities. Details for these are available in the working group report (ICES, 2018a).

Diseases and parasites

Updates to previously identified diseases and parasites affecting North Atlantic salmon are reported in ICES (2018a).

- **Update on Red Vent Syndrome (*Anisakiasis*):** Monitoring for the presence of RVS has continued on three rivers in the UK (England & Wales) in 2017 and levels were comparable to those observed earlier in the time-series. High levels (82%) were reported in one river in Ireland.
- **Update on *Gyrodactylus salaris* eradication efforts in Norway**: Actions to eradicate the parasite from salmon rivers has primarily consisted of rotenone treatment. Of the 50 Norwegian salmon rivers with the parasite, 31 have been declared free of the parasite, 12 have been treated against the parasite and are currently awaiting a parasite-free declaration, and seven rivers are still infected.
- The presence of ***Gyrodactylus salaris* was confirmed in two rivers in Russia** in 2017 and is believed to have originated from transfers of rainbow trout to aquaculture sites in the area.
- Continued presence (since 2014) of **diseased salmon in rivers in Sweden** that drain in the Baltic Sea but are within 200 km of North Atlantic salmon rivers was reported in 2017. In previous years, symptoms indicative of Ulcerative Dermal Necrosis (UDN) were present. In 2017, most cases were attributed to RVS during summer and early autumn and to fungal infections during autumn.
- Continued **mortalities of salmon in Russian rivers in 2017** were reported in areas where mortalities had occurred in 2015 and 2016. No specific causes were identified but in 2015 and 2016, the timing of the disease incidence coincided with mass mortalities of farmed salmon in late autumn 2014 and spring/summer 2015 and with the disposal in summer 2015 of dead farmed fish in the area.
- Update on **sea lice investigations and sea lice management programmes in Norway**: The surveillance programme for sea lice infections on wild salmon postsmolts and sea trout at specific localities along the Norwegian coast continued in 2017 (Nilsen *et al.,* 2018). In general, the surveillance programme demonstrated varying infestation pressure along the coast during the post-smolt migration period in 2017. In 2017, a new management regime for salmonid aquaculture was implemented under which the level of aquaculture production in

13 defined production areas along the coast will be regulated and adjusted according to the estimated added mortality inferred for wild salmon populations from lice infestations.

Environmental and ecosystem interactions with Atlantic salmon

Information related to environmental and species interactions with Atlantic salmon were reported, including updates on possible recruitment effects of exceptional weather events, interactions with native fish species, and exceptional observations of pink salmon in the North Atlantic in 2017.

- **Consequences of poor juvenile recruitment in UK (England & Wales) observed in 2016**: Poor recruitment of juvenile salmonids, particularly salmon fry, in 2016 in many rivers in UK (England and Wales) was reflected in a very poor smolt run in 2017 on an index river in southern England where almost all the smolts migrate as one-year-olds. As the majority of rivers in England and Wales produce two-year-old smolts, the consequences of the 2016 event may result in lower smolt production in 2018. It was noted that juvenile (fry) recruitment in England and Wales in 2017 was better than in 2016.
- **Interactions between striped bass and Atlantic salmon in eastern Canada**: The abundances of Atlantic salmon and striped bass (*Morone saxatilis*), both native fish species in the southern Gulf of St Lawrence, have varied over time and the interactions between them can be complex. The increased abundance of striped bass, from low levels of approximately 5000 spawners in the mid 1990s to one million spawners in 2017, as well as the expansion in 2017 in striped bass distribution beyond its historical range (DFO, 2018), have raised concerns regarding the potential predation consequences of striped bass on salmon smolts. Striped bass are generalist feeders and salmon smolts, in low numbers and low overall proportions of samples, have been recorded from bass stomachs sampled in May and June in the Miramichi River, the only confirmed spawning location of striped bass of the southern Gulf of St. Lawrence (DFO, 2016). A recent study that inferred predation rates of striped bass using movement patterns of acoustically tagged smolts in the Miramichi, reported highly variable rates between years and smolt release locations, ranging from 2.6% to 19.9% (Daniels *et al.*, In press). These variations are consistent with the extent of spatial and temporal overlap of striped bass and salmon smolts within this river system. Further directed studies that provide information with which to address questions of predator–prey interactions of co-occurring species with salmon are required to support advice on management interventions.
- **Pink salmon observations in the North Atlantic area in 2017**: Pink salmon introductions to the White Sea basin in northern Russia in the mid-1980s led to the rapid establishment of self-sustaining, odd-year populations in the White Sea rivers in the Murmansk and Archangelsk regions of Russia. A commercial fishery for pink salmon takes place in the coastal areas of the White Sea concurrently with Atlantic salmon fisheries and using the same gears. As part of a wider review of interactions between exotic salmonids and Atlantic salmon, ICES previously described the development of the pink salmon populations in the White Sea and outlined the potential effects of pink salmon on native salmonids (ICES, 2013).
    - The total catch of pink salmon in 2017 in the Northwestern part of Russia was 374 t. However, occasional catches (2001) of pink salmon in excess of 300 t in Russia have previously been reported to ICES. Catches of pink salmon in 2017, at previously unrecorded levels, were reported in various countries around the North Atlantic over a wide geographical area (Table 4). The bulk of the recoveries were reported in Russia and Norway, but pink salmon occurred in most countries, ranging from France in the southern part of the Northeast Atlantic, the British Isles, Ireland, Iceland, and Greenland, as well as in Newfoundland and Labrador in the Northwest Atlantic. The number of pink salmon detected was related to the geographic location of rivers, with more fish in the northern areas than in southern areas. Overall, pink salmon were observed in more than 370 rivers outside Russia (Table 4).
    - It is, as yet, unclear whether the marked increase in pink salmon numbers in 2017 represents a one-off occurrence, due to particularly favourable conditions for a particular cohort of fish, or whether this might mark the start of a wider range expansion by the species. The widespread capture of fish around the North Atlantic represented a notable change from earlier years, despite the reported catch in Russia being similar to that reported occasionally in the past. Widespread spawning of pink salmon in many Norwegian rivers in 2017 will likely result in an increase in both the numbers and distribution of juveniles entering the marine environment, and this expected increase in distribution and abundance could, in turn, result in widespread distribution of pink salmon again in 2019.

- In response to the widespread occurrence of pink salmon in 2017, representatives from a range of Northeast Atlantic countries met in UK (Scotland) in September 2017 to discuss various issues, including:
  - A brief review of the history of pink salmon introductions within northern Russia and western Europe, the scale of historical catches around this area, and the nature of catches made in 2017;
  - An overview of pink salmon ecology, species plasticity, invasiveness, and implications of phenological change in support of formal risk assessments, including potential impacts on Atlantic salmon;
  - Current surveillance and management measures in use to examine their efficacy and explore the potential use of new monitoring tools (such as environmental DNA [eDNA]);
  - Identifying knowledge gaps, and how these might be addressed and by whom.
- In the event of a further large run of pink salmon in future, a range of new monitoring and research activities are expected to be initiated to better assess the potential impact of the species on Atlantic salmon and other native species. Risk assessments are also being developed in some countries (e.g. UK, Norway, Ireland).

Table 4 Reported or estimated numbers of pink salmon in different countries of the North Atlantic in 2017.

Country	Number of rivers where pink salmon are reported	Estimated number of fish			Total estimated number of pink salmon reported
		Caught in fisheries	Removed in targeted efforts	Observed, but not removed	
Russia		220 000			220 000 (based on a reported catch of 373.5 t, with an assumed mean weight per fish of 1.7 kg)
Norway	272	3 925	2 454	5 428	11 807
Finland		270		125	395 (Numbers adjusted to allocate fish to Finland & Norway)
Sweden	6	80			80
Denmark	8	11			11
Iceland	35	66			66
Germany	2	2		1	3
France	2	1		1	2
UK (England & Wales)	8	208			208
UK (Scotland)	22	99	26	14	139
UK (N. Ireland)	2	1		1	2
Ireland	11	33			33
Greenland		2			2
Canada	2	3			3
USA					0
Total	369	224 698	2 480	5 570	232 750

Opportunities for salmon conservation and management

Updates on projects related to classifying the status of salmon populations, considerations of impacts of research activities on salmon survival indices, activities to improve the information on salmon distribution and characteristics at sea, modelling the populations dynamics, frameworks to guide planning of research to improve the understanding of mortality at sea, and initiatives to secure sample archives and to extract additional information from historical sampling activities were reported to ICES (2018a).

- **Progress with implementing the Quality Norm for Norwegian salmon populations**: In August 2013, a management system – The Quality Norm for Wild Populations of Atlantic Salmon ("Kvalitetsnorm for ville bestander av Atlantisk laks") – was adopted by the Norwegian government (Anon., 2013) and details are provided in ICES (2014). In 2018, the Norwegian Scientific Advisory Committee for Atlantic Salmon classified all Norwegian salmon rivers based on available information on spawning population size from various data sources (Forseth *et al.*, 2018). To be able to classify all 448 rivers, this system used a simplified version of the quality norm. In summary, 41% of the populations were classified as being in a poor or very poor state, 35% were in a moderate state, 20% in a good or very good state, and 4% could not be classified because they were under reestablishment after treatment against *Gyrodactylus salaris*. This classification was translated into the classification system used in the NASCO rivers database.

- The **impact of capture and tagging** on estimates of Atlantic salmon adult return rates: Return rate estimates commonly depend on tagging a proportion of the smolt run and assessing the subsequent numbers of this tagged cohort subsequently returning as adults. However, scientific studies indicate that tagging can have a negative effect on smolt physiology, behaviour, and ultimately on survival (Riley *et al.*, 2007). Recent investigations carried out over seven years on the River Frome (southern England, UK [England & Wales]) examined the tagging effects on smolts and return rates as adults. In a number of years, return rates were very similar for both control and experimental groups (Riley *et al.*, In press). The results provide evidence that the impact of tagging processes was negligible in many years, and the results are reassuring in the context of ongoing investigations to derive and report marine return rates in support of national and international stock assessments.

- **Update on opportunities for investigating salmon at sea**
  - **The International Ecosystem Summer Survey of the Nordic Seas (IESSNS)**: a collaborative programme involving research vessels from Iceland, the Faroes, and Norway. Surveys are carried out annually in July–August in an area that overlaps in time and space with the known distribution of post-smolts in the North Atlantic. In 2017 a total of 36 post-smolt and adult salmon were caught (Figure 6). The Institute of Marine Research (Bergen, Norway) is developing a plan to collate all the information from the analysis of the samples over all years.

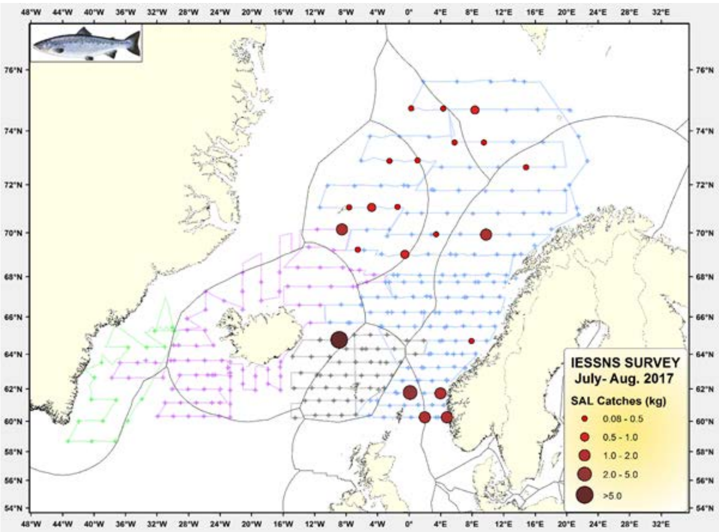


Figure 6 Catches (in kilogrammes) of Atlantic salmon taken during IESSNS surveys in the Northeast Atlantic in July 2017. This is the main survey where salmon would be expected to be taken in the survey nets.

  - **Bycatch of salmon in the Icelandic mackerel fishery**: Partial screening of the mackerel fishery catches has been undertaken by the Icelandic Directorate of Fisheries to check for bycatch of salmon. Since 2010, a total of 847 salmon have been recovered and the origin of a sample of these fish has been reported previously (originating from Iceland, the UK, Ireland, the Scandinavian countries, and Russia).
  - **Environmental DNA**: New national Norwegian research projects have been initiated to improve information on bycatch in pelagic fisheries by testing for salmon DNA in water (also called environmental DNA or eDNA) from commercial landings of pelagic fish.
  - **PIT tag screening programmes**: Screening of bycatch of salmon using automatic screening of PIT (Passive Integrated Tags) tags at factories processing pelagic fish is now possible. As the use of PIT tags for salmon is increasing rapidly, a more efficient identification of the origin of detected PIT-tagged salmon would be possible if lists of individual PIT tag numbers or codes were made available in a public database.
  - **Tracking and acoustic tagging studies:** NASCO's International Atlantic Salmon Research Board (IASRB) adopted a resolution in 2014 to further support the development of telemetry programmes in the ocean. The Atlantic Salmon Federation in Canada in partnership with the Oceans Tracking Network and a number of collaborators have continued to capture, sample, and tag with acoustic transmitters

smolts and kelts from a number of rivers in eastern Canada. Acoustic arrays have been positioned at key points in the Gulf of St. Lawrence leading to the Labrador Sea. Results from activities in 2017 indicated that kelts from Miramichi and Restigouche rivers crossed the Strait of Belle Isle array to the Labrador Sea during a three-week period at the end of June and early July, whereas smolts from many different stocks crossed this line together between 7 and 19 July (Figure 7). These studies provide useful information on migration routes and timing and have provided estimates of survival rates at several points along the migration corridor.

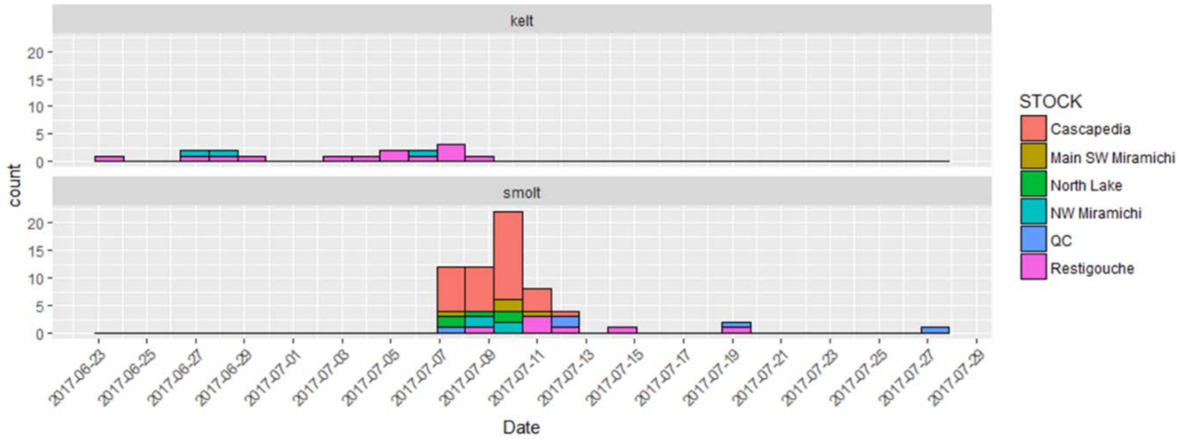


Figure 7 Counts and dates of acoustically tagged Atlantic salmon kelt (upper panel) and smolt (lower panel), originating from various Gulf of St. Lawrence rivers and crossing the Strait of Belle Isle receiver array in 2017.

- **Advances in genetic stock identification and mixed stock fishery analysis**: A genetic baseline for Atlantic salmon (*Salmo salar*) from North American and European rivers was constructed, based on single nucleotide polymorphism (SNP; Jeffery *et al.*, In press). This baseline provides accurate assignment to 29 regional groups spanning the North Atlantic (Figure 8). This baseline was applied to disentangle the stock composition of individuals in the West Greenland Atlantic salmon fishery for 2017. Consistent with the microsatellite baseline used to date, genetic mixture analysis with the SNPs indicated that 74% of individuals were North American in origin, largely from three regions: Gulf of St Lawrence, Gaspé Peninsula, and Labrador. European samples were from salmon originating in the United Kingdom and Ireland.

Further attempts to refine the spatial scale of genetic individual assignment have been recently described for the Labrador fishery (Sylvester *et al.*, 2017; Bradbury *et al.*, 2018) using large panels of sequenced microsatellites (101 sequenced loci). Using this technology, Bradbury *et al.* (2018) identified 26 groups across 36 different Labrador rivers compared to the three regional groups identified with the previous 13-microsatellite panel. Applied to the samples from the Labrador subsistence fisheries, the samples from the catches were less than 200 km from their region/river of origin. Furthermore, Sylvester *et al.* (2017) used sequencing of highly targeted amplicon panels to achieve highly accurate river-specific assignment to 12 rivers within the Lake Melville area of Labrador. Such finer scale resolution of population structure will be particularly important for salmon conservation and refined fisheries management considerations.

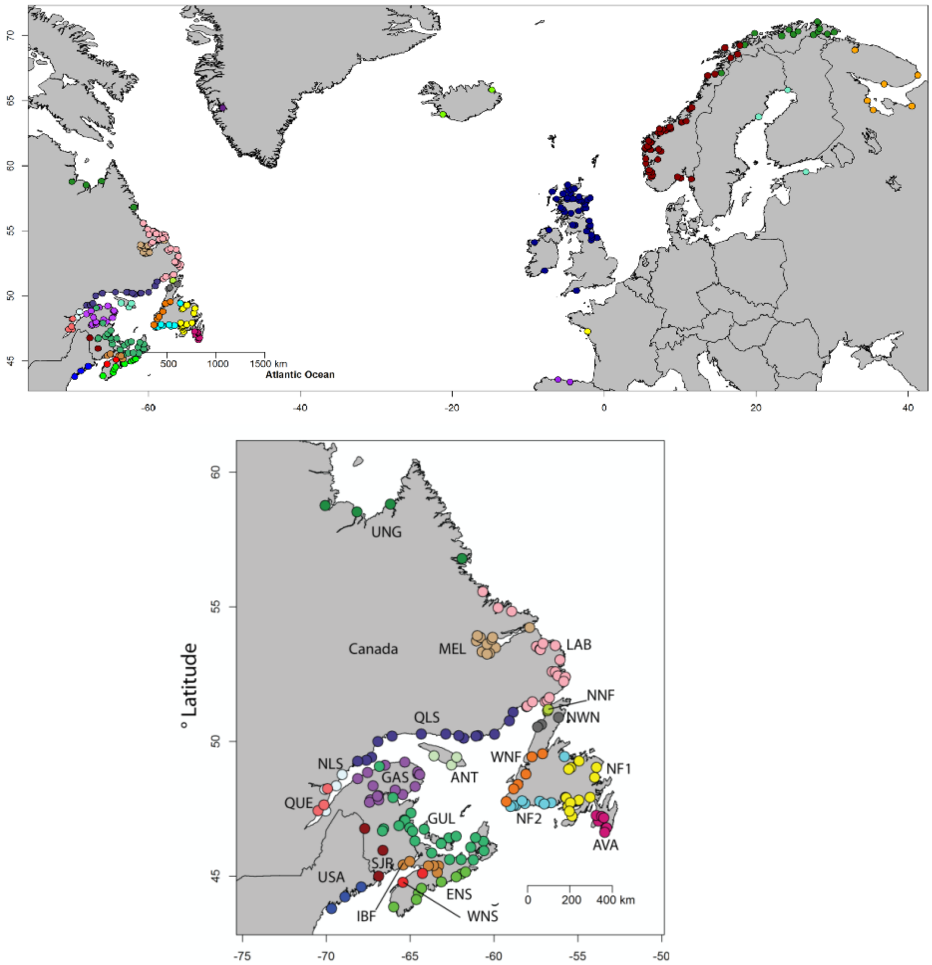


Figure 8 Range-wide SNPs baseline for Atlantic salmon following Jeffery *et al.* (In press), with eastern Atlantic groups highlighted (upper panel) and North American Atlantic reporting groups indicated (lower panel).

- **Progress in stock assessment models**: A life cycle model intended to improve the current assessment has been in development for several years. The version of the life cycle model reviewed in 2017 (ICES, 2017) was applied to six stock units in NAC and seven stock units in Southern NEAC, where all stock units follow the same life-history processes but with stock-specific parameters and data inputs. An extension of the life cycle model to 11 stock units in Northern NEAC was developed and presented in 2018 (Figure 9). Future developments will include embedding the three stock complexes within one single unique life-cycle model, thus providing an opportunity for modelling covariation in the dynamics of the different populations that share migration routes and feeding areas at sea and which are harvested in mixed-stock fisheries, particularly at West Greenland for NAC and Southern NEAC. This model will also provide opportunities for examining potential factors that are conditioning survival of salmon at sea at different life stages and across salmon stocks in the North Atlantic.

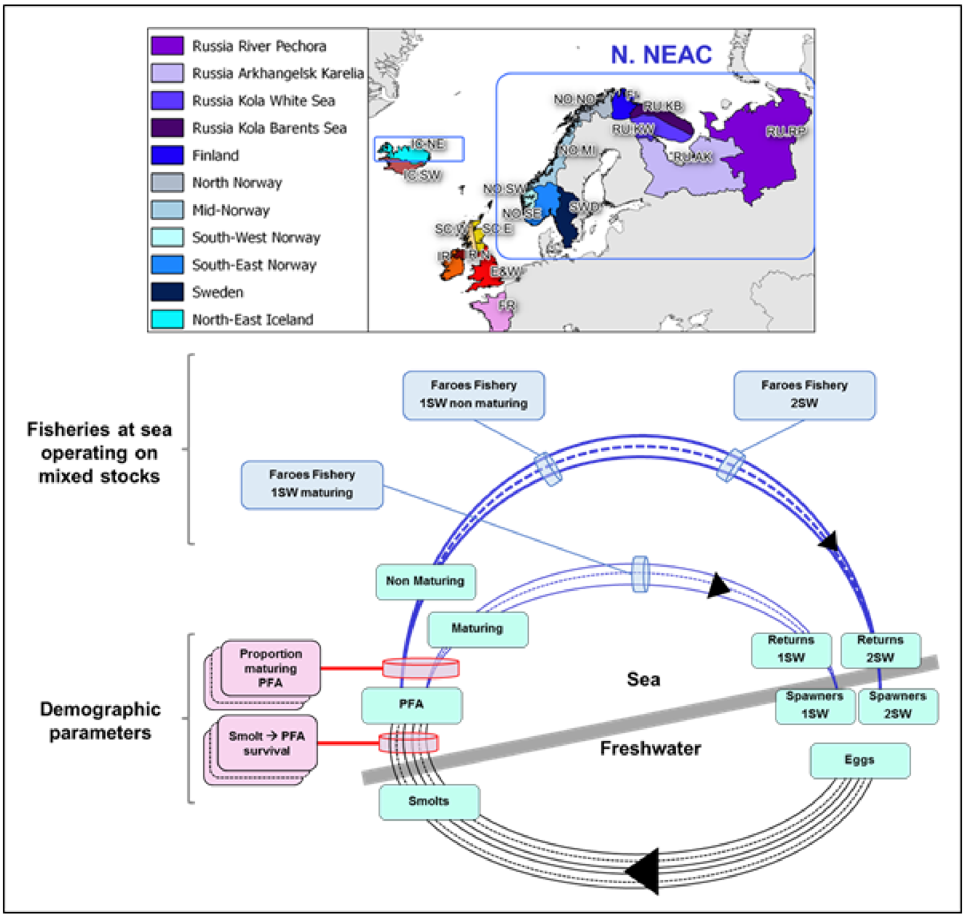


Figure 9 Schematic of the life-cycle model applied to the 11 stock units of Northern NEAC. Variables in light blue are the main stages considered in the stage-structured model. The smolt-to-PFA survival and the proportion of maturing PFA are estimated for the time-series (1971 to 2014) and modelled as a random walk with covariation among stock units. Stock units of the Northern NEAC complex are potentially harvested by the mixed-stock fishery operating around the Faroe Islands as 1SW maturing and non-maturing fish, and as 2SW fish.

- **A conceptual framework for evaluating marine mortality in Atlantic salmon**: A conceptual framework was developed during a workshop in November 2017 sponsored by the Atlantic Salmon Trust and the International Atlantic Salmon Research Board of NASCO, with scientists from both the Atlantic and Pacific regions participating. This framework is proposed to provide coherent guidance on how future research on marine survival can be identified and prioritized. Further details of the framework approach and its proposed future development will be available in the workshop report on the Atlantic Salmon Trust (AST) website. ICES recognises the value of developing high-level conceptual frameworks which may lead to hypothesis-led research into sources of, and partitioning of marine mortality in Atlantic salmon. ICES encourages the use of their ecosystem databases and products to assist with developing such frameworks and research into the underlying mechanistic relationships between variability in ecosystem drivers at particular domains and trends in salmon mortality.

- **Sampling, data, and archiving of historical samples**: The West Greenland fishery sampling programme conducted by parties to NASCO provides an opportunity to collect data and samples of potential two sea-winter Atlantic salmon from Southern Europe and North America that occur at an important summer and autumn feeding. A workshop was convened in December 2017 to review the current state of knowledge of Atlantic salmon at the summer feeding area off the coast of West Greenland, review current research efforts, identify research themes and projects to address data needs and knowledge gaps, and to develop protocols for providing access to database(s) and archived samples for collaborating researchers. The workshop concluded that it is important to continue the sampling programme at Greenland as the programme provides critical input data in support of ICES assessments. A number of recommendations were developed, including documenting the potential biases caused by the temporal changes in the design of the sampling programme, completing an inventory of the archive scale samples, database management and storage, data access, and sample access for the future. The workshop report will be published in one of the participating laboratories' reference document series.

- **Progress with establishing scale archive/biochronology repositories**: NASCO's International Atlantic Salmon Research Board (IASRB) has recognised the high value of archival scale collections that, as a result of advances in analytical methods, can now be used for genetic, stable isotope, and growth studies. There is some concern that these collections may be lost unless appropriate arrangements are in place to archive these and ensure their safe storage so that they may be available for analysis in the future. Several new initiatives with regard to scale archive collections and the establishment of permanent and secure repositories are being developed by individual parties: Unlocking the Archive (Ireland, National Funding 2017 to 2020), SAMARCH (EU Interreg UK/France, 2017 to 2022), Norwegian Research project (National Funding 2016 to 2018), and AST/Freshwater Biological Association (FBA). Common issues were identified with regard to establishing physical repositories of samples and a database to retain and manage the information, scale images, and growth information and to allow ease of analyses and retrieval of data and samples.

NASCO 1.3 Review of examples of successes and failures in wild salmon restoration and rehabilitation, and development of a classification of activities which could be recommended under various conditions or threats to the persistence of populations

The Working Group on the Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS) met on 18–22 February 2013 in Belfast, Northern Ireland, and at ICES HQ, Copenhagen, Denmark, on 12–16 May 2014 and again on 10–12 November 2015 to complete analysis of both the case studies and the Database on Effectiveness of Recovery Actions for Atlantic Salmon (DBERAAS). A range-wide overview of conservation status, programme goals, population stressors, and the benefits of recovery actions were discussed. Detailed case studies were compiled and presented on a number of rivers, providing "on-the-ground" examples of the effects of stressors, benefit of actions, and the results of recovery and rebuilding programmes. A total of 15 case studies were received, together with a total of 568 individual river stocks entered in DBERAAS. Analysis of the case studies as well as the DBERAAS have now been completed and the ICES report is currently being finalized.

An analysis of DBERAAS suggested that climate change effects (mainly expressed as low marine survival), barriers to migration, and habitat destruction were the most common stressors having a high or very high negative impact on Atlantic salmon populations. Improvements in river connectivity, improvements in water quality, and habitat restoration were the three actions most likely to have a high or very high benefit to recovery and restoration actions.

The case study conclusions were consistent with the results from DBERAAS, and further highlighted that successful restoration and recovery actions are generally characterized by being conducted on stocks experiencing relatively high marine survival and with few stressors acting on the stock, thereby reducing synergistic and additive effects. Successful recovery/restoration activities addressed most or all stressors and did not rely solely on stocking. Out of the 15 case studies, five achieved the project goals, nine did not achieve project goals, and two claimed partial achievement of project goals. Restoration programmes that do not achieve the objective of re-establishing a self-sustaining population or increasing population abundance to attain CLs are still valuable as they can reduce short-term extirpation risks.

Recommendations on appropriate recovery/rebuilding actions for Atlantic salmon are provided. As a general guiding principle, healthy and diverse habitat is needed to support healthy and resilient salmon populations. Further recommendations include:

- Pre-project assessments should establish the need for restoration action, identifying stressors and appropriate actions;
- Modelling population responses to actions under different stressor scenarios as part of the pre-project phase can be a very informative exercise to determine possible outcomes of different actions;
- Recovery and restoration programmes should principally be founded on habitat restoration and protection combined with sound management based on population monitoring;
- Stocking poses substantial risks to wild salmon populations and a time-limited stocking programme should generally only be considered in cases where population extirpation is imminent and all other fishery management and habitat restoration interventions have been realised; and
- Provide improved documentation relating to all restoration and recovery projects for Atlantic salmon, and a recommendation that after completion an in-depth evaluation and analysis exercise should be conducted, and results published so others can benefit from lessons learned.

NASCO 1.4 Provision of a compilation of tag releases by country in 2017

Data on releases of tagged, fin-clipped, and other marked salmon in 2017 are compiled as a separate report (ICES, 2018b). In summary (Table 7):

- Approximately 2.8 million salmon were marked in 2017, a decrease from the 3.2 million fish marked in 2016.
- The adipose clip was the most commonly used primary marker (2.19 million), with coded wire microtags (CWT) (0.332 million) being the next most common primary marker.
- A total of 33 873 fish were marked with external tags.
- Most marks were applied to hatchery-origin juveniles (2.70 million), while 76 712 wild juveniles and 10 625 adults were also marked.
- The use of PIT tags, Data Storage Tags (DSTs), and radio and/or sonic transmitting tags (pingers) has increased in recent years. In 2017, 132 725 salmon were tagged with these tag types (Table 5), twice the number in 2016 (64 669 salmon). ICES noted that not all electronic tags were being reported in the tag compilation. Tag users should be encouraged to include these tags or tagging programmes in the tag compilation as this greatly facilitates identification of the origin of tags recovered in fisheries or tag scanning programmes in other jurisdictions. A recommendation has been developed in a previous section (PIT tag screening programmes), relating to the creation of a database to record PIT tags, and programmes using PIT tags, on a European scale.

Since 2003, ICES has reported information on markers being applied to farmed salmon to facilitate tracing the origin of farmed salmon captured in the wild in the case of escape events. In the USA, genetic "marking" procedures have been adopted where broodstock are genetically screened and the resulting database is used to match genotyped escaped farmed salmon to a specific parental mating pair and subsequent hatchery of origin, stocking group, and marine site from which the salmon escaped.

Table 5 Summary of Atlantic salmon tagged and marked in 2017 – "Hatchery" and "Wild" juvenile refers to smolts and parr.

Country	Origin	Primary tag or mark			Other internal[1]	Total
		Microtag	External mark[2]	Adipose clip		
Canada	Hatchery Adult	0	2 052	0	2 086	**4 138**
	Hatchery Juvenile	0	54	160 161	155	**160 370**
	Wild Adult	0	2 299	0	89	**2 388**
	Wild Juvenile	0	7 979	14 621	498	**23 098**
	Total	**0**	**12 384**	**174 782**	**2 828**	**189 994**
Denmark	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	76 500	20 500	273 950	0	370 950
	Wild Adult	0	0	0	452	452
	Wild Juvenile	0	0	0	500	500
	Total	**76 500**	**20 500**	**273 950**	**952**	**371 902**
France	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[3]	0	0	0	0	0
	Wild Adult[3]	0	836	0	0	836
	Wild Juvenile	0	3 503	0	0	3 503
	Total	**0**	**4 339**	**0**	**0**	**4 339**
Iceland	Hatchery Adult	0		0	0	0
	Hatchery Juvenile	66 757	0	0	0	66 757
	Wild Adult	0	272	0	0	272
	Wild Juvenile	6 331	0	0	0	6 331
	Total	**73 088**	**272**	**0**	**0**	**73 360**
Ireland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	149 862	0	0	0	149 862
	Wild Adult	0	0	0	0	0
	Wild Juvenile	9 135	0	0	0	9 135
	Total	**158 997**	**0**	**0**	**0**	**158 997**
Norway	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	11 000	6 000	0	101 711	118 711
	Wild Adult	0	359	0	0	359
	Wild Juvenile	0	388	0	15 969	16 357
	Total	**11 000**	**6 747**	**0**	**117 680**	**135 427**

Country	Origin	Primary tag or mark Microtag	External mark[2]	Adipose clip	Other internal[1]	Total
Russia	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	1 204 587	0	1 204 587
	Wild Adult	0	1 253	0	0	1 253
	Wild Juvenile	0	0	0	0	0
	Total	**0**	**1 253**	**1 204 587**	**0**	**1 205 840**
Spain	Hatchery Adult	0	0	0	0	**0**
	Hatchery Juvenile	0	87 570	0	0	**87 570**
	Wild Adult	0	0	0	0	**0**
	Wild Juvenile	0	0	0	0	**0**
	Total	**0**	**87 570**	**0**	**0**	**87 570**
Sweden	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	3000	167 886	0	170 886
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	500	0	0	500
	Total	**0**	**3 500**	**167 886**	**0**	**171 386**
UK (England & Wales)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	9 852	0	9 852
	Wild Adult	0	692	0	0	692
	Wild Juvenile	2 383	0	10 965		13 348
	Total	**2 383**	**692**	**20 817**	**0**	**23 892**
UK (N. Ireland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	9 936	0	47 735	0	57 671
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**9 936**	**0**	**47 735**	**0**	**57 671**
UK (Scotland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	45 000	0	45 000
	Wild Adult	0	302	0	0	302
	Wild Juvenile	0	0	0	3 864	3 864
	Total	**0**	**302**	**45 000**	**3 864**	**49 166**
USA	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	258 058	3 323	261 381
	Wild Adult	0	69	0	4 002	4 071
	Wild Juvenile	0	0	0	76	76
	Total	**0**	**69**	**258 058**	**7 401**	**265 528**
All Countries	Hatchery Adult	0	2 052	0	2 086	4 138
	Hatchery Juvenile	314 055	117 124	2 167 229	105 189	2 703 597
	Wild Adult	0	6 082	0	4 543	10 625
	Wild Juvenile	17 849	12 370	25 586	20 907	76 712
	Total	**331 904**	**137 628**	**2 192 815**	**132 725**	**2 795 072**

[1] Includes other internal tags (PIT, ultrasonic, radio, DST, etc.).
[2] Includes Carlin, spaghetti, streamers, VIE, etc.
[3] Includes external dye mark.

NASCO 1.5 Identify relevant data deficiencies, monitoring needs, and research requirements

ICES recommends that the WGNAS should meet in 2019 (Chair: Martha Robertson, Canada) to address questions posed by NASCO and by ICES. Unless otherwise notified, the working group intends to convene at the headquarters of ICES in Copenhagen, Denmark. The meeting will be held from 26 March to 4 April 2019.

The following relevant data deficiencies, monitoring needs, and research requirements were identified:

North Atlantic

1) A workshop should be held on salmon scale archives/biochronology repositories to better align the management systems and goals.
2) For more efficient identification of the origin of PIT-tagged salmon detected in catches processed at pelagic fish factories, or tags detected in other fisheries, ICES recommends that lists of individual PIT tag numbers or codes, identifying the origin, source, or programme of the tags, be recorded and made available in a public

database, to coordinate on an international scale and facilitate identification of individual tagged fish taken in marine fisheries or surveys back to the source.

Northeast Atlantic Commission

No recommendations specific to NEAC are provided.

North American Commission

3) Complete and timely reporting of catch statistics from all fisheries in all areas of eastern Canada is recommended.
4) Improved catch statistics and sampling of the Labrador and Saint Pierre and Miquelon fisheries is recommended. Improved catch statistics and sampling of all aspects of the fishery across the fishing season will improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.
5) Additional monitoring should be considered in Labrador to estimate stock status for that region. Additionally, efforts should be undertaken to evaluate the utility of other available data sources (e.g. indigenous and recreational catches and effort) to describe stock status in Labrador.

