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Report of the Working Group on North Atlantic Salmon (WGNAS)

19–28 March 2014

Copenhagen, Denmark

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CIEM Conseil International pour l'Exploration de la Mer

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Contents

Executive summary

Working Group on North Atlantic Salmon [WGNAS], ICES HQ, 19–28 March 2014.

Chair: Ian Russell (UK).

Number of meeting participants: 21 representing twelve countries from North America (NAC) and the Northeast Atlantic (NEAC). Information was also provided by correspondence or by WebEx link from Greenland, Faroes, Denmark, Norway and Spain for use by the Working Group.

WGNAS met to consider questions posed to ICES by the North Atlantic Salmon Conservation Organisation (NASCO) and also generic questions for regional and species Working Groups posed by ICES. The need for catch advice was dependent on the outcome of applying two indicator frameworks prior to the meeting.

- In 2012, the Working Group advised that there were no mixed-stock fishery options at West Greenland in 2012 to 2014 nor in NAC in 2012 to 2105 that would be consistent with a 75% chance or greater of simultaneously meeting the seven (for West Greenland) and six (for NAC) management objectives for 2SW salmon. The West Greenland Framework of indicators was applied in January 2014 and did not indicate the need for an updated assessment of catch options and no new management advice for this fishery was requested by NASCO.
- A Framework of Indicators (FWI) was developed for NEAC stocks in 2012 and was also applied in January 2014 in relation to the multi-annual agreement for the Faroes fishery. This also did not indicate any need for an updated assessment of catch options and no new management advice for this fishery was requested by NASCO.

The terms of reference were addressed by reviewing working documents prepared ahead of the meeting as well as the development of documents and text for the report during the meeting. The report is structured by sections specific to the terms of reference of the WGNAS.

- In the North Atlantic, exploitation rates have declined and nominal catch of wild Atlantic salmon in 2013 was 1296 t, the lowest in the time-series beginning in 1960.
- The Working Group reported on a range of new opportunities for salmon assessment and management (e.g. developments in setting conservation limits, recovery potential assessments, fish tracking technologies, genetic investigations) and potential threats (e.g. parasites, fish farm escapees).
- The Working Group reviewed new information on levels of bycatch of salmon in pelagic fisheries and considered possible options for further investigation of this issue. The Working Group also reviewed the stock status categories used by different organizations and jurisdictions with a view to exploring possible common approaches that might be applicable for use by NASCO.
- Three of the four NEAC stock complexes were assessed as having a greater than 95% probability of exceeding their conservation limits (CLs) and were

therefore considered to be at full reproductive capacity prior to the commencement of distant water fisheries in the latest available PFA year. However, the Southern NEAC non-maturing 1SW stock was considered to be at risk of suffering reduced reproductive capacity. At a country level, stocks from several jurisdictions were below CLs.

- For the first time in the assessment time-series beginning in 1971 the midpoint of the 2SW spawners in Labrador exceeded the 2SW CL. However, this increased abundance was not realised in others areas of NAC and North American 2SW spawner estimates were below their CLs in the five other regions of NAC. Returns to southern regions (Scotia-Fundy and USA) have remained near historical lows and many populations are currently at risk of extirpation.
- There was a catch of 47 t in the fishery at Greenland in 2013. The overall abundance of salmon within the West Greenland area remains low relative to historical levels and five of the seven stock complexes exploited in the fishery are below CLs.
- Marine survival indices in the North Atlantic have improved in some index stocks in recent years, but the declining trend has persisted and survival indices remain low. Factors other than marine fisheries, acting in freshwater and in the ocean in both NAC and NEAC areas (e.g. marine mortality, fish passage, water quality) are contributing to continued low abundance of wild Atlantic salmon.

1 Introduction

1.1 Main tasks

At its 2013 Statutory Meeting, ICES resolved (C. Res. 2013/2/ACOM9) that the **Working Group on North Atlantic Salmon** [WGNAS] (chaired by: Ian Russell, UK) will meet at ICES HQ, 19–28 March 2014 to consider (a) relevant points in the Generic ToRs for Regional and Species Working Groups for each salmon stock complex; and (b) questions posed to ICES by the North Atlantic Salmon Conservation Organization (NASCO).

The terms of reference were met. The responses to the questions posed in the Generic ToRs for Regional and Species Working Groups for each salmon stock complex are provided at Annex 5. The sections of the report which provide the answers to the questions posed by NASCO are identified below:

a) With respect to Atlantic Salmon in the North Atlantic area:	Section 2
i) provide an overview of salmon catches and landings by country, including unreported catches and catch and release, and production of farmed and ranched Atlantic salmon in 2013[1];	2.1, 2.2 and Annex 4
ii) report on significant new or emerging threats to, or opportunities for, salmon conservation and management[2];	2.3 and 2.6
iii) provide a review of examples of successes and failures in wild salmon restoration and rehabilitation and develop a classification of activities which could be recommended under various conditions or threats to the persistence of populations[3];	2.4
iv) provide a review of the stock status categories currently used by the jurisdictions of NASCO, including within their Implementation Plans, and advise on common approaches that may be applicable throughout the NASCO area;	2.5
v) provide a compilation of tag releases by country in 2013;	2.7
vi) identify relevant data deficiencies, monitoring needs and research requirements.	2.8 and Annex 8
b) With respect to Atlantic salmon in the North-East Atlantic Commission area:	Section 3
i) describe the key events of the 2013 fisheries[4];	3.1
ii) review and report on the development of age-specific stock conservation limits;	3.2 and 2.3
iii) describe the status of the stocks;	3.3
iv) provide recommendations on how a targeted study of pelagic bycatch in relevant areas might be carried out with an assessment of the need for such a study considering the current understanding of pelagic bycatch impacts on Atlantic salmon populations[5];	3.4
*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that reassessment is required: **	
v) provide catch options or alternative management advice for 2014-2017, 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[6];	
vi) update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

c) With respect to Atlantic salmon in the North American Commission area:	Section 4
i) describe the key events of the 2013 fisheries (including the fishery at St Pierre and Miquelon)[4];	4.1
ii) update age-specific stock conservation limits based on new information as available;	4.2 and 2.3
iii) describe the status of the stocks;	4.3
*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that reassessment is required: **	
iv) provide catch options or alternative management advice for 2014-2017 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[6];	
v) update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

d) With respect to Atlantic salmon in the West Greenland Commission area:	Section 5
i) describe the key events of the 2013 fisheries[4];	5.1
ii) describe the implications for the provision of catch advice of any new management objectives proposed for contributing stock complexes[7];	5.2
iii) describe the status of the stocks[8];	5.3
*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that reassessment is required: **	
iv) provide catch options or alternative management advice for 2014–2016 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[6];	
v) update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	

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. With regards to question a) iii, NASCO is particularly interested in case studies highlighting successes and failures of various restoration efforts employed across the North Atlantic by all Parties/jurisdictions and the metrics used for evaluating success or failure.

4. 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 homewater fisheries, the information provided should indicate the location of the catch in the following categories: in-river; estuarine; and coastal. Information on any other sources of fishing mortality for salmon is also requested.

5. In response to question b) iv, if ICES concludes that there is a need for a study, provide an overview of the parameters and time frame that should be considered for such a study. Information reported under previous efforts and on migration corridors of post-smolts in the Northeast Atlantic developed under SALSEA-Merge should be taken into account.

6. In response to questions b) v, c) iv and d) iv, 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.

7. The proposal specifically refers to NAC(13)4, tabled during the North American and West Greenland Commissions during the 2013 NASCO Annual Meeting.

8. 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.

*** The aim should be for NASCO to inform ICES by 31 January of the outcome of utilizing the FWI.**

The NEAC and West Greenland FWI assessments completed in January 2014 both indicated that no reassessment was necessary. There was therefore no requirement for the Working Group to address questions: b) v and vi, c) iv and v, or d) iv and v during the 2014 meeting.

In response to the Terms of Reference, the Working Group considered 41 Working Documents submitted by participants (Annex 1); other references cited in the Report are given in Annex 2. Additional information was supplied by Working Group members unable to attend the meeting by correspondence and or WebEx links. A full address list for the meeting participants is provided in Annex 3. A complete list of acronyms used within this document is provided in Annex 7.

1.2 Participants

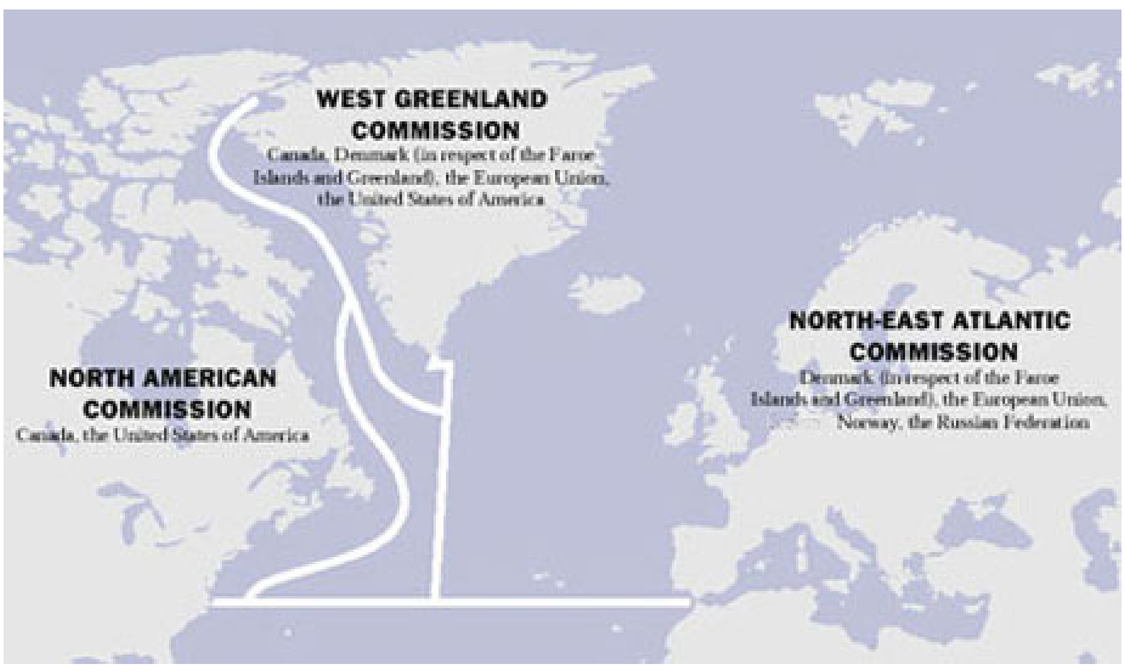
Member	Country
Chaput, G.	Canada
Dankel, D.	Norway (by WebEx)
Degerman, E.	Sweden
Dionne, M.	Canada
Ensing, D.	UK (N. Ireland)
Erkinaro, J.	Finland
Euzenat, G.	France
Fiske, P.	Norway
Gjøsæter, H.	Norway
Gudbergsson, G.	Iceland
Levy, A.	Canada
Meerburg, D.	Canada
Nygaard, R.	Greenland (by WebEx)
Ó Maoiléidigh, N.	Ireland
Orpwood, J.	UK (Scotland)
Potter, T.	UK (England & Wales)
Prusov, S.	Russia
Rivot, E.	France
Robertson, M.	Canada
Russell, I. (Chair)	UK (England & Wales)

Sheehan, T.	USA
Smith, G. W.	UK (Scotland)
Ustyuzhinskiy, G.	Russia
Wennevik, V.	Norway
White, J.	Ireland

1.3 Management framework for salmon in the North Atlantic

The advice generated by ICES in response to the Terms of Reference posed by the North Atlantic Salmon Conservation Organization (NASCO), is pursuant to NASCO's 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. While sovereign states retain their role in the regulation of salmon fisheries for salmon originating in their own rivers, distant water salmon fisheries, such as those at Greenland and Faroes, which take salmon originating in rivers of another Party are regulated by NASCO under the terms of the Convention. NASCO now has six Parties that are signatories to the Convention, including the EU which represents its Member States.

NASCO discharges these responsibilities via three Commission areas shown below:



1.4 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 NASCO's Standing Committee on the Precautionary Approach interpreted this as being "to maintain both the productive capacity and diversity of salmon stocks" (NASCO, 1998).

NASCO's Action Plan for Application of the Precautionary Approach (NASCO, 1999) provides interpretation of how this is to be achieved, as follows:

- "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".

1.5 Reference points and application of precaution

Conservation limits (CLs) for North Atlantic salmon stock complexes have been defined as the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY). 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 maximum sustainable yield (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.

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 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.

It should be noted that this is equivalent to the ICES precautionary target reference points (S_{pa}). Therefore, stocks are regarded by ICES as being at full reproductive capacity only if they are above the precautionary target reference point. This approach parallels the use of precautionary reference points used for the provision of catch advice for other fish stocks in the ICES area.

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.

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, where there are no specific management objectives:

- ICES requires that the lower bound of the confidence interval of the current estimate of spawners is above the CL for the stock to be considered at full reproductive capacity.
- When the lower bound of the confidence limit 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 be suffering reduced reproductive capacity.

For catch advice on fish exploited at West Greenland (non-maturing 1SW fish from North America and non-maturing 1SW fish from Southern NEAC), ICES has adopted, a risk level of 75% of simultaneous attainment of management objectives (ICES, 2003) as part of an management plan agreed by NASCO. ICES applies the same level of risk aversion for catch advice for homewater fisheries on the North American stock complex.

NASCO has not formally agreed a management plan for the fishery at Faroes. However, the Working Group has developed a risk-based framework for providing catch advice for fish exploited in this fishery (mainly non-maturing 1SW fish from NEAC countries). Catch advice is provided at both the stock complex and country level and catch options tables provide both individual probabilities and the probability of simultaneous attainment of meeting proposed management objectives for both. ICES has recommended (ICES, 2013a) that management decisions should be based principally on a 95% probability of attainment of CLs in each stock complex/ country individually. The simultaneous attainment probability may also be used as a guide, but managers should be aware that this will generally be quite low when large numbers of management units are used.

Full details of the assessment approaches used by the Working Group are provided in the Stock Annex (see Annex 6 of this report), and this includes a general introduction at Section 1. Readers new to this report would be advised to read the Stock Annex in the first instance.

2 Atlantic salmon in the North Atlantic area

2.1 Catches of North Atlantic salmon

2.1.1 Nominal catches of salmon

The nominal catch of a fishery is defined as the round, fresh weight of fish that are caught and retained. Total nominal catches of salmon reported by country in all fisheries for 1960–2013 are given in Table 2.1.1.1. Catch statistics in the North Atlantic also include fish farm escapees and, in some Northeast Atlantic countries, ranched fish (see Section 2.2.2). Catch and release has become increasingly commonplace in some countries, but these fish do not appear in the nominal catches (see Section 2.1.2).

Icelandic catches have traditionally been split into two separate categories, wild and ranched, reflecting the fact that Iceland has been the main North Atlantic country where large-scale ranching has been undertaken with the specific intention of harvesting all returns at the release site and with no prospect of wild spawning success. The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching for rod fisheries in two Icelandic rivers continued into 2013 (Table 2.1.1.1). Catches in Sweden have also now been split between wild and ranched categories over the entire time-series. The latter fish represent adult salmon which have originated from hatchery-reared smolts and which have been released under programmes to mitigate for hydropower development schemes. These fish are also exploited very heavily in homewaters and have no possibility of spawning naturally in the wild. 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.

Figure 2.1.1.1 shows the total reported nominal catch of salmon grouped by the following areas: 'Northern Europe' (Norway, Russia, Finland, Iceland, Sweden and Denmark); 'Southern Europe' (Ireland, UK (Scotland), UK (England & Wales), UK (Northern Ireland), France and Spain); 'North America' (Canada, USA and St Pierre et Miquelon (France)); and 'Greenland and Faroes'.

The provisional total nominal catch for 2013 was 1296 t, 115 t below the updated catch for 2012 (1411 t). The 2013 catch was the lowest in the time-series. Catches were at or below the previous ten year averages in the majority of countries, except Greenland, Denmark, St Pierre et Miquelon (France) and Iceland.

Nominal catches in homewater fisheries were split, where available, by sea age or size category (Table 2.1.1.2 weight only). The data for 2013 are provisional and, as in Table 2.1.1.1, include both wild and reared salmon and fish-farm escapees in some countries. A more detailed breakdown, providing both numbers and weight for different sea age groups for most countries, is provided at Annex 4. Countries use different methods to partition their catches by sea age class (outlined in the footnotes to Annex 4). The composition of catches in different areas is discussed in more detail in Sections 3, 4, and 5.

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. Figure 2.1.1.2 presents these data on a country-by-country basis. It should be noted, however, that the way in which the nominal catch is partitioned among categories varies between countries, particularly for estuarine and coastal fisheries. For example, in some countries these catches are split according to particular gear types and in other countries the split is based on whether fisheries operate inside or outside headlands. While it is generally easier to allocate the freshwater (riverine) component of the catch, it should also be noted that catch and release is now in widespread use in several countries (Section 2.1.2) and these fish are excluded from the nominal catch. Noting these caveats, these data are considered to provide the best available indication of catch in these different fishery areas. Figure 2.1.1.2 shows that there is considerable variability in the distribution of the catch among individual countries. There are no coastal fisheries in Iceland, Spain, Denmark, Finland. Coastal fisheries ceased in Ireland in 2007 and no commercial fishing activity occurred in coastal waters of Northern Ireland in 2012-2013. In most countries the majority of the catch is now taken in freshwater except UK (England & Wales), UK (Scotland), Norway and Russia where roughly half of the total catch is still taken in coastal waters.

Coastal, estuarine and riverine catch data for the period 2003 to 2013 aggregated by region are presented in Figure 2.1.1.3. In northern Europe, catches in coastal fisheries have been in decline over the period and reduced from 661 t in 2003 to 228 t in 2013. Freshwater catches have been fluctuating between 537 t and 763 t over the same period. At the beginning of the time-series about half the catch was taken in coastal waters and half in rivers. The proportion of the catch taken in coastal waters over the last six years represents only one third of the total. In southern Europe, catches in coastal and estuarine fisheries have declined dramatically over the period. While coastal and estuarine fisheries have historically made up the largest component of the catch, these fisheries have declined from 557 t and 167 t in 2003 to 114 t and 76 t in 2013, respectively, reflecting widespread measures to reduce exploitation in a number of countries. At the beginning of the time-series about half the catch was taken in coastal waters and one third in rivers. In the last seven years a quarter of the catch in this area has been taken in coastal waters and half in rivers.

In North America, the total catch has been fluctuating around 140 t over the period 2003 to 2013. 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 with the biggest catch taken in 2013 (15 t).

2.1.2 Catch and release

The practice of catch and release in rod fisheries has become increasingly common as a salmon management/conservation measure which aimed at conserving Atlantic salmon stocks and enhancing recreational fisheries. In some areas of Canada and USA, catch and release has been practised since 1984, and since the beginning of 1990s it has also been widely used in many European countries both as a result of statutory regulation and through voluntary practice.

The nominal catches presented in Section 2.1.1 do not include salmon that have been caught and released. Table 2.1.2.1 presents catch-and-release information from 1991 to 2013 for countries that have records. Catch and release may also be practised in other countries while not being formally recorded or where figures are only recently available.

There are large differences in the percentage of the total rod catch that is released: in 2013 this ranged from 15% in Norway (this is a minimum figure) to 80% in UK (Scotland) reflecting varying management practices and angler attitudes among these 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 caught-and-released fish in Russia since 2009. Within countries, the percentage of fish released has tended to increase over time; however there was a slight decrease in numbers reported in some European countries in 2013. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller fish. Overall, over 174 000 salmon were reported to have been released around the North Atlantic in 2013, slightly below the average of the last five years (187 500) which is mostly due to non-reporting in Russia although the level of catch and release fishing is believed to be the same.

Summary information on how catch and release levels are incorporated into national assessments was provided to the Working Group in 2010 (ICES, 2010b).

2.1.3 Unreported catches

Unreported catches by year (1987 to 2013) and Commission Area are presented in Table 2.1.3.1 and are presented relative to the total nominal catch in Figure 2.1.3.1. A description of the methods used to derive the unreported catches was provided in ICES (2000) and updated for the NEAC Region in ICES (2002). Detailed reports from different countries were also submitted to NASCO in 2007 in support of a special session on this issue. There have been no estimates of unreported catch for Russia since 2008 and for Canada in 2007 and 2008. There are also no estimates of unreported catch for Spain and St Pierre et Miquelon (France), where total reported catches are typically small (<10 t).

In general, the derivation methods used by each country have remained relatively unchanged and thus comparisons over time may be appropriate (see Stock Annex, S2.2.4). However, the estimation procedures vary markedly between countries. For example, some countries include only illegally caught fish in the unreported catch, while other countries include estimates of unreported catch by legal gear as well as illegal catches in their estimates. 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).

The total unreported catch in NASCO areas in 2013 was estimated to be 306 t. The unreported catch in the Northeast Atlantic Commission Area in 2013 was estimated at 272 t, and that for the West Greenland and North American Commission Areas at 10 t and 24 t, respectively. The 2013 unreported catch by country is provided in Table 2.1.3.2. Information on unreported catches was not fully provided to enable these to be partitioned into coastal, estuarine and riverine areas.

In the past, salmon fishing by non-contracting parties is known to have taken place in international waters to the north of the Faroe Islands. In recent years, some Norwegian coastguard surveillance flights have usually taken place over the area of international waters in the Norwegian Sea between the beginning of April and end of October. However, there were no reports of any such flights in 2013.

Summary information on how unreported catches are incorporated into national and international assessments was provided to the Working Group in 2010 (ICES, 2010b).

2.2 Farming and sea ranching of Atlantic salmon

2.2.1 Production of farmed Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2013 is 1429 kt, 119 kt below the updated production for 2012 (1548 kt). The production of farmed Atlantic salmon in this area has been over one million tonnes since 2009. The 2013 total represents an 8% decrease on 2012 and a 15% increase on the previous five-year mean (Table 2.2.1.1 and Figure 2.2.1.1). Norway and UK (Scotland) continue to produce the majority of the farmed salmon in the North Atlantic (79% and 11% respectively). Farmed salmon production in 2013 was above the previous five-year average in all countries. Data for UK (N. Ireland) since 2001 and data for east coast USA since 2011 are not publicly available.

Worldwide production of farmed Atlantic salmon has been over one million tonnes since 2002 and was over two million tonnes in 2012. It is difficult to source reliable production figures for all countries outside the North Atlantic area and it has been necessary to use 2012 data from the FAO Fisheries and Aquaculture Department database for some countries in deriving a worldwide estimate for 2013. The total production in 2013 is provisionally estimated at around 1951 kt (Table 2.2.1.1 and Figure 2.2.1.1), a 6% decrease on 2012. Production of farmed Atlantic salmon outside the North Atlantic is estimated to have accounted for 27% of the total in 2013. Production outside the North Atlantic is still dominated by Chile and is now in excess of what it was prior to the outbreak of Infectious Salmon Anaemia (ISA) which impacted the industry in that country from 2007. ISA has recently been confirmed by the Chilean National Fisheries and Aquaculture Service in two cages in a salmon farming centre in Chiloe Island. Affecting Atlantic salmon and similar to influenza viruses, ISA causes severe anaemia of infected fish and if left unchecked, the disease can cause significant mortalities (up to 100%) of farmed stock.

The worldwide production of farmed Atlantic salmon in 2013 was around 1500 times the reported nominal catch of Atlantic salmon in the North Atlantic.

2.2.2 Harvest of ranched Atlantic salmon

Ranching has been defined as the production of salmon through smolt releases with the intent of harvesting the total population that returns to freshwater (harvesting can include fish collected for broodstock) (ICES 1994). The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching with the specific intention of harvesting by rod fisheries has been practised in two Icelandic rivers since 1990 and these data have now been included in the ranched catch (Table 2.1.1.1). A similar approach has now been adopted, over the available time-series, for one river in Sweden (River Lagan). These fish originate in hatchery-reared smolts released under programmes to mitigate for hydropower development schemes with no possibility of spawning naturally in the wild. These have therefore also been designated as ranched fish and are included in Figure 2.2.2.1.

The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2013 was 36 t and taken in Iceland, Ireland and Sweden (Table 2.2.2.1; Figure 2.2.2.1). No estimate of ranched salmon production was made in Norway in 2013 where such catches have been very low in recent years (<1 t) and UK (N. Ireland) where the proportion of ranched fish was not assessed between 2008 and 2013 due to a lack of microtag returns.

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

2.3.1 Quantifying uncertainty in datasets using the 'NUSAP' approach

The Working Group considered proposals in relation to an approach for communicating uncertainty of numbers in a more transparent way. The "Numeral, Unit, Spread, Assessment and Pedigree" (NUSAP) approach has been advocated to better represent unquantifiable uncertainties (Funtowicz and Ravetz, 1986; van der Sluijs *et al*., 2005). The NUSAP approach provides a methodological framework to manage and communicate uncertainty and the quality of quantitative information. This extends the classic notational system for quantitative scientific information (usually provided as a number, a unit, and a standard deviation) with two additional qualifiers: expert judgment of the reliability (the assessment) and a multi-criteria characterization reflecting the origin and status of the information (the pedigree). It was suggested that the approach may be useful in communicating the outcome of fishery assessments and associated management advice; and has recently been applied to an analysis of Western Baltic herring (Ulrich *et al.*, 2010). A graphical representation based on the original application of the process but relating to fisheries management is shown in Figure 2.3.1.1.

The Working Group noted that one of the proposed applications of the NUSAP approach was to enhance communication of the methods used by ICES to stakeholders and managers. This is laudable, but the approach is based on subjective evaluations and the outputs appear likely to be quite detailed. It was therefore unclear how it might be implemented and how much it would assist stakeholders. It may, however, provide a better record of the provenance of data and assessment methods used by the Working Group and thereby enhance the information currently being compiled in the Stock Annex. The Working Group therefore concluded that they would be interested to hear of further development and application of the approach.

2.3.2 Interactions between wild and farmed salmon

2.3.2.1 Genetic introgression between wild and farmed escape salmon in the Magaguadavic River, Bay of Fundy and other genetic investigations in Canada

Recent studies supported by a Natural Sciences and Engineering Research Council of Canada (NSERC) grant, document the genetic temporal changes from 1980 to 2005 of the Magaguadavic River salmon population (Bay of Fundy, Canada), impacted by interbreeding with farmed escapees (Bourret *et al*., 2011). Overall, the results of this study indicate that farmed escapees have introgressed with wild Magaguadavic salmon resulting in significant alteration of the genetic integrity of the native population, including possible loss of adaptation to conditions in the wild.

Another study of interest aimed at understanding the links between the environmental and genetic divergence of Atlantic salmon populations by using a large-scale landscape genomics approach with 5500 genome-wide SNPs across 54 North American populations and 49 environmental variables (Bourret *et al.*, 2013b). Multivariate landscape genetic analysis revealed strong associations of both genetic and environmental factors with climate (temperature-precipitation) and geology being associated with adaptive and neutral genetic divergence and should be considered as candidate loci involved in adaptation at the regional scale in Atlantic salmon.

2.3.2.2 Report on a new salmon trapping technique for farmed escapees in Norway

Recently, it has been documented that gene pools of wild salmon populations in a number of Norwegian rivers are being gradually changed through introgression of genetic material from escaped farmed salmon. Comparing genetic profiles for salmon populations from 21 Norwegian rivers, developed from archival scale samples and contemporary scale and tissue samples, changes were documented through analyses of microsatellites (Glover et *al.*, 2012), and SNPs (Glover et *al.*, 2013). In many rivers, considerable effort is invested to remove escaped farmed salmon from the spawning populations through various approaches, including netting, rod catches and culling by divers. In 2013, the Resistance Board Weir trap concept, a portable salmon trap developed in North America for catching spawners migrating upstream, was tested in the River Etneelva, Norway. This was done in collaboration between the Institute of Marine Research, management authorities and the salmon farming industry.

The River Etneelva is a national salmon river (a river given special protection), and it is one of the largest salmon rivers on the west coast of Norway. The trap concept is based on floating panels, which prevent the salmon from ascending beyond the trap, and at the same time guide the fish into a trap chamber. This is the first time the concept has been tested outside North America and on Atlantic salmon and anadromous trout (*Salmo trutta)*. Altogether 1154 wild salmon, 85 escapees and 922 trout were captured. Catch efficiency of the trap was estimated by recapture rates by anglers, and by counts of spawners performed by drift dives (snorkelling). Based on the two estimates, about 85% of ascending salmon were captured in the first year of operation, and 92% of ascending escaped farmed salmon were removed. The catch rate (excluding caught and released fish) by anglers was calculated at 26%. The conclusion from the first year of operation is that the trap works very well also for Atlantic salmon and anadromous trout, and can be considered a useful tool for generating precise data on the spawning run of wild salmonid populations, as well as an efficient method for removing farmed salmon from wild salmon populations.

2.3.3 Tracking and acoustic tagging studies in Canada

The Working Group reviewed the results of ongoing projects (led by the Atlantic Salmon Federation (ASF) in collaboration with the Ocean Tracking Network (OTN), Miramichi Salmon Association, DFO and others), to assess estuarine and marine survival of tagged Atlantic salmon released in rivers of the Gulf of St Lawrence. A total of 248 smolts from four rivers in Canada (24 St Jean, 39 Cascapedia, 105 Miramichi, 80 Restigouche) and 41 kelts (16 Miramichi and 25 Restigouche) were sonically tagged between April and June 2013. Of the 41 kelts tagged with acoustic tags, eleven Miramichi kelts were also tagged with archival pop-up tags. These archival pop-up tags were set to release after four months.

The proportion of smolts detected (apparent survival) in 2013 from freshwater release points to the heads of tide, through the estuary and out of the Strait of Belle Isle, was somewhat lower than the previous years for the Cascapedia and Restigouche rivers and much lower for the Miramichi River; few St Jean fish were detected as in previous years (Figure 2.3.3.1). Smolts and kelts exited the Strait of Belle Isle together during the last week of June and first week of July, which was about the same time as in 2012. Analysis is proceeding to account for the variability in detection efficiency by receivers so stage survival estimates and their variability may be estimated.

The detector array across the Cabot Strait, between Cape Breton, Nova Scotia and Southwest Newfoundland was completed in 2012 and operational through 2013, although few fish used this exit from the Gulf of St Lawrence (one Cascapedia smolt in mid-June and one Miramichi kelt in late July, that had been tagged in spring 2012).

The satellite archival pop-up tags provided additional information in 2013, with information from seven of the tags that left the Miramichi River being recovered, and two of these transmitting information from the northern Labrador Sea when they "popped-off" at the start of September (Figure 2.3.3.2). Preliminary results show evidence of predation on salmon kelts within the Gulf of St Lawrence (likely by species such as a porbeagle shark), the concentration of kelts south of Anticosti Island during the summer and four fish leaving the Gulf of St Lawrence through the Strait of Belle Isle. The remainder stayed within the Gulf. Predation by large predatory fish has been noted previously for the Inner Bay of Fundy (le Croix, 2013).

For the second year, in 2013, a new mode of detection of acoustically tagged salmon was investigated in the Gulf of St Lawrence. A Wave Glider® was released into the Gulf of St Lawrence along the west coast of Prince Edward Island in mid-May and the movements of the Wave Glider were controlled to pass through areas expected to contain acoustically tagged smolts and kelts on their migration through the Strait of Belle Isle. Four salmon kelts were detected, as well as an acoustically tagged snow crab that was detected near the end of August. The Wave Glider trial ended off Cape Breton Nova Scotia in early September.

In 2013, the Atlantic Salmon Federation collaborated with the Miramichi Salmon Association and DFO in a study of striped bass and Atlantic salmon smolt interactions on the Miramichi River. Acoustic tags were used to document the spatial and temporal overlap of the two species, the downstream migrating salmon smolts and the spawning migration into the lower Miramichi of the Gulf of St Lawrence striped bass population. Significant losses of Miramichi smolts were detected in areas where striped bass were known to be spawning (Figure 2.3.3.3). Further work is ongoing, including diet and investigation of migrations of acoustically tagged striped bass.

The Working Group encourages the continuation of this tracking programme as information from it is expected to be useful in the assessment of marine mortality on North American salmon stocks. The Working Group also notes that these techniques are being proposed for other areas (Section 2.8.1).

2.3.4 Diseases and parasites

2.3.4.1 Testing for infectious salmon anaemia virus (ISAv) and infectious pancreatic necrosis virus (IPNv) in mixed-stock aggregations of Atlantic salmon harvested along the coast of West Greenland, 2003–2011

Infectious salmon anaemia virus (ISAv) and infectious pancreatic necrosis virus (IPNv) are fish pathogens that cause vascular disease and digestive disease respectively in Atlantic salmon often with lethal effects. ISAv can cause mortality at any life stage whereas IPNv usually causes mortality in juvenile stages (i.e. fingerling to post-smolt) but adults can be carriers of the disease and pass it to their offspring. The viruses are transmitted through a number of direct and indirect mechanisms, including contact with infected individuals and infected ambient water. Although naturally occurring, rates of ISAv and IPNv infection and epidemic outbreak are higher in and around aquaculture facilities due to the density at which fish are held. Wild individuals that come into contact with infected fish (either by migrating past farms or through contact with infected aquaculture escapees) can contract these viruses and pass disease to other wild individuals and populations. The diseases may therefore spread when individuals are in close proximity in the wild, such as when congregating at specific marine feeding areas.

Testing was carried out on 1284 Atlantic salmon sampled at West Greenland for ISAv from 2003–2007 and 2010–2011, and 358 Atlantic salmon in 2010 for IPNv. Samples from 2003–2007 were collected and processing was funded by NOAA Fisheries Service (USA). Samples from 2010–2011 were collected as part of SALSEA Greenland and processing was funded by NOAA Fisheries Service. The rate of ISAv infection was very low 0.08% (Table 2.3.4.1). A single North American origin Atlantic salmon was infected with a Scottish strain of HRPO (non-virulent ISA strain) suggesting that the transmission vector may have been another infected individual, possibly at the mixed-stock feeding grounds in the Labrador Sea or West Greenland. No fish tested positive for IPNv. These findings indicate that ISAv and IPNv are carried at very low to non-detectable levels in the wild Atlantic salmon population off the coast of West Greenland.

2.3.4.2 Update on Red Vent Syndrome (Anasakiasis)

Over recent years, there have been reports from a number of countries in the NEAC and NAC areas of salmon returning to rivers with swollen and/or bleeding vents. The condition, known as red vent syndrome (RVS or Anasakiasis), has been noted since 2005, and has been linked to the presence of a nematode worm, *Anisakis simplex* (Beck *et al*., 2008). This is a common parasite of marine fish and is also found in migratory species. However, while 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, their presence in the muscle and connective tissue surrounding the vents of Atlantic salmon is unusual. The reason for their occurrence in the vents of migrating wild salmon, and whether this might be linked to possible environmental factors, or changes in the numbers of prey species (intermediate hosts of the parasite) or marine mammals (final hosts) remains unclear.

A number of regions within the NEAC area observed a notable increase in the incidence of salmon with RVS in 2007 (ICES, 2008a). Levels in the NEAC area were typically lower from 2008 (ICES, 2009a; ICES, 2010b; ICES, 2011b). However, trapping records for rivers in UK (England & Wales) and France suggested that levels of RVS increased again in 2013, with the observed levels being the highest in the time-series for some of the monitored stocks.

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. This is consistent with the lower incidence of RVS in fish sampled in tributaries or collected as broodstock compared with fish sampled in fish traps close to the head of tide.

2.3.4.3 Update on sea lice investigations in Norway

The surveillance programme for salmon lice infection on wild salmon smolts and sea trout at specific localities along the Norwegian coast continued in 2013 (Bjørn *et al.*, 2013), and for most areas sea lice infestation tended to be lower in the salmon smolt migration period than it had been in previous years.

In general, sea lice are still regarded as a serious problem for salmonids (Skilbrei *et al*., 2013; Krkošek *et al.*, 2013) and especially sea trout (Bjørn *et al*., 2013). Furthermore, a recent study has demonstrated that sea lice infections may alter life-history characteristics of salmon populations. Long-term studies with vaccination of smolts from Dale and Vosso rivers have shown that fish infested with sea lice may delay their spawning migration and return as MSW fish instead of as grilse (Vollset *et al*., 2014).

2.3.5 Quality Norm for Norwegian salmon populations

In 2013 a management system - The Quality Norm for Wild Populations of Atlantic Salmon (“Kvalitetsnorm for ville bestander av atlantisk laks”) - was adopted by the Norwegian government (Anon., 2013). This system was based on an earlier proposal by the Norwegian Scientific Advisory Committee for Atlantic Salmon Management (Anon., 2011). In 2014 work is in progress to categorise the most important Norwegian salmon populations according to this system.

According to the quality norm the status of salmon stocks is evaluated in two dimensions (Figure 2.3.5.1), one dimension is the conservation limit and the harvest potential and the other dimension is the genetic integrity of the stocks. In the conservation limit and harvest potential dimension both the attainment of the conservation limit (after harvest) and the potential for harvest in relation to a “normal” harvest potential is evaluated. The genetic integrity is evaluated in relation to species hybridization, genetic introgression from escaped farmed salmon and altered selection as a result of selective harvest and/or human induced changes in the environment. The worst classification in any of the dimensions determines the final classification of the stock.

2.3.6 Developments in setting reference points in Canada (Québec) and Finland

2.3.6.1 Update of stock–recruitment models in Québec

Since the year 2000, management of Atlantic salmon in Québec has been based on biological reference points obtained from stock–recruitment models (Fontaine and Caron, 1999; Caron *et al*., 1999). However, population dynamics have changed in Québec through the 1990s, as elsewhere in North America, following anthropogenic and environmental changes affecting both freshwater and marine survival of salmon (Friedland *et al*., 2000). Moreover, since then, reliable data on stock abundance and characteristics have been collected in Québec (Cauchon, 2014) and stock–recruitment analyses have evolved with the development of new approaches (Parent and Rivot, 2012).

The Government of Québec has started to update its stock–recruitment model by using recent data and incorporating an up-to-date modelling approach. This initiative is part of a wider process aimed at developing a management plan for Atlantic salmon in Québec, and will allow updating of biological reference points so as to accurately represent the current status of salmon populations. The new Ricker model being developed includes twelve rivers from a broader geographical scale and having a wider range of production units than the previous model. At least 15 extra years were included in the new model, which now covers cohorts between 1972 and 2005. A Bayesian hierarchical approach was used, allowing uncertainty associated with population dynamics to be incorporated (Parent and Rivot, 2012). This approach also allowed habitat production units to be introduced as covariables in an integrated way, to better explain between river variability and estimate biological reference points to other rivers of Québec without stock–recruitment data but with known production units. It is anticipated that the new model will be implemented in 2015.

2.3.6.2 Progress with setting river-specific conservation limits in the River Teno/Tana (Finland/Norway)

In the River Teno/Tana (Finland/Norway), information has been collated to set conservation limts (CLs) for most of the tributary systems and the main stem of the river following the Norwegian standard method (Hindar *et. al*., 2007; Forseth *et al*., 2013). In addition, CLs have been updated for five Norwegian tributaries of the Teno system. A report will be published in 2014 describing the new CLs for this river system.

2.3.7 Recovery potential for Canadian populations designated as endangered or threatened

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) subdivided Canadian Atlantic salmon populations into 16 Designatable Units (DUs) based on genetic data and broad patterns in life-history variation, environmental variables, and geographic separation (COSEWIC 2010). Of the 16 DUs, one (Inner Bay of Fundy, DFO 2008) had been listed as endangered under Canada's federal Species at Risk Act (SARA) since 2003. In 2010, COSEWIC assessed five other DUs as either "Endangered" (at risk of becoming extinct) or "Threatened" (at risk of becoming endangered), and four DUs as "Special Concern" (at risk of becoming threatened or endangered). For the five DUs assessed as threatened or endangered, DFO has recently conducted Recovery Potential Assessments (RPAs) to provide scientific information and advice to meet the various requirements of the SARA listing process (DFO 2013a, DFO 2013b, DFO 2013c, DFO 2014a, and DFO 2014b). The location of each DU is shown in Figure 2.3.7.1. Among the advice, each RPA contains information on population viability and recovery potential for populations with enough information to model population dynamics, as well as information on threats to persistence and recovery.

Results of population viability analyses and review of the threats for each of these five DUs indicate:

- **South Newfoundland (DU 4), Threatened –** The DU has a low probability of extinction. Under contemporary marine survival rates, the probability of meeting or exceeding the recovery target within the next fifteen years was improved by reducing recreational fishery mortality rates. However, relatively small increases in marine survival rates greatly improved the probability of recovery. Factors influencing marine survival may include: illegal fisheries, mixed-stock marine fisheries and bycatch, ecological and genetic interactions with escaped farmed Atlantic salmon, and changes in marine ecosystems.
- **Anticosti (DU 9), Endangered –** The DU has a low probability of extinction. If survival and carrying capacity remain the same, the probability of meeting or exceeding the recovery target within the next fifteen years was improved by reducing sport fishery mortality rates. A lower survival rate during the marine phase may be one of the main causes of decline. The Anticosti rivers are rarely disturbed by human activities. However, strong natural variations in the water level and the particular geological structure of this area could be limiting factors for the DU.
- **Eastern Cape Breton (DU 13), Endangered –** The probability of extinction for the two populations (considered to be two of the healthier populations) with enough information to model population dynamics is low if conditions in future are similar to those in the recent past. Similarly, neither population is expected to reach and remain above conservation requirements unless overall productivity (including reproduction and/or survival) is improved. Given the life-history variability seen throughout the DU, the two populations included in the analyses are not considered to be representative of other populations in the DU. The only threat to persistence and recovery in freshwater environments identified with a high level of overall concern is illegal fishing. Threats identified with a high level of overall concern in estuarine and marine environments are (importance not implied by order): salmonid aquaculture; marine ecosystem changes; and diseases and parasites.
- **Southern Upland (DU 14), Endangered –** A region-wide comparison of juvenile density data indicated significant ongoing declines and provided evidence of river-specific extirpations. Modelling indicates two of the larger populations remaining in the DU have a high probability of extirpation in the absence of human intervention or a change in survival rates for some other reason. Modelling also indicates that relatively small increases in either freshwater productivity or marine survival are expected to decrease extinction probabilities, although larger changes in marine survival are required to restore populations to levels above conservation requirements. Threats to persistence and recovery in freshwater environments identified with a high level of overall concern

include (importance not implied by order): acidification; altered hydrology; invasive fish species; habitat fragmentation due to dams and culverts; and illegal fishing and poaching. Marine and estuarine threats identified with a high level of overall concern are salmonid aquaculture and marine ecosystem changes.

- **Outer Bay of Fundy (DU 16), Endangered –** The two rivers with enough information to model population dynamics are at risk of extinction. Specifically, abundance of the Nashwaak River population (index river for populations on the Saint John River below Mactaquac Dam) will continue to decline under current conditions. Increases in freshwater productivity are expected to result in an increase in population abundance and a decreased extinction probability, although increases in both freshwater productivity and marine survival are required to meet recovery targets with higher probabilities. Modelling for the Tobique River population (index for Saint John River upriver of Mactaquac Dam) indicates that it will extirpate unless the number of spawners replaced from one generation to the next improves. Freshwater production, downstream fish passage survival, and marine survival all have to improve to achieve recovery targets for this population. Threats to persistence and recovery in freshwater environments identified with a high level of overall concern for the DU include hydroelectric dams and illegal fishing activities. Marine threats identified with a high overall level of concern are (importance not implied by order): shifts in marine conditions; salmonid aquaculture; depressed population phenomenon; and disease and parasites.

2.3.8 Genetic Stock Identification

2.3.8.1 North American genetic database

A NSERC strategic grant has allowed the development of a North American genetic database using standardized markers across Canada and USA. The database includes 9042 individuals from 152 sampling locations genotyped at 15 microsatellite loci standardized across three different laboratories. The North American database can be used for the analysis of mixed-stock fisheries and individual assignment to estimate populations most impacted by such fisheries. The database also includes data from an EST-based medium-density SNP array which provides data on over 5000 SNPs for 20–25 individuals for each of 46 sampling locations (Bourret *et al.*, 2013a). The SNP dataset is divided into neutral and potentially adaptive markers based on a genome scan analysis. The first use of this database was to define regional groups. This was done by comparing microsatellites, neutral SNPs and potentially adaptive SNPs in Québec. Seven regional genetic groups were confirmed for the province of Québec, New Brunswick and Labrador (Figure 2.3.8.1), and analyses with SNP identified the same regional groups as previous analyses with microsatellites (Dionne *et al.*, 2008).

2.3.8.2 Composition of the mixed-stock fisheries at Greenland

A mixed-stock fishery analysis has previously been carried out for the salmon fishery at Greenland using part of the microsatellite baseline (Gauthier-Ouellet *et al.*, 2009). The entire North American microsatellite baseline has subsequently been used in a preliminary analysis of the 2011 West Greenland salmon harvest (Bradbury, DFO Canada, pers.

comm.). Average sample composition estimates obtained using Bayesian mixture analysis suggest that the majority of the catch comprised fish originating in Labrador (15%), Québec upper north shore (10%), Gaspé Peninsula (33%), and Maritimes (27%) populations. Other regions in North America were also detected, but at lower levels. It is proposed that samples collected in additional years (e.g. 2012, 2013) will be analysed in future.

2.3.8.3 Composition of the mixed-stock fisheries at Labrador

The stock composition and exploitation of Atlantic salmon in Labrador Aboriginal and subsistence fisheries was evaluated for 1772 individuals between 2006 and 2011, using genetic mixture analysis and individual assignment with the entire microsatellite baseline (Bradbury *et al.*, in press). For assignment purposes, eleven groups (Figure 2.3.8.1) were identified for which assignment accuracy was >90%. Bayesian and maximum likelihood mixture analyses indicate that 85–98% of the harvest originates from populations in Labrador. Estimated exploitation rates were highest for Labrador salmon (4.3–9.4% per year) and generally <1% for all other regions. Individual assignment of fishery samples indicates that non-local contributions to the fishery (e.g. Maritimes, Gaspé Peninsula) were rare and occurred primarily in southern Labrador, consistent with discrete migration pathways through the Strait of Belle Isle.

2.3.8.4 Composition of the mixed-stock fisheries at Saint-Pierre et Miquelon

The stock composition of Atlantic salmon caught in the mixed-stock fisheries at Saint-Pierre et Miquelon in 2013 was examined using the North American baseline described above. Samples from the 2013 fishery were assigned to one of eleven regions in North America (Figure 2.3.8.1). This is the first time samples from the fishery have been examined against the extensive baseline for North America with assignment of individual fish to one of eleven regional groups. Preliminary results of this analysis are reported in Section 4.1.5.

2.3.8.5 Composition of the catch in the mixed-stock fishery at Faroes

Preliminary results were reported from a genetic study of salmon scales collected in the Faroes salmon fishery in the 1980 and 1990s. This study involves scientists from UK (Cefas and Marine Scotland Science), Norway (NINA and IMR) and Faroes (MRI) and is funded by the NASCO IASRB, and by UK, Norwegian and Irish government departments. The aim of the study was to extract DNA from the historical scale samples and use the genetic stock assignment protocol developed during the SALSEA-Merge project (Gilbey *et al.*, in Prep.) to estimate the historical stock composition of the catch.

Approximately 375 scale samples collected during each of the 1983/1984 and 1984/1985 commercial fisheries and the 1993/1994 and 1994/1995 research fisheries were selected for analysis. Initial results showed significant degradation of the DNA in some of the monthly samples, possibly resulting from the way the samples were collected or stored. Reliable allele scorings could not be achieved for many of the microsatellites used, as alleles with a length above 200 base pairs were largely missing. Improved DNA amplification was achieved for the later period using a modified PCR process (Paulo Prodohl, pers. comm.) but this approach was less successful for the earlier period. As a result the decision was made to limit the analysis to the 1993/1994 and 1994/1995 samples.

Initial examination of the alleles at the SsaD486 microsatellite locus indicated that there were a number of samples with alleles normally only seen in North American fish. Further exclusion and conformation analyses also indicated that 101 of the samples (16%) were probably from salmon of North American origin. Further analysis will be undertaken to confirm the classification of these samples as coming from salmon of American origin. The remaining fish have been assigned using a mixed-stock analysis performed separately for each month represented in the samples. Fish have been assigned to the hierarchical reporting units at four Levels (1–4) as defined by the SALSEA-Merge project (Gilbey *et al.*, in Prep.). The assignments at Levels 1 and 3 were scaled to the average distribution of the catch during the fishing season when the commercial fishery operated in the 1980s. Initial results suggest that around two thirds of the European fish in the catch may have come from northern NEAC countries and one third from southern NEAC countries; this represents a significant change from the approximately 50:50 split currently used in the NEAC assessments. Further work will be undertaken to provide confidence limits for the estimation of catch composition and to determine how these results should be used in the NEAC assessment models.

2.3.9 Update on EU project ECOKNOWS –embedding Atlantic salmon stock assessment at a broad ocean scale within an integrated Bayesian life cycle modelling framework

Within the EU FP7 Ecoknows project, models are being developed that provide improvement to PFA stock assessment models. As a key step in this direction, a Bayesian integrated life cycle model has been successfully developed that brings a substantial contribution to Atlantic salmon stock assessment on a broad ocean scale. The approach also paves the way toward harmonizing the stock assessment models used in the WGBAST (ICES Baltic salmon and trout assessment working group) and in WGNAS (Rivot *et al.*, 2013).

The Bayesian integrated life cycle modelling approach provides methodological improvements to the PFA forecasting models currently used:

- Existing biological and ecological information on Atlantic salmon demographics and population dynamics are first integrated into an age and stage-based life cycle model, which explicitly separates the freshwater (egg-to-smolt) and marine phases (i.e. smolt-to-return, accounting for natural and fishing mortality of sequential fisheries along the migration routes), and incorporates the variability of life histories (i.e. river and sea ages) (Figure 2.3.9.1). This body of prior information forms the prior about the population dynamics, which is then updated through the model with assimilation of the available data.
- Both ecological processes and various sources of data are modelled in a probabilistic Bayesian rationale. Uncertainties are accounted for in both estimations and forecasting.
- The structure provides a framework for harmonizing the models and parameterization between different stock units, while maintaining the specificities and associated levels of detail in data assimilation.

- This also offers flexibility to improve the ecological realism of the model as different hypothesis regarding the population dynamics can be assessed without changing the data assimilation scheme.

The model has been successfully applied to the Eastern Scotland stock unit, the largest regional component of the southern Northeast Atlantic stock complex (Massiot-Granier *et al.*, 2014) and demonstrated by testing different demographic hypotheses:

- Density-dependent effects in the freshwater phase can change estimates of trends in marine productivity, which may critically impact forecasts of returns and ecological interpretation of the changes in marine productivity.
- Two alternative hypotheses for the decline of return rates in 2SW fish are equally supported by the data: (1) a constant natural mortality rate after the PFA stage and an increase in the proportion maturing (current hypothesis in PFA models); (2) an increase in the natural mortality rate of 2SW fish relative to 1SW fish, and a constant proportion maturing. Changing from one hypothesis to the other may critically impact management advice, as applying a greater mortality rate for 2SW limits the expected impact, and therefore size of catch for the 2SW stock component.

A multi-regional extension of the integrated life cycle model developed by Massiot-Granier *et al.* (2014) is under development. The model captures the joint dynamics of all the regional stock units considered by ICES for stock assessment in the Southern NEAC stock complex (Figure 2.3.9.1).

- Data available at the scale of eight stock units have been implemented as five units, applying the spatial variability of the post-smolt marine survival and the probability of maturing after the first winter at sea: i) France, ii) UK (England & Wales, iii) Ireland and UK (N. Ireland) iv) UK (Scotland East and West) and v) Iceland Southwest.
- The hierarchical structure provides a tool for separating out signals in demographic traits at different spatial scales: i) a common trend shared by the five stock units and, ii) fluctuations specific to each stock unit.
- Both post-smolt survival during the first months at sea (smolts to PFA stages) and the proportion of salmon returning to freshwater after two years at sea exhibit common decreasing trends in the stock units (Figure 2.3.9.2). Results support the hypothesis of a response of salmon populations to broad scale ecosystem changes but changes specific to each of the five stock units still represent a significant part of the total variability (~40%), suggesting a strong influence of drivers acting at a more regional scale.

In association with ICES, the ECOKNOWS project will disseminate findings at the end of its tenure with a concluding symposium: *"Ecological basis of risk analysis for marine ecosystems"*, which is scheduled to be held 2–4 June 2014 in Porvoo, Finland. Theme sessions include:

1) Fisheries management under uncertainty;

2) Decision modelling in fisheries management;

3) Probabilistic fish stock assessment;

4) Oil spill and eutrophication risk analysis;
5) Environmental risk assessment for marine areas;
6) Risk analysis in aquaculture.

2.4 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 Working Group on the Effectiveness of Recovery Actions for Atlantic salmon (WGERAAS) will have its second meeting on 12–16 May 2014 at ICES in Copenhagen. A subgroup of WGERAAS met in Swansea (UK) on 18–19 June 2013 to develop the database and approaches to data reporting. The database consists of all rivers from the HELCOM and NASCO river databases, combined with a system scoring the impact of a list of ten stressors and twelve recovery actions on a river-by-river basis. A guide has been developed to assist in populating the database.

ICES has granted a request to extend the duration of the Working Group by two years, taking the total duration to three years. WGERAAS received the following guidance from NASCO with regards to the TORs: "NASCO is particularly interested in case studies highlighting successes and failures of various restoration efforts employed across the North Atlantic by all Parties/jurisdictions and the metrics used for evaluating success or failure". WGERAAS acknowledged the NASCO comment and will focus the work to include such case studies as mentioned by NASCO.

2.5 NASCO has asked ICES to provide a review of the stock status categories currently used by the jurisdictions of NASCO, including within their Implementation Plans, and advise on common approaches that may be applicable throughout the NASCO area

2.5.1 Introduction

The Atlantic salmon is widely distributed throughout the North Atlantic area; from northern Portugal (~42˚N) to northwest Russia (~68˚N) in the NE Atlantic and from New England (~41˚N) to northern Québec (~59˚N) in the NW Atlantic (source NASCO website). It is estimated that Atlantic salmon occur in around 2500 rivers in this area. NASCO has developed a rivers database and NASCO parties are obliged to complete details of each of their salmon rivers. The database is an important source of information on Atlantic salmon stocks and rivers. Most countries have provided data for this database, using the classification scheme described below, but NASCO has expressed concerns that this does not reflect the use of Conservation Limits (CLs) and Management Targets (MTs) in making management decisions, as agreed by NASCO.

The NASCO rivers database provides information on the status of the salmon stocks based on seven categories http://www.nasco.int/RiversDatabase.aspx. http://www.nasco.int/pdf/reports_other/River_Categories.pdf . The database relates to salmon only and is applied to rivers primarily with reference to stock status.

The categories used in the NASCO rivers database (applied by all NASCO jurisdictions) are defined as:

> **Lost -** Rivers in which there is no natural or maintained stock of salmon but which are known to have contained salmon in the past.
>
> **Maintained -** Rivers in which there is no natural stock of salmon, which are known to have contained salmon in the past, but in which a salmon stock is now only maintained through human intervention.
>
> **Restored -** Rivers in which the natural stock of salmon is known to have been lost in the past but in which there is now a self-sustaining stock of salmon as a result of restoration efforts or natural recolonization.
>
> **Threatened with loss -** Rivers in which there is a threat to the natural stock of salmon which would lead to loss of the stock unless the factor(s) causing the threat is(are) removed.
>
> **Not threatened with loss -** Rivers in which the natural salmon stocks are not considered to be threatened with loss (as defined in the previous category).
>
> **Unknown -** Rivers in which there is no information available as to whether or not it contains a salmon stock.
>
> **Not present but potential for salmon -** Rivers in which it is believed there has never been a salmon stock but which it is believed could support salmon if, for example, natural barriers to migration were removed.

Many jurisdictions also implement other categorization systems, either through obligations under EU (e.g. EU Habitats Directive) or national legislation (e.g. Species at Risk Act, Canada and Endangered Species Act USA). Categorizations are often provided with scientific advice for management purposes, which are closely linked to national management objectives requiring stocks to attain particular biological reference points (limit reference points and or management targets). NASCO currently requires parties to report the current status of stocks relative to the reference points and how threatened and endangered stocks are identified within their national Implementation Plans. These categories may require specific assessments or data or may only be applicable to rivers being assessed for compliance and not all rivers in a jurisdiction. A key difference in the various categories in use is whether they are applied at the stock level or at the species level.

2.5.2 Review of the stock status categories currently used by the jurisdictions of NASCO, including within their Implementation Plans

A range of stock status categories are used by different jurisdictions. Table 2.5.2.1 provides examples of various different stock categories in use for countries where categories are based on clear criteria. Countries with no specific national classification are excluded, although details of the broad approaches used in all NAC and NEAC countries are included in Working Paper 41. The following provides a brief overview:

Canada

The abundance of Atlantic salmon relative to conservation limits (CLs) is used in Canada to assess stock status (Table 2.5.2.1). Of the 1082 Canadian Atlantic salmon rivers tabulated in the NASCO database, annual assessments of returns and status relative to the CLs are available from between 65 and 75 major rivers.

In addition, reference points are being developed in Canada to reflect the application of the Precautionary Approach (DFO, 2006). The framework for this is shown in Figure 2.5.2.1.

Ireland

River and age specific conservation limits (CLs) have been derived and categorisation of status of stocks for the provision of catch advice is based on a stock assessment for all 141 salmon producing rivers in Ireland separately. This provides estimates of returns (counters, catches raised by exploitation rates) and status of stocks relative to the attainment of CLs. Advice on catch options is presented in relation to the 75% probability that this CL will be met, based on the average returns of the previous five years (Table 2.5.2.1).

Norway

Spawning targets have been calculated for 439 out of the approximately 465 Norwegian rivers containing salmon. Attainment of spawning targets is assessed for about 200 river stocks; these account for about 98% of the total river catch of salmon in Norway. For the purpose of giving advice on harvest, the management target was defined as being reached when the average probability of reaching the spawning target in the four previous years was more than 75%.

Assessment is now also based on the effects of human impacts which affect fish production and stock abundance and the capacity to produce a harvestable surplus. Norway established a salmon stock registry in 1993 and a new system was published in 2012. This classification system (Table 2.5.2.1) is based on a combination of both the number of fish in the populations and influences of different threats to the populations. The most influential factor in this new category system, the Quality Norm, is the modelled genetic integrity of the population (further details are provided in Section 2.3.5).

Sweden

As river-specific CLs are lacking for Swedish rivers, the stock status for each river is assessed using the abundance of parr. Salmon habitat quality is classed in three categories according to depth, water velocity, dominant substratum, slope and stream wetted width. For each category an expected abundance is calculated from electrofishing data from the 1980s when the number of returning spawners was high. Data from each site each year are then compared to the expected value and expressed as a percentage. All sites in a river are pooled and the average (and 95% confidence limits) is calculated. Out of 23 rivers, data are collected and stock status determined annually for 17 of these to enable categorisation (Table 2.5.2.1).

UK (England & Wales)

There are 80 river systems in UK (England & Wales) that regularly support salmon, although some of the stocks are very small and support minimal catches or are dominated by sea trout. CLs have been set for 64 principal salmon rivers. Annual compliance with the CL is estimated using egg deposition figures. These are derived from returning stock estimates, where such data are available. However, for rivers without traps or counters, egg deposition is typically based on estimates of the run size derived from rod catch and estimates of exploitation (with an appropriate adjustment for under reporting). In reviewing management options and regulations, the management objective is for a river's stock to meet or exceed its CL in at least four years out of five (i.e. >80% of the time) on average. Compliance against this management objective is assessed annually and stocks categorised into four groups (Table 2.5.2.1).

UK (N. Ireland)

River-specific CLs have been used to assess compliance and stock status for twelve out of 15 rivers in UK (N. Ireland). Biological reference points, for individual catchments, have been established in both DCAL and Loughs Agency jurisdictions. The status of stocks in the DCAL area is assessed relative to CLs while Management Targets (MTs) based on CLs are used to manage in real time within the Loughs Agency area. Specific categories have been derived to advise on the status of stocks (Table 2.5.2.1).

USA

The process for designating threatened and endangered stocks is specified in the US Endangered Species Act. In short, the National Marine Fisheries Service or US Fish and Wildlife Service conducts a review of the species status.

ICES stock status categories–used by all NASCO jurisdictions

ICES categorises Atlantic salmon stock groups as being: at full reproductive capacity; at risk of suffering reduced reproductive capacity or suffering reduced reproductive capacity (Table 2.5.2.1). This categorisation is used for assessment and the provision of catch advice on management of national components and geographical groupings.

2.5.3 Review of other classification schemes used for categorising species in use by Parties to NASCO

In addition to the categorisation of stocks, species classification requirements commonly also apply. Details of these schemes are provided in Table 2.5.3.1. The following provides a brief overview:

Canada – COSEWIC

The Committee on the Status of Endangered Species in Canada (COSEWIC) identifies species at risk through processes put in place under the federal *Species at Risk Act* (SARA) and similar provincial laws (http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl2). A range of categories apply (Table 2.5.3.1).

Texel–Faial – Used for EU classification of species

The Texel-Faial classification is used by OSPAR and applied to regional assemblages rather than individual stocks:

http://www.ospar.org/documents/dbase/decrecs/agreements/03-13e_Texel_Faial%20criteria.doc

Annex V to the OSPAR Convention indicates that a package has been prepared to identify those species and habitats in need of protection, conservation and, where practical, restoration and/or surveillance or monitoring. OSPAR nominated the Atlantic salmon for inclusion under this scheme on the basis of an evaluation of their status according to the Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application (the Texel-Faial Criteria) (OSPAR, 2003), with particular reference to its global/regional importance, decline and sensitivity, with information also provided on threat. A review of the status of Atlantic salmon was therefore carried out (OSPAR, 2010).

Following this review, Atlantic salmon were classified by OSPAR as qualifying under the criteria: Global Importance, Local Importance, Sensitivity, Keystone species and Decline. Atlantic salmon, however, did not qualify under the category of Rarity (Table 2.5.3.2).

European Union Habitats Directive – used for EU classification of species

The Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna) is used by the EU for the classification of species or habitats. Further details are available at:

http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm

If a species is included under this Directive, it requires measures to be taken by individual EU Member States to maintain or restore them to favourable conservation status in their natural range. While the objective of the EU is for nominated species to achieve "favourable status", the classification system pre-supposes that the species are in need of protection. The categories are described as Annexes (Table 2.5.3.1).

Convention on the Conservation of European Wildlife and Natural Habitats (The Bern Convention)

Further details on the Bern Convention are available at:

http://www.coe.int/t/e/cultural_co--operation/environment/nature_and_biological_diversity/Nature_protection/

Atlantic salmon are included under Appendix/Annex III (freshwater only) (Table 2.5.3.1).

The World Conservation Union (IUCN) – (Red Data Books/Lists and Categories)

The IUCN Red Data Book is used to categorise species or geographic assemblages of species. A range of categories apply from 'extinct' to 'not evaluated' (Table 2.5.3.1).

2.5.4 Comparison of NASCO River Database categories with other classification systems

The primary differences in the categories illustrated above relate to whether they are applied at the stock level or at the species level. Both appear to have some relevance to the categories currently in use in the NASCO Rivers Database, given that at very low stock status levels the species criteria listed above may provide a closer match with some of the NASCO categories. For comparison purposes, the NASCO categories are tabulated against both example stock categories (Table 2.5.4.1) and species categories (Table 2.5.4.2). It should be noted that many of the categorization schemes might best be viewed as continuous scales. As such, these 'tables' should not be interpreted as strict matrices which imply direct alignment across rows; rather the 'tables' are intended to provide a basis for broad comparisons.

The NASCO categories broadly reflect these classifications, but comparisons are more difficult at a detailed scale. The NASCO categories "maintained", "not present but potential" and "restored" are descriptive and do not appear to have a close parallel with the other species or river stock classifications generally in use. They clearly relate to a special category for stocks or species which have been or might be subject to special intervention, possibly including stocking. The NASCO categories "Threatened with loss" and "Not Threatened with loss", while relating more directly to stock status, were also difficult to align directly with categories based on attainment of stock indicators because the terminology is imprecise and interpretation of these categories could tends to encompass several categories in other systems.

NASCO has recommended the development of CLs for all stocks. However, these have not yet been developed by some jurisdictions, where alternative stock abundance indicators may be used in management, and in some jurisdictions no such indicators have been developed. The implementation of any standardized classification scheme may also be difficult given the differences in the way national management advice is presented in different jurisdictions and it is unlikely that a standardised system for providing catch advice at the national level will be developed in the near future. Nevertheless, ICES concluded considered that it might be possible to develop a classification more closely reflecting the generally applied categories for species as well as integrating elements of compliance with stock indicators, such as conservation limits (CLs) used for describing stock status and providing management advice (i.e. CLs). A preliminary and tentative example of this is shown in the final two columns of Table 2.5.4.1. However, approaches would need to be developed to enable compliance with the classification criteria to be averaged over time periods and thus avoid the need for assessment and updating of the Rivers Database on an annual basis. In addition, some degree of expert judgement would also be required for stocks that do not currently have CLs.

2.6 Reports from expert group reports relevant to North Atlantic salmon

2.6.1 WGRECORDS

The Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (WGRECORDS) was established to provide a scientific forum in ICES for diadromous species. The role of the Group is to coordinate work on these species, organize Expert Groups, Theme Sessions and Symposia, and help to deliver the ICES Science Plan.

WGRECORDS held an informal meeting in June 2013, during the NASCO Annual Meeting in Drogheda, Ireland. Discussions were held on the requirements for Expert Groups to address new and ongoing issues related to diadromous species including issues arising from the NASCO Annual Meeting. The annual meeting of WGRECORDS was held in September 2013, during the ICES Annual Science Conference in Reykjavik, Iceland. The WGRECORDS Annual Meeting received reports from all the ICES Expert Groups working on diadromous species, and considered their progress and future requirements. Updates were received from expert groups of particular relevance to North Atlantic salmon which had been established by ICES following proposals by WGRECORDS. Summaries of all these expert groups are provided in this section. The following are the ongoing, recently held or proposed expert groups to be considered by ICES in 2014.

Ongoing - "The Working Group on Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS) next meeting May 2014. A brief update is provided in Section 2.4.

New expert groups were proposed by WGRECORDS for late 2013 or 2014 which will be considered by the ICES Science Committee in April 2014.

Recent - Workshop on sea trout (WKTRUTTA). Chaired by Stig Pedersen, Denmark, and Nigel Milner, UK, November 2013.

Proposed - The Workshop on Lampreys and Shads (WKLS), co-chaired by Pedro Raposo de Almeida, Portugal, and Eric Rochard, France, will be established and will meet in Lisbon, Portugal, for three days in October 2014.

Proposed - Workshop of a Planning Group on the Monitoring of Eel Quality "Development of standardized and harmonized protocols for the estimation of eel quality".

Proposed - Joint Workshop of the Working Group on Eel and the Working Group on Biological Effects of Contaminants "Are contaminants in eels contributing to their decline?"

Proposed - A Working Group on data poor diadromous fish (WGDAM), chaired by Erwin Winter, Netherlands and Karen Wilson, United States.

Other issues arising from the WGRECORDS meeting which are of particular relevance to Atlantic salmon were:

- Inclusion of new proposals for Atlantic salmon data collection under the EU DC-MAP.
- Proposals for a theme sessions at the ICES ASC in 2014: Analytical approaches to using telemetry data to assess marine survival of Diadromous and other migratory fish species.

2.6.2 Report of NASCO's *Ad hoc* West Greenland Committee Scientific Working Group

NASCO had convened a group of scientific representatives, which were nominated by Members of NASCO's West Greenland Commission (WGC), to develop a working paper in support of the upcoming WGC intersessional meeting. This meeting was held in London on 14–15 April 2014 prior to the availability of formal ICES advice based on this report. The *Ad hoc* West Greenland Committee Scientific Working Group was to compile available data on catches in the West Greenland salmon fishery from 1990 to 2013, including:

- Reported and unreported catches;
- The spatial and temporal breakdown of the catches;
- The origin of the catches by continent and at finer scales where possible (e.g. country or region of origin);
- Rates of exploitation on contributing stocks or stock complexes; and
- Any additional scientific data related to the fishery.

The *Ad hoc* West Greenland Committee Scientific Working Group presented their working paper to the Working Group for consideration and review. The Working Group supported the working paper and considered it represented an accurate representation of the historical and current data related to the Greenland fishery for use at the upcoming WGC intersessional meeting.

2.7 NASCO has asked ICES to provide a compilation of tag releases by country in 2013

Data on releases of tagged, finclipped and otherwise marked salmon in 2013 were provided to the Working Group and are compiled as a separate report (ICES 2014a). In summary (Table 2.7.1), about 3.4 million salmon were marked in 2013, a decrease from the 3.69 million fish marked in 2012. The adipose clip was the most commonly used primary mark (2.95 million), with coded wire microtags (0.347 million) the next most common primary mark and 101 591 fish were marked with external tags. Most marks were applied to hatchery-origin juveniles (2.95 million), while 53 022 wild juveniles and 8539 adults were also marked. In 2013, 7741 PIT tags, Data Storage Tags (DSTs), radio and/or sonic transmitting tags (pingers) were also used (Table 2.7.1).

From 2003, the Working Group has recorded information on marks being applied to farmed salmon. These may help trace the origin of farmed salmon captured in the wild in the case of escape events. Two jurisdictions (USA and Iceland) have required that some or all of the sea cage farmed fish reared in their area be marked. In Iceland, 10% of sea cage farm production is adipose finclipped. In USA, a genetic “marking” procedure has been adopted. The broodstock has been screened with molecular genetic techniques, which makes it feasible to trace an escaped farmed salmon back to its hatchery of origin through analysis of its DNA. Genetic assignment has also been applied for hatchery juveniles that are released in two large rivers in the Southwest of France.

2.8 NASCO has asked ICES to identify relevant data deficiencies, monitoring needs and research requirements

2.8.1 NASCO subgroup on telemetry

The Working Group received an update on the work of the NASCO Sub Group on Telemetry that had been established by the Scientific Advisory Group (SAG) to the International Atlantic Salmon Research Board (IASRB). Following discussions within the IASRB about the future direction of research that might be supported by the Board, the subgroup had been asked to develop an outline proposal for a large-scale international collaborative telemetry project to ultimately provide information on migration paths and quantitative estimates of mortality during phases of the marine life cycle of salmon.

Tracking projects undertaken in the US (Gulf of Maine) and Canada (Gulf of St Lawrence) based on acoustic tagging have demonstrated the potential for such methods to be used to identify the migration routes of emigrating post-smolts and to quantify the mortality occurring during different phases of this migration (see Section 2.3.3). Similarly, trials with pop-off satellite transmitters on salmon caught at West Greenland and kelts returning to sea after spawning have demonstrated the potential for elucidating the migration routes and behaviour of salmon at later life stages, including the return migration from the ocean feeding areas towards their home rivers. Satellite tags and archival tags have also been used to obtain additional information on conditions experienced by salmon at sea. The proposed programme will build on these studies to extend the areas for which detailed information on marine mortality is available.

The Working Group recognised that this would be a very challenging programme, but considered that it could provide important information that would greatly assist in the management and conservation of Atlantic salmon stocks throughout the North Atlantic.

2.8.2 EU Data Collection – Multi-Annual Plan

The Working Group received an update on the ongoing process for the revision of the EU Data Collection Framework (DCF) as it affects the collection of data used in the assessment of Atlantic salmon stocks and the provision of management advice. Changes to the DCF in 2007 introduced requirements for EU Member States to collect data on eel and salmon, but the specific data requested for these species did not meet the needs of national and international assessments. In 2012, the Workshop on Eel and Salmon Data Collection Framework (ICES, 2012b) provided detailed recommendations on the data requirements for European eel, and Baltic and Atlantic salmon, including data required by WGNAS to address questions posed by NASCO. In February 2014, these recommendations were presented to an Expert Working Group of the EU Scientific, Technical and Economic Committee for Fisheries (STECF). A number of suggestions were made for changes to Council Regulation 199/2008 (concerning the establishment of 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) and Commission Decision 2010/93/EU (adopting a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011–2013), which will be considered by STECF in March 2014. The revised DCF will provide the basis for data collection under the proposed Multi-Annual Plans which will apply for the period 2015 to 2021.

2.8.3 Stock annex development

The Working Group considered proposals from the Review Group regarding the establishment of an Atlantic salmon stock annex. Such stock annexes have been developed for other ICES assessment Working Group reports and are intended to provide a complete description of the methodology used in conducting stock assessments and the provision of catch advice. The Working Group developed a Stock Annex incorporating country specific inputs for the 2014 meeting (see Annex 6). These documents are intended to be informative for members of the Working Group and reviewers as well as in facilitating wider communication.

Table 2.1.1.1. Reported total nominal catch of salmon by country (in tonnes round fresh weight), 1960–2013. (2013 figures include provisional data).

	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
Year	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden Wild	Sweden Ranch (15)	Denmark	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1960	1,636	1	-	1,659	1,100	100	-	40	0	-	-	743	283	139	1,443	-	33	-	-	60	-	7,237	-	-
1961	1,583	1	-	1,533	790	127	-	27	0	-	-	707	232	132	1,185	-	20	-	-	127	-	6,464	-	-
1962	1,719	1	-	1,935	710	125	-	45	0	-	-	1,459	318	356	1,738	-	23	-	-	244	-	8,673	-	-
1963	1,861	1	-	1,786	480	145	-	23	0	-	-	1,458	325	306	1,725	-	28	-	-	466	-	8,604	-	-
1964	2,069	1	-	2,147	590	135	-	36	0	-	-	1,617	307	377	1,907	-	34	-	-	1,539	-	10,759	-	-
1965	2,116	1	-	2,000	590	133	-	40	0	-	-	1,457	320	281	1,593	-	42	-	-	861	-	9,434	-	-
1966	2,369	1	-	1,791	570	104	2	36	0	-	-	1,238	387	287	1,595	-	42	-	-	1,370	-	9,792	-	-
1967	2,863	1	-	1,980	883	144	2	25	0	-	-	1,463	420	449	2,117	-	43	-	-	1,601	-	11,991	-	-
1968	2,111	1	-	1,514	827	161	1	20	0	-	-	1,413	282	312	1,578	-	38	5	-	1,127	403	9,793	-	-
1969	2,202	1	-	1,383	360	131	2	22	0	-	-	1,730	377	267	1,955	-	54	7	-	2,210	893	11,594	-	-
1970	2,323	1	-	1,171	448	182	13	20	0	-	-	1,787	527	297	1,392	-	45	12	-	2,146	922	11,286	-	-
1971	1,992	1	-	1,207	417	196	8	17	1	-	-	1,639	426	234	1,421	-	16	-	-	2,689	471	10,735	-	-
1972	1,759	1	-	1,578	462	245	5	17	1	-	32	1,804	442	210	1,727	34	40	9	-	2,113	486	10,965	-	-
1973	2,434	3	-	1,726	772	148	8	22	1	-	50	1,930	450	182	2,006	12	24	28	-	2,341	533	12,670	-	-
1974	2,539	1	-	1,633	709	215	10	31	1	-	76	2,128	383	184	1,628	13	16	20	-	1,917	373	11,877	-	-
1975	2,485	2	-	1,537	811	145	21	26	0	-	76	2,216	447	164	1,621	25	27	28	-	2,030	475	12,136	-	-
1976	2,506	1	3	1,530	542	216	9	20	0	-	66	1,561	208	113	1,019	9	21	40	<1	1,175	289	9,327	-	-
1977	2,545	2	-	1,488	497	123	7	9	1	-	59	1,372	345	110	1,160	19	19	40	6	1,420	192	9,414	-	-
1978	1,545	4	-	1,050	476	285	6	10	0	-	37	1,230	349	148	1,323	20	32	37	8	984	138	7,682	-	-
1979	1,287	3	-	1,831	455	219	6	11	1	-	26	1,097	261	99	1,076	10	29	119	<0,5	1,395	193	8,118	-	-
1980	2,680	6	-	1,830	664	241	8	16	1	-	34	947	360	122	1,134	30	47	536	<0,5	1,194	277	10,127	-	-
1981	2,437	6	-	1,656	463	147	16	25	1	-	44	685	493	101	1,233	20	25	1,025	<0,5	1,264	313	9,954	-	-
1982	1,798	6	-	1,348	364	130	17	24	1	-	54	993	286	132	1,092	20	10	606	<0,5	1,077	437	8,395	-	-
1983	1,424	1	3	1,550	507	166	32	27	1	-	58	1,656	429	187	1,221	16	23	678	<0,5	310	466	8,755	-	-
1984	1,112	2	3	1,623	593	139	20	39	1	-	46	829	345	78	1,013	25	18	628	<0,5	297	101	6,912	-	-
1985	1,133	2	3	1,561	659	162	55	44	1	-	49	1,595	361	98	913	22	13	566	7	864	-	8,108	-	-
1986	1,559	2	3	1,598	608	232	59	52	2	-	37	1,730	430	109	1,271	28	27	530	19	960	-	9,255	315	-
1987	1,784	1	2	1,385	564	181	40	43	4	-	49	1,239	302	56	922	27	18	576	<0,5	966	-	8,159	2,788	-
1988	1,310	1	2	1,076	420	217	180	36	4	-	36	1,874	395	114	882	32	18	243	4	893	-	7,737	3,248	-
1989	1,139	2	2	905	364	141	136	25	4	-	52	1,079	296	142	895	14	7	364	-	337	-	5,904	2,277	-
1990	911	2	2	930	313	141	285	27	6	13	60	567	338	94	624	15	7	315	-	274	-	4,925	1,890	180-350

Table 2.1.1.1. Continued.

	NAC Area			NEAC (N. Area)								NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
													UK	UK	UK				East	West		Reported		
Year	Canada	USA	St. P&M	Norway	Russia	Iceland		Sweden		Denmark	Finland	Ireland	(E & W)	(N.Irl.)	(Scotl.)	France	Spain	Faroes	Grld.	Grld.	Other	Nominal	NASCO	International
	(1)			(2)	(3)	Wild	Ranch (4)	Wild	Ranch (15)			(5,6)		(6,7)		(8)	(9)	(10)		(11)	(12)	Catch	Areas (13)	waters (14)
1991	711	1	1	876	215	129	346	34	4	3	70	404	200	55	462	13	11	95	4	472	-	4,106	1,682	25-100
1992	522	1	2	867	167	174	462	46	3	10	77	630	171	91	600	20	11	23	5	237	-	4,119	1,962	25-100
1993	373	1	3	923	139	157	499	44	12	9	70	541	248	83	547	16	8	23	-	-	-	3,696	1,644	25-100
1994	355	0	3	996	141	136	313	37	7	6	49	804	324	91	649	18	10	6	-	-	-	3,945	1,276	25-100
1995	260	0	1	839	128	146	303	28	9	3	48	790	295	83	588	10	9	5	2	83	-	3,629	1,060	-
1996	292	0	2	787	131	118	243	26	7	2	44	685	183	77	427	13	7	-	0	92	-	3,136	1,123	-
1997	229	0	2	630	111	97	59	15	4	1	45	570	142	93	296	8	4	-	1	58	-	2,364	827	-
1998	157	0	2	740	131	119	46	10	5	1	48	624	123	78	283	8	4	6	0	11	-	2,395	1,210	-
1999	152	0	2	811	103	111	35	11	5	1	62	515	150	53	199	11	6	0	0	19	-	2,247	1,032	-
2000	153	0	2	1,176	124	73	11	24	9	5	95	621	219	78	274	11	7	8	0	21	-	2,912	1,269	-
2001	148	0	2	1,267	114	74	14	25	7	6	126	730	184	53	251	11	13	0	0	43	-	3,069	1,180	-
2002	148	0	2	1,019	118	90	7	20	8	5	93	682	161	81	191	11	9	0	0	9	-	2,654	1,039	-
2003	141	0	3	1,071	107	99	11	15	10	4	78	551	89	56	192	13	9	0	0	9	-	2,457	847	-
2004	161	0	3	784	82	111	18	13	7	4	39	489	111	48	245	19	7	0	0	15	-	2,157	686	-
2005	139	0	3	888	82	129	21	9	6	8	47	422	97	52	215	11	13	0	0	15	-	2,156	700	-
2006	137	0	3	932	91	93	17	8	6	2	67	326	80	29	192	13	11	0	0	22	-	2,029	670	-
2007	112	0	2	767	63	93	36	6	10	3	58	85	67	30	171	11	9	0	0	25	-	1,548	475	-
2008	158	0	4	807	73	132	69	8	10	9	71	89	64	21	161	12	9	0	0	26	-	1,721	443	-
2009	126	0	3	595	71	126	44	7	10	8	36	68	54	17	121	4	2	0	0	26	-	1,318	343	-
2010	153	0	3	642	88	147	42	9	13	13	49	99	109	12	180	10	2	0	0	40	-	1,610	393	-
2011	179	0	4	696	89	98	30	20	19	13	44	87	136	10	159	11	7	0	0	28	-	1,629	421	-
2012	126	0	1	696	82	50	20	21	9	12	64	88	58	9	124	10	8	0	0	33	-	1,411	403	-
2013	136	0	5	475	78	125	29	10	4	11	46	103	83	6	123	11	4	0	0	47	-	1,296	306	-
Average																								
2008-2012	148	0	3	687	81	111	41	13	12	11	53	86	84	14	149	9	5	0	0	31	-	1,538	401	-
2003-2012	143	0	3	788	83	108	31	12	10	7	55	230	86	28	176	11	8	0	0	24	-	1,804	538	-

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.
15. Catches from hatchery-reared smolts released under programmes to mitigate for hydropower development schemes; returning fish unable to spawn in the wild and exploited heavily.

Table 2.1.1.2. Reported total nominal catch of salmon in home waters by country (in tonnes round fresh weight), 1960–2013. (2013 figures include provisional data). S = Salmon (2SW or MSW fish). G = Grilse (1SW fish). Sm = small. Lg = large; T = S + G or Lg + Sm.

	NAC Area				NEAC (N. Area)												NEAC (S. Area)										
								Russia	Iceland		Sweden						Ireland			UK	UK(N.I.)					Spain	
Year	Canada (1)			USA	Norway (2)			(3)	Wild	Ranch	Wild	Ranch	Denmark	Finland			(4,5)			(E&W)	(4,6)	UK(Scotland)			France		Total
	Lg	Sm	T	T	S	G	T	T	T	T	T		T	S	G	T	S	G	T	T	T	S	G	T	T	T	T
1960	-	-	1,636	1	-	-	1,659	1,100	100	-	40	0	-	-	-	-	-	-	743	283	139	971	472	1,443	-	33	7,177
1961	-	-	1,583	1	-	-	1,533	790	127	-	27	0	-	-	-	-	-	-	707	232	132	811	374	1,185	-	20	6,337
1962	-	-	1,719	1	-	-	1,935	710	125	-	45	0	-	-	-	-	-	-	1,459	318	356	1,014	724	1,738	-	23	8,429
1963	-	-	1,861	1	-	-	1,786	480	145	-	23	0	-	-	-	-	-	-	1,458	325	306	1,308	417	1,725	-	28	8,138
1964	-	-	2,069	1	-	-	2,147	590	135	-	36	0	-	-	-	-	-	-	1,617	307	377	1,210	697	1,907	-	34	9,220
1965	-	-	2,116	1	-	-	2,000	590	133	-	40	0	-	-	-	-	-	-	1,457	320	281	1,043	550	1,593	-	42	8,573
1966	-	-	2,369	1	-	-	1,791	570	104	2	36	0	-	-	-	-	-	-	1,238	387	287	1,049	546	1,595	-	42	8,422
1967	-	-	2,863	1	-	-	1,980	883	144	2	25	0	-	-	-	-	-	-	1,463	420	449	1,233	884	2,117	-	43	10,390
1968	-	-	2,111	1	-	-	1,514	827	161	1	20	0	-	-	-	-	-	-	1,413	282	312	1,021	557	1,578	-	38	8,258
1969	-	-	2,202	1	801	582	1,383	360	131	2	22	0	-	-	-	-	-	-	1,730	377	267	997	958	1,955	-	54	8,484
1970	1,562	761	2,323	1	815	356	1,171	448	182	13	20	0	-	-	-	-	-	-	1,787	527	297	775	617	1,392	-	45	8,206
1971	1,482	510	1,992	1	771	436	1,207	417	196	8	17	1	-	-	-	-	-	-	1,639	426	234	719	702	1,421	-	16	7,574
1972	1,201	558	1,759	1	1,064	514	1,578	462	245	5	17	1	-	-	-	32	200	1,604	1,804	442	210	1,013	714	1,727	34	40	8,356
1973	1,651	783	2,434	3	1,220	506	1,726	772	148	8	22	1	-	-	-	50	244	1,686	1,930	450	182	1,158	848	2,006	12	24	9,767
1974	1,589	950	2,539	1	1,149	484	1,633	709	215	10	31	1	-	-	-	76	170	1,958	2,128	383	184	912	716	1,628	13	16	9,566
1975	1,573	912	2,485	2	1,038	499	1,537	811	145	21	26	0	-	-	-	76	274	1,942	2,216	447	164	1,007	614	1,621	25	27	9,603
1976	1,721	785	2,506	1	1,063	467	1,530	542	216	9	20	0	-	-	-	66	109	1,452	1,561	208	113	522	497	1,019	9	21	7,821
1977	1,883	662	2,545	2	1,018	470	1,488	497	123	7	9	1	-	-	-	59	145	1,227	1,372	345	110	639	521	1,160	19	19	7,755
1978	1,225	320	1,545	4	668	382	1,050	476	285	6	10	0	-	-	-	37	147	1,082	1,229	349	148	781	542	1,323	20	32	6,514
1979	705	582	1,287	3	1,150	681	1,831	455	219	6	11	1	-	-	-	26	105	922	1,027	261	99	598	478	1,076	10	29	6,340
1980	1,763	917	2,680	6	1,352	478	1,830	664	241	8	16	1	-	-	-	34	202	745	947	360	122	851	283	1,134	30	47	8,119
1981	1,619	818	2,437	6	1,189	467	1,656	463	147	16	25	1	-	-	-	44	164	521	685	493	101	844	389	1,233	20	25	7,351
1982	1,082	716	1,798	6	985	363	1,348	364	130	17	24	1	-	49	5	54	63	930	993	286	132	596	496	1,092	20	10	6,275
1983	911	513	1,424	1	957	593	1,550	507	166	32	27	1	-	51	7	58	150	1,506	1,656	429	187	672	549	1,221	16	23	7,298
1984	645	467	1,112	2	995	628	1,623	593	139	20	39	1	-	37	9	46	101	728	829	345	78	504	509	1,013	25	18	5,882
1985	540	593	1,133	2	923	638	1,561	659	162	55	44	1	-	38	11	49	100	1,495	1,595	361	98	514	399	913	22	13	6,667
1986	779	780	1,559	2	1,042	556	1,598	608	232	59	52	2	-	25	12	37	136	1,594	1,730	430	109	745	526	1,271	28	27	7,742
1987	951	833	1,784	1	894	491	1,385	564	181	40	43	4	-	34	15	49	127	1,112	1,239	302	56	503	419	922	27	18	6,611
1988	633	677	1,310	1	656	420	1,076	420	217	180	36	4	-	27	9	36	141	1,733	1,874	395	114	501	381	882	32	18	6,591
1989	590	549	1,139	2	469	436	905	364	141	136	25	4	-	33	19	52	132	947	1,079	296	142	464	431	895	14	7	5,197
1990	486	425	911	2	545	385	930	313	146	280	27	6	13	41	19	60	-	-	567	338	94	423	201	624	15	7	4,327

Table 2.1.1.2. Continued.

1991	370	341	711	1	535	342	876	215	129	346	34	4	3	53	17	70	-	-	404	200	55	285	177	462	13	11	3,530
1992	323	199	522	1	566	301	867	167	174	462	46	3	10	49	28	77	-	-	630	171	91	361	238	599	20	11	3,847
1993	214	159	373	1	611	312	923	139	157	499	44	12	9	53	17	70	-	-	541	248	83	320	227	547	16	8	3,659
1994	216	139	355	0	581	415	996	141	136	313	37	7	6	38	11	49	-	-	804	324	91	400	248	648	18	10	3,927
1995	153	107	260	0	590	249	839	128	146	303	28	9	3	37	11	48	-	-	790	295	83	364	224	588	10	9	3,530
1996	154	138	292	0	571	215	787	131	118	243	26	7	2	24	20	44	-	-	685	183	77	267	160	427	13	7	3,035
1997	126	103	229	0	389	241	630	111	97	59	15	4	1	30	15	45	-	-	570	142	93	182	114	296	8	3	2,300
1998	70	87	157	0	445	296	740	131	119	46	10	5	1	29	19	48	-	-	624	123	78	162	121	283	8	4	2,371
1999	64	88	152	0	493	318	811	103	111	35	11	5	1	29	33	62	-	-	515	150	53	142	57	199	11	6	2,220
2000	58	95	153	0	673	504	1,176	124	73	11	24	9	5	56	39	95	-	-	621	219	78	161	114	275	11	7	2,873
2001	61	86	148	0	850	417	1,267	114	74	14	25	7	6	105	21	126	-	-	730	184	53	150	101	251	11	13	3,016
2002	49	99	148	0	770	249	1,019	118	90	7	20	8	5	81	12	93	-	-	682	161	81	118	73	191	11	9	2,635
2003	60	81	141	0	708	363	1,071	107	99	11	15	10	4	63	15	78	-	-	551	89	56	122	71	193	13	7	2,435
2004	68	94	161	0	577	207	784	82	111	18	13	7	4	32	7	39	-	-	489	111	48	159	88	247	19	7	2,133
2005	56	83	139	0	581	307	888	82	129	21	9	6	8	31	16	47	-	-	422	97	52	126	91	217	11	13	2,133
2006	55	82	137	0	671	261	932	91	93	17	8	6	2	38	29	67	-	-	326	80	29	118	75	193	13	11	2,000
2007	49	63	112	0	627	140	767	63	93	36	6	10	3	52	6	58	-	-	85	67	30	100	71	171	11	9	1,511
2008	57	100	157	0	637	170	807	73	132	69	8	10	9	65	6	71	-	-	89	64	21	110	51	161	12	9	1,680
2009	52	74	126	0	460	135	595	71	122	44	7	10	8	21	15	36	-	-	68	54	17	83	37	121	4	2	1,274
2010	53	100	153	0	458	184	642	88	124	36	9	13	13	-	-	49	-	-	99	109	12	111	69	180	10	2	1,525
2011	69	110	179	0	556	140	696	89	98	30	20	19	13	-	-	44	-	-	87	136	10	126	33	159	11	7	1,579
2012	52	74	126	0	534	162	696	82	50	20	21	9	12	-	-	64	-	-	88	58	9	84	40	124	10	8	1,368
2013	58	79	136	0	358	117	475	78	125	29	10	4	11	-	-	46	-	-	103	83	6	76	46	123	11	4	1,243
Average																											
2008-2012	57	92	148	0	529	158	687	81	105	40	13	12	11	-	-	53	-	-	86	84	14	103	46	149	9	5	1485
2003-2012	57	86	143	0	581	207	788	83	105	30	12	10	7	-	-	55	-	-	230	86	28	114	63	177	11	7	1764

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 of the recreational (rod) fishery.
4. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
5. Improved reporting of rod catches in 1994 and data derived from carcase tagging and log books from 2002.
6. Angling catch (derived from carcase tagging and log books) first included in 2002.

Table 2.1.2.1. 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, 1991–2013. Figures for 2013 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	22,167	28	239	50			3,211	51												
1992	37,803	29	407	67			10,120	73												
1993	44,803	36	507	77			11,246	82	1,448	10										
1994	52,887	43	249	95			12,056	83	3,227	13	6,595	8								
1995	46,029	46	370	100			11,904	84	3,189	20	12,151	14								
1996	52,166	41	542	100	669	2	10,745	73	3,428	20	10,413	15								
1997	50,009	50	333	100	1,558	5	14,823	87	3,132	24	10,965	18								
1998	56,289	53	273	100	2,826	7	12,776	81	4,378	30	13,464	18								
1999	48,720	50	211	100	3,055	10	11,450	77	4,382	42	14,846	28								
2000	64,482	56	0	-	2,918	11	12,914	74	7,470	42	21,072	32								
2001	59,387	55	0	-	3,611	12	16,945	76	6,143	43	27,724	38								
2002	50,924	52	0	-	5,985	18	25,248	80	7,658	50	24,058	42								
2003	53,645	55	0	-	5,361	16	33,862	81	6,425	56	29,170	55								
2004	62,316	57	0	-	7,362	16	24,679	76	13,211	48	46,279	50					255	19		
2005	63,005	62	0	-	9,224	17	23,592	87	11,983	56	46,165	55	2,553	12			606	27		
2006	60,486	62	1	100	8,735	19	33,380	82	10,959	56	47,669	55	5,409	22	302	18	794	65		
2007	41,192	58	3	100	9,691	18	44,341	90	10,917	55	55,660	61	13,125	40	470	16	959	57		
2008	54,887	53	61	100	17,178	20	41,881	86	13,035	55	53,347	62	13,312	37	648	20	2,033	71	5,512	5
2009	52,151	59	0	-	17,514	24			9,096	58	48,418	67	10,265	37	847	21	1,709	53	6,696	6
2010	55,895	53	0	-	21,476	29	14,585	56	15,012	60	78,304	70	15,136	40	823	25	2,512	60	15,041	12
2011	71,358	57	0	-	18,593	32			14,406	62	64,669	73	12,753	39	1,197	36	2,153	55	14,303	12
2012	43,287	57	0	-	9,752	28	4,743	43	11,952	65	63,331	74	11,891	35	5,014	59	2,153	55	18,611	14
2013	59,207	61	0	-	20,675	30	3,732	39	9,302	69	55,243	80	6,993	30	1,507	64	1,932	57	15,953	15
5-yr mean 2008-2012	55,515	56			16,903	26			12,700	60	61,614	69	12,671	38	1,706	32	2,112	59	12,033	10
% change on 5-year mean	+7	+9			+22	+14			-27	+15	-10	+16	-45	-21	-12	+99	-9	-3	+33	+53

Key:

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

[2] Data for 2006-2009 is for the DCAL area only; the figures from 2010 are a total for UK (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 2.1.3.1. Estimates of unreported catches (tonnes round fresh weight) by various methods within national EEZs in the Northeast Atlantic, North American and West Greenland Commissions of NASCO, 1987–2013.

Year	North-East Atlantic	North-America	West Greenland	Total
1987	2,554	234	-	2,788
1988	3,087	161	-	3,248
1989	2,103	174	-	2,277
1990	1,779	111	-	1,890
1991	1,555	127	-	1,682
1992	1,825	137	-	1,962
1993	1,471	161	< 12	1,644
1994	1,157	107	< 12	1,276
1995	942	98	20	1,060
1996	947	156	20	1,123
1997	732	90	5	827
1998	1,108	91	11	1,210
1999	887	133	12.5	1,032
2000	1,135	124	10	1,269
2001	1,089	81	10	1,180
2002	946	83	10	1,039
2003	719	118	10	847
2004	575	101	10	686
2005	605	85	10	700
2006	604	56	10	670
2007	465	-	10	475
2008	433	-	10	443
2009	317	16	10	343
2010	357	26	10	393
2011	382	29	10	421
2012	363	31	10	403
2013	272	24	10	306
Mean 2008-2012	370		10	415

Notes:
There were no estimates available for Canada in 2007-08 and estimates for 2009-10 are incomplete.
No estimates have been available for Russia since 2008.
Unreported catch estimates are not provided for Spain and St. Pierre et Miquelon.

Table 2.1.3.2. 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, 2013.

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	0.4	36
NEAC	Finland	7	0.4	13
NEAC	Iceland	12	0.8	7
NEAC	Ireland	10	0.6	9
NEAC	Norway	204	12.7	30
NEAC	Sweden	2	0.1	9
NEAC	France	2	0.1	12
NEAC	UK (E & W)	14	0.9	14
NEAC	UK (N.Ireland)	0	0.0	5
NEAC	UK (Scotland)	16	1.0	12
NAC	USA	0	0.0	0
NAC	Canada	24	1.5	15
WGC	West Greenland	10	0.6	18
	Total Unreported Catch *	306	19.1	
	Total Reported Catch of North Atlantic salmon	1,296		

* No unreported catch estimate available for Russia in 2013.
Unreported catch estimates not provided for Spain & St. Pierre et Miquelon

Table 2.2.1.1. Production of farmed salmon in the North Atlantic area and in areas other than the North Atlantic (in tonnes round fresh weight), 1980–2013.

Year	North Atlantic Area										Outside the North Atlantic Area						World-wide
	Norway	UK (Scot.)	Faroes	Canada	Ireland	USA	Iceland	UK (N.Ire.)	Russia	Total	Chile	West Coast USA	West Coast Canada	Australia	Turkey	Total	Total
1980	4,153	598	0	11	21	0	0	0	0	4,783	0	0	0	0	0	0	4,783
1981	8,422	1,133	0	21	35	0	0	0	0	9,611	0	0	0	0	0	0	9,611
1982	10,266	2,152	70	38	100	0	0	0	0	12,626	0	0	0	0	0	0	12,626
1983	17,000	2,536	110	69	257	0	0	0	0	19,972	0	0	0	0	0	0	19,972
1984	22,300	3,912	120	227	385	0	0	0	0	26,944	0	0	0	0	0	0	26,944
1985	28,655	6,921	470	359	700	0	91	0	0	37,196	0	0	0	0	0	0	37,196
1986	45,675	10,337	1,370	672	1,215	0	123	0	0	59,392	0	0	0	10	0	0	59,392
1987	47,417	12,721	3,530	1,334	2,232	365	490	0	0	68,089	41	0	0	62	0	103	68,192
1988	80,371	17,951	3,300	3,542	4,700	455	1,053	0	0	111,372	165	0	0	240	0	405	111,777
1989	124,000	28,553	8,000	5,865	5,063	905	1,480	0	0	173,866	1,860	1,100	1,000	1,750	0	5,710	179,576
1990	165,000	32,351	13,000	7,810	5,983	2,086	2,800	<100	5	229,035	9,478	700	1,700	1,750	300	13,928	242,963
1991	155,000	40,593	15,000	9,395	9,483	4,560	2,680	100	0	236,811	14,957	2,000	3,500	2,653	1,500	24,610	261,421
1992	140,000	36,101	17,000	10,380	9,231	5,850	2,100	200	0	220,862	23,715	4,900	6,600	3,300	680	39,195	260,057
1993	170,000	48,691	16,000	11,115	12,366	6,755	2,348	<100	0	267,275	29,180	4,200	12,000	3,500	791	49,671	316,946
1994	204,686	64,066	14,789	12,441	11,616	6,130	2,588	<100	0	316,316	34,175	5,000	16,100	4,000	434	59,709	376,025
1995	261,522	70,060	9,000	12,550	11,811	10,020	2,880	259	0	378,102	54,250	5,000	16,000	6,192	654	82,096	460,198
1996	297,557	83,121	18,600	17,715	14,025	10,010	2,772	338	0	444,138	77,327	5,200	17,000	7,647	193	107,367	551,505
1997	332,581	99,197	22,205	19,354	14,025	13,222	2,554	225	0	503,363	96,675	6,000	28,751	7,648	50	139,124	642,487
1998	361,879	110,784	20,362	16,418	14,860	13,222	2,686	114	0	540,325	107,066	3,000	33,100	7,069	40	150,275	690,600
1999	425,154	126,686	37,000	23,370	18,000	12,246	2,900	234	0	645,590	103,242	5,000	38,800	9,195	0	156,237	801,827
2000	440,861	128,959	32,000	33,195	17,648	16,461	2,600	250	0	671,974	166,897	5,670	49,000	10,907	0	232,474	904,448
2001	436,103	138,519	46,014	36,514	23,312	13,202	2,645	-	0	696,309	253,850	5,443	68,000	12,724	0	340,017	1,036,326
2002	462,495	145,609	45,150	40,851	22,294	6,798	1,471	-	0	724,668	265,726	5,948	84,200	14,356	0	370,230	1,094,898
2003	509,544	176,596	52,526	38,680	16,347	6,007	3,710	-	300	803,710	280,301	10,329	65,411	15,208	0	371,249	1,174,959
2004	563,914	158,099	40,492	37,280	14,067	8,515	6,620	-	203	829,190	348,983	6,659	55,646	16,476	0	427,764	1,256,954
2005	586,512	129,588	18,962	45,891	13,764	5,263	6,300	-	204	806,484	385,779	6,123	63,369	16,780	0	472,051	1,278,535
2006	629,888	131,847	11,905	47,880	11,174	4,674	5,745	-	229	843,342	376,476	5,823	70,181	20,710	0	473,190	1,316,532
2007	744,222	129,930	22,305	36,368	9,923	2,715	1,158	-	111	946,732	331,042	6,261	70,998	25,336	0	433,637	1,380,369
2008	737,694	128,606	36,000	39,687	9,217	9,014	330	-	51	960,599	388,847	6,261	73,265	25,737	0	494,110	1,454,709
2009	862,908	144,247	51,500	43,101	12,210	6,028	742	-	2,126	1,122,862	233,308	7,930	68,662	29,893	0	339,793	1,462,655
2010	939,575	154,164	45,396	43,612	15,691	11,127	1,068	-	4,500	1,215,133	123,233	7,930	70,831	31,807	0	233,801	1,448,934
2011	1,065,974	158,018	60,500	41,448	12,196	-	1,083	-	8,500	1,347,719	264,349	8,014	74,880	25,198	0	372,441	1,720,160
2012	1,232,095	162,223	76,595	52,951	12,440	-	2,923	-	8,754	1,547,981	399,678	7,131	71,998	43,785	0	522,592	2,070,573
2013	1,121,088	152,507	75,852	52,951	15,000	-	3,018	-	8,200	1,428,616	399,678	6,834	71,998	43,785	0	522,295	1,950,911
5-yr mean 2008-2012	967,649	149,452	53,998	44,160	12,351		1,229		4,786	1,238,859	281,883	7,453	71,927	31,284	0	392,547	1,631,406
% change on 5-year mean	+16	+2	+40	+20	+21		+146		+71	+15	+42	-8	+0	+40		+33	+20

Notes: Data for 2013 are provisional for many countries.
Where production figures were not available for 2013, values as in 2012 were assumed.
West Coast USA = Washington State.
West Coast Canada = British Columbia.
Australia = Tasmania.
Source of production figures for non-Atlantic areas: http://www.fao.org/fishery/statistics/global-aquaculture-production/en
Data for UK (N. Ireland) since 2001 and data for East coast USA since 2011 are not publicly available.
Source of production figures for Russia and for Ireland since 2008: http://www.fao.org/fishery/statistics/global-aquaculture-production/en

Table 2.2.2.1. Production of ranched salmon in the North Atlantic (tonnes round fresh weight), 1980–2013.

Year	Iceland (1)	Ireland (2)	UK(N.Ireland) River Bush (2,3)	Sweden (2)	Norway various facilities (2)	Total production
1980	8.0			0.8		9
1981	16.0			0.9		17
1982	17.0			0.6		18
1983	32.0			0.7		33
1984	20.0			1.0		21
1985	55.0	16.0	17.0	0.9		89
1986	59.0	14.3	22.0	2.4		98
1987	40.0	4.6	7.0	4.4		56
1988	180.0	7.1	12.0	3.5	4.0	207
1989	136.0	12.4	17.0	4.1	3.0	172
1990	285.1	7.8	5.0	6.4	6.2	310
1991	346.1	2.3	4.0	4.2	5.5	362
1992	462.1	13.1	11.0	3.2	10.3	500
1993	499.3	9.9	8.0	11.5	7.0	536
1994	312.8	13.2	0.4	7.4	10.0	344
1995	302.7	19.0	1.2	8.9	2.0	334
1996	243.0	9.2	3.0	7.4	8.0	271
1997	59.4	6.1	2.8	3.6	2.0	74
1998	45.5	11.0	1.0	5.0	1.0	64
1999	35.3	4.3	1.4	5.4	1.0	47
2000	11.3	9.3	3.5	9.0	1.0	34
2001	13.9	10.7	2.8	7.3	1.0	36
2002	6.7	6.9	2.4	7.8	1.0	25
2003	11.1	5.4	0.6	9.6	1.0	28
2004	18.1	10.4	0.4	7.3	1.0	37
2005	20.5	5.3	1.7	6.0	1.0	35
2006	17.2	5.8	1.3	5.7	1.0	31
2007	35.5	3.1	0.3	9.7	0.5	49
2008	68.6	4.4	-	10.4	0.5	84
2009	44.3	1.1	-	9.9	-	55
2010	42.3	2.5	-	13.0	-	58
2011	30.2	2.5	-	19.1	-	52
2012	20.0	5.3	-	8.9	-	34
2013	29.4	2.8	-	4.2	-	36
5-yr mean 2008-2012	41.1	3.2		12.3		57
% change on 5-year mean	-28	-11		-66		-36

1 From 1990, catch includes fish ranched for both commercial and angling purposes.
2 Total yield in homewater fisheries and rivers.
3 The proportion of ranched fish was not assessed between 2008 and 2013 due to a lack of microtag returns.

Table 2.3.4.1. Incidence of infectious salmon anaemia virus (ISAv) and infectious pancreatic necrosis (IPNv) detected in samples collected from Atlantic salmon landed in various communities along the West Greenland coast from 2003–2011.

Year	NAFO Area	Sampling Location	Number Sampled	Number ISAv Positive	Percent ISAv Positive	Number IPNv Positive	Percent IPNv Positive
2003	1D	Nuuk	55	0	0.00 %	-	-
2004	1D	Nuuk	120	0	0.00 %	-	-
2005	1D	Nuuk	81	0	0.00 %	-	-
2006	1D	Nuuk	119	0	0.00 %	-	-
2007	1D	Nuuk	150	0	0.00 %	-	-
2010	1B	Sisimiut	85	1	1.18 %	0	0.00 %
2010	1D	Nuuk	202	0	0.00 %	0	0.00 %
2010	1F	Qaqortoq	71	0	0.00 %	0	0.00 %
2011	1A	Ilulissat	20	0	0.00 %	-	-
2011	1B	Sisimiut	59	0	0.00 %	-	-
2011	1D	Nuuk	173	0	0.00 %	-	-
2011	1F	Qaqortoq	149	0	0.00 %	-	-
Total			1284	1	0.08 %	0	0.00 %

Table 2.5.2.1. Overview of Atlantic salmon stock status categories used by different countries and organizations.

Canadian categories linked to reference points (as used in NASCO IP)	
Category 1	Rivers below 50% of their Conservation Limit (CL).
Category 2	Rivers between 50% and 100% of their CL.
Category 3	Rivers at or over 100% of their CL.

Canadian reference points for application of the Precautionary Approach (in development)	
Reference points (RP):	
Limit RP	The stock level below which productivity is sufficiently impaired to cause serious harm to the resource but above the level where the risk of extinction becomes a concern.
Upper stock RP	The stock level threshold below which the removal rate is reduced.

Zones:	
Critical zone	Below the Upper stock RP: Management actions must promote stock growth. Removals by all human sources must be kept to the lowest possible level.
Cautious zone	Between the Upper stock RP and the Limit RP: Management actions should promote stock rebuilding towards the Healthy zone. The removal rate should not exceed the Removal reference
Healthy zone	Above the Upper stock RP: The removal rate should not exceed the Removal reference.

Stock status classification system in Ireland (as used in NASCO IP)	
> 75% probability of meeting / exceeding CL	Surplus above the CL may be used for a harvest fishery (angling and commercial).
65- 75% probability of meeting CL	Catch and release fishing may be permitted.
< 65% probability of meeting CL	No fishery is advised.

Stock status classification system in Norway (as used in NASCO IP)	
Critical or lost	Stocks regarded as lost owing to low spawner numbers, or where genetic integrity of the original population is, or has a high probability of becoming lost owing to persistent extremely high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon above 35% in the period 1989–2012).
Very bad	Stocks threatened with loss if the negative influence continues or increases. For example rivers infested with *Gyrodactylus salaris* or populations where genetic integrity can be lost owing to persistent very high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon 20–35% in the period 1989–2012).

Bad	Stocks are vulnerable or may become threatened with loss if the negative influence continues or increases. Also applies to rivers with persistently high levels of escaped farmed salmon (estimated mean proportion of escaped farmed salmon 8.7–20% in the period 1989–2012).
Moderately influenced	Stocks with significantly reduced harvestable surplus, reduced production of juveniles (>10%) and/or too small spawning stocks, or rivers with persistently moderate levels of escaped farmed salmon (estimated proportion of escaped farmed salmon 3.3–8.7 % in the period 1989–2012).
Good	Stocks in the lower risk category or with naturally small populations, or rivers with low levels of escaped farmed salmon (1.6–3.3 % in the period 1989–2012).
Very good	Large stocks. Escaped farmed salmon not observed or observed at very low levels (less than 1.5% in the period 1989–2012).

Stock status classification system in Sweden (as used in NASCO IP)	
Good status	Rivers with averages of 80% or more of expected juvenile salmon density (based on habitat variables, etc) are considered to be of good status.
Intermediate status	Rivers with an average of 50–79% of expected juvenile salmon density are labelled intermediate status.
Poor status	Rivers below 50% of expected juvenile salmon density are labelled poor status.

Stock status classification system in UK (England & Wales) (as used in NASCO IP)	
Not at risk	>95% probability of meeting the Management Objective; i.e. of the stock being above the conservation limit in four years out of five, on average.
Probably not at risk	<95% but > 50% probability of meeting the Management Objective.
Probably at risk	< 50% but >5% probability of meeting the Management Objective.
At risk	<5% probability of meeting the Management Objective. Also includes recovering rivers that do not yet have CLs.

Stock status classification system in UK (N. Ireland) (as used in NASCO IP)	
Category 1	All catchment/ tributaries attaining CL and management targets.
Category 2	All catchment/ tributaries partially attaining management targets.
Category 3	All catchment/ tributaries failing to attain management targets.
Category 4	All catchment/ tributaries where stock status is unknown.

Stock status classification system in USA (as used in NASCO IP)	
Endangered	The Gulf of Maine Distinct Population Segment includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River. This represents roughly 14 major salmon rivers.
Restoration	Historically, salmon occurred in most major watersheds south of the Androscoggin River (Maine) to the Housatonic River in the south (Connecticut). Currently, there are programs to restore self-sustained runs of salmon to three rivers and a legacy program in one river (the Connecticut).

ICES stock status categories – used by all NASCO jurisdictions	
The following Precautionary reference points are used by ICES for the provision of catch advice for fish stocks in the ICES area and applied to regional assemblages or individual stocks.	
Full reproductive capacity	For the stock to be considered at full reproductive capacity ICES requires that the lower bound of the confidence interval of the current estimate of spawners should be above the CL.
At risk of suffering reduced reproductive capacity	When the lower bound of the confidence limit is below the CL, but the midpoint is above, then ICES considers the stock to be at risk of suffering reduced reproductive capacity.
Suffering reduced reproductive capacity	When the midpoint is below the CL, ICES considers the stock to be suffering reduced reproductive capacity.

Table 2.5.3.1. Overview of species categories potentially applicable to Atlantic salmon.

Canadian Species at risk classification (COSEWIC)	
The Committee on the Status of Endangered Species in Canada (COSEWIC) identifies species at risk through processes put in place under the federal *Species at Risk Act* (SARA) and similar provincial laws (http://www.cosewic.gc.ca/eng/sct0/assessment_process_e.cfm#tbl2).	
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC)	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient (DD)	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.
Not At Risk (NAR)	A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Texel – Faial classification	
The Texel-Faial classification is used by OSPAR and applied to regional assemblages rather than individual stocks: http://www.ospar.org/documents/dbase/decrecs/agreements/03-13e_Texel_Faial%20criteria.doc	
Global Importance	Global importance of the OSPAR area for a species. Importance on a global scale, of the OSPAR Area, for the species is when a high proportion of a species at any time of the life cycle occurs in the OSPAR Area
Regional importance	Importance within the OSPAR Area, of the regions for the species where a high proportion of the total population of a species within the OSPAR Area for any part of its life cycle is restricted to a small number of locations in the OSPAR Area
Rarity	A species is rare if the total population size is small. In case of a species that is sessile or of restricted mobility at any time of its life cycle, a species is rare if it occurs in a limited number of locations in the OSPAR Area, and in relatively low numbers. In case of a highly mobile species, the total population size will determine rarity.
Sensitivity	A species is "very sensitive" when: (a) it has very low resistance (that is, it is very easily adversely affected by human activity); and/or (b) very low resilience (that is, after an adverse effect from human activity, recovery is likely to be achieved only over a very long period, or is likely not to be achieved at all). A species is "sensitive" when: (a) it has low resistance (that is, it is easily adversely affected by human activity); and/or (b) it has low resilience (that is, after an adverse effect from human activity, recovery is likely to be achieved only over a long period).
Keystone species	A species which has a controlling influence on a community.

Decline	Means an observed or indicated significant decline in numbers, extent or quality (quality refers to life-history parameters). The decline may be historic, recent or current. 'Significant' need not be in a statistical sense.

European Union Habitats Directive	
Annex II	Animal and plant species of community interest whose conservation requires the designation of special areas of conservation.
Annex IV	Animal and plant species of community interest in need of strict protection.
Annex V	Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

Convention on the Conservation of European Wildlife and Natural Resources (the Bern Convention)	
Appendix/Annex III	Contains species that are in need of protection but may be hunted or otherwise exploited in exceptional instances.

The World Conservation Union (IUCN) – (Red Data Books/Lists and Categories)	
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not evaluated (NE)	A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Table 2.5.3.2. Summary assessment of *S. salar* against the Texel-Faial criteria; OSPAR review 2010.

Criterion	Comments	Evaluation
Global Importance	The results of a river-by-river assessment of the status of the Atlantic salmon in Europe and North America concludes that nearly 90% of the known healthy populations of wild salmon are found in Norway, Iceland, Scotland and Ireland (WWF 2001). This makes the OSPAR maritime area of global importance for this species.	Qualifies
Regional Importance	In Europe, the historical range of the Atlantic salmon extends from Iceland in the northwest (66°N), to the Barents and Kara Seas in the northeast (70°N, 83°E), and southward along the Atlantic coast, with only minor gaps, to the Minho river, the species present southern limit and boundary between Spain in Portugal (42°N). However, native wild stocks are no longer found in the Elbe and the Rhine (where a successful restoration program is now in progress), or in many rivers draining into the Baltic Sea, which previously had abundant salmon runs. . In recent years many Baltic salmon stocks have recovered in response to a lowered exploitation. The species is also severely depressed or extinct in the rivers of France and Spain. As a result salmon has disappeared from large European basins and the species range has generally contracted and fragmented over the last century and a half due to anthropogenic effects (Stradmeyer, 2007). However, there have been recent improvements linked to improved water management with salmon returning for example to the Seine (Perrier *et al*., 2010).	Qualifies
Rarity	According to the Texel-Faial Criteria, the total population size determines the rarity of a highly mobile species such as the Atlantic salmon. Despite the fact that the stock is close to its historical minimum in most of the distribution area, Atlantic salmon are still present in many areas.	Does not qualify
Sensitivity	The Atlantic salmon is known to be highly sensitive to water quality (estuarine and freshwater zones) particularly in relation to eutrophication, chemical contaminants increased sedimentation and temperature (climate change) (OSPAR 2006). both at the adult stage when migrating up river and at the juvenile stage when growing in nursery zones.	Qualifies - very sensitive
Keystone species	Atlantic Salmon is a cultural icon throughout its North Atlantic range; it is the focus of probably the World's highest profile recreational fishery and is the basis for one of the World's largest aquaculture industries (Stradmeyer, 2007). It is also an indicator of healthy aquatic environments (NASCO website).	Qualifies

Decline	Records of the numbers of salmon returning to monitored rivers indicate that, despite drastic reductions in directed fisheries, there has been at least a threefold reduction in marine survival rates since the early 1970s. The reduction in the numbers returning has been accompanied by a marked decline in the proportion of multi sea-winter fish. Such a change in an age distribution is a classic symptom of a sustained increase in mortality rate, a conclusion which is supported by the current relative scarcity of repeat spawners in the returning populations (IASRB SAG(09)9). Furthermore, changes in age composition result in a shortening of the life cycle and a more precocious sexual maturation age which could be an adaptive strategy to more drastic environmental conditions (Baglinière, pers.comm.). The status of salmon populations in both North America and Europe show a clear geographical pattern, with most populations in the southern areas in severe condition; in the north the populations are generally stable while at intermediate latitudes, populations are declining. While many of the problems could be attributed to the construction of dams, pollution (including acid rain), and total dewatering of streams, along with overfishing, and recently, changing ocean conditions and intensive aquaculture, many declines cannot be fully explained (ICES, 2007).	Qualifies - severely declined

Table 2.5.4.1. Compilation of stock/river status categories compared with NASCO Rivers database categories. As categories are defined in different ways, direct alignment is not possible. However, broad comparisons are presented and a tentative categorisation based on attainment of CLs or other stock indicators is provided in the final two columns.

NASCO criteria	Canada PA	Canada Imp. Plan	Ireland	Norway	Sweden	UK (E&W)	UK (N. Ire)	ICES		CL or other stock indicator	Tentative categories linked with CL or other stock indicator
Lost				Critical or lost						0% of CL	Lost
										<25% of CL	Critical condition
				Very Bad						>25% but <50% of CL	Threatened with loss
Threatened with loss	Critical zone	< 50% of CL		Bad	Bad status	At risk		Suffering reduced reproductive capacity.			
	Cautious zone	50% to 100% of CL	Closure <65% CL	Moderately influenced		Probably at risk	Failing to attain MTs	At risk of suffering reduced reproductive capacity		>50% but <75%	Not threatened with loss but actions should be taken to stop or reduce exploitation and rebuild
			C&R 65% to 100% CL		Intermediate status	Probably not at risk	Partially attaining targets			>75% but<100%	Not threatened with loss, but effort should be managed with caution or C&R only
Not threatened with loss	Healthy zone	> 100% of CL	Harvest >100 % CL	Good	Good status	Not at risk	Attaining CLs and MTs	Full reproductive capacity		approx 100 %	Not threatened with loss; effort or harvest fisheries should be managed with caution
				Very Good						>100%	Not Threatened - harvest can proceed in line with identified surplus
Unknown						Rivers with no CLs	Stock status unknown				
Not present but potential											
Restored											
Maintained											

Table 2.5.4.2. Compilation of species status categories compared with NASCO Rivers database categories. As categories are defined in different ways, direct alignment is not always possible. However, relative alignments are suggested.

NASCO criteria	Canada COSEWIC	USA ESA	IUCN	TEXEL FAIAL	EU Habitats Directive	Bern Convention
Lost	Extinct (X) Extirpated (XT)		Extinct (EX) Extinct in the wild (EW)			
Restored		Restoration				
			Critically endangered (CR)			
	Endangered (E)	Endangered	Endangered (EN)		Annex IV - Species needing strict protection	
Threatened with loss	Threatened (T)		Vulnerable (VU)	Decline	Annex V - Species where exploitation needs to be controlled	Annex III
	Special Concern (SC)		Near threatened (NT)	Very sensitive		
Not threatened with loss	Not At Risk (NAR)		Least Concern (LC)	Rare Regional importance Global importance: Keynote	Annex II - species needing SACs	
Unknown	Data Deficient (DD)		Data Deficient (DD) Not evaluated (NE)			
Not present but potential						
Maintained						

Table 2.7.1. Summary of Atlantic salmon tagged and marked in 2013.

		Primary Tag or Mark				
Country	Origin	Microtag	External mark[2]	Adipose clip	Other Internal[1]	Total
Canada	Hatchery Adult	0	1,488	68	268	1,824
	Hatchery Juvenile	0	152	106,310	30	106,492
	Wild Adult	0	2,568	0	64	2,632
	Wild Juvenile	0	10,677	9,286	457	20,420
	Total	**0**	**14,885**	**115,664**	**819**	**131,368**
Denmark	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	188,450		169,600	0	358,050
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**188,450**	**0**	**169,600**	**0**	**358,050**
France	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[3]	0	360	534,500	0	534,860
	Wild Adult[3]	2,568	0	0	413	2,981
	Wild Juvenile	183	0	0	0	183
	Total	**2,751**	**360**	**534,500**	**413**	**538,024**
Iceland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	43,329	0	0	0	43,329
	Wild Adult		255	0	0	255
	Wild Juvenile	4,928	0	0	0	4,928
	Total	**48,257**	**255**	**0**	**0**	**48,512**
Ireland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	223,463	0	7,459	0	230,922
	Wild Adult		0	0	0	0
	Wild Juvenile		0	0	0	0
	Total	**223,463**	**0**	**7,459**	**0**	**230,922**
Norway	Hatchery Adult	0	9	0	0	9
	Hatchery Juvenile	55,957	9,879	0	0	65,836
	Wild Adult	0	325	0	0	325
	Wild Juvenile	1,162	1,501	0	0	2,663
	Total	**57,119**	**11,714**	**0**	**0**	**68,833**
Russia	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0		1,509,868	0	1,509,868
	Wild Adult	0	1,406		0	1,406
	Wild Juvenile	0	0	0	0	0
	Total	**0**	**1,406**	**1,509,868**	**0**	**1,511,274**
Spain	Hatchery Adult	0	0	0	0	**0**
	Hatchery Juvenile	0	65,065	0	0	**65,065**
	Wild Adult	0	0	0	0	**0**
	Wild Juvenile	0	0	0	0	**0**
	Total	**0**	**65,065**	**0**	**0**	**65,065**
Sweden	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[4]	0	4000	155,544	0	159,544
	Wild Adult	0	0		0	0
	Wild Juvenile	0	500		0	500
	Total	**0**	**4,500**	**155,544**	**0**	**160,044**
UK (England & Wales)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	119,125	0	119,125
	Wild Adult	0	276	0	103	379
	Wild Juvenile	7,942	0	10,733	0	18,675
	Total	**7,942**	**276**	**129,858**	**103**	**138,179**
UK (N. Ireland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	20,237	0	60,384	0	80,621
	Wild Adult	0	0	0	0	0
	Wild Juvenile		0	0	0	0
	Total	**20,237**	**0**	**60,384**	**0**	**80,621**
UK (Scotland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	102,863	0	102,863
	Wild Adult	0	462	0	99	561
	Wild Juvenile	1989	0	0	3,489	5,478
	Total	**1,989**	**462**	**102,863**	**3,588**	**108,902**
USA	Hatchery Adult	0	2,668	0	1,150	3,818
	Hatchery Juvenile	0	0	111,886	1,493	113,379
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	175	175
	Total	**0**	**2,668**	**111,886**	**2,818**	**117,372**
All Countries	Hatchery Adult	0	4,165	68	1,418	5,651
	Hatchery Juvenile	531,436	79,456	2,877,539	1,523	3,489,954
	Wild Adult	2,568	5,292	0	679	8,539
	Wild Juvenile	16,204	12,678	20,019	4,121	53,022
	Total	**550,208**	**101,591**	**2,897,626**	**7,741**	**3,557,166**

[1] Includes other internal tags (PIT, ultrasonic, radio, DST, etc.)

[2] Includes Carlin, spaghetti, streamers, VIE etc.

[3] Includes external dye mark.

[4] The 4000 external tagged hatchery juveiles also adipose finclipped

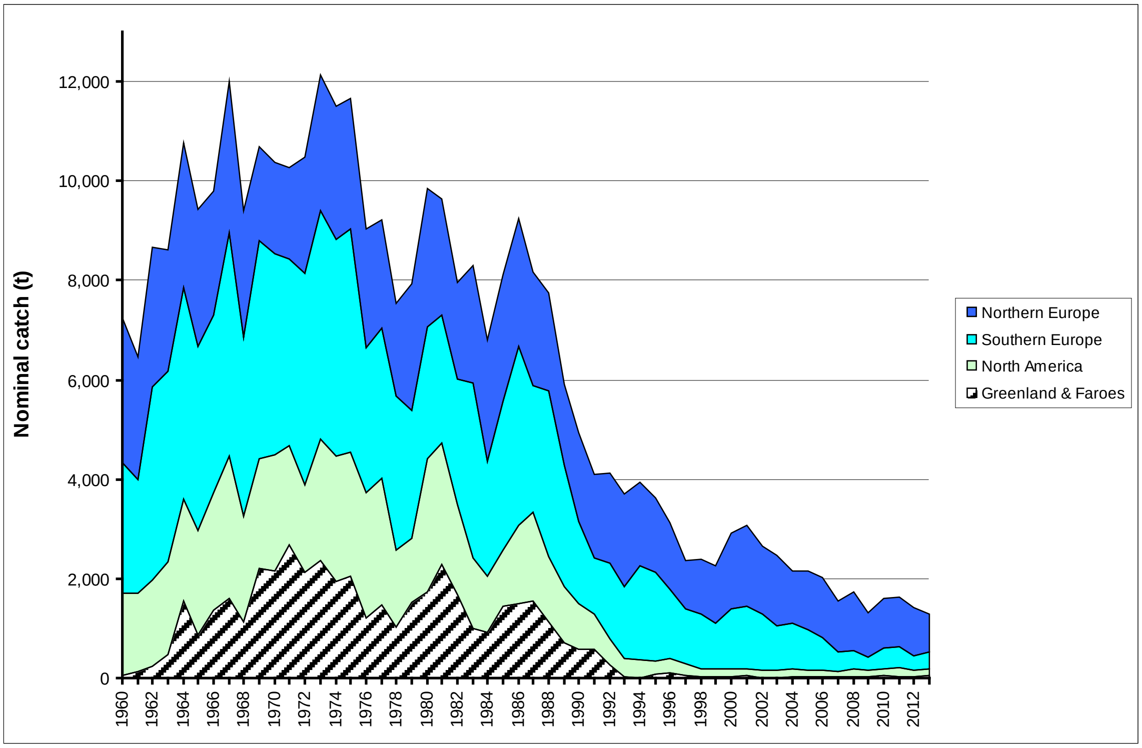


Figure 2.1.1.1. Total reported nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960–2013.

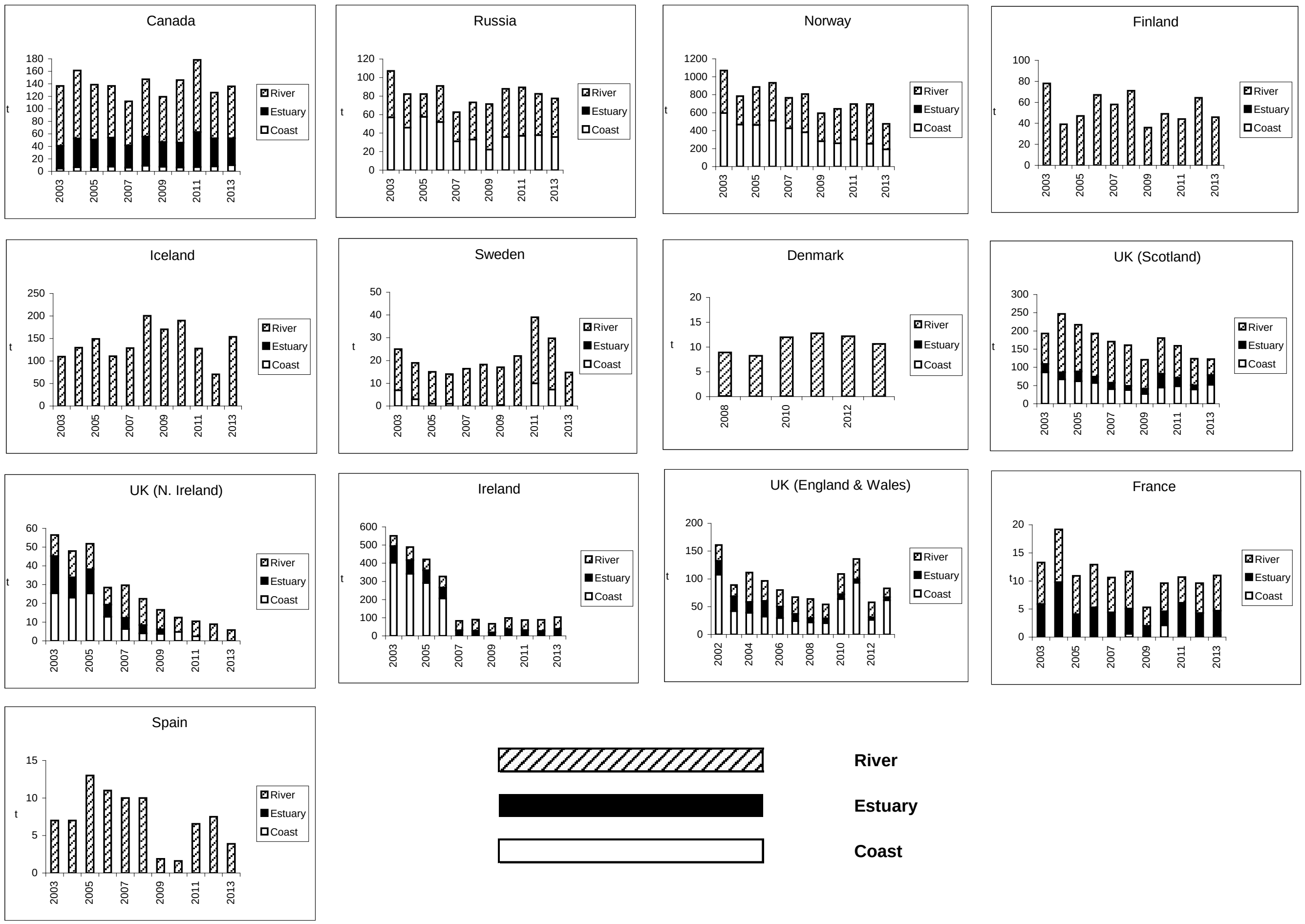


Figure 2.1.1.2. Nominal catch (tonnes) taken in coastal, estuarine and riverine fisheries by country. The way in which the nominal catch is partitioned among categories varies between countries, particularly for estuarine and coastal fisheries – see text for details. Note also that the y-axes scales vary.

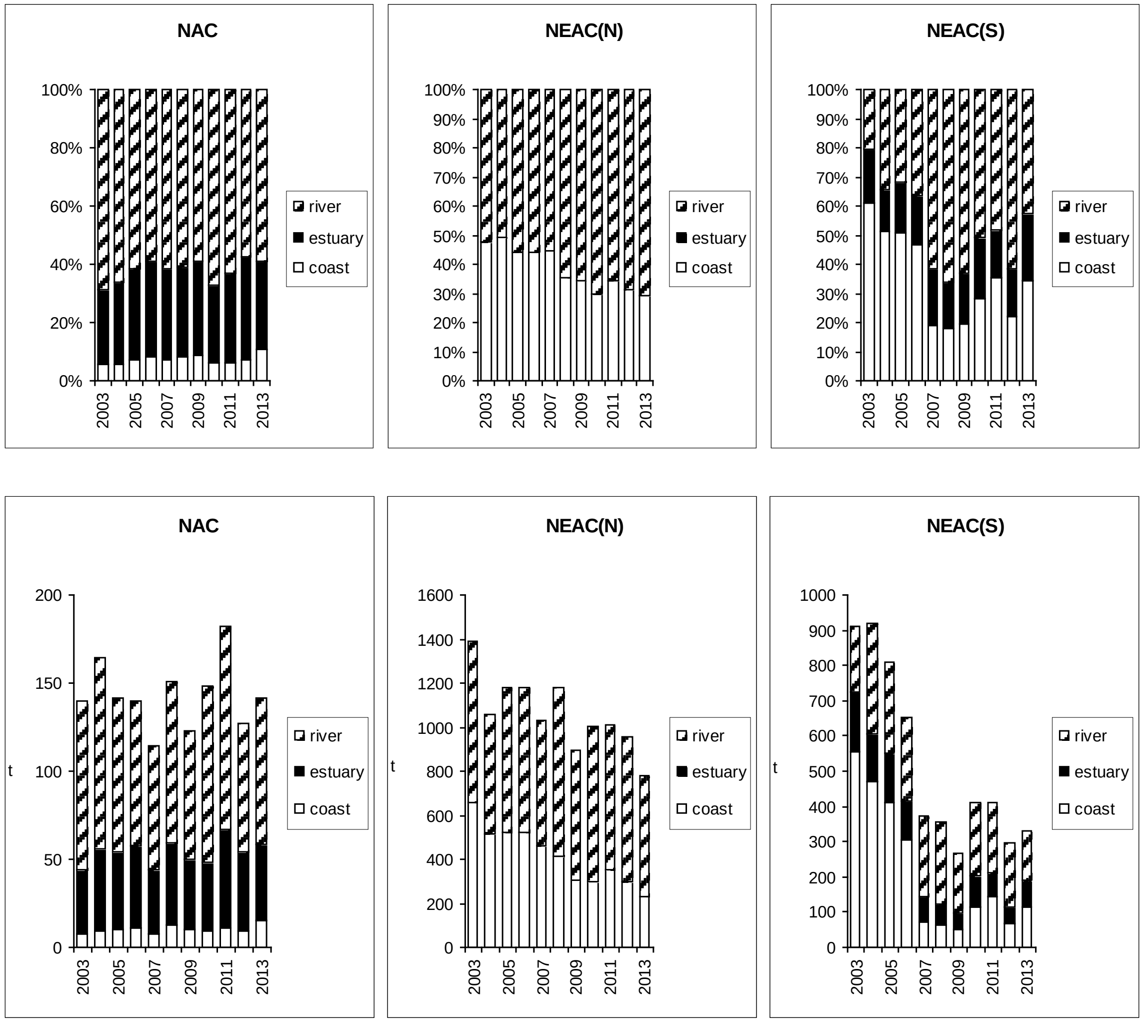


Figure 2.1.1.3. Nominal catch taken in coastal, estuarine and riverine fisheries for the NAC and NEAC northern and southern areas, 2003–2013. The way in which the nominal catch is partitioned among categories varies between countries, particularly for estuarine and coastal fisheries; see text for details. Top Panel - Percentages of nominal catch taken in coastal, estuarine and riverine fisheries. Bottom panel - Nominal catches (tonnes) taken in coastal, estuarine and riverine fisheries. Note that the y-axes scales vary for the bottom panel.

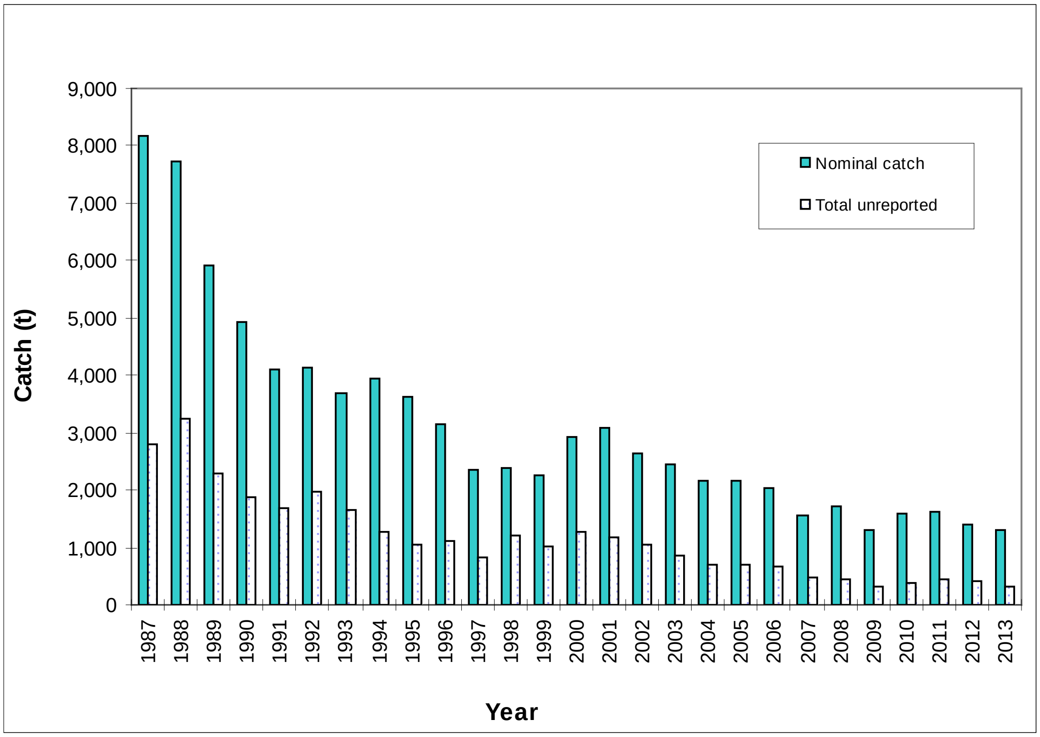


Figure 2.1.3.1. Nominal North Atlantic salmon catch and unreported catch in NASCO Areas, 1987–2013.

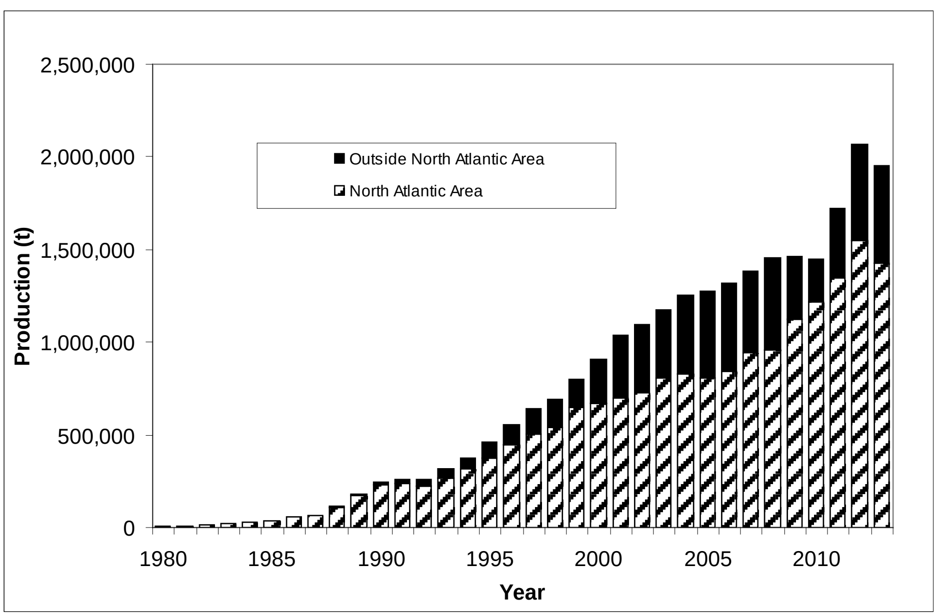


Figure 2.2.1.1. Worldwide farmed Atlantic salmon production, 1980–2013.

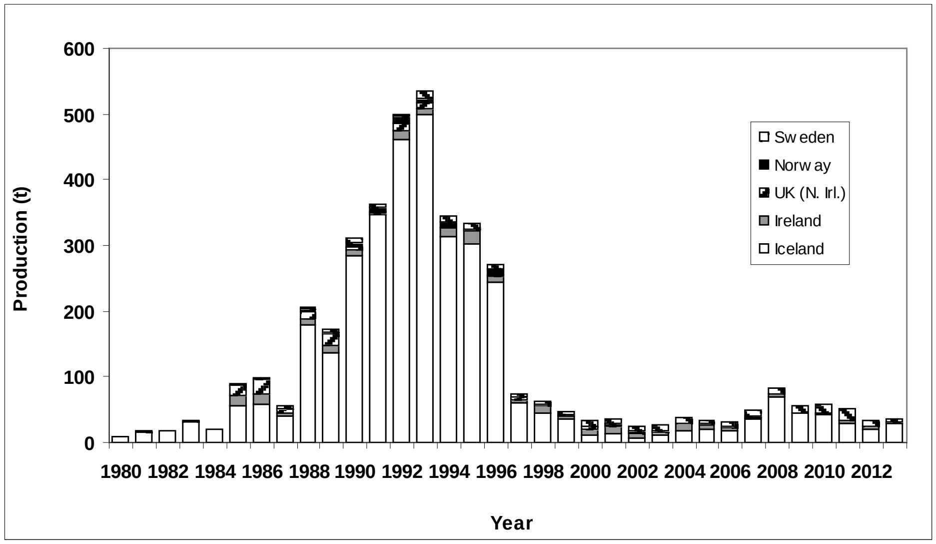


Figure 2.2.2.1. Production of ranched salmon (tonnes round fresh weight) in the North Atlantic, 1980–2013.

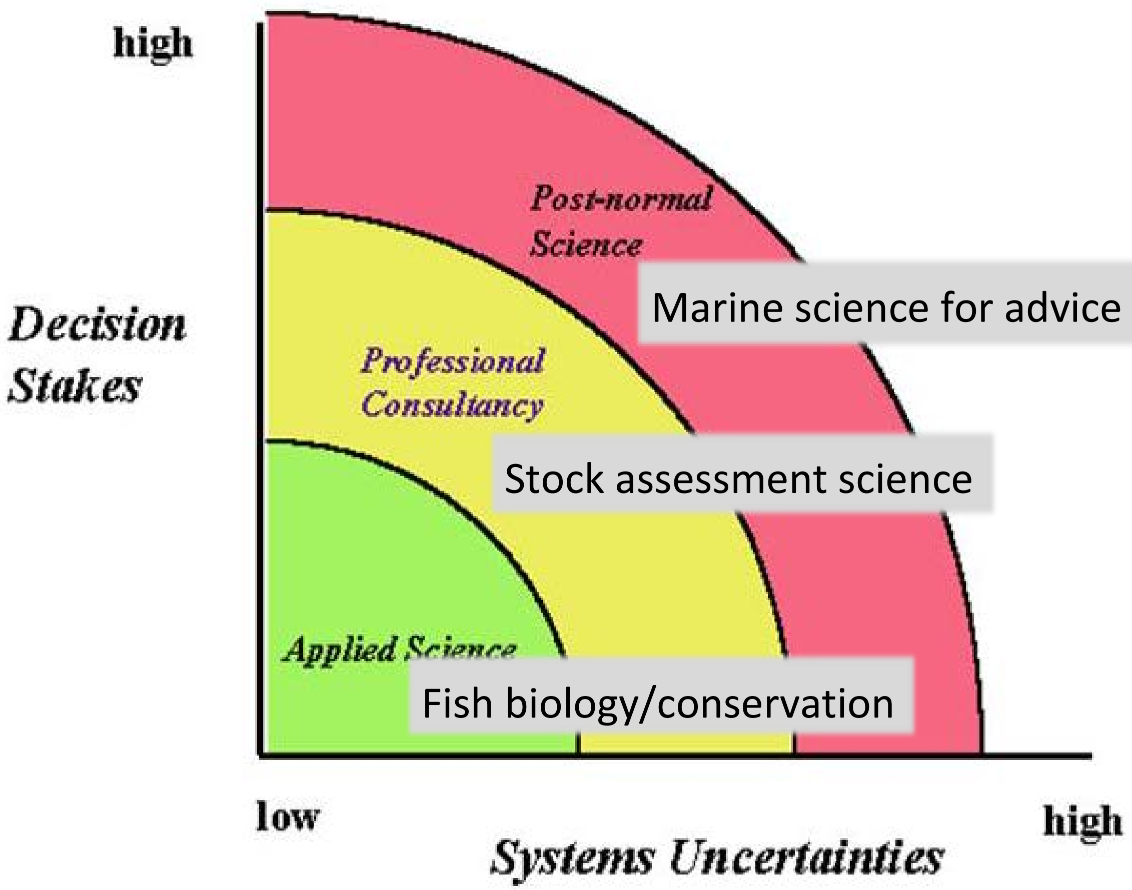


Figure 2.3.1.1. 'NUSAP' approach interpreted for fisheries (Source: Funtowicz, S.O. and J.R. Ravetz; 1990).

