Agenda Item 5.4
For Information

Council

CNL(12)8

Report of the ICES Advisory Committee

10 NORTH ATLANTIC SALMON STOCKS

10.1 Introduction

10.1.1 Main tasks

At its 2011 Statutory Meeting, ICES resolved (C. Res. 2011/2/ACOM09) that the **Working Group on North Atlantic Salmon** [WGNAS] (chaired by Gérald Chaput, Canada) will meet at ICES HQ, 26 March–4 April 2012 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.

a)	With respect to Atlantic salmon in the North Atlantic area:	Section 10.1
1.	provide an overview of salmon catches and landings, including unreported catches by country, catch and release, and production of farmed and ranched Atlantic salmon in 2011[1];	10.1.5
2.	report on significant new or emerging threats to, or opportunities for, salmon conservation and management[2];	10.1.6
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;	10.1.7
4.	provide a compilation of tag releases by country in 2011;	10.1.8
5.	identify relevant data deficiencies, monitoring needs, and research requirements. Where relevant suggest improvement for the revision of the Data Collection Framework (DCF), to be taken into account by the Workshop on Eel and Salmon DCF (WKESDCF).	10.1.9

b)	With respect to Atlantic salmon in the Northeast Atlantic Commission area:	Section 10.2
1)	describe the key events of the 2011 fisheries[3];	10.2.1
2)	review and report on the development of age-specific stock conservation limits;	10.2.1
3)	describe the status of the stocks;	10.2
4)	provide catch options or alternative management advice for 2012–2015, with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[4];	10.2
5)	further develop a risk-based framework for the provision of catch advice for the Faroese salmon fishery, providing a clear indication of the management decisions required for implementation;	10.1.10
6)	further develop a framework of indicators that could be used to identify any significant change in the assessments used in previously provided multi-annual management advice;	10.1.11
7)	provide advice on best practice for conducting monitoring surveys for the parasite *Gyrodactylus salaris*.	10.1.12

c)	With respect to Atlantic salmon in the North American Commission area:	Section 10.3
1)	describe the key events of the 2011 fisheries (including the fishery at St Pierre and Miquelon)[3];	10.3.1

	2) update age-specific stock conservation limits based on new information as available;	10.3.1
	3) describe the status of the stocks;	10.3.1
	4) provide catch options or alternative management advice for 2012–2015 with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[4].	10.3

d)	With respect to Atlantic salmon in the West Greenland Commission area:	Section 10.4
	1) describe the key events of the 2011 fisheries[3];	10.4.1
	2) Describe the status of the stocks[5];	10.4.1
	3) provide catch options or alternative management advice for 2012–2014 with an assessment of risk relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding[4];	10.4
	4) update the framework of indicators used to identify any significant change in the previously provided multi-annual management advice;	10.1.13
	5) advise on possible explanations for the variations in fishing patterns (e.g. effort, licenses, and landings) observed in the Greenland fishery in recent years.	10.4.1

Notes:

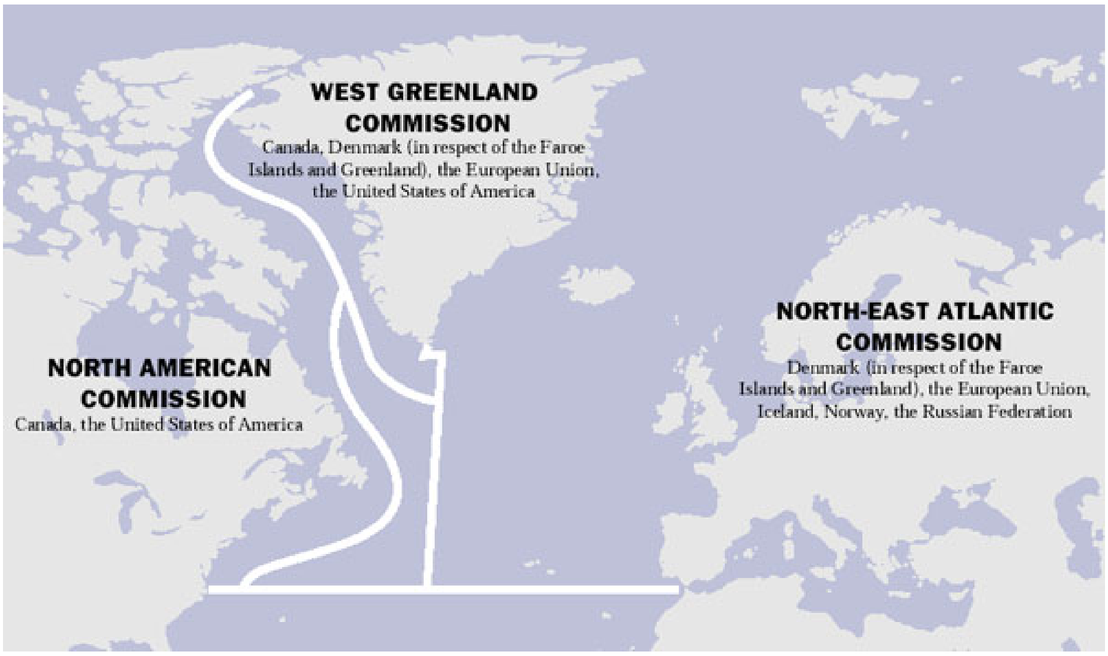
1. With regard to question a) i, for the estimates of unreported catch the information provided should, where possible, indicate the location of the unreported catch in the following categories: in-river; estuarine; and coastal. Numbers of salmon caught and released in recreational fisheries should be provided.
2. With regard to question a) ii, 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. In the responses to questions b) i, c) i, and d) i, 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. Any new information on non-catch fishing mortality of the salmon gear used, on the bycatch of other species in salmon gear, and on the bycatch of salmon in any existing and new fisheries for other species is also requested.
4. In response to questions b) iv, c) iv, and d) iii, 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.
5. In response to question d) ii, ICES is requested to provide a brief summary of the status of North American and Northeast Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions b) iii and c) iii.

In response to the terms of reference, the Working Group considered 38 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.

10.1.2 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 seven Parties that are signatories to the Convention, including the EU which represents its Member States.

NASCO discharges these responsibilities via the three Commission areas shown below:



10.1.3 Management objectives

NASCO has identified the primary management objective of that organization as:

"To contribute through consultation and cooperation to the conservation, restoration, enhancement and rational management of salmon stocks taking into account the best scientific advice 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 NASCOs 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, 1999) 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".

10.1.4 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 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, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar and B_{pa} is a reasonable initial estimate of 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.

Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield. In many regions of North America, the CLs are calculated as the number of spawners required to fully seed the wetted area of the river. In some regions of Europe, pseudo stock–recruitment observations are used to calculate a hockey-stick relationship, with the inflection point defining the CLs. In the remaining regions, the CLs are calculated as the number of spawners that will achieve long-term average MSY, as derived from the adult-to-adult stock and recruitment relationship (Ricker, 1975; ICES, 1993). NASCO has adopted the region-specific CLs (NASCO, 1998). These CLs are limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability.

Management targets have not yet been defined for all North Atlantic salmon stocks. When these have been defined they will play an important role in ICES advice.

Where there are no specific management objectives for the assessment of the status of stocks and advice on management of national components and geographical groupings of the stock complexes in the NEAC area, the following 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.

Therefore, stocks are regarded by ICES as being at full reproductive capacity only if they are above the MSY $B_{escapement}$ (or CLs).

For catch advice on the mixed-stock fishery at West Greenland (catching non-maturing 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.

10.1.5 Catches of North Atlantic salmon

10.1.5.1 Nominal catches of salmon

Figure 10.1.5.1 displays reported total nominal catch of salmon in four North Atlantic regions during 1960–2011. Nominal catches of salmon reported for countries in the North Atlantic for 1960–2011 are given in Table 10.1.5.1. Catch statistics in the North Atlantic include fish farm escapees, and in some Northeast Atlantic countries also ranched fish.

Icelandic catches have traditionally been split into two separate categories, wild and ranched, reflecting the fact that Iceland has been the only North Atlantic country where large-scale ranching has been undertaken with the specific intention of harvesting all returns at the release site. The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching for rod fisheries in two Icelandic rivers continued into 2011 (Table 10.1.5.1). While ranching does occur in some other countries, this is on a much smaller scale. Some of these operations are experimental and at others harvesting does not occur solely at the release site. The ranched component in these countries has therefore been included in the nominal catch.

Reported catches in tonnes for the three NASCO Commission Areas for 2002–2011 are provided below.

AREA	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NEAC	2490	2300	1974	1989	1832	1392	1535	1161	1422	1424
NAC	150	140	164	142	140	114	151	123	149	182
WGC	9	9	15	15	22	25	26	26	40	28
Total	2649	2449	2153	2146	1994	1531	1712	1310	1611	1634

The provisional total nominal catch for 2011 was 1634 t, just 23 t above the updated catch for 2010 (1611 t). The 2011 catch was only two tonnes above the average of the previous five years (1632 t), and over 400 t below the average of the last 10 years (2053 t).

ICES recognises that mixed-stock fisheries present particular threats to stock status. These fisheries predominantly operate in coastal areas and NASCO specifically requests that the nominal catches in homewater fisheries be partitioned according to whether the catch is taken in coastal, estuarine, or riverine areas. The 2011 nominal catch (in tonnes) was partitioned accordingly and is shown below for the NEAC and NAC Commission Areas. Figure 10.1.5.2 presents these data on a country-by-country basis. There is considerable variability in the distribution of the catch among individual countries. In most countries the majority of the catch is now taken in freshwater; the coastal catch has declined markedly.

AREA	COAST		ESTUARY		RIVER		TOTAL
	Weight	%	Weight	%	Weight	%	Weight
NEAC	484	34	63	4	878	62	1424
NAC	15	8	53	29	115	63	182

Coastal, estuarine, and riverine catch data aggregated by region are presented in Figure 10.1.5.3. In northern Europe, about half the catch has typically been taken in rivers and half in coastal waters (although there are no coastal fisheries in Iceland and Finland), with estuarine catches representing a negligible component of the catch in this area. There has been a reduction in the proportion of the catch taken in coastal waters over the last five years. In southern Europe, catches in all fishery areas have declined dramatically over the period. 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. In the last four years, the majority of the catch in this area has been taken in freshwater.

In North America, the total catch over the period 2000–2011 has been relatively constant. The majority of the catch in this area has been taken in riverine fisheries; the catch in coastal fisheries has been relatively small in any year (15 t or less), but has increased as a proportion of the total catch over the period.

10.1.5.2 Unreported catches

The total unreported catch in NASCO areas in 2011 was estimated to be 421 t; however, there was no estimate for Russia. The unreported catch in the North East Atlantic Commission Area in 2011 was estimated at 382 t, and that for the West Greenland and North American Commission Areas at 10 t and 29 t, respectively. The following table shows unreported catch by NASCO commission areas in the last 10 years:

AREA	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NEAC	946	719	575	605	604	465	433	317	357	382
NAC	83	118	101	85	56	-	-	16	15	29
WGC	10	10	10	10	10	10	10	10	10	10

The 2011 unreported catch by country is provided in Table 10.1.5.2. It has not been possible to separate the unreported catch into that taken in coastal, estuarine, and riverine areas. Over recent years efforts have been made to reduce the level of unreported catch in a number of countries (e.g. through improved reporting procedures and the introduction of carcass tagging and logbook schemes).

10.1.5.3 Catch-and-release

The practice of catch-and-release (C&R) in rod 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 has been practiced since 1984, and in more recent years it has also been widely used 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 10.1.5.3 presents C&R information from 1991 to 2011 for countries that have 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 rod catch that is released: in 2011 this ranged from 12% in Norway (this is a minimum figure, as statistics were collected on a voluntary basis) to 73% in UK (Scotland), reflecting varying management practices and angler attitudes among countries. Catch-and-release rates have typically been highest in Russia (average of 84% in the five years 2004 to 2008) and are believed to have remained at this level. However, there were no obligations to report C&R fish in Russia in 2009 and records for 2010 and 2011 are incomplete. Within countries, the percentage of fish released has tended to increase over time. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller fish. Overall, over 206 000 salmon were reported to have been released around the North Atlantic in 2011.

10.1.5.4 Farming and sea ranching of Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2011 is 1273 kt, the third year in which production in this area has been in excess of one million tonnes. The 2011 total represents an 8% increase on 2010 and a 26% increase on the previous five-year mean. Norway and UK (Scotland) continue to produce the majority of the farmed salmon in the North Atlantic (78% and 12%, respectively). Farmed salmon production in 2011 was below the previous five-year average in Canada, Ireland, and Iceland. The production of farmed salmon in Russia has increased dramatically over last two years.

World-wide production of farmed Atlantic salmon has been in excess of one million tonnes since 2002. It is difficult to source reliable production figures for all countries outside the North Atlantic area and it has been necessary to use 2010 estimates for some countries in deriving a world-wide estimate for 2011. Noting this caveat, total production in 2011 is provisionally estimated at around 1604 kt (Figure 10.1.5.4), a 17% increase on 2010, recovering after the small decrease in production first noted in 2009 and reflecting an increase in production outside the North Atlantic. Production in this area is estimated to have accounted for 20% of the total in 2011 (up from 14% in 2010). Production outside the North Atlantic is still dominated by Chile.

The world-wide production of farmed Atlantic salmon in 2011 was over 980 times the reported nominal catch of Atlantic salmon in the North Atlantic.

The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2011 was 33 t, the majority of which (30 t) was taken by the Icelandic ranched rod fisheries (Figure 10.1.5.5). Small catches of ranched fish from experimental projects were also recorded in Ireland.

10.1.6 NASCO has asked ICES to report on significant, new, or emerging threats to, or opportunities for, salmon conservation and management.

10.1.6.1 Update on SALSEA

The SALSEA–Merge programme was designed to advance the understanding of oceanic-scale, ecological, and ecosystem processes. Through a partnership of nine European nations, the programme has provided new information on genetic stock identification techniques, new genetic marker development, fine-scale estimates of marine growth on a weekly and monthly basis, the use of novel high seas pelagic trawling technology, and estimates of food and feeding patterns. In addition it has provided fine-scale migration and distribution models, merging hydrographic, oceanographic, genetic, and ecological data.

Research cruises to designated areas in the Northeast Atlantic took place in 2008 and 2009. In total, 1728 post-smolts and 53 adult salmon were captured in 233 trawl tows. The tissues from these fish and associated environmental data collected at sea were combined with a subset of 1800 tissue samples selected from archival material. A unique, comprehensive biological and environmental database (SALSEA PGNAPES) was developed to facilitate any future analyses.

The SALSEA–Merge programme facilitated the development of a unique molecular assignment protocol – GRAASP: **G**enetically-based **R**egional **A**ssignment of **A**tlantic **S**almon **P**rotocol – based on a suite of 14 microsatellite loci. The baseline database comprised 26 813 individuals from 467 locations, in 284 rivers, representing about 85% of non-Baltic European salmon production. A total of 3871 of the 4151 marine samples were assigned on a regional basis. Significant temporal and spatial heterogeneity in the distribution of the regional stock groups was found and fish of farm-origin identified, demonstrating the value and power of the tool.

Over 23 000 scales of Atlantic salmon from seven rivers, located in six countries, and smolt age and fine-scale growth of 2242 sea-caught post-smolts were analysed. The average rate of circuli formation in the marine zone of scales was estimated to be 6.3 days per circulus. Both the age structure and the number of marine circuli in the scales obtained during the post-smolt surveys suggest that the majority of the post-smolts originated in rivers in southern Europe. Marine growth rates varied among years, with highest growth rates in 2002, followed by 2003 and 2009. The lowest growth rates were in 2008. Growth rates during the first period at sea were lowest for salmon of southernmost origin. Historical growth indices from archival scale sets from Ireland, Norway, Finland, and Iceland were linked to prevailing environmental and biological conditions. There was evidence that growth is linked to oceanic conditions for all rivers and to recruitment for Irish and possibly Icelandic rivers. The diet of salmon, herring, and mackerel was studied for four years (2002, 2003, 2008, and 2009). Although the fish examined fed in close proximity in the ocean, the diet differed among the three species. Salmon showed differences in diet among years from 2002–2009. The condition factor of salmon decreased from 2002 to 2009.

While assignment to river of origin was possible for some stocks, the marine samples were assigned to 17 sub-regions of origin to provide an overview of the distribution and migrations of salmon at sea. This enabled the oceanic distribution of salmon at sea to be mapped, providing unique insights into likely migration routes, timing, and dispersal of salmon from different regions. Likely migration routes based entirely on genetic identification were assembled for two individual river stocks, the Loire Allier (France) and the Bann River, UK (N. Ireland). The distribution of post-smolts was linked to ocean currents. South of 61.5°N, the post-smolts are not randomly distributed within the migration path, but are located in areas where the currents are stronger than average. A migration drift model for specific stocks of post-smolts was developed. When temperature and salinity preferences were included with active swimming behavior, this proved to be an important mechanism for altering the migration routes and the post-smolt distribution pattern. Also, interannual variation in wind fields, and thus the surface currents, also altered the migration pathways. Several key areas in the migration routes, where shifts in the migration direction may occur due to climate change, were also identified. A conceptual ecological model was developed, where the main factors relating to the survival of salmon at sea were identified and described. A full report of the SALSEA–Merge programme is available on the NASCO web page (www.NASCO.int).

More recently, results of the pelagic ecosystem surveys conducted in the Labrador Sea during 2008 and 2009 as part of SALSEA North America were reported (Sheehan *et al.*, In press). A total of 107 Atlantic salmon were captured using a pelagic surface trawl and multi-panel surface gillnets. New information on the fish and macro-invertebrate communities located in the upper 10 m of the water column was obtained. Multiple smolt cohorts were captured, indicating that post-smolts and returning adults from different rivers in North America occupy similar habitat. The data collected have improved the knowledge of the ecology of Atlantic salmon in the Labrador Sea and are a valuable addition to the historical datasets.

10.1.6.2 Atlantic salmon genetics

SALSEA–Merge, and other current and previous projects, have contributed to the establishment of a comprehensive genetic baseline for salmon populations in northern Europe. Work continues to develop this baseline for the salmon populations of northernmost Europe into a practical and useful tool for the management of mixed-stock coastal fisheries in Norway and Russia. In 2011 a new EU project "Trilateral co-operation on our common resource; the Atlantic salmon in the Barents region" (Kolarctic Salmon) was started.

Building on the SALSEA initiative to develop a compatible genetic database over the entire salmon distribution area, a North American project supported by the Natural Sciences and Engineering Research Council of Canada (NSERC) has started. A Canadian genetic database is being constructed by expanding the river coverage for each province and standardizing genetic data from rivers already sampled. Standardization is done using a reference group of individuals analyzed by all genetic laboratories and by using the same set of microsatellite loci. Combining, calibrating, and integrating databases of all Canadian provinces and USA Atlantic salmon populations will provide a valuable tool for identifying the North American origin of salmon from the Greenland, the Labrador, and the Saint-Pierre et Miquelon fisheries.

10.1.6.3 Recent studies on marine ecology of US origin Atlantic salmon

Ultrasonic telemetry, marine trawl surveys, and modelling of environmental variables and salmon marine survival have been used to develop a better understanding of salmon's role in the marine ecosystem and the causal mechanisms of marine survival while looking for opportunities for management intervention. Acoustic tracking studies of smolts migrating on the Narraguagus River, Maine were used to estimate smolt survival to the Gulf of Maine, map migration paths, and document emigration timing for this population. Survival trajectories show higher losses in the estuary and inner bay areas and lower losses in the middle and outer bay areas (Kocik *et al.*, 2009). A Surface Trawl Survey (2001–2005) in Penobscot Bay, Maine and the nearshore Gulf of Maine waters was conducted to investigate early marine dynamics of a hatchery-dependent Atlantic salmon population. There were significant differences in the early migration success of different stocking groups, but subsequent marine survival was independent of stocking group. Migration pathways were identified and marine migration paths across the Gulf of Maine were hypothesized. The co-occurring species complex was described and any benefits of a predator refuge is considered minimal for emigrating post-smolts, given a mismatch in the size overlap among species and low abundance of other co-occurring diadromous populations (Sheehan *et al.*, 2011). Diet analyses yielded insights into the feeding ecology of early marine phase post-smolts from different rearing origins (Renkawitz and Sheehan, 2011). More than 50% of the diet was fish, although there were significant differences in diet quality (calories) and quantity (weight/volume) between different origin groups. Post-smolts that lived in the river longer (i.e., from naturally reared and parr-stocked origins) were smaller and consumed more fish than invertebrates compared to larger post-smolts that originated from smolt stocking programmes (Figure 10.1.6.1). To confirm that the pelagic surface trawl was targeting the migratory habitat of post-smolts, Renkawitz *et al.* (In press) implanted ultrasonic depth tags into hatchery-reared smolts from the Penobscot River. Greater than 95% of all detections of the releases smolts occurred in water depths of 5 m or less, thereby validating the assumption that post-smolts would be available to the surface trawl gear. Information on emigration speed and dynamics, migration path, and survival were also generated. Rapid emigration (i.e., approximately 1 km h^{-1}) and preferential surface orientation improved survival. Overall survival to the Gulf of Maine was 39% and was highest for smaller fish and those released earlier in the smolt run when river discharge was greater. These data provide valuable insights into the dynamics of the nearshore marine migration for post-smolts. Detailed emigration and behavioural data such as these allow scientists and managers to delineate areas of high mortality and to develop strategies to improve survival while providing marine spatial planners with information to minimize impacts of coastal zone development.

Friedland *et al.* (2012) further investigated hypotheses of the inter-related nature of potential climate and biological effects due to changes in spring wind pseudostress and the distribution of piscivorous predator fields on post-smolt salmon migrating through the Gulf of Maine. They concluded that there has been a concurrent decline in marine survival for Penobscot River 2SW returns with change in the direction of spring winds, which has likely extended the migration of post-smolts into the western Gulf of Maine. Higher spring sea surface temperatures were also associated with shifting distributions of a range of fish species into the salmon migration corridor, some of which likely predate upon salmon post-smolts. Climate variation and shifting predator distributions in the Gulf of Maine are consistent with the predator hypothesis of recruitment control previously suggested for the stock complex.

10.1.6.4 Recent results from acoustic tracking investigations in Canada

The Atlantic Salmon Federation (ASF) has continued to assess estuarine and coastal survival of tagged Atlantic salmon released in rivers of the Gulf of St. Lawrence. Inferred survival for smolts in 2011 from freshwater release points to the head of tide (80–90%), and from the head of tide to estuary exits (40–60%), were similar to those that have been observed in previous years. The proportion of fish detected migrating across the Gulf of St. Lawrence to the Strait of Belle Isle was similar (25–45%) to 2010 for each of the rivers. Smolt travel rates across the Gulf of St Lawrence ranged from 15 to 24 km per day (1.2–1.9 body lengths per second). There was a partial detector array functioning in the Cabot Strait (37 km northward from Cape Breton Island) exit of the Gulf of St. Lawrence in 2011, but no tagged smolts were detected.

Tagged kelts arrived at the Strait of Belle Isle slightly in advance of smolts, but there was again an overlap in 2011 of smolt and kelt movements past the array in late June through early July. One Riviere St Jean kelt, tagged as an upstream migrating 2SW maiden adult in June 2010 was detected at the Strait of Belle Isle array on 9 July 2011 and was subsequently captured 74 days later in the fishery at Nuuk, Greenland on 22 September 2011. Of the 50 Miramichi River kelts tagged in 2011, six returned to the river as consecutive year spawners between 9 and 26 July, fifteen passed the Strait of Belle Isle array between 25 June and 23 July, and at least one exited through Cabot Strait. From these studies over the past few years, high (greater than 90%) kelt survival through the estuary has been noted with most mortality of the kelts likely occurring within the Gulf of St. Lawrence. Kelts that are destined to return to the river as consecutive repeat spawners are spending about 55 days at sea while those destined to be alternate year repeat spawners are spending about 400 days at sea. Travel rates for these tagged kelts have ranged from 10 to 69 km per day.

Overwinter survival of kelts has been demonstrated to be high with 69% (N=11) of kelts tracked into the river as consecutive year spawners surviving fisheries, spawning, the overwinter period, and successfully migrating to sea the following spring.

10.1.6.5 Changing biological characteristics

Trends in various biological characteristics of salmon were previously reported in the ICES SGBICEPS (ICES, 2010), such as decreasing mean fork lengths in returning adult 1SW fish in the River Bush in UK (N. Ireland) since 1973. The same trend has been observed for 1SW returning adults on the River Bann in UK (N. Ireland), but the mean fork length of 2SW fish showed only a very small, but not significant, decrease. Also notable was the increase in numbers of 2SW returns to the River Bush in UK (N. Ireland) and the increase in the relative proportion of 2SW vs. 1SW since 2003. A similar change in 1SW:MSW ratios was found in the Norwegian stocks; from the 2006 smolt cohort onwards the estimates for the proportion returning as 1SW decreased from about 50% to about 30% and has remained at this lower level. Estimates for 2SW and 3SW returning adults for the same period have shown an opposite shift.

Data from Ireland, however, did not mirror the trends in increased numbers of MSW observed in Norway and UK (N. Ireland). Spring runs of salmon, which contain a high proportion of MSW fish did not show any clear trend in the percentage of the spring run relative to the total run. Data on three of 17 individual rivers showed a relative increase in spring run numbers, but the majority showed no trend at all. The above observations could indicate a shift in life history strategy from 1SW to MSW in some Northern NEAC and Southern NEAC stocks, possibly due to poor growth in the first season at sea.

10.1.6.6 Change in run timing and body wounds on the Miramichi River salmon

The run timing of Atlantic salmon to the Miramichi River (Canada) was previously characterized as bimodal, with the first mode occurring in the summer (prior to 31 August) and the second in the fall (after 31 August). Early and late runs of salmon to the Miramichi River were obvious from monitoring trapnets in the estuary in the early and mid-1990s, but it appears to have changed over time to a dominant summer mode (Figure 10.1.6.2). The reduced late run of salmon to the Miramichi River is not believed to be related to the loss of a distinct fall run of fish but rather to a shift in behaviour where they enter the river during the summer and no longer stay in Miramichi Bay until autumn. The reason for the change in behaviour is unknown but may lead to increased mortality from exposure to higher in-river water temperatures and longer exposure to angling exploitation.

Large and small salmon with significant wounds have been observed at the DFO index trapnets on both the Northwest and Southwest Miramichi rivers since 2009. Nearly 100% of the observations occurred during the months of June and July. The wounds are specific to salmon and none of the other 10+ species captured at these facilities show any signs of trauma. Many of the wounds are severe lacerations which expose the fishes' flesh or body cavity. Similar wounds on salmon, attributed to predators, have been reported from other locations in the North Atlantic, particularly UK (Scotland) (Thompson and Mackay, 1999).

10.1.6.7 ECOKNOWS progress

The EU 7th framework project called 'ECOKNOWS' (years 2010–2014) is a consortium with the objective to develop models and algorithms that make use of all types of relevant biological knowledge in fisheries science. The project is structured in a Bayesian environment which provides a sound framework for including information from multiple sources. The generic assessment tools are being applied to case study stocks/fisheries, one of which is the Atlantic salmon assessment and forecast models presently used in the Baltic and North Atlantic area. A life cycle approach, following cohorts through river parr and smolt classes, sea ages, and returns has been proposed as a means of providing a more appropriate structure for treating these modelling and management issues.

The proposed assessment models will be embedded into a full stage-structured life cycle model that incorporates the temporal dynamics of the recruitment process, including freshwater and marine survival (Figure 10.1.6.3). For the North Atlantic, the model will be designed at the scale of the three stock complexes (southern Northeast Atlantic, northern Northeast Atlantic, North America) to capture the complex meta-population structure stemming from homing behaviour for reproduction in freshwater. The multiscale approach will allow the exploration of long-term trends and climate influences on key population parameters shared by several population components, such as marine survival, together with time and spatial variability of region-specific life history traits such as the ones characterizing the freshwater phase of the life cycle. A major scientific challenge is to quantify the relative part of the mortality process that takes place in and during the freshwater and marine portions of the life cycle. The ECOKNOWS project will compile available freshwater stock-recruit data and carry out a meta-analysis, the outcome of which could then be used as informative prior information about the freshwater phase. A crucial factor driving the salmon stock status is the marine survival of post-smolts. In both the Baltic and North Atlantic, there is precise, well-documented information on return rates of smolts to adults for a limited number of rivers. The time-series have demonstrated the important changes in marine survival. The use of abiotic (e.g. sea surface temperature) and biotic (e.g. abundance of predator and preys) environmental covariates potentially driving spatiotemporal patterns in survival will also be given special consideration. The work in the salmon case study is being carried out in close collaboration with the ICES WGNAS and WGBAST and one of the commitments of ECOKNOWS is to report regularly to ICES WGNAS and WGBAST on progress in model development and their application.

10.1.6.8 Update on Workshop on Age Determination of Salmon (WKADS)

A Workshop on Age Determination of Salmon (WKADS) was held in Galway, Ireland (18–20 January 2011) with the objectives of reviewing, assessing, documenting, and making recommendations on current methods of ageing Atlantic salmon. The Workshop had primarily focused on digital scale reading to measure age and growth, with a view to standardization.
A second Workshop is planned for September 2012 to address issues regarding protocols, inter-laboratory calibration, and quality control as they relate to the interpretation of age and calculation of growth and other features from scales.

10.1.6.9 Red vent syndrome and other parasites

The condition known as red vent syndrome (RVS; characterized by swollen and/or bleeding vents), noted in Atlantic salmon since 2005, has been linked to the presence of a nematode worm, *Anisakis simplex* (Beck *et al*., 2008). Trapping records for rivers in UK (England & Wales) and France suggest a further reduction in 2011 and the incidence was much lower in 2011 compared to the previous three to four years in Ireland. Within the NAC stock complex, RVS has previously been detected in the Scotia–Fundy (2008 and 2009) and Quebec regions. In 2009 a monitoring programme was begun in Quebec and results will be available in 2012.

There is no clear indication that RVS affects either the survival of the fish or their spawning success. Affected fish have been taken for use as broodstock in a number of countries, successfully stripped of their eggs, and these have developed normally in hatcheries. Recent results have also demonstrated that affected vents showed signs of progressive healing in freshwater, suggesting that the time when a fish is examined for RVS, relative to its period of in-river residence, is likely to influence perceptions about the prevalence of the condition.

In 2011 *Paragnathia formica*, an estuarine crustacean isopod, was detected on 5% of salmon caught at the trap facility located near the upper limit of the estuary of the Scorff River (France). It is not clear whether this is a new infestation or one that has simply gone undetected until now. Symptoms include inflammation in the vent area and on the fins and may be mistaken for sea lice bites or red vent syndrome. Monitoring is ongoing.

10.1.6.10 Dumping of mine tailings in Norwegian fjords

It was reported that there are plans for expansion of existing mining activities in many regions in Norway. Several of the existing and planned mining activities are located within National Salmon Fjords and close to National Salmon Rivers. The National Salmon Fjords and National Salmon Rivers were established as a means of protecting the most important salmon stocks in Norway from harmful impact from human activities. Mining, and the industrial processes associated with it, can be harmful for salmonids in several ways. Runoff from mines containing sulfides and heavy metals to rivers and streams may affect freshwater production and survival, and dumping of mine tailings in fjords may have negative impacts on smolt survival, and the fjord ecosystems in general. The increased development of the mining industry in Norway, and especially in the National Salmon Fjord areas, poses a potential serious threat to salmon populations, and further evaluation of the effects of mining waste disposal on both salmon and the ecosystem in the fjords should be conducted.

10.1.6.11 River classification in fisheries management

In 1999, a three-year Atlantic salmon management plan in Newfoundland and Labrador incorporated a river classification system. The river classification system defined different season bag limits for individual licences based on four categories of river status. Rivers were assigned to a category and the corresponding season retention limits were based on the size of the river and its assessed status relative to conservation objectives. In 2011 the river classification system was assessed to determine whether there were measurable changes in the catch and effort in the recreational fishery as a result of this management structure. The analyses showed that during the first eleven years (1999–2009) of the plan there was an overall decrease in the total number of small salmon harvested (about 6000 fewer salmon per year). However, the analyses also showed that all of the reductions in harvest occurred on rivers with the lowest allowable retention (Class II and III rivers; 4 and 2 fish per year). On rivers that allowed an annual retention of 6 fish

(Class I rivers), the total harvest increased by approximately 2100 fish per year after the implementation of the plan. Effort and catch shifted from the lowest class rivers (Class II and III) to the highest class rivers (Class I), as was intended by the plan.

10.1.6.12 Environmental thresholds for managing Atlantic salmon fisheries

A recent science review in Canada considered defining environmental thresholds related to water temperature for the management of Atlantic salmon fisheries. Climate change projections for Atlantic Canada are for increases in air temperatures of 2–6°C within the next 100 years. These higher air temperatures will lead to increased water temperatures, alterations in stream flow, threats to Atlantic salmon in rivers, and pressures on resource users. In several rivers of the southern Gulf of St. Lawrence (Canada), water temperatures during June to August can frequently exceed 25°C. The high temperatures are particularly important for the early-run adult Atlantic salmon. To date, the criteria used for management intervention resulting in a closure of the recreational fishery have been *ad hoc* and not pre-defined, which has resulted in delays in management response and reduced benefits to the resource.