West Greenland Commission

6) Efforts to improve the reporting system of catch in the Greenland fishery should continue and detailed statistics related to spatially and temporally explicit catch and effort data for both licensed and unlicensed fishers should be made available for analysis.
7) Continuation of the phone survey programme according to a standardized and consistent annual approach, with consideration given to surveying a larger proportion of licensed fishers and the inclusion of the non-licensed fishers. Information gained on the level of total catch for this fishery will provide for a more accurate assessment of the status of stocks and assessment of risk with varying levels of harvest.
8) Continuation of the broad geographic sampling programme, including in Nuuk (multiple NAFO divisions including factory landings when permitted). Furthermore, consideration should be given to expanding the programme across the fishing season to more accurately estimate continent and region of origin and biological characteristics of the mixed-stock fishery.
9) In preparation for the next update to the FWI, a full suite of all potential input datasets across all regions and stock complexes should be evaluated against country-specific management objectives for Southern NEAC.

Table 6 Reported total nominal catches of salmon by country (in tonnes round fresh weight), 1960 to 2017 (2017 figures include provisional data).

	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
Year	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden Wild	Sweden Ranch (15)	Denmark	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1960	1636	1	-	1659	1100	100	-	40	0	-	-	743	283	139	1443	-	33	-	-	60	-	7237	-	-
1961	1583	1	-	1533	790	127	-	27	0	-	-	707	232	132	1185	-	20	-	-	127	-	6464	-	-
1962	1719	1	-	1935	710	125	-	45	0	-	-	1459	318	356	1738	-	23	-	-	244	-	8673	-	-
1963	1861	1	-	1786	480	145	-	23	0	-	-	1458	325	306	1725	-	28	-	-	466	-	8604	-	-
1964	2069	1	-	2147	590	135	-	36	0	-	-	1617	307	377	1907	-	34	-	-	1539	-	10759	-	-
1965	2116	1	-	2000	590	133	-	40	0	-	-	1457	320	281	1593	-	42	-	-	861	-	9434	-	-
1966	2369	1	-	1791	570	104	2	36	0	-	-	1238	387	287	1595	-	42	-	-	1370	-	9792	-	-
1967	2863	1	-	1980	883	144	2	25	0	-	-	1463	420	449	2117	-	43	-	-	1601	-	11991	-	-
1968	2111	1	-	1514	827	161	1	20	0	-	-	1413	282	312	1578	-	38	5	-	1127	403	9793	-	-
1969	2202	1	-	1383	360	131	2	22	0	-	-	1730	377	267	1955	-	54	7	-	2210	893	11594	-	-
1970	2323	1	-	1171	448	182	13	20	0	-	-	1787	527	297	1392	-	45	12	-	2146	922	11286	-	-
1971	1992	1	-	1207	417	196	8	17	1	-	-	1639	426	234	1421	-	16	-	-	2689	471	10735	-	-
1972	1759	1	-	1578	462	245	5	17	1	-	32	1804	442	210	1727	34	40	9	-	2113	486	10965	-	-
1973	2434	3	-	1726	772	148	8	22	1	-	50	1930	450	182	2006	12	24	28	-	2341	533	12670	-	-
1974	2539	1	-	1633	709	215	10	31	1	-	76	2128	383	184	1628	13	16	20	-	1917	373	11877	-	-
1975	2485	2	-	1537	811	145	21	26	0	-	76	2216	447	164	1621	25	27	28	-	2030	475	12136	-	-
1976	2506	1	3	1530	542	216	9	20	0	-	66	1561	208	113	1019	9	21	40	<1	1175	289	9327	-	-
1977	2545	2	-	1488	497	123	7	9	1	-	59	1372	345	110	1160	19	19	40	6	1420	192	9414	-	-
1978	1545	4	-	1050	476	285	6	10	0	-	37	1230	349	148	1323	20	32	37	8	984	138	7682	-	-
1979	1287	3	-	1831	455	219	6	11	1	-	26	1097	261	99	1076	10	29	119	<0,5	1395	193	8118	-	-
1980	2680	6	-	1830	664	241	8	16	1	-	34	947	360	122	1134	30	47	536	<0,5	1194	277	10127	-	-
1981	2437	6	-	1656	463	147	16	25	1	-	44	685	493	101	1233	20	25	1025	<0,5	1264	313	9954	-	-
1982	1798	6	-	1348	364	130	17	24	1	-	54	993	286	132	1092	20	10	606	<0,5	1077	437	8395	-	-
1983	1424	1	3	1550	507	166	32	27	1	-	58	1656	429	187	1221	16	23	678	<0,5	310	466	8755	-	-
1984	1112	2	3	1623	593	139	20	39	1	-	46	829	345	78	1013	25	18	628	<0,5	297	101	6912	-	-
1985	1133	2	3	1561	659	162	55	44	1	-	49	1595	361	98	913	22	13	566	7	864	-	8108	-	-
1986	1559	2	3	1598	608	232	59	52	2	-	37	1730	430	109	1271	28	27	530	19	960	-	9255	315	-
1987	1784	1	2	1385	564	181	40	43	4	-	49	1239	302	56	922	27	18	576	<0,5	966	-	8159	2788	-
1988	1310	1	2	1076	420	217	180	36	4	-	36	1874	395	114	882	32	18	243	4	893	-	7737	3248	-
1989	1139	2	2	905	364	141	136	25	4	-	52	1079	296	142	895	14	7	364	-	337	-	5904	2277	-
1990	911	2	2	930	313	141	285	27	6	13	60	567	338	94	624	15	7	315	-	274	-	4925	1890	180-350

Table 6 (continued).

Year	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden Wild	Sweden Ranch (15)	Denmark	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1991	711	1	1	876	215	129	346	34	4	3	70	404	200	55	462	13	11	95	4	472	-	4106	1682	25-100
1992	522	1	2	867	167	174	462	46	3	10	77	630	171	91	600	20	11	23	5	237	-	4119	1962	25-100
1993	373	1	3	923	139	157	499	44	12	9	70	541	248	83	547	16	8	23	-	-	-	3696	1644	25-100
1994	355	0	3	996	141	136	313	37	7	6	49	804	324	91	649	18	10	6	-	-	-	3945	1276	25-100
1995	260	0	1	839	128	146	303	28	9	3	48	790	295	83	588	10	9	5	2	83	-	3629	1060	-
1996	292	0	2	787	131	118	243	26	7	2	44	685	183	77	427	13	7	-	0	92	-	3136	1123	-
1997	229	0	2	630	111	97	59	15	4	1	45	570	142	93	296	8	4	-	1	58	-	2364	827	-
1998	157	0	2	740	131	119	46	10	5	1	48	624	123	78	283	8	4	6	0	11	-	2395	1210	-
1999	152	0	2	811	103	111	35	11	5	1	62	515	150	53	199	11	6	0	0	19	-	2247	1032	-
2000	153	0	2	1176	124	73	11	24	9	5	95	621	219	78	274	11	7	8	0	21	-	2912	1269	-
2001	148	0	2	1267	114	74	14	25	7	6	126	730	184	53	251	11	13	0	0	43	-	3069	1180	-
2002	148	0	2	1019	118	90	7	20	8	5	93	682	161	81	191	11	9	0	0	9	-	2654	1039	-
2003	141	0	3	1071	107	99	11	15	10	4	78	551	89	56	192	13	9	0	0	9	-	2457	847	-
2004	161	0	3	784	82	111	18	13	7	4	39	489	111	48	245	19	7	0	0	15	-	2157	686	-
2005	139	0	3	888	82	129	21	9	6	8	47	422	97	52	215	11	13	0	0	15	-	2155	700	-
2006	137	0	3	932	91	93	17	8	6	2	67	326	80	29	192	13	11	0	0	22	-	2028	670	-
2007	112	0	2	767	63	93	36	6	10	3	58	85	67	30	171	11	9	0	0	25	-	1548	475	-
2008	158	0	4	807	73	132	69	8	10	9	71	89	64	21	161	12	9	0	0	26	-	1721	443	-
2009	126	0	3	595	71	126	44	7	10	8	36	68	54	16	121	4	2	0	1	26	-	1318	343	-
2010	153	0	3	642	88	147	42	9	13	13	49	99	109	12	180	10	2	0	2	38	-	1610	393	-
2011	179	0	4	696	89	98	30	20	19	13	44	87	136	10	159	11	7	0	0	27	-	1629	421	-
2012	126	0	3	696	82	50	20	21	9	12	64	88	58	9	124	10	7	0	1	33	-	1412	403	-
2013	137	0	5	475	78	116	31	11	4	11	46	87	84	4	119	11	5	0	0	47	-	1270	306	-
2014	118	0	4	490	81	51	18	24	6	9	58	57	54	5	84	12	6	0	0	58	-	1134	287	-
2015	140	0	4	583	80	94	31	11	7	9	45	63	68	3	68	16	5	0	1	56	-	1284	325	-
2016	135	0	5	612	56	87	31	6	3	9	51	58	86	4	27	6	5	0	2	26	-	1208	335	-
2017	112	0	3	666	47	73	28	7	12	12	32	72	49	3	26	10	2	0	0	28	-	1182	353	
Average																								
2012-2016	131	0	4	571	75	80	26	15	6	10	53	71	70	5	84	11	6	0	1	44	-	1262	331	-
2007-2016	138	0	4	636	76	99	35	12	9	10	52	78	78	11	121	10	6	0	1	36	-	1413	373	-

Table 6 Footnotes

KEY:	
1. Includes estimates of some local sales, and, prior to 1984, by-catch	9. Weights estimated from mean weight of fish caught in Asturias (80-90% of Spanish catch).
2. Before 1966, sea trout and sea charr included (5% of total).	10. Between 1991 & 1999, there was only a research fishery at Faroes. In 1997 & 1999 no fishery took place; the commercial fishery resumed in 2000, but has not operated since 2001.
3. Figures from 1991 to 2000 do not include catches taken in the recreational (rod) fishery.	11. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965–1975.
4 From 1990, catch includes fish ranched for both commercial and angling purposes.	12. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.
5. Improved reporting of rod catches in 1994 and data derived from carcase tagging and log books from 2002.	13. No unreported catch estimate available for Canada in 2007 and 2008. Data for Canada in 2009 and 2010 are incomplete. No unreported catch estimates available for Russia since 2008.
6. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.	14. Estimates refer to season ending in given year.
7. Angling catch (derived from carcase tagging and log books) first included in 2002.	15. Catches from hatchery-reared smolts released under programmes to mitigate for hydropower development
8. Data for France include some unreported catches.	

Table 7† The catches (tonnes round fresh weight) and % of the nominal catches by country taken in coastal, estuarine, and in-river fisheries, 2000 to 2017. Data for 2017 includes provisional data.

Country	Year	Coastal		Estuarine		In-river		Total
		Weight	%	Weight	%	Weight	%	weight
Spain	2000	0	0	0	0	7	100	7
	2001	0	0	0	0	13	100	13
	2002	0	0	0	0	9	100	9
	2003	0	0	0	0	7	100	7
	2004	0	0	0	0	7	100	7
	2005	0	0	0	0	13	100	13
	2006	0	0	0	0	11	100	11
	2007	0	0	0	0	10	100	10
	2008	0	0	0	0	10	100	10
	2009	0	0	0	0	2	100	2
	2010	0	0	0	0	2	100	2
	2011	0	0	0	0	7	100	7
	2012	0	0	0	0	8	100	8
	2013	0	0	0	0	5	100	5
	2014	0	0	0	0	7	100	7
	2015	0	0	0	0	5	100	5
	2016	0	0	0	0	5	100	5
	2017	0	0	0	0	2	100	2
France	2000	0	4	4	35	7	61	11
	2001	0	4	5	44	6	53	11
	2002	2	14	4	30	6	56	12
	2003	0	0	6	44	7	56	13
	2004	0	0	10	51	9	49	19
	2005	0	0	4	38	7	62	11
	2006	0	0	5	41	8	59	13
	2007	0	0	4	42	6	58	11
	2008	1	5	5	39	7	57	12
	2009	0	4	2	34	3	62	5
	2010	2	22	3	26	5	52	10
	2011	0	3	6	54	5	43	11
	2012	0	1	4	44	5	55	10
	2013	0	3	4	40	6	57	11
	2014	0	2	5	43	7	55	12
	2015	4	23	5	32	7	45	16
	2016	0	2	3	45	3	52	6
	2017	1	5	3	36	6	59	10
Ireland	2000	440	71	79	13	102	16	621
	2001	551	75	109	15	70	10	730
	2002	514	75	89	13	79	12	682
	2003	403	73	92	17	56	10	551
	2004	342	70	76	16	71	15	489
	2005	291	69	70	17	60	14	421
	2006	206	63	60	18	61	19	327
	2007	0	0	31	37	52	63	83
	2008	0	0	29	33	60	67	89
	2009	0	0	20	30	47	70	67
	2010	0	0	38	39	60	61	99
	2011	0	0	32	37	55	63	87
	2012	0	0	28	32	60	68	88
	2013	0	0	38	44	49	56	87
	2014	0	0	26	46	31	54	57
	2015	0	0	21	33	42	67	63
	2016	0	0	19	33	39	67	58

† Version 2: table values corrected (Canada 2016-2017, Scotland 2017 and totals for 2017) and missing data added (UK (England & Wales) 2017 and Russia 2017).

Country	Year	Coastal		Estuarine		In-river		Total
		Weight	%	Weight	%	Weight	%	weight
	2017	0	0	18	25	54	75	72
UK (England & Wales)	2000	157	72	25	12	37	17	219
	2001	129	70	24	13	31	17	184
	2002	108	67	24	15	29	18	161
	2003	42	47	27	30	20	23	89
	2004	39	35	19	17	53	47	111
	2005	32	33	28	29	36	37	97
	2006	30	37	21	26	30	37	80
	2007	24	36	13	20	30	44	67
	2008	22	34	8	13	34	53	64
	2009	20	37	9	16	25	47	54
	2010	64	59	9	8	36	33	109
	2011	93	69	6	5	36	27	136
	2012	26	45	5	8	27	47	58
	2013	61	73	6	7	17	20	84
	2014	41	76	4	8	9	16	54
	2015	55	82	4	6	8	12	68
	2016	71	82	6	6	10	11	86
	2017	36	73	3	7	10	19	49
UK (Scotland)	2000	76	28	41	15	157	57	274
	2001	77	30	22	9	153	61	251
	2002	55	29	20	10	116	61	191
	2003	87	45	23	12	83	43	193
	2004	67	27	20	8	160	65	247
	2005	62	29	27	12	128	59	217
	2006	57	30	17	9	119	62	193
	2007	40	24	17	10	113	66	171
	2008	38	24	11	7	112	70	161
	2009	27	22	14	12	79	66	121
	2010	44	25	38	21	98	54	180
	2011	48	30	23	15	87	55	159
	2012	40	32	11	9	73	59	124
	2013	50	42	26	22	43	36	119
	2014	41	49	17	20	26	31	84
	2015	31	45	9	14	28	41	68
	2016	0	1	10	37	17	63	27
	2017	0	1	8	29	18	71	26
UK (N. Ireland)	2000	63	82	14	18	-	-	77
	2001	41	77	12	23	-	-	53
	2002	40	49	24	29	18	22	81
	2003	25	45	20	35	11	20	56
	2004	23	48	11	22	14	29	48
	2005	25	49	13	25	14	26	52
	2006	13	45	6	22	9	32	29
	2007	6	21	6	20	17	59	30
	2008	4	19	5	22	12	59	21
	2009	4	24	2	15	10	62	16
	2010	5	39	0	0	7	61	12
	2011	3	24	0	0	8	76	10
	2012	0	0	0	0	9	100	9
	2013	0	1	0	0	4	99	4
	2014	0	0	0	0	2	100	2
	2015	0	0	0	0	3	100	3
	2016	0	0	0	0	5	100	5
	2017	0	0	0	0	3	100	3

Country	Year	Coastal		Estuarine		In-river		Total
		Weight	%	Weight	%	Weight	%	weight
Iceland	2000	0	0	0	0	85	100	85
	2001	0	0	0	0	88	100	88
	2002	0	0	0	0	97	100	97
	2003	0	0	0	0	110	100	110
	2004	0	0	0	0	130	100	130
	2005	0	0	0	0	149	100	149
	2006	0	0	0	0	111	100	111
	2007	0	0	0	0	129	100	129
	2008	0	0	0	0	200	100	200
	2009	0	0	0	0	171	100	171
	2010	0	0	0	0	190	100	190
	2011	0	0	0	0	128	100	128
	2012	0	0	0	0	70	100	70
	2013	0	0	0	0	147	100	147
	2014	0	0	0	0	68	100	68
	2015	0	0	0	0	125	100	125
	2016	0	0	0	0	105	100	105
	2017	0	0	0	0	101	100	101
Denmark	2000							
	2001							
	2002							
	2003							
	2004							
	2005							
	2006							
	2007							
	2008	0	1	0	0	9	99	9
	2009	0	0	0	0	8	100	8
	2010	0	1	0	0	13	99	13
	2011	0	0	0	0	13	100	13
	2012	0	0	0	0	12	100	12
	2013	0	0	0	0	11	100	11
	2014	0	0	0	0	9	100	9
	2015	0	0	0	0	9	100	9
	2016	0	0	0	0	10	100	10
	2017	0	1	0	0	12	99	12
Sweden	2000	10	30	0	0	23	70	33
	2001	9	27	0	0	24	73	33
	2002	7	25	0	0	21	75	28
	2003	7	28	0	0	18	72	25
	2004	3	16	0	0	16	84	19
	2005	1	7	0	0	14	93	15
	2006	1	7	0	0	13	93	14
	2007	0	1	0	0	16	99	16
	2008	0	1	0	0	18	99	18
	2009	0	3	0	0	17	97	17
	2010	0	0	0	0	22	100	22
	2011	10	26	0	0	29	74	39
	2012	7	24	0	0	23	76	30
	2013	0	0	0	0	15	100	15
	2014	0	0	0	0	30	100	30
	2015	0	0	0	0	18	100	18
	2016	0	0	0	0	9	100	9
	2017	0	0	0	0	18	100	18

Country	Year	Coastal		Estuarine		In-river		Total
		Weight	%	Weight	%	Weight	%	weight
Norway	2000	619	53	0	0	557	47	1176
	2001	696	55	0	0	570	45	1266
	2002	596	58	0	0	423	42	1019
	2003	597	56	0	0	474	44	1071
	2004	469	60	0	0	316	40	785
	2005	463	52	0	0	424	48	888
	2006	512	55	0	0	420	45	932
	2007	427	56	0	0	340	44	767
	2008	382	47	0	0	425	53	807
	2009	284	48	0	0	312	52	595
	2010	260	41	0	0	382	59	642
	2011	302	43	0	0	394	57	696
	2012	255	37	0	0	440	63	696
	2013	192	40	0	0	283	60	475
	2014	213	43	0	0	277	57	490
	2015	233	40	0	0	350	60	583
	2016	269	44	0	0	343	56	612
	2017	290	44	0	0	376	56	666
Finland	2000	0	0	0	0	96	100	96
	2001	0	0	0	0	126	100	126
	2002	0	0	0	0	94	100	94
	2003	0	0	0	0	75	100	75
	2004	0	0	0	0	39	100	39
	2005	0	0	0	0	47	100	47
	2006	0	0	0	0	67	100	67
	2007	0	0	0	0	59	100	59
	2008	0	0	0	0	71	100	71
	2009	0	0	0	0	38	100	38
	2010	0	0	0	0	49	100	49
	2011	0	0	0	0	44	100	44
	2012	0	0	0	0	64	100	64
	2013	0	0	0	0	46	100	46
	2014	0	0	0	0	58	100	58
	2015	0	0	0	0	45	100	45
	2016	0	0	0	0	51	100	51
	2017	0	0	0	0	32	100	32
Russia	2000	64	52	15	12	45	36	124
	2001	70	61	0	0	44	39	114
	2002	60	51	0	0	58	49	118
	2003	57	53	0	0	50	47	107
	2004	46	56	0	0	36	44	82
	2005	58	70	0	0	25	30	82
	2006	52	57	0	0	39	43	91
	2007	31	50	0	0	31	50	63
	2008	33	45	0	0	40	55	73
	2009	22	31	0	0	49	69	71
	2010	36	41	0	0	52	59	88
	2011	37	42	0	0	52	58	89
	2012	38	46	0	0	45	54	82
	2013	36	46	0	0	42	54	78
	2014	33	41	0	0	48	59	81
	2015	34	42	0	0	46	58	80
	2016	24	42	0	0	32	58	56
	2017	13	28	0	0	34	72	47

Country	Year	Coastal		Estuarine		In-river		Total
		Weight	%	Weight	%	Weight	%	weight
Canada	2000	2	2	29	19	117	79	148
	2001	3	2	28	20	112	78	143
	2002	4	2	30	20	114	77	148
	2003	5	3	36	27	96	70	137
	2004	7	4	46	29	109	67	161
	2005	7	5	44	32	88	63	139
	2006	8	6	46	34	83	60	137
	2007	6	5	36	32	70	63	112
	2008	9	6	47	32	92	62	147
	2009	7	6	40	33	73	61	119
	2010	6	4	40	27	100	69	146
	2011	7	4	56	31	115	65	178
	2012	8	6	46	36	73	57	127
	2013	8	6	49	36	80	58	137
	2014	7	6	28	24	83	71	118
	2015	8	6	35	25	97	69	140
	2016	7	5	36	27	92	68	135
	2017	9	8	33	30	70	62	112
France (Islands of St. Pierre and Miquelon	2000	2	100	0	0	0	0	2
	2001	2	100	0	0	0	0	2
	2002	2	100	0	0	0	0	2
	2003	3	100	0	0	0	0	3
	2004	3	100	0	0	0	0	3
	2005	3	100	0	0	0	0	3
	2006	4	100	0	0	0	0	4
	2007	2	100	0	0	0	0	2
	2008	3	100	0	0	0	0	3
	2009	3	100	0	0	0	0	3
	2010	3	100	0	0	0	0	3
	2011	4	100	0	0	0	0	4
	2012	1	100	0	0	0	0	1
	2013	5	100	0	0	0	0	5
	2014	4	100	0	0	0	0	4
	2015	4	100	0	0	0	0	4
	2016	5	100	0	0	0	0	5
	2017	3	100	0	0	0	0	3
Total NEAC	2017	343	33	31	3	665	64	1039
Total NAC	2017	9	8	33	30	70	62	112

Table 8 Estimates of unreported catches by various methods, in tonnes by country within national EEZs in the North East Atlantic, North American, and West Greenland commissions of NASCO, 2017.

Commission Area	Country	Unreported catch (tonnes)	Unreported as % of total North Atlantic Catch (Unreported + reported)	Unreported as % of total National Catch (Unreported)
NEAC	Denmark	6	0.4	50
NEAC	Finland	6	0.4	19
NEAC	Iceland	2	0.2	2
NEAC	Ireland	7	0.5	10
NEAC	Norway	285	18.6	30
NEAC	Sweden	2	0.1	9
NEAC	UK (England &	6	0.4	12
NEAC	UK (N. Ireland)	0.3	0.02	10
NEAC	UK (Scotland)	3	0.2	11
NAC	USA	0	0.0	0
NAC	Canada	25	1.7	23
WGC	Greenland	10	0.7	36
Total unreported catch *		353	23.0	
Total reported catch of North Atlantic salmon		1181		

* No unreported catch estimate is available for France and Russia in 2017.
Unreported catch estimates are not provided for Spain or St. Pierre et Miquelon.

Table 9 Numbers of fish caught and released in angling fisheries along with the % of the total angling catch (released + retained) for countries in the North Atlantic where records are available, 1991–2017. Figures for 2017 are provisional.

Year	Canada [4]		USA		Iceland		Russia [1]		UK (E&W)		UK (Scotland)		Ireland		UK (N Ireland) [2]		Denmark		Sweden		Norway [3]	
	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch
1991	22167	28	239	50			3211	51														
1992	37803	29	407	67			10120	73														
1993	44803	36	507	77			11246	82	1448	10												
1994	52887	43	249	95			12056	83	3227	13	6595	8										
1995	46029	46	370	100			11904	84	3189	20	12151	14										
1996	52166	41	542	100	669	2	10745	73	3428	20	10413	15										
1997	50009	50	333	100	1558	5	14823	87	3132	24	10965	18										
1998	56289	53	273	100	2826	7	12776	81	4378	30	13464	18										
1999	48720	50	211	100	3055	10	11450	77	4382	42	14846	28										
2000	64482	56	0	-	2918	11	12914	74	7470	42	21072	32										
2001	59387	55	0	-	3611	12	16945	76	6143	43	27724	38										
2002	50924	52	0	-	5985	18	25248	80	7658	50	24058	42										
2003	53645	55	0	-	5361	16	33862	81	6425	56	29170	55										
2004	62316	57	0	-	7362	16	24679	76	13211	48	46279	50					255	19				
2005	63005	62	0	-	9224	17	23592	87	11983	56	46165	55	2553	12			606	27				
2006	60486	62	1	100	8735	19	33380	82	10959	56	47669	55	5409	22	302	18	794	65				
2007	41192	58	3	100	9691	18	44341	90	10917	55	55660	61	15113	44	470	16	959	57				
2008	54887	53	61	100	17178	20	41881	86	13035	55	53347	62	13563	38	648	20	2033	71			5512	5
2009	52151	59	0	-	17514	24			9096	58	48436	67	11422	39	847	21	1709	53			6696	6
2010	55895	53	0	-	21476	29	14585	56	15012	60	78041	70	15142	40	823	25	2512	60			15041	12
2011	71358	57	0	-	18593	32			14406	62	64870	73	12688	38	1197	36	2153	55			14303	12
2012	43287	57	0	-	9752	28	4743	43	11952	65	63628	74	11891	35	5014	59	2153	55			18611	14
2013	50630	59	0	-	23133	34	3732	39	10458	70	54002	80	10682	37	1507	64	1932	57	220	9	15953	15
2014	41613	54	0	-	13616	41	8479	52	7992	78	37355	82	6537	37	1065	50	1918	61	445	15	20281	19
2015	65440	64	0	-	21914	31	7028	50	8113	79	46836	84	9383	37	111	100	2989	70	725	19	25433	19
2016	68925	65	0	-	22751	43	10793	76	9700	80	49469	90	10280	41	280	100	3801	72	345	18	25198	21
2017	49513	66	0	-	21746	41	10110	77	11174	83	44257	90	11259	36	126	100	4435	69	681	15	25924	21
5-yr mean 2012-2016	53979	60			18233	35	6955	52	9643	74	50258	82	9755	37	1595	75	2559	63			21095	18
% change on 5-year mean	-8	10			19	15	45	48	16	12	-12	10	15	-4	-92	34	73	10			23	16

Key: [1] Since 2009 data are either unavailable or incomplete, however catch-and-release is understood to have remained at similar high levels as before.

[2] Data for 2006-2009, 2014 is for the DCAL area only; the figures from 2010 are a total for UK (N.Ireland). Data for 2015, 2016 and 2017 is for R. Bush only.

[3] The statistics were collected on a voluntary basis, the numbers reported must be viewed as a minimum.

[4] Released fish in the kelt fishery of New Brunswick are not included in the totals for Canada.

Annex 1 Glossary of acronyms and abbreviations

1SW (*one-sea-winter*). Maiden adult salmon that has spent one winter at sea.

2SW (*two-sea-winter*). Maiden adult salmon that has spent two winters at sea.

ACOM (*Advisory Committee*) of ICES. The Committee works on the basis of scientific assessment prepared in ICES expert groups. The advisory process includes peer review of the assessment before it can be used as the basis for advice. The Advisory Committee has one member from each ICES Member Country under the direction of an independent chair appointed by the Council.

AST *(Atlantic Salmon Trust).* A non-governmental organization dedicated to salmon and sea trout survival through research on the problems impacting migratory salmonids.

CL, i.e. S_{lim} (*conservation limit*). Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.

C&R (*catch-and-release*). Catch-and-release is a practice within recreational fishing intended as a technique of conservation. After capture, the fish are unhooked and returned to the water before experiencing serious exhaustion or injury. Using barbless hooks, it is often possible to release the fish without removing it from the water (a slack line is frequently sufficient).

CWT (*coded wire tag*). The CWT is a length of magnetized stainless steel wire 0.25 mm in diameter. The tag is marked with rows of numbers denoting specific batch or individual codes. Tags are cut from rolls of wire by an injector that hypodermically implants them into suitable tissue. The standard length of a tag is 1.1 mm.

DBERAAS (*Database on Effectiveness of Recovery Actions for Atlantic Salmon*). Database output from WGERAAS.

DFO *(Department of Fisheries and Oceans*). DFO and its Special Operating Agency, the Canadian Coast Guard, deliver programmes and services that support sustainable use and development of Canada's waterways and aquatic resources.

DNA (*deoxyribonucleic acid*). DNA is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms (with the exception of RNA – Ribonucleic Acid viruses). The main role of DNA molecules is the long-term storage of information. DNA is often compared to a set of blueprints, like a recipe or a code, since it contains the instructions needed to construct other components of cells, such as proteins and RNA molecules.

DST *(data storage tag*). A miniature data logger with sensors including salinity, temperature, and depth that is attached to fish and other marine animals.

eDNA *(environmental DNA).* DNA that is collected from environmental samples such as soil, water, or air, rather than directly sampled from an individual organism. As various organisms interact with the environment, DNA is released and accumulates in their surroundings.

EEZ *(Exclusive Economic Zone*). EEZ is a concept adopted at the Third United Nations Conference on the Law of the Sea, whereby a coastal State assumes jurisdiction over the exploration and exploitation of marine resources in its adjacent section of the continental shelf, taken to be a band extending 200 miles from the shore.

FWI (*Framework of Indicators*). The FWI is a tool used to indicate if any significant change has occurred in the status of stocks used to inform the previously provided multiannual management advice.

IASRB (*International Atlantic Salmon Research Board*). A platform established by NASCO in 2001 to encourage and facilitate cooperation and collaboration on research related to marine mortality in Atlantic salmon.

ICES (*International Council for the Exploration of the Sea*). A global organization that develops science and advice to support the sustainable use of the oceans through the coordination of oceanic and coastal monitoring and research, and advising international commissions and governments on marine policy and management issues.

IESSNS (*International Ecosystem Survey of the Nordic Seas*). A collaborative programme involving research vessels from Iceland, the Faroe Islands, and Norway.

IHN *(Infectious Haematopoietic Necrosis).* An infectious disease caused by the IHN virus.

IPN *(Infectious Pancreatic Necrosis).* An infectious disease caused by the IPN virus.

ISA *(Infectious Salmon Anaemia).* An infectious disease caused by the ISA virus.

MSA (*mixed-stock analysis*). Genetic analytical technique to estimate the proportions of various origins of fish in a mixed-stock fishery.

MSAT *(microsatellite).* A tract of repetitive DNA in which certain DNA motifs are repeated, typically 5–50 times. Can be used to estimate region of origin of salmon.

MSY (*maximum sustainable yield*). The largest average annual catch that may be taken from a stock continuously without affecting the catch of future years. A constant long-term MSY is not a reality in most fisheries, where stock sizes vary with the strength of year classes moving through the fishery.

MSW (*multi-sea-winter*). A MSW salmon is an adult salmon that has spent two or more winters at sea and may be a repeat spawner.

NAC (*North American Commission*). The North American Atlantic Commission of NASCO or the North American Commission area of NASCO.

NAFO (*Northwest Atlantic Fisheries Organization*). NAFO is an intergovernmental fisheries science and management organization that ensures the long-term conservation and sustainable use of the fishery resources in the Northwest Atlantic.

NASCO (*North Atlantic Salmon Conservation Organization*). An international organization, established by an inter-governmental convention in 1984. The objective of NASCO is to conserve, restore, enhance, and rationally manage Atlantic salmon through international cooperation, taking account of the best available scientific information.

NEAC (*North-East Atlantic Commission*). The North-East Atlantic Commission of NASCO or the North-East Atlantic Commission area of NASCO.

NEAC – N (*North-East Atlantic Commission- northern area*). The northern portion of the North-East Atlantic Commission area of NASCO.

NEAC – S (*North-East Atlantic Commission – southern area*). The southern portion of the North-East Atlantic Commission area of NASCO.

NPAFC (*North Pacific Anadromous Fish Commission*). An international inter-governmental organization established by the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean. The Convention was signed on February 11, 1992, and took effect on February 16, 1993. The member countries are Canada, Japan, Republic of Korea, Russian Federation, and United States of America. As defined in the Convention, the primary objective of the NPAFC is to promote the conservation of anadromous stocks in the Convention Area. The Convention Area is the international waters of the North Pacific Ocean and its adjacent seas north of 33°North beyond the 200-mile zones (exclusive economic zones) of the coastal States.

PFA (*pre-fishery abundance*). The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time. In the previous version of the stock complex Bayesian PFA forecast model two productivity parameters are calculated, for the *maturing* (PFAm) and *non-maturing* (PFAnm) components of the PFA. In the updated version only one productivity parameter is calculated; this parameter is used to calculate total PFA, which is then split into PFAm and PFAnm based upon the *proportion of PFAm* (p.PFAm).

PIT (*passive integrated transponder*). PIT tags use radio frequency identification technology. PIT tags lack an internal power source. They are energized on encountering an electromagnetic field emitted from a transceiver. The tag's unique identity code is programmed into the microchip's nonvolatile memory.

ROO *(region of origin)*

RVS (*Red Vent Syndrome*). This condition has been noted since 2005, and has been linked to the presence of a nematode worm, *Anisakis simplex*. This is a common parasite of marine fish and is also found in migratory species. The larval nematode stages in fish are usually found spirally coiled on the mesenteries, internal organs, and less frequently in the somatic muscle of host fish.

SALSEA (*Salmon at Sea*). An international programme of cooperative research, adopted in 2005, designed to improve understanding of the migration and distribution of salmon at sea in relation to feeding opportunities and predation.

SALSEA-Track (*Salmon at Sea Track*). SALSEA-Track is the second phase of the SALSEA programme. It employs advances in telemetry technology to precisely track Atlantic salmon along their migration routes through cooperative international research initiatives.

SER (*spawning escapement reserve*). The CL increased to take account of natural mortality between the recruitment date (assumed to be 1st of January) and the date of return to home waters.

S_{lim}, i.e. CL (*conservation limit*). Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing fisheries of these stocks will be to ensure that there is a high probability that the undesirable levels are avoided.

S_{MSY} (*spawners for maximum sustainable yield*). The spawner abundance that generates recruitment at a level that provides a maximum exploitable yield (recruitment minus spawners).

SNP (*Single Nucleotide Polymorphism*). Type of genetic marker used in stock identification and population genetic studies.

S–R (*stock–recruitment*).

TAC (*total allowable catch*). TAC is the quantity of fish that can be taken from each stock each year.

ToR (*terms of reference*).

UDN (*Ulcerative Dermal Necrosis*). Disease mainly affecting wild Atlantic salmon, sea trout, and sometimes other salmonids. It usually occurs in adult fish returning from the sea in the colder months of the year and starts as small lesions on the scale-less regions of the fish, mainly the snout, above the eye, and near the gill cover. On entry to freshwater lesions ulcerate and may become infected with secondary pathogens like the fungus *Saprolegnia* spp. Major outbreaks of UDN occurred in the 1880s (UK) and 1960s–1970s (UK and Ireland), but the disease has also been reported from France, and in 2015 from the Baltic and Russia.

VHS *(Viral Haemorrhagic Septicaemia)*. An infectious fish disease caused by the VHS virus.

WGC (*West Greenland Commission*). The West Greenland Commission of NASCO or the West Greenland Commission area of NASCO.

WGF (*West Greenland Fishery*). Regulatory measures for the WGF have been agreed by the West Greenland Commission of NASCO for most years since NASCO's establishment. These have resulted in greatly reduced allowable catches in the WGF, reflecting declining abundance of the salmon stocks in the area.

WGNAS (*Working Group on North Atlantic Salmon*). ICES working group responsible for the annual assessment of the status of salmon stocks across the North Atlantic and formulating catch advice for NASCO.

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Atlantic salmon from the Northeast Atlantic

Summary of advice for fishing seasons 2018/2019 to 2020/2021

ICES advises that when the MSY approach is applied there are no mixed-stock fisheries options on the NEAC complexes at the Faroes in the fishing seasons 2018/2019 to 2020/2021.

For the fishing seasons 2018/2019 to 2020/2021, there is a less than 95% probability of meeting the conservation limits (CLs) for potential 1-sea-winter (1SW) and multi-sea-winter (MSW) salmon from the Southern NEAC stock complex and for the 1SW salmon from the Northern NEAC stock complex. In the absence of any fisheries, the probabilities of individual countries meeting their CLs range from 11% to 91% for maturing 1SW salmon and 16% to 99% for salmon maturing as MSW.

A Framework of Indicators (FWI) has previously been developed in support of the multi-year catch advice and the potential approval of multi-year regulatory measures for the Faroes fishery. The FWI has been updated and can be applied at the beginning of 2019, with the returns or return rate data for 2018, to evaluate the appropriateness of the advice for 2019/2020, and again at the beginning of 2020, with the returns or return rate data for 2019, to evaluate the appropriateness of the advice for 2020/2021.