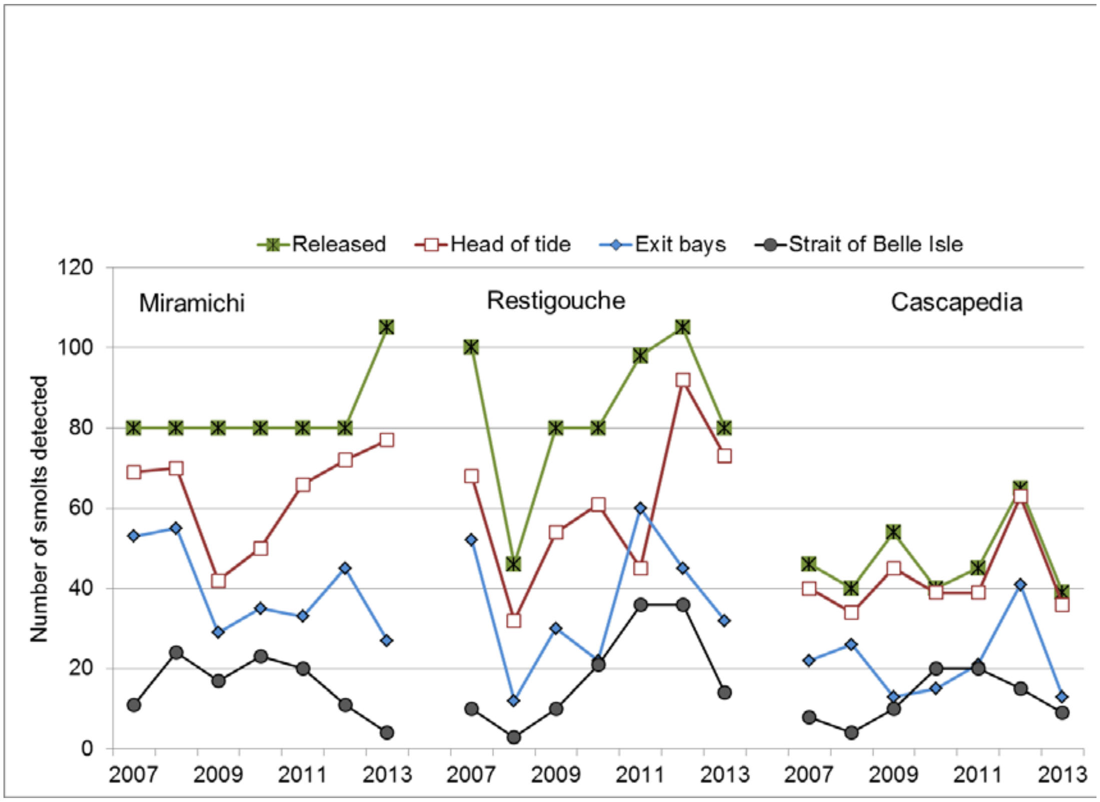


Figure 2.3.3.1. Number of smolts tagged and released from the Miramichi, Restigouche, and Cascapedia rivers, and subsequently detected at the head of tide, exit of bays, and Strait of Belle Isle arrays in 2007 to 2013.

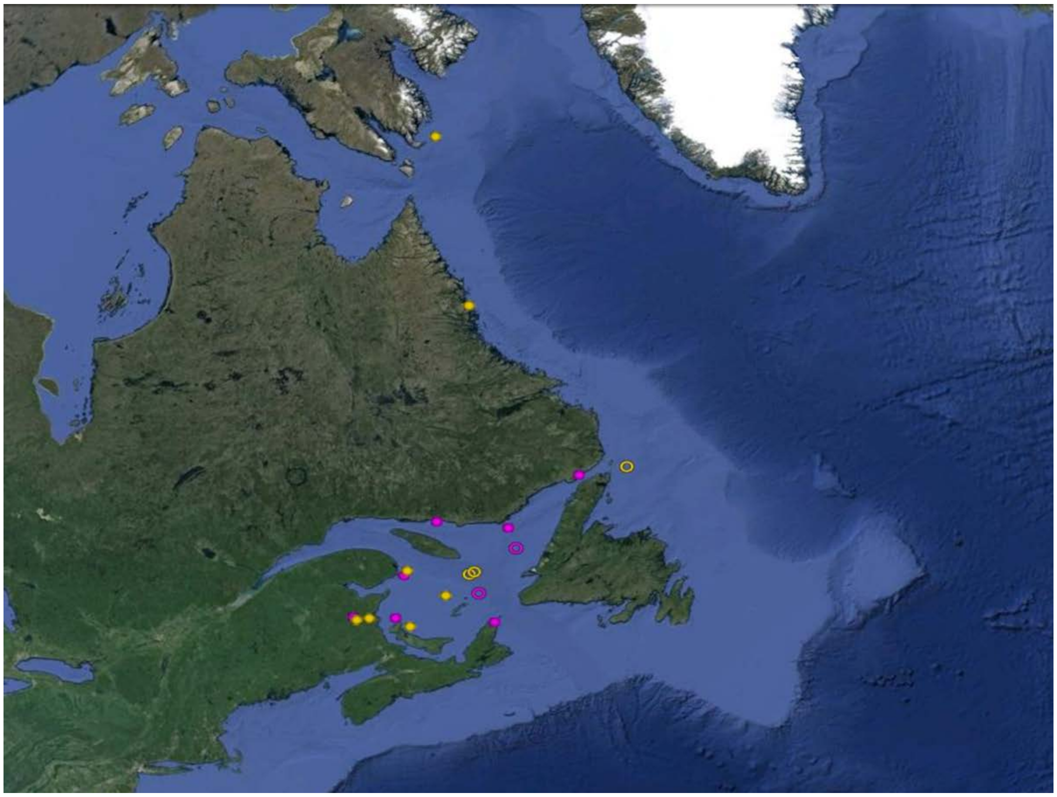


Figure 2.3.3.2 Pop-off locations of archival pop-off tags in 2012 (pink) and 2013 (yellow) from Atlantic salmon kelts tagged in the Miramichi River. Open circles never transmitted nor were recovered. Solid circles transmitted data.

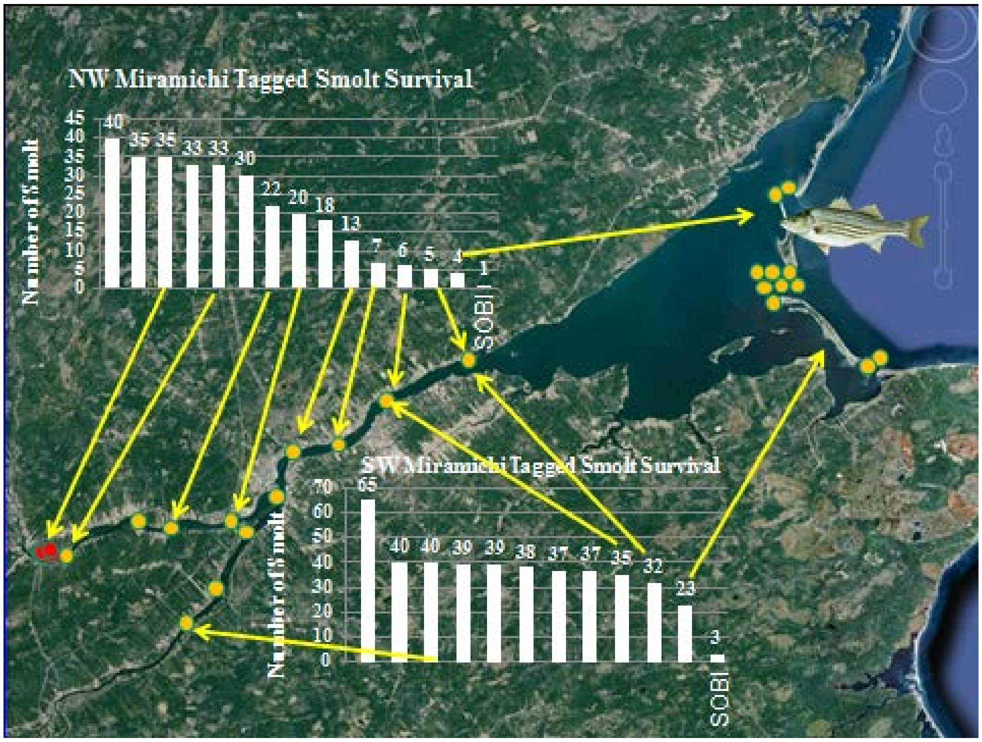


Figure 2.3.3.3. Number of acoustically tagged smolts detected migrating downstream in the NW and SW Miramichi river in 2013. Striped bass are expected to use the whole range shown above.

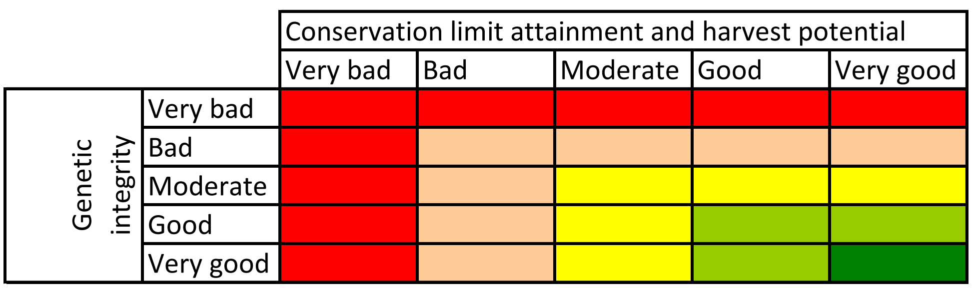


Figure 2.3.5.1. The Norwegian Quality norm classification system. Note: the worst classification in any of the dimensions determines the final classification of the stock.

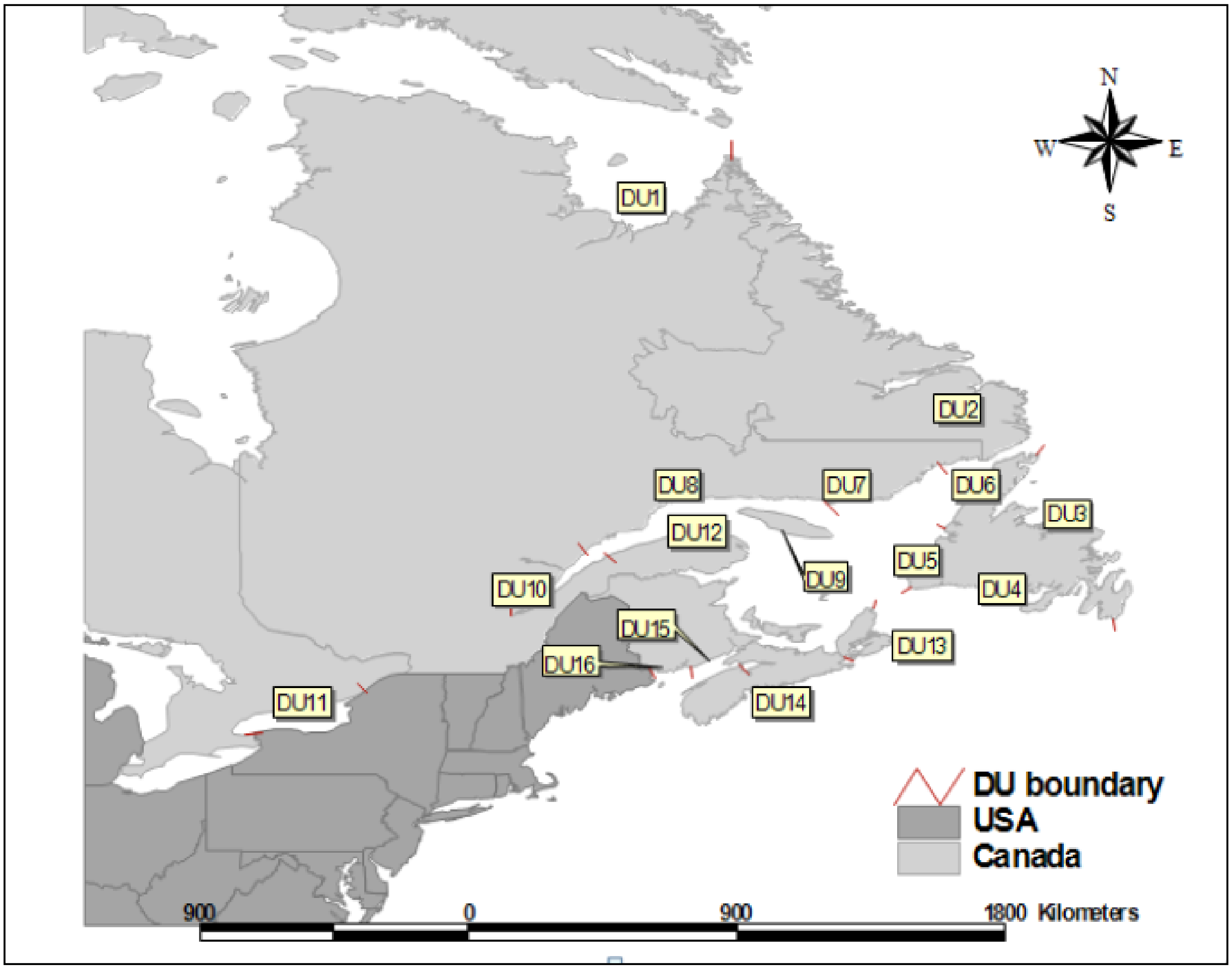


Figure 2.3.7.1. Proposed designable units (DUs) for Atlantic salmon in eastern Canada (Source: COSEWIC, 2010).

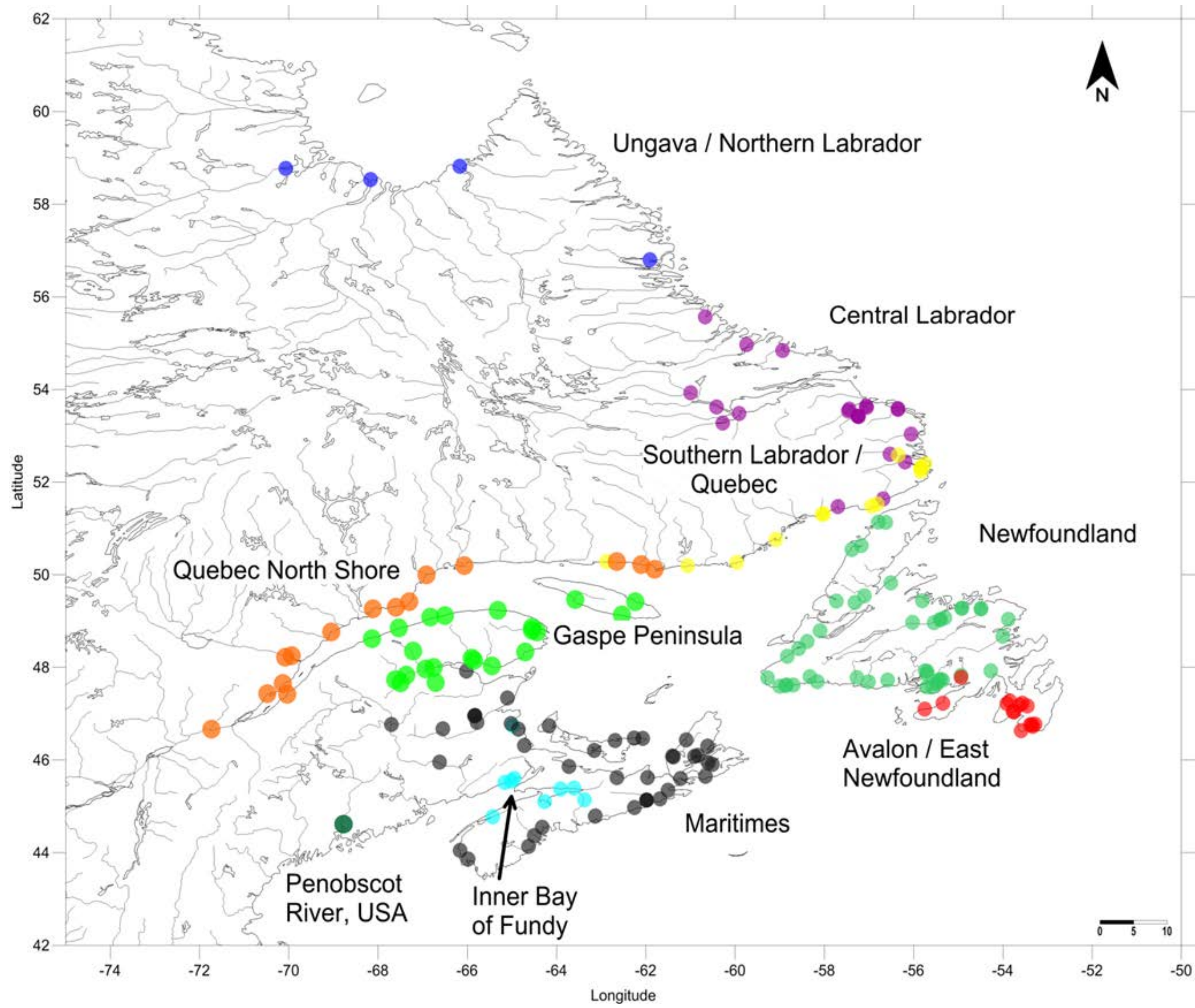


Figure 2.3.8.1. Map of baseline samples and reporting groups used in the mixture and assignment analysis of Bradbury *et al.* (in press) for Labrador Aboriginal and subsistence mixed-stock fisheries.

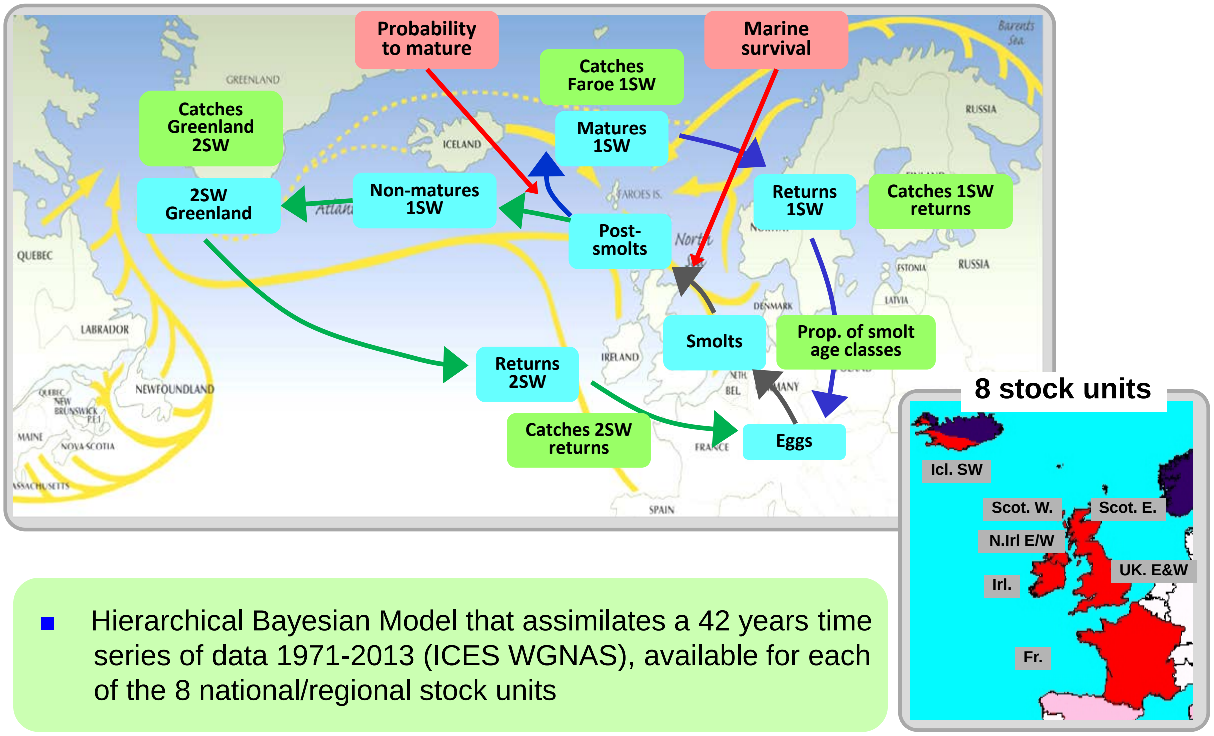


Figure 2.3.9.1. The integrated life cycle model developed for each stock unit of the southern Northeast Atlantic stock complex. Variables in light blue are the main stages considered in the age- and stage-structured model. Arrows in blue and green are the fish that mature after the first and second winter at sea. Variables in light green indicate the main sources of data assimilated in the model. The post-smolt marine survival and the probability of maturing are the key parameters estimated in the model. The hierarchical structure provides a tool for separating out signals in demographic traits at different spatial scales: (1) a common trend shared by all stock units and, (2) fluctuations specific to each stock unit.

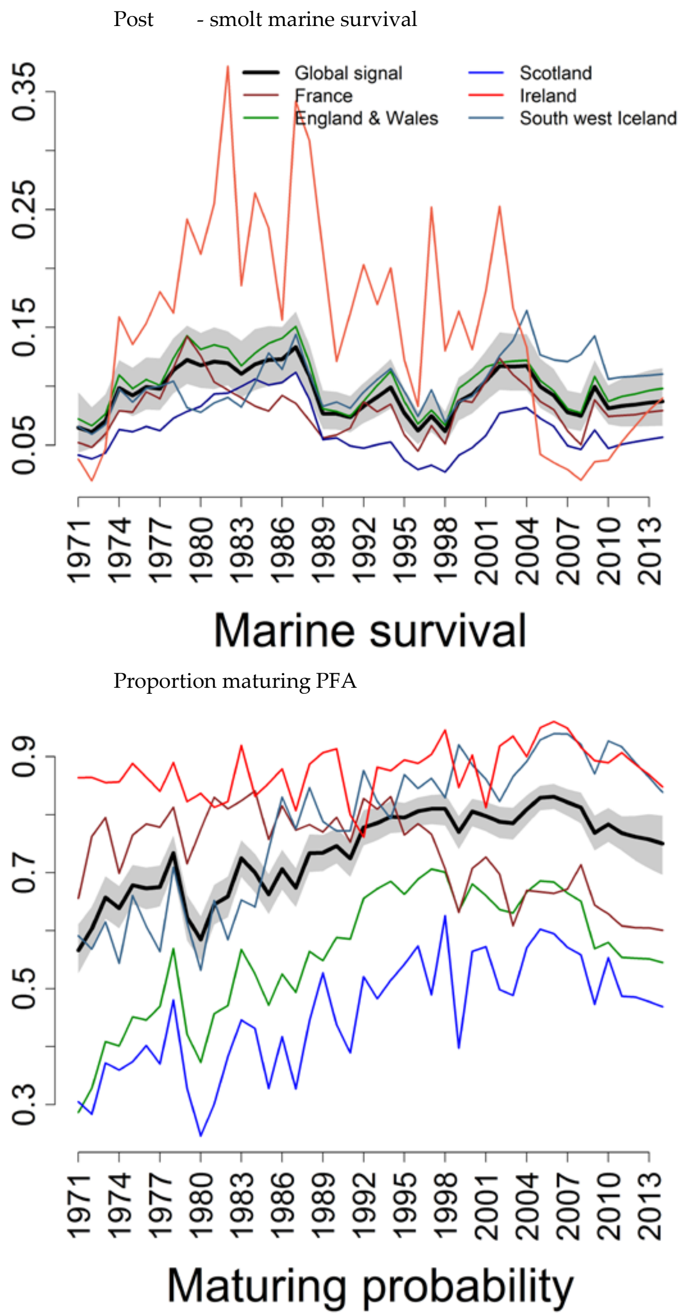


Figure 2.3.9.2. Time-series of estimates of post-smolt marine survival and probability to mature after the first winter at sea. The solid black line indicates the trend shared by all stock complexes together with the associated Bayesian uncertainty (95% Bayesian credible interval). Other solid lines are the medians of Bayesian posterior distributions. Even if the data are available at the scale of eight regions (see Figure 2.3.9.1), only five stock complexes have been considered regarding the spatial variability of the post-smolt marine survival and the probability of maturing after the first winter at sea: France, UK (England & Wales), Ireland and UK (N. Ireland), UK (Scotland) and Iceland-SW.

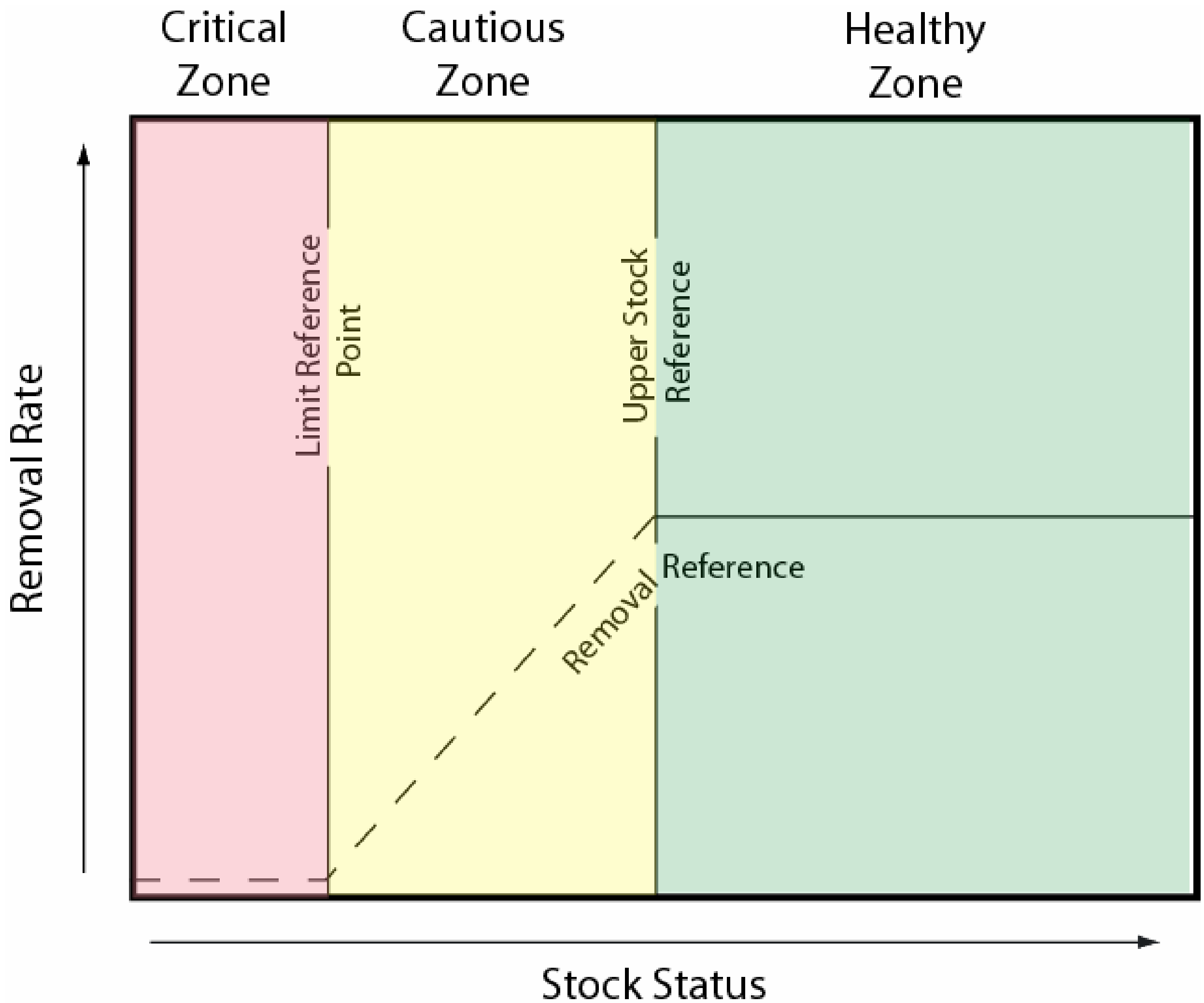


Figure 2.5.2.1. Canadian fisheries management framework consistent with the Precautionary Approach (Source: DFO, 2006). See further description in Table 2.5.2.1.

3 Northeast Atlantic Commission area

3.1 NASCO has requested ICES to describe the key events of the 2013 fisheries

3.1.1 Fishing at Faroes

No fishery for salmon has been prosecuted since 2000.

3.1.2 Key events in NEAC homewater fisheries in 2013

In France, TACs in the 30 salmon rivers of Brittany have been updated on the basis of data from the Scorff index river, which is considered more representative of the rivers in Brittany than the River Oir (a small tributary of the River Sélune, which flows into the Baie du Mont St Michel, Lower Normandy). The former TACs were established in 1996. The update took into account important changes in biological parameters (i.e. decrease in marine survival, lower proportion of MSW fish, reduced fecundity, increase in smolt production capacity). The new model has led to decreased TACs on many rivers, especially on six of the ten larger ones. However, the new TACs may allow catches to increase in some rivers, relative to the average catch in the last five years.

In Sweden, the lowest dam in the River Ätran (an index river) was removed in 2013, allowing free passage for all fish species. As this is the largest river with wild salmon on the Swedish west coast and the dam has been a barrier to fish movements, this is hoped to have large positive effects, especially on migrating smolts that previously had to pass through the power plant or over the dam. Further evaluation is planned and a ceremony is to be held on 1 April 2014 to commemorate the event when the Swedish King Carl Gustav will officially declare the river 'open'. The funding for the project was mainly provided by the municipality of Falkenberg, who removed its own hydropower plant for the benefit of salmon and biodiversity.

3.1.3 Gear and effort

No significant changes in gear type used were reported in 2013, however, changes in effort were recorded. The number of gear units licensed or authorized in several of the NEAC area countries provides a partial measure of effort (Table 3.1.3.1), but does not take into account other restrictions, for example, closed seasons. In addition, there is no indication from these data of the actual number of licences actively utilized or the time each licensee fished.

Trends in effort are shown in Figures 3.1.3.1 and 3.1.3.2 for the northern and southern NEAC countries respectively. In the Northern NEAC area, driftnet effort in Norway accounted for the majority of the effort expended in the early part of the time-series. However, this fishery closed in 1989, reducing the overall effort substantially. In Russia, the number of fishing days in the catch and release fishery in the Kola Peninsula increased for the period when data are available (1991–2006). The number of gear units in the coastal fishery in the Archangelsk region increased for the past three years. The number of units in the in-river fishery decreased markedly between 1996 and 2002, since when it has remained relatively stable.

The number of gear units licensed in UK (England & Wales), UK (Scotland) and Ireland (Table 3.1.3.1) was among the lowest reported in the time-series. The number of driftnet, draftnet, bag nets and boxes for UK (N. Ireland) decreased throughout the time-series and for 2013, five units were licensed but none was fished. In Norway, the number of bag nets and bendnets has decreased for the past 15–20 years and in 2013, was among the lowest in the time-series.

Rod effort trends, where available, have varied for different areas across the time-series (Table 3.1.3.1). In the Northern NEAC area, the number of anglers and fishing days in Finland has shown an increase throughout the time period. In the Southern NEAC area, rod licence numbers have increased since 2001 in UK (England & Wales). In Ireland, there was an apparent increase in the early 1990s owing to the introduction of one day licences. Licence numbers then remained stable for over a decade, before decreasing from 2002 due to fishery closures. In France, the effort has been fairly stable over the last ten years but showed a slight increase for the past three years.

3.1.4 Catches

NEAC area catches are presented in Table 3.1.4.1. The provisional nominal catch in the NEAC area in 2013 was the lowest in the time-series (1107 t), 143 t below the updated catch for 2012 (1250 t) and 18% and 32% below the previous 5-year and 10-year averages respectively.

The provisional total nominal catch in Northern NEAC in 2013 was the lowest in the time-series (778 t), 177 t below the updated catch for 2012 (955 t) and 23% and 29% below the previous five-year and ten-year averages respectively. Catches in 2013 were below long-term averages in most Northern NEAC countries except Iceland. There was a noticeable decrease in catches in Norway over last ten years from 1071 t in 2003 to 475 t in 2013.

In the Southern NEAC area the provisional total nominal catch for 2013 (329 t) was slightly higher than the updated catch for 2012 (296 t) and was 5% and 39% below the previous 5-year and 10-year averages respectively. Catches in 2013 were below long-term averages in most Southern NEAC countries except Ireland where the catch in 2013 (103 t) was above the previous 5-year average (86 t).

Figure 3.1.4.1 shows the trends in nominal catches of salmon in the southern and northern NEAC areas from 1971 until 2013. The catch in the Southern area has declined over the period from about 4500 t in 1972 to 1975 to below 1000 t since 2003, and was between 250 to 450 t over the last five years. The catch fell sharply in 1976 and between 1989 and 1991 and continues to show a steady decline over the last ten years. The catch in the Northern area declined over the time-series, although this decrease was less distinct than the reductions noted in the Southern area. The catch in the Northern area varied between 2000 t and 2800 t from 1971 to 1988, fell to a low of 962 t in 1997, and then increased to over 1600 t in 2001. Catch in the Northern area has exhibited a downward trend since and is now below 1000 t. Thus, the catch in the Southern area, which comprised around two-thirds of the total NEAC catch in the early 1970s, has been lower than that in the northern area since 1999.

3.1.5 Catch per unit of effort (cpue)

Cpue is a measure that can be influenced by various factors such as fishing conditions, perceived likelihood of success, and experience. It is assumed that the cpue of net fisheries is a more stable indicator of the general status of salmon stocks than rod cpue, with the latter generally assumed to be more greatly affected by varying local factors such as weather conditions, management measure and angler experience. Both cpue of net fisheries and rod cpue may also be affected by measures taken to reduce fishing effort, for example, changes in regulations affecting gear. If changes in one or more factors occur, a pattern in cpue may not be immediately evident, particularly over larger areas. It is, however, expected that for a relatively stable effort, cpue can reflect changes in the status of stocks and stock size. Cpue may be affected by increasing rates of catch and release in rod fisheries.

The cpue data are presented in Tables 3.1.5.1–3.1.5.6. The cpue for rod fisheries have been derived by relating the catch to rod days or angler season. Cpue for net fisheries were calculated as catch per licence-day, trap month or crew month.

In the southern NEAC area, cpue has generally decreased in the net fisheries in UK (England & Wales) (Figure 3.1.5.1). The cpue for both the net and coble and fixed engine fisheries in UK (Scotland) show a general decline over the time-series but both showed an increase in 2013 from the previous year (Table 3.1.5.5). The cpue values for rod fisheries in UK (England &Wales) showed an increasing trend with the 2013 cpue close to the previous 5-year mean (Table 3.1.5.4). In UK (N. Ireland), the River Bush rod fishery cpue showed an increase from 2012 (Table 3.1.5.1). The rod fishery cpue in France decreased from 2012 and was lower than the previous 5-year mean.

In the northern NEAC area, the cpue for the commercial coastal net fisheries in the Archangelsk area, Russia, showed a long-term decreasing trend while the cpue for the in-river fishery has increased (Figure 3.1.5.1 and Table 3.1.5.1). A slight decreasing trend was noted for rod fisheries in Finland (River Teno and River Näätämö) and both rivers showed a decrease from 2012 and to the previous 5-year mean. An increasing trend was observed for the Norwegian net fisheries cpue but in 2013, the values were lower than the previous year and the 5-year mean for most of the salmon size classes (Figure 3.1.5.1 and Table 3.1.5.6).

3.1.6 Age composition of catches

The percentage of 1SW salmon in NEAC catches is presented in Table 3.1.6.1 and shown separately for northern and southern NEAC countries in Figures 3.1.6.1 and 3.1.6.2 respectively. The overall percentage of 1SW fish in the Northern NEAC area catch remained reasonably consistent at 66% in the period 1987 to 1998 (range 47% to 72%), but has fallen in more recent years to 59% (range 44% to 84%), when greater variability among countries has also been evident. In Sweden and Norway there was a significant decline in the proportion of 1SW comparing the two periods (one-way Anova) (Table 3.1.6.1). However, the proportion increased significantly in Iceland.

On average, 1SW fish comprise a higher percentage of the catch in Iceland, Finland and Russia than in the other northern NEAC countries, with the percentage of 1SW fish in Norway and Sweden remaining the lowest among the Northern NEAC countries (Figure 3.1.6.1).

In the southern NEAC area, the percentage of 1SW fish in the catch in 1987–1998 averaged 60% (range 46% to 71%), and averaged 57% in 1999–2013 (range 27% to 71%). The percentage of 1SW salmon in the southern NEAC area remained reasonably consistent over the time-series, although with considerable variability among individual countries (Figure 3.1.6.2). There were no significant changes in the proportion between 1987–1998 and 1999–2013 for individual countries.

Pooling data from all countries showed an overall decline in the proportion of 1SW fish in the catch over the period 1999–2013. Looking at individual countries, the change (in percentage of 1SW fish) from the earlier to the latter period was correlated to the initial proportion of 1SW fish. In countries with a high proportion there was no decrease (UK (England & Wales)), a small decrease (Russia) or even an increase (Iceland), whereas in countries with low initial proportions there were larger decreases.

3.1.7 Farmed and ranched salmon in catches

The contribution of farmed and ranched salmon to national catches in the NEAC area in 2013 was again generally low in most countries, with the exception of Norway, Iceland and Sweden, and is similar to the values that have been reported in previous years. The occurrence of such fish is usually ignored in assessments of the status of national stocks (Section 3.3).

The estimated proportion of farmed salmon in Norwegian angling catches in 2013 was the lowest on record (3.5%), whereas the proportion in samples taken from Norwegian rivers in autumn was higher than in most recent years (21%, a preliminary number based on 21 rivers).

The number of farmed salmon that escaped from Norwegian farms in 2013 is reported to be 198 000 fish (provisional figure), up from the previous year (38 000). An assessment of the likely effect of these fish on the estimates of PFA has been reported previously (ICES, 2001). The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching for rod fisheries in two Icelandic rivers continued in 2013. Icelandic catches have traditionally been split into two separate categories, wild and ranched. In 2013, 29 t were reported as ranched salmon in contrast to 125 t harvested as wild. Similarly, Swedish catches have been split into two separate categories, wild and ranched (Table 2.1.1.1). In 2013, 9.6 t were reported as ranched salmon in contrast to 5.1 t harvested as wild. Ranching occurs on a much smaller scale in other countries. Some of these operations are experimental and at others harvesting does not occur solely at the release site.

3.1.8 National origin of catches

3.1.8.1 Catches of Russian salmon in northern Norway

Previously the Working Group has reported on investigations of the coastal fisheries in northern Norway where genetic methods have been applied to analyse the stock composition of this mixed-stock fishery (e.g. ICES, 2013a). Through tagging studies and a pilot genetic study (Svenning *et al.*, 2011), this coastal fishery has been demonstrated to intercept and exploit Russian salmon returning to Russian rivers. Norway has recently decreased fishing effort in coastal areas and the available information shows a decline in the number of fishing days and in the number of fishers operating in marine waters of Finnmark County. However, there are still significant salmon fisheries operating in this coastal area exploiting Atlantic salmon of Russian origin.

The investigations into the composition of this mixed-stock fishery were continued under the Joint Russian–Norwegian Scientific Research Programme on Living Marine Resources in 2013 (Appendix 10 of the 42nd Joint Russian–Norwegian Fishery Commission) and under the Kolarctic Salmon project (Kolarctic ENPI CBC programme). The Kolarctic Salmon project has developed a genetic baseline for over 180 rivers in northern Norway and Russia and analysed over 20 000 samples from coastal fisheries in 2008, 2009, 2011 and 2012. The samples from the coastal fisheries were assigned to rivers and regions in the study area, and estimates of exploitation of salmon of different origin in time and space is currently being developed, and will be reported by the end of March 2014. Preliminary results from this project indicate that the highest exploitation of Russian salmon taking place in the eastern regions of county Finnmark, and a decreasing trend in exploitation of Russian salmon in Norwegian coastal fisheries through the fishing season. The reports from the project, when available, will provide a detailed analysis of the coastal migration of different salmon stocks from northern Norway and Russia, and their exploitation in different areas, and provide managers with tools for regulating fisheries on a more informed basis.

3.1.8.2 Genetic investigations in support of management in UK (England & Wales)

Work has continued in UK (England & Wales) to establish the genetic identity of stocks to provide a basis for assigning salmon to specific rivers or regions of origin and to enable patterns of exploitation in mixed-stock fisheries to be assessed. This, in turn, has helped to inform management decisions. Recently, analysis of fish caught in the northeast coastal fishery was used to determine the proportions of the net catch that were from northeast English and Scottish rivers as regional groups. It was not possible to assign individual fish to their specific river of origin. However, work is ongoing to determine the levels of resolution and associated assignment probabilities that can be obtained using Single Nucleotide Polymorphic (SNP) genetic markers. This work is due to report in 2014.

More recently, similar genetic analyses have also been used to inform management deliberations in relation to the net and fixed engine fisheries in the Severn and Tamar estuaries, and to better understand stock structuring and patterns of exploitation in other rivers.

A further investigation has also explored the genetic origin of salmon recolonising the Mersey, a recovering river (Ikediashi *et al.*, 2012). This indicated that fish entering the river originated from multiple sources, with the greatest proportion (45–60%, dependent on methodology) assigning to rivers in the geographical region just to the north, suggesting fish were mainly straying in a southerly direction.

3.1.9 Exploitation indices for NEAC stocks

Exploitation estimates have been plotted for 1SW and MSW salmon from the Northern NEAC (1983 to 2013) and Southern NEAC (1971 to 2013) areas and are displayed in Figure 3.1.9.1. The overall rate of change of exploitation within the different countries in the NEAC area is presented as a plot of the change (% change per year) in exploitation rate over the time-series in Figure 3.1.9.2. This was derived from the slope of the linear regression between time and natural logarithm transformed exploitation rate.

National exploitation rates are an output of the NEAC PFA run-reconstruction model. These were combined as appropriate by weighting each individual country's exploitation rate to the reconstructed returns.

The exploitation of 1SW salmon in both Northern NEAC and Southern NEAC areas has shown a general decline over the time-series (Figure 3.1.9.1). There was a notable sharp decline in 2007 as a result of the closure of the Irish driftnet fisheries in the southern NEAC area. The weighted exploitation rate on 1SW salmon in the Northern NEAC area was 40% in 2013 representing a slight decline from the previous 5-year (41%) and 10-year (43%) averages. Exploitation on 1SW fish in the Southern NEAC complex was 12% in 2013 indicating a decrease from both the previous 5-year (14%) and the 10-year (20%) averages.

The exploitation rate of MSW fish also exhibited an overall decline over the time-series in both northern NEAC and southern NEAC areas (Figure 3.1.9.1). There was a notable sharp decline in 2008 for northern NEAC as result of a substantial reduction in coastal fishing effort in Norway. Exploitation on MSW salmon in the northern NEAC area was 45% in 2013, showing a slight decline from the previous 5-year (46%) and 10-year averages (52%). Exploitation on MSW fish in Southern NEAC was 10% in 2013, a decrease from both the previous 5-year (12%) and 10-year (14%) averages.

The relative rate of change of exploitation over the entire time-series indicates an overall reduction of exploitation in most Northern NEAC countries for 1SW and MSW salmon (Figure 3.1.9.2). Exploitation in Finland has been relatively stable over the time period whilst the largest rate of reduction has been for 1SW salmon in Russia. The southern NEAC countries have also shown a general decrease in exploitation rate (Figure 3.1.9.2) on both 1SW and MSW components. The greatest rate of decrease shown for both 1SW and MSW fish was in UK (Scotland). Whilst France (MSW) and Iceland (both 1SW and MSW) showed relative stability in exploitation rates during the time-series, exploitation for 1SW salmon in France shows an increase.

3.2 Management objectives and reference points

In the absence of specific management objectives, the status of NEAC stocks at the country and stock complex scale (Section 3.3.4) is considered with respect to general ICES guidance (Stock Annex, Section 3.1). Conservation limits (CLs) have been defined by ICES as the numbers of fish that will achieve long-term average maximum sustainable yield (MSY). NASCO has adopted this definition of CLs (NASCO 1998).

The assessment of stocks directly evaluates the risk of failing to meet or exceed the objectives for the stock. Managers can choose the risk level which they consider appropriate. Where such choices have yet to be made, ICES considers that to be consistent with the precautionary approach, and given that the CLs are considered to be limit reference points and to be avoided with a high probability, then managers should choose a risk level that results in a low chance of failing to meet the CLs. ICES recommends that the risk of failing to meet or exceed CLs for individual stocks should be less than 5% (i.e. the probability of meeting or exceeding CL should be greater than 95%) (ICES, 2012c).

The following terminology is therefore used to characterize stock status:

- 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 limit is below the CL, but the midpoint is above, then ICES considers the stock to be at risk of suffering reduced reproductive capacity.
- When the midpoint is below the CL, ICES considers the stock to be suffering reduced reproductive capacity.

ICES has also developed a risk framework for the provision of catch advice for the NEAC area. Using this framework, the ICES catch advice (e.g. ICES (2013)) indicates the probability that the NEAC stock complexes or national stocks will exceed their CLs for different catch options at Faroes. However, this risk framework has not yet been formally adopted by NASCO, and the Working Group has advised (ICES, 2013a) that NASCO would need to agree upon the following issues before it could be finalized:

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

The proposed risk analysis framework together with catch advice for the Faroes fishery from the most recent assessment is provided in Section 3.4.3 of the Stock Annex.

3.2.1 Setting conservation limits

River-specific CLs have been derived for salmon stocks in some countries in the NEAC area (France, Ireland, UK (England & Wales) and Norway). An interim approach has been developed for estimating national CLs for countries that cannot provide one based upon river-specific estimates. This approach is based on the establishment of pseudo-stock–recruitment relationships for national salmon stocks (Stock Annex, Section 3.1.2).

3.2.2 National conservation limits

CL estimates for individual countries are summed to provide estimates for northern and southern NEAC stock complexes (Table 3.2.2.1). These data are also used to estimate the SERs (the CL increased to take account of natural mortality between the recruitment date, 1st January in the first sea winter, and return to homewaters) for maturing and non-maturing 1SW salmon from the individual countries as well as northern NEAC and southern NEAC stock complexes (Table 3.2.2.1). The Working Group considers the current CL and SER levels may be less appropriate to evaluating the historical status of stocks (e.g. pre-1985), that in many cases have been estimated with less precision.

3.2.3 Progress with setting river-specific conservation limits

One of the river-specific CLs in UK (England & Wales) was revised in 2013 as a result of substantial changes in the available wetted area in the catchment. The recent installation of a fish pass (in 2008) and the removal of a further impassable barrier (in 2011) have opened up almost 175 km of newly accessible habitat on the River Monnow, a tributary of the Wye. A counter located in the fish pass has been used to monitor the natural recovery in the tributary (no supplementary stocking has taken place or is planned). Numbers of adult fish initially remained relatively low (<30 per year), but increased in 2013 when 55 salmon were detected. As a result of the increase in the accessible wetted area for spawning and juvenile rearing, the CL for the Wye has now been increased from 35.7 to 38.6 million eggs.

In UK (N. Ireland), the River Upper Bann and River Moyola have been surveyed and a CL for these river stocks established.

UK (Scotland) is working towards development of conservation limits and spawning escapement estimates so that salmon stocks can be more accurately assessed according to NASCO guidelines and appropriate management decisions taken. Current work on the determination of CLs and associated spawning stock levels has involved a critical appraisal of possible ways of transporting CLs from a donor catchment to other Scottish catchments. The limitations of the information currently available mean that it is not currently possible to transfer CLs reliably among catchments. The priority is to focus effort on obtaining the necessary information to enable the development of meaningful CLs upon which reliable management decisions can be taken. Funding has been secured to begin a programme of work to develop a Scottish salmon counter network. It is anticipated that data gathered from this network, together with other biological information, may allow both local stock recruitment information to be derived (from which CLs can be estimated) and direct measures of spawning escapement.

3.3 NASCO has requested ICES to describe the status of stocks

3.3.1 The NEAC-PFA run-reconstruction model

The Working Group has developed a model to estimate the PFA of salmon from countries in the NEAC area (Stock Annex, Section 3.2.1), defined as the number of 1SW recruits on January 1st in the first sea winter. In most countries, the model raises the annual homewater catch in numbers of 1SW and MSW salmon to take account of minimum and maximum estimates of non-reported catches and exploitation rates of these two sea-age groups. These values are then raised to take account of the natural mortality between January 1st in the first sea winter and the mid-point of return (in most cases estimated from the midpoint of the respective national fisheries) and the distant water fisheries catches. The Working Group determined a natural mortality value of 0.03 per month to be the most appropriate (ICES, 2002) and a range 0.02 to 0.04 is used within the model. A Monte Carlo simulation is used to estimate confidence intervals on the stock estimates.

3.3.2 National input to the NEAC-PFA run-reconstruction model

Model inputs are described in detail in Section 2.2 of the Stock Annex, data for the current year are provided in Annex 3 of the Stock Annex. Modifications to these inputs are reported in the year in which they are first implemented (Section 3.3.3). For some countries, the data are provided in two or more regional blocks.

The Working Group reviewed the values of the following parameters which are provided for each country/region for use in the NEAC PFA and NCL model:

- Mid-date of the homewater fisheries for 1SW and MSW salmon;
- Proportion of females in the 1SW and MSW spawning stocks;
- Fecundity of 1SW and MSW females;
- Smolt age composition.

The first of these values is incorporated in the PFA assessment to estimate the mortality between the PFA date and return to homewaters, and the remaining three parameters are used to estimate the number of lagged eggs which is used to derive regional CLs where no river-specific values have been derived and for the PFA forecast model. The values provided have been plotted in approximate order of the latitude of the region (Figures 3.3.2.1. to 3.3.2.5).

The mean time of return of 1SW salmon shows no clear trend with latitude, varying between mid-June and late August across all regions (Figure 3.3.2.1). However, there is a trend for more southerly MSW salmon stocks to return earlier than northern stocks, and so while MSW salmon return at similar times to the 1SW fish in Russia, Finland and Iceland, they return up to three months earlier in more southerly regions. This reflects the fact that MSW salmon may return throughout the year in some southern regions, whereas the window for return is rather narrower in more northerly areas.

In all regions except UK (N. Ireland) and Russia (Kola-White Sea region), fewer than 50% of the returning 1SW salmon are females, but there is an increasing trend in this proportion from north to south, with extremes of 10% in parts of Russia and 57% and in UK (N. Ireland) (Figure 3.3.2.2). More than 50% of the MSW salmon are females in all regions except Russia (Kola-White Sea region) (40%); the proportion in the other regions varies between 57% in southwest Iceland and 85% in Ireland, although there is little evidence of a trend with latitude. The proportions of females in the 1SW and MSW stocks in Russia (Kola-White Sea region) fall outside the general trend, reflecting the fact that the stocks in this region contain large proportions of late running 1SW fish.

The fecundity of the 1SW females also shows little evidence of a trend with a mean of 3865 eggs per female across all the regions; the lowest 1SW fecundities are reported for stocks in Norway (Figure 3.3.2.3) and the highest for Iceland. However there is a strong increasing trend from south to north in the numbers of eggs per female for MSW salmon, with extremes of 6000 eggs per female in Sweden and 15 000 eggs per female in the Pechora River region of Russia. The higher values in more northern areas partly reflect the larger proportion of fish older than 2SW in the catches.

Smolt ages range from one to six years, although one year olds are only reported in UK, Ireland and France and six year olds are only reported in northern Norway, Finland and parts of Russia (Figure 3.3.2.4). The mean smolt age therefore shows an increasing trend with latitude, ranging from 1.15 years in France to 4.44 years in Finland (Figure 3.3.2.5) reflecting the colder temperatures and shorter growing seasons for parr in more northerly rivers.

Overall, the general trends in these input parameters are broadly consistent with expectations.

3.3.3 Changes to the NEAC-PFA run-reconstruction model

Provisional catch data for 2012 were updated where appropriate and the assessment extended to include data for 2013.

Median dates of homewater fisheries were changed for Finland, Sweden and Russia (Pechora) to reflect changes in the respective fisheries.

Catch data were also amended for Finland to take account of new scale reading data used to allocate aggregate catch data to sea age classes. Catch data for Sweden was amended to remove catches of ranched fish (Section 2.2.2).

The smolt age structure for UK (N. Ireland) was amended in light of new survey data.

These changes were reflected in the estimates of CLs and SERs for the countries and NEAC stock complexes in 2013 compared to 2012. Changes in CL were substantial for some countries. Thus, for example, in Finland 1SW CL increased by 23% in 2013 compared to 2012 while MSW CL decreased by 20% and in Sweden 1SW CL decreased by 9% in 2013 compared to 2012 while MSW CL decreased by 17%. There was little change in the resulting CLs associated with the stock complexes, however. For northern NEAC, CLs for 1SW and MSW decreased by 1.6% and 1.2% respectively while for southern NEAC the declines were 0.6% and 0.5% respectively.

3.3.4 The abundance of NEAC stocks

The Working Group has previously noted that the NEAC PFA model provides the best available interpretation of information on national salmon stocks. However, there remains considerable uncertainty around the derived estimates, and national representatives are continuing to improve the data inputs on the basis of new data, improved sampling and further analysis.

A limitation with a single national status of stocks analysis is that it does not capture variations in status in individual rivers or small groups of rivers, although this has been addressed, in part, by the regional splits within some countries.

The model output for each country has been displayed as a summary sheet (Figures 3.3.4.1(a–j)) comprising the following:

- PFA and SER of maturing 1SW and non-maturing 1SW salmon.
- Homewater returns and spawners (90% confidence intervals) and CLs for 1SW and MSW salmon.
- Exploitation rates of 1SW and MSW salmon in homewaters estimated from the returns and catches.
- Total catch (including unreported) of 1SW and MSW salmon.
- National pseudo stock–recruitment relationship (PFA against lagged egg deposition), used to estimate CLs in countries that cannot provide one based upon river-specific estimates (Section 3.2.1).

Tables 3.3.4.1–3.3.4.6 summarise salmon abundance estimates for individual countries and stock complexes in the NEAC area. The PFA of maturing and non-maturing 1SW salmon and the numbers of 1SW and MSW spawners for the northern NEAC and southern NEAC stock complexes are shown in Figure 3.3.4.2.

The 5th and 95th percentiles indicated by the whiskers in each of the plots (Figures 3.3.4.1 and 3.3.4.2) indicate the uncertainty in the data. The Working Group recognised that the model provides an index of the current and historical status of stocks based upon fisheries data. It should be noted that the results for the full time-series can change when the assessment is re-run from year to year as the input data are refined.

The stock complexes

The abundances of both maturing 1SW and of non-maturing 1SW PFA for northern NEAC (Figure 3.3.4.2) show a general decline over the time period, the decline being more marked in the maturing 1SW stock. Both age groups have, however, been at full reproductive capacity prior to the commencement of distant water fisheries throughout the time-series.

1SW spawners in the northern stock complex have been at full reproductive capacity throughout the time-series. MSW spawners on the other hand, while generally remaining at full reproductive capacity, have spent limited periods either at risk of suffering reduced reproductive capacity or suffering reduced reproductive capacity.

Similarly to northern NEAC stocks, the abundances of both maturing 1SW and of non-maturing 1SW PFA for southern NEAC demonstrate broadly similar declining trends over the time period (Figure 3.3.4.2). Both age groups were at full reproductive capacity prior to the commencement of distant water fisheries throughout the early part of the time-series. Since the mid-1990s, however, the non-maturing 1SW stock has been at risk of suffering reduced reproductive capacity in approximately 50% of the assessment years. The maturing 1SW stock, on the other hand, was first assessed as being at risk of suffering reduced reproductive capacity in 2009.

The 1SW spawning stock in the southern NEAC stock complex has been at risk of suffering reduced reproductive capacity or suffering reduced reproductive capacity for most of the time-series. In contrast, the MSW stock was at full reproductive capacity for most of the time-series until 1996. After this point, however the stock has generally been at risk of reduced reproductive capacity or suffering reduced reproductive capacity.

Based on the NEAC run reconstruction model, the status of three of the four stock complexes (both northern NEAC age groups and the southern NEAC maturing 1SW stock) were considered to be at full reproductive capacity prior to the commencement of distant-water fisheries in the latest available PFA year. The southern NEAC non-maturing 1SW stock, on the other hand, was considered to be at risk of suffering reduced reproductive capacity prior to the commencement of distant-water fisheries in the latest available PFA year.

Individual country stocks

The assessment of PFA and spawning stocks of individual countries for the latest PFA and spawning year (Figures 3.3.4.1(a–j)) show the same broad contrasts between northern (including Iceland) and southern NEAC stocks as was apparent in the stock complex data.

Thus, for all countries in northern NEAC, the PFAs of both maturing and non-maturing 1SW stocks were at full reproductive capacity. In southern NEAC, the maturing 1SW stock for one country (UK (Scotland)) was at full reproductive capacity, while the stock in two (UK (N. Ireland) and Ireland) were at risk of suffering reduced reproductive capacity and the remaining two (UK (England & Wales) and France) were suffering reduced reproductive capacity. Similarly for non-maturing 1SW stocks, two countries (UK (England and Wales) and UK (N. Ireland) were at full reproductive capacity, while the stock in a further two (UK (Scotland) and France) were at risk of suffering reduced reproductive capacity and Ireland was suffering reduced reproductive capacity.

The spawning stocks of few countries within northern NEAC fell below full reproductive capacity in 2013. Only in Finland and Sweden was the 1SW spawning stock at risk of suffering reduced reproductive capacity, while in Finland and Russia the MSW spawning stock was suffering reduced reproductive capacity. In southern NEAC, on the other hand, only the 1SW spawning stock in UK (Scotland) was at full reproductive capacity in 2013, while the stock in two countries (UK (N. Ireland) and Ireland) was at risk of suffering reduced reproductive capacity and the stock in a further two countries (UK (England & Wales) and France) was suffering reduced reproductive capacity. For the MSW spawning stocks of southern NEAC countries, only the stock in UK (England & Wales) and UK (N. Ireland) was at full productive capacity in 2013. The stock in UK (Scotland) was at risk of suffering reduced reproductive capacity and the stock in a further two countries (Ireland and France) was suffering reduced reproductive capacity.

3.3.5 Compliance with river-specific conservation limits (CLs)

The status of individual rivers with regard to attainment of national CLs after homewater fisheries is shown in Table 3.3.5.1. The total number of rivers in each country and the number which can be assessed are also shown. Numerical evaluations can only be provided for seven countries where individual rivers are assessed for compliance with CLs. The compliance estimate for France for individual rivers is provided for 1SW and MSW components and data for the individual rivers for Norway relate to 2012. There are varying proportions of rivers meeting or exceeding CLs or other stock indicator and in most instances where information is provided there is less than 50% compliance reported. Of the seven countries, the proportion of rivers assessed for compliance with CLs ranges from 0% to 86%.

3.3.6 Marine survival (return rates) for NEAC stocks

An overview of the trends of marine survival for wild and hatchery-reared smolts returning to homewaters (i.e. before homewater exploitation) is presented in Figures 3.3.6.1 and 3.3.6.2. The figures provide the percent change in return rates between five year averages for the smolt years 2003 to 2007 and 2008 to 2012 for 1SW salmon, and 2002 to 2006 and 2007 to 2011 for 2SW salmon. The annual return rates for different rivers and experimental facilities are presented in Tables 3.3.6.1 and 3.3.6.2. Return rates of hatchery-released fish, however, may not always be a reliable indicator of return rates of wild fish.

The overall trend for hatchery smolts in Southern NEAC areas is generally indicative of a decline in their marine survival. The overall trend for Northern NEAC shows a more varied picture with two out of three dataseries showing an increase in marine survival. It has to be noted however that Northern NEAC is now only represented by two rivers; River Imsa (1SW and 2SW) in Norway and River Ranga in Iceland. For the wild smolts a decline is also apparent for the northern NEAC areas, however for the southern NEAC areas data are more variable with some rivers showing an increase in survival whilst other rivers show a decrease. The increase in survival in the southern NEAC area is especially notable in the 2SW data. The percentage change between the averages of the five year periods varied from an 83% decline (River Halseva 1SW) to a 91% increase (River Bresle) (Figure 3.3.6.1). However, the scale of change in some rivers is influenced by low total return numbers, where a few fish more or less returning may have a significant impact on the percent change. The return rates for wild and reared smolts displayed a mixed picture with some rivers above and some below the previous five and 10-year averages (Tables 3.3.6.1 and 3.3.6.2). The return of wild 1SW and 2SW salmon to the Imsa River in Norway and the Burrishoole River in Ireland was higher than both the 5-year and 10-year averages. Also the returns of 1SW and 2SW wild salmon to the River Bush in UK (N. Ireland) were above the 5-year and 10-year averages. A decrease in survival for hatchery reared fish was detected in Norway for 1SW and 2SW salmon on the Imsa River, and on the Ranga River in Iceland for 1SW fish (Table 3.3.6.2).

Comparison of return rates for the 2011 and 2012 smolt years show a decrease for 2012 compared to 2011 for wild 1SW smolts in Norway (northern NEAC) and an increase in Iceland (northern NEAC) (Table 3.3.6.1). For the southern NEAC area 1SW return rates showed a general increase in 2012 compared to 2011 with the exception of the Rivers Burrishoole and Corrib in Ireland, and the River Scorff in France. Decreased survival for 2SW returns from the 2011 smolt year compared to 2010 was noted in most rivers that reported MSW survival in northern and southern NEAC for those years, with the exception of the River Imsa in Norway (Northern NEAC). The two remaining return rates for 1SW hatchery smolts in the Northern NEAC area for the 2012 smolt year showed a small decrease relative to 2011 for the River Imsa, and an increase on the River Ranga (Table 3.3.6.2). In the Southern NEAC area return rates for hatchery smolts generally increased in the same period, except for the Irish River Burrishoole, for which the survival index was lower in 2012 compared to 2011. The only available MSW survival index for the 2011 smolt cohort, for the River Imsa in Norway (northern NEAC), showed decreased survival relative to the previous year.

Return rates for monitored rivers have been standardised to provide indices of survival for northern and southern 1SW and 2SW returning adult wild and hatchery salmon in the NEAC area (Figure 3.3.6.3). Standardisation was undertaken through application of a GLM (generalised linear model) with survival related to smolt year and river, each as factors, with a quasipoisson distribution, and hence log link. Each of the hatchery and wild, 1SW and 2SW, north and south complex river survival indices sets were run independently as presented in Tables 3.3.6.1 and 3.3.6.2. Only return rates given in separate 1SW and 2SW age classes were used. In summary:

- 1SW return rates of wild smolts to the Northern NEAC area (three river indices) although varying annually, have generally decreased since returns of the 1980 smolt cohort ($p<0.05$). The time-series can be seen as three periods, 1981 to 1993, 1994 to 2005 and 2006 to 2012. In the first period survival ranges greatly but was generally high (averaging 6.1%), before declining sharply in 1994 to a period of low, but gradually improving survival (average of 2.8%), followed by a further decline from 2004 to 2006. Survival in the last period (2006 to 2012) has been at the lowest level (average of 1.4%), although has shown a slight improvement over the period with the latest values similar to that seen in the first half of the 1994 to 2005 period. The general declining trend is not evident for the 2SW wild component (three river indices), with recent return rates within the range seen over the full time-series.

- Return rates of 1SW wild smolts to the Southern NEAC area (eight river indices) have generally decreased since 1980 ($p<0.05$). A steep decrease between 1988 and 1989 was followed by a decline from around 10% to around 6% during the period 2000 to 2008. An increase in 2009 was followed by three years of declining survival, which has improved slightly in the last year from 3.3 to 5.8%. While this declining trend is not evident for the 2SW wild component (five river indices), following a slight increase in return rates of the 2009 smolt cohort, returns of the last two cohorts (2010 and 2011) have decreased back to levels (2–4%) seen between 2000 and 2008.
- 1SW return rates of hatchery smolts to the Northern NEAC area (four river indices) although varying annually, have generally decreased since 1980 ($p<0.05$). A slight improvement has been noted in recent years, though the last two are still among the lowest in the time-series. The declining trend is not evident for the 2SW hatchery component (four river indices), and a notable increase from the 2007 to the 2009 smolt cohort has not been maintained.
- 1SW return rates of hatchery smolts to the southern NEAC area (13 river indices) although varying annually, have generally decreased since 1980 ($p<0.05$). Although there was a slight improvement in 2013 returns (2012 smolt year), five of the most recent seven years' values are the lowest in the time-series and again indicate a persistent period of poor marine survival.

Results from these analyses are broadly consistent with the information on estimated returns and spawners as derived from the PFA model (Section 3.3.4), and suggest that returns are strongly influenced by factors in the marine environment.

3.4 NASCO has asked ICES to provide recommendations on how a targeted study of pelagic bycatch in relevant areas might be carried out with an assessment of the need for such study considering the current understanding of pelagic bycatch impacts on Atlantic salmon

NASCO further elaborated the question in a note: "In response to question 2.4, if ICES concludes that there is a need for a study, provide an overview of the parameters and time frame that should be considered for such a study. Information reported under previous efforts and on migration corridors of post-smolts in the Northeast Atlantic developed under SALSEA-Merge should be taken into account."

The Working Group discussed the bycatch issue based on previous work undertaken by the Study Group on Bycatch-of Salmon (SGBYSAL), reported by ICES (ICES 2004a, 2005a), and in light of other information made available to the Working Group in 2014.

The background for the SGBYSAL study group was the observed large number of post-smolts taken together with catches of mackerel in Norwegian research surveys in the Norwegian Sea (June–August). These research surveys were targeted at salmon post-smolts, but overlapped in time and space with commercial pelagic fisheries. These observations gave rise to concerns that the large commercial fisheries in these areas, particularly for mackerel, might heavily intercept the post-smolt cohorts moving northwards during the summer months. However, Russian observers on board commercial mackerel trawlers, and in separate research surveys, detected only negligible numbers of post-smolts in screened catches. This resulted in a very large discrepancy in the estimates of post-smolts taken as bycatch if the observed ratios of post-smolts to mackerel catches were scaled up to the total commercial mackerel catch in these areas (from 60 to over one million post-smolts taken as bycatch).

SGBYSAL (ICES 2005a) recommended that catch ratios should not be extrapolated from Norwegian scientific salmon surveys to the entire pelagic fishery due to the absence of comparable efficiency estimates and the considerable differences in design and operation of the research survey and commercial trawls. It was considered, at the time, that the most reliable data for the purposes of extrapolation were those derived from the Russian research surveys that had taken place on the same spatial-temporal scale as the pelagic fishery and from the screening of commercial catches. It was further recommended that results from screening of pelagic survey catches should only be used when both the gear used and the fishery were similar to the commercial fishery. Thus, screening of the catches on board commercial fishing vessels in relevant pelagic fisheries was considered to be the primary method of producing data for bycatch estimation.

SGBYSAL also considered that catches from other research surveys should continue to be screened for salmon, as this would add to overall knowledge of the temporal and spatial distribution of salmon at sea. In addition, it was recommended that further investigations into salmon marine ecology were required, in particular in relation to the distribution of salmon in time and space, in order to allow a better assessment of the potential overlap between salmon and pelagic fisheries. Any further directed research should also include investigation of the migration routes of salmon post-smolts from the coastline of the NE-Atlantic countries into the shelf areas and onward into the northern summer feeding areas for post-smolt and adult salmon. In particular, surveys in more southerly areas should be undertaken in weeks 20–23 (mid-May to early June) while the northern areas should be covered in weeks 30–34 (late July to late August). Finally, SGBYSAL recommended that a questionnaire survey of the processing plants dealing with mackerel, herring and horse mackerel should be considered to establish whether salmon have been observed during processing.

The Working Group (ICES, 2005b) endorsed the recommendations from SGBYSAL. Furthermore, they reiterated that direct on-board observation of pelagic landings was the most reliable method of bycatch estimation. Despite the difficulty in obtaining precise estimates of bycatch, ICES noted that the then latest available upper estimate of potential salmon post-smolt bycatch in the mackerel fishery (154 482) represented approximately

5% of the estimated combined PFA for the NEAC stock complexes (10-year average 3.4 million) in the most recent assessment at the time.

Although SGBYSAL did not meet after 2005, further information was made available in 2005 and 2006 on bycatches in pelagic research surveys and from screening of commercial catches. These data were consistent with earlier findings and the Working Group (ICES 2006) continued to consider that the previous findings remained valid; i.e. that there were relatively low impacts of salmon bycatches in pelagic fisheries on PFA or returns to homewaters. However, these available new records remained insufficient to allow a detailed assessment of the effect of non-targeted fisheries on salmon abundance (the absence of disaggregated catch data, in both time and space, for pelagic fisheries also remained a key constraint). ICES (2006) also recommended that future estimates should be refined, if possible, with annual estimates based on observer based screening of catches.

Since this time, there have been further developments and new information has become available. More knowledge has been gained about post-smolt and salmon distribution and migration, mainly through the studies conducted during the SALSEA-Merge project. Figure 10.1.11.1 provides capture rates for post-smolts derived from this project and earlier captures from research surveys, indicating the distribution of some post-smolts along the shelf edge to the northwest of the British Isles and, following migration further north, their subsequent widespread capture in the Norwegian Sea, with higher concentrations towards the eastern areas. Further information on bycatch has also been provided to the Working Group from screening of catches and landings, primarily by Iceland, and also arising from the recent International Ecosystem Summer Survey of the Nordic Seas (IESSNS).

Bycatch of salmon in the Icelandic herring and mackerel fisheries was studied both by screening of landings and by screening of catches on board fishing vessels conducted by inspectors from the Icelandic Fisheries Directorate. The screening of landings only occurred when crew members indicated that some bycatch had occurred, so these do not represent an unbiased sample of the whole landings. The number of landings/ catches screened and the numbers of salmon detected during the period from 2010 to 2013 are shown in Table 3.4.1 (landings) and Table 3.4.2 (catches). The bycatch rates of salmon vary somewhat among years, but are mostly larger in screened landings (average 5.4 salmon per 1000 t catch; range 4.7–6.2 salmon per 1000 t) than in screened catches (average 2.1 salmon per 1000 t catch; range 0–5.5 salmon per 1000 t), likely reflecting the bias noted previously. Similar levels of bycatch were reported for Faroese fisheries in 2011 (ICES, 2012). In this instance, the screening of 33 315 t of mackerel taken in pelagic pair trawls occurred at land-based freezing plants and resulted in a bycatch rate of 2.4 salmon per 1000 t catch. In this screening programme, salmon were only reported from catches taken in May and June. Icelandic mackerel catches have constituted about 150 000 t in recent years and, assuming the salmon bycatch rates recorded in the screening are representative of the fishery as a whole, this would give a total salmon bycatch in the range of 300–800 individuals for this fishery. This represents 0.01 to 0.03% of the total estimated PFA of NEAC salmon (average total PFA for both maturing and non-maturing fish for the last five years). The catch composition of the Icelandic samples (Table 3.4.3) shows that salmon of length 20–50 cm made up 15% of the catch, salmon of length 50–70 cm made up 69% of the catch, and salmon of length 70–100 cm made up 16% of the salmon caught.

Bycatches of salmon taken in the IESSNS surveys in the period 2010–2013 were also presented to the Working Group. All vessels taking part in this survey have been using a specially designed pelagic trawl, fishing in the upper 30 m and in a standardized way, allowing the catches to be used quantitatively. The catches taken in these surveys are also carefully screened so the certainty of the salmon bycatch count is very high, and all salmon are weighed, measured and frozen for further analysis. These pelagic surveys, mainly targeting mackerel, cover large parts of the Norwegian Sea and Icelandic and Faroese waters (Figures 3.4.2–3.4.4). However, despite this wide coverage, the bycatch of salmon mostly occurred in the eastern parts of the Norwegian Sea (Figure 3.4.5). The salmon catch in the survey was low (Table 3.4.4), but so were the total survey catches since the IESSNS sampling trawl is smaller than commercial trawls and the haul duration is only 15 minutes. However, when these rates are extrapolated to provide estimates of salmon per 1000 t of catch (comparable to the reported Icelandic values), the IESSNS bycatch rates are, on average, 20 to 50 times higher than those recorded from the commercial Icelandic fisheries (average of 103 salmon per 1000 t of catch; Table 3.4.4).

The pelagic fisheries in the Norwegian Sea and in the areas around Iceland and along the Greenlandic east coast have changed in recent years. Catches of Norwegian spring-spawning herring have declined in the last few years (ICES, 2013b). However, catch and survey data indicate that the mackerel stock has expanded northwestwards during spawning and in the summer feeding migration. This distributional change is likely a reflection of increased stock size coupled with changes in the physical environment and in the zooplankton concentration and distribution (ICES, 2013b). A northern expansion has been indicated by the recent summer surveys in the Nordic Seas (IESSNS), while a westward expansion in the summer distribution of adult mackerel has also been observed in the Nordic Seas since 2007, as far west as southeast Greenlandic waters. Catches in ICES Areas I, II, V and XIV have increased markedly in recent years (Figure 3.4.6), with significant catches taken in Icelandic and Faroese waters, areas where almost no catches were reported prior to 2008 (ICES, 2013b). In 2012, mackerel catches in this area constituted approximately half of the total reported catches for the whole NE Atlantic. Catches from Greenland were reported for the first time in 2011, and have increased in 2012. The distribution of mackerel catches for 2012 for quarter 2 and 3 are provided in Figure 3.4.7 and indicate some potential overlap with the distribution of salmon; see Figures 3.4.1 and 3.4.5.

The latest information highlights ongoing uncertainty on the salmon bycatch question, although the issues remain very similar to those previously addressed by SGBYSAL and the Working Group. The latest bycatch estimates from the recent Icelandic and Faroese screening programmes suggest relatively low levels of bycatch in the mackerel catches and this is consistent with the previous views of the Working Group. Such assessment procedures, based on direct screening of the commercial catches, have previously been considered to provide the most reliable data for extrapolation purposes and this remains the case. The Working Group noted the markedly higher salmon bycatch rates recorded in the IESSNS surveys, but are unclear how representative these might be of the bycatch in the commercial fishery given differences in the design and operation of the gears used. In any event, the capture rates remain quite low relative to the estimates of total NEAC

PFA (<2%). The Working Group further noted that while there was clear overlap between the areas known to be frequented by salmon and the areas where the pelagic fisheries were prosecuted, there were also apparent differences in the areas where the highest salmon and mackerel catches occurred, with the former tending to occur in more easterly parts of the Norwegian Sea. Nonetheless, the catches in these pelagic fisheries have increased and substantial uncertainties remain as to the extent to which the migration routes of post-smolt and adult salmon might overlap in time and space with these pelagic fisheries.

Given that estimates of the bycatch of salmon in the total pelagic fisheries are highly uncertain, the Working Group considers it would be informative to increase efforts to obtain reliable estimates of the bycatch of salmon. The Working Group, therefore, recommends the following:

- Collate all available information on post-smolt and salmon marine distribution, particularly from the SALSEA Merge project.
- Collate information of possible interceptive pelagic fisheries operating in the identified migration routes and feeding areas of Atlantic salmon. This would require close cooperation with scientists working on pelagic fish assessments in the relevant areas and provision of disaggregated catch data in time and space which overlap areas known to have high densities of post-smolts or adults.
- Review pelagic fisheries identifying important factors such as gear type and deployment, effort and time of fishing in relation to known distribution of post-smolt and salmon in space and time and investigate ways to intercalibrate survey trawls with commercial trawls.
- Carry out comprehensive catch screening on commercial vessels fishing in areas with known high densities of salmon post-smolts or adults. This would require significant resources and would need to be a well-coordinated and well-funded programme.
- Integrate information and model consequences for productivity for salmon from different regions of Europe and America.

This might be approached as a phased investigation with the first elements possibly carried out by a combined Salmon/Pelagic Workshop or Study Group. The major element (catch screening) would likely require some preparation and agreement between NASCO parties and could be conducted as a joint collaborative exercise with cooperation from the pelagic fishing industry.

Table 3.1.3.1. Number of gear units licensed or authorized by country and gear type.

Year	UK(England & Wales)					UK (Scotland)		UK (N. Ireland)			Norway				Sweden
	Gillnet licences	Sweepnet	Hand-held net	Fixed engine	Rod & Line	Fixed engine[1]	Net and coble[2]	Driftnet	Draftnet	Bagnets and boxes	Bagnet	Bendnet	Liftnet	Driftnet (No. nets)	Salmon trap
1971	437	230	294	79	-	3080	800	142	305	18	4608	2421	26	8976	
1972	308	224	315	76	-	3455	813	130	307	18	4215	2367	24	13448	-
1973	291	230	335	70	-	3256	891	130	303	20	4047	2996	32	18616	-
1974	280	240	329	69	-	3188	782	129	307	18	3382	3342	29	14078	-
1975	269	243	341	69	-	2985	773	127	314	20	3150	3549	25	15968	-
1976	275	247	355	70	-	2862	760	126	287	18	2569	3890	22	17794	-
1977	273	251	365	71	-	2754	684	126	293	19	2680	4047	26	30201	-
1978	249	244	376	70	-	2587	692	126	284	18	1980	3976	12	23301	-
1979	241	225	322	68	-	2708	754	126	274	20	1835	5001	17	23989	-
1980	233	238	339	69	-	2901	675	125	258	20	2118	4922	20	25652	-
1981	232	219	336	72	-	2803	655	123	239	19	2060	5546	19	24081	-
1982	232	221	319	72	-	2396	647	123	221	18	1843	5217	27	22520	-
1983	232	209	333	74	-	2523	668	120	207	17	1735	5428	21	21813	-
1984	226	223	354	74	-	2460	638	121	192	19	1697	5386	35	21210	-
1985	223	230	375	69	-	2010	529	122	168	19	1726	5848	34	20329	60
1986	220	221	368	64	-	1955	591	121	148	18	1630	5979	14	17945	51
1987	213	206	352	68	-	1679	564	120	119	18	1422	6060	13	17234	60
1988	210	212	284	70	-	1534	385	115	113	18	1322	5702	11	15532	55
1989	201	199	282	75	-	1233	353	117	108	19	1888	4100	16	0	63
1990	200	204	292	69	-	1282	340	114	106	17	2375	3890	7	0	49
1991	199	187	264	66	-	1137	295	118	102	18	2343	3628	8	0	44
1992	203	158	267	65	-	851	292	121	91	19	2268	3342	5	0	39
1993	187	151	259	55	-	903	264	120	73	18	2869	2783	-	0	38
1994	177	158	257	53	37278	749	246	119	68	18	2630	2825	-	0	30
1995	163	156	249	47	34941	729	222	122	68	16	2542	2715	-	0	31
1996	151	132	232	42	35281	643	201	117	66	12	2280	2860	-	0	25
1997	139	131	231	35	32781	680	194	116	63	12	2002	1075	-	0	24
1998	130	129	196	35	32525	542	151	117	70	12	1865	1027	-	0	21
1999	120	109	178	30	29132	406	132	113	52	11	1649	989	-	0	16
2000	110	103	158	32	30139	381	123	109	57	10	1557	982	-	0	16
2001	113	99	143	33	24350	387	95	107	50	6	1976	1081	-	0	14
2002	113	94	147	32	29407	426	102	106	47	4	1666	917	-	0	16
2003	58	96	160	57	29936	363	109	105	52	2	1664	766	-	0	14
2004	57	75	157	65	32766	450	118	90	54	2	1546	659	-	0	12
2005	59	73	148	65	34040	381	101	93	57	2	1453	661	-	0	10
2006	52	57	147	65	31606	364	86	107	49	2	1283	685	-	0	6
2007	53	45	157	66	32181	238	69	20	12	2	1302	669	-	0	4
2008	55	42	130	66	33900	181	77	20	12	2	957	653	-	0	4
2009	50	42	118	66	36461	162	64	20	12	2	978	631	-	0	3
2010	51	40	118	66	36159	189	66	2	1	2	760	493	-	0	0
2011	53	41	117	66	36991	201	74	2	1	2	767	506	-	0	2
2012	51	34	115	73	35135	237	79	1	1	2	749	448	-	0	3
2013	49	29	111	62	33115	248	59	0	0	0	786	459	-	0	2
Mean 2008-2012	52	40	120	67	35729	194	72	9	5	2	842	546		0	2
% change [3]	-5.8	-27.1	-7.2	-8.0	-7.3	28.0	-17.7	-100.0	-100.0	-100.0	-6.7	-16.0			-16.7
Mean 2003-2012	54	55	137	66	33918	276	84	46	25	2	1 146	617		0	6
% change [3]	-9.1	-46.8	-18.8	-5.3	-2.4	-10.2	-29.7	-100.0	-100.0	-100.0	-31.4	-25.6			-65.5

[1] Number of gear units expressed as trap months.
[2] Number of gear units expressed as crew months.
[3] (2012/mean - 1) * 100
[3] (2012/mean - 1) * 100
[4] Dash means "no data"

Table 3.1.3.1. Cont´d. Number of gear units licensed or authorized by country and gear type.

Year	Ireland				Finland				France			Russia		
					The Teno River			R. Näätämö				Kola Peninsula	Archangel region	
	Driftnets No.	Draftnets	Other nets Commercial	Rod	Recreational fishery Tourist anglers		Local rod and net fishery	Recreational fishery	Rod and line licences in freshwater	Com. nets in freshwater[1a]	Drift net Licences in estuary[1b,2]	Catch-and-release Fishing days	Commercial, number of gears	
					Fishing days	Fishermen	Fishermen	Fishermen					Coastal	In-river
1971	916	697	213	10566	-	-	-	-	-	-	-	-	-	-
1972	1156	678	197	9612	-	-	-	-	-	-	-	-	-	-
1973	1112	713	224	11660	-	-	-	-	-	-	-	-	-	-
1974	1048	681	211	12845	-	-	-	-	-	-	-	-	-	-
1975	1046	672	212	13142	-	-	-	-	-	-	-	-	-	-
1976	1047	677	225	14139	-	-	-	-	-	-	-	-	-	-
1977	997	650	211	11721	-	-	-	-	-	-	-	-	-	-
1978	1007	608	209	13327	-	-	-	-	-	-	-	-	-	-
1979	924	657	240	12726	-	-	-	-	-	-	-	-	-	-
1980	959	601	195	15864	-	-	-	-	-	-	-	-	-	-
1981	878	601	195	15519	16859	5742	677	467	-	-	-	-	-	-
1982	830	560	192	15697	19690	7002	693	484	4145	55	82	-	-	-
1983	801	526	190	16737	20363	7053	740	587	3856	49	82	-	-	-
1984	819	515	194	14878	21149	7665	737	677	3911	42	82	-	-	-
1985	827	526	190	15929	21742	7575	740	866	4443	40	82	-	-	-
1986	768	507	183	17977	21482	7404	702	691	5919	58 [3]	86	-	-	-
1987	768	507	183	17977	22487	7759	754	689	5724 [4]	87 [4]	80	-	-	-
1988	836	507	183	11539	21708	7755	741	538	4346	101	76	-	-	-
1989	801	507	183	16484	24118	8681	742	696	3789	83	78	-	-	-
1990	756	525	189	15395	19596	7677	728	614	2944	71	76	-	-	-
1991	707	504	182	15178	22922	8286	734	718	2737	78	71	1711	-	-
1992	691	535	183	20263	26748	9058	749	875	2136	57	71	4088	-	-
1993	673	457	161	23875	29461	10198	755	705	2104	53	55	6026	59	199
1994	732	494	176	24988	26517	8985	751	671	1672	14	59	8619	60	230
1995	768	512	164	27056	24951	8141	687	716	1878	17	59	5822	55	239
1996	778	523	170	29759	17625	5743	672	814	1798	21	69	6326	85	330
1997	852	531	172	31873	16255	5036	616	588	2953	10	59	6355	68	282
1998	874	513	174	31565	18700	5759	621	673	2352	16	63	6034	66	270
1999	874	499	162	32493	22935	6857	616	850	2225	15	61	7023	66	194
2000	871	490	158	33527	28385	8275	633	624	2037 [5]	16	51	7336	60	173
2001	881	540	155	32814	33501	9367	863	590	2080	18	63	8468	53	121
2002	833	544	159	35024	37491	10560	853	660	2082	18	65	9624	63	72
2003	877	549	159	31809	34979	10032	832	644	2048	18	60	11994	55	84
2004	831	473	136	30807	29494	8771	801	657	2158	15	62	13300	62	56
2005	877	518	158	28738	27627	7776	785	705	2356	16	59	20309	93	69
2006	875	533	162	27341	29516	7749	836	552	2269	12	57	13604	62	72
2007	0	335	100	19986	33664	8763	780	716	2431	13	59	-	82	53
2008	0	160	0	20061	31143	8111	756	694	2401	12	56	-	66	62
2009	0	146	38	18314	29641	7676	761	656	2421	12	37	-	79	72
2010	0	166	40	17983	30646	7814	756	615	2200	12	33	-	55	66
2011	0	154	91	19899	31269	7915	776	727	2540	12	29	-	78	52
2012	0	149	86	19588	32614	7930	785	681	2799	12	25	-	72	53
2013	0	181	94	19588	33148	8074	785	558	3010	12	25	-	110	71
Mean 2008-2012	0	155	51	19 169	31 063	7 889	767	675	2 472	12	36		70	61
% change [6]	0.0	16.8	84.3	2.2	6.7	2.3	2.4	-17.3	21.8	0.0	-30.6		57.1	16.4
Mean 2003-2012	346	318	97	23 453	31 059	8 254	787	665	2 362	13	48	14 802	70	64
% change [6]	-100.0	-43.1	-3.1	-16.5	6.7	-2.2	-0.2	-16.1	27.4	-10.4	-47.6		56.3	11.1

[1a] Lower Adour only since 1994 (Southwestern France), due to fishery closure in the Loire Basin.

[1b] Adour estuary only (Southwestern France).

[2] Number of fishermen or boats using drift nets: overestimates the actual number of fishermen targeting salmon by a factor 2 or 3.

[3] Common licence for salmon and sea trout introduced in 1986, leading to a short-term increase in the number of licences issued.

[4] Compulsory declaration of salmon catches in freshwater from 1987 onwards.

[5] Before 2000, equal to the number of salmon licenses sold. From 2000 onwards, number estimated because of a single sea trout and salmon angling license.

[6] (2012/mean - 1) * 100

[7] Dash means "no data"

Table 3.1.4.1. Nominal catch of Salmon in the NEAC Area (in tonnes round fresh weight) (2013 figures are provisional).

Year	Southern countries	Northern countries (1)	Faroes (2)	Other catches in international waters	Total Reported Catch	Unreported catches	
						NEAC Area (3)	International waters (4)
1960	2 641	2 899	-	-	5 540	-	-
1961	2 276	2 477	-	-	4 753	-	-
1962	3 894	2 815	-	-	6 709	-	-
1963	3 842	2 434	-	-	6 276	-	-
1964	4 242	2 908	-	-	7 150	-	-
1965	3 693	2 763	-	-	6 456	-	-
1966	3 549	2 503	-	-	6 052	-	-
1967	4 492	3 034	-	-	7 526	-	-
1968	3 623	2 523	5	403	6 554	-	-
1969	4 383	1 898	7	893	7 181	-	-
1970	4 048	1 834	12	922	6 816	-	-
1971	3 736	1 846	-	471	6 053	-	-
1972	4 257	2 340	9	486	7 092	-	-
1973	4 604	2 727	28	533	7 892	-	-
1974	4 352	2 675	20	373	7 420	-	-
1975	4 500	2 616	28	475	7 619	-	-
1976	2 931	2 383	40	289	5 643	-	-
1977	3 025	2 184	40	192	5 441	-	-
1978	3 102	1 864	37	138	5 141	-	-
1979	2 572	2 549	119	193	5 433	-	-
1980	2 640	2 794	536	277	6 247	-	-
1981	2 557	2 352	1 025	313	6 247	-	-
1982	2 533	1 938	606	437	5 514	-	-
1983	3 532	2 341	678	466	7 017	-	-
1984	2 308	2 461	628	101	5 498	-	-
1985	3 002	2 531	566	-	6 099	-	-
1986	3 595	2 588	530	-	6 713	-	-
1987	2 564	2 266	576	-	5 406	2 554	-
1988	3 315	1 969	243	-	5 527	3 087	-
1989	2 433	1 627	364	-	4 424	2 103	-
1990	1 645	1 775	315	-	3 735	1 779	180-350
1991	1 145	1 677	95	-	2 917	1 555	25-100
1992	1 523	1 806	23	-	3 352	1 825	25-100
1993	1 443	1 853	23	-	3 319	1 471	25-100
1994	1 896	1 684	6	-	3 586	1 157	25-100
1995	1 775	1 503	5	-	3 283	942	-
1996	1 392	1 358	-	-	2 750	947	-
1997	1 112	962	-	-	2 074	732	-
1998	1 120	1 099	6	`	2 225	1 108	-
1999	934	1 139	0	-	2 073	887	-
2000	1 210	1 518	8	-	2 736	1 135	-
2001	1 242	1 634	0	-	2 876	1 089	-
2002	1 135	1 360	0	-	2 495	946	-
2003	908	1 394	0	-	2 302	719	-
2004	919	1 059	0	-	1 978	575	-
2005	809	1 189	0	-	1 998	605	-
2006	650	1 217	0	-	1 867	604	-
2007	373	1 036	0	-	1 409	465	-
2008	355	1 178	0	-	1 533	433	-
2009	265	898	0	-	1 163	317	-
2010	411	1 003	0	-	1 415	357	-
2011	410	1 009	0	-	1 419	382	-
2012	296	955	0	-	1 250	363	-
2013	329	778	0	-	1 107	272	-
Average							
2008-2012	347	1009	0	-	1356	370	-
2003-2012	540	1094	0	-	1633	482	-

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

Table 3.1.5.1. Cpue for salmon rod fisheries in Finland (Teno, Näätämö), France, and UK (N. Ireland; Bush).

	Finland (R. Teno)		Finland (R. Naatamo)		France	UK(N.Ire.)(R.Bush)
	Catch per angler season	Catch per angler day	Catch per angler season	Catch per angler day	Catch per angler season	Catch per rod day
Year	kg	kg	kg	kg	Number	Number
1974		2.8				
1975		2.7				
1976		-				
1977		1.4				
1978		1.1				
1979		0.9				
1980		1.1				
1981	3.2	1.2				
1982	3.4	1.1				
1983	3.4	1.2				0.248
1984	2.2	0.8	0.5	0.2		0.083
1985	2.7	0.9	-	n/a		0.283
1986	2.1	0.7	-	n/a		0.274
1987	2.3	0.8	-	n/a	0.39	0.194
1988	1.9	0.7	0.5	0.2	0.73	0.165
1989	2.2	0.8	1.0	0.4	0.55	0.135
1990	2.8	1.1	0.7	0.3	0.71	0.247
1991	3.4	1.2	1.3	0.5	0.60	0.396
1992	4.5	1.5	1.4	0.3	0.94	0.258
1993	3.9	1.3	0.4	0.2	0.88	0.341
1994	2.4	0.8	0.6	0.2	2.32	0.205
1995	2.7	0.9	0.5	0.1	1.15	0.206
1996	3.0	1.0	0.7	0.2	1.57	0.267
1997	3.4	1.0	1.1	0.2	0.44 [1]	0.338
1998	3.0	0.9	1.3	0.3	0.67	0.569
1999	3.7	1.1	0.8	0.2	0.76	0.273
2000	5.0	1.5	0.9	0.2	1.06	0.259
2001	5.9	1.7	1.2	0.3	0.97	0.444
2002	3.1	0.9	0.7	0.2	0.84	0.184
2003	2.6	0.7	0.8	0.2	0.76	0.238
2004	1.4	0.4	0.9	0.2	1.25	0.252
2005	2.7	0.8	1.3	0.2	0.74	0.323
2006	3.4	1.0	1.9	0.4	0.89	0.457
2007	2.9	0.8	1.0	0.2	0.74	0.601
2008	4.2	1.1	0.9	0.2	0.77	0.457
2009	2.3	0.6	0.7	0.1	0.50	0.136
2010	3.0	0.8	1.3	0.2	0.87	0.226
2011	2.4	0.6	1.0	0.2	0.65	0.122
2012	3.6	0.9	1.7	0.4	0.61	0.149
2013	2.5	0.6	0.7	0.2	0.57	0.373
Mean 2008-12	3.1	0.8	1.1	0.2	0.7	0.2

[1] Large numbers of new, inexperienced anglers in 1997 because cheaper licence types were introduced.

Table 3.1.5.2. Cpue for salmon in coastal and in-river fisheries the Archangelsk region in Russia.

	Archangelsk region Commercial fishery (tonnes/gear)	
Year	Coastal	In-river
1993	0.34	0.04
1994	0.35	0.05
1995	0.22	0.08
1996	0.19	0.02
1997	0.23	0.02
1998	0.24	0.03
1999	0.22	0.04
2000	0.28	0.03
2001	0.21	0.04
2002	0.21	0.11
2003	0.16	0.05
2004	0.25	0.08
2005	0.17	0.08
2006	0.19	0.05
2007	0.14	0.09
2008	0.12	0.08
2009	0.09	0.05
2010	0.21	0.08
2011	0.15	0.07
2012	0.17	0.09
2013	0.12	0.09
Mean	0.20	0.06
2008-12	0.15	0.07

Table 3.1.5.3. Cpue data for net and fixed engine salmon fisheries by Region in UK (England & Wales). Data expressed as catch per licence-tide, except the northeast, for which the data are recorded as catch per licence-day.

		Region (aggregated data, various methods)				
Year	North East drift nets	North East	South West	Midlands	Wales	North West
1988		5.49				-
1989		4.39				0.82
1990		5.53				0.63
1991		3.20				0.51
1992		3.83				0.40
1993	8.23	6.43				0.63
1994	9.02	7.53				0.71
1995	11.18	7.84				0.79
1996	4.93	3.74				0.59
1997	6.48	4.40	0.70	0.48	0.07	0.63
1998	5.92	3.81	1.25	0.42	0.08	0.46
1999	8.06	4.88	0.79	0.72	0.02	0.52
2000	13.06	8.11	1.01	0.66	0.18	1.05
2001	10.34	6.83	0.71	0.79	0.16	0.71
2002	8.55	5.59	1.03	1.39	0.23	0.90
2003	7.13	4.82	1.24	1.13	0.11	0.62
2004	8.17	5.88	1.17	0.46	0.11	0.69
2005	7.23	4.13	0.60	0.97	0.09	1.28
2006	5.60	3.20	0.66	0.97	0.09	0.82
2007	7.24	4.17	0.33	1.26	0.05	0.75
2008	5.41	3.59	0.63	1.33	0.06	0.34
2009	4.76	3.08	0.53	1.67	0.04	0.51
2010	17.03	8.56	0.99	0.26	0.09	0.47
2011	19.25	9.93	0.63	0.14	0.10	0.34
2012	7.01	5.53	0.69	-	0.21	0.31
2013	9.32	8.53	0.54	-	0.08	0.39
Mean 2008-12	10.69	6.14	0.69	0.85	0.10	0.39

Table 3.1.5.4. Catch per unit of effort (cpue) for salmon rod fisheries in each Region in UK (England & Wales). [Cpue is expressed as number of salmon (including released fish) caught per 100 days fished].

Year	Region							England &
	NE	Thames	Southern	SW	Midlands	Wales	NW	Wales
1997	5.0	0.6	3.1	5.2	1.7	2.6	5.3	4.0
1998	6.5	0.0	5.9	7.5	1.3	3.9	8.6	6.0
1999	7.4	0.3	3.1	6.3	2.1	3.5	7.4	5.5
2000	9.2	0.0	5.2	8.8	4.9	4.4	11.7	7.9
2001	11.3	0.0	11.0	6.6	5.4	5.5	15.4	8.7
2002	9.4	0.0	18.3	6.0	3.5	3.6	10.0	6.8
2003	9.7	0.0	8.8	4.7	5.2	2.9	8.3	5.7
2004	14.7	0.0	18.8	9.6	5.5	6.6	17.4	11.4
2005	12.4	0.0	12.7	6.2	6.6	4.5	13.9	9.0
2006	14.2	0.0	15.6	8.7	6.6	5.9	13.3	10.1
2007	11.7	0.0	18.0	8.7	5.7	6.0	14.2	9.6
2008	12.7	0.0	21.8	10.9	5.8	7.3	15.3	10.5
2009	9.5	0.0	13.7	5.7	3.6	3.6	9.3	6.6
2010	16.7	2.8	17.1	9.9	4.3	6.5	14.1	10.2
2011	17.5	0.0	14.5	9.4	6.5	6.0	11,4	10.9
2012	15.4	0.0	17.3	9.2	6.5	6.5	9.1	10.6
2013	15.3	0.0	13.8	5.8	6.2	7.0	7.0	9.8
Mean (2008-2012)	14.4	0.6	16.9	9.0	5.3	6.0	12.0	9.8

Table 3.1.5.5. Cpue data for Scottish net fisheries. Catch in numbers of fish per unit of effort.

Year	Fixed engine	Net and coble CPUE
	Catch/trap month [1]	Catch/crew month
1952	33.9	156.4
1953	33.1	121.7
1954	29.3	162.0
1955	37.1	201.8
1956	25.7	117.5
1957	32.6	178.7
1958	48.4	170.4
1959	33.3	159.3
1960	30.7	177.8
1961	31.0	155.2
1962	43.9	242.0
1963	44.2	182.9
1964	57.9	247.1
1965	43.7	188.6
1966	44.9	210.6
1967	72.6	329.8
1968	47.0	198.5
1969	65.5	327.6
1970	50.3	241.9
1971	57.2	231.6
1972	57.5	248.0
1973	73.7	240.6
1974	63.4	257.1
1975	53.6	235.7
1976	42.9	150.8
1977	45.6	188.7
1978	53.9	196.1
1979	42.2	157.2
1980	37.6	158.6
1981	49.6	183.9
1982	61.3	180.2
1983	55.8	203.6
1984	58.9	155.3
1985	49.6	148.9
1986	75.2	193.4
1987	61.8	145.6
1988	50.6	198.4
1989	71.0	262.4
1990	33.2	146.0
1991	35.9	106.4
1992	59.6	153.7
1993	52.8	125.2
1994	92.1	123.7
1995	75.6	142.3
1996	57.5	110.9
1997	33.0	57.8
1998	36.0	68.7
1999	21.9	58.8
2000	54.4	105.5
2001	61.0	77.4
2002	35.9	67.0
2003	68.3	66.8
2004	42.9	54.5
2005	45.8	80.9
2006	45.8	73.3
2007	47.6	91.5
2008	56.1	52.5
2009	42.2	73.3
2010	77.0	179.3
2011	62.6	80.7
2012	50.2	46.7
2013	64.6	133.0
Mean 2008-12	57.6	86.5

[1] Excludes catch and effort for Solway Region

Table 3.1.5.6. Catch per unit of effort for the marine fishery in Norway. The cpue is expressed as numbers of salmon caught per net day in bag nets and bendnets divided by salmon weight.

	Bag net			Bend net		
Year	< 3kg	3-7 kg	>7 kg	< 3kg	3-7 kg	>7 kg
1998	0.88	0.66	0.12	0.80	0.56	0.13
1999	1.16	0.72	0.16	0.75	0.67	0.17
2000	2.01	0.90	0.17	1.24	0.87	0.17
2001	1.52	1.03	0.22	1.03	1.39	0.36
2002	0.91	1.03	0.26	0.74	0.87	0.32
2003	1.57	0.90	0.26	0.84	0.69	0.28
2004	0.89	0.97	0.25	0.59	0.60	0.17
2005	1.17	0.81	0.27	0.72	0.73	0.33
2006	1.02	1.33	0.27	0.72	0.86	0.29
2007	0.43	0.90	0.32	0.57	0.95	0.33
2008	1.07	1.13	0.43	0.57	0.97	0.57
2009	0.73	0.92	0.31	0.44	0.78	0.32
2010	1.46	1.13	0.39	0.82	1.00	0.38
2011	1.30	1.98	0.35	0.71	1.02	0.36
2012	1.12	1.26	0.43	0.89	1.03	0.41
2013	0.69	1.09	0.25	0.38	1.30	0.29
Mean 2008-12	1.14	1.28	0.38	0.69	0.96	0.41

Table 3.1.6.1. Percentage of 1SW salmon in catches from countries in the Northeast Atlantic. Difference between 1987–1998 and 1999–2013 tested with one-way Anova.

Year	Iceland	Finland	Norway	Russia	Sweden	**Northern countries**	UK (Scot)	UK (E&W)	France (1)	Spain (2)	**Southern countries**
1987		66	61	71	46	**63**	61	68	77		**63**
1988		63	64	53	55	**62**	57	69	29		**60**
1989	69	66	73	73	50	**72**	63	65	33		**63**
1990	66	64	68	73	48	**69**	48	52	45		**49**
1991	71	59	65	70	48	**66**	53	71	39		**58**
1992	72	70	62	72	46	**65**	55	77	48		**59**
1993	76	58	61	61	50	**63**	57	81	74	64	**64**
1994	63	55	68	69	49	**67**	54	77	55	69	**61**
1995	71	59	58	70	45	**62**	53	72	60	26	**59**
1996	73	79	53	80	40	**61**	53	65	51	34	**56**
1997	73	69	64	82	44	**68**	54	73	51	28	**60**
1998	82	75	66	82	45	**70**	58	82	71	54	**65**
1999	70	83	65	78	46	**68**	45	68	27	14	**54**
2000	82	71	67	75	47	**69**	54	79	58	74	**65**
2001	78	48	58	74	44	**60**	55	75	51	40	**62**
2002	83	34	49	70	41	**54**	54	76	69	38	**64**
2003	75	51	61	67	48	**62**	52	66	51	16	**55**
2004	86	47	52	68	43	**58**	51	81	40	67	**59**
2005	87	72	67	66	50	**69**	58	76	41	15	**61**
2006	84	73	54	77	41	**60**	57	78	50	15	**61**
2007	91	30	42	69	38	**50**	57	78	45	26	**61**
2008	90	34	46	58	44	**54**	48	76	42	11	**55**
2009	91	62	49	63	44	**59**	49	72	42	30	**54**
2010	82	50	56	58	49	**61**	55	78	67	32	**63**
2011	85	61	41	58	42	**50**	36	57	35	2	**45**
2012	87	76	47	70	40	**55**	50	51	38	18	**49**
2013	89	59	52	65	45	**62**	55	58	46	13	**54**
Means											
1987-1998	72	65	64	71	47	66	55	71	53	46	60
1999-2013	84	57	54	68	44	59	52	71	47	27	57
Anova	**p<0.001**	p=0.116	**p=0.002**	p=0.205	**p=0.019**	**p=0.004**	p=0.062	p=0.938	p=0.257	p=0.070	p=0.250

1. No data provided for France for 2009. Data from 2008 used.
2. Based on catches in Asturias (~90 % of the Spanish catch).

Table 3.2.2.1. Conservation limit options for NEAC stock groups estimated from river-specific values, where available, or the national PFA run- reconstruction model. SERs based on the CLs used are also shown.

	National Model CLs		River Specific CLs		Conservation limit used		SER	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
Northern Europe								
Finland	16,975	13,889			16,975	13,889	20,630	23,833
Iceland (north & east)	5,986	1,565			5,986	1,565	7,385	2,727
Norway			64,467	71,218	64,467	71,218	81,954	118,599
Russia	66,896	42,031			66,896	42,031	84,959	74,147
Sweden	1,257	1,117			1,257	1,117	1,623	1,916
			Stock Complex		**155,581**	**129,820**	**196,550**	**221,222**

	National Model CLs		River Specific CLs		Conservation limit used		SER	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
Southern Europe								
France			17,400	5,100	17,400	5,100	22,120	8,493
Iceland (south & west)	19,422	1,265			19,422	1,265	23,603	2,170
Ireland			211,471	46,943	211,471	46,943	268,832	78,174
UK (E&W)			54,677	30,163	54,677	30,163	69,272	50,802
UK (NI)	17,205	1,986			17,205	1,986	20,998	3,319
UK (Sco)	241,597	189,892			241,597	189,892	303,999	319,390
			Stock complex		**561,771**	**275,348**	**708,823**	**462,347**

Table 3.3.4.1 Estimated number of RETURNING 1SW salmon by NEAC country or region and year

	Northern Europe								Southern Europe									NEAC Area		
Year	**Finland**	**Iceland N&E**	**Norway**	**Russia**	**Sweden**	**Total**			**France**	**Iceland S&W**	**Ireland**	**UK(EW)**	**UK(NI)**	**UK(Scot)**	**Total**			**Total**		
						5.0%	50.0%	95.0%							5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	25,974	9,392		154,621	17,225				49,591	62,552	1,055,563	82,549	181,401	621,169	1,835,284	**2,065,432**	2,348,518			
1972	101,067	8,587		117,352	13,647				99,663	50,768	1,123,428	79,359	158,956	542,473	1,826,452	**2,071,242**	2,377,907			
1973	47,098	10,330		172,901	16,836				60,902	54,209	1,226,889	93,565	138,767	651,539	1,973,905	**2,239,115**	2,582,422			
1974	64,992	10,265		172,809	24,482				28,084	38,613	1,395,109	117,226	151,818	619,958	2,075,964	**2,359,179**	2,737,427			
1975	77,676	12,587		265,613	26,572				56,716	59,943	1,537,660	120,235	124,873	505,162	2,109,062	**2,415,005**	2,827,082			
1976	71,169	12,625		184,211	14,982				51,879	47,378	1,045,406	80,396	86,609	433,936	1,541,777	**1,754,927**	2,038,190			
1977	39,927	17,536		117,427	6,753				40,276	48,506	904,282	91,437	85,381	452,809	1,442,785	**1,631,899**	1,874,670			
1978	38,023	17,852		118,612	8,014				41,045	63,951	791,715	104,507	111,310	519,326	1,464,363	**1,640,462**	1,860,120			
1979	34,237	17,107		164,155	8,275				46,584	58,883	724,981	99,840	77,952	428,429	1,289,805	**1,447,408**	1,651,780			
1980	26,947	2,584		116,879	10,582				97,848	26,702	554,035	93,608	98,689	266,939	1,025,254	**1,149,546**	1,307,536			
1981	24,126	13,355		96,677	19,406				78,090	34,609	290,708	98,010	77,336	328,870	839,699	**918,247**	1,004,113			
1982	14,348	6,169		84,899	17,070				47,796	35,371	604,314	83,190	111,718	472,145	1,243,137	**1,363,266**	1,501,719			
1983	35,200	9,057	699,797	142,123	22,728	816,615	**911,814**	1,020,658	51,583	44,592	1,064,957	121,849	156,714	481,940	1,743,769	**1,932,295**	2,163,666	2,628,865	**2,847,116**	3,101,178
1984	38,422	3,283	729,877	152,777	31,974	858,037	**959,592**	1,079,071	84,005	27,611	560,156	106,886	61,625	510,143	1,240,330	**1,361,319**	1,502,120	2,160,034	**2,325,000**	2,503,868
1985	50,828	22,707	742,464	209,272	38,256	964,459	**1,068,410**	1,182,754	31,582	44,566	928,408	107,623	80,068	421,529	1,455,817	**1,618,324**	1,825,300	2,489,566	**2,693,354**	2,920,623
1986	40,247	28,236	645,963	179,075	39,774	849,407	**936,880**	1,035,675	48,514	73,319	1,036,256	123,419	90,006	523,319	1,718,857	**1,915,160**	2,148,154	2,638,110	**2,854,350**	3,109,875
1987	48,490	16,612	542,577	191,028	31,614	760,371	**834,847**	916,718	84,742	45,554	669,089	128,104	49,116	403,075	1,249,057	**1,403,538**	1,600,191	2,067,461	**2,241,684**	2,452,572
1988	28,510	24,025	499,057	131,795	26,605	650,508	**712,001**	780,815	29,347	81,583	908,149	176,139	115,750	610,852	1,749,538	**1,937,760**	2,161,099	2,452,569	**2,650,163**	2,883,026
1989	62,144	12,947	547,910	196,826	7,739	755,267	**829,157**	921,933	16,078	45,593	650,701	119,004	111,291	670,445	1,475,677	**1,626,100**	1,800,318	2,286,463	**2,458,714**	2,651,094
1990	62,337	9,678	492,289	163,204	18,024	682,023	**747,251**	825,000	26,951	41,798	408,796	84,887	92,320	320,719	896,883	**985,161**	1,089,327	1,621,665	**1,735,164**	1,858,846
1991	61,288	14,083	429,642	138,465	22,694	607,854	**668,720**	739,589	19,374	46,366	291,747	84,193	51,461	318,914	749,142	**821,097**	901,650	1,395,539	**1,490,943**	1,596,120
1992	86,472	26,523	361,466	171,515	24,900	619,121	**675,070**	736,958	35,661	53,186	421,346	87,993	104,260	465,341	1,075,343	**1,181,780**	1,304,269	1,735,130	**1,857,880**	1,995,095
1993	58,164	21,826	363,158	147,079	24,892	568,239	**618,753**	672,915	50,705	52,006	343,341	121,794	122,211	417,501	1,026,957	**1,124,638**	1,243,767	1,633,426	**1,744,630**	1,872,175
1994	32,287	6,963	491,486	173,731	19,334	657,098	**727,996**	811,349	40,017	42,793	438,967	135,638	83,872	444,990	1,093,846	**1,203,310**	1,328,525	1,799,439	**1,934,422**	2,081,346
1995	32,324	20,066	320,695	156,310	28,281	514,436	**561,561**	613,751	13,323	58,029	492,385	103,074	77,915	438,016	1,086,199	**1,191,103**	1,312,796	1,637,645	**1,754,589**	1,883,860
1996	54,787	10,684	244,869	212,365	16,863	497,654	**542,584**	593,059	16,569	49,970	458,130	77,064	80,398	313,914	908,012	**1,003,705**	1,111,665	1,440,601	**1,547,654**	1,668,443
1997	49,683	14,637	282,485	208,328	7,628	518,054	**565,765**	619,514	8,445	36,610	456,234	69,002	95,303	225,271	809,530	**896,862**	1,005,672	1,363,510	**1,463,510**	1,582,586
1998	62,443	24,963	368,151	228,306	6,131	632,813	**693,559**	760,900	16,531	50,261	479,272	75,575	207,403	307,578	1,044,760	**1,147,153**	1,265,410	1,722,448	**1,841,705**	1,979,398
1999	83,576	12,673	342,452	176,198	9,707	574,781	**627,437**	684,238	5,535	40,776	447,031	59,815	54,181	152,471	682,179	**764,313**	865,086	1,293,268	**1,392,537**	1,506,536
2000	90,584	13,340	563,973	192,622	17,746	805,810	**882,245**	970,815	14,310	36,027	619,736	91,545	78,564	297,245	1,027,592	**1,145,736**	1,289,027	1,884,671	**2,031,148**	2,197,035
2001	65,683	12,096	486,568	259,629	11,073	753,138	**842,232**	951,185	12,425	32,258	492,657	79,335	62,201	291,730	901,445	**979,945**	1,072,469	1,701,475	**1,826,732**	1,963,804
2002	44,597	21,006	297,461	237,198	10,614	548,380	**614,626**	707,184	27,963	40,384	430,567	75,147	123,198	235,013	869,453	**944,469**	1,029,435	1,455,365	**1,564,034**	1,685,332
2003	44,244	11,147	412,197	211,699	5,786	615,092	**690,713**	779,903	18,352	48,174	421,492	58,220	80,307	266,446	831,491	**904,748**	987,094	1,487,371	**1,597,301**	1,716,623
2004	18,637	30,113	249,968	147,810	4,854	408,803	**454,358**	511,348	22,158	48,429	310,738	105,114	71,750	316,351	811,656	**889,347**	980,666	1,251,709	**1,347,000**	1,449,614
2005	41,173	26,650	370,481	168,846	4,748	556,201	**617,012**	690,122	14,508	71,312	309,388	86,026	91,313	344,073	854,339	**929,155**	1,011,809	1,449,111	**1,548,621**	1,657,143
2006	71,765	28,186	299,773	204,080	5,294	551,806	**614,288**	691,579	20,294	50,568	237,250	84,344	58,344	332,603	726,029	**796,994**	881,234	1,315,610	**1,415,157**	1,526,117
2007	21,021	20,866	167,982	110,122	1,640	290,817	**323,435**	365,158	15,842	57,666	269,596	79,724	94,479	326,678	755,506	**865,962**	1,065,643	1,073,963	**1,192,486**	1,393,420
2008	22,681	19,099	210,082	114,513	2,557	333,790	**372,231**	417,631	15,659	69,772	267,480	78,533	56,394	281,934	680,217	**794,256**	997,041	1,045,540	**1,170,665**	1,373,996
2009	40,066	30,812	168,519	108,589	2,718	318,676	**352,963**	392,360	5,588	78,909	222,184	49,603	43,063	240,617	565,079	**658,144**	818,812	911,831	**1,013,651**	1,179,035
2010	32,361	24,571	248,858	123,744	4,630	394,991	**437,108**	485,825	19,155	81,022	281,124	97,942	39,417	439,548	841,911	**997,094**	1,226,985	1,274,700	**1,436,448**	1,670,221
2011	36,623	20,242	175,552	131,833	3,958	334,089	**370,760**	413,604	13,396	57,098	247,397	57,257	34,218	234,740	563,173	**664,274**	855,680	926,820	**1,037,588**	1,231,310
2012	63,273	10,603	195,618	153,063	5,583	389,594	**431,865**	483,900	11,522	32,459	251,255	35,220	51,909	313,194	599,817	**734,054**	941,708	1,024,556	**1,170,192**	1,380,553
2013	36,640	29,237	184,247	118,343	3,217	337,528	**375,527**	423,358	16,286	75,518	234,892	44,106	38,407	373,830	676,905	**829,425**	1,036,270	1,047,412	**1,206,599**	1,418,642
10yr Av.	38,424	24,038	227,108	138,094	3,920	391,629	434,955	487,489	15,441	62,275	263,130	71,787	57,930	320,357	707,463	815,870	981,585	1,132,125	1,253,841	1,428,005

Table 3.3.4.2 Estimated number of RETURNING MSW salmon by NEAC country or region and year

Year	Northern Europe								Southern Europe									NEAC Area		
	Finland	Iceland N&E	Norway	Russia	Sweden	Total 5.0%	Total 50.0%	Total 95.0%	France	Iceland S&W	Ireland	UK(EW)	UK(NI)	UK(Scot)	Total 5.0%	Total 50.0%	Total 95.0%	Total 5.0%	Total 50.0%	Total 95.0%
1971	24,018	9,674		132,638	642				10,853	24,404	157,333	91,398	21,963	568,041	781,139	**881,124**	997,461			
1972	25,109	15,062		134,423	509				21,688	37,486	168,354	150,159	19,104	731,868	1,008,841	**1,139,961**	1,291,666			
1973	40,272	14,079		222,268	2,258				13,357	33,803	183,640	114,760	16,753	803,116	1,032,038	**1,173,303**	1,339,524			
1974	68,894	13,351		209,984	1,419				6,163	29,220	207,347	84,438	18,305	568,946	814,581	**922,031**	1,049,924			
1975	87,924	14,784		225,423	403				12,218	30,993	230,689	114,863	15,027	628,177	920,606	**1,042,059**	1,184,020			
1976	69,055	12,141		195,326	1,210				9,081	26,833	160,640	60,461	10,419	391,866	587,530	**665,290**	755,339			
1977	47,783	16,934		134,220	518				6,935	26,134	140,244	76,323	10,273	428,654	615,307	**695,388**	788,465			
1978	24,384	21,871		115,982	641				7,114	33,794	120,632	64,151	13,404	532,806	684,808	**777,530**	888,668			
1979	24,211	14,451		101,491	1,663				8,194	21,635	108,992	31,839	9,392	394,938	507,930	**579,075**	666,243			
1980	23,874	20,103		169,279	3,228				16,968	30,459	119,623	103,642	11,915	483,968	688,669	**775,375**	877,817			
1981	28,068	7,043		96,740	716				11,681	20,319	88,132	145,268	9,353	517,711	711,572	**801,615**	907,826			
1982	37,450	8,079		85,301	3,491				7,187	14,306	51,598	56,334	13,504	419,791	502,368	**566,591**	645,876			
1983	41,637	6,156	428,126	124,041	2,273	548,196	**604,443**	669,775	7,736	23,969	150,454	63,928	18,960	451,997	628,953	**734,770**	927,467	1,217,782	**1,343,371**	1,539,197
1984	34,955	7,947	439,107	123,705	3,194	554,801	**610,799**	675,623	12,687	20,319	76,379	51,622	7,435	376,157	491,998	**548,562**	617,958	1,079,382	**1,161,421**	1,255,075
1985	33,360	5,126	405,435	135,343	1,182	529,348	**583,173**	641,299	9,544	14,699	83,718	76,041	9,661	462,768	591,501	**660,571**	744,334	1,155,574	**1,245,781**	1,345,878
1986	27,638	13,939	485,881	133,903	605	601,747	**664,321**	734,877	9,671	12,274	94,750	103,584	10,872	594,403	737,779	**831,904**	944,314	1,382,604	**1,498,636**	1,627,519
1987	36,283	14,464	367,311	99,563	2,722	475,024	**522,362**	576,127	5,169	10,903	117,610	82,873	5,550	387,886	550,235	**614,569**	690,103	1,056,033	**1,138,365**	1,231,315
1988	25,594	9,294	306,575	99,725	2,912	407,476	**445,543**	489,576	14,183	12,419	84,793	107,402	15,635	602,187	750,807	**842,716**	949,511	1,189,727	**1,289,393**	1,403,973
1989	24,953	7,885	219,209	97,172	10,187	331,609	**361,105**	395,404	6,469	11,073	77,708	86,766	12,475	525,040	647,397	**723,746**	814,455	1,001,174	**1,085,514**	1,181,988
1990	27,579	8,344	260,059	124,656	5,294	392,978	**427,193**	468,722	6,665	11,006	37,231	106,501	11,340	438,285	549,945	**615,955**	694,259	969,100	**1,044,541**	1,132,874
1991	37,042	5,772	219,556	122,240	7,171	362,879	**393,366**	428,324	6,106	10,976	55,860	46,698	5,816	332,868	412,413	**461,425**	518,109	796,946	**856,147**	921,751
1992	36,027	8,616	239,394	116,309	9,890	379,248	**411,821**	448,916	7,670	12,357	42,954	35,771	13,314	443,748	497,787	**558,564**	633,167	900,283	**971,874**	1,054,266
1993	37,808	9,731	229,580	137,626	11,248	397,886	**427,721**	459,930	3,608	6,063	42,258	39,514	31,414	363,780	438,089	**491,880**	556,662	857,832	**920,361**	991,575
1994	35,539	8,225	224,269	121,723	8,602	370,539	**400,805**	434,135	7,632	9,814	67,628	55,776	11,034	441,480	534,093	**597,314**	673,154	928,183	**999,536**	1,079,957
1995	23,264	5,728	240,618	138,520	4,267	383,516	**414,266**	448,650	3,651	11,077	65,170	55,855	9,336	407,530	497,334	**557,355**	632,052	902,476	**973,015**	1,055,527
1996	24,015	7,522	241,361	104,417	6,952	356,479	**386,275**	419,047	6,428	7,122	43,621	57,124	10,217	312,388	393,369	**441,453**	501,697	770,459	**828,833**	897,385
1997	28,979	4,240	159,319	85,272	5,011	262,276	**284,832**	309,680	3,331	8,025	56,237	35,707	12,714	214,881	297,227	**338,230**	384,646	575,977	**623,450**	675,627
1998	27,783	6,177	191,096	105,529	2,781	309,889	**334,918**	363,256	2,829	4,961	32,866	23,356	17,476	228,453	279,093	**312,790**	352,129	605,338	**648,316**	696,869
1999	29,554	7,085	204,326	93,001	1,988	309,329	**337,454**	369,566	6,131	9,692	51,009	46,386	7,975	175,266	262,419	**306,868**	363,465	590,983	**645,369**	708,276
2000	56,301	4,153	283,013	162,282	7,117	476,687	**515,168**	558,206	4,275	2,633	64,087	48,242	10,654	224,941	319,397	**360,728**	410,232	819,700	**877,279**	939,894
2001	74,847	4,768	333,290	114,737	8,406	494,718	**539,123**	587,777	4,940	4,611	57,186	51,845	7,824	214,308	304,171	**347,408**	401,440	823,519	**888,109**	958,018
2002	66,063	4,509	289,273	125,066	5,790	452,198	**492,453**	538,015	4,585	5,010	65,743	47,041	9,275	175,568	275,143	**313,386**	360,149	750,835	**807,310**	869,702
2003	47,443	4,734	255,966	87,320	1,373	366,481	**398,713**	434,694	6,609	7,999	68,706	60,055	6,038	218,273	327,035	**375,269**	435,856	714,552	**775,179**	842,776
2004	21,483	4,652	231,611	67,255	4,249	300,988	**330,335**	364,179	12,441	6,468	38,023	50,895	5,403	282,112	352,712	**403,069**	461,823	674,466	**734,140**	801,033
2005	17,809	5,768	213,356	80,479	2,848	295,300	**321,199**	350,504	7,586	5,706	49,300	55,870	6,871	222,720	311,155	**353,731**	408,876	624,409	**675,989**	737,042
2006	28,169	5,528	270,570	77,239	2,974	353,834	**385,548**	420,814	7,697	4,727	35,819	50,921	4,392	230,712	296,774	**342,605**	398,883	672,034	**728,766**	794,314
2007	40,683	5,323	230,018	80,565	2,789	332,884	**360,224**	390,580	7,240	2,909	16,029	48,357	6,059	221,856	265,649	**308,219**	361,300	617,239	**670,174**	729,944
2008	41,113	6,835	265,194	126,324	3,933	407,916	**445,924**	490,228	8,054	3,334	23,940	53,461	3,652	249,340	299,708	**348,895**	409,256	732,255	**795,977**	870,143
2009	17,606	5,517	207,614	106,894	3,450	312,545	**342,868**	378,603	4,209	5,152	27,071	41,113	4,777	211,049	256,488	**299,257**	351,506	589,593	**643,392**	704,110
2010	28,277	7,825	228,967	132,575	3,993	368,488	**403,707**	444,442	3,551	10,664	17,481	60,326	4,396	279,174	324,973	**384,263**	458,037	720,056	**789,226**	871,543
2011	21,859	8,716	319,338	131,878	7,550	444,563	**491,800**	545,500	9,237	5,422	20,100	89,439	11,419	314,542	387,206	**461,561**	554,925	865,730	**955,276**	1,060,502
2012	26,197	4,928	279,317	64,992	10,697	350,192	**387,891**	429,715	7,212	3,081	21,461	73,402	17,004	248,344	317,828	**383,984**	466,335	695,832	**772,928**	864,549
2013	25,360	5,885	197,941	74,302	4,541	281,303	**309,180**	340,529	7,200	6,560	21,495	65,588	7,958	224,537	284,127	**345,063**	421,297	587,181	**655,108**	736,193
10yr Av.	26,855	6,098	244,393	94,250	4,702	344,801	**377,868**	415,509	7,443	5,402	27,072	58,937	7,193	248,438	309,662	**363,065**	429,224	677,880	**742,098**	816,937

Table 3.3.4.3 Estimated pre-fishery abundance of MATURING 1SW salmon (potential 1SW returns) by NEAC country or region and year

	Northern Europe								Southern Europe									NEAC Area		
Year	Finland	Iceland	Norway	Russia	Sweden	Total			France	Iceland	Ireland	UK(EW)	UK(NI)	UK(Scot)	Total			Total		
		N&E				5.0%	50.0%	95.0%		S&W					5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	32,074	11,735		NA	22,321				63,331	76,233	1,345,148	105,231	221,904	782,559	2,263,292	**2,610,195**	3,032,226			
1972	123,528	10,720		151,281	17,727				127,354	61,978	1,428,796	101,014	194,318	683,714	2,255,414	**2,616,311**	3,064,007			
1973	57,652	12,866		222,746	21,886				77,568	66,128	1,562,053	119,345	169,888	818,907	2,442,628	**2,831,594**	3,330,607			
1974	79,736	12,856		222,520	31,746				35,986	47,278	1,775,894	149,416	185,863	780,467	2,567,779	**2,989,715**	3,528,552			
1975	95,040	15,686		341,098	34,377				72,191	73,188	1,956,894	153,131	152,812	636,840	2,616,451	**3,059,188**	3,631,857			
1976	86,950	15,741		237,309	19,460				66,277	57,875	1,329,232	102,549	106,177	549,019	1,906,685	**2,224,559**	2,629,032			
1977	48,979	21,735		151,187	8,824				51,178	59,224	1,154,550	116,348	104,554	570,889	1,781,030	**2,066,454**	2,419,114			
1978	46,611	22,145		152,731	10,456				52,274	77,910	1,006,582	132,930	136,153	654,808	1,807,117	**2,073,587**	2,406,392			
1979	42,156	21,268		211,832	10,810				59,401	71,761	924,438	127,316	95,573	539,870	1,593,431	**1,829,694**	2,136,277			
1980	33,637	3,413		151,690	13,897				124,424	32,852	706,378	119,541	121,066	338,416	1,269,988	**1,457,752**	1,691,296			
1981	30,997	16,906		127,411	25,516				99,707	42,766	374,799	125,760	95,715	418,810	1,042,885	**1,168,340**	1,313,254			
1982	18,692	7,951		111,257	22,407				61,258	43,602	770,477	106,729	137,390	598,236	1,535,138	**1,728,485**	1,955,221			
1983	44,194	11,548	896,493	184,824	29,678	1,022,387	**1,169,737**	1,341,314	66,263	54,839	1,357,134	156,160	192,545	610,534	2,153,231	**2,450,179**	2,806,028	3,244,186	**3,625,483**	4,058,432
1984	47,330	4,207	930,150	196,552	41,409	1,067,404	**1,223,646**	1,407,435	106,923	33,717	713,003	136,400	75,576	643,726	1,526,826	**1,723,967**	1,953,993	2,655,244	**2,949,234**	3,282,662
1985	62,112	28,161	944,112	269,277	49,426	1,198,252	**1,358,234**	1,549,133	40,138	54,223	1,178,557	136,982	97,948	530,719	1,792,928	**2,048,372**	2,365,207	3,060,340	**3,413,537**	3,820,069
1986	50,025	35,134	825,671	231,964	51,545	1,057,858	**1,200,472**	1,356,827	62,185	89,701	1,321,020	157,698	110,586	661,153	2,120,986	**2,424,991**	2,784,572	3,246,287	**3,628,740**	4,064,033
1987	59,510	20,700	693,619	246,589	40,974	946,398	**1,065,725**	1,205,507	108,425	55,659	851,369	163,673	60,474	508,562	1,543,135	**1,778,834**	2,071,768	2,549,416	**2,846,731**	3,208,446
1988	35,351	29,879	637,443	170,243	34,406	809,412	**909,951**	1,028,295	37,520	99,563	1,153,687	224,742	141,798	770,115	2,153,188	**2,449,040**	2,805,836	3,014,290	**3,363,834**	3,770,403
1989	76,262	16,169	699,839	252,420	10,203	936,303	**1,058,060**	1,204,688	20,701	55,716	828,573	151,812	136,123	846,297	1,820,552	**2,052,974**	2,326,406	2,811,115	**3,117,562**	3,458,891
1990	76,143	12,025	628,244	208,522	23,341	841,507	**950,255**	1,072,818	34,339	50,970	518,753	108,172	112,665	404,950	1,103,905	**1,243,700**	1,409,112	1,987,214	**2,197,350**	2,429,927
1991	74,711	17,420	546,214	178,127	29,395	750,052	**849,451**	963,677	24,714	56,372	370,913	107,228	62,900	401,883	922,518	**1,034,694**	1,167,185	1,710,420	**1,886,798**	2,084,748
1992	105,298	32,812	459,820	219,173	32,281	761,254	**853,173**	960,271	45,514	64,685	534,215	111,977	127,002	585,575	1,321,912	**1,488,470**	1,684,229	2,120,919	**2,343,346**	2,598,039
1993	70,791	26,933	462,197	188,263	32,227	699,304	**783,880**	879,478	64,661	63,426	436,514	154,821	148,910	525,591	1,260,399	**1,416,509**	1,604,682	1,995,643	**2,201,902**	2,439,315
1994	39,415	8,631	625,625	223,124	24,959	814,332	**926,548**	1,060,820	51,119	52,098	558,215	172,710	102,288	560,470	1,346,558	**1,518,527**	1,717,843	2,213,188	**2,446,242**	2,712,895
1995	39,432	24,793	407,879	200,626	36,569	637,721	**712,734**	801,404	16,998	70,644	624,899	131,469	95,159	551,717	1,333,637	**1,502,092**	1,703,019	2,003,445	**2,217,560**	2,460,703
1996	66,696	13,214	311,183	271,994	21,729	613,502	**687,806**	774,566	21,111	60,818	581,365	97,987	98,274	395,047	1,116,684	**1,264,365**	1,438,168	1,765,443	**1,954,188**	2,171,214
1997	60,336	18,057	358,619	266,999	9,846	637,740	**718,084**	810,622	10,767	44,568	578,929	87,990	116,295	283,783	991,817	**1,130,185**	1,297,438	1,665,879	**1,850,610**	2,066,146
1998	75,965	30,786	467,769	293,457	7,931	781,834	**881,160**	993,318	21,060	61,095	609,056	96,121	253,544	386,518	1,277,568	**1,440,283**	1,628,251	2,101,193	**2,322,617**	2,572,721
1999	101,649	15,628	434,052	225,467	12,553	706,807	**793,078**	892,539	7,039	49,592	567,754	76,014	66,093	191,683	840,915	**963,730**	1,113,582	1,585,993	**1,761,092**	1,961,852
2000	110,045	16,462	716,695	247,130	22,986	993,246	**1,118,635**	1,265,894	18,215	43,870	785,774	116,084	95,819	374,027	1,266,505	**1,446,338**	1,664,964	2,310,388	**2,566,948**	2,865,555
2001	79,866	14,942	618,988	333,072	14,301	933,373	**1,071,085**	1,233,636	15,816	39,212	626,800	101,205	75,849	366,948	1,102,633	**1,236,769**	1,393,005	2,084,172	**2,310,421**	2,563,442
2002	54,190	25,923	378,142	304,312	13,707	679,451	**781,752**	915,723	35,639	49,050	548,027	95,350	149,939	295,526	1,061,668	**1,187,449**	1,334,651	1,782,749	**1,973,877**	2,195,497
2003	53,800	13,744	523,212	269,995	7,485	761,325	**875,556**	1,014,634	23,356	58,553	536,323	73,865	97,879	335,296	1,016,119	**1,139,555**	1,282,982	1,819,161	**2,017,792**	2,244,049
2004	22,698	37,184	317,531	189,241	6,265	505,430	**577,515**	666,293	28,317	58,827	395,624	133,598	87,546	398,064	996,787	**1,120,604**	1,264,599	1,533,897	**1,700,274**	1,887,282
2005	49,959	32,943	470,778	216,437	6,131	688,705	**782,552**	898,129	18,505	86,637	393,164	109,373	111,076	432,607	1,042,957	**1,166,547**	1,308,460	1,769,192	**1,951,798**	2,164,306
2006	87,511	34,784	381,524	260,839	6,828	680,484	**777,662**	895,792	25,952	61,375	301,642	106,792	71,092	419,113	890,925	**1,001,657**	1,137,679	1,608,262	**1,785,278**	1,985,209
2007	25,539	25,757	213,532	140,828	2,118	359,057	**410,177**	473,241	20,160	70,121	343,073	101,703	115,356	411,495	928,986	**1,091,785**	1,358,502	1,317,924	**1,507,604**	1,782,981
2008	27,537	23,556	267,363	146,077	3,303	412,146	**471,500**	541,299	19,923	84,843	340,529	100,218	68,920	354,379	841,458	**1,001,687**	1,267,654	1,290,553	**1,480,203**	1,758,283
2009	48,645	37,971	213,824	137,107	3,498	391,162	**444,185**	506,281	7,088	95,833	282,951	63,073	52,543	302,986	695,557	**829,844**	1,042,210	1,118,674	**1,278,051**	1,504,308
2010	39,362	30,422	316,608	156,670	5,976	486,662	**552,705**	628,763	24,387	98,503	357,527	124,767	48,109	552,776	1,042,633	**1,255,400**	1,561,340	1,569,278	**1,811,077**	2,133,934
2011	44,508	24,986	223,470	167,141	5,106	410,279	**467,781**	535,390	17,020	69,493	314,270	72,871	41,801	295,993	695,753	**838,483**	1,092,132	1,140,705	**1,312,810**	1,577,845
2012	76,941	13,089	248,568	195,257	7,216	479,637	**546,612**	626,843	14,631	39,402	320,185	44,871	63,232	394,460	742,840	**924,002**	1,197,017	1,263,841	**1,475,242**	1,766,643
2013	44,493	36,170	233,981	151,858	4,144	416,672	**475,480**	549,277	20,673	91,775	298,881	56,245	46,858	471,255	836,320	**1,040,599**	1,313,309	1,291,359	**1,519,800**	1,810,767
10yr Av.	46,719	29,686	288,718	176,145	5,059	483,023	**550,617**	632,131	19,666	75,681	334,785	91,351	70,653	403,313	871,422	**1,027,061**	1,254,290	1,390,369	**1,582,214**	1,837,156

Table 3.3.4.4 Estimated pre-fishery abundance of NON-MATURING 1SW salmon (potential MSW returns) by NEAC country or region and year

	Northern Europe								Southern Europe									NEAC Area		
Year	**Finland**	**Iceland N&E**	**Norway**	**Russia**	**Sweden**	**Total**			**France**	**Iceland S&W**	**Ireland**	**UK(EW)**	**UK(NI)**	**UK(Scot)**	**Total**			**Total**		
						5.0%	50.0%	95.0%							5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	52,462	28,471		261,703	5,689				56,319	66,084	394,140	368,775	34,351	1,743,860	2,273,240	**2,672,992**	3,170,521			
1972	79,456	26,908		416,752	8,436				36,821	59,602	387,869	278,078	30,707	1,737,269	2,128,562	**2,541,517**	3,049,789			
1973	125,860	24,989		387,771	5,754				21,488	51,386	409,247	207,150	32,458	1,251,038	1,664,744	**1,982,272**	2,375,330			
1974	160,608	27,852		421,826	4,584				31,562	54,599	448,220	259,231	27,572	1,356,569	1,836,071	**2,190,324**	2,645,600			
1975	125,094	22,679		358,908	5,308				28,547	47,097	342,119	178,828	19,007	1,000,092	1,386,435	**1,621,047**	1,914,244			
1976	86,392	30,586		248,030	2,945				18,964	45,605	274,946	171,818	18,284	912,503	1,217,414	**1,451,483**	1,736,908			
1977	45,458	38,924		211,396	3,086				21,372	58,746	253,761	163,404	23,261	1,134,320	1,393,914	**1,659,812**	1,999,738			
1978	47,158	26,460		196,141	5,034				18,579	37,996	210,155	82,286	17,196	804,618	977,500	**1,175,425**	1,430,168			
1979	55,453	38,144		339,386	10,715				36,725	54,282	249,357	225,420	23,772	1,075,048	1,407,923	**1,676,175**	2,008,349			
1980	71,209	17,284		240,535	9,085				28,252	38,161	202,556	301,473	21,858	1,182,416	1,499,643	**1,783,588**	2,132,425			
1981	85,524	18,747		217,017	13,240				19,601	27,581	133,568	140,961	28,337	978,862	1,124,675	**1,333,147**	1,588,600			
1982	88,288	14,357	812,705	269,501	9,580	1,007,277	**1,198,419**	1,432,401	19,261	43,514	292,006	147,167	36,201	980,605	1,265,809	**1,556,821**	1,967,713	2,315,362	**2,763,020**	3,327,482
1983	70,572	16,126	793,213	249,059	8,984	955,126	**1,140,279**	1,368,648	24,223	36,382	147,264	107,342	15,312	752,742	910,535	**1,090,063**	1,309,640	1,890,552	**2,233,387**	2,637,340
1984	68,807	11,364	740,653	270,767	5,749	921,616	**1,099,974**	1,316,200	18,683	26,864	157,211	146,983	19,220	890,029	1,051,940	**1,267,116**	1,528,900	2,006,101	**2,367,744**	2,806,848
1985	61,210	27,292	890,168	274,474	5,834	1,057,205	**1,260,726**	1,508,001	22,960	23,017	198,632	217,503	21,873	1,219,740	1,425,745	**1,711,353**	2,062,595	2,523,859	**2,977,470**	3,523,023
1986	75,327	27,958	687,158	212,886	9,078	851,238	**1,015,950**	1,213,869	13,863	20,543	227,444	172,960	12,726	831,224	1,078,623	**1,284,407**	1,540,025	1,958,477	**2,301,280**	2,718,227
1987	50,512	17,681	550,709	195,545	7,437	690,676	**825,173**	984,607	28,442	22,283	168,811	212,320	27,874	1,153,677	1,346,457	**1,623,852**	1,956,772	2,067,468	**2,449,833**	2,905,518
1988	51,003	15,543	415,761	195,130	20,520	590,903	**700,591**	833,723	17,452	20,219	167,842	186,971	22,974	1,072,638	1,259,531	**1,493,674**	1,791,961	1,867,218	**2,195,106**	2,601,425
1989	53,532	15,862	469,797	234,585	11,240	660,500	**786,878**	940,076	13,484	19,752	76,756	196,750	20,525	821,857	957,879	**1,155,922**	1,396,486	1,642,490	**1,944,117**	2,309,510
1990	67,498	10,838	386,836	222,899	13,567	590,266	**704,183**	840,227	11,363	19,349	100,484	87,272	10,691	603,537	689,561	**836,390**	1,015,820	1,297,553	**1,542,462**	1,832,711
1991	64,061	15,442	410,713	205,065	17,921	597,902	**715,300**	856,612	15,125	21,518	84,846	74,490	22,682	809,734	856,259	**1,031,608**	1,257,221	1,478,074	**1,747,406**	2,085,101
1992	66,649	17,362	392,217	240,985	20,051	623,172	**738,884**	883,145	7,507	10,660	79,098	76,469	52,788	656,358	732,190	**889,031**	1,080,139	1,375,138	**1,628,655**	1,936,996
1993	62,970	14,730	383,270	217,897	15,389	583,291	**696,447**	833,433	13,017	17,134	114,357	98,052	18,884	758,284	842,296	**1,024,119**	1,258,065	1,444,769	**1,722,569**	2,063,065
1994	42,217	10,442	412,548	245,214	8,011	605,162	**719,874**	861,840	6,405	19,317	110,804	98,411	16,208	703,344	787,352	**960,389**	1,181,157	1,412,921	**1,682,018**	2,013,684
1995	43,048	13,480	410,925	186,045	12,561	561,488	**668,901**	800,634	11,363	12,467	76,253	101,637	17,656	547,898	634,815	**771,889**	945,857	1,217,018	**1,443,533**	1,721,996
1996	49,927	7,402	265,517	147,962	8,708	402,861	**481,652**	578,998	5,928	13,797	96,062	63,587	21,379	370,927	472,688	**580,164**	716,861	890,799	**1,062,272**	1,274,036
1997	47,929	10,807	318,729	181,369	4,854	473,611	**565,362**	676,833	4,925	8,536	55,617	41,355	29,341	388,756	435,789	**532,675**	654,836	925,552	**1,100,553**	1,312,737
1998	50,860	12,351	339,793	161,845	3,441	474,305	**569,968**	686,323	10,320	16,645	85,505	80,205	13,368	297,719	414,110	**519,036**	656,279	908,608	**1,091,465**	1,314,395
1999	96,989	7,267	470,781	280,250	12,227	728,555	**867,468**	1,044,832	7,187	4,536	107,092	83,380	17,852	380,459	495,666	**608,282**	754,079	1,247,467	**1,477,121**	1,770,687
2000	129,108	8,314	555,704	199,850	14,539	758,799	**909,293**	1,091,514	8,712	7,941	97,771	92,332	13,101	372,602	487,074	**601,110**	744,400	1,271,082	**1,511,455**	1,808,673
2001	113,394	7,879	481,499	217,801	9,945	694,703	**831,603**	1,000,296	7,847	8,621	110,787	82,094	15,502	299,890	434,185	**535,015**	659,828	1,150,013	**1,369,577**	1,631,032
2002	81,553	8,258	426,059	152,691	2,390	560,881	**672,820**	807,947	11,292	13,751	116,503	104,631	10,132	372,993	517,614	**641,592**	795,898	1,099,737	**1,315,889**	1,575,313
2003	36,944	8,143	385,369	117,865	7,316	463,173	**556,700**	673,163	20,834	11,137	63,908	88,000	9,065	476,803	549,373	**679,480**	845,541	1,034,240	**1,238,220**	1,491,595
2004	30,716	10,081	354,923	140,310	4,907	451,966	**542,861**	651,636	12,788	9,813	82,700	96,780	11,480	376,109	486,712	**599,585**	743,964	956,063	**1,142,339**	1,372,011
2005	48,546	9,677	449,819	134,048	5,129	541,926	**648,626**	780,130	12,932	8,131	60,310	87,773	7,354	389,837	463,180	**579,288**	722,664	1,027,624	**1,229,345**	1,474,361
2006	69,928	9,294	382,642	138,250	4,815	508,386	**607,131**	726,781	12,249	5,004	27,389	84,018	10,114	375,747	418,284	**523,832**	658,256	947,281	**1,130,494**	1,358,619
2007	70,900	11,979	441,733	220,745	6,794	626,511	**753,961**	911,454	13,518	5,739	40,608	92,517	6,126	421,929	471,352	**590,560**	742,293	1,124,055	**1,348,052**	1,618,676
2008	30,309	9,648	345,457	185,625	5,934	479,989	**578,926**	700,005	7,084	8,873	45,766	71,471	7,995	356,911	403,778	**505,667**	636,350	905,192	**1,085,612**	1,307,064
2009	48,708	13,718	380,737	230,625	6,891	566,765	**683,041**	826,700	5,982	18,366	29,457	103,948	7,365	471,676	512,819	**648,560**	832,118	1,109,905	**1,333,393**	1,621,047
2010	37,585	15,238	531,287	229,830	12,982	686,192	**829,156**	1,004,549	15,544	9,323	34,234	154,179	19,161	534,564	612,884	**782,689**	1,002,388	1,336,210	**1,616,776**	1,956,984
2011	45,218	8,606	464,146	112,469	18,514	538,091	**652,170**	788,069	12,070	5,313	35,928	126,547	28,432	418,192	504,107	**646,865**	838,921	1,073,350	**1,301,726**	1,585,415
2012	43,521	10,328	328,574	129,010	7,855	431,663	**521,451**	630,624	12,068	11,314	36,422	113,370	13,346	382,009	454,236	**583,605**	759,457	910,576	**1,107,774**	1,356,893
10yr Av.	46,238	10,671	406,469	163,878	8,114	529,466	**637,402**	769,311	12,507	9,301	45,672	101,860	12,044	420,378	487,672	**614,013**	778,195	1,042,450	**1,253,373**	1,514,266

Table 3.3.4.5 Estimated number of 1SW SPAWNERS by NEAC country or region and year

	Northern Europe								Southern Europe									NEAC Area		
Year	**Finland**	**Iceland**	**Norway**	**Russia**	**Sweden**	**Total**			**France**	**Iceland**	**Ireland**	**UK(EW)**	**UK(NI)**	**UK(Scot)**	**Total**			**Total**		
		N&E				5.0%	50.0%	95.0%		**S&W**					5.0%	50.0%	95.0%	5.0%	50.0%	95.0%
1971	12,955	4,689			8,135				47,851	31,302	395,696	35,128	36,444	213,846	580,290	**770,856**	1,020,316			
1972	50,522	4,280		72,091	6,480				96,183	25,408	417,641	38,568	31,771	170,199	591,644	**794,711**	1,062,204			
1973	23,549	5,170		78,134	7,881				58,772	27,052	458,321	46,038	27,792	204,267	615,326	**834,663**	1,131,112			
1974	32,590	5,114		93,847	11,539				27,094	19,277	522,210	58,157	30,429	173,118	604,023	**840,308**	1,165,987			
1975	38,796	6,310		112,589	12,483				54,736	29,907	573,985	59,938	25,055	155,118	659,635	**907,947**	1,269,420			
1976	35,690	6,315		109,885	7,061				50,059	23,689	389,723	39,666	17,276	159,653	513,285	**687,885**	935,680			
1977	19,961	8,767		74,344	3,159				38,876	24,225	338,961	45,017	17,106	138,881	454,796	**612,333**	821,554			
1978	18,982	8,935		58,831	3,823				39,610	32,084	296,669	52,893	22,246	188,286	493,235	**640,777**	830,105			
1979	17,138	8,573		74,817	3,877				44,939	29,522	271,289	51,896	15,597	124,040	416,140	**547,197**	725,403			
1980	13,482	1,291		73,409	5,023				94,418	13,355	207,748	48,741	19,767	82,431	369,394	**478,314**	618,142			
1981	12,062	6,700		53,664	9,174				75,370	17,388	69,510	51,428	15,496	98,818	270,941	**338,690**	414,004			
1982	7,148	3,098		49,806	8,034				46,116	17,676	169,894	43,488	22,358	170,053	380,046	**480,076**	595,980			
1983	17,604	4,530	162,011	65,028	10,658	205,571	**260,965**	324,919	49,783	22,232	361,134	64,096	31,372	149,138	538,070	**687,772**	877,893	787,438	**952,094**	1,148,823
1984	19,223	1,637	164,756	80,651	15,075	222,769	**283,213**	350,819	81,045	13,872	197,945	56,086	12,352	189,073	459,447	**563,415**	682,942	725,377	**848,607**	984,535
1985	25,349	11,360	171,329	92,692	18,039	260,862	**321,282**	389,192	30,482	22,289	236,199	56,599	16,009	178,139	418,885	**547,580**	707,869	723,361	**871,427**	1,043,178
1986	20,180	14,107	151,793	102,624	18,763	256,255	**309,567**	370,151	45,114	36,742	321,092	65,137	18,004	223,423	573,344	**731,809**	923,383	874,901	**1,043,504**	1,246,501
1987	24,279	8,300	127,587	95,787	14,838	226,293	**273,003**	322,853	78,729	22,787	200,316	68,686	15,260	167,993	453,777	**580,361**	751,935	717,133	**855,251**	1,035,021
1988	14,261	12,007	117,889	86,593	12,534	205,771	**245,527**	289,766	27,284	40,736	343,742	95,511	41,321	383,028	799,632	**950,249**	1,129,264	1,039,551	**1,196,456**	1,378,739
1989	24,872	6,479	184,226	96,426	3,640	267,982	**317,321**	378,470	14,954	22,761	222,209	64,925	12,307	440,290	668,069	**791,481**	930,946	974,590	**1,111,455**	1,262,303
1990	24,997	4,830	165,497	97,152	9,901	260,182	**303,920**	357,203	25,065	20,813	160,669	46,220	35,144	197,622	422,272	**496,180**	582,385	713,125	**802,510**	901,216
1991	24,520	7,044	143,700	83,103	12,564	232,350	**273,365**	321,112	18,012	23,193	118,506	47,072	18,239	214,894	387,133	**449,366**	517,767	648,594	**723,471**	806,057
1992	34,583	13,270	121,831	116,138	13,575	263,359	**302,214**	345,342	33,171	26,674	159,265	49,537	45,812	333,037	571,539	**662,557**	769,158	866,864	**966,174**	1,080,137
1993	23,093	10,914	121,096	113,836	13,692	248,433	**285,099**	325,549	47,124	26,039	141,554	72,033	72,164	274,812	562,821	**650,891**	760,553	840,468	**937,079**	1,051,872
1994	12,864	3,481	166,334	116,030	10,623	263,022	**311,695**	370,718	37,207	21,363	124,402	80,941	25,207	298,122	510,505	**604,765**	714,432	807,760	**919,223**	1,040,405
1995	12,919	10,043	107,885	121,428	17,701	237,126	**272,528**	311,156	11,654	29,070	180,161	64,086	25,803	299,813	530,829	**619,993**	721,655	795,446	**893,982**	1,001,858
1996	27,404	5,335	81,303	138,529	10,539	233,426	**264,884**	299,179	14,506	24,925	183,464	49,450	34,771	228,222	464,865	**544,335**	634,719	722,851	**809,622**	906,647
1997	24,849	7,305	105,460	158,453	4,764	266,505	**302,574**	342,513	7,385	18,308	226,459	45,962	38,184	158,205	429,378	**501,265**	591,991	723,369	**805,304**	902,722
1998	31,248	12,487	138,194	163,206	3,816	306,512	**351,302**	400,182	14,466	25,226	221,561	51,838	155,698	233,447	624,403	**713,560**	815,073	964,762	**1,065,614**	1,178,697
1999	33,445	6,582	127,901	162,325	6,065	295,091	**338,781**	385,569	4,845	20,829	233,206	42,155	20,047	107,897	366,374	**434,017**	519,117	691,529	**774,421**	869,186
2000	36,242	6,941	213,805	141,161	11,019	353,636	**411,397**	480,284	12,518	18,300	350,422	64,285	32,994	218,517	606,843	**706,447**	830,003	1,001,525	**1,120,927**	1,261,467
2001	26,164	6,404	186,586	198,258	6,918	365,442	**428,322**	499,614	10,881	16,711	256,374	57,206	31,173	221,379	525,114	**602,924**	693,676	929,469	**1,033,002**	1,145,435
2002	22,258	11,354	111,501	210,733	6,609	308,539	**365,245**	430,721	24,515	21,015	215,623	54,216	70,276	179,695	503,001	**577,635**	661,245	848,411	**945,062**	1,049,210
2003	22,229	6,027	156,516	199,089	3,614	328,382	**390,422**	461,052	16,048	24,999	247,140	45,691	41,114	227,999	542,774	**614,475**	696,312	909,400	**1,006,770**	1,114,789
2004	9,304	16,574	94,021	145,885	3,039	229,066	**270,663**	319,000	19,374	25,192	156,885	81,731	40,954	266,808	529,778	**606,081**	696,671	788,874	**878,708**	978,772
2005	20,538	14,899	140,323	132,896	2,970	266,476	**314,134**	367,243	12,715	37,023	171,657	67,317	55,638	294,180	577,090	**651,159**	733,544	877,357	**966,929**	1,063,116
2006	35,808	15,530	111,387	163,124	3,301	281,747	**332,060**	387,049	17,786	26,342	126,989	67,931	38,521	286,694	507,295	**578,134**	662,583	822,477	**911,226**	1,011,561
2007	10,533	11,660	62,172	123,095	1,022	177,221	**209,985**	250,683	13,799	30,509	248,927	65,376	74,889	285,444	630,513	**741,083**	940,600	835,549	**953,286**	1,154,116
2008	11,356	11,068	87,847	93,161	1,852	176,825	**207,038**	240,467	13,674	36,874	245,359	64,704	43,454	251,689	566,450	**680,105**	882,240	770,743	**889,200**	1,093,237
2009	19,913	18,493	71,593	100,872	1,969	184,140	**215,059**	250,944	4,878	40,921	205,805	41,008	34,812	217,365	470,018	**563,122**	723,877	679,772	**780,316**	945,233
2010	16,221	14,717	115,526	92,217	3,356	209,855	**244,468**	283,729	16,748	42,963	258,977	80,801	32,080	390,832	706,109	**860,953**	1,091,581	948,312	**1,107,339**	1,339,160
2011	18,327	12,517	80,167	102,480	2,178	188,064	**217,835**	251,075	11,704	30,295	227,063	45,303	28,413	207,143	469,203	**570,243**	761,617	682,331	**789,777**	981,775
2012	31,485	6,377	90,108	109,874	4,039	211,202	**244,382**	281,336	10,055	17,239	229,283	29,327	46,810	288,763	526,086	**660,146**	867,360	764,525	**906,201**	1,113,966
2013	18,369	16,968	90,763	100,299	2,245	198,063	**230,912**	268,527	14,223	40,845	213,336	36,378	34,542	343,248	576,924	**729,078**	935,437	803,509	**960,872**	1,171,125
10yr Av.	19,185	13,880	94,391	116,390	2,597	212,266	**248,653**	290,005	13,496	32,820	208,428	57,988	43,011	283,217	555,947	**664,010**	829,551	797,345	**914,385**	1,085,206

Table 3.3.5.1. Status of spawner escapement by jurisdiction in the NEAC area in 2013 and compliance (i.e. meeting or exceeding CL or other stock indicator) with river-specific conservation limits or other stock indicator for individual river stocks after homewater fisheries (except Norway where data are for 2012).