The temperature thresholds proposed to trigger an angling closure are based on the bioenergetics of salmonids and consist of a temperature and a duration. The proposed closure trigger is: if the minimum water temperature (T_{min}) over each of two consecutive days equals or exceeds 20°C. The proposed opening trigger is: if the minimum water temperature (T_{min}) over each of two consecutive days is less than 20°C. The choice of two days as an indication of a physiologically stressful condition for Atlantic salmon is motivated by the studies on behavioural changes in juvenile Atlantic salmon. Dedicated research to determine if 20°C is a good choice for adult Atlantic salmon is required.

The performance of these opening and closing triggers was assessed by retrospective evaluation of the number of closures and the duration of the closures based on temperature data at two monitoring locations in the Miramichi River for the years 1992 to 2011. The number of closures which have been initiated annually ranged from one to five and the total number of days closed ranged from a low of 2 days to a high of 23 days. Criteria such as the number of interventions and the duration within and between interventions could be examined retrospectively to inform management if frequency of closures and duration are factors of interest.

The impacts of angling during warm water events were considered by management because fishing is an activity which can be managed under regulations. Salmon are angled during warm water temperature events and the mortality rate from catch and release angling increases sharply at temperatures above 20°C. Other human activities, including wading in streams, swimming in pools, boat traffic, as well as scientific activities, can displace fish and contribute to stress on Atlantic salmon during warm water events.

10.1.7 NASCO has asked ICES to 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

The Study Group on Effectiveness of Recovery Actions for Atlantic Salmon [SGERAAS] has not yet been able to address the question. The issue of the restoration and rehabilitation of salmon stocks remains a concern. Progress on this issue is anticipated in the coming year.

10.1.8 NASCO has asked ICES to provide a compilation of tag re-leases by country in 2011

Data on releases of tagged, fin-clipped, and otherwise marked salmon in 2011 were provided by ICES and are compiled as a separate report (ICES, 2012b). A summary of tag releases is provided in Table 10.1.8.1.

10.1.9 NASCO has requested ICES to identify relevant data deficiencies, monitoring needs, and research requirements

ICES discussed the data that are currently requested by NASCO as well as those required for the NEAC PFA run-reconstruction and forecast models and the NEAC national conservation limit model. It was recognised that while most Member States provided data to ICES, there was considerable variation in the quality. Significant amounts of additional data (e.g. from index stocks) are also provided to ICES, but it is not clear that the best use is made of this information. It was noted that index river data are used in the Baltic salmon assessment, and that the collection of these data is covered by the Data Collection Framework (DCF). It was suggested that the structure of the salmon data collection in the Baltic under the DCF might provide a good basis for the data collection in other areas. The DCF is due to be reviewed in 2013. To provide advice for that process, an ICES workshop (WKESDCF) will be convened in Copenhagen 3–6 July 2012 to examine the data requirements for salmon (and eel). ICES encouraged scientists from Member States to attend the workshop to ensure that they contribute to and fully support the recommendations that will go forward to the EU.

ICES recommends that the Working Group on North Atlantic Salmon (WGNAS) should meet in 2013 to address questions posed by ICES, including those posed by NASCO. The Working Group intends to convene in the headquarters of the ICES in Copenhagen, Denmark from 4 to 13 April 2013.

List of recommendations

1) ICES recommends that further work be undertaken to address the issues raised by the Workshop on Age Determination of Salmon regarding protocols, inter-laboratory calibration, and quality control as they relate to the interpretation of age and calculation of growth and other features from scales. A second Workshop has been convened for September 2012 to undertake this work (Section 10.1.6.8).

2) ICES recommends that efforts to convene a Study Group be re-initiated in order to address the question from NASCO for examples of successes and failures in wild salmon restoration and rehabilitation and to develop a classification of activities which could be recommended under various conditions or threats to the persistence of populations (Section 10.1.7).

3) ICES welcomed the opportunistic assessment of the incidence of salmon bycatch in pelagic mackerel fisheries at Iceland and Faroes in 2010 and 2011. The sampling effort provided new information on the temporal and spatial distribution of salmon in this area, as well as the biology of the fish. ICES recommends that similar sampling should continue in order to provide further information on the bycatch of salmon in pelagic fisheries in these areas (Section 10.2).

4) ICES recommends that further work be undertaken to check the appropriateness of the various data inputs used in the catch advice framework for the Faroese fishery, including seeking original datasets from the sampling programmes of the fishery in the historical time period (Section 10.1.10).

5) ICES recommends that further work be undertaken to permit the running of the risk framework based on management units defined at the country level, to improve the allocation of the Faroes catch to national management units and to seek additional data to improve the quality of the assessment (Section 10.1.10).

6) ICES recommends that sampling of the Labrador subsistence fisheries and Saint-Pierre et Miquelon mixed-stock fisheries be continued and expanded (i.e. sample size, geographic coverage, tissue samples, seasonal distribution of the samples) in future years. The sampling programme conducted in 2010 and 2011 in Labrador and Saint-Pierre et Miquelon provided data on biological characteristics of the harvest and this information is useful for updating parameters used in the Run-reconstruction Model for North America. The sampling also provided material (tissue samples from scales) to assess the origin of salmon in these fisheries (Section 10.3.1).

7) ICES welcomed the efforts to sample the catches at Saint-Pierre et Miquelon and Labrador for genetic stock identification and recommend that sampling be continued in the future. However, ICES identified a number of issues with the sampling programme that, if corrected, would greatly increase the value of the data (Section 4.1.5 in ICES, 2012a).

8) ICES recommends that additional data from the recreational fisheries be examined to better estimate salmon returns and stock status in Labrador (Section 10.3).

9) ICES supports the efforts of the Greenlandic authorities for the expansion of the logbook reporting system as a condition of the licensing system for the salmon fishery at West Greenland (Section 10.4.1).

10) ICES recommends a continuation and expansion of the broad geographic sampling programme (multiple NAFO divisions) to more accurately estimate continent of origin and biological characteristics of the salmon in the West Greenland mixed-stock fishery. ICES recommends that arrangements be made to enable sampling in Nuuk, as an important proportion of the catch is landed in this community on an annual basis (Section 5.1.3 in ICES, 2012a).

11) In support of the management objective from NASCO to ensure that individual river stocks meet their conservation limits, ICES recommends that additional monitoring data or analyses of existing monitoring data (catches, juvenile surveys, short-term count data), be considered to augment the river-specific data used to develop the stock status and to improve management advice in both NAC and NEAC areas.

10.1.10 NASCO has asked ICES to further develop a risk-based framework for the provision of catch advice for the Faroese salmon fishery, providing a clear indication of the management decisions required for implementation

ICES (2011) provided a detailed example of a risk-based framework for the provision of catch advice for the Faroese salmon fishery. ICES noted that management decisions were required on the following issues which were discussed in detail in the advice to NASCO:

- season (January to December, or October to May) for which a TAC should apply;
- choice of management units for NEAC stocks;
- specification of management objectives; and
- a share arrangement for the Faroes fishery.

A proposal for the share arrangement was provided by NASCO, but little feedback was provided on the other three points. A decision by managers is still required on the four issues outlined above. In the absence of decisions from NASCO, a risk analysis framework is presented which closely mirrors the system used for the provision of advice to NASCO for the West Greenland salmon fishery. Pragmatic choices were made in relation to the unresolved decisions, as follows:

- ICES (2011) recommended that NASCO manage any fishery at Faroes on the basis of fishing seasons operating from October to June. This approach has been assumed in the catch advice provided.
- ICES (2011) provided advice on the factors affecting the selection of management units. The availability of information on the composition of the catch at Faroes and limitations in model development constrained the choice of management units in this risk analysis to the four NEAC age and stock complexes used previously.
- ICES (2011) suggested that it would be appropriate to use the same management approach as for the West Greenland catch advice. The objective would therefore be that there should be an agreed probability of all management units simultaneously exceeding their CLs. ICES notes that the choice of a 75% risk level (probability) for simultaneous attainment of six or seven stock units for West Greenland and NAC is approximately equivalent to a 95% probability of attainment for each individual unit. Because of the smaller number of management units currently used for the Faroes, and in the case of future use of a larger number of management units (e.g. countries), ICES recommends that the objective for the Faroes salmon fishery be that each individual management unit be assessed relative to a 95% probability of meeting the individual unit CL rather than according to a simultaneous risk criterion. The risk analysis of catch options can nevertheless be calculated to show the probabilities of meeting or exceeding the CLs in each of the management units and meeting them simultaneously.
- NASCO proposed using the baseline period of 1984–1988 to calculate the share allocation. This value (8.4%) was applied.

The process for assessing each catch option within the risk framework, as described by ICES (2011), was applied. Work is underway to apply genetic stock identification to the scale samples collected from the Faroes fishery in the 1980s and 1990s, but this work is yet to be completed. Pending these efforts, recoveries in home waters of adults tagged in the Faroes fishery between 1991 and 1993 were examined (Hansen and Jacobsen, 2003). These data set were considered to provide the best estimate of the allocation of the Faroes catch between the Northern and Southern NEAC stock complexes. The division of the catch at the national level is considered less reliable because of the relatively small numbers of tag recoveries (approximately 100 recoveries). It was proposed that the proportions of the Faroese catch originating from the Northern and Southern NEAC stock complexes could be estimated for the years 1991–1993 (when the adult tagging programmes were undertaken) on the basis of the tag recoveries by sea age. These proportions could then be further divided to countries/regions within each stock complex on the basis of the proportion of the total PFA for the complex originating from the countries/regions. This would also allow the proportions to be adjusted according to the annual variations in PFA. The revised catch allocation for the Faroese fishery at the country scale is provided in Table 10.1.10.1 and these have been used in the PFA run-reconstruction, the Bayesian forecast model, and the risk framework for evaluation of catch options.

10.1.11 NASCO has asked ICES to further develop a framework of indicators that could be used to identify any significant change in previously provided multi-annual management advice in the NEAC area

ICES (2011) re-evaluated the approach for developing a framework of indicators (FWI) for the Faroese fishery. Since the PFA estimates for the NEAC stock complexes have predominately remained above the SER over the time-series, it was suggested that the status of stocks in the NEAC area should be re-evaluated if the FWI signals that the PFA estimates are deviating substantially from the median values from the forecast.

Several criteria for assessing when the PFA deviates substantially from the forecast were explored. In 2011 ICES suggested using the 95% confidence interval for the mean of the predicted indicator value, based on the median PFA forecast value, to determine if there was a substantial deviation from the PFA forecast (Figure 10.1.11.1, upper panel). In 2012 it was proposed that the 75% predictive interval for the indicator itself (not for its mean) be used (Figure 10.1.11.1, lower panel). This generally results in a wider interval for the indicator and, thus, a lower chance of a reassessment than the approach suggested in 2011. However, this was considered to be a more realistic criterion given the relatively wide variability in the indicator data sets.

If the FWI suggests that the forecasted PFA is either an under-estimation or an over-estimation of the realised PFA in any of the four stock complexes, then this should trigger a reassessment. Because of the relative scarcity of potential indicators when the stocks are divided into alternative, smaller management units, ICES recommends that the values of each indicator be regressed against the PFA of the stock complex to which the indicator belongs. For example, an MSW indicator from Norway should be regressed against MSW PFA for Northern NEAC.

A data set is considered informative and should be kept as an indicator in the FWI if the following conditions are met: sample size (N) ≥ 10; $R^2 \geq 0.2$; data set updated annually and new value available by January 15. Fifty possible indicator datasets were examined and 27 fulfilled the criteria for inclusion in the FWI (five for Northern NEAC 1SW PFA, four for Northern NEAC MSW PFA, five for Southern NEAC 1SW PFA and 13 for Southern NEAC MSW PFA) (Tables 10.1.11.1 and 10.1.11.2). The FWI spreadsheet was developed and it provides an automatic evaluation of the need for a reassessment once the new indicator values are available in January (Table 10.1.11.3).

ICES demonstrated the performance of the FWI by applying it as if it had been in place in January 2012. Thus, the FWI was applied using the forecasts that were made in 2011 (maturing 1SW PFA for 2011 and non-maturing PFA for 2010, for Northern and Southern NEAC separately) and the various indicator values for the 2011 season (Table 10.1.11.4). The indicators suggested that the forecasted PFA was below the realised PFA for Northern NEAC non-maturing salmon. For the other stock complexes the indicators did not suggest any substantial difference between the realised PFAs and the forecasted PFAs. However, since a change was indicated for one stock complex, then a re-assessment would have been recommended as a result of applying the FWI in January 2012.

ICES proposes that the same timeline and sequence of events be employed in implementing the FWI for NEAC as used for the existing West Greenland Commission FWI (ICES, 2007) (Figure 10.1.11.2). The FWI for NEAC could be implemented for the 2013 and 2014 fishery years. In 2012, ICES provides multi-year catch advice and updated spreadsheets of the FWI for NEAC. Subsequently, in January 2013, the FWI is applied for NEAC. If no significant deviation from forecasted PFA is indicated for any of the four stock complexes, then no re-assessment is necessary and the cycle continues to 2014. Further, if no significant deviation is detected in 2014, the cycle continues until 2015 when new assessments and multi-year catch advice will be required. However, if a significant deviation is detected in any year, then a reassessment would be recommended and this, together with an update of the FWI, would be provided by ICES. If no re-assessment proved necessary in either 2013 or 2014, the FWI would automatically be updated in 2015, at the time of the next scheduled multi-year assessment.

10.1.12 NASCO has asked ICES to provide advice on best practice for conducting monitoring surveys for the parasite *Gyrodactylus salaris*

Gyrodactylus salaris is an ectoparasite that mainly infects Atlantic salmon (*Salmo salar*), but it can survive and reproduce on several salmonids, such as rainbow trout (*Oncorhynchus mykiss*), Arctic charr (*Salvelinus alpinus*), North American brook trout (*Salvelinus fontinalis*), grayling (*Thymallus thymallus*), North American lake trout (*Salvelinus namaycush*), and brown trout (*Salmo trutta*) (in declining order of susceptibility). When introduced to areas outside its native range in the Baltic, the parasite *Gyrodactylus salaris* has proved to be highly damaging to salmon populations that have not developed resistance, resulting in mortality rates of up to 100% on salmon fry and parr. In light of this, preventing further spread of the parasite to new areas is of high importance, and monitoring programmes should be developed in areas where risk of infection is high to ensure early detection of any *G. salaris* infection and to facilitate implementation of measures to control or eradicate the parasite.

Norway, Sweden, Russia, Ireland, and UK (England & Wales) have implemented monitoring programmes for *G. salaris*.

General considerations

Samples should be taken annually from hatcheries producing Atlantic salmon and/or rainbow trout (*Oncorhynchus mykiss*) including commercial hatcheries for the fish farming industry and hatcheries that produce fish for supplementing natural stocks of salmon, or for rainbow trout fisheries. The number of fish analysed should be higher in rainbow trout samples than in samples from Atlantic salmon, since the prevalence and intensity of *G. salaris* is lower on rainbow trout than on Atlantic salmon. Furthermore, there should be more extensive monitoring in rivers. Thus, rivers that are considered important due to their size and production, economic contribution, life history characteristics or other factors, should be monitored more closely. Such priority considerations may vary between countries and regions. In addition to this, it is suggested that a risk-based framework be applied to select the most appropriate rivers for monitoring and that the consequences of infection in the river be evaluated. A contingency plan should be in place in the case of new infestations.

Priorities for monitoring

1. Highest priority should be placed on rivers with reduced densities of salmon parr, observations of high numbers of dead parr, or where there are large reductions in adult salmon numbers or catches compared to other nearby rivers or previous years.
2. Rivers where salmon stocks are supplemented by hatchery fish or that have hatchery facilities for Atlantic salmon or rainbow trout draining into them should be surveyed on an annual basis.
3. The survival of *G. salaris* is negatively correlated with salinity above 7.5 parts per thousand (Soleng and Bakke, 1997), so larger sea-areas with high salinity in between river outlets will probably reduce the risk of spread among the rivers by migrating salmonids. Therefore, rivers close to other rivers with *G. salaris* and/or with neighbouring catchment areas should also be surveyed on an annual basis.
4. Other rivers should be surveyed regularly (for example every fifth year).

Life stage to monitor

In rivers infected with *G. salaris* the numbers of salmon parr show a rapid decline from pre-infection levels (Johnsen and Jensen, 1991; Johnsen *et al.*, 1999). Older life stages are often few in number, but show high prevalence of the parasite. Therefore, older salmon parr should be analysed if found, and the number of individuals should be complemented with younger life stages to reach the designated number of fish.

When to monitor

The number of *G. salaris* per infected fish is generally highest in the autumn (Johnsen and Jensen, 1992). It is recommended that salmon should be sampled in the autumn, or directly after observations of high numbers of dead fish in the river. Prevalence of *G. salaris* tends to be lower at temperatures above 14°C.

Where to monitor

In the early stages of infection in a river, levels of infections may show local variation, and it is recommended that samples be collected from lower, middle, and upper reaches of the river. This is especially important in larger rivers. In the case of rivers with hatchery releases, samples should be taken close to the release sites. Where neighbouring river(s) are infected, samples should be taken close to the river mouth of the uninfected river because the most likely source of spread may be by direct entry of infected fish into the river.

How many fish to sample

In the Norwegian monitoring programme, 30 salmon parr have been sampled per river. In infested rivers, the parasite can normally be found on at least 40% of the older salmon parr (Johnsen and Jensen, 1988), so except in the early stages of an infestation, a minimum of 30 fish should provide a high probability of discovery if the parasite is present in the river. Investigations in Sweden indicate that the dorsal and pectoral fins of infected fish have the highest frequencies of infection and are particularly important body areas to assess for screening purposes. In Sweden, sampling levels are based on the prevalence of the parasite, and 20 fish per site is generally considered to be sufficient.

Analysis of samples

Samples should be collected, preserved and analysed according to the guidelines in the Gyrodactylosis (*G. salaris*) chapter in the Manual of diagnostic tests for aquatic animals from the World Organization for Animal Health (OIE) http://www.oie.int/fileadmin/Home/eng/Health_standards/aahm/2010/2.3.03_Gyrodactylosis.pdf.

- Whole fish should be preserved in 96% EtOH in bottles large enough to provide excess space and preservative. The concentration of EtOH after preservation should not be below 70%. Fins cut off from the body and stored in EtOH as described above can also be submitted.
- Samples from a river or a farm can be pooled, although each fish is subsequently examined and analysed separately. Fins of fish from a farm or a river can be pooled and are also examined and analysed separately.
- Dead fish, stored on ice, are not acceptable. The parasites soon die if not covered in water, and as these parasites do not have an exoskeleton, dead parasites disintegrate quickly.
- Detection of *Gyrodactylus* and identification of *G. salaris* is a two-step process. Firstly, parasite specimens are observed using optical equipment and secondly, parasites are identified, usually on an individual basis using other equipment and methods. Optical equipment (binocular dissecting microscope with good illumination) must be used to detect *Gyrodactylus*. Trained morphologists can perform morphological identification of *Gyrodactylus* specimen(s) to *G. salaris* based on structures of the attachment organ. However, a morphological diagnosis should be confirmed by molecular tools. A combination of both morphological and molecular methods is recommended.

10.1.13 NASCO has requested ICES to update the framework of indicators used to identify any significant change in the previously provided multi-annual management advice in the West Greenland Commission area

In 2007, ICES developed a Framework of Indicators (FWI) to be used in interim years to determine if there is an expectation that the previously provided multi-year management advice for the Greenland fishery is likely to change in subsequent years (ICES, 2007). A significant change in management advice would be an unforeseen increase in stock abundance to a level that would allow a fishery in the case where no catch had been previously advised, or a decrease in stock abundance when catch options had been chosen. In 2009 the FWI was updated for application for the 2010 to 2011 fisheries (ICES, 2009). The updated framework was applied in January 2010 and 2011 to determine if a re-assessment was advised.

The 2012 assessment begins the cycle of forecasting and catch advice for the 2012 to 2014 fishing years. ICES has been asked to update the FWI in support of the multi-year catch advice and the potential approval of multi-year regulatory measures.

The update consisted of:

- Adding the values of the indicator variables for the most recent years,
- 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.

A total of 40 indicator variables, represented by 22 different rivers, were retained for the North American Commission area. Of these, eight were return or survival rate indicators of hatchery fish, while the remainder were of wild 2SW or large salmon (N = 18), wild 1SW or small salmon (N = 13), or all (N = 1) returns to rivers or survival rate. A summary is provided in the following table:

Origin	Wild	Wild	Wild	Wild	Hatchery	Hatchery	
TYPE OF DATA	Return	Return	Survival	Survival	Survival	Survival	
SIZE/AGE GROUP	Small/1SW	Large/2SW/ MSW	Small/1SW	Large/2SW	Small/1SW	Large/2SW	Total
Labrador							0
Newfoundland	3						3
Quebec	4	10	1	2			17
Gulf	1	1					2
Scotia-Fundy	3	4			2	4	13
USA[1]	1	2[2]			1	1	5
Total	12	17	1	2	3	5	40

[1] for USA, returns include both wild and hatchery-origin fish.

[2] in one river (Narraguagus), returns are of all age/size groups combined.

No indicator variables were retained for the Labrador area or for the southern NEAC 1SW non-maturing complex. All the retained indicator variables had at least 80% probability of identifying a true low state or a true high state.

The FWI spreadsheet will be made available to NASCO. It would be used with the returns or return rate data for 2012 to evaluate the appropriateness of the 2013 advice, and with the returns or return rate data for 2013 to evaluate the appropriateness of the 2014 advice. The data for the indicator variables to populate the framework must be available in January of the year of interest.

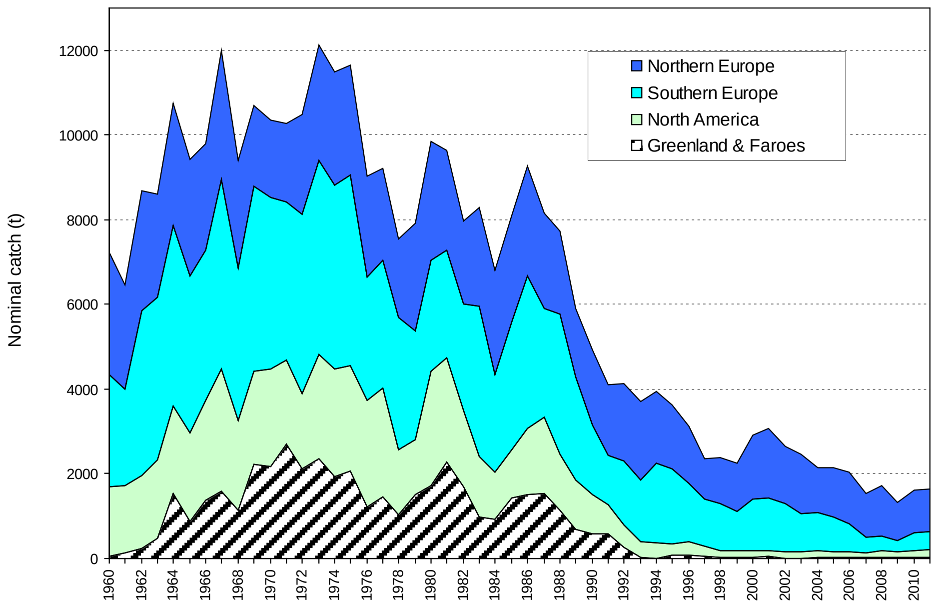


Figure 10.1.5.1 Reported total nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960 to 2011.

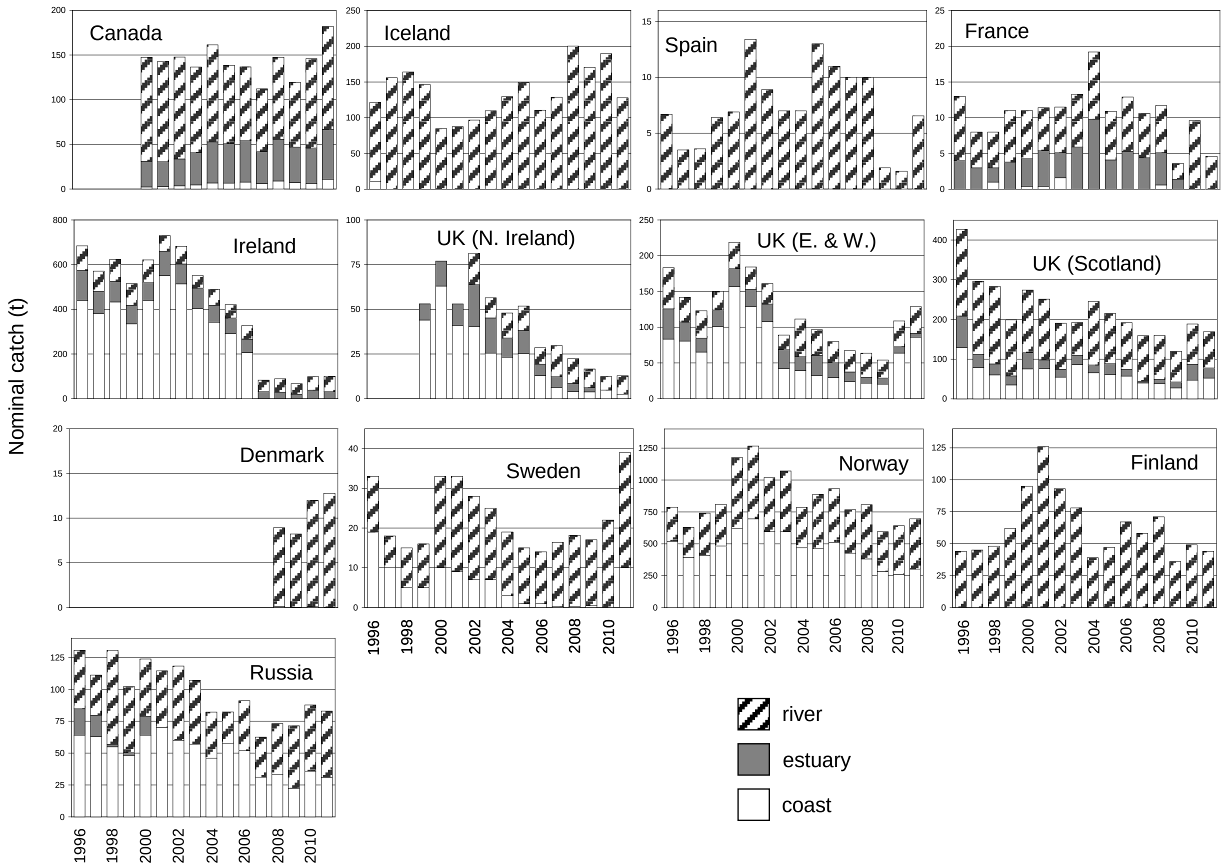


Figure 10.1.5.2 Nominal catch (t) by country taken in coastal, estuarine, and riverine fisheries.

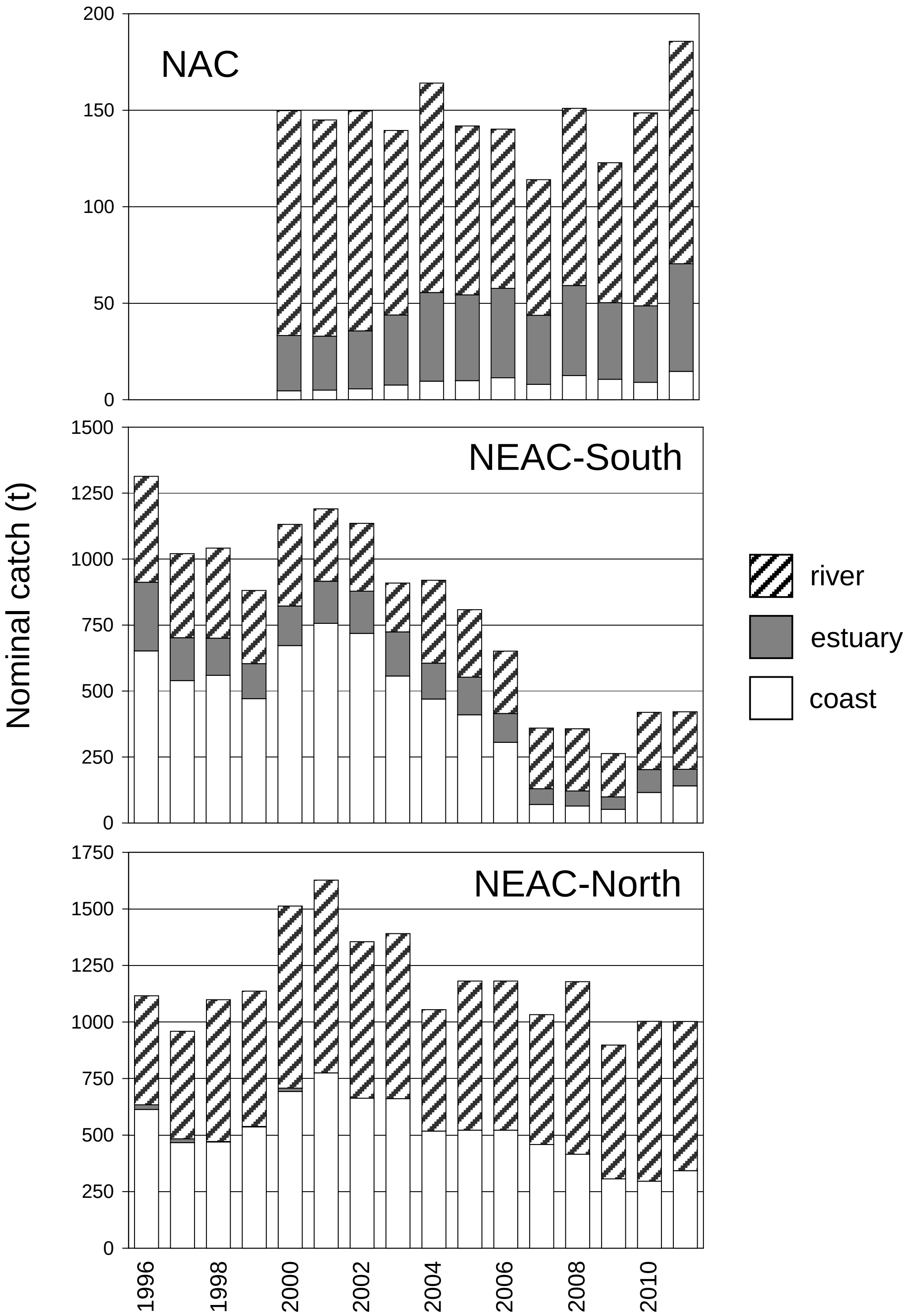


Figure 10.1.5.3 Nominal catch (t) taken in coastal, estuarine, and riverine fisheries for the NAC area, and for the northern and southern NEAC areas. Note that vertical axes scales vary.

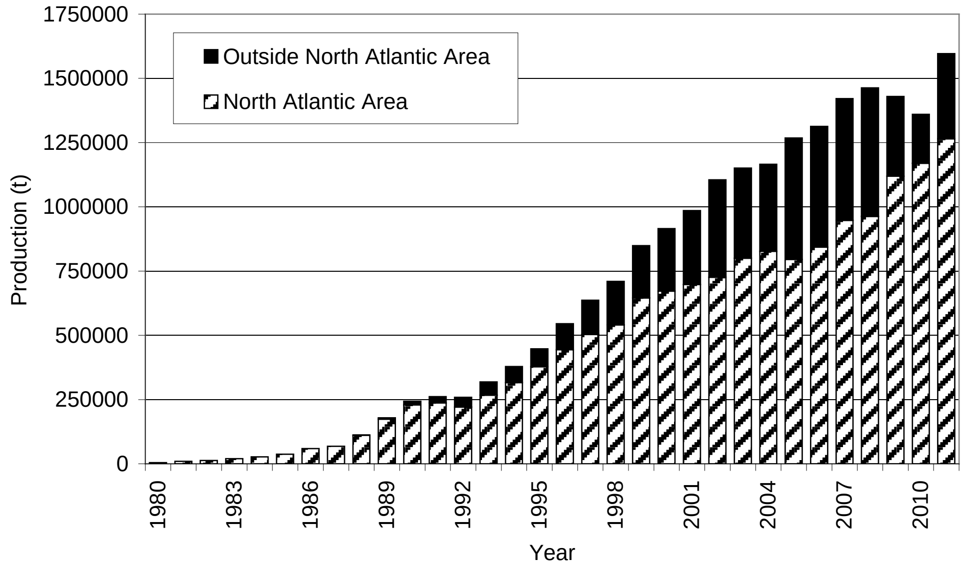


Figure 10.1.5.4 World-wide production of farmed Atlantic salmon, 1980 to 2011.