NASCO 2.1 Describe the key events of the 2017 fisheries

Reports from the NEAC area in 2017 showed no significant changes in the gear types used.

No fishery for salmon has been conducted at the Faroes since 2000.

Reported nominal catch in the NEAC area in 2017 is 1039 t, with 162 t reported in the Southern NEAC and 877 t in the Northern NEAC areas. Estimates of unreported catches in the NEAC area were 317 t in total. In 2017, the location of catches differed between Southern NEAC and Northern NEAC (Table 1). In-river fisheries accounted for 58% of the catches in Southern NEAC, 20% for estuarine fisheries, and 23% from coastal fisheries. In Northern NEAC, coastal fisheries accounted for 35% of the catches, with the remaining 65% of the catches coming from in-river fisheries.

Table 1 Salmon catches and catch locations in the NEAC area in 2017. Catches of NEAC origin salmon at Greenland are reported in the West Greenland Commission area. For Iceland all catches are reported in Northern NEAC.

	Southern NEAC	Northern NEAC	Faroes	Total NEAC
2017 nominal catch (t)	162	877	0	1039
Catch as % of NEAC total	16	84	0	
Unreported catch (t)	16	301	-	317
Location of catches				
% in-river	58	65	-	64
% in estuaries	20	0	-	3
% coastal	23	35	-	33

The NEAC area has seen a general reduction in catches since the 1980s (Figure 1 and Table 2). This reflects the decline in fishing effort as a consequence of management measures, as well as a reduction in the size of stocks. The nominal catch for 2017 (1039 t) was among the lowest in the time-series in both areas (lowest in the time-series for Southern NEAC). The catch in Southern NEAC, which constituted around two-thirds of the total NEAC catch in the early 1970s, has been lower than that in Northern NEAC since 1999 (Figure 1).

1SW salmon constituted 51% of the total catch in Northern NEAC in 2017 (Figure 2). For the Southern NEAC countries, the overall percentage of 1SW fish in the catch in 2017 was estimated at 44%, as in 2016. In both areas, there has been a declining trend in the proportion of 1SW fish in the catch over the time-series; the reduction for Southern NEAC has been particularly marked in the last 10 to 15 years (Figure 2).

Estimated exploitation rates have decreased since the early 1980s in both the Northern and Southern NEAC areas (Figure 3). The exploitation rates on 1SW and MSW salmon have become similar, with higher exploitation rates in Northern NEAC at just over 40% compared to 10% in Southern NEAC.

Estimates of the number of salmon caught and released in angling fisheries are not complete for all NEAC countries. There are large differences in the percentage of the total angling catch that is released: in 2017 this ranged from 15% in Sweden to 90% in UK (Scotland), reflecting varying management practices and angler attitudes among these countries.

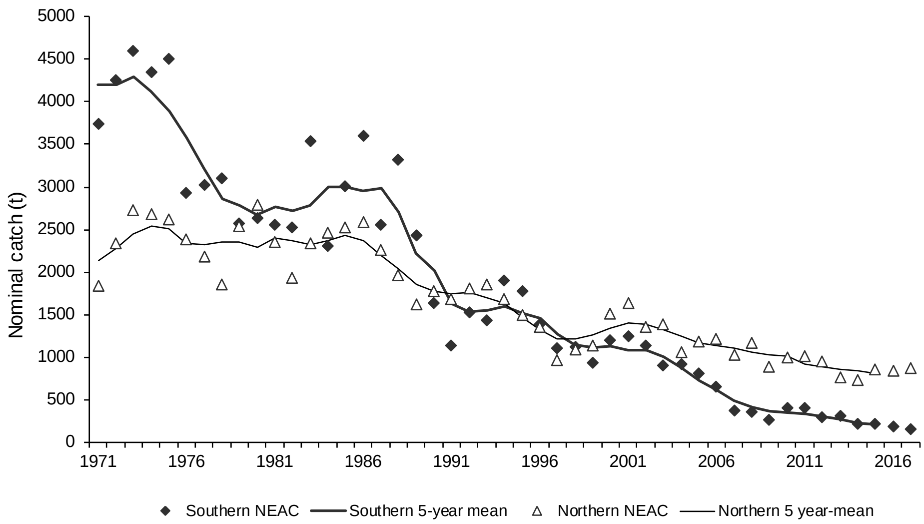


Figure 1 Nominal catches (t) of salmon in the Southern NEAC and Northern NEAC areas (1971–2017).

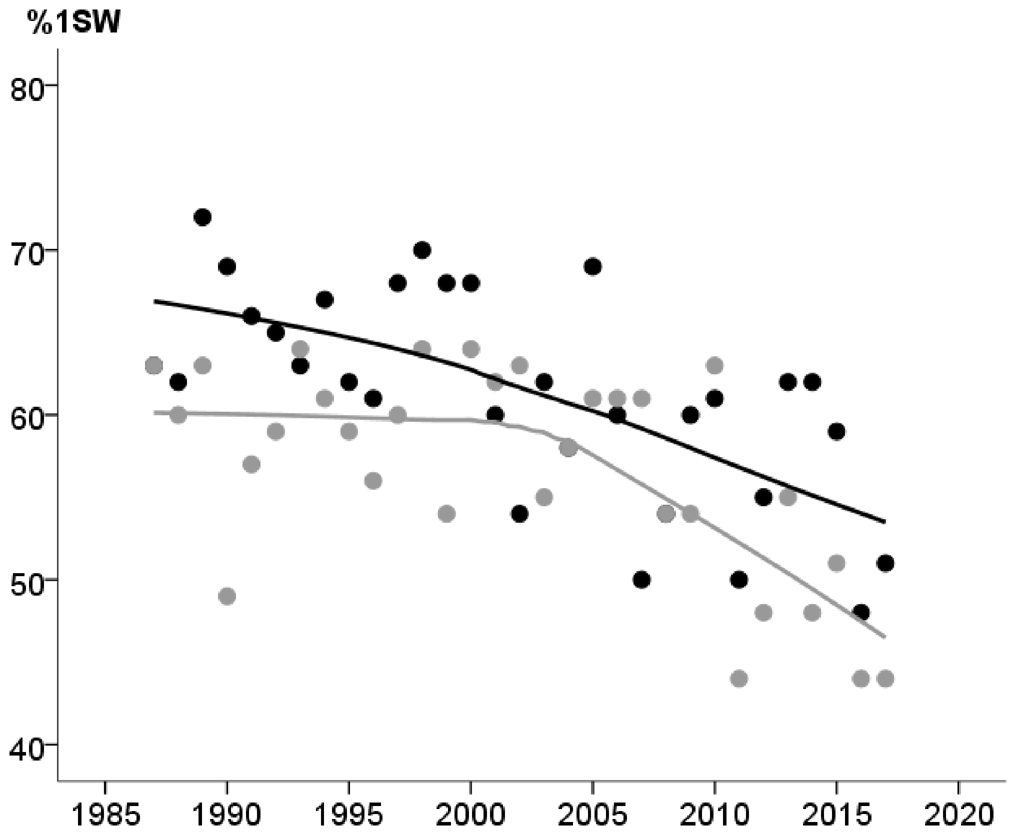


Figure 2 Percentage of 1SW salmon in the reported catch for Northern NEAC (black symbols) and Southern NEAC (grey symbols) areas, 1987–2017. The lines indicate loess regressions over the time-series.

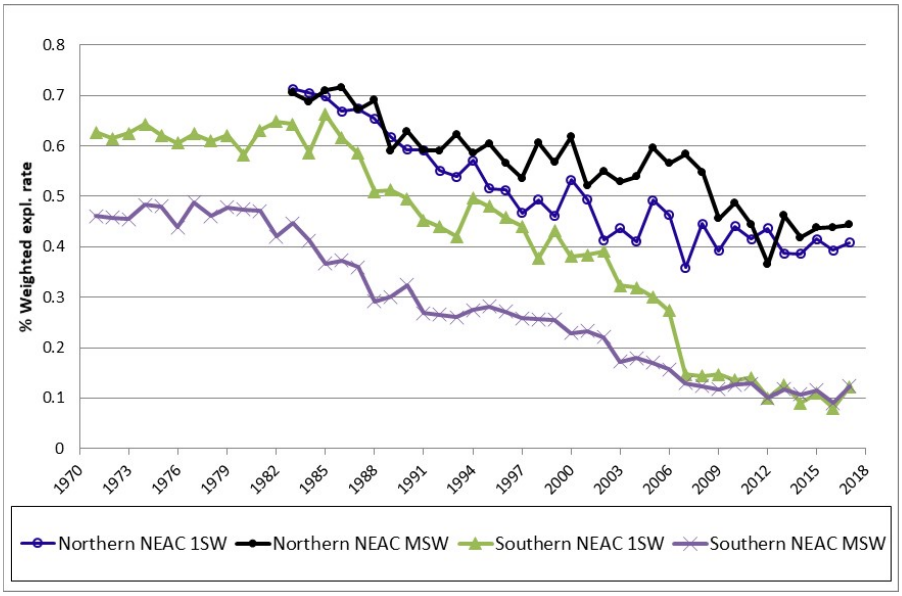


Figure 3 Exploitation rates of 1SW and MSW salmon in home water fisheries in the Northern (1983–2017) and Southern (1971–2017) NEAC areas.

Table 2 Nominal catch of salmon in the NEAC area (in tonnes, round fresh weight), 1960 to 2017 (2017 figures are provisional).

Year	Southern NEAC	Northern NEAC [1]	Faroes [2]	Other catches in international waters	Total Reported Catch	Unreported catches	
						NEAC Area [3]	International waters [4]
1960	2641	2899	-	-	5540	-	-
1961	2276	2477	-	-	4753	-	-
1962	3894	2815	-	-	6709	-	-
1963	3842	2434	-	-	6276	-	-
1964	4242	2908	-	-	7150	-	-
1965	3693	2763	-	-	6456	-	-
1966	3549	2503	-	-	6052	-	-
1967	4492	3034	-	-	7526	-	-
1968	3623	2523	5	403	6554	-	-
1969	4383	1898	7	893	7181	-	-
1970	4048	1834	12	922	6816	-	-
1971	3736	1846	-	471	6053	-	-
1972	4257	2340	9	486	7092	-	-
1973	4604	2727	28	533	7892	-	-
1974	4352	2675	20	373	7420	-	-
1975	4500	2616	28	475	7619	-	-
1976	2931	2383	40	289	5643	-	-
1977	3025	2184	40	192	5441	-	-
1978	3102	1864	37	138	5141	-	-
1979	2572	2549	119	193	5433	-	-
1980	2640	2794	536	277	6247	-	-
1981	2557	2352	1025	313	6247	-	-
1982	2533	1938	606	437	5514	-	-
1983	3532	2341	678	466	7017	-	-
1984	2308	2461	628	101	5498	-	-
1985	3002	2531	566	-	6099	-	-
1986	3595	2588	530	-	6713	-	-
1987	2564	2266	576	-	5406	2554	-
1988	3315	1969	243	-	5527	3087	-
1989	2433	1627	364	-	4424	2103	-
1990	1645	1775	315	-	3735	1779	180-350
1991	1145	1677	95	-	2917	1555	25-100
1992	1523	1806	23	-	3352	1825	25-100
1993	1443	1853	23	-	3319	1471	25-100
1994	1896	1684	6	-	3586	1157	25-100
1995	1775	1503	5	-	3283	942	-
1996	1392	1358	-	-	2750	947	-
1997	1112	962	-	-	2074	732	-
1998	1120	1099	6	`	2225	1108	-
1999	934	1139	0	-	2073	887	-
2000	1210	1518	8	-	2736	1135	-
2001	1242	1634	0	-	2876	1089	-
2002	1135	1360	0	-	2496	946	-
2003	908	1394	0	-	2303	719	-
2004	919	1059	0	-	1978	575	-
2005	809	1189	0	-	1998	605	-
2006	650	1217	0	-	1867	604	-
2007	373	1036	0	-	1408	465	-
2008	355	1178	0	-	1533	433	-
2009	266	898	0	-	1164	317	-
2010	411	1003	0	-	1414	357	-
2011	410	1009	0	-	1419	382	-
2012	295	955	0	-	1250	363	-
2013	310	770	0	-	1080	272	-

Year	Southern NEAC	Northern NEAC [1]	Faroes [2]	Other catches in international waters	Total Reported Catch	Unreported catches NEAC Area [3]	Unreported catches International waters [4]
2014	218	736	0	-	954	256	-
2015	223	859	0	-	1081	298	-
2016	186	842	0	-	1028	298	-
2017	162	877	0	-	1039	317	
Average							
2012–2016	246	832	0	-	1079	297	-
2007–2016	305	929	0	-	1233	344	-

[1] All Icelandic catches have been included in Northern countries.
[2] Since 1991, fishing carried out at the Faroes has only been for research purposes.
[3] No unreported catch estimate available for Russia since 2008.
[4] Estimates refer to season ending in given year.

NASCO 2.2 Review and report on the development of age-specific stock conservation limits, including updating the time-series of the number of river stocks with established CLs by jurisdiction

River-specific CLs (in terms of egg or spawner requirements) have been estimated for salmon stocks in most countries in the NEAC area (France, Ireland, UK (England & Wales), UK (Northern Ireland), Finland, Norway, and Sweden). Preliminary results are also available for a small number of rivers in Russia. Where sufficient numbers of CL estimates are available for individual rivers, these are summed to provide estimates at a country level. For countries that have not applied this approach at the national level (Russia, UK (Scotland), and Iceland), an interim approach has been used for estimating national CLs. This approach is based on the establishment of pseudo-stock–recruitment relationships for national salmon stocks.

In UK (Scotland), there has been further progress in establishing CLs at the scale of the river stock, or on groups of smaller neighbouring rivers where angling data are not yet available by river. A new approach to defining river-specific conservation limits is currently being developed. This uses a Bayesian hierarchical modelling framework to generate posterior predictions of CLs for a limited number of Scottish rivers where stock and recruitment data are available. By pooling information from multiple rivers and incorporating information about local environmental covariates, CL estimates can be transferred to data-poor rivers.

Spawner escapement reserves (SERs) are CLs (expressed in terms of spawner numbers), adjusted to take account of natural mortality (M = 0.03 per month) between 1 January of the first winter at sea and return time to home waters for each of the maturing (6–9 months) and non-maturing (16–21 months) 1SW salmon components from the Northern NEAC and Southern NEAC stock complexes.

National stocks within the NEAC area are combined into two geographic groups for the provision of management advice for the distant-water fisheries at West Greenland and the Faroes. The Northern group consists of Russia, Finland, Norway, Sweden, and the northeastern region of Iceland. The Southern group consists of UK (Scotland), UK (England & Wales), UK (Northern Ireland), Ireland, France, and the southwestern region of Iceland.

CLs and SERs are provided for the four stock complexes, defined as two sea ages per geographic group (Table 3), by summing national CLs to the level of the four NEAC stock complexes.

Table 3 Conservation limits (CL) and spawner escapement reserves (SER) for the salmon stock complexes in the NEAC area in 2017.

Complex	Sea age group	CL (number of fish)	SER (number of fish)
Northern NEAC	1SW	137 330	173 601
	MSW	120 953	206 201
Southern NEAC	1SW	654 921	830 559
	MSW	324 126	550 081

For the nine jurisdictions where river-specific CLs are available, time-series indicating the development in the definition of river-specific CLs, the number of rivers annually assessed against CLs, and the number of rivers that annually meet or exceed CLs (based on spawner numbers, after fisheries) are provided in Figure 4. This figure illustrates the increase in the number of CLs established within individual jurisdictions.

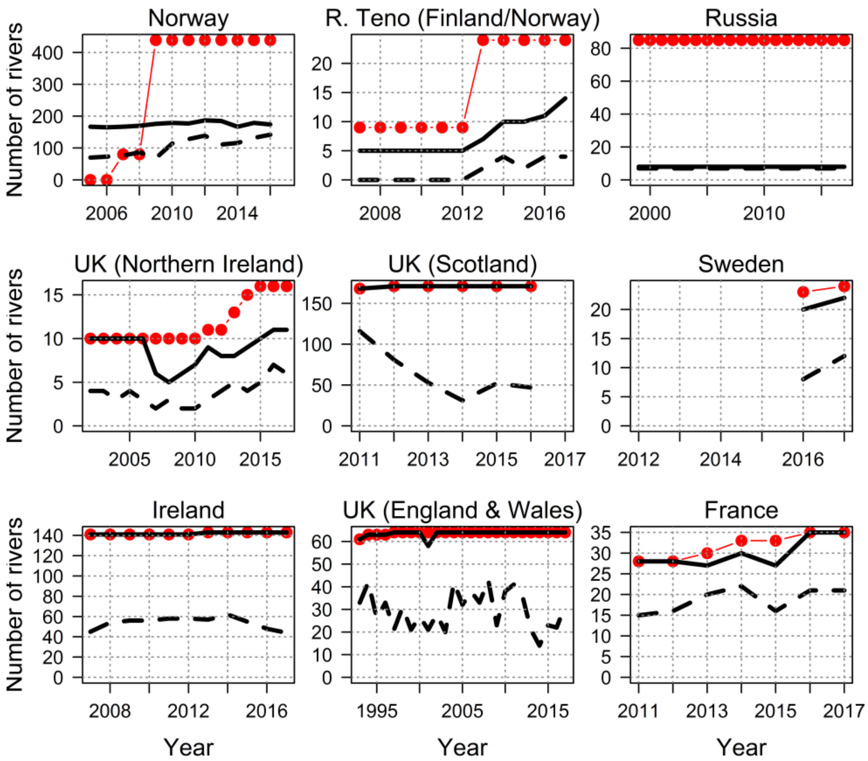


Figure 4 Time-series of jurisdictions in the NEAC area, showing the number of rivers with established CLs and trends in the number of stocks meeting CLs (•–•–• number of rivers with established CLs; — number of rivers assessed for attainment of CLs; — — number of rivers meeting or exceeding CLs).

NASCO 2.3 Describe the status of the stocks, including updating the time-series of trends in the number of river stocks meeting CLs by jurisdiction

Recruitment, expressed as pre-fishery abundance (PFA; split by sea age group as maturing and non-maturing 1SW salmon, at 1 January of the first winter at sea) is estimated by geographic groups (Northern NEAC and Southern NEAC), and individual country, and assessed relative to the spawner escapement reserve (SER).

The assessment of PFA against SER for the four complexes over the time-series is shown in Figure 5, and by country for the most recent year in Figure 6. The time-series of returns and spawners against CLs are shown by sea age groups for the Northern NEAC and Southern NEAC complexes (Figure 5) and for 2017 by individual countries for 1SW maturing (Figure 6) and MSW (1SW non-maturing at the PFA stage) salmon (Figure 7). These assessments show the same broad contrasts between Northern and Southern NEAC stocks that are seen in the stock complex data.

PFA relative to SER

PFAs of both maturing 1SW and non-maturing 1SW salmon for Northern NEAC show a general decline over the time period (since 1983), with the decline being more marked in the maturing 1SW stock (Figure 5, Tables 4 and 5). Both stock complexes have, however, been at full reproductive capacity prior to the distant-water fisheries (i.e. meeting the SER with at least 95% probability) throughout the time-series. In the most recent year, non-maturing 1SW salmon in all Northern NEAC countries were at full reproductive capacity (Figure 6). Maturing 1SW salmon were also at full reproductive capacity for some Northern NEAC countries, but at risk of suffering reduced reproductive capacity in Sweden and actually suffering reduced reproductive capacity in Finland and Russia (Figure 6).

PFAs of maturing 1SW and of non-maturing 1SW salmon for Southern NEAC (Figure 5) demonstrate broadly similar declining trends over the time period (since 1971). Both stock complexes were at full reproductive capacity prior to distant-water fisheries throughout the early part of the time-series. However, in approximately 50% of the years since the mid-1990s, the non-maturing 1SW stock has been either at risk of suffering or suffering reduced reproductive capacity before any fisheries took place. The maturing 1SW stock, on the other hand, was first assessed as being at risk of suffering reduced reproductive capacity in 2009, and has been either at risk of suffering or suffering reduced reproductive capacity in the majority of the years since then. With the exception of UK (N. Ireland), the maturing 1SW components in all Southern NEAC countries in the most recent year are either at risk of suffering (Ireland, France) or suffering reduced reproductive capacity (Figure 6). For the non-maturing 1SW salmon, stocks are at risk of suffering reduced reproductive capacity in UK (Scotland), and suffering reduced reproductive capacity in France and Ireland, whereas stocks in UK (England & Wales) and UK (N. Ireland) are assessed to be at full reproductive capacity (Figure 6).

Spawners relative to CLs

1SW spawners in the Northern NEAC stock complex have been at full reproductive capacity (i.e. meeting the CL with at least 95% probability) throughout the time-series. However, spawners have been at reduced levels since 2007 (Figure 5). MSW spawners, on the other hand, while generally remaining at full reproductive capacity, have spent limited periods at risk of suffering reduced reproductive capacity, most recently in 2007. Both 1SW and MSW stock complexes were at full reproductive capacity in 2017, although 1SW spawners were at the lowest level in the time-series and close to being at risk of suffering reduced reproductive capacity. In the most recent year, 1SW spawners in Northern NEAC countries were either at risk of suffering (Iceland) or suffering reduced reproductive capacity (Russia, Sweden, Teno/Finland; Figure 7). MSW salmon were at full reproductive capacity in Norway and Iceland, but at risk of suffering reduced reproductive capacity in Sweden and suffering reduced reproductive capacity in Finland and Russia (Figure 8).

For the Southern NEAC, there has been a progressive decline in 1SW spawner numbers (Figure 5). This sea age group has been either at risk of suffering or suffering reduced reproductive capacity for most of the time-series, and has been suffering reduced reproductive capacity consistently over the last five years. MSW spawners in Southern NEAC declined to the late 1990s but have increased since this time. However, this sea age group has been either at risk of suffering or suffering reduced reproductive capacity in most years throughout the time-series. In 2017, the MSW sea age group was at risk of suffering reduced reproductive capacity. In the most recent year, 1SW spawners in Southern NEAC countries have been suffering reduced reproductive capacity, with the exception of stocks in UK (N. Ireland; Figure 7). For MSW spawners, stocks in UK (England & Wales) and UK (N. Ireland) were at full reproductive capacity in the most recent year, whereas stocks in France, Ireland, and UK (Scotland) were suffering reduced reproductive capacity (Figure 8).

Trends in rivers meeting CLs

In the NEAC area, nine jurisdictions currently assess salmon stocks using river-specific CLs (Figure 4 and Table 4). The attainment of CLs is assessed based on spawners, after fisheries.

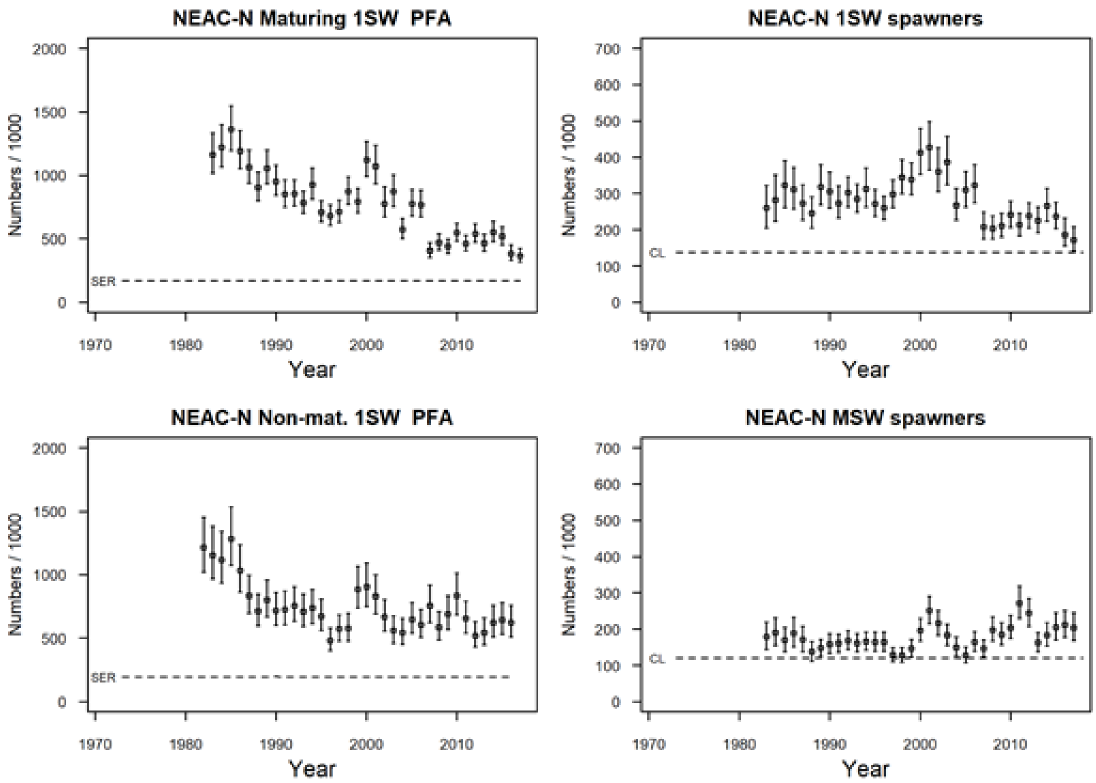
Table 4 Summary of the attainment of CLs in 2017 and trends based on all available data in the NEAC.

Country or jurisdiction	Number of rivers with CLs	Number of rivers assessed for compliance	Number of rivers attaining CL	% of assessed rivers attaining CL	Trend statement
Northern NEAC					
Russia	85	8	7	88	stable
Finland/Norway (Tana/Teno)	24	14	4	29	0% attainment to 2013, variable since 2014 (20% to 40%)
Norway	439	174	142	82	increasing
Sweden	24	22	12	55	increasing (data for 2016 and 2017 only)
Southern NEAC					
UK (Scotland)	171	171	47	27	decreasing
UK (Northern Ireland)	16	11	6	55	increasing
UK (England & Wales)	64	64	50	32	increasing since 2014
Ireland	143	143	44	31	decreasing since 2014
France	35	35	21	60	increasing

Return rates

Smolts going to sea and adult returns are monitored for a limited number of rivers, of different time-series duration. Based on the available data, there has been an overall declining trend since 1980 in the return rates (marine survival) of 1SW wild and hatchery-origin smolts in both Northern and Southern NEAC areas (Figure 9). Results from these analyses are consistent with the information on estimated returns and spawners as derived from the PFA model, and suggest that returns are strongly influenced by factors in the marine environment. The declining trend is not evident for the 2SW wild components in either area, or for hatchery-origin smolts to 2SW in Northern NEAC (no data are available for hatchery-origin 2SW return rates for Southern NEAC).

Despite management measures aimed at reducing exploitation in recent years, there has been little improvement in the status of stocks over time. This is mainly a consequence of continuing poor survival in the marine environment.



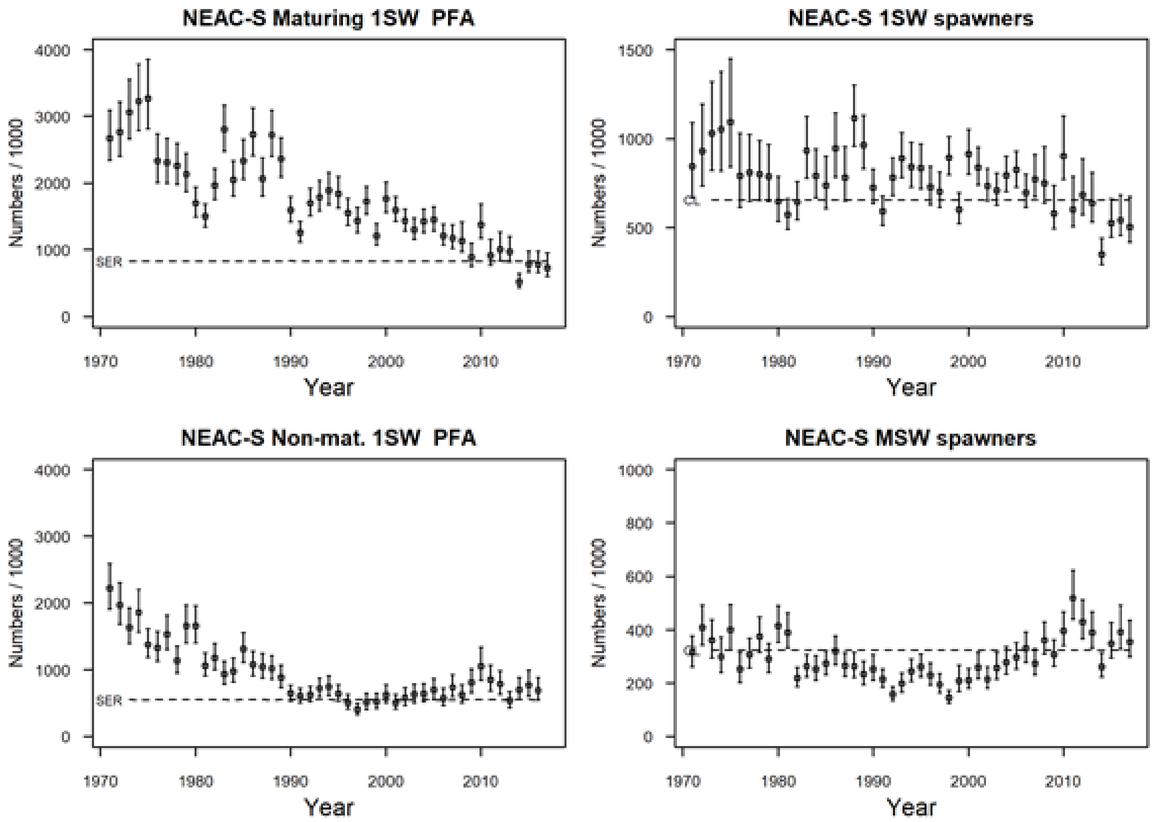


Figure 5 Pre-fishery abundance (PFA) – recruits (left panels) and spawners (right panels), with 90% confidence limits, for maturing 1SW (spawning as 1SW) and non-maturing 1SW (spawning as MSW) salmon in Northern Europe (NEAC-N) and Southern Europe (NEAC-S). The dashed horizontal lines in the left panels are the spawning escapement reserve (SER) values, and in the right panels the conservation limit (CL) values.

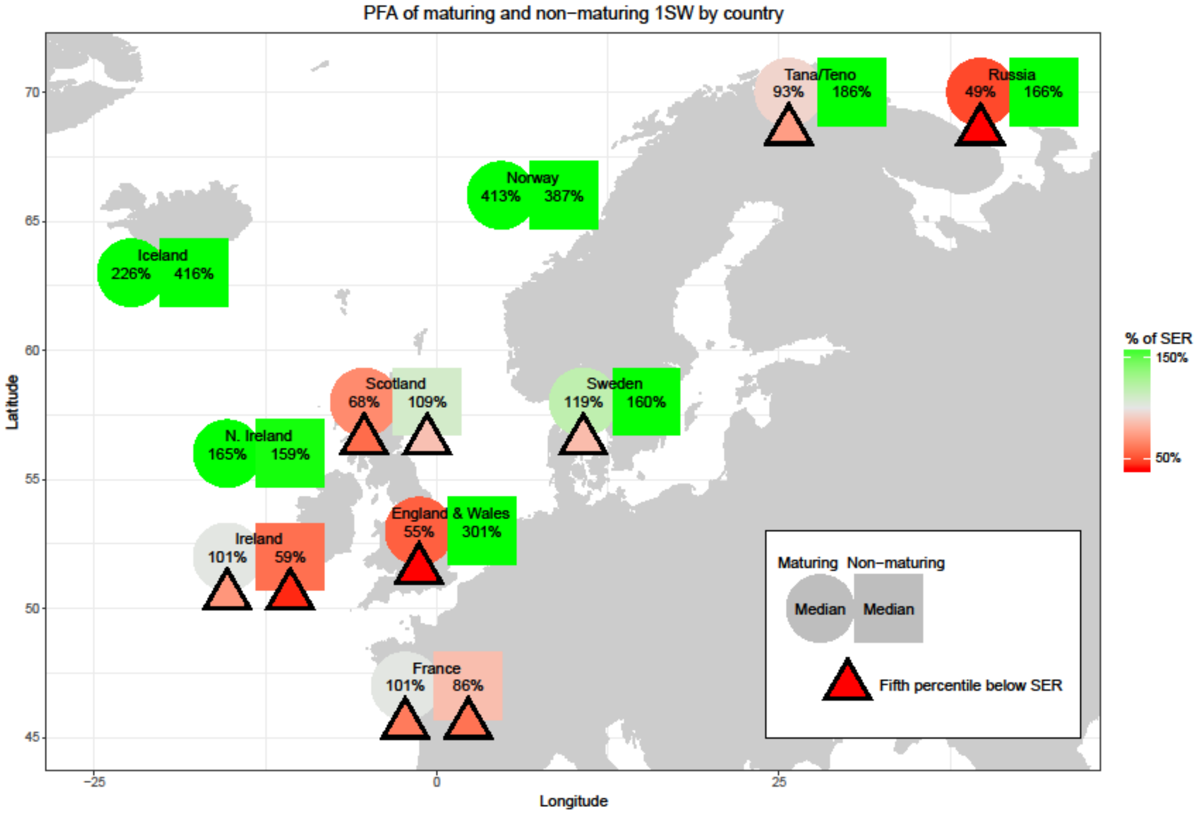


Figure 6 Medians of the most recent year PFA of maturing 1SW (for 2017; circles) and non-maturing 1SW (for 2016; squares), expressed as percentages of the respective spawner escapement reserve (% of SER). The colour shading of the symbols represents the percentage of the SER attained, with red being less than 100% and green greater than 100%. The triangles accompanying the respective PFA symbols indicate when the 5th percentiles of the estimates of PFAs are below the SERs, i.e. when the stocks are either at risk of suffering or suffering reduced reproductive capacity.

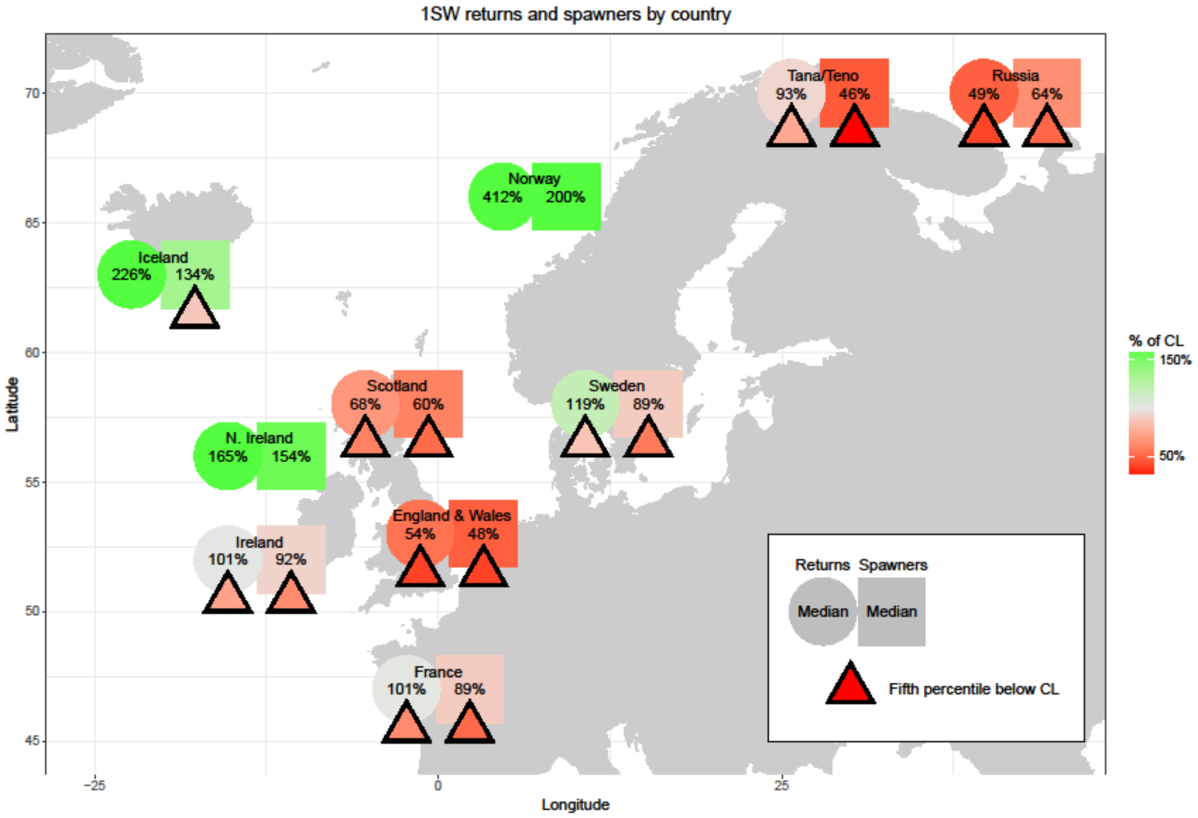


Figure 7 Medians of the estimated returns (circles) and spawners (squares) of 1SW maturing salmon, expressed as percentages of the respective CLs for 2017. The colour shading of the symbols represents the percentage of the CLs attained, with red being less than 100% and green greater than 100%. The triangles accompanying the respective returns and spawners symbols indicate when the 5th percentiles of the estimates of returns and spawners are below the CLs, i.e. when the stocks are either at risk of suffering or suffering reduced reproductive capacity.