Country	95% or higher probability of spawners meeting CL 1SW	95% or higher probability of spawners meeting CL MSW	No. rivers	No. with CL	No. assessed for compliance	No. complying	% complying
Northern NEAC	1SW	MSW					
Russia	Yes	No	112	80	7	6	86
Finland/Norway (Tana/Teno)	No	No	1	1	1	0	0
Norway	Yes	Yes	465	439	173	126	73
Sweden	No	Yes	23	23	20	7	35
Iceland	Yes	Yes	100	0	NA	NA	NA
Southern NEAC	1SW	MSW					
UK (Scotland)	Yes	No	398	0	0	NA	NA
UK (N. Ireland)	No	Yes	15	10	10	4	40
UK (England & Wales)	No	Yes	80	64	64	16	25
Ireland	No	No	141	141	141	62	44
France (1SW)	No	No	36	26	26	1	4
France (MSW)			36	26	26	3	12

Table 3.3.6.1. Estimated survival of wild smolts (%) to return to homewaters (prior to coastal fisheries) for various monitored rivers in the NE Atlantic Area.

Smolt	Iceland[1]			Norway[2]				Ireland			UK (Scotland)[2]		UK (NI)[7]	UK (E & W)						France[8]			
migration	Ellidaar	R.Vesturdalsa[4]		R. Halselva		R. Imsa		R. Corrib		B'shoole	North Esk		R. Bush	R. Dee		R. Tamar		R. Frome		Nivelle[5]	Scorff	Oir	Bresle
year	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW	1SW	MSW	1SW[3]	1SW	MSW	1SW	MSW	1SW	MSW	All ages	All ages	All ages	All ages
1975	20.8																						
1980								17.9	1.1	3.1													
1981						17.3	4.0	9.2	3.8	5.4	8.2	3.8											
1982						5.3	1.2	20.9	3.3	5.8	11.2	5.0											
1983						13.5	1.3	10.0	1.8	3.4													
1984						12.1	1.8	26.2	2.0	7.8	6.0	4.0											
1985	9.4					10.2	2.1	18.9	1.8	7.9	13.6	5.4											
1986						3.8	4.2			8.7			31.3										
1987				2.0	0.3	17.3	5.6	16.6	0.7	12.0	10.4	3.9	35.1										
1988	12.7			5.8	0.7	13.3	1.1	14.6	0.7	10.1			36.2										
1989	8.1			2.1	1.0	8.7	2.2	6.7	0.7	3.5	6.6	4.2	25.0										
1990	5.4			3.9	1.6	3.0	1.3	5.0	0.6	9.2	6.0	3.1	34.7										
1991	8.8			2.1	0.3	8.7	1.2	7.3	1.3	9.5	7.6	3.1	27.8										
1992	9.6			2.1	0.4	6.7	0.9	7.3		7.6	10.9	6.5	29.0							6.83		5.30	
1993	9.8			2.1	0.0	15.6		10.8	0.1	9.5	14.5	6.1		6.3	2.5					4.80		17.00	5.80
1994	9.0			0.6	0.4			9.8	1.4	9.4	10.9	3.6	27.1	1.3	1.2					5.37		3.54	3.60
1995	9.4		1.5	0.9	0.0	1.8	1.5	8.4	0.1	6.8	8.4	3.8		2.7	0.4					3.77	11.75	4.99	
1996	4.6	2.5	0.4	2.8	0.6	3.5	0.9	6.3	1.2	9.2	5.9	2.7	31.0	4.8	2.1					2.42	15.06	4.83	
1997	5.3	1.0	1.5	0.8	0.0	1.7	0.3	12.7	0.8	8.2	7.2	4.2	19.8	6.2	3.4					2.09	5.76	14.01	4.70
1998	5.3	1.5	1.0	1.5	0.6	7.2	1.0	5.5	1.1	5.3	2.6	1.4	13.4	2.3	3.7					2.27	6.73	6.58	2.20
1999	7.7	1.3	1.2	1.3	0.0	4.2	2.2	6.4	0.9	8.1	6.8	3.8	16.5	5.0	12.4					2.49	15.93		
2000	6.3	1.1	0.7	0.4	1.1	12.5	1.7	9.4		9.0	6.0	2.8	10.1	2.0	0.9					3.08	10.58	2.38	
2001	5.1	3.4	1.3	2.5	2.5	3.6	2.2	7.2	1.1	7.6	4.7	2.9	12.4	4.3	0.0					0.37	6.15	3.68	
2002	4.4	1.1	2.3	0.8	0.6	5.5	0.9	6.0	0.5	6.5	2.2	2.0	11.3	2.9	0.7	3.6	1.4	5.6	1.7	0.80	22.62	3.12	
2003	9.1	5.5	0.6	4.9	1.6	3.5	0.7	8.3	2.1	8.3			6.8	2.6	0.4	6.1	1.8	4.8	0.9	1.23	12.02	5.70	2.99
2004	7.7	5.7	0.6	3.5	1.2	5.9	1.4	6.3	0.8	5.8			6.8	4.5	1.0	6.0	1.5	5.3	2.9	1.07	6.47	4.00	4.43
2005	6.4	2.5	0.9	3.0	1.0	3.7	1.8			5.3	6.7	2.8	5.9	5.1	0.5	6.4	1.2			0.99	8.50	6.60	3.09
2006	7.1	1.8	1.0	0.8	0.8	0.8	5.8	1.2	0.9	13.0	3.3	3.4	14.0	4.3	1.5	3.5	2.4	5.1	2.2	2.59	7.36	5.30	3.48
2007	19.3	0.9	0.3	0.3	0.0	0.8	0.6	0.9		8.4	5.0	4.0	8.3	1.3	0.7	3.5	3.4	5.7	1.3	2.14	4.42	4.00	3.47
2008	14.9	2.6	1.1	0.2	0.2	1.1	2.3	1.7	1.03	8.22	6.4		3.97	2.5	1.3	1.7	0.9	3.1	1.6	2.85	3.03		1.92
2009	14.2	1.3	1.6	1.1	0.6	2.4	3.1	6		8.85	9	8.65	5.92	4.8	1.1	8.2	1.9	7.7	2.6	0.92	6.78		17.5
2010	8.6	2.0	1.1	0.4	0.4	1.7	1.1	2.9		7.49			3.96	1.9	1.0	3.4	5.0	8.6	2.4		4.45		4.90
2011	6.1	1.3	0.6	0		4.4	2.5	2.4		10.81			2.67	0.0	0.3 [9]	1.1	1.9 [9]	1.5	1.8 [9]		5.11		2.40
2012	10.6	2.1				3.3		1.5		9.4			10.8	4.8 [9]		2.5 [9]		3.2 [9]			6.7		
Mean																							
(5-year)	10.9	1.9	0.9	0.4	0.3	2.6	1.9	2.9	1.0	9.0	7.7	6.3	5.5	2.3	1.0	3.6	2.8	5.2	2.0	1.9	5.2		6.7
(10-year)	10.4	2.6	1.0	1.6	0.7	2.8	2.0	3.5	1.1	8.6	6.1	4.2	6.9	3.0	0.9	4.4	2.2	5.2	2.0	1.7	6.5	5.1	4.9

[1] Microtags.
[2] Carlin tags, not corrected for taggi
[3] Microtags, corrected for tagging m
[4] Assumes 50% exploitation in rod f
[5] From 0+ stage in autumn.
[6] Incomplete returns.
[7] Assumes 30% exploitation in trap fishery.
[8] France data based on retruns to freshwater
[9] Minimum count. High flows hindered sampling effort

Table 3.3.6.2. Estimated survival of hatchery smolts (%) to return to homewaters (prior to coastal fisheries) for monitored rivers and experimental facilities in the NE Atlantic Area.

Smolt year	Iceland[1]		Norway[2]							Sweden[2]	
	R. Ranga		R. Halselva			R. Imsa[3]		R. Drammen		R. Lagan	
	1SW	2SW	1SW		2SW	1SW	2SW	1SW	2SW	1SW	2SW
1981						10.1	1.3				
1982						4.2	0.6				
1983						1.6	0.1				
1984						3.8	0.4	3.5	3.0	11.8	1.1
1985						5.8	1.3	3.4	1.9	11.8	0.9
1986						4.7	0.8	6.1	2.2	7.9	2.5
1987			1.5		0.4	9.8	1.0	1.7	0.7	8.4	2.4
1988			1.2		0.1	9.5	0.7	0.5	0.3	4.3	0.6
1989	1.6	0.1	1.9		0.5	3.0	0.9	1.9	1.3	5.0	1.3
1990	0.8	0.2	2.1		0.3	2.8	1.5	0.3	0.4	5.2	3.1
1991	0.0	0.0	0.6		0.0	3.2	0.7	0.1	0.1	3.6	1.1
1992	0.4	0.1	0.5		0.0	3.8	0.7	0.4	0.6	1.5	0.4
1993	0.7	0.1				6.5	0.5	3.0	1.0	2.6	0.9
1994	1.2	0.2				6.2	0.6	1.2	0.9	4.0	1.2
1995	1.1	0.1				0.4	0.0	0.7	0.3	3.9	0.6
1996	0.2	0.0	1.2		0.2	2.1	0.2	0.3	0.2	3.5	0.5
1997	0.3	0.1	0.6		0.0	1.0	0.0	0.5	0.2	0.6	0.5
1998	0.5	0.0	0.5		0.5	2.4	0.1	1.9	0.7	1.6	0.9
1999	0.4	0.0	2.3		0.2	12.0	1.1	1.9	1.6	2.1	
2000	0.9	0.1	1.0		0.7	8.4	0.1	1.1	0.6		
2001	0.4	0.1	1.9		0.6	3.3	0.3	2.5	1.1		
2002	0.4		1.4		0.0	4.5	0.8	1.2	0.8		
2003	0.2		0.5		0.3	2.6	0.7	0.3	0.6		
2004	0.6		0.2		0.1	3.6	0.7	0.4	0.4		
2005	1.0		1.2		0.2	2.8	1.2	0.3	0.7		
2006	1.0		0.2		0.1	1.0	1.8	0.1	0.6		
2007	1.9		0.3		0.0	0.6	0.7	0.2	0.1		
2008	2.4		0.1		0	1.8	2.2	0.1	0.3		
2009						1.3	3.3				
2010	0.5		1		0.2	2.6	1.9				
2011	0.5					1.7	0.8				
2012	0.9					1.6					
Mean											
(5-year)	1.1		0.6		0.1	1.8	2.1	0.1	0.3		
(10-year)	1.0		0.5		0.1	2.0	1.4	0.2	0.5		

Table 3.3.6.2. Cont'd. Estimated survival of hatchery smolts (%) to return to homewaters (prior to coastal fisheries) for monitored rivers and experimental facilities in the NE Atlantic Area.

	Ireland										UK (N. Ireland)[3]		Iceland
Smolt year	R. Shannon	R. Screebe	R. Burrishoole[1]	R. Delphi/ R. Burrishoole[4]	R. Delphi	R. Bunowen	R. Lee	R. Corrib Cong.[2]	R. Corrib Galway[2]	R. Erne	R. Bush 1+ smolts	R. Bush 2+ smolts	Ranga 1SW
1980	8.6		5.6				8.3	0.9					
1981	2.8		8.1				2.0	1.5					
1982	4.0		11.0				16.3	2.7	0.4				
1983	3.9		4.6					2.8			1.9	8.1	
1984	5.0	10.4	27.1				2.3	5.2		9.4	13.3		
1985	17.8	12.3	31.1				15.7	1.4		8.2	15.4	17.5	
1986	2.1	0.4	9.4				16.4			10.8	2.0	9.7	
1987	4.7	8.4	14.1				8.8			7.0	6.5	19.4	
1988	4.9	9.2	17.2				5.5	4.5		2.9	4.9	6.0	
1989	5.0	1.8	10.5				1.7	6.0		1.2	8.1	23.2	1.6
1990	1.3		11.4		0.2		2.5	0.2	16.1	2.6	5.6	5.6	0.8
1991	4.2	0.3	13.6	10.8	6.2		0.8	4.9	4.1	1.3	5.4	8.8	0.0
1992	4.4	1.3	7.4	10.0	1.7	4.2		0.9	13.2		6.0	7.8	0.4
1993	2.9	3.4	12.0	14.3	6.5	5.4		1.0	14.5		1.1	5.8	0.7
1994	5.2	1.9	14.3	3.9	2.7	10.8			7.7		1.6		1.2
1995	3.6	4.1	6.6	3.4	1.7	3.5		2.4	2.2		3.1	2.4	1.1
1996	2.9	1.8	5.3	10.6	6.7	3.4					2.0	2.3	0.2
1997	6.0	0.4	13.3	17.3	5.6	5.3	7.0		4.8	7.7	-	4.1	0.3
1998	3.1	1.3	4.9	7.2	3.1	2.9	4.9	3.3	2.3	2.6	2.3	4.5	0.5
1999	1.0	2.8	8.2	19.9	8.2	2.0			4.0	3.3	2.7	5.8	0.4
2000	1.2	3.8	11.8	19.5	13.2	5.4	3.55	6.7		4.0	2.8	4.4	0.9
2001	2.0	2.5	9.7	17.2	7.4	3.2	1.95	3.4		6.0	1.1	2.2	0.4
2002	1.0	4.1	9.2	12.6	4.9	2.0	1.93		5.3	1.9	0.7	3.1	0.4
2003	1.2		6.0	3.7	1.5	1.6	4.31			1.0	2.5	1.9	0.2
2004	0.4	1.8	9.4	7.6	2.3	1.8	2.23			3.1	0.7	1.9	0.6
2005	0.6	3.4	4.4	11.0		1.0	0.96			0.9	1.8	1.7	1.0
2006	0.3	1.3	5.2	3.7	1.5	0.02	0.19	0.4	2.9	0.9	2.0	3.8	1.0
2007	0.5	0.8	7.1		3.6				3.6	0.7			1.9
2008		0.2	1.3		1.4		0.05						2.4
2009	0.3	0.2	2.3		1.5		0.07			1.1			
2010	0.2	0.1	3.0		1.9		0.09	0.8	2.0	0.9			0.5
2011	0.4		5.2		1.3		0.09	1.3	1.2	0.5	0.8	1.86	0.5
2012	0.5		3.2		1.8		0.22	3.9	4.4	1.9	2.19	3.46	0.9
Mean													
(5-year)	0.4	0.2	3.0		1.6		0.1	2.0	2.5	1.1	1.5	2.7	1.1
(10-year)	0.5	1.1	4.7	6.5	1.9	1.1	0.9	1.6	2.8	1.2	1.7	2.4	1.0

[1] Return rates to rod fishery with constant effort.

[2] Different release sites

[3] Microtagged.

[4] Delphi fish released at Burrishoole

Table 3.4.1. Tonnes of mackerel and herring, number of salmon caught and number of salmon per 1000 t mackerel and herring from landings where salmon was reported as bycatch, 2010–2013.

Year	Tonnes mackerel and herring	No salmon/ 1000 t mackerel and herring	No salmon caught	Additional salmon samples	Total number of samples
2010	35403	4.8	169	1	170
2011	40048	6.2	249	8	257
2012	8536	5.6	48	1	49
2013	23907	4.7	112	2	114
Total	107894	5.4	578	12	590

Table 3.4.2. Tonnes of mackerel and herring screened on board fishing vessels by the Icelandic Directorate of Fishery inspectors, proportion mackerel in catches and number of salmon per 1000 t mackerel and herring, 2010–2013.

Year	Tonnes Screened	Proportions Mackerel	No salmon/ 1000 t mackerel and herring	No salmon
2010				
2011	24562	67	5.5	134
2012	28813	62	0.0	0
2013	17138		0.9	15
Total	70513		2.1	149

Table 3.4.3. Number and percentage of salmon caught as bycatch in mackerel and herring fisheries in Iceland 2010–2013, divided by length group into salmon life stages.

Year	Post-smolt 20-49 cm Number	%	1SW 50-69 cm Number	%	MSW 70-100 cm Number	%	Total Number	%	No length data
2010	16	9.4	125	73.5	29	17.1	170	100	0
2011	47	18.6	156	61.7	50	19.8	253	100	4
2012	3	6.3	37	77.1	8	16.7	48	100	1
2013	21	18.4	85	74.6	8	7.0	114	100	10
Total	87	14.9	403	68.9	95	16.2	585		15

Table 3.4.4. Total catches screened (mostly mackerel) during the IESSNS surveys, number of salmon caught and number of salmon per 1000 t of catch. The number of salmon per 1000 t in the row "Total" is the weighted average of the years.

Year	Total catch (t)	No salmon	No salmon/1000 t	Average length (cm)
2010	212.6	10	47.0	54.7
2011	45.0	2	44.4	66.2
2012	214.9	26	121.0	45.1
2013	288.4	40	138.7	33.8
Total	760.9	78	102.5	

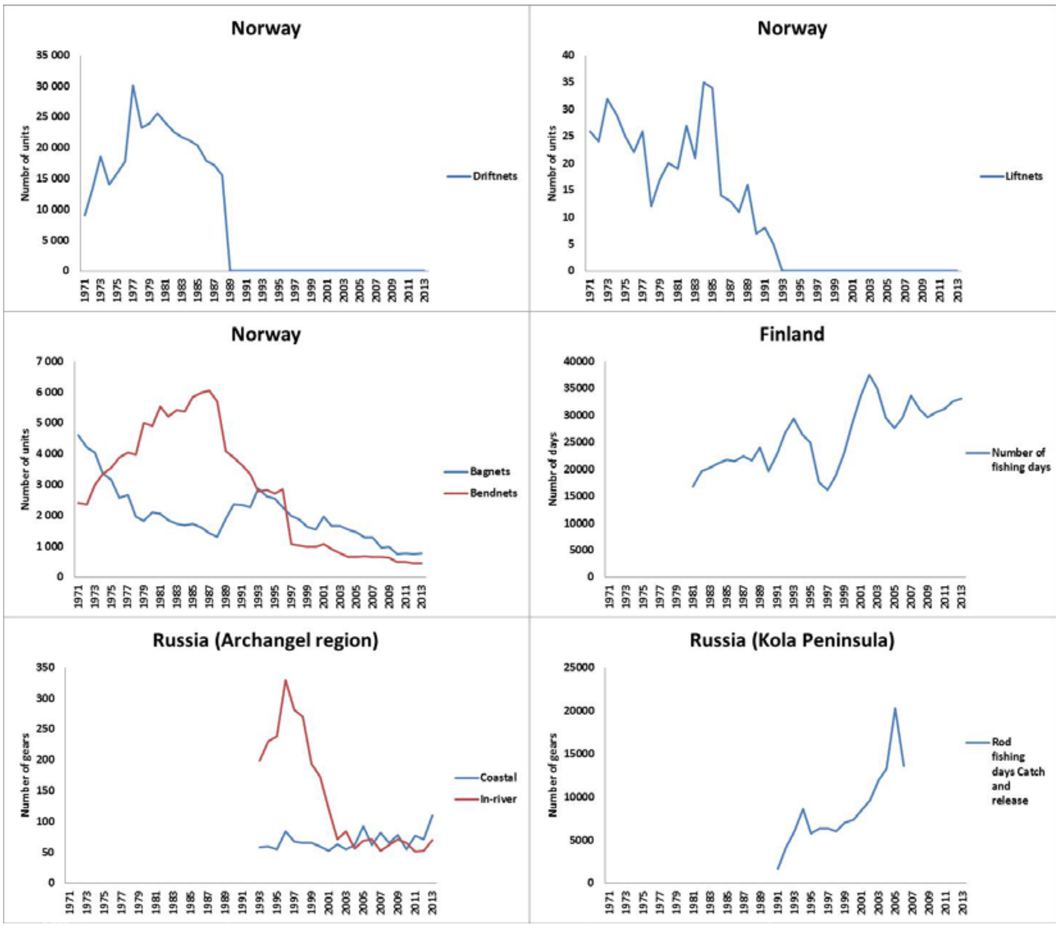


Figure 3.1.3.1. Overview of effort as reported for various fisheries and countries 1971–2013 in the northern NEAC area.

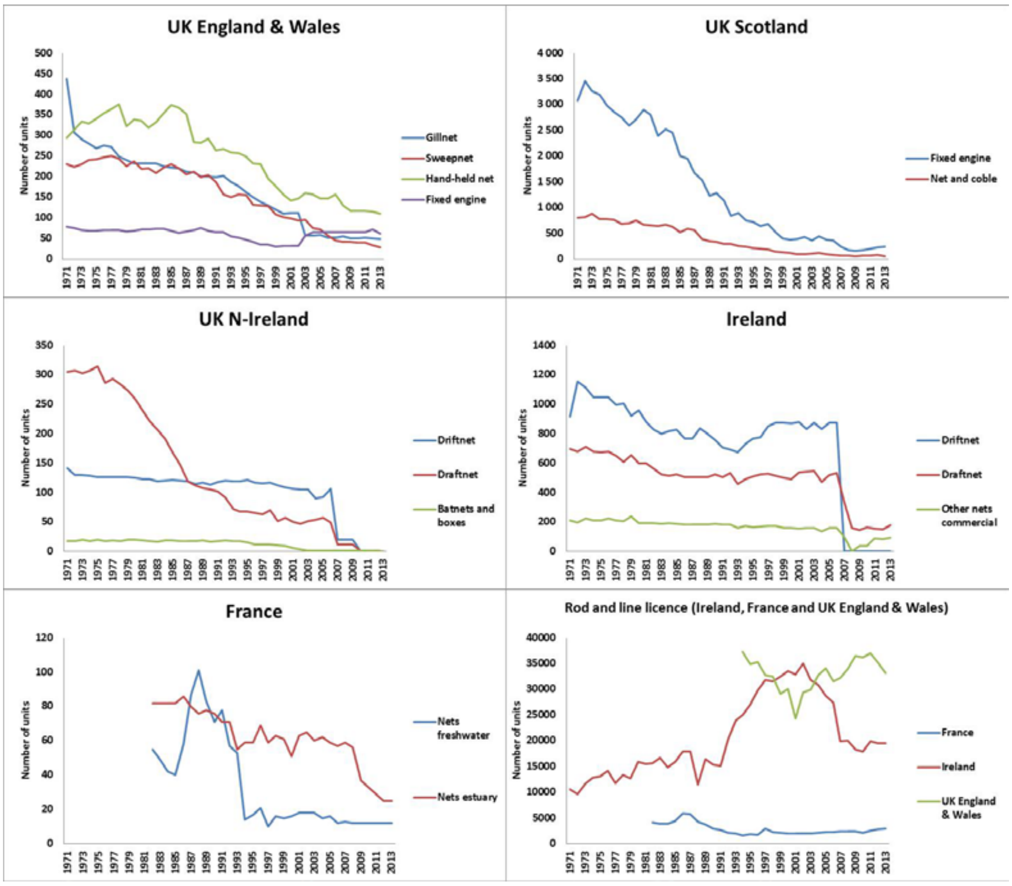


Figure 3.1.3.2. Overview of effort as reported for various fisheries and countries 1971–2013 in the southern NEAC area.

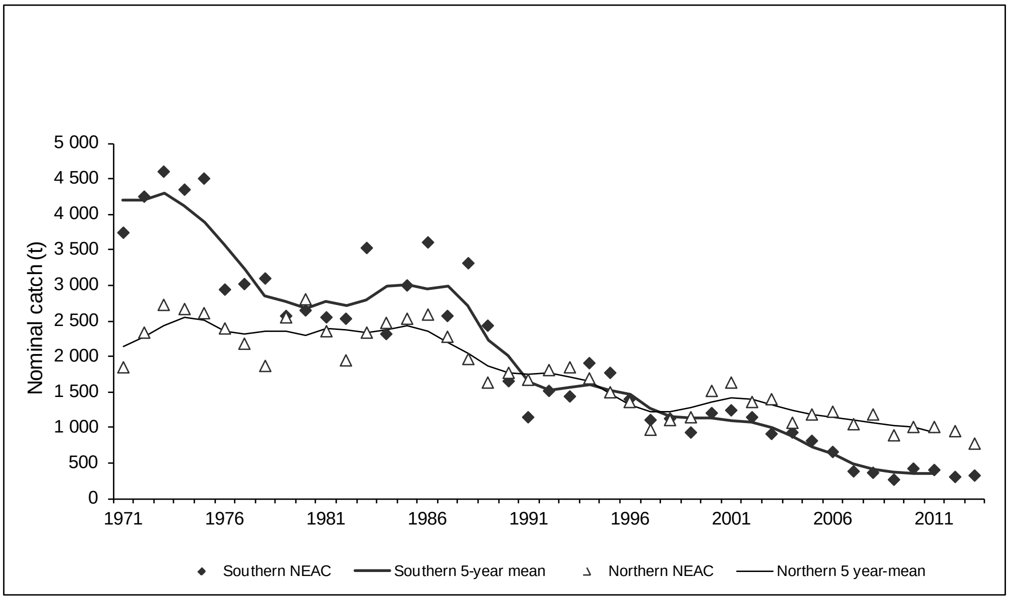


Figure 3.1.4.1. Nominal catches of salmon and 5-year running means in the southern and northern NEAC areas, 1971–2013.

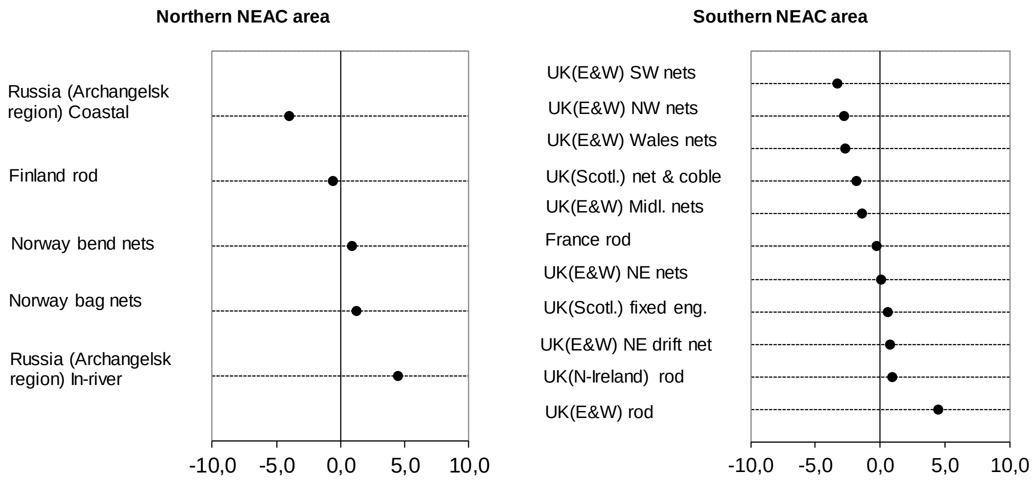


Figure 3.1.5.1. Proportional change (%) over years in cpue estimates in various rod and net fisheries in northern and southern NEAC area.

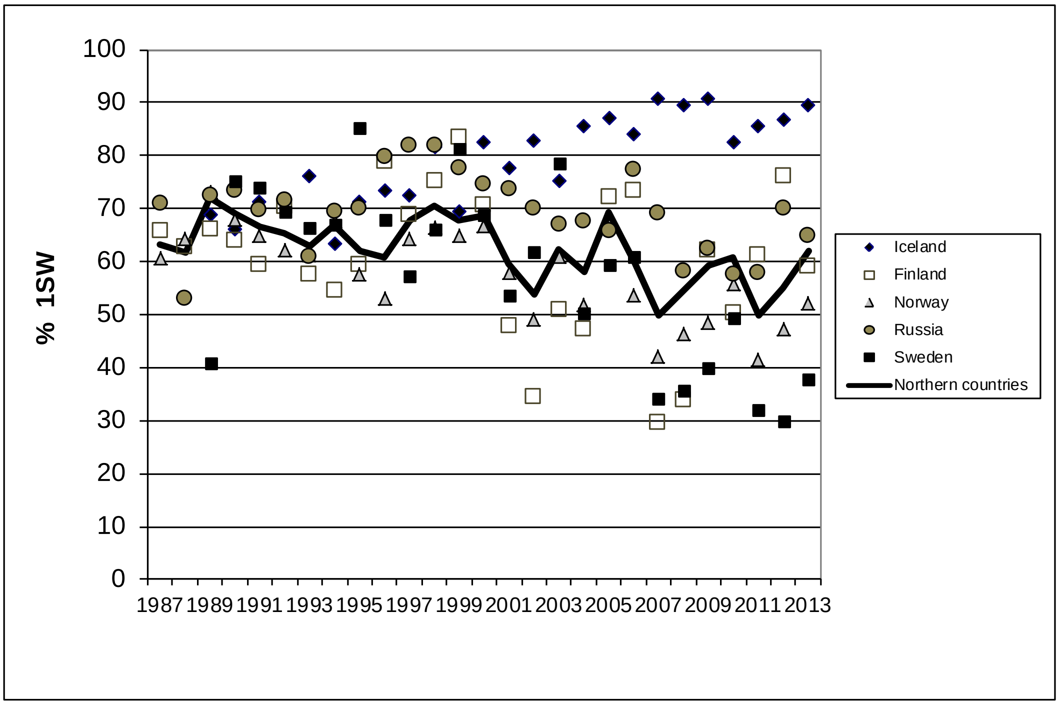


Figure 3.1.6.1. Percentage of 1SW salmon in the reported catch for northern NEAC countries, 1987–2013.

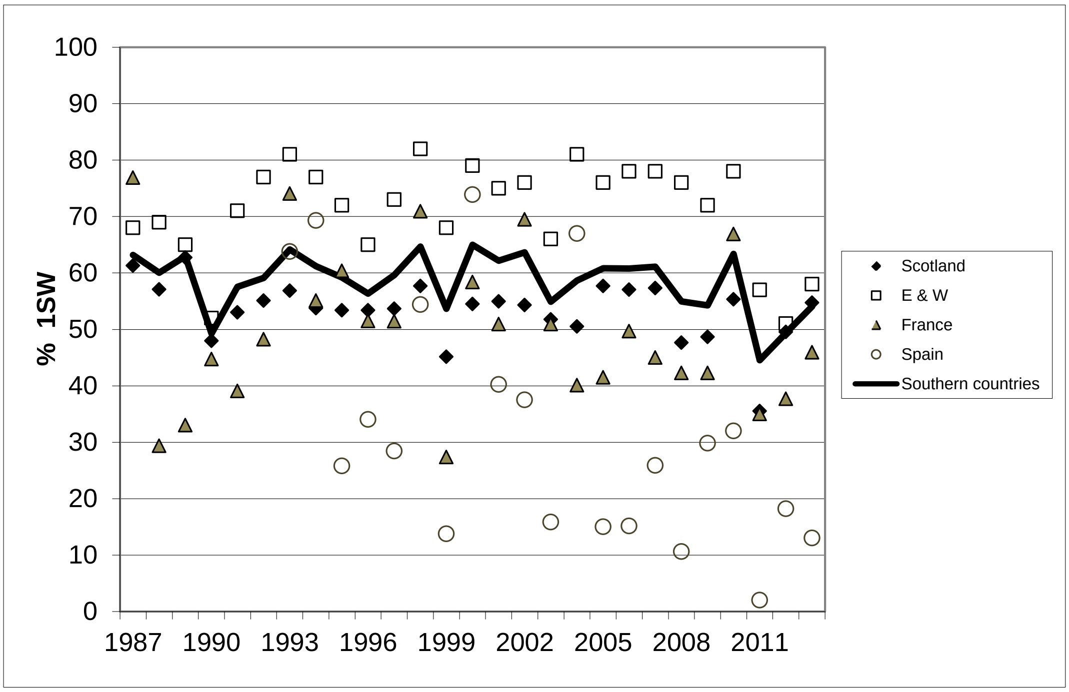
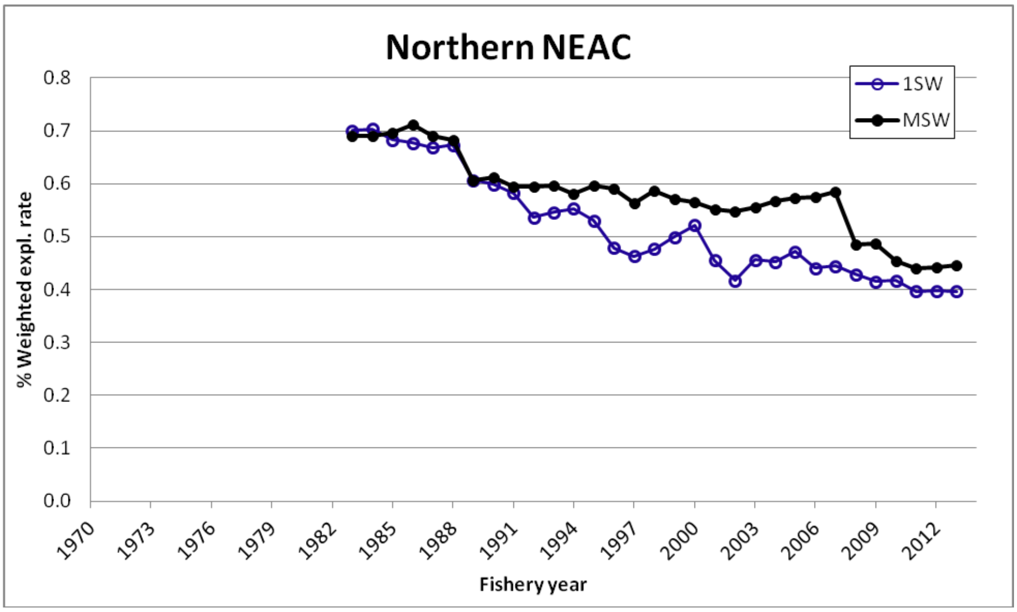


Figure 3.1.6.2. Percentage of 1SW salmon in the reported catch for southern NEAC countries, 1987–2013.



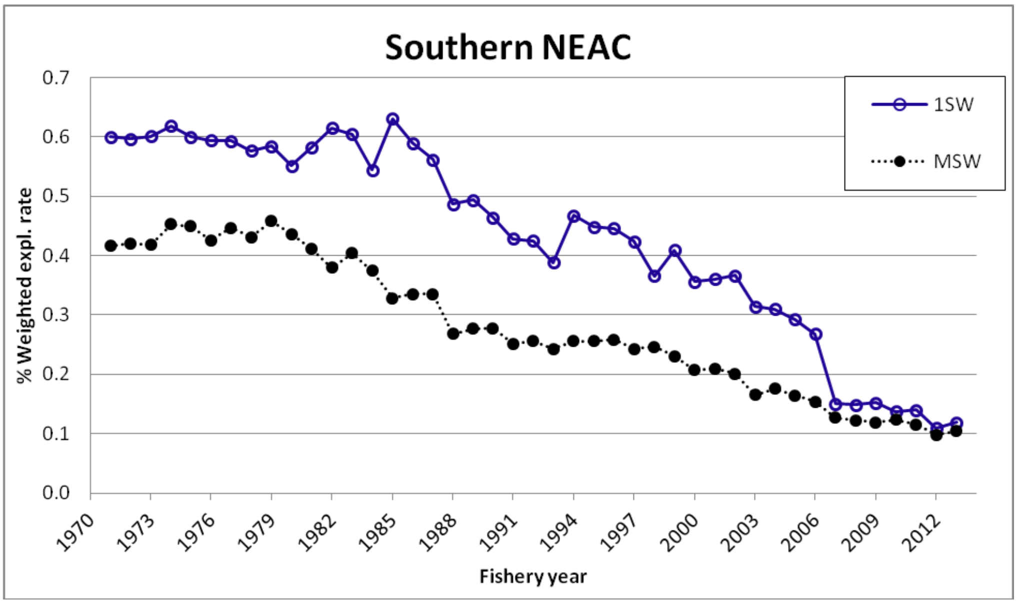


Figure 3.1.9.1. Mean annual exploitation rate of wild 1SW and MSW salmon by commercial and recreational fisheries in northern (above) and southern (bottom) NEAC countries from 1971 to 2013.

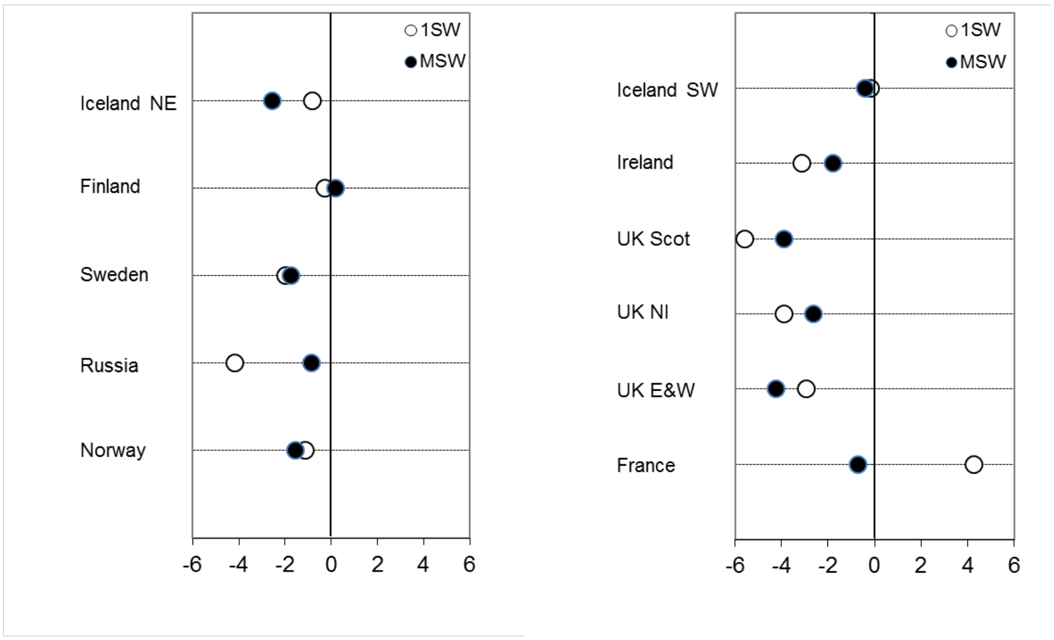


Figure 3.1.9.2. The rate of change of exploitation of 1SW and MSW salmon in northern NEAC (left) and southern NEAC (right) countries over the period 1971–2013, except for Norway (1983–2013).

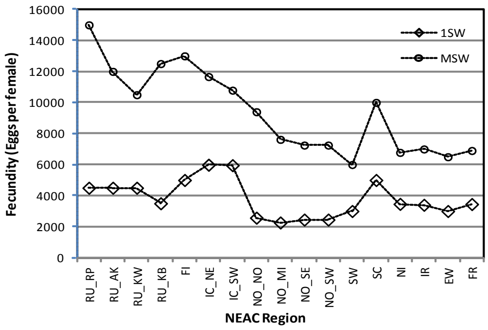


Figure 3.3.2.1 Estimates of the mid date of return to homewaters for 1SW and MSW stocks by countries/regions used in the NEAC PFA and NLC assessment model. (Region codes provided below.)

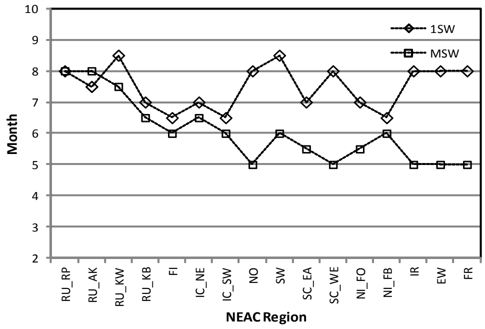


Figure 3.3.2.2 Estimates of proportion of female fish for 1SW and MSW stocks by countries/regions used in the NEAC PFA and NLC assessment model. (Region codes provided below.)

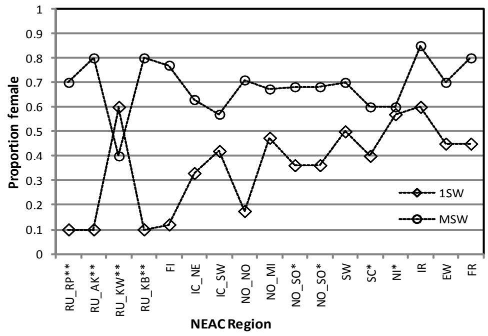


Figure 3.3.2.3 Estimates of fecundity of female fish for 1SW and MSW stocks by countries/regions used in the NEAC PFA and NLC assessment model.(Region codes provided below.)

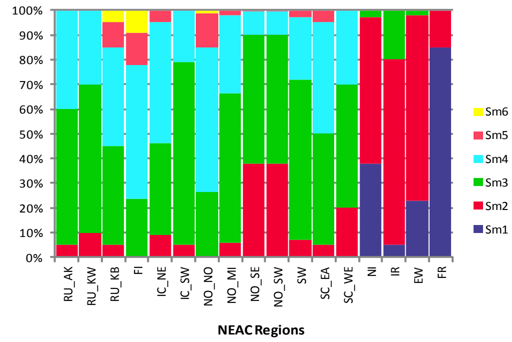


Figure 3.3.2.4 Estimates of the smolt age composition by countries/regions used in the NEAC PFA and NLC assessment model. (Region codes provided below.)

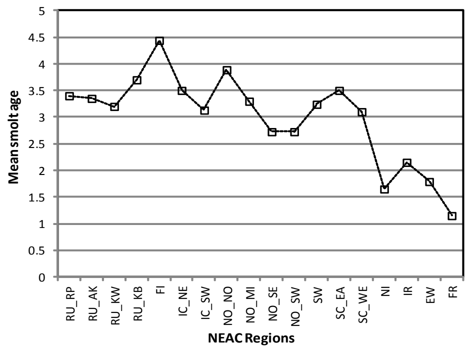


Figure 3.3.2.5 Estimates of the mean smolt age by countries/regions calculted from the smolt age compositions used in the NEAC PFA and NLC assessment model. (Region codes provided below.)

Country & Region codes:

EW - UK(England & Wales)
FI - Finland
FR - France
IC - Iceland
IR - Ireland
NI - UK(Northern Ireland)
NO - Norway (NO - North, MI - Mid, SE - Southeast (SE), Southwest (SW))
RU - Russia (RP - Pechora River, KB - Kola-Barent Sea, KW - Kola-While Sea, AK - Archangelsk
SC - UK(Scotland)
SW - Sweden

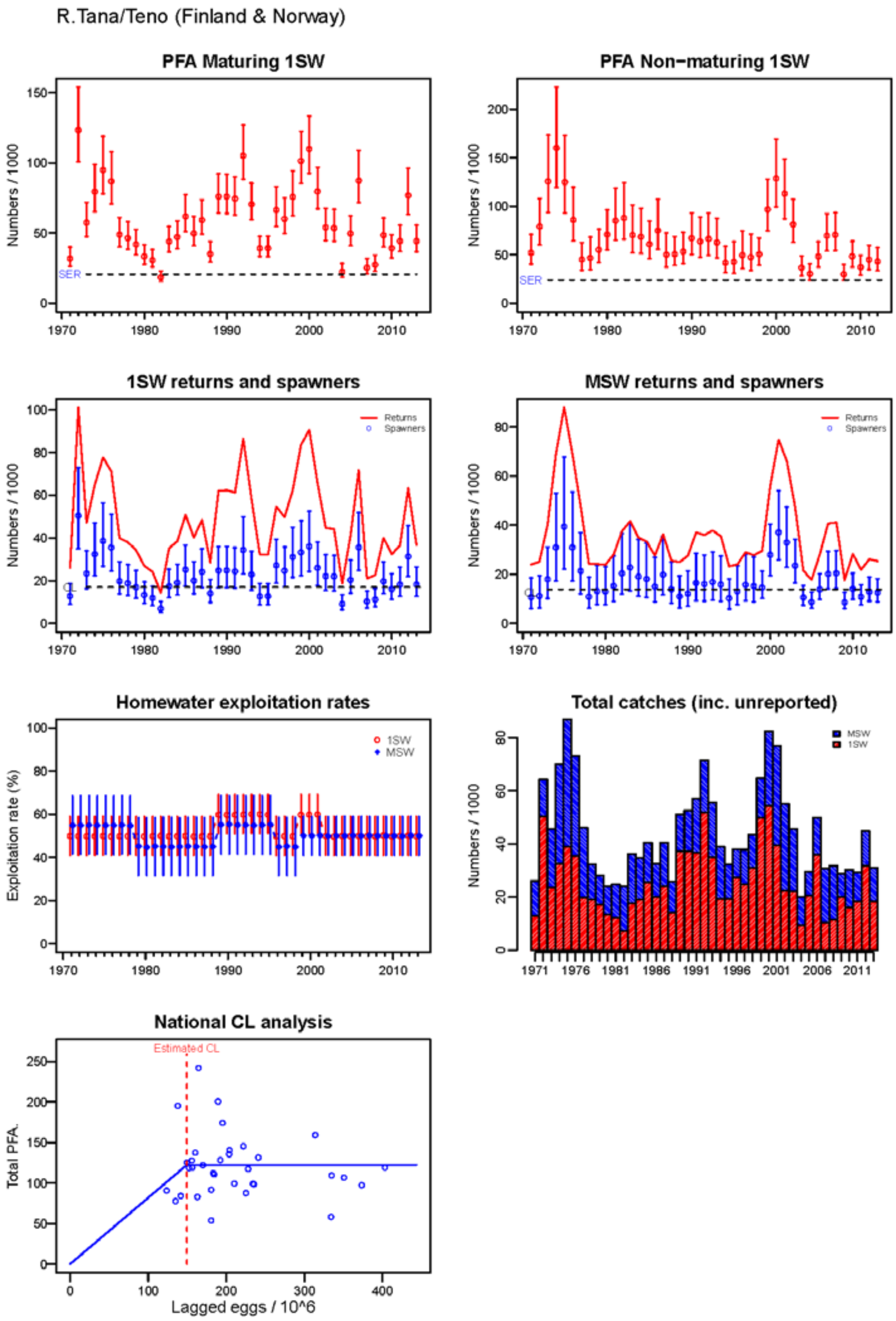


Figure 3.3.4.1a. Summary of fisheries and stock description, River Teno / Tana (Finland and Norway combined).

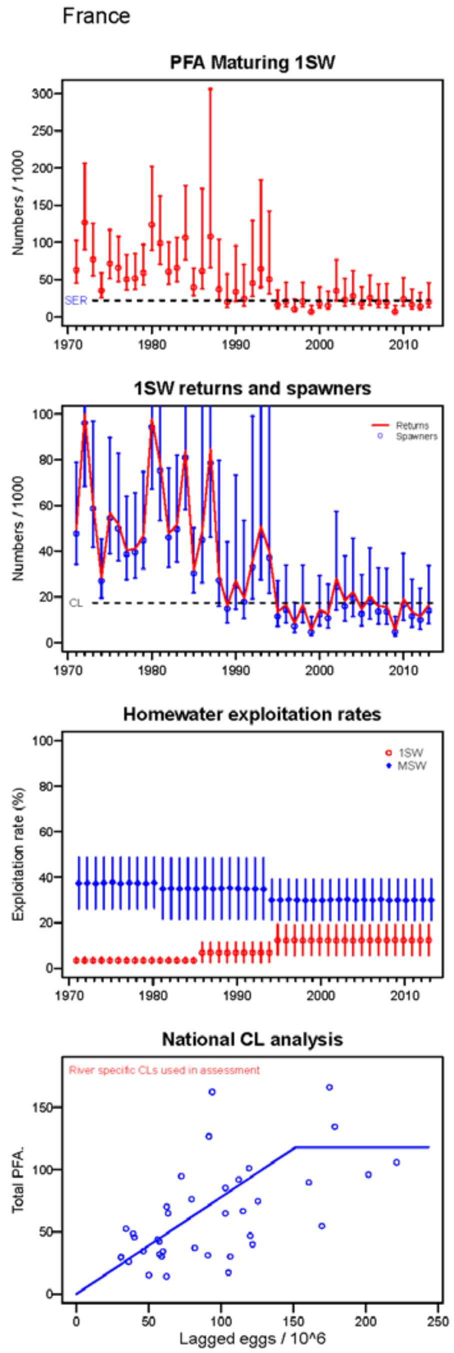


Figure 3.3.4.1b. Summary of fisheries and stock description, France. The national CL analysis is shown for information only. A river-specific CL is used for assessment.

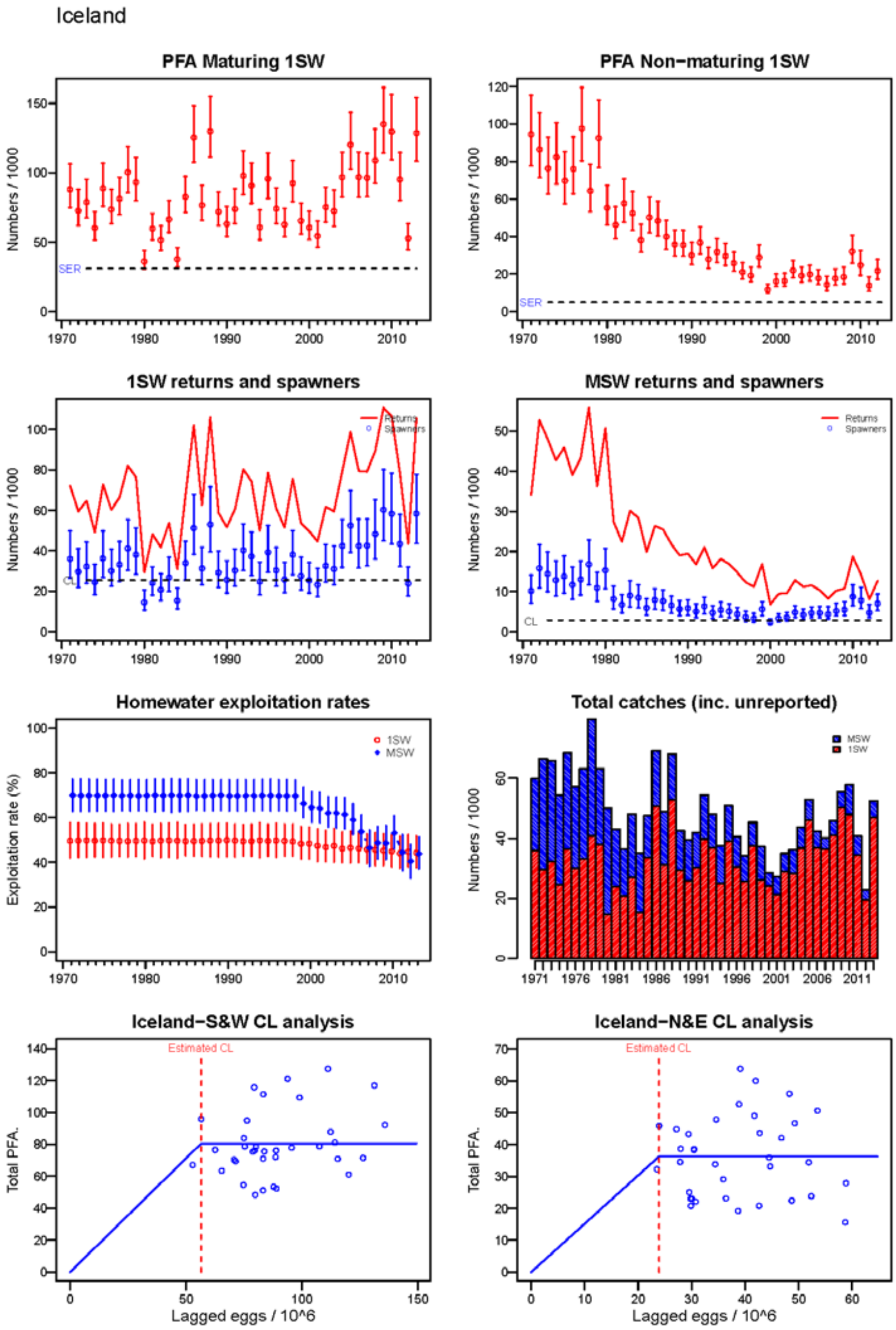


Figure 3.3.4.1c. Summary of fisheries and stock description, Iceland.

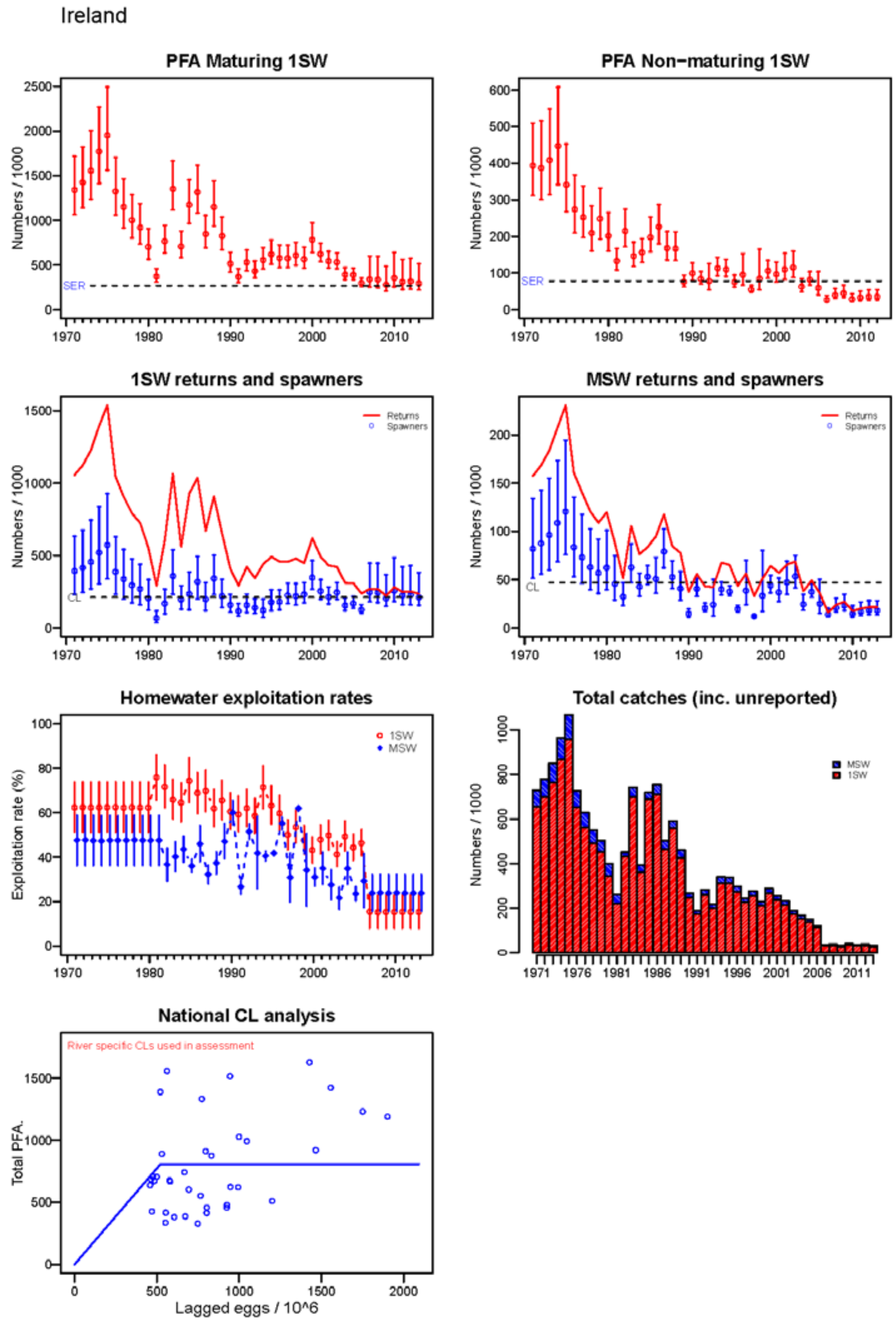


Figure 3.3.4.1d. Summary of fisheries and stock description, Ireland. The national CL analysis is shown for information only. A river-specific CL is used for assessment.

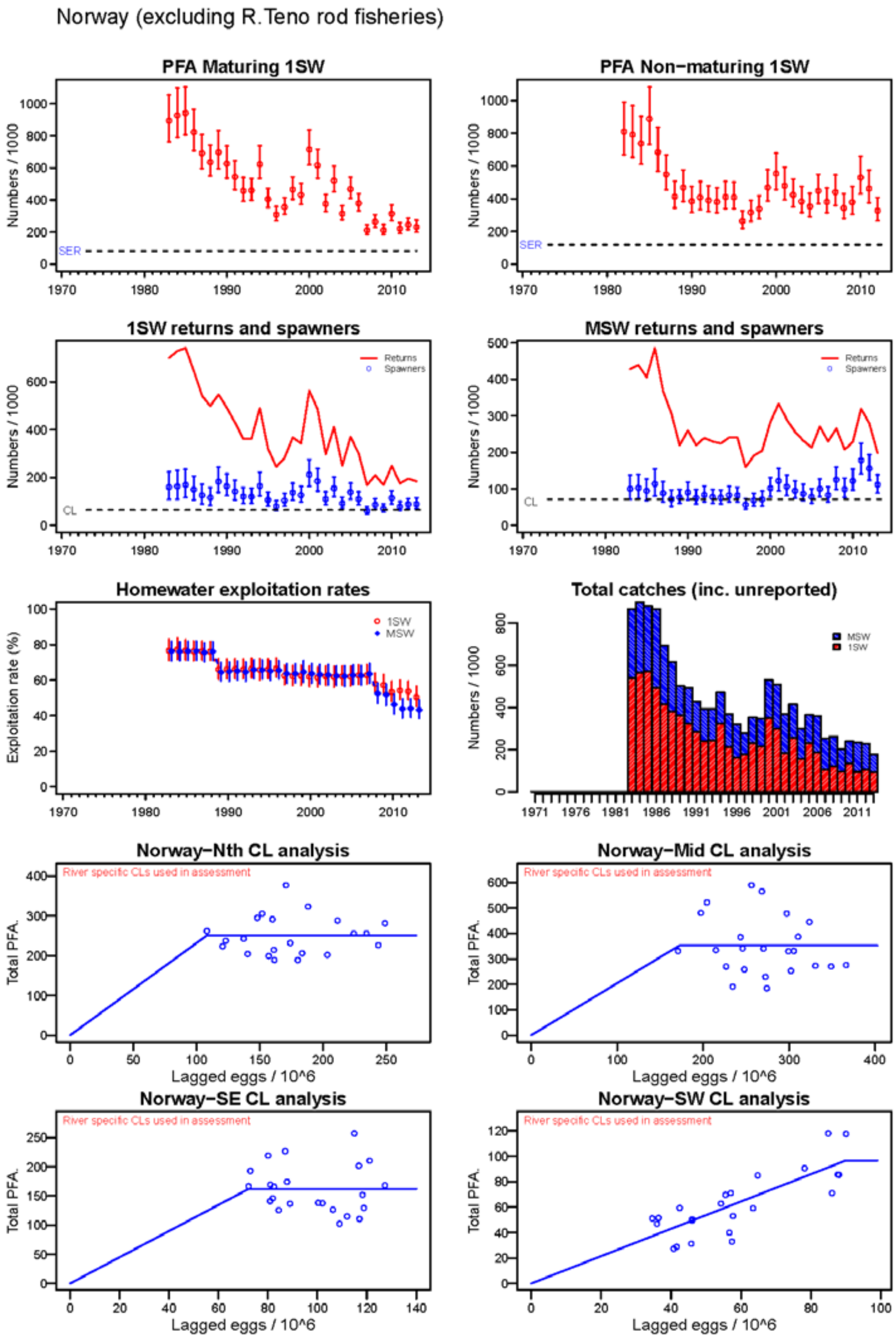


Figure 3.3.4.1e. Summary of fisheries and stock description, Norway (minus Norwegian catches from the R. Teno / Tana). The national CL analysis is shown for information only. A river-specific CL is used for assessment.

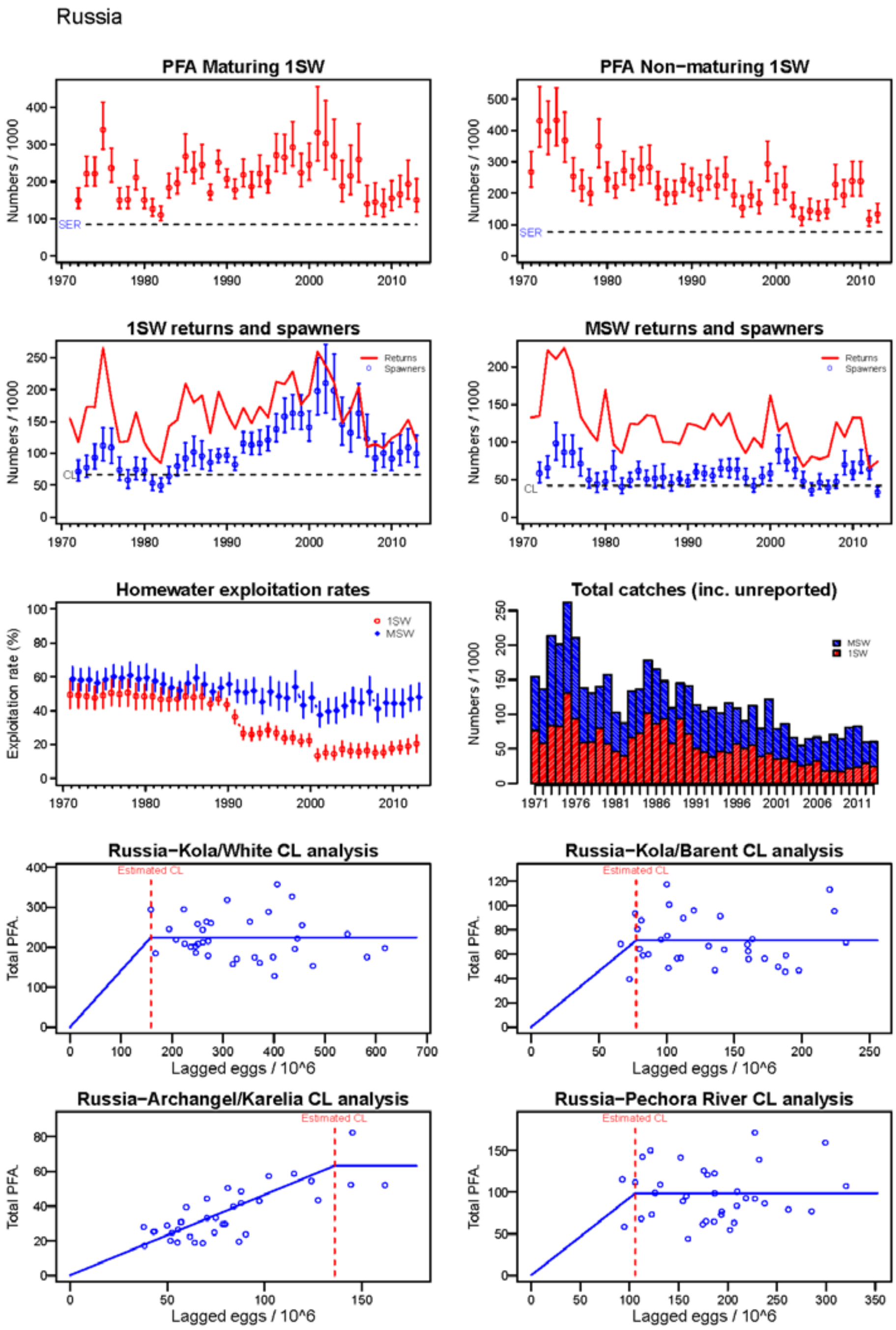


Figure 3.3.4.1f. Summary of fisheries and stock description, Russia.

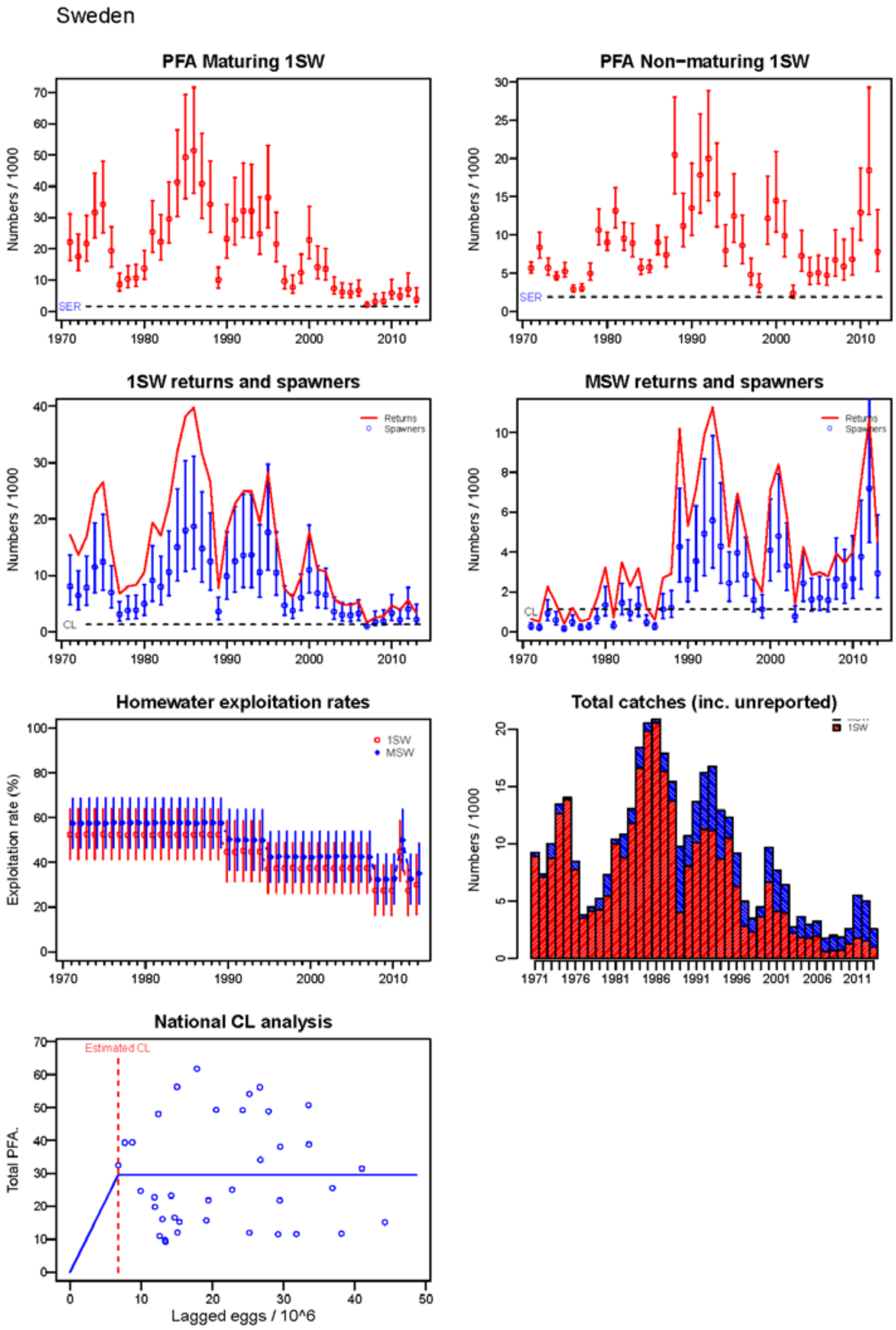


Figure 3.3.4.1g. Summary of fisheries and stock description, Sweden.

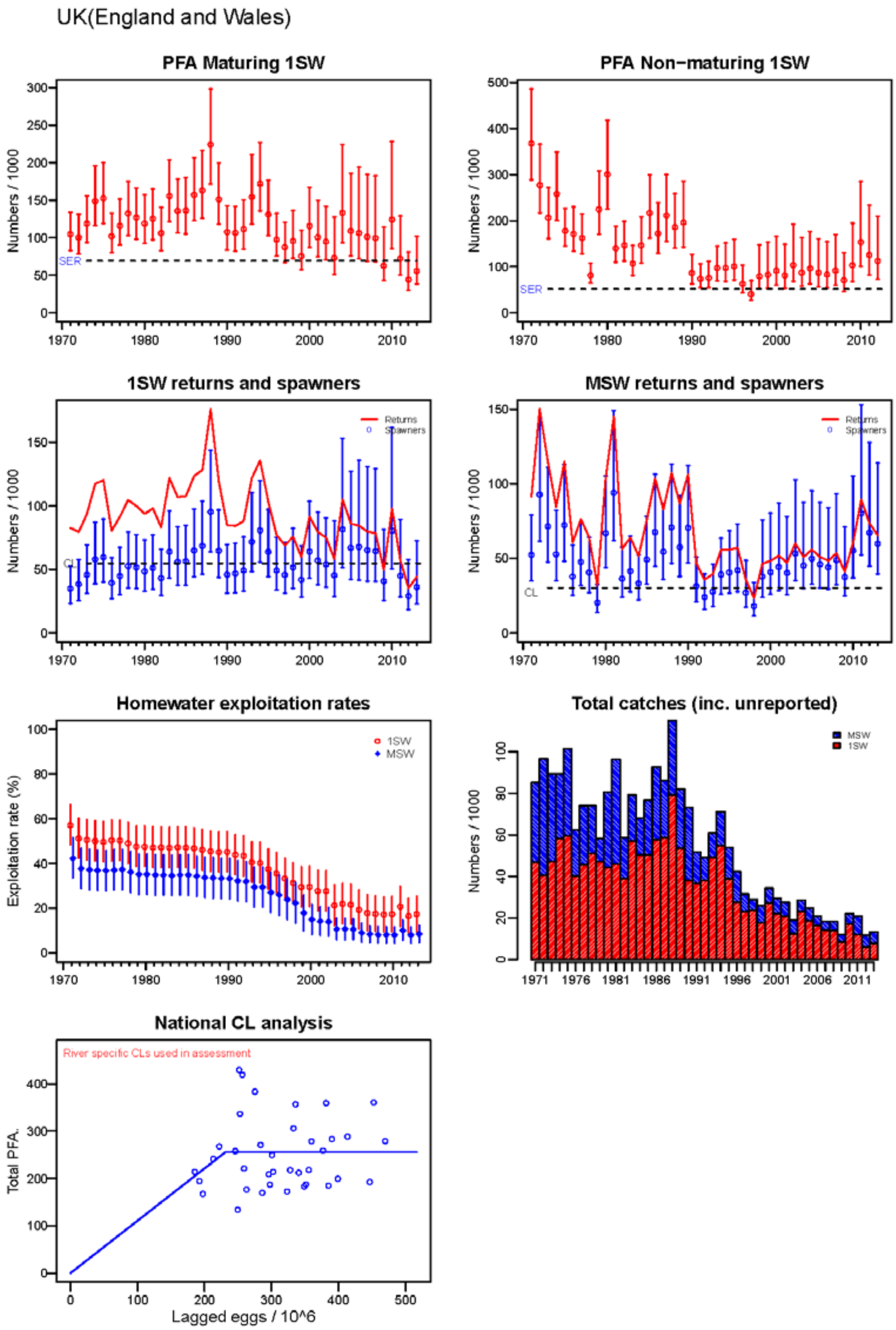


Figure 3.3.4.1h. Summary of fisheries and stock description, UK (England and Wales). The national CL analysis is shown for information only. A river-specific CL is used for assessment.

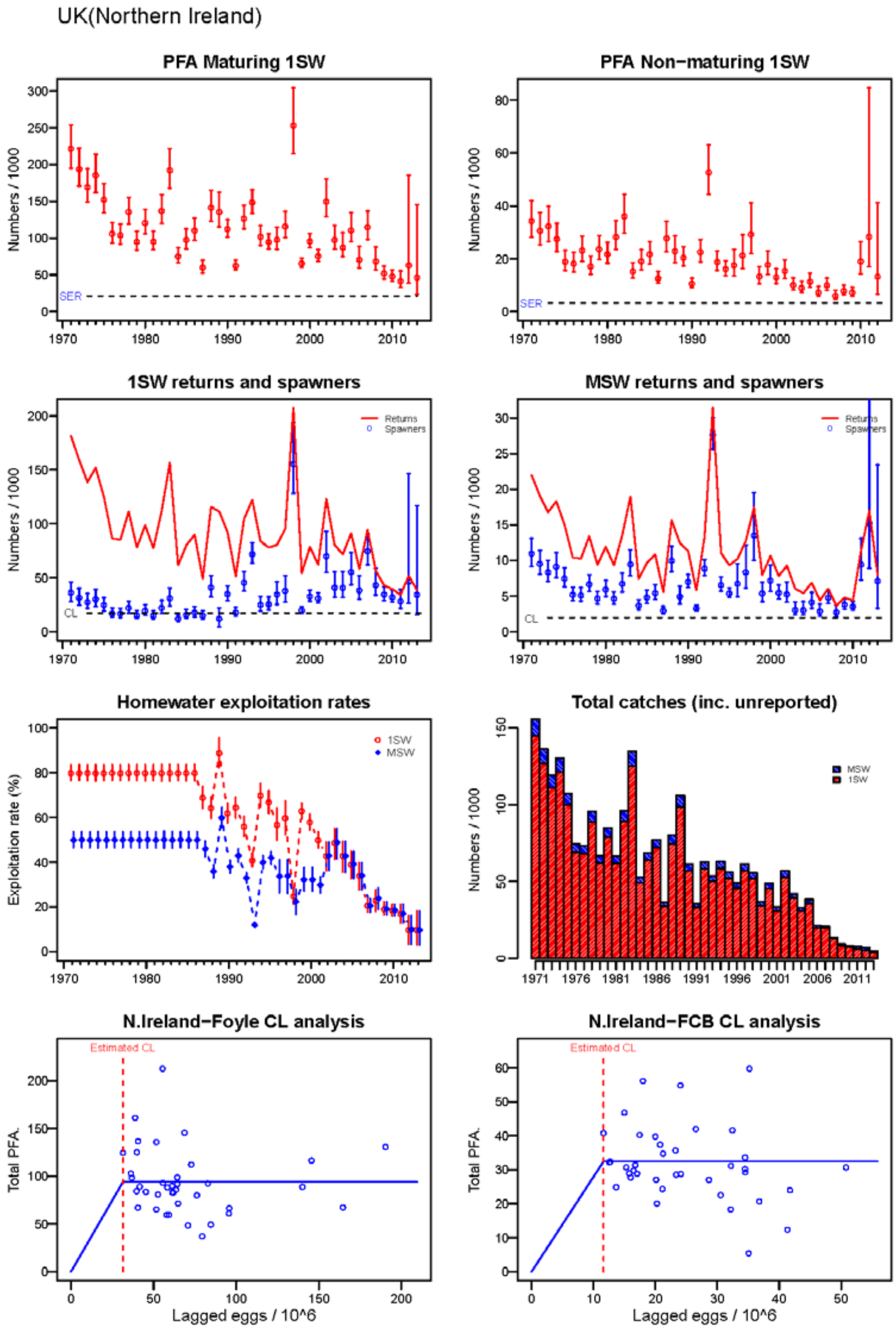


Figure 3.3.4.1i. Summary of fisheries and stock description, UK (Northern Ireland).

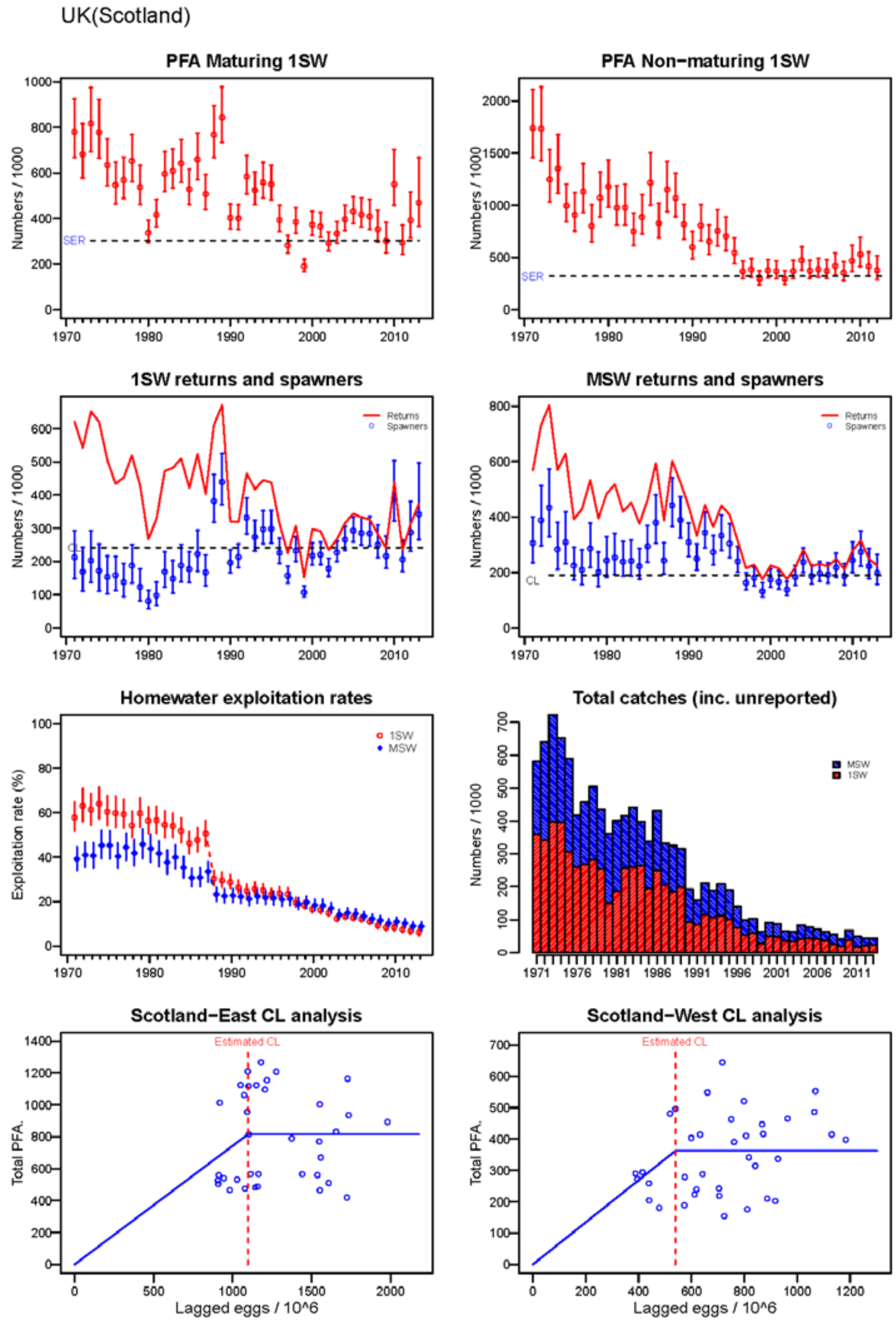


Figure 3.3.4.1j. Summary of fisheries and stock description, UK (Scotland).

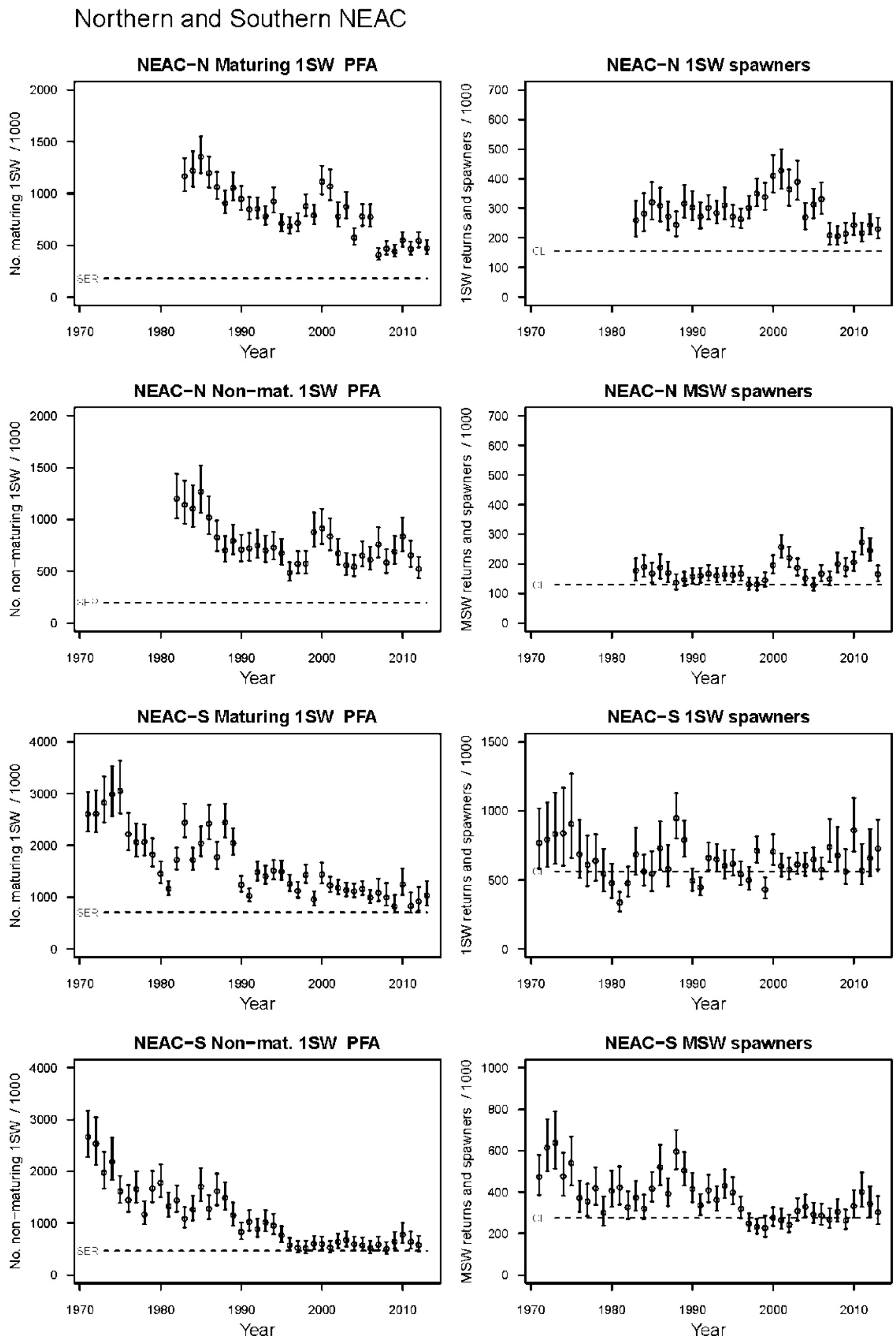


Figure 3.3.4.2. Estimated PFA (left panels) and spawning escapement (right panels) with 90% confidence limits, for maturing 1SW (1SW spawners) and non-maturing 1SW (MSW spawners) salmon in northern (NEAC – N) and southern (NEAC – S) NEAC stock complexes.

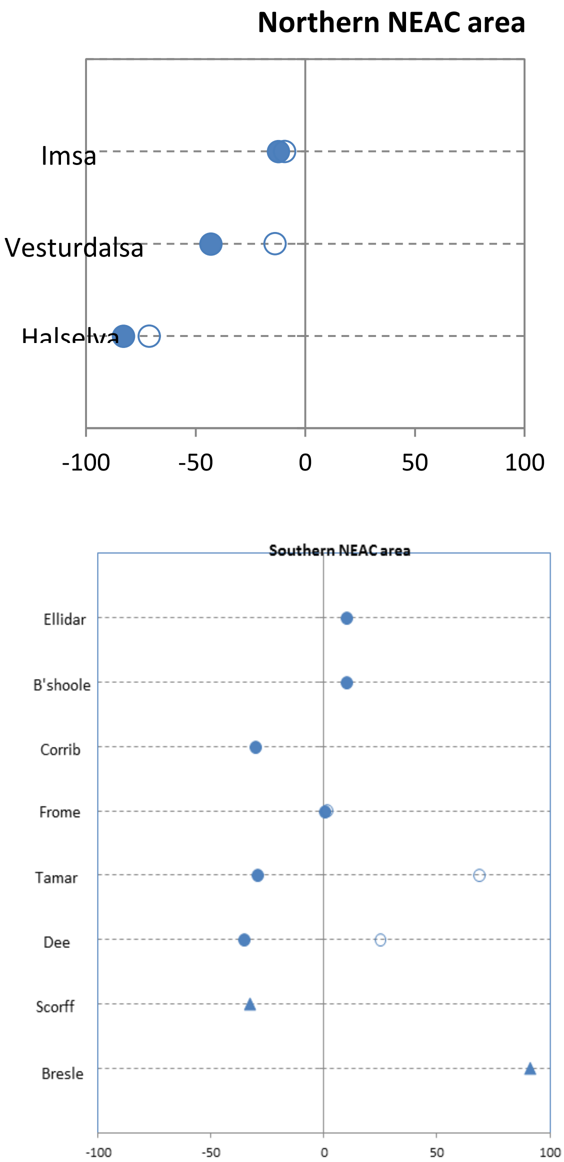


Figure 3.3.6.1. Comparison of the percent change in the five-year mean return rates for 1SW and 2SW wild salmon smolts to rivers of northern (left) and southern NEAC (right) areas for the 2003 to 2007 and 2008 to 2012 smolt years (2002 to 2006 and 2007 to 2011 for 2SW salmon). Filled circles are for 1SW and open circles are for 2SW dataseries. Triangles indicate all ages without separation into 1SW and 2SW smolts. Populations with at least three datapoints in each of the two time periods are included in the analysis. The scale of change in some rivers is influenced by low return numbers, where a few fish more or less returning may have a significant impact on the percent change.

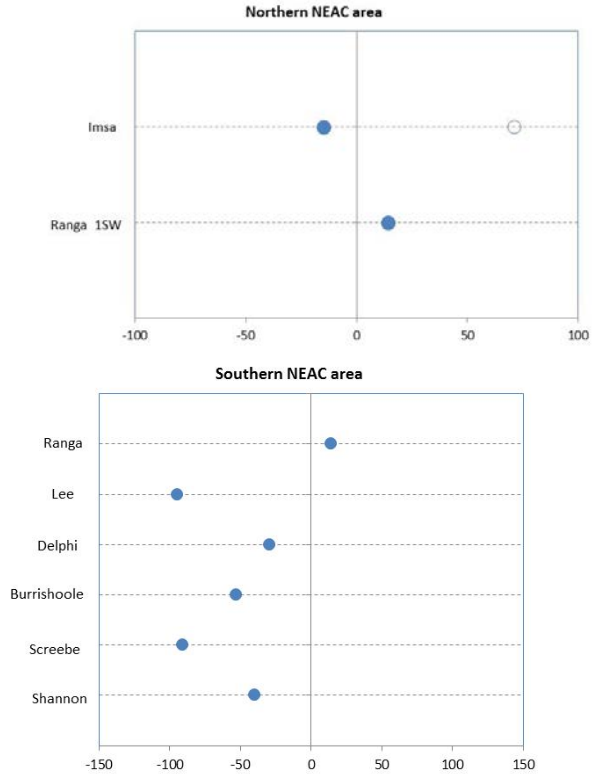


Figure 3.3.6.2. Comparison of the percent change in the five-year mean return rates for 1SW and 2SW hatchery salmon smolts to rivers of northern (upper) and southern NEAC (lower) areas for the 2003 to 2007 and 2008 to 2012 smolt years (2002 to 2006 and 2007 to 2011 for 2SW salmon). Filled circles are for 1SW and open circles are for 2SW dataseries. Triangles indicate all ages without separation into 1SW and 2SW smolts. Populations with at least three datapoints in each of the two time periods are included in the analysis. The scale of change in some rivers is influenced by low return numbers, where a few fish more or less returning may have a significant impact on the percent change.

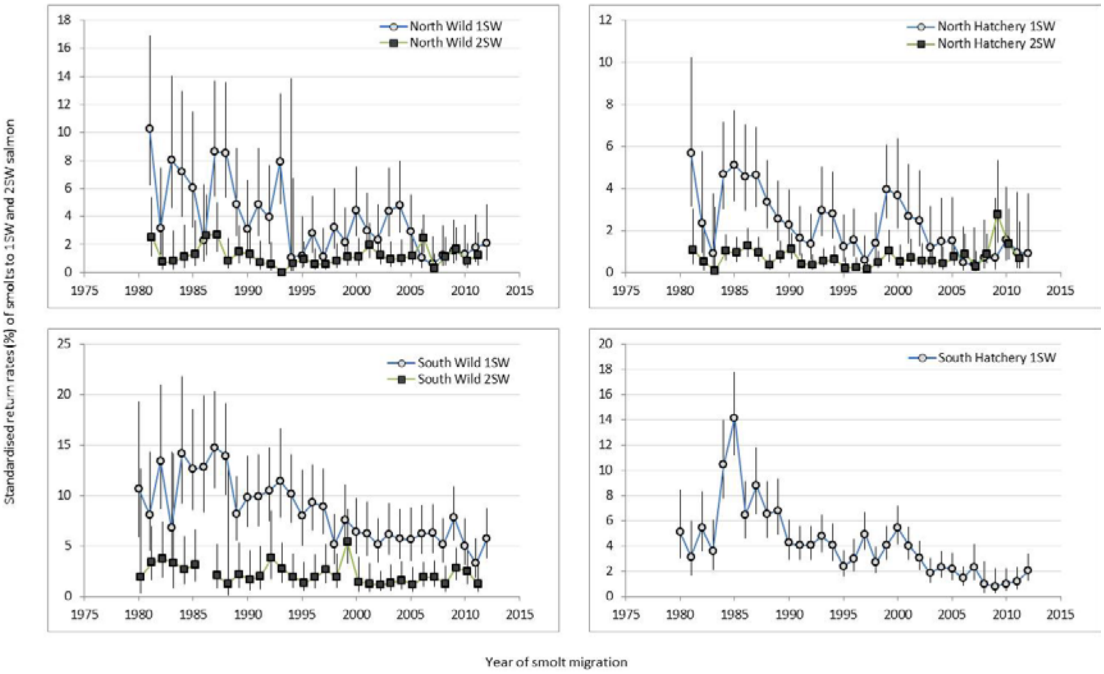


Figure 3.3.6.3. Standardised mean annual survival indices (%) of wild (left hand panels) and hatchery origin (right hand panels) smolts to 1SW and 2SW salmon to northern (top panels) and southern areas (bottom panels). The standardised values are annual means derived from a general linear model analysis of rivers in a region with a quasi-poisson distribution, hence a loglink function. Error values are 95%cls. Note y-scale differences among panels.

Following details in Tables 3.3.6.1 and 3.3.6.2 the analyses included estimated survival (%) to 1SW and 2SW returns by smolt year with: Wild returns to: northern rivers (Vesturdalsa, Halselva and Imsa) and southern rivers (Ellidaar, Corrib, Burrishoole, North Esk, Bush, Dee, Tamar and Frome). Hatchery returns to: Northern rivers (Halselva, Imsa, Drammen and Lagan) and Southern rivers (Ranga, Shannon, Screebe, Burrishoole, Delphi-Burrishoole, Delphi, Bunowen, Lee, Corrib-Cong, Corrib-Galway, Erne, Bush 1+smolts and Bush 2+smolts).

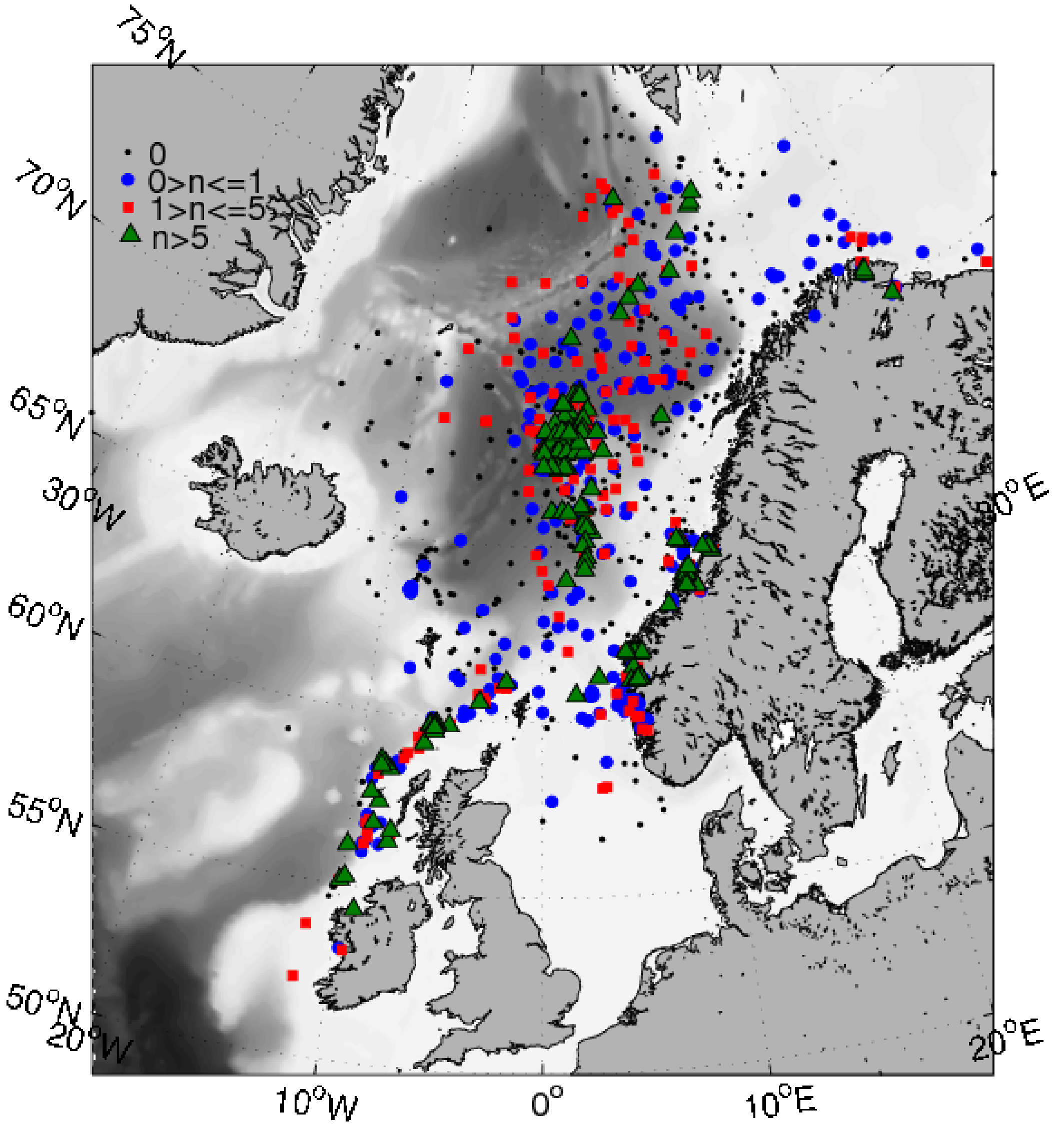


Figure 3.4.1. Distribution of Atlantic salmon post-smolts (number per hour of trawling). Data from the SALSEA-Merge project and earlier research cruises. Data are aggregated over a number of years from 1994 on, with the majority of fish being caught in the period May to August.

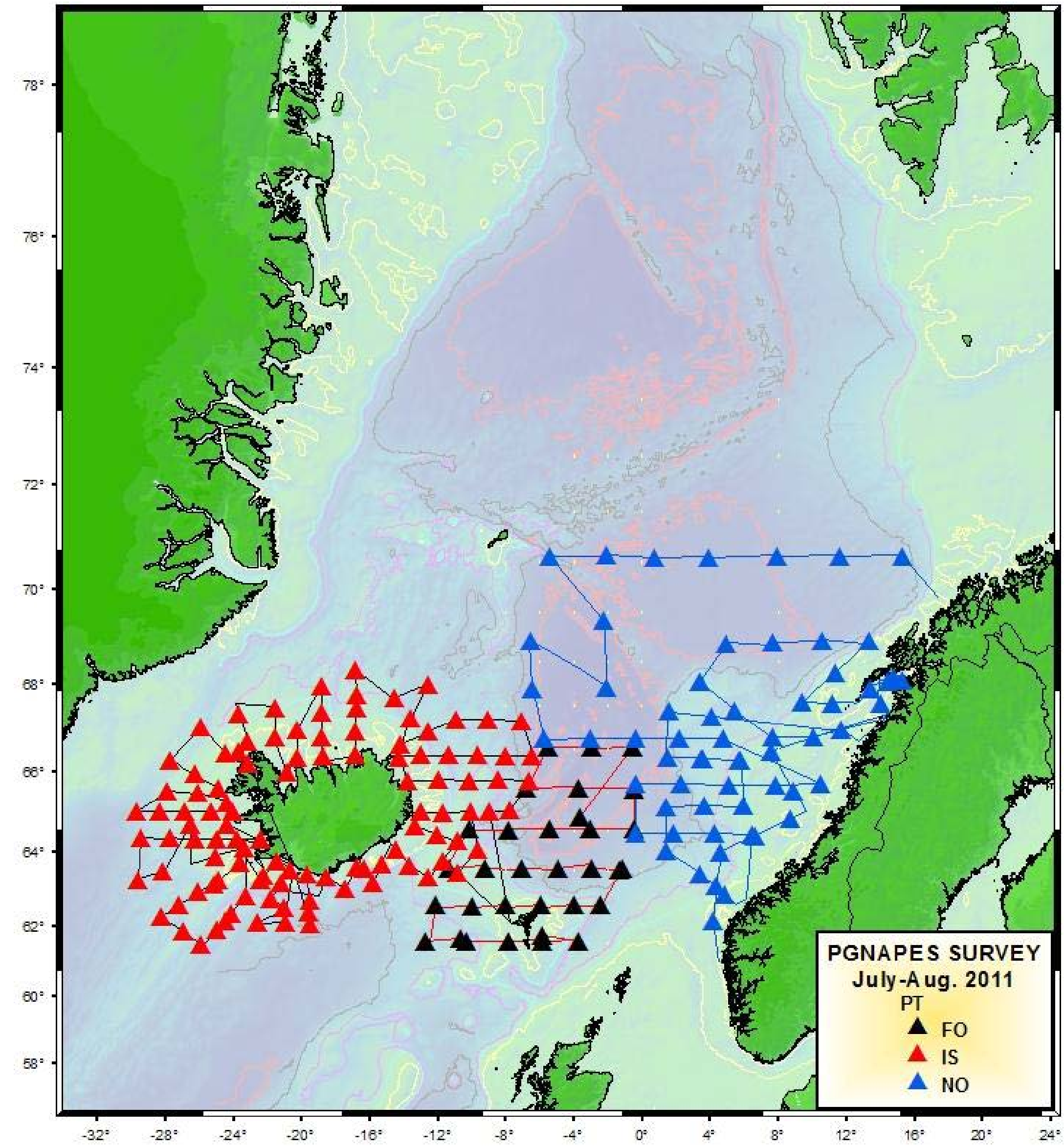


Figure 3.4.2. Cruise tracks and pelagic trawl stations shown for M/V "Libas" (Norway) in blue, M/V "Finnur Fridi" (Faroe Islands) in black RV "Arni Fridriksson" (Iceland) in red within the covered areas of the Norwegian Sea and surrounding waters from 18 July to 31 August 2011.

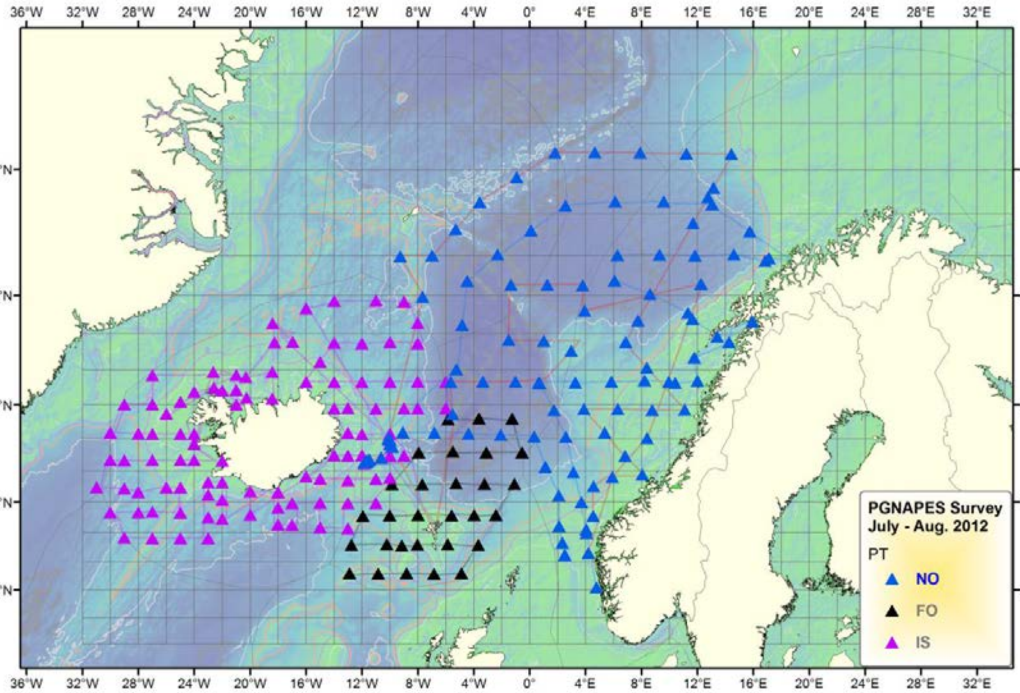


Figure 3.4.3. Cruise tracks and pelagic trawl stations shown for RV "G. O. Sars" in green, M/V "Brennholm" (Norway) in blue, M/V "Christian í Grótinum"" (Faroe Islands) in black RV "Arni Fridriksson" (Iceland) in red within the covered areas of the Norwegian Sea and surrounding waters from 2nd of July to 10th of August 2012.

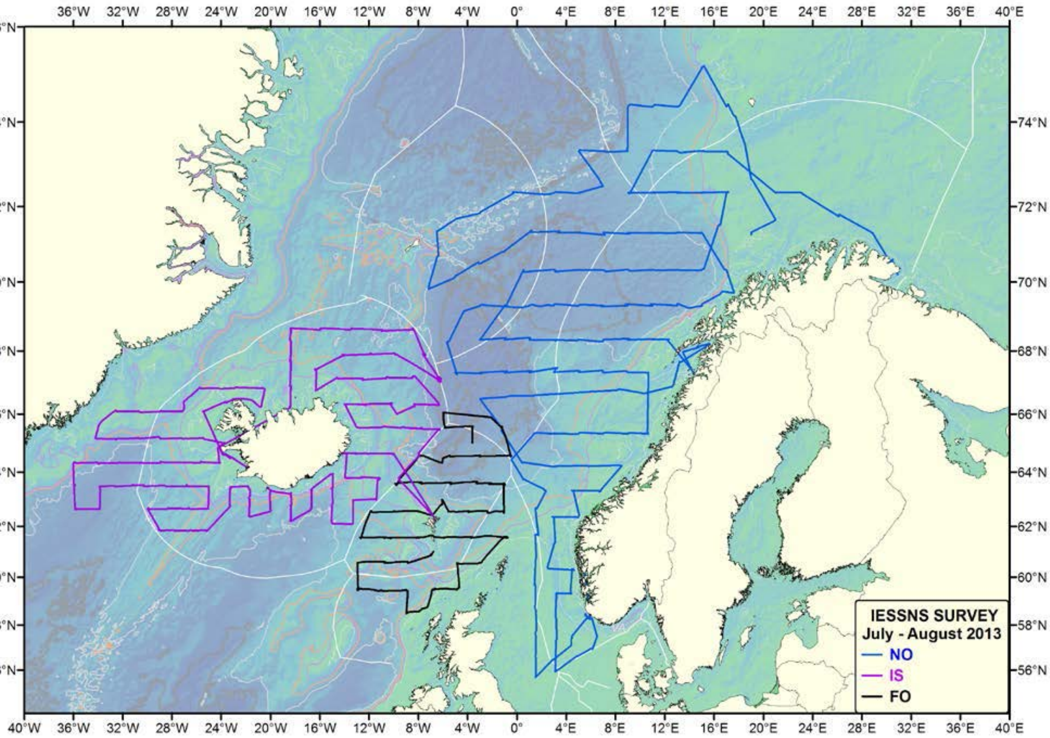


Figure 3.4.4. Cruise tracks and pelagic trawl stations shown for M/V "Libas" and "Eros" (Norway) in blue, M/V "Finnur Friði" (Faroe Islands) in black and RV "Arni Fridriksson" (Iceland) in red within the covered areas of the Norwegian Sea and surrounding waters from 2nd of July to 9th of August 2013.

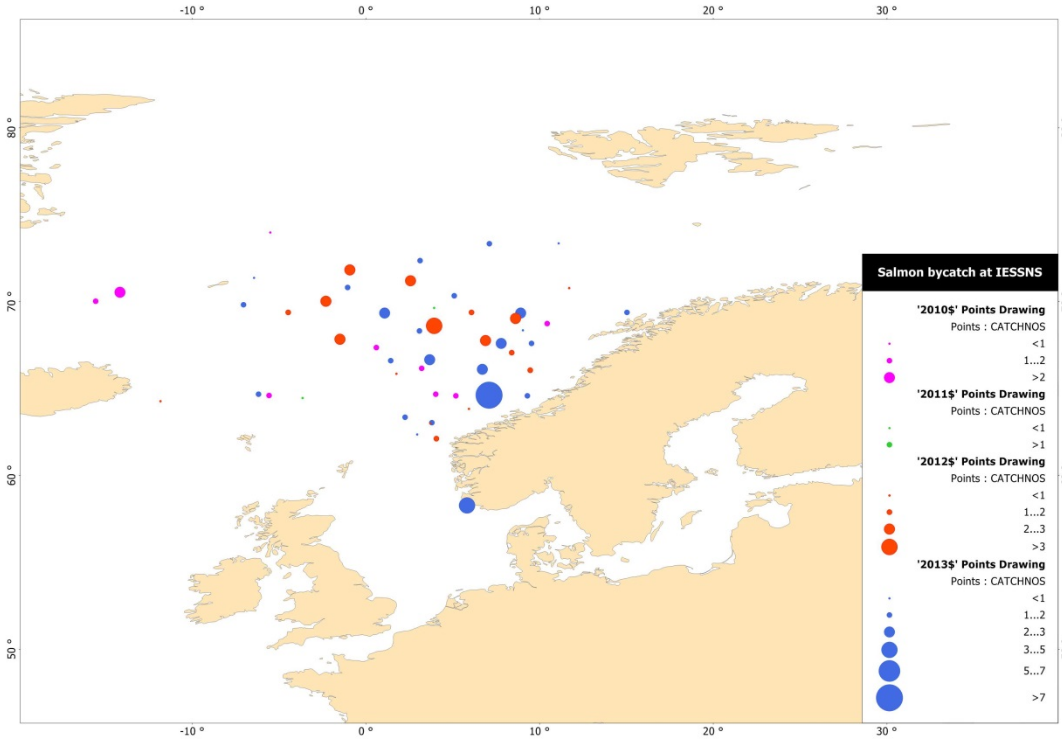


Figure 3.4.5. Salmon bycatch in the IESSNS surveys 2010–2013. The size of the bubbles show the number of salmon caught and the colour of the bubbles are coded by year, see legend on map.

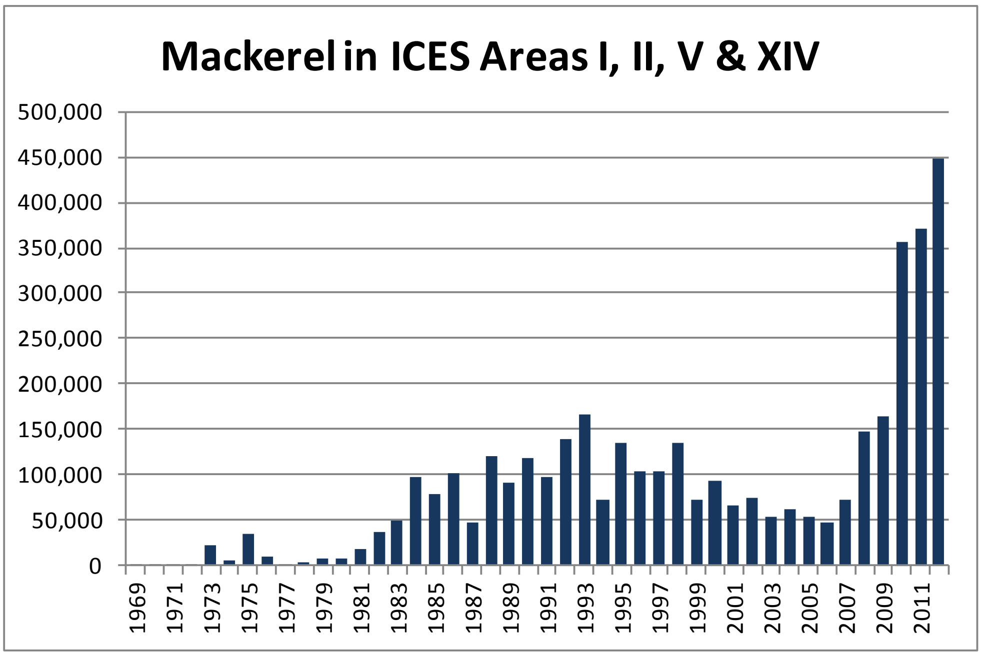


Figure 3.4.6. Reported mackerel catches (t) in ICES Areas I, II, V and XIV, 1969–2012 (from ICES 2013b).

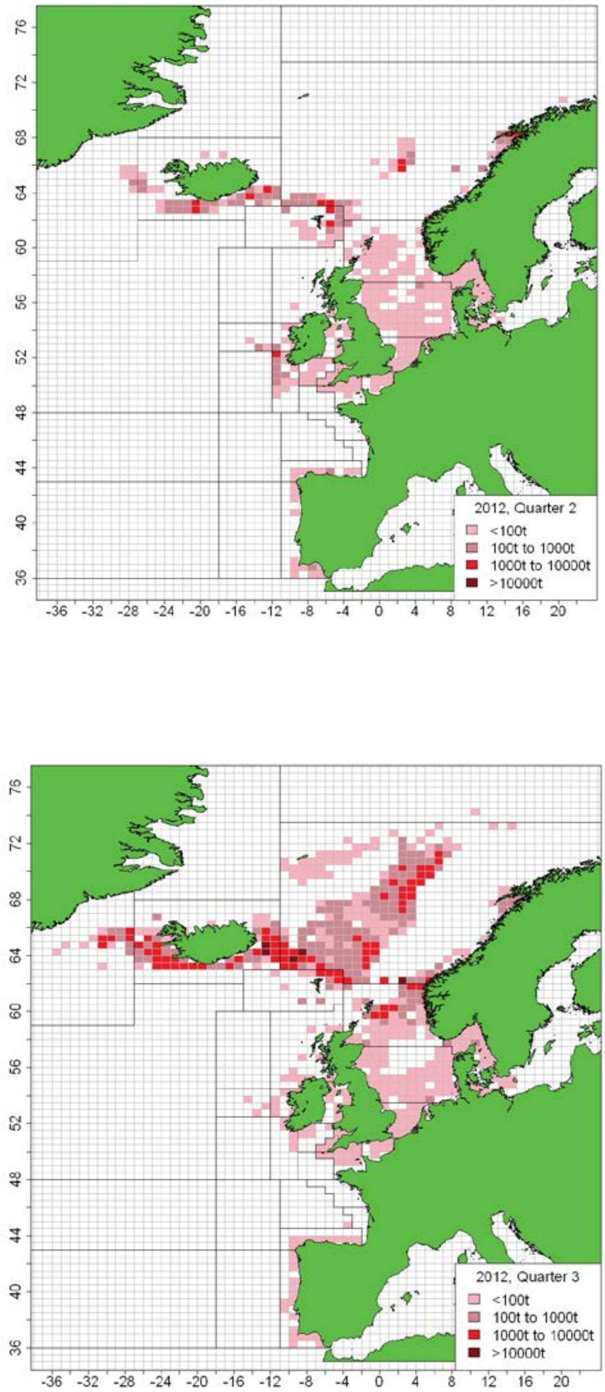


Figure 3.4.7. Distribution of mackerel catches in the NE Atlantic for 2012 for quarter 2 (upper panel) and quarter 3 (lower panel) (figures from ICES, 2013b).

4 North American commission

The previous advice provided by ICES (2012a) indicated that there were no mixed-stock fishery catch options on the 1SW non-maturing salmon component for the 2012 to 2014 PFA years. The NASCO Framework of Indicators of North American stocks for 2013 did not indicate the need for a revised analysis of catch options and no new management advice for 2014 is provided. The assessment was updated to 2013 and the stock status is consistent with the previous years' assessments and catch advice.

4.1 NASCO has requested ICES to describe the key events of the 2013 fisheries

4.1.1 Key events of the 2013 fisheries

- There were no new significant events reported for 2013 in the NAC area.
- The majority of harvest fisheries were directed to small salmon.
- The 2013 provisional harvest in Canada was 136.7 t, comprised of 45 435 small salmon and 12 969 large salmon, 6% more small salmon and 18% more large salmon compared to 2012.
- Overall, catches remain very low relative to pre-1990 values, although the catch in Saint Pierre and Miquelon in 2013 (5.3 t) was the highest in the time-series (since 1990).

4.1.2 Gear and effort

Canada

The 23 areas for which the Department of Fisheries and Oceans (DFO) manages the salmon fisheries are called Salmon Fishing Areas (SFAs); for Québec, the management is delegated to the province of Québec (Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs) and the fishing areas are designated by Q1 through Q11 (Figure 4.1.2.1). Harvests (fish which were retained) and catches (including harvests and fish caught–and–released in recreational fisheries) are categorized in two size groups: small and large. Small salmon, generally 1SW, in the recreational fisheries refer to salmon less than 63 cm fork length, whereas in commercial fisheries, it refers to salmon less than 2.7 kg whole weight. Large salmon, generally MSW, in recreational fisheries are greater than or equal to 63 cm fork length and in commercial fisheries refer to salmon greater than or equal to 2.7 kg whole weight.

Three groups exploited salmon in Canada in 2013; Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. There were no commercial fisheries in Canada in 2013. There is no legal bycatch of salmon in commercial fisheries directing for other species and there are no estimates of the extent of the bycatch and the associated mortality of salmon from these fisheries, although previous analyses by ICES indicated the extent of the mortality was low (ICES, 2004b).

In 2013, four subsistence fisheries harvested salmon in Labrador: 1) Nunatsiavut Government (NG) members fishing in the northern Labrador communities of Rigolet, Makkovik, Hopedale, Postville, and Nain and in Lake Melville; 2) Innu Nation members fishing in Natuashish and in Lake Melville from the community of Sheshatshiu; 3) NunatuKavut Community Council (NCC) members fishing in southern Labrador from Fish Cove Point to Cape St Charles and, 4) Labrador residents fishing in Lake

Melville and various coastal communities. The NG, Innu, and NCC fisheries were monitored by Aboriginal Fishery Guardians jointly administered by the Aboriginal groups and the DFO, as well as, by DFO Fishery Officers and Guardian staff. The Nunatsiavut Government is directly responsible through the Torngat Fisheries Board for regulating its fishery through its Conservation Officers. The fishing gear is multi-filament gillnets of 15 fathoms (27.4 m) in length of a stretched mesh size ranging from 3 to 4 inches (7.6 to 10.2 cm). Although nets are mainly set in estuarine waters some nets are also set in coastal areas usually within bays. Catch statistics are based on logbook reports.

Most catches (93% in 2013, Figure 2.1.1.2) in Canada now take place in rivers or in estuaries. Fisheries are principally managed on a river-by-river basis in areas where retention of large salmon in recreational fisheries is allowed, and are closely controlled. In other areas, fisheries are managed on larger management units that encompass a collection of geographically neighbouring stocks. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located in bays generally inside the headlands. Sampling of this fishery occurred again in 2013 for biological characteristics and for tissue samples for the purpose of using genetic markers to identify the origin of harvested salmon.

The following management measures were in effect in 2013.

Aboriginal peoples' food, social, and ceremonial (FSC) fisheries

In Québec, Aboriginal peoples' fisheries took place subject to agreements, conventions or through permits issued to the communities. There are approximately ten communities with subsistence fisheries in addition to the fishing activities of the Inuit in Ungava (Q11), who fished in estuaries or within rivers. The permits generally stipulate gear, season, and catch limits. Catches with permits have to be reported collectively by each Aboriginal user group. However, catches under a convention, such as for Inuit in Ungava, do not have to be reported. When reports are not available, the catches are estimated based on the most reliable information available. In the Maritimes (SFAs 15 to 23), FSC agreements were signed with several Aboriginal peoples' groups (mostly First Nations) in 2013. The signed agreements often included allocations of small and large salmon and the area of fishing was usually in-river or estuaries. Harvests that occurred both within and outside agreements were obtained directly from the Aboriginal peoples. In Labrador (SFAs 1 and 2), fishery arrangements with the Nunatsiavut Government, the Innu First Nation, and the NCC, resulted in fisheries in estuaries and coastal areas. By agreement with First Nations, there were no FSC fisheries for salmon on the island of Newfoundland in 2013. Harvest by Aboriginal peoples with recreational licences is reported under the recreational harvest categories.

Resident food fisheries in Labrador

The DFO is responsible for regulating the Resident Fishery. In 2013, a licensed subsistence trout and charr fishery for local residents took place, using gillnets, in Lake Melville (SFA 1) and in estuary and coastal areas of Labrador (SFA 1 and 2). Residents who requested a licence were permitted to retain a seasonal bycatch of three salmon of any size while fishing for trout and charr; three salmon tags accompanied each licence. When the bycatch of three salmon was caught the resident fishers were required to remove their net from the water. If bycatch during a single gillnet set exceeded three salmon, resident fishers were required to discard the excess fish. All licensees were requested to complete logbooks.

Recreational fisheries

Licences are required for all persons fishing recreationally for Atlantic salmon. Gear is restricted to fly fishing and there are daily and seasonal bag limits. Recreational fisheries management in 2013 varied by area and large portions of the southern areas remained closed to all directed salmon fisheries (Figure 4.1.2.2). Except for 42 rivers in Québec, only small salmon could be retained in the recreational fisheries.

Until 2011, recreational salmon anglers on PEI had to first obtain a trout angling licence, and then purchase a salmon licence. Beginning in 2012, separate salmon licences were no longer issued, and the provincial angling licence confers recreational fishing access to Atlantic salmon (catch and release fishing only, no retention).

In all areas of eastern Canada, there is no estimate of salmon released as bycatch in non-salmon directed recreational fisheries.

USA

There were no recreational or commercial fisheries for anadromous Atlantic salmon in the USA in 2013.

France (Islands of Saint-Pierre et Miquelon)

Nine professional and 64 recreational gillnet licences were issued in 2013, an increase of four recreational licences from 2012 and the highest number of licences in the time-series (Table 4.1.2.1). Professional licences have a maximum authorization of three nets of 360 metres maximum length whereas the recreational licence is restricted to one net of 180 metres.

4.1.3 Catches in 2013

Canada

The provisional harvest of salmon in 2013 by all users was 136.2 t, about 8% higher than the 2012 harvest of 126 t (Table 2.1.1.2; Figure 4.1.3.1). This is the fourth lowest catch in the time-series since 1960. The 2013 harvest was 45 435 small salmon and 12 969 large salmon, 5% more small salmon and 18% more large salmon compared to 2012. There has been a dramatic decline in harvested tonnage since 1988, in large part the result of the reductions in commercial fisheries effort; the closure of the insular Newfoundland commercial fishery in 1992, the closure of the Labrador commercial fishery in 1998, and the closure of the Québec commercial fishery in 2000.

Aboriginal peoples' FSC fisheries

The total harvest by Aboriginal people in 2013 was 58.6 t (Table 4.1.3.1). Harvest (by weight) decreased by 2% from 2012. The reported catch in 2013 was the seventh highest value in the time-series and the proportion large by number (51%) was the highest in the last 15 years.

Residents fishing for food in Labrador

The estimated catch for the fishery in 2013 was 2.1 t, an increase from 1.7 t in 2012. This represents approximately 731 fish, 52% of which were large (Table 4.1.3.2). The proportion large was the highest in the time-series since 2000.

Recreational fisheries

Harvest in recreational fisheries in 2013 totalled 38 559 small and large salmon (75.4 t), increased 16.4% from the 2012 harvest level and decreased 13% from the previous five-year average, and remains at low levels similar to the previous decade (Table 4.1.3.3; Figure 4.1.3.2). The small salmon harvest of 35 627 fish was 17% above the 2012 harvest. The large salmon harvest of 2932 fish was 9% higher than the 2012 harvest and occurred only in Québec. The small salmon size group has contributed 89% on average of the total recreational harvests since the imposition of catch-and-release recreational fisheries in the Maritimes and insular Newfoundland (SFA 3 to 14B, 15 to 23) in 1984. In 2013, approximately 59 200 salmon (about 33 500 small and 25 700 large) were caught and released (Table 4.1.3.4), representing about 61% of the total number caught (including retained fish).

Recreational catch statistics for Atlantic salmon are not collected regularly in all areas of Canada and there is no enforceable mechanism in place that requires anglers to report their catch statistics, except in Québec where reporting is a legal requirement. The last recreational angler survey for New Brunswick was conducted in 1997 and the catch rates for the Miramichi from that survey have been used to estimate catches (both harvest and catch-and-release) for all subsequent years; no estimates of release of salmon kelts 2011–2013 are provided. The reliability of recreational catch statistics could be improved in all areas of Canada.

Commercial fisheries

All commercial fisheries for Atlantic salmon remained closed in Canada in 2012 and the catch therefore was zero.

Unreported catches

The unreported catch estimate for Canada is complete and totalled 23.9 t in 2013, a value lower than reported for 2011 and 2012. The majority of this unreported catch is illegal fisheries directed at salmon (Tables 2.1.3.1, 2.1.3.2). Of the unreported catch which could be attributed to a geographic location (10.1 t), 6.8 t was considered to have occurred in inland waters and 3.2 t in tidal waters.

USA

There are no commercial or recreational fisheries for Atlantic salmon in USA and the catch therefore was zero. Unreported catches in the USA were estimated to be 0 t.

France (Islands of Saint-Pierre et Miquelon)

A total harvest of 5.3 t was reported in the professional and recreational fisheries in 2013, an increase of 89% from the 2012 reported harvest of 2.8 t. The 2013 harvest is the highest of the time-series beginning in 1990 (Tables 2.1.1.1, 4.1.2.1).

There are no unreported catch estimates.

4.1.4 Harvest of North American salmon, expressed as 2SW salmon equivalents

Harvest histories (1972 to 2013) of salmon, expressed as 2SW salmon equivalents are provided in Table 4.1.4.1. The Newfoundland-Labrador commercial fishery historically was a mixed-stock fishery and harvested both maturing and non-maturing 1SW salmon as well as 2SW maturing salmon. The harvest in these fisheries of repeat spawners and older sea ages was not considered in the run reconstructions.

Harvests of 1SW non-maturing salmon in Newfoundland-Labrador commercial fisheries have been adjusted by natural mortalities of 3% per month for 13 months, and 2SW harvests in these same fisheries have been adjusted by one month to express all harvests as 2SW equivalents in the year and time they would reach rivers of origin. The Labrador commercial fishery has been closed since 1998. Harvests from the Aboriginal Peoples' fisheries in Labrador (since 1998) and the residents' food fishery in Labrador (since 2000) are both included. Mortalities in mixed-stock and losses in terminal locations (including harvests, losses from catch and release mortality and other removals including broodstock) in Canada were summed with those of USA to estimate total 2SW equivalent losses in North America. The terminal fisheries included coastal, estuarine and river catches of all areas, except Newfoundland and Labrador where only river catches were included, and excluding Saint-Pierre et Miquelon. Harvest equivalents within North America peaked at about 363 000 in 1976 and have remained below 10 000 2SW salmon equivalents between 1999 and 2013 (Table 4.1.4.1).

In the most recent year, the losses of the cohort destined to be 2SW salmon in terminal areas of North America was estimated at 3587 fish, 38% of the total North American catch of 2SW salmon. The percentages of harvests occurring in terminal fisheries ranged from 15 to 32% during 1972 to 1990 and 38 to 81% during 1993 to 2013 (Table 4.1.4.1). Percentages increased significantly since 1992 with the reduction and closures of the Newfoundland and Labrador commercial mixed-stock fisheries.

In this assessment, a correction was made to the estimation of losses of 2SW salmon in Québec. The previous assessment had included losses attributed to unreported catches which are not considered harvests in other areas. The result is that the losses of 2SW salmon are lower than reported in previous Working Group reports. This also lowers the run-reconstruction estimates of returns (but not spawners) in later sections of the report; the years affected were 1984 to the present.

4.1.5 Origin and composition of catches

In the past, salmon from both Canada and the USA were taken in the commercial fisheries of eastern Canada. The Aboriginal Peoples' and resident food fisheries that occur in Labrador may intercept salmon from other areas of North America.

In 2009 to 2013, there were no reports of tagged salmon from other areas in these fisheries. No tags were reported from the fishery in Saint-Pierre et Miquelon. No tagged salmon of USA origin were reported in Canadian fisheries in 2013.

Results of sampling programme for Labrador subsistence fisheries

A sampling programme of subsistence fisheries in Labrador continued in 2013, conducted by the NunatuKavut Community Council (NCC) and Conservation Officers of the Nunatsiavut Government (NG). Landed fish were sampled opportunistically for fork length, weight (gutted weight or whole weight if available) and sex. Scales were taken for age analysis and an adipose finclip was taken for genetic analysis. Fish were also examined for the presence of external tags, brands or elastomer marks.

In 2013, a total of 544 samples were collected from the Labrador subsistence fisheries, 160 from northern Labrador (SFA 1A), 84 from Lake Melville (SFA 1B) and 300 samples from southern Labrador (SFA 2) (Figure 4.1.2.1). Based on the interpretation of the scale samples, 79% of all the samples taken were 1SW salmon, 16% were 2SW, and 5% were previously spawned salmon. The majority of salmon sampled were river ages 3 to 6 years (99%) (modal age 4). There were no river age 1 and few river age 2 (1%) salmon sampled, suggesting, as in previous years (2006 to 2012), that very few salmon from the most southern stocks of North America (USA, Scotia-Fundy) were exploited in these fisheries.

PERCENTAGE OF SAMPLES BY RIVER AGE WITHIN THE THREE SAMPLED AREAS IN 2013

Area	Number of Samples	River Age					
		1	2	3	4	5	6
Northern Labrador (SFA 1A)	160	0.0	0.0	24.4	59.4	14.4	1.9
Lake Melville (SFA 1B)	84	0.0	0.0	15.5	59.5	25.0	0.0
Southern Labrador (SFA 2)	300	0.0	1.7	18.7	61.0	17.7	1.0
All areas	544	0.0	0.9	19.9	60.3	17.8	1.1

A collaborative project between the DFO, the Atlantic Salmon Federation, the Nunatsiavut Government and the NunatuKavut Community Council initiated in 2011 to examine the stock composition of the subsistence catch of salmon in Labrador has provided the first results of the regional origin of salmon from these fisheries. Genetic analysis involved the genotyping of 15 microsatellite loci from approximately 1600 Atlantic salmon from the subsistence harvest in coastal Labrador and has recently been completed. Genetic analyses of samples from the Labrador subsistence fisheries from 2006–2011 showed that 85–98% were of Labrador origin, with lower percentages from most other regional groups of North America, including USA origin salmon (Section 2.3.8.3). Samples from 2012 and 2013 are currently being processed.

The Working Group noted that this sampling programme provides biological characteristics of the harvest and the origin of the fish in the fishery which are important parameters in the Run Reconstruction Model for North America and in development of catch advice.

Sampling programme for Saint-Pierre et Miquelon

Sampling of the salmon catches was conducted in 2013 with 71 samples for genetic stock identification and 74 samples for age analysis from a total of 79 salmon sampled. The tissue samples collected in 2013 were analysed using the North American baseline described in Section 2.3.8.1.

Samples were obtained from the fishery covering the period 17 May to 17 June, 2013 (Figure 4.1.5.1). Based on the genetic data, analysis indicated that the sample (n = 71) contained 37% Gaspé Peninsula salmon (30 fish), 34% Newfoundland salmon (23 fish), 22% Maritimes salmon (13 fish), and 7% Upper North Shore Québec salmon (five fish) (Table 4.1.5.1; Figures 2.3.8.1 & 4.1.5.2). The salmon sampled in 2013 were mostly two-sea-winter maiden salmon, with fewer one-sea-winter maiden salmon and just three repeat spawning salmon. Scale analysis of fishery individuals by reporting group indicates river age increases and sea age declines with increasing latitude of regional group consistent with expectations based on known characteristics of these stocks (Figure 4.1.5.2). Continued analysis of additional years will be informative of the characteristics of the salmon, age and size structure and origin of the fish and the variation in the stock specific characteristics of the catches.

The Working Group welcomed the analysis for genetic origin of samples of the catches at Saint-Pierre et Miquelon. The ongoing collaboration between French and Canadian researchers was encouraged to ensure that adequate samples are collected and that the North American genetic baseline is used in the analysis of these samples. This initiative addressed gaps identified in the previous sampling activities (ICES, 2011b, 2012a).

Recommendations for future activities

The Working Group recommends that sampling and supporting descriptions of the Labrador and Saint-Pierre et Miquelon fisheries be continued and expanded (i.e. sample size, geographic coverage, tissue samples, seasonal distribution of the samples) in future years and analysed using the North American baseline to improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.

4.1.6 Exploitation rates

Canada

In the insular Newfoundland recreational fishery, final exploitation rates in 2012 for retained small salmon ranged from 5% on Terra Nova River to 11% on Exploits River (mean 7%). Provisional exploitation rates in 2013 ranged from 6% on Terra Nova River to 16% on Campbellton River (mean 11%). In Sand Hill River, Labrador, the final exploitation rate in 2012 for retained small salmon was 2% and the provisional rate for 2013 was 3%.

In Québec, the 2013 total fishing exploitation rate was about 15% (from 4 to 21% depending on the management zone); lower than the average of the five previous years. Native peoples' fishing exploitation rate was 6% of the total return. Recreational fishing exploitation rate was 9% on the total run, 13% for the small and 7% for the large salmon, lower than the previous five year average of 18% for small salmon and 8% for large salmon.

USA

There was no exploitation of anadromous USA salmon in homewaters.

Exploitation trends for North American salmon fisheries

Annual exploitation rates of small salmon (mostly 1SW) and large salmon (mostly MSW) in North America for the 1971 to 2013 time period were calculated by dividing annual harvests in all North American fisheries by annual estimates of the returns to North America prior to any homewater fisheries. The fisheries included coastal, estuarine and river fisheries in all areas, as well as the commercial fisheries of Newfoundland and Labrador which harvested salmon from all regions in North America.

Exploitation rates of both small and large salmon fluctuated annually but remained relatively steady until 1984 when exploitation of large salmon declined sharply with the introduction of the non-retention of large salmon in angling fisheries and reductions in commercial fisheries (Figure 4.1.6.1). Exploitation of small salmon declined steeply in North America with the closure of the Newfoundland commercial fishery in 1992. Declines continued in the 1990s with continuing management controls in all fisheries to reduce exploitation. In the last few years, exploitation rates on small salmon and large salmon have remained at the lowest in the time-series, averaging

10% for large salmon and 15% for small salmon over the past ten years. However, exploitation rates across regions within North America are highly variable.

4.2 Management objectives and reference points

Management objectives are described in Section 1.4.

There were no changes to the 2SW salmon Conservation Limits (CLs) from those identified previously. CLs for 2SW salmon for Canada total 123 349 and for the USA, 29 199, for a combined total of 152 548.

Country and Comission Area	Stock Area	2SW spawner requirement
	Labrador	34 746
	Newfoundland	4022
	Gulf of St Lawrence	30 430
	Québec	29 446
	Scotia-Fundy	24 705
Canada Total		123 349
USA		29 199
North American Total		152 548

4.3 Status of stocks

To date, 1082 Atlantic salmon rivers have been identified in eastern Canada and 21 rivers in eastern USA, where salmon are or were present within the last half century. Conservation requirements have been defined for 485 (45%) of these rivers and assessments of adult spawners and egg depositions relative to conservation requirements were reported for 73 of these rivers in 2013.

4.3.1 Smolt abundance

Canada

Wild smolt production was estimated in twelve rivers in 2013 (Table 4.3.1.1). Smolt production increased from 2012 in four rivers (range 23% to 45%), decreased in three rivers (range 34% to 67%) and remained unchanged (within +/-10%) in four rivers. An estimate of smolt abundance (10 943 fish) was obtained for the first time from Middle River (SFA 19) in 2013. The relative smolt production, scaled to the size of the river using the conservation egg requirements, was highest in Western Arm Brook, Newfoundland, and lowest in the LaHave River, Scotia-Fundy (Figure 4.3.1.1). Significant linear declines in smolt production ($p<0.05$) have been observed in St Jean (1989–2013) and de la Trinité (1984–2013) (Québec), whereas production has increased significantly in Western Arm Brook (Newfoundland; 1971–2013).

USA

Wild salmon smolt production has been estimated on the Narraguagus River from 1997 to 2013 (17 years) (Figure 4.3.1.1). Smolt production in 2013 was 43% higher than in 2012 and has declined significantly since 1997 ($p < 0.05$).

4.3.2 Estimates of total adult abundance by geographic area

Returns of small (1SW), large, and 2SW salmon (a subset of large) to each region (Figures 4.3.2.1 to 4.3.2.3; Tables 4.3.2.1 to 4.3.2.3) were originally estimated by the methods and variables developed by Rago *et al*. (1993) and reported by ICES (1993). Further details are provided in the Stock Annex. The returns for individual river systems and management areas for both sea age groups were derived from a variety of methods. These methods included counts of salmon at monitoring facilities, population estimates from mark‑recapture studies, and applying angling and commercial catch statistics, angling exploitation rates, and measurements of freshwater habitat. The 2SW component of the large returns was determined using the sea age composition of one or more indicator stocks.

Returns are the number of salmon that returned to the geographic region, including fish caught by homewater commercial fisheries, except in the case of the Newfoundland and Labrador regions where returns do not include landings in commercial and food fisheries. This avoided double counting fish because commercial catches in Newfoundland and Labrador and food fisheries in Labrador were added to the sum of regional returns to create the PFA of North American salmon.

Total returns of salmon to USA rivers are the sum of trap catches and redd based estimates.