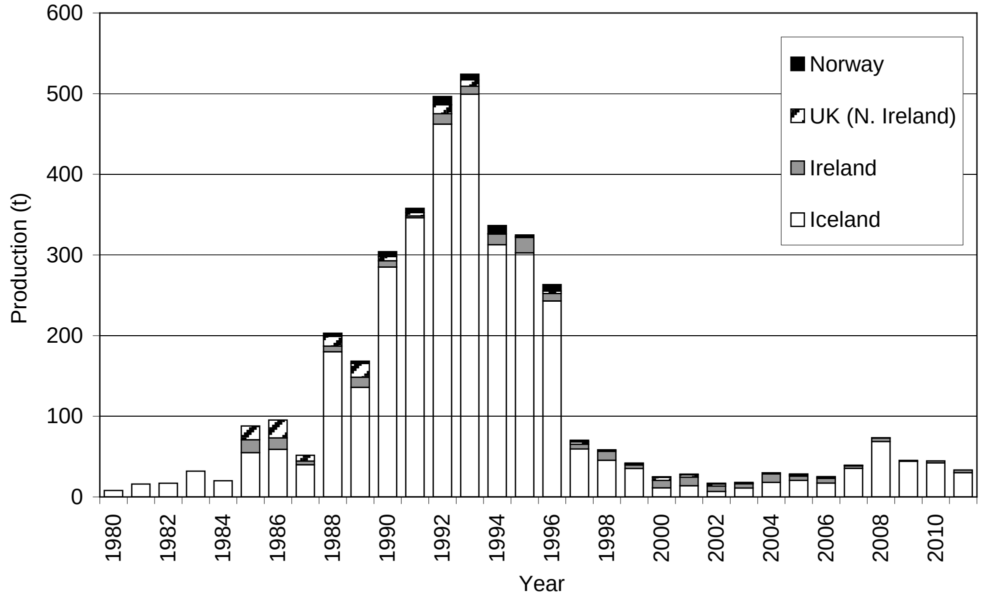


Figure 10.1.5.5 Production of ranched Atlantic salmon (tonnes round fresh weight) in the North Atlantic, 1980 to 2011**.**

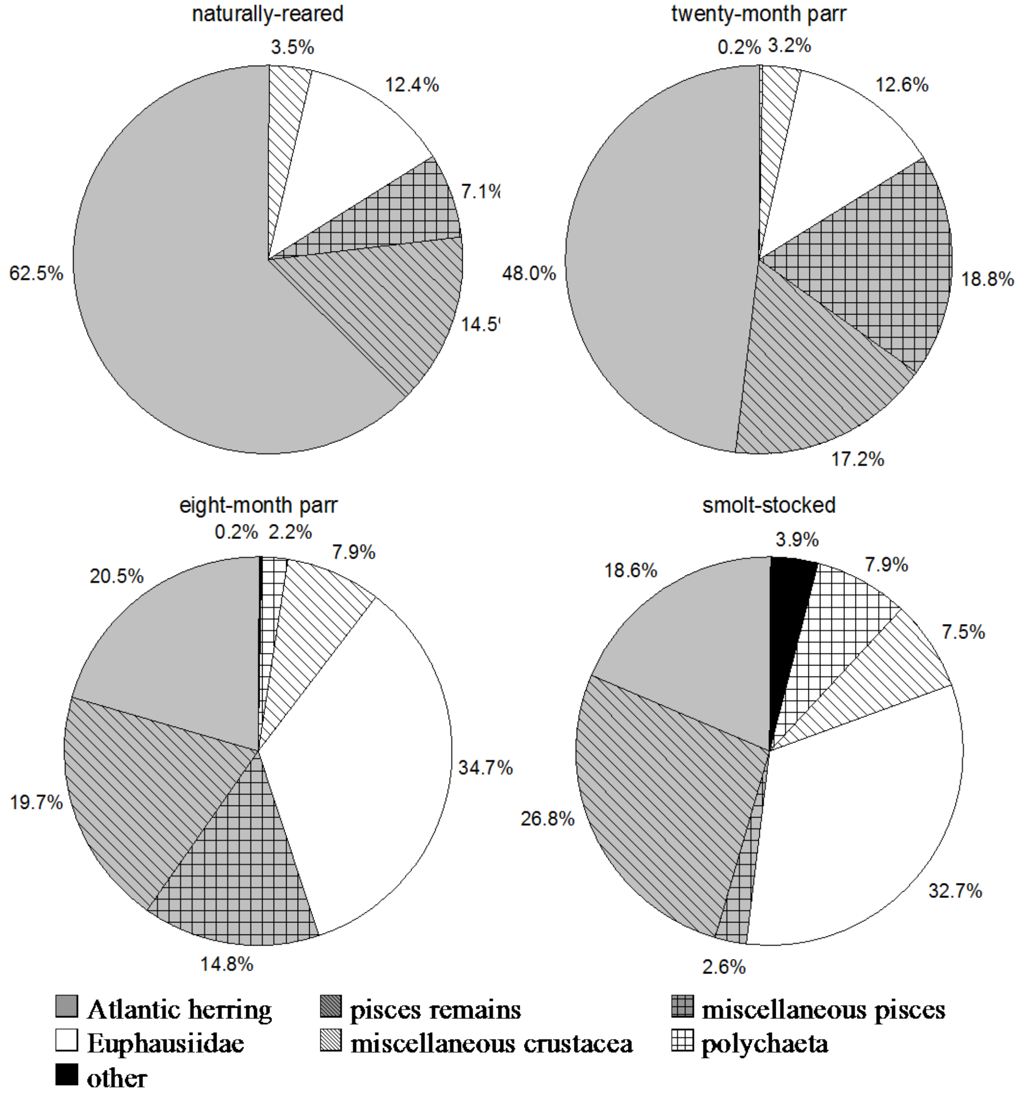


Figure 10.1.6.1 Dietary composition by wet weight (g) of Atlantic salmon post-smolts caught in Penobscot Bay, Maine from 2001 to 2005 grouped by four rearing origins: naturally reared, twenty-month parr, eight-month parr, and smolt stocking. Post smolts with a longer river residence phase (i.e., naturally reared) generally fed on more fish, particularly Atlantic herring, and fewer euphausiids during their emigration through Penobscot Bay as compared to post smolts with shorter river residence phases (i.e., smolt-stocked).

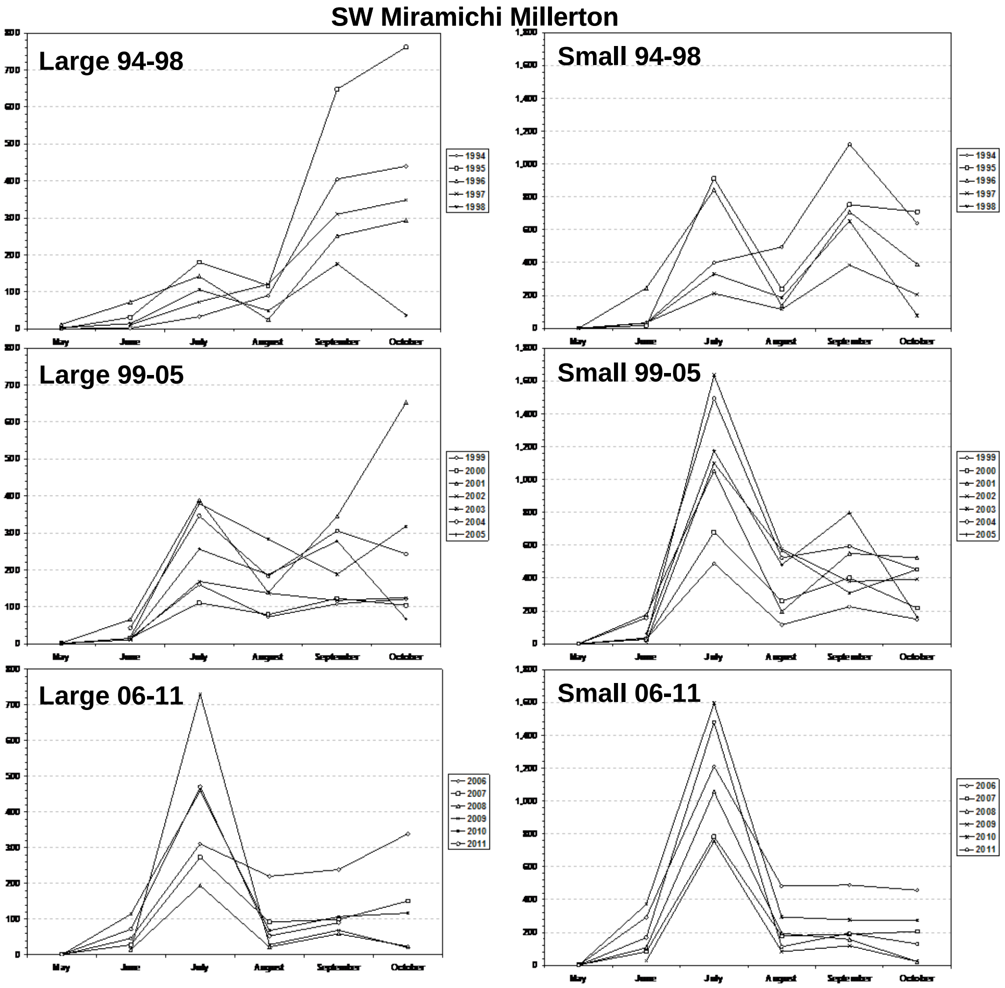


Figure 10.1.6.2 Run timing of large salmon and small salmon to estuary trapnets on the Southwest Miramichi River, 1994–2011.

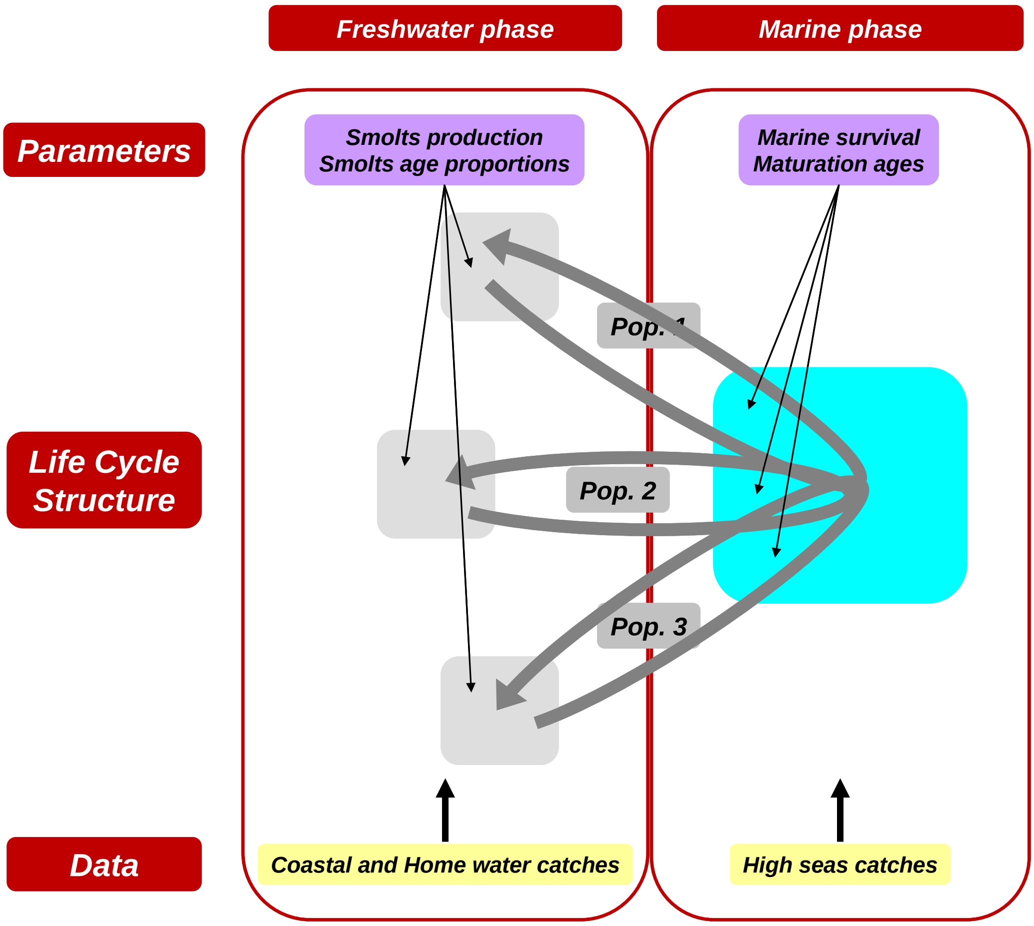


Figure 10.1.6.3 Schematic structure of stage-structured life cycle model that incorporates the temporal dynamics of the recruitment process, including the freshwater and marine phases. The model captures the complex meta-population structure stemming from homing behaviour for reproduction in freshwater. Hierarchical structure will be used to capture time and spatial variability of region-specific parameters such as the ones characterizing the freshwater phase of the life cycle**.**

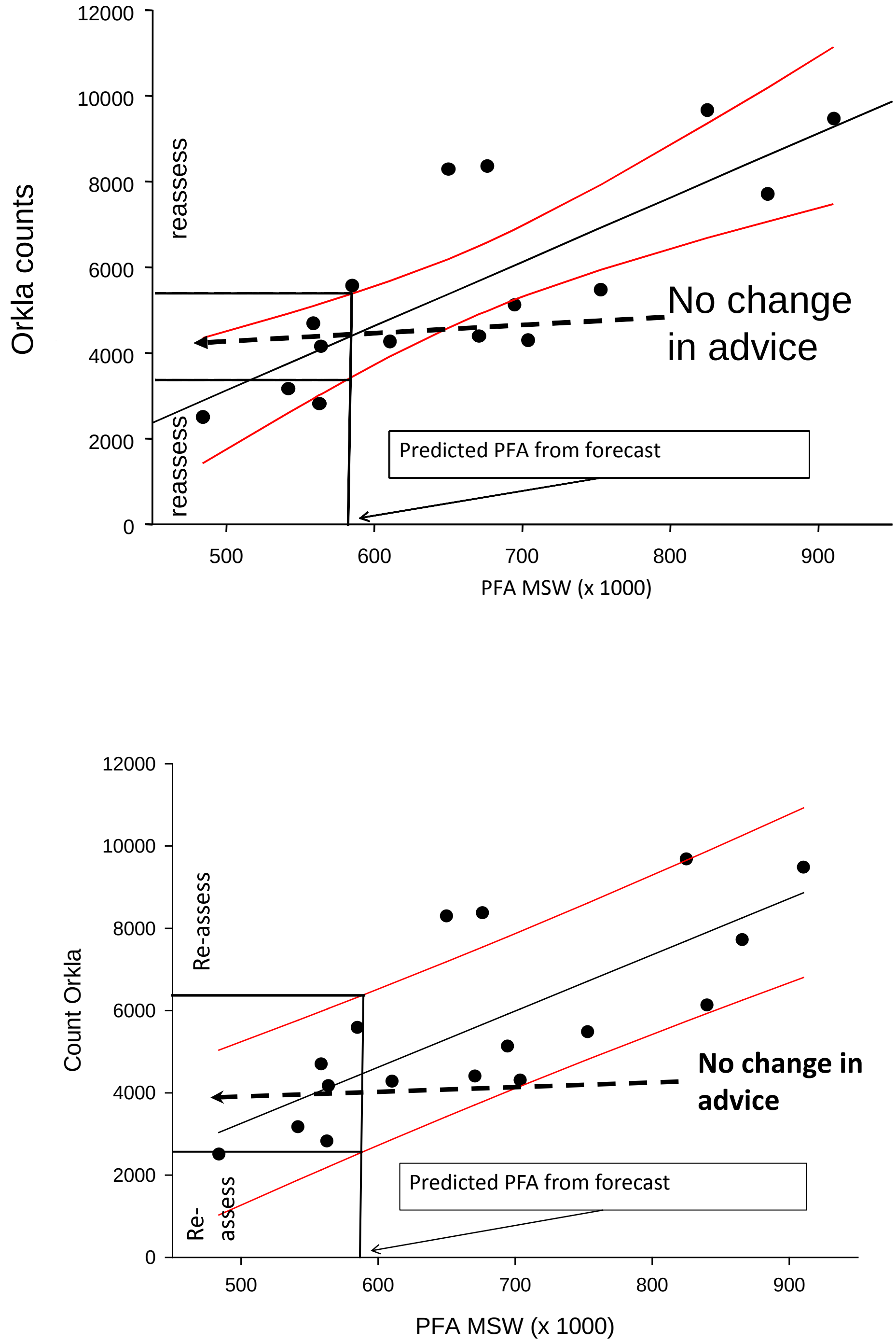


Figure 10.1.11.1 An example of the reassessment intervals for the indicators proposed by ICES (2011) based on confidence intervals for the indicator mean values (upper panel), compared to the proposed reassessment intervals for the indicators based on the predictive intervals for the indicator values (lower panel). The values of an indicator (counts in this example) are plotted against the PFA. The regression line is shown in black and the limits for the mean prediction (95%, upper panel) and for the predicted value (75%, lower panel) are shown in red. From the forecasted PFA in the year in question, the values of the indicator corresponding to the upper and lower interval limits are estimated. If the indicator value falls outside these limits, a reassessment is recommended by this particular indicator.

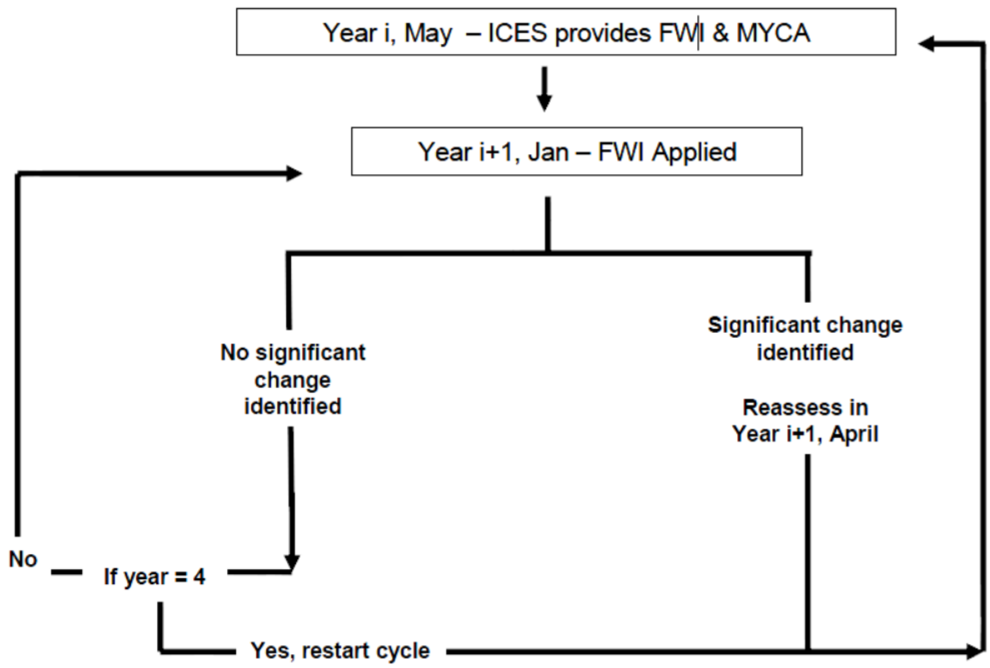


Figure 10.1.11.2 Suggested timeline for employment of the Framework of Indicators (FWI). In Year i, ICES provides multi-year catch advice (MYCA) and an updated FWI which re-evaluates the updated datasets and is summarized in an Excel worksheet. In January of Year i+1, the FWI is applied and two options are available depending on the results. If no significant change with respect to forecasted PFAs is detected, no re-assessment is necessary and the cycle continues to Year i+2. If no significant change is detected in Year i+2, the cycle continues to Year i+3. If a significant change is detected in any year, then reassessment is recommended. In that case, ICES would provide an updated FWI the following May. ICES would also provide an updated FWI if year equals four.

Table 10.1.5.1 Reported total nominal catches of salmon by country (in tonnes round fresh weight), 1960 to 2011 (2011 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 (West)	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	-	-	743	283	139	1443	-	33	-	-	60	-	7237	-	-
1961	1583	1	-	1533	790	127	-	27	-	-	707	232	132	1185	-	20	-	-	127	-	6464	-	-
1962	1719	1	-	1935	710	125	-	45	-	-	1459	318	356	1738	-	23	-	-	244	-	8673	-	-
1963	1861	1	-	1786	480	145	-	23	-	-	1458	325	306	1725	-	28	-	-	466	-	8604	-	-
1964	2069	1	-	2147	590	135	-	36	-	-	1617	307	377	1907	-	34	-	-	1539	-	10759	-	-
1965	2116	1	-	2000	590	133	-	40	-	-	1457	320	281	1593	-	42	-	-	861	-	9434	-	-
1966	2369	1	-	1791	570	104	2	36	-	-	1238	387	287	1595	-	42	-	-	1370	-	9792	-	-
1967	2863	1	-	1980	883	144	2	25	-	-	1463	420	449	2117	-	43	-	-	1601	-	11991	-	-
1968	2111	1	-	1514	827	161	1	20	-	-	1413	282	312	1578	-	38	5	-	1127	403	9793	-	-
1969	2202	1	-	1383	360	131	2	22	-	-	1730	377	267	1955	-	54	7	-	2210	893	11594	-	-
1970	2323	1	-	1171	448	182	13	20	-	-	1787	527	297	1392	-	45	12	-	2146	922	11286	-	-
1971	1992	1	-	1207	417	196	8	18	-	-	1639	426	234	1421	-	16	-	-	2689	471	10735	-	-
1972	1759	1	-	1578	462	245	5	18	-	32	1804	442	210	1727	34	40	9	-	2113	486	10965	-	-
1973	2434	3	-	1726	772	148	8	23	-	50	1930	450	182	2006	12	24	28	-	2341	533	12670	-	-
1974	2539	1	-	1633	709	215	10	32	-	76	2128	383	184	1628	13	16	20	-	1917	373	11877	-	-
1975	2485	2	-	1537	811	145	21	26	-	76	2216	447	164	1621	25	27	28	-	2030	475	12136	-	-
1976	2506	1	3	1530	542	216	9	20	-	66	1561	208	113	1019	9	21	40	<1	1175	289	9327	-	-
1977	2545	2	-	1488	497	123	7	10	-	59	1372	345	110	1160	19	19	40	6	1420	192	9414	-	-
1978	1545	4	-	1050	476	285	6	10	-	37	1230	349	148	1323	20	32	37	8	984	138	7682	-	-
1979	1287	3	-	1831	455	219	6	12	-	26	1097	261	99	1076	10	29	119	<0,5	1395	193	8118	-	-
1980	2680	6	-	1830	664	241	8	17	-	34	947	360	122	1134	30	47	536	<0,5	1194	277	10127	-	-
1981	2437	6	-	1656	463	147	16	26	-	44	685	493	101	1233	20	25	1025	<0,5	1264	313	9954	-	-
1982	1798	6	-	1348	364	130	17	25	-	54	993	286	132	1092	20	10	606	<0,5	1077	437	8395	-	-
1983	1424	1	3	1550	507	166	32	28	-	58	1656	429	187	1221	16	23	678	<0,5	310	466	8755	-	-
1984	1112	2	3	1623	593	139	20	40	-	46	829	345	78	1013	25	18	628	<0,5	297	101	6912	-	-
1985	1133	2	3	1561	659	162	55	45	-	49	1595	361	98	913	22	13	566	7	864	-	8108	-	-
1986	1559	2	3	1598	608	232	59	54	-	37	1730	430	109	1271	28	27	530	19	960	-	9255	315	-
1987	1784	1	2	1385	564	181	40	47	-	49	1239	302	56	922	27	18	576	<0,5	966	-	8159	2788	-
1988	1310	1	2	1076	420	217	180	40	-	36	1874	395	114	882	32	18	243	4	893	-	7737	3248	-
1989	1139	2	2	905	364	141	136	29	-	52	1079	296	142	895	14	7	364	-	337	-	5904	2277	-
1990	911	2	2	930	313	141	285	33	13	60	567	338	94	624	15	7	315	-	274	-	4925	1890	180-350

Table 10.1.5.1 continued.

Year	NAC Area: Canada (1)	NAC Area: USA	NAC Area: St. P&M	NEAC (N. Area): Norway (2)	NEAC (N. Area): Russia (3)	NEAC (N. Area): Iceland Wild	NEAC (N. Area): Iceland Ranch (4)	NEAC (N. Area): Sweden (West)	NEAC (N. Area): Denmark	NEAC (N. Area): Finland	NEAC (S. Area): Ireland (5,6)	NEAC (S. Area): UK (E & W)	NEAC (S. Area): UK (N.Irl.) (6,7)	NEAC (S. Area): UK (Scotl.)	NEAC (S. Area): France (8)	NEAC (S. Area): Spain (9)	Faroes & Greenland: Faroes (10)	Faroes & Greenland: East Grld.	Faroes & Greenland: West Grld. (11)	Faroes & Greenland: Other (12)	Total Reported Nominal Catch	Unreported catches: NASCO Areas (13)	Unreported catches: International waters (14)
1991	711	1	1	876	215	129	346	38	3	70	404	200	55	462	13	11	95	4	472	-	4106	1682	25-100
1992	522	1	2	867	167	174	462	49	10	77	630	171	91	600	20	11	23	5	237	-	4119	1962	25-100
1993	373	1	3	923	139	157	499	56	9	70	541	248	83	547	16	8	23	-	-	-	3696	1644	25-100
1994	355	0	3	996	141	136	313	44	6	49	804	324	91	649	18	10	6	-	-	-	3945	1276	25-100
1995	260	0	1	839	128	146	303	37	3	48	790	295	83	588	10	9	5	2	83	-	3629	1060	-
1996	292	0	2	787	131	118	243	33	2	44	685	183	77	427	13	7	-	0	92	-	3136	1123	-
1997	229	0	2	630	111	97	59	19	1	45	570	142	93	296	8	4	-	1	58	-	2364	827	-
1998	157	0	2	740	131	119	46	15	1	48	624	123	78	283	8	4	6	0	11	-	2395	1210	-
1999	152	0	2	811	103	111	35	16	1	62	515	150	53	199	11	6	0	0	19	-	2247	1032	-
2000	153	0	2	1176	124	73	11	33	5	95	621	219	78	274	11	7	8	0	21	-	2912	1269	-
2001	148	0	2	1267	114	74	14	33	6	126	730	184	53	251	11	13	0	0	43	-	3069	1180	-
2002	148	0	2	1019	118	90	7	28	5	93	682	161	81	191	11	9	0	0	9	-	2654	1039	-
2003	141	0	3	1071	107	99	11	25	4	78	551	89	56	192	13	9	0	0	9	-	2457	847	-
2004	161	0	3	784	82	111	18	20	4	39	489	111	48	245	19	7	0	0	15	-	2157	686	-
2005	139	0	3	888	82	129	21	15	8	47	422	97	52	215	11	13	0	0	15	-	2156	700	-
2006	137	0	3	932	91	93	17	14	2	67	326	80	29	192	13	11	0	0	22	-	2029	670	-
2007	112	0	2	767	63	93	36	16	3	58	85	67	30	169	11	9	0	0	25	-	1546	475	-
2008	158	0	4	807	73	132	69	18	9	71	89	64	21	160	12	9	0	0	26	-	1720	443	-
2009	126	0	3	595	71	126	44	17	8	36	67	54	17	120	4	2	0	0	26	-	1317	327	-
2010	153	0	3	642	88	147	42	22	13	49	98	109	12	180	10	2	0	0	40	-	1609	367	-
2011	179	0	4	696	83	98	30	39	13	44	100	129	13	169	5	7	0	0	28	-	1635	441	-
Average																							
2006-2010	137	0	3	749	77	118	42	17	7	56	133	75	22	164	10	6	0	0	28	-	1644	456	-
2001-2010	142	0	3	877	89	109	28	21	6	66	354	102	40	192	11	8	0	0	23	-	2071	673	-

Key:

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Before 1966, sea trout and sea charr included (5% of total).
3. Figures from 1991 to 2000 do not include catches taken in the recreational (rod) fishery.
4. From 1990, catch includes fish ranched for both commercial and angling purposes.
5. Improved reporting of rod catches in 1994 and data derived from carcase tagging and log books from 2002.
6. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
7. Angling catch (derived from carcase tagging and log books) first included in 2002.
8. Data for France include some unreported catches.
9. Weights estimated from mean weight of fish caught in Asturias (80-90% of Spanish catch).
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.
11. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
12. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.
13. No unreported catch estimate available for Canada in 2007 and 2008. Data for Canada in 2009 and 2010 are incomplete. No unreported catch estimate available for Russia since 2008.
14. Estimates refer to season ending in given year.

Table 10.1.5.2 Estimates of unreported catches by various methods, in tonnes by country within national EEZs in the Northeast Atlantic, North American, and West Greenland Commissions of NASCO, 2011.

Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Denmark	6	0.3	31
NEAC	Finland	7	0.4	14
NEAC	Iceland	10	0.5	7
NEAC	Ireland	10	0.5	9
NEAC	Norway	298	15.1	30
NEAC	Sweden	4	0.2	9
NEAC	France	1	0.1	18
NEAC	UK (E & W)	23	1.2	15
NEAC	UK (N.Ireland)	0	0.0	2
NEAC	UK (Scotland)	23	1.2	12
NAC	USA	0	0.0	0
NAC	Canada	29	1.5	14
WGC	West Greenland	10	0.5	26
	Total Unreported Catch *	421	21.3	
	Total Reported Catch of North Atlantic salmon	1635		

* No unreported catch estimate available for Russia in 2011.
Unreported catch estimates not provided for Spain and St. Pierre et Miquelon

Table 10.1.5.3 Numbers of fish caught and released in rod fisheries along with the % of the total rod catch (released + retained) for countries in the North Atlantic where records are available, 1991–2011. Figures for 2011 are provisional.

Year	Canada [4]		USA		Iceland		Russia [1]		UK (E&W)		UK (Scotland)		Ireland		UK (N Ireland) [2]		Denmark		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
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	5959	40	21072	32								
2001	59387	55	0	-	3611	12	16945	76	4869	41	27724	38								
2002	50924	52	0	-	5985	18	25248	80	5910	47	24058	42								
2003	53645	55	0	-	5361	16	33862	81	4943	53	29170	55								
2004	62316	57	0	-	7362	16	24679	76	11516	46	46279	50					255	19		
2005	63005	62	0	-	9224	17	23592	87	10554	54	46165	55	2553	12			606	27		
2006	60486	62	1	100	8735	19	33380	82	9955	55	47669	55	5409	22	302	18	794	65		
2007	41192	58	3	100	9691	18	44341	90	9942	53	55660	61	13125	40	470	16	959	57		
2008	54887	53	61	100	17178	20	41881	86	11918	54	53347	62	13312	37	648	20	2033	71	5512	5
2009	52151	59	0	-	17514	24	-	-	8397	57	48371	67	10265	37	847	21	1709	53	6696	6
2010	55895	53	0	-	21476	29	14585	56	13958	59	78267	70	15136	40	823	25	2512	60	15041	12
2011	77641	59	0	-	18593	32	-	-	13079	61	67989	73	11383	31	1197	32	2153	55	14303	12
5-yr mean 2006-2010	52922	57			14919	22			10834	55	56663	63	11449	35	715	22	1220	55		
% change on 5-year mean	+47	+3			+25	+45			+21	+9	+20	+16	-1	-12	+68	+46	+76	+1		

Key: [1] No data were provided by the authorities for 2009 nor for 2011 and data for 2010 were incomplete, however catch-and-release is understood to have remained at similar high levels.
[2] Data for 2006-2009 is for the DCAL area only; the figure for 2010 is a total for N.Ireland.
[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.

Table 10.1.8.1 Summary of Atlantic salmon tagged and marked in 2011 – ‘Hatchery’ and ‘Wild’ refer to smolts and parr; ‘Adults’ relates to both wild and hatchery-origin fish.