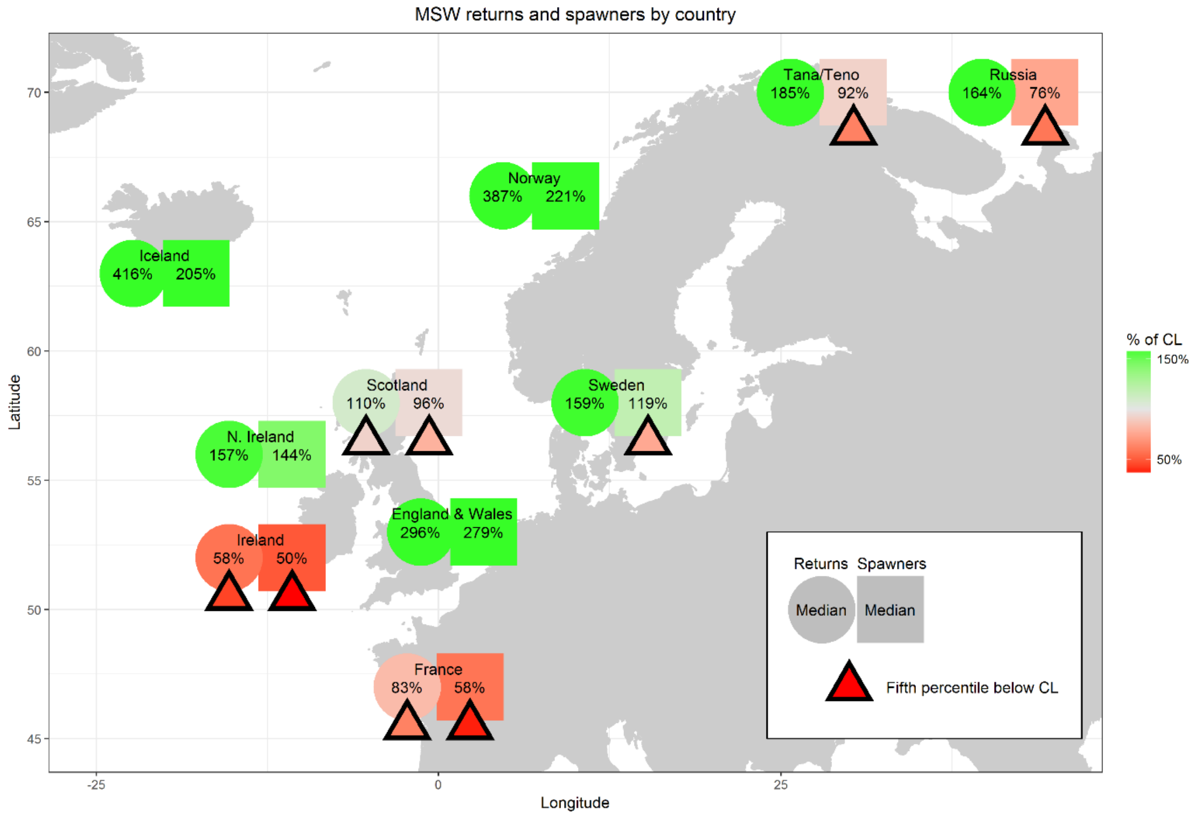


Figure 8 Medians of the estimated returns (circles) and spawners (squares) of MSW salmon, expressed as percentages of the respective CLs for 2017. The colour shading of the symbols represents the percentage of the CLs attained, with red being less than 100% and green greater than 100%. The triangles accompanying the respective returns and spawners symbols indicate when the 5th percentiles of the estimates of returns and spawners are below the CLs, i.e. when the stocks are either at risk of suffering or suffering reduced reproductive capacity.

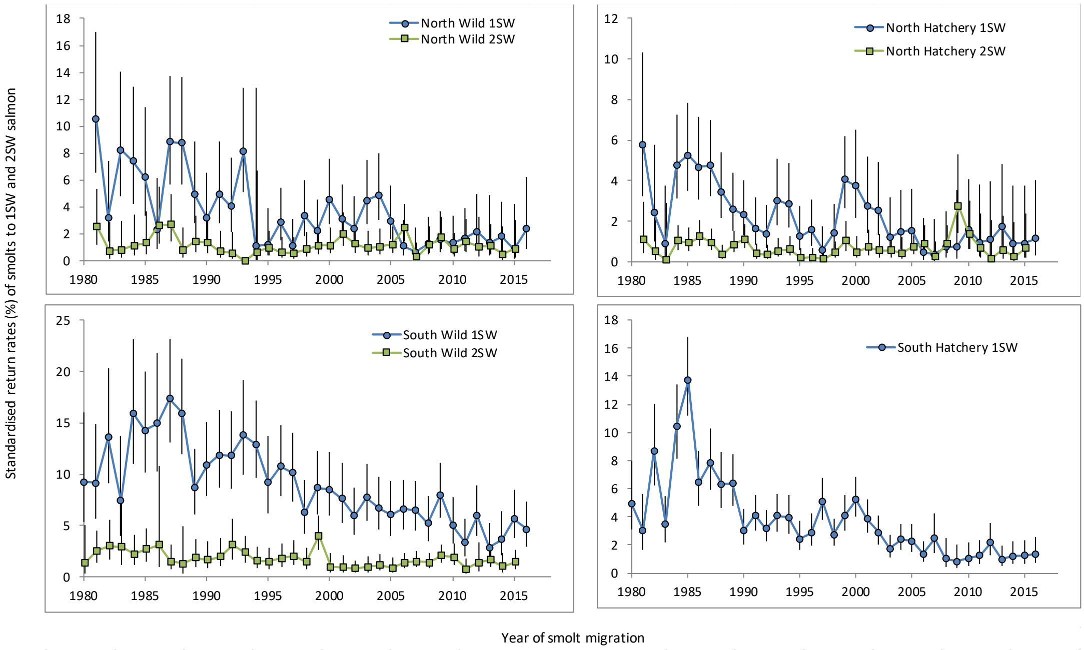


Figure 9 Standardized mean annual return rates indices (%) of wild (left panels) and hatchery-origin (right panels) smolts to 1SW and 2SW adult salmon to Northern (top panels) and Southern (bottom panels) NEAC areas. The standardized values are derived from a general linear model analysis of rivers in a region. Note the differences in scales of the *y*-axes among panels. The *x*-axis denotes the smolt migration year.

Table 4 Estimated pre-fishery abundance (median values) of maturing 1SW salmon (potential 1SW returns) by NEAC country or region and year.

	Northern NEAC								Southern NEAC									NEAC Area		
	Finland	Iceland N&E	Norway	Russia	Sweden		Total		France	Iceland S&W	Ireland	UK(EW)	UK(NI)	UK(Scot)		Total			Total	
Year						5.0%	50.0%	95.0%							5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	31856	11748		NA	22116				64633	77130	1347376	105823	222959	842475	2337600	2673746	3091509			
1972	123962	10731		150935	17628				128270	62846	1430769	101729	194723	828718	2404353	2765507	3218743			
1973	57507	12880		222230	21853				79188	67383	1562477	120398	170618	1043379	2659812	3063260	3548561			
1974	79463	12777		220966	31518				36870	48042	1786138	149999	185899	1012087	2789470	3230690	3781092			
1975	95197	15579		339998	34153				73317	74432	1953983	153292	152453	845694	2815018	3272652	3861062			
1976	86465	15658		236934	19315				68108	58854	1335273	103312	106020	643258	2005675	2330268	2742034			
1977	48948	21743		151649	8736				51253	60211	1158355	117080	104985	800692	2001499	2306090	2671353			
1978	46601	22063		153087	10366				53236	78628	1011310	133261	136100	835099	1982586	2260135	2600595			
1979	41765	21096		211551	10637				60639	72684	927388	127129	95675	832218	1871353	2132058	2446629			
1980	33056	3279		151003	13716				126516	33154	710290	120415	121326	571827	1491835	1698797	1944687			
1981	29770	16575		125138	25013				100716	43043	379541	126726	96201	741795	1341798	1501226	1680057			
1982	17829	7751	889276	109836	22127				62742	44115	775091	108020	138310	825802	1755296	1966925	2214106			
1983	43273	11404	889276	183496	29304	1018164	1160139	1330999	67566	55790	1364118	158111	193610	946472	2482294	2802665	3172469	3570933	3967083	4415277
1984	47110	4156	927356	196463	41154	1064366	1220778	1397246	109779	34281	714738	137177	76366	960949	1810985	2051466	2332254	2942971	3276724	3652756
1985	62042	28132	944601	269811	49273	1195092	1359635	1547176	40894	55187	1180901	137075	98643	809381	2061711	2334611	2654439	3332729	3697878	4117227
1986	49142	34892	823014	230532	51637	1055457	1192643	1351784	62865	90574	1324401	157843	110295	963846	2411531	2733562	3129601	3532024	3929765	4397063
1987	59500	20511	691651	245342	40919	939636	1063205	1200716	111438	56387	855085	164257	60385	785396	1810942	2066483	2382344	2807846	3135392	3510816
1988	34959	29771	634760	169576	34211	801210	905218	1024597	38340	101378	1155386	225043	142325	1036900	2405604	2720771	3097236	3265914	3628212	4061076
1989	75901	16073	699680	251777	10012	933692	1055526	1199582	21221	56513	831672	151846	136535	1147701	2091897	2361969	2683123	3080989	3423282	3810649
1990	76252	12024	628752	208742	23338	841271	951323	1077090	35085	52142	520789	109169	112981	749796	1414745	1595793	1803083	2303137	2548828	2822712
1991	74841	17356	546698	178035	29128	750970	849213	962144	25237	57452	371275	107332	63043	626123	1118628	1263649	1429689	1910250	2114828	2346667
1992	105347	32726	460454	218952	32419	760640	854276	960915	45571	65613	538107	111847	127225	794165	1509610	1702531	1921806	2313476	2560011	2832989
1993	71158	26957	461742	188008	32122	699572	783371	877393	66764	64084	437913	155181	148992	894430	1585881	1794119	2041772	2323962	2578358	2874859
1994	39567	8630	626202	223681	24966	813325	926362	1059234	51655	52707	559656	172570	102417	931422	1673607	1893067	2153138	2536392	2823143	3147421
1995	39531	22558	408377	199945	36459	634069	710808	799488	17048	65279	626061	131994	95161	894316	1628888	1843995	2100944	2296935	2558273	2859045
1996	60742	12064	310886	272771	21642	606902	681729	767330	21394	56362	580523	97631	98283	685183	1367440	1553008	1773128	2009532	2237513	2497257
1997	55170	16509	359459	267446	9797	632434	712205	803078	11042	41101	581074	87630	116641	584647	1263508	1433716	1631544	1930608	2147756	2391208
1998	69178	28050	468593	292777	8008	770391	870374	987876	21459	56346	608354	96263	253656	676426	1535240	1726699	1950087	2352299	2600780	2884611
1999	101755	14254	434929	226246	12559	705541	793449	894347	7127	45721	568175	76089	66169	442826	1066351	1214434	1390946	1810471	2010595	2239328
2000	110710	14982	715753	248115	23111	990955	1118295	1264613	18473	40543	786934	116079	96031	694562	1557565	1767621	2017205	2603977	2887919	3209014
2001	80145	13576	618946	334597	14205	932085	1068606	1235626	15996	36431	627365	101897	77227	725313	1423477	1596074	1803156	2410683	2668744	2971369
2002	49496	23659	378258	303677	13697	670679	774948	910364	36122	45413	548806	96099	139806	555088	1282644	1436735	1610257	2000088	2215335	2462263
2003	48928	12475	525200	271551	7470	757143	870969	1005339	23731	54284	537273	74398	85854	514580	1158014	1304345	1475537	1962075	2178605	2424611
2004	20707	33872	317590	190004	6270	499994	572685	658767	28640	54391	394900	133534	82448	708580	1264477	1422623	1607537	1795320	1998149	2221716
2005	45525	30114	469836	216532	6111	679451	773914	888711	18693	80228	393056	108824	103350	729317	1288132	1451866	1640663	2013334	2230594	2474155
2006	79622	31683	381736	261467	6825	671586	767178	884365	26109	56823	301489	107134	70017	632286	1070145	1210716	1383503	1781206	1982680	2213327
2007	23233	23558	213649	140910	2116	353993	406002	468960	20388	64964	199596	101600	103355	653877	1017912	1174581	1376960	1401758	1584364	1806243
2008	25144	21480	267450	146556	3316	409206	467721	537361	20483	78780	320702	100351	65186	521651	969973	1139436	1419692	1412573	1612395	1905378
2009	44701	34801	214164	137961	3496	385189	437950	498725	5800	88992	263113	62574	40521	404675	757172	887840	1101234	1171227	1331393	1553708
2010	35879	27731	317508	156433	5941	481383	546825	623070	19338	91406	345988	125222	40339	717555	1173861	1378624	1683968	1694167	1931108	2257642
2011	40686	22885	223409	166918	5082	405949	461844	527774	13348	64278	298921	84034	29207	398421	771169	912915	1159064	1207873	1380477	1635863
2012	70264	11931	248244	194836	7225	470968	537757	619145	14557	36389	309334	48662	65991	489184	838511	1004788	1271541	1347700	1549810	1835889
2013	40648	28533	234359	151078	4166	404284	464523	534450	20499	108606	261515	68101	74581	394938	817607	972373	1202056	1254567	1441200	1688789
2014	57834	13422	319926	143077	11479	478712	552172	639384	18013	26642	159565	39967	33785	221261	439667	521781	644936	949844	1079407	1239250
2015	35910	37718	281937	149664	5079	450346	516411	594198	16835	74732	228492	48566	35877	358204	671188	791559	976159	1153717	1311958	1520622
2016	28019	15932	218578	106186	3180	331064	381115	450233	15109	43813	224635	52437	68315	346848	660440	782670	975443	1019758	1169709	1375238
2017	15220	16934	288664	38216	3036	317817	366724	424625	22685	44949	271000	37483	40021	288310	608383	729976	951224	953777	1102160	1334930
10yr Av.	39431	23137	261424	139092	5200	413492	473304	544896	16667	65859	268327	66739	49382	414105	770797	912196	1138532	1216520	1390962	1634731

Table 5 Estimated pre-fishery abundance (median values) of non-maturing 1SW salmon (potential MSW returns) by NEAC country or region and year.

	Northern NEAC								Southern NEAC									NEAC Area		
	Finland	Iceland	Norway	Russia	Sweden		**Total**		France	Iceland	Ireland	UK(EW)	UK(NI)	UK(Scot)		**Total**			**Total**	
Year		N&E				5.0%	**50.0%**	95.0%		S&W					5.0%	**50.0%**	95.0%	5.0%	**50.0%**	95.0%
1971	51951	27105		266693	4393				60046	65555	386724	369669	32782	1295080	1911576	**2220963**	2592808			
1972	79187	25463		429223	7074				39465	59295	385499	282000	28956	1162584	1683092	**1966549**	2305436			
1973	125588	23921		398415	4890				23748	51046	409276	213410	31271	893154	1392111	**1631215**	1922145			
1974	161116	26448		429843	3257				33958	54182	443980	260097	25982	1027601	1567134	**1857171**	2210725			
1975	125119	21730		366742	4522				30750	46808	340674	181485	17975	757052	1188527	**1379966**	1620012			
1976	86740	29634		253588	2363				20406	45436	273490	174328	17582	792849	1126163	**1330900**	1577350			
1977	45495	38070		218822	2605				22403	58710	251617	161301	22778	1011405	1300397	**1537294**	1817655			
1978	47170	25423		199100	4349				20732	37757	211010	86354	16244	754865	953767	**1132322**	1352635			
1979	54181	36039		345893	8781				40613	53650	245507	231064	21261	1054225	1405402	**1656752**	1967152			
1980	70324	14357		238983	5766				30871	37043	193779	306888	17753	1056851	1400671	**1655243**	1958225			
1981	85209	15975		213971	10187				21340	26578	125138	145876	24577	715990	910019	**1063787**	1248414			
1982	87140	12237	835030	269630	7205	1020074	1214007	1450424	20793	42692	207593	148626	33172	723320	1003544	**1180508**	1389958	2045050	2396788	2808369
1983	69865	14698	807346	251518	7570	965504	**1153982**	1383355	26817	35835	143385	109538	13478	603840	783810	**938165**	1125489	1779226	**2091314**	2474862
1984	68591	9908	755175	276216	4121	934553	**1116483**	1340724	20637	26278	152890	149363	17242	611289	823465	**982193**	1180316	1781470	**2099535**	2490335
1985	60507	25350	909739	280156	3877	1073733	**1281447**	1536424	24903	22345	192202	218701	19400	828039	1110421	**1313409**	1556069	2211104	**2597827**	3053523
1986	74600	26110	705647	214963	7467	862312	**1031814**	1238347	16583	19973	231530	184339	10451	607473	914535	**1074917**	1275162	1797469	**2108375**	2483156
1987	50323	16698	558358	197708	6606	694890	**833767**	995571	31436	21998	167365	215423	26727	573902	879537	**1043854**	1242996	1594904	**1879354**	2208859
1988	50874	14408	427113	197201	19627	597407	**711612**	848086	18829	19848	163399	187939	21552	603401	865799	**1020322**	1210425	1478812	**1731640**	2039596
1989	53315	14936	478188	241728	10546	668151	**801428**	958093	14826	19510	74235	198424	19492	551752	732491	**883396**	1066611	1420864	**1685750**	1999076
1990	68090	10325	393607	231509	13338	600284	**719059**	860047	12586	19254	99478	88530	10109	406752	531139	**642058**	771163	1147158	**1363596**	1609962
1991	64082	14985	413867	214096	17924	606963	**727335**	870829	16358	21441	82436	73428	22405	383543	508820	**603363**	720192	1128918	**1332900**	1571896
1992	66977	16955	395755	253172	20231	633347	**755359**	902980	8239	10578	78571	76960	52696	389777	519968	**624558**	755435	1170038	**1380590**	1635674
1993	63161	14332	386669	226060	15306	592638	**708813**	846265	14485	17073	113624	98133	18638	457309	596498	**724427**	879605	1204950	**1435030**	1702677
1994	42435	9205	416697	258320	7771	613730	**736371**	882923	7080	17589	109936	98503	15846	492057	614510	**746904**	909137	1245701	**1482753**	1766228
1995	38768	11963	414818	194486	12531	561265	**673601**	808469	12672	11307	75853	103095	17310	411736	526081	**637402**	782280	1105151	**1312804**	1568330
1996	45056	6656	265884	154519	8839	402537	**482310**	581428	6575	12590	95837	63949	21422	298832	413642	**508154**	625905	830564	**993219**	1187749
1997	42981	9693	319733	192185	4917	475609	**572181**	686280	5487	7798	55825	41060	29426	260280	331834	**404030**	493606	818379	**976965**	1162567
1998	51190	11132	340504	168726	3497	478746	**576383**	696648	11427	15202	85705	80540	13369	287090	405616	**510250**	648685	904564	**1087993**	1316171
1999	97146	6536	471621	295383	12363	738568	**884809**	1064210	7923	4130	106846	83420	17854	291297	423006	**518856**	643915	1179985	**1405229**	1679519
2000	117535	7501	555410	207566	14820	752718	**904944**	1092049	9663	7264	97372	91622	13124	393059	503462	**622180**	776194	1281797	**1528526**	1834190
2001	103048	7068	481052	226304	10163	691101	**830148**	1000027	8726	7842	110952	81620	14186	275228	409603	**508694**	631480	1120507	**1341712**	1602925
2002	74293	7439	425929	158213	2447	556948	**668896**	805656	12453	12523	116892	106016	8512	310864	464571	**578303**	728084	1044579	**1250085**	1502720
2003	33833	7319	386887	121745	7494	461759	**558198**	674392	23250	10162	63984	88576	9007	428504	508389	**633394**	787111	989748	**1193899**	1429466
2004	28027	9079	355354	145844	4990	452638	**544934**	656586	14279	8937	82811	97615	11294	415407	517634	**639670**	796952	988773	**1186473**	1427770
2005	44114	8681	449956	139725	5225	539607	**648737**	779600	14371	7420	60131	87911	8895	500517	556072	**692118**	868400	1118636	**1343002**	1614373
2006	63911	8347	382718	145477	4886	506346	**606492**	726950	13695	4564	23668	84403	9234	429264	461599	**573767**	719911	990033	**1181956**	1424258
2007	64453	10777	441310	229405	6907	623860	**754515**	916132	15093	5219	31684	92116	7180	576190	594238	**737534**	925868	1243868	**1495030**	1801312
2008	27617	8693	346532	194177	6063	483599	**584502**	708807	6984	8081	39961	70911	7308	482933	504208	**625109**	778019	1008890	**1211531**	1455675
2009	44247	12277	380958	240174	7024	567510	**687524**	834176	5762	16727	36928	104651	10671	625665	655857	**811298**	1011667	1248331	**1500146**	1808902
2010	34215	13739	531206	240168	13226	685947	**834798**	1010932	16222	8498	40341	174725	13691	782735	842116	**1056420**	1332890	1559920	**1894455**	2300758
2011	41150	7738	465967	117591	18692	538887	**653996**	792509	12759	4839	35296	138213	32044	609585	683000	**853981**	1072669	1248567	**1512113**	1827093
2012	39726	8858	328120	133852	8002	431559	**519954**	629544	13174	13396	40378	134957	10192	554964	628058	**784166**	983553	1081914	**1306123**	1582320
2013	43131	10606	337617	133324	15904	447154	**543146**	660851	16433	8171	33974	91799	5603	367733	429323	**534697**	671911	897167	**1080730**	1301113
2014	41660	10134	426478	125619	17132	511417	**623894**	760952	18693	7458	36166	149957	7216	463419	555639	**698287**	889074	1093166	**1326506**	1605075
2015	44561	12134	469289	107259	7112	529171	**642139**	779839	7945	10675	34279	195249	13379	488950	603401	**768998**	994838	1162146	**1416645**	1725448
2016	30615	7001	474970	99041	7302	510246	**620346**	757854	8061	14404	46278	154417	8874	441946	546347	**691133**	886830	1084091	**1315368**	1603432
10yr Av.	41138	10196	420245	162061	10736	532935	**646481**	785160	12113	9747	37529	130699	11616	539412	604219	**756162**	954732	1162806	**1405865**	1701113

NASCO 2.4 Provide catch options or alternative management advice for the 2018/2019–2020/2021 fishing seasons, with an assessment of risks relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding

PFA forecasts until 2021 (Figures 10 and 11) for the NEAC complexes were performed using a Bayesian model framework described in ICES (2016a). The probabilities of meeting CLs under different catch scenarios for the mixed-stock fishery in the Faroes in seasons 2018/2019 to 2020/2021, assuming the full catch allocation (sharing agreement) is taken in home waters and no fishing in Greenland, are provided in Table 6. The probabilities of meeting CLs in the individual NEAC countries are presented in Tables 7 and 8. Probabilities of meeting CLs are higher in the Northern than in the Southern complex and are generally higher for Northern countries than Southern countries.

MSY approach

ICES considers that to be consistent with the MSY and the precautionary approach, fisheries should only take place on salmon from stocks that can be shown to be at full reproductive capacity.

Fisheries on mixed stocks pose particular difficulties for management as these fisheries 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. Fisheries in estuaries and, especially, rivers are more likely to meet this requirement.

NEAC stocks are defined at southern and northern geographic group levels and at a finer jurisdiction/country level. No specific risk level has so far been agreed by NASCO for the provision of catch advice for the Faroes fishery; in the absence of this, ICES uses a 95% probability of meeting conservation limits, which can be applied at the level of the NEAC stock complexes and the NEAC countries (ten countries and two age classes).

In the absence of any fisheries in 2018/2019 to 2020/2021, there is less than 95% probability of meeting the CLs for the two Southern NEAC complexes (potential 1SW and MSW spawners) and for the Northern NEAC potential 1SW spawners (Table 6). There is also less than a 95% probability of many individual countries meeting their CLs for MSW fish in the absence of any fisheries and no countries meet their CLs for 1SW fish (Tables 7 and 8). Therefore, in the absence of specific management objectives, ICES advises that there are no mixed-stock fisheries options on the NEAC complexes/countries at the Faroes in 2018/2019 to 2020/2021.

Additional considerations

National stocks are combined into Southern NEAC and Northern NEAC groups. The groups fulfilled an agreed set of criteria for defining stock groups for the provision of management advice (ICES, 2005). At that time, consideration of the level of exploitation of national stocks resulted in the advice for the Faroes fishery (both 1SW and MSW) being based on all NEAC area stocks, and the advice for the West Greenland fishery being based on the Southern NEAC non-maturing 1SW stock only.

ICES (2012) previously emphasized the problem of basing a risk assessment and catch advice for the Faroes fishery on management units comprising large numbers of river stocks. In providing catch advice at the age and stock complex or country levels for Northern and Southern NEAC areas, consideration needs to be given to the recent performance of the stocks within individual countries. Figure 4 indicates that many rivers in the NEAC area are not meeting their CLs.

ICES emphasizes that the national stock CLs discussed above are not appropriate for the management of home-water fisheries, particularly where these exploit separate river stocks. This is because of the relative imprecision of the national CLs and because they do not account for differences in the status of different river stocks or sub-river populations. Management at finer scales should take account of individual river stock status.

At present, insufficient monitoring occurs to assess performance of individual stocks in all countries or jurisdictions in the NEAC area, and in some instances river-specific CLs are in the process of being developed. As a result the combined CLs for the main stock groups (national stocks) exploited by the distant-water fisheries are used to provide general management advice to the distant-water fisheries.

While the abundance of stocks remains low, even in the absence of a fishery at Faroes, particular care should be taken to ensure that fisheries in home waters are managed to protect stocks that are below their CLs.

ICES has indicated that the Faroes fishery may in the past have caught a larger number of North American fish than previously thought (ICES, 2015). North American fish have not been taken into account in the current catch advice, pending a decision from NASCO on how they wish this to be undertaken.

Comparison with previous assessment and catch options

The most recent catch advice in 2016 concluded that there were no catch options at the Faroes for 2016/2017 to 2018/2019 (ICES, 2016a). The current assessment and forecast confirms that advice.

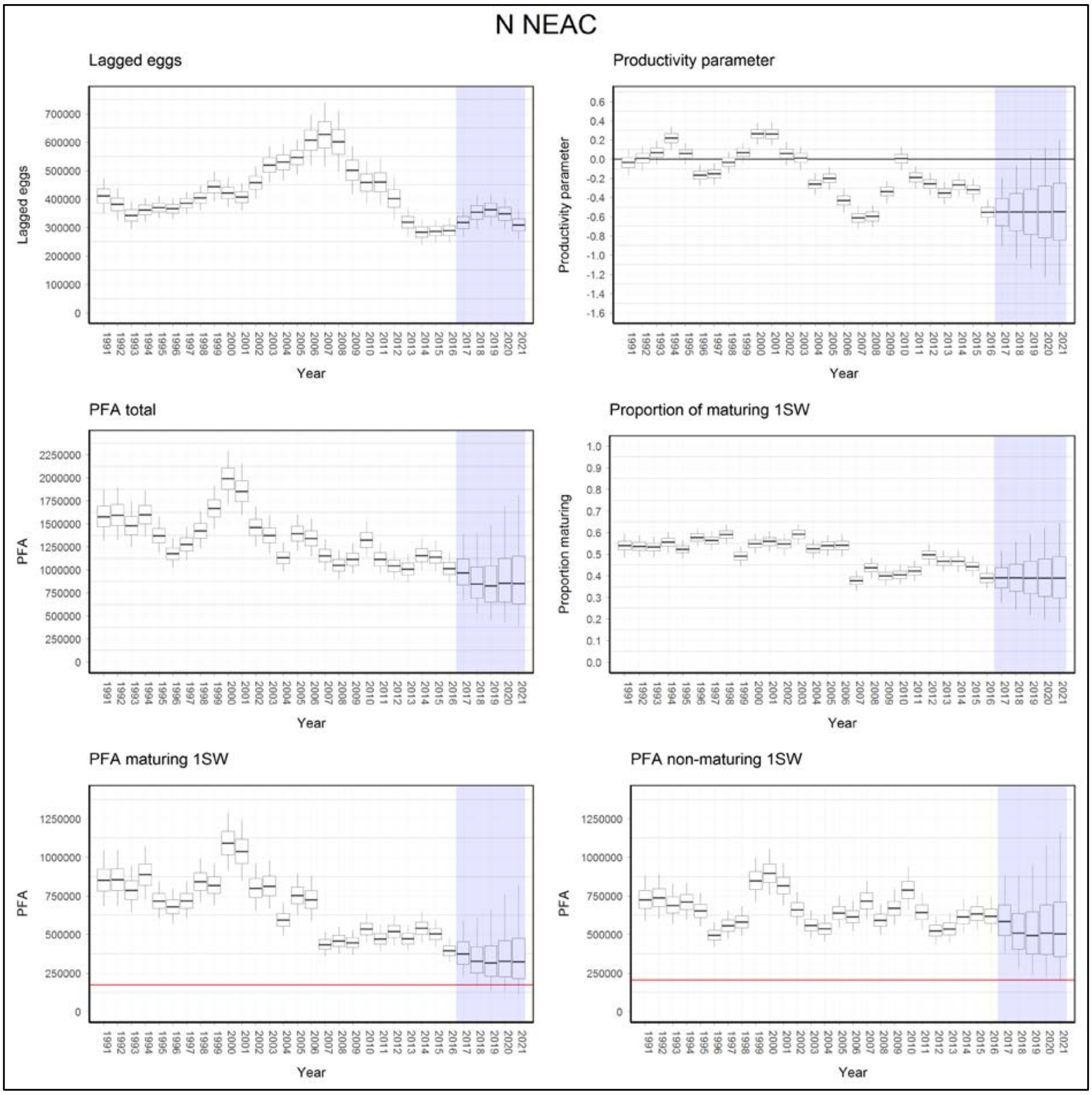


Figure 10 Northern NEAC PFA for maturing (bottom left panel) and non-maturing (bottom right panel) 1SW fish, lagged eggs in thousands, productivity parameter, and proportion maturing as 1SW. The last five years are forecasts (indicated by shading). The horizontal lines in the lower panels are the SER values. Box and whiskers show the 5th, 25th, 50th, 75th, and 95th percentiles of the estimated or forecast distribution.

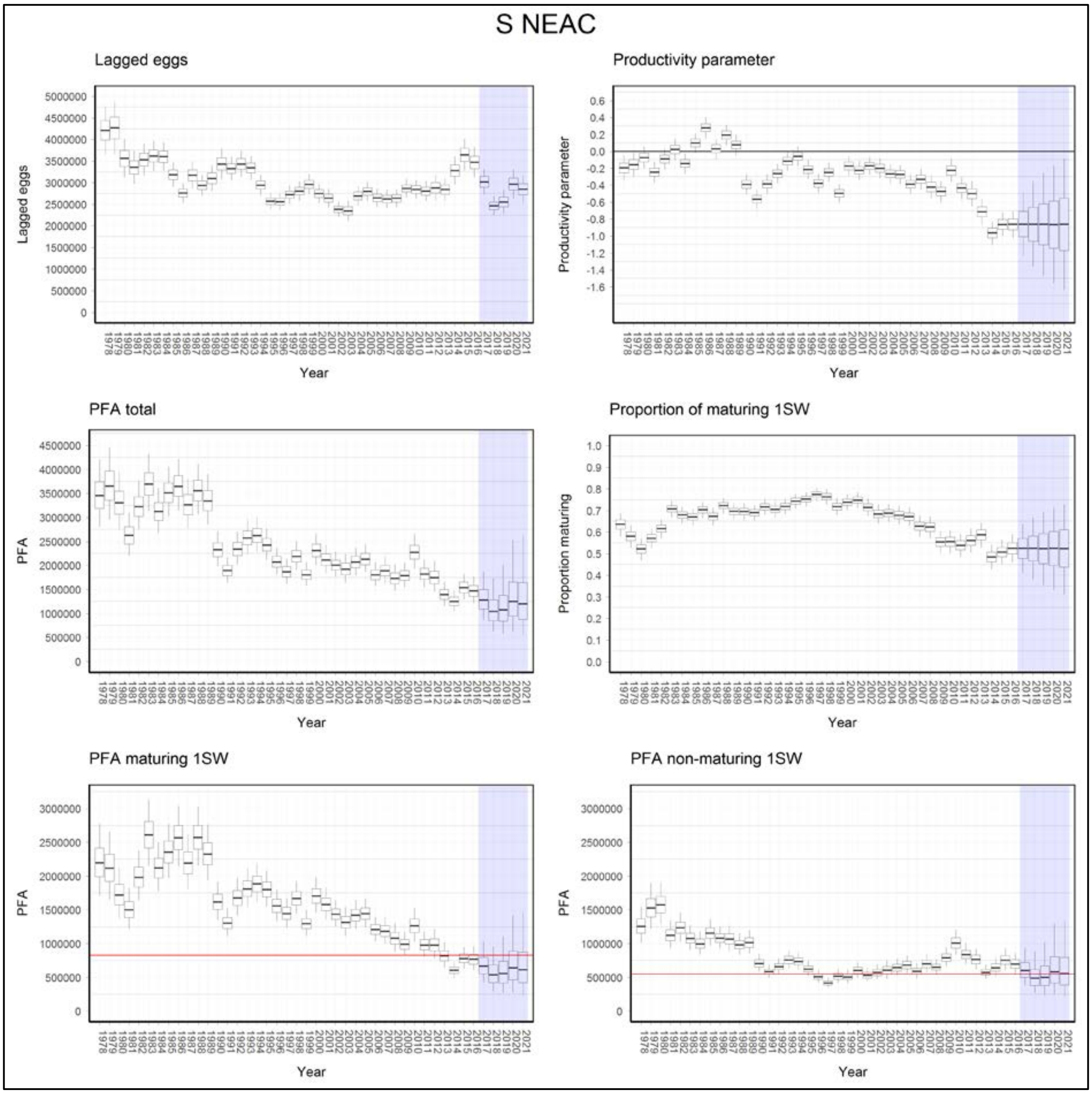


Figure 11 Southern NEAC PFA for maturing (bottom left panel) and non-maturing (bottom right panel) 1SW fish, lagged eggs in thousands, productivity parameter, and proportion maturing as 1SW. The last five years are forecasts (indicated by shading). The horizontal lines in the lower panels are the SER values. Box and whiskers show the 5th, 25th, 50th, 75th, and 95th percentiles of the estimated or forecast distribution.

Table 6 Probability of 1SW and MSW stock complexes in Northern and Southern NEAC achieving their CLs independently and simultaneously for different catch options for the Faroes fishery in the 2018/2019 to 2020/2021 fishing seasons. Shaded cells denote achievement of CLs with ≥95% probability.