Canada

Labrador

The median of the estimated returns of small salmon in 2013 to Labrador (191 300) was 11% higher than the previous year and 15% higher than the previous five-year mean (165 634, Figure 4.3.2.1). Large salmon returns in 2013 of 68 130 were 101% higher than in 2012 and the highest of the time-series beginning in 1970 (Figure 4.3.2.2; Table 4.3.2.2). The median of the estimated 2SW returns in 2013 to Labrador (44 170) was 101% higher than the previous year and 116% higher than the previous five-year mean (20 461, Figure 4.3.2.3; Table 4.3.2.3).

Since 2002, Labrador regional estimates are generated from data collected at four counting facilities, one in SFA 1 and three in SFA 2 (Figure 4.1.2.1). The production area in SFA 1 is approximately equal to the production area in SFA 2. The current method to estimate Labrador returns assumes that the total returns to the northern area are represented by returns at the single monitoring facility in SFA 1 and returns in the southerly areas (SFA2 and 14b) are represented by returns at the three monitoring facilities in SFA 2.

The large increase in the estimated returns and spawners of large salmon and 2SW salmon for 2013 are a reflection of the high counts of large salmon noted in the single monitoring site in SFA 1 in 2013 and at two of three facilities in SFA 2 (Figure 4.3.2.4). The uncertainty in the estimates of returns and spawners is high (coefficient of variation of >40% in the recent three years).

Further work is needed to understand the best use of these data in describing stock status and the Working Group recommends that additional data be considered in Labrador to better estimate salmon returns in that region. Nonetheless, the changes in abundance reported for Labrador were in line with changes observed elsewhere in North America and consistent with coherent patterns operating over a broad geographic scale.

Newfoundland

Finalized angling information from 2012 was used to update estimates of salmon returns in that year. The median of the estimated returns of small salmon in 2013 to Newfoundland (215 100) was 20% below the previous year and 14% below the previous five-year mean (250 280, Figure 4.3.2.1). The median (40 460) of the estimated large salmon returns in 2013 to Newfoundland was 40% higher than the previous year and 14% higher than the previous five year mean (34 204, Figure 4.3.2.3; Table 4.2.3.2). The median (3453) of the estimated 2SW returns in 2013 to Newfoundland was 51% higher than the previous year but 10% lower than the previous five-year mean (3823, Figure 4.3.2.3; Table 4.3.2.3). Note that there are only low numbers of 2SW salmon in Newfoundland and the bulk of the large salmon comprise previous spawners that were originally virgin 1SW returns.

Québec

The median of the estimated returns of small salmon in 2013 to Québec (20 650) was 8% lower than the previous year and 25% lower than the previous five-year mean (27 450, Figure 4.3.2.1; Table 4.3.2.1). The median of the estimated returns of large salmon in 2013 to Québec (34 780) was 10% above the previous year and 2% lower than the previous five-year mean (35 458, Figure 4.3.2.2; Table 4.3.2.2). The median of the estimated returns of 2SW in 2013 to Québec (25 390) was 10% above the previous year and 2% lower than the previous five-year mean (25 886, Figure 4.3.2.3; Table 4.3.2.3).

Gulf of St Lawrence

The median of the estimated returns of small salmon in 2013 to the Gulf (24 410) was 35% higher than the previous year but 52% lower than the previous five-year mean (50 524, Figure 4.3.2.1). The median of the estimated returns of large salmon in 2013 to the Gulf (34 260) was 24% higher than the previous year but 13% lower than the previous five-year mean (39 406, Figure 4.3.2.2; Table 4.3.2.2). The median of the estimate of 2SW returns in 2013 to the Gulf (24 430) was 24% above the previous year and 13% lower than the previous five-year mean (28 070, Figure 4.3.2.3).

Scotia–Fundy

The median of the estimated returns of small salmon in 2013 to Scotia-Fundy (2105) was the second lowest of record beginning in 1971 and followed on the record low return of 605 fish in 2012 (Table 4.3.2.1; Figure 4.3.2.1). The 2013 value was 76% lower than the previous five-year mean (8 905, Figure 4.3.2.1). The median of the estimated large salmon returns in 2013 to Scotia-Fundy (3185) was 143% higher than the record low return of 1310 fish in 2012, and 6% higher than the previous five-year mean (3007, Figure 4.3.2.2; Table 4.3.2.2). The median of the estimated 2SW returns in 2013 to Scotia-Fundy (2983) was 188% higher than the previous year and 11% higher than the previous five-year mean (2682, Figure 4.3.2.3; Table 4.3.2.3).

The model currently being used to extrapolate for the Nova Scotia Atlantic coast assessed rivers to total abundance (both returns and spawners) within SFAs 19–21 is likely leading to an overestimation of this portion of the regional abundance. The model is based on the assumption that the LaHave River salmon count is a representative index of this portion, an assumption that is likely invalid due to continued low productivity as a result of acidification in many rivers in this region (ICES, 2010b; DFO, 2013b, 2014a). This issue only affects estimates since the closure of the recreational fisheries in the mid-2000s, and is expected to have very little effect on the advice provided on overall status of salmon in North America, but does have implications for regional management.

USA

The estimated return of small salmon in 2013 to USA was only 78 fish, compared to the record low return of 26 fish in 2012 (Figure 4.3.2.1; Table 4.3.2.1). The return in 2013 is 84% lower than the average of 2001 to 2010 (473, Figure 4.3.2.1; Table 4.3.2.1). The estimated returns of 2SW in 2013 to USA (525) were 40% lower than the previous year and 70% lower than the previous five-year mean (1767, Figure 4.3.2.3; Table 4.3.2.3).

4.3.3 Estimates of spawning escapements

Updated estimates for small, large and 2SW spawners (1971 to 2013) were derived for the six geographic regions (Tables 4.3.2.4 to 4.3.2.6). A comparison between the numbers of small and large returns and spawners is presented in Figures 4.3.2.1 and 4.3.2.2. A comparison between the numbers of 2SW returns, spawners, and CLs is presented in Figure 4.3.2.3.

Canada

Labrador

The median of the estimated numbers of 2SW spawners (44 000) was 101% higher than the previous year and 117% higher than the previous five-year mean (20 287). The 2013 2SW spawners achieved 127% of the 2SW CL for Labrador (Figure 4.3.2.3). The 2SW CL had not been met in any other year in the time-series. The median of the estimated numbers of small spawners (189 400) was 11% higher than the previous year and 16% higher than the previous five-year mean (163 626, Figure 4.3.2.1).

Newfoundland

Finalized angling information from 2012 was used to update estimates of salmon spawners in that year. The median of the estimated numbers of 2SW spawners in 2013 (3422) was 51% higher than the previous year and 9% lower than the previous five-year mean (3762). The 2013 2SW spawners achieved 85% of the 2SW CL for Newfoundland. The 2SW CL has been met or exceeded in five out of the previous ten years (Figure 4.3.2.3). The median of the estimated number of small spawners (185 500) was 25% below the previous year and 17% lower than the previous five-year mean (222 180, Figure 4.3.2.1). There was a general increase in both 2SW and 1SW spawners during the period 1992 to 1996 and 1998 to 2000, which is consistent with the closure of the commercial fisheries in Newfoundland.

Québec

The median of the estimated numbers of 2SW spawners in 2013 (23 030) was 11% higher than the previous year and 1% lower than the previous five-year mean (23 260). The 2013 2SW spawners achieved 76% of the 2SW CL for Québec (Figure 4.3.2.3). The median of the estimated number of small spawners in 2013 (17 710) was 4% lower than the previous year and 19% lower than the previous five-year mean (21 918, Figure 4.3.2.1).

Gulf of St Lawrence

The median of the estimated numbers of 2SW spawners in 2013 (23 450) was 24% higher than the previous year and 13% lower than the previous five-year mean (27 086). The 2013 2SW spawners achieved 80% of the 2SW CL for the Gulf (Figure 4.3.2.3). The 2SW CL has been met or exceeded in only one (2011) of the last ten years. The median of the estimated number of small spawners in 2013 (15 040) was 37% higher than the previous year but 54% lower than the previous five-year mean (32 382, Figure 4.3.2.1).

Scotia–Fundy

The median of the estimated numbers of 2SW spawners in 2013 (2937) was 199% higher than the previous year and 14% higher than the previous five-year mean (2585). The 2013 2SW spawners achieved 12% of the 2SW CL and 27% of the management objective (10 976) for Scotia-Fundy (Figure 4.3.2.3). The median of the estimated number of small spawners (2079) was 252% higher than the previous year but 76% lower than the previous five-year mean (8 786, Figure 4.3.2.1). As was the case with returns, these values may be overestimates (see Section 4.3.2).

USA

The estimated numbers of 2SW spawners in 2013 (525) was 74% lower than the previous year and 79% lower than the previous five-year mean (2495). The 2013 2SW spawners achieved 2% of the 2SW CL and 11.5% of the management objective (4549) for USA (Figure 4.3.2.3). The estimated number of small spawners (78) was 200% higher than the previous year and 85% lower than the previous five-year mean (537, Figure 4.3.2.1).

4.3.4 Egg depositions in 2013

Egg depositions by all sea ages combined in 2013 exceeded or equalled the river-specific CLs in 44 of the 73 assessed rivers (60%) and were less than 50% of CLs in 16 rivers (22%) (Figure 4.3.4.1).

- Two of the four (50%) assessed rivers in Labrador exceeded their CLs.
- In Newfoundland, 64% (nine of 14) of assessed rivers exceeded their CLs. Two rivers (upper Exploits River and Rocky River), in which the stocks are continuing to colonize previously inaccessible habitat, were below 50% of their CLs.
- Four of the five (80%) assessed rivers in the Gulf exceeded their CLs.
- In Québec, 78% (28 of 36) of assessed rivers exceeded their CLs. Three rivers (Nouvelle, à l'Huile, Jacques-Cartier), which are under restoration, were below 50% of their CLs.
- One (North River; 14%) of the seven assessed rivers in Scotia-Fundy exceeded its CL. Four rivers were below 50% of CLs. With the exception of three rivers where catch and release fishing only was permitted, fisheries were closed on all these rivers.
- Large deficiencies in egg depositions were noted in the USA. All seven assessed rivers were below 15% of their CLs and all fisheries are closed on these stocks.

4.3.5 Marine survival (return rates)

In 2013, return rate data were available from nine wild and four hatchery (2SW only for Connecticut River) populations from rivers distributed among Newfoundland, Québec, Scotia-Fundy, and USA (Tables 4.3.5.1 to 4.3.5.4). Wild return rates to 1SW fish in 2013 decreased (range 4% to 100%) relative to 2012 for five of the nine assessed populations and increased (range 16% to 394%) for four populations. Large increases (in excess of 900%) were noted in 1SW return rates for the hatchery populations on the Penobscot (USA) and Saint John (Scotia-Fundy) rivers from 2012 to 2013, whereas hatchery return rates on the Merrimack (USA) remained unchanged from 2012 (at 0%). These large increases in 1SW hatchery return rates result from the comparison with the exceptionally low (range 0.0% to 0.2%) return rates to these rivers in 2012. The 1SW return rate in 2013 remains within the range of values observed in recent years on the Saint John River (Scotia-Fundy), but is the second lowest value on record for the Penobscot River (USA) (Table 4.3.5.3).

Return rates in 2013 for wild 2SW salmon from the 2011 smolt class decreased (45% and 100%) on two of the five populations with available information and increased (range 65% to 180%) on the other three populations. Return rates for hatchery 2SW salmon declined for three of the four populations (range 47% to 85%), but increased slightly on the Connecticut River (5%).

Analyses of time-series of return rates of smolts to 1SW and 2SW adults by area (Tables 4.3.5.1 to 4.3.5.4; Figure 4.3.5.1) and analysis of the rates of change for individual rivers (Figure 4.3.5.2) provide insights into spatial and long and short-term temporal changes in marine survival of wild and hatchery populations:

- Return rates of wild populations exceed those of hatchery populations.
- Five-year average return rates for wild 2SW salmon migrating as smolts in 2007 to 2011 and returning to rivers of eastern North America (excluding Newfoundland) in 2009 to 2013 increased from the previous five-year average (smolts in 2002 to 2006) for all areas (range 12% to 53%) and increased (23% and 30%) for two of the three hatchery stocks with available information.

Trends based on standardized return rates from the period 1970 to 2013 (Figure 4.3.5.1) include:

- 1SW return rates of wild smolts to insular Newfoundland vary annually and have no significant temporal trend over the period 1970 to 2013 (p-value>0.05).
- 1SW and 2SW return rates of wild smolts to Québec, although varying annually, have declined over the period 1983/1984 to 2013 (p<0.05).
- 1SW and 2SW return rates of wild smolts to the Scotia-Fundy and USA, although varying annually, have no significant temporal trend over the period 1970 to 2013 (p>0.05).
- In Scotia-Fundy and USA, hatchery smolt return rates to 2SW salmon have decreased over the period 1970 to 2013 (p<0.05). 1SW return rates for Scotia-Fundy hatchery stocks have also declined for the period (p<0.05), while for USA there has been no significant trend (p>0.05).

Spatial trends include:

- 1SW return rates for Newfoundland populations (range 4% to 9%) in 2013 were greater than those for other populations in eastern North America (range 0% to 2%).

4.3.6 Pre-fisheries abundance

4.3.6.1 North American run-reconstruction model

The run–reconstruction model developed by Rago *et al*. (1993) and described in previous Working Group reports (ICES, 2008a; 2009a) and in the primary literature (Chaput *et al*., 2005) was used to estimate returns and spawners by size (small salmon, large salmon) and sea age group (2SW salmon) to the six geographic regions of NAC. The input data were similar in structure to the data used previously by the Working Group (ICES, 2012a; Stock Annex Section 2.3.1). Estimates of returns and spawners to regions were provided for the time-series to 2013. The full set of data inputs are included in the Stock Annex and the summary output tables of returns and spawners by sea age or size group are provided in Tables 4.3.2.1 to 4.3.2.6.

4.3.6.2 Non-maturing 1SW salmon

The non-maturing component of 1SW fish, destined to be 2SW returns (excluding 3SW and previous spawners) is represented by the pre-fishery abundance estimator for year i designated as PFANAC1SW. This annual pre-fishery abundance is the estimated number of salmon in the North Atlantic on August 1st of the second summer at sea. As the pre-fishery abundance estimates for potential 2SW salmon requires estimates of returns to rivers, the most recent year for which an estimate of PFA is available is 2012. This is because pre-fishery abundance estimates for 2013 require 2SW returns to rivers in North America in 2014.

The medians derived from Monte Carlo simulations for 2SW salmon returns by region and for NAC overall are shown in Figure 4.3.2.3. The estimated abundance of 2SW returns to rivers for NAC in 2013 was about 100 900 fish (95% C.I. range 70 420 to 132 600) (Figure 4.3.2.3; Table 4.3.2.3). The median estimate for 2013 is 46% above than the previous year and 22% higher than the previous five year average (82 694). The 2013 estimate ranks 25th (descending) out of the 44 year time-series.

The PFA estimates accounting for returns to rivers, fisheries at sea in North America, fisheries at West Greenland, and corrected for natural mortality are shown in Figure 4.3.6.1 and Table 4.3.6.1. The median of the estimates of non-maturing 1SW salmon in 2012 was 158 500 fish (95% C.I. range 114 000 to 209 000). This value is 43% higher than the previous year (110 900) and 13% higher than the previous five year average (140 160). The estimated non-maturing 1SW salmon in 2012 ranks 26th (descending) out of the 42 year time-series.

4.3.6.3 Maturing 1SW salmon

Maturing 1SW salmon are in some areas (particularly Newfoundland) a major component of salmon stocks, and their abundance when combined with that of the 2SW age group provides an index of the majority of an entire smolt cohort.

The medians of the region-specific estimates of returns of the 1SW maturing component to rivers of NAC are summarized in Figure 4.3.2.1. Estimated abundance of 1SW returns in 2013 (454 000) was 6% lower than the previous year's estimate (484 000) and 10% lower than the previous five year mean (503 460). With the exception of Labrador (+15%), returns of 1SW maturing salmon in 2013 were below the previous five-year mean values (-10% to -85%). Returns of maturing 1SW salmon have generally increased over the time-series for the NAC, mainly as a result of the commercial fishery closures in Canada and increased returns over time to Labrador and Newfoundland, however important variations in annual abundances continue to be noted, such as the very low returns of 2009 and the very high returns of 2011 (Figure 4.3.2.1).

The reconstructed distribution of the PFA of the 1SW maturing cohort of North American origin is shown in Figure 4.3.6.1 and Table 4.3.6.1. The estimated PFA of the maturing component in 2013 was 477 600 fish, 6% lower than the previous year and 10% lower than the previous five year average (529 500). Maximum abundance of the maturing cohort was estimated at over 910 000 fish in 1981 and the recent estimate ranks 30th (descending) out of the 43 year time-series, similar to the rank of the abundance in 2012 (29th out of 42 years).

4.3.6.4 Total 1SW recruits (maturing and non-maturing)

The pre-fishery abundance of 1SW maturing salmon and 1SW non-maturing salmon from North America from 1971–2012 (2013 PFA requires 2SW returns in 2014) were summed to give total recruits of 1SW salmon (Figure 4.3.6.1; Table 4.3.6.1). The PFA of the 1SW cohort, estimated for 2012, was 668 500 fish, 14% lower than the 2011 PFA value (777 800), and similar to the previous five year average (670 080). The 2012 PFA estimate ranks 28th (descending) of the 42 year time-series. The abundance of the 1SW cohort has declined by 69% over the time-series from a peak of 1 705 000 fish in 1975.

4.3.7 Summary on status of stocks

In 2013, the midpoints of the spawner abundance estimates were below the CLs for 2SW salmon for all regions of NAC with the exception of Labrador (Figure 4.3.2.3). For the first time in the assessment time-series beginning in 1971, the midpoint of the 2SW spawners in Labrador exceeded the 2SW CL (Figure 4.3.2.3). The proportion of the 2SW CL attained from 2SW spawners in the other northern areas ranged from 76% to 85% while the percentage of CL that would have been attained from returns to rivers of 2SW salmon, prior to in-river exploitation, ranged from 83% to 86%. For the two southern areas of NAC, Scotia-Fundy and USA, the 2SW spawners in 2013 were 12% and 2%, respectively, of the region specific CLs. Returns of 2SW salmon to these southern areas were 27% and 11.5% of the management objectives for the Scotia-Fundy (10 976) and USA (4549), respectively.

The rank of the estimated returns in the 1971 to 2013 time-series and the proportions of the 2SW CLs achieved in 2013 for six regions in North America are shown below:

Region	Rank of 2013 returns in 1971 to 2013, (43=LOWEST)		Rank of 2013 returns in 2004 to 2013 (10=LOWEST)		Median estimate of 2SW spawners as percentage of Conservation Limit (% of management objective)
	1SW	2SW	1SW	2SW	(%)
Labrador	6	1	6	1	127
Newfoundland	14	28	7	8	85
Québec	38	31	8	3	76
Gulf	42	31	9	5	80
Scotia-Fundy	42	33	9	3	12 (27)
USA	37	42	9	10	2 (12)

Estimates of PFA suggest continued low abundance of North American adult salmon. The total population of 1SW and 2SW Atlantic salmon in the Northwest Atlantic has oscillated around a generally declining trend since the 1970s with a period of persistent low abundance since the early 1990s. During 1993 to 2008, the total population of 1SW and 2SW Atlantic salmon was about 600 000 fish, about half of the average abundance during 1972 to 1990. The maturing 1SW salmon in 2013 declined by 6% relative to 2012 and within the range of values for this age group over the period 1990 to 2013 (Figure 4.3.6.1). The non-maturing 1SW PFA for 2012 increased by 43% from 2011 and remains among the lowest in the time-series.

The abundances of 1SW maturing salmon in 2013 were similar to the abundances in 2012 and were among the lowest of record in Gulf, Scotia-Fundy, and USA. The abundances of large salmon (multi-sea-winter salmon including maiden and repeat spawners) improved in all areas with the exception of the USA for which returns were among the lowest of the time-series. The returns of 2SW fish in 2013 increased slightly from 2012 in four geographic areas, decreased in USA, and increased to the highest levels of the time-series for Labrador.

Egg depositions by all sea ages combined in 2013 exceeded or equalled the river-specific CLs in 44 of the 73 assessed rivers (60%) and were less than 50% of CLs in 16 other rivers (22%; Figure 4.3.4.1).

Despite major changes in fisheries, returns to southern regions (Scotia-Fundy and USA) have remained near historical lows and many populations are currently at risk of extirpation. All salmon stocks within the USA and the Scotia-Fundy regions have been or are being considered for listing under country specific species at risk legislation. Recovery Potential Assessments for the three Designatable Units of salmon in Scotia-Fundy as well as for one DU in Québec and one in Newfoundland were completed in 2012 and 2013 to inform the requirements under the Species at Risk Act listing process in Canada (see Section 2.5.1.1).

In 2013 abundances of 1SW salmon remained at comparably low levels to those of 2012, whereas 2SW and large salmon returns improved slightly from 2012. The 2SW salmon returns and spawners in Labrador in 2013 exceeded the 2SW CL for the first time in the time-series beginning in 1971. This increased abundance was not realized in the other areas of NAC. The estimated PFA of 1SW non-maturing salmon ranked 26th (descending) of the 42-year time-series and the estimated PFA of 1SW maturing salmon ranked 30th (descending) of the 43-year time-series. The continued low abundance of salmon stocks across North America, despite significant fishery reductions, and generally sustained smolt production (from the limited number of monitored rivers) strengthens the conclusions that factors acting on survival in the first and second years at sea are constraining abundance of Atlantic salmon.

Table 4.1.2.1. The number of professional and recreational gillnet licences issued at Saint-Pierre et Miquelon and reported landings.

	Number of licences		Reported Landings (tonnes)		
Year	Professional	Recreational	Professional	Recreational	Total
1990			1.146	0.734	1.880
1991			0.632	0.530	1.162
1992			1.295	1.024	2.319
1993			1.902	1.041	2.943
1994			2.633	0.790	3.423
1995	12	42	0.392	0.445	0.837
1996	12	42	0.951	0.617	1.568
1997	6	36	0.762	0.729	1.491
1998	9	42	1.039	1.268	2.307
1999	7	40	1.182	1.140	2.322
2000	8	35	1.134	1.133	2.267
2001	10	42	1.544	0.611	2.155
2002	12	42	1.223	0.729	1.952
2003	12	42	1.620	1.272	2.892
2004	13	42	1.499	1.285	2.784
2005	14	52	2.243	1.044	3.287
2006	14	48	1.730	1.825	3.555
2007	13	53	0.970	0.977	1.947
2008	9	55	Na	Na	3.54
2009	8	50	1.87	1.59	3.46
2010	9	57	1.00	1.78	2.78
2011	9	56	1.76	1.99	3.75
2012	9	60	1.05	1.75	2.80
2013	9	64	2.29	3.01	5.30

Table 4.1.3.1. Harvests (by weight) and the percent large by weight and number in the Aboriginal Peoples' Food, Social, and Ceremonial (FSC) fisheries in Canada.

Aboriginal Peoples' FSC fisheries			
Year	Harvest (t)	% large	
		by weight	by number
1990	31.9	78	
1991	29.1	87	
1992	34.2	83	
1993	42.6	83	
1994	41.7	83	58
1995	32.8	82	56
1996	47.9	87	65
1997	39.4	91	74
1998	47.9	83	63
1999	45.9	73	49
2000	45.7	68	41
2001	42.1	72	47
2002	46.3	68	43
2003	44.3	72	49
2004	60.8	66	44
2005	56.7	57	34
2006	61.4	60	39
2007	48.0	62	40
2008	62.4	66	44
2009	51.1	65	45
2010	59.3	59	38
2011	70.4	63	41
2012	59.6	62	40
2013	58.6	68	51

Table 4.1.3.2. Harvests (by weight) and the percent large by weight and number in the Resident Food Fishery in Labrador, Canada.

Labrador resident food fishery			
Year	Harvest (t)	% large	
		by weight	by number
2000	3.5	30	18
2001	4.6	33	23
2002	6.1	27	15
2003	6.7	32	21
2004	2.2	40	26
2005	2.7	32	20
2006	2.6	39	27
2007	1.7	23	13
2008	2.3	46	25
2009	2.9	42	28
2010	2.3	38	26
2011	2.1	51	37
2012	1.7	47	32
2013	2.1	67	52

Table 4.1.3.3. Harvests of small and large salmon, and the percent large by number, in the recreational fisheries of Canada, 1974 to 2013. The values for 2013 are provisional.

Year	Small	Large	Both size groups	% Large
1974	53 887	31 720	85 607	37%
1975	50 463	22 714	73 177	31%
1976	66 478	27 686	94 164	29%
1977	61 727	45 495	107 222	42%
1978	45 240	28 138	73 378	38%
1979	60 105	13 826	73 931	19%
1980	67 314	36 943	104 257	35%
1981	84 177	24 204	108 381	22%
1982	72 893	24 640	97 533	25%
1983	53 385	15 950	69 335	23%
1984	66 676	9 982	76 658	13%
1985	72 389	10 084	82 473	12%
1986	94 046	11 797	105 843	11%
1987	66 475	10 069	76 544	13%
1988	91 897	13 295	105 192	13%
1989	65 466	11 196	76 662	15%
1990	74 541	12 788	87 329	15%
1991	46 410	11 219	57 629	19%
1992	77 577	12 826	90 403	14%
1993	68 282	9 919	78 201	13%
1994	60 118	11 198	71 316	16%
1995	46 273	8 295	54 568	15%
1996	66 104	9 513	75 617	13%
1997	42 891	6 756	49 647	14%
1998	45 810	4 717	50 527	9%
1999	43 667	4 811	48 478	10%
2000	45 811	4 627	50 438	9%
2001	43 353	5 571	48 924	11%
2002	43 904	2 627	46 531	6%
2003	38 367	4 694	43 061	11%
2004	43 124	4 578	47 702	10%
2005	33 922	4 132	38 054	11%
2006	33 668	3 014	36 682	8%
2007	26 279	3 499	29 778	12%
2008	46 458	2 839	49 297	6%
2009	32 944	3 373	36 317	9%
2010	45 407	3 209	48 616	7%
2011	49 931	4 141	54 072	8%
2012	30 453	2 680	33 133	8%
2013	35 627	2 932	38 559	8%

Table 4.1.3.4. Numbers of salmon hooked and-released in Eastern Canadian salmon angling fisheries. Blank cells indicate no data. Released fish in the kelt fishery of New Brunswick are not included in the totals for New Brunswick nor Canada. Totals for all years prior to 1997 are incomplete and are considered minimal estimates.

	Newfoundland			Nova Scotia			New Brunswick					Prince Edward Island			Quebec			CANADA		
Year	Small	Large	Total	Small	Large	Total	Small Kelt	Small Bright	Large Kelt	Large Bright	Total	Small	Large	Total	Small	Large	Total	SMALL	LARGE	TOTAL
1984				939	1,655	2,594	661	851	1,020	14,479	15,330							**1,790**	**16,134**	**17,924**
1985		315	315	1,323	6,346	7,669	1,098	3,963	3,809	17,815	21,778			67				**5,286**	**24,476**	**29,762**
1986		798	798	1,463	10,750	12,213	5,217	9,333	6,941	25,316	34,649							**10,796**	**36,864**	**47,660**
1987		410	410	1,311	6,339	7,650	7,269	10,597	5,723	20,295	30,892							**11,908**	**27,044**	**38,952**
1988		600	600	1,146	6,795	7,941	6,703	10,503	7,182	19,442	29,945	767	256	1,023				**12,416**	**27,093**	**39,509**
1989		183	183	1,562	6,960	8,522	9,566	8,518	7,756	22,127	30,645							**10,080**	**29,270**	**39,350**
1990		503	503	1,782	5,504	7,286	4,435	7,346	6,067	16,231	23,577			1,066				**9,128**	**22,238**	**31,366**
1991		336	336	908	5,482	6,390	3,161	3,501	3,169	10,650	14,151	1,103	187	1,290				**5,512**	**16,655**	**22,167**
1992	5,893	1,423	7,316	737	5,093	5,830	2,966	8,349	5,681	16,308	24,657			1,250				**14,979**	**22,824**	**37,803**
1993	18,196	1,731	19,927	1,076	3,998	5,074	4,422	7,276	4,624	12,526	19,802							**26,548**	**18,255**	**44,803**
1994	24,442	5,032	29,474	796	2,894	3,690	4,153	7,443	4,790	11,556	18,999	577	147	724				**33,258**	**19,629**	**52,887**
1995	26,273	5,166	31,439	979	2,861	3,840	770	4,260	880	5,220	9,480	209	139	348		922	922	**31,721**	**14,308**	**46,029**
1996	34,342	6,209	40,551	3,526	5,661	9,187						472	238	710		1,718	1,718	**38,340**	**13,826**	**52,166**
1997	25,316	4,720	30,036	713	3,363	4,076	3,457	4,870	3,786	8,874	13,744	210	118	328	182	1,643	1,825	**31,291**	**18,718**	**50,009**
1998	31,368	4,375	35,743	688	2,476	3,164	3,154	5,760	3,452	8,298	14,058	233	114	347	297	2,680	2,977	**38,346**	**17,943**	**56,289**
1999	24,567	4,153	28,720	562	2,186	2,748	3,155	5,631	3,456	8,281	13,912	192	157	349	298	2,693	2,991	**31,250**	**17,470**	**48,720**
2000	29,705	6,479	36,184	407	1,303	1,710	3,154	6,689	3,455	8,690	15,379	101	46	147	445	4,008	4,453	**37,347**	**20,526**	**64,482**
2001	22,348	5,184	27,532	527	1,199	1,726	3,094	6,166	3,829	11,252	17,418	202	103	305	809	4,674	5,483	**30,052**	**22,412**	**59,387**
2002	23,071	3,992	27,063	829	1,100	1,929	1,034	7,351	2,190	5,349	12,700	207	31	238	852	4,918	5,770	**32,310**	**15,390**	**50,924**
2003	21,379	4,965	26,344	626	2,106	2,732	1,555	5,375	1,042	7,981	13,356	240	123	363	1,238	7,015	8,253	**28,858**	**22,190**	**53,645**
2004	23,430	5,168	28,598	828	2,339	3,167	1,050	7,517	4,935	8,100	15,617	135	68	203	1,291	7,455	8,746	**33,201**	**23,130**	**62,316**
2005	33,129	6,598	39,727	933	2,617	3,550	1,520	2,695	2,202	5,584	8,279	83	83	166	1,116	6,445	7,561	**37,956**	**21,327**	**63,005**
2006	30,491	5,694	36,185	1,014	2,408	3,422	1,071	4,186	2,638	5,538	9,724	128	42	170	1,091	6,185	7,276	**36,910**	**19,867**	**60,486**
2007	17,719	4,607	22,326	896	1,520	2,416	1,164	2,963	2,067	7,040	10,003	63	41	104	951	5,392	6,343	**22,592**	**18,600**	**41,192**
2008	25,226	5,007	30,233	1,016	2,061	3,077	1,146	6,361	1,971	6,130	12,491	3	9	12	1,361	7,713	9,074	**33,967**	**20,920**	**54,887**
2009	26,681	4,272	30,953	670	2,665	3,335	1,338	2,387	1,689	8,174	10,561	6	25	31	1,091	6,180	7,271	**30,835**	**21,316**	**52,151**
2010	27,256	5,458	32,714	717	1,966	2,683	463	5,730	1,920	5,660	11,390	42	27	69	1,356	7,683	9,039	**35,101**	**20,794**	**55,895**
2011	26,240	8,119	34,359	1,157	4,320	5,477		6,537		12,466	19,003	46	46	92	3,100	9,327	12,427	**37,080**	**34,278**	**71,358**
2012	20,940	4,089	25,029	339	1,693	2,032		2,504		5,330	7,834	46	46	92	2,126	6,174	8,300	**25,955**	**17,332**	**43,287**
2013	28,237	7,751	35,988	375	2,059	2,434		2,646		8,049	10,695	12	23	35	2,250	7,805	10,055	**33,520**	**25,687**	**59,207**

Table 4.1.4.1. Reported harvests and losses expressed as 2SW salmon equivalents in North American salmon fisheries. Only midpoints of the Monte Carlo simulated values are shown.

	MIXED STOCK					CANADA													
						LOSSES FROM ALL SOURCES (TERMINAL FISHERIES, CATCH AND RELEASE MORTALITY, BYCATCH MORTALITY) IN Year i													
Year (i)	NF-LAB Comm / Food 1SW (Year i-1) (a)	% 1SW of total 2SW equivalents (Year i)	NF-LAB Comm / Food 2SW (Year i) (a)	NF-Lab Comm / Food total (Year i)	Saint-Pierre and Miquelon (Year i)	Labrador	Newfoundland	Quebec	Gulf	Scotia - Fundy	Canadian total	USA	North American Total	Terminal losses as a % of NA Total	Greenland Total	NW Atlantic Total	Harvest in homewaters as % of total NW Atlantic	Estimated abundance in North America (2SW)	Exploitation rates in North America on 2SW equivalents
1972	20115	0.12	153816	173931	0	430	597	27350	20250	5600	54227	345	228503	24	197920	426423	54	302300	0.76
1973	17448	0.07	219224	236671	0	1010	773	32740	15490	6215	56228	327	293226	19	148170	441397	66	377000	0.78
1974	23717	0.09	235915	259633	0	800	499	47670	18230	13030	80229	247	340109	24	186489	526597	65	449600	0.76
1975	23467	0.09	237565	261032	0	330	503	41100	14100	12520	68553	389	329974	21	154640	484614	68	416800	0.79
1976	35038	0.12	256586	291623	323	830	375	42070	16220	11120	70615	191	362752	20	194541	557293	65	431700	0.84
1977	26757	0.10	241253	268010	0	1290	782	42280	29200	13460	87012	1355	356377	25	113015	469392	76	473400	0.75
1978	26994	0.15	157309	184303	0	770	529	37490	20350	9372	68511	894	253708	27	142778	396487	64	317600	0.80
1979	13494	0.13	92056	105550	0	609	123	25220	6253	3838	36043	433	142026	26	103813	245839	58	172100	0.83
1980	20610	0.09	217186	237795	0	890	635	53540	25330	17360	97755	1533	337083	29	141916	478999	70	451700	0.75
1981	33731	0.14	201367	235098	0	520	433	44290	14662	12850	72755	1267	309120	24	120851	429972	72	365600	0.85
1982	33589	0.20	134407	167995	0	620	397	35160	20660	8935	65772	1413	235180	29	161183	396363	59	291100	0.81
1983	25254	0.18	111601	136855	323	428	416	34400	17320	12282	64846	386	202410	32	145942	348352	58	237300	0.85
1984	19052	0.19	82808	101860	323	510	186	16110	3440	4020	24266	675	127124	20	26837	153962	83	195900	0.65
1985	14340	0.15	78761	93101	323	294	12	19600	1090	5050	26046	645	120115	22	32438	152553	79	209500	0.57
1986	19587	0.16	104905	124492	269	467	40	24010	1660	2990	29167	606	154535	19	99068	253602	61	262900	0.59
1987	24801	0.16	132175	156975	215	640	16	24070	2010	1440	28176	300	185667	15	123367	309034	60	256800	0.72
1988	31585	0.28	81129	112714	215	710	17	24190	1420	1440	27777	248	140954	20	123727	264681	53	211700	0.67
1989	21903	0.21	81362	103265	215	461	9	21650	1300	350	23770	397	127647	19	84905	212552	60	193700	0.66
1990	19289	0.25	57363	76652	205	357	19	20920	1320	650	23266	695	100818	24	43646	144464	70	173900	0.58
1991	11842	0.23	40438	52280	129	93	12	20390	930	1380	22805	231	75445	31	52208	127654	59	145100	0.52
1992	9844	0.28	25105	34950	248	782	54	20950	1220	1170	24176	167	59540	41	79585	139125	43	142700	0.42
1993	3108	0.19	13276	16384	312	387	45	15690	750	1164	18036	166	34898	52	29807	64705	54	118900	0.29
1994	2077	0.15	11936	14014	366	490	157	16060	680	778	18165	2	32547	56	1889	34436	95	103600	0.31
1995	1183	0.12	8677	9860	86	450	131	13430	550	370	14931	0	24877	60	1891	26768	93	129400	0.19
1996	1033	0.15	5646	6679	172	390	171	12740	860	816	14977	0	21828	69	19174	41002	53	110100	0.20
1997	943	0.15	5391	6334	161	220	149	10570	850	601	12390	0	18885	66	19339	38224	49	90160	0.21
1998	1130	0.39	1761	2891	248	201	89	4370	520	332	5512	0	8651	64	13048	21699	40	61200	0.14
1999	174	0.17	842	1016	250	280	63	3920	830	459	5552	0	6818	81	4322	11140	61	65840	0.10
2000	150	0.12	1050	1200	244	270	160	3540	600	198	4768	0	6212	77	6442	12654	49	67330	0.09
2001	284	0.18	1336	1620	232	320	60	4490	970	264	6104	0	7956	77	5932	13888	57	78430	0.10
2002	260	0.19	1078	1338	210	200	48	1850	540	182	2820	0	4369	65	8606	12974	34	49200	0.09
2003	308	0.15	1689	1997	311	236	74	3480	810	211	4811	0	7119	68	3223	10342	69	76120	0.09
2004	351	0.11	2870	3220	300	270	73	3360	860	115	4678	0	8198	57	3475	11673	70	74180	0.11
2005	462	0.17	2187	2650	354	280	83	3090	930	106	4489	0	7493	60	4339	11831	63	76080	0.10
2006	558	0.19	2399	2957	383	220	63	2310	820	150	3563	0	6902	52	4181	11084	62	72270	0.10
2007	558	0.21	2059	2617	210	240	82	2570	850	110	3852	0	6678	58	4934	11612	58	67750	0.10
2008	494	0.14	3035	3528	381	230	102	2330	830	95	3587	0	7496	48	6618	14114	53	74440	0.10
2009	538	0.17	2596	3134	372	220	55	2620	950	119	3964	0	7470	53	7542	15012	50	88710	0.08
2010	439	0.13	2892	3331	299	198	92	2510	850	135	3785	0	7415	51	6671	14086	53	68310	0.11
2011	538	0.13	3456	3994	404	150	37	3440	1580	84	5291	0	9689	55	8764	18453	53	137400	0.07
2012	610	0.16	3283	3893	156	70	21	2230	710	53	3084	0	7133	43	6871	14003	51	74550	0.10
2013	549	0.10	5042	5591	215	170	31	2360	980	46	3587	0	9393	38	7078	16471	57	109800	0.09
2014	430														9598				

Variations in numbers from previous assessments is due to stochastic variation from Monte Carlo simulation

NF-Lab Comm / Food 1SW (Year i-1) = Catch of 1SW non-maturing * 0.677057 (M of 0.03 per month for 13 months to July for Canadian terminal fisheries)

NF-Lab Comm / Food 2SW (Year i) = catch of 2SW salmon * 0.970446 (M of 0.03 per month for 1 month to July of Canadian terminal fisheries)

Canada - Losses from all sources = 2SW returns - 2SW spawners (includes losses from harvests, from catch and release mortality, and other inriver losses such as bycatch mortality but excludes the fisheries at St-Pierre and Miquelon and NF-Lab Comm / Food fisheries)

a - starting in 1998, there was no commercial fishery in Labrador; numbers reflect harvests of the aboriginal and residential subsistence fisheries

Table 4.1.5.1. Number of samples by age group (upper table) and the assignment of individual fish by sea age group to a regional group based on genetic stock identification (lower table) for salmon sampled from the fishery at Saint-Pierre et Miquelin in 2013.

Freshwater age (years)	Total sea age				All samples
	1SW	2SW	Repeat	Not determined	
2	7	27			34
3	15	20	3		38
Not determined		2		3	5
All samples	22	49	3	3	77

Assigned region	Sea age				All age groups
	1SW	2SW	Repeat	Not determined	
Gaspé	3	23	2	2	30
Maritimes	4	9	0	0	13
Newfoundland	14	6	1	2	23
Québec North	1	3	0	1	5
All samples	22	41	3	5	71

Table 4.3.1.1. Estimated smolt production by smolt migration year in monitored rivers of eastern North America, 1991 to 2013.

Smolt Migration Year	USA	Scotia-Fundy				Gulf				
	Narraguagus	Nashwaak	Big Salmon	LaHave	St. Mary's (West Br.)	Margaree	Northwest Miramichi	Southwest Miramichi	Restigouche	Kedgwick
1991										
1992										
1993										
1994										
1995										
1996				20 510						
1997	2898			16 550						
1998	2866	22 750		15 600						
1999	4346	28 500		10 420			390 500			
2000	2094	15 800		16 300			162 000			
2001	2621	11 000	5 100	15 700			220 000	306 300		
2002	1800	15 000	4 300	11 860		63 200	241 000	711 400		
2003	1368	9 000	9 200	14 034		83 100	286 000	48 500	379 000	91 800
2004	1344	13 600	6 000	21 613		105 800	368 000	1 167 000	449 000	131 500
2005	1298	5 200	4 550	5 270	7 350	94 200	151 200		630 000	67 000
2006	2612	25 400		22 971	25 100	113 700	435 000	1 330 000	500 000	129 000
2007	1240	21 550		24 430	16 110	112 400		1 344 000	1 087 000	116 600
2008	1029	7 310		14 450	15 217	128 800		901 500	486 800	110 100
2009	1180	15 900		8 643	14 820	96 800		1 035 000	491 000	126 800
2010	2 170	12 500		16 215				2 165 000	636 600	108 600
2011	1 404	8 750					768 000		792 000	275 178
2012	969	11 060							842 000	155 012
2013	1 386	10 120		7 159					842 000	104 081

Table 4.3.1.1 (continued). Estimated smolt production by smolt migration year in monitored rivers of eastern North America, 1991 to 2013.

Smolt Migration Year	Québec		Newfoundland					Labrador
	St. Jean	De la Trinite	Conne	Rocky	NE Trepassey	Campbellton	Western Arm Brook	Sand Hill River
1991	113 927	40 863	74 645	7 732	1911		13 453	
1992	154 980	50 869	68 208	7 813	1674		15 405	
1993	142 972	86 226	55 765	5 115	1849	31 577	13 435	
1994	74 285	55 913	60 762	9 781	944	41 663	9 283	
1995	60 227	71 899	62 749	7 577	792	39 715	15 144	
1996	104 973	61 092	94 088	14 261	1749	58 369	14 502	
1997		31 892	100 983	16 900	1829	62 050	23 845	
1998	95 843	28 962	69 841	12 163	1727	50 441	17 139	
1999	114 255	56 557	63 658	8 625	1419	47 256	13 500	
2000	50 993	39 744	60 777	7 616	1740	35 596	12 706	
2001	109 845	70 318	86 899	9 392	916	37 170	16 013	
2002	71 839	44 264	81 806	10 144	2074	32 573	14 999	
2003	60 259	53 030	71 479	4 440	1064	35 089	12 086	
2004	54 821	27 051	79 667	13 047	1571	32 780	17 323	
2005	96 002	34 867	66 196	15 847	1384	30 123	8 607	
2006	102 939		35 487	13 200	1385	33 302	20 826	
2007	135 360	42 923	63 738	12 355	1777	35 742	16 621	
2008	45 978	35 036	68 242	18 338	1868	40 390	17 444	
2009	37 297	32 680	71 085	14 041	1600	36 722	18 492	60 619
2010	47 187	37 500	54 392	15 098	1012	41 069	19 044	
2011	45 050	44 400	50 701	9 311	800	37 033	20 544	
2012	40 787	45 108	51 220	5 673	1557	44 193	13 573	82 537
2013	36 849	42 378	66 261	6 989	520	40 355	19 710	

Table 4.3.5.1. Return rates (%), by year of smolt migration, of wild Atlantic salmon to 1SW (or small) salmon to North American rivers, 1991 to 2012. The year 1991 was selected for illustration as it is the first year of the commercial fishery moratorium for the island of Newfoundland.

SMOLT YEAR	USA	SF			GULF				QUÉBEC				NFLD					
	Narraguagus	**Nashwaak**	**LaHave**	**St.Mary's**	**Margaree**	**NWMiramichi**	**SW Miramcihi**	**Miramichi**	**à la barbe**	**Saint Jean**	**Becscie**	**de la Trinite**	**Highlands**	**Conne**	**Rocky**	**NE Trepassey**	**Campbellton**	**WAB**
1991									0.6	0.5	1.2	1.6		3.4	3.1	2.6		3.6
1992									0.5	0.4	1.3	0.8		4.0	3.7	4.7		6.1
1993									0.4	0.3	0.9	0.7	1.5	2.7	3.1	5.4	9.0	7.1
1994										0.3	1.2	0.6	1.6	5.8	3.9	8.5	7.3	8.9
1995										0.6	1.4	0.9	1.6	7.2	4.7	9.2	8.1	8.1
1996			1.5							0.3		0.6	3.2	3.4	3.1	2.9	3.4	3.5
1997	0.04		4.3									1.7	1.4	2.9	2.5	5.0	5.3	7.2
1998	0.22	2.9	2.0							0.3		1.4	2.5	3.4	2.7	4.9	6.1	6.1
1999	0.30	1.8	4.8			3.0				0.3		0.4	0.6	8.1	3.2	5.9	3.8	11.1
2000	0.25	1.5	1.2			4.9				0.5		0.3	0.6	2.5	3.1	3.2	6.0	4.4
2001	0.16	3.1	2.7			6.6	8.6	7.9		0.5		0.6		3.0	2.9	7.1	5.3	9.2
2002	0.00	1.9	2.0		1.5	2.4	3.0	3.0		0.6		0.9		2.4	4.0	5.5	6.8	9.4
2003	0.08	6.4	1.8		1.6	4.1	6.8	5.9		0.6		0.6		5.3	3.8	6.6	7.8	9.5
2004	0.08	5.1	1.1		0.9	2.6	1.8	2.0		0.7		1.0		2.5	3.3	4.4	11.4	5.9
2005	0.24	12.7	8.0	3.1	1.1	3.6				0.4		1.5		4.0	2.2	5.5	9.2	15.1
2006	0.09	1.8	1.5	0.7	0.7	1.4	1.5	1.5		0.3				3.3	1.3	2.7	5.6	3.8
2007	0.33	5.6	2.3	1.7	1.3		1.6			0.4		1.5		4.4	5.6	5.5	11.2	11.6
2008	0.21	3.9	1.2	0.6	0.3		1.0			0.6		0.7		2.4	2.7	2.6	8.8	6.1
2009	0.26	12.4	3.5		1.0		3.3			0.8		1.9		2.5	6.8	4.9	9.5	9.6
2010	0.95	7.9					1.5			0.7		2.5		2.7	5.1	5.6	11.0	7.1
2011	0.25	0.3								0.4		0.6		3.9	4.6	3.0	9.7	5.7
2012	0.00	1.6								0.4		0.4		5.3	3.7	4.0	9.3	5.2

Table 4.3.5.2. Return rates (%), by year of smolt migration, of wild Atlantic salmon to 2SW salmon to North American rivers, 1991 to 2011. The year 1991 was selected for illustration as it is the first year of the commercial fishery moratorium for the island of Newfoundland.

Smolt year	USA	Scotia-Fundy			Gulf				Québec				Nfld
	Narraguagus	**Nashwaak**	**LaHave**	**St.Mary's**	**Margaree**	**NWMiramichi**	**SW Miramcihi**	**Miramichi**	**à la barbe**	**Saint Jean**	**Bec scie**	**de la Trinite**	**Highlands**
1991									0.6	0.9	0.4	0.6	
1992									0.5	0.7	0.4	0.5	
1993									0.4	0.8	0.9	0.7	1.2
1994										0.9	1.5	0.7	1.4
1995										0.9	0.4	0.5	1.3
1996			0.3							0.4		0.5	0.9
1997	0.84		0.5									1.1	1.2
1998	0.29	0.7	0.4							0.4		0.7	1.1
1999	0.50	0.8	1.0			1.2				0.7		0.2	0.7
2000	0.15	0.3	0.2			0.5				1.2		0.1	0.7
2001	0.83	0.9	0.6			0.6	3.3	2.3		0.9		0.3	
2002	0.60	1.3	0.6		6.2	0.7	1.4	1.3		0.9		0.5	
2003	1.00	1.6	0.2		3.9	0.9	2.0	1.6		1.4		0.2	
2004	0.94	1.3			3.0	0.5	0.8	0.7		1.1		0.7	
2005	0.71	1.5	0.7	0.2	2.3	1.1				0.6		0.5	
2006	0.74	0.6	0.4	0.1	3.0	0.2	0.5	0.4		0.5			
2007	1.99	1.3	0.2	0.0	2.1		0.8			0.5		0.3	
2008	0.63	2.1	0.4		2.4		0.7			1.8		0.5	
2009	1.71	3.3			5.7		2.2			1.9		0.8	
2010	0.20	0.0								1.0		0.6	
2011	0.51	1.0								1.7		0.3	
2012													

Table 4.3.5.3. Return rates (%), by year of smolt migration, of hatchery Atlantic salmon to 1SW salmon to North American rivers, 1991 to 2012. The year 1991 was selected for illustration as it is the first year of the commercial fishery moratorium for the island of Newfoundland.

	USA			SF				Gulf				Québec
Smolt year	**Connecticut**	**Penobscot**	**Merrimack**	**Saint John**	**LaHave**	**East Sheet**	**Liscomb**	**Morell**	**Mill**	**West**	**Valley-field**	**auxRochers**
1991	0.003	0.14	0.01	0.69	4.51	0.15	0.50	3.16			0.48	0.43
1992		0.04	0.00	0.41	1.26	0.21	0.42	1.43	0.44	2.16	0.70	0.07
1993	0.003	0.05	0.00	0.39	0.62	0.32	0.56	0.14	0.37		0.02	0.10
1994	0.003	0.03	0.00	0.66	1.44	0.36	0.35	5.20	0.11		0.08	0.02
1995		0.09	0.02	1.14	2.26	0.37	0.64					0.07
1996		0.04	0.02	0.56	0.47	0.07	0.17					0.31
1997		0.04	0.02	0.75	0.87	0.03	0.15					0.46
1998		0.04	0.09	0.47	0.34	0.05	0.10					1.04
1999		0.03	0.05	0.46	0.79	0.23						0.32
2000	0.003	0.03	0.01	0.27	0.43	0.03						1.15
2001		0.07	0.06	0.45	0.87							0.02
2002		0.04	0.02	0.34	0.63							0.07
2003		0.05	0.03	0.32	0.72							
2004		0.05	0.02	0.39	0.53							
2005	0.015	0.06	0.02	0.56								
2006	0.000	0.04	0.02	0.24								
2007	0.010	0.13	0.01	0.83								
2008	0.000	0.03	0.00	0.13								
2009		0.07	0.03	1.44								
2010	0.005	0.12	0.18	0.12								
2011	0.000	0.00	0.00	0.02								
2012		0.01	0.00	0.67								

Table 4.3.5.4. Return rates (%), by year of smolt migration, of hatchery Atlantic salmon to 2SW salmon to North American rivers, 1991 to 2011. The year 1991 was selected for illustration as it is the first year of the commercial fishery moratorium for the island of Newfoundland.

Smolt year	USA			SF				Gulf				Québec
	Connecticut	**Penobscot**	**Merrimack**	**Saint John**	**LaHave**	**East Sheet**	**Liscomb**	**Morell**	**Mill**	**West**	**Valley-field**	**auxRochers**
1991	0.039	0.19	0.02	0.15	0.48	0.00	0.05	0.04			0.00	0.13
1992	0.084	0.08	0.00	0.22	0.24	0.01	0.03	0.07	0.00	0.05	0.06	0.06
1993	0.041	0.19	0.03	0.19	0.21	0.02	0.03	0.31	0.91		0.01	0.19
1994	0.038	0.21	0.05	0.27	0.23	0.06	0.02					0.05
1995		0.16	0.06	0.19	0.23	0.00	0.03					0.04
1996		0.14	0.09	0.08	0.13	0.01						0.07
1997		0.10	0.11	0.20	0.17	0.01						0.08
1998		0.05	0.06	0.06	0.11	0.00						0.09
1999		0.08	0.13	0.16	0.21	0.00						0.02
2000	0.006	0.06	0.03	0.05	0.07							0.01
2001		0.16	0.26	0.15	0.13							0.02
2002		0.17	0.18	0.11	0.17							
2003	0.004	0.12	0.05	0.06	0.09							
2004	0.034	0.12	0.13	0.09	0.11							
2005		0.10	0.10	0.12								
2006		0.23	0.15	0.06								
2007		0.30	0.08	0.17								
2008	0.010	0.15	0.05	0.16								
2009	0.035	0.39	0.17	0.13								
2010	0.002	0.09	0.11	0.07								
2011	0.011	0.05	0.02	0.02								
2012												

Table 4.3.2.1. Estimated small salmon returns (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of returns of small salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	49220	135600	23630	62920	26530		
1971	64190	118800	18740	49800	18880	32	271300
1972	48570	110600	15550	62890	16980	18	255700
1973	13960	159800	20750	63190	24390	23	282400
1974	53810	120500	21050	98420	43500	55	338500
1975	103300	150900	22590	88390	33860	84	400300
1976	73790	158500	24910	128800	52860	186	440900
1977	65640	159800	22720	46270	46120	75	341700
1978	32750	139300	21190	41070	15810	155	251400
1979	42340	152000	27090	72310	48830	250	344000
1980	95500	172500	37300	63280	70650	818	441400
1981	105200	225400	52010	106400	59390	1130	552100
1982	73240	200700	29600	121100	36090	334	463000
1983	45800	156600	22490	37150	22620	295	286200
1984	24100	206500	24870	54230	42730	598	353800
1985	43180	195500	26450	86290	47480	392	400500
1986	65400	200300	37920	161400	49270	758	517100
1987	82020	135500	43450	122400	51310	1128	437900
1988	75580	217200	50010	172400	51820	992	570900
1989	51890	107500	39630	102800	54520	1258	359400
1990	30300	152300	45130	116900	55250	687	401800
1991	24260	105600	34980	85180	28190	310	279400
1992	34360	229000	39690	192600	34010	1194	532200
1993	45750	265500	34340	135900	25700	466	509200
1994	33930	161100	32680	67260	10470	436	306900
1995	47740	204100	26040	60650	19990	213	360200
1996	90060	313300	35160	55290	31800	651	528700
1997	95340	176900	26600	30570	9378	365	340300
1998	151100	183800	28240	39530	20380	403	423600
1999	147700	201200	29200	35730	10590	419	424700
2000	181800	228800	26760	51160	12360	270	501300
2001	145300	156200	18160	42090	5423	266	367300
2002	102400	155700	28560	69010	9853	450	366000
2003	85530	242500	24230	40710	5843	237	398900
2004	94950	210200	32980	75270	8395	319	422100
2005	220700	221300	22110	46730	7489	319	518800
2006	213400	212800	26990	58210	10270	450	522000
2007	194800	183500	20520	42490	7732	297	449200
2008	203500	247700	34380	61510	15350	814	563500
2009	89050	222300	19700	25600	4240	241	361300
2010	91620	267700	25480	73690	14880	525	473900
2011	271400	243300	35200	73710	9449	1080	634600
2012	172600	270400	22490	18110	604.6	26	484000
2013	191300	215100	20650	24410	2105	78	454000

5th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	30160	89930	11330	30300	14630		
1971	40740	78870	9578	25490	9352	29	182900
1972	30860	73350	8415	31060	7941	17	170100
1973	1974	106800	11260	36670	14660	13	187500
1974	34970	80250	10330	61600	26720	40	239200
1975	67420	99800	11880	54510	22760	66	284400
1976	45490	104600	13310	72220	34440	150	302300
1977	40970	105700	12300	18680	26240	54	227700
1978	20260	93120	11730	17980	7696	126	165800
1979	25140	102000	16250	40150	29930	245	238500
1980	62400	116700	21340	35110	41630	716	309000
1981	67320	151200	31720	49360	31870	1000	377800
1982	46480	135300	17270	64180	19670	287	319100
1983	27350	105500	12340	16230	12060	253	193700
1984	13860	140100	18080	12350	26640	535	233400
1985	26740	131500	17670	42290	28900	360	278300
1986	41620	137300	24710	88210	31940	654	365500
1987	51010	94010	29060	65200	33160	1077	309800
1988	46420	150100	32310	91820	34380	915	401000
1989	31080	76360	27550	47820	35430	1070	248300
1990	17590	108100	29470	60380	35240	612	279500
1991	14260	75860	22670	48950	18540	233	198900
1992	21430	176000	24360	131400	21650	1114	408300
1993	30570	208500	19530	65620	16690	440	379800
1994	22260	107500	18390	35330	8035	423	210200
1995	33080	140900	15850	39390	15340	211	265700
1996	64900	230500	20740	28220	23960	645	398000
1997	71160	134200	15900	14680	7223	362	260700
1998	100300	146000	18700	20490	18290	399	323600
1999	97900	160700	21250	17750	9437	415	326800
2000	120400	192700	18010	26250	10970	268	388600
2001	96300	125300	12130	21640	4688	264	274000
2002	63760	120500	19130	36470	8699	446	268900
2003	49360	209900	17290	20550	5098	235	317400
2004	69950	170400	22820	39470	7397	316	333000
2005	163200	151900	16100	22850	6610	316	396600
2006	138100	172400	19410	29410	9061	446	396300
2007	135900	142900	14710	20520	6786	294	349300
2008	146500	192000	23740	29770	13660	807	438800
2009	41460	168800	14350	11280	3690	239	264800
2010	57700	223700	18140	39770	13320	520	372600
2011	95860	187200	24970	37330	8418	1070	395200
2012	73370	226800	16230	7868	532.3	26	348300
2013	65040	164900	15630	10460	1880	77	283900

95th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	68810	120400	16280	48330	22150		
1971	91500	105400	13770	39720	14960	29	244100
1972	68710	99040	12120	49390	13700	17	221800
1973	12380	142200	16200	54540	21960	13	230100
1974	76870	107700	14840	90720	39530	40	301000
1975	149200	135400	17130	80100	29580	68	380200
1976	103200	143700	19150	107900	47110	152	385000
1977	92440	144900	17720	30850	38050	54	297000
1978	45320	128300	16890	27590	10360	128	211400
1979	58750	139500	23400	59290	43140	249	296300
1980	139100	156700	30700	51970	57520	729	401000
1981	152700	206700	45640	90700	48620	1018	493700
1982	105000	182200	24900	114100	29150	293	414600
1983	63690	143200	17740	31310	17630	257	250600
1984	32710	193600	22680	31310	38890	545	295300
1985	61240	186300	22570	77780	43520	366	356400
1986	94380	188100	30670	156300	47100	666	470500
1987	117300	128000	36560	114700	49060	1097	405200
1988	107600	204700	40380	162900	49920	931	515100
1989	72650	102000	33890	91240	51690	1090	319200
1990	41890	136600	36140	108400	52830	623	345800
1991	33970	94320	27790	84010	26010	237	245800
1992	48310	234300	30380	187900	30960	1134	497300
1993	64070	269300	24490	160200	24250	448	500500
1994	45360	152100	23080	54680	10220	431	264700
1995	64110	201400	19600	56770	20410	215	337600
1996	124000	318700	25590	40180	32530	657	506700
1997	128100	169700	20040	23580	9469	368	330700
1998	197400	170700	23670	30120	21560	407	424500
1999	192200	192000	26220	25330	10970	423	427800
2000	237100	216700	24130	36780	13020	272	507900
2001	189700	141700	15210	30260	5494	268	368700
2002	136300	145200	23560	51900	10390	454	347800
2003	116400	229200	21370	29790	6095	239	388400
2004	115300	206500	29780	57350	8891	322	395300
2005	272500	242100	20440	35650	7987	322	542900
2006	284200	209400	23770	46500	11000	454	548200
2007	248800	192600	18700	34630	8274	300	475300
2008	256100	243000	29680	49600	16600	821	563900
2009	134000	225500	18100	20120	4468	243	377400
2010	122200	246800	22860	55290	16260	530	444100
2011	444800	241200	30650	58830	10310	1090	746900
2012	268400	266700	20560	14080	648.7	26	546800
2013	315200	205900	19790	19570	2278	79	536100

Table 4.3.2.2. Estimated large salmon returns (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of returns of large salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	10070	14870	103200	69550	20290		
1971	14430	12580	59180	40050	15880	653	143200
1972	12370	12650	77140	57050	18990	1383	180000
1973	17300	17310	85180	53390	14760	1427	189900
1974	17060	14260	114400	77510	28560	1394	253800
1975	15950	18400	97050	50350	30620	2331	215100
1976	18280	16650	96450	48720	28810	1317	210900
1977	16230	14600	113700	87780	38070	1998	273000
1978	12690	11340	102500	43830	22260	4208	197300
1979	7222	7189	56510	17860	12810	1942	103800
1980	17420	12050	134300	62510	43760	5796	276300
1981	15650	28860	105400	39300	28210	5601	223700
1982	11600	11600	93540	54040	23650	6056	200900
1983	8398	12450	76840	40680	20610	2155	161400
1984	6016	12390	59160	32740	24510	3222	138300
1985	4738	10930	62310	44420	34170	5529	162400
1986	8121	12300	73530	68510	28230	6176	197100
1987	11010	8423	69000	46760	17700	3081	156300
1988	6853	12980	76290	53770	16430	3286	169800
1989	6593	6912	70800	42740	18530	3197	149000
1990	3806	10280	69610	56730	15990	5051	161600
1991	1880	7566	60990	57760	15650	2647	146600
1992	7528	31560	61050	60250	14300	2459	177400
1993	9457	17120	46450	64070	10060	2231	149800
1994	12920	17360	46470	41490	6322	1346	126400
1995	25560	19060	53010	48410	7505	1748	155800
1996	18770	28950	47490	41510	10870	2407	150500
1997	16230	27990	39320	36230	5581	1611	127400
1998	13460	35290	29030	31180	3847	1526	114300
1999	16100	32130	33290	28110	4942	1168	115700
2000	21940	27010	31560	30540	2869	533	114500
2001	23220	17860	33620	40320	4661	797	120500
2002	16930	16820	23280	24180	1585	526	83340
2003	14180	24460	38520	40630	3523	1199	122500
2004	17010	22190	32770	41040	3098	1316	117400
2005	20940	28420	32330	38660	2024	994	123400
2006	21090	35730	29250	38690	2986	1030	128700
2007	21820	29600	27090	35550	1596	958	116700
2008	26170	28880	33020	28800	3272	1799	122000
2009	39320	34460	32310	36970	3144	2095	148400
2010	13840	35400	35460	33140	2514	1098	121500
2011	44210	43460	44960	70510	4794	3087	210900
2012	33920	28820	31540	27610	1310	913	124200
2013	68130	40460	34780	34260	3185	525	181200

5th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	4393	9696	32060	9637	5544		
1971	6616	8426	16610	9421	6434	486	56090
1972	5656	8713	32510	25500	10110	1029	95990
1973	7500	11850	33120	27800	6286	1090	101200
1974	7523	11470	40260	44470	12950	1137	132700
1975	7512	14880	33470	26470	15250	1925	112700
1976	8151	13580	31790	22150	14150	1116	104500
1977	6726	10200	45790	43150	18130	637	141100
1978	5498	8774	41950	14650	9167	3284	93330
1979	2938	5731	17980	6669	6718	1495	47110
1980	7633	9185	50010	26910	19800	4225	132800
1981	7135	23910	36690	9886	9974	4295	106100
1982	5051	8848	37170	15730	8249	4601	92380
1983	3698	9912	24290	11200	3520	1753	63710
1984	2433	8643	34090	19220	16660	2524	93950
1985	2038	7662	31580	30650	23690	4840	112700
1986	3536	9352	36630	47180	20440	5520	136400
1987	4777	6419	32550	31600	13390	2756	102900
1988	2668	9770	38580	38080	12070	3011	116300
1989	2801	5358	37490	29640	15200	2775	103100
1990	1520	8326	36550	38130	12760	4317	111300
1991	830.1	6114	29360	38650	11900	2394	96930
1992	3195	22140	28490	49690	11020	2271	130200
1993	5513	13640	23150	33910	7601	2046	95520
1994	7988	13350	22710	32220	4787	1332	90610
1995	17710	14210	32690	40620	6179	1732	123100
1996	12980	23210	27820	32130	8659	2385	118100
1997	11370	22490	23020	27430	4320	1596	99500
1998	7667	27040	21240	23990	3162	1512	94590
1999	9148	24630	25730	21700	4096	1157	96150
2000	12620	22460	23830	24370	2390	1573	96680
2001	13290	14780	24860	33580	3970	1478	100700
2002	9591	13400	18420	19020	1236	506	69710
2003	7048	19060	30480	32550	2956	1181	104000
2004	11160	16630	25650	31430	2691	1271	98870
2005	11700	20020	25800	29660	1715	1078	102100
2006	12930	29530	23910	29560	2510	1406	110600
2007	12520	23060	21450	28130	1328	1178	98280
2008	15520	21990	26700	21250	2810	2211	102500
2009	20350	23640	26310	29140	2711	2297	119800
2010	7844	28180	29470	25990	2134	1488	105000
2011	12350	30650	37210	51280	4230	3879	165100
2012	12370	22960	26120	19190	1111	2036	95540
2013	25260	28070	29330	25150	2764	520	130700

95th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	16500	15780	46170	14140	10200		
1971	23840	13530	23890	14230	9964	494	77130
1972	20420	13860	46780	41130	13840	1047	123500
1973	28070	19020	47600	42930	8949	1110	132900
1974	28060	14620	57900	67280	17470	1157	170000
1975	26560	19450	48150	40970	20450	1959	143100
1976	30010	17600	45780	36210	19820	1136	135900
1977	26110	13500	65860	67890	25000	649	181000
1978	20610	10780	60360	24190	12570	3344	120700
1979	11590	7536	25880	10910	9155	1523	60520
1980	28390	11070	71910	41970	28080	4301	169300
1981	25800	31060	52810	22250	15480	4373	136300
1982	18840	11870	53500	38270	12550	4685	125800
1983	13650	12240	34990	24920	7944	1785	85520
1984	9619	15100	40060	37780	23370	2570	117500
1985	7684	14170	39340	55910	33390	4928	142700
1986	13230	15050	44650	85870	29330	5620	179100
1987	17880	10350	39530	56600	18720	2806	133500
1988	10930	16010	47740	66130	17520	3065	148400
1989	10700	8424	44780	51850	20980	2825	129000
1990	6079	12130	45300	71750	17770	4395	147400
1991	3058	8950	36720	74030	16340	2438	133800
1992	11940	40780	36240	67020	14950	2313	158900
1993	14700	20290	26780	92090	9921	2084	155000
1994	19780	20460	26230	48580	6075	1356	112800
1995	36960	22960	36540	54690	8016	1764	149500
1996	27260	33550	32250	48500	11250	2429	142800
1997	23450	32620	26630	42410	5492	1625	121700
1998	18570	42770	24830	36490	3785	1540	118000
1999	22200	38930	30090	31520	4790	1178	119000
2000	30410	30490	29600	34580	2907	1601	120100
2001	32130	20180	30090	44350	4756	1504	124200
2002	23670	19620	23010	27490	1511	516	88350
2003	20600	29180	37020	46300	3628	1203	127200
2004	22090	27040	30680	47860	3229	1295	122100
2005	29380	35760	30350	44660	2085	1098	131200
2006	28570	40970	28250	44920	3112	1432	136600
2007	30540	35420	25680	40230	1607	1200	124000
2008	36190	34630	32990	33660	3509	2251	131100
2009	57730	44660	31140	41960	3297	2339	165900
2010	19160	41450	34560	37410	2595	1516	126800
2011	74980	54960	43280	85760	5182	3949	242800
2012	55380	34050	30860	29600	1385	2072	141600
2013	110400	52050	33780	40580	3511	530	221200

Table 4.3.2.3. Estimated 2SW salmon returns (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of returns of 2SW salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	10070	4131	75360	59580	17120		
1971	14430	3592	43200	34830	13500	653	110600
1972	12370	3736	56310	49470	15980	1383	139600
1973	17300	4617	62180	47680	12910	1427	146600
1974	17060	3638	83480	67260	27110	1394	200400
1975	15950	5205	70850	43020	28880	2331	166600
1976	18280	4352	70410	40260	26650	1317	161900
1977	16230	3551	83010	80520	32280	1998	218100
1978	12690	3583	74830	36300	18780	4208	150800
1979	7222	1740	41250	12020	10520	1942	74910
1980	17420	3895	98020	56830	38670	5796	221200
1981	15650	7022	76970	24390	23220	5601	153400
1982	11600	3168	68280	41850	16750	6056	148000
1983	8398	3699	56090	31280	16480	2155	118400
1984	6016	3360	43180	29540	21490	3222	107000
1985	4738	2741	45480	35950	29690	5529	124300
1986	8121	3267	53680	57040	21410	6176	150000
1987	11010	2350	50370	35960	13650	3081	116800
1988	6853	3431	55690	42760	11770	3286	124000
1989	6593	1686	51680	28290	14640	3197	106300
1990	3806	2689	50810	37060	11660	5051	111200
1991	1880	2057	44520	36040	13040	2647	100200
1992	7528	8163	44560	38110	11990	2459	113100
1993	9457	4356	33910	43380	8087	2231	101800
1994	12920	4048	33920	30400	5168	1346	88250
1995	25560	3841	38700	39710	6828	1748	116800
1996	18770	5668	34670	29840	9202	2407	101000
1997	16230	6015	28700	24420	4574	1611	81940
1998	8786	6457	21190	16820	2605	1526	57370
1999	10530	6275	24300	16320	4193	1168	62810
2000	14340	6371	23040	17360	2377	533	64060
2001	15170	2494	24540	27330	4272	788	74560
2002	11070	2425	16990	14510	968.3	504	46460
2003	9287	3376	28120	26530	3329	1192	71870
2004	11100	3325	23920	26460	2690	1283	68830
2005	13690	4412	23600	26930	1694	984	71300
2006	13770	5365	21350	23270	2544	1023	67350
2007	14290	4169	19770	22900	1390	954	63480
2008	17090	3878	24110	18880	3054	1764	68840
2009	25550	4625	23590	24610	2666	2069	83120
2010	8985	4665	25890	20470	2017	1078	63110
2011	28670	3663	32820	56750	4640	3045	129500
2012	22010	2286	23020	19640	1035	879	68900
2013	44170	3453	25390	24430	2983	525	100900

5th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	4393	2302	23410	8171	4694		
1971	6616	2078	12120	8283	5595	486	41040
1972	5656	2207	23730	22340	8737	1029	73160
1973	7500	2785	24170	25340	5537	1090	76350
1974	7523	2429	29390	38970	11940	1137	103600
1975	7512	3451	24430	22670	13890	1925	84650
1976	8151	2990	23210	18250	12930	1116	77350
1977	6726	2183	33430	40000	15720	637	112300
1978	5498	2466	30620	12040	7948	3284	70080
1979	2938	1235	13130	4387	5646	1495	32890
1980	7633	2643	36510	24610	17690	4225	106200
1981	7135	5101	26780	5843	8254	4295	67060
1982	5051	2169	27130	12110	6183	4601	67170
1983	3698	2651	17730	8493	2656	1753	44120
1984	2433	2271	24890	17340	14530	2524	71510
1985	2038	1903	23050	24230	20560	4840	85220
1986	3536	2345	26740	39000	15290	5520	102300
1987	4777	1648	23760	24010	10220	2756	75680
1988	2668	2425	28160	30000	8520	3011	83090
1989	2801	1238	27370	19480	12090	2775	72920
1990	1520	1992	26680	25140	9259	4317	75590
1991	830.1	1558	21440	24080	9817	2394	65560
1992	3195	5407	20800	31030	9171	2271	80180
1993	5513	3185	16900	22550	6049	2046	62740
1994	7988	2779	16580	23450	3903	1332	61500
1995	17710	2453	23870	33250	5647	1732	91300
1996	12980	3914	20310	22570	7318	2385	76700
1997	11370	4131	16810	17790	3535	1596	61140
1998	5007	4428	15510	12500	2074	1512	46030
1999	5979	4307	18780	12310	3458	1157	51210
2000	8247	4389	17400	13540	1965	1573	52860
2001	8696	1647	18150	22460	3658	1478	61440
2002	6257	1562	13450	11190	718.7	506	37780
2003	4602	2166	22250	20810	2803	1181	59670
2004	7278	2031	18720	19830	2353	1271	56900
2005	7653	2467	18830	20470	1440	1078	58270
2006	8439	3485	17450	17540	2149	1406	56440
2007	8176	2593	15660	17960	1165	1178	52210
2008	10130	2357	19490	13670	2634	2784	57610
2009	13190	2747	19200	19230	2312	2271	66000
2010	5085	3042	21510	15460	1708	1469	53460
2011	8011	2345	27170	40860	4106	3837	99280
2012	8017	1585	19070	14980	875.8	2002	52350
2013	16420	2168	21410	18030	2580	520	69170

95th percentile of estimates of returns							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	16500	4162	33700	11790	8309		
1971	23840	3877	17440	12560	8515	494	60390
1972	20420	4069	34150	36100	12020	1047	97450
1973	28070	4898	34750	39070	7861	1110	104700
1974	28060	3843	42270	58940	16220	1157	136900
1975	26560	5956	35150	35140	18830	1959	111700
1976	30010	4962	33420	29900	18110	1136	105700
1977	26110	3360	48070	62720	21960	649	147700
1978	20610	3638	44060	19840	10890	3344	93210
1979	11590	1999	18890	7164	7714	1523	44410
1980	28390	3886	52500	38400	24940	4301	138200
1981	25800	8081	38550	13680	12470	4373	92250
1982	18840	3373	39050	30310	9432	4685	94800
1983	13650	3910	25550	19430	5742	1785	62230
1984	9619	4070	29250	34690	20460	2570	92510
1985	7684	3551	28720	45680	28710	4928	110200
1986	13230	4110	32600	71860	21560	5620	138300
1987	17880	3023	28860	43960	14210	2806	101300
1988	10930	4401	34850	52790	12130	3065	109100
1989	10700	2118	32690	34550	16530	2825	91640
1990	6079	3348	33070	46440	12750	4395	98920
1991	3058	2534	26800	46260	13490	2438	88940
1992	11940	10790	26450	42770	12480	2313	97460
1993	14700	5435	19550	62820	7812	2084	104500
1994	19780	5000	19150	35920	4882	1356	79470
1995	36960	4959	26670	45070	7287	1764	114900
1996	27260	7088	23540	35430	9449	2429	96790
1997	23450	7612	19440	29390	4412	1625	78920
1998	12300	8296	18120	20060	2474	1540	57800
1999	14690	8120	21960	18670	4009	1178	63420
2000	20150	8043	21610	19940	2391	1601	67870
2001	21280	3226	21970	30330	4361	1504	77240
2002	15660	3197	16800	16750	853	516	49640
2003	13610	4446	27030	30690	3434	1203	74370
2004	14660	4461	22400	31350	2795	1295	71370
2005	19420	6177	22160	31510	1736	1098	75570
2006	18920	7090	20620	27390	2640	1432	72020
2007	20190	5615	18750	26070	1394	1200	67640
2008	23970	5184	24080	22480	3284	2834	75220
2009	37750	6384	22730	28160	2783	2313	93010
2010	12570	6074	25230	23760	2057	1495	65990
2011	48830	4902	31600	69780	5010	3907	151300
2012	36090	2950	22530	22900	1089	2038	81950
2013	71980	4678	24660	28830	3293	530	126000

Table 4.3.2.4. Estimated small salmon spawners (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of spawners of small salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	45210	105200	13810	39300	18380		
1971	60250	92120	11690	32650	12160	29	209700
1972	45620	86120	10250	40270	10830	17	194100
1973	6468	124400	13750	45650	18330	13	208700
1974	51310	94080	12580	76220	33130	40	268600
1975	99300	117700	14500	67250	26170	67	326100
1976	68060	124100	16240	90010	40780	151	340900
1977	61050	125200	14990	24740	32160	54	259500
1978	30060	110700	14330	22750	9017	127	188000
1979	38230	120700	19800	49660	36580	247	266300
1980	91700	136600	26000	43530	49570	722	349800
1981	100100	178900	38730	69960	40310	1009	431200
1982	69130	158900	21090	89110	24410	290	364700
1983	41430	124200	15040	23800	14840	255	220800
1984	21160	166900	20390	21810	32760	540	264600
1985	40080	158900	20100	59980	36210	363	316900
1986	61940	162700	27690	122500	39500	660	417200
1987	76650	110900	32790	89840	41140	1087	354600
1988	70060	177500	36350	127500	42190	923	456700
1989	47210	89130	30730	69570	43570	1080	282900
1990	26990	122400	32780	84190	44140	617	312300
1991	21930	85040	25230	66500	22280	235	222000
1992	31600	205300	27350	159700	26290	1124	452700
1993	43060	239100	22010	112700	20450	444	439200
1994	31010	129800	20720	44980	9129	427	237300
1995	44920	171200	17720	48110	17860	213	301500
1996	87120	274700	23180	34210	28260	651	450600
1997	92750	151900	17970	19130	8358	365	291700
1998	148600	158400	21190	25310	19920	403	373900
1999	145200	176400	23730	21530	10210	419	377400
2000	178600	204700	21070	31490	11990	270	448300
2001	142800	133500	13670	25960	5093	266	321200
2002	99810	132900	21350	44170	9538	450	308200
2003	82930	219600	19320	25140	5596	237	352700
2004	92540	188400	26300	48430	8138	319	364100
2005	218000	197000	18270	29270	7295	319	470300
2006	211100	191000	21590	37970	10030	450	472200
2007	192500	167800	16710	27600	7530	297	412300
2008	201000	217600	26690	39660	15120	814	501000
2009	87360	197300	16210	15700	4078	241	321000
2010	89670	235300	20490	47480	14780	525	408200
2011	269200	214000	27820	48070	9360	1080	569400
2012	170900	246700	18380	11000	590.2	26	448000
2013	189400	185500	17710	15040	2079	78	409700

5th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	30160	89930	11330	30300	14630		
1971	40740	78870	9578	25490	9352	29	182900
1972	30860	73350	8415	31060	7941	17	170100
1973	1974	106800	11260	36670	14660	13	187500
1974	34970	80250	10330	61600	26720	40	239200
1975	67420	99800	11880	54510	22760	66	284400
1976	45490	104600	13310	72220	34440	150	302300
1977	40970	105700	12300	18680	26240	54	227700
1978	20260	93120	11730	17980	7696	126	165800
1979	25140	102000	16250	40150	29930	245	238500
1980	62400	116700	21340	35110	41630	716	309000
1981	67320	151200	31720	49360	31870	1000	377800
1982	46480	135300	17270	64180	19670	287	319100
1983	27350	105500	12340	16230	12060	253	193700
1984	13860	140100	18080	12350	26640	535	233400
1985	26740	131500	17670	42290	28900	360	278300
1986	41620	137300	24710	88210	31940	654	365500
1987	51010	94010	29060	65200	33160	1077	309800
1988	46420	150100	32310	91820	34380	915	401000
1989	31080	76360	27550	47820	35430	1070	248300
1990	17590	108100	29470	60380	35240	612	279500
1991	14260	75860	22670	48950	18540	233	198900
1992	21430	176000	24360	131400	21650	1114	408300
1993	30570	208500	19530	65620	16690	440	379800
1994	22260	107500	18390	35330	8035	423	210200
1995	33080	140900	15850	39390	15340	211	265700
1996	64900	230500	20740	28220	23960	645	398000
1997	71160	134200	15900	14680	7223	362	260700
1998	100300	146000	18700	20490	18290	399	323600
1999	97900	160700	21250	17750	9437	415	326800
2000	120400	192700	18010	26250	10970	268	388600
2001	96300	125300	12130	21640	4688	264	274000
2002	63760	120500	19130	36470	8699	446	268900
2003	49360	209900	17290	20550	5098	235	317400
2004	69950	170400	22820	39470	7397	316	333000
2005	163200	151900	16100	22850	6610	316	396600
2006	138100	172400	19410	29410	9061	446	396300
2007	135900	142900	14710	20520	6786	294	349300
2008	146500	192000	23740	29770	13660	807	438800
2009	41460	168800	14350	11280	3690	239	264800
2010	57700	223700	18140	39770	13320	520	372600
2011	95860	187200	24970	37330	8418	1070	395200
2012	73370	226800	16230	7868	532	26	348300
2013	65040	164900	15630	10460	1880	77	283900

95th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	68810	120400	16280	48330	22150		
1971	91500	105400	13770	39720	14960	29	244100
1972	68710	99040	12120	49390	13700	17	221800
1973	12380	142200	16200	54540	21960	13	230100
1974	76870	107700	14840	90720	39530	40	301000
1975	149200	135400	17130	80100	29580	68	380200
1976	103200	143700	19150	107900	47110	152	385000
1977	92440	144900	17720	30850	38050	54	297000
1978	45320	128300	16890	27590	10360	128	211400
1979	58750	139500	23400	59290	43140	249	296300
1980	139100	156700	30700	51970	57520	729	401000
1981	152700	206700	45640	90700	48620	1018	493700
1982	105000	182200	24900	114100	29150	293	414600
1983	63690	143200	17740	31310	17630	257	250600
1984	32710	193600	22680	31310	38890	545	295300
1985	61240	186300	22570	77780	43520	366	356400
1986	94380	188100	30670	156300	47100	666	470500
1987	117300	128000	36560	114700	49060	1097	405200
1988	107600	204700	40380	162900	49920	931	515100
1989	72650	102000	33890	91240	51690	1090	319200
1990	41890	136600	36140	108400	52830	623	345800
1991	33970	94320	27790	84010	26010	237	245800
1992	48310	234300	30380	187900	30960	1134	497300
1993	64070	269300	24490	160200	24250	448	500500
1994	45360	152100	23080	54680	10220	431	264700
1995	64110	201400	19600	56770	20410	215	337600
1996	124000	318700	25590	40180	32530	657	506700
1997	128100	169700	20040	23580	9469	368	330700
1998	197400	170700	23670	30120	21560	407	424500
1999	192200	192000	26220	25330	10970	423	427800
2000	237100	216700	24130	36780	13020	272	507900
2001	189700	141700	15210	30260	5494	268	368700
2002	136300	145200	23560	51900	10390	454	347800
2003	116400	229200	21370	29790	6095	239	388400
2004	115300	206500	29780	57350	8891	322	395300
2005	272500	242100	20440	35650	7987	322	542900
2006	284200	209400	23770	46500	11000	454	548200
2007	248800	192600	18700	34630	8274	300	475300
2008	256100	243000	29680	49600	16600	821	563900
2009	134000	225500	18100	20120	4468	243	377400
2010	122200	246800	22860	55290	16260	530	444100
2011	444800	241200	30650	58830	10310	1090	746900
2012	268400	266700	20560	14080	649	26	546800
2013	315200	205900	19790	19570	2278	79	536100

Table 4.3.2.5. Estimated large salmon spawners (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of spawners of large salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	9509	12750	39120	11880	7868		
1971	13940	10980	20260	11810	8200	490	65840
1972	11940	11290	39670	33320	11980	1038	109600
1973	16290	15400	40340	35360	7614	1100	116500
1974	16260	13050	49050	55800	15200	1147	151000
1975	15620	17170	40760	33650	17860	1942	127500
1976	17450	15580	38820	29180	16980	1126	119500
1977	14940	11850	55800	55500	21560	643	160800
1978	11920	9784	51150	19430	10870	3314	106900
1979	6613	6634	21960	8787	7934	1509	53600
1980	16530	10130	60930	34430	23950	4263	150600
1981	15130	27480	44770	16050	12730	4334	120800
1982	10980	10350	45370	26990	10390	4643	109100
1983	7970	11080	29710	18050	5730	1769	74480
1984	5506	11870	37090	28530	20020	2547	105800
1985	4444	10900	35460	43380	28560	4884	127700
1986	7654	12200	40640	66680	24900	5570	157800
1987	10370	8388	36030	44120	16050	2781	118100
1988	6143	12890	43150	52040	14790	3038	132300
1989	6132	6886	41130	40680	18110	2800	116000
1990	3449	10230	40950	54920	15260	4356	129300
1991	1787	7545	33060	56220	14130	2416	115200
1992	6746	31450	32340	58360	12980	2292	144500
1993	9070	16940	24960	63150	8762	2065	125400
1994	12430	16890	24460	40470	5430	1344	101500
1995	25110	18570	34620	47640	7090	1748	135300
1996	18380	28400	30050	40360	9955	2407	130000
1997	16010	27570	24830	34920	4901	1611	110300
1998	13140	34900	23050	30240	3474	1526	106300
1999	15680	31760	27920	26600	4443	1168	107600
2000	21540	26490	26720	29470	2647	1587	108500
2001	22740	17500	27470	38910	4361	1491	112500
2002	16630	16510	20740	23260	1373	511	79000
2003	13830	24100	33760	39460	3294	1192	115600
2004	16600	21810	28160	39670	2962	1283	110500
2005	20520	27880	28090	37140	1900	1088	116600
2006	20750	35230	26080	37300	2811	1419	123600
2007	21460	29240	23560	34140	1468	1189	111200
2008	25830	28290	29840	27460	3161	2231	116800
2009	38990	34180	28730	35600	3006	2318	142800
2010	13540	34850	32030	31690	2364	1502	115900
2011	43990	42860	40250	68630	4706	3914	204100
2012	33820	28500	28480	24390	1247	2054	118500
2013	67880	40010	31550	32820	3139	525	175800

5th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	4393	9696	32060	9637	5544		
1971	6616	8426	16610	9421	6434	486	56090
1972	5656	8713	32510	25500	10110	1029	95990
1973	7500	11850	33120	27800	6286	1090	101200
1974	7523	11470	40260	44470	12950	1137	132700
1975	7512	14880	33470	26470	15250	1925	112700
1976	8151	13580	31790	22150	14150	1116	104500
1977	6726	10200	45790	43150	18130	637	141100
1978	5498	8774	41950	14650	9167	3284	93330
1979	2938	5731	17980	6669	6718	1495	47110
1980	7633	9185	50010	26910	19800	4225	132800
1981	7135	23910	36690	9886	9974	4295	106100
1982	5051	8848	37170	15730	8249	4601	92380
1983	3698	9912	24290	11200	3520	1753	63710
1984	2433	8643	34090	19220	16660	2524	93950
1985	2038	7662	31580	30650	23690	4840	112700
1986	3536	9352	36630	47180	20440	5520	136400
1987	4777	6419	32550	31600	13390	2756	102900
1988	2668	9770	38580	38080	12070	3011	116300
1989	2801	5358	37490	29640	15200	2775	103100
1990	1520	8326	36550	38130	12760	4317	111300
1991	830.1	6114	29360	38650	11900	2394	96930
1992	3195	22140	28490	49690	11020	2271	130200
1993	5513	13640	23150	33910	7601	2046	95520
1994	7988	13350	22710	32220	4787	1332	90610
1995	17710	14210	32690	40620	6179	1732	123100
1996	12980	23210	27820	32130	8659	2385	118100
1997	11370	22490	23020	27430	4320	1596	99500
1998	7667	27040	21240	23990	3162	1512	94590
1999	9148	24630	25730	21700	4096	1157	96150
2000	12620	22460	23830	24370	2390	1573	96680
2001	13290	14780	24860	33580	3970	1478	100700
2002	9591	13400	18420	19020	1236	506	69710
2003	7048	19060	30480	32550	2956	1181	104000
2004	11160	16630	25650	31430	2691	1271	98870
2005	11700	20020	25800	29660	1715	1078	102100
2006	12930	29530	23910	29560	2510	1406	110600
2007	12520	23060	21450	28130	1328	1178	98280
2008	15520	21990	26700	21250	2810	2211	102500
2009	20350	23640	26310	29140	2711	2297	119800
2010	7844	28180	29470	25990	2134	1488	105000
2011	12350	30650	37210	51280	4230	3879	165100
2012	12370	22960	26120	19190	1111	2036	95540
2013	25260	28070	29330	25150	2764	520	130700

95th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	16500	15780	46170	14140	10200		
1971	23840	13530	23890	14230	9964	494	77130
1972	20420	13860	46780	41130	13840	1047	123500
1973	28070	19020	47600	42930	8949	1110	132900
1974	28060	14620	57900	67280	17470	1157	170000
1975	26560	19450	48150	40970	20450	1959	143100
1976	30010	17600	45780	36210	19820	1136	135900
1977	26110	13500	65860	67890	25000	649	181000
1978	20610	10780	60360	24190	12570	3344	120700
1979	11590	7536	25880	10910	9155	1523	60520
1980	28390	11070	71910	41970	28080	4301	169300
1981	25800	31060	52810	22250	15480	4373	136300
1982	18840	11870	53500	38270	12550	4685	125800
1983	13650	12240	34990	24920	7944	1785	85520
1984	9619	15100	40060	37780	23370	2570	117500
1985	7684	14170	39340	55910	33390	4928	142700
1986	13230	15050	44650	85870	29330	5620	179100
1987	17880	10350	39530	56600	18720	2806	133500
1988	10930	16010	47740	66130	17520	3065	148400
1989	10700	8424	44780	51850	20980	2825	129000
1990	6079	12130	45300	71750	17770	4395	147400
1991	3058	8950	36720	74030	16340	2438	133800
1992	11940	40780	36240	67020	14950	2313	158900
1993	14700	20290	26780	92090	9921	2084	155000
1994	19780	20460	26230	48580	6075	1356	112800
1995	36960	22960	36540	54690	8016	1764	149500
1996	27260	33550	32250	48500	11250	2429	142800
1997	23450	32620	26630	42410	5492	1625	121700
1998	18570	42770	24830	36490	3785	1540	118000
1999	22200	38930	30090	31520	4790	1178	119000
2000	30410	30490	29600	34580	2907	1601	120100
2001	32130	20180	30090	44350	4756	1504	124200
2002	23670	19620	23010	27490	1511	516	88350
2003	20600	29180	37020	46300	3628	1203	127200
2004	22090	27040	30680	47860	3229	1295	122100
2005	29380	35760	30350	44660	2085	1098	131200
2006	28570	40970	28250	44920	3112	1432	136600
2007	30540	35420	25680	40230	1607	1200	124000
2008	36190	34630	32990	33660	3509	2251	131100
2009	57730	44660	31140	41960	3297	2339	165900
2010	19160	41450	34560	37410	2595	1516	126800
2011	74980	54960	43280	85760	5182	3949	242800
2012	55380	34050	30860	29600	1385	2072	141600
2013	110400	52050	33780	40580	3511	530	221200

Table 4.3.2.6. Estimated 2SW salmon spawners (medians, 5th percentile, 95th percentile) to the six geographic areas and overall for NAC, 1971 to 2013. Returns for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

Median estimates of spawners of large salmon							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	9509	3235	28560	9978	6489		
1971	13940	2978	14790	10420	7062	490	49760
1972	11940	3139	28960	29220	10380	1038	84970
1973	16290	3844	29440	32190	6695	1100	89870
1974	16260	3139	35810	49030	14080	1147	119900
1975	15620	4702	29750	28920	16360	1942	97610
1976	17450	3977	28340	24040	15530	1126	90730
1977	14940	2769	40730	51320	18820	643	129700
1978	11920	3054	37340	15950	9408	3314	81290
1979	6613	1617	16030	5767	6682	1509	38340
1980	16530	3260	44480	31500	21310	4263	121700
1981	15130	6589	32680	9728	10370	4334	79070
1982	10980	2771	33120	21190	7815	4643	80810
1983	7970	3283	21690	13960	4198	1769	53090
1984	5506	3174	27070	26100	17470	2547	82080
1985	4444	2729	25880	34860	24640	4884	97680
1986	7654	3227	29670	55380	18420	5570	120200
1987	10370	2334	26300	33950	12210	2781	88300
1988	6143	3414	31500	41340	10330	3038	96040
1989	6132	1677	30030	26990	14290	2800	82140
1990	3449	2670	29890	35740	11010	4356	87280
1991	1787	2045	24130	35110	11660	2416	77190
1992	6746	8109	23610	36890	10820	2292	88760
1993	9070	4311	18220	42630	6923	2065	83710
1994	12430	3891	17860	29720	4390	1344	70050
1995	25110	3710	25270	39160	6458	1748	101800
1996	18380	5497	21930	28980	8386	2407	86010
1997	16010	5866	18130	23570	3973	1611	69560
1998	8585	6368	16820	16300	2273	1526	51850
1999	10250	6212	20380	15490	3734	1168	57240
2000	14070	6211	19500	16760	2179	1587	60300
2001	14850	2434	20050	26360	4008	1491	69230
2002	10870	2377	15140	13970	786.1	511	43640
2003	9051	3302	24640	25720	3118	1192	67050
2004	10830	3252	20560	25600	2575	1283	64140
2005	13410	4329	20510	26000	1588	1088	66920
2006	13550	5302	19040	22450	2394	1419	64160
2007	14050	4087	17200	22050	1280	1189	59890
2008	16860	3776	21780	18050	2959	2809	66270
2009	25330	4570	20970	23660	2547	2292	79350
2010	8787	4573	23380	19620	1882	1482	59690
2011	28520	3626	29380	55170	4556	3872	125100
2012	21940	2265	20790	18930	982.1	2020	66930
2013	44000	3422	23030	23450	2937	525	97320

5th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	4393	2302	23410	8171	4694		
1971	6616	2078	12120	8283	5595	486	41040
1972	5656	2207	23730	22340	8737	1029	73160
1973	7500	2785	24170	25340	5537	1090	76350
1974	7523	2429	29390	38970	11940	1137	103600
1975	7512	3451	24430	22670	13890	1925	84650
1976	8151	2990	23210	18250	12930	1116	77350
1977	6726	2183	33430	40000	15720	637	112300
1978	5498	2466	30620	12040	7948	3284	70080
1979	2938	1235	13130	4387	5646	1495	32890
1980	7633	2643	36510	24610	17690	4225	106200
1981	7135	5101	26780	5843	8254	4295	67060
1982	5051	2169	27130	12110	6183	4601	67170
1983	3698	2651	17730	8493	2656	1753	44120
1984	2433	2271	24890	17340	14530	2524	71510
1985	2038	1903	23050	24230	20560	4840	85220
1986	3536	2345	26740	39000	15290	5520	102300
1987	4777	1648	23760	24010	10220	2756	75680
1988	2668	2425	28160	30000	8520	3011	83090
1989	2801	1238	27370	19480	12090	2775	72920
1990	1520	1992	26680	25140	9259	4317	75590
1991	830.1	1558	21440	24080	9817	2394	65560
1992	3195	5407	20800	31030	9171	2271	80180
1993	5513	3185	16900	22550	6049	2046	62740
1994	7988	2779	16580	23450	3903	1332	61500
1995	17710	2453	23870	33250	5647	1732	91300
1996	12980	3914	20310	22570	7318	2385	76700
1997	11370	4131	16810	17790	3535	1596	61140
1998	5007	4428	15510	12500	2074	1512	46030
1999	5979	4307	18780	12310	3458	1157	51210
2000	8247	4389	17400	13540	1965	1573	52860
2001	8696	1647	18150	22460	3658	1478	61440
2002	6257	1562	13450	11190	719	506	37780
2003	4602	2166	22250	20810	2803	1181	59670
2004	7278	2031	18720	19830	2353	1271	56900
2005	7653	2467	18830	20470	1440	1078	58270
2006	8439	3485	17450	17540	2149	1406	56440
2007	8176	2593	15660	17960	1165	1178	52210
2008	10130	2357	19490	13670	2634	2784	57610
2009	13190	2747	19200	19230	2312	2271	66000
2010	5085	3042	21510	15460	1708	1469	53460
2011	8011	2345	27170	40860	4106	3837	99280
2012	8017	1585	19070	14980	876	2002	52350
2013	16420	2168	21410	18030	2580	520	69170

95th percentile of estimates of spawners							
Year	1-LAB	2-NFLD	3-QC	4-GF	5-SF	6-USA	7-NAC
1970	16500	4162	33700	11790	8309		
1971	23840	3877	17440	12560	8515	494	60390
1972	20420	4069	34150	36100	12020	1047	97450
1973	28070	4898	34750	39070	7861	1110	104700
1974	28060	3843	42270	58940	16220	1157	136900
1975	26560	5956	35150	35140	18830	1959	111700
1976	30010	4962	33420	29900	18110	1136	105700
1977	26110	3360	48070	62720	21960	649	147700
1978	20610	3638	44060	19840	10890	3344	93210
1979	11590	1999	18890	7164	7714	1523	44410
1980	28390	3886	52500	38400	24940	4301	138200
1981	25800	8081	38550	13680	12470	4373	92250
1982	18840	3373	39050	30310	9432	4685	94800
1983	13650	3910	25550	19430	5742	1785	62230
1984	9619	4070	29250	34690	20460	2570	92510
1985	7684	3551	28720	45680	28710	4928	110200
1986	13230	4110	32600	71860	21560	5620	138300
1987	17880	3023	28860	43960	14210	2806	101300
1988	10930	4401	34850	52790	12130	3065	109100
1989	10700	2118	32690	34550	16530	2825	91640
1990	6079	3348	33070	46440	12750	4395	98920
1991	3058	2534	26800	46260	13490	2438	88940
1992	11940	10790	26450	42770	12480	2313	97460
1993	14700	5435	19550	62820	7812	2084	104500
1994	19780	5000	19150	35920	4882	1356	79470
1995	36960	4959	26670	45070	7287	1764	114900
1996	27260	7088	23540	35430	9449	2429	96790
1997	23450	7612	19440	29390	4412	1625	78920
1998	12300	8296	18120	20060	2474	1540	57800
1999	14690	8120	21960	18670	4009	1178	63420
2000	20150	8043	21610	19940	2391	1601	67870
2001	21280	3226	21970	30330	4361	1504	77240
2002	15660	3197	16800	16750	853	516	49640
2003	13610	4446	27030	30690	3434	1203	74370
2004	14660	4461	22400	31350	2795	1295	71370
2005	19420	6177	22160	31510	1736	1098	75570
2006	18920	7090	20620	27390	2640	1432	72020
2007	20190	5615	18750	26070	1394	1200	67640
2008	23970	5184	24080	22480	3284	2834	75220
2009	37750	6384	22730	28160	2783	2313	93010
2010	12570	6074	25230	23760	2057	1495	65990
2011	48830	4902	31600	69780	5010	3907	151300
2012	36090	2950	22530	22900	1089	2038	81950
2013	71980	4678	24660	28830	3293	530	126000

Table 4.3.6.1. Estimates (medians, 5th percentiles, 95th percentiles) of Prefishery Abundance (PFA) for 1SW maturing salmon, 1SW non-maturing salmon, and the total cohort of 1SW salmon by year (August 1 of the second summer at sea) for NAC for the years of Prefishery Abundance 1971 to 2013.

	median			5th percentile			95th percentile		
Year of PFA	1SW maturing	1SW non-maturing	1SW cohort	1SW maturing	1SW non-maturing	1SW cohort	1SW maturing	1SW non-maturing	1SW cohort
1971	520000	713600	1234000	484800	650400	1165000	561000	778100	1307000
1972	521000	740700	1262000	491200	685000	1204000	553700	801400	1326000
1973	666700	902000	1569000	635800	820600	1486000	698300	986000	1654000
1974	698900	812200	1512000	661900	751300	1446000	738800	877400	1583000
1975	798600	905100	1705000	746300	840000	1627000	860700	974600	1790000
1976	798600	835900	1635000	751200	766400	1556000	849700	909500	1719000
1977	636200	667600	1304000	595000	606400	1236000	682400	729500	1376000
1978	410700	396700	807500	382800	368400	770500	439400	426600	846200
1979	589500	837500	1427000	557600	773000	1357000	623700	907900	1504000
1980	832200	711600	1545000	781600	655600	1476000	892500	771800	1621000
1981	911100	666900	1579000	849000	621100	1506000	981700	715900	1658000
1982	765800	560600	1327000	714800	524100	1267000	820600	599900	1390000
1983	511300	330000	841500	479600	300600	801200	545300	361400	884700
1984	538500	349200	887900	504900	318400	842800	572400	382800	934700
1985	656800	521700	1179000	615300	479600	1121000	699700	567500	1240000
1986	833300	555300	1389000	776900	508000	1318000	891800	603900	1462000
1987	798600	504800	1304000	747100	468000	1245000	856000	543000	1367000
1988	846700	412000	1259000	787000	380000	1193000	909400	445700	1328000
1989	593200	323900	917300	555100	296000	871900	633400	354000	965400
1990	559800	285800	846000	524400	261500	802500	595600	312300	890600
1991	413400	317800	731500	388200	296100	697500	438800	341300	766100
1992	575300	206400	781900	529600	174600	724400	621900	241200	840800
1993	543200	145600	689200	480900	128800	623900	606500	164500	755700
1994	327400	179300	507000	299200	158400	470600	356300	204000	545700
1995	380200	176900	557500	343600	158600	515400	417700	197800	601100
1996	553300	150000	703600	498500	134400	646000	611300	167800	764900
1997	360600	102400	463500	328600	91740	428600	401400	114100	505800
1998	440500	95110	535900	388200	83880	481300	493100	107400	590600
1999	441200	99970	541600	389100	87270	487000	493400	114100	596100
2000	522400	114500	636900	460700	100500	572700	584200	130100	702000
2001	384000	78730	463000	335100	69000	412500	433300	89520	514000
2002	383400	107600	491300	342300	94320	446900	424900	122200	536000
2003	418400	105500	524100	381300	92420	483400	455600	119800	564800
2004	444400	109400	553900	410500	94870	516200	477800	125400	591500
2005	545900	104100	650300	470100	90770	572800	622000	118700	728300
2006	549300	99100	648400	470500	86140	567700	627800	113500	729500
2007	472700	110300	583300	406600	95610	515200	537900	126500	651400
2008	591500	130900	722900	526800	109800	652900	656900	153900	793200
2009	381400	102100	483500	324000	90520	424500	440100	114800	543900
2010	499000	198400	697700	461400	159400	641100	537400	239900	756200
2011	666400	110900	777800	485100	89190	594200	848400	134900	961700
2012	509200	158500	668500	407300	118200	554000	611900	202800	783400
2013	477600			347700			608000		

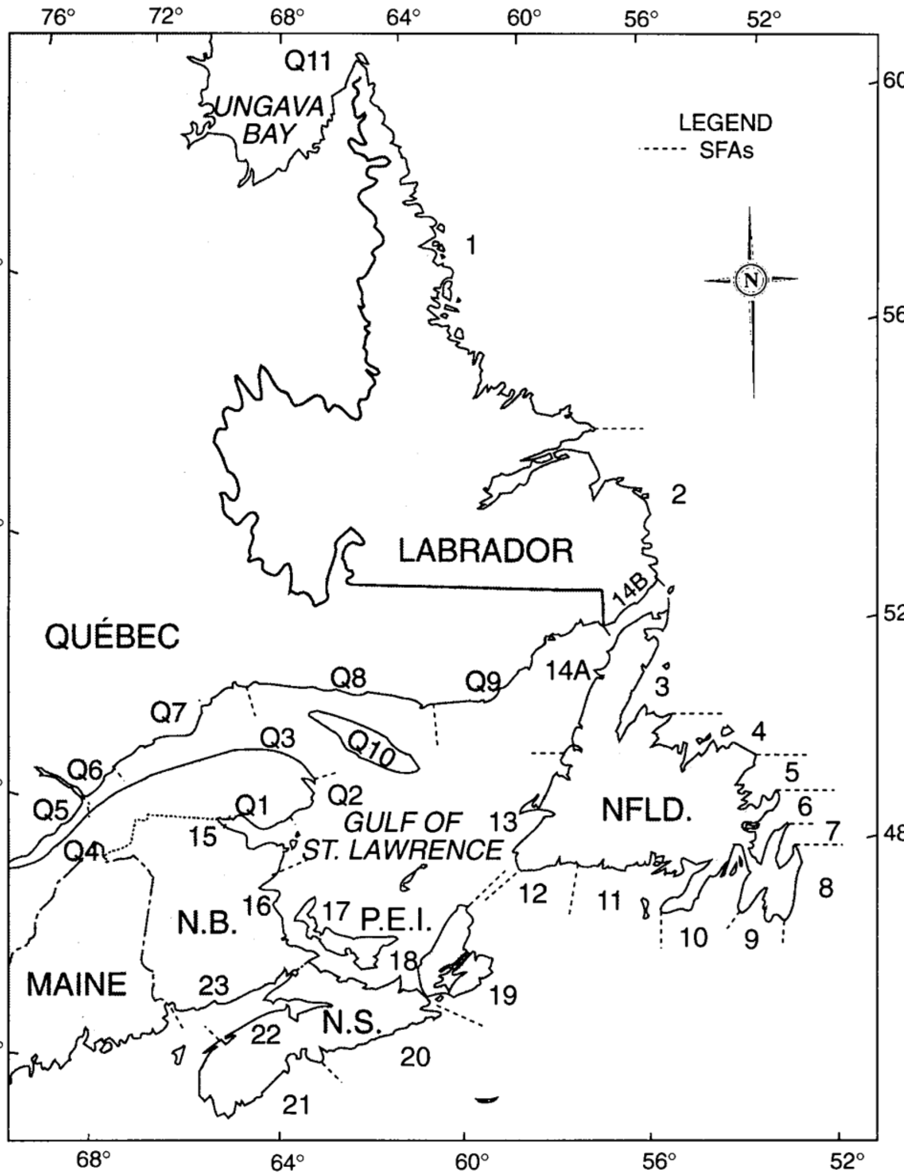


Figure 4.1.2.1. Map of Salmon Fishing Areas (SFAs) and Québec Management Zones (Qs) in Canada.

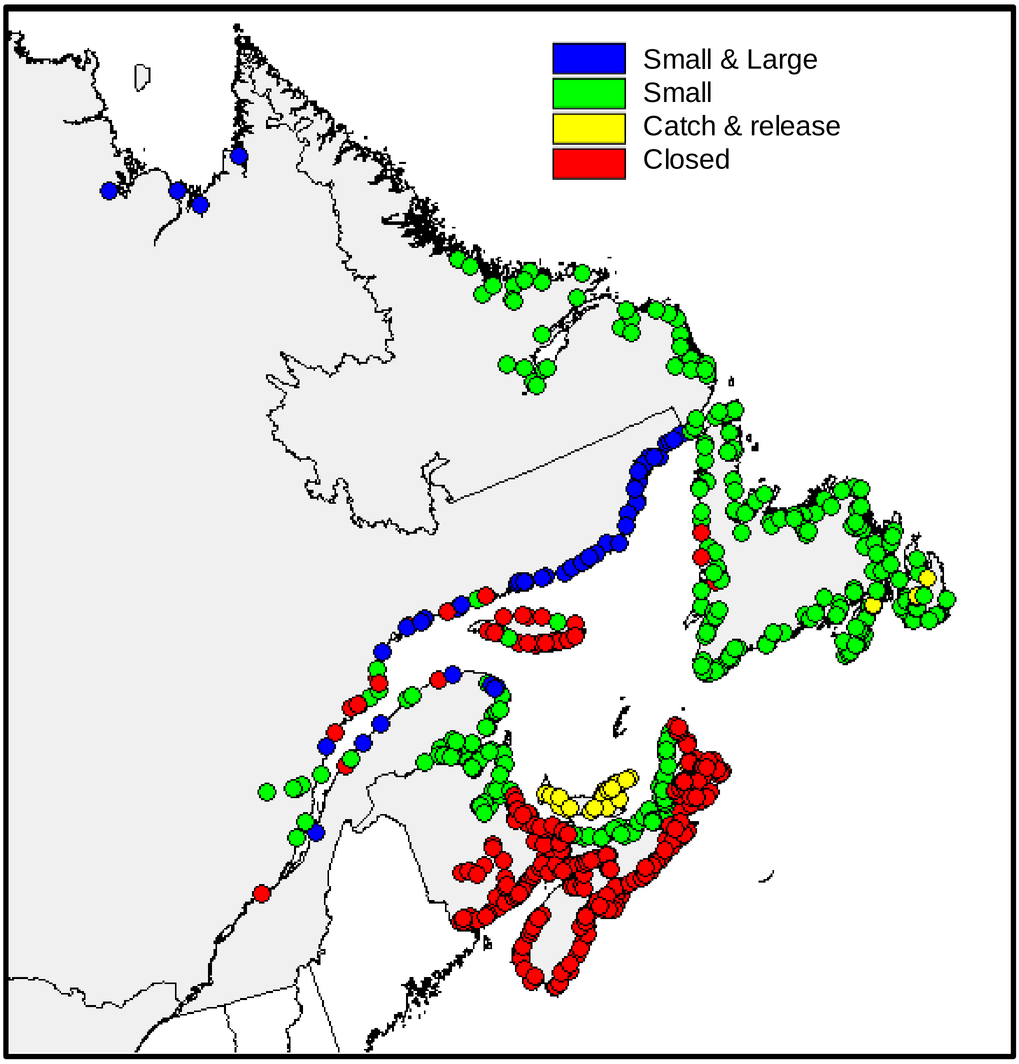


Figure 4.1.2.2. Summary of recreational fisheries management measures in Canada in 2013.

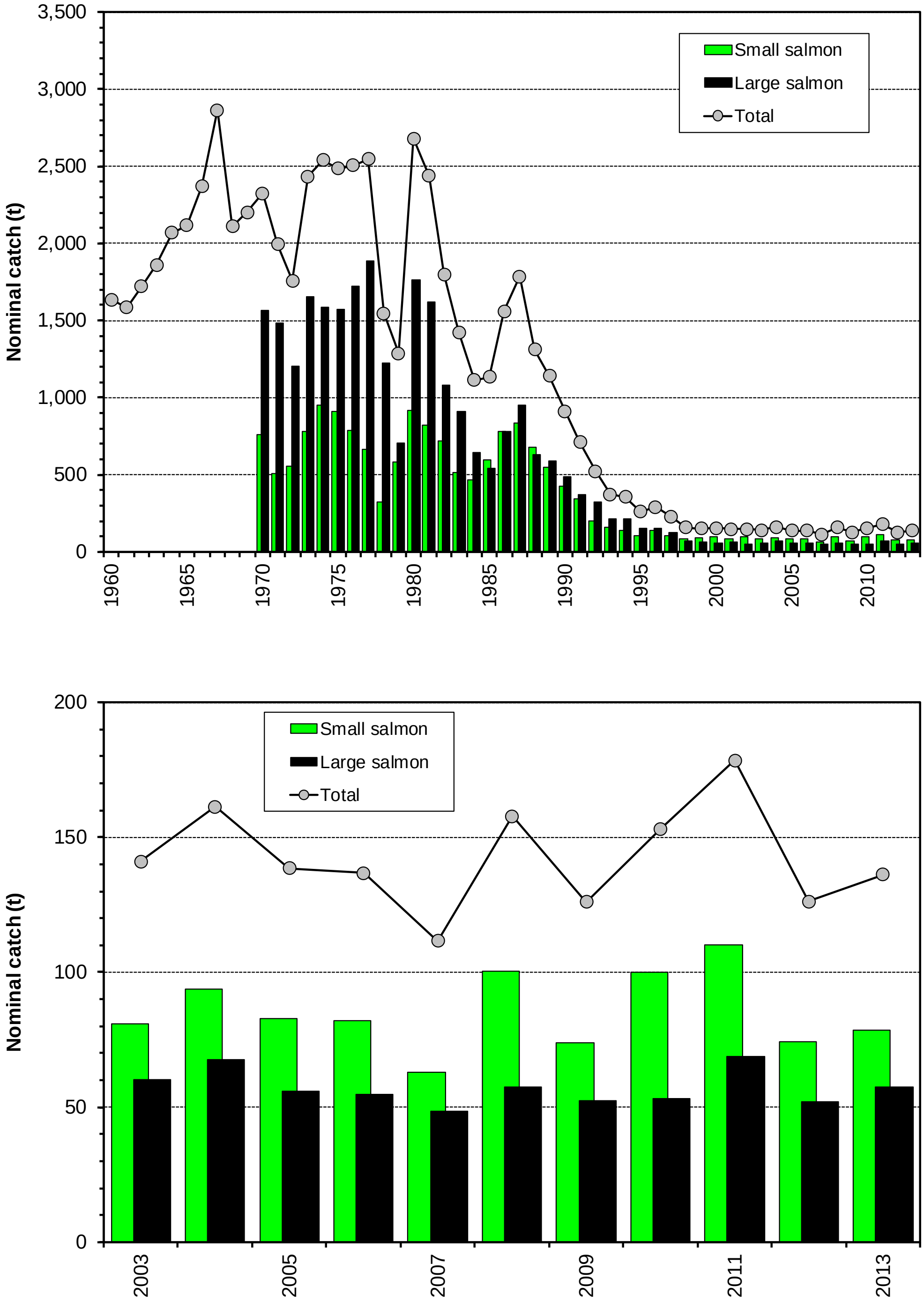
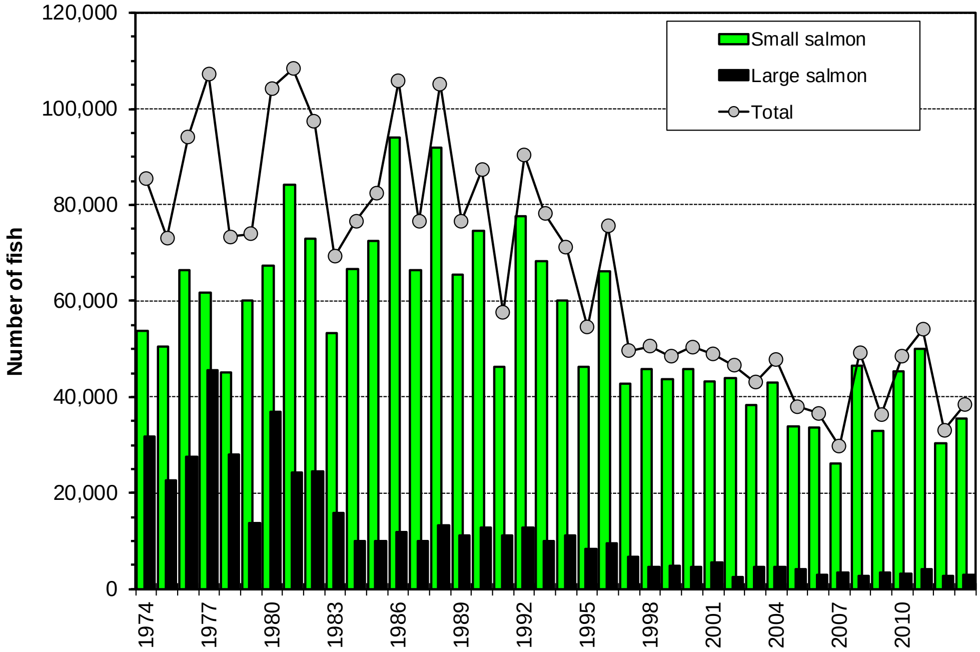


Figure 4.1.3.1. Harvest (t) of small salmon, large salmon and both sizes combined for Canada, 1960 to 2013 (top panel) and 2003 to 2013 (bottom panel) by all users.



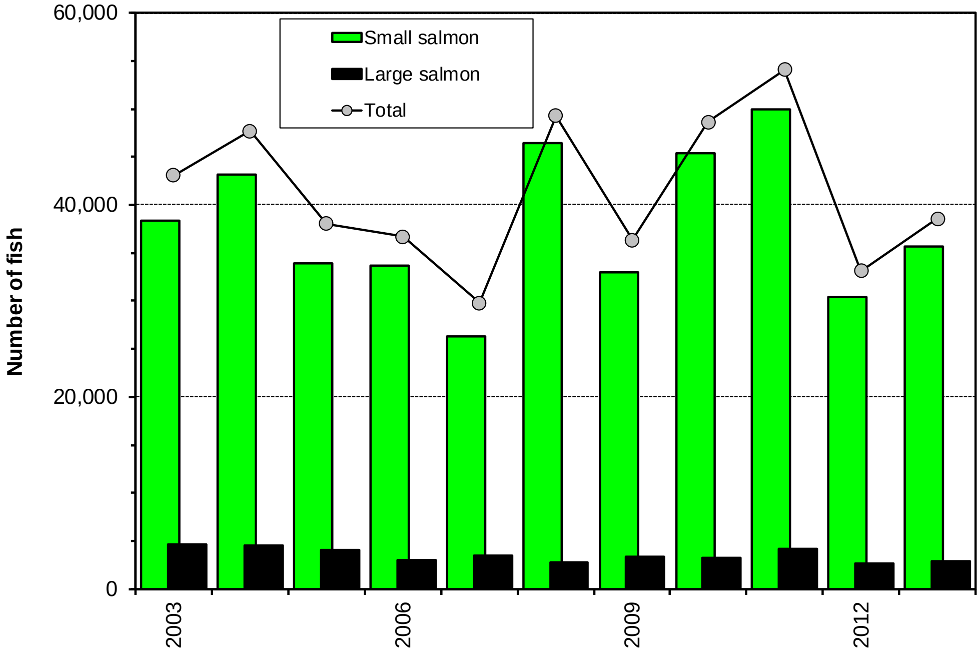


Figure 4.1.3.2. Harvest (number) of small salmon, large salmon and both sizes combined in the recreational fisheries of Canada, 1974 to 2013 (top panel) and 2003 to 2013 (bottom panel).

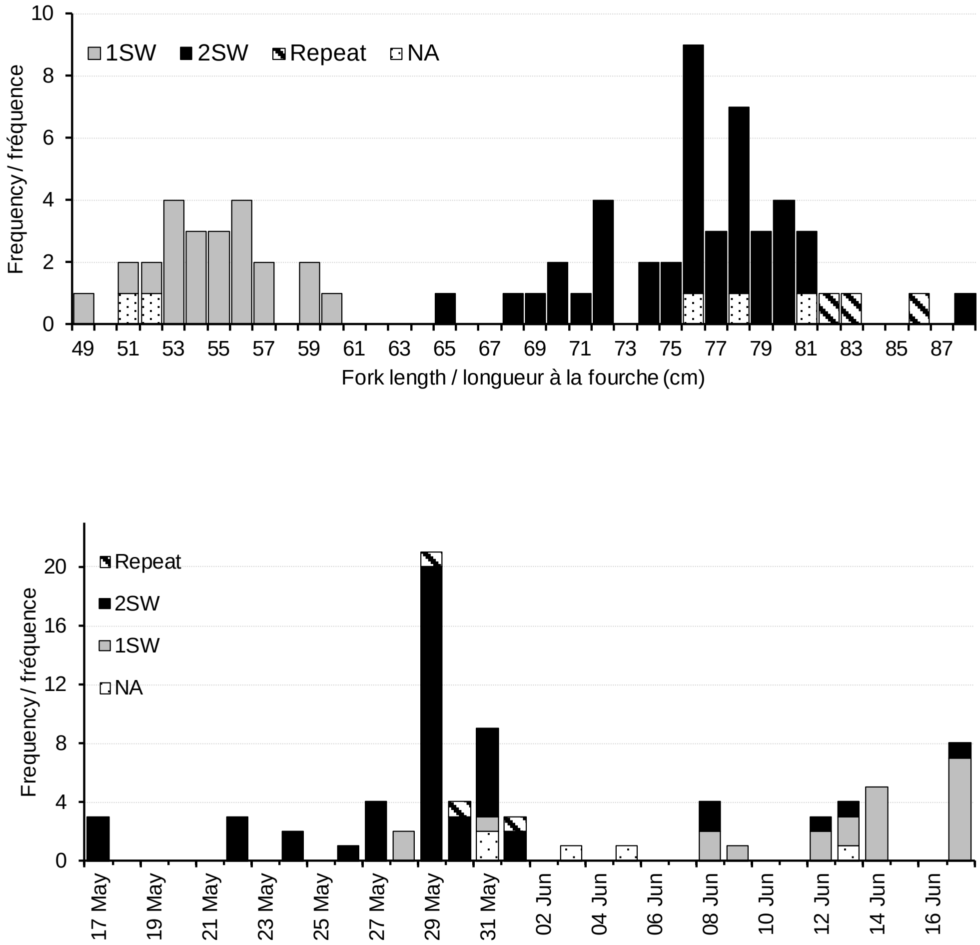


Figure 4.1.5.1. Age composition by fork length (upper panel) and by date of sampling (lower panel) of Atlantic salmon sampled from the Saint-Pierre et Miquelon fishery in 2013. Two samples from 2012 are in the unaged (NA) category assigned to each of Gaspe (76 cm) and Newfoundland (51 cm).

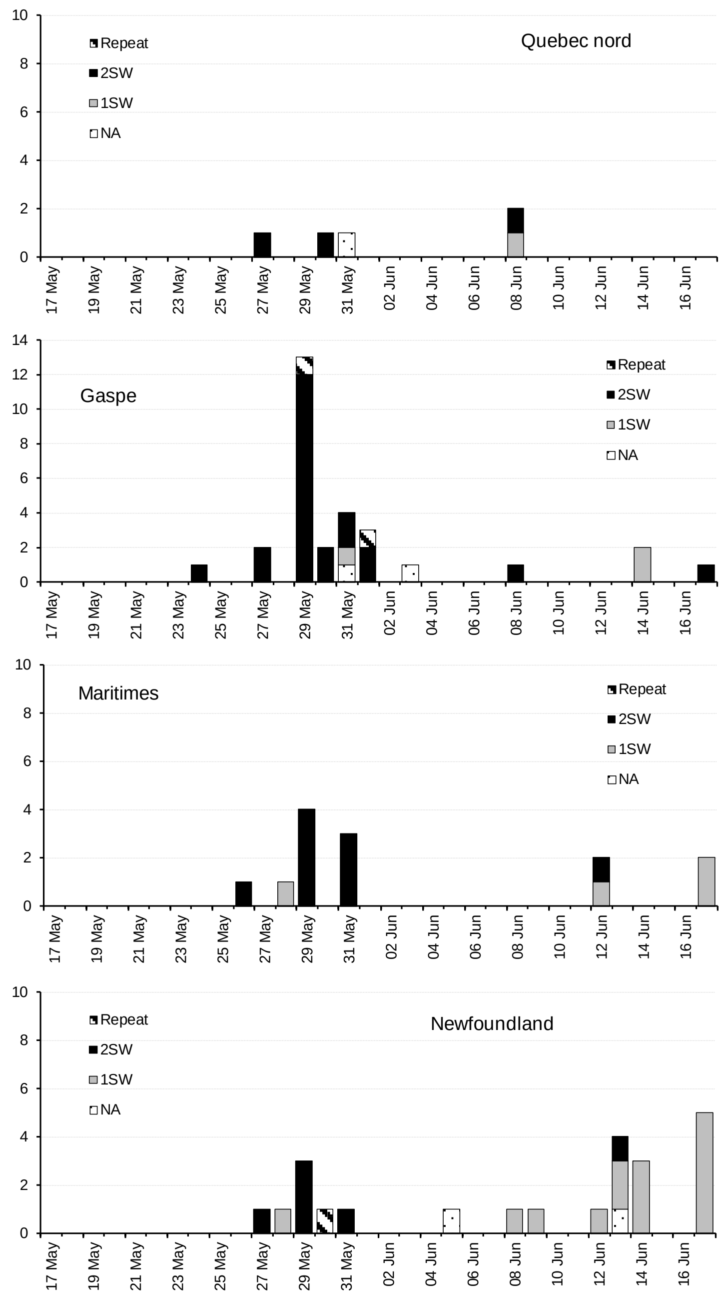


Figure 4.1.5.2. Timing of the samples collected from the Saint-Pierre et Miquelon fishery in 2013 by sea age group for the four regions of origin to which samples were assigned in 2013. Two samples from 2012 are in the unaged (NA) category assigned to each of Gaspé (3 June) and Newfoundland (5 June).

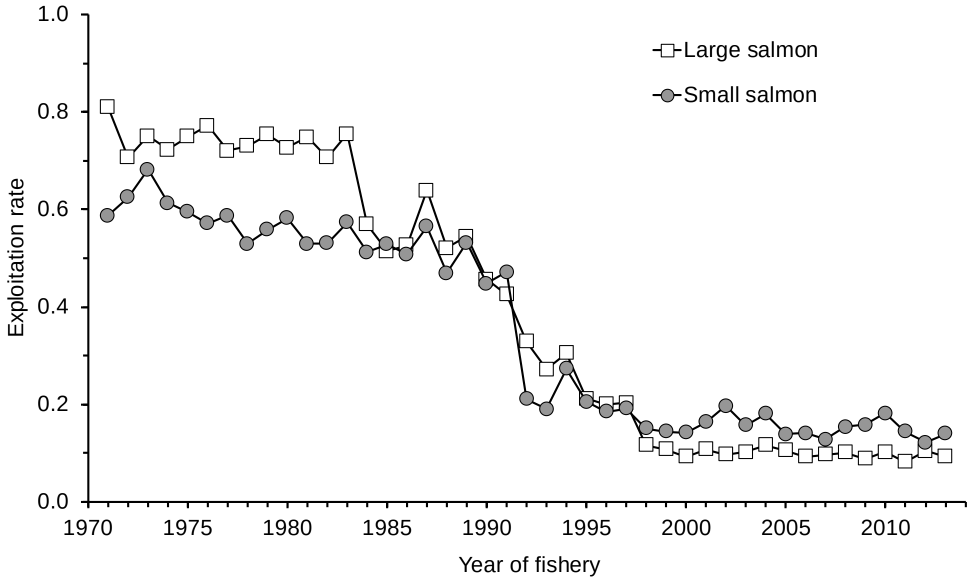


Figure 4.1.6.1. Exploitation rates in North America on the North American stock complex of small and large salmon, 1971 to 2013.

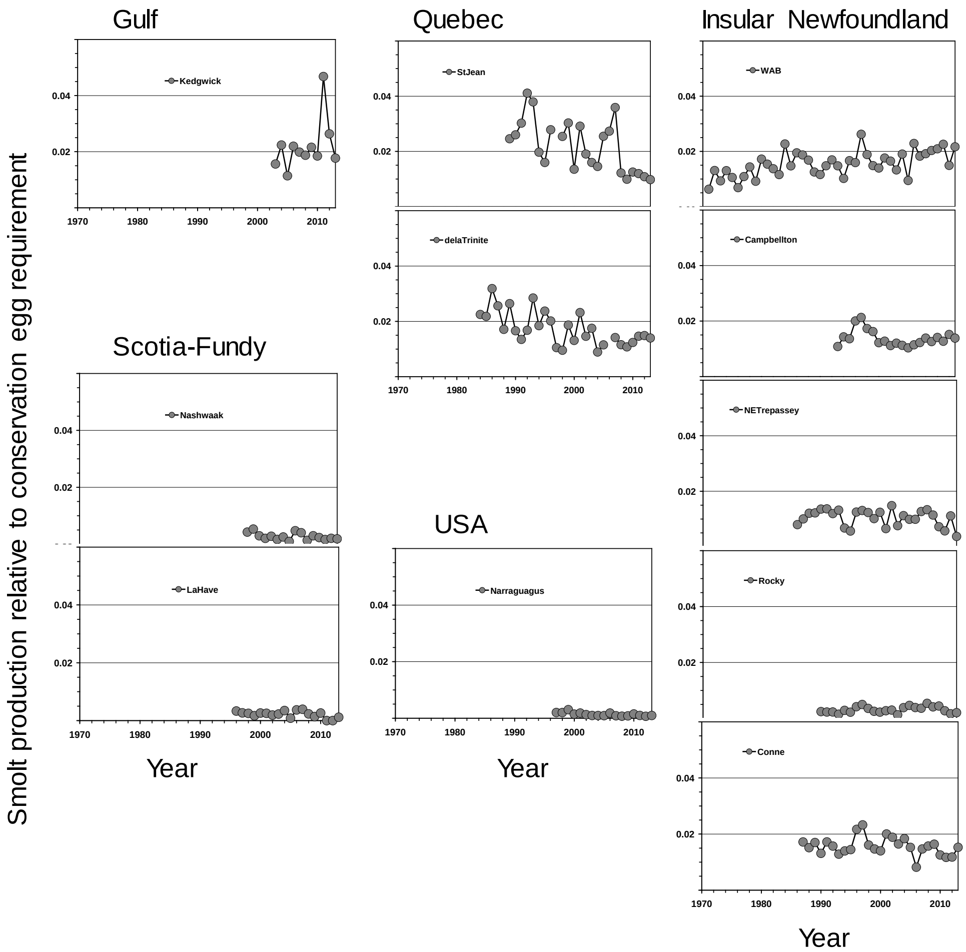


Figure 4.3.1.1 Time-series of wild smolt production from ten monitored rivers in eastern Canada and one river in eastern USA, 1970 to 2013. Smolt production is expressed as a proportion of the conservation egg requirements for the river.

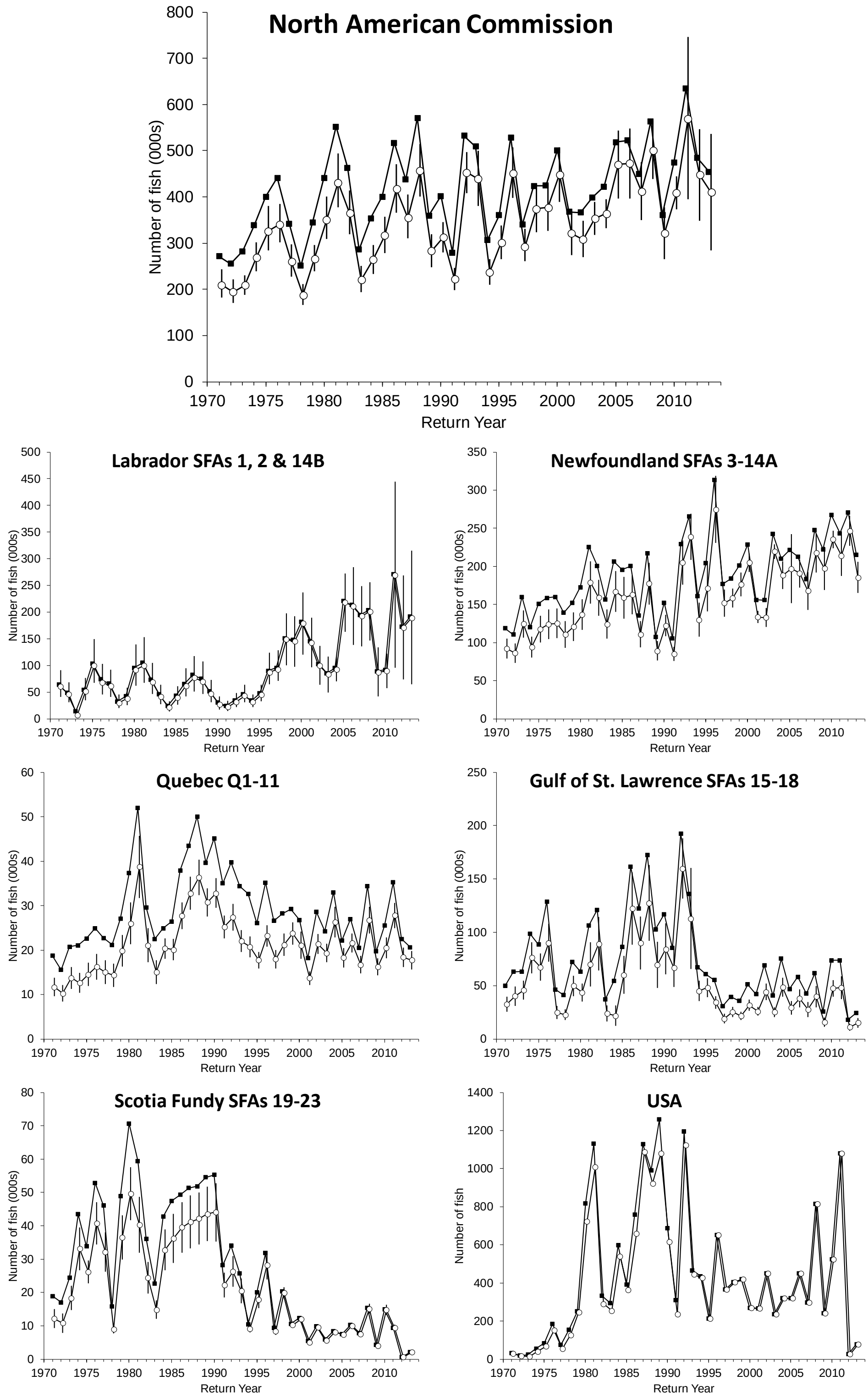


Figure 4.3.2.1. Comparison of estimated small salmon returns (median, squares) and small salmon spawners (open circles; medians with 90% confidence interval ranges) overall for NAC and to the six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Note the difference in scale for USA (number of fish).

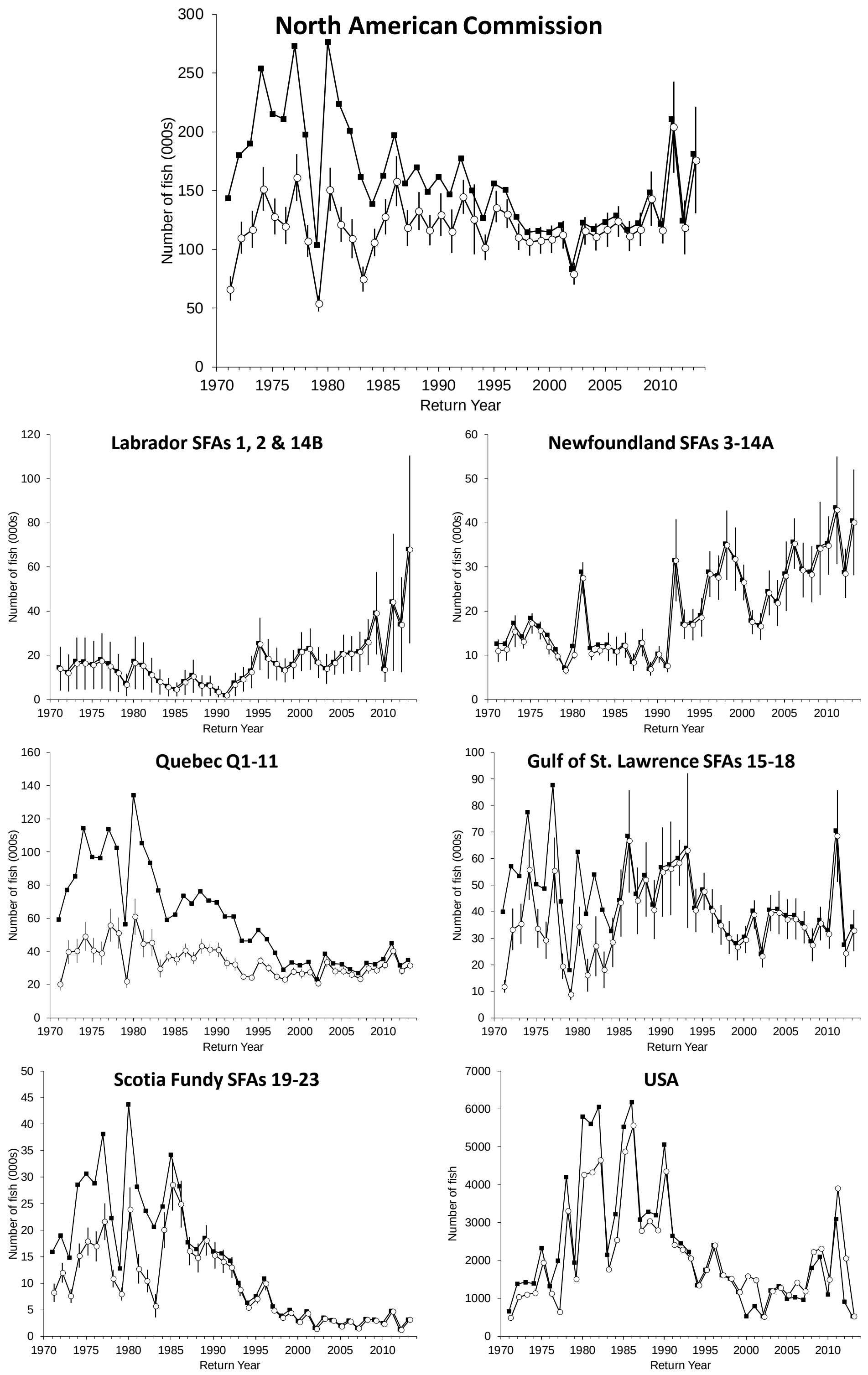


Figure 4.3.2.2. Comparison of estimated large salmon returns (medians, squares) and large salmon spawners (open circles; medians with 90% confidence interval ranges) overall for NAC and in six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. For USA estimated spawners exceed the estimated returns due to adult stocking restoration efforts. Also note the difference in scale for USA (number of fish).

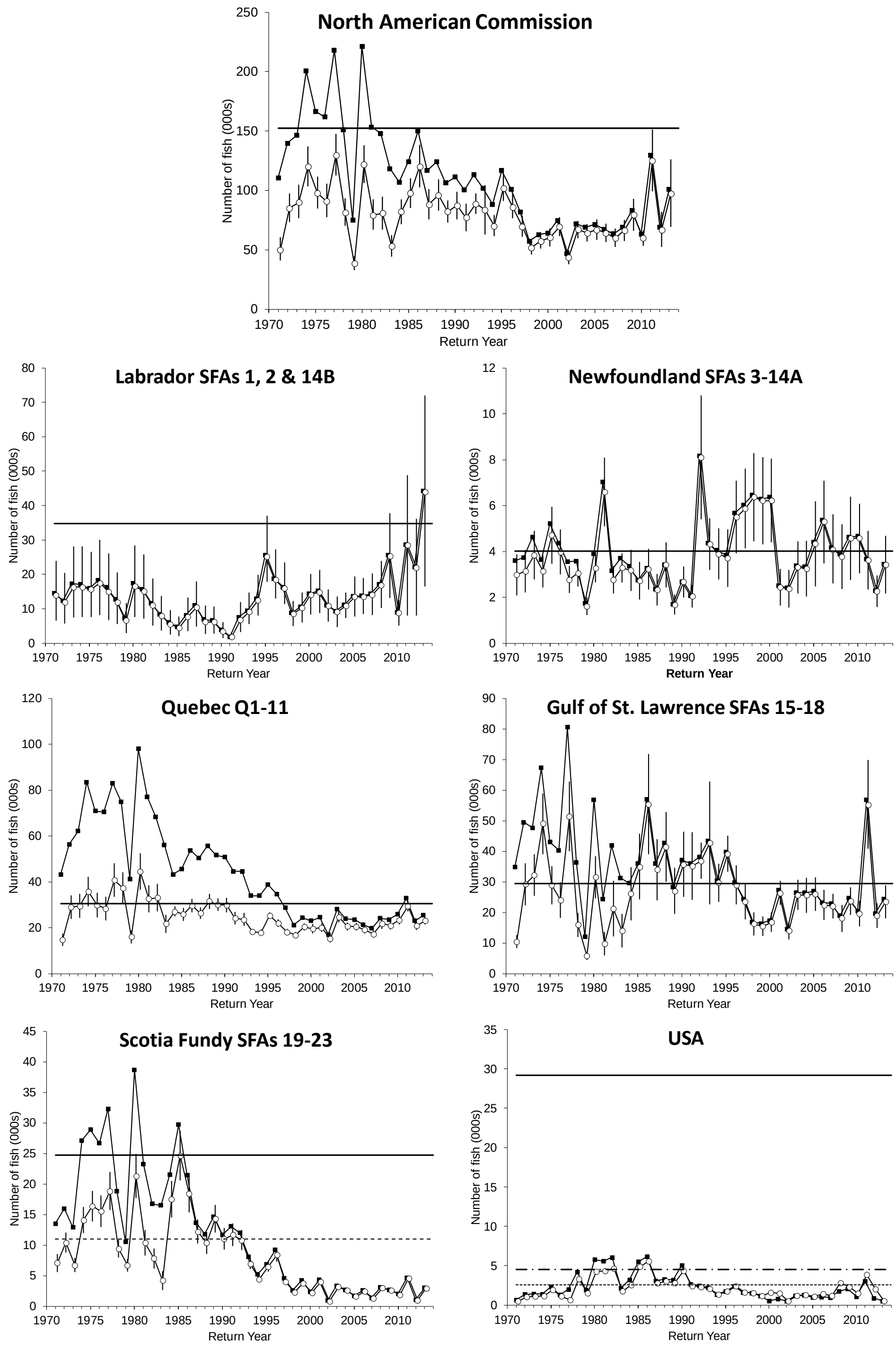


Figure 4.3.2.3. Comparison of the 2SW conservation limits (solid horizontal line) and management objectives (dashed lines) to the estimated returns of 2SW salmon (medians, squares) and spawners of 2SW salmon (open circles; medians with 90% confidence interval ranges) overall and to six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. For USA estimated spawners exceed the estimated returns due to adult stocking restoration efforts. For Scotia-Fundy, the dashed line is the current management objective of 10 976 2SW salmon spawners. For USA, the dash-dotted line is the revised management objective of 4459 2SW salmon spawners (Section 5.3).

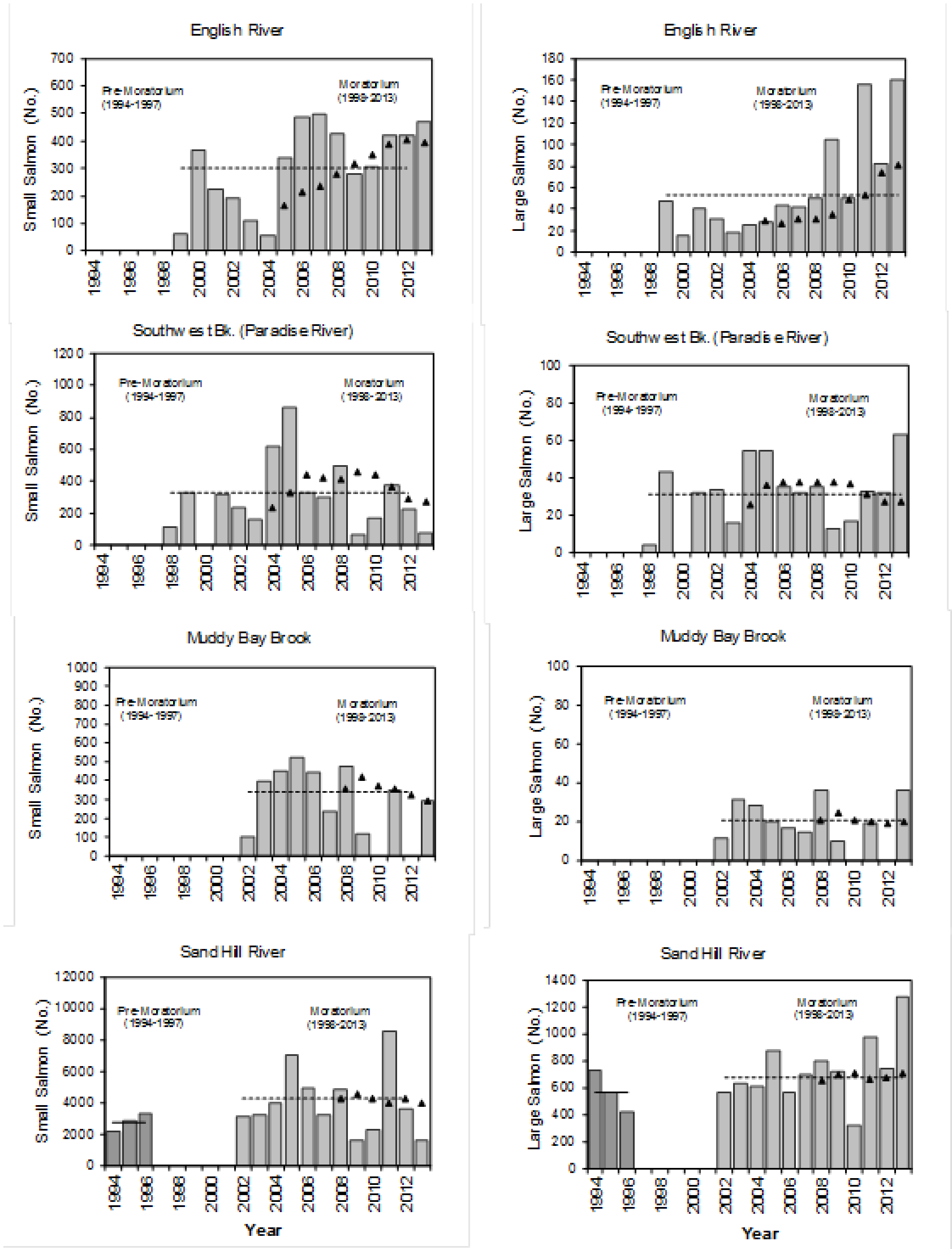


Figure 4.3.2.4. Total returns of small salmon (left column) and large salmon (right column) to English River (SFA 1), Southwest Brook (Paradise River) (SFA 2), Muddy Bay Brook (SFA 2) and Sand Hill River (SFA 2), Labrador, 1994–2013. The solid horizontal line represents the pre-moratorium (commercial salmon fishery in Newfoundland and Labrador) mean, the dashed line the moratorium mean, and the triangles the previous 6-year mean.