		Primary Tag or Mark				
Country	Origin	Microtag	External mark	Adipose clip	Other Internal[1]	Total
Canada	Hatchery Adult	0	1,034	1,031	881	2,946
	Hatchery Juvenile	0	6,975	419,996	525	427,496
	Wild Adult[2]	0	3,958	902	172	5,032
	Wild Juvenile[2]	0	13,667	9,240	648	23,555
	Total	**0**	**25,634**	**431,169**	**2,226**	**459,029**
Denmark	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	118,500	0	162,700	0	281,200
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**118,500**	**0**	**162,700**	**0**	**281,200**
France	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[3]	0	0	525,380	0	525,380
	Wild Adult[3]	178	0	0	0	178
	Wild Juvenile	2,813	1,659	0	0	4,472
	Total	**2,991**	**1,659**	**525,380**	**0**	**530,030**
Germany	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	18,000	0	0	0	18,000
	Wild Adult	0	0	0	0	0
	Wild Juvenile	5,420	0	0	0	5,420
	Total	**23,420**	**0**	**0**	**0**	**23,420**
Iceland	Hatchery Adult	0	4	0	0	4
	Hatchery Juvenile	54,400		0	0	54,400
	Wild Adult		228	0	0	228
	Wild Juvenile	2,700		0	0	2,700
	Total	**57,100**	**232**	**0**	**0**	**57,332**
Ireland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	189,240	0	187,497	0	376,737
	Wild Adult	0	0	0	0	0
	Wild Juvenile	5,317	0	0	0	5,317
	Total	**194,557**	**0**	**187,497**	**0**	**382,054**
Norway	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	127,188	5,995	0	0	133,183
	Wild Adult	0	716	0	0	716
	Wild Juvenile	1,700	2,123		0	3,823
	Total	**128,888**	**8,834**	**0**	**0**	**137,722**
Russia	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	1,184,725	0	1,184,725
	Wild Adult	0	2,525	0	0	2,525
	Wild Juvenile	0	0	0	0	0
	Total	**0**	**2,525**	**1,184,725**	**0**	**1,187,250**
Sweden	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	3000	164,544	0	167,544
	Wild Adult	0			0	0
	Wild Juvenile	0	500		0	500
	Total	**0**	**3,500**	**164,544**	**0**	**168,044**
UK (England & Wales)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	6,800	0	224,570	0	231,370
	Wild Adult		239	0	0	239
	Wild Juvenile	9,855	0	5,917	0	15,772
	Total	**16,655**	**239**	**230,487**	**0**	**247,381**
UK (N. Ireland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	17,809	0	32,089	0	49,898
	Wild Adult	0	0	0	0	0
	Wild Juvenile	1957	0	0	0	1,957
	Total	**19,766**	**0**	**32,089**	**0**	**51,855**
UK (Scotland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	25,000	1,280	26,280
	Wild Adult	0	594	0	0	594
	Wild Juvenile	2373	0	0	1,929	4,302
	Total	**2,373**	**594**	**25,000**	**3,209**	**31,176**
USA	Hatchery Adult	0	2,050	58	5,318	7,426
	Hatchery Juvenile	0	0	504,648	539	505,187
	Wild Adult	0	0	0	733	733
	Wild Juvenile	0	0	0	184	184
	Total	**0**	**2,050**	**504,706**	**6,774**	**513,530**
All Countries	Hatchery Adult	0	3,088	1,089	6,199	10,376
	Hatchery Juvenile	531,937	15,970	3,431,149	2,344	3,981,400
	Wild Adult	178	8,260	902	905	10,245
	Wild Juvenile	32,135	17,949	15,157	2,761	68,002
	Total	**564,250**	**45,267**	**3,448,297**	**12,209**	**4,070,023**

[1] Includes other internal tags (PIT, ultrasonic, radio, DST, etc.)
[2] May include hatchery fish.
[3] Includes external dye mark.

Table 10.1.10.1 Revised estimation of composition (proportion) of catch at Faroes by complex and country/region, based on recoveries of adults tagged at the Faroes, 1991 to 1993.

Complex	Country	Maturing 1SW	Non-maturing 1SW
Northern NEAC	Russia	0.116	0.163
	Finland	0.059	0.050
	Norway	0.290	0.295
	Sweden	0.019	0.016
	Iceland-NE	0.016	0.011
	Subtotal	0.500	0.535
Southern NEAC	France	0.018	0.005
	Ireland	0.173	0.043
	UK(N. Ireland)	0.046	0.014
	UK(England & Wales)	0.044	0.034
	UK(Scotland)	0.195	0.337
	Iceland-SW	0.025	0.007
	Subtotal	0.500	0.440
Other	Canada, Spain, Denmark	0.000	0.2060
Total		1.000	1.000

Table 10.1.11.1 Candidate indicator data sets examined and results of the analyses of suitability of indicator data for inclusion in the Framework of Indicators (FWI) for the Northern NEAC complex.

Northern NEAC stock complex indicators

Candidate indicator data set	N	R^2	Significant (p<= 0.05)	$R^2 > 0.2$	Comment
1SW					
Returns all 1SW Norway (PFA)	23	0.92	significant	yes	
Survival W 1SW Imsa Norway	29	0.42	significant	yes	
Counts all Nausta Norway	14	0.39	significant	yes	
Counts all Øyensåa Norway	13	0.34	significant	yes	
Survival H 1SW Imsa Norway	28	0.26	significant	yes	
Catch all 1SW Finland	28	0.12	not significant	no	
Counts 1SW Tuloma Russia	26	0.06	not significant	no	
MSW					
PFA MSW Coast Norway	23	0.72	significant	yes	
Survival H 2SW Drammen Norway	25	0.59	significant	yes	No data collected after 2010
Counts all Orkla Norway	17	0.58	significant	yes	
Counts all Nausta Norway	14	0.37	significant	yes	
Counts all Målselv Norway	21	0.23	significant	yes	
Counts MSW Tuloma Russia	25	0.08	not significant	no	
Catch W 2SW Finland	25	0.04	not significant	no	

Table 10.1.11.2 Candidate indicator data sets examined and results of the analyses of suitability of indicator data for inclusion in the Framework of Indicators (FWI) for the Southern NEAC complex.

Southern NEAC stock complex indicators					
Candidate indicator data set	N	R^2	Significant (p<= 0.05)	$R^2 > 0.2$	Comment
1SW					
Ret. W 1SW Bush UK(N.I.)	18	0.61	significant	yes	
Ret. W 1SW North Esk UK(Sc.)	31	0.52	significant	yes	
Ret. W 1SW Itchen UK(E&W)	24	0.34	significant	yes	
Ret. W 1SW Frome UK(E&W)	39	0.30	significant	yes	
Ret. Freshw 1SW Bush UK(N.I.)	37	0.23	significant	yes	
Survey coast 1SW Dee UK(E&W)	18	0.18	not significant	no	
Ret. W 1SW Test UK(E&W)	23	0.14	not significant	no	
Ret. W 1SW Dee UK(E&W)	20	0.13	not significant	no	
Ret. W 1SW Tamar UK(E&W)	15	0.06	not significant	no	
Count 1SW Lune UK(E&W)	15	0.01	not significant	no	
Count 1SW Fowey UK(E&W)	15	0.01	not significant	no	
MSW					
Ret. W MSWItchen UK(E&W)	24	0.70	significant	yes	
Ret. W 1SW Bush UK(N.I.)	18	0.68	significant	yes	
Catch W MSW Ellidaar Iceland	40	0.55	significant	yes	
Ret. W 2SW Baddoch UK(Sc.)	24	0.45	significant	yes	
Ret. W MSW Frome UK(E&W)	39	0.44	significant	yes	
Ret. W 1SW Tamar UK(E&W)	14	0.43	significant	yes	
Ret. W 1SW Frome UK(E&W)	38	0.37	significant	yes	
Ret. W 1SW North Esk UK(Sc.)	30	0.36	significant	yes	
Count MSW Lune UK(E&W)	15	0.34	significant	yes	
Ret. W 1SW Itchen UK(E&W)	23	0.25	significant	yes	
Ret. Freshw 2SW Bush UK(N.I.)	36	0.25	significant	yes	
Count MSW Fowey UK(E&W)	15	0.23	not significant	yes	
Ret. W 2SW North Esk UK(Sc.)	31	0.20	significant	yes	
Ret. W 2SW Girnoch UK(Sc.)	40	0.20	significant	no	
Ret. W MSW Test UK(E&W)	23	0.16	not significant	no	
Count 1SW Fowey UK(E&W)	14	0.12	not significant	no	
Ret. W 1SW Dee UK(E&W)	19	0.10	not significant	no	
Ret. W All West water UK(Sc.)	21	0.10	not significant	no	
Ret. W 1SW Test UK(E&W)	23	0.07	not significant	no	
Survey coast 1SW Dee UK(E&W)	17	0.04	not significant	no	
Ret. W All West water UK(Sc.)	21	0.04	not significant	no	
Ret. W MSW Dee UK(E&W)	20	0.01	not significant	no	
Ret. W MSW Tamar UK(E&W)	15	0.00	not significant	no	
Count 1SW Lune UK(E&W)	14	0.00	not significant	no	
Survival coast MSW Dee UK(E&W)	17	0.00	not significant	no	

Table 10.1.11.3 FWI spreadsheet at the stock complex level for NEAC. In January 2013 the values of the indicators should be put into this spreadsheet to determine if a reassessment in 2013 is recommended. The advice provided will be automatically updated when data are entered. The conclusion of the spreadsheet in this illustration is irrelevant in the absence of data.

FWI NEAC	2013	Indicators suggest:	REASSESS

Indicators for Northern NEAC 1SW PFA

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2013? Outside 75% conf.lim. below	above	Outside 75% confidence limits below	above
1	Returns all 1SW NO PFA est		23	0.536108	-73170.20	0.91	577600	194219.71	278751.74	0	0	Uninformative	Uninformative
2	Survivals W 1SW NO Imsa		28	0.000012	-4.14	0.42	577600	-1.59	7.56	0	0	Uninformative	Uninformative
3	Survivals H 1SW NO Imsa		29	0.000006	-1.11	0.26	577600	-0.75	5.47	0	0	Uninformative	Uninformative
4	Counts all NO Øyensåa (1SW)		13	0.002703	256.13	0.33	577600	708.37	2926.92	0	0	Uninformative	Uninformative
5	Counts all NO Nausta (1SW)		14	0.002486	-490.54	0.39	577600	2.84	1888.12	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Northern NEAC MSW PFA

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2013? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	PFA-MSW-CoastNorway		23	0.344433	-12251.11	0.71	824900	240360.77	303382.23	0	0	Uninformative	Uninformative
2	Orkla counts		17	0.013484	-3478.47	0.57	824900	5669.61	9619.69	0	0	Uninformative	Uninformative
3	Målselv counts		21	0.003871	14.46	0.22	824900	2126.89	4289.14	0	0	Uninformative	Uninformative
4	Counts all NO Nausta		14	0.004249	-1647.46	0.36	824900	865.86	2849.54	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC 1SW PFA

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2013? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	Ret. W 1SW UK(E&W) Itchen M		24	0.000330	-106.71	0.34	1187000	80.15	489.51	0	0	Uninformative	Uninformative
2	Ret. W 1SW UK(E&W) Frome M		39	0.000497	65.49	0.31	1187000	103.51	1206.63	0	0	Uninformative	Uninformative
3	Ret. W 1SW UK(Sc.) North Esk M		31	0.006129	5122.42	0.52	1187000	9092.67	15701.63	0	0	Uninformative	Uninformative
4	Ret. W 1SW UK(NI) Bush M		18	0.004420	-2435.32	0.61	1187000	1028.93	4593.43	0	0	Uninformative	Uninformative
5	Ret. Freshw 1SW UK(NI) Bush		37	0.000673	478.23	0.23	1187000	477.32	2078.00	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC MSW PFA

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2013? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	Ret. W 2SW UK(Sc.) Baddoch NM		24	0.000034	3.23	0.45	781000	15.75	43.05	0	0	Uninformative	Uninformative
2	Ret. W 2SW UK(Sc.) North Esk NM		31	0.003676	4605.52	0.21	781000	4124.05	10828.88	0	0	Uninformative	Uninformative
3	Ret. W 1SW UK(Sc.) North Esk NM		30	0.006340	8457.39	0.35	781000	9640.38	17176.92	0	0	Uninformative	Uninformative
4	Ret. W MSW UK(E&W) Itchen NM		24	0.000289	-96.89	0.70	781000	60.20	198.12	0	0	Uninformative	Uninformative
5	Ret. W 1SW UK(E&W) Itchen NM		23	0.000426	-2.64	0.25	781000	108.40	551.24	0	0	Uninformative	Uninformative
6	Ret. W MSW UK(E&W) Frome NM		39	0.000737	104.10	0.44	781000	157.03	1202.63	0	0	Uninformative	Uninformative
7	Ret. W 1SW UK(E&W) Frome NM		38	0.000720	119.80	0.37	781000	151.71	1212.30	0	0	Uninformative	Uninformative
8	Catch W MSW Ice Ellidaar NM		40	0.000092	-22.38	0.55	781000	-8.28	107.53	0	0	Uninformative	Uninformative
9	Ret. Freshw 2SW UK(NI) Bush		36	0.000157	41.30	0.24	781000	25.26	302.32	0	0	Uninformative	Uninformative
10	Ret. W 1SW UK(NI) Bush NM		18	0.005612	-802.38	0.66	781000	1940.95	5220.71	0	0	Uninformative	Uninformative
11	Ret. W 1SW UK(E&W) Tamar NM		14	0.009158	-1853.33	0.44	781000	4034.89	6563.82	0	0	Uninformative	Uninformative
12	Count MSW UK(E&W) Lune NM		15	0.003815	-1088.59	0.36	781000	1290.37	2491.09	0	0	Uninformative	Uninformative
13	Count MSW UK(E&W) Fowey NM		15	0.000200	-45.65	0.24	781000	68.31	152.17	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Table 10.1.11.4 Output of the spreadsheet for the test of FWIs for NEAC for 2012 based on the values of the indicators from 2011. Because the indicators suggest that the forecast for Northern NEAC MSW PFA was an underestimate, the overall advice from the spreadsheet is reassess.

FWI NEAC	2012	Indicators suggest:	REASSESS
An example			

Indicators for Northern NEAC 1SW PFA

		Insert data from 2011 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2012? Outside 75% conf.lim. below	above	Outside 75% confidence limits below	above
1	Returns all 1SW NO PFA est	171994	22	0.530320	-68503.69	0.91	366400	79749.32	171861.94	-1	1	NO	YES
2	Survivals W 1SW NO Imsa	1.8	27	0.000012	-4.13	0.40	366400	-4.52	5.27	-1	-1	NO	NO
3	Survivals H 1SW NO Imsa	2.3	28	0.000006	-1.21	0.26	366400	-2.31	4.35	-1	-1	NO	NO
4	Counts all NO Øyensåa (1SW)	1446	12	0.002637	316.65	0.29	366400	-28.89	2594.93	-1	-1	NO	NO
5	Counts all NO Nausta (1SW)	1824	13	0.002934	-903.82	0.51	366400	-771.96	1114.67	-1	1	NO	YES
								Sum of scores		-5	-1		
												Indicators do not suggest that the PFA forecast is an overestimation.	Indicators do not suggest that the PFA forecast is an underestimation.

Indicators for Northern NEAC MSW PFA

		Insert data from 2011 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2012? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	PFA-MSW-Coast Norway	285788	22	0.340604	-9302.74	0.70	575800	155137.47	218496.75	-1	1	NO	YES
2	Orkla counts	6131	16	0.015027	-4373.19	0.62	575800	2401.72	6156.64	-1	-1	NO	NO
3	Målselv counts	2899	20	0.004227	-196.54	0.24	575800	1147.60	3326.79	-1	-1	NO	NO
4	Counts all NO Nausta	1824	13	0.004430	-1755.77	0.35	575800	-224.55	1814.61	-1	1	NO	YES
								Sum of scores		-4	0		
												Indicators do not suggest that the PFA forecast is an overestimation.	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC 1SW PFA

		Insert data from 2011 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2012? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	Ret. W 1SW UK(E&W) Itchen M	474	23	0.000372	-171.97	0.43	842600	-58.54	340.89	-1	1	NO	YES
2	Ret. W 1SW UK(E&W) Frome M	675	38	0.000507	47.11	0.31	842600	-93.23	1041.10	-1	-1	NO	NO
3	Ret. W 1SW UK(Sc.) North Esk M	8103	30	0.005915	5535.57	0.50	842600	7125.86	13913.14	-1	-1	NO	NO
4	Ret. W 1SW UK(NI) Bush M	2578	17	0.004451	-2473.57	0.61	842600	-641.31	3195.82	-1	-1	NO	NO
5	Ret. Freshw 1SW UK(NI) Bush	471	36	0.000634	559.00	0.21	842600	275.86	1910.38	-1	-1	NO	NO
								Sum of scores		-5	-3		
												Indicators do not suggest that the PFA forecast is an overestimation.	Indicators do not suggest that the PFA forecast is an underestimation.

Indicators for Southern NEAC MSW PFA

		Insert data from 2011 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Reassess in year 2012? Outside 75% conf.lim. below	above	Outside 75% conf.lim. below	above
1	Ret. W 2SW UK(Sc.) Baddoch NM	40	23	0.000033	2.78	0.46	613000	9.57	37.00	-1	1	NO	YES
2	Ret. W 2SW UK(Sc.) North Esk NM	16215	30	0.003880	4121.60	0.31	613000	3708.32	9291.16	-1	1	NO	YES
3	Ret. W 1SW UK(Sc.) North Esk NM	16832	29	0.006428	8249.22	0.37	613000	8413.37	15965.65	-1	1	NO	YES
4	Ret. W MSW UK(E&W) Itchen NM	223	23	0.000288	-99.96	0.73	613000	10.38	142.47	-1	1	NO	YES
5	Ret. W 1SW UK(E&W) Itchen NM	613	22	0.000411	-5.05	0.26	613000	32.79	460.48	-1	1	NO	YES
6	Ret. W MSW UK(E&W) Frome NM	731	38	0.000727	109.23	0.44	613000	19.68	1090.22	-1	-1	NO	NO
7	Ret. W 1SW UK(E&W) Frome NM	730	38	0.000707	128.83	0.37	613000	27.72	1096.76	-1	-1	NO	NO
8	Catch W MSW Ice Ellidaar NM	11	39	0.000091	-20.32	0.55	613000	-22.79	93.39	-1	-1	NO	NO
9	Ret. Freshw 2SW UK(NI) Bush	178	35	0.000156	41.08	0.24	613000	-5.01	278.28	-1	-1	NO	NO
10	Ret. W 1SW UK(NI) Bush NM	2578	17	0.005636	-831.45	0.67	613000	942.10	4305.27	-1	-1	NO	NO
11	Count MSW UK(E&W) Fowey NM	65	14	0.000477	-200.69	0.65	613000	66.46	116.94	1	-1	YES	NO
								Sum of scores		-9	-1		
												Indicators do not suggest that the PFA forecast is an overestimation.	Indicators do not suggest that the PFA forecast is an overestimation.

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.

ASF (*Atlantic Salmon Federation*)

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).

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.

DCF (*Data Collection Framework*)

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.

DST (*data storage tag*)

EU DCR *(The EU Data Collection Regulation)* DCR established a community framework for the collection, management, and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy.

FWI (*Framework of Indicators*)

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)* An adult salmon which has spent two or more winters at sea or a repeat spawner.

MYCA (*multi-year catch advice*)

NAC (*North American Commission*) One of three Commission areas reporting to NASCO. Member countries: Canada and the United States of America.

NAFO (*Northwest Atlantic Fisheries Organization*)

NEAC (*North-East Atlantic Commission*) One of three Commission areas reporting to NASCO. Member countries: Denmark (for Faroe Islands and Greenland), the European Union, Iceland, Norway, and the Russian Federation.

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

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.

RVS *(red vent syndrome)* The condition known as RVS 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.

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

SFA *(salmon fishing areas)* Areas for which the Department of Fisheries and Oceans (DFO) Canada manages the salmon fisheries.

SGBICEPS *(Study Group on the Identification of Biological Characteristics for Use as Predictors of Salmon Abundance)* The ICES Study Group established to complete a review of the available information on the life-history strategies of salmon and changes in the biological characteristics of the fish in relation to key environmental variables.

S_{lim}, i.e. CL *(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 the undesirable levels are avoided.

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

WGC (*West Greenland Commission*) One of three Commission areas reporting to NASCO. Member countries: Canada, Denmark (for Faroe Islands and Greenland), the European Union, and the United States of America.

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10.2 Stock summaries

10.2.1 Advice May 2012

ECOREGION North Atlantic
STOCK Atlantic salmon from the Northeast Atlantic

Advice for 2012 to 2015

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

In the absence of any fisheries in 2012 to 2015, there is less than 95% probability of meeting the CL (full reproductive capacity) in the two age groups of the southern NEAC stock complex. Therefore, in the absence of specific management objectives, ICES advises that there are no mixed-stock fisheries options on the NEAC complexes at Faroes in 2012 to 2015. In all years, there is 71% to 73% probability of meeting the CLs for the NEAC complexes simultaneously, in the absence of any mixed-stock fisheries (Table 10.2.1).

A Framework of Indicators (FWI) has been developed in support of the multi-year catch advice and the potential approval of multi-year regulatory measures for Faroes (Table 10.2.2). The FWI can be applied at the beginning of 2013, with the returns or return rate data for 2012, to evaluate the appropriateness of the 2013/2014 advice, and again at the beginning of 2014, with the returns or return rate data for 2013, to evaluate the appropriateness of the 2014/2015 advice.

Stock status

National stocks within the NEAC area are combined into two stock groupings for the provision of management advice for the distant water fisheries at West Greenland and Faroes. The Northern group consists of: Russia, Finland, Norway, Sweden, and the northeast regions of Iceland. The Southern group consists of: UK (Scotland), UK (England and Wales), UK (Northern Ireland), Ireland, France, Spain, and the southwest regions of Iceland.

Recruitment, expressed as pre-fishery abundance (PFA; split by maturing and non-maturing 1SW salmon, at 1 January of the first winter at sea) is estimated by stock complex (northern NEAC and southern NEAC) and interpreted relative to the spawner escapement reserve (SER) (Figures 10.2.1 to 10.2.3). SERs are the conservation limits (CLs; expressed in terms of spawner numbers) increased to take account of natural mortality (M = 0.03 per month) between 1 January of the first winter at sea and return time to homewaters for each of the maturing (6 to 9 months) and non-maturing (16 to 21 months) 1SW salmon from the northern NEAC and southern NEAC stock complexes.

Recruitment (PFA) of maturing 1SW salmon and of non-maturing 1SW salmon for northern NEAC shows broadly similar patterns of a general decline during 1983–2010, interrupted by a short period of increased recruitment from 1998 to 2003 (Figure 10.2.3). Both components (1SW maturing and 1SW non-maturing) have been at full reproductive capacity prior to the commencement of distant water fisheries throughout the time-series. Recruitment of maturing 1SW salmon and of non-maturing 1SW salmon for southern NEAC also shows broadly similar declining trends during 1971–2010 (Figure 10.2.3). Both components have been at full reproductive capacity over most of the time period, but the non-maturing 1SW component has been at risk of suffering reduced reproductive capacity before any fisheries took place in two (2006 and 2008) of the last five PFA years. This is broadly consistent with the general pattern of decline in marine survival in most monitored stocks in the area.

Trends in spawner numbers for the Northern stock complex for 1SW and MSW salmon are similar (Figure 10.2.3). Throughout most of the time-series, both 1SW and MSW spawners have been either at full reproductive capacity or at risk of reduced reproductive capacity. The spawner estimates indicated that the 1SW and MSW stock complexes were both at full reproductive capacity in 2011, with the MSW complex showing a further improvement since 2010. Declining trends in spawner numbers are evident in the southern NEAC stock complex for 1SW and MSW salmon. The 1SW stock has been at risk of reduced reproductive capacity or suffering reduced reproductive capacity for most of the time-series. In contrast, the MSW stock has been at full reproductive capacity for most of the time-series until 1997. Thereafter, the stock was either at risk of reduced reproductive capacity or suffering reduced reproductive capacity, with the exception of 2004 and 2011 when the stock was at full reproductive capacity.

Estimated exploitation rates have generally been decreasing over the time period in northern and southern NEAC areas (Figure 10.2.4). 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 attributed to climate effects.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of 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 (both 1SW and MSW) is based upon all NEAC area stocks. The advice for the West Greenland fishery is based upon the southern NEAC non-maturing 1SW stock.

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

The fisheries

No fishery for salmon has been prosecuted at Faroes since 2000. No significant changes in gear type used were reported in the NEAC area in 2011. The NEAC area has seen a general reduction in catches since the 1980s (Figure 10.2.5; Table 10.2.3). This reflects the decline in fishing effort as a consequence of management measures, as well as a reduction in the size of stocks. The provisional total nominal catch for 2011 was 1003 t in northern NEAC and 422 t in southern NEAC. The catch in the southern area, which comprised around two-thirds of the total NEAC catch in the early 1970s, has been lower than in the northern area since 1999 (Figure 10.2.5).

1SW salmon constituted 49% of the total catch in the northern area in 2011 and was the lowest value in the time-series (Figure 10.2.6). For the southern European countries, the overall percentage of 1SW fish in the catch in 2011 (44%) was also the lowest value in the time-series. There is considerable variability among individual countries (Figure 10.2.6).

The contribution of escaped farmed salmon in catches in the NEAC area in 2011 was again generally low in most countries, and similar to the values that have been reported in previous years, with the exception of Norway, Iceland, and Sweden. From sampling in northern Norway, 12% of the fish were escaped farmed salmon. Presence of escaped farmed salmon in central and southern Norway was highest from two coastal locations (48%), whereas samples from three locations in fjords showed lower proportions of escaped farmed salmon (13%).

Monitoring of new and expanded fisheries for mackerel in Iceland and Faroes has provided samples of Atlantic salmon bycatch, primarily as post-smolts.

Effects of the fisheries on the ecosystem

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

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Provisional catch data for 2010 were updated, where appropriate, and the assessment extended to include data for 2011.

Scientific basis

Assessments are carried out using common input variables across stock complexes. Run-reconstruction models and Bayesian forecasts are performed taking into account uncertainties in the data and process error, and the results are presented in a risk analysis framework.

Supporting information: WGNAS.

10.2.1 Supporting information May 2012

ECOREGION North Atlantic
STOCK Atlantic salmon from the Northeast Atlantic

Reference points

National run-reconstruction models have been used for all countries that do not have river-specific CLs (i.e. all countries except France, Ireland, UK (England & Wales), and Norway). To provide catch options to NASCO, CLs are required for stock complexes. These have been derived either by summing individual river CLs to national level, or by taking overall national CLs as provided by the national model, and then summing to the level of the four NEAC stock complexes. The CLs have also been used to estimate the spawner escapement reserves (SERs), which are the CLs increased to take account of natural mortality (M = 0.03 per month) between 1 January of the first winter at sea and return time to homewaters 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.

Complex	Age group	CL (number)	SER (number)
Northern NEAC	1SW	167 615	212 986
	MSW	128 778	218 259
Southern NEAC	1SW	599 197	758 477
	MSW	241 269	406 436

Outlook for 2012 to 2015

PFA (pre-fishery abundance at 1 January of the first winter at sea) forecasts for the southern and northern NEAC complexes were developed within a Bayesian model framework. Probabilities that the PFAs are above or equal to spawner escapement reserves in 2011 to 2015 are given in Table 10.2.6. Probabilities of meeting SERs are higher in the northern than in the southern complex.

MSY approach

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 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, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY $B_{escapement}$).

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 above CLs. Due to the different status of individual stocks, mixed-stock fisheries present particular threats.

In the absence of any fisheries in 2012 to 2015, there is less than 95% probability of meeting the CLs for the two age groups of the southern NEAC complex (Table 10.2.1). Therefore, in the absence of specific management objectives, ICES advises that there are no mixed-stock fisheries options on the NEAC complexes at Faroes in 2012 to 2015.

Additional considerations

ICES emphasizes that the national stock CLs discussed above are not appropriate for the management of homewater fisheries, particularly where these exploit separate river stocks. This is because of the relative imprecision of the national CLs and because they will not take account of differences in the status of different river stocks or sub-river populations. Management at finer scales should take account of individual river stock status. Nevertheless, the combined CLs for the main stock groups (national stocks) exploited by the distant water fisheries could be used to provide general management advice to the distant water fisheries.

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

There has been an overall declining trend in marine survival rates of hatchery smolts in northern and southern NEAC areas. Most of the survival indices for wild and reared smolts are below the previous 5- and 10-year averages. For wild smolts the decline is also apparent for the northern NEAC areas; however, for the southern NEAC areas the trends are more variable (Figure 10.2.7). Comparison of survival indices for the 2008 and 2009 smolt years show a general increase in 2009 compared to 2008 for wild smolts in northern and southern NEAC areas, but a decline in 2010. 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.

Scientific basis

Data and methods

Input data to estimate the historic PFAs are the catch in numbers of 1SW and MSW salmon in each country, unreported catch levels (minimum and maximum) and exploitation rates (minimum and maximum). Data beginning in 1971 are available for most countries . In addition, catches at the Faroes and catches of NEAC-origin salmon at West Greenland are incorporated. Results are presented in Tables 10.2.4 and 10.2.5.

The Bayesian inference and forecast models for the southern NEAC and northern NEAC complexes have the same structure and are run independently. For both southern and northern NEAC complexes, PFA forecasts were derived based on lagged spawners and productivity. PFA was forecasted from 2012 to 2015 for maturing 1SW salmon and and from 2011 to 2015 for non-maturing 1SW salmon.

The risk framework was used to evaluate catch options for the Faroes fishery in the 2012/13, 2013/14, and 2014/15 fishing seasons, based on the northern and southern NEAC stock complexes of maturing and non-maturing 1SW salmon. The catch options examined assumed that homewater fisheries would also take the total catch allocation based on a share of 8.4% of the total catch at Faroes. The risk analysis calculates the probability of stocks achieving the management objective for each of the age groups of the NEAC stock complexes and can display the resulting probabilities in tabular and/or graphic form. Further work is required to permit running the risk framework based on management units defined at finer scales, to improve the data in order to attribute the historical Faroes catch to these management units, and to seek additional data to improve the quality of the assessment.

The computing platform for conducting the run-reconstruction and the derivation of CLs for jurisdictions without river-specific CLs is being moved from Crystal Ball (CB) to “R”. During that transition, modifications to the algorithms have been implemented, particularly in the derivation of CLs from the pseudo stock–recruitment relationships. Differences in CLs derived for countries as a whole can be attributed to changes in the methods used to aggregate regional CLs. For countries with more than one region, the CB model derives CLs from the national CL model aggregated over all regions. In the R model, the method more closely matches how stock complex CLs are derived from regional data, with CLs estimated for each region separately and then summed to produce the overall country CL. This modification will be implemented for the next assessment.

Uncertainties in assessments and forecasts

The model estimates the PFA from the catch in numbers of 1SW and MSW salmon in each country. Uncertainties are accounted for using minimum and maximum ranges for unreported catches and exploitation rates. A natural mortality value of 0.03 (range 0.02 to 0.04) per month is applied during the second year at sea. Monte Carlo simulation is used to generate confidence intervals of the eggs from spawners and the returns to each country.

Risks were defined each year as the posterior probability that the number of spawners would be above the age- and stock-specific CLs under various catch scenarios.

The large uncertainty in the PFA forecasts encompasses the historic range of estimated abundance (Figures 10.2.1 and 10.2.2). This increased uncertainty also results in increased risk of not achieving the CLs. As a result, the advice is more cautious regarding fishing opportunities.

The surpluses to SER for the northern NEAC complex forecasted for 2012 to 2015 arise because of the high productivity estimated for 2010, which is applied when forecasting PFA in future years. Productivity increased in 2010 for the northern and southern NEAC areas, but increases and decreases have been noted in the past. The returns of 1SW maturing salmon to NEAC countries in 2011, the first indication of the possible strength of the MSW returns to homewaters in 2012, were lower than in 2010 but at similar levels to 2009, a year when the non-maturing PFA age group was estimated to have been above SERs prior to any exploitation in high seas fisheries and in homewaters.

ICES (2010, 2011) previously emphasized the problem of basing the risk analysis on management units comprising large numbers of river stocks. However, at present, the performance of individual stocks in all countries in the NEAC area cannot be assessed.

Comparison with previous assessment and catch options

Previously, ICES assessed the status of stocks and provided advice on management of the stock complexes in the NEAC area based on the uncertainties in the estimates of spawners relative to CLs. Specifically, if the lower bound of the 95% confidence interval of the current estimate of spawners was above the CL, then the stock was considered at full reproductive capacity. When the lower bound of the confidence limit was below the CL, but the midpoint was above, the stock was considered to be at risk of suffering reduced reproductive capacity. Finally, when the midpoint was below the CL, the stock was considered to be suffering reduced reproductive capacity.

The risk assessment framework in this year's advice directly evaluates the risk of meeting or exceeding the stock complex objectives. Managers can choose the risk level which they consider appropriate. ICES considers, however, that to be consistent with the MSY and the precautionary approach, and given that the CLs are considered to be limit reference points to be avoided with high probability, managers should choose a risk level that results in a low chance of failing to meet the CLs. ICES recommends that the probability of meeting or exceeding CLs for individual stocks should be greater than 95%.

Assessment and management area

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). Consideration of the level of exploitation of national stocks resulted in the advice for the Faroes fishery (both 1SW and MSW) being based upon all NEAC area stocks, and the advice for the West Greenland fishery being based upon the southern NEAC non-maturing 1SW stock only.