Catch options for	TAC option (t)	NEAC-N 1SW	NEAC-N MSW	NEAC-S 1SW	NEAC-S MSW	All complexes simultaneously
2018/2019	0	89%	99%	17%	37%	10%
	20	89%	97%	17%	33%	9%
	40	89%	93%	17%	30%	8%
	60	89%	86%	16%	27%	7%
	80	89%	76%	16%	24%	5%
	100	89%	66%	16%	21%	4%
	120	89%	54%	15%	19%	3%
	140	88%	44%	15%	17%	2%
	160	88%	35%	15%	15%	2%
	180	88%	28%	15%	13%	1%
	200	88%	22%	14%	12%	1%
Catch options for	TAC option (t)	NEAC-N 1SW	NEAC-N MSW	NEAC-S 1SW	NEAC-S MSW	All complexes simultaneously
2019/2020	0	87%	98%	30%	42%	16%
	20	87%	94%	30%	38%	15%
	40	87%	88%	29%	36%	13%
	60	87%	80%	29%	33%	11%
	80	87%	70%	29%	30%	9%
	100	87%	60%	28%	28%	8%
	120	87%	51%	28%	26%	6%
	140	87%	42%	28%	24%	5%
	160	86%	34%	27%	22%	4%
	180	86%	28%	27%	20%	3%
	200	86%	23%	27%	18%	2%
Catch options for	TAC option (t)	NEAC-N 1SW	NEAC-N MSW	NEAC-S 1SW	NEAC-S MSW	All complexes simultaneously
2020/2021	0	84%	96%	29%	55%	18%
	20	84%	92%	28%	52%	17%
	40	84%	86%	28%	49%	15%
	60	84%	79%	28%	46%	13%
	80	84%	71%	28%	44%	11%
	100	84%	62%	27%	41%	10%
	120	83%	53%	27%	39%	8%
	140	83%	46%	27%	37%	7%
	160	83%	38%	26%	35%	5%
	180	83%	32%	26%	33%	4%
	200	83%	27%	26%	31%	4%

Table 7 Probability (%) of National NEAC 1SW stock complexes achieving their CLs individually and simultaneously for different catch options for the Faroes fishery in the 2018/2019 to 2020/2021 fishing seasons. Shaded cells denote achievement of CLs with ≥95% probability.

Catch options for	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
2018/ 2019	0	54%	75%	91%	59%	88%	11%	69%	25%	38%	19%	0.0%
	20	54%	75%	91%	59%	88%	11%	68%	25%	38%	19%	0.0%
	40	54%	75%	91%	59%	88%	11%	68%	25%	38%	19%	0.0%
	60	54%	74%	91%	59%	88%	11%	68%	25%	38%	19%	0.0%
	80	53%	74%	90%	58%	88%	10%	67%	25%	37%	19%	0.0%
	100	53%	74%	90%	58%	87%	10%	67%	24%	37%	19%	0.0%
	120	53%	74%	90%	58%	87%	10%	66%	24%	37%	19%	0.0%
	140	53%	74%	90%	58%	87%	10%	66%	24%	37%	18%	0.0%
	160	53%	74%	90%	58%	87%	10%	66%	24%	37%	18%	0.0%
	180	52%	74%	90%	58%	87%	10%	65%	24%	36%	18%	0.0%
	200	52%	74%	90%	58%	87%	10%	65%	24%	36%	18%	0.0%

Catch options for	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
2019/ 2020	0	51%	73%	90%	43%	90%	19%	79%	28%	43%	25%	0.1%
	20	51%	73%	90%	43%	90%	18%	79%	28%	43%	25%	0.1%
	40	51%	73%	90%	43%	90%	18%	79%	28%	43%	25%	0.1%
	60	51%	73%	90%	43%	89%	18%	79%	28%	43%	25%	0.1%
	80	50%	72%	90%	43%	89%	18%	78%	28%	42%	25%	0.1%
	100	50%	72%	90%	43%	89%	18%	78%	27%	42%	25%	0.1%
	120	50%	72%	89%	43%	89%	17%	78%	27%	42%	24%	0.1%
	140	50%	72%	89%	43%	89%	17%	78%	27%	42%	24%	0.1%
	160	50%	72%	89%	43%	89%	17%	77%	27%	42%	24%	0.1%
	180	50%	72%	89%	42%	89%	17%	77%	27%	41%	24%	0.1%
	200	49%	72%	89%	42%	89%	16%	77%	27%	41%	24%	0.1%

Catch options for	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
2020/ 2021	0	45%	70%	88%	37%	87%	20%	70%	34%	38%	29%	0.0%
	20	45%	70%	88%	37%	87%	20%	70%	34%	38%	29%	0.0%
	40	44%	70%	88%	37%	87%	19%	70%	34%	38%	29%	0.0%
	60	44%	70%	88%	37%	87%	19%	70%	33%	38%	28%	0.0%
	80	44%	70%	88%	37%	87%	19%	69%	33%	37%	28%	0.0%
	100	44%	70%	88%	37%	87%	19%	69%	33%	37%	28%	0.0%
	120	44%	70%	87%	37%	87%	19%	69%	33%	37%	28%	0.0%
	140	44%	69%	87%	37%	87%	18%	68%	33%	37%	28%	0.0%
	160	44%	69%	87%	37%	87%	18%	68%	33%	37%	28%	0.0%
	180	43%	69%	87%	37%	86%	18%	68%	32%	37%	28%	0.0%
	200	43%	69%	87%	37%	86%	18%	68%	32%	36%	28%	0.0%

Table 8 Probability (%) of National NEAC MSW stock complexes achieving their CLs individually and simultaneously for different catch options for the Faroes fishery in the 2018/2019 to 2020/2021 fishing seasons. Shaded cells denote achievement of CLs with ≥95% probability.

Catch options for 2018/ 2019	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
	0	73%	79%	99%	67%	99%	24%	51%	16%	84%	42%	0.3%
	20	58%	71%	98%	61%	98%	21%	49%	16%	81%	41%	0.1%
	40	44%	63%	94%	55%	97%	19%	47%	15%	79%	39%	0.0%
	60	33%	56%	89%	50%	96%	17%	45%	15%	77%	38%	0.0%
	80	23%	49%	83%	46%	94%	15%	44%	14%	75%	37%	0.0%
	100	17%	43%	75%	42%	93%	14%	42%	14%	73%	35%	0.0%
	120	12%	38%	66%	38%	91%	12%	41%	13%	70%	34%	0.0%
	140	8%	34%	58%	35%	89%	11%	39%	13%	69%	33%	0.0%
	160	5%	30%	50%	32%	87%	10%	38%	13%	66%	32%	0.0%
	180	4%	26%	43%	29%	85%	9%	37%	12%	64%	31%	0.0%
	200	3%	23%	36%	27%	83%	8%	36%	12%	62%	30%	0.0%
Catch options for 2019/ 2020	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
	0	60%	74%	98%	67%	96%	21%	63%	23%	89%	28%	0.2%
	20	46%	67%	95%	62%	94%	20%	61%	22%	87%	27%	0.1%
	40	34%	60%	91%	57%	92%	18%	60%	22%	86%	26%	0.0%
	60	25%	54%	85%	53%	89%	16%	59%	21%	85%	25%	0.0%
	80	18%	49%	79%	49%	87%	15%	57%	21%	83%	24%	0.0%
	100	13%	44%	72%	46%	84%	13%	56%	20%	82%	24%	0.0%
	120	9%	39%	65%	43%	81%	12%	55%	20%	81%	23%	0.0%
	140	7%	36%	58%	40%	79%	11%	54%	19%	79%	22%	0.0%
	160	5%	32%	52%	37%	76%	10%	52%	19%	78%	21%	0.0%
	180	4%	29%	45%	35%	74%	9%	51%	18%	76%	21%	0.0%
	200	3%	26%	40%	32%	71%	8%	50%	18%	75%	20%	0.0%
Catch options for 2020/ 2021	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All 1SW MUs simultaneously
	0	57%	72%	97%	49%	96%	30%	73%	26%	88%	35%	0.4%
	20	44%	65%	94%	44%	94%	28%	72%	26%	87%	34%	0.2%
	40	34%	60%	90%	40%	92%	26%	71%	25%	85%	33%	0.1%
	60	25%	54%	86%	37%	90%	25%	70%	25%	84%	32%	0.0%
	80	19%	50%	81%	34%	88%	23%	69%	24%	83%	31%	0.0%
	100	15%	45%	75%	31%	86%	22%	68%	24%	82%	30%	0.0%
	120	11%	42%	69%	28%	84%	20%	67%	24%	80%	29%	0.0%
	140	8%	38%	63%	26%	82%	19%	66%	23%	79%	29%	0.0%
	160	6%	35%	58%	24%	80%	18%	65%	23%	78%	28%	0.0%
	180	5%	32%	52%	23%	78%	16%	64%	22%	77%	27%	0.0%
	200	4%	30%	47%	21%	76%	15%	63%	22%	76%	26%	0.0%

NASCO 2.5 Update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice

The Framework of Indicators (FWI) previously used in support of multi-annual catch options was updated in 2018. In 2016, the FWI had been revised such that only stock complexes deemed appropriate to changing the multi-year advice were included (i.e. those stock complexes that were based on the zero catch option for Faroes when catch advice was last provided; ICES, 2016a). As future catch advice could be determined by the status of stocks in any of the four stock complexes, indicators for each of these have been retained in the FWI in 2018. All existing indicators were updated and examined to see if they still met the criteria for inclusion in the framework (ICES, 2012). As a result of this analysis, four indicators were dropped from the FWI and three new ones added.

Assuming a new multi-annual agreement is confirmed, the updated FWI has been structured such that it could be applied for the next two years, in January 2019 and 2020, based on new indicator values for 2018 and 2019, respectively. Since only the Northern NEAC 1SW salmon and the two Southern NEAC stock complexes are currently forecast to be below CLs, thus resulting in no catch option in the Faroes, the indicators for Northern NEAC MSW salmon would not need to be included in the FWI assessments in 2019 and 2010 to determine whether new catch advice might be required (Figure 12). A full reassessment would be required if any of the other three, the Northern NEAC 1SW salmon and the two Southern NEAC stock complexes suggest an increase in PFA abundance which is above the 75th percentile of the forecast PFA.

FWI NEAC	2019	Indicators suggest:	REASSESS

Indicators for Northern NEAC 1SW PFA

										Reassess in year 2019? Outside 75% conf.lim.		Outside 75% confidence limits	
		Insert data from 2018 here	N reg	Slope	Intercept	r^2	Median PFA in 2018	12.5%ile	87.5%ile	below	above	below	above
1	Returns all 1SW NO PFA est		34	0,552774	-65761,51	0,94	326598	67692,85	161853,66	0	0	Uninformative	Uninformative
2	Survivals W 1SW NO Imsa		34	0,000011	-3,08	0,46	326598	-3,56	4,83	0	0	Uninformative	Uninformative
3	Survivals H 1SW NO Imsa		35	0,000006	-0,87	0,32	326598	-1,83	3,88	0	0	Uninformative	Uninformative
4	Counts all Akujoki (1SW)		15	0,000138	-8,74	0,32	326598	-5,23	78,13	0	0	Uninformative	Uninformative
5	Counts all NO Nausta (1SW)		20	0,001660	263,72	0,22	326598	-125,03	1736,90	0	0	Uninformative	Uninformative
6	Catch rT&N 1SW FI		19	0,0151338	734,79504	0,46	326598	-2961,36	14316,29	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation.	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Northern NEAC MSW PFA

										Reassess in year 2019? Outside 75% conf.lim.		Outside 75% conf.lim.	
		Insert data from 2018 here	N reg	Slope	Intercept	r^2	Median PFA in 2018	12.5%ile	87.5%ile	below	above	below	above
1	PFA-MSW-CoastNorway		34	0,347271	-2431,03	0,85	585215	164371,17	237223,69	0	0	Uninformative	Uninformative
2	Orkla counts		17	0,013444	-3450,23	0,56	585215	2472,78	6382,68	0	0	Uninformative	Uninformative
3	Counts all NO Nausta		20	0,004011	-1337,28	0,34	585215	186,66	1833,25	0	0	Uninformative	Uninformative
4	Returns all 2SW NO PFA est		24	0,2308162	14443,76	0,42	585215	80382,62	218776,12	0	0	Uninformative	Uninformative
5	Catch W rT&N 2SW FI		19	0,007122	-1574,301	0,32	585215	-119,21	5306,43	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation.	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC 1SW PFA

										Reassess in year 2019? Outside 75% conf.lim.		Outside 75% conf.lim.	
		Insert data from 2018 here	N reg	Slope	Intercept	r^2	Median PFA in 2018	12.5%ile	87.5%ile	below	above	below	above
1	Ret. 1SW UK(E&W) Tamar M		24	0,001432	1602,12	0,21	541573	996,21	3759,15	0	0	Uninformative	Uninformative
2	Ret. W 1SW UK(E&W) Frome M		45	0,000509	-86,67	0,40	541573	-332,59	710,90	0	0	Uninformative	Uninformative
3	Ret. W 1SW UK(Sc.) North Esk M		37	0,006373	2890,55	0,67	541573	3114,74	9569,75	0	0	Uninformative	Uninformative
4	Surv. W 1SW UK(NI) Bush M		29	1,806E-05	-9,622657	0,61	541573	-8,97	9,29	0	0	Uninformative	Uninformative
5	Ret. Freshw 1SW UK(NI) Bush		43	0,000562	525,54	0,23	541573	25,84	1633,54	0	0	Uninformative	Uninformative
6	Ret. W 1SW UK(E&W) Dee M		26	0,0031263	-652,8733	0,5	541573	-528,24	2608,76	0	0	Uninformative	Uninformative
7	Surv coast 1SW UK(E&W) Dee M		22	2,513E-06	0,0508386	0,28	541573	-0,63	3,45	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation.	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC MSW PFA

										Reassess in year 2019? Outside 75% conf.lim.		Outside 75% conf.lim.	
		Insert data from 2018 here	N reg	Slope	Intercept	r^2	Median PFA in 2018	12.5%ile	87.5%ile	below	above	below	above
1	Ret. W 2SW UK(Sc.) Baddoch NM		30	0,000055	-10,62	0,38	600538	8,74	36,62	0	0	Uninformative	Uninformative
2	Ret. W 2SW UK(Sc.) Girnoch NM		46	0,000045	4,59	0,39	600538	1,77	61,05	0	0	Uninformative	Uninformative
3	Ret. W MSW UK(E&W) Itchen NM		30	0,000325	-98,19	0,33	600538	5,59	188,77	0	0	Uninformative	Uninformative
4	Ret. W 1SW UK(E&W) Itchen NM		30	0,000733	-153,86	0,29	600538	58,86	513,87	0	0	Uninformative	Uninformative
5	Ret. W MSW UK(E&W) Frome NM		45	0,000790	95,58	0,30	600538	-8,53	1148,62	0	0	Uninformative	Uninformative
6	Ret. W 1SW UK(E&W) Frome NM		45	0,000673	169,47	0,24	600538	-1,21	1148,94	0	0	Uninformative	Uninformative
7	Catch W MSW Ice Ellidaar NM		46	0,000117	-37,84	0,54	600538	-24,79	89,24	0	0	Uninformative	Uninformative
8	Ret. W 2SW UK(Sc.) North Esk NM		37	0,0079838	1458,9333	0,51	600538	3804,18	8702,83	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation.	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Figure 12 The Framework of Indicators spreadsheet for the Faroes fishery. The Northern NEAC MSW stock complex is shaded out since only the two Southern NEAC stock complexes and the Northern NEAC 1SW stock complex currently determine the outcome of the FWI. The Northern NEAC MSW stock complex is still retained in the spreadsheet because it may influence the advice in future.

Identify relevant data deficiencies, monitoring needs, and research requirements

No data deficiencies, monitoring needs, or research requirements of relevance to the Northeast Atlantic Commission were found.

The full list of data deficiencies, monitoring needs and research requirements for North Atlantic salmon is presented in Section 1.5 of the sal.oth.nasco advice (ICES, 2018b).

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Annex 1 Glossary of acronyms and abbreviations

1SW *(one-sea-winter).* Maiden adult salmon that has spent one winter at sea.

2SW (*two-sea-winter*). Maiden adult salmon that has spent two winters at sea.

CL (or **CLs**)**, i.e. S_{lim}** *(conservation limit).* Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.

FWI *(Framework of Indicators).* The FWI is a tool used to indicate if any significant change in the status of stocks used to inform the previously provided multi-annual management advice has occurred.

ICES (*International Council for the Exploration of the Sea*).

MSY (*maximum sustainable yield*). The largest average annual catch that may be taken from a stock continuously without affecting the catch of future years; a constant long-term MSY is not a reality in most fisheries, where stock sizes vary with the strength of year classes moving through the fishery.

MSW (*multi-sea-winter*). A MSW salmon is an adult salmon which has spent two or more winters at sea and may be a repeat spawner.

NASCO (*North Atlantic Salmon Conservation Organization*). An international organization, established by an inter-governmental convention in 1984. The objective of NASCO is to conserve, restore, enhance, and rationally manage Atlantic salmon through international cooperation, taking account of the best available scientific information.

NEAC (*North East Atlantic Commission).* The commission within NASCO with responsibility for Atlantic salmon in the North-east Atlantic.

PFA *(pre-fishery abundance).* The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time.

SER *(spawning escapement reserve).* The CL increased to take account of natural mortality between the recruitment date (assumed to be 1st January) and the date of return to home waters.

TAC (*total allowable catch*). TAC is the quantity of fish that can be taken from each stock each year.

Annex 2 General considerations

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 (CLs) by the use of management targets. CLs for North Atlantic salmon stock complexes have been defined by ICES as the level of a stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY). 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. Advice for the Faroes fishery (which historically harvested both 1SW and MSW salmon) is currently based upon all NEAC area stocks. The advice for the West Greenland fishery (ICES, 2018a) is based upon the Southern NEAC non-maturing 1SW stock and the non-maturing 1SW salmon from North America. A 75% risk level (probability) of achieving the management objectives simultaneously in the six North American regions and Southern NEAC has been agreed by NASCO for the provision of catch advice at West Greenland. No specific risk level has so far been agreed by NASCO for the provision of catch advice for the Faroes fishery; in the absence of this, ICES uses a 95% probability of meeting individual conservation limits, which can be applied at the level of the European stock complexes (two areas and two age classes) and the NEAC countries (ten countries and two age classes). A framework of indicators 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 Northeast Atlantic area, their current distribution extends from northern Portugal to the Pechora River in Northwest Russia and Iceland. 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 the Northeast Atlantic stocks being exploited at both West Greenland and the Faroes.

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, for some stocks, are now at their lowest levels in the time-series, even after closure of marine fisheries. Climatic factors modifying ecosystem conditions and the impact of predators of salmon at sea are considered to be the main contributing factors of lower productivity, which is expressed almost entirely in terms of lower marine survival.

Effects of the fisheries on the ecosystem

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

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Provisional catch data for 2016 were updated, where appropriate, and the assessment extended to include data for 2017.

Scientific basis

ICES stock data category	1 (ICES, 2016b).
Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in data and process error. Results presented in a risk analysis framework.
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	Discard data are included in risk-based framework for the Faroes fishery. Not relevant for other NEAC assessments.
Indicators	Framework of Indicators (FWI) is 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. Stock annex developed in 2014 and updated in 2017 (ICES, 2017).
Working group	Working Group on North Atlantic Salmon (WGNAS) (ICES, 2018c).

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Atlantic salmon from North America

Summary of the advice for 2018 to 2021

ICES advises that, in line with the management objectives agreed by the North Atlantic Salmon Organization (NASCO) and consistent with the MSY approach, there are no mixed-stock fishery options on 1SW non-maturing salmon and 2SW salmon in North America in the period 2018 to 2021.

In the absence of any fishing on 1SW non-maturing salmon and 2SW salmon in North America, there is less than 75% probability in the period 2018 to 2021 that the numbers of 2SW salmon returning to the six regions of North America will be above those defined in the management objectives (conservation limits for the four northern areas; rebuilding objectives for the two southern areas) simultaneously for the six regions.

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 2019, with the returns or return rate data for 2018, to evaluate the appropriateness of the advice for 2019, and again at the beginning of 2020, with the returns or return rate data for 2019, to evaluate the appropriateness of the advice for 2020.

NASCO 3.1 Describe the key events of the 2017 fisheries (including the fishery at Saint Pierre and Miquelon)

The provisional catch of Atlantic salmon in eastern North America in 2017 was estimated at 115 tonnes (t), of which 112 t was reported from Canada, 3 t from France (Islands of Saint Pierre and Miquelon), and 0 t from USA (tables 1 and 2; Figure 1). There were no commercial or recreational fisheries for Atlantic salmon in USA in 2017.
The dramatic decline in harvested tonnage since 1980 is in large part the result of the reductions in commercial fisheries effort, with closure of the Newfoundland commercial fishery in 1992, the Labrador commercial fishery in 1998, and the Quebec commercial fishery in 2000. All commercial fisheries for Atlantic salmon remained closed in Canada in 2017.

Unreported catch for Canada in 2017 was 25 t and 0 t for USA. France (Islands of Saint Pierre and Miquelon) did not provide an unreported catch value.

The assessment regions for North America are shown in Figure 2.

Three groups exploited salmon in Canada in 2017: Indigenous people, residents fishing for food in Labrador, and recreational fishers. No rivers in the Gulf and Scotia-Fundy were opened for retention recreational fisheries. Mandatory catch and release measures were in effect during the period 2015–2017 in the recreational fisheries for the Gulf region. Fishing regulations in Quebec limited the retention of small and large salmon to 19 of 114 rivers, retention of small salmon to only 55 rivers; eight rivers were opened to catch and release only and 32 rivers were closed to salmon fishing. Only retention of small salmon was allowed in rivers which were open for recreational fisheries in Newfoundland and Labrador.

For Canada in 2017, 8% of the harvests were taken in coastal areas, entirely from Labrador. The harvest from France (Islands of Saint Pierre and Miquelon) was entirely from coastal areas. Overall for eastern North America in 2017, 61% of the harvests were in-river, 29% from estuaries, and 10% from coastal areas.

Exploitation rates of both large salmon (≥ 63 cm, fork length) (2SW, 3SW, and previous spawners) and small salmon (mostly 1SW) remained relatively stable until 1984 and 1992, and then declined sharply with the introduction of restrictive management measures (Figure 3). Declines continued in the 1990s. In the last few years, exploitation rates have remained among the lowest in the time-series.
In the recreational fisheries of Canada, 49 513 salmon (26 354 small and 23 159 large) were estimated to have been caught and released, representing about 67% of the total catch by number.

Table 1 Salmon catches and catch locations in the NAC area in 2017. Catches of NAC origin salmon at Greenland are reported in the West Greenland Commission area.

	Canada					St Pierre & Miquelon	USA	North America
	Commercial	Indigenous	Labrador resident	Recreational	Total			
2017 reported harvests (t)	0	61	2	49	112	3	0	115
% of NAC total	-	53	1	43	98	2	0	100
Unreported catch (t)					25	na	0	25
Location of catches								
% in-river					62	0	-	61
% in estuaries					30	0	-	29
% coastal					8	100	-	10

Table 2 Total reported nominal harvest (in tonnes, round fresh weight) of salmon in home waters in North America for Canada (small salmon, large salmon, and total), for USA, and for France (Saint Pierre and Miquelon [SPM]), 1980 to 2017. The 2017 figures include provisional data.

Year	Canada			USA	SPM
	Small	Large	Total		
1980	917	1763	2680	6	-
1981	818	1619	2437	6	-
1982	716	1082	1798	6	-
1983	513	911	1424	1	3
1984	467	645	1112	2	3
1985	593	540	1133	2	3
1986	780	779	1559	2	3
1987	833	951	1784	1	2
1988	677	633	1310	1	2
1989	549	590	1139	2	2
1990	425	486	911	2	2
1991	341	370	711	1	1
1992	199	323	522	1	2
1993	159	214	373	1	3
1994	139	216	355	0	3
1995	107	153	260	0	1
1996	138	154	292	0	2
1997	103	126	229	0	2
1998	87	70	157	0	2
1999	88	64	152	0	2
2000	95	58	153	0	2
2001	86	61	148	0	2
2002	99	49	148	0	2
2003	81	60	141	0	3
2004	94	68	161	0	3
2005	83	56	139	0	3
2006	82	55	137	0	3
2007	63	49	112	0	2
2008	100	57	158	0	4
2009	74	52	126	0	3
2010	100	53	153	0	3
2011	110	69	179	0	4
2012	74	52	126	0	3
2013	72	66	137	0	5
2014	77	41	118	0	4
2015	86	54	140	0	4
2016	79	56	135	0	5
2017	57	55	112	0	3

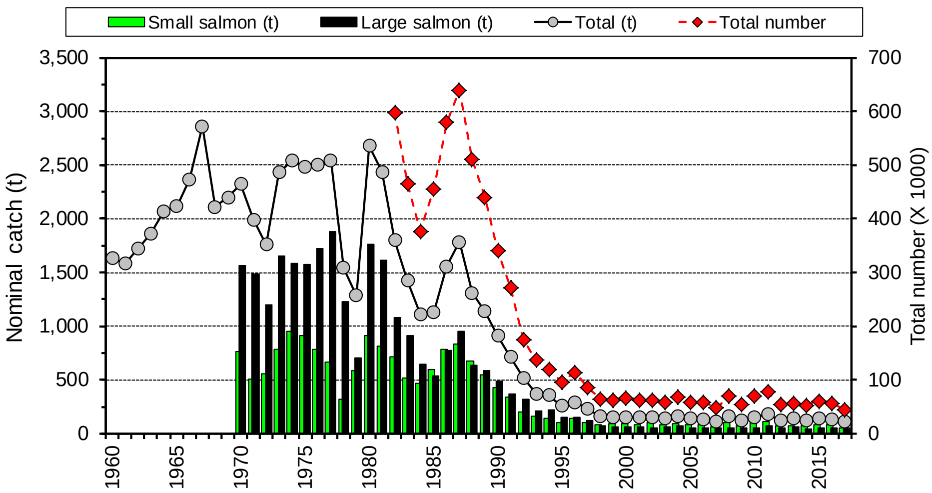

Figure 1 Nominal catch (harvest; t) of salmon in Canada (combined harvests in USA and Saint Pierre and Miquelon are ≤ 6 t in any year), 1960 to 2017.

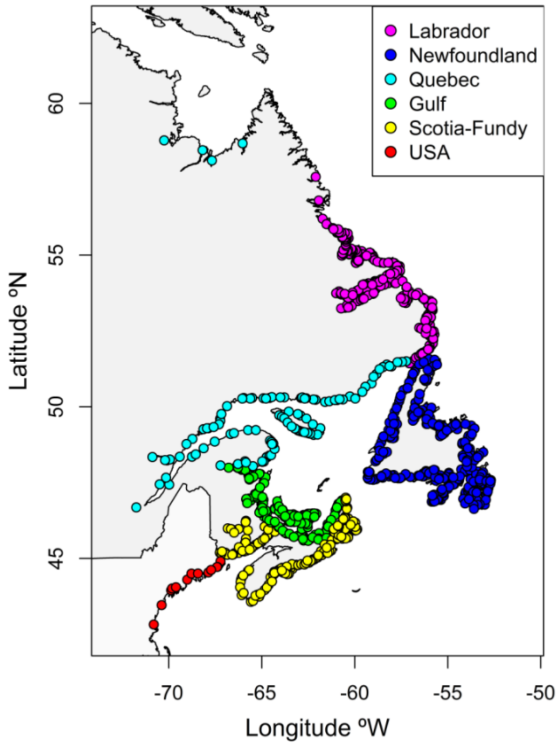

Figure 2 Regional groups (colours) used for the assessment of salmon in the North American Commission. Dots indicate locations of salmon rivers.

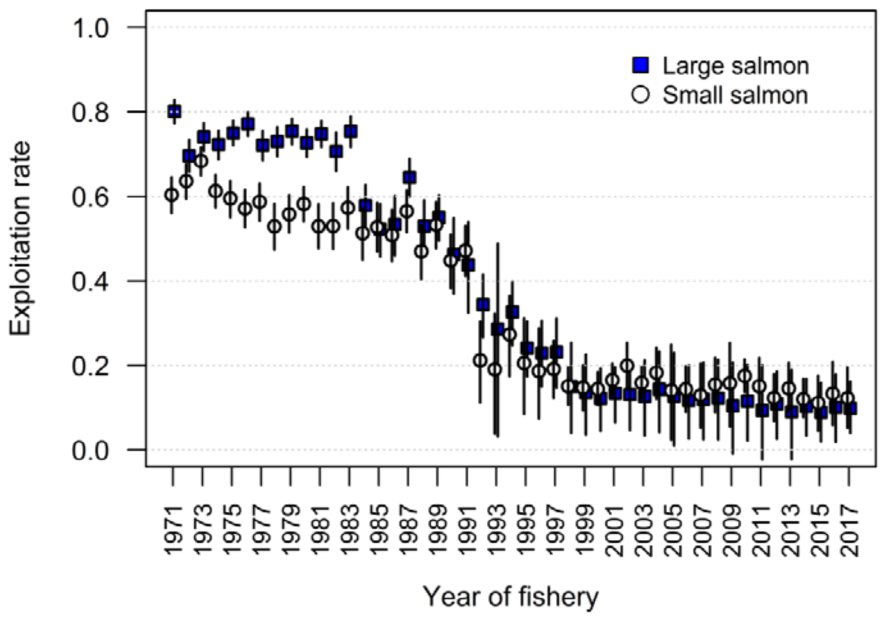

Figure 3 Exploitation rates in North America on small (mostly 1SW) and large (2SW, 3SW, and repeat spawners) salmon, 1971 to 2017.

Origin and composition of catches

In the past, salmon from both Canada and the USA were taken in the commercial fisheries of eastern Canada. Sampling programmes of current marine fisheries (Labrador subsistence and Saint Pierre and Miquelon (SPM)) are used to monitor the stock composition of these mixed-stock fisheries.

The stock composition is determined using a North American genetic baseline for Atlantic salmon, which allows assignment to twelve regional groups (Figure 4) based on 15 microsatellite loci (Bradbury *et al.*, 2014; Moore *et al.*, 2014). The origin of salmon in the mixed-stock fisheries has been previously reported for the Labrador subsistence fishery (Bradbury *et al.*, 2015; ICES, 2015) and for the SPM fishery (ICES, 2015; Bradbury *et al.*, 2016). The accuracy of assignment in these analyses was very high (94.5%). The regional groups from the genetic assignments do not correspond directly to the regions used by ICES to characterize stock status and to provide catch advice. Assessment of stock status and provision of catch advice is not possible at the scale of the genetic groups because historical catch reporting is available at a jurisdictional scale that is broader than the genetic groups. However, the regional genetic groups can be aligned to the ICES regions (Figure 4).

ICES region	Regional group	Group acronym
Quebec		
Labrador	Ungava / Northern Labrador	UNG
	Labrador Central	LAB
	Quebec / Labrador South	QLS
Quebec	Quebec	QUE
	Anticosti	ANT
	Gaspe	GAS
Gulf		
	Gulf of St. Lawrence	GUL
Scotia-Fundy	Nova Scotia	NOS
	Inner Bay of Fundy	FUN
USA	USA	US
Newfoundland	Newfoundland	NFL
	Avalon	AVA

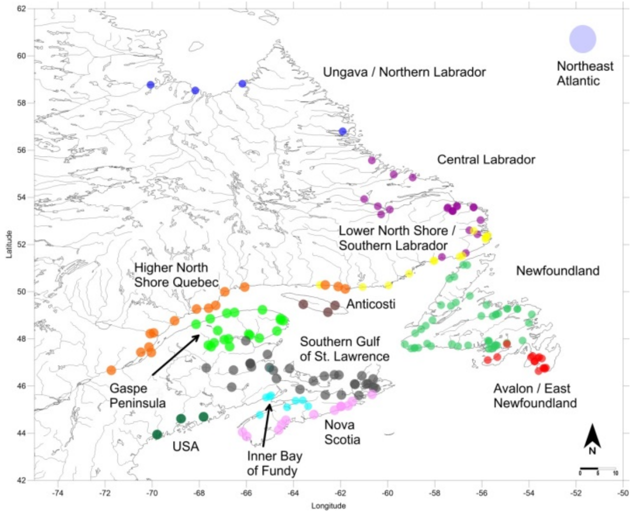

Figure 4 Map of sample locations used in the microsatellite baseline for Atlantic salmon which provided twelve defined regional groups for eastern North America (labelled and identified by colour) and correspondence between regional groups and ICES assessment regions for eastern North America.

Labrador fishery origin and composition of the catches

In 2015 to 2017, a total of 1486 samples (728, 445, 492 in 2015 to 2017, respectively), (3% to 5% of the estimated annual harvest by number) were collected from the Labrador subsistence (Indigenous and Labrador resident) fisheries. Based on genetic analyses of these tissue samples, the Labrador Central (LAB) regional group represented the majority (average over years of 98.9%) of the salmon sampled, consistent with previous analyses conducted for the period 2006–2014 which estimated > 95.0% of the harvest was attributable to Labrador stocks (Figure 5; Bradbury *et al.,* 2015; ICES, 2015). In 2015 and 2016, no samples were assigned with greater than 1% probability to the USA regional group; however in 2017, two of 180 samples from SFA 2 (southern Labrador) were assigned to the USA group. No USA origin salmon were identified in the mixed-stock analysis of samples from 2012 to 2016; however, Bradbury et al. (2014) previously reported the presence of a few samples of USA origin salmon from the fisheries in the period 2006 to 2011.

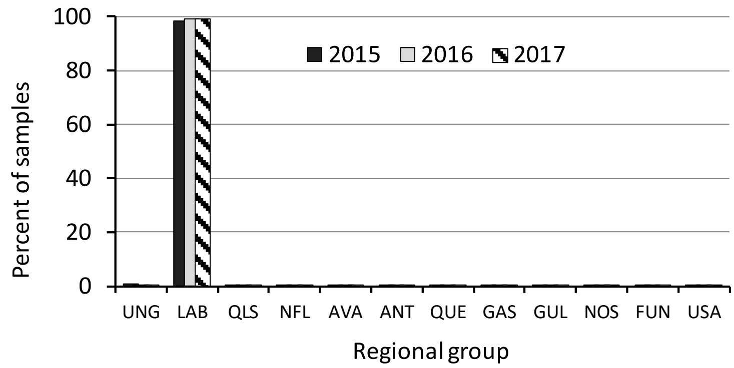

Figure 5 Percentages of Labrador subsistence fishery samples assigned to regional groups of eastern North America for the fishery years 2015 to 2017.

Saint Pierre and Miquelon (SPM) fishery origin and composition of the catches

A total of 398 salmon sampled from the Saint Pierre and Miquelon fishery in the period 2015 to 2017 were analysed using the microsatellite panel (Figure 6). In contrast to the 2013 and 2014 samples, which were dominated by large salmon (≥ 63 cm), samples from the 2015 to 2017 fisheries were dominated by small salmon (< 63 cm). Regional analysis indicated the dominance of three regional groups (83–89%: Southern Gulf of St. Lawrence, Gaspe Peninsula, and Newfoundland), consistent with previous studies to 2014 (ICES, 2015; Bradbury *et al.*, 2016) (Figure 6). Consistent with increases in the proportion of small salmon in the samples, the proportion from the

Newfoundland regional group increased over time (Figure 6). There was no information on the proportion of small salmon in the total harvest for Saint Pierre and Miquelon nor on how the samples were collected making it difficult to interpret whether sampling is representative of the harvest.

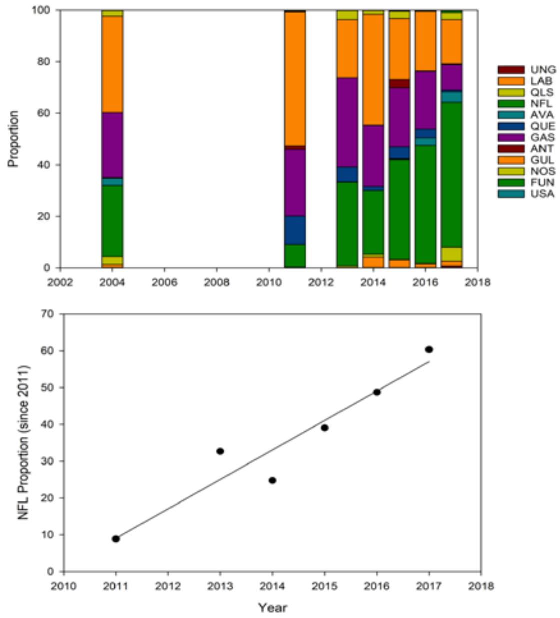

Figure 6 Changes in estimates of region of origin of samples from the Saint Pierre and Miquelon Atlantic salmon fishery over time 2004–2017. Baseline locations refer to North American regional reporting groups shown in Figure 4. Pre-2015 data from Bradbury *et al*. (2016). In the bottom panel, NFL proportion refers to the proportion of the samples from the fishery assigned to the Newfoundland and Avalon regional groups.