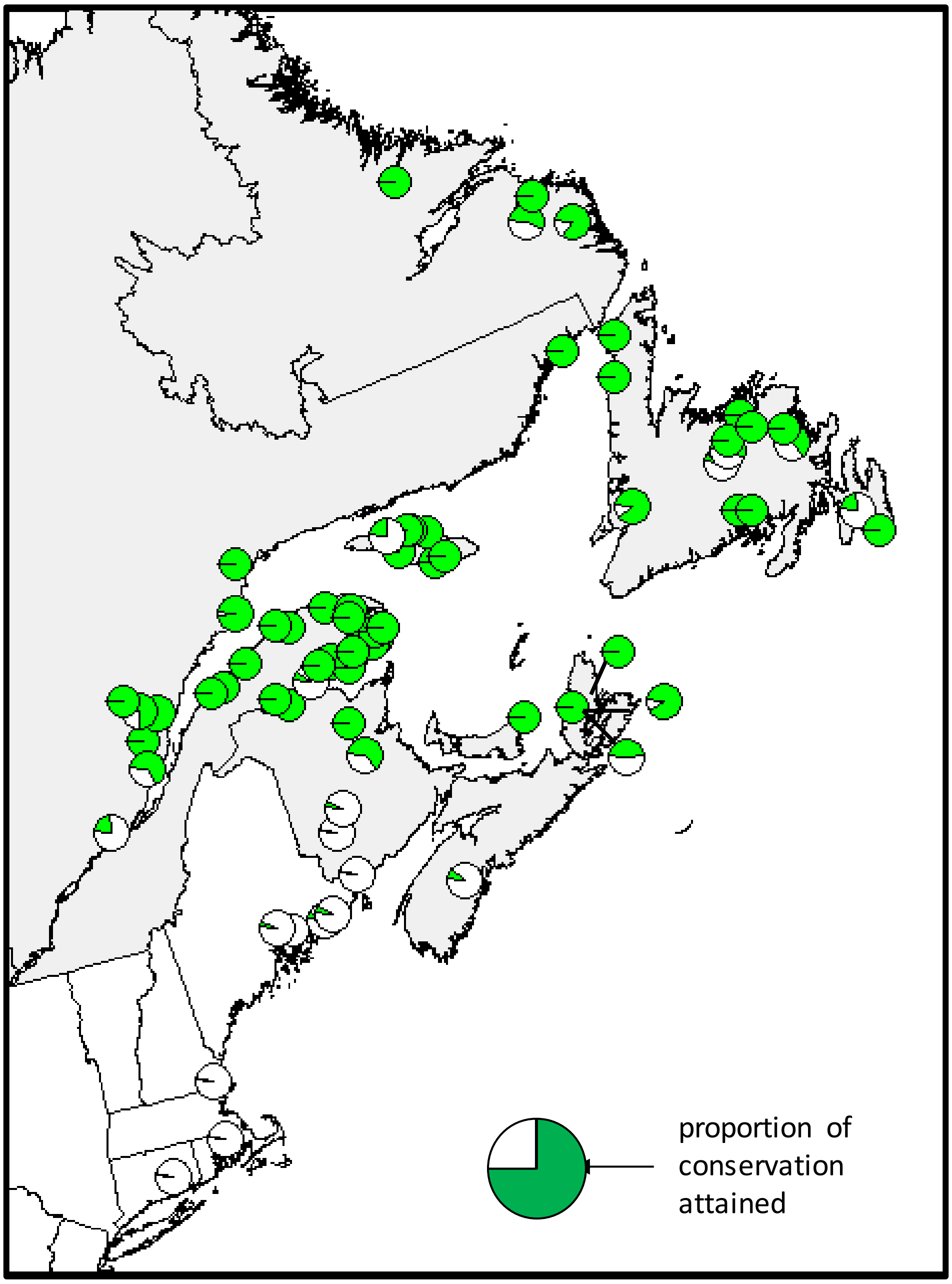


Figure 4.3.4.1. Proportion of the conservation requirement attained in the 73 assessed rivers of the North American Commission area in 2013.

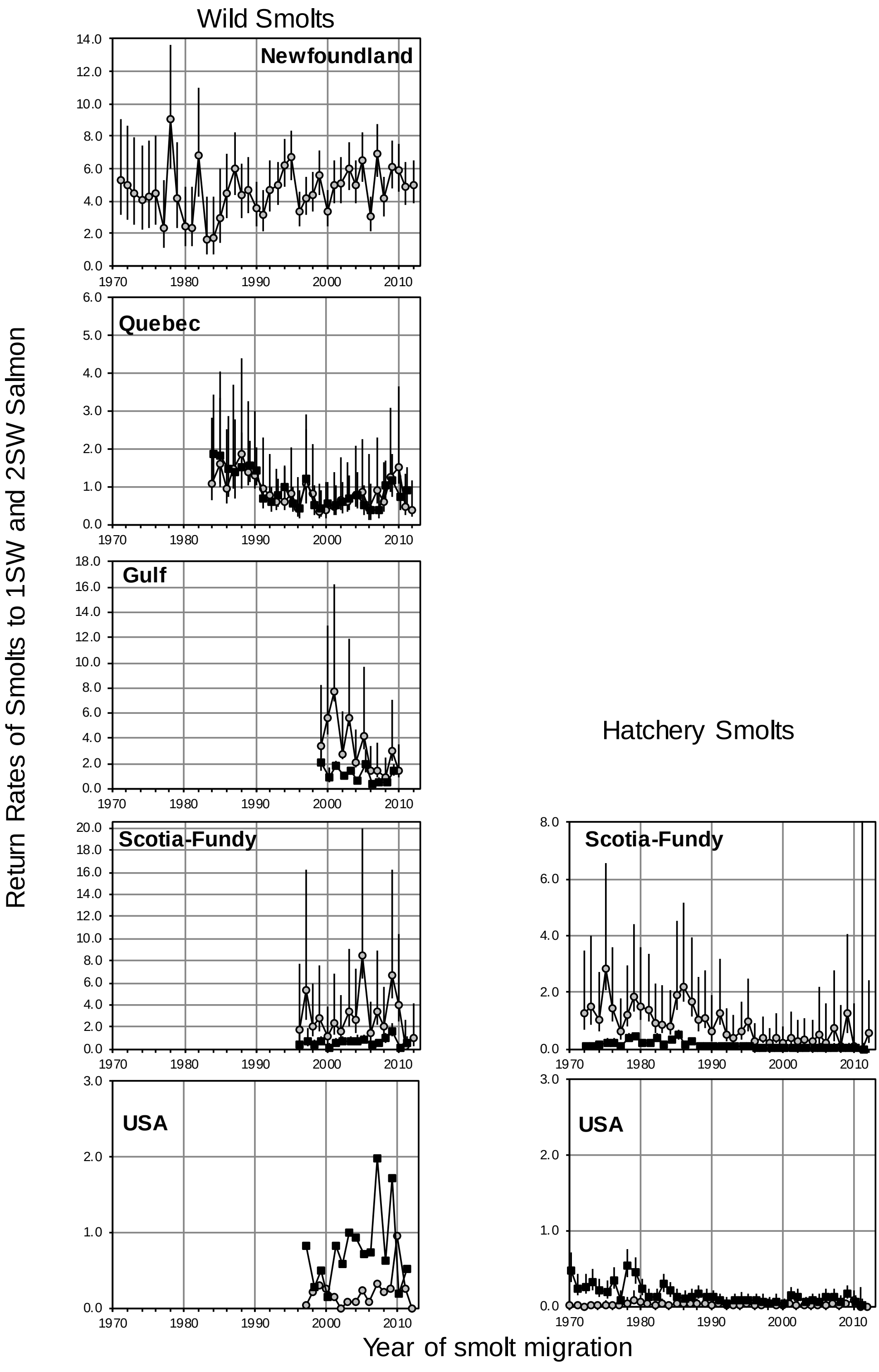


Figure 4.3.5.1. Standardized mean (one standard error bars) annual return rates of wild and hatchery origin smolts to 1SW (grey circles) and 2SW (black squares) salmon to the geographic areas of North America. The standardized values are annual means derived from a general linear model analysis of rivers in a region. Note y-scale differences among panels. Error bars are not included for estimates based on a single population.

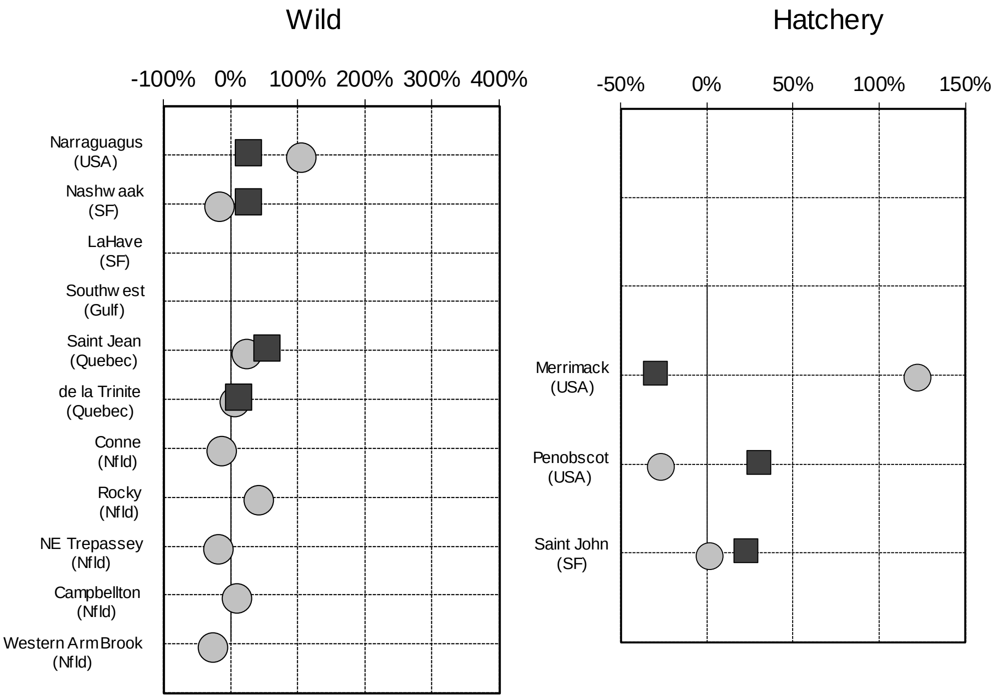


Figure 4.3.5.2. The percent change in the five-year mean return rates for 1SW and 2SW salmon returning to rivers of eastern North America in 2009 to 2013 compared to the previous period (2004 to 2008). Grey circles are for 1SW and dark squares are for 2SW dataseries. Populations with at least three datapoints in each of the two time periods are included in the analysis.

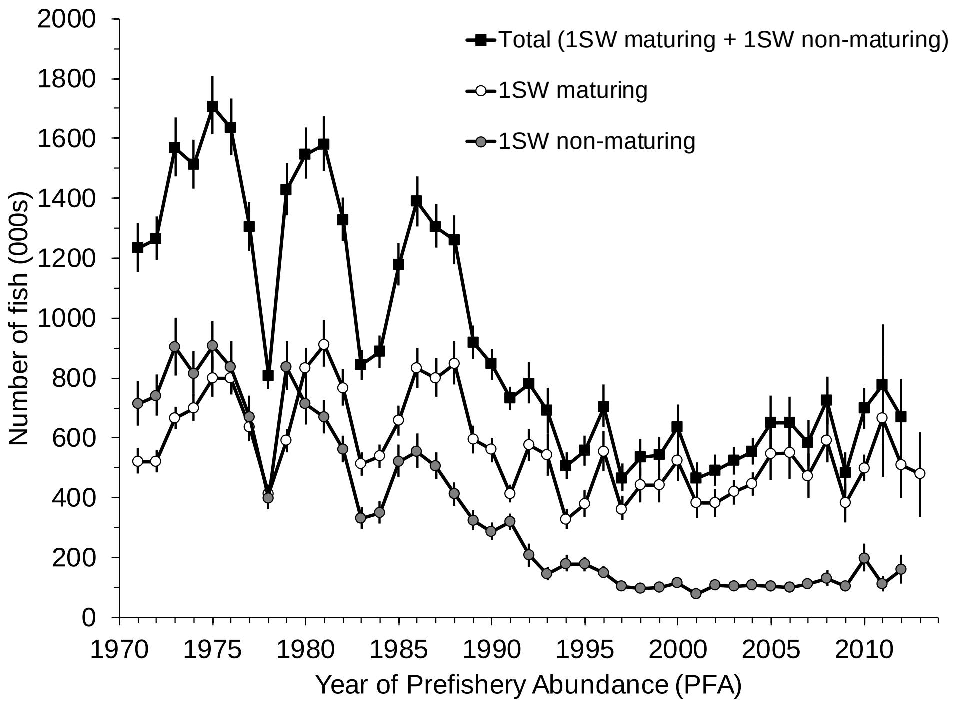


Figure 4.3.6.1. Estimates of Prefishery Abundance (PFA) for 1SW maturing salmon, 1SW non-maturing salmon and the total cohort of 1SW salmon by year (August 1 of the second summer at sea) for NAC for the years of Prefishery Abundance 1971 to 2013. Median and 95% CI interval ranges derived from Monte Carlo simulations are shown.

5 Atlantic salmon in the West Greenland Commission

The previous advice provided by ICES (2012c) indicated that there were no catch options for the West Greenland fishery for the years 2012–2014. The NASCO Framework of Indicators for the West Greenland fishery did not indicate the need for a revised analysis of catch options and therefore no new management advice for 2014 is provided. This year's assessment of the contributing stock complexes confirms that advice.

5.1 NASCO has requested ICES to describe the events of the 2013 fishery and status of the stocks

5.1.1 Catch and effort in 2013

The Atlantic salmon fishery is currently regulated according to the Government of Greenland Executive Order No 12 of August 1, 2012, which replaces the previous Executive Order no. 21 of August 10, 2002. The only significant change from the previous Executive Order is that fishers are no longer required to submit daily catch reports, rather they can record their daily catches in a journal and the journal can be submitted at the end of the season.

With the closure of the commercial fishery since 1998, with the exception of 2001, the export of Atlantic salmon has been banned. Since 2002 there have been two landing categories reported for the fishery: a commercial fishery where licensed fishers can sell salmon to hotels, institutions and local markets and a private fishery where unlicensed fishers fish for private consumption. Since 2012, licensed fishers were also allowed to land to factories and an internal 35 t quota was set by the Greenland authorities. This quota does not apply to the commercial or private landings and the export ban persists as the landed salmon could only be sold within Greenland.

As before, only hook, fixed gillnets and driftnets are allowed to target salmon directly and the minimum mesh size has been 140 mm (stretched mesh) since 1985. Fishing seasons have varied from year to year, but in general the season has started in August and continued until the quota has been met or until a specified date later in the season. As in recent years, the 2013 season was August 1 to October 31.

Catch data were collated from fisher reports. The reports were screened for errors and missing values. Catches were assigned to NAFO/ICES area based on the reporting community. Reports which contained only the total number of salmon caught or the total catch weight without the number of salmon, were corrected using an average of 3.25 kg gutted weight per salmon. Since 2005 it has been mandatory to report gutted weights, and these have been converted to whole weight using a conversion multiplier of 1.11.

Catches of Atlantic salmon decreased until the closure of the export commercial fishery in 1998, but the subsistence fishery has been increasing in recent years (Table 5.1.1.1; Figure 5.1.1.1). In 2013, catches were distributed among the six NAFO Divisions on the west coast of Greenland and in ICES Division XIV (East Greenland) (Table 5.1.1.2; Figure 5.1.1.2). A total catch of 47.0 t of salmon was reported for the 2013 fishery compared to 32.6 t of salmon in the 2012 fishery, an increase of 44.2% from 2012. A harvest of <0.03 t was reported from East Greenland in 2013, accounting for <0.1% of the total reported catch at Greenland. Harvest reported for East Greenland is not included in assessments of the contributing stock complexes.

Reported landings to factories in 2013 (Table 5.1.1.3) occurred in four communities (two communities in NAFO Division 1C, one community in NAFO Division 1D and one community in 1E) and amounted to 25.6 t, an 86.8% increase over the 2012 reported factory landings (13.7 t). If landings to factories continue in future years, there should be consideration given to placing samplers in communities with factories receiving fish, thereby increasing access to landed fish. Increasing the proportion of sampled fish will improve the characterization of the biological characteristics of the harvest.

Reported factory landings are considered to be precise given the reporting structure in place between the factories receiving salmon and the Greenland Fisheries Licence Control Authority (GFLK). Uncertainty in the catch statistics is likely caused by unreported catch in the commercial fishery, outside the factory landings, and the private fishery. There is currently no quantitative approach for estimating the unreported catch but the 2013 value is likely to have been at the same level proposed in recent years (10 t).

Of the total catch, 7.9 t was reported as being commercial, 13.4 t for private consumption and 25.6 t as factory landings. The commercial and factory landings increased over the 2012 reported values (5.5 t and 13.7 t respectively), while the private consumption catch fell slightly (14.1 t in 2012, Table 5.1.1.3). In total, 97% of the landings (45.6 t) came from licensed fishers. Of the 7.9 t reported commercial landings, 1.3 t is reported as having come from unlicensed fishers.

The seasonal distribution of catches has previously been reported to the Working Group (ICES, 2002). However since 2002, this has not been possible. Although fishers are required to record daily catches, comparisons of summed reported catch and number of returned catch reports reveal that a large number of fishers report their total catch in only one report for the entire season, without detailed daily catch statistics. The seasonal distribution for factory landings is assumed to be precise given the reporting structure in place between the factories and the GFLK.

Greenland Authorities issued 228 licences (Table 5.1.1.4) and received 553 reports from 95 fishers in 2013 compared to 553 reports from 122 fishers in 2012 (Table 5.1.1.3). The number of fishers decreased while the number of reports stayed the same. The total number of fishers reporting catches from all areas has increased from a low of 41 in 2002 to its current level. These levels remain well below the 400 to 600 people reporting landings in the commercial export fishery from 1987 to 1991.

The variations in the numbers of people reporting catches, variation in reported landings in each of the NAFO Divisions and documentation of underreporting of landings (ICES 2012a) suggest that there are inconsistencies in the catch data and highlights the need for better data. Continuation and improvement of the voluntary logbook reporting system initiated by the Greenlandic Authorities in 2012 is anticipated to improve the quality of the reported catch statistics.

In 2013, the following procedures were in place for reporting salmon harvest:

Landings type	Licence required	Mandatory reporting	Process
Private	No	Yes	Individual fishers report catch to GFLK by e-mail, phone, fax or return logbook at the conclusion of the fishing season.
Commercial	Yes	Yes	Individual fishers report catch to GFLK by e-mail, phone, fax or return logbook at the conclusion of the fishing season.
Factory	Yes	Yes	Factories register landings from individual fishers and digitallized reports are submitted to GFLK weekly.

The data requested are:

- Date;
- Fishing place;
- Number of salmon;
- Weight in kg (gutted);
- Number of nets;
- Number of fishing hours;
- Catch sold;
- Community sold in;
- Notes.

It is noted that factory landing reports contain similar information to that requested in the logbooks provided to commercial fishers; private fishers do not receive logbooks. These data will allow for a more accurate characterization of the nature and extent of the fishery than is currently available. Logbook and factory data may provide catch and effort statistics (cpue) that will allow a more detailed assessment based on time and location of fishing activities and will allow for better management of this resource. Cpue statistics represent indirect measures of the abundance and trends. Increasing cpue values may be indicative of increasing abundance, decreasing cpue values may be indicative of decreasing abundance, and constant cpue values may be indicative of stable abundance.

The Working Group recommends that the reporting system continues and that logbooks be provided to all fishers. Efforts should continue to encourage compliance with the logbook voluntary system. Detailed statistics related to catch and effort should be made available to the Working Group for analysis.

5.1.1.1 Exploitation

An extant exploitation rate for NAC and NEAC non-maturing 1SW fish at West Greenland can be calculated by dividing the recorded harvest of 1SW salmon at West Greenland by the PFA estimate for the corresponding year for each complex. Exploitation rates are available for the 1971 to 2012 PFA years (Figure 5.1.1.3). The most recent estimate of exploitation available is for the 2012 fishery as the 2013 exploitation rate estimates are dependent on the 2014 returns of 2SW to NAC or MSW to Southern NEAC. NAC PFA estimates are provided for August of the PFA year and NEAC PFA estimates are provided for January of the PFA year, the latter adjusted by eight months (January to August) of natural mortality at 0.03 per month. The 2012 NAC exploitation rate was 6.2% and is a decrease from the previous year's estimate (7.9%), which is equal to the previous five-year mean and remains among the lowest in the time-series. NAC exploitation rate peaked in 1971 at 38.6%. The 2012 NEAC exploitation rate was 0.5% and is a slight increase from the previous year's estimate (0.2%). It is slightly above the previous five-year mean (0.4%), but remains among the lowest in the time-series. NEAC exploitation rate peaked in 1975 at 28.6%.

5.1.2 International sampling programme

5.1.2.1 International sampling programme

The international sampling programme for the fishery at West Greenland agreed by the parties at NASCO continued in 2013. The sampling was undertaken by participants from Canada, Ireland, UK(Scotland), UK(England&Wales), and USA. Additionally, staff from the Greenland Institute of Natural Resources assisted with coordination of the programme. Sampling began in August and continued through October.

Samplers were stationed in three different communities (Figure 5.1.1.2) representing three different NAFO Divisions: Sisimiut (1B), Maniitsoq (1C), and Qaqortoq (1F). As in previous years no sampling occurred in the fishery in East Greenland. Tissue and biological samples were collected from all sampled fish.

In total 1156 individual salmon were sampled representing approximately 9% by weight of the reported landings. Of these, 1155 fork lengths were measured (Table 5.1.2.1). Scale samples were taken from 1156 salmon for age determination and 1149 tissue samples were collected for DNA analysis and continent of origin assignment.

A total of 13 adipose finclipped fish were recovered, but none of these carried tags. A single tag was recovered during the fishing season which was returned directly to the Nature Institute. No tags were recovered by the sampling programme. The recaptured tag came from Norwegian hatchery origin smolt released into the Imsa River on 15 May 2012.

As part of the sampling programme sex was determined by gonadal examination of 26 salmon. They were 23% males and 77% females.

A total of 29 salmon microbiomes (bacterial communities in the gut and skin) samples were also collected from two NAFO Divisions (1B and 1C) in 2013. The purpose of the research is to genetically characterize the composition of the microbiomes population and look at the role of salmon skin and gut bacterial communities, in particular how they provide common 'services' such as nutrient absorption and immune response. The samples are for research being conducted jointly at the University of Laval in Québec and Bangor University in Wales.

In all years since 2002, except for 2006 and 2011, non-reporting of harvest was evident based on a comparison of reported landings to the sample data. In at least one of the NAFO Divisions where international samplers were present, the sampling team observed more fish than were reported as being landed. When there is this type of discrepancy, the reported landings are adjusted according to the total weight of the fish identified as being landed during the sampling effort and these adjusted landings are carried forward for all future assessments. Adjusted landings do not supplant the official reported statistics (Tables 5.1.1.1 and 5.1.1.2).

The time-series of reported landings and subsequent adjusted landings for 2002–2013 are presented in Table 5.1.2.2. The 2013 adjusted landings represented a 0.7 t increase over the reported landings. It should be noted that samplers are only stationed within select communities for 2–5 weeks per year whereas the fishing season runs for twelve weeks. It is not possible to correct for misreporting for an entire fishing season or area given the discrepancy in sampling coverage vs. fishing season without more accurate daily/weekly catch statistics.

As reported previously (ICES, 2012a), access to fish in support of the sampling programme in Nuuk has been compromised. No solution to this issue was reached prior to the 2013 sampling season and consequently no sampling was conducted within the capital city. Unless assurances can be provided that access to fish will be allowed, sampling in Nuuk may not occur for the foreseeable future.

The small catch levels and the broad geographic and temporal coverage of the internal use only fishing caused practical problems for the sampling teams. The need to obtain samples from fish landed in factories and from fish landed in Nuuk is reiterated. In 2012 and 2013, factory landings accounted for 41% and 55% of the total reported landings respectively (Table 5.1.1.3). Nuuk accounted for 11% of the adjusted landings in 2013 and has accounted for an average of 18% since 2002 (range 7–36%, Table 5.1.2.2). Not being able to sample fish landed at factories or in Nuuk may compromise the sampling programme's ability to collect the samples needed to accurately describe the biological characteristics of the salmon harvest at West Greenland. The Working Group recommends that the Government of Greenland facilitate the coordination of sampling within factories receiving Atlantic salmon, if landings to factories are allowed in 2014. Sampling could be conducted by samplers participating in the International Sampling Programme or by factory staff working in close coordination with the sampling Programme Coordinator. The Working Group also recommends that arrangements be made to enable sampling in Nuuk as a significant amount of salmon is reported as being landed in this community on an annual basis.

5.1.2.2 Biological characteristics of the catches

The mean length and whole weight of North American 1SW salmon was 66.2 cm and 3.33 kg weight and the means for European 1SW salmon were 64.6 cm and 3.16 kg (Table 5.1.2.3). The North American 1SW whole weight estimate remained approximately equal to the 2012 estimate, but above the ten-year mean. The European estimate decreased from the 2012 estimate and is approximately equal to ten-year mean. The North American and European 1SW fork lengths were similar to the 2012 and ten-year mean estimates.

Over the period of sampling (1969 to 2013) the mean weights of 1SW non-maturing salmon at West Greenland declined from high values in the 1970s to the lowest mean weights of the time-series in 1990 to 1995, before increasing subsequently to 2010. Mean weight have since remained close to the 2010 level. However, these mean weight trends are unadjusted for the period of sampling and it is known that salmon grow quickly during the period of sampling in the fishery from August to October.

The Working Group recommends that the longer time-series of sampling data from West Greenland should be analysed to assess the extent of the variations in the condition of fish taken in the fishery over the time period corresponding to the large variations in productivity as identified by the NAC and NEAC assessment and forecast models. Progress has been made in compiling the West Greenland sampling database and should be available for analysis prior to the 2015 Working Group meeting.

North American salmon up to river age six sampled from the fishery at West Greenland (Table 5.1.2.4) comprised predominantly two year old (32.6%), three year old

(37.3%) and four year old (20.8%) smolts. The river ages of European salmon ranged from one to five years (Table 5.1.2.5) and comprised predominantly two year old (68.2%) and three year old (24.4%) smolts.

As expected, the 1SW age group dominated the 2013 sample collection for both the North American and European origin fish (94.9% and 96.6% respectively, Table 5.1.2.6).

5.1.3 Continent of origin of catches at West Greenland

A total of 1149 samples were analysed from salmon from three communities representing three NAFO Divisions: Sisimiut (1B, n=680), Maniitsoq (1C, n=298), and Qaqortoq (1F, n=171). DNA isolation and the subsequent microsatellite analysis was performed (King *et al*., 2001). As in previous years, a database of approximately 5000 Atlantic salmon genotypes of known origin was used as a baseline to assign these individuals to continent of origin. Overall, 81.6% of the salmon sampled were determined to be of North American origin and 18.4% were determined to be of European origin. The NAFO Division-specific continent of origin assignments are presented in Table 5.1.3.1.

These data show the high proportion of North American origin individuals contributing to the fishery over the recent past (Table 5.1.3.2; Figure 5.1.3.1). The variability in the continental representation among divisions (Table 5.1.3.1) underscores the need to sample multiple NAFO Divisions to achieve the most accurate estimate of the contribution of fish from each continent to the mixed-stock fishery.

The estimated weighted proportions of North American and European salmon since 1982 and the weighted numbers of North American and European Atlantic salmon caught at West Greenland (excluding the unreported catch and reported harvest from ICES Area XIV) are provided in Table 5.1.3.2 and Figure 5.1.3.2. Approximately 11 500 (~38.9 t) North American origin fish and approximately 2700 (~8.8 t) European origin fish were harvested in 2013. These are the highest estimates in the past ten years (2004–2013), but remain among the lowest in the time-series (1982–present).

The Working Group recommends a continuation and expansion of the broad geographic sampling programme (multiple NAFO divisions) to more accurately estimate continent of origin in the mixed-stock fishery.

5.2 NASCO has requested ICES to describe the status of the stocks

Five out of the seven stock complexes exploited at West Greenland are below CLs. In European and North American areas, the overall abundance of stocks contributing to the West Greenland fishery has recently increased, but remains low relative to historical levels. A more detailed overview of status of stocks in the NEAC and NAC areas is presented in the relevant commission sections (Sections 3 and 4).

5.2.1 North American stock complex

North American 2SW spawner estimates were below their CLs for all regions of NAC with the exception of Labrador (Figure 4.3.2.3). Within each of the geographic areas there are individual river stocks which are failing to meet CLs, particularly in the southern areas of Scotia-Fundy and the USA. The estimated exploitation rate of North American origin salmon in North American fisheries has declined (Figure 4.1.6.1) from approximately 68% in 1973 to 14% in 2013 for 1SW salmon and 81% in 1971 to 9% in 2013 for 2SW salmon. The 2013 exploitation rates on 1SW and 2SW salmon both remained close to the 2012 estimates (12.2% and 10.4% respectively) and among the lowest in the time-series.

5.2.2 Southern European stock complex

The status of stocks in the four Northeast Atlantic stock complexes is assessed with respect to abundance relative to spawning escapement reserve and prior to the commencement of distant water fisheries. In the latest available PFA year, three of the four NEAC stock complexes (both Northern NEAC age groups and the Southern NEAC maturing 1SW stock) were assessed to be at full reproductive capacity prior to the commencement of distant-water fisheries. The Southern NEAC non-maturing 1SW stock, however, was assessed to be at risk of suffering reduced reproductive capacity (Figure 3.3.4.2). At a country level, stocks from several jurisdictions were also below CLs (Figures 3.3.4.1.a–j). Stocks from countries in Northern NEAC area were generally above their CLs while stocks from countries in Southern NEAC were generally below their CLs. Further, within all countries there were individual river stocks that are not meeting CLs (Table 3.3.5.1). Homewater exploitation rates on the four NEAC stock complexes (Northern NEAC 1SW and MSW and Southern NEAC 1SW and MSW) are shown in Figure 3.1.9.1. Exploitation rates on 1SW salmon in the Northern and Southern areas were 40% and 12% in 2013; both representing declines from the previous five year averages (41% and 14% respectively). Exploitation rates on MSW salmon in the Northern and Southern areas were 45% and 10% in 2013; both representing declines from the previous five year averages (46% and 12% respectively). The recent exploitation estimates for both stock complexes are at or among the lowest in the time-series.

5.3 NASCO has asked ICES to describe the implications for the provision of catch advice of any new management objectives proposed for contributing stock complexes

The reference points for provision of catch advice for West Greenland are the CLs of 2SW salmon from six regions in North American and MSW CL from the southern European stock complex. NASCO has adopted these region specific CLs as limit reference points with the understanding that having populations fall below these limits should be avoided with high probability. CLs for the West Greenland fishery for North America are limited to 2SW salmon and southern European stocks are limited to MSW fish because fish at West Greenland are primarily (>90%) 1SW non-maturing salmon destined to mature as either 2SW or 3SW salmon.

Alternate management objectives to the CLs were first proposed for the Scotia-Fundy and USA stock complexes in 2002, roughly the same time that the risk analysis framework for providing catch advice at Greenland was developed and in response to strongly divergent trends in status of stocks between northern and southern regions of North America (ICES, 2002). Managers were concerned that the potential fishery at Greenland could be constrained by the status of the weakest stocks with no hope of meeting their CLs even if production from the northern areas became very high and in excess of CLs. Considering the differences in stock status among the regions, ICES (2002) proposed that fishery managers attempt to meet the CLs simultaneously in the four productive northern regions of North America (Labrador, Newfoundland, Québec, and Gulf) while defining and managing to meet stock rebuilding objectives for the two southern regions (Scotia-Fundy and USA). Possible rebuilding objectives included achieving pre-agreed increases in returns relative to the realized returns of a defined time period. Rates of annual increase could be as low as 10% for those stocks that are approaching a stock status objective and higher rates such as 25% per year could be used for stocks that are very far from their desired state. ICES (2004b) recommended establishing the baseline period at the 1992 to 1996 return years for the Scotia-Fundy and USA regions against which to assess PFA abundance and fishery options. These years corresponded to about one generation time for 2SW salmon following the closure of the Newfoundland commercial fishery and reductions in the Labrador commercial fishery prior to the complete moratorium in 1998. Both levels of rebuilding rates were quantified in the risk analysis (ICES 2004).

In the years since these management objectives were agreed, the estimated returns of 2SW salmon to Scotia-Fundy have remained relatively stable and low, in the range of 10 000 to less than 5000 fish during 1997 to 2012 (Figure 5.3.1). The returns have represented less than 20% of the 2SW CL and less than 50% of the management objective. This contrasts with the returns of 2SW salmon to the USA which were often at or above 50% of the management objective and in 2011 exceed the objective (Figure 5.3.1). In terms of performance, the USA 2SW returns have, never exceeded more than 21% of the 2SW CL, but have been much closer to the management objective than Scotia-Fundy (Figure 5.3.1). ICES has provided catch advice considering these rebuilding objectives since 2002. However, ICES (2012a) also acknowledged that to be consistent with the maximum sustainable yield and the precautionary approach, fisheries should only take place on salmon stocks that have been shown to be at full reproductive capacity and that CLs are limit reference points and having populations fall below these limits should be avoided with high probability.

5.3.1 Proposed revised management objective for USA

At the Thirtieth Annual Meeting of NASCO, the USA proposed a new management objective for the USA stock complex for the provision of catch advice at Greenland (NASCO, 2013). The previous management objective (ICES 2004) was viewed as a rebuilding objective and was established in light of the extremely depleted state of the endangered USA populations. It was indicated that this management objective is inconsistent with NASCO's Agreement on the Adoption of the Precautionary Approach (NASCO, 1998), Action Plan for the Application of the Precautionary Approach (NASCO, 1999), NASCO Guidelines for the Management of Salmon Fisheries (NASCO, 2009) and interim recovery criteria for USA stocks protected by the Endangered Species Act. However, NASCO has also acknowledged that when a stock has fallen well below its CL, or has been below the CL for an extended period, it may be appropriate to consider an intermediate 'recovery' reference point (NASCO, 2004). Given these discrepancies, the USA therefore recommended aligning the management objectives for the USA stock complex with the recovery criteria for the remnant stocks currently under protection of the Endangered Species Act. It was felt this would better align the objective for the management of the Greenland fishery with federal obligations in USA, and NASCO policies and ICES advice (NASCO, 2013).

Remnant Atlantic salmon stocks within the USA are currently listed as endangered under the Endangered Species Act (74 Federal Register 29344, 19 June 2009). For the purpose of listing under the ESA, the USA stock complex was segregated into three Distinct Population Segments (DPS): Long Island Sound (LIS), Central New England (CNE) and Gulf of Maine (GOM). The LIS and CNE segments were extirpated in the 1800s and all remnant populations of USA Atlantic salmon are within the GOM DPS.

One requirement of the ESA is defining objective, measurable criteria for determining when Atlantic salmon may be considered for de-listing from the Endangered Species

Act. The draft recovery criteria for the GOM DPS are a census population abundance of 6000 adult returns of all sea ages and assuming a 1:1 sex ratio equally distributed among three distinct areas within the GOM DPS. There are additional criteria that must be met before proposing de-listing the GOM DPS, such as demonstrating consistent positive population growth and achieving the census population criteria based on wild spawners only. Further details can be found in Appendix A of the Critical Habitat Designation (http://www.nero.noaa.gov/prot_res/altsalmon).

The fishery at West Greenland primarily exploits (>90%) 1SW non-maturing salmon destined to mature as either 2SW or 3SW salmon. As such, the provision of catch advice for West Greenland is based on the forecasts of 2SW returns compared to the stated management objectives. To convert the draft recovery criteria to 2SW equivalents, the average percentage of 2SW fish in returns to the USA for the base period 2003–2012 was applied, 75.8%, resulting in a value of 4549 2SW returns. This value was proposed as a replacement to the previous USA management objective of achieving a 25% increase in returns of 2SW salmon from the average returns in the 1992–1996 base period. The objective would now be stated as: “achieve 2SW adult returns of 4549 or greater for the USA region”.

5.3.2 Review of management objective for Scotia-Fundy

As stated above, the reference value of the management objective for Scotia-Fundy is the average of the returns in 1992–1996, a period corresponding to the returns following on the closure of the Newfoundland commercial salmon fishery. The value of 10 976 2SW fish represents 44% of the 2SW conservation limit (24 705) for Scotia-Fundy. In contrast the previously used USA objective of 2548 fish represents only 9% of the 2SW CL for the USA region.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the salmon stocks of the three Scotia-Fundy Designatable Units (DU) as endangered (at risk of extinction) due to population declines associated with low marine survival and threats in freshwater. Recovery Potential Assessments (RPAs) of each DU were conducted in 2012 and 2013 (as described in Section 2.3.7). The RPA science advisory reports proposed recovery objectives for distribution and abundance which could be considered as an alternative to the currently defined rebuilding management objective for the Scotia-Fundy area. Only the RPA for the Outer Bay of Fundy DU specifically quantified the short-term abundance target through the identification of priority rivers; the recovery objectives for abundance were based on an egg deposition rate corresponding to the conservation requirement rate of 2.4 eggs per m^2. The egg requirements are converted to numbers of fish based on contemporary life-history characteristics of the populations in the DU. The number of 2SW salmon represented within the recovery objectives are estimated from the contemporary life-history characteristics. No short-term abundance target or priority rivers were identified for the Eastern Cape Breton (DFO, 2013b) and Nova Scotia Southern Upland (DFO, 2013a) regions during the Recovery Potential Assessments to allow for similar 2SW target calculations for these regions within Scotia-Fundy.

It is not possible at this time to propose a revised management objective for the Scotia-Fundy region that takes into account advice on recovery targets identified in the recent Recovery Potential Assessments for the three DUs of Atlantic salmon in this region. Specific short-term and long-term recovery objectives for distribution and abundance within each DU would be developed during the development of recovery plans. The developments of recovery plans are pending listing decisions by the Government of Canada for these DUs. Assuming recovery plans will be developed with specific abundance and distribution targets and until recovery plan objectives can be assessed for their appropriateness for the provision of management advice for West Greenland, the current management objective of a 25% increase in returns from the average of 1992–1996 can be retained for the following reasons:

1) The current management objective for Scotia-Fundy is aimed at rebuilding the stocks which are well below the 2SW conservation limit for the Scotia-Fundy region (i.e. 44% of the 2SW CL);
2) Recovery objectives in terms of number of fish have not been proposed in scientific Recovery Potential Assessments for two of the three DUs in the Scotia-Fundy region; and
3) If the current management objective is lower than recovery objectives that will be identified from river-specific recovery objectives that have yet to be developed in recovery plans, then there is a low risk of impacting management advice to West Greenland in the short term given the current stock status in relation to existing management objective.

5.3.3 Impact of the revised management objective for the USA on catch advice

The previous management objectives used for the provision of catch advice for the West Greenland fishery (ICES 2012a) were as follows;

- 75% probability of simultaneous attainment of seven management objectives:
    - Meet the 2SW CLs for the four northern areas of NAC (Labrador, Newfoundland, Québec, Gulf);
    - Achieve a 25% increase in returns of 2SW salmon from the average returns in 1992–1996 for the Scotia-Fundy and USA regions;
    - Meet the MSW southern NEAC CL.

To evaluate the implications of the revised management objective, the previous, most recent catch options provided for the West Greenland fishery (ICES, 2012a) were compared to a re-analysis of the catch options, using the same input data, with the proposed new USA stock complex management objective.

The scientific advice has been for zero harvest of the mixed-stock complex at West Greenland since 2002. The probability of meeting each individual management objective and simultaneously meeting all seven objectives for the period of 2012–2014 under the existing and the proposed new USA management objectives are provided in Table 5.3.1. The time-series of realized 2SW returns against the USA CL, the existing and the proposed new management objectives is provided in Figure 5.3.2.

Due to the record high returns realized in USA rivers in 2011 (highest in the time-series since 1990 and the 6th highest since 1971), the probability of meeting the management objective for the USA stock complex based on a forecast of USA returns in the years 2012-2014 ranged from 75-89%. However, realized returns of 2SW fish were well below the forecast values for 2012 and 2013 and were <30% of the 2011 returns (Figure 5.3.2).

Prior to 2012, the probability of USA returns exceeding the management objective was assessed jointly with the Scotia-Fundy stock complex and therefore cannot be reported independently. However for the five years that catch option were provided prior to this time, the probability of USA and Scotia-Fundy returns jointly exceeding their management objectives remained below 5% in each year (ICES, 2004b; 2005b; 2006; 2007; 2009).

There was a 0.16–0.23 difference in the probability of the USA stock complex meeting the proposed new management objective (range 0.50 to 0.70) compared to the existing management objective (range 0.75 to 0.89) (Table 5.3.1). However, the provision of catch advice for the West Greenland fishery depends on the simultaneous achievement of all seven management objectives at a probability level of 0.75. It is therefore most appropriate to evaluate changes in the simultaneous probability between the two scenarios. The probability difference for simultaneously achieving all seven management objectives for both options of USA management objectives resulted in only a 0.01 (i.e. 1%) probability difference. As such, the proposed modification of the USA management objective would have had a negligible impact on the catch advice for the 2012–2014 fishing years. The USA is a single component of the West Greenland complex and the management of the fishery depends on the performance of all contributing stock complexes.

In evaluating the implication of the revised catch advice, the Working Group reviewed the recovery criteria for the GOM DPS. The Working Group concluded that the process used to develop the recovery criteria was appropriate and that the revision of the USA management objective would better align this with federal obligations and NASCO agreements. The implication for the provision of catch advice would have been negligible given that the management of the fishery is based on the simultaneous achievement of all seven management objectives.

Further considerations

The Working Group noted that the protocols for updating the management objectives if and when stocks recover have not been developed. The management objectives for the southern regions are interim objectives intended to guide management in assessing progress in increasing abundance of Atlantic salmon while not unduly restricting Greenland and domestic governments from exploiting stocks that are at high abundance and achieving their conservation objectives. Ultimately, the catch options for the fishery at West Greenland should be assessed against the 2SW conservation limits for each of the contributing regions.

Table 5.1.1.1. Nominal catches of salmon at West Greenland since 1960 (metric tons round fresh weight) by participating nations. For Greenlandic vessels specifically, all catches up to 1968 were taken with set gillnets only and catches after 1968 were taken with set gillnets and driftnets. All non-Greenlandic vessel catches from 1969–1975 were taken with driftnets. The quota figures applied to Greenlandic vessels only.

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1960	-	-	-	-	60	60		
1961	-	-	-	-	127	127		
1962	-	-	-	-	244	244		
1963	-	-	-	-	466	466		
1964	-	-	-	-	1539	1539		
1965	-	36	-	-	825	858		Norwegian harvest figures not avaialble, but known to be less than Faroese catch
1966	32	87	-	-	1251	1370		
1967	78	155	-	85	1283	1601		
1968	138	134	4	272	579	1127		
1969	250	215	30	355	1360	2210		
1970	270	259	8	358	1244	2139		Greenlandic total includes 7 t caught by longlines in the Labrador Sea
1971	340	255	-	645	1449	2689	-	
1972	158	144	-	401	1410	2113	1100	
1973	200	171	-	385	1585	2341	1100	
1974	140	110	-	505	1162	1917	1191	
1975	217	260	-	382	1171	2030	1191	
1976	-	-	-	-	1175	1175	1191	
1977	-	-	-	-	1420	1420	1191	
1978	-	-	-	-	984	984	1191	

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1979	-	-	-	-	1395	1395	1191	
1980	-	-	-	-	1194	1194	1191	
1981	-	-	-	-	1264	1264	1265	Quota set to a specific opening date for the fishery
1982	-	-	-	-	1077	1077	1253	Quota set to a specific opening date for the fishery
1983	-	-	-	-	310	310	1191	
1984	-	-	-	-	297	297	870	
1985	-	-	-	-	864	864	852	
1986	-	-	-	-	960	960	909	
1987	-	-	-	-	966	966	935	
1988	-	-	-	-	893	893	840	Quota for 1988–1990 was 2520 t with an opening date of August 1. Annual catches were not to exceed an annual average (840 t) by more than 10%. Quota adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates.
1989	-	-	-	-	337	337	900	
1990	-	-	-	-	274	274	924	
1991	-	-	-	-	472	472	840	
1992	-	-	-	-	237	237	258	Quota set by Greenland authorities
1993	-	-	-	-			89	The fishery was suspended. NASCO adopt a new quota allocation model.
1994	-	-	-	-			137	The fishery was suspended and the quotas were bought out.
1995	-	-	-	-	83	83	77	Quota advised by NASCO
1996	-	-	-	-	92	92	174	Quota set by Greenland authorities
1997	-	-	-	-	58	58	57	Private (non-commercial) catches to be reported after 1997
1998	-	-	-	-	11	11	20	Fishery restricted to catches used for internal consumption in Greenland

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
1999	-	-	-	-	19	19	20	
2000	-	-	-	-	21	21	20	
2001	-	-	-	-	43	43	114	Final quota calculated according to the ad hoc management system
2002	-	-	-	-	9	9	55	Quota bought out, quota represented the maximum allowable catch (no factory landing allowed), and higher catch figures based on sampling programme information are used for the assessments
2003	-	-	-	-	9	9		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments
2004	-	-	-	-	15	15		same as previous year
2005	-	-	-	-	15	15		same as previous year
2006	-	-	-	-	22	22		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland
2007	-	-	-	-	25	25		Quota set to nil (no factory landing allowed), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments
2008	-	-	-	-	26	26		same as previous year
2009	-	-	-	-	26	26		same as previous year
2010	-	-	-	-	40	40		same as previous year
2011	-	-	-	-	28	28		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland

Year	Norway	Faroes	Sweden	Denmark	Greenland	Total	Quota	Comments
2012	-	-	-	-	33	33		Quota set to nil (unilateral decision made by Greenland to allow factory landing with a 35 t quota), fishery restricted to catches used for internal consumption in Greenland, and higher catch figures based on sampling programme information are used for the assessments
2013	-	-	-	-	47	47		same as previous year

Table 5.1.1.2. Distribution of nominal catches (metric tons) by Greenland vessels since 1960. NAFO Division is represented by 1A–1F. Since 2005, gutted weights have been reported and converted to total weight by a factor of 1.11.

Year	1A	1B	1C	1D	1E	1F	Unk.	West Greenland	East Greenland	Total
1960							60	60		60
1961							127	127		127
1962							244	244		244
1963	1	172	180	68	45			466		466
1964	21	326	564	182	339	107		1539		1539
1965	19	234	274	86	202	10	36	861		861
1966	17	223	321	207	353	130	87	1338		1338
1967	2	205	382	228	336	125	236	1514		1514
1968	1	90	241	125	70	34	272	833		833
1969	41	396	245	234	370		867	2153		2153
1970	58	239	122	123	496	207	862	2107		2107
1971	144	355	724	302	410	159	560	2654		2654
1972	117	136	190	374	385	118	703	2023		2023
1973	220	271	262	440	619	329	200	2341		2341
1974	44	175	272	298	395	88	645	1917		1917
1975	147	468	212	224	352	185	442	2030		2030
1976	166	302	262	225	182	38		1175		1175
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

Year	1A	1B	1C	1D	1E	1F	Unk.	West Greenland	East Greenland	Total
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9
2004	3	1	4	2	3	2	-	15	-	15
2005	1	3	2	1	3	5	-	15	-	15
2006	6	2	3	4	2	4	-	22	-	22
2007	2	5	6	4	5	2	-	25	-	25
2008	4.9	2.2	10.0	1.6	2.5	5.0	0	26.2	0	26.2
2009	0.2	6.2	7.1	3.0	4.3	4.8	0	25.6	0.8	26.3
2010	17.3	4.6	2.4	2.7	6.8	4.3	0	38.1	1.7	39.6
2011	1.8	3.7	5.3	8.0	4.0	4.6	0	27.4	0.1	27.5
2012	5.4	0.8	15.0	4.6	4.0	3.0	0	32.6	0.5	33.1
2013	3.1	2.4	17.9	13.4	6.4	3.8	0	47.0	0.0	47.0

[1] The fishery was suspended.

+ Small catches <5 t.

- No catch.

Table 5.1.1.3. Reported landings (t) by landing category, the number of fishers reporting and the total number of landing reports received for licensed and unlicensed fishers in 2010–2013.

NAFO/ICES	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total
2013	-	-	-	-	-	-	-	2012						
1A	NO	10	32	0.3	0.0		0.3	NO	8	25		0.6		0.6
1A	YES	18	94	1.2	1.6		2.8	YES	27	142	1.3	3.5		4.8
1A	TOTAL	28	126	1.5	1.6		3.1	TOTAL	35	167	1.3	4.1		5.4
1B	NO	2	5	0.2			0.2	NO	3	3		0.2		0.2
1B	YES	6	14	1.3	0.9		2.2	YES	6	19	0.1	0.5		0.5
1B	TOTAL	8	19	1.4	0.9		2.4	TOTAL	9	22	0.1	0.7		0.8
1C	NO							NO	2	6		0.3		0.3
1C	YES	21	205	2.2	3.5	12.3	18.0	YES	30	172	1.8	0.8	12.1	14.7
1C	TOTAL	21	205	2.2	3.5	12.3	18.0	TOTAL	32	178	1.8	1.2	12.1	15.0
1D	NO	10	23	0.4	0.0		0.5	NO	5	15	0.0	0.4		0.4
1D	YES	9	112	0.1	4.8	8.0	12.9	YES	3	23	1.4	1.2	1.6	4.2
1D	TOTAL	19	135	0.5	4.9	8.0	13.4	TOTAL	8	38	1.4	1.6	1.6	4.6
1E	NO	1	1	0.1			0.1	NO	13	22		1.3		1.3
1E	YES	6	41	0.8	0.2	5.3	6.4	YES	3	45	0.8	1.9		2.7
1E	TOTAL	7	42	0.9	0.2	5.3	6.4	TOTAL	16	67	0.8	3.2		4.0
1F	NO	5	10	0.3			0.3	NO	6	17		0.7		0.7
1F	YES	6	15	1.0	2.4		3.4	YES	10	40	0.1	2.2		2.3
1F	TOTAL	11	25	1.4	2.4		3.8	TOTAL	16	57	0.1	2.8		3.0
XIV	NO	1	1	0.0			0.0	NO	6	24		0.5		0.5
XIV	YES							YES	0	0				
XIV	TOTAL	1	1	0.0			0.0	TOTAL	6	24		0.5		0.5
ALL	NO	29	72	1.3	0.1		1.4	NO	43	112	0.0	4.1		4.1

NAFO/ICES	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total
ALL	YES	66	481	6.6	13.4	25.6	45.6	YES	79	441	5.5	9.9	13.7	29.1
ALL	TOTAL	95	553	7.9	13.4	25.6	47.0	TOTAL	122	553	5.5	14.1	13.7	33.2
2011	-	-	-	-	-	-	-	2010						
1A	NO	4	4		0.2		0.2	YES	54	93	4.6	8.2		12.7
1A	YES	21	54	0.9	0.8		1.7	NO	32	39		4.5		4.5
1A	TOTAL	25	58	0.9	1.0		1.9	TOTAL	86	132	4.6	12.7		17.3
1B	NO	3	3		0.2		0.2	YES	14	28	1.5	2.8		4.4
1B	YES	6	27	2.8	0.6		3.5	NO	3	3	0.0	0.2		0.2
1B	TOTAL	9	30	2.8	0.8		3.7	TOTAL	17	31	1.6	3.0		4.6
1C	NO	6	6		0.7		0.7	YES	9	13	1.1	0.5		1.6
1C	YES	14	50	3.2	1.4		4.6	NO	10	15		0.7		0.7
1C	TOTAL	20	56	3.2	2.1		5.3	TOTAL	19	28	1.1	1.3		2.4
1D	NO	9	9		0.7		0.7	YES	7	16	1.5	0.6		2.2
1D	YES	6	86	7.1	0.2		7.3	NO	9	16	0.1	0.5		0.6
1D	TOTAL	15	95	7.1	0.9		8.0	TOTAL	16	32	1.6	1.1		2.7
1E	NO	16	29		1.8		1.8	YES	10	46	1.7	1.4		3.1
1E	YES	4	65	1.1	1.1		2.2	NO	20	32		3.7		3.7
1E	TOTAL	20	94	1.1	2.9		4.0	TOTAL	30	78	1.7	5.1		6.8
1F	NO	13	19		2.5		2.5	YES	16	29	1.9	1.5		3.4
1F	YES	10	31	1.5	0.7		2.1	NO	11	19		0.9		0.9
1F	TOTAL	23	50	1.5	3.1		4.6	TOTAL	27	48	1.9	2.3		4.3
XIV	NO	5	11		0.1		0.1	YES	0	0				
XIV	YES	0	0					NO	13	40		1.7		1.7
XIV	TOTAL	5	11		0.1		0.1	TOTAL	13	40		1.7		1.7

NAFO/ICES	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total	Licensed	No. of Fishers	No. of Reports	Comm.	Private	Factory	Total
ALL	NO	56	81		6.1		6.1	YES	110	225	12.3	15.0		27.3
ALL	YES	61	313	16.5	4.9		21.4	NO	98	164	0.1	12.3		12.4
ALL	TOTAL	117	394	16.5	11.0		27.5	TOTAL	208	389	12.4	27.3		39.7

Table 5.1.1.4. Total number of licences issued by NAFO (1A-1F)/ICES Divisions and the number of people (licensed and unlicensed) reporting catches of Atlantic salmon in the Greenland fishery. Reports received by fish plants prior to 1997 and to the Licence Office from 1998 to present.

Year	Licences	1A	1B	1C	1D	1E	1F	ICES	Unk.	Total
1987		78	67	74		99	233		0	579
1988		63	46	43	53	78	227		0	516
1989		30	41	98	46	46	131		0	393
1990		32	15	46	52	54	155		0	362
1991		53	39	100	41	54	123		0	410
1992		3	9	73	9	36	82		0	212
1993										
1994										
1995		0	17	52	21	24	31		0	145
1996		1	8	74	15	23	42		0	163
1997		0	16	50	7	2	6		0	80
1998		16	5	8	7	3	30		0	69
1999		3	8	24	18	21	29		0	102
2000		1	1	5	12	2	25		0	43
2001	452	2	7	13	15	6	37		0	76
2002	479	1	1	9	13	9	8		0	41
2003	150	11	1	4	4	12	10		0	42
2004	155	20	2	8	4	20	12		0	66
2005	185	11	7	17	5	17	18		0	75
2006	159	43	14	17	20	17	30		0	141
2007	260	29	12	26	10	33	22		0	132
2008	260	44	8	41	10	16	24		0	143
2009	294	19	11	35	15	25	31	9	0	145
2010	309	86	17	19	16	30	27	13	0	208
2011	234	25	9	20	15	20	23	5	0	117
2012	279	35	9	32	8	16	16	6	0	122
2013	228	28	8	21	19	7	11	1	0	95

Table 5.1.2.1. Size of biological samples and percentage (by number) of North American and European salmon in research vessel catches at West Greenland (1969 to 1982), from commercial samples (1978 to 1992, 1995 to 1997, and 2001) and from local consumption samples (1998 to 2000, and 2002 to present).

		Sample Size			Continent of Origin (%)			
Source		Length	Scales	Genetics	NA	(95% CI)[1]	E	(95% CI)[1]
Research	1969	212	212		51	(57, 44)	49	(56, 43)
	1970	127	127		35	(43, 26)	65	(75, 57)
	1971	247	247		34	(40, 28)	66	(72, 50)
	1972	3488	3488		36	(37, 34)	64	(66, 63)
	1973	102	102		49	(59, 39)	51	(61, 41)
	1974	834	834		43	(46, 39)	57	(61, 54)
	1975	528	528		44	(48, 40)	56	(60, 52)
	1976	420	420		43	(48, 38)	57	(62, 52)
	1978[2]	606	606		38	(41, 38)	62	(66, 59)
	1978[3]	49	49		55	(69, 41)	45	(59, 31)
	1979	328	328		47	(52, 41)	53	(59, 48)
	1980	617	617		58	(62, 54)	42	(46, 38)
	1982	443	443		47	(52, 43)	53	(58, 48)
Commercial	1978	392	392		52	(57, 47)	48	(53, 43)
	1979	1653	1653		50	(52, 48)	50	(52, 48)
	1980	978	978		48	(51, 45)	52	(55, 49)
	1981	4570	1930		59	(61, 58)	41	(42, 39)
	1982	1949	414		62	(64, 60)	38	(40, 36)
	1983	4896	1815		40	(41, 38)	60	(62, 59)
	1984	7282	2720		50	(53, 47)	50	(53, 47)
	1985	13 272	2917		50	(53, 46)	50	(52, 34)
	1986	20 394	3509		57	(66, 48)	43	(52, 34)
	1987	13 425	2960		59	(63, 54)	41	(46, 37)
	1988	11 047	2562		43	(49, 38)	57	(62, 51)
	1989	9366	2227		56	(60, 52)	44	(48, 40)
	1990	4897	1208		75	(79, 70)	25	(30, 21)
	1991	5005	1347		65	(69, 61)	35	(39, 31)
	1992	6348	1648		54	(57, 50)	46	(50, 43)
	1995	2045	2045		68	(75, 65)	32	(35, 28)
	1996	3341	1397		73	(76, 71)	27	(29, 24)
	1997	794	282		80	(84, 75)	20	(25, 16)
Local Consumption	1998	540	406		79	(84, 73)	21	(27, 16)
	1999	532	532		90	(97, 84)	10	(16, 3)
	2000	491	491		70		30	
Commercial	2001	4721	2655		69	(71, 67)	31	(33, 29)

		Sample Size			Continent of Origin (%)			
Source		Length	Scales	Genetics	NA	(95% CI)[1]	E	(95% CI)[1]
Local Consumption	2002	501	501	501	68		32	
	2003	1743	1743	1779	68		32	
	2004	1639	1639	1688	73		27	
	2005	767	767	767	76		24	
	2006	1209	1209	1193	72		28	
	2007	1116	1110	1123	82		18	
	2008	1854	1866	1853	86		14	
	2009	1662	1683	1671	91		9	
	2010	1261	1265	1240	80		20	
	2011	967	965	964	92		8	
	2012	1372	1371	1373	82		18	
	2013	1155	1156	1149	82		18	

[1] CI - confidence interval calculated by method of Pella and Robertson (1979) for 1984–1986 and binomial distribution for the others.

[2] During 1978 Fishery

[3] Research samples after 1978 fishery closed.

Table 5.1.2.2. Reported landings (kg) for the West Greenland Atlantic salmon fishery from 2002 by NAFO Division and the division-specific adjusted landings where the sampling teams observed more fish landed than were reported. Adjusted landings were not calculated for 2006 and 2011 as the sampling teams did not observe more fish 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	17 263	4558	2363	2747	6766	4252	37 949
	Adjusted		4824		6566		5274	43 056
2011	Reported	1858	3662	5274	7977	4021	4613	27 407
	Adjusted							
2012	Reported	5353	784	14 991	4564	3993	2951	32 636
	Adjusted		2001				3694	34 596
2013	Reported	3052	2358	17 950	13 356	6442	3774	46 933
	Adjusted		2461				4408	47 669

Table 5.1.2.3. Annual mean whole weights (kg) and fork lengths (cm) by sea age and continent of origin of Atlantic salmon caught at West Greenland 1969 to 1992 and 1995 to present (NA = North America and E = Europe).

	Whole weight (kg)									Fork Length (cm)					
	1SW		2SW		PS		All sea ages		Total	1SW		2SW		PS	
	NA	E	NA	E	NA	E	NA	E		NA	E	NA	E	NA	E
1969	3.12	3.76	5.48	5.80	-	5.13	3.25	3.86	3.58	65.0	68.7	77.0	80.3	-	75.3
1970	2.85	3.46	5.65	5.50	4.85	3.80	3.06	3.53	3.28	64.7	68.6	81.5	82.0	78.0	75.0
1971	2.65	3.38	4.30	-	-	-	2.68	3.38	3.14	62.8	67.7	72.0	-	-	-
1972	2.96	3.46	5.85	6.13	2.65	4.00	3.25	3.55	3.44	64.2	67.9	80.7	82.4	61.5	69.0
1973	3.28	4.54	9.47	10.00	-	-	3.83	4.66	4.18	64.5	70.4	88.0	96.0	61.5	-
1974	3.12	3.81	7.06	8.06	3.42	-	3.22	3.86	3.58	64.1	68.1	82.8	87.4	66.0	-
1975	2.58	3.42	6.12	6.23	2.60	4.80	2.65	3.48	3.12	61.7	67.5	80.6	82.2	66.0	75.0
1976	2.55	3.21	6.16	7.20	3.55	3.57	2.75	3.24	3.04	61.3	65.9	80.7	87.5	72.0	70.7
1978	2.96	3.50	7.00	7.90	2.45	6.60	3.04	3.53	3.35	63.7	67.3	83.6	-	60.8	85.0
1979	2.98	3.50	7.06	7.60	3.92	6.33	3.12	3.56	3.34	63.4	66.7	81.6	85.3	61.9	82.0
1980	2.98	3.33	6.82	6.73	3.55	3.90	3.07	3.38	3.22	64.0	66.3	82.9	83.0	67.0	70.9
1981	2.77	3.48	6.93	7.42	4.12	3.65	2.89	3.58	3.17	62.3	66.7	82.8	84.5	72.5	-
1982	2.79	3.21	5.59	5.59	3.96	5.66	2.92	3.43	3.11	62.7	66.2	78.4	77.8	71.4	80.9
1983	2.54	3.01	5.79	5.86	3.37	3.55	3.02	3.14	3.10	61.5	65.4	81.1	81.5	68.2	70.5
1984	2.64	2.84	5.84	5.77	3.62	5.78	3.20	3.03	3.11	62.3	63.9	80.7	80.0	69.8	79.5
1985	2.50	2.89	5.42	5.45	5.20	4.97	2.72	3.01	2.87	61.2	64.3	78.9	78.6	79.1	77.0
1986	2.75	3.13	6.44	6.08	3.32	4.37	2.89	3.19	3.03	62.8	65.1	80.7	79.8	66.5	73.4
1987	3.00	3.20	6.36	5.96	4.69	4.70	3.10	3.26	3.16	64.2	65.6	81.2	79.6	74.8	74.8
1988	2.83	3.36	6.77	6.78	4.75	4.64	2.93	3.41	3.18	63.0	66.6	82.1	82.4	74.7	73.8
1989	2.56	2.86	5.87	5.77	4.23	5.83	2.77	2.99	2.87	62.3	64.5	80.8	81.0	73.8	82.2
1990	2.53	2.61	6.47	5.78	3.90	5.09	2.67	2.72	2.69	62.3	62.7	83.4	81.1	72.6	78.6
1991	2.42	2.54	5.82	6.23	5.15	5.09	2.57	2.79	2.65	61.6	62.7	80.6	82.2	81.7	80.0
1992	2.54	2.66	6.49	6.01	4.09	5.28	2.86	2.74	2.81	62.3	63.2	83.4	81.1	77.4	82.7
1995	2.37	2.67	6.09	5.88	3.71	4.98	2.45	2.75	2.56	61.0	63.2	81.3	81.0	70.9	81.3
1996	2.63	2.86	6.50	6.30	4.98	5.44	2.83	2.90	2.88	62.8	64.0	81.4	81.1	77.1	79.4
1997	2.57	2.82	7.95	6.11	4.82	6.9	2.63	2.84	2.71	62.3	63.6	85.7	84.0	79.4	87.0
1998	2.72	2.83	6.44	-	3.28	4.77	2.76	2.84	2.78	62.0	62.7	84.0	-	66.3	76.0
1999	3.02	3.03	7.59	-	4.20	-	3.09	3.03	3.08	63.8	63.5	86.6	-	70.9	-
2000	2.47	2.81	-	-	2.58	-	2.47	2.81	2.57	60.7	63.2	-	-	64.7	-
2001	2.89	3.03	6.76	5.96	4.41	4.06	2.95	3.09	3.00	63.1	63.7	81.7	79.1	75.3	72.1
2002	2.84	2.92	7.12	-	5.00	-	2.89	2.92	2.90	62.6	62.1	83.0	-	75.8	-
2003	2.94	3.08	8.82	5.58	4.04	-	3.02	3.10	3.04	63	64.4	86.1	78.3	71.4	-
2004	3.11	2.95	7.33	5.22	4.71	6.48	3.17	3.22	3.18	64.7	65.0	86.2	76.4	77.6	88.0
2005	3.19	3.33	7.05	4.19	4.31	2.89	3.31	3.33	3.31	65.9	66.4	83.3	75.5	73.7	62.3
2006	3.10	3.25	9.72		5.05	3.67	3.25	3.26	3.24	65.3	65.3	90.0		76.8	69.5
2007	2.89	2.87	6.19	6.47	4.94	3.57	2.98	2.99	2.98	63.5	63.3	80.9	80.6	76.7	71.3
2008	3.04	3.03	6.35	7.47	3.82	3.39	3.08	3.07	3.08	64.6	63.9	80.1	85.5	71.1	73.0
2009	3.28	3.40	7.59	6.54	5.25	4.28	3.48	3.67	3.50	64.9	65.5	84.6	81.7	75.9	73.5
2010	3.44	3.24	6.40	5.45	4.17	3.92	3.47	3.28	3.42	66.7	65.2	80.0	75.0	72.4	70.0

2011	3.30	3.18	5.69	4.94	4.46	5.11	3.39	3.49	3.40	65.8	64.7	78.6	75.0	73.7	76.3
2012	3.34	3.38	6.00	4.51	4.65	3.65	3.44	3.40	3.44	65.4	64.9	75.9	70.4	72.8	68.9
2013	3.33	3.16	6.43	4.51	3.64	5.38	3.39	3.20	3.35	66.2	64.6	81.0	72.8	69.9	73.6
10-yr mean	3.20	3.18	6.88	5.48	4.50	4.23	3.30	3.29	3.29	65.3	64.9	82.1	77.0	74.1	72.6
Overall mean	2.87	3.17	6.60	6.19	4.09	4.72	3.01	3.25	3.13	63.4	65.3	81.9	80.9	71.7	75.8

Table 5.1.2.4. River age distribution (%) and mean river age for all North American origin salmon caught at West Greenland 1968 to 1992 and 1995 to present. Continent of origin assignments were based on scale characteristics until 1995, scale characteristics and DNA based assignments until 2001 and DNA based assignments only from 2002 on.

YEAR	1	2	3	4	5	6	7	8
1968	0.3	19.6	40.4	21.3	16.2	2.2	0	0
1969	0	27.1	45.8	19.6	6.5	0.9	0	0
1970	0	58.1	25.6	11.6	2.3	2.3	0	0
1971	1.2	32.9	36.5	16.5	9.4	3.5	0	0
1972	0.8	31.9	51.4	10.6	3.9	1.2	0.4	0
1973	2.0	40.8	34.7	18.4	2.0	2.0	0	0
1974	0.9	36	36.6	12.0	11.7	2.6	0.3	0
1975	0.4	17.3	47.6	24.4	6.2	4.0	0	0
1976	0.7	42.6	30.6	14.6	10.9	0.4	0.4	0
1977	-	-	-	-	-	-	-	-
1978	2.7	31.9	43.0	13.6	6.0	2.0	0.9	0
1979	4.2	39.9	40.6	11.3	2.8	1.1	0.1	0
1980	5.9	36.3	32.9	16.3	7.9	0.7	0.1	0
1981	3.5	31.6	37.5	19.0	6.6	1.6	0.2	0
1982	1.4	37.7	38.3	15.9	5.8	0.7	0	0.2
1983	3.1	47.0	32.6	12.7	3.7	0.8	0.1	0
1984	4.8	51.7	28.9	9.0	4.6	0.9	0.2	0
1985	5.1	41.0	35.7	12.1	4.9	1.1	0.1	0
1986	2.0	39.9	33.4	20.0	4.0	0.7	0	0
1987	3.9	41.4	31.8	16.7	5.8	0.4	0	0
1988	5.2	31.3	30.8	20.9	10.7	1.0	0.1	0
1989	7.9	39.0	30.1	15.9	5.9	1.3	0	0
1990	8.8	45.3	30.7	12.1	2.4	0.5	0.1	0
1991	5.2	33.6	43.5	12.8	3.9	0.8	0.3	0
1992	6.7	36.7	34.1	19.1	3.2	0.3	0	0
1993	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-
1995	2.4	19.0	45.4	22.6	8.8	1.8	0.1	0
1996	1.7	18.7	46.0	23.8	8.8	0.8	0.1	0
1997	1.3	16.4	48.4	17.6	15.1	1.3	0	0
1998	4.0	35.1	37.0	16.5	6.1	1.1	0.1	0
1999	2.7	23.5	50.6	20.3	2.9	0.0	0	0
2000	3.2	26.6	38.6	23.4	7.6	0.6	0	0
2001	1.9	15.2	39.4	32.0	10.8	0.7	0	0
2002	1.5	27.4	46.5	14.2	9.5	0.9	0	0
2003	2.6	28.8	38.9	21.0	7.6	1.1	0	0
2004	1.9	19.1	51.9	22.9	3.7	0.5	0	0
2005	2.7	21.4	36.3	30.5	8.5	0.5	0	0
2006	0.6	13.9	44.6	27.6	12.3	1.0	0	0
2007	1.6	27.7	34.5	26.2	9.2	0.9	0	0

YEAR	1	2	3	4	5	6	7	8
2008	0.9	25.1	51.9	16.8	4.7	0.6	0	0
2009	2.6	30.7	47.3	15.4	3.7	0.4	0	0
2010	1.6	21.7	47.9	21.7	6.3	0.8	0	0
2011	1.0	35.9	45.9	14.4	2.8	0	0	0
2012	0.3	29.8	39.4	23.3	6.5	0.7	0	0
2013	0.1	32.6	37.3	20.8	8.6	0.6	0	0
10-yr mean	1.3	25.8	43.9	22.0	6.6	0.6	0.0	0.0
Overall Mean	2.6	31.6	39.6	18.3	6.8	1.1	0.1	0.0

Table 5.1.2.5. River age distribution (%) and mean river age for all European origin salmon caught at West Greenland 1968 to 1992 and 1995 to present. Continent of origin assignments were based on scale characteristics until 1995, scale characteristics and DNA based assignments until 2001 and DNA based assignments only from 2002 on.

YEAR	1	2	3	4	5	6	7	8
1968	21.6	60.3	15.2	2.7	0.3	0	0	0
1969	0	83.8	16.2	0	0	0	0	0
1970	0	90.4	9.6	0	0	0	0	0
1971	9.3	66.5	19.9	3.1	1.2	0	0	0
1972	11.0	71.2	16.7	1.0	0.1	0	0	0
1973	26.0	58.0	14.0	2.0	0	0	0	0
1974	22.9	68.2	8.5	0.4	0	0	0	0
1975	26.0	53.4	18.2	2.5	0	0	0	0
1976	23.5	67.2	8.4	0.6	0.3	0	0	0
1977	-	-	-	-	-	-	-	-
1978	26.2	65.4	8.2	0.2	0	0	0	0
1979	23.6	64.8	11.0	0.6	0	0	0	0
1980	25.8	56.9	14.7	2.5	0.2	0	0	0
1981	15.4	67.3	15.7	1.6	0	0	0	0
1982	15.6	56.1	23.5	4.2	0.7	0	0	0
1983	34.7	50.2	12.3	2.4	0.3	0.1	0.1	0
1984	22.7	56.9	15.2	4.2	0.9	0.2	0	0
1985	20.2	61.6	14.9	2.7	0.6	0	0	0
1986	19.5	62.5	15.1	2.7	0.2	0	0	0
1987	19.2	62.5	14.8	3.3	0.3	0	0	0
1988	18.4	61.6	17.3	2.3	0.5	0	0	0
1989	18.0	61.7	17.4	2.7	0.3	0	0	0
1990	15.9	56.3	23.0	4.4	0.2	0.2	0	0
1991	20.9	47.4	26.3	4.2	1.2	0	0	0
1992	11.8	38.2	42.8	6.5	0.6	0	0	0
1993	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-
1995	14.8	67.3	17.2	0.6	0	0	0	0
1996	15.8	71.1	12.2	0.9	0	0	0	0
1997	4.1	58.1	37.8	0.0	0	0	0	0
1998	28.6	60.0	7.6	2.9	0.0	1.0	0	0
1999	27.7	65.1	7.2	0	0	0	0	0
2000	36.5	46.7	13.1	2.9	0.7	0	0	0
2001	16.0	51.2	27.3	4.9	0.7	0	0	0
2002	9.4	62.9	20.1	7.6	0	0	0	0
2003	16.2	58.0	22.1	3.0	0.8	0	0	0
2004	18.3	57.7	20.5	3.2	0.2	0	0	0
2005	19.2	60.5	15.0	5.4	0	0	0	0
2006	17.7	54.0	23.6	3.7	0.9	0	0	0
2007	7.0	48.5	33.0	10.5	1.0	0	0	0
2008	7.0	72.8	19.3	0.8	0.0	0	0	0
2009	14.3	59.5	23.8	2.4	0.0	0	0	0
2010	11.3	57.1	27.3	3.4	0.8	0	0	0
2011	19.0	51.7	27.6	1.7	0	0	0	0
2012	9.3	63.0	24.0	3.7	0	0	0	0
2013	4.5	68.2	24.4	2.5	0	0	0	0
10-yr mean	12.8	59.3	23.8	3.7	0.3	0.0	0.0	0.0
Overall Mean	17.3	61.0	18.7	2.7	0.3	0.0	0.0	0.0

Table 5.1.2.6. Sea age composition (%) of samples from fishery landings at West Greenland from 1985 by continent of origin.

	North American			European		
Year	1SW	2SW	Previous Spawners	1SW	2SW	Previous Spawners
1985	92.5	7.2	0.3	95.0	4.7	0.4
1986	95.1	3.9	1.0	97.5	1.9	0.6
1987	96.3	2.3	1.4	98.0	1.7	0.3
1988	96.7	2.0	1.2	98.1	1.3	0.5
1989	92.3	5.2	2.4	95.5	3.8	0.6
1990	95.7	3.4	0.9	96.3	3.0	0.7
1991	95.6	4.1	0.4	93.4	6.5	0.2
1992	91.9	8.0	0.1	97.5	2.1	0.4
1993	-	-	-	-	-	-
1994	-	-	-	-	-	-
1995	96.8	1.5	1.7	97.3	2.2	0.5
1996	94.1	3.8	2.1	96.1	2.7	1.2
1997	98.2	0.6	1.2	99.3	0.4	0.4
1998	96.8	0.5	2.7	99.4	0.0	0.6
1999	96.8	1.2	2.0	100.0	0.0	0.0
2000	97.4	0.0	2.6	100.0	0.0	0.0
2001	98.2	2.6	0.5	97.8	2.0	0.3
2002	97.3	0.9	1.8	100.0	0.0	0.0
2003	96.7	1.0	2.3	98.9	1.1	0.0
2004	97.0	0.5	2.5	97.0	2.8	0.2
2005	92.4	1.2	6.4	96.7	1.1	2.2
2006	93.0	0.8	5.6	98.8	0.0	1.2
2007	96.5	1.0	2.5	95.6	2.5	1.5
2008	97.4	0.5	2.2	98.8	0.8	0.4
2009	93.4	2.8	3.8	89.4	7.6	3.0
2010	98.2	0.4	1.4	97.5	1.7	0.8
2011	93.8	1.5	4.7	82.8	12.1	5.2
2012	93.2	0.7	6.0	98.0	1.6	0.4
2013	94.9	1.4	3.7	96.6	2.4	1.0

Table 5.1.3.1. The number of samples and continent of origin of Atlantic salmon by NAFO Division sampled at West Greenland in 2013. NA = North America, E = Europe.

		Numbers			Percentages	
NAFO Div	Sample dates	NA	E	Totals	NA	E
1B	September 9–September 29	567	113	680	83.4	16.6
1C	September 8–October 11	245	53	298	82.2	17.8
1F	August 28–October 07	126	45	171	73.7	26.3
Total		938	211	1149	81.6	18.4

Table 5.1.3.2. The numbers of North American (NA) and European (E) Atlantic salmon caught at West Greenland 1971 to 1992 and 1995 to present and the proportion by continent of origin, based on NAFO Division continent of origin weighted by catch (weight) in each division. Numbers are rounded to the nearest hundred fish. Unreported catch is not included in this assessment.

	Proportion by continent weighted by catch in number		Numbers of salmon by continent	
	NA	E	NA	E
1982	57	43	192 200	143 800
1983	40	60	39 500	60 500
1984	54	46	48 800	41 200
1985	47	53	143 500	161 500
1986	59	41	188 300	131 900
1987	59	41	171 900	126 400
1988	43	57	125 500	168 800
1989	55	45	65 000	52 700
1990	74	26	62 400	21 700
1991	63	37	111 700	65 400
1992	45	55	46 900	38 500
1995	67	33	21 400	10 700
1996	70	30	22 400	9700
1997	85	15	18 000	3300
1998	79	21	3100	900
1999	91	9	5700	600
2000	65	35	5100	2700
2001	67	33	9400	4700
2002	69	31	2300	1000
2003	64	36	2600	1400
2004	72	28	3900	1500
2005	74	26	3500	1200
2006	69	31	4000	1800
2007	76	24	6100	1900
2008	86	14	8000	1300
2009	89	11	7000	800
2010	80	20	10 000	2600
2011	93	7	6800	600
2012	79	21	7800	2100
2013	82	18	11 500	2700

Table 5.3.1. The probability of meeting each management objective individually and of meeting all seven objectives simultaneously for fishing years 2012–2014, assuming zero harvest under the previous and the revised US management objectives. The pre-2014 assessment was reported by ICES (2014) and the post-2014 assessment was based on a re-analysis of catch options with the 2012 input data and the revised USA management objective.

	LAB	NFLD	QC	GULF	SF	US	SNEAC MSW	Simultaneous
Pre-2014 Management Objective for US stock complex								
2012	0.45	0.86	0.71	0.50	0.15	0.89	0.92	0.05
2013	0.48	0.78	0.73	0.50	0.25	0.75	0.86	0.07
2014	0.56	0.78	0.75	0.55	0.20	0.86	0.87	0.08
Post-2014 Management Objective for US stock complex								
2012	0.45	0.86	0.71	0.50	0.15	0.66	0.92	0.05
2013	0.48	0.78	0.73	0.50	0.25	0.50	0.86	0.06
2014	0.56	0.78	0.75	0.55	0.20	0.70	0.87	0.07

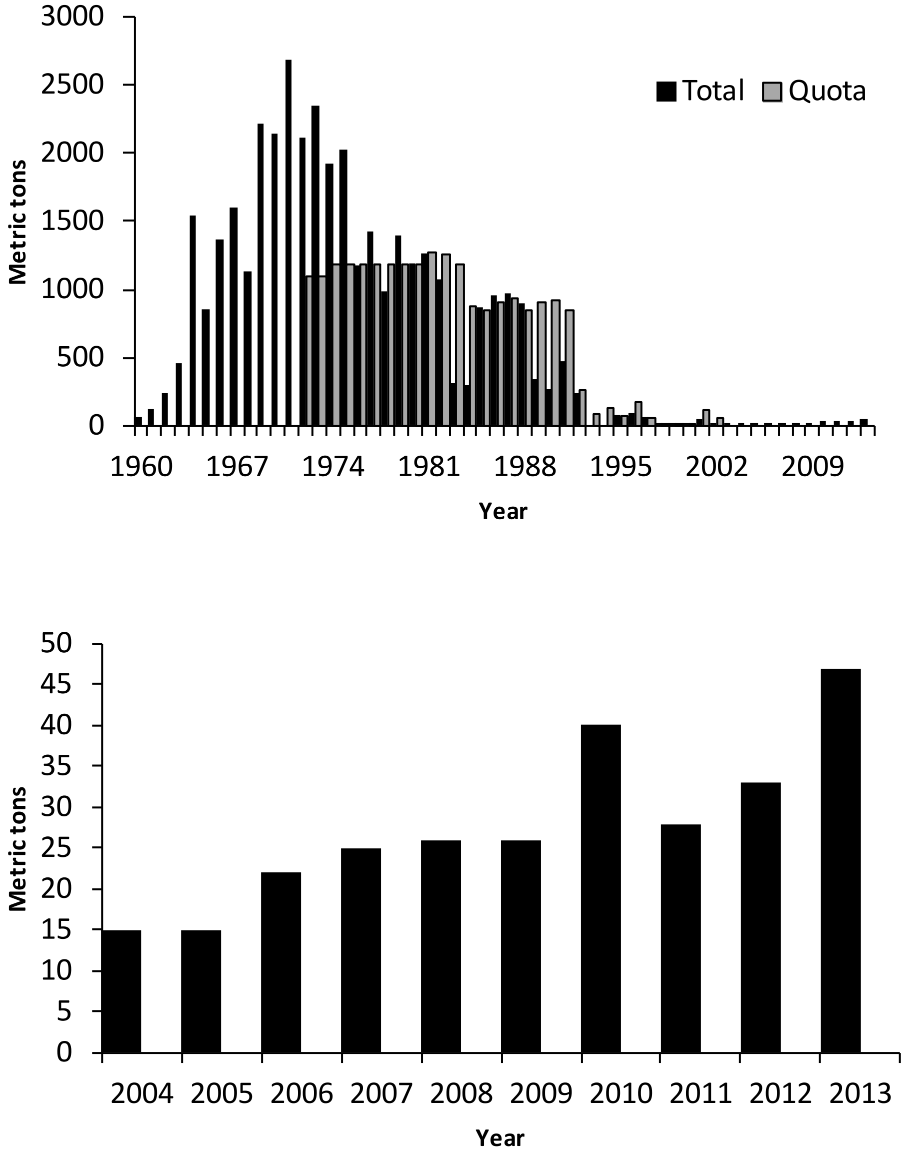


Figure 5.1.1.1. Nominal catches and commercial quotas (metric tonnes, round fresh weight) of salmon at West Greenland for 1960–2013 (top panel) and 2004–2013 (bottom panel). The quota has been set to nil since 2003 although factory landings, with an internal quota of 35 t, have been allowed since 2012.

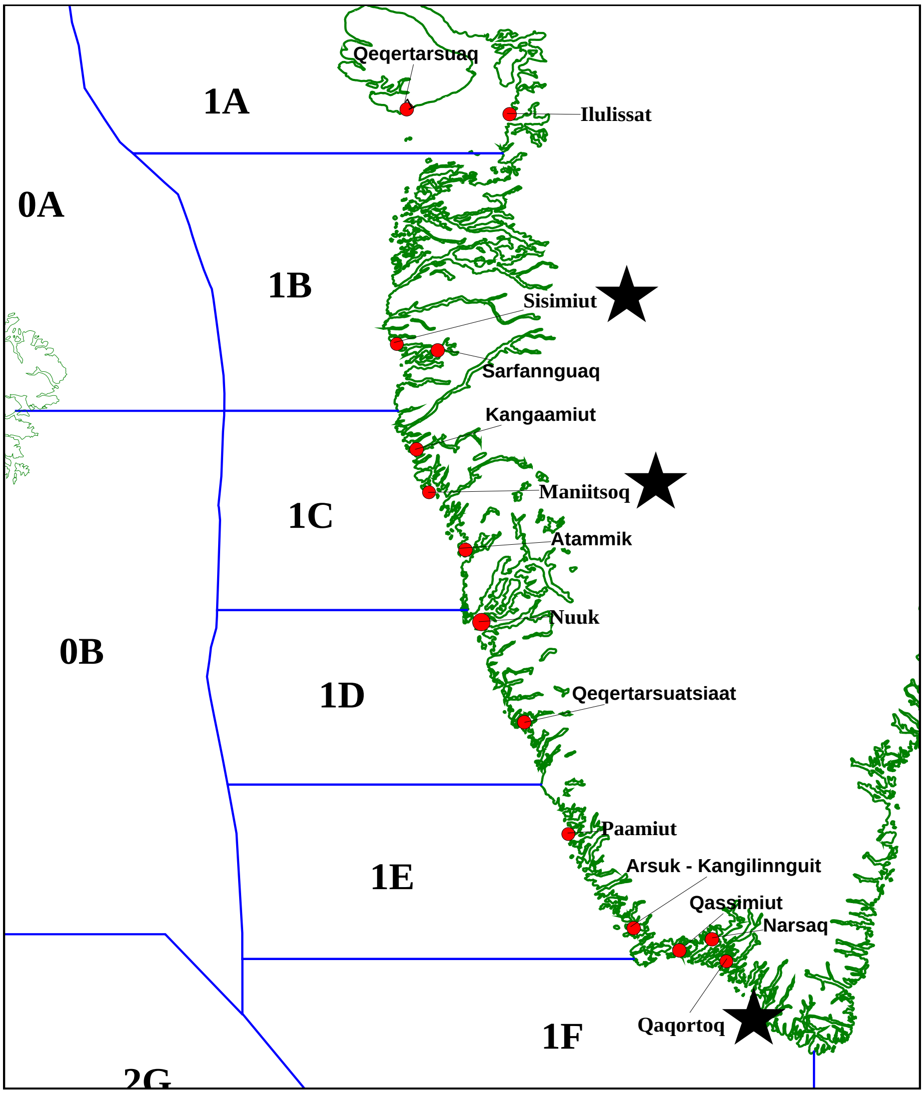


Figure 5.1.1.2. Location of NAFO divisions along the coast of West Greenland. Stars identify the communities where biological sampling occurred (Sisimiut, Maniitsoq and Qaqortoq).

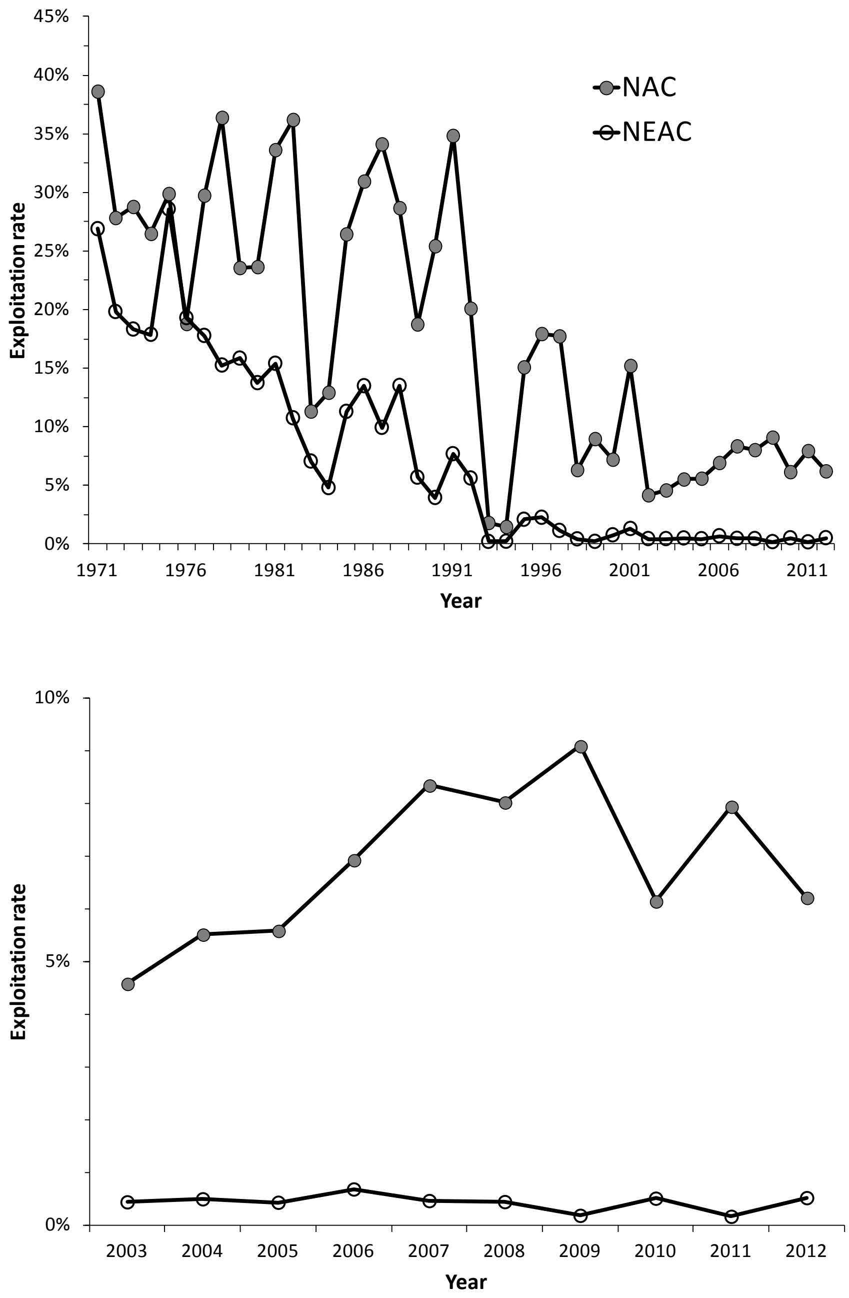


Figure 5.1.1.3. Exploitation rate (%) for NAC 1SW non-maturing and southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2012 (upper panel) and 2003–20012 (lower panel). Exploitation rate estimates are only available to 2012, as 2013 exploitation rates are dependent on 2014 2SW NAC or MSW NEAC returns.

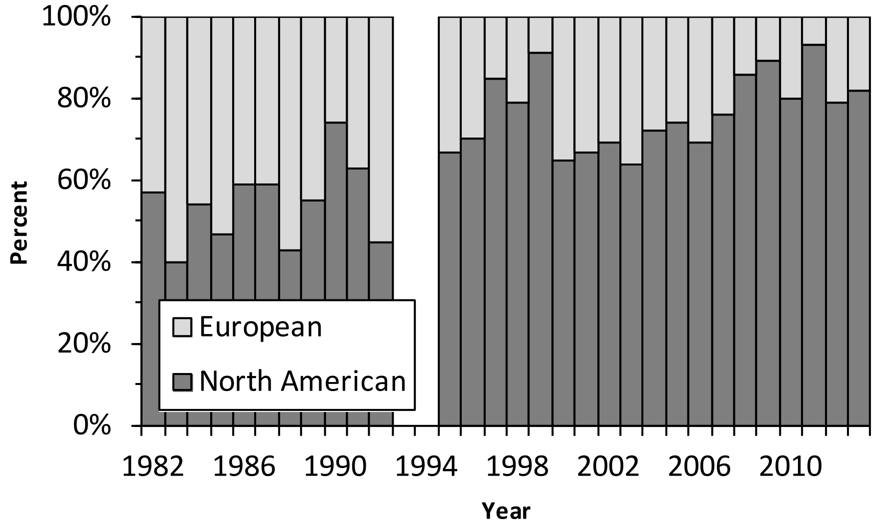


Figure 5.1.3.1. Percent of the sampled catch by continent of origin for the 1982 to 2013 Atlantic salmon West Greenland fishery.

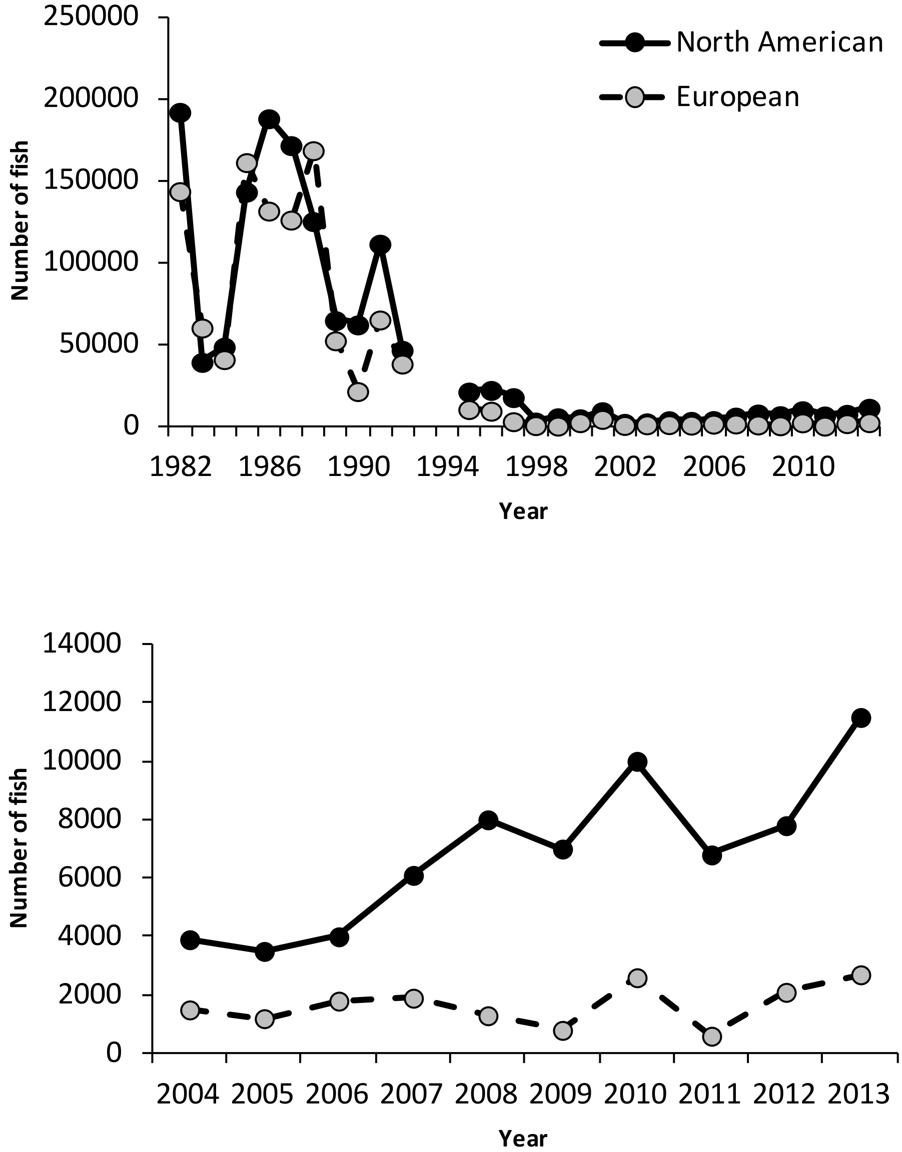


Figure 5.1.3.2. Number of North American and European Atlantic salmon caught at West Greenland from 1982 to 2013 (upper panel) and 2004 to 2013 (lower panel) based on NAFO Division continent of origin weighted by catch (weight) in each division. Numbers are rounded to the nearest hundred fish. Unreported catch is not included in this assessment.

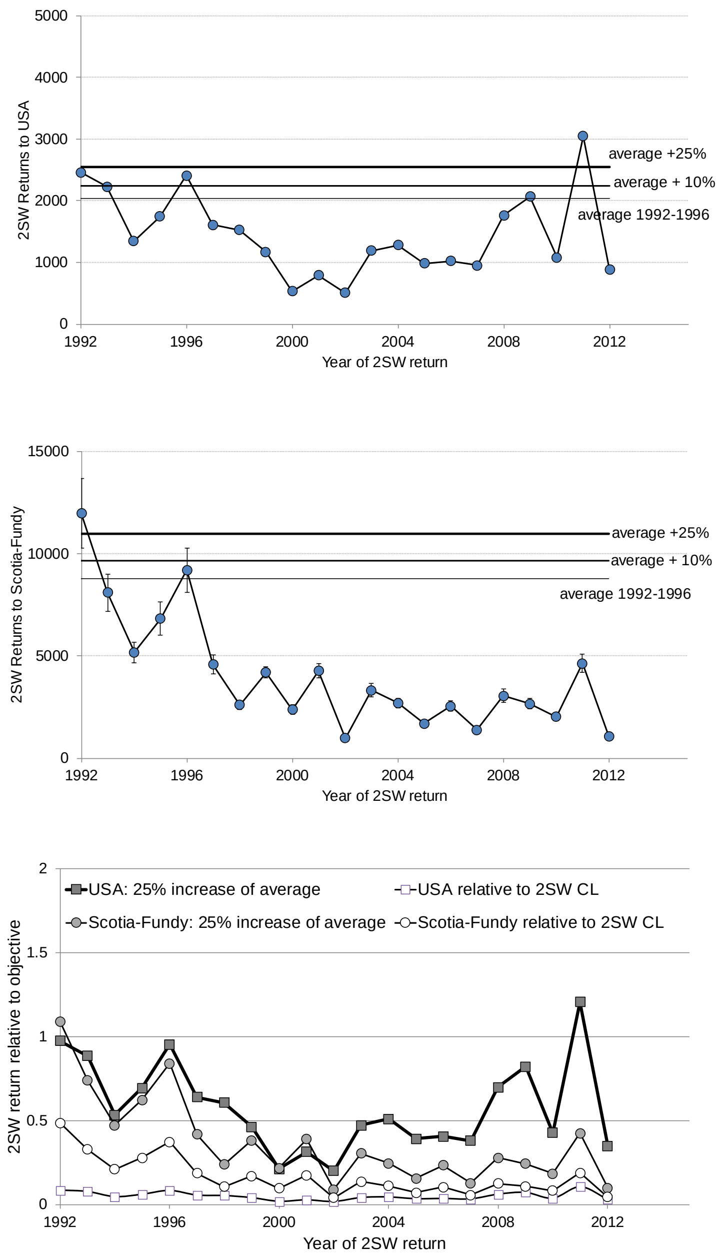


Figure 5.3.1. Median returns of 2SW salmon to the USA (upper panel) and Scotia-Fundy regions (middle panel, 5th to 95th percentile error bars) and the ratio of the returns to the management objective (25% increase from the average returns of 1992–1996, 2SW CL) for Scotia-Fundy and USA (lower panel) for 1992 to 2012.

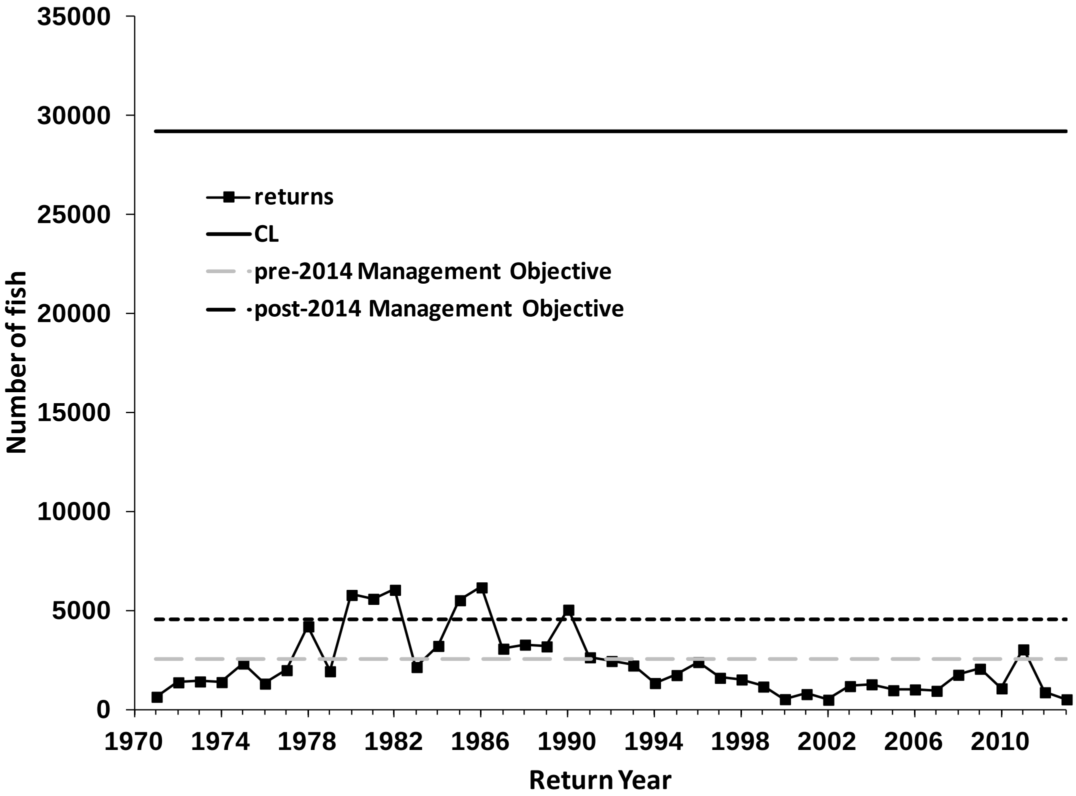


Figure 5.3.2. US returns (1971–2012) compared against three different management objectives; US stock complex CL (29 199), the pre-2014 Management Objective (2548) and the post-2014 Management Objective (4549).

Annex 1: Working documents submitted to the Working Group on North Atlantic Salmon, 19–28 March, 2014

WP No.	Authors	Title
1	Nygaard, R.	The Salmon Fishery in Greenland, 2013.
2	de la Hoz, J.	Salmon fisheries and status of stocks in Spain (Asturias-2013). Report for 2014 Meeting WGNAS.
3	Jacobsen, J.A.	Status of the fisheries for Atlantic salmon and production of farmed salmon in 2013 for the Faroe Islands.
4	Dionne, M., April, J. and Cauchon, V.	Status of Atlantic salmon stocks in Québec for 2013.
5	Dionne, M. and Cauchon, V.	Smolt production, freshwater and sea survival on two index rivers in Québec, the Saint-Jean and the Trinité.
6	Rasmussen, G.	National report for Denmark, 2013.
7	Biron, M., Cairns, D., Cameron, P., Douglas, S., and Chaput, G.	Stock Status of Atlantic Salmon (Salmo salar) in DFO Gulf Region (Salmon Fishing Areas 15 to 18).
8	Chaput, G., Dionne, Biron, M., Cairns, D., Cameron, P., Douglas, S., Jones, R., Levy, A., Poole, R., and Robertson, M.	Catch Statistics and Aquaculture Production Values for Canada: preliminary 2013, final 2012.
9	Chaput, G., Jones, R., and Levy, A.	Review of rebuilding management objective for the provision of catch advice for the Scotia-Fundy region of NAC.
10	Chaput, G.	Considerations for defining Reference Points under the Precautionary Approach.
11	White, J., Romakkaniemi, A., Massiot-Granier, E., Pulkkinen, H., Rivot, E., Prévost, E., Chaput, G.	Ecoknows update.
12	Gilbey, J., Wennevik, V., Potter, T., Fiske, P., Jacobsen, J.A. and Hansen, L.P.	Interim report on the genetic stock identification of salmon caught in the Faroes fishery.
13	Orpwood, J.E., Smith, G.W. & MacLean, J.C.	National Report for UK (Scotland): 2013 season.
14	Levy, A. L., R. A. Jones, M.L. Wilson and A. J. F. Gibson	Status of Atlantic Salmon in Canada's Maritimes Region (Salmon Fishing Areas 19 to 23).
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38	Euzenat, G.	National report for France.
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Annex 4: Reported catch of salmon by sea age class

Reported catch of salmon in numbers and weight (tonnes round fresh weight) by sea age class. Catches reported for 2013 may be provisional. Methods used for estimating age composition given in footnote.

West Greenland

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
West Greenland	1982	315532	-	17810	-	-	-	-	-	-	-	-	-	2688	-	336030	1077
	1983	90500	-	8100	-	-	-	-	-	-	-	-	-	1400	-	100000	310
	1984	78942	-	10442	-	-	-	-	-	-	-	-	-	630	-	90014	297
	1985	292181	-	18378	-	-	-	-	-	-	-	-	-	934	-	311493	864
	1986	307800	-	9700	-	-	-	-	-	-	-	-	-	2600	-	320100	960
	1987	297128	-	6287	-	-	-	-	-	-	-	-	-	2898	-	306313	966
	1988	281356	-	4602	-	-	-	-	-	-	-	-	-	2296	-	288254	893
	1989	110359	-	5379	-	-	-	-	-	-	-	-	-	1875	-	117613	337
	1990	97271	-	3346	-	-	-	-	-	-	-	-	-	860	-	101477	274
	1991	167551	415	8809	53	-	-	-	-	-	-	-	-	743	4	177103	472
	1992	82354	217	2822	18	-	-	-	-	-	-	-	-	364	2	85540	237
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1995	31241	-	558	-	-	-	-	-	-	-	-	-	478	-	32277	83
	1996	30613	-	884	-	-	-	-	-	-	-	-	-	568	-	32065	92
	1997	20980	-	134	-	-	-	-	-	-	-	-	-	124	-	21238	58
	1998	3901	-	17	-	-	-	-	-	-	-	-	-	88	-	4006	11
	1999	6124	18	50	0	-	-	-	-	-	-	-	-	84	1	6258	19
	2000	7715	21	0	0	-	-	-	-	-	-	-	-	140	0	7855	21
	2001	14795	40	324	2	-	-	-	-	-	-	-	-	293	1	15412	43
	2002	3344	10	34	0	-	-	-	-	-	-	-	-	27	0	3405	10
	2003	3933	12	38	0	-	-	-	-	-	-	-	-	73	0	4044	12
	2004	4488	14	51	0	-	-	-	-	-	-	-	-	88	0	4627	15
	2005	3120	13	40	0	-	-	-	-	-	-	-	-	180	1	3340	14
	2006	5746	20	183	1	-	-	-	-	-	-	-	-	224	1	6153	22
	2007	6037	24	82	0	6	0	-	-	-	-	-	-	144	1	6263	25
	2008	9311	26	47	0	0	0	-	-	-	-	-	-	177	1	9535	26
	2009	7442	27	268	1	0	0	-	-	-	-	-	-	328	1	8038	29
	2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11747	40
	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8396	28
	2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9689	33
	2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12920	47

Canada

Canada	1982	358000	716	-	-	-	-	-	-	-	-	240000	1082	-	-	598000	1798
	1983	265000	513	-	-	-	-	-	-	-	-	201000	911	-	-	466000	1424
	1984	234000	467	-	-	-	-	-	-	-	-	143000	645	-	-	377000	1112
	1985	333084	593	-	-	-	-	-	-	-	-	122621	540	-	-	455705	1133
	1986	417269	780	-	-	-	-	-	-	-	-	162305	779	-	-	579574	1559
	1987	435799	833	-	-	-	-	-	-	-	-	203731	951	-	-	639530	1784
	1988	372178	677	-	-	-	-	-	-	-	-	137637	633	-	-	509815	1310
	1989	304620	549	-	-	-	-	-	-	-	-	135484	590	-	-	440104	1139
	1990	233690	425	-	-	-	-	-	-	-	-	106379	486	-	-	340069	911
	1991	189324	341	-	-	-	-	-	-	-	-	82532	370	-	-	271856	711
	1992	108901	199	-	-	-	-	-	-	-	-	66357	323	-	-	175258	522
	1993	91239	159	-	-	-	-	-	-	-	-	45416	214	-	-	136655	373
	1994	76973	139	-	-	-	-	-	-	-	-	42946	216	-	-	119919	355
	1995	61940	107	-	-	-	-	-	-	-	-	34263	153	-	-	96203	260
	1996	82490	138	-	-	-	-	-	-	-	-	31590	154	-	-	114080	292
	1997	58988	103	-	-	-	-	-	-	-	-	26270	126	-	-	85258	229
	1998	51251	87	-	-	-	-	-	-	-	-	13274	70	-	-	64525	157
	1999	50901	88	-	-	-	-	-	-	-	-	11368	64	-	-	62269	152
	2000	55263	95	-	-	-	-	-	-	-	-	10571	58	-	-	65834	153
	2001	51225	86	-	-	-	-	-	-	-	-	11575	61	-	-	62800	147
	2002	53464	99	-	-	-	-	-	-	-	-	8439	49	-	-	61903	148
	2003	46768	81	-	-	-	-	-	-	-	-	11218	60	-	-	57986	141
	2004	54253	94	-	-	-	-	-	-	-	-	12933	68	-	-	67186	162
	2005	47368	83	-	-	-	-	-	-	-	-	10937	56	-	-	58305	139
	2006	46747	82	-	-	-	-	-	-	-	-	11248	55	-	-	57995	137
	2007	37075	63	-	-	-	-	-	-	-	-	10311	49	-	-	47386	112
	2008	58386	100	-	-	-	-	-	-	-	-	11736	57	-	-	70122	158
	2009	42943	74	-	-	-	-	-	-	-	-	11226	52	-	-	54169	126
	2010	58531	100	-	-	-	-	-	-	-	-	10972	53	-	-	69503	153
	2011	63756	110	-	-	-	-	-	-	-	-	13668	69	-	-	77424	179
	2012	43192	74	-	-	-	-	-	-	-	-	10980	52	-	-	54172	126
	2013	45435	79	-	-	-	-	-	-	-	-	12969	58	-	-	58404	136

USA

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
USA	1982	33	-	1206	-	5	-	-	-	-	-	-	-	21	-	1265	6
	1983	26	-	314	1	2	-	-	-	-	-	-	-	6	-	348	1
	1984	50	-	545	2	2	-	-	-	-	-	-	-	12	-	609	2
	1985	23	-	528	2	2	-	-	-	-	-	-	-	13	-	566	2
	1986	76	-	482	2	2	-	-	-	-	-	-	-	3	-	563	2
	1987	33	-	229	1	10	-	-	-	-	-	-	-	10	-	282	1
	1988	49	-	203	1	3	-	-	-	-	-	-	-	4	-	259	1
	1989	157	0	325	1	2	-	-	-	-	-	-	-	3	-	487	2
	1990	52	0	562	2	12	-	-	-	-	-	-	-	16	-	642	2
	1991	48	0	185	1	1	-	-	-	-	-	-	-	4	-	238	1
	1992	54	0	138	1	1	-	-	-	-	-	-	-	-	-	193	1
	1993	17	-	133	1	0	0	-	-	-	-	-	-	2	-	152	1
	1994	12	-	0	0	0	0	-	-	-	-	-	-	-	-	12	0
	1995	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1996	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1997	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1998	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1999	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2000	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2001	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2002	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2003	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2004	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2005	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2006	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2007	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2008	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2009	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2010	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2011	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2012	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2013	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0

Faroe Islands

Faroe Islands	1982/83	9086	-	101227	-	21663	-	448	-	29	-	-	-	-	-	132453	625
	1983/84	4791	-	107199	-	12469	-	49	-	-	-	-	-	-	-	124508	651
	1984/85	324	-	123510	-	9690	-	-	-	-	-	-	-	1653	-	135177	598
	1985/86	1672	-	141740	-	4779	-	76	-	-	-	-	-	6287	-	154554	545
	1986/87	76	-	133078	-	7070	-	80	-	-	-	-	-	-	-	140304	539
	1987/88	5833	-	55728	-	3450	-	0	-	-	-	-	-	-	-	65011	208
	1988/89	1351	-	86417	-	5728	-	0	-	-	-	-	-	-	-	93496	309
	1989/90	1560	-	103407	-	6463	-	6	-	-	-	-	-	-	-	111436	364
	1990/91	631	-	52420	-	4390	-	8	-	-	-	-	-	-	-	57449	202
	1991/92	16	-	7611	-	837	-	-	-	-	-	-	-	-	-	8464	31
	1992/93	-	-	4212	-	1203	-	-	-	-	-	-	-	-	-	5415	22
	1993/94	-	-	1866	-	206	-	-	-	-	-	-	-	-	-	2072	7
	1994/95	-	-	1807	-	156	-	-	-	-	-	-	-	-	-	1963	6
	1995/96	-	-	268	-	14	-	-	-	-	-	-	-	-	-	282	1
	1996/97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1997/98	339	-	1315	-	109	-	-	-	-	-	-	-	-	-	1763	6
	1998/99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1999/00	225	-	1560	-	205	-	-	-	-	-	-	-	-	-	1990	8
	2000/01	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2001/02	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2002/03	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2003/04	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2004/05	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2005/06	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2006/07	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2007/08	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2008/09	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2009/10	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2010/11	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2011/12	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2012/13	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2013/14	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0

Finland

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Finland	1982	2598	5	-	-	-	-	-	-	-	-	5408	49	-	-	8006	54
	1983	3916	7	-	-	-	-	-	-	-	-	6050	51	-	-	9966	58
	1984	4899	9	-	-	-	-	-	-	-	-	4726	37	-	-	9625	46
	1985	6201	11	-	-	-	-	-	-	-	-	4912	38	-	-	11113	49
	1986	6131	12	-	-	-	-	-	-	-	-	3244	25	-	-	9375	37
	1987	8696	15	-	-	-	-	-	-	-	-	4520	34	-	-	13216	49
	1988	5926	9	-	-	-	-	-	-	-	-	3495	27	-	-	9421	36
	1989	10395	19	-	-	-	-	-	-	-	-	5332	33	-	-	15727	52
	1990	10084	19	-	-	-	-	-	-	-	-	5600	41	-	-	15684	60
	1991	9213	17	-	-	-	-	-	-	-	-	6298	53	-	-	15511	70
	1992	15017	28	-	-	-	-	-	-	-	-	6284	49	-	-	21301	77
	1993	11157	17	-	-	-	-	-	-	-	-	8180	53	-	-	19337	70
	1994	7493	11	-	-	-	-	-	-	-	-	6230	38	-	-	13723	49
	1995	7786	11	-	-	-	-	-	-	-	-	5344	38	-	-	13130	49
	1996	12230	20	1275	5	1424	12	234	4	19	1	-	-	354	3	15536	44
	1997	10341	15	2419	10	1674	15	141	2	22	1	-	-	418	3	15015	45
	1998	11792	19	1608	7	1660	16	147	3	-	-	-	-	460	3	15667	48
	1999	18830	33	1528	8	1579	16	129	2	6	0	-	-	490	3	22562	62
	2000	20817	39	5152	24	2379	25	110	2	-	-	-	-	991	6	56000	95
	2001	13296	21	6286	32	5369	57	103	2	-	-	-	-	2372	13	27426	125
	2002	6427	12	5227	20	4048	43	145	2	11	0	-	-	2496	16	18354	93
	2003	8130	15	1828	7	3599	35	161	3	6	0	-	-	2204	15	15928	75
	2004	3349	7	2784	7	1943	11	473	4	7	1	-	-	2744	11	11300	39
	2005	9007	18	1145	6	1342	15	56	1	40	1	-	-	755	7	12345	47
	2006	14893	30	3698	17	1257	13	60	1	0	-	-	-	683	5	20591	67
	2007	3850	9	4785	20	2194	23	17	1	6	-	-	-	1130	8	11982	59
	2008	3955	8	2118	9	4001	40	221	4	0	-	-	-	1744	10	12039	71
	2009	8076	12	1368	5	1142	11	222	3	0	-	-	-	710	5	11518	36
	2010	6376	12	3014	13	1161	12	278	4	5	-	-	-	880	7	11714	49
	2011	7740	14	1682	9	1344	14	171	3	10	-	-	-	734	4	11681	44
	2012	13496	30	2606	12	1169	12	197	3	5	0	-	-	839	6	18312	64
	2013	8178	13	2701	15	1143	12	63	1	7	0	-	-	604	4	12696	46

Iceland

Iceland	1991	29601	-	11892	-	-	-	-	-	-	-	-	-	-	-	41493	130
	1992	38538	-	15312	-	-	-	-	-	-	-	-	-	-	-	53850	175
	1993	36640	-	11541	-	-	-	-	-	-	-	-	-	-	-	48181	160
	1994	24224	59	14088	76	-	-	-	-	-	-	-	-	-	-	38312	135
	1995	32767	90	13136	56	-	-	-	-	-	-	-	-	-	-	45903	145
	1996	26927	66	9785	52	-	-	-	-	-	-	-	-	-	-	36712	118
	1997	21684	56	8178	41	-	-	-	-	-	-	-	-	-	-	29862	97
	1998	32224	81	7272	37	-	-	-	-	-	-	-	-	-	-	39496	119
	1999	22620	59	9883	52	-	-	-	-	-	-	-	-	-	-	32503	111
	2000	20270	49	4319	24	-	-	-	-	-	-	-	-	-	-	24589	73
	2001	18538	46	5289	28	-	-	-	-	-	-	-	-	-	-	23827	74
	2002	25277	64	5194	26	-	-	-	-	-	-	-	-	-	-	30471	90
	2003	24738	61	8119	37	-	-	-	-	-	-	-	-	-	-	32857	99
	2004	32600	84	6128	28	-	-	-	-	-	-	-	-	-	-	38728	111
	2005	39980	101	5941	28	-	-	-	-	-	-	-	-	-	-	45921	129
	2006	29857	71	5635	23	-	-	-	-	-	-	-	-	-	-	35492	93
	2007	31899	74	3262	15	-	-	-	-	-	-	-	-	-	-	35161	89
	2008	44391	106	5129	26	-	-	-	-	-	-	-	-	-	-	49520	132
	2009	43981	103	4561	24	-	-	-	-	-	-	-	-	-	-	48542	126
	2010	43457	105	9251	43	-	-	-	-	-	-	-	-	-	-	52708	147
	2011	28550	74	4854	24	-	-	-	-	-	-	-	-	-	-	33404	98
	2012	17011	15	2848	14	-	-	-	-	-	-	-	-	-	-	19859	29
	2013	40998	100	4842	24	-	-	-	-	-	-	-	-	-	-	45840	124

Sweden

Sweden	1990	7430	18	-	-	-	-	-	-	-	-	3135	15	-	-	10565	33
	1991	8990	20	-	-	-	-	-	-	-	-	3620	18	-	-	12610	38
	1992	9850	23	-	-	-	-	-	-	-	-	4655	26	-	-	14505	49
	1993	10540	23	-	-	-	-	-	-	-	-	6370	33	-	-	16910	56
	1994	8035	18	-	-	-	-	-	-	-	-	4660	26	-	-	12695	44
	1995	9761	22	-	-	-	-	-	-	-	-	2770	14	-	-	12531	36
	1996	6008	14	-	-	-	-	-	-	-	-	3542	19	-	-	9550	33
	1997	2747	7	-	-	-	-	-	-	-	-	2307	12	-	-	5054	19
	1998	2421	6	-	-	`	-	-	-	-	-	1702	9	-	-	4123	15
	1999	3573	8	-	-	-	-	-	-	-	-	1460	8	-	-	5033	16
	2000	7103	18	-	-	-	-	-	-	-	-	3196	15	-	-	10299	33
	2001	4634	12	-	-	-	-	-	-	-	-	3853	21	-	-	8487	33
	2002	4733	12	-	-	-	-	-	-	-	-	2826	16	-	-	7559	28
	2003	2891	7	-	-	-	-	-	-	-	-	3214	18	-	-	6105	25
	2004	2494	6	-	-	-	-	-	-	-	-	2330	13	-	-	4824	19
	2005	2122	5	-	-	-	-	-	-	-	-	1770	10	-	-	3892	15
	2006	2585	4	-	-	-	-	-	-	-	-	1772	10	-	-	4357	14
	2007	1228	3	-	-	-	-	-	-	-	-	2442	13	-	-	3670	16
	2008	1197	3	-	-	-	-	-	-	-	-	2752	16	-	-	3949	18
	2009	1269	3	-	-	-	-	-	-	-	-	2495	14	-	-	3764	17
	2010	2109	5	-	-	-	-	-	-	-	-	3066	17	-	-	5175	22
	2011	2726	7	-	-	-	-	-	-	-	-	5759	32	-	-	8485	39
	2012	1900	5	-	-	-	-	-	-	-	-	4826	25	-	-	6726	30
	2013	1052	3	-	-	-	-	-	-	-	-	1996	12	-	-	3048	15

Norway

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Norway	1981	221566	467	-	-	-	-	-	-	-	-	213943	1189	-	-	435509	1656
	1982	163120	363	-	-	-	-	-	-	-	-	174229	985	-	-	337349	1348
	1983	278061	593	-	-	-	-	-	-	-	-	171361	957	-	-	449422	1550
	1984	294365	628	-	-	-	-	-	-	-	-	176716	995	-	-	471081	1623
	1985	299037	638	-	-	-	-	-	-	-	-	162403	923	-	-	461440	1561
	1986	264849	556	-	-	-	-	-	-	-	-	191524	1042	-	-	456373	1598
	1987	235703	491	-	-	-	-	-	-	-	-	153554	894	-	-	389257	1385
	1988	217617	420	-	-	-	-	-	-	-	-	120367	656	-	-	337984	1076
	1989	220170	436	-	-	-	-	-	-	-	-	80880	469	-	-	301050	905
	1990	192500	385	-	-	-	-	-	-	-	-	91437	545	-	-	283937	930
	1991	171041	342	-	-	-	-	-	-	-	-	92214	535	-	-	263255	877
	1992	151291	301	-	-	-	-	-	-	-	-	92717	566	-	-	244008	867
	1993	153407	312	62403	284	35147	327	-	-	-	-	-	-	-	-	250957	923
	1994	-	415	-	319	-	262	-	-	-	-	-	-	-	-	-	996
	1995	134341	249	71552	341	27104	249	-	-	-	-	-	-	-	-	232997	839
	1996	110085	215	69389	322	27627	249	-	-	-	-	-	-	-	-	207101	786
	1997	124387	241	52842	238	16448	151	-	-	-	-	-	-	-	-	193677	630
	1998	162185	296	66767	306	15568	139	-	-	-	-	-	-	-	-	244520	741
	1999	164905	318	70825	326	18669	167	-	-	-	-	-	-	-	-	254399	811
	2000	250468	504	99934	454	24319	219	-	-	-	-	-	-	-	-	374721	1177
	2001	207934	417	117759	554	33047	295	-	-	-	-	-	-	-	-	358740	1266
	2002	127039	249	98055	471	33013	299	-	-	-	-	-	-	-	-	258107	1019
	2003	185574	363	87993	410	31099	298	-	-	-	-	-	-	-	-	304666	1071
	2004	108645	207	77343	371	23173	206	-	-	-	-	-	-	-	-	209161	784
	2005	165900	307	69488	320	27507	261	-	-	-	-	-	-	-	-	262895	888
	2006	142218	261	99401	453	23529	218	-	-	-	-	-	-	-	-	265148	932
	2007	78165	140	79146	363	28896	264	-	-	-	-	-	-	-	-	186207	767
	2008	89228	170	69027	314	34124	322	-	-	-	-	-	-	-	-	192379	807
	2009	73045	135	53725	241	23663	219	-	-	-	-	-	-	-	-	150433	595
	2010	98490	184	56260	250	22310	208	-	-	-	-	-	-	-	-	177060	642
	2011	71597	140	81351	374	20270	183	-	-	-	-	-	-	-	-	173218	696
	2012	81638	162	63985	289	26689	245	-	-	-	-	-	-	-	-	172312	696
	2013	70059	117	49264	227	14367	131	-	-	-	-	-	-	-	-	133690	475

Russia

Russia	1987	97242	-	27135	-	9539	-	556	-	18	-	-	-	2521	-	137011	564
	1988	53158	-	33395	-	10256	-	294	-	25	-	-	-	2937	-	100065	420
	1989	78023	-	23123	-	4118	-	26	-	0	-	-	-	2187	-	107477	364
	1990	70595	-	20633	-	2919	-	101	-	0	-	-	-	2010	-	96258	313
	1991	40603	-	12458	-	3060	-	650	-	0	-	-	-	1375	-	58146	215
	1992	34021	-	8880	-	3547	-	180	-	0	-	-	-	824	-	47452	167
	1993	28100	-	11780	-	4280	-	377	-	0	-	-	-	1470	-	46007	139
	1994	30877	-	10879	-	2183	-	51	-	0	-	-	-	555	-	44545	141
	1995	27775	62	9642	50	1803	15	6	0	0	0	-	-	385	2	39611	129
	1996	33878	79	7395	42	1084	9	40	1	0	0	-	-	41	1	42438	131
	1997	31857	72	5837	28	672	6	38	1	0	0	-	-	559	3	38963	110
	1998	34870	92	6815	33	181	2	28	0	0	0	-	-	638	3	42532	130
	1999	24016	66	5317	25	499	5	0	0	0	0	-	-	1131	6	30963	102
	2000	27702	75	7027	34	500	5	3	0	0	0	-	-	1853	9	37085	123
	2001	26472	61	7505	39	1036	10	30	0	0	0	-	-	922	5	35965	115
	2002	24588	60	8720	43	1284	12	3	0	0	0	-	-	480	3	35075	118
	2003	22014	50	8905	42	1206	12	20	0	0	0	-	-	634	4	32779	107
	2004	17105	39	6786	33	880	7	0	0	0	0	-	-	529	3	25300	82
	2005	16591	39	7179	33	989	8	1	0	0	0	-	-	439	3	25199	82
	2006	22412	54	5392	28	759	6	0	0	0	0	-	-	449	3	29012	91
	2007	12474	30	4377	23	929	7	0	0	0	0	-	-	277	2	18057	62
	2008	13404	28	8674	39	669	4	8	0	0	0	-	-	312	2	23067	73
	2009	13580	30	7215	35	720	5	36	0	0	0	-	-	173	1	21724	71
	2010	14834	33	9821	48	844	6	49	0	0	0	-	-	186	1	25734	88
	2011	13779	31	9030	44	747	5	51	0	0	0	-	-	171	1	23778	82
	2012	17484	42	6560	34	738	5	53	0	0	0	-	-	173	1	25008	83
	2013	14576	35	6938	36	857	6	27	0	0	0	-	-	93	1	22491	78

Ireland

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Ireland	1980	248333	745	-	-	-	-	-	-	-	-	39608	202	-	-	287941	947
	1981	173667	521	-	-	-	-	-	-	-	-	32159	164	-	-	205826	685
	1982	310000	930	-	-	-	-	-	-	-	-	12353	63	-	-	322353	993
	1983	502000	1506	-	-	-	-	-	-	-	-	29411	150	-	-	531411	1656
	1984	242666	728	-	-	-	-	-	-	-	-	19804	101	-	-	262470	829
	1985	498333	1495	-	-	-	-	-	-	-	-	19608	100	-	-	517941	1595
	1986	498125	1594	-	-	-	-	-	-	-	-	28335	136	-	-	526460	1730
	1987	358842	1112	-	-	-	-	-	-	-	-	27609	127	-	-	386451	1239
	1988	559297	1733	-	-	-	-	-	-	-	-	30599	141	-	-	589896	1874
	1989	-	-	-	-	-	-	-	-	-	-	-	-	-	-	330558	1079
	1990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188890	567
	1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	135474	404
	1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235435	631
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200120	541
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	286266	804
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	288225	790
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	249623	685
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	209214	570
	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	237663	624
	1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180477	515
	2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	228220	621
	2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270963	730
	2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256808	682
	2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204145	551
	2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180953	489
	2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156308	422
	2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120834	326
	2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30946	84
	2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33200	89
	2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25170	68
	2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36508	99
	2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32308	87
	2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32599	88
	2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37876	102

UK(England and Wales)

UK	1985	62815	-	-	-	-	-	-	-	-	-	32716	-	-	-	95531	361
(England & Wales)	1986	68759	-	-	-	-	-	-	-	-	-	42035	-	-	-	110794	430
	1987	56739	-	-	-	-	-	-	-	-	-	26700	-	-	-	83439	302
	1988	76012	-	-	-	-	-	-	-	-	-	34151	-	-	-	110163	395
	1989	54384	-	-	-	-	-	-	-	-	-	29284	-	-	-	83668	296
	1990	45072	-	-	-	-	-	-	-	-	-	41604	-	-	-	86676	338
	1991	36671	-	-	-	-	-	-	-	-	-	14978	-	-	-	51649	200
	1992	34331	-	-	-	-	-	-	-	-	-	10255	-	-	-	44586	171
	1993	56033	-	-	-	-	-	-	-	-	-	13144	-	-	-	69177	248
	1994	67853	-	-	-	-	-	-	-	-	-	20268	-	-	-	88121	324
	1995	57944	-	-	-	-	-	-	-	-	-	22534	-	-	-	80478	295
	1996	30352	-	-	-	-	-	-	-	-	-	16344	-	-	-	46696	183
	1997	30203	-	-	-	-	-	-	-	-	-	11171	-	-	-	41374	142
	1998	30272	-	-	-	-	-	-	-	-	-	6645	-	-	-	36917	123
	1999	27953	-	-	-	-	-	-	-	-	-	13154	-	-	-	41107	150
	2000	48153	-	-	-	-	-	-	-	-	-	12800	-	-	-	60953	219
	2001	38480	-	-	-	-	-	-	-	-	-	12827	-	-	-	51307	184
	2002	34708	-	-	-	-	-	-	-	-	-	10961	-	-	-	45669	161
	2003	14656	-	-	-	-	-	-	-	-	-	7550	-	-	-	22206	89
	2004	24753	-	-	-	-	-	-	-	-	-	5806	-	-	-	30559	111
	2005	19883	-	-	-	-	-	-	-	-	-	6279	-	-	-	26162	97
	2006	17204	-	-	-	-	-	-	-	-	-	4852	-	-	-	22056	80
	2007	15540	-	-	-	-	-	-	-	-	-	4383	-	-	-	19923	67
	2008	14467	-	-	-	-	-	-	-	-	-	4569	-	-	-	19036	64
	2009	10015	-	-	-	-	-	-	-	-	-	3895	-	-	-	13910	54
	2010	25502	-	-	-	-	-	-	-	-	-	7193	-	-	-	32695	109
	2011	19708	-	-	-	-	-	-	-	-	-	14867	-	-	-	34575	136
	2012	7493	-	-	-	-	-	-	-	-	-	7433	-	-	-	14926	58
	2013	12954	-	-	-	-	-	-	-	-	-	9381	-	-	-	22335	83

UK(Scotland)

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
UK (Scotland)	1982	208061	496	-	-	-	-	-	-	-	-	128242	596	-	-	336303	1092
	1983	209617	549	-	-	-	-	-	-	-	-	145961	672	-	-	355578	1221
	1984	213079	509	-	-	-	-	-	-	-	-	107213	504	-	-	320292	1013
	1985	158012	399	-	-	-	-	-	-	-	-	114648	514	-	-	272660	913
	1986	202838	525	-	-	-	-	-	-	-	-	148197	744	-	-	351035	1269
	1987	164785	419	-	-	-	-	-	-	-	-	103994	503	-	-	268779	922
	1988	149098	381	-	-	-	-	-	-	-	-	112162	501	-	-	261260	882
	1989	174941	431	-	-	-	-	-	-	-	-	103886	464	-	-	278827	895
	1990	81094	201	-	-	-	-	-	-	-	-	87924	423	-	-	169018	624
	1991	73608	177	-	-	-	-	-	-	-	-	65193	285	-	-	138801	462
	1992	101676	238	-	-	-	-	-	-	-	-	82841	361	-	-	184517	600
	1993	94517	227	-	-	-	-	-	-	-	-	71726	320	-	-	166243	547
	1994	99479	248	-	-	-	-	-	-	-	-	85404	400	-	-	184883	648
	1995	89971	224	-	-	-	-	-	-	-	-	78511	364	-	-	168482	588
	1996	66465	160	-	-	-	-	-	-	-	-	57998	267	-	-	124463	427
	1997	46866	114	-	-	-	-	-	-	-	-	40459	182	-	-	87325	296
	1998	53503	121	-	-	-	-	-	-	-	-	39264	162	-	-	92767	283
	1999	25255	57	-	-	-	-	-	-	-	-	30694	143	-	-	55949	199
	2000	44033	114	-	-	-	-	-	-	-	-	36767	161	-	-	80800	275
	2001	42586	101	-	-	-	-	-	-	-	-	34926	150	-	-	77512	251
	2002	31385	73	-	-	-	-	-	-	-	-	26403	118	-	-	57788	191
	2003	29598	71	-	-	-	-	-	-	-	-	27588	122	-	-	57091	192
	2004	37631	88	-	-	-	-	-	-	-	-	36856	159	-	-	74033	245
	2005	39093	91	-	-	-	-	-	-	-	-	28666	126	-	-	67117	215
	2006	36668	75	-	-	-	-	-	-	-	-	27620	118	-	-	63848	192
	2007	32335	71	-	-	-	-	-	-	-	-	24098	100	-	-	56433	171
	2008	23431	51	-	-	-	-	-	-	-	-	25745	110	-	-	49176	161
	2009	18189	37	-	-	-	-	-	-	-	-	19185	83	-	-	37374	121
	2010	33426	69	-	-	-	-	-	-	-	-	26988	111	-	-	60414	180
	2011	15706	33	-	-	-	-	-	-	-	-	28496	126	-	-	44202	159
	2012	19371	40	-	-	-	-	-	-	-	-	19785	84	-	-	39156	124
	2013	21388	46	-	-	-	-	-	-	-	-	17738	76	-	-	39126	123

France

France	1987	6013	18	-	-	-	-	-	-	-	-	1806	9	-	-	7819	27
	1988	2063	7	-	-	-	-	-	-	-	-	4964	25	-	-	7027	32
	1989	1124	3	1971	9	311	2	-	-	-	-	-	-	-	-	3406	14
	1990	1886	5	2186	9	146	1	-	-	-	-	-	-	-	-	4218	15
	1991	1362	3	1935	9	190	1	-	-	-	-	-	-	-	-	3487	13
	1992	2490	7	2450	12	221	2	-	-	-	-	-	-	-	-	5161	21
	1993	3581	10	987	4	267	2	-	-	-	-	-	-	-	-	4835	16
	1994	2810	7	2250	10	40	1	-	-	-	-	-	-	-	-	5100	18
	1995	1669	4	1073	5	22	0	-	-	-	-	-	-	-	-	2764	10
	1996	2063	5	1891	9	52	0	-	-	-	-	-	-	-	-	4006	13
	1997	1060	3	964	5	37	0	-	-	-	-	-	-	-	-	2061	8
	1998	2065	5	824	4	22	0	-	-	-	-	-	-	-	-	2911	8
	1999	690	2	1799	9	32	0	-	-	-	-	-	-	-	-	2521	11
	2000	1792	4	1253	6	24	0	-	-	-	-	-	-	-	-	3069	11
	2001	1544	4	1489	7	25	0	-	-	-	-	-	-	-	-	3058	11
	2002	2423	6	1065	5	41	0	-	-	-	-	-	-	-	-	3529	11
	2003	1598	5	-	-	-	-	-	-	-	-	1540	8	-	-	3138	13
	2004	1927	5	-	-	-	-	-	-	-	-	2880	14	-	-	4807	19
	2005	1236	3	-	-	-	-	-	-	-	-	1771	8	-	-	3007	11
	2006	1763	3	-	-	-	-	-	-	-	-	1785	9	-	-	3548	13
	2007	1378	3	-	-	-	-	-	-	-	-	1685	9	-	-	3063	12
	2008	1471	3	-	-	-	-	-	-	-	-	1931	9	-	-	3402	12
	2009	487	1	-	-	-	-	-	-	-	-	975	4	-	-	1462	5
	2010	1658	4	-	-	-	-	-	-	-	-	821	4	-	-	2479	7
	2011	1145	3	-	-	-	-	-	-	-	-	2126	9	-	-	3271	11
	2012	1010	2	-	-	-	-	-	-	-	-	1669	7	-	-	2679	10
	2013	1457	3	-	-	-	-	-	-	-	-	1679	7	-	-	3136	11

Spain

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Spain (2)	1993	1589	-	827	-	75	-	-	-	-	-	-	-	-	-	2491	8
	1994	1658	5	-	-	-	-	-	-	-	-	735	4	-	-	2393	9
	1995	389	1	-	-	-	-	-	-	-	-	1118	6	-	-	1507	7
	1996	349	1	-	-	-	-	-	-	-	-	676	3	-	-	1025	4
	1997	169	0	-	-	-	-	-	-	-	-	425	2	-	-	594	3
	1998	481	1	-	-	-	-	-	-	-	-	403	2	-	-	884	3
	1999	157	0	-	-	-	-	-	-	-	-	986	5	-	-	1143	6
	2000	1227	3	-	-	-	-	-	-	-	-	433	3	-	-	1660	6
	2001	1129	3	-	-	-	-	-	-	-	-	1677	9	-	-	2806	12
	2002	651	2	-	-	-	-	-	-	-	-	1085	6	-	-	1736	8
	2003	210	1	-	-	-	-	-	-	-	-	1116	6	-	-	1326	6
	2004	1053	3	-	-	-	-	-	-	-	-	731	4	-	-	1784	6
	2005	412	1	-	-	-	-	-	-	-	-	2336	11	-	-	2748	12
	2006	350	1	-	-	-	-	-	-	-	-	1864	9	-	-	2214	10
	2007	481	1	-	-	-	-	-	-	-	-	1468	7	-	-	1949	8
	2008	162	0	-	-	-	-	-	-	-	-	1371	7	-	-	1533	7
	2009	106	0	-	-	-	-	-	-	-	-	250	1	-	-	356	1
	2010	81	0	-	-	-	-	-	-	-	-	166	1	-	-	247	1
	2011	18	0	-	-	-	-	-	-	-	-	1027	5	-	-	1045	5
	2012	237	1	-	-	-	-	-	-	-	-	1064	6	-	-	1301	6
	2013	111	0	-	-	-	-	-	-	-	-	725	4	-	-	836	4

1. MSW includes all sea ages >1, when this cannot be broken down. Different methods are used to separate 1SW and MSW salmon in different countries:

Scale reading: Faroe Islands, Finland (1996 onwards), France, Russia, USA and West Greenland.

Size (split weight/length): Canada (2.7 kg for nets; 63 cm for rods), Finland up until 1995 (3 kg).

Iceland (various splits used at different times and places), Norway (3 kg), UK Scotland (3 kg in some places and 3.7 kg in others). All countries except Scotland report no problems with using weight to categorise catches into sea age classes; misclassification may be very high in some years. In Norway, catches shown as 3SW refer to salmon of 3SW or greater.

2. Based on catches in Asturias (80–90% of total catch). No data for 2008, previous year's data used to estimate split.

Annex 5: WGNAS responses to the generic ToRs for Regional and Species Working Groups

The Working Group was asked, where relevant, to consider the questions posed by ICES under their generic ToRs for regional and species Working Groups. This was the first time that WGNAS had been asked to consider these ToRs.

GENERIC TOR QUESTIONS	WGNAS RESPONSE
For the ecoregion:	
a) Consider ecosystem overviews where available, and propose and possibly implement incorporation of ecosystem drivers in the basis for advice.	A brief ecosystem overview is provided in the WGNAS stock annex (see below) and environmental influences on the stock are incorporated in the annual advice to NASCO. The advice to NASCO is provided for three Commission areas – Northeast Atlantic, North America and West Greenland and may address a wide range of factors affecting salmon at different stages in their life cycle. Detailed consideration has been given to possible ecosystem drivers in both freshwater and the marine environment, but at present it is not possible to incorporate such drivers in the assessment process.
b) For the ecoregion or fisheries considered by the Working Group, produce a brief report summarising for the stocks and fisheries where the item is relevant: i) Mixed fisheries overview and considerations; ii) Species interaction effects and ecosystem drivers; iii) Ecosystem effects of fisheries; iv) Effects of regulatory changes in the assessment or projections;	i) Salmon are not caught in mixed fisheries to any great extent. Most salmon are caught in targeted fisheries in homewaters, principally net and trap fisheries in estuaries and coastal waters, and rod fisheries in freshwater. There is very little bycatch of other species in these fisheries or in the inshore drift and gillnet fishery at West Greenland. There was some limited bycatch of other fish species (e.g. lumpsucker) in the Faroese longline fishery when this fishery operated. There is also some bycatch of salmon post-smolts and adults in pelagic fisheries operated in the Norwegian Sea and North Atlantic; further details are available at Section 3.4 of this report. Some fisheries targeted at other fish species in freshwater and coastal areas (e.g. aboriginal trout and charr fisheries in Canada) are licensed to land salmon caught as a bycatch. Numbers are typically small. ii) Species interaction effects and ecosystem drivers are summarised in the stock annex (see below). iii) 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 limited knowledge of the magnitude of these effects. iv) In recent years, many salmon fisheries have been subject to management controls and closures, with resulting reductions in exploitation rates. This has resulted in increasing sensitivity of assessment procedures to these values.

	GENERIC TOR QUESTIONS	WGNAS RESPONSE
For all stocks:		
c)	If no stock annex is available this should be prepared prior to the meeting, based on the previous year's assessment and forecast method used for the advice, including analytical and data-limited methods.	WGNAS has now drafted an initial stock annex to provide details of the assessment procedures used by both NEAC and NAC. The stock annex will be updated as further developments occur.
d)	Audit the assessments and forecasts carried out for each stock under consideration by the Working Group and write a short report.	The Working Group routinely audits all assessments. Input data and outputs are checked by appropriate country/ region representatives during each meeting. All model developments have been subject to review by the Working Group and the modelling approaches have been described in the peer-reviewed literature. A number of members of the Working Group have also been involved in collaborative efforts to explore further model developments. For example, close links have been established with the ECOKNOWS project; see latest developments reported in Section 2.3.9 of this report.
e)	Propose specific actions to be taken to improve the quality and transmission of the data (including improvements in data collection).	There are significant uncertainties in some of the input data for the assessment models, particularly relating to unreported catches (used in the NEAC assessments). However, efforts are made to take account of these in the stock status and stock forecast models. Data deficiencies are recorded in the 'Quality Considerations' section of the annual advice document and specific concerns/ recommendations for improvement are included in WGNAS reports. Recommendations in relation to data collection needs for assessment of Atlantic salmon were recently provided in the report of the ICES Workshop on Eel and Salmon Data Collection Framework WKESDCF (ICES, 2012b); discussions have continued with the EU on the implementation of these recommendations.
f)	Propose indicators of stock size (or of changes in stock size) that could be used to decide when an update assessment is required and suggest threshold % (or absolute) changes that the EG thinks should trigger an update assessment on a stock by stock basis.	WGNAS has previously developed indicator frameworks for both NAC and NEAC for use in assessing the need for new assessments and catch advice in the intermediate years of multi-annual catch agreements. Full details are provided in the WGNAS stock annex (see below).
g)	Prepare planning for benchmarks next year, and put forward proposals for benchmarks of integrated ecosystem, multi or single species for 2016.	There are no immediate plans for a benchmark assessment for WGNAS. This will be discussed further at the Review Group/ Advice Drafting Group meeting.