ICES (2010, 2011) previously emphasized the problem of basing a risk assessment and catch advice for Faroes fishery on management units comprising large numbers of river stocks. In providing catch advice at the age and stock complex levels for northern and southern NEAC, consideration needs to be given to the recent performance of the stocks within individual countries. At present, insufficient data are available to assess performance of individual stocks in all countries in the NEAC area. In some instances CLs are in the process of being developed (UK (Scotland) and Iceland). Alternatively, the probability that the country-specific PFAs have exceeded their SERs should be assessed for a recent time period (five years) and consideration given to simultaneously attaining the management objectives for the four large management units.

Sources of information

b) ICES. 2001. Report of the Working Group on North Atlantic Salmon. Aberdeen, 2–11 April 2001. ICES CM 2001/ACFM:15. 290 pp.

c) ICES. 2003. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 31 March–10 April 2003. ICES CM 2003/ACFM:19. 297 pp.

d) ICES. 2005. Report of the Working Group on North Atlantic Salmon. Nuuk, Greenland, 4–14 April 2005. ICES CM 2005/ACFM:17. 290 pp.

e) ICES. 2010. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 22–31 March 2010. ICES CM 2010/ACOM:09. 302 pp.

f) ICES. 2011. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 22–31 March 2011. ICES CM 2011/ACOM:06. 283 pp.

g) ICES. 2012. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 26 March–4 April 2012. ICES CM 2012/ACOM:09. 337 pp.

h) NASCO. 1998. North Atlantic Salmon Conservation Organization. Agreement on the adoption of a precautionary approach. Report of the 15th annual meeting of the Council. CNL(98)46. 4 pp.

i) NASCO. 1999. North Atlantic Salmon Conservation Organization. Action plan for the application of the precautionary approach. CNL(99)48. 14 pp.

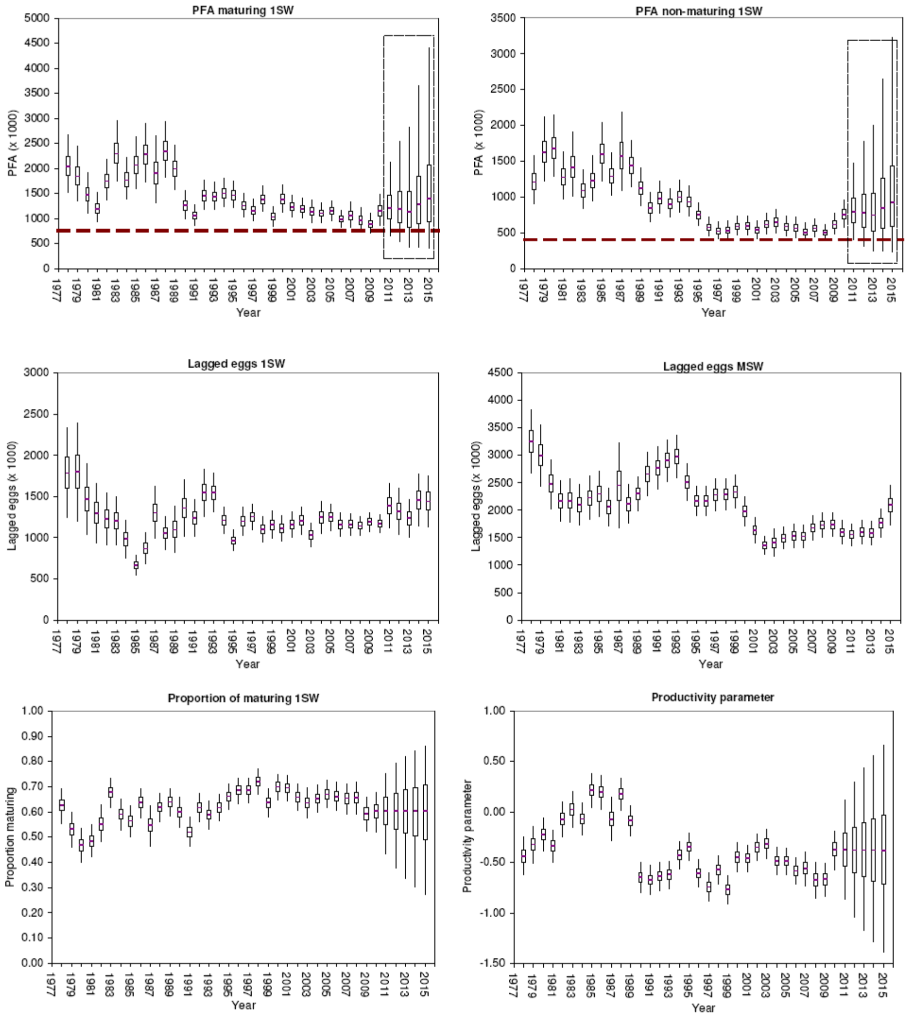

Figure 10.2.1 Southern NEAC PFA for maturing 1SW and non-maturing 1SW fish, lagged eggs from 1SW and MSW, proportion 1SW maturing, and productivity (in logarithmic scale, i.e. logarithm of PFA per lagged egg), for PFA years 1978 to 2015. The last five years (2011 to 2015) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values.

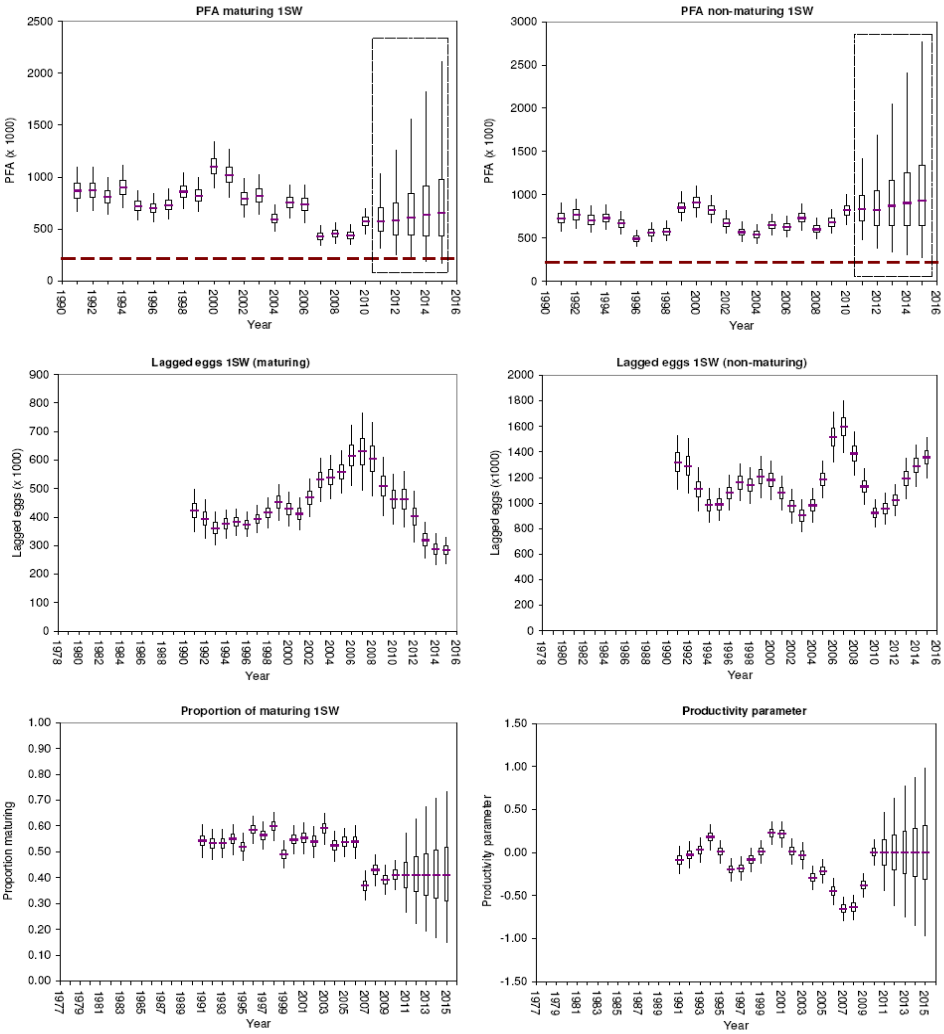

Figure 10.2.2 Northern **NEAC PFA for maturing 1SW and non-maturing 1SW fish, lagged eggs from 1SW and MSW, proportion 1SW maturing, and productivity (in logarithmic scale, i.e. logarithm of PFA per lagged egg), for PFA years 1991 to 2015. The last five years (2011 to 2015) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values.**

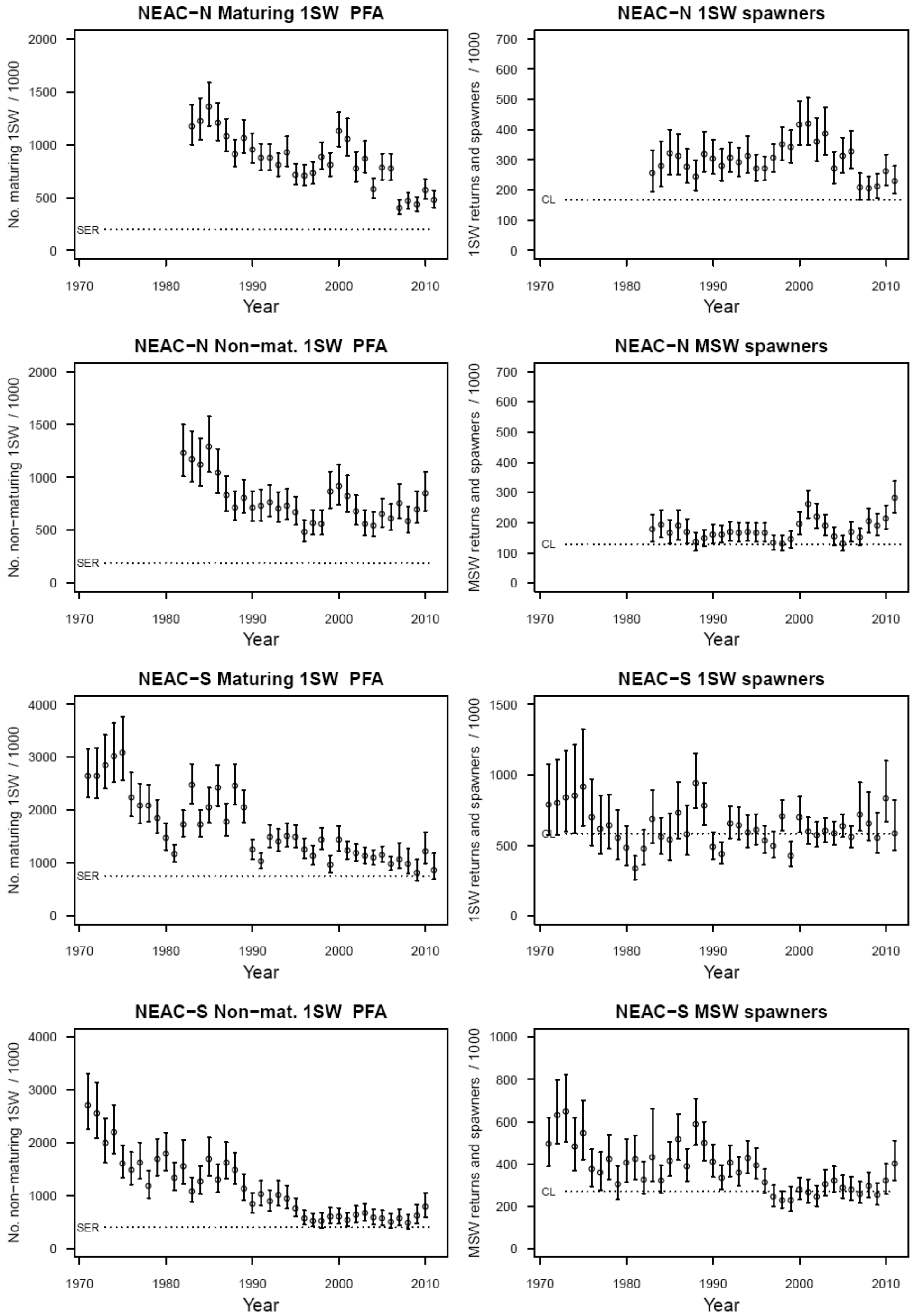

Figure 10.2.3 Estimated PFA (recruits; left panels) and spawning escapement (right panels), with 95% confidence limits, for maturing 1SW (1SW) and non-maturing 1SW (MSW) salmon in northern Europe (NEAC-N) and southern Europe (NEAC-S). **The dashed horizontal lines in the left panels are the age-specific SER values, and in the right panels the age-specific CL values.**

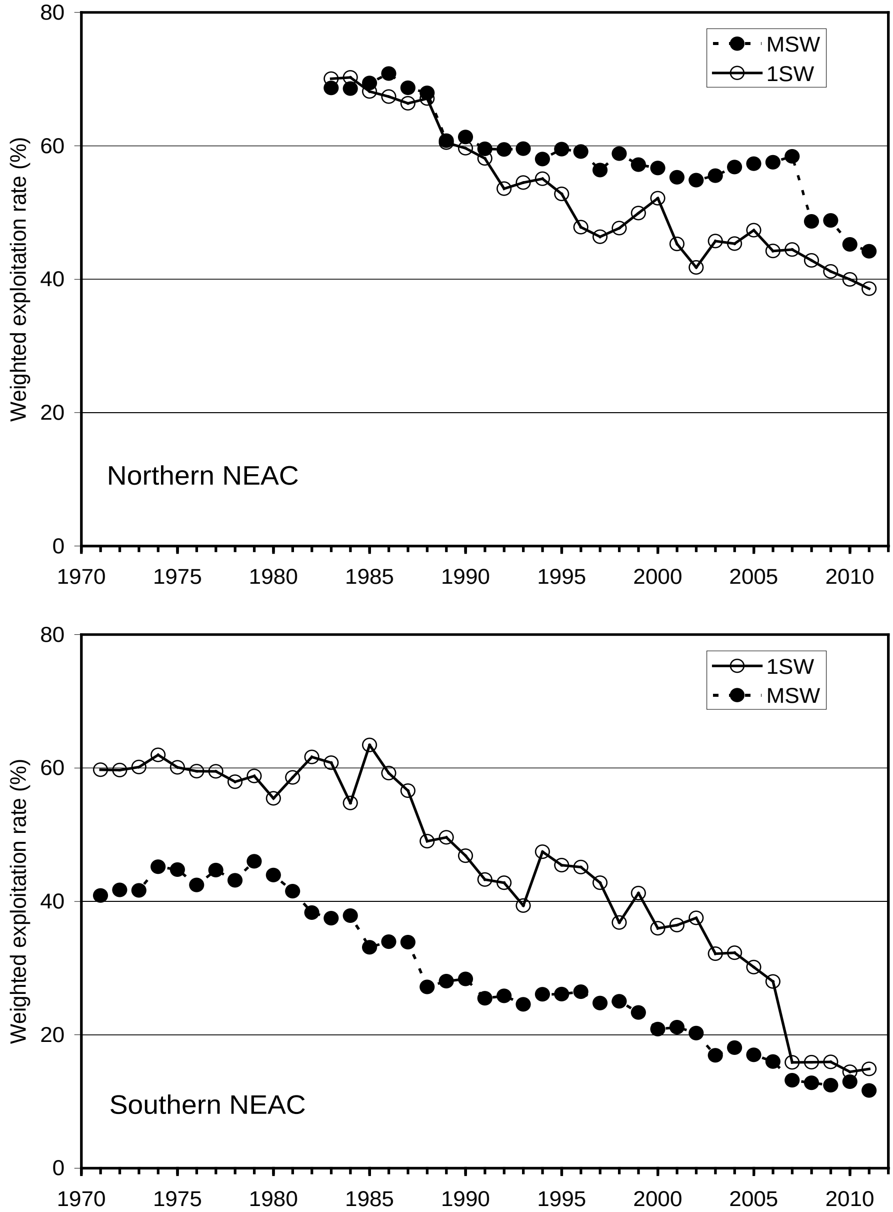

Figure 10.2.4 Exploitation rates of wild 1SW and MSW salmon in all fisheries in the northern NEAC area (upper panel) and the southern NEAC area (lower panel), from 1971 to 2011.

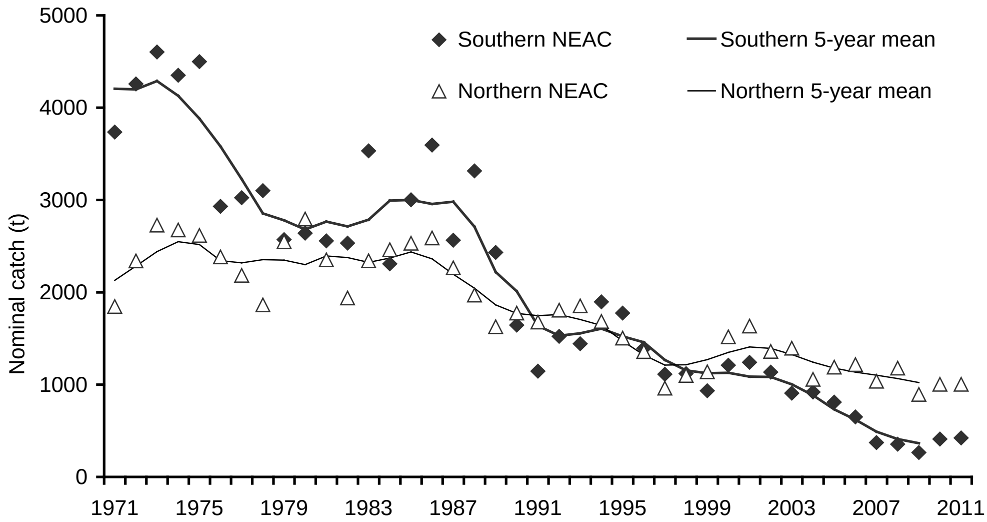

Figure 10.2.5 Nominal catch of salmon and 5-year running means in the southern NEAC and northern NEAC areas, 1971 to 2011.

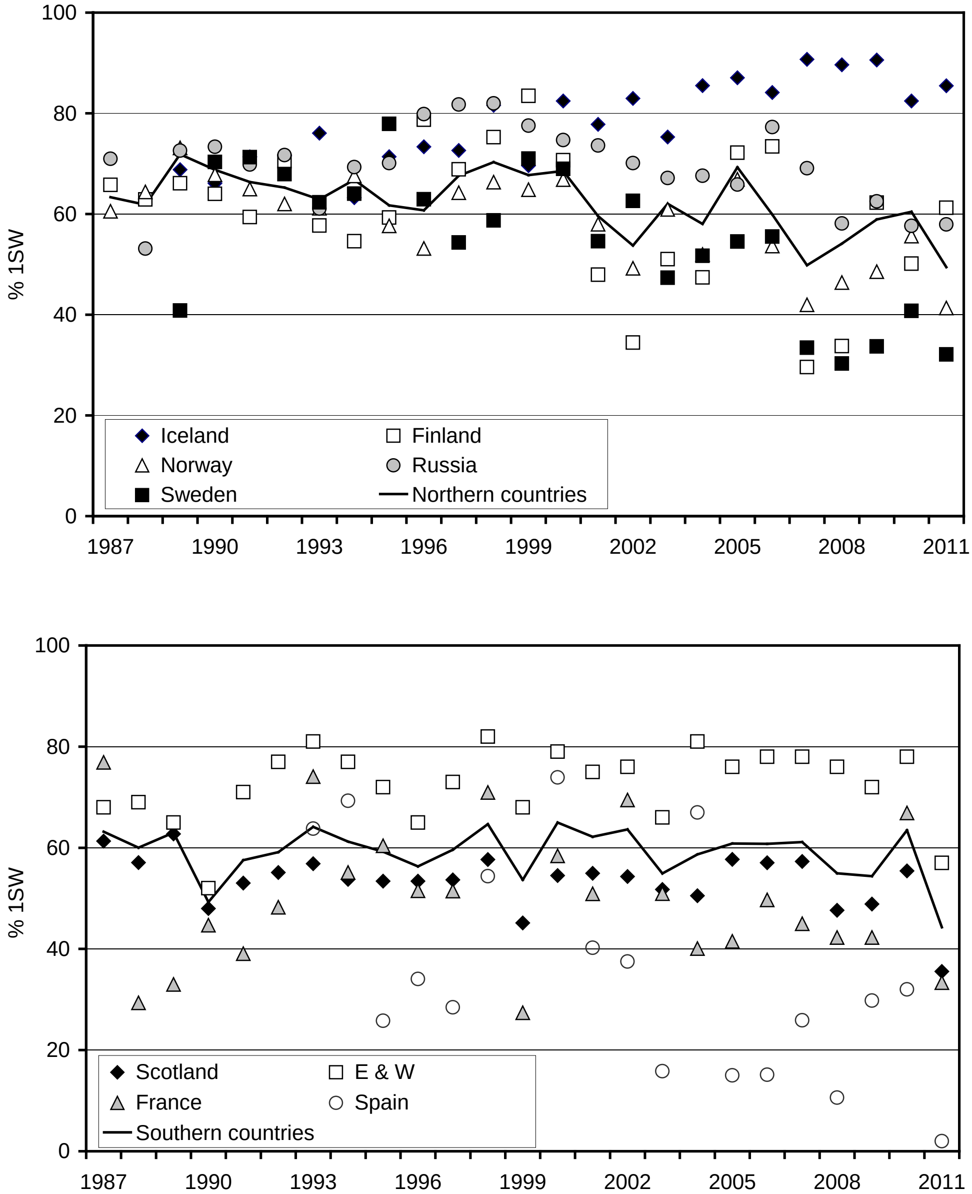

Figure 10.2.6 Percentage of 1SW salmon in the reported catch for northern NEAC countries (upper panel) and southern NEAC countries (lower panel), 1987 to 2011. Solid line denotes mean value from catches in all countries within the complex.

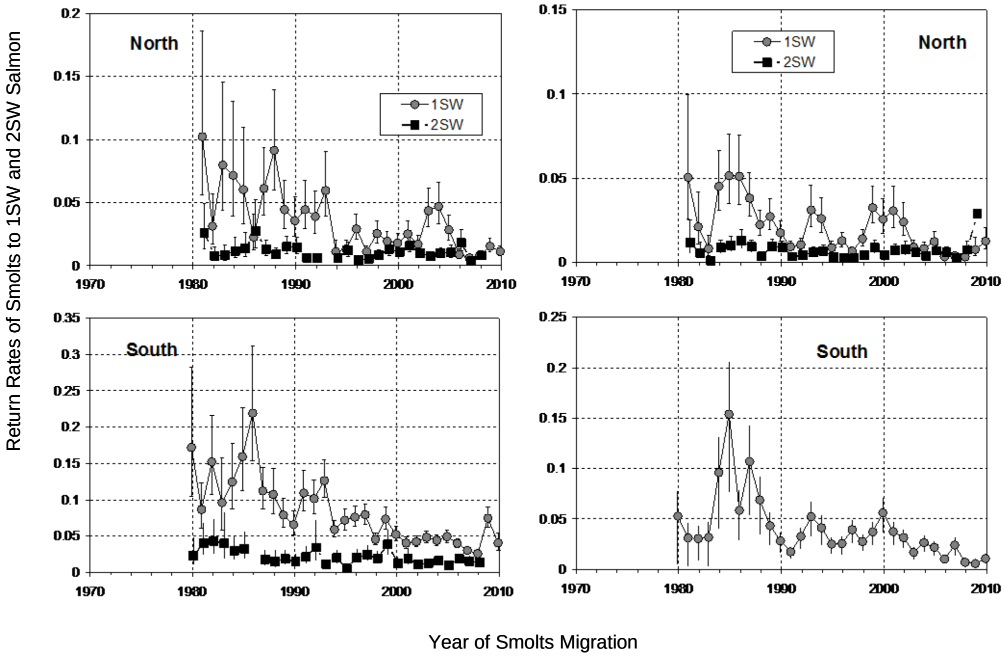

Figure 10.2.7 Median (one standard error bars) annual return rates (proportion) of wild (left panels) and hatchery origin (right panels) smolts to 1SW and 2SW adult salmon to northern and southern NEAC areas. The standardized values are derived from a general linear model analysis of rivers in a region. Note differences in vertical axes’ scales among panels.

Table 10.2.1 Probability (%) of 1SW and MSW salmon spawner abundance in northern and southern NEAC areas being at or above the CLs for different catch options in Faroes for the 2012/2013, 2013/2014 and 2014/2015 fishing seasons.

Catch options for 2012/13 season: (2013 PFA)	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW	All complexes
	0	98	100	81	87	71
	20	97	99	80	85	69
	40	97	99	80	82	66
	60	97	98	80	80	64
	80	97	97	80	77	61
	100	97	96	80	74	58
	120	97	95	80	71	55
	140	97	93	79	68	52
	160	97	91	79	65	49
	180	96	89	79	62	46
	200	96	86	79	59	43

Catch options for 2013/14 season: (2014 PFA)	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW	All complexes
	0	96	99	84	88	73
	20	96	99	84	86	71
	40	96	98	84	84	69
	60	96	97	84	82	67
	80	96	96	83	80	64
	100	96	95	83	78	62
	120	96	93	83	75	59
	140	95	92	83	73	56
	160	95	89	83	71	53
	180	95	87	83	68	50
	200	95	84	82	66	47

Catch options for 2014/15 season: (2015 PFA)	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW	All complexes
	0	95	99	84	88	72
	20	95	98	84	87	70
	40	95	97	84	85	68
	60	95	96	84	83	66
	80	95	95	84	81	64
	100	94	94	84	79	62
	120	94	92	84	77	59
	140	94	90	84	75	56
	160	94	88	83	73	54
	180	94	86	83	71	51
	200	93	84	83	69	48

Table 10.2.2 FWI spreadsheet at the stock complex level for NEAC. The conclusion of the spreadsheet in this illustration is irrelevant in the absence of data.

FWI NEAC	2013	Indicators suggest:	REASSESS

Indicators for Northern NEAC 1SW PFA

Reassess in year 2013?

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Outside 75% conf.lim. below	Outside 75% conf.lim. above	Outside 75% confidence limits below	Outside 75% confidence limits above
1	Returns all 1SW NO PFA est		23	0.536108	-73170.20	0.91	577600	194219.71	278751.74	0	0	Uninformative	Uninformative
2	Survivals W 1SW NO Imsa		28	0.000012	-4.14	0.42	577600	-1.59	7.56	0	0	Uninformative	Uninformative
3	Survivals H 1SW NO Imsa		29	0.000006	-1.11	0.26	577600	-0.75	5.47	0	0	Uninformative	Uninformative
4	Counts all NO Øyensåa (1SW)		13	0.002703	256.13	0.33	577600	708.37	2926.92	0	0	Uninformative	Uninformative
5	Counts all NO Nausta (1SW)		14	0.002486	-490.54	0.39	577600	2.84	1888.12	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Northern NEAC MSW PFA

Reassess in year 2013?

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Outside 75% conf.lim. below	Outside 75% conf.lim. above	Outside 75% conf.lim. below	Outside 75% conf.lim. above
1	PFA-MSW-CoastNorway		23	0.344433	-12251.11	0.71	824900	240360.77	303382.23	0	0	Uninformative	Uninformative
2	Orkla counts		17	0.013484	-3478.47	0.57	824900	5669.61	9619.69	0	0	Uninformative	Uninformative
3	Målselv counts		21	0.003871	14.46	0.22	824900	2126.89	4289.14	0	0	Uninformative	Uninformative
4	Counts all NO Nausta		14	0.004249	-1647.46	0.36	824900	865.86	2849.54	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC 1SW PFA

Reassess in year 2013?

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Outside 75% conf.lim. below	Outside 75% conf.lim. above	Outside 75% conf.lim. below	Outside 75% conf.lim. above
1	Ret. W 1SW UK(E&W) Itchen M		24	0.000330	-106.71	0.34	1187000	80.15	489.51	0	0	Uninformative	Uninformative
2	Ret. W 1SW UK(E&W) Frome M		39	0.000497	65.49	0.31	1187000	103.51	1206.63	0	0	Uninformative	Uninformative
3	Ret. W 1SW UK(Sc.) North Esk M		31	0.006129	5122.42	0.52	1187000	9092.67	15701.63	0	0	Uninformative	Uninformative
4	Ret. W 1SW UK(NI) Bush M		18	0.004420	-2435.32	0.61	1187000	1028.93	4593.43	0	0	Uninformative	Uninformative
5	Ret. Freshw 1SW UK(NI) Bush		37	0.000673	478.23	0.23	1187000	477.32	2078.00	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Indicators for Southern NEAC MSW PFA

Reassess in year 2013?

		Insert data from 2012 here	N reg	Slope	Intercept	r^2	Median PFA	12.5%ile	87.5%ile	Outside 75% conf.lim. below	Outside 75% conf.lim. above	Outside 75% conf.lim. below	Outside 75% conf.lim. above
1	Ret. W 2SW UK(Sc.) Baddoch NM		24	0.000034	3.23	0.45	781000	15.75	43.05	0	0	Uninformative	Uninformative
2	Ret. W 2SW UK(Sc.) North Esk NM		31	0.003676	4605.52	0.21	781000	4124.05	10828.88	0	0	Uninformative	Uninformative
3	Ret. W 1SW UK(Sc.) North Esk NM		30	0.006340	8457.39	0.35	781000	9640.38	17176.92	0	0	Uninformative	Uninformative
4	Ret. W MSW UK(E&W) Itchen NM		24	0.000289	-96.89	0.70	781000	60.20	198.12	0	0	Uninformative	Uninformative
5	Ret. W 1SW UK(E&W) Itchen NM		23	0.000426	-2.64	0.25	781000	108.40	551.24	0	0	Uninformative	Uninformative
6	Ret. W MSW UK(E&W) Frome NM		39	0.000737	104.10	0.44	781000	157.03	1202.63	0	0	Uninformative	Uninformative
7	Ret. W 1SW UK(E&W) Frome NM		38	0.000720	119.80	0.37	781000	151.71	1212.30	0	0	Uninformative	Uninformative
8	Catch W MSW Ice Ellidaar NM		40	0.000092	-22.38	0.55	781000	-8.28	107.53	0	0	Uninformative	Uninformative
9	Ret. Freshw 2SW UK(NI) Bush		36	0.000157	41.30	0.24	781000	25.26	302.32	0	0	Uninformative	Uninformative
10	Ret. W 1SW UK(NI) Bush NM		18	0.005612	-802.38	0.66	781000	1940.95	5220.71	0	0	Uninformative	Uninformative
11	Ret. W 1SW UK(E&W) Tamar NM		14	0.009158	-1853.33	0.44	781000	4034.89	6563.82	0	0	Uninformative	Uninformative
12	Count MSW UK(E&W) Lune NM		15	0.003815	-1088.59	0.36	781000	1290.37	2491.09	0	0	Uninformative	Uninformative
13	Count MSW UK(E&W) Fowey NM		15	0.000200	-45.65	0.24	781000	68.31	152.17	0	0	Uninformative	Uninformative
								Sum of scores		0	0	Indicators suggest that the PFA forecast is an overestimation. REASSESS	Indicators suggest that the PFA forecast is an underestimation. REASSESS

Table 10.2.3 Nominal catch of salmon in NEAC Area (in tonnes, round fresh weight), 1960 to 2011 (2011 figures are provisional).

Year	Southern countries	Northern countries	Faroes (1)	Other catches in international waters	Total Reported Catch	Unreported catches	
						NEAC Area (3)	International waters (2)
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	-	2495	946	-
2003	908	1394	0	-	2302	719	-
2004	919	1058	0	-	1977	575	-
2005	810	1189	0	-	1999	605	-
2006	651	1217	0	-	1868	604	-
2007	372	1036	0	-	1407	465	-
2008	354	1179	0	-	1533	433	-
2009	264	893	0	-	1158	317	-
2010	410	1003	0	-	1414	357	-
2011	422	1003	0	-	1424	382	
Means							
2006-2010	410	1065	0	-	1476	435	-
2001-2010	707	1196	0	-	1903	611	-

1. Since 1991, fishing carried out at the Faroes has only been for research purposes.
2. Estimates refer to season ending in given year.
3. No unreported catch estimate available for Russia since 2008.