NASCO 3.2 Update age-specific stock conservation limits based on new information as available, including updating the time-series of the number of river stocks with established CLs by jurisdiction

Fisheries and Oceans Canada (DFO) reviewed and refined the reference points for Atlantic salmon to conform to the precautionary approach used in Canada (DFO, 2009). DFO Maritimes Region (Scotia-Fundy) has retained the previous conservation egg deposition requirement of 240 eggs per 100 m² as the limit reference point (DFO, 2012). DFO Newfoundland and Labrador regions retained the previous conservation requirement, as equivalent to the Limit Reference Point, and further defined the upper stock reference as 150% of the limit reference point (DFO, 2017). The Province of Quebec revised the limit reference point and upper stock reference point using a Bayesian hierarchical analysis of stock–recruitment data (Dionne *et al*., 2015; MFFP, 2016). DFO Gulf Region undertook an exercise in 2017 to revise and define the limit reference point in that region of Canada using the proportion of eggs from MSW salmon as a covariate in the Bayesian Hierarchical Model (DFO, 2018). The limit reference points in all cases are defined in terms of total eggs from all sizes and sea ages of salmon.

In Canada, conservation limits (CLs) were first established in 1991 for 74 rivers. Since then the number of rivers with defined CLs increased to 266 in 1997 and to 476 since 2014 (Figure 7). Conservation limits have been established for 33 river stocks in USA since 1995 (Figure 7).

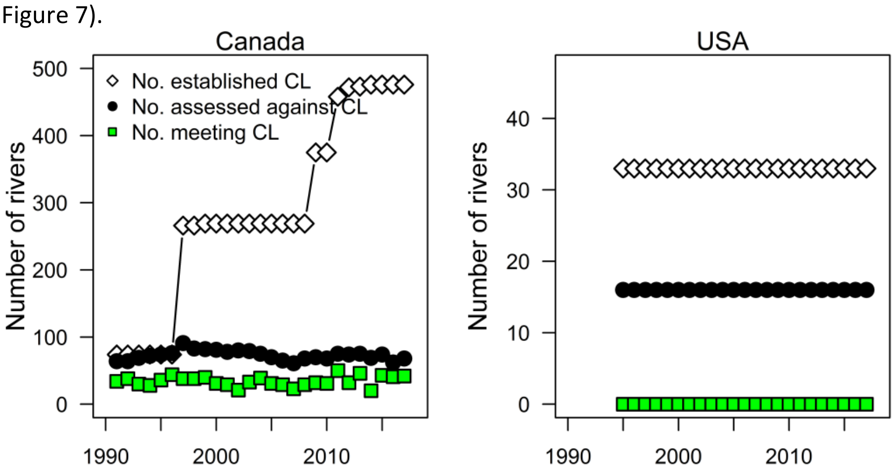

Figure 7 Time-series for Canada and the USA showing the number of rivers with established CLs, the number rivers assessed, and the number of assessed rivers meeting CLs, for the period 1991 to 2017.

These revised limit reference points for Canada have yet to be converted to adult (and 2SW) sea age equivalents, as a result, there were no changes to the 2SW conservation limits for the regions in North America. Rebuilding management objectives have been defined for Scotia-Fundy and USA. For Scotia-Fundy, the management objective 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 (Table 3).

Table 3 2SW CLs and management objectives for the regional groups in North America in 2017.

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

NASCO 3.3 Describe the status of the stocks, including updating the time-series of trends in the number of river stocks meeting CLs by jurisdiction

Stock status is presented for six assessment regional groups (Figure 2) and overall for North America.

Returns of small (1SW), large (MSW), and 2SW salmon (a subset of large) to each region are estimated by the methods reported by ICES (1993). 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 home water commercial fisheries, except in the case of the Newfoundland and Labrador regions where returns do not include landings in commercial and subsistence fisheries.

The non-maturing component of 1SW salmon, destined to be 2SW returns (excluding 3SW and previous spawners) is the estimated number of salmon in the North Atlantic on August 1 of the second summer at sea. The pre-fishery abundance (PFA) estimates account for returns to rivers, fisheries at sea in North America, fisheries at West Greenland, and corrected for natural mortality. Harvests of North American origin salmon in the fishery at Faroes are not included. As the PFA estimate for potential 2SW salmon requires an estimate of returns to rivers, the most recent year for which an estimate of PFA is available is 2016. Maturing 1SW salmon are in some areas (particularly Newfoundland) a major component of salmon stocks, and their abundance when combined with that of the 2SW age group provides an index of the majority of a smolt cohort.

The total estimate of small salmon returns to North America in 2017 (370 000) was 19% lower than in 2016 and near the lower third of the values of the 48-year time-series (Figure 8). Small salmon returns in 2017 decreased from the previous year in four of the six geographical regions (Labrador, Newfoundland, Quebec, Gulf), and increased in the Scotia-Fundy and USA although returns of small salmon to Scotia-Fundy were the fifth lowest on record. Small salmon returns to Labrador (163 100) and Newfoundland (155 200) combined represent 86% of the total small salmon returns to North America (370 000) in 2017.

The total estimate of large salmon returns to North America in 2017 (161 500) was 7% lower than in 2016 (173 900) and in the mid-range of values of the 48-year time-series (Figure 9). Large salmon returns in 2017 decreased from the previous year in four of the six geographical regions (Newfoundland, Quebec, Gulf, and Scotia-Fundy) and increased in Labrador and USA. Large salmon returns in 2017 were the third lowest on record for Scotia-Fundy (1196), and the fourth lowest on record for Gulf (27 090), whereas large salmon returns to Labrador (76 970) in 2017 were the second highest on record. Large salmon returns to Labrador, Quebec, and Gulf regions collectively represented 88% of the total large salmon returns to North America in 2017.

The total estimate of 2SW salmon returns to North America in 2017 (101 350) was 6% lower than in 2016 and ranks 30th (descending) out of the 48-year time-series (Figure 10). The regional trends in returns of 2SW salmon follow closely those of the large salmon as 2SW salmon are a relatively stable subset of the large salmon. Returns in 2017 decreased from the previous year in four (Newfoundland, Quebec, Gulf, and Scotia-Fundy) of the six geographical regions, but increased in Labrador and USA. 2SW salmon returns in 2017 were among the lowest values on record for Newfoundland (eighth lowest), Gulf (eighth lowest), Scotia-Fundy (fifth lowest), and USA (seventh lowest), whereas 2SW salmon returns to Labrador (49 870) in 2017 were the second highest on record. Three regions (Labrador, Quebec, Gulf) collectively accounted for 96% of 2SW salmon returns to North America in 2017.

Estimates of PFA (defined as the number of 1SW salmon on 1 August of the second summer at sea) suggest continued low abundance of North American salmon (Figure 11). The total population of 1SW and 2SW salmon 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. During the period 1993 to 2016, the total population of 1SW and 2SW salmon was approximately 610 000 fish, about half of the average abundance during the period 1971 to 1992.

PFA of maturing and non-maturing 1SW salmon in 2016 was estimated at 638 250 fish. Abundance declined by 63% over the time-series from a peak of 1 704 000 fish in 1975 (Figure 11).

In 2017, the medians of the estimates of returns to rivers and of spawners were below the CLs for 2SW salmon for all regions of NAC except Labrador, and are therefore suffering reduced reproductive capacity (Figure 12). The medians of the 2SW returns and spawners for Labrador exceeded the CL, but the fifth percentiles were below the CL and for this region the stock is at risk of suffering reduced reproductive capacity (Figure 12). Particularly large deficits relative to CLs and rebuilding management objectives are noted in the Scotia-Fundy and USA regions.

River-specific assessments are provided for 84 rivers in 2017. Egg depositions by all sea ages combined in 2017 exceeded or equaled the river-specific CLs in 42 of the 84 assessed rivers (50%) and were at, or less, than half of CLs in 30 rivers (36%) (Figure 13). In Canada, the number of rivers assessed annually has ranged from 61 to 91 and the annual percentages of these rivers achieving CL has ranged from 26% to 67% (62% in 2017) with no temporal trend (Figure 7). Sixteen rivers in the USA are assessed against CL attainment annually with none meeting CLs to date (Figure 7).

Despite major changes in fisheries management two to three decades ago, and increasingly more restrictive fisheries measures since then, returns of salmon have remained near historical lows, except for those in Labrador and Newfoundland. All salmon populations within US and the Scotia-Fundy regions have been or are being considered for listing under country-specific species at risk legislation. The continued low abundance of salmon stocks in USA and in three regions of Canada (Scotia-Fundy, Gulf, and Quebec), despite significant fishery reductions, strengthens the conclusions that factors acting on survival in the first and second years at sea at both local and broad ocean scales are constraining abundance of salmon. Declines in smolt production in some rivers of eastern Canada may also be contributing to lower adult abundance.

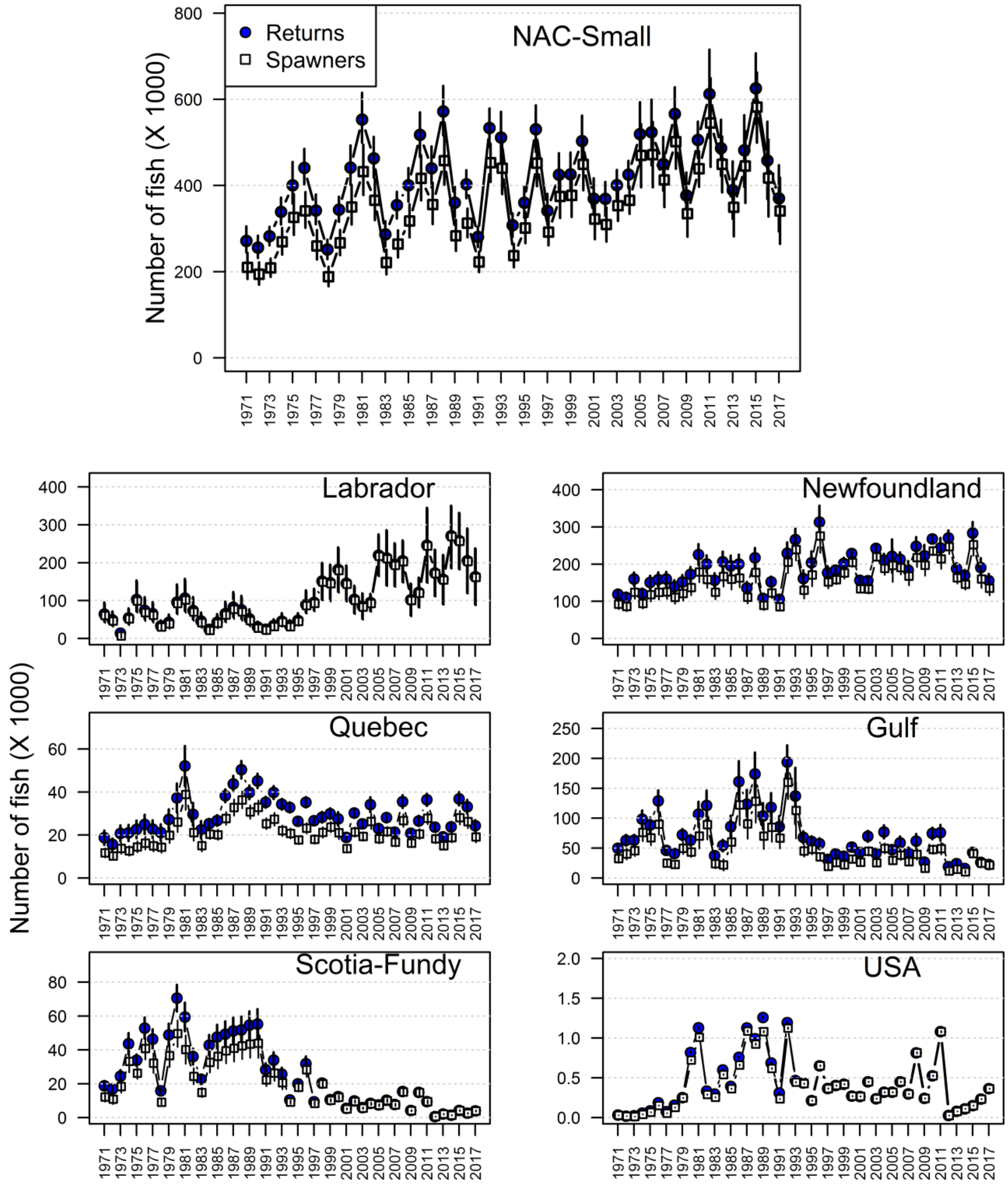

Figure 8 Estimated (median, fifth to 95th percentile range) returns (shaded circles) and spawners (open squares) of small salmon (primarily 1SW maturing) for eastern North America overall and for each of the six regions, 1971 to 2017.

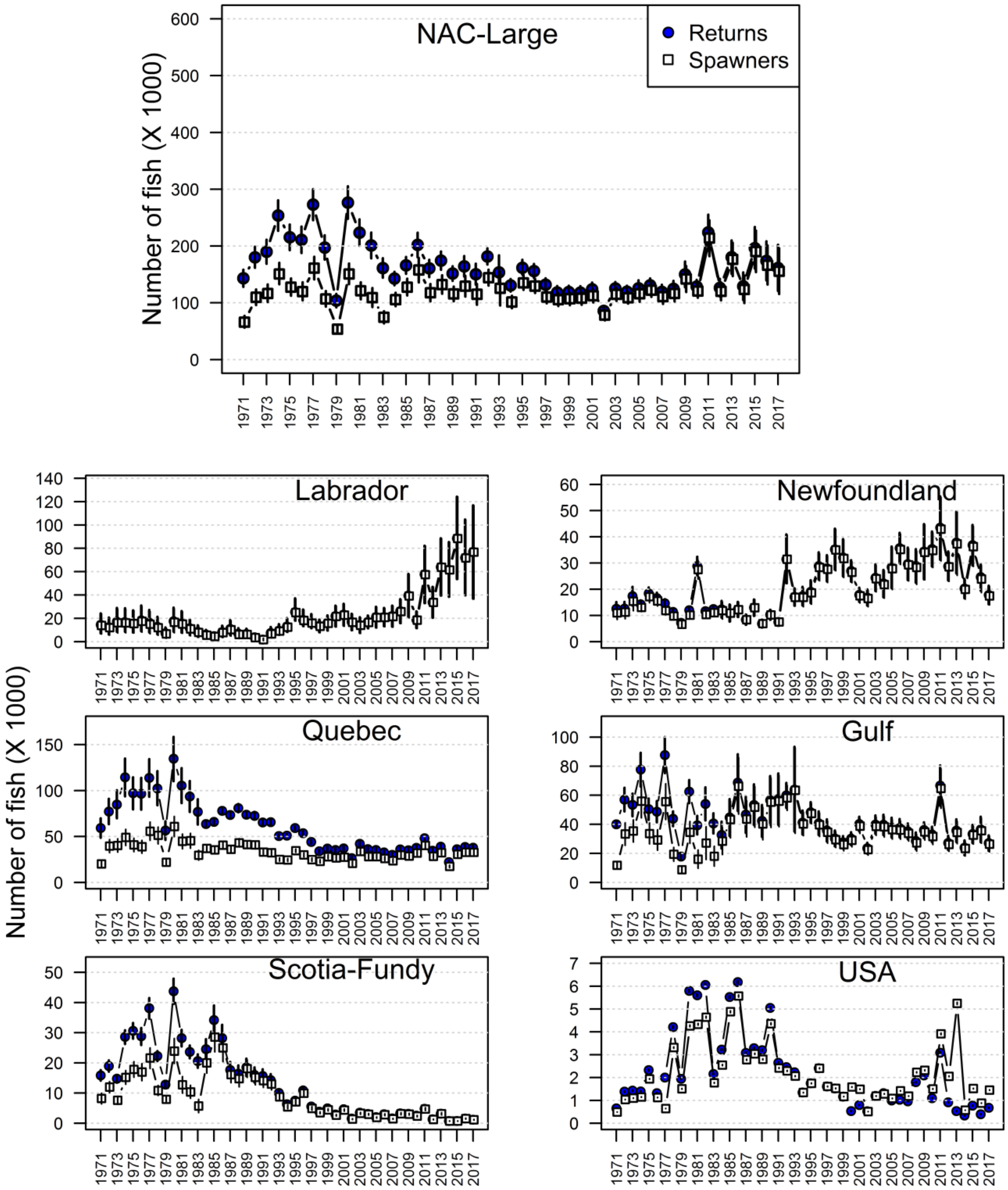

Figure 9 Estimated (median, fifth to 95th percentile range) returns (shaded circles) and spawners (open squares) of large salmon (primarily 1SW maturing) for eastern North America overall and for each of the six regions, 1971 to 2017.

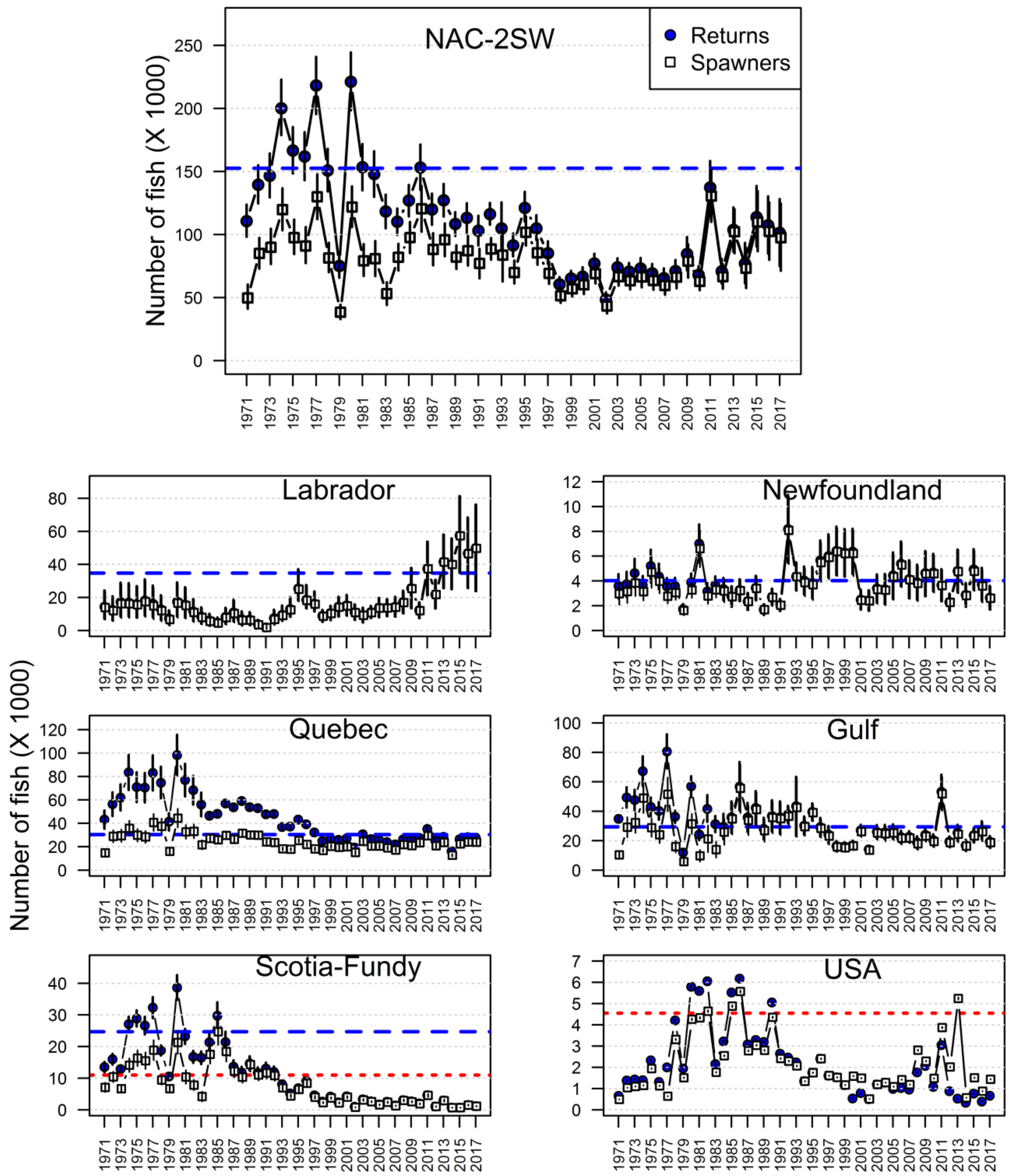

Figure 10 Estimated (median, fifth to 95th percentile range) returns (shaded circles) and spawners (open squares) of 2SW salmon for eastern North America overall and for each of the six regions. The dashed line is the corresponding 2SW CL; the 2SW CL (29 199 fish) is off scale in the plot for USA. The dotted lines in the Scotia–Fundy and US panels are the region-specific management objectives. For USA, estimated spawners exceed the estimated returns in some years due to adult stocking restoration efforts, 1971 to 2017.

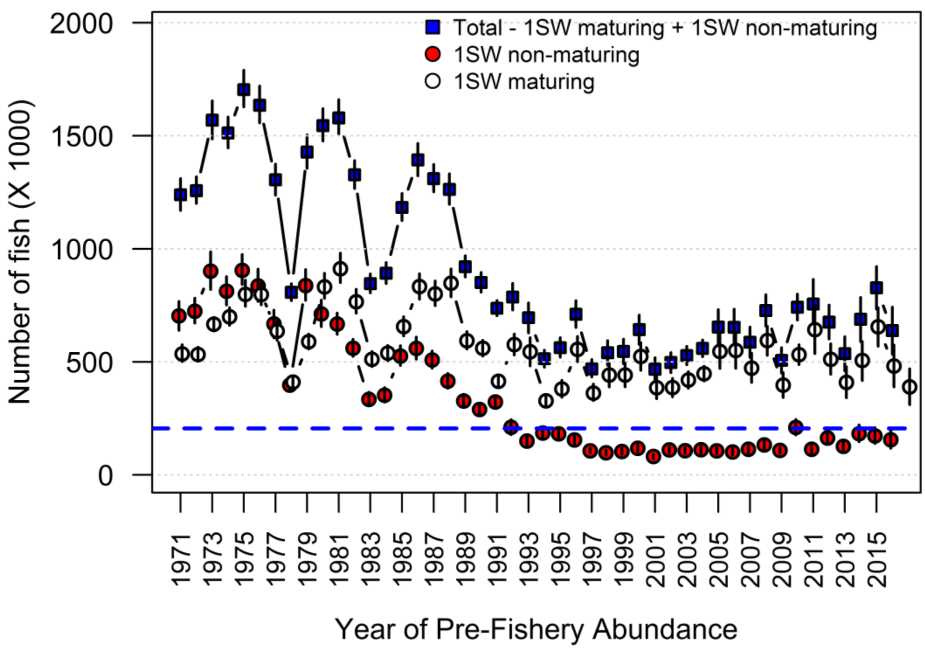

Figure 11 Estimated (median, fifth to 95th percentile range) pre-fishery abundance (PFA) for 1SW maturing, 1SW non-maturing, and total cohort of 1SW salmon for North America. The dashed blue horizontal line is the corresponding sum of the 2SW conservation limits for North America, corrected for 11 months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

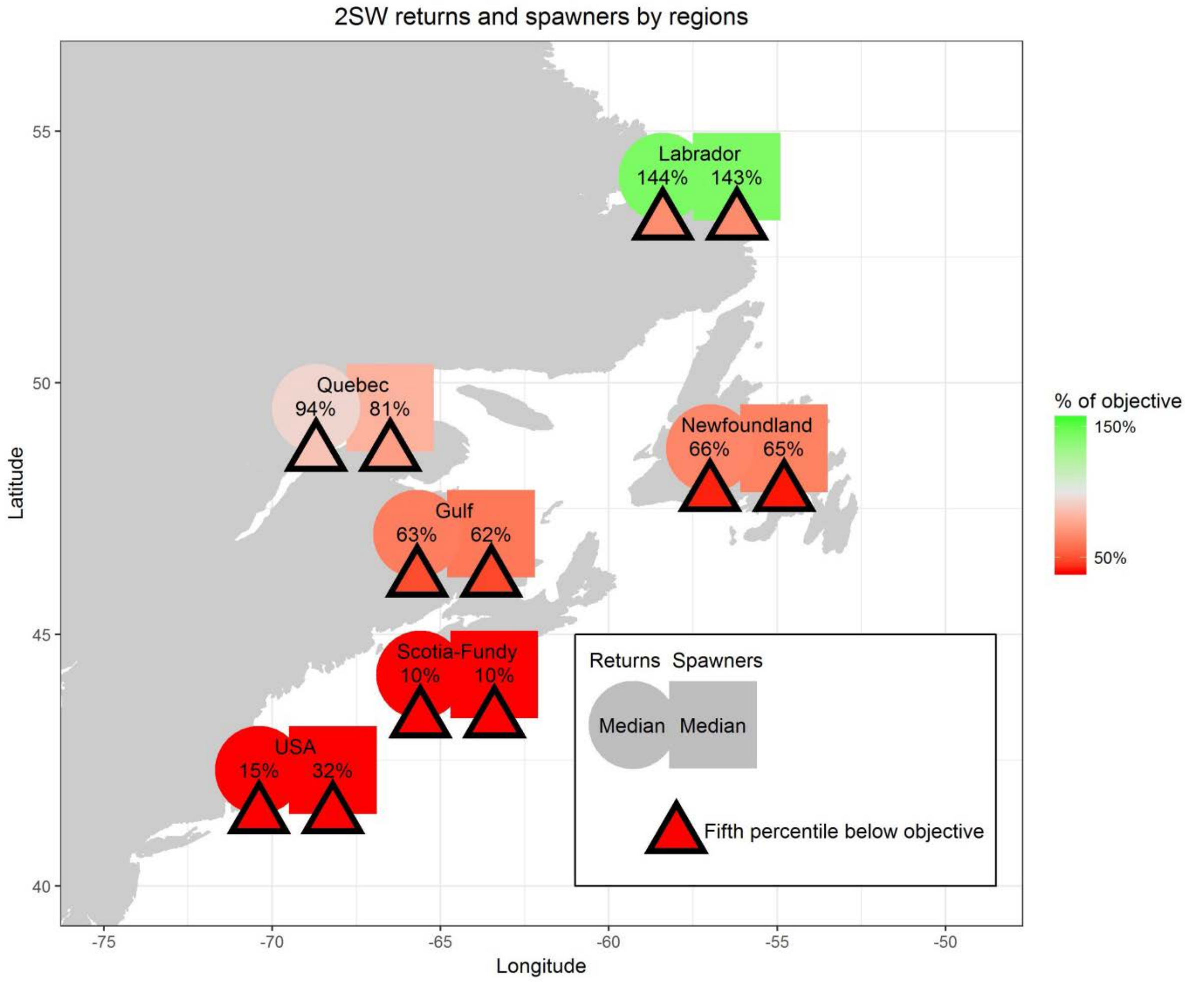

Figure 12 Medians of the estimated returns (circle symbol) and spawners (square symbol) of 2SW salmon in 2017 to six regions of North America expressed as a percentage of the 2SW CLs for the four northern regions and to the rebuilding management objectives for the two southern areas. The colour shading of the symbols represents the percentage of the CL or rebuilding objective attained, with red less than 100% and green > 100%. The triangular symbols accompanying the respective returns and spawners symbols indicate when the fifth percentiles of the estimates are below the CLs or management objective, i.e., the stocks are at risk of or suffering reduced reproductive capacity. The intensity of the red colour shading is inversely associated with the percentage of the objective attained.

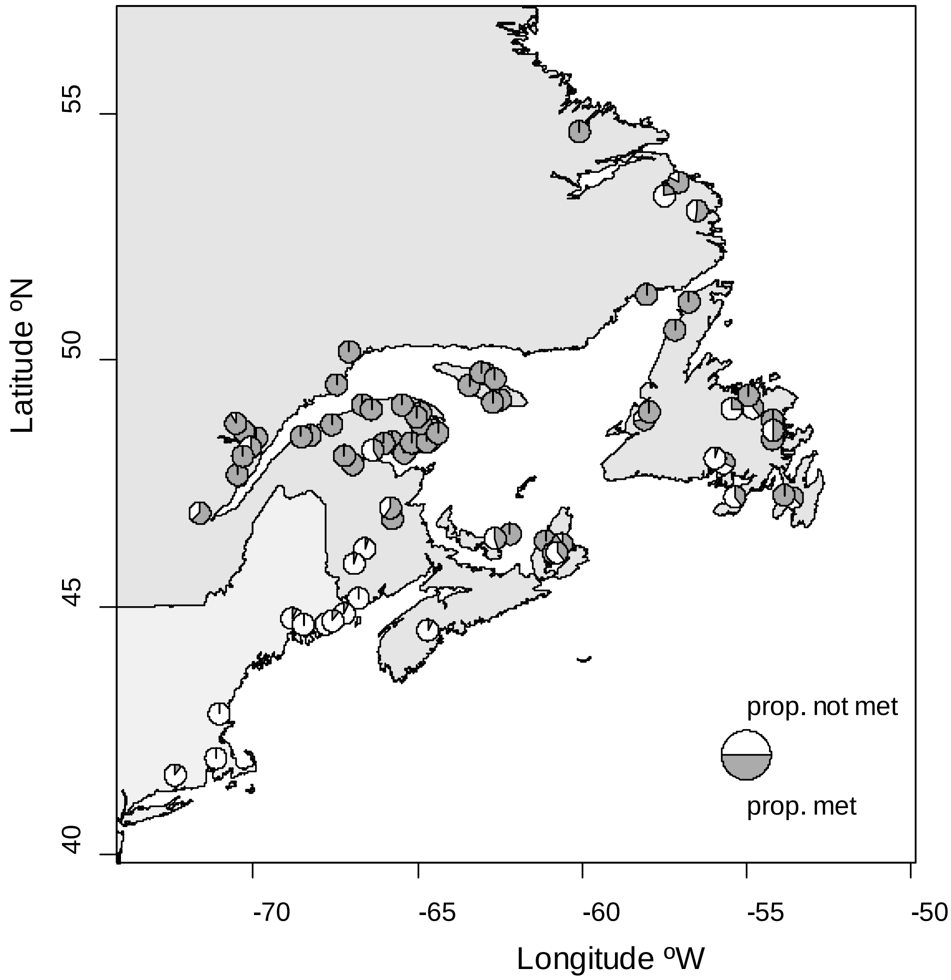

Figure 13 Proportion of the river-specific conservation egg requirement (CL) attained in the 84 rivers of the North American Commission area assessed in 2017. Eight rivers in the USA are not shown because they were partially assessed but they are considered to not have achieved CLs in 2017.

NASCO 3.4 Provide catch options or alternative management advice for 2018–2021 with an assessment of risks relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding

Catch options for mixed-stock fisheries are only provided for the non-maturing 1SW and maturing 2SW components as the maturing 1SW component is not fished outside home waters.

As the predicted numbers of 2SW salmon returning to the six regions in North America in the period 2018 to 2021 are substantially below the region-specific 2SW CLs of the four northern areas and of the 2SW management objectives of the two southern areas, there are no catch options for the 2SW mixed-stock fisheries in North America.

Wild salmon populations are critically low in the southern regions (Scotia-Fundy, USA) of North America and the remnant populations require alternative conservation actions including habitat restoration, captive rearing strategies, and very restrictive fisheries regulations for salmon and other species in some areas.

Relevant factors to be considered in management

The management for all fisheries should be based upon assessments of the status of individual stocks. Fisheries on mixed-stocks, particularly in coastal waters or on the high seas, pose particular difficulties for management as they may harvest stocks that are not meeting their CLs. Conservation would be best achieved if fisheries target stocks that have been shown to be meeting CLs. Fisheries in estuaries and especially rivers are more likely to meet this requirement.

The salmon caught in the Labrador subsistence fisheries are predominantly (> 95%) from rivers in Labrador, although there is occasional attribution of very low proportions of salmon in the sampled catches from other areas, including USA. The salmon caught in the Saint Pierre & Miquelon mixed-stock fisheries originate in all areas of North America and all sea age groups, including previous spawners, contribute to the fisheries in varying proportions.

Updated forecast and catch options for 2018 to 2021 fisheries on 2SW maturing fish

It is possible to provide catch options for the North American Commission area for four years.

ICES (2015) developed estimates of the pre-fishery abundance for the non-maturing 1SW salmon (PFA) using a Bayesian framework that incorporates the estimates of 2SW lagged spawners and works through the fisheries at sea to determine the corresponding returns of 2SW salmon, conditioned by fisheries removals and natural mortality at sea. This model considered lagged spawners (Figure 14) and returns of 2SW salmon for each of the six regions of North America (Figure 10). Data series were finalized for 2017 and updated for past years in some regions. North American region-specific PFA and productivity value inferences are provided by the model (Figures 15 and 16).

The overall productivity estimate (log scale) for NAC in the most recent year PFA (2016) decreased to near zero and is substantially below the levels observed from the late 1990s to early 2000s (Figure 15). By region, the most recent year values (2016 PFA year) are positive for Labrador and Newfoundland, just above zero for Quebec, just below zero for Gulf, and negative for Scotia-Fundy and USA (Figures 15). Negative productivity parameters (on the log scale) indicate that the PFA is less than the lagged spawner abundance that produced it and the salmon abundances in these regions are expected to decline further from current levels of very low abundance.

The fifth percentiles of the posterior distributions of the regional PFAs for the period 2017 to 2020 are all less than the management objectives (Figure 16). There are, therefore, no mixed-stock fishery options on 1SW non-maturing salmon in the period 2018 to 2020 or on 2SW salmon in the period 2018 to 2021 which would provide a greater than 95% chance of meeting the individual management objectives; the probability of simultaneous attainment in any year is zero (Table 4). The forecasts have very high uncertainty and the uncertainties increase as the forecasts move further forward in time.

Table 4 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 fishing on the 1SW non-maturing and 2SW age groups for the 2SW salmon return years 2019 to 2021. For the 2018 return year, catches of 1SW non-maturing salmon in 2017 in Labrador and at Greenland have already occurred and are accounted for in the estimation of the probabilities of meeting the 2SW objectives for the 2018 return year.

Region	Region specific 2SW objective	Probability of meeting the 2SW objectives in the absence of fisheries for the 2SW return year			
		2018	2019	2020	2021
Labrador	34 746	0.826	0.871	0.888	0.898
Newfoundland	4 022	0.100	0.308	0.289	0.392
Quebec	29 446	0.391	0.387	0.271	0.316
Gulf	30 430	0.033	0.087	0.102	0.194
Scotia-Fundy	10 976	0.000	0.001	0.000	0.003
USA	4 549	0.000	0.001	0.002	0.006
Simultaneous to North America		0.000	0.000	0.000	0.000

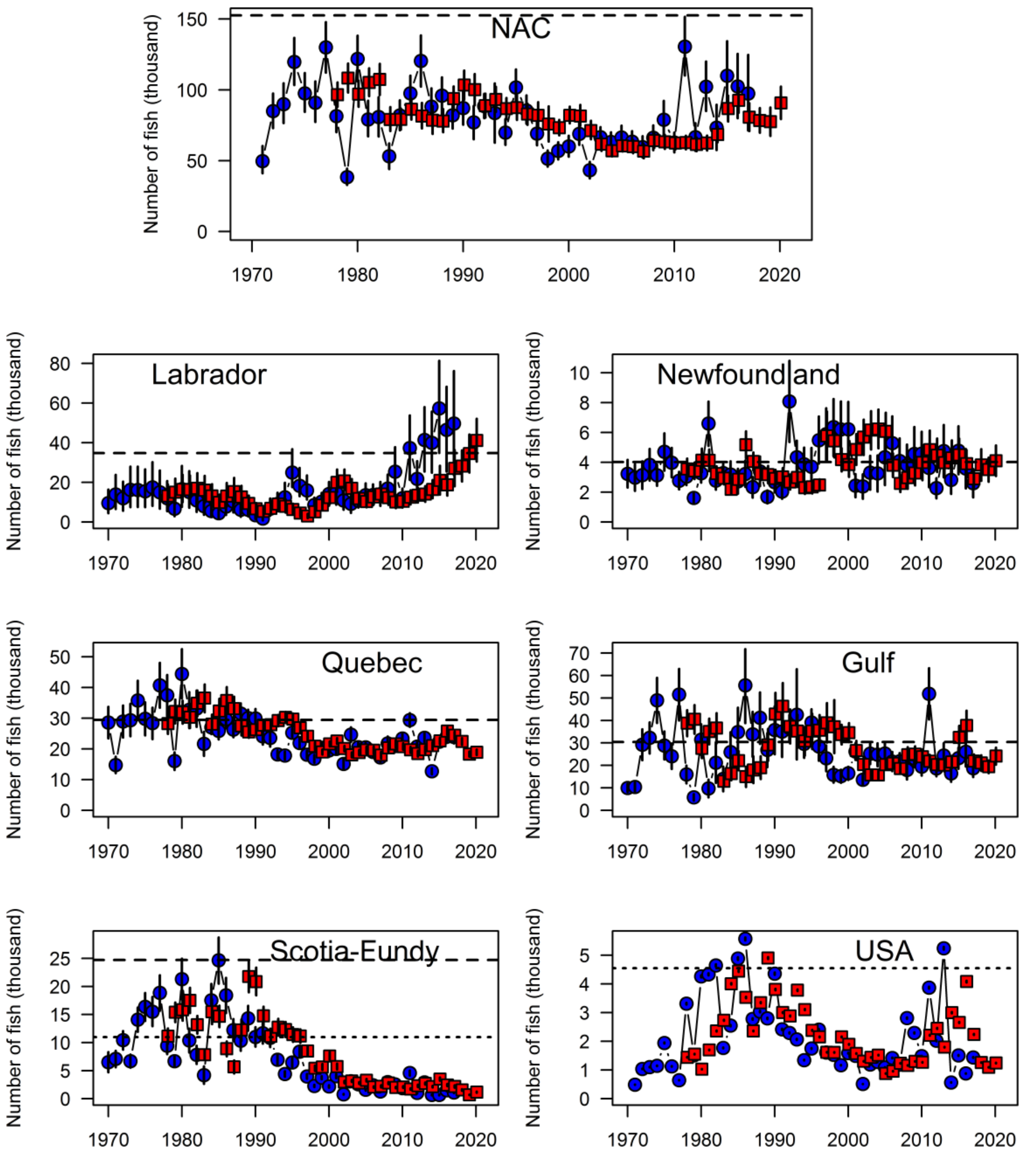

Figure 14 Median (fifth to 95th percentile range) of spawners (circles) and lagged spawners (squares) of 2SW salmon to NAC overall and for each of the six assessment regions. For spawners, year corresponds to the year of spawning. For lagged spawners, year corresponds to the year of PFA. The dashed horizontal line is the corresponding 2SW CLs for NAC overall and for each region; the 2SW CL for the US (29 990 fish) is off scale in the plot. The dotted horizontal line in Scotia-Fundy and USA panels are the region specific 2SW management objectives.