GENERIC ToR QUESTIONS		WGNAS RESPONSE
h)	Check the existing static parts of the popular advice and update as required.	WGNAS has not previously been required to produce popular advice. However, this will be developed in 2014 following the WGNAS meeting, with the objective of having a final version by the time of the WGNAS Review Group/ Advice Drafting Group meeting in late April.
i)	In the autumn, where appropriate, check for the need to reopen the advice based on the summer survey information and the guidelines in AGCREFA (2008 report). The relevant groups will report on the AGCREFA 2008 procedure on reopening of the advice before 13 October and will report on reopened advice before 29 October.	This is not relevant to WGNAS.
j)	Take into account new guidance on giving catch advice (ACOM, December 2013).	The different components of the catch of Atlantic salmon are reported as fully as possible in the Working Group report in response to the specific questions posed by NASCO. Details of the data collection procedures for each country / region are also provided in the stock annex. Nominal catches are reported annually by country for all fisheries and estimates of unreported catch are also provided for most countries. These values are carried forward to the advice. Discards do not typically apply for salmon fisheries, although when the Faroese longline fishery was being prosecuted (the fishery has not operated since 2000) there was a legal requirement for salmon <63 cm in total length to be discarded. The catch options risk framework developed by WGNAS for the Faroes fishery makes allowance for these discards. In the most recent catch advice, there were no catch options for the salmon fisheries at either West Greenland or Faroes that were consistent with meeting management objectives.
k)	Update, quality check and report relevant data for the stock: i. Load fisheries data on effort and catches (landings, discards, bycatch, including estimates of misreporting when appropriate) in the INTERCATCH database by fisheries/fleets, either directly or, when relevant, through the regional database. Data should be provided to the data coordinators at deadlines specified in the ToRs of the individual groups. Data submitted after the deadlines can be incorporated in the assessments at the discretion of the Expert Group chair; ii. Abundance survey results; iii. Environmental drivers.	The InterCatch database is not used by WGNAS. All data inputs used in assessments are updated and reported in the WGNAS report. All data are subject to routine checking and QA by appropriate WGNAS members.

Generic ToR questions	WGNAS response
l) Produce an overview of the sampling activities on a national basis based on the INTERCATCH database or, where relevant, the regional database.	The InterCatch database is not used by WGNAS.
For <u>update</u> advice stocks:	
m) Produce a first draft of the advice on the fish stocks and fisheries under considerations according to ACOM guidelines and implementing the generic introduction to the ICES advice (Section 1.2). If no change in the advice is needed, one page 'same advice as last year' should be drafted.	None of the questions posed in this section of the generic ToR imply a change in the procedures that WGNAS normally follows every year. The issues raised in ToR 'n' are addressed routinely in the WGNAS report when responding to the questions posed by NASCO.
n) For each stock , when possible prior to the meeting: i) Update the assessment using the method (analytical, forecast or trends indicators) as described in the stock annex. ii) Produce a brief report of the work carried out regarding the stock, summarising for the stocks and fisheries where the item is relevant: 1. Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections); 2. Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information; 3. Stock status and catch options for next year; 4. Historical performance of the assessment and brief description of quality issues with the assessment; 5. In cooperation with the Secretariat, update the description of major regulatory changes (technical measures, TACs, effort control and management plans) and comment on the potential effects of such changes including the effects of newly agreed management and recovery plans. Describe the fleets that are involved in the fishery.	See above.
o) Review the outcomes of WKMSRREF2 for the specific stocks of the EG. Calculate reference points for stocks where the information exists but the calculations have not been done yet and resolve inconsistencies between MSY and precautionary reference points if possible.	This is not applicable to WGNAS.

GENERIC TOR QUESTIONS	WGNAS RESPONSE
For stocks with <u>multiyear</u> advice or <u>biennial</u> (2nd year) advice:	
p) In principle, there is no reason to update this advice. The advice should be drafted as a one page version referring to earlier advice. If a change in the advice (basis) is considered to be needed, this should be agreed by the working group on the first meeting day and communicated to the ACOM leadership. Agreement by the ACOM leadership will revert the stock to an <u>update</u> procedure.	This is not applicable to WGNAS, which has an established procedure for updating (or not updating) the advice based on the results of the FWI assessments.

Annex 6: WGNAS Stock Annex for Atlantic salmon

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Atlantic salmon
Working Group	Working Group on North Atlantic Salmon (WGNAS)
Date	28 March 2014

1. General

1.1 Stock definition

1.1.1 Background

Atlantic salmon, *Salmo salar* L., have a wide range of life-history strategies. Most forms are anadromous however, with a juvenile phase in freshwater followed by a period at sea feeding and growing, during which the fish undergo extensive migrations in the open ocean, before they migrate back to freshwater to spawn. Most Atlantic salmon return to their river of origin to spawn. This precise homing behaviour has resulted in groups of fish originating in different rivers or tributaries becoming genetically distinct as they adapt to the particular conditions that they face in their home river and along their migration routes. As a result, fish from one river or tributary can differ from fish originating in other rivers/ tributaries which have become adapted to a different set of conditions. These subgroups comprise genetically distinct 'populations' and these are regarded as basic biological units of the Atlantic salmon species.

Large rivers and their tributaries can support several, genetically distinct populations, each with separate spawning beds within the main-stem of the river or its tributaries. In most instances however, it is not possible to demarcate clear population boundaries within a river, and managing stocks and fisheries at this level of detail would be very complex. Thus, while there is a need to protect the sustainability of these units, the primary management unit (e.g. for reporting catch statistics and regulating fishing) is generally taken to be the river stock, comprising all fish originating from eggs laid within the river.

Atlantic salmon are native to the temperate and Subarctic regions of the North Atlantic Ocean and there are over 2000 rivers draining into the North Atlantic that support the fish, about 1500 of which discharge into the Northeast Atlantic. In this area, salmon distribution extends from northern Portugal to northern Russia and Iceland, while in the Northwest Atlantic, the species ranges from northeastern USA (Connecticut) to northern Canada (Ungava Bay).

Ideally, the management of all individual river stocks, and the fisheries that exploit them, might be based upon the status of each individual population. This is not always practical, however, particularly where decisions relate to the management of distant water salmon fisheries, which exploit large numbers of stocks originating in broad geographic areas. WGNAS has therefore had to consider how populations or river stocks should be grouped in providing management advice. For this purpose, groups have been established which fall within the meaning of a stock as 'an exploited or managed unit' (Royce, 1984) and that are consistent with the ICES (1996) definition of salmon 'stocks' as 'units of a size (encompassing one or more populations) which provide a practical basis for the fishery manager'. The issues around the grouping of Atlantic salmon stocks for the provision of management advice are reviewed in detail in Crozier *et al*. (2003). Such stock groupings have typically been referred to as stock complexes.

Salmon mature at various sea ages, typically returning to freshwater to spawn after one to three years at sea, but also sometimes at older sea ages; this varies widely between populations. Those salmon that return after one year at sea are referred to as one-sea-winter (1SW) salmon, with older fish categorised as 2SW, 3SW, etc. In practice, however, for management purposes these older sea age fish are typically aggregated and collectively referred to as multi-sea-winter (MSW) salmon. The sea age when salmon become sexually mature depends on genetics as well as growing conditions in the sea, and possibly freshwater, although the precise proximate factors initiating homeward migration are unknown (Hansen and Quinn, 1998). The sea age of Atlantic salmon is important in the context of stock definition since these different groups of fish have different migration routes, return at different times and are differentially exploited in fisheries. Thus, for example, it is only potential MSW salmon that are exploited in the distant water salmon fishery that operates off the west coast of Greenland.

1.1.2 Management framework for salmon in the North Atlantic

The advice generated by WGNAS is in response to Terms of Reference posed by the North Atlantic Salmon Conservation Organisation (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. NASCO now has six Parties that are signatories to the Convention, Canada, Denmark (in respect of Faroe Islands and Greenland), the EU (which represents its Member States), Norway, Russia and the USA. While sovereign states retain their role in the regulation of salmon fisheries for salmon originating in their own rivers, fisheries within the jurisdiction of one Party that exploit salmon originating in the rivers of another Party may be regulated by NASCO under the terms of the Convention. This is currently the case for the distant water salmon fisheries at Greenland and Faroes.

NASCO discharges these responsibilities via three Commission areas shown below:

While homewater fisheries are not regulated directly by NASCO, national/ regional jurisdictions seek to comply with NASCO agreements and guidelines in exercising their responsibilities. In particular, NASCO's Agreement on the Adoption of a Precautionary Approach states that an objective for the management of salmon fisheries is to maintain 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".

In requesting scientific advice from ICES, NASCO asks for an annual review of events in the salmon fisheries and of the status of salmon stocks around the North Atlantic; NASCO also requests management advice for stocks in each of the Commission Areas. In fulfilling these requirements, three specific purposes have been identified for which stock groupings may be required (Crozier *et al*., 2003):

- providing descriptions of the status of stocks;
- developing models to estimate and/or forecast pre-fishery abundance (PFA); and
- developing management advice for the distant water fisheries.

Crozier *et al.* (2003) further noted that there is no reason to assume that the same stock groupings should be used for all these purposes, indeed both the criteria used (e.g. geographical or biological features) and the resulting groups are likely to differ.

1.1.3 Stock groupings used by WGNAS in providing management advice

As noted above, Atlantic salmon would, ideally, be assessed and managed on the basis of river-specific stock units. In reality, <25% of the rivers with salmon populations in the North Atlantic are so assessed (Chaput, 2012; ICES, 2013). Consequently, stock status is often, of necessity, assessed at broader regional, national and subcontinental scales. While there might be merit in grouping stocks according to biological criteria (which could cross jurisdictional boundaries), it has generally been considered that the difficulties of collecting data in a similar format in different jurisdictions is likely to outweigh the benefits of using such groups (Crozier *et al*., 2003). It is also recognised that compilations of data on stocks within each jurisdiction are of importance to regional/ national managers. As such, regional/ national stock groups are typically used by ICES in providing advice on the status of stocks, with additional information compiled on biological groups (e.g. sea ages) as required.

ICES has previously provided information on the status of stocks in the Northeast Atlantic Commission (NEAC) area by region or by country (as well as sea age). For the North American Commission (NAC) area similar information is provided for the USA and the five main provincial regions in eastern Canada: Labrador, Newfoundland, Québec, Gulf and Scotia-Fundy.

In providing management advice for the mixed-stock distant-water fisheries, broader scale stock groupings have been considered appropriate. For the NAC area this is based on the six geographic regions of North America detailed above. For the NEAC area, the following national groupings have been used in recent years to provide NASCO with catch advice or alternative management advice for the distant-water fisheries at West Greenland and Faroes.

Southern NEAC countries	Northern NEAC countries
France	Russia
Ireland	Finland
UK (N. Ireland)	Norway
UK (England & Wales)	Sweden
UK (Scotland)	Iceland (north/east regions)[1]
Iceland (south/west regions)[1]	

[1] The Iceland stock complex was split into two groups for stock assessment purposes in 2005 (ICES 2005), largely on the basis of tag recapture information. Prior to 2005, all regions of Iceland were considered part of the Northern NEAC stock complex.

These groups were deemed appropriate by WGNAS as they fulfilled an agreed set of criteria for defining stock groups for the provision of management advice that were considered in detail at the 2002 WGNAS meeting (ICES, 2002) and re-evaluated at the 2005 WGNAS meeting (ICES, 2005). ICES subsequently noted however, that provision of catch advice for NEAC stocks in the distant water fisheries should preferably be based on a larger number of smaller management units, similar to those used in the NAC area (ICES, 2010a; 2011). Such an approach was developed at the 2013 WGNAS meeting (ICES, 2013) and indicative catch advice was provided at the country level as well as the Southern and Northern NEAC stock complexes. ICES is awaiting feedback from NASCO on the choice of management units.

Salmon from most NEAC stocks mix in the Norwegian Sea in autumn and winter and are exploited by the fishery at Faroes. While there is evidence that some salmon from NAC rivers have been caught in the Norwegian Sea, they are currently not considered in the NEAC assessments. Consideration of the level of exploitation of national stocks in the Faroes fishery (ICES, 2005) resulted in the proposal that catch advice for the fishery should be based upon all NEAC area stocks and both 1SW and MSW fish.

In contrast, the fishery to the west of Greenland operates in an area where salmon from all North America and some Northeast Atlantic stocks mix in their second summer at sea. Catch advice for this fishery is thus based on non-maturing (potential MSW) fish from all regions of North America, while consideration of the level of exploitation of national stocks in the fishery from NEAC, resulted in catch advice being based upon only Southern NEAC non-maturing 1SW (potential MSW) fish (ICES, 2005).

1.2 Fisheries

Most exploitation of Atlantic salmon is restricted to fisheries close to or within the rivers of origin of the stocks; these homewater fisheries take adult fish that are mainly returning to these rivers to spawn. As noted above, these fisheries are not directly regulated by NASCO since the Parties retain responsibility for the regulation of fisheries for salmon originating in their own rivers. However, NASCO can regulate fisheries undertaken by a Party that take salmon originating in another Party's rivers, such as is the case for the distant-water fisheries at Greenland and Faroes. These fisheries take salmon originating in a large number of rivers over a wide geographical range.

1.2.1 The Northern Norwegian Sea Fishery

A longline fishery for salmon in parts of the Norwegian Sea, north of latitude 67°N, commenced in the early 1960s. Several countries participated in this fishery and the pattern of fishing, area of operation and catches changed markedly over the years. At its peak in 1970 this fishery harvested almost 1000 tonnes of salmon.

The Convention for the Conservation of Salmon in the North Atlantic Ocean, which resulted in the formation of NASCO, came into force in October 1983. The Convention created a large protected zone, free of targeted fisheries for Atlantic salmon in most areas beyond 12 nautical miles from the coast. An immediate effect was the cessation of the salmon fishery in the Northern Norwegian Sea outside the Faroes EEZ, with the last catches in this area reported in 1984 (ICES, 2013).

In the late 1980s and early 1990s, NASCO acted through diplomatic initiatives to address fishing for salmon in international waters by vessels registered to non-NASCO Parties. There have been no reports of such activities since.

1.2.2 The Faroes fishery

The fishery in the Faroes area commenced in 1968 with a small number of vessels fishing up to 70 miles north of the Faroes; initially catches increased slowly up to 40 tonnes in 1977. Danish vessels participated in the fishery between 1978 and 1982 and, at the same time, catches started to increase rapidly, peaking at 1025 tonnes in 1981. Several factors contributed to this increase: the season was extended, more vessels entered the fishery, and the fishery shifted northwards.

From 1982, the Faroese Government agreed to a voluntary quota system, involving a total catch of 750 tonnes in 1982 and 625 tonnes in 1983 (255 boats allowed 25 tonnes each). Since NASCO's establishment, regulatory measures or decisions have been agreed by the North-East Atlantic Commission in most years (Table 1.2.2.1). These have resulted in greatly reduced allowable catches in the Faroese fishery, reflecting declining abundance of the salmon stocks. There has been no commercial salmon fishery targeting salmon around the Faroes since the early 1990s. Catches in the fishery are presented in Figure 1.2.2.1.

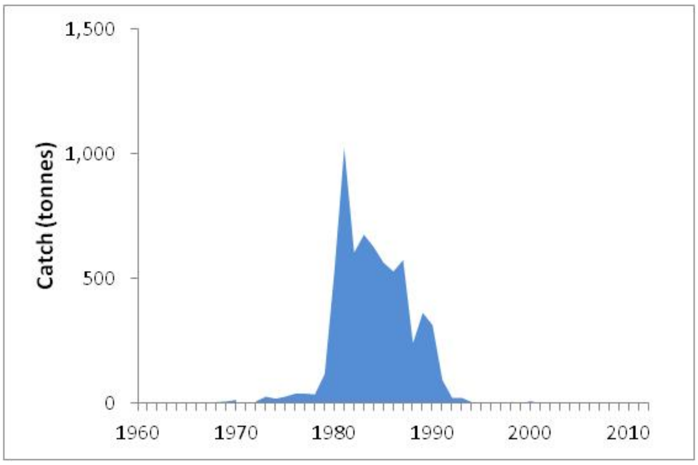

Figure 1.2.2.1. Nominal catch of salmon (tonnes, round fresh weight) in the Faroese longline fishery, 1960–2012.

Table 1.2.2.1. Summary of Regulatory Measures agreed by NASCO for the Faroese Salmon Fishery (courtesy of NASCO).

Year	Allowable catch (tonnes)	Comments/other details in the measures/decisions
1984–1985	625	
1986	-	
1987–1989	1790	Catch in any year not to exceed annual average (597t) by more than 5%.
1990–1991	1100	Catch in any year not to exceed annual average (550t) by more than 15%.
1992	550	
1993	550	
1994	550	
1995	550	
1996	470	No more than 390 tonnes of the quota to be allocated if fishing licences issued.
1997	425	No more than 360 tonnes of the quota to be allocated if fishing licences issued.
1998	380	No more than 330 tonnes of the quota to be allocated if fishing licences issued.
1999	330	No more than 290 tonnes of the quota to be allocated if fishing licences issued.
2000	300	No more than 260 tonnes of the quota to be allocated if fishing licences issued.
2001–2003	No quota set	It is the intention of the Faroese authorities to manage the fishery in a precautionary manner with a view to sustainability, and to make management decisions with due consideration to the advice from ICES concerning status of stocks contributing to the fishery.
2004–2006	No quota set	It is the intention of the Faroese authorities to manage the fishery on the basis of the advice from ICES concerning status of stocks contributing to the fishery in a precautionary manner with a view to sustainability and taking into account relevant factors such as socio-economic needs and other fisheries on mixed-stocks.
2007–2012	No quota set	It is the intention of the Faroese authorities to manage any salmon fishery on the basis of the advice from ICES regarding the stocks contributing to the Faroese salmon fishery in a precautionary manner and with a view to sustainability, taking into account relevant factors such as socio-economic needs.
2013–2015	No quota set	It is the intention of the Faroese authorities to manage any salmon fishery on the basis of the advice from ICES regarding the stocks contributing to the Faroese salmon fishery in a precautionary manner and with a view to sustainability, taking into account relevant factors such as socio-economic needs. This decision will apply in 2014 and 2015 unless the application of the Framework of Indicators shows that a reassessment is warranted.

Note: The quotas for the Faroe Islands detailed above for the period 1984–2000 were agreed as part of effort limitation programmes (limiting the number of licences, season length and maximum number of boat fishing days) together with measures to minimise the capture of fish less than 60 cm in length. The measure for 1984/85 did not set limits on the number of licences or the number of boat fishing days.

The Faroes salmon fishery operated over the winter months from November through to May. The salmon caught in the fishery originated almost entirely from European countries with salmon from many countries being present in the area (Jacobsen *et al.*, 2001). Small numbers of tagged fish originating in North America have also been recaptured in the fishery (e.g. ICES, 1991). Genetic investigations, based on salmon scales removed from fish caught in the fishery in the 1980s and 1990s, are being undertaken to confirm this.

The fishery exploited mainly 2SW fish, although some 1 and 3SW fish were also caught. Small salmon (<60 cm total length) in their first winter at sea were required to be discarded. Large numbers of farmed salmon were also observed at Faroes and there is evidence that farmed salmon escaping from netpens in Norway entered this area (Hansen *et al.*, 1987; Hansen and Jacobsen, 2003). Such farmed fish accounted for a significant proportion of the catch; in the early 1990s, the proportion of farmed fish in this area was estimated at between 25 and 40% (Hansen *et al.*, 1999).

Tagging studies (of adult fish caught in the fishery) have indicated that some fish caught at Faroes were apparently on their way westwards, as they were reported from West Greenland later the same year (Jákupsstovu, 1988). However, salmon tagged at West Greenland were also reported in the area north of the Faroes the following year (ICES, 1984). Thus, salmon of European origin are believed to move through the Faroese area on their way to the feeding areas in the West Atlantic as well as on their return to homewaters.

1.2.3 The Greenland fishery

Limited fishing at West Greenland is reported as far back as the early 1900s, although the present fishery dates from 1959 when local fishermen began setting fixed gillnets from small boats in certain fjords around Maniitsoq (Shearer, 1992). Rapid expansion along the coast followed and from the mid-1960s Faroese and Norwegian fishermen introduced offshore driftnets, followed soon by fishermen from Greenland and Denmark. At around the same time improvements in gear (the introduction of light monofilament nets) enabled fishing in daylight and improved the efficiency of the gear. As a consequence, catches rose quickly reaching a peak of almost 2700 tonnes in 1971. Fishing by non-Greenlandic vessels was phased out in 1972–1975. However, the total catch remained at around 2000 tonnes until 1976 when a TAC of 1190 tonnes was set; the fishery has been regulated since this time. Small catches of salmon are also made on the east coast of Greenland although these are sporadic and restricted by the small number of communities in this area and by drifting polar ice.

Regulatory measures have been agreed by the West Greenland Commission for most of the years since NASCO's establishment (Table 1.2.3.1). These have resulted in greatly reduced allowable catches in the West Greenland fishery, reflecting declining abundance of the contributing salmon stocks. In all but two years since 1998, the fishery has been restricted to an internal-use fishery and commercial export of salmon is not permitted. Catches in the Greenland fishery are presented in Figure 1.2.3.1.

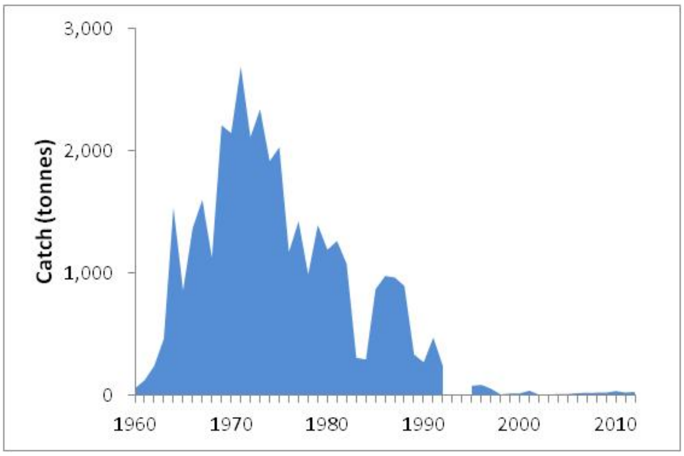

Figure 1.2.3.1. Nominal catch of salmon (tonnes, round fresh weight) in the Greenland salmon fishery.

The Greenland salmon fishery operates in the summer months, with a fairly high proportion of the catch commonly being taken in the weeks after the opening of the season in August. Both drift and fixed gillnets continue to operate. The salmon caught in the fishery to the west of Greenland originate in both North America and the Northeast Atlantic. Data on continent of origin in the catch indicate a reasonably even split between fish from North America and Europe in the early 1990s (ICES, 2013). However, the proportion of North American fish in the catch has increased steadily since this time with North American fish comprising 80–90% of the fish caught in recent years.

The salmon caught at West Greenland are almost exclusively fish in their second summer at sea, however, these are non-maturing 1SW salmon destined to return to homewaters as 2SW, or older, fish. Fish from all parts of North America are taken in the fishery, while it is primarily only potential MSW salmon from southern countries in Europe (UK, Ireland and France) that are exploited here. Very few salmon of farmed origin appear in the catches at Greenland, and these are not taken into account in assessments.

Table 1.2.3.1. Summary of Regulatory Measures agreed by NASCO for the West Greenland Salmon Fishery (courtesy of NASCO).

YEAR	ALLOWABLE CATCH (TONNES)	COMMENTS/OTHER DETAILS IN THE MEASURES
1984	870	
1985	-	Greenlandic authorities unilaterally established quota of 852t.
1986	850	Catch limit adjusted for season commencing after 1 August.
1987	850	Catch limit adjusted for season commencing after 1 August.
1988-1990	2520	Annual catch in any year not to exceed annual average (840t) by more than 10%. Catch limit adjusted for season commencing after 1 August.
1991	-	Greenlandic authorities unilaterally established quota of 840t.
1992	-	No TAC imposed by Greenlandic authorities but if the catch in first 14 days of the season had been higher compared to the previous year a TAC would have been imposed.
1993	213	An agreement detailing a mechanism for establishing annual quota in each of the years 1993 to 1997 was adopted by the Commission.
1994	159	
1995	77	
1996	-	Greenlandic authorities unilaterally established a quota of 174t.
1997	57	An addendum to the 1993 Agreement was agreed by the Commission.
1998	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t.
1999	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t.
2000	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t. A Resolution Regarding the Fishing of Salmon at West Greenland was agreed by the Commission.
2001	28 – 200	Under an ad hoc management programme the allowable catch will be determined on the basis of cpue data obtained during the fishery.
2002	20 - 55	Under an ad hoc management programme the allowable catch will be determined on the basis of cpue data obtained during the fishery.
2003–2008	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t.
2009–2011	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t.
2012–2014	Internal consumption fishery only	Amount for internal consumption in Greenland has been estimated in the past to be 20t. The measure applies in 2013 and 2014 unless application of the Framework of Indicators indicates a significant change and reassessment of the catch advice is warranted.

1.3 Ecosystem aspects

Over the past 20–30 years there has been a marked decline in the abundance of Atlantic salmon across the species' distributional range. Wild Atlantic salmon populations are declining across most of their home range and, in some cases, disappearing (ICES, 2008). Generally, populations on the southern edge of the distribution seem to have suffered the greatest decline (Parrish *et al*., 1998; Jonsson and Jonsson, 2009; Vøllestad *et al*., 2009). This may be linked to climatic factors. The decline in salmon abundance has coincided with a variety of environmental changes linked to an increase in greenhouse gases and a corresponding increase in temperatures (IPCC, 2001), which is most likely to have manifest effects at the edge of the species range. However, these areas are often also the ones with higher human population densities and therefore, typically, where potential impacts on the freshwater environment may also be greater. A range of factors in freshwater are known to impact on stocks including, for example, contaminants, river obstructions, and changing river flows and temperatures (ICES, 2009b; 2010b; Russell *et al.*, 2012). Such factors have potential implications for the survival of juvenile salmon and their resulting fitness when they migrate to sea as smolts (e.g. Fairchild *et al*., 2002).

Atlantic salmon occupy three aquatic habitats during their life cycle: freshwater, estuarine and marine. Similar factors contribute to mortality in each of these habitats - competition, predation and environmental factors - but despite occurring in different habitats, these are not independent. Conditions experienced within the freshwater environment can affect the survival of emigrating smolts and marine conditions may subsequently modify the spawning success of fish in freshwater.

The decline in salmon populations has occurred despite significant reductions in exploitation, although this does not preclude possible fishery effects. An underlying cause has been a marked increase in the natural mortality of salmon at sea; the proportion of fish surviving between the smolts' seaward migration and their return to freshwater as adult fish (e.g. Peyronnet *et al*., 2008; Chaput, 2012). For many stocks, return rates are now at the lowest levels in the time-series, even after the closure of marine fisheries. This reduced survival is thought to reflect climatic factors and broad-scale changes in ocean ecosystems as well as factors in freshwater. The exact processes controlling marine survival are relatively poorly understood (Friedland, 1998), although there is growing support for the hypotheses that survival and recruitment is mediated by growth during the post-smolt year, for European stocks at least (Friedland *et al*., 2009).

Although their habitats are widely separated geographically, there is strong coherence in recruitment patterns between North American and European stock complexes. Recent research suggests recruitment is correlated with ocean temperature variation associated with the Atlantic Multidecadal Oscillation (AMO) (Friedland *et al*., 2013). It further appears that there are differences in the mechanisms affecting stocks in the Northwest and Northeast Atlantic, with ocean climate variability during the first spring months of post-smolt life most important to the survival of North American stocks, while summer climate variation appears to be more important to adult recruitment variation for European stocks (Friedland *et al.*, 2013). It has been speculated that this may be related to the varying roles of predation pressure and size-related mortality on the two continental stock complexes.

In addition to changes in climate and potential issues operating in both freshwater and marine environments, various other factors have been postulated as possibly contributing to the decline in stock abundance, including predation, aquaculture impacts and the effects of fisheries. Huge increases in aquaculture production of Atlantic salmon over recent decades (see Section 2.2.1 of the report) have created some concerns for wild populations. The main potential impacts include: (i) genetic impacts on wild fish; (ii) discharge of organic material and other wastes; (iii) transmission of diseases and parasites (particularly sea lice) to wild populations; and (iv) concerns about obtaining adequate feed resources from an already heavily exploited marine ecosystem. For example, recent investigations in Norway have demonstrated that gene pools of wild salmon populations in a number of rivers have been gradually changed through introgression of genetic material from escaped farmed salmon (Glover et *al.*, 2012; Glover et *al.*, 2013). Sea lice also continue to be regarded as a serious problem for wild salmonids (Skilbrei *et al.*, 2013; Krkošek *et al.*, 2013) affecting their survival and perhaps also their life-history characteristics (Vollset *et al.*, 2014).

As well as declines in abundance, changes in salmon life histories are also widely reported throughout the geographic range of the species, affecting factors such as sea age composition, size at age, age-at-maturity, condition, sex ratio and growth rates (e.g. Nicieza and Braña, 1993; Hutchings and Jones, 1998; Niemelä *et al*., 2006; Peyronnet *et al*., 2007; Aprahamian *et al*., 2008; Todd *et al*., 2008). Changes are also manifest in freshwater stages, affecting factors such as the size and growth of parr and the age of smolting (e.g. Davidson and Hazelwood, 2005; Jutila *et al*., 2006) and run timing (Kennedy and Crozier, 2010; Otero *et al*., 2013).

2. Data

2.1 Introduction

Assessment of Atlantic salmon differs from the approaches commonly adopted for other species, for example in respect of the need for at sea surveys and collection of commercial cpue data. Instead, the assessment of salmon is based mainly on data collected on individual river stocks (e.g. catches and counts of returning fish), which are raised and aggregated to provide estimates of the number of fish returning to homewaters for different stock groupings. These estimates are used, in turn, to estimate abundance at earlier points in the life cycle of the fish and to inform the development of catch advice.

The provision of management advice for the mixed-stock fisheries at Faroes and West Greenland is based on assessments of the status of stocks at broad geographic scales. The North American Commission (NAC) area is divided into six management units, and Northeast Atlantic (NEAC) Commission area is divided into 19 regions. Assessment of the status of the stocks in these areas is based on estimates of the total abundance - the pre-fishery abundance (PFA) - of different cohorts of salmon at a stage before the distant water fisheries operate. PFA is defined as the cohorts of salmon maturing as 1SW and MSW fish that are alive prior to all the marine fisheries for 1SW salmon (Rago *et al.*, 1993a). The catch advice for the NEAC area is then provided for the northern (N-NEAC) and southern (S-NEAC) stock complexes and for countries.

The models to estimate the PFA of salmon from different areas are typically based on the catch in numbers of one-sea-winter (1SW) and multi-sea-winter (MSW) salmon in each country or region, which are then raised to take account of estimates of non-reported catches and exploitation rates on the two age groups. In some cases, particularly in the NAC area, returns to homewater are estimated by alternative methods, such as counts at fishways and counting fences, or from mark and recapture studies. The estimates of fish numbers returning to homewaters are then raised to take account of the natural mortality (M) between the date that the fish are deemed to recruit to the particular fishery of interest and the midpoint of the timing of the respective national fisheries. A value of 0.03 per month is assumed for M (Section 3.2.3). The date of recruitment of NAC stocks (and thus the PFA date) is taken as August 1st in the second summer at sea because these fish are first exploited in the distant water fishery at West Greenland. However, NEAC stocks recruit to the Faroes fishery during their first sea winter and so PFA is calculated at January 1st (i.e. eight months earlier) for these stocks.

2.2 Input data for assessments – NEAC area

PFA for NEAC stocks is estimated using the run-reconstruction approach described by Potter *et al*. (2004). The model estimates the PFA of both maturing and non-maturing 1SW salmon because both stock components may be caught in the Faroes fishery, and data for both the Faroes and West Greenland fisheries are incorporated into the model.

In order to run the NEAC PFA model, each country provides time-series (beginning in 1971) of catch in numbers, non-reporting rates and exploitation rates for 1SW and MSW salmon. Best estimates and a measure of the uncertainty or error are provided for the non-reporting and exploitation rate data in order to obtain a measure of the uncertainty in the PFA estimates, since these data are commonly derived from expert opinion. The latest data input variables used in running the NEAC assessment are listed at Annex 3.

In some instances, the above information has been supplied in two or more regional blocks per country. In these instances, the model output is provided for the regions and is also combined to provide one set of output data for the country as a whole.

The input data for Finland consists solely of catches from the River Tana/Teno. These comprise both Finnish and Norwegian net and rod catches, as the river marks the border between these countries. The Norwegian catches from the river are not included in the input data for Norway.

Where possible, when the input data are themselves derived from other data sources, the raw data are included in the model. This allows the uncertainty in these analyses to be incorporated into the modelling approach. Thus, the catch and sample data used to estimate the catches of Scottish fish in the northeast English coastal fishery are incorporated into the assessments for both UK (England and Wales) and UK (Scotland). For Greenland, catch data are input in the form of harvests (reported and unreported) in weight, along with data from the West Greenland sampling programme.

Descriptions of how the model input data have been derived are presented below for different countries (updated from Crozier *et al*., 2003; ICES, 2002). The methods used to derive the PFA input data for NEAC countries and options for improving the data are also discussed in Crozier *et al*. (2003).

2.2.1 Median dates of return to homewater fisheries

NEAC stocks recruit to the Faroes fishery during their first sea winter and so the date of recruitment (and thus the PFA date) is calculated at January 1st. In deriving PFA from the estimates of fish numbers returning to homewaters, it is necessary to take account of natural mortality between the date that the fish recruit to the particular fishery of interest and the midpoint of the timing of the respective national fisheries.

The median return date for 1SW and MSW fish for each country/region are provided in the table below. Thus there is about a six to nine month period between the PFA date and the median time of return to homewaters for maturing 1SW fish and 17 to 20 months for non-maturing fish.

Table 2.2.1.1. Midpoint of recruitment to homewater fisheries for NEAC countries/regions.

NEAC Country/ region	1SW	MSW
Northern NEAC		
Russia - Pechora River	8	8
Russia - Archangel / Karelia	7.5	8
Russia - Kola / White Sea	8.5	7.5
Russia - Kola / Barents Sea	7	6.5
Finland	6.5	6
Iceland - north & east	7	6.5
Norway	8	5
Sweden	8.5	6
Southern NEAC		
Iceland - south & west	6.5	6
UK (Scotland - east)	7	5.5
UK (Scotland - west)	8	5
UK (N. Ireland - Fo area)	7	5.5
UK (N. Ireland - FB area)	6.5	6
Ireland	8	5
UK (England & Wales)	8	5
France	8	5

2.2.2 Data inputs for Northern NEAC countries

2.2.2.1 Finland

Catch: The catch input to the model of Finland represents an estimate based on catch enquiries and the total number of licences issued. The Norwegian catch from the River Teno has been included in the Finnish catch, which results in a set of input data that effectively represents a single river system. Catch composition is estimated based on catch samples and corresponding scale analyses.

Level of unreported catch: Unreported catch is estimated by extrapolating the catches of the fishermen that failed to report their catches, as reporting is not mandatory.

Exploitation rates: Exploitation rates in the river fisheries are derived from radio tagging studies in 1992-93 and 1995, when 70–100 adult fish (1SW and MSW) were tagged yearly in the estuary. Most of the important river fisheries were covered by these experiments.

2.2.2.2 Norway

Area split: Salmon catches in Norway are split into four regions on the basis of climatic differences and oceanographic differences among the areas. The areas are: (1) southeast Norway from the Swedish border to the border between Rogaland and

Hordaland counties, (2) southwest Norway from the border between Rogaland and Hordaland counties to Stad (3) mid Norway from Stad to Lofoten, and (4) north Norway from Lofoten to the border with Russia.

Catch: Nominal catches of salmon in the four regions are used. In recent years there have been improvements in declaring catches. From 1979 there was a weight split 1SW/MSW (<3 kg/>3 kg). From 1993 the split was changed to 1SW/2SW/3SW (<3 kg/3–7 kg/>7 kg). Mean weight was provided for most groups and used to estimate numbers in the early part of the time-series, but in recent years the reported nominal catch (reported number of killed salmon in river and sea fisheries summed) is being used. In the input to the PFA model salmon smaller than 3 kg are regarded as 1 SW fish, whereas salmon larger than 3 kg are regarded as MSW fish. The two largest size groups are thus summed into MSW salmon. In the PFA model input the Norwegian catch data for the River Teno have been removed from the Norwegian catches and incorporated in the Finnish catches.

Unreported catch: No systematic effort is used to estimate unreported catches. Inputs are guesstimates based on occasional reports from test fishing, surveillance reports, and questionnaires. Currently there is no evidence that the level of unreported catches differs between the four regions. These estimates are provided by the management authorities.

Exploitation rates: The rates for the national model are guesstimates. For parts of southeast and southwest Norway they are derived from estimated marine exploitation rates from the River Imsa and the River Drammen. In recent years (from 2009 onwards) exploitation rates for many rivers (>50) have been taken into consideration. These exploitation rates have been obtained using a multitude of methods, mainly from drift counts of spawners or results from counting facilities combined with reported catches in the rivers. The exploitation rates have been adjusted in relation to reduced fishing effort. At present different exploitation levels are used for the different regions, reflecting different harvest regimes in the regions.

For Norway, only data from 1983 onwards have been used for assessment purposes.

2.2.2.3 Russia

Area split: The Atlantic salmon rivers of northwest Russia are split into the following four regions: Kola Peninsula - Barents Sea basin; Kola Peninsula - White Sea basin; Archangelsk Region and the Karelia; and the Pechora River region. The split is based on four regions with separate catch statistics and different biological characteristics of the stocks. For example, the difference in age composition and relative abundance of summer and autumn salmon evident among these four regions has influenced the split.

Catch: The declared catch data, in numbers, is available for the full time period (1971 onwards) for all four regions. Catches were allocated to 1SW or MSW age groups on the basis of commercial and scientific catch sampling programmes.

Level of unreported catch: Unreported catches in legal fisheries are estimated from logbooks and catch statistics, by comparing catch survey results with reported catch. Illegal catch is guesstimated and based on local knowledge of fisheries. The major component of the illegal catch in the Barents Sea basin (Kola Penisula and Pechora River) comes from in-river fisheries and a considerable part of the illegal catch in the White Sea basin (Kola Peninsula and Archangelsk region) comes from coastal areas and this contributes the greatest uncertainties. There is a particular problem with illegal catches on the Pechora River where scientific sampling programmes suggest that the illegal catch on this river is very high. The level of non-reporting increased considerably in the early 1990s due to the economic changes in Russia and temporary reduction of control and enforcement. Since late 2000s the higher level of non-reporting occurred in recreational fisheries due to unclear legislation for reporting. All these factors have been considered in deriving the level of unreported catch for the PFA model.

Exploitation rates: Information on exploitation rates is derived from several fisheries in the Kola Peninsula where counting fences are operated and from mark–recapture exercises on the rivers with recreational fisheries. Exploitation rates in Archangelsk and Pechora are guesstimated. These are the basis of the inputs to the model, regional sea age differences being adjusted on the basis of local knowledge from estimated stock levels.

2.2.2.4 Sweden

Catch: The catch input to the model is based on annual reported commercial salmon catch on the Swedish west coast, and on voluntary reporting from sport fishing in rivers. This reporting is detailed and considered accurate and is handled by the government agency "Swedish agency for marine and water management" (commercial catches) and the Swedish University of Agricultural Sciences (non-commercial catches). Unfortunately, reporting of catches from non-commercial fishing for salmon with gillnets or rod and line on the coast is lacking. However, due to fishing regulation these catches are small (permits required for trapnets, ban on gillnets in deeper waters, restrictions on the use of gillnets in shallow waters, limited fishing season, large marine protected areas, ban on selling fish, etc.).

There is a high proportion (ca. 60–70%) of reared fish in catches and stocks as a result of compensatory releases of reared smolts (ranching). As all ranched salmon are fin-clipped the catches of reared fish can be treated separately in the catch statistics. In the reporting from the commercial fishing the catch is not separated into wild and reared fish. The proportion of wild salmon is instead estimated from catch statistics in nearby rivers. Stocking of reared salmon is done in three rivers; all of these also have wild stocks in tributaries.

Catch-and-release is practised in most rivers (only rod-and-line fishing allowed in rivers) but the extent of C&R is not always known. Reported catch is landed fish, but in most rivers a proportion of fish is released back alive and any subsequent mortality is not accounted for.

Level of unreported catch: Unreported catch, i.e. non-commercial catch of salmon in the coastal area with gillnets and rod and line, is estimated from guesstimates based on expert judgement from regional fishery officers and the Swedish University of Agricultural Sciences. These estimates are supported with catch inventories carried out in 1999 (Thörnqvist, unpubl.), 2004 (Swedish agency for marine and water management), 2008 (Thörnqvist, unpubl.). Generally, the unreported catch is estimated to be 5–10% of the reported catch.

Exploitation rates: Few fish counters are present and tagging data exist mainly for reared stocks, where the fishing pressure is higher than for wild stocks. Input for the PFA model is based on guesstimates. In the index River Ätran, data on size and composition of the spawning run and estimates of exploitation are developed at present. Since 2000, a fish ladder with an automatic counter has provided data on the spawning run in this river. Counter data in combination with results from small-scale tagging in this river are used to provide estimates of exploitation rates. An update, using radio-telemetry, is planned for 2014. A problem is that exploitation rate differs considerably between rivers. During the period 2000–2012 the average exploitation rates for the Swedish stock as a whole have been estimated to 22% for 1SW and 27% for MSW.

2.2.2.5 Iceland

Area split: The input data for the PFA model is divided into two areas. Rivers in the west and south of Iceland are combined into one area and rivers in the north and east into another. This is done on the basis of historic tag recoveries in ocean fisheries (which occurred in different areas) and different climate and oceanic conditions affecting the salmon life cycle, e.g. run-timing, smolt age, and sea age. The southern and western parts of Iceland fall within the NEAC southern area, while the northern and eastern parts of Iceland fall within the NEAC northern area.

Catch: Age class information is available from individual catch records from logbooks used in the rod fishery. The division into sea age classes is based on a bimodal weight distribution. The 1SW females are <3.5 kg and 2SW females >3.5 kg, while 1SW males are <4 kg and 2SW >4 kg. Scale analyses have shown that the presence of salmon having spent more than two winters at sea and of previous spawners is uncommon and that the categorisation into 1SW and 2SW age classes by weight is regarded as fairly accurate. The net catches are recorded on a daily basis. The age split in the net fishery is derived from the weight distribution in the rod fishery from the same river system or from rivers in the same area.

In the River Ranga in southern Iceland substantial smolt releases have occurred since the early 1990s and have now reached a level of 300 000–500 000 smolts annually. Originally, the River Ranga had a small salmon stock with an annual catch of ten to 90 fish until 1990. The river has very limited habitat for salmon production, but these 'ranched' fish now support a substantial rod fishery. The catch in the River Ranga comprised 23% (18–27%) of the total reported salmon rod catch in Iceland between 2009 and 2013. Since these fish are expected to have very low spawning success in the river they are excluded from the PFA catch input data.

Level of unreported catch: The fishing rights in Icelandic salmon rivers belong to landowners who must, by law, form a fishery association that manage the fishing right. The rod fishing rights are leased to the highest bidder. No ocean or estuary fisheries are allowed. The unreported catch was originally believed to be low with a guesstimate value of 2% applied. With increased use of midwater trawls in pelagic fisheries off the coast of Iceland, new information was provided which suggested an increased level of salmon bycatch. Based on a questionnaire survey, the value of unreported catch was therefore revised after 1995 to a value of 10% of the declared salmon catch. This estimate will need further revision once information on the origin (country or area) of fish becomes available as a result of DNA analyses of salmon collected as bycatch in the pelagic fisheries. This is expected to become available in 2014 and tentative indications suggest the estimate of unreported catch will need to be reduced.

Exploitation rates: Rates of rod exploitation are based on rivers with fish counters and catch records from logbooks. The estimates of exploitation are 40–50% for 1SW salmon and 50% to over 70% for 2SW salmon. The exploitation estimate for an in-river gillnet fishery is 39% to 52%, with a higher exploitation rate on larger fish. Information on the number of fish subject to catch and release in rod fisheries are also available from logbooks. The proportion of released fish has been increasing from 1996. The reduced exploitation due to catch and release is taken into account in the annual estimate of exploitation for both 1SW and 2SW stock components in the PFA model inputs.

Median return date of 1SW and MSW: Run timing can vary both between years and between areas. The median return date of 1SW and 2SW salmon in south and west Iceland is mid-June and early June respectively. The median date of return is later in the north and east of Iceland, mid-June for MSW and early July for 1SW salmon.

2.2.2.6 Denmark

The Working Group collects and routinely reports the annual catch of salmon taken in Denmark. However, the small Danish catches are not included in the assessment process used in developing catch advice for the distant water fisheries.

Catch: The catch input is based on continuously collected reports of salmon taken in the recreational fishery in Danish west coast streams (from Internet sources), which all hold populations of wild salmon. In four of these, where salmon populations have always been found, there is a high proportion of reared (finclipped) salmon in the catch, but these are all F1 offspring from the original populations. In the one catchment in eastern Denmark (Gudenå), where the salmon population is not genetically native to the stream, the annual catch is guesstimated.

Level of unreported catch: Unreported catch is expected to be negligible in the western streams because the fishing is closely regulated and controlled by the anglers. In the eastern stream (Gudenå) unreported catch is guesstimated.

Exploitation rates: Exploitation rates may be derived from the total catch related to estimates of the total run (calculated by mark–recapture surveys on a three-year cycle in the four streams with original populations on the west coast).

2.2.3 Data inputs for Southern NEAC countries

2.2.3.1 France

Catch: The estimation of salmon catch in France comes from two main sources: (1) mandatory declaration of rod and line catches and from the Adour nets operating in the lower river (scales are sampled from each fish caught) to the Office National de l'Eau et des Milieux Aquatiques (ONEMA), under the Ministère de l'Ecologie, which assumed responsibility from the Conseil Supérieur de la Pêche (CSP) in 2006; and (2) mandatory declaration of catches made by professional net fishermen to Affaires Maritimes, under the Ministère de la Mer, who since 2008 have delegated responsibility for collection and first processing of catch data to the Regional Boards for Sea Fisheries and Aquaculture Catch. At the same time, catches at sea are declared to the Institut Français de Recherches pour l'Exploitation de la Mer (Ifremer), who are responsible for archiving and scientific processing of all fisheries data. Salmon and sea trout catches have not been reliably collated and made available until recently. Since 1985, the 1SW/MSW split has been based on scale interpretation of the in-river catch (based on scale reading) and on a categorisation based on length thresholds for catches in estuaries and at sea. The figures prior to 1985 are not considered as reliable as the later ones.

Level of unreported catch: Unreported legal catch for the rod and line fishery has been estimated by catch inquiries made by environmental inspectors of ONEMA on each river. These procedures are still operating in some areas, but estimates are considered less reliable in recent years. The estimation of the professional net fishery catch (Adour Basin) is thought to be reliable and no unreported legal catch is considered to apply.

For most years, the unreported illegal catch is not assessed and a minimal value is provided on a precautionary basis. This unreported illegal catch has been assessed in some years by ad hoc inquiries in the estuary of a number of rivers in Brittany (e.g. in 2001) and on the coast (e.g. Baie of Mont Saint-Michel in 2000). The "unreported catch" is included in the nominal catch. No estimates of unreported catch are available for the early part of the time-series (prior to 2001). Thus, the rates input to the model for 1SW and MSW for the early period are near zero and range from -0.00001 to 0.00001. Higher values in the range 20 to 40% for 1SW and 15 to 30% for MSW fish are applied more recently.

Exploitation rates: Exploitation rates are derived from the index River Scorff in Brittany. This is an in-river rate, by rods only, where there are no, or very few, fish thought to be caught on the estuary or coast. Rates are also derived for the Adour river system, where a rough estimation is provided by using the lower values of adult run estimates through facilities in the three rivers flowing to Adour , and the declared catches on the coast, estuary and river, respectively by nets and rods. Some caution is necessary regarding these rates from the Adour given the uncertainties in the different estimates. The rod catch on the index river Nivelle is very small and the probable net exploitation in the estuary and coast is unknown, so exploitation rates are not used for this system. Some data on exploitation rates are also collected by ONEMA on the index river Bresle, but sea trout are the dominant angled species in this river.

2.2.3.2 Ireland

Catch: The data are derived from annual declared catches within fisheries districts, management units implemented by Regional Fisheries Boards. Since 2007 river and estuarine specific angling and commercial catch data have been complied. The Fisheries Boards were amalgamated into a single body, Inland Fisheries Ireland, in 2010 which currently takes responsibility for compiling catch statistics. Catches are split by age on the basis of a reported age distribution from 1980 to 1988. In the absence of any other information the mean proportion of 2SW salmon in the series (7.5%) has been used since 1988 and a mean of 10% has been used prior to 1980. Since the introduction of a carcass tagging and logbook scheme for angling and commercial fisheries in Ireland in 2002, sea age classes in the time-series since 2007 have been determined based upon catch dates and weights in accordance with national river stock assessments. The catch is not corrected for returns from releases of smolts for ranching or enhancement but these are not a major component of the catch.

Level of unreported catch: The values are guesstimated from local reports and knowledge achieved during catch sampling and fisheries protection activities.

Exploitation rates: A coded-wire tagging (CWT) programme has been operated in several rivers in Ireland since 1980. Up to 300 000 hatchery smolts and up to 5000 wild smolts are tagged and released annually. There is also a substantial dataset on wild salmon from the monitored River Burrishoole, providing a further index of wild returns and exploitation rates. Overall, there are estimates of exploitation rates available for three wild stocks and seven hatchery stocks for both 1SW and 2SW salmon. Up to the closure of the marine mixed-stock fishery in 2006, the annual mean of the 1SW wild exploitation index is used as the input data for the lower range of exploitation in the PFA model while the mean of the 1SW hatchery index is used as the upper range. The annual mean of the 2SW wild and hatchery exploitation index was used as the input data for the upper and lower range of exploitation in the PFA model depending on which is higher or lower in that year. Since 2006 the main exploitation input has been from the rod catch which is estimated from coded wire tags estimates for some rivers and also rivers with counters.

2.2.3.3 UK (England & Wales)

Catch: Nominal catches for UK (England & Wales) have been derived from the catch returns submitted by netsmen and anglers and split into 1SW and MSW categories using two different methods. Since 1992, monthly age–weight keys derived from salmon caught in the River Dee trap (an index river) have been used to estimate the age of all rod-caught fish where a weight and date of capture have been provided. This has then been scaled up to the total catch (rods and nets combined) on a pro-rata basis. In earlier years (1971–1991), the age composition of the total catch has been estimated using the mean weight of the fish caught and the mean weight of 1SW and MSW salmon recovered in tagging programmes.

As the contribution of farmed and ranched salmon to the national UK (England & Wales) catch is negligible, the occurrence of such fish is ignored in the assessments of the status of national stocks. However, a large proportion of the fish taken in the northeast coast fishery are destined for Scottish rivers, and these are deducted from the returning stock estimate for UK (England & Wales) and added to the data for UK (Scotland) in the ICES assessment. This proportion is estimated to have declined from 95% of the northeast net catch in the early part of the time-series to 75% in the late 1990s and to around 65% since 2003. This reflects both the steady improvement in the status of the stocks in northeast England and the phase out of the English drift-net fishery since 2003.

Level of unreported catch: All licence holders are required to provide the Environment Agency with details of their catch of salmon and migratory trout and the number of days fished on each river or, for nets, each fishery at the end of the season. Catch returns are received from all net licence holders and from ~90% of full season anglers, and the latter account for the majority of fish caught in a catchment, typically 96–98%. The main correction for underreporting is therefore currently made in respect of perceived inaccuracies in the returns, although more substantial corrections have applied in the past.

There are few independent measures of underreporting in the rod fishery, but these indicate that the level is currently small. A value of 10% is applied for correction purposes based on the method of Small (1991). Historically, underreporting was a much more serious problem. As a result of changes in the licensing and associated catch return system covering UK (England & Wales) in the early 1990s, the percentage of underreporting in the rod catch was estimated to have decreased from ~ 50% to ~20%. Since the mid-1990s, awareness campaigns and enhanced catch reminder systems have further reduced underreporting to the levels currently estimated.

For the net fishery, a figure of 8% has been used in recent years to adjust for the level of underreporting, based on the outcome of surveillance operations. The level may have been substantially higher in the past in certain fisheries, possibly as much as 50%. However, following the successful introduction of logbooks and a carcass tagging scheme in 2009, there is now considered to be minimal underreporting in net fisheries. A figure of 2% has been assumed since 2009.

An earlier questionnaire survey of Environment Agency enforcement staff suggested illegal catches were around 12% of the declared net and rod catch. However, since the introduction of a carcass tagging scheme and a ban on the sale of rod caught fish in 2009, it has been substantially more difficult to dispose of illegally caught fish. Since this time, illegal catches have been estimated to have been reduced to 6% of the declared catch.

Exploitation rates: Exploitation rates for a number of monitored fisheries in UK (England & Wales) are derived annually. National exploitation rates have then been estimated by deriving time-series of 'standard fishing units' employed in the salmon fisheries for the period 1971 to the present. For the period 1971 to 1997, these are calculated from the numbers of licences issued weighted by their relative catching power, which is estimated from historic cpue data; and for the period 1998 to the present, they are calculated from the numbers of days fished by different net categories weighted in the same way. The annual exploitation rates are then estimated by referencing the number of 'standard fishing units' employed over the two periods relative to average age-specific exploitation estimates derived for the 1997 and 1998 seasons.

Additional information: Further details on the derivation of estimates within UK (England & Wales) are available in the annual stock status reports (e.g. Cefas and Environment Agency, 2013), available at:

http://www.cefas.defra.gov.uk/publications/salmon/salmonreport2012.pdf

2.2.3.4 UK (Northern Ireland)

Area split: Originally, a single assessment was carried out for UK (Northern Ireland). However, the data used were derived from two fishery management areas (Foyle and Fishery Conservancy Board (FCB) areas), which publish separate catch statistics and have differing fishing regulations. On the basis that stock status in the two areas may differ (Crozier *et al*., 2003) the two areas were assessed separately from 2001.

Catch: As no commercial fishing has been conducted in the Loughs Agency area since 2010 and in the DCAL area since 2012 the Northern Ireland catch statistics currently (2014) rely solely on rod catches. Overall UK (Northern Ireland) rod catch estimates are available since the introduction of a carcass-tagging scheme in 2001. These catch statistics are used as an input in the model. Estimates of sea age composition of the catch for the time-series are based on 1SW/MSW data from adults returning to the River Bush.

Level of unreported catch: Estimates of unreported catch, as a result of illegal fishing, are based on intelligence reports from DCAL and Loughs Agency fishery officers. These are guesstimates only, with no verification possible. Annual adjustments in unreported catches have been used since tagging programmes started in the mid-1980s. Prior to that, a constant underreporting figure is used, as no annual data are available. The introduction of the carcass tagging scheme in 2001 has led to a reduction in unreported catches.

Exploitation rates: Estimates of exploitation rates were historically based on the River Bush microtagging programme. Exploitation from this monitored river (which is in the DCAL fishery area) was used as an input figure for all UK (Northern Ireland) fisheries (Foyle and DCAL areas). However, as currently no commercial fishery for salmon exists in the DCAL and Loughs Agency areas, exploitation rates are based on rod exploitation in the DCAL and Loughs Agency alone.

Possible improvements: A possible improvement would be to have better data available on sea age composition of all Northern Irish fish. Currently the River Bush estimate is applied to all Northern Irish data, but independent data from large river systems like the Bann and Foyle would result in a more reliable country wide estimate. In addition, a higher return rate for the carcass tagging scheme would result in more reliable estimates of exploitation rates. Recently the carcass tagging return rate in UK (Northern Ireland) has varied between 14–55%.

2.2.3.5 UK (Scotland)

Area split: The country is divided into eleven regions for the purposes of collating and publishing salmon and sea trout fishery statistics (Marine Scotland Science, 2012). Within the PFA run-reconstruction model, UK (Scotland) is divided into two broad areas (east and west), the split being influenced by the contrasts in climate, river size and the timing and sea age of returning fish. The east grouping comprises the east, northeast, Moray-Firth, and north statistical regions, the remaining regions comprise the west grouping.

Catch: Catches were collated according to the area split defined above. Reported retained catches of wild salmon, taken by both net and rod fisheries, are provided separately for two age classes, one sea-winter and multi sea-winter fish. Catch sampling programmes have shown that there is a variable (by region, year, and fishery) proportion of 1SW salmon categorised as MSW salmon in the reported catches. Catch data used in the model are not currently corrected to account for such misreporting.

Level of unreported catch: The ranges used in the national model are based on previous guesstimates made by local managers in some eastern areas of the country (MAFF 1991). The differences in the ranges used for the east and west groupings are based on a subjective view that unreported catches in the west area are likely to be greater than in the east area. It is thought that human population densities are lower in the west and therefore there is likely to be less surveillance over the reporting of salmon catches. Further, west coast rivers are generally smaller and more numerous than east coast rivers, leading to a greater number of locations where unreported catches may be taken. Ranges provided are a subjective estimate of uncertainty in these parameters.

Exploitation rates: Rates for the national model are guesstimates derived from estimated exploitation rates over a range of fisheries in the early part of the time-series (Shearer, 1992), and the time-series of exploitation rates derived from the River North Esk (Marine Scotland Science, 2010), together with reported net effort indices and the proportion of rod caught fish which were subsequently released (e.g. Marine Scotland Science, 2013).

2.2.3.6 Spain

The Working Group collects and routinely reports the annual catch of salmon taken in the recreational rod fisheries in Spain (mainly Asturias). However, the small Spanish catches are not included in the assessment process used in developing catch advice for the distant water fisheries.

2.2.4 Data inputs for Faroes and West Greenland fisheries

2.2.4.1 Faroes

Reported catch: Catches are derived from the landings of salmon caught in the commercial and research fisheries that operated in the Faroes EEZ and the northern Norwegian Sea. Catches for each season (i.e. November in year n to May in year n+1) are assigned to the second year (i.e. year n+1). These fish are classified into 1SW and MSW age groups according to their age (or potential age) on January 1st during the fishery (i.e. a post-smolt caught in November is classified as 1SW).

Unreported catch: All fish less than 63 cm total length have been discarded in this fishery and so an unreporting rate of 10–15% (with an error of +/- 5%) has been used for 1SW fish; there is thought to have been negligible non-reporting of MSW fish.

Catch composition: Estimates of the proportion of farmed fish in the catch for the period 1981 to 1995 have been derived from scale reading (ICES, 1996; Hansen *et al.*, 1997); prior to 1981 all fish are assumed to have been wild, and since 1997 a value of 0.8 has been used. The country of origin of the catch has also been estimated based on tagging studies undertaken in the early 1990s (Hansen *et al.*, 1999) and applied to the full time-series of catches.

2.2.4.2 West Greenland

Catch: The total nominal catch (i.e. tonnes round fresh weight) in the West Greenland is reported and converted to numbers using a mean weight obtained from the sampling programme.

Unreported catch: Estimates of unreported catch were not provided for the period from 1993 to 1999 an annual estimate on non-reported catch, varying from 5 to 20 tonnes was provided by the Greenland representative. Since 2000 a nominal figure of 10 t per year has been provided.

Continent of origin: The catch at West Greenland was divided in NAC and NEAC components using scale characteristics until around 2000 and since that time genetic analysis has been used. For the period when scale characteristics the input data to the model is the min and max estimates of the proportion of NAC fish (from which min and max proportions of NEAC fish are calculated). For the subsequent period the inputs are the numbers of NAC and NEAC fish identified in the samples.

2.2.5 Improvements to NEAC input data

NEAC countries have made ongoing efforts to improve the input data used in assessments. Modifications to input variables are reported by WGNAS in the year in which they are first implemented.

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). However, the methods used to derive estimates of unreported catch vary markedly between countries. For example, some countries include only illegally caught fish in the unreported catch, while other countries include estimates of unreported catch by legal gear as well as illegal catches in their estimates.

Descriptions of the national approaches used for evaluating unreported catches have been reported at various WGNAS meetings (e.g. ICES, 1996; 2000; 2002; 2010a). In addition, detailed reports describing national procedures for evaluating illegal and unreported catch, and efforts to minimise this, were submitted by parties to NASCO in 2007 in support of a special theme session on this issue. Full details are available at: http://www.nasco.int/pdf/2007%20papers/CNL(07)26.pdf.

Input data commonly rely on rod catches and the practice of catch-and-release has become increasingly important in recent years to reduce levels of exploitation on stocks. In the NEAC areas, catch and release estimates from the rod fisheries are not available from all countries and, when they are, corrections for catch-and-release mortality are commonly not applied. As the practice of catch-and-release is increasing, WGNAS have previously recommended (ICES, 2010a) that consideration should be given to incorporating mortality associated with this practice in river-specific, regional and national assessments.

The procedures currently used to incorporate catch-and-release and unreported catches into regional, national and international assessments are summarised at Annex 1 (from ICES, 2010a).

One weakness of the NEAC model is that it is heavily dependent upon catch data and the estimates of exploitation rate. In most salmon fisheries in the NEAC area, more than half the catch is reported, and in many cases it approaches 100%. However, as stocks have declined, exploitation rates have been reduced to very low levels, and estimates of abundance are therefore becoming increasingly sensitive to this parameter. This inevitably means that uncertainty in the estimates is increasing, and it therefore strengthens the need to make use of alternate sources of information on stock abundance, such as adult counts.

2.3 Input data for assessments–NAC area

The run-reconstruction model for NAC developed by Rago *et al.* (1993a) is used to estimate the PFA of non-maturing 1SW salmon of North American origin (beginning in 1971). Only the West Greenland fishery is of relevance in the context of distant water exploitation of NAC stocks. This fishery exploits predominantly (>95%) 1SW non-maturing salmon (destined to return primarily as 2SW salmon) and hence it is only necessary to estimate the abundance of this age group prior to the fishery at Greenland. The other fish taken in the fishery represent 2SW and older non-maturing salmon and previous spawners (ICES, 2003). However, PFA estimates for maturing 1SW salmon as well as large salmon (containing all MSW age groups of salmon including repeat spawners) can be derived from the run-reconstruction model.

The starting point for the reconstruction requires estimation of the returns of 2SW salmon to the six regions in eastern North America: Labrador, Newfoundland, Québec, Gulf, Scotia-Fundy, and USA. With the progressive closure of commercial fisheries (1984 for the Gulf and Scotia-Fundy regions; 1992 for Newfoundland; and 1998–2000 for Labrador and Québec) abundance estimates of 2SW salmon have relied less on harvests and increasingly on estimated returns to rivers raised to production areas. The returns for each region are estimated with the uncertainty defined by a range of minimum and maximum values based on the best information available for each region (Chaput *et al.*, 2005).

The annual pre-fishery abundance of non-maturing 1SW fish for year i, destined to be 2SW returns (excluding 3SW and previous spawners), represents the estimated number of salmon at West Greenland prior to the start of the fishery on August 1st. Definitions of the input variables used in the model are given in Table 2.3.1. The PFA estimate is constructed by summing 2SW returns in year i+1 [NR2(i+1)], 2SW salmon catches in commercial and Aboriginal peoples' food fisheries in Canada [NC2(i+1)], and catches in year i from fisheries on non-maturing 1SW salmon in Canada [NC1(i)] and Greenland [NG1(i)].

Table 2.3.1. Definitions of key variables used in continental run-reconstruction models for North American salmon.

i	Index for PFA year corresponding to the year of the fishery on 1SW salmon in Greenland and Canada
M	Natural mortality rate (0.03 per month)
t1	Time between the midpoint of the Canadian fishery and return to river = 1 month
S1	Survival of 1SW salmon between the homewater fishery and return to river $\{exp^{-M * t1}\}$
H_s(i)	Number of "Small" salmon caught in Canada in year i; fish <2.7 kg
H_l(i)	Number of "Large" salmon caught in Canada in year i; fish >=2.7 kg
AH_s	Aboriginal and resident food harvests of small salmon in northern Labrador
AH_l	Aboriginal and resident food harvest of large salmon in northern Labrador
f_imm	Fraction of 1SW salmon that are immature, i.e. non-maturing: range = 0.1 to 0.2
af_imm	Fraction of 1SW salmon that are immature in native and resident food fisheries in N Lab
q	Fraction of 1SW salmon present in the large size market category; range = 0.1 to 0.3
MC1(i)	Harvest of maturing 1SW salmon in Newfoundland and Labrador in year i
i+1	Year of fishery on 2SW salmon in Canada
MR1(i)	Return estimates of maturing 1SW salmon in Atlantic Canada in year i
NN1(i)	Pre-fishery abundance (PFA) of non-maturing 1SW + maturing 2SW salmon in year i
NR(i)	Return estimates of non-maturing + maturing 2SW salmon in year i
NR2(i+1)	Return estimates of maturing 2SW salmon in Canada
NC1(i)	Harvest of non-maturing 1SW salmon in Nfld + Labrador in year i
NC2(i+1)	Harvest of maturing 2SW salmon in Canada
NG(i)	Catch of 1SW North American origin salmon at Greenland
T2	Time between the start of the fishery at West Greenland (August 1) and return to the coast of North America = 10 months
S2	Survival of 2SW salmon between August 1 (at West Greenland) and return to the coast of North America $\{exp^{-M * t2}\}$
MN1(i)	Pre-fishery abundance of maturing 1SW salmon in year i

2.3.1 Data inputs for NAC

The latest data input variables used in running the NAC assessment are listed at Annex 4. More detailed descriptions of how the model input data have been derived for each region of North America are presented below.

2.3.1.1 Labrador

For Labrador stocks, it was thought inappropriate to develop total recruits from angling catches and exploitation rates similar to techniques used for rivers in insular Newfoundland. The problem with using angling catches to derive returns for Labrador is, that until 1994, there were no estimates of exploitation rates available other than for the salmon population of Sand Hill River and these were 20 years out of date. Also, because Labrador coastal rivers are isolated, the exploitation rates are low and highly variable depending on the presence of an angling camp and its success in attracting guests as well as the nearness of local communities. Thus, exploitation rates would depend and vary from one year to the next based on the success of angling camps in attracting anglers and may not be applicable to other Labrador rivers. Thus, all estimates of returns and spawners until 1998 were based on commercial catches as the only source available of usable continuous time-series of data.

Before 1998

The general approach is to use exploitation rates to convert commercial catches of small and large salmon in Labrador to total population prior to the commercial fishery. River returns and spawners were estimated by subtracting the commercial catch from these populations, and accounting for non-Labrador interceptions. The estimated number of Labrador origin large returns is calculated as:

$$LR = (CC*PL) / u \tag{1}$$

where,

LR = Labrador returns, PL = proportion Labrador origin, CC = commercial catch, and u = exploitation rate

The estimated number of Labrador origin small returns is determined from equation (1) but using commercial catches of small salmon.

Parameter values for sea age and the proportion of salmon of Labrador origin comes from the sampling program in the commercial fishery, 1974–1991. In 1997, commercial sampling resumed with samples being collected throughout the fishery at Makkovik and Rigolet in SFA 1 and Cartwright and St Lewis/Fox Harbour in SFA 2. River age distribution of commercial samples of small and large salmon from Labrador have been found to consist, on average, of about 75–80% river age 4 and older in SFAs 1 & 2. The commercial samples came from commercial catches sampled in Labrador at several sites along the Labrador coast including Square Islands (SFA 2) and at Nain (SFA 1) (Anon., 1993b). In total, 46 320 salmon were sampled for scales and aged. Labrador salmon stocks are thought to contribute about 70% of the total production of four year, and older, river age salmon, with the other 30% coming from northern Québec. Thus, when non-Labrador salmon are factored in at 30% applied to the river age distribution, then 60–80% of the harvest of small and large salmon (PL) in Labrador are of Labrador origin (Anon., 1993b). In 1997, in SFA 1, the percentage of the commercial catch that was of Labrador origin was for large salmon 68% (95% C. I. 64.3–72.5%); whereas for small salmon it was 39% (95% C.I. 35.6%–41.6%). In 1997, in SFA 2, the percentage of the commercial catch that was Labrador origin was for large salmon 92% (95% C. I. 88.4–95.2%); whereas for small salmon it was 80% (95% C.I. 74.8%–85.0%).

Exploitation rates (u) were calculated from the smolt tagging study in 1969–1973 on Sand Hill River (Reddin, 1981; Reddin and Dempson, 1989). Exploitation rates of 0.28 to 0.51 for small salmon and 0.83 to 0.97 for large salmon from the tagging study were changed to base exploitation rates of 0.3 to 0.5 on small salmon and 0.7 to 0.9 on large salmon and were assumed to apply to all of the salmon populations in SFAs 1, 2, and 14B for the period of 1969–1991 (Anon., 1993b). After 1991, due to the Management Plans for the commercial fishery in Labrador and Newfoundland, several changes occurred that would reduce exploitation of Labrador origin salmon. These changes include: (1) reductions in effort as commercial salmon fishermen chose to sell their licences from a buy-out agreement begun in 1992, (2) a moratorium on commercial fishing in Newfoundland would increase the number of Labrador salmon in Labrador coastal waters, and (3) season reductions due to the varying opening dates and early closures from the quotas applied in 1995 and 1996. The effects of these changes were quantified in the exploitation model as follows:

$$u=1-e^{-aF} \tag{2}$$

where: a = fraction of the 1991 licensed effort remaining in 1992–1996.

In 1994–1996, the licensed effort for all of Labrador was 37% of the 1991 level of 570 licences, in 1993 it was 55%, and in 1992 it was 87%. In any given year, it was assumed that 90% of licensed fishermen were active. Fishermen reported during public consultations that in 1995 and 1996 many licensed salmon fishermen did not fish for salmon in 1995–1996 but fished for crab instead. This was verified by Fisheries Officers who reported that of the 218 licensed salmon fishermen only 132 were active in 1996. Another method of obtaining actual effort information is also available since, beginning in 1993 commercial fishing vessel (CFV) numbers have been recorded on sales receipts issued to fishermen by fish plants. Enumeration of licensed salmon fishermen actively fishing was made by determining the number of CFVs in the Statistics Branch catch records. Active effort in 1991 and 1992 was assumed to be 90% as it was in 1993 and 1994 from the CFV file. Thus, the exploitation rates (u) were modified due to effort reductions in equation (2) using estimated active licences from 1991 as a base and the number of active licences in 1995, 1996 and 1997. The modified exploitation rates (ue) for 1992–1997 used the licensed effort in equation (2).

The tagging study on Sand Hill River, 1969–1973 showed that Labrador small and large salmon were not only caught in Labrador, but also in the commercial fisheries along the northeast coast of Newfoundland (both small and large) and at West Greenland (large only) (Anderson, 1985). For small salmon, out of a total of 100 (1SW) tag returns there were 24 from Newfoundland. For large salmon, out of a total of 137 (2SW) tag returns there were 41 from Newfoundland.

For 1992–1997: the moratorium on commercial fishing in Newfoundland would have released small and large salmon to Labrador. The effect of salmon released from Newfoundland in 1992–1996 was evaluated against the exploitation rates as follows:

$$un = (1-((24 * (1 - ue))/100)) * ue \text{ , for small salmon, and}$$
$$un = (1-((41 * (1 - ue))/137)) * ue \text{ , for large salmon} \tag{3}$$

The new estimates of fishing mortality (un) in 1992–1994 included adjustments for the closure of the commercial fishery in Newfoundland based on the results of the Sand Hill River tagging study. Season reductions due to the varying opening dates and early closures from the quotas applied in 1995 and 1996. In 1995, adjustments were made to account for the new opening date for the commercial fishery in Labrador of July 3 changed from June 20 the previous year. For 1995, the accumulative effect of these, weighted to SFA catches, was to reduce the catch so that for small salmon the current catch represents 86.0% of small salmon and 62.7% of large salmon. In 1996, the opening date reverted to June 20 but the quota levels resulted in early closures in SFA 2 of 2A - July 10, 2B - July 8, and 2C - July 2 while SFA 1 and 14B did not close. For 1996, the accumulative effect of these weighted to SFA catches was to reduce the catch so that for small salmon the current catch represents 53% of small salmon and 61% of large salmon. In 1997, the opening date remained at June 20 but the quota levels resulted in early closures in SFA 2 of 2A -July 12, 2B - July 15, and 2C - July 13 while SFA 1 closed on October 15 as the quota was not caught. For 1997, the accumulative effect of these early closures was to reduce the catch so that for small salmon the current catch represents 47% of small salmon and 64% of large salmon. The season changes reduce catches and hence lower exploitation rates. The effect of shorter seasons in 1995, 1996 and 1997 was evaluated against the exploitation rates in section B as follows:

US = UN * SC, for small salmon, where SC is season change, and
US = UN * SC, for large salmon (4)

The new estimates of fishing mortality including effort reductions, adjustments for the closure of the commercial fishery in Newfoundland, and shorter seasons due to opening dates and quotas results in the following exploitation rates which were applied to catches. The cumulative effect of factors A, B, and C is to reduce exploitation on Labrador origin salmon.

Labrador origin 2SW returns (LR2SW) were derived from eq. 1 by:

LR2SW = LR * P2SW (5)

where, P2SW = proportion of the large salmon that is 2SW salmon.

The SR1SW were calculated as in equation (5) but using P1SW which is the proportion of the catch that is 1-sea winter in age and maturing to enter freshwater and spawning in the year of capture. The parameter values for P1SW of 0.1 to 0.2 come from Anon. (1991).

The 2SW component was estimated separately for salmon caught in SFA 1, 2 and 14B. In SFA 1, commercial sampling at Nain of large salmon showed the proportion of 2SW were on average about 84% (n=6542), 1977–1991. Thus, a range of 0.7–0.9 was used for SFA 1. In SFA 2, commercial sampling of large salmon averaged 69% (n=4793) 2SW salmon, 1977–1991. There were no commercial samples available for SFA 14B. Thus, for SFAs 2 & 14B a range of 0.6–0.8 was used. For the 1SW component, commercial samples at Nain in SFA 1 of small salmon showed the proportion of 1SW salmon were on average about 94% (n=4757). In SFA 2 the 1SW component was on average about 97% (n=8872) of small salmon. There were no samples from commercial sampling in SFA 14B. In 1997, aged commercial samples indicated that the previous range was acceptable.

Total river returns of 2SW salmon (TRR) were calculated as follows:

TRR = LR2SW / (1-us) (6)

The total river returns of small salmon are also calculated by equation 6 but from SR.

Spawning escapement (SE) or spawners was calculated according to the formula:

SE = TRR - AC, (7)

where

AC = angling catch which includes retained catch plus 10% of hook & released mortality for released salmon.

A couple of modifications were made to the estimation procedure for Labrador in 1997. Firstly, determination of exploitation rates were calculated separately for SFA 1, 2 and 14B using the active effort individually for each SFA. For SFA 1, the active number of licences declined from 141 in 1991 to 39 in 1997. For SFA 2, the active number of licences declined from 320 in 1991 to 99 in 1997. For SFA 14B, active licences declined from 52 in 1991 to 0 in 1997 when the fishery was closed. Exploitation rates determined as in equations 2, 3 and 4 are: SFA 1 - small was 0.0735 to 0.1399 and - large was 0.2221 to 0.3959; and SFA 2 - small was 0.0384 to 0.0728 and - large was 0.1589 to 0.2799.

Numbers of small and large salmon for SFAs 1 & 2 were estimated from the exploitation model while for SFA 14B the results of assessments on Forteau Brook and Pinware River were expanded to include all of the watershed in SFA 14B. Returns to SFA 14B were 663 to 1545 small salmon and 146 to 327 large salmon.

Total mortalities of small and large salmon were accounted for by summing commercial catches of small salmon in Labrador and Newfoundland, large salmon in Labrador, Newfoundland, and Greenland, angling catches in Labrador of small and large salmon including 10% of the hook and released salmon, and small and large spawners. All of the above mortality estimates except catches of Labrador salmon in Newfoundland, 1969–1991 and Greenland could be obtained from equations 1 to 7. Catches in Newfoundland and Greenland were assessed as follows:

Greenland: for 1969–1992 and 1995–2004, removals of Labrador salmon by the Greenland fishery were assessed from data based on the sampling program in commercial fish plants at west Greenland (Anon., 1996). The Greenland fishery catches salmon that would have returned to homewaters as large salmon in the year following the Greenland fishery. Numbers of Labrador salmon were determined by converting catches in kg to numbers of salmon of 1SW North American origin that were of river age 4 and older. The number of Labrador salmon were estimated by assuming that 70% of the production of 4-year and older river age salmon are from Labrador (Anon., 1993b).

Newfoundland: for 1969–1991, catches of Labrador small and large salmon in Newfoundland were included in total mortalities as the product of the ratio of tags caught in Newfoundland to Labrador and the catch in Labrador. For small salmon the ratio was (24/(100-24)) = 0.32 and for large salmon it was (41/(137-41) = 0.43.

1998–2001

For the years, 1998–2001 when only one or two counting projects took place in Labrador, the raising factors previously used and explained of 1.04 to 1.49 for small salmon and 1.05 to 1.27 for large salmon were used to estimate returns and spawners for Labrador from the overall PFA minus catches in Greenland, as was the case in previous years. However, in this case returns to rivers were derived for Labrador by subtracting landings in food fisheries. Also, catches in 1994–2006 were updated to reflect changes made to catch statistics in Labrador from the Licence Stub Return System. Procedures for the collection and compilation of commercial and angling fishery data are described in Ash and O'Connell (1987) for fishery years 1974–1996. For years 1969–1974, commercial catch data came from Anon. (1978). In 1997, the angling catch statistics were converted to a licence stub system (O'Connell *et al.*, 1998) which continues to present.

2002–present

Counting projects occur on four Labrador rivers; out of about 100 extant salmon rivers. Because they occur on the same four rivers each year, it is possible to extrapolate from return rates for small and large salmon per accessible drainage areas in these four rivers to unsurveyed ones in the remainder of Labrador. The area accessible drainages were 9267 km² for Lake Melville (SFA 1A), 25 485 km² for Northern Labrador (SFA 1B), 28 160 km² for Southern Labrador (SFA 2), and 2651 km² for the Straits Area (SFA 14B). Accessible drainage area in the counting facility rivers was 1878 km² resulting in an expansion factor of 35 to one. Not all rivers in Lake Melville were included due to a lack of information on presence of salmon populations in rivers in this region of Labrador. Lake Melville rivers whose drainage areas were included are Sebaskachu, Cape Caribou, Goose, MacKenzie, Kenamu, Caroline, Traverspine.

Return rates for SFAs 1A and 1B were derived from English River return rates with maximum and minimum values developed using the observed variability of return rates in SFA 2. Total returns and spawners for Labrador are estimated by Monte Carlo simulation based on 10 000 random draws from the range of values assuming return rates per km² of accessible drainage were uniformly distributed. The return rates for each SFA were then multiplied times the total accessible drainage area to derive total returns of small and large salmon. Ranges of values were developed to convert numbers of small and large salmon to numbers of 1SW and 2SW salmon from scale age information collected from counting fences and angling fisheries in Labrador. A bootstrap procedure was used to develop estimates of the proportions of sea age 1 salmon in estimates of small salmon returns and spawners, proportions of sea age 2 salmon in estimates of large salmon returns and spawners and proportions of sea age 1 salmon in the estimates of large salmon returns.

Sea age correction factors were:

Small to 1SW - 96 to 100%
Large to 2SW - 60 to 71%
Small overlap in large - 12 to 21%

Spawners of 1SW and 2SW salmon were derived by subtraction of angling catches including an estimate of hook and release mortalities (10%) from the returns.

2.3.1.2 Newfoundland

Inputs for the run-reconstruction model for Newfoundland include estimates of small, large and 2SW returns and spawners to rivers (minimum and maximum). The methods used to estimate returns and spawners to the rivers in Newfoundland are described by Reddin and Veinott (2010). In brief, returns and spawner estimates were derived from recreational fishery exploitation rates of retained small salmon for rivers with enumeration facilities; and ratios of large to small salmon were utilized to estimate large salmon. Exploitation rates were then applied to all rivers with reported angling catches. A non-parametric bootstrap technique was used, whereby exploitation rates and ratios of large to small salmon from rivers with enumeration facilities were chosen at random with replacement. The 95th confidence interval from 500 iterations of the weighted exploitation rate and ratio of large to small salmon was applied to angling catches on a Salmon Fishing Area (SFA) basis. The midpoint of the 95th confidence interval was used as the minimum and maximum estimate returns of large and small salmon in each SFA. Estimates of 2SW returns are based on the expected proportion of 2SW in the large salmon category (≥63 cm). Commercial and recreational angling catches were derived as described for Labrador (2.3.1.1). Spawners in all years were determined as the returns to rivers minus angling catches including an adjustment for hook-and-release mortality.

2.3.1.3 Québec

In order to estimate abundance of stocks, rivers were classified into six categories (C1–C6) depending on the information available to estimate salmon returns (according to the method of Caron and Fontaine, 1999), with C1 being the most reliable evaluation and C6 the least. C1 corresponds to a river where the evaluation of the returns is based on a counting method, either from a fence or from a visual count through snorkelling or from a canoe. C2 uses the same evaluation, but without knowing the number of small and large salmon, which is then estimated from proportions reported in the sport fishing landings and, if necessary, the catch and release. Salmon returns on C3 rivers are determined based on multiple correlation factors, using catch number, fishing effort, season duration and river accessibility distance (Guillouët, 1993).

When estimation of the returns using a C1–C3 category is not possible, and when data of returns from previous years are available, the C4 category is used. C4 assumes that interannual variations in salmon returns in the targeted river are approximately the same as variations observed in the other rivers of the corresponding region. Category C5 is for rivers where only landings data are available. In these rivers the salmon run is estimated from the average regional exploitation rate. Finally, a few small rivers have essentially no available data. C6 then assumes that the run is related to the available river salmon habitat and is estimated with respect to rivers of the same area for which run estimates and salmon habitat area are known. Estimated numbers of returns from C4 to C6 cannot be used as management tools regarding the conservation limit. However, they provide at least approximate numbers to estimate returns and spawners for salmon rivers in Québec.

The evaluation of the uncertainty associated with return estimates depends on the river category. For C1 and C2 rivers, the correction factor for the minimum and maximum number of returns is +5% and +10% for all rivers with a fish ladder and for all others in zones Q1 to Q3 and Q10. The correction factor for rivers with darker water from zones Q5, Q6 and Q7 is rather +10% and +30%. For the other categories, an uncertainty of ±25% is associated with salmon return estimates, except for category C3 where calculation depends on the method of Guillouët (1993).

The number of spawners is obtained using the return estimate minus all river catches, which include landings and other types of removal. In most cases, river catches include landings from sport fishing only, which may be conducted by native people such as that on the Betsiamites River. The other types of removal are of limited number and include mainly natural mortality, salmon captured for hatchery use and subsistence fishing when practised in river.

Overall return estimates for all Québec rivers are obtained by adding in-river salmon returns, commercial fishing (when operated), native people subsistence fishing when practised in estuaries and an estimate of non-registered landings. However, little scientific data are available on non-registered landings and thus, estimates are based on good judgment, following consultations with regional biologists.

2.3.1.4 Gulf

Estimation of returns and spawners are developed for the four salmon fishing areas of Gulf Region (SFAs 15 to 18).

SFA 15

The major river in this area is the Restigouche River. The returns and spawners are estimated for the Restigouche River exclusive of returns to the Matapedia River, which are included in Québec zone Q1. The Restigouche River stock assessment is based on angling catch with assumed exploitation rates between 50% (min.) and 30%

(max) with estuary catches added back after the estimates of returns. Return and spawner estimates for SFA 15 are based on Restigouche River data, scaled up for SFA 15 using angling data. The return and spawner estimates for SFA 15 are derived from the return and spawner estimates for Restigouche (New Brunswick). The minimum and maximum return and spawner estimates are derived from the minimum and maximum ratios of angling catch in all of SFA15 relative to angling catch in Restigouche (New Brunswick) (min = 1.117; max = 1.465). Harvests represent retained angling catch plus 6% catch and release mortality for released fish. The proportion of 2SW in large salmon numbers is based on aged scale samples from angling, trapnets, and broodstock. In the years when no scale samples analysis is available, a mean value of 0.65 is used.

SFA 16

The most important Atlantic salmon river in SFA 16 is the Miramichi River. The Miramichi makes up 91% of total rearing area of SFA 16 and returns to the river are assessed annually. For 1971 to 1991, minimum and maximum values are based on capture efficiencies of the Millbank estuary trapnet representing a lower CI of -20% of the estimate and upper CI of 33% of the estimate. For 1992 to 1997, minimum and maximum are lower and upper CI and based on estimate bounds of -18.5% to +18.5%. Since 1998 to the present, minimum and maximum are 5th and 95th percentile range from a Bayesian hierarchical model used in the assessment. Returns to SFA 16 are Miramichi returns (Minimum, Maximum) / 0.91. Proportion 1SW in small salmon is from scale ageing; proportions have varied from 0.97 to 1.0. Proportion 2SW in the large salmon category is obtained from scale ageing. Spawners are returns minus harvests. For 1998 to 2011, the harvest of large salmon is estimated as the sum of the aboriginal fisheries harvests for large salmon and 1% of the large salmon catch (30% exploitation rate, 3% catch and release mortality). The harvest of small salmon is estimated as 30% of the small salmon return plus the harvest from the aboriginal fisheries.

SFA 17

For 1970–1994, small returns are estimated from retained small salmon catch in the Morell River divided by the river-specific exploitation rate. Salmon catch in the Morell River was estimated in 1970–1990 by DFO Fisheries Officers; and in 1991, 1992, and 1994 by angler mail-out surveys. The number of small retained salmon in 1993 was not recorded, so the number used is the mean for 1986–1992. For 1970–1993, exploitation rate was taken as the mean of exploitation rates estimated for 1994, 1995, and 1996 (0.317). For 1994, exploitation rate was 0.34. The min and max of small returns are calculated using exploitation +/- 0.1; e.g. 0.34 +/- 0.1 gives 0.24 and 0.44. Large returns = (number of small returns/proportion small) - number of small returns. For 1970–1980, proportion small is calculated from numbers of small and large salmon in the angling catch of each year. For 1981–1994, proportion small is taken from counts at the Leards Pond trap on the Morell River. Small spawners = number of small recruits - number of small retained. Large spawners = number of large recruits - number of large retained.

Spawners estimates for 1995 to the present are derived from redd counts in 23 rivers. For years and rivers in which redd counts are unavailable, redd numbers are estimated by linear interpolation from the preceding and succeeding count year. Redd numbers in years prior to the first count are taken as the first count. Redd numbers in years after the last count are taken as the last count. Female spawners are estimated from the ratio of 3.357 redds/female spawner, measured in the West River in 1990. Total spawners are estimated from size-specific sex ratios derived from counts at Leards and Mooneys Ponds, Morell River, in 1986–2001. The proportion of salmon that are large is taken as 0.5 in the Cains, Carruthers, Trout (Coleman), Morell, Cardigan, West, and Dunk Rivers, and 0.9 in all other rivers. Spawners are presented as Min (estimated spawners -20%) and Max (estimated spawners + 20%). Returns are spawners + total estimated fishing mortality, including angler catches, hook-and-release mortality, and native harvests. Angler catches and hook-and-release mortality are estimated from angler card surveys. Returns are presented as Min (estimated returns -20%) and Max (estimated returns + 20%). It is assumed that large salmon and 2SW salmon are equivalent.

SFA 18

Returns and spawners to SFA 18 are derived from estimates of returns and spawners to the Margaree River, adjusted for the ratio of the SFA 18 angling catch to the Margaree River catch. For small salmon, the ration of SFA 18 catch to Margaree catch varies between 1.15 and 2.71 for years 1984 to 2004. For large salmon, the ratio of SFA 18 catch to Margaree catch varies between 1.08 and 2.32 for years 1984 to 2004. Returns to Margaree River are estimated using various techniques.

- 1970 to 1983 angling catch divided by range of exploitation rates with maximum exploitation rate of 0.37 and minimum exploitation rate of 0.215;
- 1984 to 1986 based on annual assessments;
- 1987 to present angling catch and effort data from logbooks and provincial licence stubs are used to derive the returns. The catchability coefficient per rod day is estimated from angling catch and effort data for the years 1988 to 1996 when mark and recapture programmes were used to estimate returns, independently from angling data.

Spawners for 1970–1983 equal returns minus removals. Spawners for 1984 to the present equal returns minus catch for small salmon and returns minus catch, corrected for 5% mortality, for large salmon. 2SW salmon represent between 0.77 and 0.87 of large salmon returns and spawners.

2.3.1.5 Scotia–Fundy

Salmon originating in rivers of the Atlantic coast of Nova Scotia and southwest New Brunswick in Salmon Fishing Areas (SFAs) 19–21 and the portion of SFA 23 outside the inner Bay of Fundy comprise the Scotia-Fundy stocks. With the exception of at least one stock in SFA 19, they have a large salmon component that migrates to the North Atlantic/Labrador Sea (Amiro *et al.*, 2008). Estimates of returns and spawning escapement for the Scotia-Fundy stocks are provided as inputs to the run-reconstruction model. Inner Bay of Fundy Atlantic Salmon (SFA 22 and part of SFA 23) have been federally listed as endangered under the Canadian Species at Risk Act and are not included as inputs into the run-reconstruction model. With the exception of one population, inner Bay of Fundy stocks have a localized migration strategy while at sea and an incidence of maturity after one winter at sea.

Consistent with the requirements of the model, a range (minimum to maximum) of returns and spawning escapement for the Scotia-Fundy stocks is provided for the run-reconstruction model. The methods used to estimate total returns and spawners are described by Amiro *et al*. (2008). In brief, for SFAs 19–21, the escapement is based on the count of small and large salmon at the Morgan Falls fish-way on the LaHave River from 1970 to the present year, scaled up to the region using the relationship between this count and the recreational catch data for rivers in SFA 19 to 21 from 1970 to 1997 and a catch rate for the LaHave River from 1970 to 1997. Estimates of the returns also include estimates of landings in the commercial salmon fisheries in SFA 19–21 from 1970 to 1983. The model is fitted using maximum likelihood, and the 90% confidence limits are carried forward as the minimum and maximum values. In SFA 23 from 1970 until 1992, estimates of total 1SW and large wild-origin salmon returns are based on the estimated number of returns destined for tributaries above Mactaquac Dam on the Saint John River; this includes in-river and outer-Fundy commercial landings (1970–1971 and 1981–1983), in-river aboriginal harvests (since 1974), and counts at Mactaquac Dam. These estimates are raised by the proportion of the total accessible productive habitat in SFA 23 that is upstream of Mactaquac Dam (0.4–0.6). Hatchery-origin returns were attributed to above Mactaquac Dam only and no hatchery 1SW and MSW returns were estimated for other rivers within SFA 23 (outer Fundy). Since 1993 the estimates of 1SW and MSW returns to the Nashwaak River have been used to estimate the wild production from tributaries of the Saint John River below Mactaquac Dam. The estimated 1SW and MSW returns to the Nashwaak River (above Counting Fence), is raised by the proportion of the total production area accounted for below Mactaquac (0.21–0.3) and then added to the above Mactaquac totals.

2.3.1.6 USA

Total salmon returns and spawners for USA rivers are based on trap and weir catches and for the small rivers in Maine that do not have fish counting facilities, estimates of spawners were based on redd counts.

2.3.2 Improvements to NAC input data

Modifications to input variables used in assessments for the NAC area are reported by WGNAS in the year in which they are first implemented.

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). However, the methods used to derive estimates of unreported catch vary markedly between countries. For example, some countries include only illegally caught fish in the unreported catch, while other countries include estimates of unreported catch by legal gear as well as illegal catches in their estimates.

Descriptions of the national approaches used for evaluating unreported catches have been reported at various WGNAS meetings (e.g. ICES, 1996; 2000; 2002; 2010a). In addition, detailed reports describing national procedures for evaluating illegal and unreported catch, and efforts to minimise this, were submitted by parties to NASCO in 2007 in support of a special theme session on this issue. Full details are available at: *http://www.nasco.int/pdf/2007%20papers/CNL(07)26.pdf*

Input data commonly rely on rod catches and the practice of catch-and-release has become increasingly important in recent years to reduce levels of exploitation on stocks. As the practice is increasing, WGNAS have previously recommended (ICES, 2010a) that consideration should be given to incorporating mortality associated with this practice in river-specific, regional and national assessments.

The procedures currently used to incorporate catch-and-release and unreported catches into regional, national and international assessments are summarised at Annex 1 (from ICES, 2010a).

2.4 Biological and other data requirements

As noted previously, many of the 'conventional' data requirements (e.g. marine survey data and commercial cpue) used in the assessment of other commercially important fish species are inappropriate to salmon. A range of biological, catch and exploitation rates and other data pertinent to appropriate stock assessments are however, collected and made available to WGNAS to help inform assessments and to aid in responding to the various questions posed by NASCO.

Annex 2 of this Stock Annex provides an overview of current and possible future data requirements for Atlantic salmon assessment/ scientific advice. This was compiled at a recent meeting of WGNAS (ICES, 2013) in relation to monitoring requirements under the European Data Collection Framework (DCF) and following a more detailed review of the data requirements under DCF (ICES, 2012b). This table illustrates the type of information collected/available, but is provided for illustrative purposes only. It should be noted that many Atlantic salmon producing countries fall outside the DCF provisions, which only relate to countries within the European Union. Further, Sovereign states are responsible for the regulation of salmon fisheries within their areas of jurisdiction. Formal ICES catch advice is only required for the distant water salmon fisheries, which take salmon originating in rivers of another party.

3 Assessment methods

In managing Atlantic salmon fisheries, NASCO has adopted a fixed escapement strategy (Potter, 2001), in recognition of the importance of the spawning stock to subsequent recruitment. Therefore, in managing the distant water fisheries at Faroes and West Greenland, the spawning requirements of the rivers contributing to these fisheries must be defined. Management advice, expressed as allowable harvest (tonnes), is then predicated on a forecast of salmon abundance prior to the fishery such that the spawning requirements of the contributing stocks can be achieved. The provision of catch advice thus proceeds through a number of steps:

The definition of spawning objectives;

The development of a measure of abundance prior to the fishery; i.e. the prefishery abundance or PFA;

A measure of the spawning stock contributing to the PFA;

A model to forecast the PFA;

The development of a risk analysis framework for the catch advice.

These steps are described in detail in the following sections, subdivided as necessary for the different distant water fisheries and the various stock complexes which contribute to the two fisheries (Greenland and Faroes).

3.1 Definition of spawning objectives

3.1.1 Management objectives and reference points

Conservation limits (CLs) for North Atlantic salmon have been defined by ICES as the stock level that will achieve long-term average maximum sustainable yield (MSY). NASCO has adopted the following definition of CLs (NASCO, 1998): 'The CL is a limit reference point; having populations fall below these limits should be avoided with high probability.'

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 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 there is a high probabaility that 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.

It should be noted that this is equivalent to the ICES precautionary target reference points (S_{pa}). Therefore, stocks are regarded by ICES as being at full reproductive capacity only if they are above the precautionary target reference point. This approach parallels the use of precautionary reference points used for the provision of catch advice for other fish stocks in the ICES area.

For the assessment of the status of stocks and advice on management of national components and geographical groupings of the stock complexes, where there are no specific management objectives:

- ICES requires that the lower bound of the 90% confidence interval of the current estimate of spawners is above the CL for the stock to be considered at full reproductive capacity (equivalent to a probability of at least 95% of meeting the CL).
- When the lower bound of the confidence limit 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 be suffering reduced reproductive capacity.

Ideally, Atlantic salmon should be assessed and managed on the basis of river-specific stock units, the scale corresponding best to the spawner to recruitment dynamic (Chaput, 2012). In reality, this is not the case for the majority of rivers, although efforts are continuing to develop river-specific CLs and assessment protocols and developments are reported annually to WGNAS (e.g. ICES, 2013).

The risk assessment frameworks applied by WGNAS directly evaluate 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 and to be avoided with a high probability, then 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% (ICES, 2012c).

3.1.2 Reference points in the NEAC area

River-specific CLs have been derived for salmon stocks in some countries in the NEAC area (France, Ireland, UK (England & Wales) and Norway). An interim approach has been developed for estimating national CLs for countries that cannot provide one based upon river-specific estimates. This approach is based on the establishment of pseudo stock–recruitment relationships for national salmon stocks (Potter *et al*., 2004).

The NEAC-PFA run reconstruction model (see below) provides a means of relating estimates of the numbers of recruits to the numbers of spawners. The numbers of 1SW and MSW spawners are converted into numbers of eggs deposited using the proportion of female fish in each age class and the average number of eggs produced per female. The egg deposition in year 'n' is assumed to contribute to the recruitment in years "n+3" to "n+8" in proportion to the numbers of smolts produced of ages 1 to 6 years respectively. These proportions are then used to estimate the 'lagged egg deposition' contributing to the recruitment of maturing and non-maturing 1SW fish in the appropriate years. The plots of lagged eggs (stock) against the 1SW adults in the sea (recruits) are presented as 'pseudo stock–recruitment' relationships for each homewater country or region that is unable to provide river-specific CLs. In countries where with more than one region, the analysis is carried out for each region separately and the resulting estimates are summed to provide a national figure.

As noted previously, ICES currently define the CL for salmon as the stock size that will result in the maximum sustainable yield (MSY) in the long term. However, it is not straightforward to estimate this point on the stock–recruitment relationships established by the national PFA run-reconstruction models, as the replacement line (i.e. the line on which 'stock' equals 'recruits') is not known for these relationships. This is because the stock is expressed as eggs, while the recruits are expressed as adult salmon. To address this, WGNAS has developed a method for setting biological reference points from the national/ regional pseudo stock–recruitment datasets (ICES, 2001). This model assumes that there is a critical spawning stock level below which recruitment decreases linearly towards zero and above which recruitment remains constant. The position of this critical stock level is determined by searching for the stock value that provides the line of best fit for the stock and recruitment data provided by the PFA run-reconstruction model as determined by the residual sum of squares. This point is a proxy for S_{lim} and is therefore defined as the CL for the stock, and is indicated by the inflection point in the hockey-stick relationship (e.g. see example at Figure 3.1.2.1).

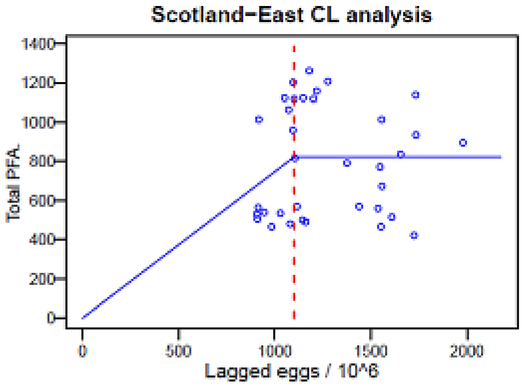

Figure 3.1.2.1. Pseudo stock–recruitment relationship for UK (Scotland) eastern region (from ICES, 2013).

Where river-specific estimates of CLs have been derived for all the rivers in a country or region, these are aggregated to provide national estimates. For countries where the development of river-specific CLs has not been completed, the method described above has been used (see example in Table 3.1.2.1, from ICES, 2013). The estimated national CLs are then summed to provide aggregate CLs for the northern and southern NEAC stock complexes (Table 3.1.2.1).

The CLs have also been used to estimate the spawning escapement reserves (SERs). These represent the CLs increased to take account of natural mortality between the recruitment date, 1st January, and the return to homewaters for maturing and non-maturing 1SW salmon from the northern NEAC and southern NEAC stock complexes (Table 3.1.2.1).

Table 3.1.2.1. Conservation limits (CLs) for NEAC countries and stock complexes estimated from river-specific values, where available, or the national PFA run- reconstruction model. Spawner escapement reserves (SERs) are also included for each stock complex.

	National Model CLs		River Specific CLs		Conservation limit used		SER	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
Northern Europe								
Finland	16,975	13,889			16,975	13,889	20,630	23,833
Iceland (north & east)	5,986	1,565			5,986	1,565	7,385	2,727
Norway			64,467	71,218	64,467	71,218	81,954	118,599
Russia	66,896	42,031			66,896	42,031	84,959	74,147
Sweden	1,257	1,117			1,257	1,117	1,623	1,916
			Stock Complex		**155,581**	**129,820**	**196,550**	**221,222**
	National Model CLs		River Specific CLs		Conservation limit used		SER	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
Southern Europe								
France			17,400	5,100	17,400	5,100	22,120	8,493
Iceland (south & west)	19,422	1,265			19,422	1,265	23,603	2,170
Ireland			211,471	46,943	211,471	46,943	268,832	78,174
UK (E&W)			54,677	30,163	54,677	30,163	69,272	50,802
UK (NI)	17,205	1,986			17,205	1,986	20,998	3,319
UK (Sco)	241,597	189,892			241,597	189,892	303,999	319,390
			Stock complex		**561,771**	**275,348**	**708,823**	**462,347**

WGNAS considers the current CL and SER levels may be less appropriate to evaluating the historical status of stocks (e.g. pre-1985), that in many cases have been estimated with less precision.

3.1.3 Reference points in the NAC area

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. The methods and values used to derive the egg and spawner conservation requirements for Atlantic Canada are documented in O'Connell *et al.* (1997). CLs have generally been derived using freshwater production dynamics translated to adult returns to estimate the spawning stock for maximum sustainable yield (MSY). Data were available for a limited number of stocks and these values were transported to the remaining rivers using information on habitat area and the age composition of the spawners. A similar procedure was used to determine the CLs for rivers in the USA (ICES, 1995). In Québec, adult-to-adult stock–recruitment relationships for six rivers were used to define the CLs for the other rivers (Caron *et al.*, 1999).

The NAC conservation requirements for 2SW salmon (only these are required in developing catch options for the West Greenland fishery) are summarised in Table 3.1.3.1 (from ICES, 2013). These are calculated from the adult age structure within the different regions and total 123 349 2SW salmon for Canada and 29 199 2SW salmon for the USA, for a combined total of 152 548.

Table 3.1.3.1. 2SW Conservation limits (CLs) for the six regions in the NAC area estimated from river-specific values.

Country and Comission Area	Stock Area	2SW spawner requirement
	Labrador	34 746
	Newfoundland	4022
	Gulf of St Lawrence	30 430
	Québec	29 446
	Scotia-Fundy	24 705
Canada Total		123 349
USA		29 199
North American Total		152 548

3.2 Estimating PFA

Estimates of PFA are derived by run-reconstruction methods. These work back in time from estimates of abundance in homewaters to earlier periods of the salmon's life cycle by adding in catches at appropriate times and adjusting for survival. The run-reconstruction approach was first presented at ICES in 1992 and was subsequently adopted for stocks on both sides of the Atlantic (Rago *et al.*, 1993a; Potter and Dunkley, 1993; Potter *et al.*, 1998; 2004). The main advantage of backwards-running, run-reconstruction models over alternative forward-running approaches is that more extensive data are available on adult returns (e.g. traps, counters and catch data) than on freshwater production of juveniles. In addition, rates of natural mortality (M) were thought to be lower and more stable for large salmon after their first winter in the sea than during the post-smolt phase (Potter *et al.*, 2003).

The models used to estimate PFA take the generalised form:

$$PFA = Nh * \exp(Mt_h) + \sum_i C_i \ * \ \exp(Mt_i)$$

Where: Nh is the number of adult fish returning to homewaters, C_i the catch of fish from the stock in each interception fishery i (operating before the fish return to homewaters), M the monthly instantaneous rate of natural mortality of salmon in the sea after the first sea-winter, t_i the time in months between the PFA date and the midpoint of fishery i, and t_h is the time in months between the PFA date and the midpoint of the return of fish to homewaters. Coastal catches are also added to the estimate where appropriate.

3.2.1 NEAC area run reconstruction model

The original model used to estimate the PFA of salmon from countries in the NEAC area was described by Potter *et al*. (2004); modifications have been described in subsequent WGNAS reports. PFA in the NEAC area is defined as the number of 1SW recruits on January 1st in the first sea winter. As there are relatively few fish of sea age three or more in most stocks, the model caters for two age groups, 1SW and MSW, the latter including all fish of sea age two or more that are treated as a single cohort. The model is therefore based on the annual catch in numbers of 1SW and MSW salmon in each country. These are raised to take account of minimum and maximum estimates of non-reported catches and exploitation rates of these two sea-age groups.

Thus, for each country (or region) c in year y, the total number of fish of sea age a caught in homewater fisheries ($Ch_{a,y,c}$) is calculated by dividing the declared catch ($Cd_{a,y,c}$) by the non-reporting rate ($1 - U_{a,y,c}$):

$$Ch_{a,y,c} = Cd_{a,y,c} / (1 - U_{a,y,c})$$

where: $U_{a,y,c}$ is the estimated proportion of the total catch that is unreported or discarded. The number of fish returning to homewaters ($Nh_{a,y,c}$) is estimated by dividing the total homewater catch by the exploitation rate ($H_{a,y,c}$):

$$Nh_{a,y,c} = Ch_{a,y,c} / H_{a,y,c}$$

As the model provides estimates of total returns and total catch (including non-catch fishing mortality), it is then also possible to estimate the spawner escapement ($Ns_{a,y,c}$):

$$Ns_{a,y,c} = Nh_{a,y,c} - Ch_{a,y,c}$$

Total catches in the Faroese ($Cf_{a,y}$) and West Greenland ($Cg_{a,y}$) fisheries are similarly calculated by correcting the declared catches for non-reporting, but they are not raised for the exploitation rate, because the uncaught fish are accounted for from the returns to homewaters. The West Greenland fishery only exploits salmon that would otherwise mature as MSW fish, although the majority are 1SW in the summer that they are caught; for the purpose of the model, all are classed as 1SW. The Faroese fishery exploits predominantly MSW salmon, but also a small number of 1SW fish, 78% of which have been estimated to be maturing (ICES, 1994). Over the past two decades, a substantial proportion of the fish caught in the Faroese fishery have been escapees from salmon farms, and these are discounted from the assessment of wild stocks on the basis of data from Hansen *et al*. (1999). The incidence of farm escapees in the West Greenland catch is thought to be <1.5% (Hansen *et al*., 1997), so this portion is ignored in the model. The total estimated catches of wild fish in both distant-water fisheries are assigned to the PFA for different countries on the basis of historic tagging studies (Potter, 1996).

The returns to homewaters and catches in the distant-water fisheries of 1SW and MSW salmon are then raised to take account of the marine mortality between January

1st in the first sea winter (the PFA date) and the mid-point of the period over which the respective national fisheries operate. WGNAS determined a natural mortality value of 0.03 per month to be the most appropriate (ICES, 2002) and a range 0.02 to 0.04 is applied within the model in a Monte Carlo simulation. Thus, the PFA of maturing 1SW fish (PFAm), survivors of which will return to homewaters as 1SW adults, is:

$$PFAm_{y,c} = Nh_{1,y,c} * \exp(Mt_{h,1,c}) + 0.78 * Cf_{1,y} * w_y * pf_{1,c} * \exp(Mt_{f,1,c})$$

and the PFA of non-maturing 1SW fish (PFAn), survivors of which will return to homewaters as MSW adults, is:

$$PFAn_{y,c} = Nh_{2,y+1,c} * \exp(Mt_{h,2,c}) + Cg_{1,y} * pg_{1,c} * \exp(Mt_{g,1,c})$$
$$+ 0.22 * Cf_{1,y} * w_y * pf_{1,c} * \exp(Mt_{f,1,c}) + Cf_{2,y+1} * w_{y+1} * pf_{2,c} * \exp(Mt_{f,2,c})$$

where indices y and c represent year and country/region, indices 1 and 2 the 1SW and MSW sea age groups, w is the proportion of the Faroese catch that is of wild origin, pf and pg are the proportion of the catches in the Faroese and West Greenland fisheries originating from each country (as indexed), and t_h, t_f and t_g are the times in months between the PFA date and the midpoints of the homewater fisheries, the Faroese fishery, and the West Greenland fishery, respectively, for the year classes and country/region as indexed.

Total 1SW recruitment for the NEAC area in year y is therefore the sum of the maturing 1SW and non-maturing 1SW recruitments for that year for all countries:

$$PFA_y = \sum_c PFAm_{y,c} + \sum_c PFAn_{y,c}$$

The non-reporting rates, exploitation rates, natural mortality, and migration times in the above equations cannot be estimated precisely, so national experts provide minimum and maximum values based upon best available knowledge that are considered likely to be centred on the true values (ICES, 2003). A Monte Carlo simulation (12 000 trials) is used to estimate confidence intervals on the stock estimates.

Where appropriate to the provision of management advice, the national outputs from the model are combined into stock complexes, such as those for southern and northern NEAC (ICES, 2002). The confidence limits for these combined estimates are derived from the sum of the national variances obtained from the MCS (the covariances are assumed to be small). This model has provided time-series of PFA estimates for NEAC salmon stocks from 1971 to the present.

The model was initially run using 'Crystal Ball' (CB) in Excel (Decisioneering, 1996). However, an updated version of the model which runs in the 'R' programming language (R Development Core Team, 2007) was developed in 2011 (ICES, 2011). This provided a more flexible platform for the further development of the model and to allow its integration with the Bayesian forecast model for the development of catch options (see below). In 2012, the outputs of the CB and 'R' models were compared to examine the approaches taken and to validate the outputs (ICES, 2012a). Since 2013, the run-reconstruction analysis has been completed by WGNAS using the 'R' programme (ICES, 2013). This has also enabled additional sources of uncertainty to be incorporated into the modelling approach (ICES, 2013).

The full set of data inputs, as used in the most recent assessment (ICES, 2013) is provided at Annex 3. The 'R' code used for running the model is available on the WGNAS SharePoint site.

3.2.2 NAC area run reconstruction model

The run–reconstruction model developed by Rago *et al*. (1993a) and described in previous WGNAS reports (ICES, 2008; 2009a) and in the primary literature (Chaput *et al*., 2005) is used to estimate returns and spawners by size (small salmon, large salmon) and sea age group (2SW salmon) to the six geographic regions of NAC from 1971 to the present. The model takes the form:

$$PFA_{year(i)} = [NR2_{year(i+1)} * e^{MX1} + NC2_{year(i+1)}] * e^{MX10} + NC1_{year(i)} + NG1_{year(i)}$$

where: $NR2_{year(i+1)}$ is the sum of 2SW returns to six regions of North America in year i + 1, $NC2_{year(i+1)}$ is the catch of 2SW salmon in Newfoundland and Labrador commercial fisheries in year i + 1, $NC1_{year(i)}$ is the catch of 1SW non-maturing salmon in Newfoundland and Labrador commercial fisheries in year i, $NG1_{year(i)}$ is the catch of 1SW non-maturing salmon of North American origin in the Greenland fishery in year i, and M is the monthly instantaneous natural mortality of 0.03.

The reconstruction begins with the estimation of returns of 2SW salmon in year i + 1 to six regions in eastern North America: Labrador, Newfoundland, Québec, Gulf, Scotia-Fundy, and USA. For the four southern regions, the regional returns include the harvest in the coastal commercial fisheries but this is not the case for Newfoundland and Labrador. For Labrador, the returns to rivers are estimated from the commercial harvest factored by an exploitation rate. The harvest of 2SW salmon in the Newfoundland and Labrador mixed-stock fisheries in year i + 1 is added to the sum of the returns to the six regions (prorated backward for one month of natural mortality - equates to 1 June of year i + 1) to produce the returns to North America. Finally, the harvests of North American origin salmon in the Greenland fisheries in year i and the harvest of non-maturing 1SW salmon in the Newfoundland and Labrador commercial fisheries in year i are added to the prorated returns to North America (ten months between abundance at Greenland on 1 August year i and North America on 1 June year i + 1) to produce the pre-fishery abundance of non-maturing 1SW salmon of North American origin. An instantaneous natural mortality rate of 0.03 per month is assumed for salmon in the second year at sea for all years (ICES, 2002). Adjustments to the input data resulting from reductions and subsequent closures of commercial fisheries in North America are summarized by Friedland *et al*. (2003).

Following earlier WGNAS recommendations (ICES, 2008), the run–reconstruction model since 2009 has been developed using Monte Carlo simulation (OpenBUGS; http://mathstat.helsinki.fi/openbugs/; Lunn *et al*., 2000). This is similar to the approach applied for the NEAC area.

The PFA of the non-maturing component of 1SW fish, destined to be 2SW returns (excluding 3SW and previous spawners) is the estimated number of salmon in the North Atlantic on August 1st of the second summer at sea. As this requires estimates of 2SW returns to rivers, there is always a lag in providing this figure (PFA estimates for year n require 2SW returns to rivers in North America in year n + 1).

The full set of data inputs, as used in the most recent assessment (ICES, 2013) is provided at Annex 4. The 'R' code used for running the model is available on the WGNAS SharePoint site.

3.2.3 Instantaneous natural mortality rate (M)

The natural mortality rate for salmon after they recruit to the distant water fisheries has been the subject of much discussion. WGNAS originally used a value of 0.01 per month, based upon Doubleday *et al*. (1979), but this was modified to 0.03 per month following a detailed review as part of the EU SALMODEL project (Crozier *et al.*, 2003; ICES, 2002) on the basis of inverse-weight and maturity-schedule models. The rate is assumed to have been constant over the time-series. While mortality may be expected to vary among years and may also be different for maturing and non-maturing 1SW recruits, WGNAS has not had data on which to base the use of different values, or values that change over time. However, this is now being further investigated within the EU ECOKNOWS project and Bayesian modelling may provide alternative approaches in future.

3.3 PFA forecast models

3.3.1 Introduction

The provision of quantitative catch advice for the distant water fisheries requires estimates of abundance before the fisheries take place. While there has been some use of in-season surveys in the management of these fisheries (NASCO, 2001), such methods are considered too impractical and costly to implement on a widespread scale (Potter *et al.*, 2004). Models have therefore been developed by WGNAS which relate abundance estimates obtained at other life stages to the PFA. The objective has been to account for this relationship in terms of biological or environmental factors that affect natural mortality, and to use this to forecast future stock levels.

An initial PFA forecast model for North American stocks (Rago *et al.*, 1993b) utilised indices of thermal habitat in relation to historically observed PFA (from the run-reconstruction model) to predict future PFA. Similar approaches were explored by Crozier *et al.* (2003) for NEAC stocks. However, while statistically significant temperature indices could be constructed, the relationships were not always consistent or intuitively correct. Alternative approaches were therefore explored for NEAC; these are described by Potter *et al.* (2004). More recently work by the ICES Study Group on Salmon Stock Assessment and Forecasting (SGSSAFE) has, however, resulted in the development of Bayesian forecast models for both NAC and NEAC (ICES, 2009a; 2011; Chaput, 2012).

In the latest models, PFA dynamics by complex are modelled using the estimates of adult spawners, adjusted to the number of eggs per fish based on life-history characteristics of the age groups within each region of the stock complexes (ICES, 2011; Chaput, 2012). The spawner to PFA dynamic is modelled as:

$$PFA_y = e^{\alpha_y} LE_y e^{\varepsilon}$$

where: α_y is the productivity parameter from eggs (×1000) to PFA (number of fish) for PFA year y (on a log-scale), LE_y the estimated lagged eggs (×1000) corresponding to the PFA cohort in year y, and the progress of α_y is modelled as $a_{y+1} = a_y + \varepsilon$, *with* $\varepsilon \sim N(0,\sigma^2)$.

Productivity is modelled as an integration of survival in freshwater and during the first year at sea. An important assumption is the absence of heritability of age at maturity, i.e. all eggs are considered equivalent regardless of the age of the spawners. Lagged eggs refer to the adjustment of the egg depositions to correspond to the expected age at smoltification. Spawners in year ‘n’ contribute to recruitment in years ‘n+3’ to ‘n+8’ depending upon the relative proportions of 1 to 6 year-old smolts that they produce. For example, spawners in year ‘n’ produce eggs that hatch in year ‘n+1’ and may produce one year-old smolts in year ‘n+2’, which would become 1SW recruits in year ‘n+3’. Any two year-old smolts from the same spawners would produce 1SW recruits in year ‘n+4’, etc..

At the stock complex level, lagged eggs are the sum of the eggs from the spawners in year y - (s + 2) weighted by the proportion of the smolts produced at age s in region k summed over regions in the complex. Two years are added to the smolt age, for the spawning year and smolt migration year, to lag the eggs to the corresponding year of PFA:

$$LE_y = \sum_k \sum_s Eggs_{y-(s+2),k} * \mathrm{prop}_{\mathrm{s,k}}$$

3.3.2 NEAC PFA Forecast model

A forecast model to estimate PFA for all four NEAC stock complexes has been developed in a Bayesian framework by the Study Group on Salmon Stock Assessment and Forecasting (SGSSAFE). The model was originally reported to WGNAS in 2009 (ICES, 2009a), but was subsequently refined and has been in use by WGNAS in its present form since 2011 (ICES, 2011). The models for the northern and southern NEAC stock complexes have exactly the same structure and are run independently. A Directed Acyclic Graph (DAG) for the models is provided in Figure 3.3.2.1. The model considers both the maturing *PFA* (denoted *PFAm*) and the non-maturing PFA (denoted *PFAnm*). The full code used for running the model is available on the WGNAS SharePoint site.

A disaggregated version of the Bayesian model has since been developed using the same structure to provide forecasts at a country level data, for all countries in both southern and northern NEAC model implementations (ICES, 2013). In these, countries are linked hierarchically only through the variance parameter on the productivity parameter “a”. There is no modelling linkage between the northern and southern complexes.

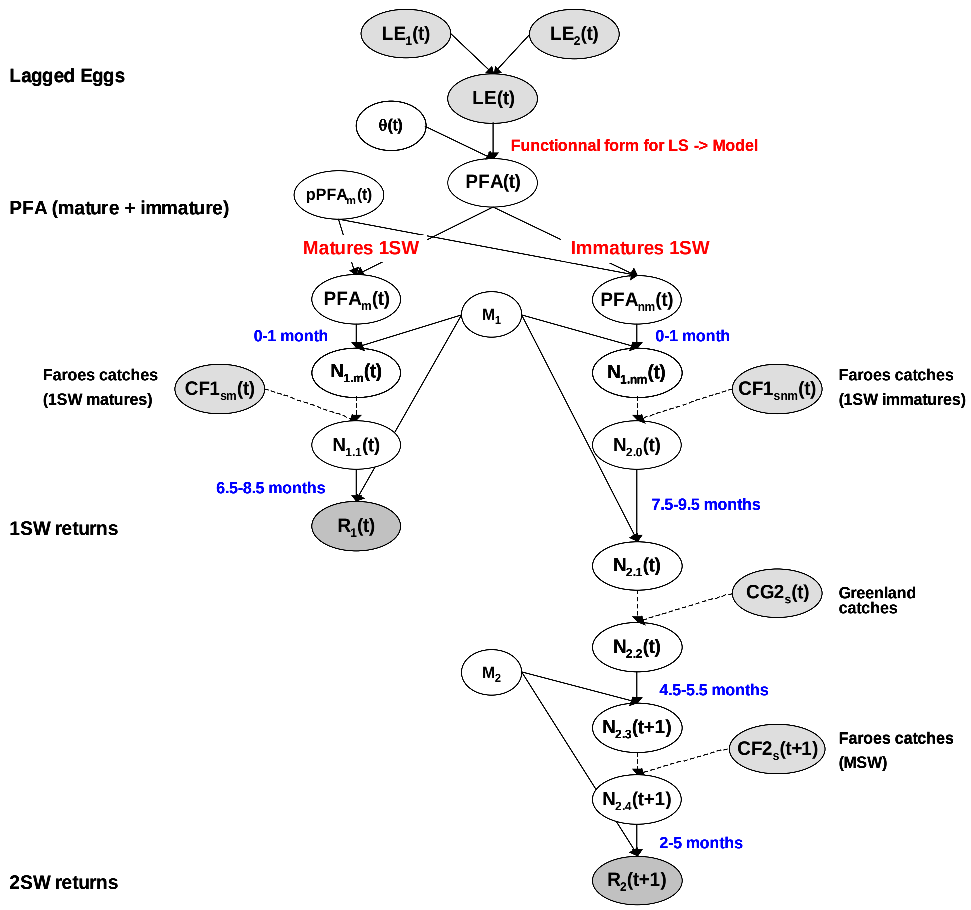

Figure 3.3.2.1. Directed Acyclical Graph (DAG) of the structure of the combined sea age model for the southern NEAC and northern NEAC forecast models. Ellipses in grey are observations (or pseudo-observations) derived from sampling programmes or from submodels (run-reconstruction).

The *PFA* is modelled using the summation of lagged eggs from 1SW and MSW fish (*LE*) for each year *t* and an exponential productivity parameter (*a*).

$PFAt = LEt^{*} \exp(at)$

The productivity parameter (*a)* is the proportionality coefficient between lagged eggs and PFA. This is forecasted one year at a time (a_{t+1}) in an auto correlated random walk, using the previous year's value (*a*) as the mean value in a normal distribution, with a common variance for the time-series of *a*.

$at{+}1 = at + \varepsilon; \quad \varepsilon \sim N(0, a.\sigma 2)$

The maturing *PFA* (denoted *PFAm*) and the non-maturing *PFA* (denoted *PFAnm*) recruitment streams are subsequently calculated from the proportion of *PFA* maturing (*p.PFAm*) for each year *t*. *p.PFAm* is forecast as an autocorrelated value from a normal distribution based on a logit scale, using the previous year's value as the mean and a common variance across the time-series of *p.PFAm*.

$logit.p.PFAmt{+}1 \sim N(logit.p.PFAmt\ , p.\sigma 2)$
$logit.p.PFAmt = logit\ (p.PFAmt)$

Uncertainties in the lagged eggs were accounted for by assuming that the lagged eggs of 1SW and MSW fish were normally distributed with means and standard deviations derived from the Monte-Carlo run-reconstruction at the scale of the stock complex. The uncertainties in the maturing and non-maturing PFA returns are derived in the Bayesian forecast models through the pseudo-observation method proposed by Michielsens *et al*. (2008), as used in the NAC model.

The natural mortality in the post-PFA time point was assumed constant among years, centred on an instantaneous rate value of 0.03 per month with a 95% confidence interval range of 0.02 to 0.04.

Catches of salmon at sea in the West Greenland fishery (as 1SW non-maturing salmon) and at Faroes (as 1SW maturing and MSW salmon) were introduced as covariates and incorporated directly within the inference and forecast structure of the model. For southern NEAC, the data are available for a time-series of lagged eggs and returns commencing in 1978. Although the return estimates to southern NEAC begin in 1971, the lagged eggs are only available from 1978 due to the smolt age distributions (one to five years). For northern NEAC, data are available for a shorter time-series. Return and spawner estimates begin in 1983 but due to the smolt age distributions (one to six years), the lagged eggs are only available from 1991 onward. The models are fitted and forecasts derived in a consistent Bayesian framework.

The model provides forecasts for maturing and non-maturing stocks for both southern and northern NEAC complexes (and countries) for five years. Risks are defined each year as the posterior probability that the PFA would be greater than or equal to the age and stock complex/ country specific Spawner Escapement Reserves (SERs), under the scenario of no exploitation.

The country disaggregated version of the Bayesian NEAC inference and forecast model incorporates country specific catch proportions at Faroes, lagged eggs and returns of maturing and non-maturing components. Model structure and operation is as described above, incorporating country and year indexing. Linkage between countries in the model is through the common variance parameter associated with the productivity parameter (*a*) (the proportionality coefficient between lagged eggs and PFA), which is forecast forward and used along with the forecast proportion maturing to estimate the future maturing and non-maturing PFAs. The evolution of *a* is independent between countries with the exception of its associated variance. Evolution of the proportion maturing (*p.PFAm*) is also independent for each country, as is its variance.

3.3.3 NAC PFA Forecast model

WGNAS (ICES, 2009a) developed forecasts of the pre-fishery abundance for the non-maturing 1SW salmon (PFA) using a Bayesian framework that incorporates the estimates of lagged spawners and works through the fisheries at sea to determine the corresponding returns of 2SW salmon, conditioned by fisheries removals and natural mortality at sea. This model considers regionally-disaggregated lagged spawners and returns of 2SW salmon for the six regions of North America. The model is summarised in the Directed Acyclical Graph in Figure 3.3.1.1. The year is identified by the i index. The full code used for running the model is available on the WGNAS SharePoint site.

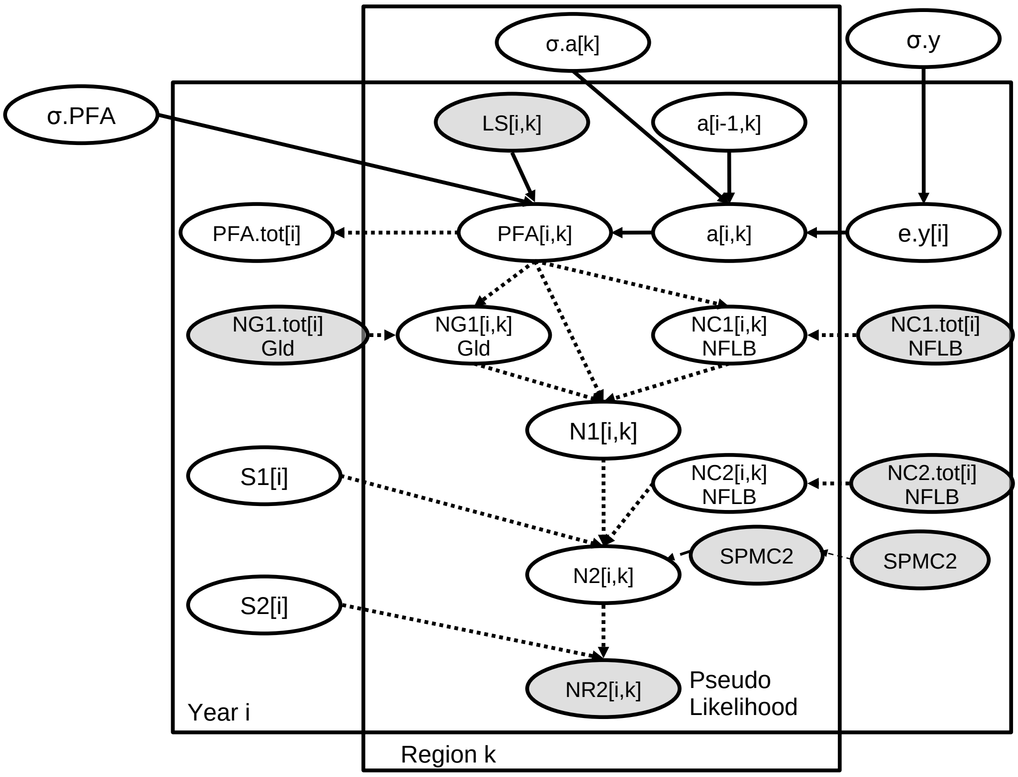

Figure 3.3.1.1. Directed Acyclical Graph (DAG) of the structure of the region disaggregated forecast model for 2SW salmon of North American origin. Ellipses in grey are observations (or pseudo-observations) derived from sampling programmes or from submodels (run-reconstruction).

Annually varying and regionally specific Pre-Fishery Abundance estimates ($PFA_{i,k}$; in year i and region k) are assumed to be proportional to lagged-spawners ($LS_{i,k}$), with independent and identically distributed (i.i.d.) lognormal errors. These are modelled separately for each region (k = 6; Labrador, Newfoundland, Québec, Gulf, Scotia-Fundy, USA). The proportionality (log) coefficient $\alpha_{i,k}$ between $LS_{i,k}$ and $PFA_{i,k}$, referred to as the productivity for each region, is modelled dynamically as a random walk.

$$PFA_{k,i} \sim Lognormal(\mu.PFA_{k,i}, \sigma^{PFA})$$
$$\mu.PFA_{k,i} = \alpha_{k,i} + \log(LS_{k,i})$$

A regionally common but annually varying parameter γ_i is included. The common yearly variation (γ_i) accounts for the fact that the fish share a common marine environment during part of their life cycle. The interaction term ($\alpha_{k,i}$) can be interpreted as accounting for regional specificities in the freshwater and/or the marine coastal environment.

$$\alpha_{k,i} \sim Normal(u.\alpha_{k,i}, \sigma_k^{\alpha})$$
$$\mu.\alpha_{k,i} = \alpha_{k,i-1} + \gamma_i$$
$$\gamma_i \overset{iid}{\sim} Normal(0, \sigma^{\gamma})$$

The dynamic component of the model requires initialization for the first year (i = 1978) and an uninformative prior is assumed:

$$a_{1,k} \overset{i.i.d}{\sim} N(0,100)$$

$LS_{i,k}$ is a weighted sum of spawners over the years (i) having contributed to produce the $PFA_{i,k}$. The $LS_{i,k}$ are not directly observed but estimated from the run-reconstruction model developed by WGNAS. The model provides probability distributions of LS, conditional on observed data and expertise. The probability distributions are assumed to be normal with known mean LS.m and variance tau.LS. The use of these distributions as likelihood functions is equivalent to having pseudo-observations equal to LS.m issuing from sampling distributions with means and variances equal to LS and tau.LS (Michielsens *et al.*, 2008).

$LS.m_{i,k} \sim N(LS_{i,k}, tau.LS_{i,k})$

Similarly, the returns of 2SW salmon to the six regions ($NR2_{i,k}$) are not directly observed but estimated from the run-reconstruction model. The probability distributions were assumed to be normal with known mean NR2.m and variance tau.NR2. As with the LS variable, the NR2 were treated as pseudo-observations equal to NR2.m issuing from normal sampling distributions with means and variances equal to NR2 and tau.NR2.

$NR2.m_{i,k} \sim N(NR2_{i,k}, tau.NR2_{i,k})$

In between the lagged spawners and returns as 2SW salmon, the catches in the various sea fisheries and conditioning for natural mortality as the fish move from the time of the PFA to homewaters are incorporated (Figure 3.3.1.1). The catches in the commercial fisheries of West Greenland and the Newfoundland and Labrador commercial and coastal fisheries (NG1.tot, NC1.tot and NC2.tot) are not directly observed but estimated with error. The catches are converted to numbers of fish of 1SW non-maturing and 2SW fish based on characteristics of the fish in the catch. Their (prior) probability distributions are obtained from catch statistics according to a formal structure included in the model.

Catches of large salmon (assumed to be 2SW salmon) from the St Pierre & Miquelon fisheries (SPMC) are also included in the model as point estimates.

The natural mortality in the post-PFA time point was assumed constant between years, centred on an instantaneous rate value of 0.03 per month (95% confidence interval range of 0.02 to 0.04).

For the NAC 2SW component, the model is fitted to an historical dataseries of lagged eggs starting from 1978. Although the return and spawner estimates for NAC begin in 1971, the lagged eggs are only available from 1978 due to the smolt age distributions (one to six years).

The models are fitted and forecasts derived in a consistent Bayesian framework under the OpenBUGS 3.0.3 software (http://mathstat.helsinki.fi/openbugs/; Lunn *et al.*, 2000).

3.3.4 Summary of NAC and NEAC forecast models

The data inputs and models currently used by WGNAS for forecasting and provision of catch advice differ between the Commission areas; outline details are summarised in the text table below.

FORECAST MODELS		
	NAC	NEAC
Data inputs		
Time period of data	1978 on	1978 on for southern NEAC 1991 on for northern NEAC
Spatial aggregation	Separately for six regions of North America	By southern and northern stock complexes & NEAC countries
Age components	2SW salmon component only	1SW and MSW age components
Spawners	Lagged spawners by region for 2SW salmon only	Lagged eggs by sea age component for the southern and northern complexes/ country
Returns	Returns by region of 2SW salmon only	Returns of 1SW and MSW age components by stock complex / country
Model structure		
Spatial aggregation	Spawners and returns of 2SW salmon for six regions	Spawners and returns for two sea age components for the southern and northern NEAC complexes / countries
Dynamic function	Random walk dynamic	Random walk dynamic
	Region-specific recruitment rates linked with an annual recruitment rate variable	Sea age specific recruitment rates linked with a probability of maturing variable
Latent variables of interest	PFA 1SW non-maturing Recruitment rate by region and year	PFA 1SW maturing and PFA 1SW non-maturing by stock complex/ country Recruitment rate by sea age component and the probability of maturing variable
Forecast years	four years	5 years – i.e. the present year -1, the present year, and the next 3 years (y-1 is a forecast, as the MSW stock component is yet to return).

3.4 The development of a risk analysis framework for catch advice

3.4.1 Introduction

The provision of catch advice in a risk framework involves incorporating the uncertainty in all the factors used to develop the catch options (ICES, 2002). The ranges in the uncertainties of all the factors will result in assessments of differing levels of precision. The analysis of risk involves four steps:

1) identifying the sources of uncertainty;

2) describing the precision or imprecision of the assessment;

3) defining a management strategy; and

4) evaluating the probability of an event (either desirable or undesirable) resulting from the fishery action.

The uncertainties have been identified and quantified in the assessment of PFA for salmon stocks in both the NAC and NEAC areas. NASCO's strategy for the management of salmon fisheries is based upon the principle of ensuring that stocks are above CLs (defined in terms of spawner escapement or egg deposition) with a high probability. The undesirable event to be avoided is that the spawning escapement after the fisheries will be below the CLs.

3.4.2 Catch advice and risk analysis framework for the West Greenland fishery

A risk framework for the provision of catch advice for the West Greenland fishery was been applied since 2003 (ICES, 2003) and has been subject to a number of subsequent updates. The current procedure is outlined below. This involves estimating the uncertainty in meeting defined management objectives at different levels of catch (catch options). The risk framework has been formally accepted by NASCO.

Two stock complexes are of relevance to the management of the West Greenland fishery; non-maturing 1SW fish from North America and non-maturing 1SW fish from southern NEAC. The risk assessments for the two stock complexes are developed in parallel and then combined at the end of the process into a single summary plot or catch options table. The risk analysis proceeds as illustrated in the flowchart in Figure 3.4.2.1).

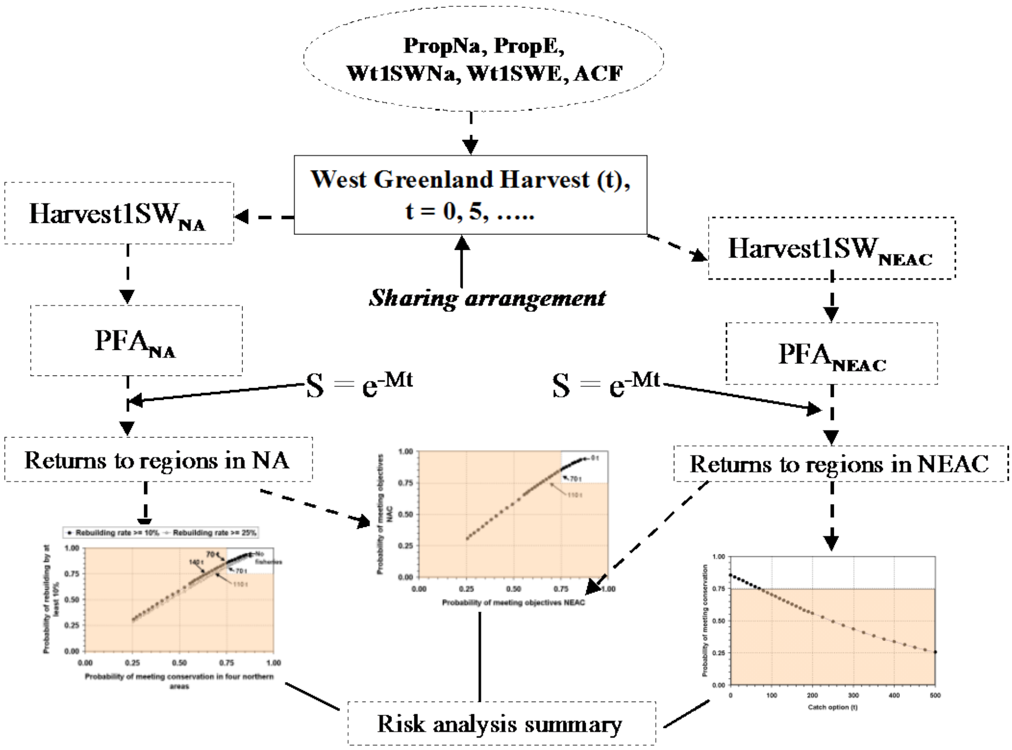

Figure 3.4.2.1. Flowchart, risk analysis for catch options at West Greenland using the PFANA and the PFANEAC predictions for the year of the fishery. Inputs with solid borders are considered known without error. Estimated inputs with observation error that is incorporated in the analysis have dashed borders. Solid arrows are functions that introduce or transfer without error whereas dashed arrows transfer errors through the components.

The primary inputs to the risk analysis for the complex at West Greenland are:

- PFA forecast for the year of the fishery; PFA_{NA} and PFA_{NEAC};
- Harvest level being considered (t of salmon);
- Conservation spawning limits or alternate management objectives; and
- The post-fishery returns to each region.

The risk analysis of catch options incorporates the following input parameter uncertainties: (i) the uncertainty of the pre-fishery abundance forecast, (ii) the uncertainty in the biological parameters used to translate catches (weight) into numbers of salmon, and (iii) the uncertainty in attaining the conservation requirements simultaneously in different regions.

The uncertainty in the PFA_{NA} and PFA_{NEAC} is accounted for in the forecast approach described above. The number of 1SW non-maturing fish of North American and European origin in a given catch (t) is conditioned by the continent of origin of the fish ($prop_{NA}$, $prop_{E}$), by the average weight of the fish in the fishery ($Wt_{Allages}$), and by the proportion 1SW non-maturing fish in the respective continent of origin catches. These parameters define how many fish originating in North America and Europe are expected in the fishery harvests. For a level of fishery under consideration, the weight of the catch is converted to number of fish of each continent's origin using the following equation:

$$C1SW_c = \frac{t \; X \; propC}{ACF * \;(propNA \; X \; Wt1SW_{NA} + propE \; X \; Wt1SW_E)}$$

where: $C1SW_C$ is the catch (number of fish) of 1SW salmon originating in continent C (either North America or Europe), t is the fishery harvest at West Greenland in kg, *propC* is the proportion of the 1SW salmon harvest which originates from continent C, $Wt1SW_{NA}$ and $Wt1SW_E$ are the average weight (kg) in the fishery of a 1SW salmon of North American and European origin, respectively, and *ACF* is the age correction factor by weight for salmon in the fishery which are not at age 1SW.

Since these parameters are not known for the forecast years of interest, they are estimated from previous values. Thus, $prop_{NA}$ (and $prop_{NEAC}$ as 1 – $prop_{NA}$) are drawn randomly from observed values of the past five years taking account of uncertainty due to sample sizes. For the other parameters, it is assumed that the parameters for $Wt_{Allages}$ and the proportion non-maturing 1SW in the catch by continent of origin could vary uniformly within the values observed in the past five years.

For a level of fishery under consideration, the weight of the catch is converted to fish of each continent's origin and subtracted from one of the simulated forecast values of PFA_{NA} and PFA_{NEAC}. The fish that escape the Greenland fishery are immediately discounted by the fixed sharing fraction (F_{na}) historically used in the negotiations of the West Greenland fishery. The sharing fraction chosen is the 40%: 60% West Greenland: North America split. The same sharing arrangement has been used for NEAC stocks (ICES 2003). [Any sharing fraction could be considered and incorporated at this stage of the risk assessment].

After the fishery, fish returning to homewaters are discounted for natural mortality from the time they leave West Greenland to the time they return to rivers. For North America this is a total of eleven months at a rate of M = 0.03 (equates to 28.1% mortality). For Southern NEAC stocks this is a total of eight months at a rate of M = 0.03 (equates to 21% mortality). The fish that survive to North American homewaters are then distributed among the regions based on the regional proportions of lagged spawners for the last five years when estimates of spawners were available. The uncertainty in the regional proportions is characterised by drawing at random from a uniform distribution defined by the minimum and maximum regional ranges from the five years and calculating the average proportion for each of the six regions in North America.

The final step in the risk analysis of the catch options involves combining the conservation requirement or alternate management objectives with the probability distribution of the returns to North America for different catch options. Estimated 2SW returns to each region are compared to the conservation objectives of Labrador, Newfoundland, Québec, and Gulf. Estimated returns for Scotia-Fundy and USA are compared to the objective of achieving an increase of 25% relative to average returns of the base period, 1992–1996. The advice to fisheries managers is presented as a probability plot (or table) of meeting or exceeding the objectives relative to increasing harvest levels at West Greenland.

ICES has adopted, a risk level of 75% of simultaneous attainment of management objectives (ICES, 2003) as part of an agreed management plan for the West Greenland fishery. The same level of risk aversion is applied for catch advice for homewater fisheries on the North American stock complex.

The catch advice for the West Greenland fishery is currently tabulated to show the probability of each management unit achieving its CL (or alternative reference level) individually and the probability of this being achieved by all management units simultaneously (i.e. in the same given year) (e.g. ICES, 2012a). This allows managers to evaluate both individual and simultaneous attainment levels in making their management decisions. Table 3.4.2.1 provides an example of catch options for West Greenland for the years 2012 to 2014 (ICES, 2012a).

The models currently used by WGNAS in developing catch advice are considered to provide consistent characterisation of the status and expectations for Atlantic salmon in the North Atlantic. Compared to previous models used by WGNAS prior to 2009, the Bayesian models provide more flexibility, are consistent with the emerging emphasis on such approaches in natural resource assessment, and can provide management advice consistent with the probability of achieving management objectives.

Table 3.4.2.1. Catch options tables for mixed-stock fishery at West Greenland by year of PFA, 2012 to 2014.

2012 Catch option (t)	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	0.98	0.06
10	0.42	0.84	0.67	0.48	0.14	0.88	0.98	0.05
20	0.40	0.83	0.63	0.45	0.13	0.87	0.98	0.05
30	0.38	0.81	0.59	0.42	0.12	0.85	0.98	0.04
40	0.36	0.78	0.54	0.40	0.12	0.83	0.98	0.04
50	0.34	0.76	0.50	0.38	0.11	0.81	0.98	0.03
60	0.32	0.73	0.46	0.36	0.10	0.79	0.98	0.03
70	0.30	0.70	0.42	0.33	0.09	0.77	0.98	0.03
80	0.28	0.67	0.39	0.31	0.08	0.74	0.98	0.03
90	0.26	0.64	0.35	0.29	0.08	0.72	0.97	0.02
100	0.24	0.60	0.32	0.27	0.07	0.68	0.97	0.02
2013 Catch Option (t)	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	0.95	0.08
10	0.46	0.76	0.70	0.48	0.24	0.73	0.95	0.07
20	0.44	0.75	0.67	0.46	0.23	0.72	0.95	0.06
30	0.42	0.73	0.63	0.44	0.22	0.70	0.95	0.06
40	0.41	0.70	0.60	0.42	0.21	0.68	0.95	0.06
50	0.39	0.68	0.56	0.40	0.20	0.66	0.94	0.05
60	0.37	0.65	0.53	0.38	0.19	0.64	0.94	0.05
70	0.35	0.63	0.50	0.36	0.18	0.62	0.94	0.05
80	0.33	0.60	0.47	0.34	0.17	0.59	0.94	0.04
90	0.31	0.57	0.44	0.32	0.16	0.57	0.94	0.04
100	0.30	0.54	0.41	0.31	0.15	0.55	0.94	0.04
2014 Catch Option (t)	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	0.94	0.08
10	0.55	0.77	0.73	0.53	0.20	0.85	0.94	0.08
20	0.53	0.75	0.70	0.51	0.19	0.84	0.94	0.07
30	0.52	0.73	0.67	0.49	0.18	0.83	0.94	0.07
40	0.50	0.71	0.64	0.47	0.17	0.82	0.94	0.06
50	0.48	0.69	0.62	0.46	0.17	0.81	0.94	0.06
60	0.46	0.67	0.59	0.44	0.16	0.79	0.94	0.06
70	0.45	0.65	0.56	0.42	0.16	0.77	0.94	0.05
80	0.43	0.63	0.54	0.41	0.15	0.76	0.94	0.05
90	0.42	0.61	0.51	0.39	0.14	0.74	0.94	0.05
100	0.40	0.59	0.49	0.38	0.14	0.72	0.94	0.05

3.4.3 Catch advice and risk analysis framework for the Faroes fishery

3.4.3.1 Outline of the risk framework and management decisions required

There is currently no agreed framework for the provision of catch advice for the Faroes fishery adopted by NASCO. However, NASCO has asked ICES, for a number of years, to provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits for salmon in the NEAC area. An initial risk framework that could be used to provide and evaluate catch options for the Faroes fishery was outlined by WGNAS in 2010 (ICES, 2010a). This was based on the method currently used to provide catch advice for the West Greenland fishery, which involves estimating the uncertainty in meeting defined management objectives at different catch levels (TAC options). The Faroes risk framework was developed further at subsequent WGNAS meetings (ICES, 2011; 2012a) and the current proposed procedure is outlined below.