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Table 10.2.4 **Estimated-pre fishery abundance (median values) of maturing 1SW salmon (potential 1SW returns) by NEAC country or region and year.**

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		
						2.5%	50.0%	97.5%							2.5%	50.0%	97.5%	2.5%	50.0%	97.5%
1971	33017	11939		NA	22965				64039	79531	1336003	127529	231590	785565	2246686	**2642715**	3159368			
1972	51763	10947		152309	18226				127107	64473	1432179	110895	202412	684566	2220061	**2642770**	3168941			
1973	46804	13125		223378	22452				78009	69126	1557038	128619	177299	820748	2402318	**2851656**	3442788			
1974	92965	13122		221482	31782				36422	49079	1777789	158786	193745	781478	2525595	**3010439**	3648429			
1975	64817	15969		339942	34049				72373	76546	1964053	161101	158652	637576	2573847	**3085977**	3762824			
1976	44589	16087		237641	19326				66541	60170	1332046	107398	110311	548416	1873699	**2237184**	2712415			
1977	22849	22295		151123	9110				51199	61797	1147060	120318	108622	570748	1743215	**2069867**	2489086			
1978	31059	22689		153015	10473				52899	80922	1006432	134923	141573	656071	1777096	**2084772**	2475250			
1979	36307	21700		212000	11020				59799	74952	924715	127534	99649	539589	1561459	**1842132**	2198122			
1980	16343	3293		151585	14365				125956	33956	702747	119136	126362	338403	1244310	**1462537**	1740303			
1981	25251	16963		127276	26247				100767	43759	373931	125506	99879	420132	1024824	**1175958**	1345236			
1982	7362	7840		110717	22635				61848	45011	768684	106450	143042	597902	1503486	**1733308**	2008655			
1983	36288	11509	896506	184977	30513	994664	**1163910**	1367963	66728	56970	1357452	153875	201293	614308	2120385	**2463408**	2893361	3193609	**3631612**	4143157
1984	40640	4182	928727	196330	41359	1037407	**1215165**	1439771	108197	34933	710441	131906	78932	645048	1495274	**1723724**	1990509	2612312	**2942223**	3325476
1985	61316	28889	948898	270595	49287	1176129	**1363916**	1589674	40593	56795	1180526	132313	102592	532895	1762742	**2056417**	2425397	3023275	**3425540**	3899312
1986	55835	35926	824055	230511	51929	1043200	**1203925**	1397222	61869	93210	1323097	150256	114970	660633	2078965	**2427963**	2858717	3199542	**3634831**	4157813
1987	71288	21162	692349	245332	41981	933436	**1078773**	1247266	109797	57971	851365	156116	62688	509458	1512435	**1782332**	2124455	2515567	**2863831**	3276223
1988	34093	30649	636773	170260	35472	791088	**909142**	1047775	38352	103850	1155735	212610	148025	773442	2110128	**2449397**	2863115	2964469	**3360598**	3839387
1989	79715	16476	701048	252260	11685	923233	**1063926**	1240282	20868	58099	827847	140298	142433	844915	1778609	**2050817**	2374957	2763195	**3116975**	3528759
1990	75346	12316	627570	208368	25155	823989	**952083**	1101769	34304	53338	517699	101511	117518	405702	1075839	**1244086**	1441830	1947727	**2199730**	2477978
1991	91797	17951	547161	178294	30088	752199	**868607**	1006172	25076	59092	369646	98791	65696	402359	896240	**1032013**	1191626	1693219	**1902071**	2143710
1992	121549	33803	460298	218528	32890	761214	**872649**	1000421	45541	67504	536435	101745	132895	585497	1292046	**1487662**	1718196	2100553	**2361442**	2651311
1993	85574	27769	462991	188710	35383	704454	**803860**	918061	65594	66226	436650	139722	155552	525296	1232169	**1411419**	1633064	1978499	**2218019**	2498937
1994	33969	8851	624670	222796	26783	793466	**921898**	1079421	50700	54335	559006	154778	106955	560248	1306760	**1506405**	1743568	2151727	**2431150**	2745942
1995	33458	25502	408452	200046	39262	620643	**710266**	818288	17221	74119	622589	118860	99042	549666	1296228	**1489834**	1727660	1957933	**2203555**	2490148
1996	77591	13649	311652	272170	24388	613840	**703325**	811029	21134	63603	582110	85561	102445	394195	1087101	**1259488**	1464441	1737367	**1964662**	2226534
1997	66227	18594	359292	267368	11008	630783	**726169**	838251	10736	46564	579293	77816	121475	283729	969389	**1128051**	1322634	1644462	**1856909**	2108231
1998	76428	31756	468021	292231	9777	768464	**883656**	1019374	21045	63531	608334	86819	264510	386717	1253294	**1442384**	1674795	2068309	**2327773**	2631096
1999	109415	16185	434397	226204	14390	702637	**804926**	923538	6995	51895	565934	70908	68843	191149	817391	**962393**	1143232	1564307	**1769526**	2011304
2000	115243	16967	717225	247272	28563	979218	**1130060**	1304006	18131	45982	786874	107069	99914	371185	1230462	**1438265**	1697258	2269351	**2575130**	2924131
2001	52106	15412	618665	333197	18663	888755	**1046605**	1243983	15749	41249	627581	94616	78950	365299	1074897	**1233134**	1415642	2022238	**2284743**	2582503
2002	36491	26644	378661	303750	19103	650853	**771945**	930497	35281	51397	546825	88899	156644	294083	1038794	**1187228**	1360564	1740044	**1962554**	2228358
2003	43286	14114	524011	269848	11547	738990	**869096**	1033879	23442	61485	535803	63136	102174	335511	995334	**1133924**	1298456	1778983	**2006098**	2267396
2004	16753	38168	317719	189929	10049	493365	**577567**	682639	28375	61776	395390	106820	91408	398839	961214	**1096141**	1253134	1489227	**1676376**	1885535
2005	42493	33911	471031	215702	8506	667171	**778790**	916506	18126	91081	394263	89818	116103	431818	1016676	**1153303**	1307737	1724138	**1934578**	2169722
2006	80495	35985	381014	260624	10322	661843	**774744**	916925	25739	64092	301910	83584	73971	419680	862071	**981868**	1122377	1565185	**1756716**	1985668
2007	14983	26532	213523	140559	4924	344446	**403529**	477515	20253	73577	343823	79107	120509	412035	898161	**1073366**	1383858	1273570	**1483719**	1814720
2008	15399	24306	267104	146322	6333	394666	**463601**	548360	19853	88844	338369	76895	71570	354392	804049	**977270**	1280732	1236602	**1447654**	1769649
2009	31523	39257	214145	137704	6684	370734	**432470**	506550	7207	100668	282800	47605	54594	304099	670357	**817778**	1067970	1074081	**1254647**	1529087
2010	29385	31210	317984	179407	11147	487920	**572955**	672935	24189	103439	359413	95151	50284	554347	992322	**1225349**	1594190	1528303	**1804849**	2198409
2011	35803	26922	223085	179083	9375	405861	**477454**	564031	16995	72796	340567	59165	41715	312454	697491	**867503**	1186267	1140947	**1351895**	1691318
10yr Av.	34661	29705	330828	202293	9799	521585	612215	724984	21946	76916	383916	79018	87897	381726	893647	1051373	1285528	1455108	1667909	1953986

ii)

Table 10.2.5 **Estimated pre-fishery abundance (median values) of non-maturing 1SW salmon (potential MSW returns) by NEAC country or region and year.**

Year	Northern NEAC								Southern NEAC									NEAC Area		
	Finland	Iceland	Norway	Russia	Sweden	Total			France	Iceland	Ireland	UK(EW)	UK(NI)	UK(Scot)	Total			Total		
		N&E				2.5%	50.0%	97.5%		S&W					2.5%	50.0%	97.5%	2.5%	50.0%	97.5%
1971	63137	26034		265888	7303				55559	63444	396707	388650	31912	1725628	2216230	**2678268**	3250411			
1972	74959	24345		421923	10262				36017	57185	392601	291937	27861	1715313	2072861	**2535279**	3129730			
1973	111504	22843		390276	6917				19423	49157	403953	206126	30412	1198672	1569859	**1916110**	2374454			
1974	124904	25411		427122	5760				30674	52569	453466	266735	25080	1335999	1770476	**2177685**	2692288			
1975	102226	20878		361428	5926				26941	45219	338590	176731	17391	960383	1309100	**1574554**	1907449			
1976	62443	28733		250259	4127				18612	44057	277072	176300	17155	906217	1181728	**1448739**	1786526			
1977	39935	36826		212800	3307				18878	56789	243101	151591	22320	1076175	1274728	**1577828**	1957916			
1978	42806	24526		199144	6383				18735	36534	215762	84960	15695	810518	960459	**1187113**	1481494			
1979	44620	34544		344162	13016				35580	51699	255085	221693	19800	1040261	1334617	**1633434**	2008613			
1980	49130	13217		250099	12687				25955	35373	208863	291138	15540	1118558	1394577	**1708696**	2089524			
1981	63417	14847		225773	16387				17779	25373	141053	136422	22503	926374	1044301	**1275568**	1559830			
1982	69796	11302	876602	276258	12137	1026289	**1249859**	1524521	17681	41017	297026	139550	31518	937184	1178370	**1503390**	1990184	2258690	**2764175**	3413023
1983	65972	13936	836073	254336	10929	970723	**1183517**	1451017	23409	34571	150283	102023	12391	724655	856199	**1051601**	1302315	1862691	**2238186**	2694368
1984	51483	9231	787568	274983	7758	930343	**1134453**	1385839	17568	25206	160601	140211	16073	861498	991668	**1226106**	1526465	1962990	**2359084**	2853761
1985	45289	24220	949184	281557	9033	1073741	**1311170**	1602414	21257	21398	199934	201491	18101	1172056	1330625	**1642480**	2041856	2451160	**2960571**	3572027
1986	56258	24970	737477	218168	13207	865588	**1054184**	1287207	12363	18997	229618	161060	9237	790516	1004117	**1227638**	1514742	1905845	**2283504**	2743747
1987	36039	16011	577757	198350	10252	688857	**839801**	1024617	28240	21213	173094	202167	26075	1147099	1296797	**1606764**	1992005	2023426	**2450239**	2963250
1988	40945	13780	449366	198464	23546	600780	**728273**	881483	16241	19067	167450	171050	20787	1044344	1176391	**1445067**	1775249	1805161	**2176447**	2617282
1989	51364	14296	494640	237846	15314	667799	**814867**	990937	12762	18770	77252	182860	18877	800932	896935	**1116639**	1392836	1594664	**1931685**	2342275
1990	61928	9902	403124	224587	16037	587767	**718054**	871537	10964	18509	101582	79120	9702	592984	657622	**815331**	1020081	1267636	**1534343**	1857932
1991	66014	14511	418684	206515	19527	594755	**727958**	889816	14880	20786	85206	67884	22200	807193	817615	**1021561**	1279683	1441400	**1751216**	2125873
1992	76066	16353	399786	242552	26226	628164	**763819**	929055	7369	10251	79260	68634	52315	653264	703377	**877856**	1104778	1356382	**1643459**	1996381
1993	63193	13886	391704	219264	19220	582687	**710537**	866349	12895	16547	115478	86328	18459	753249	800296	**1006674**	1272001	1408995	**1718941**	2098378
1994	39069	9713	422261	247125	13841	601963	**733799**	897173	6162	18671	111515	87845	15586	699387	748330	**942987**	1194040	1377859	**1679067**	2046968
1995	34432	12690	418589	187498	17213	552690	**672540**	823273	11275	12034	77308	89386	17155	543388	601611	**754865**	955112	1178716	**1429559**	1743588
1996	50029	7075	266370	147656	10824	396182	**484990**	594355	5919	13408	96507	56051	21370	372293	453194	**571300**	725985	868688	**1058586**	1292724
1997	42112	10301	319865	181164	7945	461655	**563474**	691359	4903	8281	55577	36900	29444	387932	420733	**526373**	663272	901355	**1090465**	1323907
1998	39586	11827	340127	162281	6790	457407	**561917**	692737	10291	16153	85646	78023	13288	297464	394371	**516987**	682811	875319	**1080744**	1336906
1999	87459	6932	471368	280406	14840	708764	**863840**	1056059	7181	4391	107197	83128	17713	380034	478922	**606880**	773447	1216501	**1472826**	1790981
2000	126622	7983	556031	200056	17977	741296	**911670**	1124097	8689	7712	97737	91725	13056	370884	468621	**600333**	771299	1241623	**1516069**	1853560
2001	101401	7531	481478	218080	13169	670742	**823924**	1017287	7907	8377	111303	81296	15532	299582	419150	**533399**	682042	1115475	**1359474**	1659891
2002	71722	7931	426679	153415	15095	551599	**677185**	831896	11396	13334	116807	97212	10112	374167	495636	**634188**	811969	1072266	**1312332**	1602425
2003	34446	7748	386156	117685	10849	452607	**557338**	690979	20746	10784	63723	74806	9067	477166	524718	**665683**	850814	1001779	**1224574**	1505026
2004	26695	9649	356095	141087	8262	441813	**543228**	667362	12847	9517	82939	85088	11480	377667	459900	**586982**	754255	922864	**1132332**	1389929
2005	46779	9279	449967	134560	8279	532268	**650437**	799586	12954	7884	59936	72329	7329	391740	439965	**563411**	727301	995562	**1214405**	1488140
2006	66414	8908	382729	138323	11381	499214	**608855**	747101	12241	4864	27341	69151	10060	376616	393335	**507964**	656917	915675	**1118658**	1373612
2007	63017	11435	442276	220699	16258	613096	**757408**	933767	13583	5579	40740	74559	6117	422685	441600	**572062**	743534	1084316	**1331222**	1631691
2008	29517	9154	346468	185341	14693	477572	**588566**	727442	7078	8598	45501	56870	7949	351461	371811	**485391**	634434	873059	**1074610**	1324231
2009	46536	13131	381348	238634	18226	565949	**700591**	867517	5944	17811	29442	83398	7335	470439	474597	**624157**	818303	1073874	**1326996**	1640385
2010	36648	14943	531213	238093	23481	683744	**846905**	1054257	15570	6695	30794	133893	18370	567824	593701	**786246**	1056289	1317582	**1638495**	2041292
10yr Av.	52318	9971	418441	178592	13969	548860	675444	833719	12027	9344	60852	82860	10335	410935	461441	595948	773586	1037245	1273310	1565662

Table 10.2.6 Probability (%) that the forecast PFA for the components of the southern NEAC and northern NEAC stock complexes will meet or exceed the spawner escapement reserve (SER) by age group, in 2011 to 2015.

Southern NEAC		Maturing	Non-maturing
	SER	758 477	406 436
Year			
2011		95	98
2012		87	93
2013		81	87
2014		84	89
2015		84	88

Northern NEAC		Maturing	Non-maturing
	SER	212 986	218 259
Year			
2011		100	100
2012		99	100
2013		98	100
2014		96	99
2015		95	99

ECOREGION **North Atlantic**

STOCK **Atlantic salmon from North America**

Advice for 2012 to 2015

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

Management advice in the form of catch options is only provided for the non-maturing 1SW and maturing 2SW components, as the maturing 1SW component is not fished outside of home waters.

As there is less than 75% probability that the numbers of 2SW salmon returning to the six regions of North America will be above the management objectives (conservation limits for the four northern areas, rebuilding objectives for the two southern areas) simultaneously, there are no mixed-stock fisheries catch options on 1SW non-maturing and 2SW salmon in North America in 2012 to 2015 (Table 10.3.1).

The Framework of Indicators (FWI; ICES, 2009) was updated in support of the multi-year catch advice and the potential approval of multi-year regulatory measures (Table 10.3.2). The FWI can be applied at the beginning of 2013, with the returns or return rate data for 2012, to evaluate the appropriateness of the 2013 advice, and again at the beginning of 2014, with the returns or return rate data for 2013, to evaluate the appropriateness of the 2014 advice.

Stock status

Stock status is presented for six regions and overall for North America (Figure 10.3.1). Recruitment (pre-fishery abundance (PFA), defined as the number of maturing and non-maturing 1SW on 1 August of the second summer at sea) estimates suggest continued low abundance of North American salmon (Figure 10.3.2). The total PFA in the northwest Atlantic has oscillated around a generally declining trend since the 1970s, with a period of persistent low abundance since the early 1990s. The maturing 1SW salmon PFA in 2011 increased 37% from the 2010 value and ranked 10th of the 41-year time-series. The non-maturing 1SW salmon PFA estimate for 2010 increased by 100% over the 2009 estimate, but ranked 23rd of the 40-year time-series.

In 2011, 2SW median spawner estimates for Newfoundland and Gulf were above the conservation limits (CL), for Quebec marginally below, and for Labrador, Scotia–Fundy, USA, and the North American Commission overall below CLs (Figure 10.3.3). Particularly large deficits are noted in the Scotia–Fundy and USA regions. Egg depositions by all sea-ages combined in 2011 exceeded or equaled the river-specific CLs in 45 of the 74 assessed rivers (61%), an improvement on the 44% of the 71 rivers assessed in 2010. Egg depositions in 2011 were less than 50% of CLs in 15 other rivers (Figure 10.3.4).

Exploitation rates of both small salmon (mostly 1SW maturing) and large salmon (all other sea age groups) fluctuated annually but remained relatively stable until 1984 and 1992, when they declined sharply with the introduction of the restrictive management measures (Figure 10.3.5). Declines continued in the 1990s. In the last few years, exploitation rates have remained at the lowest in the time-series, averaging 15%.

Despite major changes in fisheries management around 18 to 25 years ago, and increasingly more restrictive fisheries measures since then, returns have remained near historical lows and many populations are currently threatened with extirpation. The continued low abundance of salmon stocks across North America, with a slight upturn observed in 2011, despite significant fishery reductions, further strengthens the conclusions that factors other than fisheries, acting both in freshwater and at sea, are constraining production.

Management plans

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

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northwest Atlantic they range from the Connecticut River (USA, 41.6°N) northward to 58.8°N (Quebec, Canada). Juveniles emigrate to the ocean at ages of one to eight years (dependent on latitude) and generally return after one or two years at sea. Long distance migrations to ocean feeding grounds are known to take place, with adult salmon from both the North American and Northeast Atlantic stocks migrating to West Greenland to feed in their second summer and fall 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 predator fields of salmon at sea are considered to be the main contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

Three groups exploited salmon in Canada: Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. The provisional harvest of salmon by all users in 2011 was 179 t (Table 10.3.3). The dramatic decline in harvested tonnage since 1988 is in large part the result of the reductions in commercial fisheries effort, with closure of the insular Newfoundland commercial fishery in 1992, closure of the Labrador commercial fishery in 1998, and closure of the Quebec commercial fishery in 2000 (Figure 10.3.6). All commercial fisheries for Atlantic salmon remained closed in Canada in 2011 and the catch therefore was zero. The total reported harvests for the Aboriginal peoples' food fisheries was 70.4 t, 2.1 t for residents fishing for food in Labrador, and 106.2 t (about 54 200 small and large salmon) were harvested in the recreational fisheries. In 2011, approximately 77 600 salmon (about 41 200 small and 36 400 large) were caught and released by recreational fishers, representing about 59% of the total number caught (including retained fish). France (Islands of Saint-Pierre and Miquelon) reported a total harvest of 3.8 t in the professional and recreational fisheries in 2011 (Table 10.3.3). There are no commercial or recreational fisheries for Atlantic salmon in USA (Table 10.3.3).

	Canada				St Pierre & Miquelon	USA
	Commer-cial	Aboriginal	Labrador resident	Recrea-tional		
2011 catch (t)	0	70.4	2.1	106.2	3.8	0

% of NAC total	-	39	1	58	2	-

Effects of the fisheries on the ecosystem

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

Quality considerations

Uncertainties in input variables to the stock status and stock forecast models are incorporated in the assessment. Because of absence of catch data from some regions in Canada, the values were estimated based on historical exploitation rates. Estimates of abundance of adult salmon in some areas, in particular Labrador, are based on a small number of counting facilities raised to a large production area.

Scientific basis

Assessments are carried out using common input variables across regions. Run-reconstruction models and Bayesian forecasts are performed, taking into account uncertainties in the data.

Supporting information: WGNAS.

ECOREGION **North Atlantic**

STOCK **Atlantic salmon from North America**

Reference points

Conservation limits for 2SW salmon to North America total 152 548 fish. Management objectives for Scotia–Fundy and USA are based on an increase of 25% in returns of 2SW salmon from the mean return in the base years 1992 to 1996.

COUNTRY AND COMISSION AREA	STOCK AREA	2SW CONSERVATION LIMIT (NUMBER OF FISH)	MANAGEMENT OBJECTIVE (NUMBER OF FISH)
	Labrador	34 746	34 746
	Newfoundland	4022	4022
	Gulf of St. Lawrence	30 430	30 430
	Quebec	29 446	29 446
	Scotia–Fundy	24 705	10 976
Canada Total		123 349	
USA		29 199	2 548
North American Commission		152 548	

Outlook for 2012 to 2015

Pre-fishery abundance (PFA, recruitment of non-maturing 1SW salmon at 1 August in the second summer at sea) forecasts are derived from abundance of lagged spawners and a productivity parameter by region for the six regions of North America (Figure 10.3.1).

The estimated productivity (PFA divided by lagged spawners) in 2010 increased to the highest value since 1991, but is still below the peak productivity in 1980 (Figure 10.3.7). Productivity by region is displayed in Figure 10.3.8. In all regions, the productivity over the past decade remains low compared to values estimated during 1978 to 1990.

Following on the estimated improvements in productivity for 2010 and sustained or improved estimates of lagged spawners in the 2011 to 2014 PFA years, the medians of the PFAs for North America overall and for the six regions are predicted to remain high or to increase over the 2011 to 2014 period (Figures 10.3.7 and 10.3.9). The PFA forecasts have very high uncertainty and the uncertainties increase as the forecasts move farther forward in time.

MSY approach

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 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, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (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 the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats.

In the absence of any fisheries in 2012–2015, there is less than 75% probability that the numbers of 2SW salmon returning to the six regions of North America will be above the management objectives (conservation limits for the four northern areas, rebuilding objectives for the two southern areas) simultaneously (Table 10.3.1). Therefore, there are no mixed-stock fisheries catch options on 1SW non-maturing and 2SW salmon in North America in 2012 to 2015.

Additional considerations

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

Most catches (92%) in North America now take place in rivers or in estuaries. Fisheries are principally managed on a river-by-river basis and, in areas where retention of large salmon is allowed, it is closely controlled. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located in bays, generally inside the headlands. The coastal fishery in St. Pierre & Miquelon (SPM) is a mixed-stock fishery which catches salmon from stocks in Canada and USA; there are no salmon producing rivers in SPM.

It would be desirable to resolve the outstanding issues regarding stock origin of the salmon caught in the estuarine and coastal fisheries at Labrador and in SPM. Genetic analysis techniques offer the opportunity to identify the origin of harvested individuals at varying levels of origin and can provide the information necessary to evaluate the effect that these mixed-stock fisheries have on the contributing populations. Sampling of these fisheries catches and the development of appropriate baselines that represent all populations subjected to the fisheries is occurring and the results should be available in the near future.

The returns of 2SW fish in 2011 increased in all six geographic areas relative to 2010 (range 16 to 218%) and the previous 5-year mean (19 to 184%) (Figure 10.3.3). Returns of 1SW salmon in 2011 relative to 2010 increased in Labrador (196%), Quebec (37%), and USA (106%), decreased in Gulf (6%) and Scotia–Fundy (36%), and remained the same in Newfoundland (Figure 10.3.10). Returns of 1SW salmon were also above (18 to 132%) the previous 5-year mean (2006 to 2010) in all regions except for Scotia–Fundy (10% decrease).

The rank of the estimated returns in the 1971 to 2011 time-series and the proportions of the 2SW CL achieved in 2011 for six regions in North America are shown below:

Region	Rank of 2011 returns in 1971 to 2011, (41=lowest)		Rank of 2011 returns in 2002 to 2011 (10=lowest)		Median estimate of 2SW spawners as percentage of Conservation Limit
	1SW	2SW	1SW	2SW	(%)
Labrador	1	1	1	1	81
Newfoundland	3	8	2	1	133
Québec	8	27	1	1	96
Gulf	17	3	3	1	204
Scotia–Fundy	34	27	5	1	18
USA	5	12	1	1	13

Scientific basis

Data and methods

The returns for individual river systems and management areas for both sea-age groups were derived from a variety of methods. These methods included counts of salmon at monitoring facilities, population estimates from mark–recapture studies, and applying angling and commercial catch statistics, angling exploitation rates, and measurements of freshwater habitat. The 2SW component of the large returns was determined using the sea-age composition of one or more indicator stocks. Returns of small (1SW), large, and 2SW salmon (a subset of large) to each region were originally estimated by the methods and variables developed by Rago *et al.* (1993) and reported by ICES (1993).

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

Estimates and forecasts of the pre-fishery abundance for the non-maturing 1SW salmon (PFA) are derived using a Bayesian framework that incorporates the estimates of lagged 2SW 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. The model considered regionally disaggregated lagged spawners and returns of 2SW salmon for the six regions of North America. Annually varying and regionally specific PFA estimates are assumed to be proportional to lagged spawners for that year and region. The proportionality coefficient between lagged spawners and PFA, referred to as the productivity, for each region is modelled dynamically as a random walk (in logarithmic scale).

Uncertainties in assessments and forecasts

To date, 1082 Atlantic salmon rivers have been tabulated in eastern Canada and 21 rivers in eastern USA, where salmon are or have been present within the last half century. Conservation requirements in terms of eggs have been defined for 45% (485) of the 1082 rivers in Canada. For over 59% of the rivers with defined conservation requirements, these are less than 1 million eggs, which translates roughly into 200 to 300 spawners, depending upon life history type. Collectively, 91% of the rivers have conservation requirements of less than five million eggs. Assessments were reported for 74 of these rivers in 2011.

Recreational catch statistics for Atlantic salmon are not collected regularly in Canada and there is no mechanism in place that requires anglers to report their catch statis-tics, except in Quebec. The reliability of recreational catch statistics could be improved in all areas of Canada.

The unreported catch estimate for Canada is complete and is estimated at 29 t in 2011, mostly from illegal retentions in fisheries directed at salmon.

Comparison with previous assessment and catch options

The NASCO Framework of Indicators of North American stocks for 2011 did not indicate the need for a revised analysis of catch options. Therefore, no assessment and no new management advice was provided for 2011. The assessment was updated this year using returns data to 2011 and the stock status was consistent with the previous assessment (ICES, 2009). The predicted values of the PFA for 2009 and 2010 were very close to the realized values based on this year's assessment, and there is little change (+17%) in the updated prediction for the 2011 PFA from the 2009 assessment to the present assessment. The previous advice provided by ICES (in 2009) indicated that there were no mixed-stock fishery catch options on the 1SW non-maturing salmon component for the 2009 to 2011 PFA years, and this year's assessment confirms that advice.

Assessment and management area

The advice for the North America Commission is based upon the objectives defined by management in six geographic areas of North America (Figure 10.3.1).

Sources of information

ICES. 1993. Report of the North Atlantic Salmon Working Group. Copenhagen, 5–12 March 1993. ICES CM 1993/Assess:10.

ICES. 2003. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 31 March–10 April 2003. ICES CM 2003/ACFM:19. 297 pp.

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NASCO. 1998. North Atlantic Salmon Conservation Organization. Agreement on the adoption of a precautionary approach. Report of the 15th annual meeting of the Council. CNL(98)46. 4 pp.

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Rago, P. J., Reddin, D. G., Porter, T. R., Meerburg, D. J., Friedland, K. D., and Potter, E. C. E. 1993. A continental run-reconstruction model for the non-maturing component of North American Atlantic salmon: analysis of fisheries in Greenland and Newfoundland Labrador, 1974–1991. ICES CM 1993/M:25.

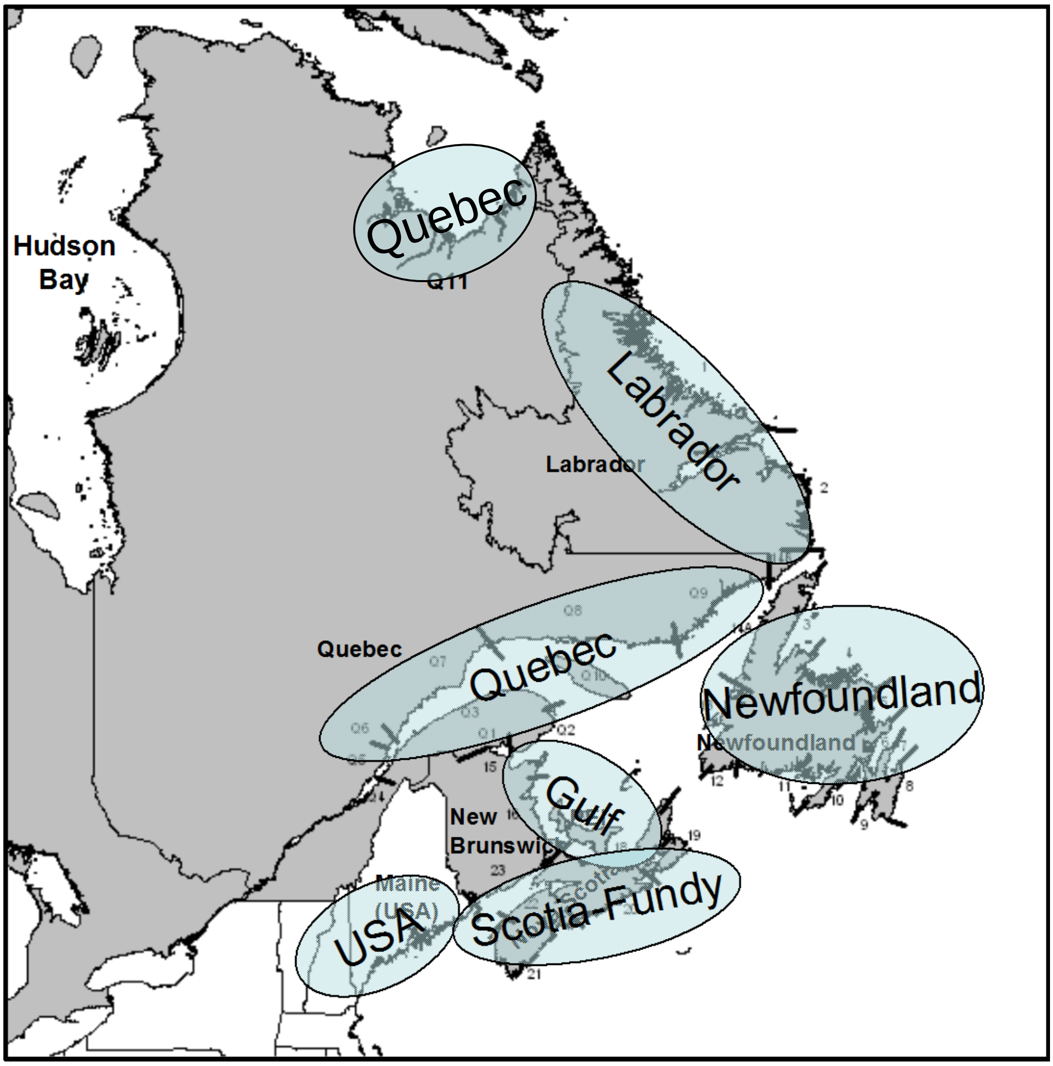

Figure 10.3.1 Regional groupings of Atlantic salmon in the North American Commission.