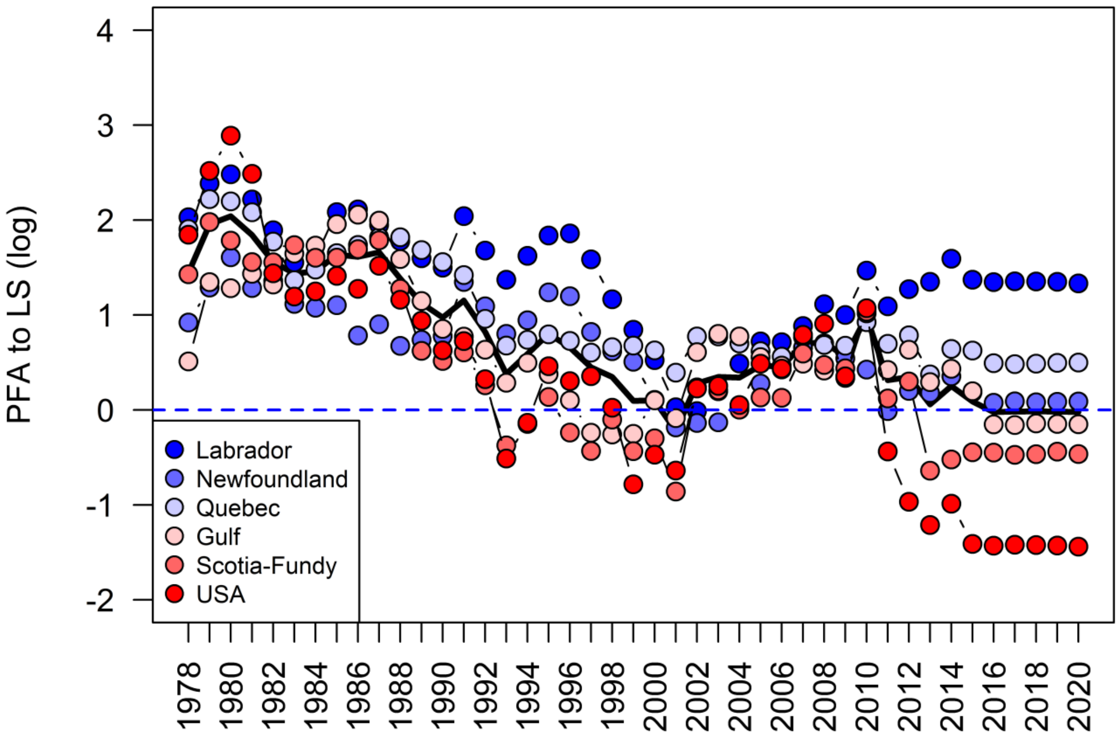

Figure 15 Region specific (median) PFA to LS ratio (log scale; productivity) and mean over all regions (solid black line) for NAC for PFA years 1978 to 2020. The horizontal dashed blue line is the PFA to LS ratio on the log scale of zero, which equates to a PFA to LS ratio of one. The values for 2017 to 2020 are forecast values.

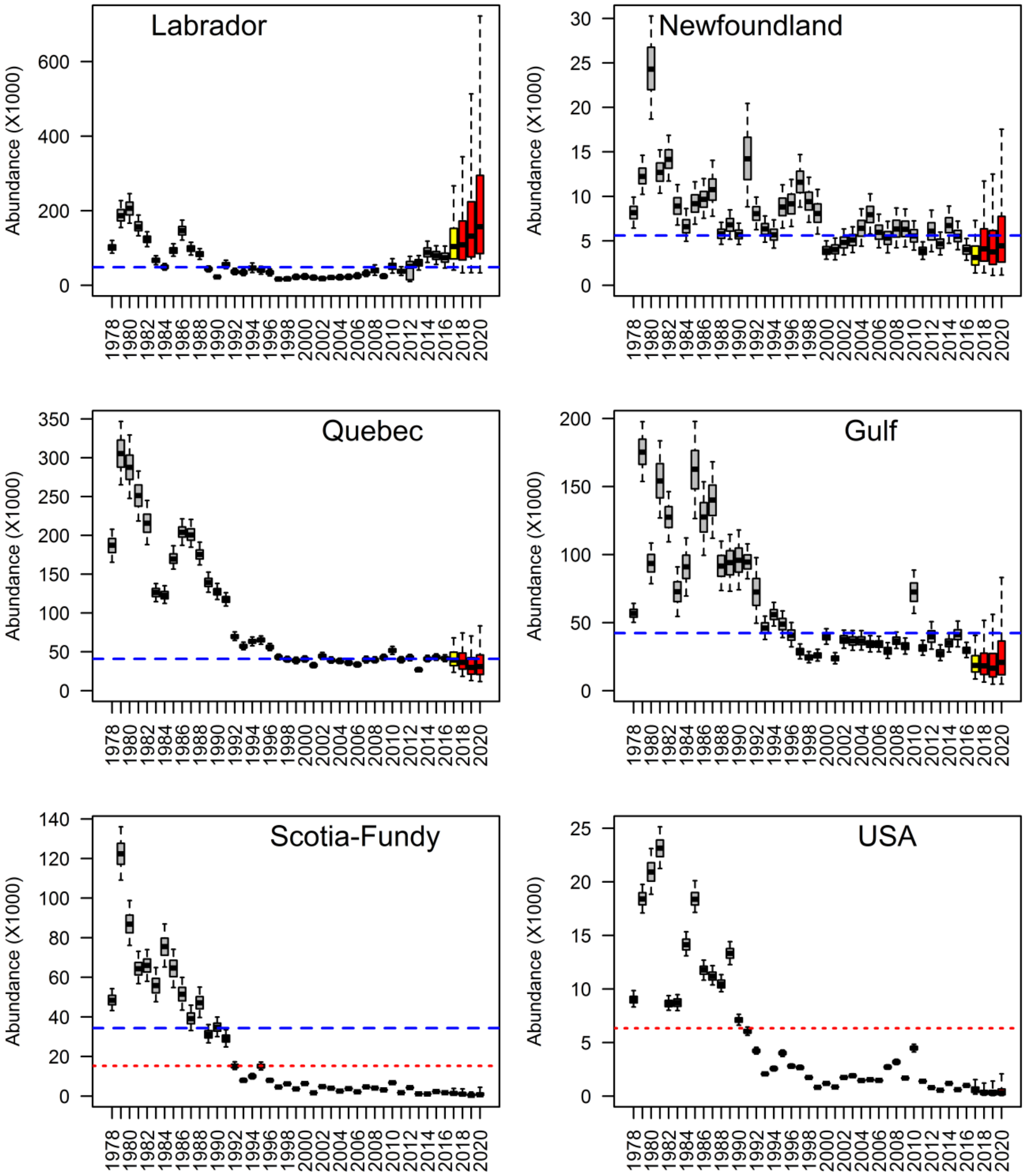

Figure 16 Region-specific PFA values for PFA years 1978 to 2020. The values for 2017 (yellow shading) and for the period 2018 to 2020 (red shading) are predicted based on lagged spawners and forecasts of the PFA to LS ratio. The dashed blue line is the corresponding 2SW conservation limit reserve for each region. For Scotia-Fundy and US the dotted red line corresponds to the 2SW management objectives (adjusted for eleven 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 fifth to 95th percentile range.

NASCO 3.5 Update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice

An updated Framework of Indicators (FWI) that can be used to identify any significant change in the previously provided multi-annual management advice has been provided. The same Framework of Indicators is used the North American Commission and West Greenland Commission areas of NASCO with the exception that for the North American Commission, only indicators from regions in North America apply.

The update consisted of:

- Adding the values of the indicator variables for the most recent years;
- Running the objective function spreadsheet for each indicator variable and the variable of interest relative to the management objectives;
- Quantifying the threshold value for the indicator variables and the probabilities of a true high state and a true low state for those indicator variables retained for the framework;
- Revising/adding the indicator variables and the functions for evaluating the indicator score to the framework spreadsheet; and
- Providing the spreadsheet for doing the framework of indicators assessment.

The updated FWI contains 21 indicator variables, represented by 13 different rivers. Of these, two were survival rate indicators of hatchery fish, two were survival rate indicators of wild fish, while the remainder were of wild 2SW, MSW and large salmon (n=13) or wild 1SW or small salmon (n=4) returns to rivers. No indicator variables were retained for the Labrador or Newfoundland.

The FWI can be applied at the beginning of 2019, with the returns or return rate data for 2018, to evaluate the appropriateness of the advice for 2019, and again at the beginning of 2020, with the returns or return rate data for 2019, to evaluate the appropriateness of the advice for 2020.

Catch Advice	Catch option > 0 (Yes = 1, No = 0)	0

Overall Recommendation
No Significant Change Identified by Indicators

Geographic Area	River/ Indicator	2017 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	530	22%	2 368	100%	100%	-1	1	-1	
	possible range				*-1,00*	*1,00*				
	Average		22%						**-1,00**	**No**
Scotia-Fundy	Saint John Return Large	83	2%	3 329	97%	100%	-1	0,97	-0,97	
	Lahave Return Large	51	18%	285	81%	85%	-1	0,81	-0,81	
	North Return Large	192	31%	626	96%	74%	-1	0,96	-0,96	
	Saint John Survival 2SW (%)	0,04	18%	0,222	96%	81%	-1	0,96	-0,96	
	Saint John Survival 1SW (%)	0,1	13%	0,763	89%	73%	-1	0,89	-0,89	
	Saint John Return 1SW	195	9%	2 276	89%	80%	-1	0,89	-0,89	
	LaHave Return 1SW	45	3%	1 679	96%	67%	-1	0,96	-0,96	
	possible range				*-0,92*	*0,80*				
	Average		13%						**-0,92**	**No**
Gulf	Miramichi Return 2SW	10149	69%	14 669	100%	82%	-1	1,00	-1,00	
	Miramichi Return 1SW	1330	3%	41 588	92%	68%	-1	0,92	-0,92	
	Margaree Return Large	1550	49%	3 149	88%	56%	-1	0,88	-0,88	
	possible range				*-0,93*	*0,69*				
	Average		41%						**-0,93**	**No**
Quebec	Bonaventure Return Large	1067	72%	1 479	82%	76%	-1	0,82	-0,82	
	Grande Rivière Return Large	467	106%	442	100%	89%	1	0,89	0,89	
	Saint-Jean Return Large	554	73%	758	88%	78%	-1	0,88	-0,88	
	Dartmouth Return Large	927	123%	756	84%	87%	1	0,87	0,87	
	Madeleine Return Large	672	100%	672	88%	79%	1	0,79	0,79	
	York Return Large	1267	90%	1405	73%	83%	-1	0,73	-0,73	
	De la Trinité Return Large	264	69%	385	82%	100%	-1	0,82	-0,82	
	De la Trinité Return Small	212	37%	578	83%	85%	-1	0,83	-0,83	
	Saint-Jean 2SW Survival	1,18	164%	0,72	100%	50%	1	0,5	0,5	
	De la Trinité 2SW Survival	0,40	82%	0,49	92%	68%	-1	0,92	-0,92	
	possible range				*-0,87*	*0,80*				
	Average		91%						**-0,20**	**No**
Newfoundland										
	possible range									
	Average								**NA**	**Unknown**
Labrador										
	possible range									
	Average								**NA**	**Unknown**

Figure 17 Framework of indicators spreadsheet for the North American Commission. For illustrative purposes, the 2017 value of returns or survival rates for the 21 retained indicators is entered in the cells corresponding to the annual indicator variable values.

Relevant data deficiencies, monitoring needs and research requirements

The following relevant data deficiencies, monitoring needs, and research requirements of relevance to the North American Commission were identified:

- Complete and timely reporting of catch statistics from all fisheries for all areas of eastern Canada is recommended.
- Improved catch statistics and sampling of the Labrador and Saint Pierre and Miquelon fisheries is recommended. Improved catch statistics and sampling of all aspects of the fishery across the fishing season will improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.
- Additional monitoring be considered in Labrador to estimate stock status for that region. Additionally, efforts should be undertaken to evaluate the utility of other available data sources (e.g. Indigenous and recreational catches and effort) to describe stock status in Labrador.

The full list of data deficiencies, monitoring needs and research requirements for North Atlantic salmon is presented in Section 1.5 of the sal.oth.nasco advice (ICES, 2018a).

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Annex 1 Glossary of acronyms and abbreviations

1SW *(one-sea-winter).* Maiden adult salmon that have spent one winter at sea.
2SW *(two-sea-winter).* Maiden adult salmon that have spent two winters at sea.
3SW *(three-sea-winter).* Maiden adult salmon that have spent three winters at sea.
CL, i.e. S_{lim} *(conservation limit).* Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.
FWI *(Framework of Indicators).* The FWI is a tool used to indicate if any significant change in the status of stocks used to inform the previously provided multi-annual management advice has occurred.
ICES (*International Council for the Exploration of the Sea*).
NAC (*North American Commission*). A commission under NASCO.
NASCO (*North Atlantic Salmon Conservation Organization*).
PFA *(pre-fishery abundance).* The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time.
SPM (*the islands of Saint Pierre and Miquelon [France]*).

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Annex 2 General considerations

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 through 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 for the North American Commission, a risk level (probability) of 75% for simultaneous attainment of the 2SW CLs for the four northern regions (Labrador, Newfoundland, Quebec, Gulf) and management objectives defined as achieving a 25% increase in 2SW returns relative to a baseline period (average returns in the period 1992–1996) for the Scotia-Fundy region, and to achieve 2SW adult returns of 4549 fish or greater for has been agreed for the provision of catch advice on 2SW salmon exploited in North America (as non-maturing 1SW and 2SW salmon). A framework of indicators has been developed to identify any significant change in the multi-annual management advice in the intervening years of the three-year assessment cycle.

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 the Ungava Bay rivers (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.

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 the impact of predators 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.

Effects of the fisheries on the ecosystem

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

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. The reliability of catch statistics could be improved in all North America. 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.

Basis of the assessment

ICES stock data category	1 (ICES, 2016).
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, indigenous, and recreational fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	It is illegal to retain salmon that are incidentally captured in fisheries not directed at salmon (no by-catch). In the directed recreational fishery, mortality from catch and release is accounted for in the regional assessments to estimate spawners. There is no accounting of discarding mortality in non-salmon directed fisheries.
Indicators	The Framework of Indicators is used to indicate whether a significant change has occurred in the status of stocks in intermediate years where multiannual management advice applies.
Other information	Advice subject to annual review. A stock annex was developed in 2014 and updated to 2017.
Working group	Working Group on North Atlantic Salmon (WGNAS) (ICES, 2018b).

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Atlantic salmon at West Greenland

Summary of the advice for 2018–2020

ICES advises that, in line with the management objectives agreed by NASCO and consistent with the MSY approach, there are no mixed-stock fishery options at West Greenland for the fishing years 2018 to 2020.

Management advice for West Greenland is based on non-maturing 1SW salmon from North America and Southern NEAC. In the absence of any fishing in the period 2018 to 2020, there is less than 75% probability that the numbers of 2SW salmon returns will be above the management objectives simultaneously for the six regions of North America and for the MSW stock of Southern NEAC.

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 2019, with the returns or return rate data for 2018, to evaluate the appropriateness of the advice for 2019, and again at the beginning of 2020, with the returns or return rate data for 2019, to evaluate the appropriateness of the advice for 2020.

NASCO 4.1 Describe the key events of the 2017 fishery, including details of catch, gear, effort, composition and origin of the catch, rates of exploitation, and location of the catch as in-river, estuarine, and coastal

Fishing for salmon at Greenland is currently allowed using hook, fixed gillnets, and driftnets along the entire coast of Greenland (Figure 1). The commercial fishery for export closed in 1998; however, the fishery for internal use continues. Since 2002, licensed fishers have only been allowed to sell salmon to hotels, institutions, and local markets. People fishing for private consumption only are not required to have a licence, but they are prohibited from selling salmon. Since 2012, the Government of Greenland has unilaterally set the quota for the fishery, since the quota could not be agreed to by all parties of the West Greenland Commission of NASCO (Table 2). From 2012 to 2015, licensed fishers were also permitted to sell to factories, although the export ban persisted. Specific factory quotas were set at 35 tonnes (t) for 2012 and 2013, and 30 t in 2014. In 2015, the Government of Greenland set a quota for all components of the fishery (private, commercial, and factory landings) at 45 t but stated that any overharvest in a particular year would result in an equal reduction in the quota the following year. As a result of an overharvest in 2015, the 2016 quota was set by Greenland at 32 t. The quota for 2017 remained at 45 t. Factory landings were not permitted in 2016 and 2017. In 2017, the fishing season opened on 15 August and the closing date of the salmon season was extended by one day, to 10:00 pm 1 November, due to bad weather.

Catches of Atlantic salmon at West Greenland (Figure 2 and Table 2) increased through the 1960s, reaching a peak reported harvest of approximately 2700 t in 1971 and then decreased until the closure of the commercial fishery for export in 1998. However, the fishery for internal use has been increasing in recent years.

A total salmon catch of 28 t was reported for the 2017 fishery, similar to that for 2016 (Table 1). In total, 89% of the commercial landings in 2017 were from licensed fishers (24.9 t). For private landings, 24% (3.1 t) were from unlicensed fishers and 76% (9.7 t) from licensed fishers. Although not permitted to sell catch, 0.2% (32 kg, approximately ten fish) of the commercial landings were reported by unlicensed fishers. The 2017 commercial landings increased over the 2016 value whereas the private landings in 2017 decreased from the 2016 value (Tables 1 and 4).

Landings were reported across all NAFO divisions and a harvest of 0.3 t was reported from ICES Division 14 (East Greenland; Table 3).

Table 1 Reported 2016 and 2017 catches by fisheries. A value of 0.0 indicates a catch less than 0.05 t.

Licence type	Fishery Type	Reported 2017 catch (t)	Reported 2016 catch (t)
Licensed	Commercial	15.3	8.6
	Private	9.7	10.8
Unlicensed	Commercial	0.0	0.1
	Private	3.1	7.6
All	Commercial	15.3	8.7
	Private	12.8	18.4
All	Total	28.0	27.1

There is currently no quantitative approach for estimating the unreported catch for the private fishery, but the 2017 value is likely to have been at the same level as in recent years (10 t), as reported by the Greenlandic authorities. The 10 t estimate was historically meant to account for private non-licensed fishers in smaller communities fishing for personal consumption – not to represent underreporting by commercial fishers.

The variations in the numbers of people reporting catches, variation in reported landings in each of the NAFO divisions, and documentation of underreporting of landings suggest that there are inconsistencies in the reported catch data in both the commercial and private fisheries. A phone survey to gain further information on catch and effort was conducted after the fishing season from 2014 to 2016. Unreported catches of 12.2 t (2014), 5 t (2015), and 4.2 t (2016) were identified from these surveys (referred to as adjusted landings (survey) for assessment). With just nine fishers taking part, the phone survey conducted in 2017 was not considered adequate to adjust the reported landings.

An adjustment for some unreported catch, primarily for commercial landings, has been done since 2002 by comparing the weight of salmon observed by the sampling teams and the corresponding community-specific reported landings for the entire fishing season (commercial and private landings combined; referred to as adjusted landings (sampling) for assessment). However, sampling only occurs during a portion of the fishing season, and therefore these adjustments are considered to be minimum adjustments for unreported catch (Table 5).

The international sampling programme continued in 2017 (Figures 1 and 3). A summary of the biological characteristics of the 2017 catch is presented in Table 6. The 2017 total number of fish harvested (8300) was similar to the 2016 estimate (8400) and only 2.5% of the maximum fish harvest (1982: 336 000) (Figure 4). In 2017, 74.4% of the salmon sampled were determined to be of North American origin and 25.6% of European origin (Figure 3), approximately 6100 (20.9 t) North American and 2200 (7.2 t) Fish of European origin were harvested in 2017. The North American origin of salmon harvested at West Greenland has been further refined to 12 regional groups of North America using genetic microsatellite analyses (Figure 5) (Bradbury *et al.*, 2016). Contributions from 2015 to 2017 samples were dominated by three regional groups: Labrador, Gulf of St Lawrence, and Gaspe Peninsula (Table 7).

Table 2 Nominal catches of salmon at West Greenland since 1960 (tonnes, round fresh weight) by participating nations. For Greenlandic vessels specifically, all catches up to 1968 were taken with set gillnets only and catches after 1968 were taken with set gillnets and driftnets. All non-Greenlandic vessel catches from 1969–1975 were taken with driftnets. The quota figures applied to Greenlandic vessels only and parenthetical entries identify when quotas did not apply to all sectors of the fishery.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1960	-	-	-	-	60	60		
1961	-	-	-	-	127	127		
1962	-	-	-	-	244	244		
1963	-	-	-	-	466	466		
1964	-	-	-	-	1539	1539		
1965	-	36	-	-	825	858		Norwegian harvest figures not available, but known to be less than Faroese catch
1966	32	87	-	-	1251	1370		
1967	78	155	-	85	1283	1601		
1968	138	134	4	272	579	1127		
1969	250	215	30	355	1360	2210		
1970	270	259	8	358	1244	2139		Greenlandic total includes 7 t caught by longlines in the Labrador Sea
1971	340	255	-	645	1449	2689	-	
1972	158	144	-	401	1410	2113	1100	
1973	200	171	-	385	1585	2341	1100	
1974	140	110	-	505	1162	1917	1191	
1975	217	260	-	382	1171	2030	1191	
1976	-	-	-	-	1175	1175	1191	
1977	-	-	-	-	1420	1420	1191	
1978	-	-	-	-	984	984	1191	
1979	-	-	-	-	1395	1395	1191	
1980	-	-	-	-	1194	1194	1191	
1981	-	-	-	-	1264	1264	1265	Quota set to a specific opening date for the fishery
1982	-	-	-	-	1077	1077	1253	Quota set to a specific opening date for the fishery
1983	-	-	-	-	310	310	1191	
1984	-	-	-	-	297	297	870	
1985	-	-	-	-	864	864	852	
1986	-	-	-	-	960	960	909	
1987	-	-	-	-	966	966	935	
1988	-	-	-	-	893	893	840	Quota for 1988–1990 was 2520 t with an opening date of August 1. Annual catches were not to exceed an annual average (840 t) by more than 10%. Quota adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates.
1989	-	-	-	-	337	337	900	
1990	-	-	-	-	274	274	924	
1991	-	-	-	-	472	472	840	
1992	-	-	-	-	237	237	258	Quota set by Greenlandic authorities
1993	-	-	-	-			89	The fishery was suspended. NASCO adopted a new quota allocation model.
1994	-	-	-	-			137	The fishery was suspended and the quotas were bought out.
1995	-	-	-	-	83	83	77	Quota advised by NASCO
1996	-	-	-	-	92	92	174	Quota set by Greenlandic authorities
1997	-	-	-	-	58	58	57	Private (non-commercial) catches to be reported after 1997
1998	-	-	-	-	11	11	20	Fishery restricted to catches used for internal consumption in Greenland
1999	-	-	-	-	19	19	20	
2000	-	-	-	-	21	21	20	

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
2001	-	-	-	-	43	43	114	Final quota calculated according to the *ad hoc* management system
2002	-	-	-	-	9	9	55	Quota bought out, quota represented the maximum allowable catch (no factory landing allowed), and higher catch figures based on sampling programme information are used for the assessments.
2003	-	-	-	-	9	9		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2004	-	-	-	-	15	15		Same as previous year
2005	-	-	-	-	15	15		Same as previous year
2006	-	-	-	-	22	22		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland.
2007	-	-	-	-	25	25		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments.
2008	-	-	-	-	26	26		Same as previous year
2009	-	-	-	-	26	26		Same as previous year
2010	-	-	-	-	40	40		No factory landing allowed and fishery restricted to catches used for internal consumption in Greenland
2011	-	-	-	-	28	28		Same as previous
2012	-	-	-	-	33	33	(35)	Unilateral decision made by Greenland to allow factory landing with a 35 t quota for factory landings only, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments
2013	-	-	-	-	47	47	(35)	same as previous year
2014	-	-	-	-	58	58	(30)	Unilateral decision made by Greenland to allow factory landing with a 30 t quota for factory landings only, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2015	-	-	-	-	57	57	45	Unilateral decision made by Greenland to set a 45 t quota for all sectors of the fishery, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2016	-	-	-	-	27	27	32	Unilateral decision made by Greenland to reduce the previously set 45 t quota for all sectors of the fishery to 32 t based on overage of 2015 fishery, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information and phone surveys are used for the assessments.
2017	-	-	-	-	28	28	45	Unilateral decision made by Greenland to set a 45 t quota for all sectors of the fishery, fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments,

Table 3 Annual distribution of nominal catches (t) at Greenland by NAFO division when known. NAFO divisions are shown in Figure 2. Since 2005, gutted weights have been reported and converted to total weight by a factor of 1.11.

Year	1A	1B	1C	1D	1E	1F	Unknown	West Greenland	East Greenland	Total
1960							60	60		60
1961							127	127		127
1962							244	244		244
1963	1	172	180	68	45			466		466
1964	21	326	564	182	339	107		1 539		1 539
1965	19	234	274	86	202	10	36	861		861
1966	17	223	321	207	353	130	87	1 338		1 338
1967	2	205	382	228	336	125	236	1 514		1 514
1968	1	90	241	125	70	34	272	833		833
1969	41	396	245	234	370		867	2 153		2 153
1970	58	239	122	123	496	207	862	2 107		2 107
1971	144	355	724	302	410	159	560	2 654		2 654
1972	117	136	190	374	385	118	703	2 023		2 023
1973	220	271	262	440	619	329	200	2 341		2 341
1974	44	175	272	298	395	88	645	1 917		1 917
1975	147	468	212	224	352	185	442	2 030		2 030
1976	166	302	262	225	182	38		1 175		1 175
1977	201	393	336	207	237	46	-	1 420	6	1 426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1 395	+	1 395
1980	52	275	404	231	158	74	-	1 194	+	1 194
1981	105	403	348	203	153	32	20	1 264	+	1 264
1982	111	330	239	136	167	76	18	1 077	+	1 077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993 [1]	-	-	-	-	-	-	-	-	-	-
1994 [1]	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19
2000	+	+	1	7	+	13	-	21	-	21
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9
2004	3	1	4	2	3	2	-	15	-	15
2005	1	3	2	1	3	5	-	15	-	15
2006	6	2	3	4	2	4	-	22	-	22
2007	2	5	6	4	5	2	-	25	-	25
2008	4.9	2.2	10.0	1.6	2.5	5.0	0	26.2	0	26.2
2009	0.2	6.2	7.1	3.0	4.3	4.8	0	25.6	0.8	26.3
2010	17.3	4.6	2.4	2.7	6.8	4.3	0	38.1	1.7	39.6
2011	1.8	3.7	5.3	8.0	4.0	4.6	0	27.4	0.1	27.5
2012	5.4	0.8	15.0	4.6	4.0	3.0	0	32.6	0.5	33.1
2013	3.1	2.4	17.9	13.4	6.4	3.8	0	47.0	0.0	47.0
2014	3.6	2.8	13.8	19.1	15.0	3.4	0	57.8	0.1	57.9

Year	1A	1B	1C	1D	1E	1F	Unknown	West Green-land	East Green-land	Total
2015	0.8	8.8	10.0	18.0	4.2	14.1	0	55.9	1.0	56.8
2016	0.8	1.2	7.3	4.6	4.5	7.3	0	25.7	1.5	27.1
2017	1.1	1.7	9.3	6.9	3.2	5.6	0	27.8	0.3	28.0

[1] The fishery was suspended.
+ Small catches < 5 t.
- No catch.

Table 4 Reported landings (t) by landing category, the number of fishers reporting, and the total number of landing reports received for licensed and unlicensed fishers in 2014–2017. Empty cells identify categories with no reported landings and 0.0 entries represents reported values of < 0.1.

NAFO/ICES	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total		Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total
	2017								2016						
1A	No	2	12	0.0	0.0		0.0		No						0.0
1A	Yes	15	66	0.3	0.8		1.1		Yes	9	19		0.7		0.7
1A	Total	17	78	0.3	0.9		1.1		Total	9	19	0.0	0.7		0.7
1B	No						0.0		No	4	9		0.2		0.2
1B	Yes	9	40	1.4	0.2		1.7		Yes	7	22	0.1	1.0		1.0
1B	Total	9	40	1.4	0.2		1.7		Total	11	31	0.1	1.1		1.2
1C	No	7	23	0.0	0.4		0.4		No	8	30		1.0		1.0
1C	Yes	33	135	5.9	3.0		8.9		Yes	23	113	4.1	2.1		6.2
1C	Total	40	158	5.9	3.4		9.3		Total	31	143	4.1	3.1		7.3
1D	No	17	44	0.0	0.9		0.9		No	8	13		0.9		0.9
1D	Yes	7	23	5.1	0.9		5.9		Yes	8	42	1.2	2.5		3.8
1D	Total	24	67	5.1	1.8		6.9		Total	16	55	1.2	3.4		4.6
1E	No	8	24	0.0	0.6		0.6		No	13	22		1.4		1.4
1E	Yes	15	114	0.7	1.9		2.6		Yes	10	74	0.6	2.5		3.1
1E	Total	23	138	0.7	2.5		3.2		Total	23	96	0.6	3.9		4.5
1F	No	16	51	0.0	1.2		1.2		No	27	66	0.1	2.9		3.0
1F	Yes	12	78	1.8	2.6		4.4		Yes	13	46	2.6	1.7		4.3
1F	Total	28	129	1.8	3.8		5.6		Total	40	112	2.7	4.6		7.3
XIV	No						0.0		No	9	46		1.3		1.3
XIV	Yes	2	21	0.1	0.2		0.3		Yes	1	1		0.2		0.2
XIV	Total	2	21	0.1	0.2		0.3		Total	10	47	0.0	1.5		1.5
ALL	No	50	154	0.0	3.1		3.1		No	69	186	0.1	7.6		7.7
ALL	Yes	93	477	15.3	9.7		24.9		Yes	71	317	8.6	10.8		19.4
ALL	Total	143	631	15.3	12.8		28.0		Total	140	503	8.7	18.4		27.1

NAFO/ICES	Li-censed	No. of Fish-ers	No. of Re-ports	Comm.	Pri-vate	Fac-tory	To-tal		Li-censed	No. of Fish-ers	No. of Re-ports	Comm.	Pri-vate	Fac-tory	To-tal
	2015								2014						
1A	No	5	6		0.1		0.1		No	1	1		0.1		0.1
1A	Yes	13	29	0.1	0.6		0.7		Yes	20	87	3.0	0.5		3.5
1B	Total	18	35	0.1	0.7		0.8		Total	21	88	3.0	0.6		3.6
1B	No	3	5		0.1		0.1		No						
1B	Yes	15	96	7.3	1.5		8.7		Yes	8	28	2.1	0.7		2.8
1C	Total	18	101	7.3	1.5		8.8		Total	8	28	2.1	0.7		2.8
1C	No	16	58	0.1	1.7		1.8		No	5	18	0.6			0.6
1C	Yes	42	181	2.9	3.9	1.5	8.2		Yes	35	212	1.5	2.1	9.7	13.2
1D	Total	58	239	3.0	5.6	1.5	10.1		Total	40	230	2.1	2.1	9.7	13.8
1D	No	20	35		0.8		0.8		No	6	10	0.2	0.3		0.5
1D	Yes	11	161	14.3	0.5	2.4	17.1		Yes	14	115	0.4	5.5	12.8	18.6
1E	Total	31	196	14.3	1.3	2.4	18.0		Total	20	135	0.6	5.7	12.8	19.1
1E	No	3	5	0.1	0.2		0.2		No	1	1	0.2			0.2
1E	Yes	11	71	2.0	1.9		3.9		Yes	9	102	1.4	0.8	12.6	14.8
1F	Total	14	76	2.1	2.1		4.2		Total	10	103	1.6	0.8	12.6	15.0
1F	No	20	69		2.4		2.4		No	3	3	0.1	0.1		0.2
1F	Yes	21	173	7.1	4.6		11.7		Yes	11	80	2.0	1.2		3.2
XIV	Total	41	242	7.1	7.0		14.1		Total	14	83	2.1	1.3		3.4
XIV	No	8	32		0.6		0.6		No						0.0
XIV	Yes	1	17	0.0	0.4		0.4		Yes	1	12	0.1	0.0		0.1
ALL	Total	9	49	0.0	0.9		1.0		Total	1	12	0.1	0.0		0.1
ALL	No	75	210	0.1	5.9		6.0		No	16	33	1.2	0.4		1.6
ALL	Yes	114	728	33.7	13.3	3.8	50.8		Yes	98	636	10.5	10.7	35.0	56.2
	Total	189	938	33.8	19.2	3.8	56.8		Total	114	669	11.6	11.2	35.0	57.8

Table 5 Reported landings and adjusted landings for assessment of Atlantic salmon at West Greenland 2002–2017. The total adjusted landings number does not include the unreported catch (10 t per year since 2000).

Year	Reported landings (West Greenland)	Adjusted landings (Sampling)	Adjusted landings (Survey)	Total adjusted landings
2002	9.0	0.7	-	9.8
2003	8.7	3.6	-	12.3
2004	14.7	2.5	-	17.2
2005	15.3	2.0	-	17.3
2006	23.0	0.0	-	23.0
2007	24.6	0.2	-	24.8
2008	26.1	2.5	-	28.6
2009	25.5	2.5	-	28.0
2010	37.9	5.1	-	43.1
2011	27.4	0.0	-	27.4
2012	32.6	2.0	-	34.6
2013	46.9	0.7	-	47.7
2014	57.7	0.6	12.2	70.5
2015	55.9	0.0	5.0	60.9
2016	25.7	0.3	4.2	30.2
2017	27.8	0.3	-	28.0

Table 6 Summary of biological characteristics of catches of Atlantic salmon at West Greenland in 2017 (NA – North America, E – Europe).

River-age distribution (%) by origin								
	1	2	3	4	5	6	7	8
NA	0.3	31.0	41.6	19.6	7.2	0.3	0	0
E	10.0	73.0	15.4	1.7	0	0	0	0

Length and weight by origin and sea age								
	1 SW		2 SW		Previous spawners		All sea ages	
	Fork length	Whole	Fork length	Whole	Fork length	Whole	Fork length	Whole
NA	66.6	3.42	85.1	6.50	76.7	4.94	67.4	3.50
E	64.8	3.31	72.4	3.69	81.9	8.00	65.4	3.36

Continent of origin (%)	
North America	Europe
74.4	25.6

Sea-age composition (%) by continent of origin			
	1SW	2SW	Previous spawners
NA	92.5	1.5	6.0
E	93.1	5.7	1.2

Table 7 Genetic mixture analyses (proportion of samples) of Atlantic salmon harvested at West Greenland from 2015–2017. Three regional groups (GUL, GAS, and LAB) account for > 70% of the harvest on average. Mean (proportion) estimates provided with 95% credible interval in parentheses. Credible intervals with a lower bound of zero indicate little support for mean assignment value. Regional group acronyms were identified in Figure 5.