A number of decisions are required by managers before full catch advice could be provided (ICES, 2011; 2012a). Specifically, ICES has indicated that NASCO would need to agree upon the following issues before the risk framework could be finalised:

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

In developing an indicative risk framework, WGNAS has made pragmatic choices regarding these issues:

Faroes fishing season: A decision is required on the period to which any TAC for the Faroes fishery would apply. The Faroes fishery has historically operated between October/November and May/June, but the historical TACs applied to a calendar year. This means that two different cohorts of salmon of each age class (e.g. two cohorts of 1SW salmon, etc.) were exploited under each TAC. ICES (2011) recommended that NASCO manage any fishery on the basis of fishing seasons operating from October to June, and catch advice should be provided on this basis.

Sharing agreement: The ‘sharing agreement’ establishes the proportion of any harvestable surplus within the NEAC area that could be made available to the Faroes fishery through the TAC. In effect, for any TAC option being evaluated for the Faroes, it is assumed that the total harvest would be the TAC divided by the Faroes share. WGNAS has proposed using a share allocation derived using the same approach and baseline period (1986–1990) as for West Greenland (ICES, 2010a). This gave a potential share allocation of 7.5% to Faroes. Following discussion within NASCO, one Party proposed an alternative baseline period of 1984–1988, which would give a share allocation of 8.4% to Faroes. In the absence of further advice from NASCO, WGNAS has applied a value of 8.4%.

Choice of management units: ICES (2010a) noted that the stock complexes currently used for the provision of NEAC catch advice (southern NEAC and northern NEAC) are significantly larger than each of the six management units used for North American salmon (2SW only) in the catch advice for the West Greenland fishery. Basing an assessment of stock status on these large units greatly increases the risks to individual

NEAC river stocks or groups of stocks that are already in a more depleted state than the average.

For the provision of catch advice on the West Greenland fishery, the total CL for NAC (2SW salmon only) of about 152 000 fish is assessed in six management units, which means that each unit has an average CL of about 25 000 salmon. In contrast, the total CLs for each of the NEAC stock complexes are:

Northern NEAC 1SW–	158 223
Northern NEAC MSW–	131 356
Southern NEAC 1SW–	565 183
Southern NEAC MSW–	275 549

The NEAC stock complexes are therefore between eight and 25 times the size of the average NAC ones. There is also wide variation in the size and status of stocks both within and among the NEAC national stock groups. WGNAS recommended (ICES, 2012a) that the NEAC catch advice should be based on more management units than are used at present, but also noted that there are practical limitations on the extent to which the assessments can be disaggregated, since the availability of information on the composition of the catch at Faroes constrained the selection of management units. In 2013, WGNAS (ICES, 2013) proposed a method to estimate the stock composition of the Faroes catch at a national level based on tag returns and the PFA estimates, but did not consider it appropriate to extend this to stock complexes smaller than this. Genetic stock assignment studies are underway to analyse scale samples collected at Faroes, but these are not expected to facilitate disaggregation below this level. In addition, other parameter values used in the assessment are currently only available for the total fishery and not smaller stock complexes.

In providing indicative catch advice with the new framework, WGNAS considered that it would be informative to managers to provide catch options tables for the ten NEAC countries as well as for the four stock complexes and has therefore run the risk framework using management units based on countries.

Management objectives: The management objectives provide the basis for determining the risks to stocks in each management unit associated with different catch options. The NASCO agreement on the adoption of a Precautionary Approach (NASCO, 1998) calls for the 'formulation of pre-agreed management actions in the form of procedures to be applied over a range of stock conditions', indicating that the management objectives (e.g. the required probability of exceeding the CL) should be agreed in advance of specific management proposals being considered.

At the request of NASCO, WGNAS considered the implications of applying probabilities of achieving CLs to separate management units vs. the use of simultaneous probabilities; this issue was outlined in detail in ICES (2013).

The probability of simultaneous attainment of management objectives in a number of separate management units is roughly equal to the product of the probabilities of individual attainment for each management unit. The probability threshold for each individual management unit might reasonably be set at a fixed level unless there are specific reasons for adopting an alternative (e.g. for stock rebuilding). ICES (2012) recommended that an appropriate probability level for individual stock complexes would be 95%. This individual probability level can be applied to each management unit regardless of the number of units used; however, this is less obvious for the probability of simultaneous attainment, as explained next.

Management decisions for the West Greenland fishery have been based on a 75% probability of simultaneous attainment of CLs. For a given probability of achieving individual stock CLs, the probability of simultaneous attainment decreases rapidly as the number of management units considered increases. For the example of 20 management units (e.g. two age groups from each of ten countries), the use of the simultaneous probability level applied for West Greenland (75%) would correspond to the probability of individual stocks meeting the CLs being 98.6% or higher, assuming the same individual probability for all stocks. The use of a 95% probability level for meeting the CLs individually in the 20 management unit example, implies a simultaneous attainment probability of about 36%, i.e. there would be a 64% chance that at least one stock failed to meet its CL in any given year. On the other hand, the use of a 75% probability of simultaneous attainment could result in a fishery being advised when the individual probability of one management unit is as low as 75% if all the other management units have a 100% chance of meeting the CL (as in that case, the probability of simultaneous attainment would still be 75%). This may not be an acceptable risk for managing multiple river stocks.

WGNAS considered that the probability of simultaneous attainment can provide useful information to managers of the risk of failing to meet CLs in at least one stock in the MSF. However, as the management units being considered by NASCO for managing the MSF at Faroes are still very large and each unit encompasses a large number of individual river stocks, choosing a high probability level (such as 95%) of attaining CLs in individual units would be less risky to individual stocks than the use of a simultaneous attainment objective set at the value used for the West Greenland fishery.

On the basis of these considerations, WGNAS provided both individual probabilities and the probability of simultaneous attainment of the management units in the catch options tables (ICES 2013). ICES recommends that management decisions should be based principally on a 95% probability of attainment of CLs in each stock complex individually. The simultaneous attainment probability may also be used as a guide, but managers should be aware that this will generally be quite low when large numbers of management units are used (as illustrated above, in the example with 20 management units).

3.4.3.2 Modelling approach for the catch options risk framework

The basic model for assessing each catch option within the risk framework is the same for both stock complexes and at a country level (ICES, 2013). The PFA forecasts derived in the Winbugs model are transferred to the risk framework model run in 'R'. The estimates and distributions of the PFA estimates used in the risk framework are derived by taking the first 50 000 values from the Winbugs posterior forecast simulations. Parameters in the following description that are marked with an '*' in the equations have uncertainty around them generated by means of 50 000 random draws from the annual values observed from the sampling programmes conducted in the Faroes between the 1983/1984 and 1990/1991 fishing seasons. They therefore contribute to the estimation of the probability density function around the potential total harvest arising from each TAC option. When the assessment is run at a national level, the number of draws has to be limited to 25 000 because of memory limitations in 'R'.

The modelling procedure involves:

- estimating the total number of 1SW and MSW salmon that could be killed as a result of any TAC at Faroes, including catches in homewaters;

- adjusting these to their equivalent numbers at the time of recruitment to the Faroes fishery;
- subtracting these from the PFA estimates for maturing and non-maturing 1SW salmon in the appropriate years;
- assessing the results against the SERs (i.e. the CLs adjusted to the time of recruitment to the Faroes fishery).

The TAC option (T) is first divided by the mean weight (Wt*) of salmon caught in the Faroes fishery to give the number of fish that would be caught, and this value is converted to numbers of wild fish (Nw) by multiplying by one minus the proportion of fish farm escapees in samples taken from the Faroes catch (pE*) observed in historical sampling programmes. A correction factor (C = 0.63) is applied to the proportion of fish farm escapees to take account of reductions in the numbers of farm escapees over the past 20 years based on observations in Norwegian coastal waters:

$$Nw = T / Wt^* \times (1 - (pE^* \times C))$$

This value is split into numbers by sea age classes (1SW and MSW) according to the proportion of each age group (pAi*, where 'i' is 1SW or MSW) observed in historical catch sampling programmes at Faroes. In the past, there has also been a requirement to discard any fish less than 60 cm total length caught in the Faroes fishery, and 80% of these fish were estimated to die, so these mortalities are also added to the 1SW catch. Thus:

$$Nw1SW = Nwtotal \times pA1SW^* + (Nwtotal \times pD^* / (1 - pD^*) \times 0.8)$$

and

$$NwMSW = Nwtotal \times pAMSW^*$$

where pD* is the proportion of the total catch that is discarded (i.e. fish <60 cm total length).

Further corrections are made to the 1SW and MSW numbers to reduce the 1SW total to take account of the proportion that will not mature as 1SW fish and to add the survivors from this group to the MSW fish in the following year. For the first catch advice year the number added to the MSW total is adjusted to the TAC of the current season (i.e. zero in 2012/2013). Thus:

$$Nw1SW = Nw1SW \times pK^*$$

and

$$NwMSW = NwMSW + Nw1SW \times (1 - pK^*)$$

where '*pK*' is the proportion of 1SW salmon that are expected to mature in the same year (0.78) derived from experimental studies conducted in the 1980s (Youngson and Webb, 1993).

The numbers in each age group are then divided among the management units by multiplying by the appropriate proportions (pUij), where 'i' denotes the age groups and 'j' denotes the management units, and each of these values is raised by the Faroes share allocation (S) to give the total potential harvest (Hij) of fish from each management unit and sea age group:

$$Nwij = (Nwi \times pUij) / S$$

Finally, these values are adjusted for natural mortality so that they can be compared with the PFA forecasts and SER values from the mid-date of the fishery to the recruitment date by using an instantaneous monthly rate of mortality of 0.03.

These harvests are then subtracted from the stock forecasts (PFAij) for the management units and sea age groups and compared with the Spawner Escapement Reserves (SERij) to evaluate attainment of the management objective. In practice, the attainment of the management objective is assessed by determining the probability that PFAij – Hij – SERij is greater than zero. The SER is the number of fish that need to be alive at the time of the Faroes fishery to meet the CL when the fish return to homewaters; this equals the CL raised by the mortality over the intervening time. CLs and SERs are currently estimated without uncertainty.

3.4.3.3 Input data for the risk framework

The analysis estimates probability of each management unit achieving its SER (the overall abundance objective) for different catch options in the Faroes fishery (from 0 to 200 t). The analysis assumes:

- no fishery operated in the 2012/2013 season;
- the TAC allocated to Faroes is the same in each year and is taken in full;
- homewater fisheries also take their catch allocation in full.

The analysis requires the following input data for the catch that would occur at the Faroes if a TAC was allocated (full details are provided in ICES 2013):

- mean weights;
- proportion by sea age;
- discard rates (fish less than 60 cm total length);
- proportion of fish farm escapees;
- composition of catches by management unit;
- proportion of 1SW fish not maturing.

3.4.3.4 Indicative catch advice

Table 3.4.3.4.1 provides an example of catch options for the Faroes fishery for the seasons 2013/2014 to 2015/2016 (ICES 2013). Equivalent tables were provided for both 1SW and MSW salmon for all NEAC countries, and WGNAS also estimates the exploitation rates that these TAC options would impose on each stock complex or national stock (ICES, 2013).

Table 3.4.3.4.1. Probability of northern and southern NEAC - 1SW and MSW stock complexes achieving their SERs independently and simultaneously for different catch options for the Faroes fishery in the 2013/2014 to 2015/2016 fishing seasons.

Catch options for 2013/14 season:	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW	All complexes
	0	96.2%	99.8%	74.3%	75.6%	56.8%
	20	96.2%	99.2%	74.2%	69.8%	52.7%
	40	96.2%	98.2%	74.2%	63.9%	48.2%
	60	96.1%	96.3%	74.1%	57.9%	43.3%
	80	96.1%	93.4%	74.1%	52.1%	38.1%
	100	96.1%	89.3%	74.0%	46.6%	32.9%
	120	96.0%	84.3%	74.0%	41.7%	28.1%
	140	96.0%	78.4%	73.9%	36.8%	23.4%
	160	95.9%	71.6%	73.9%	32.5%	19.2%
	180	95.9%	64.6%	73.8%	28.5%	15.4%
	200	95.8%	57.6%	73.8%	25.0%	12.2%
Catch options for 2014/15 season:	**TAC option (t)**	**NEAC-N-1SW**	**NEAC-N-MSW**	**NEAC-S-1SW**	**NEAC-S-MSW**	**All complexes**
	0	94.6%	99.2%	75.4%	79.6%	59.0%
	20	94.6%	98.2%	75.3%	75.3%	55.8%
	40	94.6%	96.6%	75.3%	70.8%	52.0%
	60	94.5%	94.2%	75.2%	66.4%	48.0%
	80	94.4%	90.9%	75.2%	61.8%	43.6%
	100	94.4%	86.8%	75.1%	57.3%	38.9%
	120	94.3%	82.1%	75.1%	53.1%	34.4%
	140	94.3%	76.8%	75.0%	49.0%	30.1%
	160	94.3%	71.2%	75.0%	45.0%	25.9%
	180	94.2%	65.5%	74.9%	41.5%	22.1%
	200	94.2%	59.6%	74.9%	38.0%	18.6%
Catch options for 2015/16 season:	**TAC option (t)**	**NEAC-N-1SW**	**NEAC-N-MSW**	**NEAC-S-1SW**	**NEAC-S-MSW**	**All complexes**
	0	94.6%	98.5%	70.1%	79.7%	55.2%
	20	94.6%	97.2%	70.1%	76.0%	52.4%
	40	94.5%	95.1%	70.0%	72.2%	49.2%
	60	94.5%	92.3%	70.0%	68.4%	45.6%
	80	94.5%	89.0%	69.9%	64.6%	41.9%
	100	94.4%	85.0%	69.9%	60.7%	38.0%
	120	94.4%	80.6%	69.8%	57.1%	34.2%
	140	94.3%	75.7%	69.8%	53.5%	30.4%
	160	94.3%	70.6%	69.7%	50.0%	26.7%
	180	94.2%	65.4%	69.7%	46.8%	23.4%
	200	94.2%	60.4%	69.7%	43.7%	20.4%

3.5 Development of indicator frameworks to identify significant changes in previously provided multiannual management advice

3.5.1 Background

In support of the multiannual management advice that is provided for all three NASCO Commission Areas, NASCO asked ICES to provide an assessment of the minimal information needed to signal an unforeseen change in productivity for stocks contributing to fisheries within each Commission area. A particular concern was that an increase in productivity may alter the reliability of the previously provided multiyear catch options and could result in unrealised harvest within various mixed-stock fisheries. Initial progress on this issue was presented to WGNAS in 2006 (ICES, 2006) and further developments were made by the Study Group on Establishing a Framework of Indicators of Salmon Stock Abundance [SGEFISSA] which met in November 2006 (ICES, 2007b) and reported to WGNAS in 2007 (ICES, 2007a). This resulted in the development of a suggested framework (Framework of Indicators - FWI) which could be used to indicate if any significant change in the status of stocks had occurred and thus confirm whether the previously provided multi-annual management advice was still appropriate.

The initial FWI was developed with both the Greenland and Faroes fisheries in mind, although the methodology only proved suitable for the West Greenland fishery and an alternative approach was subsequently developed for the NEAC area (ICES, 2011; 2012a; 2013). Thus, FWIs are now routinely applied in the interim (non-assessment) years of multiyear agreements for both NAC and NEAC to facilitate the management of the West Greenland and Faroes fisheries respectively. Both operate according to the timeline outlined in Figure 3.5.1.1. Outline descriptions of the two different schemes are provided below.

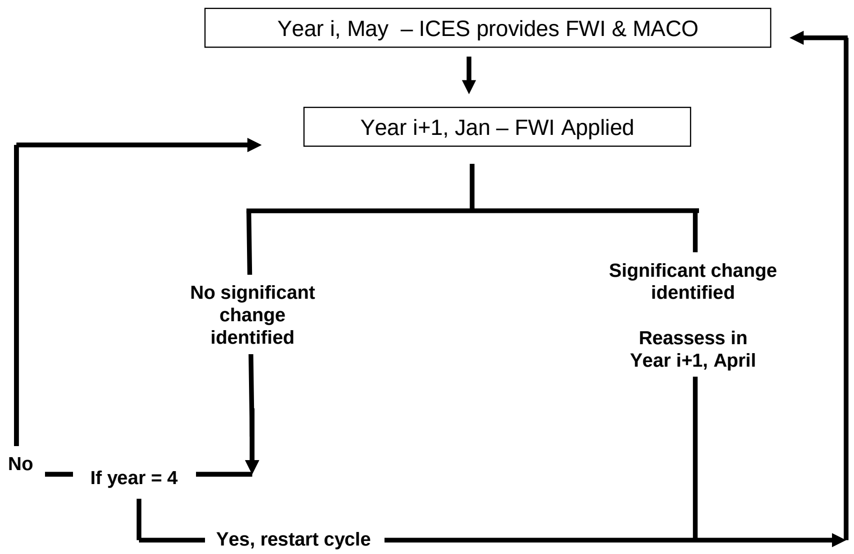

Figure 3.5.1.1. Timeline for employment of the Framework of Indicators (FWI). In Year i, ICES provides an updated FWI which re-evaluates the updated datasets and is summarized in an Excel worksheet. In January of Year i+1 the FWI is applied and two options are available depending on the results. If no significant change 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 4.

3.5.2 Framework of Indicators (FWI) for the West Greenland Fishery

The process for developing and applying the FWI for the Greenland fishery consists of six general steps:

<u>Definition of a significant change</u> - Define measurable criteria for what the statement "a significant change in the previously provided multi-annual management advice" represents.

Evaluating historical relationships between indicators and variable of interest - Define and evaluate the historical relationships between numerous indicators and the variable of interest for individual rivers across all stock complexes.

Establishing threshold values - Define the threshold level (i.e. variable of interest level) that will satisfy the management objectives for each stock complex.

Decision rule determinations - Define and apply a standardised approach for determining the appropriate decision rule value. The decision rule should provide a signal if the variable of interest will be greater than or less than the threshold level with high precision.

Combining Indicators within the Framework - Define and apply a standardised approach for combining indicator datasets within and across stock complexes for future comparison against contemporary indicator values.

Applying the FWI - Define and apply a standard approach to input contemporary indicator values into the FWI to determine if there is likely to be a significant change in the previously provided management advice.

Each of these is considered in turn; full details are available in ICES (2007b).

3.5.2.1 Definition of a significant change

A significant change in the previously provided multiannual management advice is regarded as an unforeseen change in stock status that would alter the previously provided advice based on analysis of current population data obtained from various monitored populations across the North Atlantic. This would be indicated by a situation where stock abundance has increased to a level where a fishery could be recommended when no catch had previously been advised, or a decrease in stock abundance when catch options had been chosen.

For the fishery at West Greenland, ICES would recommend that a harvestable surplus exists within the West Greenland stock complex if there was a high probability (75%) that the following three objectives could be met simultaneously:

> The conservation limits of the four northern regions of North America (Labrador, Newfoundland, Québec, and Gulf) were achieved.
>
> There was a 25% increase in returns to the Scotia-Fundy and USA regions relative to the mean returns for the 1992–1996 period.
>
> The conservation limit for the Southern NEAC MSW complex was achieved.

3.5.2.2 Evaluating historical relationships between indicators and variable of interest

A number of variables were considered for inclusion as indicators in the FWI, but only two were considered sufficiently informative to be carried forward into the framework: adult returns (returns, catch or estimated PFA) and return rates (i.e. smolt survival rates, marine survival). These are available, by sea age class, for a number of monitored rivers throughout the North Atlantic and can be directly related to the management objectives for the fishery.

3.5.2.3 Establishing threshold values

In keeping with the 75% probability of meeting or exceeding the objectives for the West Greenland catch options (see above), the 25th percentile of the return estimates of the six areas in North America are compared to the corresponding 2SW conservation limits of the four northern areas of North America and to the 25% increase objective for the two southern areas. For the southern NEAC non-maturing component, the 25th percentile of the PFA estimate of the southern NEAC non-maturing complex is compared to the spawning escapement reserve (SER) for the southern NEAC non-maturing complex.

3.5.2.4 Decision rule determinations

The procedure for analysing the relationships between the indicators and the returns of 2SW salmon or the PFA estimates was originally suggested by ICES (2006). The individual river catches, returns or return rates are lagged to correspond to the same smolt cohort for the 2SW returns to North America or to the PFA estimates for NEAC complexes. Bivariate plots of each indicator dataset relative to the 2SW returns or the PFA estimates are prepared. Upper and lower halves are defined by the management objective value for the corresponding geographic area in North America or the NEAC stock complexes as outlined above. Estimates of returns of 2SW or PFA estimates in the upper half correspond to years when the returns or PFA exceed the management objectives. Points in the lower half correspond to years when the returns or PFA are less than the management objective.

Left and right halves are defined by a sliding rule along the indicator range. An objective function that maximises the number of correct assignments (true highs and true lows) is used to define the indicator decision rule. The objective function also minimises the number of incorrect assignments (false highs and false lows, Figure 3.5.2.4.1).

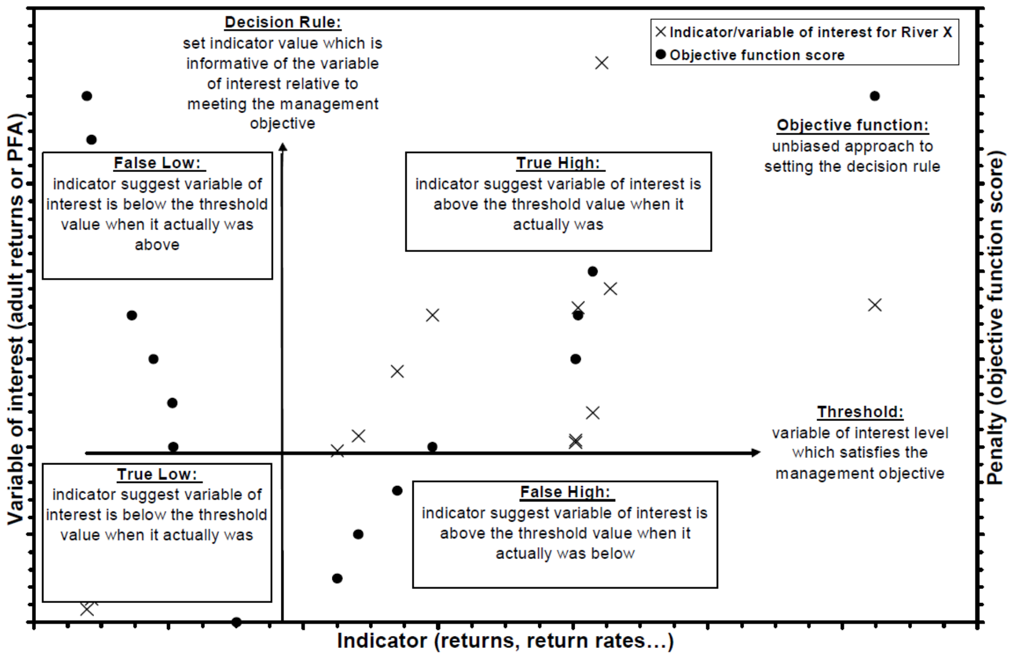

Figure 3.5.2.4.1. Example of Indicator/Variable of Interest exploratory graph identifying the threshold value, decision rule, penalty function and the four states (true high, true low, false high and false low).

The value of the indicator variable that minimises the sum of the penalty scores (i.e. minimises the number of incorrect assignments) is assigned as the decision rule for that dataset. Equal penalty weights are assigned to false highs (lower right quadrant) and false lows (upper left quadrant). Correct assignments are scored as zero. In the case when multiple minima occurred, the lowest indicator value among the low minima values is chosen.

Indicators are retained in the framework when they are evaluated as being informative of the magnitude of returns or PFA relative to the management objectives. These informative indicator datasets also have to meet the following two criteria to be retained:

Expectation that the indicator variable would be available in future (in January), and

A minimum of five observations are present in each of the correct quadrats (true low; true high).

3.5.2.5 Combining Indicators within the Framework

The probabilities of correct assignments are calculated for each of the true low and true high states for each of the indicator datasets retained. The respective probabilities correspond to the ratio of the correct assignment to all observations within the respective low and high indicator halves:

$P(State_{low} \mid Indicator_{low})$ (i.e. true low) = $N(State_{low} \mid Indicator_{low}) / N\ Indicator_{low}$
$P(State_{high} \mid Indicator_{high})$ (i.e. true high) = $N(State_{high} \mid Indicator_{high}) / N\ Indicator_{high}$

Indicator datasets are then pooled according to management objective/stock complex groupings. Each NAC stock complex (n=6) and the Southern NEC non-maturing stock complex are pooled separately as these stock complexes relate to the management objectives for the West Greenland fishery.

3.5.2.6 Applying the FWI

To apply the FWI, the most recent year's indicator value for each of the retained indicator datasets is compared to the decision rule as determined from the historical datasets. If the contemporary indicator value is low relative to the decision rule, it is assigned a value of -1. If the value is high, it is assigned a score of +1. Multiple indicators within the stock complex groupings are then combined by arithmetic average of the product of the indicator value (-1, +1) and the probability of a correct assignment corresponding to the true low or true high states. An average geographic area or stock complex score equal to or greater than zero suggests there is a likelihood of meeting the management objective for that grouping based on the historic relation between the variable of interest (adults returns or PFA) and the indicators evaluated.

If the scores for all the groupings within a fishery complex are greater than zero, then there is a likelihood that all the management objectives for that fishery will be met. Under that scenario, the multiyear management advice should be reassessed. When the score(s) for one of more of the groupings is less than zero, there is unlikely to be a significant change in the management advice and there would be no need for a reassessment.

SGEFISSA (ICES, 2007b) developed a spreadsheet template FWI (see example at Figure 3.5.2.6.1) in which the underlying variable of interest/ indicator dataset relationships and decision rules are summarised and collated according to the specific management objectives for each fishery. This provides one of two conclusions for the user:

1) No significant change identified by the indicators;

2) Reassess.

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**

Figure 3.5.2.6.1. 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.

If no significant change has been identified by the indicators, then the multiyear catch advice for the year of interest could be retained. If a significant change is signalled by the indicators, the response is to reassess.

The framework spreadsheet is designed to capture both fishing and non-fishing scenarios:

- Multiyear advice provides no catch options greater than zero but indicators are suggesting that the management objectives may be met (conclusion: Reassess);
- Multiyear advice provides catch options greater than zero but the indicators suggest the management objectives may not be met (conclusion: Reassess).

There are two steps required by the user to run the framework. The first step in the framework evaluation is to enter the catch advice option (i.e. tonnes of catch) for the West Greenland fishery. This feature provides the two way evaluation of whether a change in management advice may be expected and a reassessment would be required. The second step is to enter the values for the indicator variables in the framework for the year of interest. The spreadsheet evaluation update is automated and the conclusion is shown in the row underneath "Overall Recommendation".

The conclusions from the framework evaluation are based on whether there is simultaneous achievement of the management objectives in the six stock areas of North America and the southern NEAC 1SW non-maturing complex. If there are no indicator variables for a geographic area, the attainment of the management objectives is evaluated as unknown and that area or complex is not used in the decision structure of the framework.

Within the geographic areas for which indicator variables are retained, all the available indicators are used to assess the indicator score. If an update value for an indicator variable is not available for the year of interest, the indicator variable is not used to quantify the indicator score for that area.

3.5.3 Framework of Indicators (FWI) for the Faroes Fishery

3.5.3.1 Background

The original FWI applied to the West Greenland fishery (ICES, 2007b) was not applicable for the Faroese fishery for a number of different reasons. Among these were the lack of quantitative catch advice, the absence of specific management objectives and a sharing agreement for this fishery and the fact that none of the available indicator datasets met the criteria for inclusion in the FWI.

In 2011, WGNAS re-evaluated the approach for developing a FWI for the Faroese fishery (ICES, 2011). Since over the available time-series the PFA estimates for the NEAC stock complexes have predominately remained above the SER, the Working Group suggested a different set of decision rules for this FWI. It was suggested that the status of stocks should be re-evaluated if the FWI suggests that the PFA estimates are deviating substantially from the median values from the forecast.

3.5.3.2 Description of the FWI

It was initially suggested that the 95% confidence interval range for the mean of the indicator prediction, relative to the median forecast value, be used to compute the decision thresholds for whether the indicator suggests a reassessment or not (ICES, 2011). The limits should be computed at the median values of the PFA forecasts in each of the years in multiyear advice. However, the 95% criterion was subsequently re-examined (ICES, 2012a) and it was recommended that the upper and lower 75% confidence limits of the individual predictions be used for comparison (Figure 3.5.3.2.1). WGNAS recognised that this was a relaxation of the decision rule suggested in 2011, and will lead to a larger interval, and thus a lower chance of a reassessment than the approach suggested in 2011. However, this was considered to be a more realistic confidence level given the relatively wide variability in the indicator datasets, and was also consistent with the approach adopted by NAC.

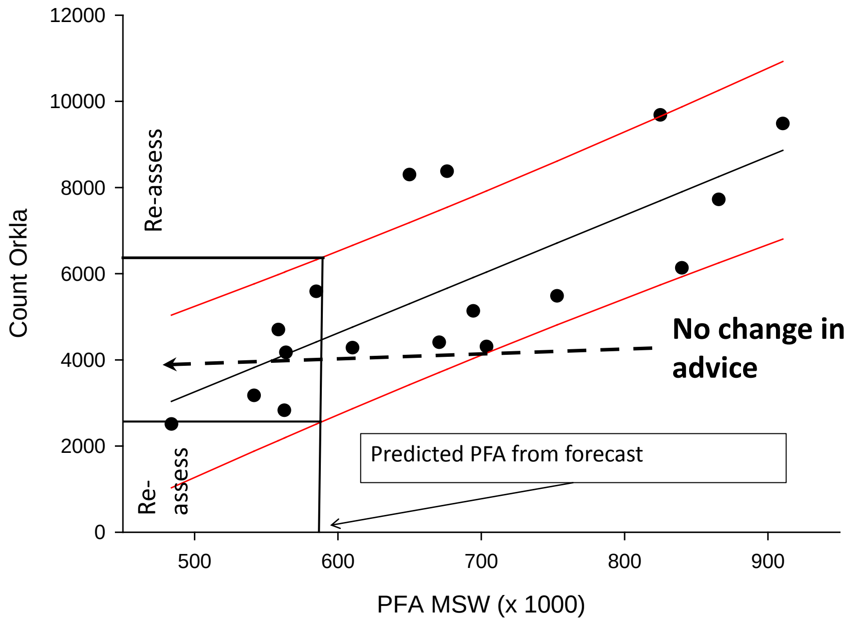

Figure 3.5.3.2.1. Example of how the reassessment intervals for the indicators are computed. The values of an indicator (counts) are plotted against the PFA. The regression line is shown in black and 75% confidence limits for the individual estimates are shown in red. From the forecasted PFA in the year in question the values of the indicator corresponding to the upper and lower 75% confidence interval are estimated. If the indicator value falls outside these limits a reassessment is recommended by this particular indicator.

When the stocks are divided into smaller management units, potential indicators for each management unit become relatively scarce. Therefore, the Working Group recommended that the FWI be regressed against the stock complexes that they belong to. For example, MSW indicators from Norway should be regressed against PFA MSW for northern NEAC.

In 2012, the FWI was applied as a two-tailed test (ICES, 2012a). However, it was subsequently agreed that, in the event of a closed fishery, the indicators should only be compared to the upper 75% confidence limit (i.e. a one-tailed test). This means that for a closed fishery, a reassessment is only triggered where the forecast appeared to be an underestimate and there may be a possibility of a harvest being denied. In the case of an open fishery they should be compared to both the upper and lower 75% confidence limits. In this case, if the FWIs suggest that the forecasted PFA is either an underestimation or an overestimation of the realised PFA in any of the four stock complexes, then this should trigger a reassessment.

WGNAS developed a FWI spreadsheet (ICES, 2011) to provide an automatic evaluation of the need for a reassessment once the new indicator values are available in January; this has been updated subsequent years (ICES, 2012a; 2013). An example spreadsheet is provided at Figure 3.5.3.2.2.

The following summarizes the main steps performed by the spreadsheet following updating of the relevant data for the variable of interest by adding the latest year's number:

- Regression analysis with the dataset x to determine its power to predict PFA in the forecasted years.
- Calculation of the 75% confidence intervals of individual predictions of the regression for dataset x. An indicator value below the 75% individual confidence interval (CI) is interpreted as indicative of an overestimation of the PFA, while a point above the 75% individual confidence interval is interpreted as indicative of an underestimation of PFA.
- A dataset is considered informative and should be kept as an indicator in the FWI if the following conditions are met: sample size (n) ≥ 10; $r^2 \geq 0.2$; dataset updated annually and new value available by January 15. Datasets that do not meet these criteria are discarded.
- Apply a binary score to each indicator value. Thus, for dataset x, if the current year's indicator value is outside the 75% individual regression point estimate CI (below or above) then that indicator receives a score of 1. If the indicator is within the 75% CI, then the indicator receives a score of -1. In the absence of an indicator datapoint for any year, a score of zero is applied. Whether the indicator value is above or below the upper and lower CI values is checked separately in two spreadsheet columns and a decision whether the indicator value is within the CI is assessed by combining the information in the two columns.
- Separate columns are used to sum the scores for all the indicator datasets within each stock complex. This is done separately for points that fall above the CI and those that fall below. In the case of a two-sided approach (open fishery), if the sum of these columns is ≥0, then the spreadsheet signals "REASSESS"; if the sum is <0, then it signals "No significant OVERestimation of PFA identified by indicators, do not reassess" for indicator values that fall below the CI, and "No significant UNDERestimation of PFA identified by indicators, do not reassess" for indicator values that are above the CI. In case of a one-sided approach (closed fishery), only underestimation will signal a "REASSESS".
- FWI results are generated for each stock complex (northern NEAC maturing and non-maturing, and southern NEAC maturing and non-maturing). A score of ≥0 for any of these stock complexes would signal a reassessment.

WGNAS reassessed the effects of applying stricter criteria than $r^2 \geq 0.2$ for inclusion of indicators in the FWI. As stricter criteria are used, the number of indicators included reduces rapidly. It was therefore concluded to keep the criterion of $r^2 \geq 0.2$ in order to obtain a sufficient number of indicators to be able to use the FWI even in the event of one or more indicators being unavailable by the time the FWI is applied each year. The r^2 value of 0.2 corresponds to a value slightly lower than what is considered to be a "large" effect size ($r = 0.5$, $r^2 = 0.25$) by Cohen (1988). Even though a criterion of $r^2 \geq 0.2$ gives each indicator little predictive power alone (Prairie, 1996), the approach of using a suite of indicators is more similar to meta-analysis (Rosenthal, 1984) meaning that the outcome of the FWI is not dependent on the result of one indicator in isolation, but rather on the combined performance of the indicator set.

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.

Figure 3.5.3.2.2. 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 was an underestimate, the overall advice from the spreadsheet is reassess.

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Appendices to Stock Annex

Appendix 1 (a): Description of how catch-and-release mortality is incorporated in regional and national stock assessments

Commission Area	Country/Region	How it is used in regional and national assessments	Future developments / improvements
NAC	Canada-Quebec	C&R has become more popular in the region and C&R only angling licenses are sold. C&R data are incomplete as there is no requirement to report C&R numbers. Generally, C&R mortality is considered in the assessment but the majority of the assessments are conducted as spawner counts after the fisheries so any losses due to C&R mortality are accounted for in the spawner estimates but not in the returns (which are the sum of known losses and spawning escapement).	New studies of the contribution of C&R fish to spawning success have been initiated. C&R monitoring is becoming more complete. Consideration will be given in the future to incorporating these losses in the returns and in the assessments based on angling catches, especially as reporting improves.
	Canada-Newfoundland & Labrador	Catch and release mortality is included in estimates of spawners. Spawning escapement is reduced by 5-15% (mean 10%) of the released catch.	No plans for further development.
	Canada - Gulf	Assessments of spawners are adjusted by mortality rates of 3% to 6% of the total C&R estimates of small and large salmon. The rates vary by river according to angling seasons, and the occurence of other factors such as disease which can affect survival of salmon.	Catch and release mortality is known to be affected by the water temperatures when fish are angled. In some cases, angling fisheries are closed when water temperatures are high in the summer to reduce the losses of fish from C&R. Methods to determine catch and release numbers vary by river and in some cases, the number of released fish is estimated from returns and historical creel survey data. As the practice of C&R becomes more popular, estimation methods for C&R values will have to be revisited.
	Canada – Scotia/Fundy	Assessments are currently adjusted by 4% of the C&R fish to correct for C&R mortality.	Numbers of C&R fish are currently low (retention fisheries are closed). If C&R catches increase, further research on the correction factor would be warranted.
	USA	No correction for mortality due to C&R used in estimating spawner numbers. However, all fisheries have been closed and the number of fish caught relative to stock size is very small.	
NEAC	Russia Norway Sweden Iceland UK(Scotland)	With increasing C&R the retained catch for similar effort is reduced. Therefore the exploitation rate for retained fish is lower. The increase in C&R in recent years is incorporated into the national run-reconstruction model by reducing the exploitation rate value used in the model input. This is assessed qualitatively. No correction for increased C&R mortality is applied when estimating the spawning escapement.	If C&R information is incorporated into formal assessments then muliple recaptures should be taken into account. C&R mortality should be incorporated into estimates of spawning escapement.
	Ireland	No correction for mortality due to C&R used in estimating spawner numbers or in the national run-reconstruction model.	Incorporation of formal method for estimating the effect of C&R on number of returning fish. Incorporation of C&R mortality in estimates of spawning escapement
	UK(England & Wales)	With increasing C&R the retained catch for similar effort is reduced. Therefore the exploitation rate for retained fish is lower. The increase in C&R in recent years is incorporated into the national run-reconstruction model by reducing the exploitation rate value used in the model input. This is assessed qualitatively. 20% mortality of C&R fish used in assessing compliance with river-specific conservation	If C&R information is incorporated into formal assessments then multiple recaptures should be taken into account.
	UK(N. Ireland)	Returns are estimated by raising the reported net catch by exploitation rate. No correction for increased C&R mortality is applied when estimating the spawning escapement.	If C&R information is incorporated into formal assessments then multiple recaptures should be taken into account. C&R mortality should be incorporated into estimates of spawning escapement.
	Denmark	C&R rates recorded, but no national run-reconstruction assessment applied.	
	Finland	No record of C&R	If C&R information is collected, it should be incorporated into formal assessments and multiple recaptures should be

Appendix 1 (b): Description of how unreported catch is incorporated in regional, national and international stock assessments

Commission Area	Country/Region	How it is used in regional and national assessments	How used in international assessments	Future developments / improvements
NAC	Canada-Quebec	Unreported catches are based on historical estimates relative to stock size or are provided by field conservation and protection staff. Unreported catches when available are included in the regional assessment of returns and spawners.	Unreported catches which occur in marine waters outside the jurisdiction of the regions are not included in the run reconstruction models.	If unreported catch estimates were provided they could be incorporated in the regional assessments and in the continent estimates of abundance and spawners. Unreported catch may be accounted for in either the returns or the spawners, depending upon when and where the illegal activity occurs relative to the location and time of the assessment model.
	Canada-Newfoundland & Labrador	Catch statistics include estimates of harvests by log book non-respondents. Therefore they are included in the regional assessments and the PFA estimate. No account is taken of illegal fisheries.		
	Canada - Gulf	Unreported catches are sometimes provided by Conservation and Protection Personnel and are estimates of illegal fishing removals within specific regions. Unreported catches have not been used in the assessments of returns or spawners.		
	Canada – Scotia/Fundy	No adjustment made, with the exception of the Saint John River where returns/spawners are adjusted for estimated bycatch and poaching. In other rivers where assessments directly quantify spawners, returns would be underestimated if catch is under reported.		
	USA	Unreported catch is estimated to be zero and therefore has no effect on national assessments.		
NEAC	Russia	Minimum and maximum estimates of the unreporting rate are used in deriving national PFA estimates from the catch of 1SW & MSW salmon.	National estimates (which incorporate unreported ctaches) are aggregated to provide PFA, return and spawner estimates for stock complexes.	Incorporate revised estimates of minimum and maximum estimates of unreporting rate as national estimates are improved.
	Finland			
	Norway			
	Sweden			
	Iceland			
	Ireland			
	UK(Scotland)			
	UK(England & Wales)			
	UK(N. Ireland)			
	France			
	Denmark	No national assessment		
NEAC	Faroes	Not applicable	Assumed to be negligible unreported catch. Estimate of discard mortality for 1SW fish is incorporated in stock assessments.	Sampling programme if fishery resumes.
W. Greenland	W. Greenland	Not applicable	Unreported catch at West Greenland is incorporated in assessments for both the NAC and NEAC areas. Since 1993, this has been provided by the Greenlandic authorities. Prior to this time, no unreported catch component is included in the models.	Annual variation in unreported catch estimates would be incorporated into the model.

Appendix 2: Overview of current DCF and future data needs for Atlantic salmon assessment/ scientific advice

Type of data	Collected under DCF	Available to WG	Reviewed and evaluated by WG	Used in current assessment models	Future plans	Notes
How to be filled	Yes/ No/ Partially	Yes/ No/ Partially	Yes/ No/ Partially	Yes/ No/ Partially used	Keep as current DCF/ Improve sampling intensity/ No need to be collected/ (other free text)	Free text
Fleet capacity	No **	No *	No	No	No need to be collected	See 'Fishing gear and effort'
Fuel consumption	No **	No *	No	No	No need to be collected	Many salmon fisheries use unpowered vessels
Fishing gear and effort	Partially **	Partially	Partially	Partially, but information requested by NASCO	Use for estimation of exploitation rates. Improve coverage and sampling intensity in DC-MAP	Data required for all relevant areas/fisheries
Landings	Partially **	Yes	Yes	Yes	Improve coverage in DC-MAP	Data required on: catch in numbers and weights for recreational and commercial fisheries in rivers, estuaries and coastal waters.

Type of data	Collected under DCF	Available to WG	Reviewed and evaluated by WG	Used in current assessment models	Future plans	Notes
Discards	No **	No *	No	No	No need to be collected	Not relevant to salmon except (historically) in Faroes fishery. NB: ‘catch and release’ fish are deliberately caught and so not classed as discards.
Recreational fisheries	Partially **	Yes	Yes	Yes	Improve coverage in DC-MAP	Extent of DCF coverage unclear. Complete catch data needed for all recreational fisheries (see ‘Landings’)
Catch & Release	No **	Partially	Partially	No - but data requested by NASCO	Include collection in DC-MAP	Data on numbers of fish caught and released required for all recreational fisheries
cpue dataseries	Partially **	Partially	Partially	Partially	Improve sampling intensity in DC-MAP	Data used to generate national inputs to models
Age composition	Partially ** Some ageing based on fish lengths or weights	Yes	Yes	Yes	Improve coverage and sampling intensity in DC-MAP	Extent of DCF coverage unclear; sampling intensities in other fisheries inappropriate to salmon

Type of data	Collected under DCF	Available to WG	Reviewed and evaluated by WG	Used in current assessment models	Future plans	Notes
Wild/reared origin (scale reading)	No **	Partially from other sources	Partially	Partially used - information on farmed fish is requested by NASCO	Improve sampling intensity in DC-MAP	Extent of DCF coverage unclear
Length and weight-at-age	Partially **	Partially	Yes	Yes - but some ageing based on fish lengths or weights	Improve sampling coverage in DC-MAP	DCF does not cover all relevant areas/fisheries; sampling intensities inappropriate to salmon
Sex ratio	No **	Yes- from other sources	Partially	Yes	Modify sampling intensity in DC-MAP	Estimates required at national/regional level every five years
Maturity	Not known **	No *	No	No	No need to be collected – all returning adults are mature	DCF requires collection but extent of coverage unclear; data not required for assessments
Fecundity	No **	Yes	Partially	Yes	Include collection in DC-MAP	Estimates required at national/regional level every 5 years
Data processing industry	No **	No **	No	No	No need to be collected	Requirement not clear

TYPE OF DATA	COLLECTED UNDER DCF	AVAILABLE TO WG	REVIEWED AND EVALUATED BY WG	USED IN CURRENT ASSESSMENT MODELS	FUTURE PLANS	NOTES
Juvenile surveys (Electrofishing)	Partially ** but not requested for Atlantic salmon in DCF	Yes	Partially	Partially	Include collection in DC-MAP	Data used to develop reference points and confirm stock status. Also required for assessments under WFD
Adult census data (Counters, fish ladders, etc.)	Partially ** but not requested for Atlantic salmon in DCF	Yes	Partially	Yes	Include collection in DC-MAP	Counts required for ~one river in 30. Data required to provide exploitation rates for assessments
Index river data (Smolt & adult trapping; tagging programmes; etc.)	Partially ** but not requested for Atlantic salmon in DCF	Yes	Partially	Yes	Include collection in DC-MAP	Index rivers are identified by ICES. Data used to develop reference points and inputs to assessment models
Genetic data (for mixed-stock analysis)	No **	Partially	Partially - for some mixed-stock fisheries	Not currently	Include collection in DC-MAP - sampling in mixed-stock fisheries every 5 years	Genetic analysis is now advised to provide more reliable stock composition in mixed-stock fisheries

ICES WGNAS REPORT 2014

Type of data	Collected under DCF	Available to WG	Reviewed and evaluated by WG	Used in current assessment models	Future plans	Notes
Economic data	Not known **	No *	No	No - but data are of use to NASCO		Collection of economic data would be useful to managers
Aquaculture data	Not known **	Partially - marine farm production collected	Yes	No - but information on farm production is requested by NASCO		Currently not required for freshwater

Add other data type to the cells with a light blue shading, if needed.

*** Not asked for by the ICES WGNAS.**

****) Not mandatory for some or all areas/stocks/fisheries under the current DCF.**

Appendix 3: Input data for NEAC Pre Fishery Abundance analysis using Monte Carlo simulation

Finland

Annual input data for NEAC PFA run-reconstruction & NCL models for FINLAND (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	8,422	8,538	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1972	13,160	13,341	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1973	11,969	15,958	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1974	23,709	23,709	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1975	16,527	26,417	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1976	11,323	21,719	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1977	5,807	13,227	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1978	7,902	8,452	35.0	5.0	35.0	5.0	50.0	10.0	55.0	15.0
1979	9,249	7,390	35.0	5.0	35.0	5.0	50.0	10.0	45.0	15.0
1980	4,792	8,938	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1981	7,386	9,835	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1982	2,163	12,826	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1983	10,680	13,990	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1984	11,942	13,262	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1985	18,039	10,339	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1986	16,389	9,028	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1987	20,950	11,290	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1988	10,019	7,231	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1989	28,091	10,011	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1990	26,646	12,562	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1991	32,423	15,136	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1992	42,965	16,158	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1993	30,197	18,720	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1994	12,016	15,521	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1995	11,801	9,634	25.0	5.0	25.0	5.0	60.0	10.0	55.0	15.0
1996	22,799	6,956	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1997	19,481	10,083	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1998	22,460	8,497	25.0	5.0	25.0	5.0	50.0	10.0	45.0	15.0
1999	38,687	8,854	25.0	5.0	25.0	5.0	60.0	10.0	50.0	10.0
2000	40,654	19,707	25.0	5.0	25.0	5.0	60.0	10.0	50.0	10.0
2001	18,372	28,337	25.0	5.0	25.0	5.0	60.0	10.0	50.0	10.0
2002	10,757	22,717	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2003	12,699	16,093	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2004	4,912	7,718	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2005	12,499	5,969	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2006	23,727	10,473	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2007	4,407	14,878	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2008	4,539	14,165	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2009	9,260	6,600	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2010	8,627	10,434	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2011	10,554	8,204	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2012	22,902	10,649	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2013	13,724	9,494	25.0	5.0	25.0	5.0	50.0	10.0	50.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

France

Annual input data for NEAC PFA run-reconstruction & NCL models for FRANCE. (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	1,740	4,060	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1972	3,480	8,120	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1973	2,130	4,970	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1974	990	2,310	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1975	1,980	4,620	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1976	1,820	3,380	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1977	1,400	2,600	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1978	1,435	2,665	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1979	1,645	3,055	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1980	3,430	6,370	NA	NA	NA	NA	3.5	1.5	37.5	12.5
1981	2,720	4,080	NA	NA	NA	NA	3.5	1.5	35.0	15.0
1982	1,680	2,520	NA	NA	NA	NA	3.5	1.5	35.0	15.0
1983	1,800	2,700	NA	NA	NA	NA	3.5	1.5	35.0	15.0
1984	2,960	4,440	NA	NA	NA	NA	3.5	1.5	35.0	15.0
1985	1,100	3,330	NA	NA	NA	NA	3.5	1.5	35.0	15.0
1986	3,400	3,400	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1987	6,013	1,806	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1988	2,063	4,964	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1989	1,124	2,282	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1990	1,886	2,332	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1991	1,362	2,125	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1992	2,490	2,671	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1993	3,581	1,254	NA	NA	NA	NA	7.0	5.0	35.0	15.0
1994	2,810	2,290	NA	NA	NA	NA	7.0	5.0	30.0	10.0
1995	1,669	1,095	NA	NA	NA	NA	12.5	7.5	30.0	10.0
1996	2,063	1,943	NA	NA	NA	NA	12.5	7.5	30.0	10.0
1997	1,060	1,001	NA	NA	NA	NA	12.5	7.5	30.0	10.0
1998	2,065	846	NA	NA	NA	NA	12.5	7.5	30.0	10.0
1999	690	1,831	NA	NA	NA	NA	12.5	7.5	30.0	10.0
2000	1,792	1,277	NA	NA	NA	NA	12.5	7.5	30.0	10.0
2001	1,544	1,489	NA	NA	NA	NA	12.5	7.5	30.0	10.0
2002	2,423	1,065	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2003	1,598	1,540	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2004	1,927	2,880	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2005	1,256	1,771	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2006	1,763	1,785	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2007	1,378	1,685	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2008	1,365	1,865	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2009	487	975	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2010	1,658	821	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2011	1,162	2,142	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2012	1,010	1,669	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2013	1,418	1,668	30.0	10.0	22.5	7.5	12.5	7.5	30.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Iceland (South and West)

Annual input data for NEAC PFA run-reconstruction & NCL models for ICELAND (SOUTH-WEST). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	30,618	16,749	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1972	24,832	25,733	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1973	26,624	23,183	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1974	18,975	20,017	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1975	29,428	21,266	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1976	23,233	18,379	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1977	23,802	17,919	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1978	31,199	23,182	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1979	28,790	14,840	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1980	13,073	20,855	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1981	16,890	13,919	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1982	17,331	9,826	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1983	21,923	16,423	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1984	13,476	13,923	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1985	21,822	10,097	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1986	35,891	8,423	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1987	22,302	7,480	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1988	40,028	8,523	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1989	22,377	7,607	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1990	20,584	7,548	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1991	22,711	7,519	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1992	26,006	8,479	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1993	25,479	4,155	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1994	20,985	6,736	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1995	25,371	6,777	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1996	21,913	4,364	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1997	16,007	4,910	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1998	21,900	3,037	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1999	17,448	5,757	12.5	2.5	12.5	2.5	49.0	10.0	68.0	10.0
2000	15,502	1,519	12.5	2.5	12.5	2.5	49.0	10.0	66.0	10.0
2001	13,586	2,707	12.5	2.5	12.5	2.5	48.0	10.0	67.0	10.0
2002	16,952	2,845	12.5	2.5	12.5	2.5	48.0	10.0	65.0	10.0
2003	20,271	4,751	12.5	2.5	12.5	2.5	48.0	10.0	68.0	10.0
2004	20,319	3,784	12.5	2.5	12.5	2.5	48.0	10.0	67.0	10.0
2005	29,969	3,241	12.5	2.5	12.5	2.5	48.0	10.0	65.0	10.0
2006	21,153	2,689	12.5	2.5	12.5	2.5	48.0	10.0	65.0	10.0
2007	23,728	1,679	12.5	2.5	12.5	2.5	47.0	9.0	66.0	10.0
2008	28,774	1,659	12.5	2.5	12.5	2.5	47.0	10.0	57.0	10.0
2009	33,190	2,838	12.5	2.5	12.5	2.5	48.0	10.0	63.0	10.0
2010	33,318	6,061	12.5	2.5	12.5	2.5	47.0	10.0	65.0	10.0
2011	23,436	2,934	12.5	2.5	12.5	2.5	47.0	10.0	62.0	10.0
2012	13,312	1,429	12.5	2.5	12.5	2.5	47.0	10.0	53.0	10.0
2013	30,261	2,993	12.5	2.5	12.5	2.5	46.0	10.0	52.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Iceland (North and East)

Annual input data for NEAC PFA run-reconstruction & NCL models for ICELAND (NORTH-EAST). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	4,610	6,625	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1972	4,223	10,337	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1973	5,060	9,672	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1974	5,047	9,176	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1975	6,152	10,136	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1976	6,184	8,350	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1977	8,597	11,631	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1978	8,739	14,998	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1979	8,363	9,897	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1980	1,268	13,784	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1981	6,528	4,827	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1982	3,007	5,539	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1983	4,437	4,224	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1984	1,611	5,447	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1985	11,116	3,511	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1986	13,827	9,569	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1987	8,145	9,908	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1988	11,775	6,381	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1989	6,342	5,414	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1990	4,752	5,709	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1991	6,900	3,965	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1992	12,996	5,903	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1993	10,689	6,672	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1994	3,414	5,656	2.0	1.0	2.0	1.0	50.0	10.0	70.0	10.0
1995	8,776	3,511	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1996	4,681	4,605	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1997	6,406	2,594	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1998	10,905	3,780	12.5	2.5	12.5	2.5	50.0	10.0	70.0	10.0
1999	5,326	4,030	12.5	2.5	12.5	2.5	48.0	10.0	65.0	10.0
2000	5,595	2,324	12.5	2.5	12.5	2.5	48.0	10.0	64.0	10.0
2001	4,976	2,587	12.5	2.5	12.5	2.5	47.0	10.0	62.0	10.0
2002	8,437	2,366	12.5	2.5	12.5	2.5	46.0	10.0	60.0	10.0
2003	4,478	2,194	12.5	2.5	12.5	2.5	46.0	10.0	53.0	10.0
2004	11,823	2,239	12.5	2.5	12.5	2.5	45.0	10.0	55.0	10.0
2005	10,297	2,726	12.5	2.5	12.5	2.5	44.0	10.0	54.0	10.0
2006	11,082	2,179	12.5	2.5	12.5	2.5	45.0	10.0	45.0	10.0
2007	8,046	1,672	12.5	2.5	12.5	2.5	44.0	10.0	36.0	10.0
2008	7,021	2,693	12.5	2.5	12.5	2.5	42.0	10.0	45.0	10.0
2009	10,779	1,735	12.5	2.5	12.5	2.5	40.0	10.0	36.0	10.0
2010	8,621	2,602	12.5	2.5	12.5	2.5	40.0	10.0	38.0	10.0
2011	6,759	2,596	12.5	2.5	12.5	2.5	38.0	10.0	34.0	10.0
2012	3,699	1,419	12.5	2.5	12.5	2.5	40.0	10.0	33.0	10.0
2013	10,739	1,848	12.5	2.5	12.5	2.5	42.0	10.0	36.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Ireland

Annual input data for NEAC PFA run-reconstruction & NCL models for IRELAND. (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon	Declared net catch 1SW salmon	Declared net catch MSW salmon	Catch and release 1SW salmon	Catch and release MSW salmon	1SW salmon in Small rivers	MSW salmon in Small rivers	1SW salmon in closed rivers	MSW salmon in closed rivers
1971	409,965	46,594	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1972	437,089	49,863	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1973	476,131	54,008	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1974	542,124	60,976	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1975	598,524	68,260	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1976	407,018	47,358	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1977	351,745	41,256	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1978	307,569	35,708	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1979	282,700	32,144	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1980	215,116	35,447	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1981	137,366	26,101	37.5	7.5	37.5	7.5	75.7	11.4	47.5	12.5	NA	NA	NA	NA	NA	NA	NA	NA
1982	269,847	11,754	37.5	7.5	37.5	7.5	71.9	10.8	36.7	8.3	NA	NA	NA	NA	NA	NA	NA	NA
1983	437,751	26,479	37.5	7.5	37.5	7.5	66.1	9.9	40.1	7.5	NA	NA	NA	NA	NA	NA	NA	NA
1984	224,872	20,685	37.5	7.5	37.5	7.5	64.6	9.7	43.5	6.5	NA	NA	NA	NA	NA	NA	NA	NA
1985	430,315	18,830	37.5	7.5	37.5	7.5	74.6	11.2	36.1	3.4	NA	NA	NA	NA	NA	NA	NA	NA
1986	443,701	27,111	37.5	7.5	37.5	7.5	68.7	10.3	46.0	9.0	NA	NA	NA	NA	NA	NA	NA	NA
1987	324,709	26,301	30.0	10.0	30.0	10.0	69.8	10.5	32.2	4.7	NA	NA	NA	NA	NA	NA	NA	NA
1988	391,475	22,067	30.0	10.0	30.0	10.0	62.0	9.3	37.4	5.6	NA	NA	NA	NA	NA	NA	NA	NA
1989	297,797	25,447	30.0	10.0	30.0	10.0	65.7	9.9	47.2	8.8	NA	NA	NA	NA	NA	NA	NA	NA
1990	172,098	15,549	30.0	10.0	30.0	10.0	60.7	9.1	59.9	6.1	NA	NA	NA	NA	NA	NA	NA	NA
1991	120,408	10,334	30.0	10.0	30.0	10.0	59.5	8.9	26.5	3.5	NA	NA	NA	NA	NA	NA	NA	NA
1992	182,255	15,456	30.0	10.0	30.0	10.0	62.1	9.3	51.5	3.8	NA	NA	NA	NA	NA	NA	NA	NA
1993	150,274	13,156	25.0	10.0	25.0	10.0	58.6	8.8	42.0	18.0	NA	NA	NA	NA	NA	NA	NA	NA
1994	234,126	20,506	25.0	10.0	25.0	10.0	71.4	10.7	40.5	2.5	NA	NA	NA	NA	NA	NA	NA	NA
1995	232,480	20,454	25.0	10.0	25.0	10.0	63.5	9.5	41.8	1.2	NA	NA	NA	NA	NA	NA	NA	NA
1996	203,920	18,021	25.0	10.0	25.0	10.0	59.9	9.0	55.1	3.2	NA	NA	NA	NA	NA	NA	NA	NA
1997	170,774	14,724	25.0	10.0	15.0	5.0	50.1	7.5	30.8	12.2	NA	NA	NA	NA	NA	NA	NA	NA
1998	191,868	17,269	25.0	10.0	15.0	5.0	53.7	8.1	61.9	1.4	NA	NA	NA	NA	NA	NA	NA	NA
1999	158,818	14,801	25.0	10.0	15.0	5.0	47.8	7.2	34.1	18.1	NA	NA	NA	NA	NA	NA	NA	NA
2000	199,827	16,848	25.0	10.0	15.0	5.0	43.2	6.5	31.0	4.5	NA	NA	NA	NA	NA	NA	NA	NA
2001	218,715	18,436	7.5	2.5	7.5	2.5	48.0	7.2	35.0	8.0	NA	NA	NA	NA	NA	NA	NA	NA
2002	198,719	16,702	7.5	2.5	7.5	2.5	49.9	7.5	27.5	7.5	NA	NA	NA	NA	NA	NA	NA	NA
2003	161,270	13,745	7.5	2.5	7.5	2.5	41.3	6.2	21.5	5.5	NA	NA	NA	NA	NA	NA	NA	NA
2004	142,251	12,299	7.5	2.5	7.5	2.5	49.5	7.5	35.0	8.0	NA	NA	NA	NA	NA	NA	NA	NA
2005	127,371	10,716	7.5	2.5	7.5	2.5	44.5	6.5	23.5	3.5	NA	NA	NA	NA	NA	NA	NA	NA
2006	101,938	9,740	7.5	2.5	7.5	2.5	46.5	6.5	29.5	13.5	NA	NA	NA	NA	NA	NA	NA	NA
2007	30,418	2,477	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	8,334	679	12,137	988	9,548	777	40,255	3,278
2008	30,257	3,935	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	8,253	650	10,485	1,492	12,206	961	34,382	4,580
2009	24,184	4,756	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	6,264	493	9,799	1,623	-	-	46,570	4,964
2010	33,211	3,297	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	13,125	1,034	13,903	1,255	-	-	35,804	1,504
2011	29,117	3,970	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	11,071	902	11,222	1,530	-	-	33,251	1,208
2012	29,979	4,198	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	9,542	777	10,429	1,463	-	-	32,964	1,648
2013	25,157	4,122	7.5	2.5	7.5	2.5	15.5	8.4	23.9	9.1	13,218	1,076	5,607	1,386	-	-	45,855	1,698
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Norway (Southeast)

Annual input data for NEAC PFA run-reconstruction & NCL models for NORWAY (SOUTH-EAST). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1972	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1973	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1974	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1980	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1982	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1983	9,039	9,004	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1984	11,402	11,527	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1985	18,699	11,883	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1986	23,089	12,077	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1987	19,601	14,179	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1988	17,520	9,443	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1989	23,965	12,254	50.0	10.0	50.0	10.0	65.0	10.0	60.0	10.0
1990	25,792	11,502	50.0	10.0	50.0	10.0	65.0	10.0	60.0	10.0
1991	21,064	10,753	50.0	10.0	50.0	10.0	65.0	10.0	60.0	10.0
1992	26,044	15,332	50.0	10.0	50.0	10.0	65.0	10.0	60.0	10.0
1993	23,070	12,596	40.0	10.0	40.0	10.0	65.0	10.0	60.0	10.0
1994	23,987	9,988	40.0	10.0	40.0	10.0	65.0	10.0	60.0	10.0
1995	21,847	11,630	40.0	10.0	40.0	10.0	65.0	10.0	60.0	10.0
1996	20,738	13,538	40.0	10.0	40.0	10.0	65.0	10.0	60.0	10.0
1997	21,121	7,756	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1998	32,586	10,396	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1999	23,904	6,664	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2000	43,151	14,261	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2001	47,339	19,210	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2002	33,087	14,400	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2003	33,371	20,648	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2004	28,506	15,948	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2005	40,628	14,628	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2006	30,979	21,192	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2007	15,735	18,130	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2008	15,696	16,678	30.0	10.0	30.0	10.0	55.0	10.0	50.0	10.0
2009	15,584	11,995	30.0	10.0	30.0	10.0	55.0	10.0	50.0	10.0
2010	22,139	12,175	30.0	10.0	30.0	10.0	50.0	10.0	40.0	10.0
2011	15,773	28,589	30.0	10.0	30.0	10.0	50.0	10.0	40.0	10.0
2012	18,582	23,389	30.0	10.0	30.0	10.0	50.0	10.0	40.0	10.0
2013	16,702	13,564	30.0	10.0	30.0	10.0	50.0	10.0	40.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Norway (Southwest)

Annual input data for NEAC PFA run-reconstruction & NCL models for NORWAY (SOUTH-WEST) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1972	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1973	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1974	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1980	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1982	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1983	31,845	28,601	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1984	23,428	27,641	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1985	29,857	25,515	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1986	29,894	30,769	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1987	30,005	26,623	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1988	36,976	28,255	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1989	19,183	13,041	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1990	18,490	14,423	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1991	9,759	8,323	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1992	6,448	8,832	50.0	10.0	50.0	10.0	70.0	10.0	65.0	10.0
1993	11,433	10,239	40.0	10.0	40.0	10.0	70.0	10.0	65.0	10.0
1994	18,597	10,961	40.0	10.0	40.0	10.0	70.0	10.0	65.0	10.0
1995	10,863	13,122	40.0	10.0	40.0	10.0	70.0	10.0	65.0	10.0
1996	7,048	12,546	40.0	10.0	40.0	10.0	70.0	10.0	65.0	10.0
1997	10,279	7,194	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1998	5,726	6,583	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1999	7,357	3,219	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2000	11,538	7,961	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2001	12,109	10,716	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2002	6,000	7,145	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2003	8,269	7,602	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2004	7,180	6,420	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2005	10,370	7,334	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2006	5,173	9,381	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2007	2,630	6,011	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2008	3,143	4,807	30.0	10.0	30.0	10.0	55.0	10.0	50.0	10.0
2009	3,069	3,792	30.0	10.0	30.0	10.0	55.0	10.0	50.0	10.0
2010	3,450	2,447	30.0	10.0	30.0	10.0	50.0	10.0	35.0	10.0
2011	2,888	4,409	30.0	10.0	30.0	10.0	45.0	10.0	30.0	10.0
2012	4,171	5,733	30.0	10.0	30.0	10.0	45.0	10.0	30.0	10.0
2013	3,111	3,581	30.0	10.0	30.0	10.0	45.0	10.0	30.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Mid-Norway

Annual input data for NEAC PFA run-reconstruction & NCL models for NORWAY (MID AREA) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1972	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1973	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1974	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1980	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1982	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1983	121,221	74,648	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1984	94,373	67,639	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1985	114,613	56,641	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1986	106,921	77,225	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1987	83,669	62,216	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1988	80,111	45,609	50.0	10.0	50.0	10.0	75.0	10.0	75.0	10.0
1989	94,897	30,862	50.0	10.0	50.0	10.0	65.0	10.0	65.0	10.0
1990	78,888	40,174	50.0	10.0	50.0	10.0	65.0	10.0	65.0	10.0
1991	67,370	30,087	50.0	10.0	50.0	10.0	65.0	10.0	65.0	10.0
1992	51,463	33,092	50.0	10.0	50.0	10.0	65.0	10.0	65.0	10.0
1993	58,326	28,184	40.0	10.0	40.0	10.0	65.0	10.0	65.0	10.0
1994	113,427	33,520	40.0	10.0	40.0	10.0	65.0	10.0	65.0	10.0
1995	57,813	42,696	40.0	10.0	40.0	10.0	65.0	10.0	65.0	10.0
1996	28,925	31,613	40.0	10.0	40.0	10.0	65.0	10.0	65.0	10.0
1997	43,127	20,565	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1998	63,497	26,817	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
1999	60,689	28,792	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2000	109,278	42,452	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2001	88,096	52,031	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2002	42,669	52,774	35.0	10.0	35.0	10.0	60.0	10.0	60.0	10.0
2003	91,118	46,963	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2004	38,286	49,760	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2005	63,749	37,941	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2006	46,495	47,691	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2007	26,608	33,106	30.0	10.0	30.0	10.0	60.0	10.0	60.0	10.0
2008	31,936	34,869	30.0	10.0	30.0	10.0	55.0	10.0	45.0	10.0
2009	26,267	30,715	30.0	10.0	30.0	10.0	55.0	10.0	45.0	10.0
2010	37,557	30,524	30.0	10.0	30.0	10.0	50.0	10.0	45.0	10.0
2011	20,932	37,272	30.0	10.0	30.0	10.0	50.0	10.0	45.0	10.0
2012	22,368	28,265	30.0	10.0	30.0	10.0	50.0	10.0	45.0	10.0
2013	25,121	17,727	30.0	10.0	30.0	10.0	45.0	10.0	40.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Norway North

Annual input data for NEAC PFA run-reconstruction & NCL models for NORWAY (NORTH) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1972	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1973	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1974	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1976	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1978	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1980	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1981	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1982	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1983	104,040	49,413	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1984	150,372	58,858	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1985	118,841	58,956	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1986	84,150	63,418	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1987	72,370	34,232	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1988	53,880	32,140	50.0	10.0	50.0	10.0	80.0	10.0	80.0	10.0
1989	42,010	13,934	50.0	10.0	50.0	10.0	70.0	10.0	70.0	10.0
1990	38,216	17,321	50.0	10.0	50.0	10.0	70.0	10.0	70.0	10.0
1991	42,888	21,789	50.0	10.0	50.0	10.0	70.0	10.0	70.0	10.0
1992	34,593	19,265	50.0	10.0	50.0	10.0	70.0	10.0	70.0	10.0
1993	51,440	39,014	40.0	10.0	40.0	10.0	70.0	10.0	70.0	10.0
1994	37,489	33,411	40.0	10.0	40.0	10.0	70.0	10.0	70.0	10.0
1995	36,283	26,037	40.0	10.0	40.0	10.0	70.0	10.0	70.0	10.0
1996	40,792	36,636	40.0	10.0	40.0	10.0	70.0	10.0	70.0	10.0
1997	39,930	30,115	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
1998	46,645	34,806	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
1999	46,394	46,744	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
2000	61,854	51,569	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
2001	46,331	54,023	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
2002	38,101	43,100	35.0	10.0	35.0	10.0	70.0	10.0	70.0	10.0
2003	44,947	35,972	30.0	10.0	30.0	10.0	70.0	10.0	70.0	10.0
2004	34,640	28,077	30.0	10.0	30.0	10.0	70.0	10.0	70.0	10.0
2005	45,530	33,334	30.0	10.0	30.0	10.0	70.0	10.0	70.0	10.0
2006	48,688	39,508	30.0	10.0	30.0	10.0	70.0	10.0	70.0	10.0
2007	28,748	44,550	30.0	10.0	30.0	10.0	70.0	10.0	70.0	10.0
2008	34,338	40,553	30.0	10.0	30.0	10.0	65.0	10.0	65.0	10.0
2009	22,511	28,241	30.0	10.0	30.0	10.0	65.0	10.0	65.0	10.0
2010	29,836	28,611	30.0	10.0	30.0	10.0	65.0	10.0	55.0	10.0
2011	26,813	27,233	30.0	10.0	30.0	10.0	65.0	10.0	55.0	10.0
2012	28,289	28,000	30.0	10.0	30.0	10.0	65.0	10.0	55.0	10.0
2013	20,021	24,689	30.0	10.0	30.0	10.0	65.0	10.0	55.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Russia (Archangelsk and Karelia)

Annual input data for NEAC PFA run-reconstruction & NCL models for RUSSIA (ARCHANGLE/KORELIA). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	134	16,592	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1972	116	14,434	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1973	169	20,924	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1974	170	21,137	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1975	140	17,398	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1976	111	13,781	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1977	78	9,722	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1978	82	10,134	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1979	112	13,903	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1980	156	19,397	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1981	68	8,394	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1982	71	8,797	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1983	48	11,938	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1984	21	10,680	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1985	454	11,183	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1986	12	12,291	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1987	647	8,734	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1988	224	9,978	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1989	989	10,245	10.0	5.0	10.0	5.0	60.0	20.0	60.0	20.0
1990	1,418	8,429	15.0	5.0	15.0	5.0	60.0	20.0	60.0	20.0
1991	421	8,725	20.0	5.0	20.0	5.0	60.0	20.0	60.0	20.0
1992	1,031	3,949	25.0	5.0	25.0	5.0	60.0	20.0	60.0	20.0
1993	196	4,251	30.0	5.0	30.0	5.0	60.0	20.0	60.0	20.0
1994	334	5,631	35.0	5.0	35.0	5.0	60.0	20.0	60.0	20.0
1995	386	5,214	45.0	5.0	45.0	5.0	60.0	20.0	60.0	20.0
1996	231	3,753	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
1997	721	3,351	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
1998	585	4,208	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
1999	299	3,101	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2000	514	3,382	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2001	363	2,348	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2002	1,676	2,439	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2003	893	2,041	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2004	990	3,761	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2005	1,349	4,915	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2006	2,183	2,841	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2007	1,618	2,621	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2008	332	2,496	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2009	252	2,214	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2010	397	3,823	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2011	313	2,585	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2012	1,332	2,446	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2013	2,296	3,480	55.0	5.0	55.0	5.0	60.0	20.0	60.0	20.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Russia (Kola Peninsula: Barents Sea Basin)

Annual input data for NEAC PFA run-reconstruction & NCL models for RUSSIA (KOLA-BARENT SEA). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	4,892	5,979	15.0	5.0	15.0	5.0	45.0	5.0	45.0	5.0
1972	7,978	9,750	15.0	5.0	15.0	5.0	45.0	5.0	45.0	5.0
1973	9,376	11,460	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1974	12,794	15,638	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1975	13,872	13,872	15.0	5.0	15.0	5.0	45.0	5.0	45.0	5.0
1976	11,493	14,048	15.0	5.0	15.0	5.0	55.0	5.0	55.0	5.0
1977	7,257	8,253	15.0	5.0	15.0	5.0	50.0	5.0	50.0	5.0
1978	7,106	7,113	15.0	5.0	15.0	5.0	55.0	5.0	55.0	5.0
1979	6,707	3,141	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1980	6,621	5,216	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1981	4,547	5,973	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1982	5,159	4,798	15.0	5.0	15.0	5.0	35.0	5.0	35.0	5.0
1983	8,504	9,943	15.0	5.0	15.0	5.0	35.0	5.0	35.0	5.0
1984	9,453	12,601	15.0	5.0	15.0	5.0	35.0	5.0	35.0	5.0
1985	6,774	7,877	15.0	5.0	15.0	5.0	35.0	5.0	35.0	5.0
1986	10,147	5,352	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1987	8,560	5,149	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1988	6,644	3,655	15.0	5.0	15.0	5.0	35.0	5.0	35.0	5.0
1989	13,424	6,787	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1990	16,038	8,234	15.0	5.0	15.0	5.0	40.0	5.0	40.0	5.0
1991	4,550	7,568	15.0	5.0	15.0	5.0	30.0	5.0	30.0	5.0
1992	11,394	7,109	15.0	5.0	15.0	5.0	30.0	5.0	30.0	5.0
1993	8,642	5,690	15.0	5.0	15.0	5.0	30.0	5.0	30.0	5.0
1994	6,101	4,632	15.0	5.0	15.0	5.0	30.0	5.0	30.0	5.0
1995	6,318	3,693	15.0	5.0	15.0	5.0	30.0	5.0	30.0	5.0
1996	6,815	1,701	20.0	5.0	20.0	5.0	25.0	5.0	25.0	5.0
1997	3,564	867	25.0	5.0	25.0	5.0	15.0	5.0	15.0	5.0
1998	1,854	280	35.0	5.0	35.0	5.0	12.5	2.5	12.5	2.5
1999	1,510	424	40.0	5.0	40.0	5.0	7.5	2.5	7.5	2.5
2000	805	323	50.0	5.0	50.0	5.0	6.0	2.0	6.0	2.0
2001	591	241	60.0	5.0	60.0	5.0	3.5	1.5	3.5	1.5
2002	1,436	2,478	50.0	10.0	50.0	10.0	10.0	5.0	20.0	5.0
2003	1,938	1,095	50.0	10.0	50.0	10.0	10.0	5.0	20.0	5.0
2004	1,095	850	50.0	10.0	50.0	10.0	10.0	5.0	20.0	5.0
2005	859	426	60.0	10.0	60.0	10.0	10.0	5.0	20.0	5.0
2006	1,372	844	60.0	10.0	60.0	10.0	10.0	5.0	20.0	5.0
2007	784	707	60.0	10.0	60.0	10.0	10.0	5.0	20.0	5.0
2008	1,446	997	60.0	10.0	60.0	10.0	15.0	5.0	20.0	5.0
2009	2,882	1,080	60.0	10.0	60.0	10.0	15.0	5.0	20.0	5.0
2010	3,884	1,486	60.0	10.0	60.0	10.0	20.0	5.0	25.0	5.0
2011	3,861	1,407	60.0	10.0	60.0	10.0	20.0	5.0	25.0	5.0
2012	2,708	1,027	60.0	10.0	60.0	10.0	20.0	5.0	25.0	5.0
2013	939	904	60.0	10.0	60.0	10.0	20.0	5.0	25.0	5.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Russia (Kola Peninsula: White Sea Basin)

Annual input data for NEAC PFA run-reconstruction & NCL models for RUSSIA (KOLA-WHITE SEA). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Catch 1SW following-year spawners	Catch MSW following-year spawners	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	67,845	29,077	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1972	45,837	19,644	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1973	68,684	29,436	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1974	63,892	27,382	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1975	109,038	46,730	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1976	76,281	41,075	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1977	47,943	32,392	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1978	49,291	17,307	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1979	69,511	21,369	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1980	46,037	23,241	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1981	40,172	12,747	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1982	32,619	14,840	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1983	54,217	20,840	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1984	56,786	16,893	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1985	87,274	16,876	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1986	72,102	17,681	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	60.0	10.0
1987	79,639	12,501	0.0	0.0	3.0	2.0	3.0	2.0	50.0	10.0	50.0	10.0
1988	44,813	18,777	0.0	0.0	3.0	2.0	3.0	2.0	45.0	5.0	45.0	5.0
1989	53,293	11,448	0.0	0.0	7.5	2.5	7.5	2.5	45.0	5.0	45.0	5.0
1990	44,409	11,152	0.0	0.0	12.5	2.5	12.5	2.5	45.0	5.0	45.0	5.0
1991	31,978	6,263	0.0	0.0	17.5	2.5	17.5	2.5	35.0	5.0	35.0	5.0
1992	23,827	3,680	0.0	0.0	22.5	2.5	22.5	2.5	25.0	5.0	25.0	5.0
1993	20,987	5,552	0.0	0.0	25.0	5.0	25.0	5.0	25.0	5.0	25.0	5.0
1994	25,178	3,680	0.0	0.0	30.0	5.0	30.0	5.0	25.0	5.0	15.0	5.0
1995	19,381	2,847	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
1996	27,097	2,710	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
1997	27,695	2,085	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
1998	32,693	1,963	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
1999	22,330	2,841	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
2000	26,376	4,396	0.0	0.0	35.0	5.0	35.0	5.0	25.0	5.0	15.0	5.0
2001	20,483	3,959	0.0	0.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2002	19,174	3,937	0.0	0.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2003	15,687	3,734	0.0	0.0	35.0	5.0	25.0	5.0	15.0	5.0	15.0	5.0
2004	10,947	1,990	0.0	0.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2005	13,172	2,388	1212.0	878.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2006	15,004	2,071	3852.0	399.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2007	7,807	1,404	2264.0	852.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2008	8,447	4,711	3175.0	832.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2009	5,351	3,105	5130.0	1710.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2010	6,731	4,158	3684.0	1228.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2011	7,363	4,325	3082.0	1027.3	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2012	10,398	1,431	2267.0	756.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2013	8,986	1,660	2203.0	734.0	35.0	5.0	35.0	5.0	15.0	5.0	15.0	5.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Russia (Pechora River)

Annual input data for NEAC PFA run-reconstruction & NCL models for RUSSIA (PECHORA RIVER). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Return estimate 1SW salmon	Return estimate MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	605	17,728	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1972	825	24,175	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1973	1,705	49,962	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1974	1,320	38,680	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1975	1,298	38,046	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1976	991	34,394	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1977	589	20,464	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1978	759	26,341	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1979	421	14,614	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1980	1,123	39,001	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1981	126	20,874	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1982	54	13,546	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1983	598	16,002	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1984	1,833	15,967	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1985	2,763	29,738	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1986	66	32,734	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1987	21	21,179	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1988	3,184	12,816	NA	NA	20.0	10.0	20.0	10.0	65.0	15.0	65.0	15.0
1989	NA	NA	24,596	27,404	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1990	NA	NA	50	49,950	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1991	NA	NA	7,975	47,025	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1992	NA	NA	550	54,450	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1993	NA	NA	68	67,932	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1994	NA	NA	3,900	48,100	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1995	NA	NA	9,280	70,720	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1996	NA	NA	8,664	48,336	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1997	NA	NA	1,440	38,560	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1998	NA	NA	780	59,220	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
1999	NA	NA	2,120	37,880	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2000	NA	NA	84	83,916	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2001	NA	NA	2,244	41,756	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2002	NA	NA	405	44,595	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2003	NA	NA	1,650	31,350	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2004	NA	NA	6,075	20,925	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2005	NA	NA	2,852	28,148	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2006	NA	NA	1,472	30,528	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2007	NA	NA	817	42,183	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2008	NA	NA	300	49,700	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2009	NA	NA	1,116	47,385	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2010	NA	NA	1,096	53,704	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2011	NA	NA	2,990	56,810	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2012	NA	NA	4,424	27,176	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2013	NA	NA	4,225	30,983	10.0	5.0	10.0	5.0	65.0	15.0	65.0	15.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Sweden

Annual input data for NEAC PFA run-reconstruction & NCL models for SWEDEN. (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	6,220	254	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1972	4,943	201	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1973	6,124	895	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1974	8,870	563	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1975	9,620	160	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1976	5,420	480	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1977	2,453	206	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1978	2,903	254	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1979	2,988	661	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1980	3,842	1,283	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1981	7,013	284	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1982	6,177	1,381	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1983	8,222	903	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1984	11,584	1,266	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1985	13,810	470	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1986	14,415	240	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1987	11,450	1,084	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1988	9,604	1,160	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1989	2,803	4,044	30.0	15.0	30.0	15.0	52.5	12.5	57.5	12.5
1990	6,839	2,249	15.0	10.0	15.0	10.0	45.0	15.0	50.0	15.0
1991	8,599	3,033	15.0	10.0	15.0	10.0	45.0	15.0	50.0	15.0
1992	9,550	4,205	15.0	10.0	15.0	10.0	45.0	15.0	50.0	15.0
1993	9,468	4,762	15.0	10.0	15.0	10.0	45.0	15.0	50.0	15.0
1994	7,347	3,628	15.0	10.0	15.0	10.0	45.0	15.0	50.0	15.0
1995	8,933	1,528	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
1996	5,318	2,507	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
1997	2,415	1,809	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
1998	1,953	1,000	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
1999	3,075	712	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2000	5,660	2,546	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2001	3,504	3,026	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2002	3,374	2,075	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2003	1,833	496	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2004	1,537	1,528	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2005	1,503	1,027	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2006	1,676	1,069	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2007	521	1,001	15.0	10.0	15.0	10.0	37.5	12.5	42.5	12.5
2008	615	1,112	12.5	7.5	12.5	7.5	27.5	12.5	32.5	12.5
2009	651	979	12.5	7.5	12.5	7.5	27.5	12.5	32.5	12.5
2010	1,111	1,139	12.5	7.5	12.5	7.5	27.5	12.5	32.5	12.5
2011	1,460	3,100	17.5	7.5	17.5	7.5	45.0	15.0	50.0	15.0
2012	1,336	3,130	12.5	7.5	10.0	5.0	27.5	12.5	32.5	12.5
2013	874	1,431	10.0	5.0	10.0	5.0	30.0	15.0	35.0	15.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

UK (England and Wales)

Annual input data for NEAC PFA run-reconstruction & NCL models for UK(ENGLAND AND WALES). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared total catch	Estimated proportion 1SW (total)	Declared catch in NE coastal fishery total	Declared catch in NE coastal fishery - drift nets	Declared catch in NE coastal fishery - T/J nets	Estimated proportion 1SW (NE fishery)	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon	Estimated % unreported catch in NE fishery	Estimated proportion Scottish fish in NE fishery (total)	Estimated proportion Scottish fish in NE fishery (drift)	Estimated proportion Scottish fish in NE fishery (T/J nets)
1971	109,861	0.55	60,353	NA	NA	0.55	38.3	9.6	38.3	9.6	57.3	10.0	42.5	10.0	32.3	0.95	NA	NA
1972	108,074	0.42	51,681	NA	NA	0.42	39.0	9.7	39.0	9.7	51.3	10.0	37.8	10.0	32.3	0.95	NA	NA
1973	114,786	0.53	62,842	NA	NA	0.53	38.4	9.6	38.4	9.6	50.6	10.0	37.3	10.0	32.3	0.95	NA	NA
1974	104,325	0.65	52,756	NA	NA	0.65	39.3	9.8	39.3	9.8	50.2	10.0	37.0	10.0	32.3	0.95	NA	NA
1975	113,062	0.59	53,451	NA	NA	0.59	38.5	9.6	38.5	9.6	49.8	10.0	36.7	10.0	32.3	0.95	NA	NA
1976	54,294	0.64	15,701	NA	NA	0.64	36.8	9.2	36.8	9.2	50.3	10.0	37.1	10.0	32.3	0.94	NA	NA
1977	94,282	0.62	52,888	NA	NA	0.62	39.0	9.8	39.0	9.8	50.4	10.0	37.2	10.0	32.3	0.93	NA	NA
1978	93,125	0.69	51,630	NA	NA	0.69	38.4	9.6	38.4	9.6	49.1	10.0	36.2	10.0	32.3	0.92	NA	NA
1979	75,386	0.81	43,464	NA	NA	0.81	38.6	9.6	38.6	9.6	47.7	10.0	35.2	10.0	32.3	0.91	NA	NA
1980	90,218	0.55	45,780	NA	NA	0.55	39.1	9.8	39.1	9.8	47.8	10.0	35.2	10.0	32.3	0.9	NA	NA
1981	121,039	0.48	69,113	NA	NA	0.48	38.3	9.6	38.3	9.6	47.4	10.0	34.9	10.0	32.3	0.89	NA	NA
1982	80,289	0.67	50,167	NA	NA	0.67	38.3	9.6	38.3	9.6	47.3	10.0	34.8	10.0	32.3	0.88	NA	NA
1983	116,995	0.72	77,277	NA	NA	0.72	37.1	9.3	37.1	9.3	47.1	10.0	34.7	10.0	32.3	0.87	NA	NA
1984	94,271	0.74	59,295	NA	NA	0.74	36.5	9.1	36.5	9.1	47.4	10.0	34.8	10.0	32.3	0.86	NA	NA
1985	95,531	0.66	57,356	NA	NA	0.66	38.9	9.7	38.9	9.7	47.4	10.0	34.8	10.0	32.3	0.85	NA	NA
1986	110,794	0.62	63,425	NA	NA	0.62	38.0	9.5	38.0	9.5	46.9	10.0	34.3	10.0	32.3	0.84	NA	NA
1987	83,439	0.68	36,143	NA	NA	0.68	38.2	9.5	38.2	9.5	46.1	10.0	33.7	10.0	32.3	0.83	NA	NA
1988	110,163	0.69	NA	47,465	3,384	0.69	39.7	9.9	39.7	9.9	45.5	10.0	33.5	10.0	32.3	NA	0.82	0.5
1989	83,668	0.65	NA	36,236	5,217	0.65	36.9	9.2	36.9	9.2	45.3	10.0	33.3	10.0	32.3	NA	0.81	0.5
1990	86,676	0.52	NA	48,219	3,311	0.52	36.7	9.2	36.7	9.2	45.3	10.0	33.2	10.0	31.3	NA	0.8	0.5
1991	51,649	0.71	NA	22,463	2,966	0.71	37.3	9.3	37.3	9.3	44.0	10.0	32.3	10.0	29.7	NA	0.79	0.5
1992	44,586	0.77	NA	17,574	2,570	0.77	39.8	10.0	39.8	10.0	43.5	10.0	31.8	10.0	28.0	NA	0.78	0.5
1993	69,177	0.81	NA	39,224	2,576	0.81	38.0	9.5	38.0	9.5	40.6	10.0	29.5	10.0	26.3	NA	0.77	0.5
1994	88,121	0.77	NA	41,298	5,256	0.77	23.9	6.0	23.9	6.0	40.5	10.0	29.5	10.0	24.4	NA	0.76	0.5
1995	80,478	0.72	NA	48,005	5,205	0.72	22.3	5.6	22.3	5.6	37.6	10.0	27.1	10.0	22.5	NA	0.75	0.5
1996	46,696	0.65	NA	15,172	3,409	0.65	20.6	5.1	20.6	5.1	35.8	10.0	25.8	10.0	20.6	NA	0.75	0.5
1997	41,374	0.73	NA	19,241	2,681	0.73	18.8	4.7	18.8	4.7	33.4	10.0	23.9	10.0	18.5	NA	0.75	0.5
1998	36,917	0.82	NA	17,328	937	0.82	18.9	4.7	18.9	4.7	31.4	10.0	22.4	10.0	18.5	NA	0.75	0.5
1999	41,094	0.68	NA	24,812	2,021	0.68	17.4	4.4	17.4	4.4	29.5	10.0	17.9	9.0	17.1	NA	0.75	0.5
2000	60,953	0.79	NA	40,059	3,295	0.79	14.9	3.7	14.9	3.7	29.7	10.0	15.0	7.5	13.1	NA	0.75	0.5
2001	51,307	0.75	NA	32,374	3,741	0.75	14.8	3.7	14.8	3.7	27.9	10.0	14.3	7.1	13.1	NA	0.75	0.5
2002	45,669	0.76	NA	27,685	3,295	0.76	15.3	3.8	15.3	3.8	27.8	10.0	14.1	7.0	13.9	NA	0.75	0.5
2003	22,206	0.66	NA	5,511	4,924	0.66	17.4	4.4	17.4	4.4	21.4	10.0	10.7	5.3	17.1	NA	0.75	0.5
2004	30,559	0.81	NA	5,921	5,096	0.81	17.7	4.4	17.7	4.4	22.1	10.0	10.6	5.3	17.1	NA	0.75	0.5
2005	26,162	0.76	NA	5,607	3,380	0.76	17.6	4.4	17.6	4.4	21.8	10.0	10.6	5.3	17.1	NA	0.75	0.5
2006	22,056	0.78	NA	4,040	3,526	0.78	17.6	4.4	17.6	4.4	19.5	9.8	9.1	4.6	17.1	NA	0.75	0.5
2007	19,923	0.78	NA	4,894	2,197	0.78	17.7	4.4	17.7	4.4	17.9	9.0	8.4	4.2	17.1	NA	0.75	0.5
2008	19,036	0.76	NA	3,649	2,592	0.76	17.8	4.4	17.8	4.4	17.6	8.8	8.2	4.1	17.1	NA	0.75	0.5
2009	13,910	0.72	NA	2,590	2,805	0.72	11.4	2.9	11.4	2.9	17.4	8.7	8.2	4.1	7.4	NA	0.75	0.5
2010	32,695	0.78	NA	12,214	7,768	0.78	10.8	2.7	10.8	2.7	17.5	8.8	8.0	4.0	7.4	NA	0.75	0.5
2011	34,575	0.57	NA	14,915	9,233	0.57	10.6	2.6	10.6	2.6	20.8	10.0	10.2	5.1	7.4	NA	0.75	0.5
2012	14,926	0.50	NA	3,571	3,705	0.50	11.5	2.9	11.5	2.9	16.8	8.4	8.0	4.0	7.4	NA	0.75	0.5
2013	22,335	0.58	NA	7,964	8,679	0.58	9.8	2.4	9.8	2.4	17.5	8.7	8.6	4.3	7.4	NA	0.75	0.5
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

UK (N. Ireland)-Foyle Fisheries Area

Annual input data for NEAC PFA run-reconstruction & NCL models for UK(NORTHERN IRELAND) (FOYLE). (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared net catch 1SW salmon	Declared net catch MSW salmon	Declared rod catch 1SW salmon	Declared rod catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	78,037	5,874	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1972	64,663	4,867	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1973	57,469	4,326	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1974	72,587	5,464	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1975	51,061	3,843	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1976	36,206	2,725	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1977	36,510	2,748	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1978	44,557	3,354	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1979	34,413	2,590	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1980	45,777	3,446	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1981	32,346	2,435	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1982	55,946	4,211	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1983	77,424	5,828	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1984	27,465	2,067	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1985	37,685	2,836	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1986	43,109	3,245	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1987	17,189	1,294	NA	NA	21.5	11.5	21.5	11.5	69.0	7.0	46.0	5.0
1988	43,974	3,310	NA	NA	21.5	11.5	21.5	11.5	64.5	6.5	36.0	4.0
1989	60,288	4,538	NA	NA	23.5	13.5	23.5	13.5	89.0	9.0	60.0	6.0
1990	39,875	3,001	NA	NA	13.5	3.5	13.5	3.5	62.0	6.0	38.0	4.0
1991	21,709	1,634	NA	NA	13.5	3.5	13.5	3.5	64.5	6.5	43.0	4.0
1992	39,299	2,958	NA	NA	16.5	6.5	16.5	6.5	56.0	6.0	33.0	3.0
1993	35,366	2,662	NA	NA	13.5	3.5	13.5	3.5	41.0	4.0	12.0	1.0
1994	36,144	2,720	NA	NA	19.0	9.0	19.0	9.0	70.0	7.0	40.0	4.0
1995	33,398	2,514	NA	NA	13.5	3.5	13.5	3.5	67.0	7.0	42.0	4.0
1996	28,406	2,138	NA	NA	15.0	5.0	15.0	5.0	57.0	10.0	34.0	10.0
1997	40,886	3,077	NA	NA	10.0	5.0	10.0	5.0	60.0	10.0	34.0	10.0
1998	37,154	2,797	NA	NA	10.0	5.0	10.0	5.0	25.0	5.0	22.5	7.5
1999	21,660	1,630	NA	NA	10.0	5.0	10.0	5.0	63.0	5.0	32.5	7.5
2000	30,385	2,287	NA	NA	10.0	5.0	10.0	5.0	58.0	5.0	32.5	7.5
2001	21,368	1,608	NA	NA	5.0	5.0	5.0	5.0	50.0	5.0	30.0	5.0
2002	37,914	2,854	9163.0	690.0	2.5	2.5	2.5	2.5	15.0	3.0	15.0	3.0
2003	30,441	2,291	4576.0	344.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2004	20,730	1,560	4570.0	344.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2005	23,746	1,787	7079.0	533.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2006	11,324	852	4886.0	368.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2007	5,050	322	9530.0	608.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2008	3,880	292	4755.0	304.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2009	1,743	194	3640.0	405.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2010	-	-	4257.0	473.0	0.5	0.5	0.5	0.5	15.0	3.0	15.0	3.0
2011	-	-	3770.0	1256.0	1.0	1.0	1.0	1.0	15.0	5.0	15.0	5.0
2012	-	-	4781.0	1594.0	1.0	1.0	1.0	1.0	10.0	7.5	10.0	7.5
2013	-	-	3718.0	762.0	1.0	1.0	1.0	1.0	10.0	7.5	10.0	7.5
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

UK (N. Ireland)-DCAL area

Annual input data for NEAC PFA run-reconstruction & NCL models for UK(NORTHERN IRELAND) (LOCHS AGENCY AREA) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared net catch 1SW salmon	Declared net catch MSW salmon	Declared rod catch 1SW salmon	Declared rod catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	35,506	2,673	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1972	34,550	2,601	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1973	29,229	2,200	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1974	22,307	1,679	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1975	26,701	2,010	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1976	17,886	1,346	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1977	16,778	1,263	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1978	24,857	1,871	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1979	14,323	1,078	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1980	15,967	1,202	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1981	15,994	1,204	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1982	14,068	1,059	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1983	20,845	1,569	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1984	11,109	836	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1985	12,369	931	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1986	13,160	991	NA	NA	21.5	11.5	21.5	11.5	80.0	5.0	50.0	5.0
1987	9,240	695	NA	NA	21.5	11.5	21.5	11.5	69.0	7.0	46.0	5.0
1988	14,320	1,078	NA	NA	21.5	11.5	21.5	11.5	64.5	6.5	36.0	4.0
1989	15,081	1,135	NA	NA	23.5	13.5	23.5	13.5	89.0	9.0	60.0	6.0
1990	9,499	715	NA	NA	13.5	3.5	13.5	3.5	62.0	6.0	38.0	4.0
1991	6,987	526	NA	NA	13.5	3.5	13.5	3.5	64.5	6.5	43.0	4.0
1992	9,346	703	NA	NA	16.5	6.5	16.5	6.5	56.0	6.0	33.0	3.0
1993	7,906	595	NA	NA	13.5	3.5	13.5	3.5	41.0	4.0	12.0	1.0
1994	11,206	843	NA	NA	19.0	9.0	19.0	9.0	70.0	7.0	40.0	4.0
1995	11,637	876	NA	NA	13.5	3.5	13.5	3.5	67.0	7.0	42.0	4.0
1996	10,383	781	NA	NA	15.0	5.0	15.0	5.0	57.0	10.0	34.0	10.0
1997	10,479	789	NA	NA	10.0	5.0	10.0	5.0	60.0	10.0	34.0	10.0
1998	9,375	706	NA	NA	10.0	5.0	10.0	5.0	25.0	5.0	22.5	7.5
1999	9,011	678	NA	NA	10.0	5.0	10.0	5.0	63.0	5.0	32.5	7.5
2000	10,598	798	NA	NA	10.0	5.0	10.0	5.0	58.0	5.0	32.5	7.5
2001	8,104	610	NA	NA	5.0	5.0	5.0	5.0	50.0	5.0	30.0	5.0
2002	3,315	249	2218.0	167.0	2.5	2.5	2.5	2.5	13.7	8.8	13.7	8.8
2003	2,236	168	1884.0	141.0	2.5	2.5	2.5	2.5	12.3	6.6	12.3	6.6
2004	2,411	181	3053.0	230.0	0.5	0.5	0.5	0.5	18.3	9.7	18.3	9.7
2005	3,012	227	1791.0	135.0	0.5	0.5	0.5	0.5	11.9	7.1	11.9	7.1
2006	2,288	172	1289.0	97.0	0.5	0.5	0.5	0.5	12.4	8.0	12.4	8.0
2007	2,533	162	2427.0	155.0	0.5	0.5	0.5	0.5	11.0	3.6	11.0	3.6
2008	1,825	116	2444.0	156.0	0.5	0.5	0.5	0.5	13.9	7.1	13.9	7.1
2009	1,383	154	1457.0	162.0	0.5	0.5	0.5	0.5	9.9	3.0	9.9	3.0
2010	1,723	191	1327.0	147.0	0.5	0.5	0.5	0.5	14.6	2.5	14.6	2.5
2011	857	285	1132.0	378.0	1.0	1.0	1.0	1.0	15.0	5.0	15.0	5.0
2012	15	5	263.0	87.0	1.0	1.0	1.0	1.0	10.0	5.0	10.0	5.0
2013	8	2	95.0	19.0	1.0	1.0	1.0	1.0	5.0	10.0	5.0	10.0
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

UK (Scotland)-East

Annual input data for NEAC PFA run-reconstruction & NCL models for SCOTLAND (EAST) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	216,873	135,530	25.0	10.0	25.0	10.0	75.4	12.6	49.9	10.0
1972	220,106	183,875	25.0	10.0	25.0	10.0	76.8	12.8	51.4	10.3
1973	259,773	204,826	25.0	10.0	25.0	10.0	74.9	12.5	49.9	10.0
1974	245,424	158,959	25.0	10.0	25.0	10.0	82.0	13.7	56.3	11.3
1975	181,940	180,828	25.0	10.0	25.0	10.0	80.5	13.4	55.1	11.0
1976	150,069	92,179	25.0	10.0	25.0	10.0	76.5	12.8	50.7	10.1
1977	154,306	118,645	25.0	10.0	25.0	10.0	81.4	13.6	55.8	11.2
1978	158,859	139,763	25.0	10.0	25.0	10.0	75.6	12.6	51.0	10.2
1979	160,796	116,559	25.0	10.0	25.0	10.0	78.4	13.1	53.9	10.8
1980	101,665	155,646	17.5	7.5	17.5	7.5	76.8	12.8	52.0	10.4
1981	129,690	156,683	17.5	7.5	17.5	7.5	75.9	12.7	51.2	10.2
1982	175,374	113,198	17.5	7.5	17.5	7.5	71.1	11.8	45.3	9.1
1983	170,843	126,104	17.5	7.5	17.5	7.5	77.0	12.8	49.4	9.9
1984	175,675	90,829	17.5	7.5	17.5	7.5	70.1	11.7	43.9	8.8
1985	133,119	95,044	17.5	7.5	17.5	7.5	61.9	10.3	38.9	7.8
1986	180,292	128,654	17.5	7.5	17.5	7.5	59.5	9.9	37.6	7.5
1987	139,252	88,519	17.5	7.5	17.5	7.5	64.5	10.8	40.5	8.1
1988	118,614	91,151	17.5	7.5	17.5	7.5	40.3	6.7	29.2	5.8
1989	143,049	85,385	10.0	5.0	10.0	5.0	37.5	6.3	28.0	5.6
1990	63,318	73,971	10.0	5.0	10.0	5.0	39.8	6.6	28.7	5.7
1991	53,860	53,693	10.0	5.0	10.0	5.0	36.8	6.1	27.4	5.5
1992	79,883	67,968	10.0	5.0	10.0	5.0	32.1	5.4	25.9	5.2
1993	73,396	60,496	10.0	5.0	10.0	5.0	35.3	5.9	26.9	5.4
1994	80,429	72,758	10.0	5.0	10.0	5.0	33.1	5.5	26.1	5.2
1995	72,973	69,051	10.0	5.0	10.0	5.0	30.9	5.2	25.4	5.1
1996	56,627	50,365	10.0	5.0	10.0	5.0	28.8	4.8	24.5	4.9
1997	37,448	34,850	10.0	5.0	10.0	5.0	30.6	5.1	25.1	5.0
1998	44,952	32,231	10.0	5.0	10.0	5.0	24.2	4.0	22.9	4.6
1999	20,907	27,011	10.0	5.0	10.0	5.0	24.8	4.1	23.3	4.7
2000	36,871	31,280	10.0	5.0	10.0	5.0	21.8	3.6	22.3	4.5
2001	36,646	30,470	10.0	5.0	10.0	5.0	20.4	3.4	21.6	4.5
2002	26,616	21,740	10.0	5.0	10.0	5.0	19.3	3.2	21.2	4.2
2003	25,871	24,270	10.0	5.0	10.0	5.0	17.3	2.8	19.3	4.3
2004	31,667	30,773	10.0	5.0	10.0	5.0	17.3	2.8	19.3	4.3
2005	31,597	23,676	10.0	5.0	10.0	5.0	17.3	2.8	19.3	4.3
2006	30,739	22,954	10.0	5.0	10.0	5.0	15.3	2.8	16.5	3.5
2007	26,015	19,444	10.0	5.0	10.0	5.0	13.8	2.8	15.0	3.5
2008	18,586	20,757	10.0	5.0	10.0	5.0	10.8	2.8	14.0	3.5
2009	14,863	15,042	10.0	5.0	10.0	5.0	9.8	2.8	13.0	3.5
2010	28,252	22,908	10.0	5.0	10.0	5.0	9.8	2.8	13.0	3.5
2011	12,485	24,213	10.0	5.0	10.0	5.0	9.3	2.8	12.5	3.5
2012	16,117	16,165	10.0	5.0	10.0	5.0	8.3	2.8	11.5	3.5
2013	18,983	15,355	10.0	5.0	10.0	5.0	7.3	2.8	11.0	3.5
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

UK (Scotland)-West

Annual input data for NEAC PFA run-reconstruction & NCL models for SCOTLAND (WEST) (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation).

Year	Declared catch 1SW salmon	Declared catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	Estimated % unreported catch of MSW salmon	Uncertainty in % unreported catch of MSW salmon	Estimated exploitation rate (%) - 1SW salmon	Uncertainty in exploitation rate (%) - 1SW salmon	Estimated exploitation rate (%) - MSW salmon	Uncertainty in exploitation rate (%) - MSW salmon
1971	45,287	26,071	35.0	10.0	35.0	10.0	37.7	6.3	24.9	5.0
1972	31,358	34,148	35.0	10.0	35.0	10.0	38.4	6.4	25.7	5.1
1973	33,317	33,094	35.0	10.0	35.0	10.0	37.5	6.2	24.9	5.0
1974	43,992	29,369	35.0	10.0	35.0	10.0	41.0	6.8	28.2	5.6
1975	40,424	27,145	35.0	10.0	35.0	10.0	40.2	6.7	27.5	5.5
1976	38,409	22,367	35.0	10.0	35.0	10.0	38.3	6.4	25.3	5.1
1977	39,952	20,335	35.0	10.0	35.0	10.0	40.7	6.8	27.9	5.6
1978	45,611	23,191	35.0	10.0	35.0	10.0	37.8	6.3	25.5	5.1
1979	26,440	15,950	35.0	10.0	35.0	10.0	39.2	6.5	26.9	5.4
1980	19,776	16,942	27.5	7.5	27.5	7.5	38.4	6.4	26.0	5.2
1981	21,048	18,038	27.5	7.5	27.5	7.5	38.0	6.3	25.6	5.1
1982	32,687	15,044	27.5	7.5	27.5	7.5	35.5	5.9	22.6	4.5
1983	38,774	19,857	27.5	7.5	27.5	7.5	38.5	6.4	24.7	4.9
1984	37,404	16,384	27.5	7.5	27.5	7.5	35.1	5.8	21.9	4.4
1985	24,861	19,571	27.5	7.5	27.5	7.5	30.9	5.2	19.5	3.9
1986	22,546	19,543	27.5	7.5	27.5	7.5	29.7	5.0	18.8	3.8
1987	25,533	15,475	27.5	7.5	27.5	7.5	32.3	5.4	20.3	4.1
1988	30,484	21,011	27.5	7.5	27.5	7.5	20.1	3.4	14.6	2.9
1989	31,892	18,501	20.0	5.0	20.0	5.0	18.8	3.1	14.0	2.8
1990	17,776	13,953	20.0	5.0	20.0	5.0	19.9	3.3	14.4	2.9
1991	19,748	11,500	20.0	5.0	20.0	5.0	18.4	3.1	13.7	2.7
1992	21,793	14,873	20.0	5.0	20.0	5.0	16.1	2.7	12.9	2.6
1993	21,121	11,230	20.0	5.0	20.0	5.0	17.7	2.9	13.5	2.7
1994	18,234	12,304	20.0	5.0	20.0	5.0	16.5	2.8	13.0	2.6
1995	16,831	9,137	20.0	5.0	20.0	5.0	15.5	2.6	12.7	2.5
1996	9,537	7,463	20.0	5.0	20.0	5.0	14.4	2.4	12.2	2.4
1997	9,059	5,504	20.0	5.0	20.0	5.0	15.3	2.5	12.6	2.5
1998	8,369	6,150	20.0	5.0	20.0	5.0	12.1	2.0	11.5	2.3
1999	4,147	3,587	20.0	5.0	20.0	5.0	12.4	2.1	11.7	2.3
2000	6,974	5,301	20.0	5.0	20.0	5.0	10.9	1.8	11.1	2.2
2001	5,603	4,191	20.0	5.0	20.0	5.0	10.2	1.7	10.8	2.3
2002	4,691	4,548	20.0	5.0	20.0	5.0	9.6	1.6	10.6	2.1
2003	3,536	3,061	20.0	5.0	20.0	5.0	4.8	0.8	5.3	1.3
2004	5,836	6,024	20.0	5.0	20.0	5.0	7.0	1.0	7.5	1.5
2005	7,428	4,913	20.0	5.0	20.0	5.0	7.0	1.0	7.5	1.5
2006	5,767	4,403	20.0	5.0	20.0	5.0	7.0	1.0	7.5	1.5
2007	6,178	4,470	20.0	5.0	20.0	5.0	7.0	1.0	7.5	1.5
2008	4,740	4,853	20.0	5.0	20.0	5.0	7.0	1.0	7.5	1.5
2009	3,250	4,095	20.0	5.0	20.0	5.0	6.0	1.0	6.5	1.5
2010	5,107	4,052	20.0	5.0	20.0	5.0	6.0	1.0	6.5	1.5
2011	3,206	4,246	20.0	5.0	20.0	5.0	5.5	1.0	6.0	1.5
2012	3,239	3,391	20.0	5.0	20.0	5.0	4.5	1.0	5.0	1.5
2013	2,399	2,346	20.0	5.0	20.0	5.0	4.0	1.0	4.8	1.5
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Faroes

Annual input data for NEAC PFA run-reconstruction & NCL models for Faroes. (Uncertainty values define uniform distribution around estimate used in Monte Carlo simulation).

Year	Catch 1SW salmon	Catch MSW salmon	Estimated % unreported catch of 1SW salmon	Uncertainty in % unreported catch of 1SW salmon	% wild
1971	2,620	105,796	10.0	5.0	1.0
1972	2,754	111,187	10.0	5.0	1.0
1973	3,121	126,012	10.0	5.0	1.0
1974	2,186	88,276	10.0	5.0	1.0
1975	2,798	112,984	10.0	5.0	1.0
1976	1,830	73,900	10.0	5.0	1.0
1977	1,291	52,112	10.0	5.0	1.0
1978	974	39,309	10.0	5.0	1.0
1979	1,736	70,082	10.0	5.0	1.0
1980	4,523	182,616	10.0	5.0	1.0
1981	7,443	300,542	10.0	5.0	1.0
1982	6,859	276,957	10.0	5.0	1.0
1983	15,861	215,349	10.0	5.0	1.0
1984	5,534	138,227	10.0	5.0	1.0
1985	378	158,103	10.0	5.0	0.9
1986	1,979	180,934	10.0	5.0	1.0
1987	90	166,244	10.0	5.0	1.0
1988	8,637	87,629	10.0	5.0	0.9
1989	1,788	121,965	10.0	5.0	0.8
1990	1,989	140,054	10.0	5.0	0.5
1991	943	84,935	10.0	5.0	0.5
1992	68	35,700	10.0	5.0	0.6
1993	6	30,023	10.0	5.0	0.7
1994	15	31,672	10.0	5.0	0.7
1995	18	34,662	10.0	5.0	0.8
1996	101	28,381	10.0	5.0	0.8
1997	-	-	15.0	5.0	0.8
1998	339	1,424	15.0	5.0	0.8
1999	-	-	15.0	5.0	0.8
2000	225	1,765	15.0	5.0	0.8
2001	-	-	15.0	5.0	0.8
2002	-	-	15.0	5.0	0.8
2003	-	-	15.0	5.0	0.8
2004	-	-	15.0	5.0	0.8
2005	-	-	15.0	5.0	0.8
2006	-	-	15.0	5.0	0.8
2007	-	-	15.0	5.0	0.8
2008	-	-	15.0	5.0	0.8
2009	-	-	15.0	5.0	0.8
2010	-	-	15.0	5.0	0.8
2011	-	-	15.0	5.0	0.8
2012	-	-	15.0	5.0	0.8
2013	-	-	15.0	5.0	0.8
2014	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA

Stock composition		
Country	1SW	MSW
NNEAC		
Finland	0.059	0.050
Iceland-NE	0.016	0.011
Norway	0.290	0.295
Russia	0.116	0.163
Sweden	0.019	0.016
SNEAC		
France	0.018	0.005
Iceland-SW	0.025	0.007
Ireland	0.173	0.043
UK(England	0.044	0.034
UK(N.Ireland	0.046	0.014
UK(Scotland	0.195	0.337
Other	0.000	0.025
Total	1	1

West Greenland

Annual input data for NEAC PFA run-reconstruction & NCL models for WEST GREENLAND. (Uncertainty values define uniform distribution around estimates used in Monte Carlo simulation)

Year	Declared catch (t)	Estimated unreported catch	Wean weight	Estimated min' proportion of NAC fish (from scale analysis)	Estimated max' proportion of NAC fish (from scale analysis)	Proportion 1SW in NAC fish	Proportion 1SW in NEAC fish	No. Fish identified as NAC (from genetic analysis)	No. Fish identified as NEAC (from genetic analysis)
1971	2689	0	3.14	0.28	0.4	0.945	0.964	-	-
1972	2113	0	3.44	0.34	0.37	0.945	0.964	-	-
1973	2341	0	4.18	0.39	0.59	0.945	0.964	-	-
1974	1917	0	3.58	0.39	0.46	0.945	0.964	-	-
1975	2030	0	3.12	0.4	0.48	0.945	0.964	-	-
1976	1175	0	3.04	0.38	0.48	0.945	0.964	-	-
1977	1420	0	3.21	0.38	0.57	0.945	0.964	-	-
1978	984	0	3.35	0.47	0.57	0.945	0.964	-	-
1979	1395	0	3.34	0.48	0.52	0.945	0.964	-	-
1980	1194	0	3.22	0.45	0.51	0.945	0.964	-	-
1981	1264	0	3.17	0.58	0.61	0.945	0.964	-	-
1982	1077	0	3.11	0.6	0.64	0.945	0.964	-	-
1983	310	0	3.1	0.38	0.41	0.945	0.964	-	-
1984	297	0	3.11	0.47	0.53	0.945	0.964	-	-
1985	864	0	2.87	0.46	0.53	0.925	0.950	-	-
1986	960	0	3.03	0.48	0.66	0.951	0.975	-	-
1987	966	0	3.16	0.54	0.63	0.963	0.980	-	-
1988	893	0	3.18	0.38	0.49	0.967	0.981	-	-
1989	337	0	2.87	0.52	0.6	0.923	0.955	-	-
1990	274	0	2.69	0.7	0.79	0.957	0.963	-	-
1991	472	0	2.65	0.61	0.69	0.956	0.934	-	-
1992	237	0	2.81	0.5	0.57	0.919	0.975	-	-
1993	0	12	2.73	0.5	0.76	0.946	0.961	-	-
1994	0	12	2.73	0.5	0.76	0.946	0.961	-	-
1995	83	20	2.56	0.65	0.72	0.968	0.973	-	-
1996	92	20	2.88	0.71	0.76	0.941	0.961	-	-
1997	58	5	2.71	0.75	0.84	0.982	0.993	-	-
1998	11	11	2.78	0.73	0.84	0.968	0.994	-	-
1999	19	12.5	3.08	0.84	0.97	0.968	1.000	-	-
2000	21	10	2.57	0	0	0.974	1.000	344	146
2001	43	10	3	0.67	0.71	0.982	0.978	1	1
2002	9.8	10	2.9	0	0	0.973	1.000	338	163
2003	12.3	10	3.04	0	0	0.967	0.989	1,212	567
2004	17.2	10	3.18	0	0	0.970	0.970	1,192	447
2005	17.3	10	3.31	0	0	0.924	0.967	585	182
2006	23	10	3.24	0	0	0.930	0.988	857	326
2007	24.8	10	2.98	0	0	0.965	0.956	917	206
2008	28.6	10	3.08	0	0	0.974	0.988	1,593	260
2009	28	10	3.5	0	0	0.934	0.894	1,483	138
2010	43.1	10	3.42	0	0	0.982	0.975	991	249
2011	27.4	10	3.4	0	0	0.939	0.831	888	72
2012	34.5	10	3.44	0	1	0.932	0.980	1,121	252
2013	47.7	10	3.35	0	1	0.949	0.966	938	211
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA

Stock composition

Country	MSW
France	0.027
Finland	0.001
Iceland	0.001
Ireland	0.147
Norway	0.027
Russia	0.000
Sweden	0.003
UK (E&W)	0.149
UK (NI)	0.000
UK (Sc)	0.645
Other	
Total	1

Appendix 4: Input data for Atlantic salmon used to do the run-reconstruction and estimates of returns and spawners by size group and age group for North America

Appendix 4.i. Input data for the fishery at West Greenland used in the run reconstruction model.

	Harvest of salmon at West Greenland in tons	Unreported harvest of salmon at West Greenland in tons	Mean weight of salmon (all ages and origin) at West Greenland	Sample size of salmon assigned to NAC based on genetic identification (since 2002)	Sample size of salmon assigned to NEAC based on genetic identification (since 2002)	Lower CI of prop. of salmon assigned to NAC based on scale analyses and discriminant analyses	Upper CI of prop. of salmon assigned to NAC based on scale analyses and discriminant analyses	Prop. of salmon of NAC origin which are 1SW non-maturing age group	Prop. of salmon of NEAC origin which are 1SW non-maturing age group
Year of the fishery	**WGHarv[]**	WGUnHarv[]	WGMeanWt[]	WGSampleNAC[]	WGSampleNEAC[]	WGPropNACMin[]	WGPropNACMax[]	WGProp1SWNAC[]	WGProp1SWNEAC[]
1970	**0**	0	3	0	0	0.2	0.5	0.900	1.0
1971	2689	0	3.14	0	0	0.28	0.40	0.945	0.964
1972	2113	0	3.44	0	0	0.34	0.37	0.945	0.964
1973	2341	0	4.18	0	0	0.39	0.59	0.945	0.964
1974	1917	0	3.58	0	0	0.39	0.46	0.945	0.964
1975	2030	0	3.12	0	0	0.40	0.48	0.945	0.964
1976	1175	0	3.04	0	0	0.38	0.48	0.945	0.964
1977	1420	0	*3.21*	0	0	0.38	0.57	0.945	0.964
1978	984	0	3.35	0	0	0.47	0.57	0.945	0.964
1979	1395	0	3.34	0	0	0.48	0.52	0.945	0.964
1980	1194	0	3.22	0	0	0.45	0.51	0.945	0.964
1981	1264	0	3.17	0	0	0.58	0.61	0.945	0.964
1982	1077	0	3.11	0	0	0.60	0.64	0.945	0.964
1983	310	0	3.10	0	0	0.38	0.41	0.945	0.964
1984	297	0	3.11	0	0	0.47	0.53	0.945	0.964
1985	864	0	2.87	0	0	0.46	0.53	0.925	0.950
1986	960	0	3.03	0	0	0.48	0.66	0.951	0.975
1987	966	0	3.16	0	0	0.54	0.63	0.963	0.980
1988	893	0	3.18	0	0	0.38	0.49	0.967	0.981
1989	337	0	2.87	0	0	0.52	0.60	0.923	0.955
1990	274	0	2.69	0	0	0.70	0.79	0.957	0.963
1991	472	0	2.65	0	0	0.61	0.69	0.956	0.934
1992	237	0	2.81	0	0	0.50	0.57	0.919	0.975
1993	0	12	2.73	0	0	0.50	0.76	0.95	0.96
1994	0	12	2.73	0	0	0.50	0.76	0.95	0.96
1995	83	20	2.56	0	0	0.65	0.72	0.968	0.973
1996	92	20	2.88	0	0	0.71	0.76	0.941	0.961
1997	58	5	2.71	0	0	0.75	0.84	0.982	0.993
1998	11	11	2.78	0	0	0.73	0.84	0.968	0.994
1999	19	12.5	3.08	0	0	0.84	0.97	0.968	1.000
2000	21	10	2.57	344	146	0	0	0.974	1.000
2001	43	10	3.00	1	1	0.67	0.71	0.982	0.978
2002	9.8	10	2.90	338	163	0	0	0.973	1.000
2003	12.3	10	3.04	1212	567	0	0	0.967	0.989
2004	17.2	10	3.18	1192	447	0	0	0.970	0.970
2005	17.3	10	3.31	585	182	0	0	0.924	0.967
2006	23.0	10	3.24	857	326	0	0	0.930	0.988
2007	24.8	10	2.98	917	206	0	0	0.965	0.956
2008	28.6	10	3.08	1593	260	0	0	0.974	0.988
2009	28.0	10	3.50	1483	138	0	0	0.934	0.894
2010	43.1	10	3.42	991	249	0	0	0.982	0.975
2011	27.4	10	3.4	888	72	0	0	0.939	0.831
2012	34.5	10	3.44	1121	252	0	0	0.932	0.98
2013	47.7	10	3.35	938	211	0.00	0.00	0.949	0.966

Appendix 4.ii. Input data for sea fisheries on large salmon and small salmon from Newfoundland and Labrador used in the run reconstruction model. Labrador represents harvests from Labrador in aboriginal fisheries for food, social and ceremonial purposes and the resident food fishery beginning in 1998.

	Catches of large salmon			Catches of small salmon		
Year of the fishery	SFA 1 to 7	SFA 8 to 14A	Subsistence Labrador	SFA 1 to 7	SFA 8 to 14A	FSC Labrador
Winbugs labels	Nlg_LBandNF1to7[]	Nlg_NF8to14a[]	Nlg_LBFSC[]	Nsm_LBandNF1to7[]	Nsm_NF8to14a[]	Nsm_LBFSC[]
1970	0	0	0	0	0	0
1971	199176	0	0	158896	70936	0
1972	144496	42861	0	143232	111141	0
1973	227779	43627	0	188725	176907	0
1974	196726	85714	0	192195	153278	0
1975	215025	72814	0	302348	91935	0
1976	210858	95714	0	221766	118779	0
1977	231393	63449	0	220093	57472	0
1978	155546	37653	0	102403	38180	0
1979	82174	29122	0	186558	62622	0
1980	211896	54307	0	290127	94291	0
1981	211006	38663	0	288902	60668	0
1982	129319	35055	0	222894	77017	0
1983	108430	28215	0	166033	55683	0
1984	87742	15135	0	123774	52813	0
1985	70970	24383	0	178719	79275	0
1986	107561	22036	0	222671	91912	0
1987	146242	19241	0	281762	82401	0
1988	86047	14763	0	198484	74620	0
1989	85319	15577	0	172861	60884	0
1990	59334	11639	0	104788	46053	0
1991	39257	10259	0	89099	42721	0
1992	32341	0	0	24249	0	0
1993	17096	0	0	17074	0	0
1994	15377	0	0	8640	0	0
1995	11176	0	0	7980	0	0
1996	7272	0	0	7849	0	0
1997	6943	0	0	9753	0	0
1998	0	0	2269	0	0	2988
1999	0	0	1084	0	0	2739
2000	0	0	1352	0	0	5323
2001	0	0	1721	0	0	4789
2002	0	0	1389	0	0	5806
2003	0	0	2175	0	0	6477
2004	0	0	3696	0	0	8385
2005	0	0	2817	0	0	10436
2006	0	0	3090	0	0	10377
2007	0	0	2652	0	0	9208
2008	0	0	3909	0	0	9834
2009	0	0	3344	0	0	7988
2010	0	0	3725	0	0	9867
2011	0	0	4451	0	0	11138
2012	0	0	4228	0	0	9977
2013	0	0	6495	0	0	7190

Appendix 4.iii. Input data for sea fisheries on large salmon and small salmon from St Pierre & Miquelon used in the run-reconstruction model.

Year of the fishery	Reported harvest (kg)	Number of salmon	Number of large salmon	Number of small salmon
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
1973	0	0	0	0
1974	0	0	0	0
1975	0	0	0	0
1976	3000	1331	333	998
1977	0	0	0	0
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	3000	1331	333	998
1984	3000	1331	333	998
1985	3000	1331	333	998
1986	2500	1109	277	832
1987	2000	887	222	665
1988	2000	887	222	665
1989	2000	887	222	665
1990	1900	843	211	632
1991	1200	532	133	399
1992	2300	1020	255	765
1993	2900	1287	322	965
1994	3400	1508	377	1131
1995	800	355	89	266
1996	1600	710	177	532
1997	1500	665	166	499
1998	2300	1020	255	765
1999	2322	1030	258	773
2000	2267	1006	251	754
2001	2155	956	239	717
2002	1952	866	217	650
2003	2892	1283	321	962
2004	2784	1235	309	926
2005	3287	1458	365	1094
2006	3555	1577	394	1183
2007	1947	864	216	648
2008	3540	1571	393	1178
2009	3460	1535	384	1151
2010	2780	1233	308	925
2011	3757	1667	417	1250
2012	1450	643	161	482
2013	5300	2351	588	1764
Winbugs labels			SPMNLarge[]	SPMNSmall[]

Appendix 4.iv. Input data for large salmon for Labrador used in the run-reconstruction.

	Large Salmon																
	Commercial harvest			Proportion Labrador origin						Exploitation rate		Proportion 2SW		Returns to Labrador rivers		Angling catches	
	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		All SFAs							
Year				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Released
1970	25127	64806	13673	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	562	0
1971	21599	55708	11753	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	486	0
1972	30204	77902	16436	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	424	0
1973	13866	93036	15863	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	1009	0
1974	28601	71168	14752	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	803	0
1975	38555	77796	15189	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	327	0
1976	28158	70158	18664	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	830	0
1977	30824	48934	11715	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	1286	0
1978	21291	27073	3874	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	767	0
1979	28750	87067	9138	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	609	0
1980	36147	68581	7606	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	889	0
1981	24192	53085	5966	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	520	0
1982	19403	33320	7489	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	621	0
1983	11726	25258	6218	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	428	0
1984	13252	16789	3954	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	510	0
1985	19152	34071	5342	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	294	0
1986	18257	49799	11114	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	467	0
1987	12621	32386	4591	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	633	0
1988	16261	26836	4646	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	710	0
1989	7313	17316	2858	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	461	0
1990	1369	7679	4417	0.6	0.8	0.6	0.8	0.6	0.8	0.7	0.9	0.70	0.90	0	0	357	0
1991	9981	19608	2752	0.6	0.8	0.6	0.8	0.6	0.8	0.580	0.830	0.70	0.90	0	0	93	0
1992	3825	9651	3620	0.6	0.8	0.6	0.8	0.6	0.8	0.38	0.62	0.70	0.90	0	0	781	10
1993	3464	11056	857	0.6	0.8	0.6	0.8	0.6	0.8	0.29	0.50	0.70	0.90	0	0	378	91
1994	2150	8714	312	0.6	0.8	0.6	0.8	0.6	0.8	0.14	0.25	0.70	0.90	0	0	455	347
1995	1375	5479	418	0.6	0.8	0.6	0.8	0.6	0.8	0.13	0.23	0.70	0.90	0	0	408	508
1996	1393	5550	263	0.6433	0.7247	0.8839	0.9521	0.6	0.8	0.17	0.30	0.70	0.90	0	0	334	489
1997	0	0	0	1	1	1	1	1	1	0.17	0.30	0.60	0.71	0	0	158	566
1998	0	0	0	1	1	1	1	1	1			0.60	0.71	7374	19486	231	814
1999	0	0	0	1	1	1	1	1	1			0.60	0.71	8827	23328	320	931
2000	0	0	0	1	1	1	1	1	1			0.60	0.71	12052	31850	262	1446
2001	0	0	0	1	1	1	1	1	1			0.60	0.71	12744	33677	338	1468
2002	0	0	0	1	1	1	1	1	1			0.60	0.71	9076	24769	207	978
2003	0	0	0	1	1	1	1	1	1			0.60	0.71	6676	21689	222	1326
2004	0	0	0	1	1	1	1	1	1			0.60	0.71	10964	23092	259	1519
2005	0	0	0	1	1	1	1	1	1			0.60	0.71	11159	30796	291	1290
2006	0	0	0	1	1	1	1	1	1			0.60	0.71	12414	29783	227	1133
2007	0	0	0	1	1	1	1	1	1			0.60	0.71	11887	31913	235	1222
2008	0	0	0	1	1	1	1	1	1			0.60	0.70	14700	37677	200	1461
2009	0	0	0	1	1	1	1	1	1			0.60	0.70	18643	60062	216	1219
2010	0	0	0	1	1	1	1	1	1			0.60	0.70	7498	20099	197	1080
2011	0	0	0	1	1	1	1	1	1			0.60	0.70	8994	78695	0	2233
2012	0	0	0	1	1	1	1	1	1			0.60	0.70	10054	57905	0	1072
2013	0	0	0	1	1	1	1	1	1			0.60	0.70	20726	115347	0	2541
Winbugs variables	LB_SFA1_Lg_Comm[]	LB_SFA2_Lg_Comm[]	LB_SFA14B_Lg_Comm[]	pLB_SFA1_Lg_L[]	pLB_SFA1_Lg_H[]	pLB_SFA2_Lg_L[]	pLB_SFA2_Lg_H[]	pLB_SFA14B_Lg_L[]	pLB_SFA14B_Lg_H[]	ER_LB_Lg_L[]	ER_LB_Lg_H[]	p2SW_L[]	p2SW_H[]	LB_Lg_L[]	LB_Lg_H[]	LB_Ang_Lg_Ret[]	LB_Ang_Lg_Rel[]

Appendix 4.v. Input data for small salmon for Labrador used in the run-reconstruction.