Year of PFA

Figure 10.3.2 **Estimates of PFA for 1SW maturing salmon, 1SW non-maturing salmon, and the total cohort of 1SW salmon based on the Monte Carlo simulations of the run-reconstruction model for NAC. Median and 95% CI interval ranges derived from Monte Carlo simulations are shown.**

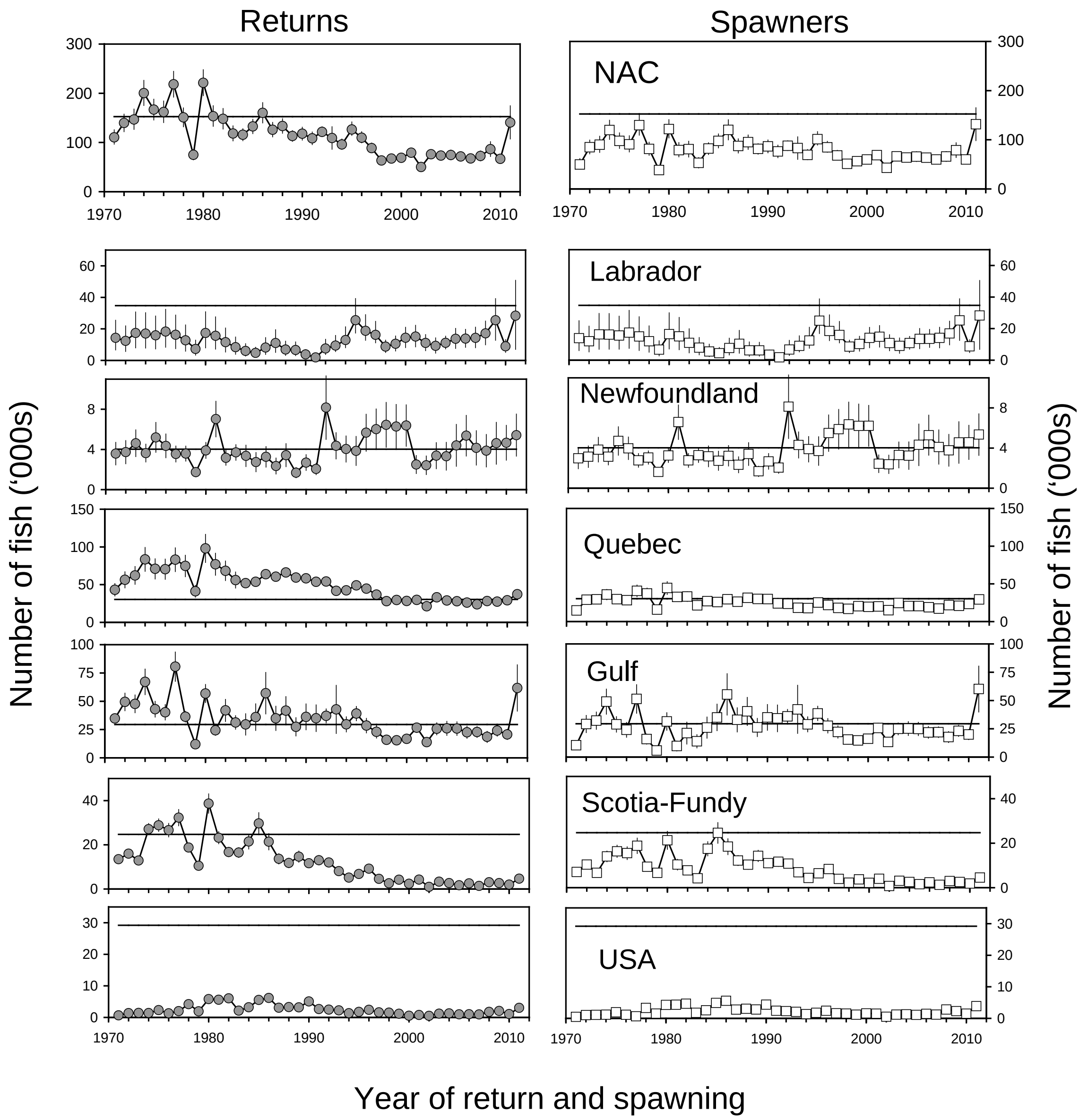

Figure 10.3.3 **Comparison of the 2SW conservation limits (solid horizontal lines) to 2SW returns (medians, 95% confidence interval range; left panels) and to 2SW spawners (right panels), in six geographic areas of NAC and in NAC overall. Returns and spawners for Scotia–Fundy do not include those from salmon fishing area (SFA) 22 and a portion of SFA 23. For USA, estimated spawners may exceed the estimated returns due to adult stocking restoration efforts.**

Figure 10.3.4 **Proportion of the conservation egg requirement attained in assessed rivers of the North American Commission area in 2011.**

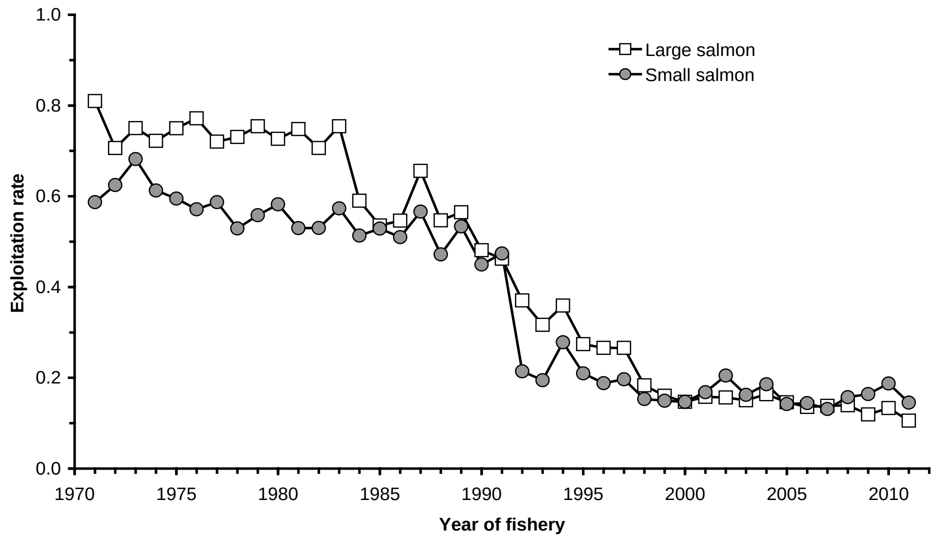

Figure 10.3.5 Exploitation rates in North America on the North American stock complex of small salmon (mostly 1SW) and large salmon (2SW, 3SW, and repeat spawners).

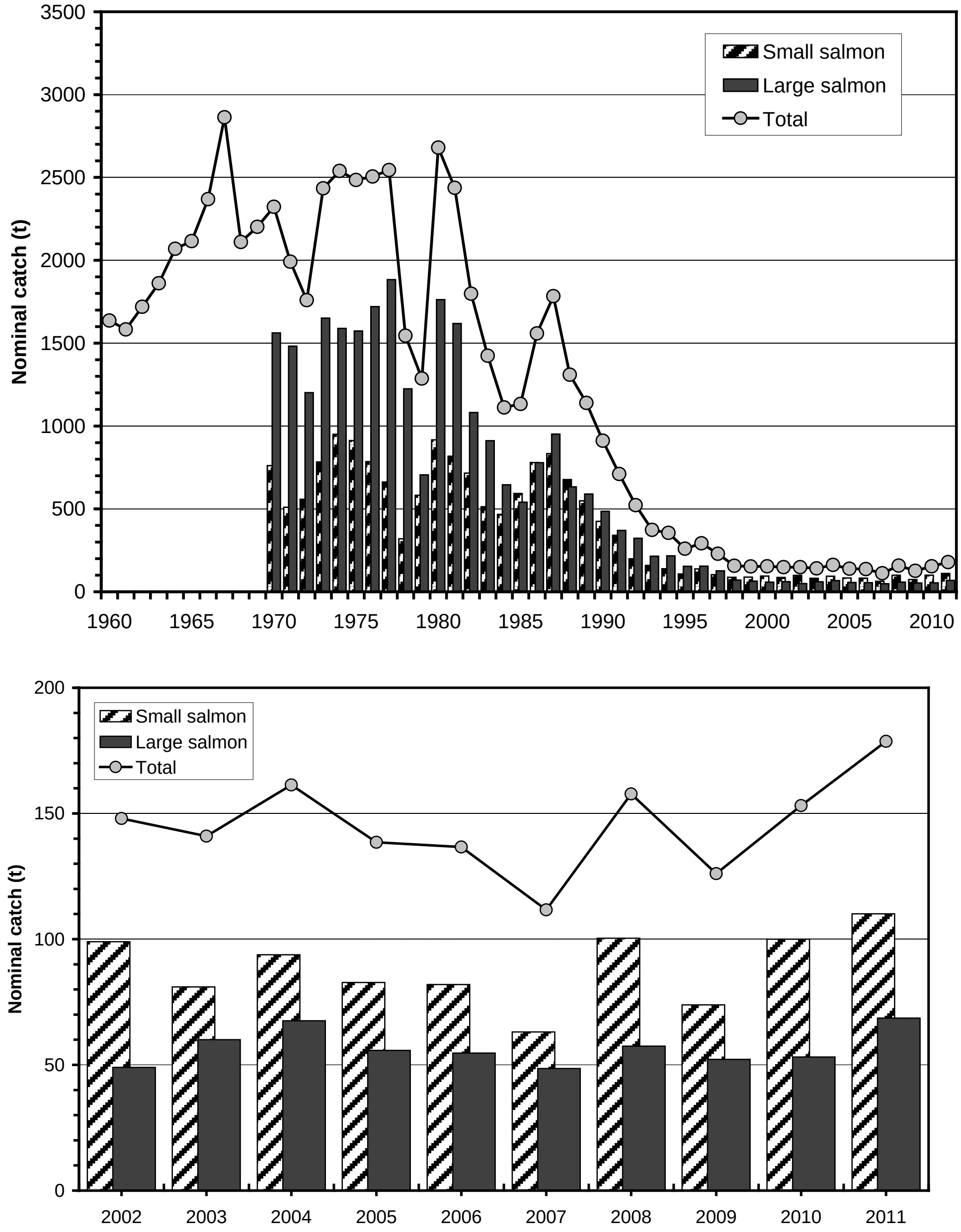

Figure 10.3.6 **Harvest (t) of small salmon, large salmon and combined for Canada, 1960 to 2011 (top panel) and 2002 to 2011 (bottom panel) by all users.**

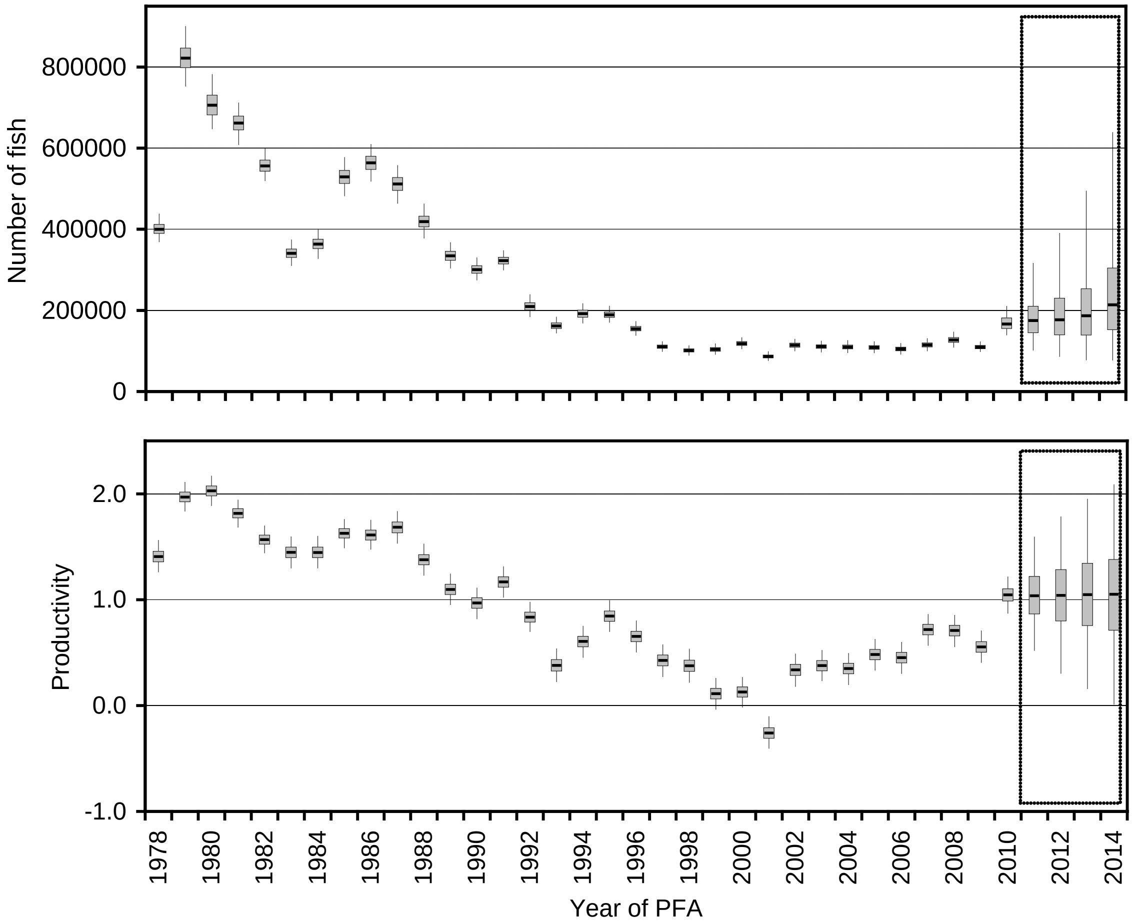

Figure 10.3.7 Estimated pre-fishery abundance (PFA; upper panel) and overall productivity (in logarithmic scale, i.e. logarithm of PFA per lagged spawner; lower panel) for the North America 1SW non-maturing salmon complex. The distributions for years 2011 to 2014, shown in the dotted rectangle, are predicted values.

Figure 10.3.8 Estimated productivity (in logarithmic scale, i.e. logarithm of PFA per lagged spawner) for the six regions of North America by year of pre-fishery abundance (PFA). The distributions for years 2011 to 2014, shown in the dotted rectangle, are predicted values.

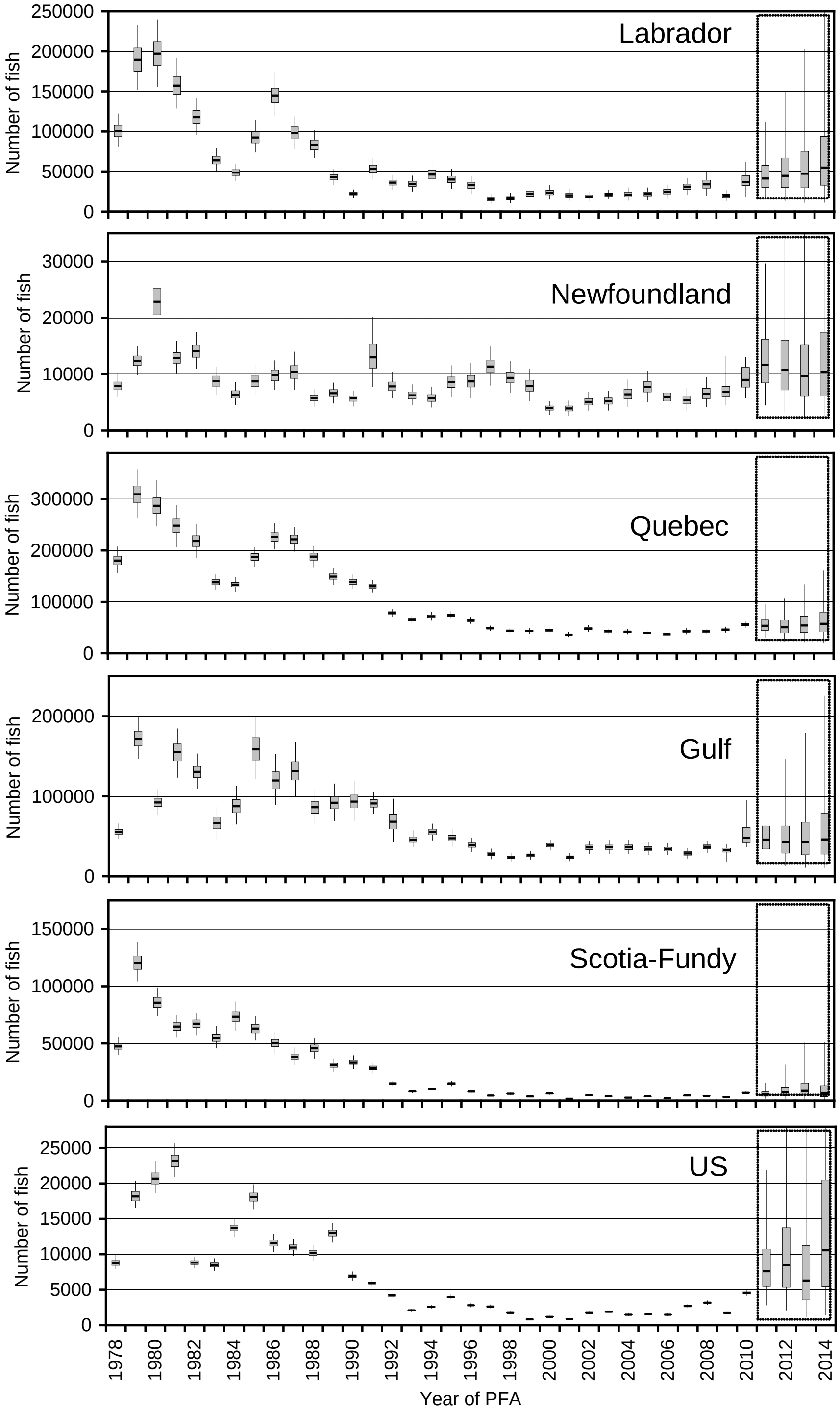

Figure 10.3.9 **Estimated pre-fishery abundance (PFA; number of fish) for the six regions of North America by year of PFA. The distributions for years 2011 to 2014, shown in the dotted rectangle, are predicted values.**

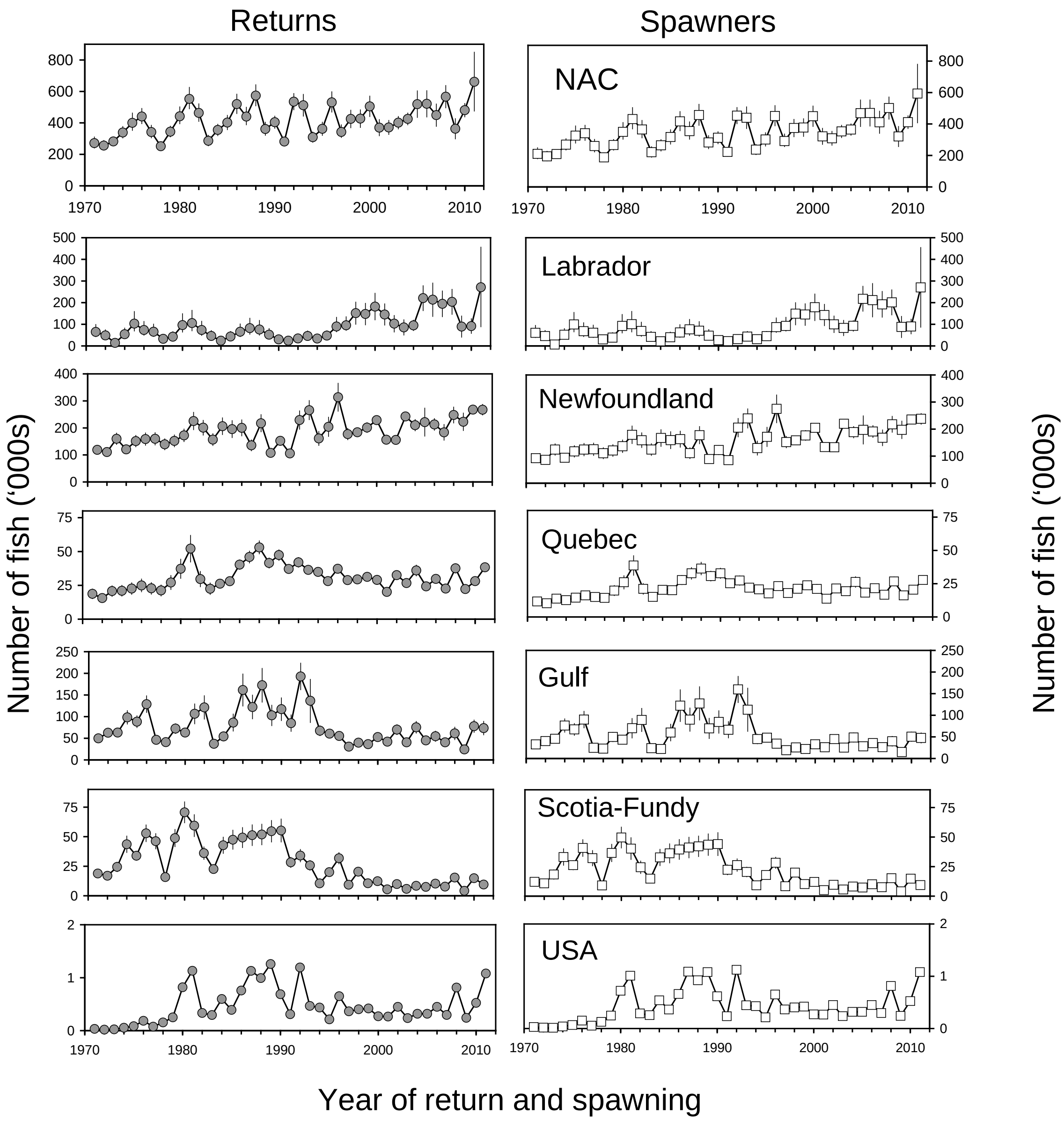

Figure 10.3.10 **Estimates (median, 95% confidence interval range) of 1SW maturing returns (left panels) and 1SW maturing spawners (right panels), in six geographic areas of NAC and in NAC overall. Returns and spawners for Scotia–Fundy do not include those from SFA 22 and a portion of SFA 23.**

Table 10.3.1 Probability that the 2SW salmon returns to regions in North America will meet or exceed the management objectives, by region and simultaneously in all six regions, in 2012 to 2015, in the absence of fisheries.

Region	Management objective (No. of fish)	Probability of meeting or exceeding the management objective in the absence of fisheries			
		2012	2013	2014	2015
Labrador	34 746	0.38	0.45	0.48	0.56
Newfoundland	4 022	0.93	0.86	0.78	0.78
Quebec	29 446	0.83	0.71	0.73	0.75
Gulf	30 430	0.57	0.50	0.50	0.55
Scotia–Fundy	10 976	0.03	0.15	0.25	0.20
USA	2 548	0.94	0.90	0.75	0.86
Simultaneous		0.01	0.06	0.08	0.09

Table 10.3.2 Framework of indicators spreadsheet for the North American Commission and West Greenland Commission areas. For illustrative purposes, the 2011 value of returns or survival rates for the 40 retained indicators is entered in the cells corresponding to the annual indicator variable values.

possible range			
Average		**NA**	**Unknown**

Table 10.3.3 Total reported nominal catch of salmon in homewaters by country (in tonnes, round fresh weight), 1980–2011 (2011 figures include provisional data).

	Canada			USA	St. P&M
Year	Total	Large	Small	Total	Total
1980	2 680	1 763	917	6	-
1981	2 437	1 619	818	6	-
1982	1 798	1 082	716	6	-
1983	1 424	911	513	1	3
1984	1 112	645	467	2	3
1985	1 133	540	593	2	3
1986	1 559	779	780	2	3
1987	1 784	951	833	1	2
1988	1 310	633	677	1	2
1989	1 139	590	549	2	2
1990	911	486	425	2	2
1991	711	370	341	1	1
1992	522	323	199	1	2
1993	373	214	159	1	3
1994	355	216	139	0	3
1995	260	153	107	0	1
1996	292	154	138	0	2
1997	229	126	103	0	2
1998	157	70	87	0	2
1999	152	64	88	0	2
2000	153	58	95	0	2
2001	148	61	86	0	2
2002	148	49	99	0	2
2003	141	60	81	0	3
2004	161	68	94	0	3
2005	139	56	83	0	3
2006	137	55	82	0	3
2007	112	49	63	0	2
2008	158	58	100	0	4
2009	126	52	67	0	3
2010	153	53	100	0	3
2011	179	69	110	0	4

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Advice for 2012 to 2014

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

There are no mixed-stock fisheries catch options at West Greenland in 2012, 2013, and 2014. In the absence of fishing mortality there is only a 6% to 8% chance of simultaneously meeting or exceeding the management objectives of the seven management units in 2012 to 2014 (Table 10.4.1).

The Framework of Indicators (FWI; ICES, 2009) was updated in support of the multi-year catch advice and the potential approval of multi-year regulatory measures (Table 10.4.2). The FWI can be applied at the beginning of 2013, with the returns or return rate data for 2012, to evaluate the appropriateness of the 2013 advice, and again at the beginning of 2014, with the returns or return rate data for 2013, to evaluate the appropriateness of the 2014 advice.

Stock status

For West Greenland (Figure 10.4.1), stock status for 1SW non-maturing salmon (destined to be 2SW salmon) of North America and the Southern NEAC MSW complex are relevant.

Recruitment (pre-fishery abundance (PFA) of non-maturing 1SW salmon) estimates suggest continued low abundance of North American salmon (Figure 10.4.2). The non-maturing 1SW salmon PFA estimate for 2010 increased by 100% over the 2009 estimate, but ranked 23rd of the 40-year time-series. Estimated PFA for the Southern NEAC non-maturing 1SW complex has declined to low levels over the period 1996 to 2008, with a slight improvement in 2009 and 2010 (Figure 10.4.3).

North American 2SW spawner estimates (medians) were below CLs in four of the six regions in 2011 (Figure 10.4.4). Within each of the geographic areas in NAC there are varying numbers of individual river stocks which are failing to meet CLs, particularly in Scotia–Fundy and the USA. Declining trends in spawner numbers are evident in the Southern NEAC MSW complex (Figure 10.4.3). The MSW stock has been at full reproductive capacity for most of the time-series until 1997 and, thereafter, the stock was generally either at risk of reduced reproductive capacity or suffering reduced reproductive capacity. Within all countries in Southern NEAC there are individual river stocks that are not meeting CLs.

The exploitation rate (catch in Greenland / PFA) on NAC fish in 2010 was about 6%, which is among the lowest in the time-series (Figure 10.4.5). The exploitation rate on salmon from NAC peaked in 1971 at 39%. The exploitation rate on NEAC salmon in 2010 was less than 1%, which is also among the lowest in the time-series (Figure 10.4.5). The exploitation rate on NEAC salmon peaked in 1975 at 29%.

In European and North American areas, the overall abundance of stocks contributing to the West Greenland fishery has recently increased, but it is low compared to historical levels. Despite major changes in fisheries management around 18 to 25 years ago, and increasingly more restrictive fisheries measures since then, returns in many regions have remained near historical lows and many populations are currently threatened with extirpation. 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.

Management plans

The North Atlantic Salmon Conservation Organization (NASCO) has adopted an Action Plan for Application of the Precautionary Approach which stipulates that management measures should be aimed at maintaining all stocks above their conservation limits by the use of management targets. NASCO has adopted the region-specific CLs as limit reference points (S_{lim}); having populations fall below these limits should be avoided with high probability. Within the agreed management plan, a risk level (probability) of 75% of simultaneous attainment of seven management objectives has been agreed for the provision of catch advice on fish exploited at West Greenland (non-maturing 1SW fish from North America and non-maturing 1SW fish from Southern NEAC). The management objectives are to meet the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Quebec, Gulf), to achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia–Fundy and USA regions, and to meet the MSW southern NEAC CL.

Biology

Atlantic salmon (*Salmo salar*) is an anadromous species found in rivers of countries bordering the North Atlantic. In the Northeast Atlantic, their current distribution extends from northern Portugal to the Pechora River in Northwest Russia and Iceland. In the Northwest Atlantic, they range from the Connecticut River (USA, 41.6°N) northward to the Leaf River, Quebec (Canada, 58.8°N). 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 on abundant fish and invertebrate prey during their second summer and fall 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 predator fields of salmon at sea are considered to be the main contributory factors to lower productivity, which is expressed almost entirely in terms of lower marine survival.

The fisheries

Catches of Atlantic salmon at West Greenland (Table 10.4.3) decreased until the closure of the commercial fishery for export in 1998, but the subsistence fishery has been increasing in recent years (Figure 10.4.6). A total catch of 27.5 t of salmon was reported for the 2011 fishery, representing a 31% decrease with respect to the 40 t of salmon caught in the 2010 fishery. In total, 92% of the salmon sampled were of North American origin and 8% of European origin (Figure 10.4.7), and the 1SW age group constituted 93% of the catch (Table 10.4.4). Approximately 6800 (25 t) fish of American origin and 600 (2 t) fish of European origin were harvested. These totals remain among the lowest in the time-series (Figure 10.4.8).

Effects of the fisheries on the ecosystem

The current salmon fishery is practiced with nearshore surface gillnets. There is no information on bycatch of other species with this gear.

Quality considerations

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

Scientific basis

Assessments are carried out using common input variables across stock complexes in NEAC and NAC. Run-reconstruction models and Bayesian forecasts are performed, taking into account uncertainties in the data.

Supporting information: WGNAS.

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Reference points

The management objectives are to meet the 2SW CLs for the four northern areas of the NAC (Labrador, Newfoundland, Quebec, Gulf), to achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia–Fundy and USA regions, and to meet the southern NEAC MSW CL.

Region	Unit	Management objective (number of fish)
Labrador	2SW CL	34 746
Newfoundland	2SW CL	4 022
Quebec	2SW CL	29 446
Gulf	2SW CL	30 430
Scotia–Fundy	2SW Return	10 976
USA	2SW Return	2 548
Southern NEAC	MSW CL	241 269

Outlook for 2012 to 2014

The region-specific abundances, even in the absence of fishing, are predicted to be below the management objectives in several regions in 2012 to 2014 (Table 10.4.1).

MSY approach

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 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, similar to the basis for estimating B_{pa} in the precautionary approach. In short-lived stocks, where most of the annual surplus production is from recruitment (not growth), MSY $B_{escapement}$ and B_{pa} might be expected to be similar. Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined by ICES as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (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. Due to differences in the status of individual stocks within stock complexes, mixed-stock fisheries present particular threats.

Harvest at Greenland cannot be targeted towards individual stocks, so weaker performing stocks are at risk. The advice for the West Greenland fishery is based upon simultaneously achieving the seven management objectives with a 75% probability. In the absence of any marine fishing mortality at Greenland, there is only a 6% to 8% chance of simultaneously meeting or exceeding the management objectives for all seven management units in 2012 to 2014 (Table 10.4.1). Therefore, there are no mixed-stock fishery catch options on salmon for West Greenland in 2012 to 2014.

Additional considerations

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

Scientific basis

Data and methods

The international sampling programme for the fishery at West Greenland agreed by the parties at NASCO continued in 2011. The sampling was undertaken in four communities representing four NAFO divisions (Figure 10.4.1). As in previous years, no sampling occurred in the fishery in East Greenland. The decentralised landings and broad geographic distribution of the fishery causes practical problems for the sampling programme. In total, 970 individual salmon (12% by weight of the reported landings) were sampled for length and weight, and scale and genetics samples were collected for age and origin determination.

In all years since 2002, except for 2006 and 2011, non-reporting of harvest becomes evident by comparing reported landings to the sample data. In at least one of the divisions where international samplers were present, the sampling team observed more fish landed than were reported. When there is this type of weight discrepancy, the reported landings are adjusted according to the total weight of the fish identified as being landed during the sampling effort. These adjusted landings are carried forward for all future assessments (Table 10.4.5).

Uncertainties in catch reporting and fishing activities

The fluctuations in the number of people reporting catches and the catches them-selves in each of the NAFO divisions suggest that there are inconsistencies in the catch data and highlight the need for better data. Since 2002, in at least one of the divisions where international samplers were present, the sampling team observed more fish landed than were reported, except for 2006 and 2011. There is presently no quantitative approach for estimating the unreported catch, but the 2011 value is likely to have been at the same level proposed in recent years (10 t).

Over the past ten years, reported harvests have mostly remained within the 15–25 t range. Landings of Atlantic salmon to factories are banned and freezing salmon for shipping to other communities is illegal, so only local harvest is available for local consumption. The increase in landings in 2010 could have been due to an increase in abundance of salmon, especially in NAFO Division 1A (Figure 10.4.1). If more salmon were available to a larger part of the population, this may have resulted in increased effort in 2010 and subsequently increased reported landings. Considering the regulations preventing the exporting of salmon for sale or the freezing of salmon for shipping to other communities, it is assumed that all salmon harvested is consumed in Greenland. Continued and increased participation in a logbook programme would allow a better assessment of annual variation in fishing patterns and harvests.

Comparison with previous assessment and catch options

The management advice for the West Greenland fishery for 2012 to 2014 is based on the models previously used by ICES. The current modelling approaches have provided stable comparisons with predictions of the previous years. In the previous assessment for the mixed-stock fishery at West Greenland, ICES (2009) advised that there were no catch options at West Greenland in 2009, 2010, and 2011 that would be consistent with a 75% or greater chance of simultaneously meeting the seven management objectives. The assessment this year confirmed the validity of that advice.

Assessment and management area

The advice for the West Greenland fishery is based upon the Southern NEAC non-maturing 1SW stock complex and the North American 2SW complex.

Sources of information

ICES. 2009. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 30 March–8 April 2009. ICES CM 2009/ACFM:06. 283 pp.

ICES. 2012. Report of the Working Group on North Atlantic Salmon. ICES Headquarters, Copenhagen, 26 March–4 April 201. ICES CM 2012/ACOM:09.337 pp.

NASCO. 1998. North Atlantic Salmon Conservation Organization. Agreement on the adoption of a precautionary approach. Report of the 15th annual meeting of the Council. CNL(98)46. 4 pp.

NASCO. 1999. North Atlantic Salmon Conservation Organization. Action plan for the application of the precautionary approach. CNL(99)48. 14 pp.