Region	Overall	2015	2016	2017
GUL	0.263 (0.161, 0.361)	0.225 (0.152, 0.296)	0.243 (0.165, 0.322)	0.306 (0.165, 0.439)
FUN	0.001 (0, 0.019)	0.002 (0, 0.013)	0 (0, 0.012)	0 (0, 0.028)
QUE	0.083 (0.036, 0.155)	0.119 (0.062, 0.181)	0.076 (0.026, 0.136)	0.06 (0.024, 0.149)
GAS	0.275 (0.166, 0.367)	0.29 (0.2, 0.356)	0.218 (0.138, 0.295)	0.305 (0.16, 0.429)
ANT	0.016 (0.003, 0.042)	0.028 (0.006, 0.054)	0.016 (0.003, 0.037)	0.007 (0.001, 0.037)
QLS	0.041 (0.008, 0.102)	0.022 (0.003, 0.061)	0.05 (0.014, 0.099)	0.05 (0.008, 0.135)
AVA	0 (0, 0.013)	0 (0, 0.007)	0 (0, 0.007)	0 (0, 0.023)
NFL	0.042 (0.018, 0.126)	0.064 (0.031, 0.149)	0.049 (0.024, 0.124)	0.019 (0.004, 0.111)
LAB	0.189 (0.132, 0.285)	0.212 (0.154, 0.29)	0.229 (0.165, 0.315)	0.141 (0.091, 0.259)
UNG	0.068 (0.023, 0.123)	0.032 (0.009, 0.061)	0.075 (0.034, 0.114)	0.09 (0.026, 0.175)
NOS	0.006 (0, 0.035)	0 (0, 0.008)	0.01 (0.001, 0.04)	0.007 (0, 0.052)
USA	0.018 (0.005, 0.045)	0.007 (0.003, 0.018)	0.034 (0.011, 0.066)	0.014 (0.002, 0.051)
Samples	1806	749	508	549

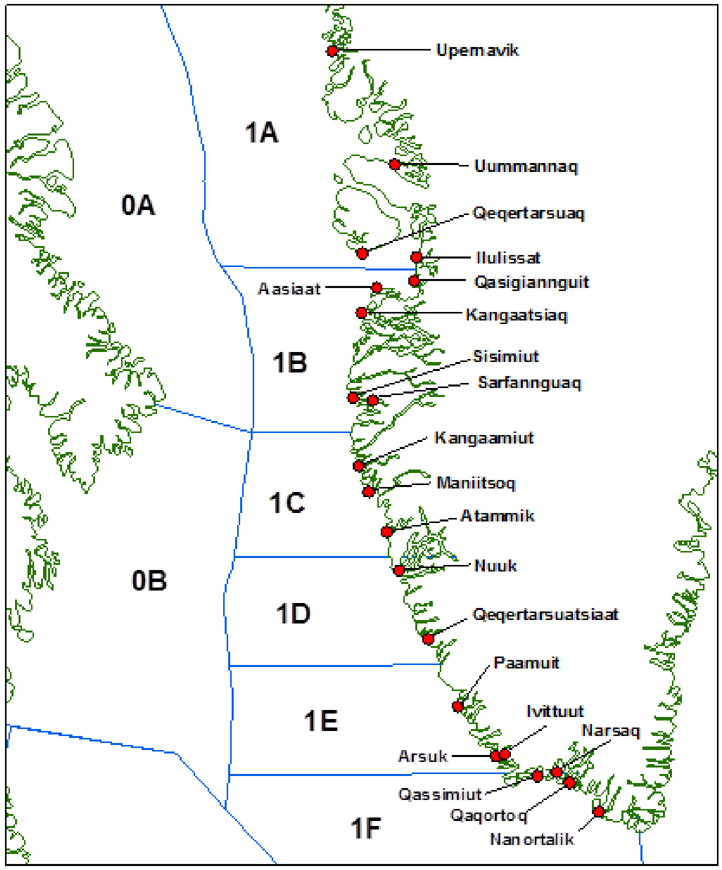


Figure 1 Map of communities in West Greenland where Atlantic salmon have historically been landed and corresponding NAFO divisions (1A–1F). In 2017, samples were obtained from Sisimiut (1B), Maniitsoq (1C), Paamuit (1E), and Qaqortoq (1F).

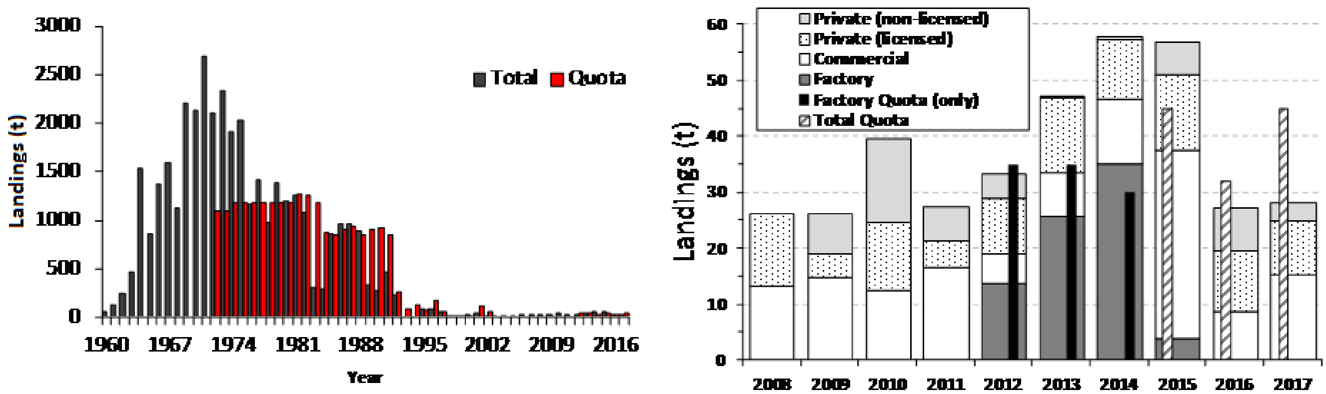


Figure 2 Nominal landings and commercial quotas (t, round fresh weight) of salmon at West Greenland from 1960–2017 (left panel). Landings from 2008–2017 are also displayed by landing type (right panel). No quotas were set from 2002–2011.

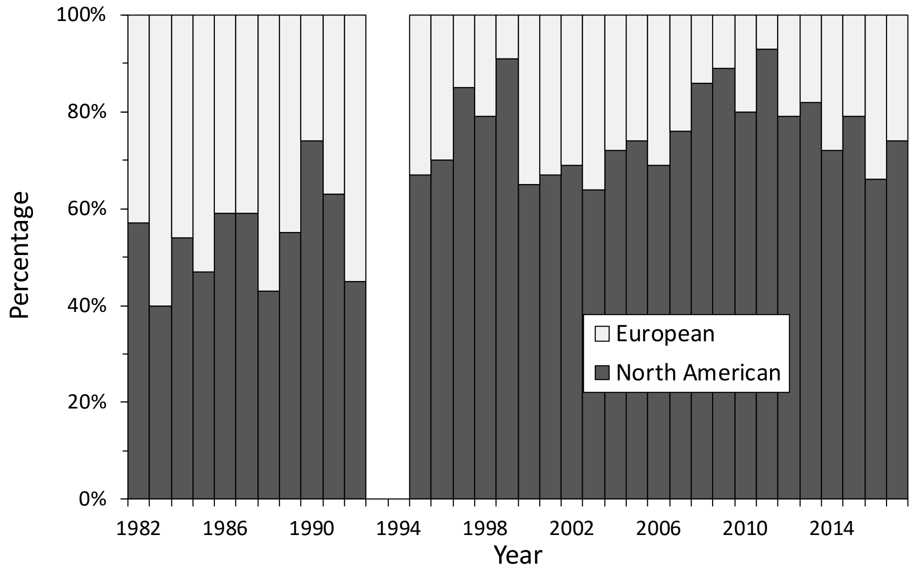


Figure 3 Estimated percent continent of origin of Atlantic salmon harvested at West Greenland from 1982 to 2017.

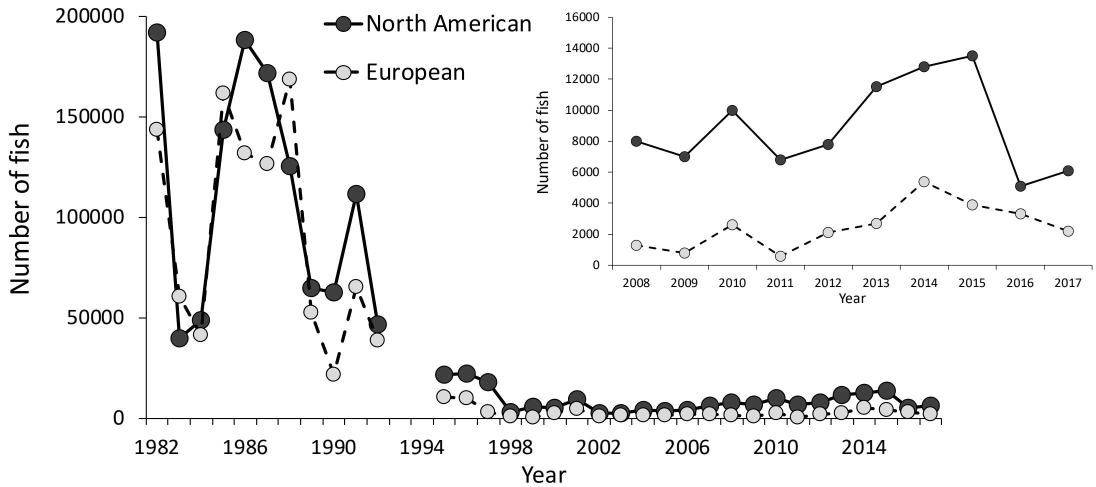
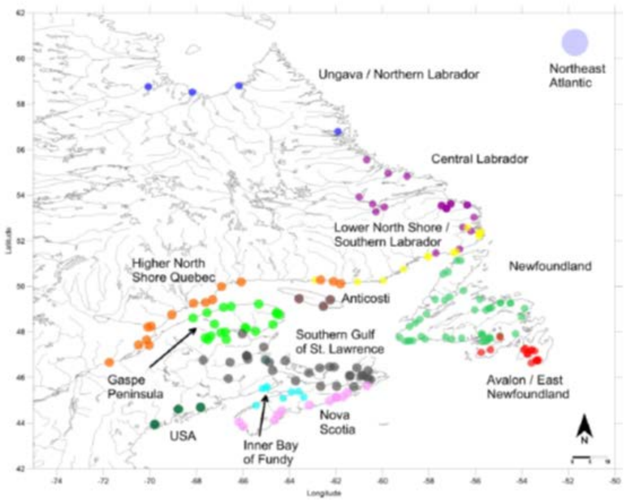


Figure 4 Number of North American (red bars) and European (blue bars) Atlantic salmon caught at West Greenland from 1982–2017 and 2008–2017 (inset). Estimates are based on continent of origin by NAFO division, weighted by catch (weight) in each division. Numbers are rounded to the nearest hundred fish. Unreported catch not included.



ICES region	Regional group	Group acronym
Quebec		
	Ungava / Northern Labrador	UNG
Labrador	Labrador Central	LAB
	Quebec / Labrador South	QLS
	Quebec	QUE
Quebec	Anticosti	ANT
	Gaspe	GAS
Gulf		
	Gulf of St. Lawrence	GUL
Scotia-Fundy		
	Nova Scotia	NOS
	Inner Bay of Fundy	FUN
USA	USA	US
Newfoundland	Newfoundland	NFL
	Avalon	AVA

Figure 5 Map of sample locations used in the microsatellite baseline for Atlantic salmon which provided twelve defined regional groups for eastern North America (labelled and identified by colour) and correspondence between regional groups and ICES assessment regions for eastern North America.

NASCO 4.2 Describe the status of the stocks

Recruitment (pre-fishery abundance) estimates of non-maturing 1SW salmon suggest continued low abundance of North American (Figure 6) and Southern NEAC (Figure 7) salmon at Greenland. In 2017, the median estimates of returns to rivers and spawners were below the CLs for 2SW salmon for all regions of NAC except Labrador, and are therefore suffering reduced reproductive capacity (Figure 8). The median estimates of the 2SW returns and spawners for Labrador exceeded the CL, but the fifth percentiles were below the CL and for this region the stock is at risk of suffering reduced reproductive capacity (Figure 8). Particularly large deficits relative to CLs and rebuilding management objectives are noted in the Scotia–Fundy and USA regions. In 2017, the median estimates of spawners for the southern NEAC MSW stock complex was above the CL, but the fifth percentiles were below the CL and, as such, considered at risk of suffering reduced reproductive capacity (Figure 8). For individual countries within the Southern NEAC MSW stock complex, estimated spawners for three countries were considered at full reproductive capacity, whereas spawners for three countries were suffering reduced reproductive capacity.

The exploitation rate (catch in Greenland/PFA) on NAC fish in 2016 was 5.4%, and among the lowest in the time-series (Figure 9). The 2016 southern NEAC exploitation rate was 0.8% and among the lowest in the time-series (Figure 9).

The abundance of salmon within the West Greenland area is considered to be low compared to historical levels (Figures 6 and 7). This is broadly consistent with the general pattern of decline in marine survival in most monitored stocks. Despite major changes in fisheries management in the past few decades and increasingly more restrictive fisheries measures, returns in many of these regions have remained near historical lows. The continued low abundance of salmon stocks across North America and in the Northeast Atlantic, despite significant fishery reductions, further strengthens the conclusions that factors other than fisheries are constraining production.

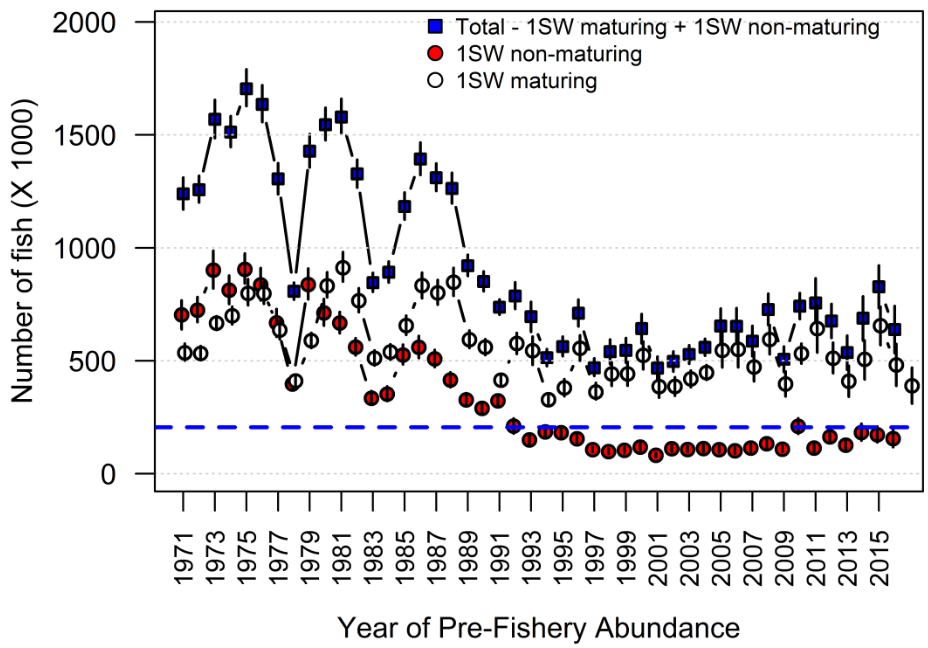


Figure 6 Estimated (median, fifth to 95th percentile range) pre-fishery abundance (PFA) for 1SW maturing, 1SW non-maturing, and total cohort of 1SW salmon for NAC, PFA years 1971 to 2016. The dashed blue horizontal line is the corresponding sum of the 2SW conservation limits for NAC (152 548), corrected for 11 months of natural mortality (205 918) against which 1SW non-maturing are assessed.

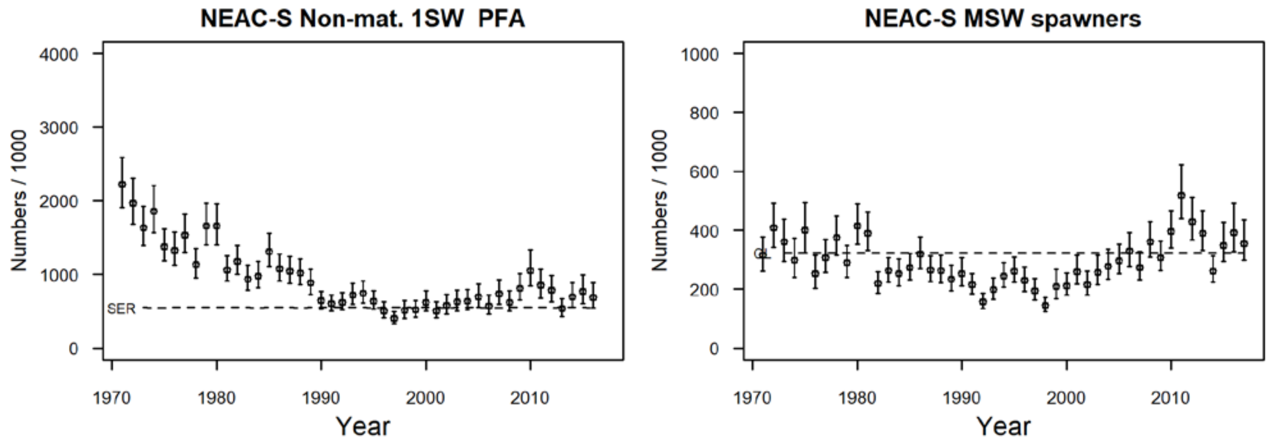


Figure 7 Estimated PFA (left panel) and spawning escapement (right panel) with 90% confidence limits, for non-maturing 1SW (MSW spawners) salmon in southern NEAC (NEAC – S) stock complex.

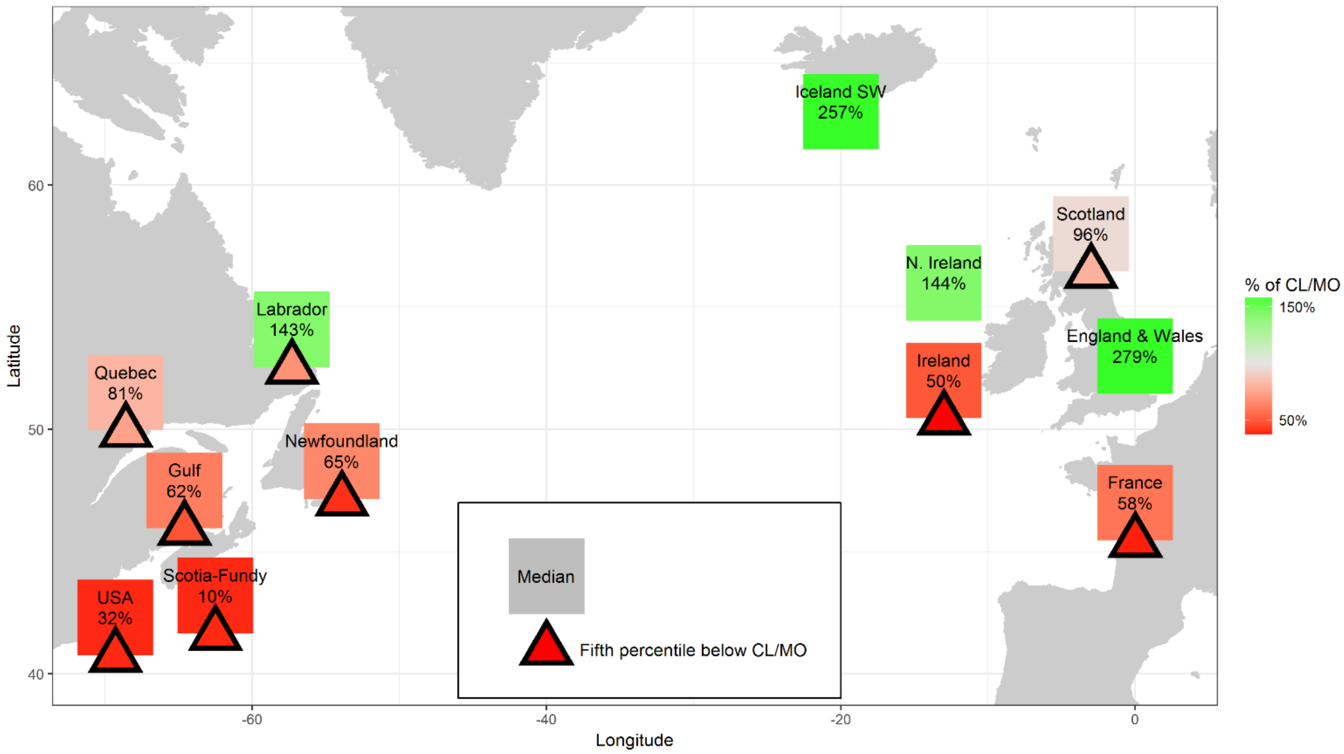


Figure 8 Summary of 2SW (NAC regions) and MSW (Southern NEAC regions) spawner estimates in 2017 in relation to CLs or management objectives (for USA and Scotia-Fundy). Median and fifth percentiles refer to the Monte Carlo posterior distributions of each estimate. The colour shading of the symbols represents the percentage of the CL or rebuilding objective attained, with red < 100% and green > 100%. The triangular symbols accompanying the respective spawners symbols indicate when the fifth percentiles of the estimates are below the CLs or management objective, i.e., the stocks are at risk of or suffering reduced reproductive capacity. The intensity of the red colour shading is inversely associated with the percentage of the objective attained.

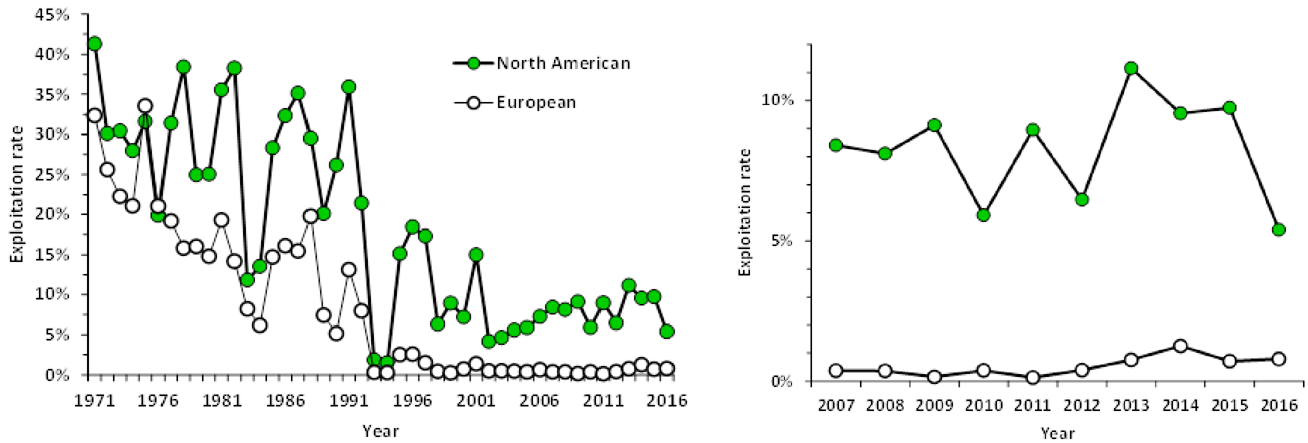


Figure 9 Exploitation rate (%) for NAC 1SW non-maturing and southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2016 (left panel) and 2007–2016 (right panel). Exploitation rate estimates are only available to 2016, as 2017 exploitation rates are dependent on 2018 returns.

NASCO 4.3 Provide catch options or alternative management advice for 2018-2020 with an assessment of risk relative to the objective of exceeding stock conservation limits, or pre-defined NASCO Management Objectives, and advise on the implications of these options for stock rebuilding

None of the management objectives agreed by NASCO would allow a mixed-stock fishery at West Greenland to take place in 2018, 2019, or 2020 (Table 8).

- In the absence of any fishing in the years 2018 to 2020, there is less than 75% probability that the numbers of 2SW salmon returns will be above the management objectives simultaneously for the six regions of North America and for Southern NEAC.
- In the absence of any fishing, there is a low probability (from 0.000 to 0.003) that the returns in the southern region of Scotia-Fundy will be sufficient to meet the stock rebuilding objective during the period 2018 to 2020. The probability of meeting or exceeding the stock rebuilding objective of the USA region is estimated at 0.001 to 0.006 over the three years.
- In the absence of any fishing, the probabilities of meeting or exceeding the CLs for the southern NEAC MSW complex is 0.369, 0.417, and 0.548 in 2018 to 2020, respectively.

Table 8 Catch options tables for the mixed-stock fishery at West Greenland for the fishing years 2018 to 2020. '0.000' refers to attainment of less than three out of 5000 draws.

2018 Catch option	Probability of meeting or exceeding region-specific management objectives							
	Labrador	Newfoundland	Québec	Gulf	Scotia-Fundy	US	Southern NEAC	Simultaneous
0	0.871	0.308	0.387	0.087	0.001	0.001	0.369	0.000
10	0.857	0.295	0.363	0.084	0.001	0.001	0.365	0.000
20	0.842	0.283	0.340	0.080	0.001	0.001	0.360	0.000
30	0.825	0.271	0.316	0.074	0.001	0.001	0.355	0.000
40	0.813	0.254	0.293	0.068	0.001	0.001	0.351	0.000
50	0.797	0.240	0.273	0.064	0.001	0.001	0.348	0.000
60	0.780	0.228	0.259	0.061	0.001	0.001	0.344	0.000
70	0.762	0.216	0.241	0.057	0.001	0.001	0.341	0.000
80	0.742	0.204	0.224	0.053	0.001	0.001	0.337	0.000
90	0.725	0.191	0.205	0.048	0.001	0.001	0.333	0.000
100	0.705	0.178	0.193	0.045	0.000	0.001	0.330	0.000
2019 Catch option	Probability of meeting or exceeding region-specific management objectives							
	Labrador	Newfoundland	Québec	Gulf	Scotia-Fundy	US	Southern NEAC	Simultaneous
0	0.888	0.289	0.271	0.102	0.000	0.002	0.417	0.000
10	0.875	0.278	0.258	0.098	0.000	0.001	0.412	0.000
20	0.863	0.266	0.243	0.094	0.000	0.001	0.408	0.000
30	0.851	0.253	0.230	0.088	0.000	0.001	0.405	0.000
40	0.838	0.244	0.216	0.083	0.000	0.001	0.400	0.000
50	0.823	0.235	0.205	0.080	0.000	0.001	0.397	0.000
60	0.810	0.224	0.193	0.076	0.000	0.001	0.394	0.000
70	0.795	0.215	0.182	0.071	0.000	0.001	0.389	0.000
80	0.782	0.205	0.173	0.066	0.000	0.001	0.384	0.000
90	0.765	0.196	0.163	0.063	0.000	0.001	0.379	0.000
100	0.749	0.187	0.155	0.059	0.000	0.001	0.376	0.000
2020 Catch option	Probability of meeting or exceeding region-specific management objectives							
	Labrador	Newfoundland	Québec	Gulf	Scotia-Fundy	US	Southern NEAC	Simultaneous
0	0.898	0.392	0.316	0.194	0.003	0.006	0.548	0.000
10	0.889	0.379	0.305	0.186	0.003	0.006	0.544	0.000
20	0.881	0.368	0.290	0.181	0.003	0.006	0.540	0.000
30	0.872	0.357	0.281	0.176	0.003	0.006	0.536	0.000
40	0.861	0.348	0.270	0.171	0.003	0.006	0.532	0.000
50	0.849	0.339	0.260	0.165	0.003	0.006	0.527	0.000
60	0.838	0.329	0.250	0.159	0.002	0.005	0.523	0.000
70	0.827	0.319	0.240	0.155	0.002	0.005	0.520	0.000
80	0.813	0.311	0.229	0.150	0.002	0.005	0.514	0.000
90	0.802	0.302	0.220	0.142	0.002	0.005	0.512	0.000
100	0.788	0.295	0.211	0.137	0.002	0.005	0.510	0.000

NASCO 4.4 Update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.

An updated Framework of Indicators (FWI) that can be used to identify any significant change in the previously provided multi-annual management advice has been provided (Figure 9). The update consisted of:

- Adding the values of the indicator variables for the most recent years;
- Running the objective function spreadsheet for each indicator variable and the variable of interest relative to the management objectives;
- Quantifying the threshold value for the indicator variables and the probabilities of a true high state and a true low state for those indicator variables retained for the framework;
- Revising/adding the indicator variables and the functions for evaluating the indicator score to the framework spreadsheet; and
- Providing the spreadsheet for doing the framework of indicators assessment.

The updated FWI contains 22 indicator variables, represented by 14 different rivers. Of these, two were survival rate indicators of hatchery fish, two were survival rate indicators of wild fish, while the remainder were of wild 2SW, MSW, and large salmon (n=16) or wild 1SW or small salmon (n=4) returns to rivers. No indicator variables were retained for the Labrador or Newfoundland areas and 15 indicator variables were explored for southern NEAC and only one met the qualifying criteria.

Catch Advice	Catch option > 0 (Yes = 1, No = 0)	0

Overall Recommendation
No Significant Change Identified by Indicators

Geographic Area	River/ Indicator	2017 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	530	22%	2 368	100%	100%	-1	1	-1	
	possible range				*-1,00*	*1,00*				
	Average		22%						**-1,00**	**No**
Scotia-Fundy	Saint John Return Large	83	2%	3 329	97%	100%	-1	0,97	-0,97	
	Lahave Return Large	51	18%	285	81%	85%	-1	0,81	-0,81	
	North Return Large	192	31%	626	96%	74%	-1	0,96	-0,96	
	Saint John Survival 2SW (%)	0,04	18%	0,222	96%	81%	-1	0,96	-0,96	
	Saint John Survival 1SW (%)	0,1	13%	0,763	89%	73%	-1	0,89	-0,89	
	Saint John Return 1SW	195	9%	2 276	89%	80%	-1	0,89	-0,89	
	LaHave Return 1SW	45	3%	1 679	96%	67%	-1	0,96	-0,96	
	possible range				*-0,92*	*0,80*				
	Average		13%						**-0,92**	**No**
Gulf	Miramichi Return 2SW	10149	69%	14 669	100%	82%	-1	1,00	-1,00	
	Miramichi Return 1SW	1330	3%	41 588	92%	68%	-1	0,92	-0,92	
	Margaree Return Large	1550	49%	3 149	88%	56%	-1	0,88	-0,88	
	possible range				*-0,93*	*0,69*				
	Average		41%						**-0,93**	**No**
Quebec	Bonaventure Return Large	1067	72%	1 479	82%	76%	-1	0,82	-0,82	
	Grande Rivière Return Large	467	106%	442	100%	89%	1	0,89	0,89	
	Saint-Jean Return Large	554	73%	758	88%	78%	-1	0,88	-0,88	
	Dartmouth Return Large	927	123%	756	84%	87%	1	0,87	0,87	
	Madeleine Return Large	672	100%	672	88%	79%	1	0,79	0,79	
	York Return Large	1267	90%	1405	73%	83%	-1	0,73	-0,73	
	De la Trinité Return Large	264	69%	385	82%	100%	-1	0,82	-0,82	
	De la Trinité Return Small	212	37%	578	83%	85%	-1	0,83	-0,83	
	Saint-Jean 2SW Survival	1,18	164%	0,72	100%	50%	1	0,5	0,5	
	De la Trinité 2SW Survival	0,40	82%	0,49	92%	68%	-1	0,92	-0,92	
	possible range				*-0,87*	*0,80*				
	Average		91%						**-0,20**	**No**
Newfoundland										
	possible range									
	Average								**NA**	**Unknown**
Labrador										
	possible range									
	Average								**NA**	**Unknown**
Scotland	North Esk HW Return MSW	6196	74%	8369	72%	100%	-1	0,72	-0,72	
	possible range				*-0,72*	*1,00*				
	Average		74%						**-0,72**	**No**

Figure 9 Framework of indicators spreadsheet for the West Greenland fishery. For illustrative purposes, the 2017 value of returns or survival rates for the 22 retained indicators is entered in the cells corresponding to the annual indicator variable values.

Relevant data deficiencies, monitoring needs and research requirements

The following relevant data deficiencies, monitoring needs, and research requirements of relevance to the West Greenland Commission were identified:

- Efforts to improve the reporting system of catch in the Greenland fishery should continue and that detailed statistics related to spatially and temporally explicit catch and effort data for both licensed and unlicensed fishers should be made available for analysis.
- Continuation of the phone survey programme according to a standardized and consistent annual approach with consideration given to surveying a larger proportion of licensed fishers and the inclusion of the non-licensed fishers. Information gained on the level of total catch for this fishery will provide for a more accurate assessment of the status of stocks and assessment of risk with varying levels of harvest.
- Continuation of the broad geographic sampling programme including in Nuuk (multiple NAFO divisions including factory landings when permitted) and consideration should be given to expanding the programme across the fishing season to more accurately estimate continent and region of origin and biological characteristics of the mixed-stock fishery.
- In preparation for the next update to the FWI, a full suite of all potential input datasets across all regions and stock complexes be evaluated against country-specific management objectives for Southern NEAC.

The full list of data deficiencies, monitoring needs and research requirements for North Atlantic salmon is presented in Section 1.5 of the sal.oth.nasco advice (ICES, 2018a).

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Annex 1 Glossary of acronyms and abbreviations

1SW *(one-sea-winter).* Maiden adult salmon that has spent one winter at sea.
2SW *(two-sea-winter).* Maiden adult salmon that has spent two winters at sea.
CL, i.e. S_{lim} *(conservation limit).* Demarcation of undesirable stock levels or levels of fishing activity; the ultimate objective when managing stocks and regulating fisheries will be to ensure that there is a high probability that undesirable levels are avoided.
CPUE *(catch per unit of effort).* A derived quantity obtained from the independent values of catch and effort.
ICES (*International Council for the Exploration of the Sea*).
NAC (*North American Commission*). A commission under NASCO.
NAFO (*Northwest Atlantic Fisheries Organization*). NAFO is an intergovernmental fisheries science and management organization that ensures the long-term conservation and sustainable use of the fishery resources in the Northwest Atlantic.
NASCO (*North Atlantic Salmon Conservation Organization*).
NEAC (*North East Atlantic Commission*). A commission under NASCO.
PFA *(pre-fishery abundance).* The numbers of salmon estimated to be alive in the ocean from a particular stock at a specified time.
TAC *(total allowable catch).* TAC is the quantity of fish that can be taken from each stock each year.

Annex 2 General considerations

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 CLs 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 simultaneous risk level (probability) of 75% has been agreed for the provision of catch advice on the stock complexes exploited at West Greenland (non-maturing 1SW fish from North America and Southern NEAC). The management objectives are to meet the Southern NEAC MSW CL, the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, and Gulf), to achieve a 25% increase in returns of 2SW salmon from the average returns in the period 1992–1996 for the Scotia-Fundy region of NAC, and to achieve 2SW adult returns of 4549 fish or greater for the USA region of NAC. A framework of indicators 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 Northeast Atlantic area their current distribution extends from northern Portugal to the Pechora River in northwestern Russia and Iceland. In the Northwest Atlantic distribution ranges from the Connecticut River in USA (41.6°N) to the Leaf River in Ungava Bay (Quebec, Canada; 58.8°N). Juveniles migrate to the ocean at ages 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 during their second summer and autumn at sea.

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 the impact of predators of salmon at sea are considered to be the main factors contributing to lower productivity, which is expressed almost entirely in terms of lower marine survival.

Effects of the fisheries on the ecosystem

The current salmon fishery uses nearshore surface gillnets. There is no information on bycatch of other species with this gear. The fisheries probably have no influence, or only a minor influence, on the marine ecosystem.

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Catch reporting at Greenland is considered to be incomplete.

Scientific basis

ICES stock data category	1 (ICES, 2016).
Assessment type	Run–reconstruction models and Bayesian forecasts, taking into account uncertainties in the data.
Input data	Nominal catches (by sea-age class and continent of origin) for internal use fisheries. Estimates of unreported/illegal catches. Estimates of exploitation rates. Natural mortalities (from earlier assessments).
Discards and bycatch	No salmon discards in the directed salmon fishery.
Indicators	A framework of indicators (FWI) is used to indicate whether 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. Stock annex completed in 2014 and updated in 2017.
Working group	Working Group on North Atlantic Salmon (WGNAS) (ICES, 2018b).