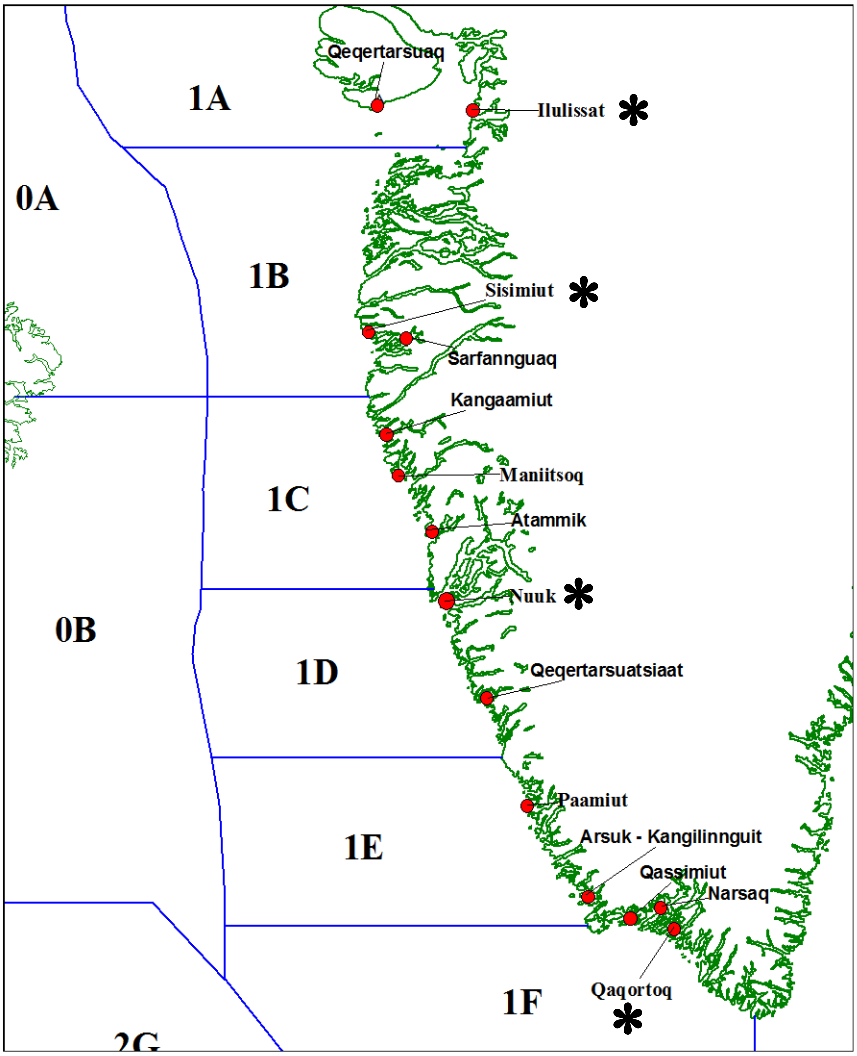

Figure 10.4.1 Location of NAFO divisions and communities (∗) where the fishery catches were sampled in 2011 at West Greenland.

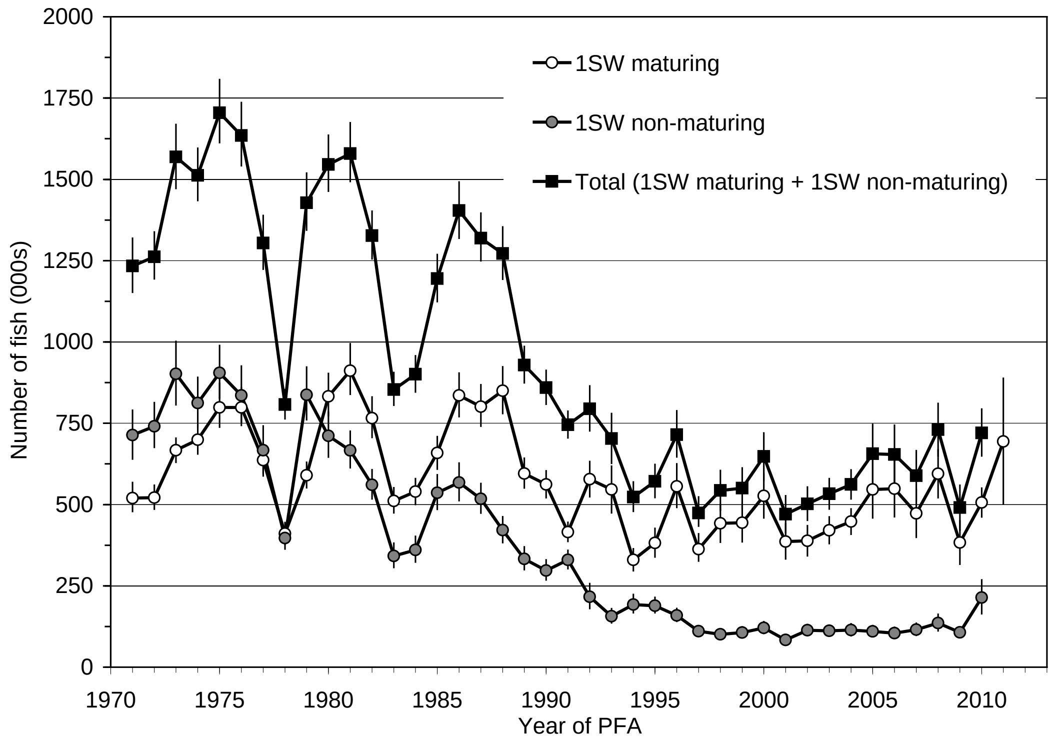

Figure 10.4.2 **Estimates of PFA for 1SW maturing salmon, 1SW non-maturing salmon, and the total cohort of 1SW salmon for North America.**

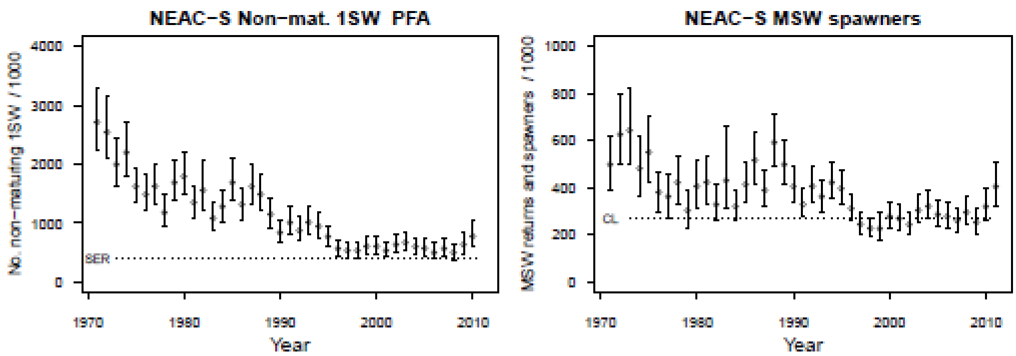

Figure 10.4.3 Estimated (median, 95% confidence interval range) PFA (recruitment, as 1SW non-maturing; left panel) and spawners (as MSW salmon; right panel) for Southern NEAC. PFA is shown relative to the Spawner Escapement Reserve (SER), which is the conservation limit for spawners adjusted for natural mortality from the time of PFA estimation (1 January of the first winter at sea) to spawning time.

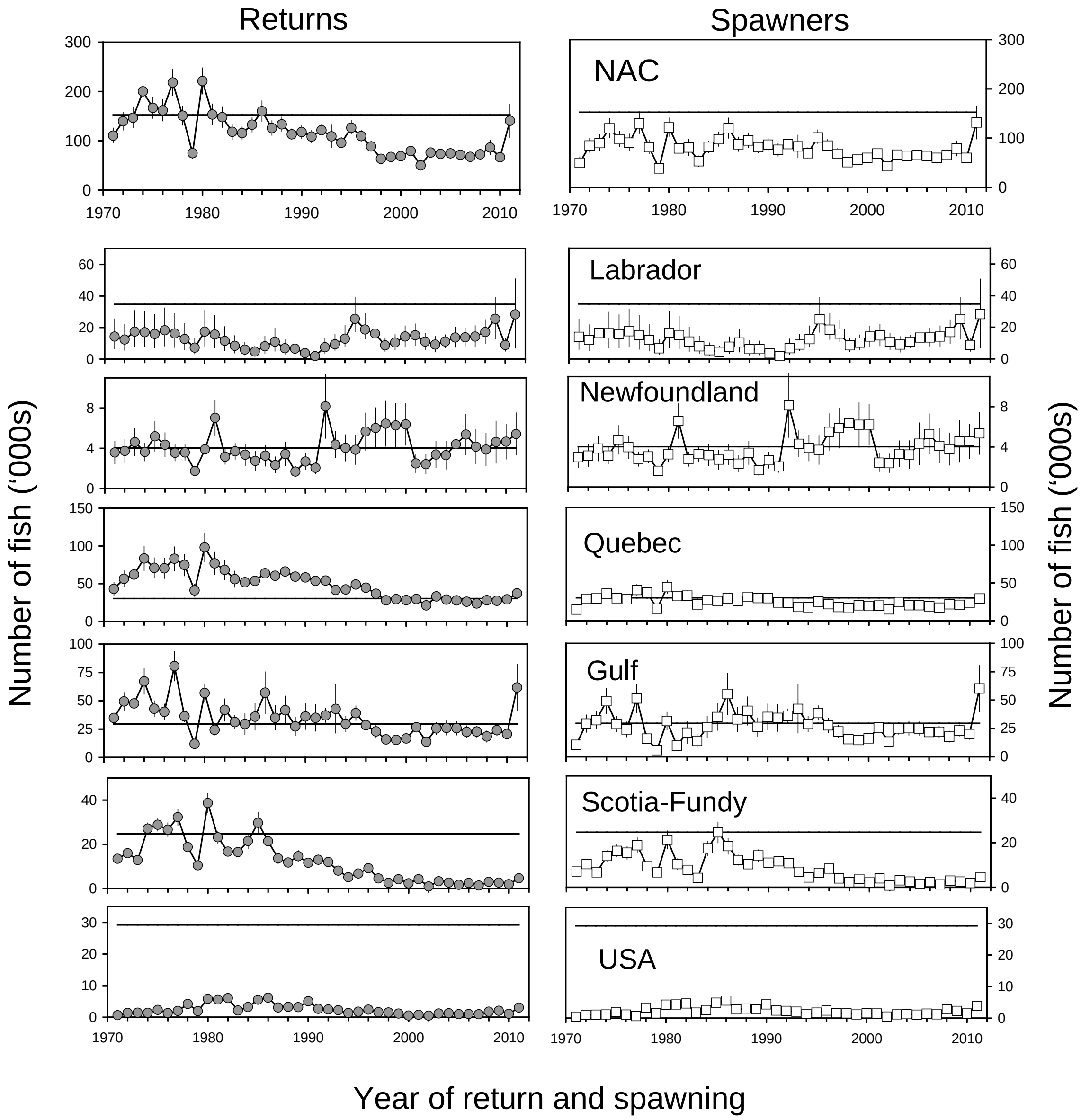

Figure 10.4.4 **Comparison of the 2SW conservation limits (solid horizontal lines) to 2SW returns (medians and 95% confidence interval ranges; left panels), and to 2SW spawners (right panels), in six geographic areas of NAC and in NAC overall. Returns and spawners for Scotia–Fundy do not include those from SFA 22 and a portion of SFA 23. For USA, estimated spawners may exceed the estimated returns due to adult stocking restoration efforts.**

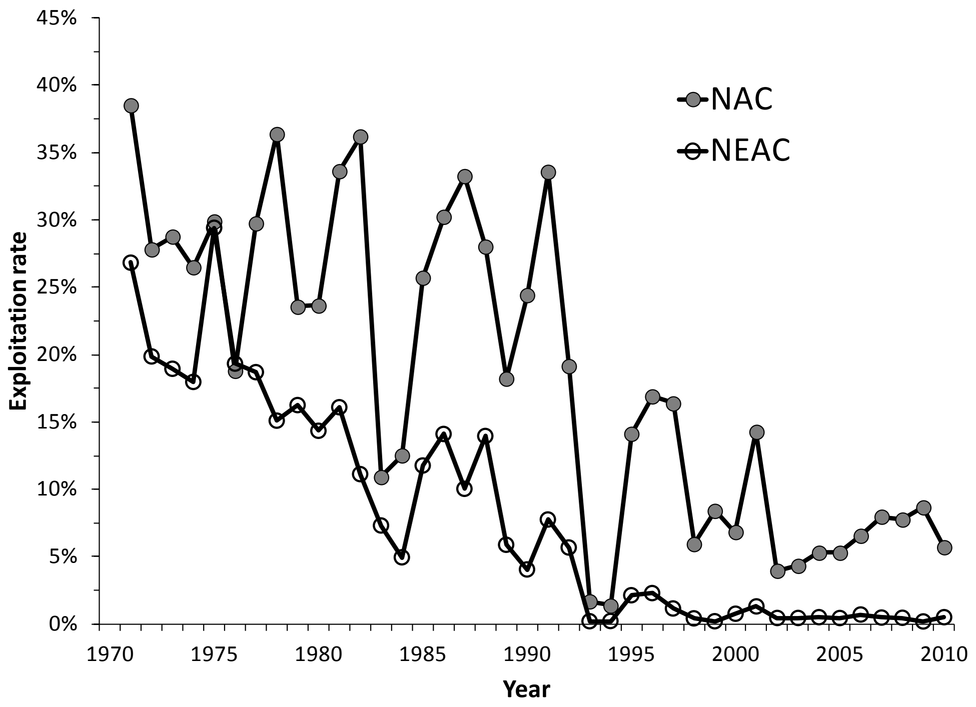

Figure 10.4.5 Exploitation rate (%) for NAC 1SW non-maturing and southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2010. Exploitation rate estimates are only available until 2010, as 2011 exploitation rates are dependent on 2012 2SW NAC or MSW southern NEAC returns.

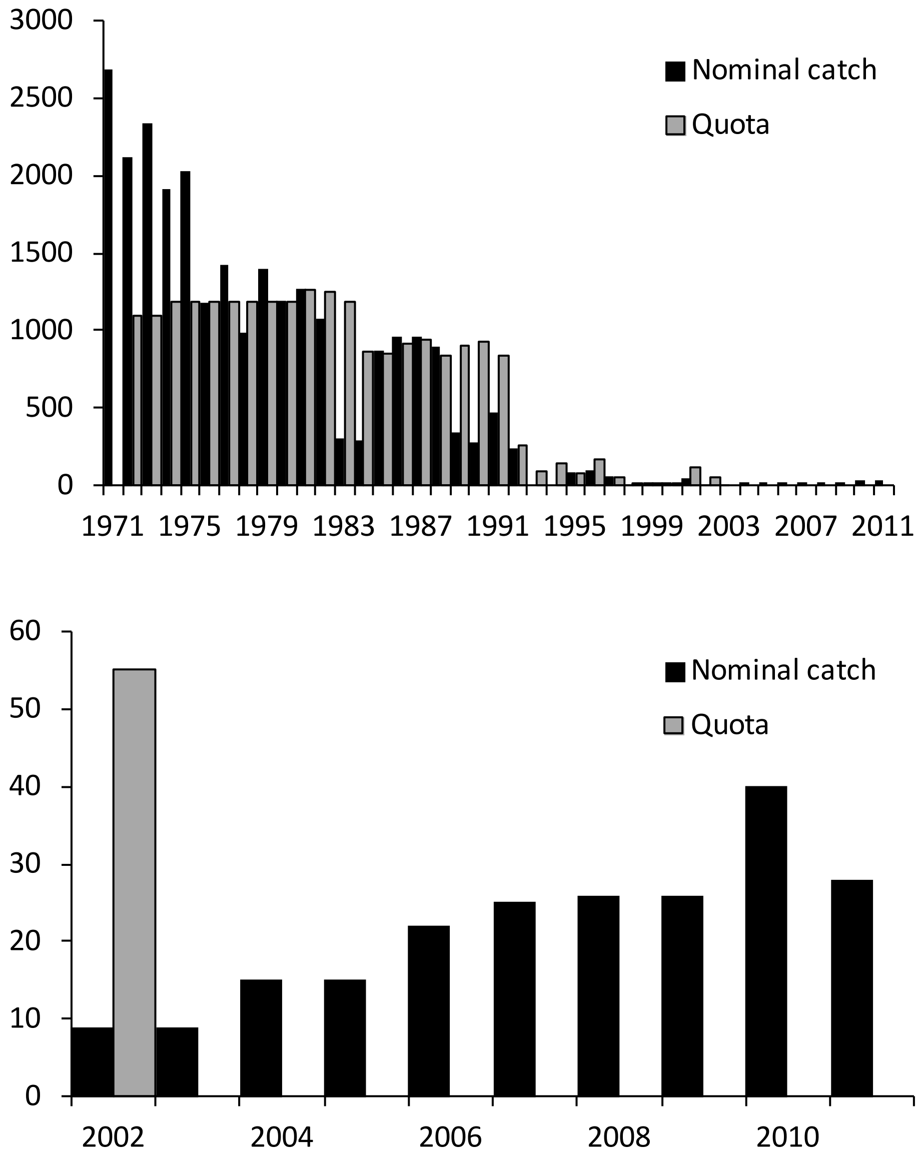

Figure 10.4.6 Nominal catches and commercial quotas (metric tonnes, round fresh weight) of salmon at West Greenland for 1971–2011 (top panel) and 2002–2011 (bottom panel).

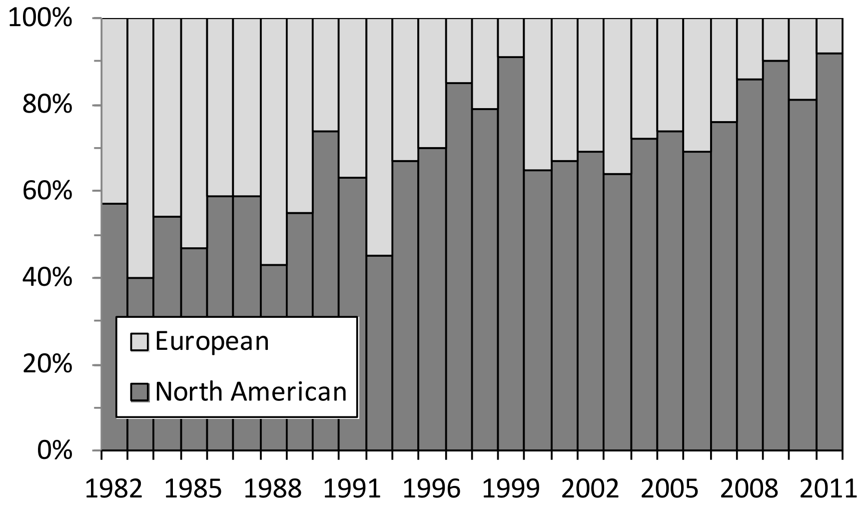

Figure 10.4.7 Percent of the sampled catch by continent of origin for the 1982 to 2011 Atlantic salmon, West Greenland fishery.

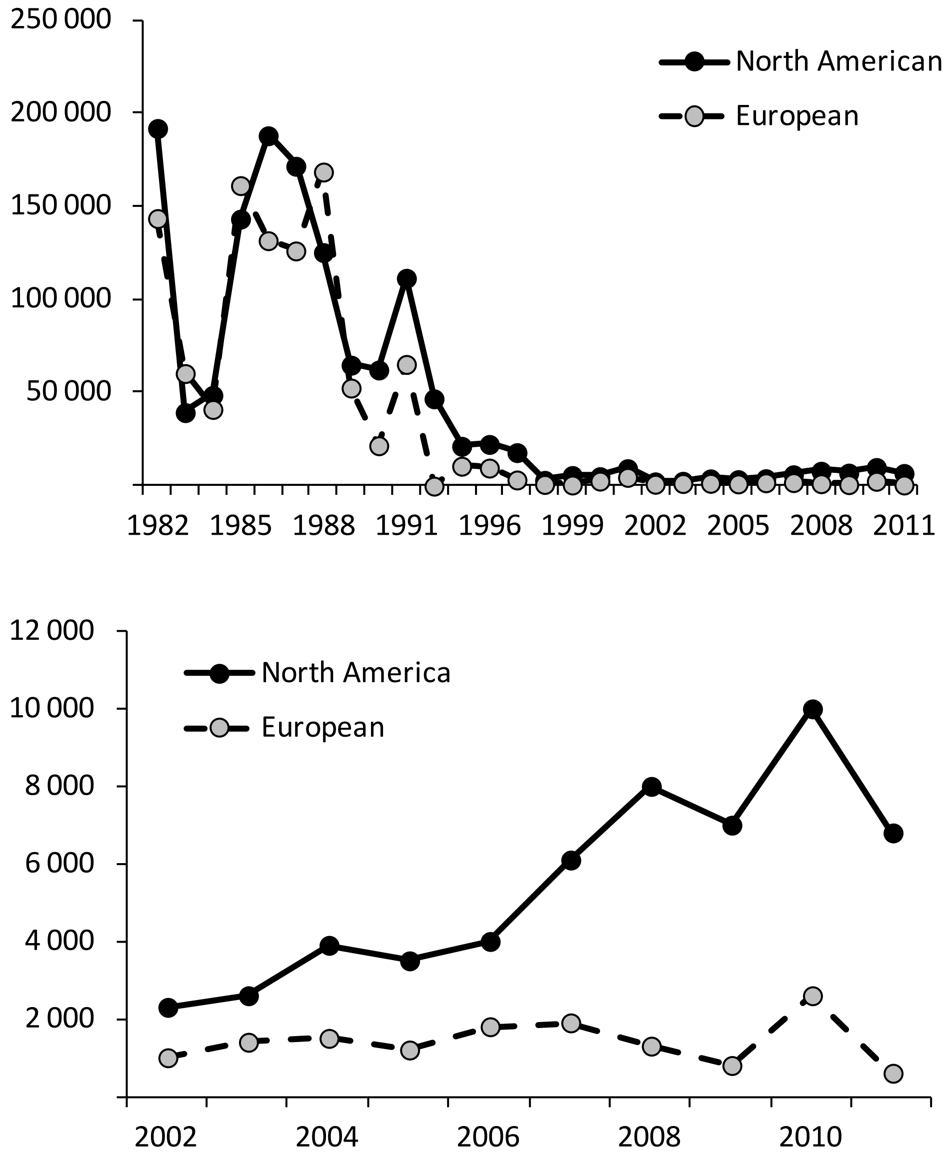

Figure 10.4.8 Number of North American and European Atlantic salmon caught at West Greenland from 1982 to 2011 (upper panel) and 2002 to 2011 (lower panel).

Table 10.4.1 Catch options tables for the mixed-stock fishery at West Greenland by fishing year, 2012 to 2014.

2012 Catch option	Probability of meeting or exceeding region-specific management objectives							
	LAB	NFLD	QC	GULF	SF	USA	S-NEAC	ALL
0	0.45	0.86	0.71	0.50	0.15	0.89	0.92	0.06
10	0.42	0.84	0.67	0.48	0.14	0.88	0.92	0.05
20	0.40	0.83	0.63	0.45	0.13	0.87	0.92	0.05
30	0.38	0.81	0.59	0.42	0.12	0.85	0.92	0.04
40	0.36	0.78	0.54	0.40	0.12	0.83	0.92	0.04
50	0.34	0.76	0.50	0.38	0.11	0.81	0.92	0.03
60	0.32	0.73	0.46	0.36	0.10	0.79	0.92	0.03
70	0.30	0.70	0.42	0.33	0.09	0.77	0.92	0.03
80	0.28	0.67	0.39	0.31	0.08	0.74	0.92	0.03
90	0.26	0.64	0.35	0.29	0.08	0.72	0.92	0.02
100	0.24	0.60	0.32	0.27	0.07	0.68	0.92	0.02
2013 Catch option	Probability of meeting or exceeding region-specific management objectives							
	LAB	NFLD	QC	GULF	SF	USA	S-NEAC	ALL
0	0.48	0.78	0.73	0.50	0.25	0.75	0.86	0.08
10	0.46	0.76	0.70	0.48	0.24	0.73	0.86	0.07
20	0.44	0.75	0.67	0.46	0.23	0.72	0.85	0.06
30	0.42	0.73	0.63	0.44	0.22	0.70	0.85	0.06
40	0.41	0.70	0.60	0.42	0.21	0.68	0.85	0.06
50	0.39	0.68	0.56	0.40	0.20	0.66	0.85	0.05
60	0.37	0.65	0.53	0.38	0.19	0.64	0.85	0.05
70	0.35	0.63	0.50	0.36	0.18	0.62	0.85	0.05
80	0.33	0.60	0.47	0.34	0.17	0.59	0.85	0.04
90	0.31	0.57	0.44	0.32	0.16	0.57	0.85	0.04
100	0.30	0.54	0.41	0.31	0.15	0.55	0.85	0.04
2014 Catch option	Probability of meeting or exceeding region-specific management objectives							
	LAB	NFLD	QC	GULF	SF	USA	S-NEAC	ALL
0	0.56	0.78	0.75	0.55	0.20	0.86	0.87	0.08
10	0.55	0.77	0.73	0.53	0.20	0.85	0.87	0.08
20	0.53	0.75	0.70	0.51	0.19	0.84	0.87	0.07
30	0.52	0.73	0.67	0.49	0.18	0.83	0.87	0.07
40	0.50	0.71	0.64	0.47	0.17	0.82	0.87	0.06
50	0.48	0.69	0.62	0.46	0.17	0.81	0.87	0.06
60	0.46	0.67	0.59	0.44	0.16	0.79	0.87	0.06
70	0.45	0.65	0.56	0.42	0.16	0.77	0.87	0.05
80	0.43	0.63	0.54	0.41	0.15	0.76	0.87	0.05
90	0.42	0.61	0.51	0.39	0.14	0.74	0.87	0.05
100	0.40	0.59	0.49	0.38	0.14	0.72	0.86	0.05

Table 10.4.2 Framework of indicators spreadsheet for the West Greenland fishery. For illustrative purposes, the 2011 value of returns or survival rates for the 40 retained indicators is entered in the cells corresponding to the annual indicator variable values.

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

Overall Recommendation

No Significant Change Identified by Indicators

Geographic Area	River/ Indicator	2011 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	2368	167%	1415	100%	92%	1	0.92	0.92	
	Penobscot 1SW Returns	741	197%	377	83%	88%	1	0.88	0.88	
	Penobscot 2SW Survival (%)	0.39	170%	0.23	100%	60%	1	0.6	0.6	
	Penobscot 1SW Survival (%)	0.12	133%	0.09	85%	73%	1	0.73	0.73	
	Narraguagus Returns	196	196%	100	95%	61%	1	0.61	0.61	
	possible range				*-0.93*	*0.75*				
	Average		173%						**0.75**	**Yes**
Scotia-Fundy	Saint John Return Large	294	9%	3 329	96%	100%	-1	0.96	-0.96	
	Lahave Return Large	146	51%	285	77%	85%	-1	0.77	-0.77	
	St. Mary's Return Large	14	6%	221	100%	73%	-1	1	-1	
	North Return Large	1 193	168%	712	95%	67%	1	0.67	0.67	
	Saint John Return 1SW	582	26%	2 276	86%	80%	-1	0.86	-0.86	
	LaHave Return 1SW	565	34%	1 679	94%	67%	-1	0.94	-0.94	
	St. Mary's Return 1SW	331	16%	2 038	95%	93%	-1	0.95	-0.95	
	Saint John Survival 2SW (%)	0.13	59%	0.22	95%	81%	-1	0.95	-0.95	
	Lahave Survival 2SW (%)	0.88	367%	0.24	81%	81%	1	0.81	0.81	
	Saint John Survival 1SW (%)	0.12	16%	0.76	86%	73%	-1	0.86	-0.86	
	Lahave Survival 1SW (%)	0.72	50%	1.44	92%	78%	-1	0.92	-0.92	
	Liscomb Survival 2SW (%)	0.03	60%	0.05	86%	91%	-1	0.86	-0.86	
	East Sheet Harbour Survival 2SW (%)	0.005	25%	0.02	67%	82%	-1	0.67	-0.67	
	possible range				*-0.88*	*0.81*				
	Average		68%						**-0.64**	**No**
Gulf	Miramichi Return 2SW	28 977	183%	15 800	100%	85%	1	0.85	0.85	
	Miramichi Return 1SW	45 880	110%	41 790	89%	67%	1	0.67	0.67	
	possible range				*-0.95*	*0.76*				
	Average		147%						**0.76**	**Yes**
Quebec	Cascapédia Return Large	3 815	167%	2 280	69%	92%	1	0.92	0.92	
	Bonaventure Return Large	1 259	85%	1 479	75%	81%	-1	0.75	-0.75	
	Grande Rivière Return Large	533	121%	442	100%	94%	1	0.94	0.94	
	Saint-Jean Return Large	688	91%	758	86%	89%	-1	0.86	-0.86	
	Dartmouth Return Large	1 171	155%	756	86%	89%	1	0.89	0.89	
	Madeleine Return Large	996	153%	653	70%	93%	1	0.93	0.93	
	Sainte-Anne Return Large	871	201%	433	67%	88%	1	0.88	0.88	
	Godbout Return Large	694	108%	641	86%	100%	1	1	1	
	De la Trinite Return Large	317	82%	385	75%	100%	-1	0.75	-0.75	
	York Return Return Large	1 585	113%	1405	63%	83%	1	0.83	0.83	
	Grande Rivière Return Small	237	119%	199	59%	80%	1	0.8	0.8	
	Saint-Jean Return Small	343	87%	394	53%	80%	-1	0.53	-0.53	
	Godbout Return Small	623	123%	508	85%	92%	1	0.92	0.92	
	De la Trinite Return Small	949	238%	399	89%	83%	1	0.83	0.83	
	De la Trinite Survival Large (%)	0.76	155%	0.49	88%	96%	1	0.96	0.96	
	De la Trinite Survival Small (%)	2.54	170%	1.49	63%	89%	1	0.89	0.89	
	Saint-Jean Survival Small (%)	1.86	258%	0.72	100%	64%	1	0.64	0.64	
	possible range				*-0.77*	*0.88*				
	Average		143%						**0.50**	**Yes**
Newfoundland	Exploits Return Small	34 085	137%	24 924	83%	56%	1	0.56	0.56	
	Middle Brook Return Small	2 642	141%	1 868	84%	63%	1	0.63	0.63	
	Torrent Return Small	2 784	67%	4 154	94%	64%	-1	0.94	-0.94	
	possible range				*-0.87*	*0.61*				
	Average		115%						**0.08**	**Yes**
Labrador										
	possible range									
	Average								**NA**	**Unknown**
Southern NEAC										
	possible range									
	Average								**NA**	**Unknown**

Table 10.4.3 Distribution of nominal catches (metric tonnes) by Greenland vessels since 1977. NAFO Divisions are represented by 1A–1F.

Year	1A	1B	1C	1D	1E	1F	Unk.	W. Greenland	E. Greenland	Total
1977	201	393	336	207	237	46	-	1 420	6	1426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1 395	+	1395
1980	52	275	404	231	158	74	-	1 194	+	1194
1981	105	403	348	203	153	32	20	1 264	+	1264
1982	111	330	239	136	167	76	18	1 077	+	1077
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 *	5	2	10	2	3	5	0	26	-	26
2009 *	0.2	6	7	3	4	5	0	26	1	26
2010 *	17	5	2	3	7	4	0	38	2	40
2011 *	2	4	5	8	4	5	0	28	+	28

[1] The fishery was suspended.

+ Small catches <5 t.

- No catch.

*** Corrected from gutted weight to total weight (factor 1.11).**

Table 10.4.4 Summary of biological characteristics of catches at West Greenland in 2011.

Distribution of 2011 nominal catch (metric tonnes)

Total	NAFO Division 1A	1B	1C	1D	1E	1F
28	2	4	5	8	4	5

River age distribution (%) by origin (NA – North America, E – Europe)

	1	2	3	4	5	6	7	8
NA	1.5	36.1	44.5	15.1	2.8	0	0	0
E	19.0	51.7	27.6	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 (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)
NA	66.2	3.56	85.6	5.48	72.5	4.53	66.7	3.67
E	65.0	3.24	76.3	5.18	76.3	5.11	66.9	3.82

Continent of origin (%)

North America	Europe
91.5	8.5

Sea age composition (%) by continent of origin:
North America (NA) and Europe (E)

	1SW	2SW	Previous spawners
NA	93.8	1.5	4.7
E	82.8	12.1	5.2

Table 10.4.5 Reported landings (kg) for the West Greenland Atlantic salmon fishery from 2002 by NAFO Division as reported by the Home Rule Government, and the division-specific adjusted landings where the sampling teams observed more fish landed than were reported.

Year		1A	1B	1C	1D	1E	1F	Total
2002	Reported	14	78	2100	3752	1417	1661	9022
	Adjusted						2408	9769
2003	Reported	619	17	1621	648	1274	4516	8694
	Adjusted			1782	2709	5912		12 312
2004	Reported	3476	611	3516	2433	2609	2068	14 712
	Adjusted				4929			17 209
2005	Reported	1294	3120	2240	756	2937	4956	15 303
	Adjusted				2730			17 276
2006	Reported	5427	2611	3424	4731	2636	4192	23 021
	Adjusted							
2007	Reported	2019	5089	6148	4470	4828	2093	24 647
	Adjusted						2252	24 806
2008	Reported	4882	2210	10024	1595	2457	4979	26 147
	Adjusted				3577		5478	28 627
2009	Reported	195	6151	7090	2988	4296	4777	25 496
	Adjusted				5466			27 975
2010	Reported	17263	4558	2363	2747	6766	4252	37 949
	Adjusted		4824		6566		5274	43 056
2011	Reported	1858	3662	5274	7977	4021	4613	27 407
	Adjusted							