	Small salmon														
	Commercial harvest			Proportion Labrador origin						Exploitation rate		Returns to Labrador rivers		Angling catches	
	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		All SFAs					
Year				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Released
1970	19109	38359	11212	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4013	0
1971	14303	28711	8392	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3934	0
1972	3130	6282	1836	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2947	0
1973	9848	37145	9328	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	7492	0
1974	34937	57560	19294	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2501	0
1975	17589	47468	13152	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3972	0
1976	17796	40539	11267	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5726	0
1977	17095	12535	4026	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4594	0
1978	9712	28808	7194	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2691	0
1979	22501	72485	8493	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4118	0
1980	21596	86426	6658	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3800	0
1981	18478	53592	7379	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5191	0
1982	15964	30185	3292	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4104	0
1983	11474	11695	2421	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4372	0
1984	15400	24499	7460	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2935	0
1985	17779	45321	8296	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3101	0
1986	13714	64351	11389	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3464	0
1987	19641	56381	7087	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5366	0
1988	13233	34200	9053	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5523	0
1989	8736	20699	3592	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4684	0
1990	1410	20055	5303	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3309	0
1991	9588	13336	1325	0.6	0.8	0.6	0.8	0.6	0.8	0.22	0.39	0	0	2323	0
1992	3893	12037	1144	0.6	0.8	0.6	0.8	0.6	0.8	0.13	0.25	0	0	2738	251
1993	3303	4535	802	0.6	0.8	0.6	0.8	0.6	0.8	0.10	0.19	0	0	2508	1793
1994	3202	4561	217	0.6	0.8	0.6	0.8	0.6	0.8	0.07	0.13	0	0	2549	3681
1995	1676	5308	865	0.6	0.8	0.6	0.8	0.6	0.8	0.04	0.07	0	0	2493	3302
1996	1728	8025	332	0.3557	0.4163	0.748	0.85	0.6	0.8	0.05	0.08	0	0	2565	3776
1997	0	0	0	1	1	1	1	1	1	0.05	0.08	0	0	2365	2187
1998	0	0	0	1	1	1	1	1	1	0.05	0.08	97408	205197	2131	3758
1999	0	0	0	1	1	1	1	1	1	0.05	0.08	94894	199901	2076	4407
2000	0	0	0	1	1	1	1	1	1	0.05	0.08	117063	246602	2561	7095
2001	0	0	0	1	1	1	1	1	1	0.05	0.08	93660	197301	2049	4640
2002	0	0	0	1	1	1	1	1	1	0.05	0.08	62321	142951	2071	5052
2003	0	0	0	1	1	1	1	1	1	0.05	0.08	48256	122813	2112	4924
2004	0	0	0	1	1	1	1	1	1	0.05	0.08	69808	120244	1808	5968
2005	0	0	0	1	1	1	1	1	1	0.05	0.08	160038	281401	2007	7120
2006	0	0	0	1	1	1	1	1	1	0.05	0.08	132205	294669	1656	5815
2007	0	0	0	1	1	1	1	1	1	0.05	0.08	131895	257360	1762	4641
2008	0	0	0	1	1	1	1	1	1	0.05	0.08	142851	264694	1936	5917
2009	0	0	0	1	1	1	1	1	1	0.07	0.14	38031	140890	1355	3396
2010	0	0	0	1	1	1	1	1	1	0.07	0.14	55949	127622	1477	4704
2011	0	0	0	1	1	1	1	1	1	0.07	0.14	78531	466737	1628	5340
2012	0	0	0	1	1	1	1	1	1	0.07	0.14	64227	281051	1376	3302
2013	0	0	0	1	1	1	1	1	1	0.07	0.14	52946	331145	1420	5214
Winbugs variables	LB_SFA1_Sm_Comm[]	LB_SFA2_Sm_Comm[]	LB_SFA14B_Sm_Comm[]	pLB_SFA1_Sm_L[]	pLB_SFA1_Sm_H[]	pLB_SFA2_Sm_L[]	pLB_SFA2_Sm_H[]	pLB_SFA14B_Sm_L[]	pLB_SFA14B_Sm_H[]	ER_LB_Sm_L[]	ER_LB_Sm_H[]	LB_Sm_L[]	LB_Sm_H[]	LB_Ang_Sm_Ret[]	LB_Ang_Sm_Rel[]

Appendix 4.vi. Input data for returns of small salmon and large salmon for Salmon Fishing Areas 3 to 8 in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 3				Salmon Fishing Area 4				Salmon Fishing Area 5				Salmon Fishing Area 6				Salmon Fishing Area 7				Salmon Fishing Area 8			
	Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon	
	Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bugs label	SFA3Sm_L[]	SFA3Sm_H[]	SFA3Lg_L[	SFA3Lg_H	SFA4Sm_L[	SFA4Sm_H[]	SFA4Lg_L	SFA4Lg_H[]	SFA5Sm_L[	SFA5Sm_H[	SFA5Lg_L	SFA5Lg_H	SFA6Sm_I	SFA6Sm_	SFA6Lg_L	SFA6Lg_H	SFA7Sm_I	SFA7Sm_	SFA7Lg_L	SFA7Lg_H	SFA8Sm_I	SFA8Sm_	SFA8Lg_L	SFA8Lg_H
1970	2613	5227	155	737	16163	32327	957	4559	7420	14840	439	2093	280	560	17	79	67	133	4	19	62	123	4	17
1971	2473	4947	146	698	12610	25220	746	3557	5600	11200	331	1579	183	367	11	52	133	267	8	38	83	167	5	24
1972	1660	3320	98	468	11480	22960	679	3238	6317	12633	374	1782	397	793	23	112	203	407	12	57	93	187	6	26
1973	3960	7920	234	1117	22367	44733	1324	6308	7040	14080	417	1986	833	1667	49	235	437	873	26	123	313	627	19	88
1974	2797	5593	322	645	17910	35820	2065	4131	5457	10913	629	1258	1010	2020	116	233	443	887	51	102	170	340	20	39
1975	3690	7380	520	1041	19810	39620	2794	5587	6627	13253	935	1869	313	627	44	88	133	267	19	38	290	580	41	82
1976	3157	6313	380	760	22277	44553	2683	5365	6327	12653	762	1524	823	1647	99	198	100	200	12	24	267	533	32	64
1977	5100	10200	482	964	27987	55973	2645	5290	15387	30773	1454	2908	1337	2673	126	253	260	520	25	49	270	540	26	51
1978	2527	5053	150	299	29247	58493	1731	3461	9527	19053	564	1128	987	1973	58	117	330	660	20	39	147	293	9	17
1979	6800	13600	390	779	26753	53507	1533	3067	4437	8873	254	509	813	1627	47	93	417	833	24	48	333	667	19	38
1980	5810	11620	261	522	31380	62760	1410	2819	9007	18013	405	809	1067	2133	48	96	340	680	15	31	400	800	18	36
1981	7860	15720	1045	2090	45120	90240	5998	11996	11627	23253	1546	3091	2017	4033	268	536	410	820	55	109	257	513	34	68
1982	8780	17560	212	424	33243	66487	802	1604	8110	16220	196	391	960	1920	23	46	517	1033	12	25	283	567	7	14
1983	5390	10780	247	495	29847	59693	1370	2740	7857	15713	361	721	987	1973	45	91	463	927	21	43	137	273	6	13
1984	3532	7526	55	540	34933	74436	548	5337	9538	20323	150	1457	1101	2346	17	168	339	722	5	52	279	594	4	43
1985	4772	9879	72	683	44408	91931	671	6352	12692	26275	192	1816	1563	3235	24	224	408	845	6	58	375	777	6	54
1986	2826	5898	70	413	34015	70993	840	4977	14835	30963	366	2170	1629	3400	40	238	373	779	9	55	505	1054	12	74
1987	2218	4458	57	318	21485	43175	556	3078	6556	13175	170	939	540	1085	14	77	110	222	3	16	169	340	4	24
1988	6624	13644	159	956	37171	76566	892	5367	15715	32370	377	2269	1618	3333	39	234	483	995	12	70	298	614	7	43
1989	3004	6114	90	461	15409	31367	461	2365	5767	11740	172	885	1001	2038	30	154	269	547	8	41	403	820	12	62
1990	6750	11816	236	920	22244	38934	776	3033	9485	16602	331	1293	1312	2297	46	179	193	337	7	26	338	591	12	46
1991	5650	9281	193	750	21005	34499	718	2788	8793	14443	301	1167	799	1312	27	106	155	254	5	21	47	78	2	6
1992	11418	22836	416	4095	38670	77339	1408	13867	14189	28377	516	5088	1681	3363	61	603	292	585	11	105	0	0	0	0
1993	11793	22699	415	1614	45610	87791	1605	6242	16661	32071	586	2280	2574	4954	91	352	462	890	16	63	422	813	15	58
1994	13082	28738	769	3268	29401	64585	1729	7343	9740	21395	573	2433	539	1183	32	135	64	141	4	16	111	243	7	28
1995	10205	24587	609	2665	31439	75745	1877	8211	11108	26762	663	2901	386	931	23	101	233	560	14	61	185	446	11	48
1996	19519	43650	1439	4273	52515	117438	3870	11497	17384	38875	1281	3806	643	1438	47	141	151	338	11	33	224	500	16	49
1997	11763	21437	1226	3970	24074	43872	2509	8125	6468	11786	674	2183	235	429	25	79	60	110	6	20	60	110	6	20
1998	19617	27571	1956	6992	52347	73573	5219	18658	11863	16673	1183	4228	538	756	54	192	249	350	25	89	161	227	16	58
1999	13981	20350	1286	4196	62141	90450	5717	18651	10474	15245	964	3143	405	589	37	122	69	100	6	21	151	220	14	45
2000	19313	26033	1466	3728	37551	50618	2850	7248	12414	16734	942	2396	1128	1520	86	218	159	214	12	31	106	143	8	20
2001	11754	15383	907	2104	39901	52218	3080	7143	10007	13095	773	1791	296	387	23	53	53	69	4	9	20	26	2	4
2002	10500	15736	684	2006	34310	51418	2234	6556	3870	5799	252	739	241	361	16	46	0	0	0	0	72	108	5	14
2003	21615	26166	1092	3485	74615	90328	3768	12032	6583	7970	332	1062	458	555	23	74	104	126	5	17	52	63	3	8
2004	7992	12452	396	1686	49598	77280	2455	10464	8385	13065	415	1769	180	281	9	38	0	0	0	0	41	64	2	9
2005	6421	18899	487	2678	36753	108180	2790	15329	5309	15627	403	2214	114	336	9	48	0	0	0	0	26	76	2	11
2006	10757	17194	1251	3239	42745	68322	4971	12872	8571	13700	997	2581	69	110	8	21	0	0	0	0	172	275	20	52
2007	10422	21117	1182	3828	36934	74834	4188	13567	8734	17696	990	3208	78	157	9	28	129	262	15	47	17	35	2	6
2008	13901	23285	1062	3396	63476	106328	4851	15508	11459	19195	876	2800	330	552	25	81	84	141	6	21	196	329	15	48
2009	13313	24903	787	5088	59555	111403	3518	22760	10610	19847	627	4055	485	908	29	185	0	0	0	0	135	252	8	52
2010	21058	26262	1610	4596	79694	99392	6094	17393	23093	28801	1766	5040	997	1243	76	218	211	263	16	46	110	137	8	24
2011	15720	26791	1308	6277	60515	103137	5033	24165	14418	24574	1199	5758	850	1448	71	339	100	170	8	40	272	464	23	109
2012	23561	33459	1662	4417	72540	103017	5117	13600	16241	23065	1146	3045	827	1174	58	155	112	159	8	21	408	580	29	77
2013	13687	21444	1045	5566	59007	92451	4507	23997	16142	25291	1233	6565	1025	1606	78	417	338	529	26	137	153	240	12	62

ICES WGNAS REPORT 2014

Appendix 4.vi. (continued). Input data for returns of small salmon and large salmon for Salmon Fishing Areas 9 to 14A in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 9				Salmon Fishing Area 10				Salmon Fishing Area 11				Salmon Fishing Area 12				Salmon Fishing Area 13				Salmon Fishing Area 14A			
	Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon	
	Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns		Returns	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bugs labels	SFA9Sm_L[	SFA9Sm_H[	SFA9Lg_L	SFA9Lg_H	SFA10Sm_	SFA10Sm_H	SFA10Lg_	SFA10Lg_	SFA11Sm_L	SFA11Sm_H	SFA11Lg_	SFA11Lg_	SFA12Sm_	SFA12Sm_H	SFA12Lg_	SFA12Lg_	SFA13Sm_L	SFA13Sm_H	SFA13Lg_	SFA13Lg_H	SFA14ASm_	SFA14ASm_H	SFA14ALg_L	SFA14ALg_H[
1970	6310	12620	373	1780	2003	4007	119	565	16760	33520	992	4727	2497	4993	148	704	25942	38282	3251	5060	14817	29633	365	2571
1971	5400	10800	320	1523	3093	6187	183	872	13533	27067	801	3817	1513	3027	90	427	26011	40151	2678	4750	12523	25047	308	2173
1972	3797	7593	225	1071	1890	3780	112	533	16350	32700	968	4611	3093	6187	183	872	23526	37589	3107	5169	8057	16113	198	1398
1973	7200	14400	426	2031	5950	11900	352	1678	16187	32373	958	4565	2153	4307	127	607	27287	40227	3303	5200	17607	35213	433	3055
1974	4980	9960	574	1149	4040	8080	466	932	14920	29840	1720	3441	2193	4387	253	506	19274	28824	2913	4257	10400	20800	902	1805
1975	6240	12480	880	1760	1423	2847	201	401	15003	30007	2116	4232	1700	3400	240	479	33671	54424	4497	7424	16060	32120	507	1015
1976	5410	10820	651	1303	2433	4867	293	586	13880	27760	1671	3343	990	1980	119	238	29382	46902	3378	5488	24603	49207	1437	2874
1977	3600	7200	340	680	3657	7313	346	691	13653	27307	1290	2581	1860	3720	176	352	17610	25240	2877	3598	19023	38047	666	1331
1978	4343	8687	257	514	5317	10633	315	629	13320	26640	788	1576	1220	2440	72	144	17807	27681	4716	5289	10803	21607	266	532
1979	5680	11360	326	651	2830	5660	162	324	11433	22867	655	1311	2443	4887	140	280	20372	31829	1183	1862	21927	43853	233	467
1980	7930	15860	356	712	5080	10160	228	456	16897	33793	759	1518	2733	5467	123	246	26538	38871	5236	5913	12477	24953	694	1388
1981	6207	12413	825	1650	4390	8780	584	1167	23540	47080	3129	6258	3533	7067	470	939	31359	45989	5148	7452	19607	39213	1090	2180
1982	6083	12167	147	293	4187	8373	101	202	24460	48920	590	1180	5183	10367	125	250	31628	46698	3442	3831	15877	31753	3094	6189
1983	7677	15353	352	705	3800	7600	174	349	15897	31793	730	1460	2223	4447	102	204	20828	31701	4465	5100	12667	25333	1704	3407
1984	7989	17023	125	1221	5141	10955	81	785	24767	52774	389	3784	6782	14451	106	1036	26184	37852	2296	3710	16962	36143	266	2591
1985	6375	13198	96	912	4831	10000	73	691	21213	43914	320	3034	3996	8273	60	572	16028	25505	1375	2508	13209	27345	199	1890
1986	8411	17555	208	1231	5619	11727	139	822	20300	42368	501	2970	3433	7166	85	502	22881	36916	2079	3649	18411	38426	455	2694
1987	3416	6865	88	489	1690	3397	44	242	15087	30317	391	2162	3274	6580	85	469	19629	32325	1546	3022	18203	36580	471	2608
1988	5179	10668	124	748	4308	8873	103	622	18985	39106	456	2741	5330	10979	128	770	26162	43480	1950	3917	23580	48570	566	3405
1989	5352	10895	160	821	3655	7440	109	561	12047	24524	360	1849	2279	4640	68	350	10154	16156	849	1565	13036	26537	390	2001
1990	7332	12834	256	1000	3281	5743	115	447	17470	30578	610	2382	3363	5887	117	459	21518	31183	1778	3084	19843	34732	693	2706
1991	2404	3949	82	319	988	1622	34	131	7956	13068	272	1056	2765	4542	95	367	16225	20945	1709	2433	15307	25141	523	2031
1992	5044	10088	184	1809	1791	3582	65	642	16615	33231	605	5958	4671	9342	170	1675	25990	44119	3087	8928	34927	69854	1271	12525
1993	11402	21948	401	1560	5578	10736	196	763	24574	47301	865	3363	5936	11426	209	812	27523	46889	2618	4746	31116	59893	1095	4258
1994	3007	6607	177	751	2544	5588	150	635	7649	16803	450	1910	2761	6066	162	690	22103	37166	3476	5879	13321	29263	783	3327
1995	5321	12821	318	1390	4371	10532	261	1142	10757	25916	642	2809	2294	5527	137	599	27022	49781	1843	5096	20840	50209	1244	5443
1996	6015	13450	443	1317	8245	18438	608	1805	18938	42350	1396	4146	5025	11238	370	1100	36576	67672	3479	7132	32761	73263	2415	7172
1997	3636	6627	379	1227	5071	9242	528	1712	16648	30339	1735	5619	4556	8303	475	1538	31402	46494	4240	8521	25241	45998	2630	8519
1998	4694	6597	468	1673	7821	10992	780	2788	8467	11900	844	3018	2360	3318	235	841	21816	27955	3194	7080	23995	33724	2392	8552
1999	4015	5844	369	1205	5113	7443	470	1535	9643	14036	887	2894	1139	1658	105	342	32407	40858	3878	7739	26960	39241	2480	8091
2000	7850	10582	596	1515	7639	10297	580	1475	17260	23266	1310	3332	2634	3551	200	509	54330	67784	5519	10048	36819	49632	2795	7107
2001	2043	2674	158	366	2924	3826	226	523	9396	12296	725	1682	2201	2880	170	394	37393	45761	3749	6510	20775	27188	1604	3719
2002	1917	2873	125	366	3713	5565	242	709	9011	13505	587	1722	2321	3478	151	443	34070	46011	3452	6469	26558	39801	1729	5075
2003	2229	2699	113	359	3771	4565	190	608	14208	17201	718	2291	5917	7163	299	954	50367	57997	4421	8434	40802	49395	2061	6579
2004	1926	3001	95	406	3697	5760	183	780	13762	21443	681	2903	3131	4879	155	661	49924	66549	4308	9118	30057	46833	1488	6341
2005	1948	5734	148	813	2779	8180	211	1159	6260	18425	475	2611	2686	7905	204	1120	40658	88340	4595	12966	17340	51040	1316	7232
2006	4355	6960	506	1311	5344	8542	622	1609	11033	17634	1283	3322	3460	5530	402	1042	53311	74546	8499	15058	28081	44883	3266	8456
2007	2377	4817	270	873	3497	7086	397	1285	5650	11449	641	2076	2808	5689	318	1031	33808	59140	4691	10959	19966	40454	2264	7334
2008	3944	6606	301	963	4786	8016	366	1169	11136	18654	851	2721	2610	4373	200	638	51933	75122	3901	9668	25802	43220	1972	6304
2009	3445	6443	203	1316	5137	9608	303	1963	7536	14097	445	2880	1746	3266	103	667	36368	55458	3722	10806	21146	39555	1249	8081
2010	6597	8227	504	1440	8168	10187	625	1783	8024	10008	614	1751	2999	3740	229	654	57930	67116	5798	11067	31675	39504	2422	6913
2011	5271	8983	438	2105	9015	15364	750	3600	6897	11755	574	2754	2489	4243	207	994	40348	68766	3356	16112	24110	41092	2005	9628
2012	6717	9539	474	1259	8422	11960	594	1579	6727	9554	475	1261	2624	3726	185	492	50082	71123	3533	9390	35229	50030	2485	6605
2013	4247	6654	324	1727	7697	12059	588	3130	8237	12905	629	3350	2492	3904	190	1013	39146	61333	2990	15920	15405	24137	1177	6265

Appendix 4.vii. Input data for spawners of small salmon and large salmon for Salmon Fishing Areas 3 to 8 in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 3				Salmon Fishing Area 4				Salmon Fishing Area 5				Salmon Fishing Area 6				Salmon Fishing Area 7				Salmon Fishing Area 8			
	Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon	
	Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	SFA3SSm_L[]	SFA3SSm_H[]	SFA3SLg_l	SFA3SLg_	SFA4SSm_l	SFA4SSm_H[]	SFA4SLg_	SFA4SLg_H	SFA5SSm_l	SFA5SSm_l	SFA5SLg_	SFA5SLg_	SFA6SSm	SFA6SSm	SFA6SLg_	SFA6SLg_	SFA7SSm	SFA7SSm	SFA7SLg_	SFA7SLg_	SFA8SSm	SFA8SSm	SFA8SLg_	SFA8SLg_
1970	1829	4443	154	736	11314	27478	910	4512	5194	12614	404	2058	196	476	14	76	47	113	3	18	43	105	0	13
1971	1731	4205	135	687	8827	21437	688	3499	3920	9520	293	1541	128	312	10	51	93	227	8	38	58	142	0	15
1972	1162	2822	98	468	8036	19516	655	3214	4422	10738	354	1762	278	674	23	112	142	346	12	57	65	159	6	26
1973	2772	6732	232	1115	15657	38023	1275	6259	4928	11968	405	1974	583	1417	49	235	306	742	26	123	219	533	15	84
1974	1958	4754	318	641	12537	30447	1983	4049	3820	9276	608	1237	707	1717	115	232	310	754	49	100	119	289	20	39
1975	2583	6273	520	1041	13867	33677	2628	5421	4639	11265	912	1846	219	533	43	87	93	227	19	38	203	493	41	82
1976	2210	5366	379	759	15594	37870	2495	5177	4429	10755	697	1459	576	1400	97	196	70	170	12	24	187	453	32	64
1977	3570	8670	478	960	19591	47577	1559	4204	10771	26157	1410	2864	936	2272	107	234	182	442	24	48	189	459	26	51
1978	1769	4295	149	298	20473	49719	1229	2959	6669	16195	536	1100	691	1677	51	110	231	561	19	38	103	249	9	17
1979	4760	11560	390	779	18727	45481	1206	2740	3106	7542	234	489	569	1383	45	91	292	708	24	48	233	567	19	38
1980	4067	9877	224	485	21966	53346	903	2312	6305	15311	376	780	747	1813	34	82	238	578	14	30	280	680	18	36
1981	5502	13362	1042	2087	31584	76704	5637	11635	8139	19765	1511	3056	1412	3428	239	507	287	697	53	107	180	436	34	68
1982	6146	14926	124	336	23270	56514	544	1346	5677	13787	143	338	672	1632	6	29	362	878	2	15	198	482	0	5
1983	3773	9163	245	493	20893	50739	1073	2443	5500	13356	191	551	691	1677	35	81	324	788	0	9	96	232	1	8
1984	2531	6525	55	540	25033	64536	533	5322	6835	17620	149	1456	789	2034	12	163	243	626	1	48	200	515	4	43
1985	3462	8569	72	683	32218	79741	671	6352	9208	22791	192	1816	1134	2806	24	224	296	733	6	58	272	674	6	54
1986	2054	5126	70	413	24722	61700	840	4977	10782	26910	366	2170	1184	2955	40	238	271	677	9	55	367	916	12	74
1987	1655	3895	57	318	16032	37722	556	3078	4892	11511	170	939	403	948	14	77	82	194	3	16	126	297	4	24
1988	4868	11888	159	956	27317	66712	892	5367	11549	28204	377	2269	1189	2904	39	234	355	867	12	70	219	535	7	43
1989	2266	5376	90	461	11623	27581	461	2365	4350	10323	172	885	755	1792	30	154	203	481	8	41	304	721	12	62
1990	5032	10098	236	920	16583	33273	776	3033	7071	14188	331	1293	978	1963	46	179	144	288	7	26	252	505	12	46
1991	4334	7965	193	750	16113	29607	718	2788	6745	12395	301	1167	613	1126	27	106	119	218	5	21	36	67	2	6
1992	9844	21262	415	4094	33228	71898	1407	13866	12175	26363	516	5088	1450	3132	61	603	252	545	11	105	0	0	0	0
1993	10054	20961	400	1599	39162	81344	1590	6226	14370	29779	576	2270	2243	4623	90	351	404	831	16	63	369	760	15	58
1994	9146	24802	749	3247	20576	55760	1644	7259	6855	18510	560	2420	381	1026	30	133	46	122	4	16	79	212	6	27
1995	7409	21791	580	2636	22872	67179	1801	8135	8122	23776	642	2880	287	831	23	100	173	501	14	60	135	397	11	48
1996	15729	39860	1412	4247	42346	107268	3757	11383	14095	35586	1263	3787	522	1317	46	139	124	311	11	33	180	457	16	48
1997	9422	19095	1209	3954	19309	39107	2467	8083	5228	10547	668	2177	190	384	24	79	49	99	6	20	48	98	6	20
1998	16390	24345	1933	6969	43559	64785	5160	18599	9943	14753	1155	4201	455	673	53	191	212	313	25	88	135	201	16	57
1999	11804	18173	1279	4189	52390	80698	5650	18583	8832	13603	947	3126	343	528	37	121	58	90	6	21	119	188	14	45
2000	17003	23723	1449	3711	32879	45946	2803	7201	10897	15217	923	2377	993	1386	84	217	140	195	12	31	88	125	8	20
2001	9861	13489	892	2089	33365	45682	3023	7086	8344	11433	767	1786	250	342	23	53	42	59	4	9	17	23	2	4
2002	8620	13856	671	1994	28099	45208	2175	6498	3194	5124	250	737	199	319	15	45	0	0	0	0	55	91	5	14
2003	19386	23938	1085	3478	67026	82739	3738	12001	5926	7312	331	1060	412	508	23	74	94	116	5	17	47	58	3	8
2004	6942	11402	390	1680	43104	70785	2430	10438	7307	11987	412	1766	158	259	9	38	0	0	0	0	35	58	2	9
2005	5056	17534	473	2664	28896	100323	2695	15235	4200	14518	394	2205	92	314	8	47	0	0	0	0	18	69	2	11
2006	9402	15839	1228	3216	37156	62732	4925	12825	7495	12623	969	2554	61	102	8	20	0	0	0	0	141	244	20	52
2007	9147	19842	1171	3818	32243	70143	4122	13501	7641	16603	978	3196	68	148	8	28	112	245	12	45	15	33	2	6
2008	11799	21183	1045	3379	53591	96443	4745	15402	9669	17405	867	2791	274	497	22	78	69	125	4	18	159	292	15	48
2009	11205	22795	779	5080	49881	101728	3491	22732	8828	18065	622	4049	412	834	28	185	0	0	0	0	111	228	7	51
2010	18364	23569	1595	4581	69075	88772	6006	17304	20114	25822	1754	5028	874	1120	76	217	183	235	16	46	93	120	8	24
2011	13193	24264	1291	6261	50806	93428	4789	23920	12075	22230	1176	5734	716	1314	70	339	83	153	8	39	220	412	22	108
2012	21149	31048	1639	4394	64959	95436	5046	13528	14554	21377	1140	3039	738	1086	57	154	100	147	8	21	361	533	25	73
2013	11294	19052	1025	5546	48783	82227	4453	23942	13195	22344	1200	6532	843	1424	77	415	272	463	25	137	120	207	12	62

Appendix 4.vii. (continued). Input data for spawners of small salmon and large salmon for Salmon Fishing Areas 9 to 14A in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 9				Salmon Fishing Area 10				Salmon Fishing Area 11				Salmon Fishing Area 12				Salmon Fishing Area 13				Salmon Fishing Area 14A			
	Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon		Small salmon		Large salmon	
	Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners		Spawners	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bugs labels	SFA9SSm_l	SFA9SSm_l	SFA9SLg_	SFA9SLg_	SFA10SSr	SFA10SSm_	SFA10SLg	SFA10SLg	SFA11SSm_	SFA11SSm_	SFA11SLg	SFA11SLg	SFA12SSr	SFA12SSm_	SFA12SLg	SFA12SLg	SFA13SSm_	SFA13SSm_	SFA13SLg	SFA13SLg_	SFA14ASSm	SFA14ASSm_	SFA14ASLg_	SFA14ASLg_H
1970	4417	10727	361	1768	1402	3406	112	558	11732	28492	918	4653	1748	4244	69	625	16203	28543	1608	3417	10372	25188	134	2340
1971	3780	9180	301	1504	2165	5259	166	855	9473	23007	736	3752	1059	2573	74	411	16489	30629	1633	3705	8766	21290	0	1850
1972	2658	6454	217	1063	1323	3213	108	529	11445	27795	882	4525	2165	5259	163	852	15125	29188	2004	4066	5640	13696	83	1283
1973	5040	12240	406	2011	4165	10115	310	1636	11331	27517	923	4530	1507	3661	102	582	17019	29959	1911	3808	12325	29931	91	2713
1974	3486	8466	565	1140	2828	6868	452	918	10444	25364	1682	3403	1535	3729	240	493	12085	21635	1997	3341	7280	17680	789	1692
1975	4368	10608	874	1754	996	2420	192	392	10502	25506	2076	4192	1190	2890	220	459	21668	42421	3611	6538	11242	27302	417	925
1976	3787	9197	639	1291	1703	4137	283	576	9716	23596	1629	3301	693	1683	114	233	18999	36519	2752	4862	17222	41826	1337	2774
1977	2520	6120	331	671	2560	6216	341	686	9557	23211	1272	2563	1302	3162	128	304	10898	18528	1828	2549	13316	32340	194	859
1978	3040	7384	240	497	3722	9038	273	587	9324	22644	770	1558	854	2074	52	124	12518	22392	3861	4434	7562	18366	194	460
1979	3976	9656	311	636	1981	4811	154	316	8003	19437	648	1304	1710	4154	130	270	14363	25820	1070	1749	15349	37275	174	408
1980	5551	13481	295	651	3556	8636	201	429	11828	28724	715	1474	1913	4647	94	217	18625	30958	4243	4920	8734	21210	514	1208
1981	4345	10551	773	1598	3073	7463	555	1138	16478	40018	3088	6217	2473	6007	453	922	22059	36689	4485	6789	13725	33331	953	2043
1982	4258	10342	114	260	2931	7117	91	192	17122	41582	537	1127	3628	8812	110	235	22062	37132	2847	3236	11114	26990	2987	6082
1983	5374	13050	281	634	2660	6460	95	270	11128	27024	703	1433	1556	3780	94	196	14491	25364	3855	4490	8867	21533	1635	3338
1984	5725	14759	120	1216	3684	9498	79	783	17748	45755	374	3769	4860	12529	38	968	18413	30081	1987	3401	12155	31336	179	2504
1985	4625	11448	96	912	3505	8674	73	691	15390	38091	320	3034	2899	7176	57	569	10726	20203	1349	2482	9583	23719	197	1887
1986	6113	15257	208	1231	4084	10192	139	822	14754	36822	501	2970	2495	6228	81	499	15535	29570	2013	3583	13381	33396	445	2683
1987	2549	5998	88	489	1261	2968	44	242	11258	26488	391	2162	2443	5749	82	466	13611	26307	1512	2988	13583	31960	467	2604
1988	3806	9295	124	748	3166	7731	103	622	13952	34073	456	2741	3917	9566	126	767	17945	35263	1909	3877	17329	42319	549	3388
1989	4037	9580	160	821	2757	6542	109	561	9087	21564	360	1849	1719	4080	67	349	6980	12982	836	1552	9833	23334	385	1996
1990	5466	10968	256	1000	2446	4908	115	447	13024	26132	610	2382	2507	5031	114	456	14866	24531	1744	3051	14793	29682	679	2692
1991	1844	3389	82	319	758	1392	34	131	6103	11215	272	1056	2121	3898	93	365	11037	15757	1689	2413	11742	21576	512	2020
1992	4334	9378	183	1809	1496	3287	65	642	14239	30854	605	5958	3985	8657	162	1667	20506	38635	2992	8833	30096	65023	1234	12488
1993	9956	20502	400	1559	4809	9967	194	761	21423	44150	861	3359	5176	10666	207	810	22341	41708	2544	4673	27010	55787	1058	4221
1994	2124	5723	172	746	1804	4848	144	630	5295	14449	430	1891	1949	5253	154	681	15381	30444	3207	5611	9385	25327	742	3286
1995	3887	11386	304	1376	3218	9378	253	1133	7770	22930	625	2792	1689	4922	130	592	20570	43329	1607	4860	15218	44587	1187	5385
1996	4868	12304	431	1304	6687	16880	592	1789	15226	38638	1362	4113	4082	10295	358	1088	29056	60152	3199	6852	26584	67085	2357	7115
1997	2927	5918	372	1221	4086	8257	519	1702	13304	26995	1718	5602	3655	7401	464	1527	25508	40599	3985	8266	20359	41117	2578	8467
1998	3937	5840	458	1663	6606	9777	771	2779	7024	10457	836	3009	1968	2925	225	831	18279	24417	3031	6918	19992	29721	2347	8507
1999	3401	5230	359	1195	4313	6642	455	1520	8086	12478	881	2889	958	1477	102	339	28647	37098	3760	7621	22659	34941	2402	8013
2000	6913	9645	581	1501	6664	9322	534	1429	14895	20901	1288	3310	2291	3208	195	504	48055	61508	5250	9779	32314	45127	2731	7044
2001	1709	2339	151	359	2436	3338	215	513	7804	10704	714	1671	1818	2497	162	386	31037	39405	3536	6297	17331	23744	1559	3674
2002	1562	2518	118	360	3049	4901	231	699	7347	11840	581	1716	1896	3053	147	439	28083	40025	3313	6330	21764	35007	1668	5013
2003	1985	2454	109	355	3368	4162	185	603	12701	15693	703	2276	5282	6528	288	943	45027	52657	4206	8218	36597	45189	1988	6506
2004	1674	2749	91	402	3210	5273	177	774	11863	19544	660	2882	2704	4452	149	655	43889	60513	4074	8883	26116	42892	1429	6282
2005	1478	5264	130	794	2171	7572	194	1142	4827	16992	456	2591	2062	7282	191	1107	33349	81031	4320	12691	13676	47376	1246	7163
2006	3791	6397	498	1302	4627	7824	602	1590	9554	16155	1271	3310	2986	5056	392	1032	46296	67532	8247	14807	24532	41334	3210	8400
2007	2063	4502	263	867	3047	6636	387	1275	4907	10706	636	2071	2442	5323	314	1027	29402	54734	4511	10780	17446	37934	2222	7293
2008	3285	5948	293	955	3971	7202	351	1154	9314	16832	841	2711	2178	3940	193	631	43277	66465	3580	9346	21887	39305	1915	6246
2009	2835	5834	198	1311	4193	8665	298	1957	6203	12763	442	2877	1450	2970	100	664	31106	50196	3526	10610	17820	36229	1200	8032
2010	5703	7334	496	1432	7062	9081	616	1774	6859	8842	604	1742	2606	3347	226	651	49703	58889	5478	10747	27468	35298	2358	6848
2011	4364	8077	433	2099	7477	13826	716	3566	5696	10554	564	2744	2074	3827	203	990	33849	62267	3160	15915	20249	37231	1953	9575
2012	5898	8720	471	1256	7488	11027	581	1566	5993	8819	468	1255	2348	3450	184	490	44778	65820	3395	9251	31467	46268	2451	6571
2013	3483	5890	310	1713	6241	10604	565	3107	6678	11347	617	3338	2034	3447	183	1006	32351	54538	2790	15719	12678	21409	1121	6209

Appendix 4.viii. Input data for 2SW salmon returns and spawners for Salmon Fishing Areas 3 to 8 in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 3				Salmon Fishing Area 4				Salmon Fishing Area 5				Salmon Fishing Area 6				Salmon Fishing Area 7				Salmon Fishing Area 8			
	2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW	
	Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bugs labels	SFA3R2_L[]	SFA3R2_H[]	SFA3S2_L []	SFA3S2_ H[]	SFA4R2_L[]	SFA4R2_H[]	SFA4S2_ L[]	SFA4S2_H[ ]	SFA5R2_L[]	SFA5R2_H[ ]	SFA5S2_ L[]	SFA5S2_ H[]	SFA6R2_ L[]	SFA6R2_ H[]	SFA6S2_ L[]	SFA6S2_ H[]	SFA7R2_ L[]	SFA7R2_ H[]	SFA7S2_ L[]	SFA7S2_ H[]	SFA8R2_ L[]	SFA8R2_ H[]	SFA8S2_ L[]	SFA8S2_ H[]
1970	15	147	15	147	96	912	91	902	44	419	40	412	2	16	1	15	0	4	0	4	0	3	0	3
1971	15	140	14	137	75	711	69	700	33	316	29	308	1	10	1	10	1	8	1	8	0	5	0	3
1972	10	94	10	94	68	648	66	643	37	356	35	352	2	22	2	22	1	11	1	11	1	5	1	5
1973	23	223	23	223	132	1262	127	1252	42	397	40	395	5	47	5	47	3	25	3	25	2	18	1	17
1974	32	129	32	128	207	826	198	810	63	252	61	247	12	47	12	46	5	20	5	20	2	8	2	8
1975	52	208	52	208	279	1117	263	1084	93	374	91	369	4	18	4	17	2	8	2	8	4	16	4	16
1976	38	152	38	152	268	1073	249	1035	76	305	70	292	10	40	10	39	1	5	1	5	3	13	3	13
1977	48	193	48	192	264	1058	156	841	145	582	141	573	13	51	11	47	2	10	2	10	3	10	3	10
1978	15	60	15	60	173	692	123	592	56	226	54	220	6	23	5	22	2	8	2	8	1	3	1	3
1979	39	156	39	156	153	613	121	548	25	102	23	98	5	19	4	18	2	10	2	10	2	8	2	8
1980	26	104	22	97	141	564	90	462	40	162	38	156	5	19	3	16	2	6	1	6	2	7	2	7
1981	104	418	104	417	600	2399	564	2327	155	618	151	611	27	107	24	101	5	22	5	21	3	14	3	14
1982	21	85	12	67	80	321	54	269	20	78	14	68	2	9	1	6	1	5	0	3	1	3	0	1
1983	25	99	25	99	137	548	107	489	36	144	19	110	5	18	4	16	2	9	0	2	1	3	0	2
1984	6	108	6	108	55	1067	53	1064	15	291	15	291	2	34	1	33	1	10	0	10	0	9	0	9
1985	7	137	7	137	67	1270	67	1270	19	363	19	363	2	45	2	45	1	12	1	12	1	11	1	11
1986	7	83	7	83	84	995	84	995	37	434	37	434	4	48	4	48	1	11	1	11	1	15	1	15
1987	6	64	6	64	56	616	56	616	17	188	17	188	1	15	1	15	0	3	0	3	0	5	0	5
1988	16	191	16	191	89	1073	89	1073	38	454	38	454	4	47	4	47	1	14	1	14	1	9	1	9
1989	9	92	9	92	46	473	46	473	17	177	17	177	3	31	3	31	1	8	1	8	1	12	1	12
1990	24	184	24	184	78	607	78	607	33	259	33	259	5	36	5	36	1	5	1	5	1	9	1	9
1991	19	150	19	150	72	558	72	558	30	233	30	233	3	21	3	21	1	4	1	4	0	1	0	1
1992	42	819	42	819	141	2773	141	2773	52	1018	52	1018	6	121	6	121	1	21	1	21	0	0	0	0
1993	42	323	40	320	161	1248	159	1245	59	456	58	454	9	70	9	70	2	13	2	13	1	12	1	12
1994	46	457	45	455	104	1028	99	1016	34	341	34	339	2	19	2	19	0	2	0	2	0	4	0	4
1995	37	373	35	369	113	1150	108	1139	40	406	39	403	1	14	1	14	1	9	1	8	1	7	1	7
1996	86	598	85	595	232	1610	225	1594	77	533	76	530	3	20	3	19	1	5	1	5	1	7	1	7
1997	74	556	73	554	151	1138	148	1132	40	306	40	305	1	11	1	11	0	3	0	3	0	3	0	3
1998	117	979	116	976	313	2612	310	2604	71	592	69	588	3	27	3	27	1	12	1	12	1	8	1	8
1999	77	587	77	586	343	2611	339	2602	58	440	57	438	2	17	2	17	0	3	0	3	1	6	1	6
2000	88	522	87	520	171	1015	168	1008	57	335	55	333	5	30	5	30	1	4	1	4	0	3	0	3
2001	39	196	38	194	132	664	130	659	33	167	33	166	1	5	1	5	0	1	0	1	0	0	0	0
2002	29	187	29	185	96	610	94	604	11	69	11	69	1	4	1	4	0	0	0	0	0	1	0	1
2003	47	324	47	323	162	1119	161	1116	14	99	14	99	1	7	1	7	0	2	0	2	0	1	0	1
2004	17	157	17	156	106	973	104	971	18	165	18	164	0	4	0	4	0	0	0	0	0	1	0	1
2005	21	249	20	248	120	1426	116	1417	17	206	17	205	0	4	0	4	0	0	0	0	0	1	0	1
2006	54	301	53	299	214	1197	212	1193	43	240	42	237	0	2	0	2	0	0	0	0	1	5	1	5
2007	51	356	50	355	180	1262	177	1256	43	298	42	297	0	3	0	3	1	4	1	4	0	1	0	1
2008	46	316	45	314	209	1442	204	1432	38	260	37	260	1	7	1	7	0	2	0	2	1	4	1	4
2009	34	473	33	472	151	2117	150	2114	27	377	27	377	1	17	1	17	0	0	0	0	0	5	0	5
2010	69	427	69	426	262	1618	258	1609	76	469	75	468	3	20	3	20	1	4	1	4	0	2	0	2
2011	56	584	56	582	216	2247	206	2225	52	535	51	533	3	32	3	31	0	4	0	4	1	10	1	10
2012	71	411	70	409	220	1265	217	1258	49	283	49	283	3	14	2	14	0	2	0	2	1	7	1	7
2013	45	518	44	516	194	2232	191	2227	53	610	52	607	3	39	3	39	1	13	1	13	1	6	1	6

ICES WGNAS REPORT 2014

Appendix 4.viii. (continued). Input data for 2SW salmon returns and spawners for Salmon Fishing Areas 9 to 14A in Newfoundland used in the run-reconstruction.

	Salmon Fishing Area 9				Salmon Fishing Area 10				Salmon Fishing Area 11				Salmon Fishing Area 12				Salmon Fishing Area 13				Salmon Fishing Area 14A			
	2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW		2SW	
	Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners		Returns		Spawners	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bugs labels	SFA9R2_L[]	SFA9R2_H[]	SFA9S2_L[]	SFA9S2_H[]	SFA10R2_L[]	SFA10R2_H[]	SFA10S2_L[]	SFA10S2_H[]	SFA11R2_L[]	SFA11R2_H[]	SFA11S2_L[]	SFA11S2_H[]	SFA12R2_L[]	SFA12R2_H[]	SFA12S2_L[]	SFA12S2_H[]	SFA13R2_L[]	SFA13R2_H[]	SFA13S2_L[]	SFA13S2_H[]	SFA14AR2_L[]	SFA14AR2_H[]	SFA14AS2_L[]	SFA14AS2_H[]
1970	37	356	36	354	12	113	11	112	99	945	92	931	15	141	7	125	1300	3036	643	2050	36	514	13	468
1971	32	305	30	301	18	174	17	171	80	763	74	750	9	85	7	82	1071	2850	653	2223	31	435	0	370
1972	22	214	22	213	11	107	11	106	97	922	88	905	18	174	16	170	1243	3101	802	2439	20	280	8	257
1973	43	406	41	402	35	336	31	327	96	913	92	906	13	121	10	116	1321	3120	764	2285	43	611	9	543
1974	57	230	57	228	47	186	45	184	172	688	168	681	25	101	24	99	1165	2554	799	2005	90	361	79	338
1975	88	352	87	351	20	80	19	78	212	846	208	838	24	96	22	92	1799	4454	1445	3923	51	203	42	185
1976	65	261	64	258	29	117	28	115	167	669	163	660	12	48	11	47	1351	3293	1101	2917	144	575	134	555
1977	34	136	33	134	35	138	34	137	129	516	127	513	18	70	13	61	1151	2159	731	1530	67	266	19	172
1978	26	103	24	99	31	126	27	117	79	315	77	312	7	29	5	25	1886	3173	1544	2660	27	106	19	92
1979	33	130	31	127	16	65	15	63	66	262	65	261	14	56	13	54	473	1117	428	1049	23	93	17	82
1980	36	142	30	130	23	91	20	86	76	304	71	295	12	49	9	43	2094	3548	1697	2952	69	278	51	242
1981	83	330	77	320	58	233	55	228	313	1252	309	1243	47	188	45	184	2059	4471	1794	4073	109	436	95	409
1982	15	59	11	52	10	40	9	38	59	236	54	225	13	50	11	47	1377	2298	1139	1941	309	1238	299	1216
1983	35	141	28	127	17	70	10	54	73	292	70	287	10	41	9	39	1786	3060	1542	2694	170	681	163	668
1984	13	244	12	243	8	157	8	157	39	757	37	754	11	207	4	194	918	2226	795	2041	27	518	18	501
1985	10	182	10	182	7	138	7	138	32	607	32	607	6	114	6	114	550	1505	540	1489	20	378	20	377
1986	21	246	21	246	14	164	14	164	50	594	50	594	8	100	8	100	832	2190	805	2150	45	539	44	537
1987	9	98	9	98	4	48	4	48	39	432	39	432	8	94	8	93	618	1813	605	1793	47	522	47	521
1988	12	150	12	150	10	124	10	124	46	548	46	548	13	154	13	153	780	2350	764	2326	57	681	55	678
1989	16	164	16	164	11	112	11	112	36	370	36	370	7	70	7	70	339	939	334	931	39	400	39	399
1990	26	200	26	200	11	89	11	89	61	476	61	476	12	92	11	91	711	1851	698	1830	69	541	68	538
1991	8	64	8	64	3	26	3	26	27	211	27	211	9	73	9	73	684	1460	676	1448	52	406	51	404
1992	18	362	18	362	7	128	6	128	60	1192	60	1192	17	335	16	333	1235	5357	1197	5300	127	2505	123	2498
1993	40	312	40	312	20	153	19	152	86	673	86	672	21	162	21	162	1047	2848	1018	2804	110	852	106	844
1994	11	105	10	104	9	89	9	88	27	267	26	265	10	97	9	95	1390	3528	1283	3366	47	466	44	460
1995	19	195	18	193	16	160	15	159	39	393	38	391	8	84	8	83	737	3058	643	2916	75	762	71	754
1996	27	184	26	183	36	253	35	250	84	580	82	576	22	154	22	152	1391	4279	1280	4111	145	1004	141	996
1997	23	172	22	171	32	240	31	238	104	787	103	784	28	215	28	214	1696	5113	1594	4960	158	1193	155	1185
1998	28	234	27	233	47	390	46	389	51	422	50	421	14	118	13	116	1278	4248	1212	4151	144	1197	141	1191
1999	22	169	22	167	28	215	27	213	53	405	53	404	6	48	6	48	1551	4643	1504	4573	149	1133	144	1122
2000	36	212	35	210	35	206	32	200	79	466	77	463	12	71	12	71	2208	6029	2100	5867	168	995	164	986
2001	7	34	7	33	10	49	9	48	31	156	31	155	7	37	7	36	697	2324	658	2248	69	346	67	342
2002	5	34	5	33	10	66	10	65	25	160	25	160	6	41	6	41	642	2309	616	2260	74	472	72	466
2003	5	33	5	33	8	57	8	56	31	213	30	212	13	89	12	88	822	3011	782	2934	89	612	85	605
2004	4	38	4	37	8	73	8	72	29	270	28	268	7	61	6	61	801	3255	758	3171	64	590	61	584
2005	6	76	6	74	9	108	8	106	20	243	20	241	9	104	8	103	855	4629	804	4531	57	673	54	666
2006	22	122	21	121	27	150	26	148	55	309	55	308	17	97	17	96	1581	5376	1534	5286	140	786	138	781
2007	12	81	11	81	17	119	17	119	28	193	27	193	14	96	13	95	872	3912	839	3849	97	682	96	678
2008	13	90	13	89	16	109	15	107	37	253	36	252	9	59	8	59	726	3451	666	3337	85	586	82	581
2009	9	122	9	122	13	183	13	182	19	268	19	268	4	62	4	62	692	3858	656	3788	54	752	52	747
2010	22	134	21	133	27	166	26	165	26	163	26	162	10	61	10	61	1078	3951	1019	3837	104	643	101	637
2011	19	196	19	195	32	335	31	332	25	256	24	255	9	92	9	92	144	1498	136	1480	86	895	84	890
2012	20	117	20	117	26	147	25	146	20	117	20	117	8	46	8	46	152	873	146	860	107	614	105	611
2013	14	161	13	159	25	291	24	289	27	312	27	310	8	94	8	94	129	1481	120	1462	51	583	48	577

Appendix 4.ix. Input data for small salmon returns to Québec by category of data used in the run-reconstruction.

	Small returns								Small returns							
	Minimum								Maximum							
Year	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**FN Harvest**	**Other rivers**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**FN Harvest**	**Other rivers**
Bugs labels	QCSmC1_L[]	QCSmC2_L[]	QCSmC3_L[]	QCSmC4_L[]	QCSmC5_L[]	QCSmC6_L[]	QCSmFn_L[]	QCSmO_L[]	QCSmC1_H[]	QCSmC2_H[]	QCSmC3_H[]	QCSmC4_H[]	QCSmC5_H[]	QCSmC6_H[]	QCSmFn_H[]	QCSmO_H[]
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	3830	5434	2955	460	1670	5160	267	31	4085	5639	6053	792	2784	8599	445	52
1985	5266	2271	1767	210	5449	4384	267	40	5869	2336	3586	352	9224	7307	445	67
1986	8648	5193	2396	63	6719	5133	267	77	9471	5321	4895	107	11198	8555	445	129
1987	10043	4775	3852	327	8396	5501	267	71	10869	4910	7875	546	13993	9168	445	118
1988	11190	5968	4404	468	8440	6423	267	85	12244	6133	8962	780	14067	10705	445	142
1989	10121	4743	2924	301	6744	5622	267	68	10910	4878	5940	503	11240	9369	445	113
1990	12245	7332	4377	694	7096	2976	377	77	13278	7511	8917	1158	11826	4960	628	129
1991	9554	5851	3776	349	5009	2001	256	57	10249	5987	7679	584	8348	3336	426	95
1992	9188	6928	4567	428	5131	3462	243	70	9847	7144	9297	715	8552	5770	405	117
1993	8143	6325	3973	1029	4315	1447	525	55	8883	6517	8075	1717	7192	2412	875	92
1994	8707	5928	3840	1051	4011	437	408	30	9442	6129	7828	1753	6686	729	681	50
1995	6943	3439	2697	1017	3853	434	184	30	7538	3527	5471	1696	6422	723	306	50
1996	15010	1809	3600	477	4666	500	120	5	16122	1923	7370	797	7816	833	200	8
1997	11491	201	3457	292	3529	462	58	563	12089	242	7049	487	5882	770	97	938
1998	11285	1183	3578	328	5121	1127	58	0	11849	1406	7347	555	8536	1878	97	0
1999	10877	708	3194	1868	5401	1429	0	0	11556	741	6536	3098	9002	2382	0	0
2000	11886	429	1116	602	7399	633	0	0	12635	458	2284	1004	14050	1055	0	0
2001	8050	185	2632	266	3225	728	0	0	8588	228	5392	443	5374	1213	0	0
2002	14599	31	3189	689	4333	1448	0	0	15494	36	6530	1149	7222	2414	0	0
2003	11362	0	3203	721	3566	1512	0	0	11903	0	6538	1201	5944	2520	0	0
2004	13747	107	6526	284	4889	1639	0	0	14177	127	13104	474	8149	2731	0	0
2005	8771	0	3689	794	3353	1508	0	0	9188	0	7485	1323	5588	2513	0	0
2006	12762	0	3736	1800	2944	1455	0	0	13369	0	7584	2999	4907	2426	0	0
2007	8515	0	3758	1710	1830	1024	0	0	8964	0	7631	2850	3051	1707	0	0
2008	16445	0	5542	2266	3144	1401	0	0	17350	0	11261	3776	5240	2336	0	0
2009	8872	0	3601	903	1907	1056	0	0	9315	0	7306	1505	3178	1759	0	0
2010	12889	0	4801	993	1675	1081	0	0	13538	0	9746	1655	2792	1802	0	0
2011	17993	0	5120	1365	3685	1694	0	0	18899	0	10386	2276	6142	2824	0	0
2012	9566	0	3615	584	3600	1228	0	0	10038	0	7332	973	6000	2047	0	0
2013	7164	88	3185	448	2364	3484	0	0	7517	104	6461	747	3940	5807	0	0

Appendix 4.ix. (continued). Input data for large salmon returns to Québec by category of data used in the run-reconstruction.

	Large returns								Large returns							
	Minimum								Maximum							
Year	C1	C2	C3	C4	C5	C6	FN Harvest	Other rivers	C1	C2	C3	C4	C5	C6	FN Harvest	Other rivers
Bugs labels	QCLgC1_L[]	QCLgC2_L[]	QCLgC3_L[]	QCLgC4_L[]	QCLgC5_L[]	QCLgC6_L[]	QCLgFn_L[]	QCLgO_L[]	QCLgC1_H[]	QCLgC2_H[]	QCLgC3_H[]	QCLgC4_H[]	QCLgC5_H[]	QCLgC6_H[]	QCLgFn_H[]	QCLgO_H[]
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	14119	9501	2922	3407	3712	5071	329	108	15631	9788	6035	6477	6187	8452	548	181
1985	14015	7028	3836	345	9215	3351	329	76	15611	7281	7809	577	15827	5586	548	127
1986	18589	8598	6152	35	5877	4971	329	89	20602	8839	12596	61	9795	8284	548	149
1987	17574	6715	5178	273	6335	3012	329	82	19017	6889	10575	458	10558	5019	548	137
1988	21445	6432	7540	346	6789	4781	329	98	22979	6618	15336	576	11315	7969	548	164
1989	20278	8503	5530	278	5718	4567	329	106	21906	8736	11252	465	9531	7611	548	176
1990	17098	10803	8164	1365	5179	2424	442	112	18222	11041	16613	2276	8631	4040	737	187
1991	19112	6988	7183	696	3856	357	242	101	20443	7192	14602	1161	6427	595	403	168
1992	18392	7360	7930	372	2687	1503	461	76	19578	7560	16149	622	4478	2505	769	127
1993	14578	10133	2866	373	2649	333	423	52	15454	11463	5849	624	4414	555	705	87
1994	16538	9172	2644	506	2853	145	427	60	17594	10241	5411	845	4755	242	712	100
1995	21658	9598	1926	813	4390	154	246	31	22968	10936	3915	1358	7317	256	410	52
1996	22679	5822	3843	577	2486	135	113	4	24117	6941	7844	964	4155	225	189	7
1997	18106	4221	2816	333	2865	138	48	9	19154	5154	5768	553	4775	229	80	15
1998	13180	4927	2861	347	2790	291	48	0	13891	5962	5907	592	4649	485	80	0
1999	16912	842	2554	3661	3870	492	0	0	17700	995	5232	6103	6450	838	0	0
2000	14568	619	3901	560	6420	563	0	0	15300	669	7947	933	10700	949	0	0
2001	17837	633	5320	241	3988	556	0	0	18889	879	10914	402	6647	926	0	0
2002	12335	8	4515	339	2103	345	0	0	13001	9	9277	565	3505	575	0	0
2003	21853	0	5787	269	4889	384	0	0	22893	0	11779	449	8148	641	0	0
2004	18369	107	4870	357	4432	401	0	0	19043	126	9170	595	7387	668	0	0
2005	19154	0	3204	734	4815	351	0	0	20066	0	6515	1223	8025	585	0	0
2006	16704	0	3387	901	3945	403	0	0	17500	0	6904	1502	6575	672	0	0
2007	14832	0	3638	1301	3171	305	0	0	15604	0	7406	2168	5285	508	0	0
2008	15216	0	5187	1328	5423	390	0	0	16002	0	10595	2213	9038	649	0	0
2009	18479	0	3727	950	4556	275	0	0	19412	0	7589	1584	7594	458	0	0
2010	21375	0	4488	1047	3656	338	0	0	22454	0	9157	1744	6093	564	0	0
2011	26977	0	4697	1571	5574	483	0	0	28373	0	9529	2619	9290	805	0	0
2012	17918	0	3665	904	4490	313	0	0	18837	0	7434	1507	7483	522	0	0
2013	21601	205	4171	1063	2071	1445	0	0	22689	242	8461	1772	3452	2409	0	0

Appendix 4.ix. (continued). Input data for small salmon spawners to Québec by category of data used in the run-reconstruction.

	Small spawners						Small spawners					
	Minimum						Maximum					
Year	C1	C2	C3	C4	C5	C6	C1	C2	C3	C4	C5	C6
	QCSSmC1_L	QCSSmC2_L	QCSSmC3_L	QCSSmC4_L	QCSSmC5_L	QCSSmC6_L	QCSSmC1_H	QCSSmC2_H	QCSSmC3_H	QCSSmC4_H	QCSSmC5_H	QCSSmC6_H
Bugs labels	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0
1984	3061	4342	1915	415	1264	5160	3316	4547	5013	747	2378	8599
1985	3960	1622	1025	209	4241	4384	4563	1687	2844	351	8016	7307
1986	6337	3827	1499	63	5151	5133	7160	3955	3998	107	9630	8555
1987	7493	3489	2365	291	6411	5501	8319	3624	6388	510	12008	9168
1988	8173	4188	2738	419	6432	6423	9227	4353	7296	731	12059	10705
1989	7779	3810	1878	273	5149	5622	8568	3945	4894	475	9645	9369
1990	8735	5757	2822	604	5437	2976	9768	5936	7362	1068	10167	4960
1991	7247	4551	2465	316	3827	2001	7942	4687	6368	551	7166	3336
1992	5989	4841	2937	370	3957	3462	6648	5057	7667	657	7378	5770
1993	4852	4311	2524	747	3339	1447	5592	4503	6626	1435	6216	2412
1994	5506	3996	2501	894	3089	437	6241	4197	6489	1596	5764	729
1995	5348	2835	1760	877	2956	434	5943	2923	4534	1556	5525	723
1996	10636	1330	2260	372	3678	500	11748	1444	6030	692	6828	833
1997	8238	142	2250	266	3074	462	8836	178	5842	461	5426	770
1998	7734	995	2347	289	4229	1124	8298	1218	6116	516	7643	1875
1999	8155	509	2495	1653	4581	1426	8834	542	5837	2883	8182	2379
2000	8291	372	693	519	5900	583	9040	401	1861	921	12551	1005
2001	5329	143	1870	263	2579	658	5867	186	4140	440	4729	1137
2002	9296	31	2231	658	3405	1448	10191	36	5572	1118	6294	2414
2003	8180	0	2269	661	2826	1509	8721	0	5604	1141	5204	2517
2004	9030	29	5574	278	3962	1639	9460	49	12152	468	7222	2731
2005	6339	0	3025	716	2709	1506	6756	0	6821	1245	4945	2511
2006	8628	0	3159	1691	2372	1455	9235	0	7007	2890	4335	2426
2007	5768	0	3226	1511	1501	1024	6217	0	7099	2651	2722	1707
2008	10562	0	4882	1756	2522	1401	11467	0	10601	3266	4618	2336
2009	6293	0	3115	764	1633	1056	6736	0	6820	1366	2904	1759
2010	8860	0	4289	914	1311	1080	9509	0	9234	1576	2428	1801
2011	12143	0	4496	1116	3036	1688	13049	0	9762	2027	5493	2818
2012	6620	0	3152	472	3020	1225	7092	0	6869	861	5420	2044
2013	4904	88	2840	365	2101	3484	5257	104	6116	664	3677	5807

Appendix 4.ix. (continued). Input data for large salmon spawners to Québec by category of data used in the run-reconstruction.

	Large spawners						Large spawners					
	Minimum						Maximum					
Year	C1	C2	C3	C4	C5	C6	C1	C2	C3	C4	C5	C6
Bugs labels	QCSLgC1_L []	QCSLgC2_L []	QCSLgC3_L []	QCSLgC4_L []	QCSLgC5_L []	QCSLgC6_L []	QCSLgC1_H []	QCSLgC2_H []	QCSLgC3_H []	QCSLgC4_H []	QCSLgC5_H []	QCSLgC6_H []
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0
1984	10421	7648	1861	2357	2815	5071	11933	7935	4974	5427	5290	8452
1985	9985	4991	2125	340	7214	3351	11581	5244	6098	572	13826	5586
1986	13659	5804	3695	35	4498	4971	15672	6045	10139	61	8416	8284
1987	13432	4791	3025	246	4830	3012	14875	4965	8422	431	9053	5019
1988	15535	4258	4381	312	5172	4781	17069	4444	12177	542	9698	7969
1989	14645	6742	3239	253	4375	4567	16273	6975	8961	440	8188	7611
1990	12398	8463	4557	1228	3950	2424	13522	8701	13006	2139	7402	4040
1991	14061	5019	3970	596	2940	357	15392	5223	11389	1061	5511	595
1992	12850	4819	4492	325	2044	1503	14036	5019	12711	575	3835	2505
1993	9848	6936	1809	282	2038	333	10724	8266	4792	533	3803	555
1994	10468	5920	1693	448	2173	145	11524	6989	4460	787	4075	242
1995	16562	8323	1321	781	3367	154	17872	9661	3310	1326	6294	256
1996	16431	4417	2389	394	1924	135	17869	5536	6390	781	3593	225
1997	13433	3393	1744	308	2237	138	14481	4326	4696	528	4147	229
1998	10402	4429	1849	302	2213	290	11113	5464	4895	547	4073	484
1999	14169	747	1962	3100	2956	491	14957	900	4640	5542	5536	837
2000	11937	570	3322	491	5096	363	12669	620	7368	864	9376	749
2001	14527	505	4281	239	2980	348	15579	751	8986	400	5639	717
2002	10843	8	4071	313	1500	344	11509	9	8833	539	2902	574
2003	18832	0	5164	267	3763	383	19872	0	11156	447	7022	640
2004	15558	107	4231	355	3268	401	16232	126	8531	593	6223	668
2005	16485	0	2901	719	3556	351	17397	0	6212	1208	6766	585
2006	14977	0	3055	872	2863	403	15773	0	6572	1473	5493	672
2007	12470	0	3203	1287	2444	303	13242	0	6971	2154	4558	506
2008	13725	0	4676	1266	4296	390	14511	0	10084	2151	7911	649
2009	16489	0	3188	849	3588	275	17422	0	7050	1483	6626	458
2010	19170	0	3926	1023	3017	338	20249	0	8595	1720	5454	564
2011	24130	0	4180	1497	4315	479	25526	0	9012	2545	8031	801
2012	16098	0	3221	868	3739	313	17017	0	6990	1471	6732	522
2013	19379	205	3701	994	1598	1445	20467	242	7991	1703	2979	2409

Appendix 4.ix. (continued). Year specific harvest data (1984 to 2009) and returns and spawners data for Québec for years when category splits are not available (1970 to 1983) used in the run-reconstruction.

							These data are specific to the 1970 to 1983 period when detailed returns by river category are not available.							
	Harvests in various fisheries not in the other inputs													
	Small salmon			Large salmon			Small returns		Large returns		Small spawners		Large spawners	
Year	Sport	FN	Commercial	Sport	FN	Commercial	Min	Max	Min	Max	Min	Max	Min	Max
Bugs labels	QCSportSm[]	QCFnSm[]	QCCmSm[]	QCSportLg[]	QCFnLg[]	QCCmLg[]	QCSm_L[]	QCSm_H[]	QCLg_L[]	QCLg_H[]	QCSSm_L[]	QCSSm_H[]	QCSLg_L[]	QCSLg_H[]
1970	0	0	0	0	0	0	18904	28356	82680	124020	11045	16568	31292	46937
1971	0	0	0	0	0	0	14969	22453	47354	71031	9338	14007	16194	24292
1972	0	0	0	0	0	0	12470	18704	61773	92660	8213	12320	31727	47590
1973	0	0	0	0	0	0	16585	24877	68171	102256	10987	16480	32279	48419
1974	0	0	0	0	0	0	16791	25186	91455	137182	10067	15100	39256	58884
1975	0	0	0	0	0	0	18071	27106	77664	116497	11606	17409	32627	48940
1976	0	0	0	0	0	0	19959	29938	77212	115818	12979	19469	31032	46548
1977	0	0	0	0	0	0	18190	27285	91017	136525	12004	18006	44660	66990
1978	0	0	0	0	0	0	16971	25456	81953	122930	11447	17170	40944	61416
1979	0	0	0	0	0	0	21683	32524	45197	67796	15863	23795	17543	26315
1980	0	0	0	0	0	0	29791	44686	107461	161192	20817	31226	48758	73137
1981	0	0	0	0	0	0	41667	62501	84428	126642	30952	46428	35798	53697
1982	0	0	0	0	0	0	23699	35549	74870	112305	16877	25316	36290	54435
1983	0	0	0	0	0	0	17987	26981	61488	92232	12030	18045	23710	35565
1984	3492	357	794	8561	4530	13053	0	0	0	0	0	0	0	0
1985	4046	273	2093	9883	3623	16619	0	0	0	0	0	0	0	0
1986	6266	372	3707	11643	4519	20889	0	0	0	0	0	0	0	0
1987	7443	366	2992	9740	4466	22745	0	0	0	0	0	0	0	0
1988	8663	397	4760	12980	4747	19750	0	0	0	0	0	0	0	0
1989	6080	196	2615	11040	2905	18175	0	0	0	0	0	0	0	0
1990	8581	108	3425	12132	2900	16092	0	0	0	0	0	0	0	0
1991	6271	265	3282	11194	4335	16372	0	0	0	0	0	0	0	0
1992	8263	120	3849	12291	4550	15851	0	0	0	0	0	0	0	0
1993	8319	7	3627	9798	3976	11242	0	0	0	0	0	0	0	0
1994	7655	161	3861	10932	4496	10424	0	0	0	0	0	0	0	0
1995	4187	353	3915	7892	6194	10038	0	0	0	0	0	0	0	0
1996	7265	72	4532	9618	6113	7454	0	0	0	0	0	0	0	0
1997	5075	35	3531	6771	4875	7202	0	0	0	0	0	0	0	0
1998	5867	35	1068	4702	4875	1038	0	0	0	0	0	0	0	0
1999	4428	710	814	4407	3683	471	0	0	0	0	0	0	0	0
2000	5553	821	0	4297	3818	0	0	0	0	0	0	0	0	0
2001	4213	770	0	5558	3574	0	0	0	0	0	0	0	0	0
2002	7206	1672	0	2484	3164	0	0	0	0	0	0	0	0	0
2003	4898	972	0	4610	3541	0	0	0	0	0	0	0	0	0
2004	6633	1158	0	4412	3558	0	0	0	0	0	0	0	0	0
2005	3767	909	0	3973	3062	0	0	0	0	0	0	0	0	0
2006	5366	1117	0	3032	3512	0	0	0	0	0	0	0	0	0
2007	3787	869	0	3419	2932	0	0	0	0	0	0	0	0	0
2008	7604	1171	0	3038	2971	0	0	0	0	0	0	0	0	0
2009	3444	1141	0	3338	2752	0	0	0	0	0	0	0	0	0
2010	4917	1057	0	3166	2362	0	0	0	0	0	0	0	0	0
2011	7298	1205	0	4295	3216	0	0	0	0	0	0	0	0	0
2012	4044	1224	0	2740	2963	0	0	0	0	0	0	0	0	0
2013	2911	1037	0	2992	2337	0	0	0	0	0	0	0	0	0

Appendix 4.x. Input data for 2SW salmon returns to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Returns of 2SW												
	SFA 15		SFA 16		SFA 17		SFA 18		SFA 19-21		SFA 23		USA
Year of return to rivers	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Point estimate
Winbugs labels	SF15R2_L[]	SF15R2_H[]	SF16R2_L[]	SF16R2_H[]	SF17R2_L[]	SF17R2_H[]	SF18R2_L[]	SF18R2_H[]	SF19_21R2_L []	SF19_21R2_H []	SF23R2_L[]	SF23R2_H[]	**USAR2[]**
1970	8243	10576	42901	45798	31	60	4744	6836	5600	7447	8540	12674	0
1971	3587	4616	26038	30669	29	29	1891	2782	4120	5215	7155	10536	653
1972	4980	9756	29092	43510	402	402	4693	6024	5744	6993	7869	11368	1383
1973	6211	12009	26599	40492	206	206	4140	5481	6922	8659	4205	6036	1427
1974	7264	14570	39270	60090	386	386	5481	6928	13138	15363	10755	14988	1394
1975	4353	7922	25889	39325	345	345	3452	4340	12261	13797	13107	18578	2331
1976	7293	14416	20448	30758	575	578	2755	3674	8607	10104	14274	20281	1317
1977	9174	18077	49881	73330	606	606	3985	5463	10872	12851	16869	23995	1998
1978	5458	10749	19504	26041	0	0	4585	6265	8272	9779	8225	11294	4208
1979	1472	2535	6501	9306	459	463	1290	2014	3781	4879	5165	7207	1942
1980	7102	14045	35163	48457	2	5	3732	5177	14094	17318	19056	26865	5796
1981	4572	7357	11144	19268	40	77	2490	3769	8662	11471	11026	15267	5601
1982	4314	6313	21442	41643	16	31	4135	5901	4458	5353	9782	13871	6056
1983	3453	5280	16349	28419	17	32	3733	5241	4134	5356	9662	13836	2155
1984	3329	6092	12216	31455	13	26	2391	3573	1758	2854	15706	22627	3222
1985	4805	9500	14614	37625	8	15	921	4481	6894	12124	16541	23828	5529
1986	7831	15403	21617	55640	5	11	2274	11479	6755	11878	9891	14261	6176
1987	4836	9123	12524	32224	66	128	2611	10422	3748	6591	6922	10043	3081
1988	7152	13998	14384	36938	96	185	2533	10205	4393	7735	4716	6697	3286
1989	4390	8492	9113	23385	149	287	2108	8600	4808	8469	6560	9437	3197
1990	4326	8369	14269	36639	284	545	1893	7684	3591	6320	5486	7918	5051
1991	2387	4668	14685	37736	188	361	2350	9628	2960	5213	7337	10563	2647
1992	4002	7787	21381	30728	95	183	2374	9577	2633	4634	6878	9809	2459
1993	1395	2684	15579	60246	22	43	1341	5317	2542	4470	4345	4820	2231
1994	3960	7745	13652	24887	169	310	1981	8094	1360	2396	3084	3495	1346
1995	2713	5333	25593	37215	384	576	1498	6160	2253	3969	3439	3998	1748
1996	3917	7754	11126	19117	394	591	3247	13507	3000	5278	4729	5397	2407
1997	2488	4898	8545	14244	387	581	3421	14254	1163	2045	2769	3176	1611
1998	1687	3260	6292	10783	385	577	2055	8560	924	1270	1372	1642	1526
1999	1780	3425	7098	11206	383	575	1557	6596	1419	1951	2375	2640	1168
2000	2270	4410	7560	11744	378	566	1467	6302	1078	1483	988	1206	533
2001	3779	7442	14257	19289	376	564	1689	7251	1822	2506	1938	2279	788
2002	2335	4540	5572	9079	372	557	1228	5307	382	525	483	548	504
2003	3947	7778	10991	16823	371	557	2380	10207	1854	2548	1056	1198	1192
2004	3005	5886	10596	18488	367	550	2639	11397	1028	1413	1335	1605	1283
2005	3422	6725	11310	19988	373	560	2217	9293	662	906	809	1012	984
2006	2551	4973	9779	17103	392	587	2114	9010	1263	1734	922	1171	1023
2007	4267	8422	9451	15183	412	618	1353	6122	603	825	616	736	954
2008	2848	5572	5811	11066	429	644	2020	9357	1793	2465	812	1042	1764
2009	3948	7781	10580	17076	402	602	1524	7251	827	1135	1485	1886	2069
2010	2978	5831	7804	11581	439	658	2049	9574	934	1277	829	992	**1078**
2011	7265	14445	21216	48573	653	980	3633	16729	1489	2044	2486	3259	3045
2012	3230	6338	7987	15163	653	980	831	4118	623	849	268	331	879
2013	5324	10544	7305	16555	993	1487	1117	5533	2108	2893	420	543	525

Appendix 4.x. (continued). Input data for large salmon returns to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Returns of large salmon												
	SFA 15		SFA 16		SFA 17		SFA 18		SFA 19-21		SFA 23		USA
Year of return to rivers	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Point estimate
Winbugs labels	SF15Lg_L[]	SF15Lg_H[]	SF16Lg_L[]	SF16Lg_H[]	SF17Lg_L[]	SF17Lg_H[]	SF18Lg_L[]	SF18Lg_H[]	SF19_21Lg_L[]	SF19_21Lg_H[]	SF23Lg_L[]	SF23Lg_H[]	**USALg[]**
1970	12681	16270	46462	49599	31	60	6161	7858	7273	9671	9691	13945	0
1971	5518	7102	28365	33409	29	29	2456	3198	5350	6773	8056	11573	653
1972	8441	16536	30146	45087	402	402	6095	6924	7460	9082	8890	12536	1383
1973	8393	16229	27771	42276	206	206	5376	6299	8049	10069	4760	6638	1427
1974	9950	19959	43249	66179	386	386	7119	7963	13138	15363	12187	16444	1394
1975	5510	10028	29826	45305	345	345	4483	4989	12261	13797	14829	20351	2331
1976	9596	18969	23943	36016	575	578	3578	4223	8873	10416	16128	22175	1317
1977	11053	21779	52673	77434	606	606	5175	6280	14119	16690	19165	26183	1998
1978	7277	14332	22653	30245	0	0	5954	7201	10471	12378	9335	12342	4208
1979	2886	4971	9435	13507	459	463	1676	2315	5180	6684	5856	7903	1942
1980	8768	17340	37014	51008	2	5	4846	5951	16388	20137	21464	29480	5796
1981	9729	15652	16708	28887	40	77	3234	4332	11706	15501	12481	16743	5601
1982	7311	10700	26504	51475	16	31	5370	6783	9485	11390	11147	15303	6056
1983	5852	8950	20309	35304	17	32	4848	6024	6562	8501	10908	15235	2155
1984	4214	7711	12941	33321	13	26	3105	4107	2408	3909	17706	24992	3222
1985	7627	15080	16798	43247	8	15	1196	5150	8512	14968	18582	26289	5529
1986	10305	20267	25342	65228	5	11	2953	13195	10722	18854	11142	15761	6176
1987	7556	14255	15734	40483	66	128	3391	11980	5950	10462	7865	11116	3081
1988	9933	19441	17627	45267	96	185	3289	11729	7321	12891	5360	7312	3286
1989	7701	14898	13955	35812	149	287	2738	9885	6969	12275	7393	10380	3197
1990	6362	12307	23164	59479	284	545	2458	8832	6191	10897	6235	8710	5051
1991	4773	9335	24273	62373	188	361	3052	11066	4112	7240	8312	11659	2647
1992	7411	14420	34573	49686	95	183	3083	11008	3657	6437	7749	10726	2459
1993	3487	6711	22602	87407	22	43	1742	6112	3218	5658	5260	5980	2231
1994	6600	12908	18098	32992	169	310	2573	9303	1743	3071	3659	4155	1346
1995	4171	8199	30324	44094	384	576	1946	7081	2532	4460	3728	4289	1748
1996	6026	11929	16317	28035	394	591	4217	15526	3571	6283	5535	6365	2407
1997	3828	7535	14711	24521	387	581	4443	16384	1550	2726	3210	3678	1611
1998	2595	5015	15207	26060	385	577	2669	9839	1359	1867	2032	2437	1526
1999	2738	5269	14585	23026	383	575	2022	7581	1709	2350	2734	3090	1168
2000	3493	6785	15950	24778	378	566	1905	7244	1315	1809	1189	1430	533
2001	5815	11449	22082	29875	376	564	2194	8335	1980	2724	2113	2501	797
2002	3592	6985	11094	18077	372	557	1595	6100	749	1029	639	752	526
2003	6072	11966	18783	28749	371	557	3091	11732	1952	2682	1128	1289	1199
2004	4623	9055	18589	32435	367	550	3427	13100	1302	1789	1402	1698	1316
2005	5265	10346	17008	30057	373	560	2879	10682	860	1177	890	1121	994
2006	3924	7651	18805	32890	392	587	2746	10356	1559	2141	997	1276	1030
2007	6565	12957	16018	25734	412	618	1757	7037	701	959	689	841	958
2008	4382	8572	10377	19761	429	644	2623	10755	1928	2650	858	1105	1799
2009	6074	11970	17065	27543	402	602	1979	8335	1034	1418	1678	2158	2095
2010	4581	8972	15301	22708	439	658	2662	11005	1061	1451	1117	1398	1098
2011	11177	22223	24960	57144	653	980	4718	19229	1504	2065	2598	3421	3087
2012	4969	9750	11411	21661	653	980	1080	4733	788	1075	335	422	913
2013	8190	16222	10587	23993	719	1077	1451	6359	2196	3014	503	660	525

ICES WGNAS REPORT 2014

Appendix 4.x. (continued). Input data for small salmon returns to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Returns of small salmon												
	SFA 15		SFA 16		SFA 17		SFA 18		SFA 19-21		SFA 23		USA
Year of return to rivers	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Point estimate
Winbugs labels	SF15Sm_L[]	SF15Sm_H[]	SF16Sm_L[]	SF16Sm_H[]	SF17Sm_L[]	SF17Sm_H[]	SF18Sm_L[]	SF18Sm_H[]	SF19_21Sm_L[]	SF19_21Sm_H[]	SF23Sm_L[]	SF23Sm_H[]	**USASm[]**
1970	2834	6279	47779	67697	0	0	264	1073	16177	24106	5306	7521	0
1971	2113	4681	38388	54120	0	0	65	265	11911	18004	3248	4541	32
1972	2185	4699	48886	69270	0	0	131	530	11587	17992	1831	2506	18
1973	3010	6668	47190	66835	5	9	516	2095	14169	22159	5474	7012	23
1974	2226	4895	78091	110470	0	0	187	757	25032	39058	10195	12901	55
1975	2393	5298	69993	98443	0	0	112	454	10860	15753	18022	23101	84
1976	8667	14696	96504	136107	14	28	299	1212	21071	33009	22835	28864	186
1977	6085	12084	30621	42689	0	0	215	871	24599	37314	13738	16671	75
1978	4350	7749	29783	39927	0	0	78	316	7621	10023	6271	7695	155
1979	4378	9495	50667	70714	2	5	1857	7536	24298	37514	15356	20517	250
1980	7994	15278	41687	58839	12	23	520	2108	34377	50250	25139	31483	818
1981	9380	17119	63278	108226	259	498	2797	11348	31204	48945	16826	21803	1130
1982	6541	13383	78072	133171	175	336	2150	8722	17619	27075	11811	15636	334
1983	2723	4638	24585	41332	17	32	212	858	9313	14068	9270	12592	295
1984	12003	15867	28714	49595	17	32	460	1867	18382	29867	15556	21678	598
1985	7003	15516	53393	92224	113	217	730	3167	24384	39541	13056	17928	392
1986	10813	23926	103230	178295	566	1088	965	3854	24369	39663	14274	20183	758
1987	9630	21220	74485	128644	1141	2194	1646	5713	27269	44266	13358	17662	1128
1988	13168	29092	107071	184904	1542	2963	1381	4833	24509	39750	16381	23084	992
1989	6357	13900	66069	114097	400	770	893	3208	25602	41557	17579	24521	1258
1990	7880	17314	73020	126115	1842	3539	983	3528	29471	48039	13820	19176	687
1991	4441	9828	53453	92327	1576	3028	1160	4166	9762	15955	13041	17685	310
1992	8853	19614	142416	204708	1873	3599	994	3531	13754	22269	13563	18404	1194
1993	5783	12812	70090	175096	1277	2454	1146	3892	13297	21681	7610	8828	466
1994	9136	20208	41773	59888	210	385	671	2425	3154	5393	5770	6610	436
1995	2902	6429	44357	63453	658	987	543	1985	8397	13873	8265	9458	213
1996	6034	13370	32067	45995	710	1065	2431	8958	13120	22293	12907	15256	651
1997	5797	12845	14377	24122	517	776	561	2134	3410	5863	4508	4979	365
1998	6288	13932	21965	32523	508	762	633	2419	8833	11927	9203	10801	403
1999	4936	10929	21494	29707	413	620	705	2681	3971	5337	5508	6366	419
2000	7459	16520	31923	42435	395	593	615	2428	6155	8312	4796	5453	270
2001	4947	10953	26496	36655	415	622	822	3205	2326	3138	2513	2862	266
2002	11719	25958	40432	54790	390	585	844	3319	5197	7015	3501	3991	450
2003	3119	6904	26530	39772	515	773	773	3088	2844	3837	2292	2716	237
2004	12091	26783	43242	62082	330	495	1092	4339	3847	5192	3454	4297	319
2005	4117	9116	28441	47190	343	514	781	3015	2870	3871	3597	4640	319
2006	8724	19322	30671	52560	331	497	869	3406	5144	6940	3720	4743	450
2007	4259	9430	23038	44016	275	413	718	2820	4198	5664	2466	3136	297
2008	13601	30129	25722	46587	298	447	1245	5061	7282	9831	5924	7691	814
2009	5169	11445	10819	21456	233	350	302	1417	2066	2788	1603	2027	241
2010	8187	18132	48123	67747	258	387	877	3672	3686	4975	9114	11994	525
2011	10234	22668	39511	67884	291	436	1248	5124	3615	4878	4466	5943	1080
2012	4350	9631	6914	13254	291	436	211	1077	346	466	178	219	26
2013	4661	10320	9877	21479	274	410	303	1517	922	1244	894	1151	78

Appendix 4.x. (continued). Input data for 2SW salmon spawners to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Spawners of 2SW												
	SFA 15		SFA 16		SFA 17		SFA 18		SFA 19-21		SFA 23		USA
Year of return to rivers	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Point estimate
Winbugs labels	SF15S2_L[]	SF15S2_H[]	SF16S2_L[]	SF16S2_H[]	SF17S2_L[]	SF17S2_H[]	SF18S2_L[]	SF18S2_H[]	SF19_21S2_L[]	SF19_21S2_H[]	SF23S2_L[]	SF23S2_H[]	USAS2[]
1970	1156	3252	5346	8242	18	47	304	1587	2388	4234	1536	4846	0
1971	510	1434	6724	11354	0	0	133	694	1418	2513	3612	6576	490
1972	2367	6656	17031	31450	0	0	148	775	1616	2865	6472	9806	1038
1973	2873	8081	19277	33170	0	0	165	863	2246	3984	2752	4412	1100
1974	3620	10183	31192	52012	0	0	151	790	2878	5103	8123	12046	1147
1975	1769	4975	18536	31972	0	0	91	473	1987	3523	10987	16209	1942
1976	3530	9928	11842	22152	1	4	116	604	1935	3432	10071	15583	1126
1977	4412	12408	30623	54071	0	0	198	1033	2559	4539	12013	18568	643
1978	2622	7375	6998	13535	0	0	223	1166	1948	3455	5346	8076	3314
1979	527	1482	3000	5806	3	7	115	598	1419	2517	3772	5650	1509
1980	3440	9677	17667	30961	1	4	198	1033	4170	7394	12023	19005	4263
1981	1380	3880	2392	10515	36	73	196	1027	3631	6439	3642	7014	4334
1982	991	2786	8418	28619	8	23	253	1322	1158	2053	4475	7939	4643
1983	906	2547	5516	17586	15	30	210	1100	1579	2800	468	3561	1769
1984	2656	5402	11650	30889	13	26	259	1148	1416	2512	12280	18798	2547
1985	4514	9180	14019	37030	8	15	871	4359	6761	11990	11885	18624	4884
1986	7279	14804	20606	54630	5	11	2164	11213	6624	11748	7224	11280	5570
1987	4122	8383	11414	31114	66	128	2534	10189	3676	6519	5628	8597	2781
1988	6582	13386	13801	36355	96	185	2451	9954	4322	7664	3420	5248	3038
1989	3944	8021	8466	22739	149	287	2042	8397	4735	8396	6310	9158	2800
1990	3886	7903	13669	36039	284	545	1829	7491	3530	6260	4926	7292	4356
1991	2193	4460	14200	37251	188	361	2275	9399	2912	5165	6080	9158	2416
1992	3639	7400	20770	30116	95	183	2291	9324	2588	4589	5826	8633	2292
1993	1239	2521	15239	59907	22	43	1296	5180	2493	4421	3291	3654	2065
1994	3639	7401	13418	24653	166	307	1920	7907	1339	2375	2387	2680	1344
1995	2519	5124	25326	36949	380	576	1453	6022	2218	3934	3126	3652	1748
1996	3688	7502	10743	18662	388	591	3166	13262	2946	5224	4009	4585	2407
1997	2316	4710	8106	13754	385	581	3334	13988	1140	2022	2219	2565	1611
1998	1512	3076	6098	10548	382	577	2000	8390	915	1261	1068	1302	1526
1999	1581	3217	6589	10660	379	575	1523	6493	1409	1941	1934	2181	1168
2000	2057	4184	7262	11408	376	566	1438	6214	1072	1477	805	1004	1587
2001	3521	7161	13688	18674	374	564	1654	7143	1812	2497	1699	2008	1491
2002	2120	4312	5332	8808	371	557	1203	5230	378	521	317	356	511
2003	3683	7491	10593	16372	368	557	2333	10063	1834	2528	878	998	1192
2004	2770	5633	10144	17965	365	550	2581	11219	1017	1401	1238	1492	1283
2005	3175	6457	10755	19354	371	560	2162	9124	646	890	726	914	1088
2006	2329	4737	9336	16594	390	587	2062	8851	1248	1720	796	1023	1419
2007	3994	8124	8963	14644	409	618	1320	6023	587	809	530	633	1189
2008	2618	5325	5376	10584	429	644	1961	9180	1778	2450	736	953	2809
2009	3684	7494	10062	16500	401	602	1481	7122	811	1118	1391	1774	2292
2010	2743	5580	7335	11078	438	658	1998	9419	910	1253	726	877	1482
2011	6902	14038	20445	47555	652	980	3543	16455	1467	2023	2430	3196	3872
2012	2988	6077	7603	14713	652	980	816	4070	601	828	238	298	2020
2013	5019	10208	6722	15889	989	1483	1093	5459	2078	2864	405	526	525

Appendix 4.x. (continued). Input data for large salmon spawners to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Spawners of large salmon												
	SFA 15		SFA 16		SFA 17		SFA 18		SFA 19-21		SFA 23		USA
Year of return to rivers	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Point estimate
Winbugs labels	SF15SLg_L[]	SF15SLg_H[]	SF16SLg_L[]	SF16SLg_H[]	SF17SLg_L[]	SF17SLg_H[]	SF18SLg_L[]	SF18SLg_H[]	SF19_21SLg_L[]	SF19_21SLg_H[]	SF23SLg_L[]	SF23SLg_H[]	**USASLg[]**
1970	1779	5003	5790	8926	18	47	395	1824	3101	5499	1451	5705	0
1971	785	2207	7324	12369	0	0	173	797	1841	3264	3888	7405	490
1972	4011	11282	17648	32589	0	0	193	891	2099	3721	7246	10892	1038
1973	3883	10920	20126	34632	0	0	215	992	2612	4632	3050	4928	1100
1974	4960	13949	34352	57282	0	0	196	908	2878	5103	9090	13347	1147
1975	2239	6297	21355	36834	0	0	118	544	1987	3523	12335	17857	1942
1976	4644	13063	13867	25940	1	4	151	694	1995	3538	11183	17230	1126
1977	5315	14949	32337	57097	0	0	257	1187	3324	5895	13452	20470	643
1978	3496	9833	8128	15720	0	0	290	1340	2466	4373	5948	8955	3314
1979	1033	2906	4355	8426	3	7	149	688	1944	3448	4217	6264	1509
1980	4248	11947	18597	32590	1	4	257	1187	4849	8598	13190	21206	4263
1981	2935	8256	3586	15765	36	73	255	1181	4907	8702	3794	8056	4334
1982	1679	4723	10405	35376	8	23	329	1519	2464	4369	4903	9059	4643
1983	1535	4317	6852	21846	15	30	273	1264	2506	4445	92	4419	1769
1984	3362	6838	12341	32721	13	26	337	1320	1940	3441	13675	20961	2547
1985	7164	14571	16114	42563	8	15	1131	5010	8347	14803	13104	20811	4884
1986	9577	19479	24157	64044	5	11	2811	12889	10515	18647	8004	12623	5570
1987	6441	13099	14340	39088	66	128	3291	11711	5835	10347	6343	9594	2781
1988	9141	18592	16913	44553	96	185	3183	11442	7203	12773	3835	5787	3038
1989	6919	14072	12965	34822	149	287	2652	9651	6862	12168	7099	10086	2800
1990	5715	11623	22190	58504	284	545	2376	8611	6087	10793	5576	8051	4356
1991	4386	8920	23472	61572	188	361	2955	10803	4045	7173	6833	10180	2416
1992	6738	13704	33583	48697	95	183	2976	10717	3594	6374	6511	9488	2292
1993	3099	6302	22109	86914	22	43	1683	5953	3156	5596	4026	4746	2065
1994	6065	12334	17787	32682	166	307	2493	9088	1717	3045	2827	3273	1344
1995	3873	7877	30007	43778	380	576	1887	6922	2492	4420	3362	3923	1748
1996	5674	11541	15755	27367	388	591	4112	15244	3507	6219	4688	5497	2407
1997	3563	7247	13955	23677	385	581	4330	16078	1520	2696	2565	3028	1611
1998	2326	4732	14737	25493	382	577	2597	9643	1346	1854	1675	2074	1526
1999	2433	4948	13539	21905	379	575	1979	7464	1697	2338	2251	2601	1168
2000	3165	6437	15321	24069	376	566	1867	7142	1307	1801	975	1216	1587
2001	5417	11018	21201	28923	374	564	2148	8210	1970	2714	1831	2210	1491
2002	3261	6633	10618	17538	371	557	1562	6011	741	1021	442	542	511
2003	5666	11525	18102	27978	368	557	3029	11567	1931	2661	919	1074	1192
2004	4261	8666	17796	31517	365	550	3351	12895	1287	1774	1287	1574	1283
2005	4884	9934	16172	29104	371	560	2807	10487	839	1156	791	1012	1088
2006	3583	7288	17954	31911	390	587	2678	10174	1541	2123	847	1113	1419
2007	6145	12498	15191	24820	409	618	1715	6923	683	941	586	726	1189
2008	4028	8192	9601	18901	429	644	2547	10551	1912	2634	767	1007	2231
2009	5668	11529	16229	26612	401	602	1924	8186	1014	1398	1565	2034	2318
2010	4221	8584	14382	21722	438	658	2595	10826	1034	1424	996	1275	**1502**
2011	10619	21597	24053	55948	652	980	4601	18913	1482	2043	2532	3353	3914
2012	3230	6338	10861	21019	652	980	1059	4679	761	1048	300	387	2054
2013	7721	15704	9742	23028	717	1075	1419	6275	2165	2983	486	643	525

Appendix 4.x. (continued). Input data for small salmon spawners to Salmon Fishing Areas 15 to 23 for Canada and for USA used in the run-reconstruction.

	Spawners of small salmon												
	SFA 15		**SFA 16**		**SFA 17**		**SFA 18**		**SFA 19-21**		**SFA 23**		**USA**
Year of return to rivers	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Point estimate**
Winbugs labels	SF15SSm_L[]	SF15SSm_H[]	SF16SSm_L[]	SF16SSm_H[]	SF17SSm_L[]	SF17SSm_H[]	SF18SSm_L[]	SF18SSm_H[]	SF19_21SSm_L[]	SF19_21SSm_H[]	SF23SSm_L[]	SF23SSm_H[]	**USASSm[]**
1970	1417	4396	25958	45876	0	0	167	842	9429	17358	3886	6101	0
1971	1056	3277	22463	38195	0	0	41	208	7246	13339	1216	2509	29
1972	1034	3208	27639	48023	0	0	82	416	7616	14021	0	1	17
1973	1505	4668	31703	51349	3	7	325	1645	9502	17492	4037	5575	13
1974	1098	3405	57376	89755	0	0	118	595	16680	30706	8071	10777	40
1975	1195	3707	50438	78888	0	0	71	357	5819	10712	15363	20442	67
1976	2480	7692	64526	104130	8	22	188	951	14196	26134	17572	23601	151
1977	2467	7653	13270	25338	0	0	135	684	15120	27835	9196	12129	54
1978	1398	4337	14689	24833	0	0	49	248	2857	5259	4256	5680	127
1979	2104	6528	31829	51876	1	4	1170	5915	15716	28932	11640	16801	247
1980	2996	9293	27791	44943	7	18	327	1655	18876	34749	19597	25941	722
1981	3183	9874	35423	80370	151	390	1762	8908	21096	38837	7805	12782	1009
1982	3038	9027	51324	106423	102	263	1354	6847	11244	20700	6532	10357	290
1983	820	2486	13298	30045	10	25	133	674	5653	10408	5132	8454	255
1984	1620	4971	7389	28271	10	25	177	1200	13658	25143	10290	16412	540
1985	3557	10936	32275	71106	66	170	145	1788	18024	33181	8164	13036	363
1986	5589	16990	71918	146983	330	852	63	1729	18187	33481	10725	16634	660
1987	4867	14920	49971	104131	665	1718	527	3075	20213	37210	10257	14561	1087
1988	6664	20468	71967	149800	899	2320	344	2388	18125	33366	13061	19764	923
1989	3191	9741	37696	85724	233	603	232	1650	18973	34928	13124	20066	1080
1990	3996	12190	46902	99996	1074	2771	229	1750	22080	40648	10025	15381	617
1991	2215	6872	39648	78522	919	2371	271	2068	7363	13556	9495	14139	235
1992	4426	13728	116657	178949	1092	2818	189	1634	10125	18640	9485	14326	1124
1993	2891	8968	52050	157056	745	1922	261	1805	9970	18354	5762	6868	444
1994	4554	14125	25649	43764	118	292	179	1266	2661	4900	4965	5738	427
1995	1451	4501	34650	53746	250	375	148	1055	6512	11988	8025	9218	213
1996	3017	9359	19511	29260	258	387	1005	5596	10909	20082	11576	13892	651
1997	2899	8991	8702	15524	256	384	203	1290	2917	5370	3971	4433	365
1998	3144	9752	13997	21387	255	382	228	1464	8818	11912	8775	10348	403
1999	2465	7646	12193	17943	253	380	347	1837	3895	5261	5196	6048	419
2000	3727	11560	18837	26196	252	378	314	1717	6148	8305	4455	5087	270
2001	2470	7663	15703	22815	250	376	403	2217	2315	3127	2210	2530	266
2002	5857	18166	25458	35509	249	373	426	2334	5180	6998	3232	3689	450
2003	1557	4829	15727	24997	248	371	396	2201	2829	3822	2069	2469	237
2004	6043	18744	27425	40613	246	369	496	2934	3833	5178	3229	4039	319
2005	2056	6377	17065	30189	246	368	300	1881	2854	3855	3433	4450	319
2006	4359	13522	19763	35085	247	370	358	2201	5119	6915	3528	4501	450
2007	2127	6597	14420	29105	248	372	330	1905	4176	5642	2305	2937	297
2008	6798	21086	16299	30904	249	373	451	3189	7252	9801	5729	7467	814
2009	2581	8007	5867	13313	233	350	105	953	2051	2773	1472	1864	241
2010	4090	12688	30506	44243	256	384	387	2516	3674	4963	9032	11901	**525**
2011	5114	15864	25264	45125	290	435	562	3506	3601	4864	4391	5867	1080
2012	2172	6738	3457	7895	290	435	119	860	343	463	167	208	26
2013	2328	7220	5200	13321	272	408	135	1121	919	1241	870	1127	78

Appendix 5: Model walkthroughs

The following summarise of data preparation, model running and output processing were presented at a one-day workshop prior to the 2014 WGNAS meeting and are intended as step by step walkthroughs and to briefly summarise.

5.1 NEAC pre-fishery abundance and national conservation limit model in R

[NB: Instructions apply to model version on 18/3/14]

1) Introduction

This program performs the run-reconstruction estimation of pre-fishery abundance (PFA) of maturing and non-maturing 1SW salmon for each country (and region) in the NASCO-NEAC area. PFA is estimated for January 1st in the first sea winter. The program also establishes the pseudo stock–recruitment (S–R) relationship between lagged egg deposition and Total 1SW PFA, and applies a hockey-stick S–R analysis to estimate the National/Regional Conservation Limit where river-specific CLs are not available.

The original model is described by Potter *et al*. (2004). Minor changes to the estimation approach used for different countries and regions have been reported in the annual reports of WGNAS.

2) To get started

- a) Load RStudio or R;
- b) Set up a folder from which you will run the program;
- c) Use folder and file names without spaces;
- d) Put the program, the input files (annual and multiannual) and the summary data file (see 6f) in this folder.

3) Input Data

3.1) Annual data (filenames: Annual-data-XX-YY.txt)

- a) There is a file for each country (XX) and region (YY) which contains the 40+ year time-series of data on catches, exploitation rates and non-reporting rates (plus additional data for some countries).
- b) To read the .txt files, it is easiest to open them from within Excel. i.e.
  - Open Excel;
  - select the correct folder;
  - click on 'Open'
  - You will probably need to change the setting in the lower right corner of the open box from 'Excel files' to 'All files';
  - Double-click on the file you want to open and it should open the 'Text Import Wizard';
  - select 'finish' (If this doesn't work reopen the file, but select 'Delimited' at step 1, 'Tab' at step 2 and 'General' at step 3.)
- c) Do not add any formatting to the file. If loading a new version of a file that has been saved in Excel (e.g. after addition of a new

year's data), re-save the file by clicking 'Save As' and selecting 'Text (Tab delimited)' from the 'Save as type' list. This will remove the formatting and add the .txt extension.

d) When closing or saving the data file, you will be prompted to confirm that you want to lose the formatting; click 'yes'.

3.2) Multiannual-data (file-name: 'Multiannual-data.txt'

a) This file contains most of the other parameters used in the model including: smolt age composition, fecundity and sex ratios by region, M, etc.

b) The file is not formatted in columns so can be read easily in Notebook, which should be selected automatically if you click on the file to open it. (NB: Don't open the file in Excel because it will probably add " " marks.

c) All blank lines and lines starting with '#' are ignored in this file. Apart from these:

- The first line must start with 'list(
- The last line must be ')'
- All other lines must be 'variable name' <- number, followed by a comer. Model code:

4) Model structure

a) Introductory section: contains working directory, source files and various parameters controlling the way the program runs (some of these will need to be changed for your laptop.

b) Functions: functions are sections of code that the program calls up to repeat the same job. They have to be run before they are first called by the program; this is achieved by placing them at the beginning of the code. The code contains functions to run the hockey-stick analysis for the NCL model and to output certain figures and tables (see below).

c) Faroes and Greenland sections: these sections calculate the harvest in the distant water fisheries.

d) NEAC country/regions sections: there is a section for each country (in alphabetic order) and region to calculate the main outputs of the R-R model.

e) Output summaries: the final sections create the summary figures and tables.

5) Running the code from RStudio

a) Open R Studio

b) Select "File/Open File" and use the browser to select and open the code file; the code should open in the Top left panel. The code is currently called "NEAC_PFA_CL_RR_model_2014"

c) If you have been using the code recently, you can select "File/Recent Files" and select the file from the drop-down list (if it is there); you can open several code file simultaneously and they appear as tabs above the Top Left panel.

d) To set up the code for your PC/laptop, R-click on the code and scroll down to:

line 43 –enter the full path name of the working directory (replace the text between the parentheses with the full pathname of the folder containing the code on your laptop (e.g. "D:/Modelling_NEAC/PFA_NCL_R/2014").

line 47 –ensure that the text between the parentheses shows the correct filename for the multi-annual data file.

line 53 –enter the number of simulations that you want to run; for a full run use 10 000; for a trial you can use fewer.

line 54 –enter the last data year (from the annual data files).

lines 63 tom 72 –select which countries you wish to run the assessment for by setting "run-XX": 1 = run country XX; 0 = do not run. The summaries will only be run if all countries are set to 1.

line 75 –set "PrintFigs" <- 1 to output the summary figures (or any other value not to output them).

line 78 –set "WinbugsFiles" <- 1 to output the data files for the Bayesian forecast model (or any other value not to output them).

line 81 –set "PrintCountryTables" <- 1 to output summary output data for each region that is run (or any other value not to output them).

e) You do not need to save your changes before you run the code, but you may wish to save a version to be safe. To do this use "File/Save" or "File/Save As" as normal. It's a good idea to include the extension ".R". NB: You will be prompted to save the file before you close it.

f) To run the program press "Ctrl-Alt-R"

g) You will see when part of the code run in the lower left panel. Errors will show in red. The run is complete when the final line shows ">"

6) Running the program from R

a) Open R Studio

b) Select "File/Open script" and use the browser to select and open the code file; the code should open in a separate panel. The code is currently called "NEAC_PFA_CL_RR_model_2014"

c) To set up the code for your PC/laptop, R-click on the code and scroll down to:

SET WORKING DIRECTORY (wd): In line starting "wd <-" replace the text between the parentheses with the full pathname of the folder containing the code on your laptop (e.g. "D:/Modelling_NEAC/PFA_NCL_R/2014").

SET MULTI-ANNUAL DATA FILE [source()] in the line starting "source <-" ensure that the text between the parentheses shows the correct filename for the multiannual data file.

SET NUMBER OF SIMULATIONS and LATEST DATA YEAR: in the line starting “n.mc <-“ enter the number of simulations that you want to run; for a full run use 10,000; for a trial you can use fewer, and

In the line starting “lastdatayear <-“ enter the last data year (from the annual data files).

SET "run_XX": in the lines starting “run_XX <-“ select which countries you wish to run the assessment for by setting “run-XX”: 1 = run country XX; 0 = do not run. The summaries will only be run if all countries are set to 1.

SET 'PrintFigs': set “PrintFigs“ <- 1 to output the summary figures (or any other value not to output them).

SET 'WinbugsFiles: set “WinbugsFiles” <- 1 to output the data files for the Bayesian forecast model (or any other value not to output them).

SET 'PrintCountryTables': set “PrintCountryTables” <- 1 to output summary output data for each region that is run (or any other value not to output them).

d) You do not need to save your changes before you run the code, but you may wish to save a version to be safe. To do this use “File/Save” or “File/Save As” as normal. It’s a good idea to include the extension “.R”. NB: You will be prompted to save the file before you close it.

e) To run the program select “Edit/run all”

f) You will see when the code runs in the ‘R console’ panel. Errors will show in red. The run is complete when the final line shows “>”

7) Output files

The program produces the following outputs (if requested):

a) National plots: (filenames “Fig-XX”)

PDF files showing the national plots currently used in the WG report. This includes: maturing and non-maturing 1SW PFA; returns and spawners for 1SW and MSW; homewater exploitation rates; and total catches (inc. non-reported) for each country (XX). It also shows the pseudo stock–recruitment hockey-stock plots for each region; these show the estimated CL, where this is used in the assessment.

b) Regional data: (filenames “Region_data_XX_YY”)

Excel files showing PFA, returns, catch, exploitation rates and spawners for 1SW and MSW fish and total eggs and lagged egg estimates for each country (XX) and region (YY).

c) Input files for Forecast analysis: (filenames: “Winbugs_Data_XX_YY”)

Excel files for each country/region containing mean and sd estimates for the simulations for lagged eggs, 1SW returns and MSW returns.

d) Summary tables by country:

- Median spawner numbers
- Conservation limits and SERs
- Maturing 1SW PFA
- 1SW returns
- 1SW spawners
- Non-maturing 1SW PFA
- MSW returns
- MSW spawners

e) Summary plot for N-NEAC and S-NEAC

f) A formatted Excel workbook is set up to link to the output files and format the tables ready for use in the WGNAS report.

8) Common problems

a) The code will crash if an output file (Figure or Table) is left open. The error message (in red) may say:

- Error .... : cannot open file 'Fig-XX'

or

- Error in .... : cannot open file 'Region_data_XX.csv': Permission denied

b) It doesn't matter if an input file is open, but the program may not read the latest version of it.

c) More problems to be added .... when they are found!

9) References

Potter, E. C. E., Crozier, W. W., Schön, P-J., Nicholson, M. D., Prévost, E., Erkinaro, J., Gudbergsson, G., Karlsson, L., Hansen, L. P., MacLean, J. C., Ó Maoiléidigh, N. and Prusov S. 2004. Estimating and forecasting pre-fishery abundance of Atlantic salmon (*Salmo salar* L.) in the Northeast Atlantic for the management of mixed stock fisheries. ICES Journal of Marine Science, 61: 1359–1369.

5.2 Bayesian NEAC PFA Model Preparation, Running and Results Processing

1) Introduction

This is a step by step summary of the data preparation, code running and result processing steps in running the Bayesian NEAC PFA forecast models; applicable to the north and south complex models and country disaggregated models. Full input, run, and out-put files are available on the WGNAS ICES SharePoint for 2013, in the folders:

- Data/NEAC_Bayesian_forecsat_Complex_models_2013 and
- Data/NEAC_Bayesian_forecast_Country_models_2013

The example given below details the procedure for the northern NEAC stock complex.

2) Data Preparation

- Data from Run Reconstruction Goes into WinBUGS format table:

(data_NEAC_N_OpenBUGS_Transformed_2013.xls)

  - Returns, 1SW, 2SW, Means & standard deviations.
- Check data, including:
  - Lagged eggs 1SW & 2SW
  - Include Faroes catch and Greenland catch
  - Check all other variables are present & correct.

This creates the data that are read by the BUGS code (last Tab of the Workbook).

  - Paste into WinBUGS windows (with header as previous year).

Note: the header states point values that do not change between years, except for the Number of years included (n.data) which iterates up one, each year(!) (as in “data_NEAC_North_2013.txt”).

3) Running Code in WinBUGS

Compiling model and loading data:

  - “Check” model code (Model >Specification tool) (place cursor IN the code).
  - “Load” Data (place cursor IN the code).
  - “Compile”.
  - “Load inits” (place cursor IN the inits).

4) Set the sampling:

- Open Sample “Monitor Tool” (Inference > Samples).
- Set variables/ parameters to be monitored.
  - either by typing each into the “node window”.
  - or by running lines in “Script” file (highlight the lines to be run, Model >script).

5) Set the model running:

- Open the model updater “Model > Update”.
- Set number of iterations (100,000).
- Set model running (update).

6) Extracting results:

- Choose percentiles to draw (“Monitoring Tool”).
- Place an “*” in the “node” selection box.
- Set beginning iteration point to take values from (50 001 if you set the No. of iterations to 100 000 and want to drop the first half as burn in) Click “stats”.
- Results are printed to a window.
- Select all and copy!

7) Graphing Results:

- Copied values are pasted into output graphing file (N - NEAC Forecast output 2013_Final.xls).
- Trace through the work books tabs to ensure each is graphing the correct variable and its full time-series.

Annex 7: Glossary of acronyms used in this Report

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

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

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

BCI *(Bayesian Credible Interval).* The Bayesian equivalent of a confidence interval. If the 90% BCI for a parameter A is 10 to 20, there is a 90% probability that A falls between 10 and 20.

BHSRA *(Bayesian Hierarchical Stock and Recruitment Approach)*. Models for the analysis of a group of related stock–recruit datasets. Hierarchical modelling is a statistical technique that allows the modelling of the dependence among parameters that are related or connected through the use of a hierarchical model structure. Hierarchical models can be used to combine data from several independent sources.

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. Slim *(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.

COSEWIC *(Committee on the Status of Endangered Wildlife in Canada).* COSEWIC is the organization that assesses the status of wild species, subspecies, varieties, or other important units of biological diversity, considered to be at risk of extinction in Canada. COSEWIC uses scientific, Aboriginal traditional and community knowledge provided by experts from governments, academia and other organizations. Summaries of assessments on Atlantic salmon are currently available to the public on the COSEWIC website (www.cosewic.gc.ca)

Cpue *(Catch Per Unit of Effort).* A derived quantity obtained from the independent values of catch and effort.

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

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

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

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

ECOKNOWS *(Effective use of Ecosystems and biological Knowledge in fisheries).* The general aim of the ECOKNOWS project is to improve knowledge in fisheries science and management. The lack of appropriate calculus methods and fear of statistical over partitioning in calculations, because of the many biological and environmental influences on stocks, has limited reality in fisheries models. This reduces the biological credibility perceived by many stakeholders. ECOKNOWS will solve this technical estimation problem by using an up-to-date methodology that supports more effective use of data. The models will include important knowledge of biological processes.

ENPI CBC *(European Neighbourhood and Partnership Instrument Cross-Border Cooperation).* ENPI CBC is one of the financing instruments of the European Union. The ENPI programmes are being implemented on the external borders of the EU. It is designed to target sustainable development and approximation to EU policies and standards; supporting the agreed priorities in the European Neighbourhood Policy Action Plans, as well as the Strategic Partnership with Russia.

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

GRAASP *(Genetically based Regional Assignment of Atlantic Salmon Protocol).* GRAASP was developed and validated by twelve European genetic research laboratories. Existing and new genetic data were calibrated and integrated in a purpose built electronic database to create the assignment baseline. The unique database created initially encompassed 32 002 individuals from 588 rivers. The baseline data, based on a suite of 14 microsatellite loci, were used to identify the natural evolutionary regional stock groupings for assignment.

ICPR *(The International Commission for the Protection of the River Rhine).* ICPR coordinates the ecological rehabilitation programme involving all countries bordering the river Rhine. This programme was initiated in response to catastrophic river pollution in Switzerland in 1986 which killed hundreds of thousands of fish. The programme aims to bring about significant ecological improvement of the Rhine and its tributaries enabling the re-establishment of migratory fish species such as salmon.

ISAV *(Infectious Salmon Anemia Virus).* ISAV is a highly infectious disease of Atlantic salmon caused by an enveloped virus.

LE *(Lagged Eggs)*. The summation of lagged eggs from 1 and 2 sea winter fish is used for the first calculation of PFA.

LMN *(Labrador Métis Nation).* LMN is one of four subsistence fisheries harvesting salmonids in Labrador. LMN members are fishing in southern Labrador from Fish Cove Point to Cape St Charles.

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

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

NG *(Nunatsiavut Government).* NG is one of four subsistence fisheries harvesting salmonids in Labrador. NG members are fishing in the northern Labrador communities.

NSERC *(Natural Sciences and Engineering Research Council of Canada)*. NSERC is a Canadian government agency that provides grants for research in the natural sciences and in engineering. Its mandate is to promote and assist research. Council supports a project to develop a standardized genetic database for North America.

OSPAR (*Convention for the Protection of the Marine Environment of the North-East Atlantic*). OSPAR is the mechanism by which fifteen Governments of the west coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the Northeast Atlantic. It started in 1972 with the Oslo Convention against dumping. It was broadened to cover land-based sources and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.

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

PGA *(The Probabilistic-based Genetic Assignment model).* An approach to partition the harvest of mixed-stock fisheries into their finer origin parts. PGA uses Monte Carlo sampling to partition the reported and unreported catch estimates to continent, country and within country levels.

PGCCDBS *The Planning Group on Commercial Catches, Discards and Biological Sampling*.

PGNAPES *(Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys)*. PGNAPES coordinates international pelagic surveys in the Norwegian Sea and to the West of the British Isles, directed in particular towards Norwegian Spring-spawning Herring and Blue Whiting. In addition, these surveys collect environmental information. The work in the group has progressed as planned.

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.

PSAT (*Pop-up Satellite Archival Tags*). Used to track movements of large, migratory, marine animals. A PSAT is an archival tag (or data logger) that is equipped with a means to transmit the data via satellite.

PSU *(Practical Salinity Units).* PSU are used to describe salinity: a salinity of 35‰ equals 35 PSU.

Q Areas for which the Ministère des Ressources naturelles et de la Faune manages the salmon fisheries in Québec.

RR model *(Run-Reconstruction model).* RR model is used to estimate PFA and national CLs.

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

SALSEA (*Salmon at Sea*). SALSEA is an international programme of co-operative research designed to improve understanding of the migration and distribution of salmon at sea in relation to feeding opportunities and predation. It differentiates between tasks which can be achieved through enhanced coordination of existing ongoing research, and those involving new research for which funding is required.

SARA *(Species At Risk Act).* SARA is a piece of Canadian federal legislation which became law in Canada on December 12, 2002. It is designed to meet one of Canada's key commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy. SARA defines a method to determine the steps that need to be taken in order to help protect existing relatively healthy environments, as well as recover threatened habitats. It identifies ways in which governments, organizations, and individuals can work together to preserve species at risk and establishes penalties for failure to obey the law.

SCICOM *(Science Committee)* of ICES. SCICOM is authorized to communicate to third-parties on behalf of the Council on science strategic matters and is free to institute structures and processes to ensure that inter alia science programmes, regional considerations, science disciplines, and publications are appropriately considered.

SER *(Spawning Escapement Reserve).* The CL increased to take account of natural mortality between the recruitment date (assumed to be 1st January) and the date of return to homewaters.

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

SGBICEPS *(The 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.

SGBYSAL *(Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries).* The ICES study group that was established in 2005 to study Atlantic salmon distribution at sea and fisheries for other species with a potential to intercept salmon.

SGEFISSA (*Study Group on Establishing a Framework of Indicators of Salmon Stock Abundance*). SGEFISSA is a study group established by ICES and met in November 2006.

SGERAAS (*Study Group on Effectiveness of Recovery Actions for Atlantic Salmon*). SGERAAS is the previous acronym for WGERAAS (*Working Group on Effectiveness of Recovery Actions for Atlantic Salmon*).

SGSSAFE (*Study Group on Salmon Stock Assessment and Forecasting*). The study group established to work on the development of new and alternative models for forecasting Atlantic salmon abundance and for the provision of catch advice.

Slim, 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.

SSGEF *(SCICOM Steering Group on Understanding Ecosystem Functioning).* SSGEF is one of five Steering Groups of SCICOM (Science Committee of ICES). Chair: Graham Pierce (UK); term of office: January 2012–December 2014.

SST (*Sea surface temperatures*). SST is the water temperatures close to the surface. In practical terms, the exact meaning of surface varies according to the measurement method used. A satellite infrared radiometer indirectly measures the temperature of a very thin layer of about 10 micrometres thick of the ocean which leads to the phrase skin temperature. A microwave instrument measures subskin temperature at about 1 mm. A thermometer attached to a moored or drifting buoy in the ocean would measure the temperature at a specific depth, (e.g. at one meter below the sea surface). The measurements routinely made from ships are often from the engine water intakes and may be at various depths in the upper 20 m of the ocean. In fact, this temperature is often called sea surface temperature, or foundation temperature.

SVC *(Spring Viraemia of Carp).* SVC is a contagious and potentially fatal viral disease affecting fish. As its name implies, SVC may be seen in carp in spring. However, SVC may also be seen in other seasons (especially in autumn) and in other fish species including goldfish and the European wells catfish. Until recently, SVC had only been reported in Europe and the Middle East. The first cases of SVC reported in the United States were in spring 2002 in cultivated ornamental common carp (Koi) and wild common carp. The number of North American fish species susceptible to SVC is not yet known.

TAC *(Total Allowable Catch).* TAC is the quantity of fish that can be taken from each stock each year.

WFD *(Water Framework Directive).* Directive 2000/60/EC (WFD) aims to protect and enhance the water environment, updates all existing relevant European legislation, and promotes a new approach to water management through river-based planning. The Directive requires the development of River Basin Management Plans (RBMP) and Programmes of Measures (PoM) with the aim of achieving Good Ecological Status or, for artificial or more modified waters, Good Ecological Potential.

WGBAST (*Assessment Working Group on Baltic Salmon and Trout*). The Assessment Working Group on Baltic Salmon and Trout assesses the status and trends of salmon and sea trout stocks in the Baltic Sea and provides annual catch advice on salmon. WGBAST last took place in Tallinn, Estonia, during April 2013, chaired by Tapani Pakarinen (Finland).

WGERAAS *(Working Group on Effectiveness of Recovery Actions for Atlantic Salmon).* The task of the working group is 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 Working Group held its first meeting in Belfast in February 2013. The next meeting is scheduled for May 2014 at ICES in Copenhagen.

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

WGRECORDS *(Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species).* WGRECORS was reconstituted as a Working Group from the Transition Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (TGRECORDS).

WKADS *(Workshop on Age Determination of Salmon).* WKADS took place in Galway, Ireland, January 18th to 20th 2011, with the objectives of reviewing, assessing, documenting and making recommendations on current methods of ageing Atlantic salmon. The Workshop focused primarily on digital scale reading to measure age and growth with a view to standardization.

WKADS2 (*A second Workshop on Age Determination of Salmon*). Took place from September 4th to 6th, 2012 in Derry ~ Londonderry, Northern Ireland to addressed recommendations made at the previous WKADS meeting (2011) (ICES CM 2011/ACOM:44) to review, assess, document and make recommendations for ageing and growth estimations of Atlantic salmon using digital scale reading, with a view to standardization. Available tools for measurement, quality control and implementation of interlaboratory QC were considered.

WKDUHSTI (*Workshop on the Development and Use of Historical Salmon Tagging Information from Oceanic Areas*). This workshop, established by ICES, was held in February 2007.

WKSHINI (*Workshop on Salmon historical information-new investigations from old tagging data*). This workshop met from 18–20 September 2008 in Halifax, Canada.

WKLUSTRE *(Workshop on Learning from Salmon Tagging Records).* This ICES Work-shop established to complete compilation of available data and analyses of the resulting distributions of salmon at sea.

This glossary has been extracted from various sources. It was initially based on the EU SALMODEL report (Crozier *et al.*, 2003), but has subsequently been updated at successive Working Group meetings.

Annex 8: NASCO has requested ICES to identify relevant data deficiencies, monitoring needs and research requirements

The Working Group recommends that it should meet in 2015 to address questions posed by ICES, including those posed by NASCO. The Working Group may be invited to hold its next meeting in Canada, but would otherwise intend to convene in the headquarters of ICES in Copenhagen, Denmark. The meeting will be held from 17 to 26 March 2015.

List of recommendations

1) The Working Group recommends the following actions to improve our understanding of salmon bycatch:

1.1) Collate all available information on post-smolt and salmon marine distribution, particularly from the SALSEA Merge project.

1.2) Collate information of possible interceptive pelagic fisheries operating in the identified migration routes and feeding areas of Atlantic salmon. This would require close cooperation with scientists working on pelagic fish assessments in the relevant areas and provision of disaggregated catch data in time and space which overlap areas known to have high densities of post- smolts or adults.

1.3) Review pelagic fisheries identifying important factors such as gear type and deployment, effort and time of fishing in relation to known distribution of post-smolt and salmon in space and time and investigate ways to intercalibrate survey trawls with commercial trawls.

1.4) Carry out comprehensive catch screening on commercial vessels fishing in areas with known high densities of salmon post-smolts or adults. This would require significant resources and would need to be a well-coordinated and well-funded programme.

1.5) Integrate information and model consequences for productivity for salmon from different regions of Europe and America.

The Working Group recommends that the first elements of such a programme could be carried out by a combined Salmon/Pelagic species Working Group. The major element (catch screening) would require some preparation and agreement between NASCO parties and could be conducted as a joint collaborative exercise with cooperation from the pelagic fishing industry.

2) The Working Group recommends that sampling and supporting descriptions of the Labrador and Saint-Pierre et Miquelon fisheries be continued and expanded (i.e. sample size, geographic coverage, tissue samples, seasonal distribution of the samples) in future years and analysed using the North American genetic baseline to improve the information on biological characteristics and stock origin of salmon harvested in these mixed-stock fisheries.

3) The Working Group recommends that the Greenland catch reporting system continues and that logbooks be provided to all fishers. Efforts should continue to encourage compliance with the logbook voluntary system. Detailed statistics related to catch and effort should be made available to the Working Group for analysis.

4) The Working Group recommends that the Government of Greenland facilitate the coordination of sampling within factories receiving Atlantic salmon, if landings to factories are allowed in 2014. Sampling could be conducted by samplers participating in the international sampling program or by factory staff working in close coordination with the sampling Program Co-ordinator. The Working Group also recommends that arrangements be made to enable sampling in Nuuk as a significant amount of salmon is reported as being landed in this community on an annual basis.

5) The Working Group recommends that the longer time-series of sampling data from West Greenland should be analysed to assess the extent of the variations in fish condition over the time period corresponding to the large variations in productivity as identified by the NAC and NEAC assessment and forecast models. Progress has been made compiling the West Greenland sampling database and should be available for analysis prior to the 2015 Working Group meeting.

6) The Working Group recommends a continuation and expansion of the broad geographic sampling programme at West Greenland (multiple NAFO divisions) to more accurately estimate continent of origin in the mixed-stock fishery.

Annex 9: Response of WGNAS 2014 to Technical Minutes of the Review Group (ICES 2013a)

As per the request of the ICES Review Group (RG), this section is the response of the Working Group on North Atlantic Salmon (WGNAS) to the Technical Minutes of the RG provided in Annex 10 of ICES (2013). The points are addressed in the same order as they were listed in the Technical Minutes.

General

The RG noted that the time available for the reviewers to assess the compiled Working Group report had been very short in 2013 due largely to the short time period between the Working Group meeting and the RG/ADG meeting. The RG considers that a minimum of two working weeks is required between the two meetings in order to give the Working Group members and chair enough time to complete their report, while also ensuring that reviewers have adequate time to prepare for the RG/ADG. This should be achieved in 2014 given the earlier timing of the WGNAS meeting.

In response to RG comments the previous year, the Working Group has also now produced a stock annex detailing the methodology used to conduct Atlantic salmon stock assessments and to provide catch advice. It is hoped that this will also facilitate the ongoing review process.

Section 3: Northeast Atlantic Commission

The RG advised that the NEAC analyses are technically correct and that their scope and depth are appropriate to generate the advice required. The RG recognised that the following comments on aspects of the analyses were unlikely to result in a change in advice, but may be useful in considering future developments.

RG COMMENT	WGNAS RESPONSE
Section 3.1.6 describes a general downward trend in the proportion of 1SW salmon in the reported catch, especially in the Northern NEAC areas (since ~2005), and with country-specific variation. The text notes that the causes are uncertain, but may be due to management measures (e.g. resulting from size-selective fishing?). A similar trend is shown in the reconstructed spawner numbers for Northern NEAC, for which numbers have increased since 2005 for MSW spawners and remained stable for 1SW spawners. Could this trend be a result (at least in part) due to increases in the proportion of fish maturing after MSW (due to, for example, a change in marine environmental conditions)? To what extent might continued trends in the proportion of fish maturing at each age (PFAm, Section 3.5.1) affect forecasts of PFA in the Risk Framework (which currently assumes constant mean PFAm 2012–2016 at 2011 levels)?	WGNAS recognises that changes in the age composition of stocks could reflect a variety of factors including changing environmental conditions at sea and management actions. The proportions of fish maturing at different sea ages have fluctuated previously, with many NEAC countries experiencing a reduction in MSW fish over recent decades (albeit an increase in the most recent years). There is also evidence of extensive variability over longer time-scales with 1SW fish dominant at some time periods and MSW fish at others. However, no mechanistic framework has been identified to explain how different factors might combine to produce annual variability in maturation. Given this inherent variability and uncertainty, WGNAS has been reluctant to assume ongoing trends in maturation rates in providing forecasts of PFA.
Country-specific CLs depicted in Figures 3.3.4.1 (a–j) are based on residual sums of squares estimate of the hockey-stick model. For many countries (regions within countries) the CLs are near (at) the low end of estimated lagged egg abundances, suggesting the CLs may be overestimated. Although this is precautionary from a conservation perspective, it may result in unnecessary fishery closures if those countries/stocks constrain a multistock fishery. Indeed, the uncertainty in dropping below CLs is due to both uncertainty in current egg (or spawner) numbers and uncertainty in the CL itself. Have uncertainty estimates for CLs been considered (e.g. derived from the likelihood profile for the CL)? In addition, the acceptable buffer between current egg (or spawner) numbers and CL may depend on our certainty in the CL itself. For highly certain CLs, the buffer described in Section 3.2 that is derived from confidence intervals of spawner estimates may be sufficient. For highly uncertain CLs, a larger buffer may be prudent. * Comment from RG chair: I do not immediately follow the comment that CLs derived in this way may be overestimated. It would be good if WGNAS could clarify. * Response from reviewer: My comment simply pertains to the observation that CLs are defined at the lower boundary of lagged egg abundances, where there may not be any evidence of reductions in PFA (e.g. Figure 3.3.4.1.f). But, I note the comment at the end of this section that CLs may be underestimated when derived for multiple asynchronous stocks within a region.	The Working Group has previously considered the process for setting CLs based on these pseudo stock–recruitment relationships in some detail. It was recognised that fitting classic (e.g. Ricker or Beverton and Holt) stock recruitment curves was probably inappropriate considering that this is the 'sum' of many river-specific S-R relationships (Potter *et al*., 1998). Instead, the WG considered a range of non-parametric methods as proposed by ICES for estimating the minimum biologically acceptable level (MBAL) / CLs for stocks (ICES, 1993) and selected the hockey-stick model as the most appropriate. The WG has previously noted that where there is no trend in the S-R data, the inflection in the hockey-stick analysis will often be at or close to the lowest stock data point. This was considered to be consistent with ICES advice at the time, that if there is no evidence of the stock experiencing reduced recruitment at low stock sizes the MBAL should be set at the lowest stock size previously recorded (ICES, 1993). This may result in the CL being overestimated if the true CL is at a lower stock size than experienced in the data; however this is considered to be consistent with a precautionary approach. It is also possible that CLs may be underestimated, where the lack of a clear S-R relationship is due to uncertainty/variability in the assessment parameters. The Working Group confirms that the CL is being used as a fixed value. WGNAS has discussed the possibility of including uncertainty in the estimation of the CL and taking account of this in providing catch advice. However, it was thought that this may result in the limit being set at a very high proportion of S_{opt} and therefore impose an unrealistic restriction on ever having a fishery.

RG COMMENT	WGNAS RESPONSE
The assessment of spawner number against CLs and PFA against SERs give inconsistent results in some years (Figures 3.3.4.1 (a–j)). Can these differences be explained? Is there a reason why both are presented if CLs are typically the basis for management advice? I assume this is because the Bayesian forecasting model within the Risk Framework provides PFAs which are evaluated against SERs.	The CL is the number of spawners required to achieve S_{MSY} in a river; CLs are (effectively) summations of countries rivers, to provide national CLs. The SER is the number of fish required at the end of the first sea-winter to achieve that CL if no fishing takes place. SERs are therefore used to assess the state of the stock before any exploitation (i.e. the PFA), and to provide catch advice for the distant water fisheries. The CLs are used to assess the status of stocks returning to homewaters (i.e. after the distant water fisheries) or assess the adequacy of the spawning escapement (i.e. after all exploitation). Thus, both PFA/SER and Spawners/CLs are needed to address the questions from NASCO.
The CLs for Ireland changed significantly from 2012 to 2013 due to a change in methodology. Presumably the revised set of stocks used in the Bayesian hierarchical analyses conform to the exchangeability assumption to a higher degree than the prior set, but it is not possible to evaluate this without relevant model and data (but perhaps this is outside the scope of the current report?). * Comment from RG chair: As a general point (not specifically for Ireland), it would be good if WGNAS could provide some more background information on how CLs are computed. During RG discussions it was not possible to clarify completely how CLs had been derived, when based on an MSY concept. Clarification of this, and inclusion in the Stock Annex, would help.	River-specific CLs were re-calculated in 2012–2013 for Irish national stock assessments. The recalculated CLs were based on an increased number of Irish index river stocks and more up-to-date biological data. The changes were not reviewed in detail by the group but are applied in national stock assessments and the process is currently in preparation for publication. Countries that have developed river-specific CLs have used a variety of approaches to transport information from data-rich to data-poor stocks. Further details on the methodology for computing CLs is now provided in the Stock Annex, but most of the detailed accounts are in published papers.
Although the updates to the run-reconstruction model seem reasonable (Section 3.3.3), the model itself is not provided, so cannot be reviewed. It is noted that "errors in the outputs largely reflect uncertainties in the estimates of the data". One way to account for uncertainties in model input is a state-space model that explicitly considers errors in the data (for a Pacific salmon example, see Fleishman *et al*., 2013). Without reviewing previous WGNAS reports for a model description, it's difficult to assess to what extent that approach would be useful (or is already implemented). Fleischman, S.J., Catalano, M.J., Clark, R.A., and Bernard, D.R. 2013. An age-structured state–space stock–recruit model for Pacific salmon (*Oncorhynchus* spp.) Can. J. Fish. Aquat. Sci. 70. dx.doi.org/10.1139/cjfas-2012-0112. Interestingly, the size of the confidence limits on spawner numbers will depend on the extent to which uncertainties are considered in the model, which has implications on stock status relative to CLs. The more assumptions made in the model, the smaller the size of the confidence intervals and the smaller the buffer (and vice versa).	A full description of the modelling approach is now provided in the Stock Annex. It is unlikely that the group has the data required to implement a state-space model of the form of Fleishman *et al*., 2013. WGNAS has included uncertainty for most model parameters in the NEAC model (these are now detailed in the Stock annex) and has recognised that while stocks are low this reduces the chance of having a fishery. Exploitation rates for 1SW and MSW salmon have been staggered in the latest plots.

RG COMMENT	WGNAS RESPONSE
When plotting results for exploitation rates of 1SW and MSW (Figures 3.3.4.1 a–j), I suggest 'jittering' the data points so that both 1SW and MSW points and confidence intervals can be viewed in each year.	
The report correctly notes that management objectives are required to proceed in providing useful advice for management, and this point cannot be overemphasized. Indeed, for the Risk Framework, management objectives would inform the choice of management unit and share arrangements (Section 3.4.1.). It is noted that NASCO's recommendation to base fisheries decisions on river and age-specific CL's is contradictory to NASCO's agreement to manage distant water fisheries on four stock complexes in NEAC (which are much larger than those in the West Greenland fishery). Provisionally (?), the choice to provide management advice at the stock complex level, and provide implications of that advice at the country level seems like a pragmatic approach. Indeed when applied to the Risk Framework, these approaches give consistent catch advice (fishery closure), but this may not be the case in future. Given the possibility of future assessments at river-specific level, it may be necessary to derive more sophisticated management approaches that incorporate emerging information on stock identification and stock-specific spatial and temporal migration patterns (e.g. to avoid exploitation of weak stocks through spatial/temporal fishing restrictions).	NASCO is aware of the difficulties of extending the river-specific approach to the management of mixed-stock distant fisheries where over 1000 individual stocks can be exploited, and have accepted that management decisions on these fisheries should be based on assessment of larger management units (i.e. stock complexes or national stocks). It is recognised that this approach will fail to protect the weakest river stocks from some exploitation. However, exploitation in homewater fisheries can still be targeted at stocks that are above CL. The WG intends to continue to incorporate emerging information on stock identification and distribution in its advice, however it is unlikely that it will be practical to manage the distant water fisheries on the basis of smaller management units for the foreseeable future.
Choice of risk levels is recommended on p.112 (Section 3.4.3), but would this depend on trade-offs between values derived from the fishery as an aggregate and value of conserving a diversity of stocks? In Canadian Pacific salmon fisheries, such decisions typically require engagement of stakeholders to include societal values.	As indicated by the group the choice of the risk level is dependent in part upon the number of management units chosen for the assessment. In the absence of any decision from NASCO on the appropriate risk level to use, the group has presented the assessment in a form that allows managers to consider/choose any risk level. Some NASCO Parties already engage with stakeholder groups in making such decisions and there is active NGO participation in NASCO meetings.
The Risk Framework includes a Bayesian forecast model that generates forecast for PFA generated in WinBUGS (Section 3.4.4). It's not clear from the text which parameters were given priors, which prior distributions were used, and the impact of those priors on the posteriors (though perhaps this is described and reviewed in a previous WGNAS report?). In addition, the structure of the model is unclear. Are the 1SW (maturing) and MSW catch covariates included in the model to predict PFAt, as in the equation on p.115? 1SW non-maturing fish not considered in the model (p.116)? Is this because they are not caught in Faroes fishery?	The modelling approaches used by the Working Group have been presented in earlier reports and are now explained in detail in the Stock Annex. The formulation of a hierarchical structure on the productivity parameter has been

RG COMMENT	WGNAS RESPONSE
a) The productivity parameter is derived independently for each stock complex and/or country. However, given similar trends in marine survival among stocks from countries, there may be value in developing a hierarchical model that estimates productivity parameters from a shared hyper-distribution among those groups. Has this been considered? Complexes were separated as the development in the productivity diverged for the different complexes. Hyperdistribution should be considered. b) In addition, the forecast component of the model assumes constant average productivity over time (2012–2016), despite evidence of declining marine survival. Additional sensitivity analyses could show probabilities of achieving CLs (and associated catch implications) from different assumptions about a continued decline in productivity vs. constant productivity (as similar approach has been applied to Pacific salmon on the Fraser River, Canada), as well as a continued trend in PFAm and constant average PFAm (see also comment 2 above). * Comment from RG chair: I agree with the reviewer's general comment (before getting into parts a or b) that the description of the Bayesian forecast model needs some improving, in terms of what data are being used as "data", which parameters are given prior distributions, what the observation equations are (i.e. how are the observations linked to the underlying model variables and parameters), etc. This will hopefully be addressed as part of the Stock Annex. * Related comment from RG chair: it seems to me that the Bayesian forecast model could actually be made into a closed loop, so that the whole cycle from lagged eggs to PFA, returns, spawners, and again lagged eggs, could be modelled consistently in a loop (without running a separate run-reconstruction model). It would be interesting to get WGNAS views on this. * Response from reviewer: yes, I think this approach would provide an opportunity to account for uncertainties in the run-reconstruction model in a more realistic way.	implemented for the NAC inference and forecast model of the six regions but for which only one age group is included. Presently in the NEAC forecast model, the precision parameter on productivity is hierarchical in nature across countries within each of the northern and southern stock complex models. Further hierarchical parameterization on the productivity parameter is one of the next steps in model development. Productivity is modelled as a random walk in the model such that the productivity values used in the forecast year are the previous year's value. Ideally, any consequences of patterns of change in productivity over time should be incorporated in the model such that this dynamic is properly captured in the forecast. As a start, consequences of trends in productivity could be examined but in the Bayesian structure of the model, this is not that easily done for a multiyear forecast. For the first forecast year, a value that is the average of the previous five years may be used, but for the second forecast year, would a moving average be used, including the forecast value for the first year or should some other trend estimation approach be implemented, such as a multinomial regression, or other? Modelling of such assumed foresight may be misleading. This issue will be considered in future developments of the model. The development of a life cycle model may provide opportunities to include covariates, which may be more suggestive of the next productivity time-step. Possibilities of incorporating climate forecasts are a possibility if suggestive links can be detailed. Closed loop formulation of the model is currently being developed and investigated in the ECOKNOWS project and a recent publication by Massiot-Granier *et al.* (2014) shows an example for one of the NEAC countries. Again, this aspect will be examined in the future development of the model.
The Risk Framework assumes monthly instantaneous mortality of 0.03 (Section 3.4.4., p.114). How was this derived? What are the implications of assuming (more realistic) variability in this value? A major assumption in the Risk Framework applied at the country level is the apportioning of catches to management units (Section 3.4.5). The text states that an alternative method was proposed for estimating the split of catches in 2012 (p. 115), but the results of that alternative method are not described here. Given continuing	A similar question was asked by the RG in 2012, and the detailed response from the WG can be found in Annex 9 of the 2013 report. In brief, the mortality rate has been subject to detailed investigation in the past, and 0.03 identified as the most suitable value for adult fish after the fist sea-winter (Potter et al 2003). In the absence of suitable information to vary this parameter the group has had no basis to change it. The assumption is therefore made that the mortality of adult fish after the first sea winter has not changed and that all the variability in marine

RG COMMENT	WGNAS RESPONSE
lack of fishery derived data around the Faroes (due to lack of a fishery), pelagic fishery bycatch of salmon could become an important source of stock- or country-specific information, if those fish can be identified to country/stock, as noted in the text. This opportunity should be emphasized.	survival has occurred at the post-smolt stage. Efforts are continuing to explore levels of mortality and to better partition this between different stages of the life cycle of the fish. If M during the adult phase is actually greater than 0.03, it would increase the estimates of both PFA and the SERs by the same proportions, with values increasing more for the non-maturing 1SW component than the maturing 1SW component of stocks. Where PFA exceeds SER this would result in an increase in the estimated harvestable surplus available to the distant water fisheries and if PFA is less than the SER it would increase the size of the deficit. However this would not affect the assessments of returns to homewaters or spawners against the CLs. (NB see separate comments on CLs and SERs.) The effect of this on the catch advice is more difficult to predict because this will also depend on the uncertainty around M; this will be investigated in more detail in 2014. The pelagic fishery bycatch comprises mainly fish in their first year at sea (i.e. post-smolts), while the Faroes longline fishery exploited primarily fish a year older than this. The stock composition of the bycatch is not therefore a reliable indicator of the composition of the potential catch in the Faroes fishery.
A few additional comments on the risk framework for catch options at the Faroes: The exploitation rate for maturing 1SW (from both Northern and Southern NEAC) salmon at the Faroes seems very low, and this raises the question of whether these two stock complexes should be included in the risk framework for the Faroes. At the moment, their inclusion does not affect the catch advice for the Faroes (which would be zero in any case, given that the PFA of the Southern NEAC MSW stock complex is below the SER). But their inclusion, if not needed, could lead to unnecessarily restrictive advice for the Faroes fishery in future. The RG requests WGNAS to consider this question in their next meeting.	In the absence of any decision from NASCO on the risk framework, the Working Group has had some difficulty deciding what information to provide. In 2013 the Group noted (p.121) that the flatness of the risk curves for the 1SW stocks indicated that the risk to these management units is affected very little by any harvest at Faroes, principally because the exploitation rate on these stock components in the fishery is very low (Table 3.6.1.2). The Working Group agrees that the inclusion of 1SW in the risk framework, if not needed, could lead to unnecessarily restrictive catch advice. This will be highlighted in presentations to NASCO in 2015 when full assessments and catch advice will next be required.
In Table 3.6.1.1 it should be made clear the years in which potential returns are being measured against CLs. Because the Faroese fishery seems to exploit mainly MSW salmon during their second winter in the sea (so fish that are due to return just after the Faroese fishery takes place), the RG understands that it would make most sense to measure, e.g. for catch options in 2013/2014, the potential returns in 2014 vs. the CL in 2014. This should be made clear in the presentation of Table 3.6.1.1.	Requirement noted and the proposed change will be actioned in 2015 when the Working Group is next required to provide catch advice.

RG COMMENT	WGNAS RESPONSE
Section 3.7.2 recommends that the framework for indicators approach be revised so that an assessment for a closed fishery is only triggered when the indicators are above the upper 75% confidence limit. This is a reasonable recommendation given finite resources for assessments.	The Working Group welcomed the supportive comments. This recommendation had been accepted by NASCO in 2013.
The R software provides a less error-prone platform (though not error-free!) for performing statistical analyses that involve multiple datasets than Excel spreadsheets that usually require multiple cutting and pasting steps. There may be value in transferring the analyses for the framework of indicators (Section 3.7.2) from spreadsheets to R, and providing R code in the annex (for this analysis, and other models) to this report for review.	NEAC assessments had been run in both Crystal ball and R in 2013 for control purposes, but were migrated fully to R from 2014. The suggestion of also moving the FWI analyses to R was noted by the Working Group. However, the FWI is provided to NASCO and run by a NASCO Working Group. It was felt to be more appropriate to provide this framework in Excel, because many more people will be familiar with this platform.
Minor comments on formatting:	
The inclusion of Equation numbers would aid in the review process when comments refer to specific parameters or equations.	Now addressed in the Stock Annex.
Annexes that include model description, equations, and R/WinBUGS code for all models would also help in the review process. Such annexes could be appended annually to each assessment (or for years when an assessment is performed). Although a folder for "software" was noted on the WGNAS website, it did not contain any code (as of Wednesday 17 April).	Now addressed by full descriptions in the Stock Annex.
At least two tables were misplaced and Figures were commonly cut off of the printed page. This is a common consequence of managing such a large file in MSWord, when figures and tables are pasted from different software packages (e.g. Excel). An alternative software for developing complex documents such as this one, is LaTeX, which can be seamlessly be integrated with R code to create figures, tables, and captions that are incorporated with the text with user-specified formatting. LaTeX is commonly used for the documentation of complex stock assessments in Canada, and is favoured, in part because assessments can be updated with additional data in subsequent years very easily ("with the click of a button") since figures and tables are automatically generated.	Something for ICES secretariat to consider.

Section 4: North American Commission

The NASCO Framework of Indicators for NAC indicated that an evaluation of catch options and management advice were not required. The assessment was updated with 2012 data, but the modelling approach remains unchanged from previous years, and therefore was not reviewed.

The RG recognised that the assessment of continued low abundances of stocks across North America (especially in USA and Scotia-Fundy areas) is supported by the updated data. As noted in the text, given the consistent declines over broad spatial scales, reductions in marine survival for selected stocks where monitoring exists, and sustained smolt production over time, it is likely that this depletion is due in large part to factors acting on marine survival in the first and second years at sea.

RG COMMENT	WGNAS RESPONSE
Several gaps in data are noted. First a change in monitoring of adult returns in Labrador from four counting facilities to only three in 2010 and 2012 may have caused the large variability in returns (especially for large returns) in the last several years (Figure 4.3.2.1 and 4.3.2.2). The previous time-series could be re-analysed omitting information from the 4th counting facility to identify if variability in the last few years are from change in monitoring, or are driven by population dynamics. I suggest highlighting those years in the Figures to emphasize the possible different interpretation of those values. Given this issue, and the large area covered by a single counting facility in SFA1, I agree with the authors that, "Future work is needed to understand the best use of these data in describing stock status and the Working Group recommends that additional data be considered in Labrador to better estimate salmon returns in that region" (p. 225).	This issue was clarified with Canadian colleagues during the RG and the text in the 2013 Working Group report was revised to address this point. The loss of one monitoring facility was a temporary problem (loss of trapping facility due to flooding). The absence of this facility was unfortunate, but it was not considered to explain the large variability of the returns in Labrador which were consistent with other parts of North America and indicative of wider coherent issues acting in the sea on stocks across a broad geographic area. Thus, other big changes in the region as a whole (North America) indicate that the variability could be explained without addressing the uncertainty/variability.
The section on the estimates of total abundances for Scotia-Fundy states that the current model overestimates total abundances. It's unclear whether this overestimate is only for the current year (2012), or for the entire time-series. Given the dramatic declines in 2012, I have assumed they are for the entire time-series. In addition, I suggest including the ranking of abundances in this section to emphasize that for several time-series the current abundances are the lowest on record.	This issue was clarified with Canadian colleagues during the RG and the text in the 2013 Working Group report was revised to address this point. The overestimation issue only affects estimates since the closure of the recreational fisheries in the mid-2000s, and is expected to have very little effect on the advice provided on overall status of salmon in North America, but does have implications for regional management. The suggestion regarding ranking abundances in this section has been noted.
In Section 4.3.4. (Egg deposition), for what portion of rivers have CLs been identified?	This issue was clarified with Canadian colleagues during the RG and the text in the 2013 Working Group report was revised to address this point. CLs are only presented for 74 (of ~1000 rivers) where detailed monitoring takes place, although CLs have been determined for over 400 Canadian rivers (ca. 40%) many of which are relatively small (CLs of around 200–300 spawners).
In Section 4.3.5. (Marine survival, return rates), the declines in marine survival in 2012 from 2011 are alarming at first, but are in large part due to relatively high marine survival in 2011. Five-year average analyses provide more meaningful results.	The suggestion regarding use of five-year averages has been noted.
Are the declines in Gulf region significant? Results are not provided in the text, but are presented in Figure 4.3.5.1.	This issue was clarified with Canadian colleagues during the RG and the text in the 2013 Working Group report was revised to address this point. No trend data were provided for the Gulf Region since there were no return data available for 2012.

Section 5: West Greenland Commission

The NASCO Framework of Indicators for NAC indicated that an evaluation of catch options and management advice were not required. The updated 2012 assessment is based on status of stocks in the NEAC and NAC (reviewed above). The modelling approach remains unchanged from previous years, and therefore was not reviewed.

RG COMMENT	WGNAS RESPONSE
Additional information on the number of NAC and NEAC salmon caught in West Greenland (Figure 5.1.3.2.) is provided to estimate impact of the West Greenland fishery on those stocks. Currently, sampling to determine continent of origin is based on three sampling stations (omitting sampling station at Nuuk), that do not cover the spatial range of the fishery. The report notes that the lack sampling at Nuuk compromises the ability to correctly identify biological characteristics of the catch (including continent of origin). However, the figure depicting temporal trends in catch of NEAC and NAC salmon (Figure 5.1.3.2) does not include confidence limits, so the consequences of increased uncertainty in biological characteristics are not shown. If included, a large increase in the range covered by the confidence limits in 2012 due to a reduction in information about continent of origin might clarify the importance of those samples.	This question is similar to that asked in last year's RG. The WG recognises that there are significant reported harvests at Nuuk and division-specific trends in the biological characteristics. However, to minimize any potential bias, extensive sampling has occurred in areas to both the north and south of Nuuk, enabling a reasonable assessment of the biological characteristics of the harvest both temporally and spatially. The WG remains aware of this issue and continues to recommend that action is taken to resolve the difficulties at Nuuk. The WG recognizes that sampling bias needs to be further explored and will consider the possibility of including confidence intervals in the figure in future.

General comments

RG COMMENT	WGNAS RESPONSE
General comment on the use of a single stock–recruit function to represent an entire stock complex or stocks from many rivers at the nation level. The stock–recruit functions used for salmonids generally includes density-dependence in the freshwater environment. Since the density-dependence is a local process caused by for example competitive interactions it is difficult to justify a region wide outcome, especially since the different river stock sizes may not cover completely. It can easily be verified that the sum of several local stock–recruit (SR) functions cannot be reformulated in to a single function with the same few parameters. For example, joining two Hockey-stick SR-functions would imply (focusing only on the linear parts): R1+R2=a1*E1+a2*E2 where R denotes recruits and E denotes eggs. Merging these into a single function: ax*(E1+E2) = a1*E1+a2*E2, requires that ax will be a function of a1, a2, E1 and E2; ax=(a1*E1+a2*E2)/ (E1+E2), that is, ax is not a constant! In contrast the maximum threshold will sum up for all rivers, but the question is how often that limit will be reached when joining data from many rivers? In the WG analyses the statistical fit of the upper limit to the data, but the question is how relevant that is. Statistically it will still be possible to fit a traditional SR-curve to multistock data, but there will most likely be an additional level of uncertainty (due to the dependence of the parameters ax on how the number of eggs are distributed among the various populations). Fitting the entire hockey-stick, that is, also to the maximum recruitment, to the data are likely to lead to underestimation of the maximum recruitment capacity. Independent measures of the maximum capacity as that based on the number of recruits related to the wet area of the rivers should be considered for all regions. When the maximum recruitment capacity depends on a statistical fit one needs to assume that all or most stock dynamics are synchronous. If this is not the case the maximum recruitment is not likely to be covered by the estimated or observed spawner counts. Consequently the maximum recruitments are likely to lie above the currently fitted maximum recruitment lines. If this is the case, then there is a risk that the current CLs are underestimated. The RG has no solution to suggest on how to solve this issue (besides using the wetted area approach). * Comment from RG chair: It was discussed during the RG meeting whether the hockey-stick approach used sometimes at the national level is consistent (or inconsistent) with the approach of having river-specific CLs (then summed up to national level) based on, we understand, different stock–recruit	The Working Group is aware of these uncertainties about both combining river-specific CLs and the use of the hockey-stick approach to estimate national CLs, but also has no solutions at the current time. In the absence of methods to develop regional CLs, advice would have to be based on the status of individual river stocks. This would almost certainly preclude ever advising for a harvest in the distant water fisheries. This is considered to be contrary to the principles already accepted by NASCO.

relationships (e.g. Ricker). Does this matter for the consistency of the results? In essence, there are two questions here: (1) one refers to computing CLs by river and then summing up to national level vs. computing CLs directly at national level; (2) the second question is about the potential impact of using alternative stock–recruit forms (e.g. hockey-stick vs. Ricker or Beverton–Holt).	

Annex 10: Technical minutes from the North Atlantic salmon Review Group

- Salmon Review and Advice Drafting Group (RG/ADGSalmon)
- ICES HQ, Copenhagen, Denmark 22–25 April, 2014.
- Participants: Carmen Fernández (Chair), Carrie Holt (WGNAS Reviewer), Kjell Leonardsson (WGBAST Reviewer), Tapani Pakarinen (WGBAST Chair), Ian Russell (WGNAS Chair), Henrik Sparholt (Secretariat), Marc Trudel (WGNAS Reviewer), Jonathan White (WGNAS).
- Review of ICES Working Group on North Atlantic Salmon (WGNAS).

General comments on the report

Two written reviews of the WGNAS 2014 report were provided by Carrie Holt and Marc Trudel, which are presented in full at the end of this Technical Minutes document. These reviews were discussed via WebEx during one afternoon of the RG/ADG meeting, and this provided a good opportunity for exchanging feedback in both directions. After the WebEx, many of the minor and editorial comments were already incorporated in the 2014 WGNAS report. The main comments will be considered more carefully by the whole of WGNAS in 2015; initial responses to these comments are included in the table below.

The Review Group (RG) acknowledges the efforts expended by WGNAS in undertaking a substantial body of work and producing a thorough and informative report on the status and trends of salmon in the Atlantic. The WGNAS report is well-written and addresses all NASCO and ICES Terms of Reference. Given results from the Framework of Indicators, the assessments relative to CLs for stock complexes impacted by fisheries at West Greenland and Faroes, and the sensitivity analyses considered (e.g., for revised US management objectives), there is no evidence that catch options for fisheries at West Greenland or the Faroes should be re-assessed.

The inclusion of the Stock Annex and model code are significant improvements over previous years' WGNAS reports. The Annex allows for comparison of models and data inputs among regions (especially NAC and NEAC).

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
General comments:	
One theme that is mentioned throughout the document is the spatial scale of assessments and the possibility of matching to scales that are relevant to the biology and management of the species. The evolution from assessments at the level of the stock complex, to countries, to individual rivers reflect progress towards increased relevancy for biology (and to some extent management). Further work on identifying river-specific CLs and assessments for all countries is recommended. However, in the absence of such fine-scale assessments given current practical constraints, precautionary management (as is currently in place) is recommended.	Presently Northeast Atlantic stocks are assessed as a North and South complex, within which country level reviews are now provided both in the status of stocks and forecasts. This break down to a country level has resulted as the lowest common denominator in terms of scale. While some countries are further disaggregated into regions owing to distinct differences in management practices and/or detail of data availability, assessment at the level of individual rivers or sub-regions at the present time is practically not possible. Country level break downs in advice is the preferred level for the time being.
Annex 1 (Section 1.1.2) refers to Crozier *et al*. (2003) to justify the application of relatively large stock groupings in assessments, given difficulties in collecting data across jurisdictions. Given changes in data availability over the past eleven years, might this be reconsidered?	This text will be reviewed and updated during the next working group to reflect the currently applied spatial scale.
The report refers to the difficulty in simultaneously achieving river-specific CLs when fine spatial scales are considered. However, if more rivers are considered in assessment, it may be possible to relax objectives to a lower probability of achieving CLs on all rivers simultaneously (<75%), or include additional specifications for the number of rivers (e.g. 16 of 20 rivers) that must achieve their respective CLs with a given probability (e.g. 75%). In this way, the level of precaution can be adjusted according to additional fishery objectives.	Discussions on this issue occur regularly and are presently being debated both within the WG and with NASCO. A number of possible mechanisms are available: The level of simultaneous attainment across all countries could be reduced: the level at which this would be acceptable is not presently clear. A number of countries attaining CL could be set: at what level this should be is also not presently clear. Each of these approaches is possible, yet the potential cut-off level of each is debatable and requires both scientific advice and a management decision to be made, based upon the acceptable level of risk of losing river populations that would result.
The inclusion of the Stock Annex and model code are significant improvements over previous years' WGNAS reports. The Annex allows for comparison of models and data inputs among regions (especially NAC and NEAC). Further streamlining would be valuable, by, for example, using similar notation in model descriptions, and same levels of detail in model/data description among regions. Indeed, differences in assessment among regions may occur not only because of differences in biological status, but also differences models used or data inputted; this section should be able to highlight where and how those differences occur in a clear way.	Summaries of the models detailed in the Stock Annex will be introduced at the next WG.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Further, the Annex provides a thorough introduction and overview of the assessment approaches, and it may be useful for reviewers to read this document first, before the main report. I suggest referring to the Annex (especially Section 1 of the Annex) early in the text of the main report to help guide reviewers (and other non-specialist readers) through the complex information in the report. Also, would it be possible to shorten the text of the main document and/or provide summaries at the beginning of Sections to facilitate review? For example, many sections of the text describe Figures in detail (as in Section 3.1), often drowning out the main message (e.g. that recent exploitation rates and catches have remained low for most regions for that Section).	This will be taken into consideration during drafting of the WG report in 2015.
Section specific comments:	
Section 1: Introduction	
Section 1.5 states that in many regions in North America, CLs are calculated as the number of spawners required to fully seed the wetted area of a river, which is not consistent with the MSY approaches used elsewhere. Given that ICES has requested that advice be provided according to MSY approaches by 2015 ("General Context of ICES Advice", June 2013), how will these differences be reconciled, if at all?	This will be reviewed during the 2015 WG
ICES considers a stock complex to be at full reproductive capacity when the lower confidence interval of the abundance estimate exceeds the Conservation Limit. However, the width of the confidence interval depends on which sources of uncertainty are included in the abundance estimates, and how they are included. Although details on those uncertainties are mentioned in various places in the Annex (Section 3), including a concise description of the sources of uncertainty considered when providing status advice would be beneficial. As the model evolves over years, and different uncertainties (or levels of uncertainties) are considered, the confidence intervals will change, and clear documentation of historical assumptions will be valuable.	The stock annex should include a section detailing the variables incorporated into each model and their associated variabilities / uncertainties in order to document sources and ranges of uncertainty that influence the variability in estimates. This may be best incorporated in a tabular format, with the possibility of documenting changes that occur between model application years.
Section 2: Atlantic Salmon in the North Atlantic area	
Section 2.1.1. What are the implications of the relatively large component of the catch in UK (England and Wales), UK (Scotland), Norway, and Russia being taken in coastal waters (instead of freshwater) for mixed-stock fisheries. Bycatches in Norway/Russia are noted in Section 3.4, but no information is provided for the UK.	These are acknowledged as being mixed-stock fisheries. They are most probably homing to rivers within the country for which they are reported. With advice presently based at the national level their differentiation is unlikely to change advice, however it is acknowledged that they may be caught during homeward migration to another country, in which case national reports could differ but it is expected that this would be to such a minor degree it would not be noticed within the advice.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Section 2.1.3 The authors indicate that there were no estimate of unreported catch for Spain and St-Pierre and Miquelon where catch is typically. Are they authors implying that the unreported catch should also be low for these areas?	Comment?
Section 2.3.1. I agree that the quantification of uncertainty requires more attention than has been given so far. The NUSAP approach has the advantage of including the "spread" of the data (e.g. confidence intervals) as well as qualitative judgments about the data. Currently, these additional uncertainties are often captured in the text of the report (e.g. some regions may not be well represented by the single river for which there are data), but this information is not translated into concrete assessment advice. However, there may be additional ways of capturing those added dimensions of uncertainty (beyond NUSAP). For example, quantitative estimates of uncertainty on a variety of dimensions (data representativeness, data quality derived from survey methods, and confidence intervals from models) may be accounted for, by standardizing each to common scale (e.g. 1–5, low to high) and combining in a rule-based approach (like the rule-based approach for Norwegian Quality norm classification system in Figure 2.3.6.1). For Pacific salmon assessments in Canada, quantitative information on a variety of dimensions of uncertainties are included, and these are combined qualitatively by stock assessment experts to provide an overall stock assessment (categorized into healthy, cautious, and critical zones) that account for those uncertainties.	NUSAP will be reviewed in more detail during the WG in 2015. Information on other similar approaches is appreciated and will also be reviewed. The potential of summarising the quality of assessments could be a useful mechanism for both highlighting good quality in assessments and indicating areas which would benefit the process through further development, review, further study or further sampling.
Section 2.3.4. One fish was diagnosed with ISAv. Although this fish was assigned to North America (based on DNA analysis), the strain of the virus originated from Scotland. The authors conclude that this fish may have been infected by another fish originating from Europe while they were feeding in the Labrador Sea or West Greenland. While this is certainly a possibility, it is also possible that this fish may have been incorrectly classified as a North American fish. It should be remembered that classification errors do occur. For Chinook Salmon, an independent evaluation of the genetic baseline with fish of known origin indicated that 96% of the fish were correctly classified to basin of origin. Another way of looking at this is that about 1 out of every 20 fish is misclassified. And it is not possible to tell which fish is actually misclassified. With 1284 fish, approximately 51 fish would be misclassified (for Chinook Salmon). This illustrates that we have to be careful when conclusions are based on only very few fish.	Acknowledged, the provenance of this one sample will be checked.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Section 2.3.9. The EU ECOKNOWS model provides improved approaches for considering uncertainties when estimating PFA. Documentation on prior and posterior distributions of uncertain parameters used in the Bayesian integrated life-cycle provides important information on uncertainties considered in the derivation of confidence (or credible) intervals that could used in assessments.	ECOKNOWS has currently produced a life cycle model equivalent to the southern NEAC stock complex. Equivalent northern NEAC and NAC models have not yet been formulated. Before implementation, a northern NEAC version is required as a minimum. While the ECOKNOWS project will conclude at the end of 2014 the WG is confident that the modelling development will be continued.
Will this approach be considered in the near-term by WGNAS? If so, will both models be run simultaneously at first to assess differences in outputs?	Implementation will not be possible in the next full assessment year (2015). Before it is implemented a benchmarking exercise will be undertaken comparing the current approach with the new approach, both in terms of model structures and their forecasts. Comparisons would be presented in the WG report.
Section 2.5.3. A comparison of NASCO River Database categories with other classification systems is provided. Table 2.5.3.1. suggests that NASCO's category, "Threatened with loss" is equivalent with IUCN categories "Critically endangered" through "near threatened". Table 2.5.3.2 suggests that the same NASCO category, "Threatened with loss", is equivalent to all ICES statuses less than the CL (and > "Lost"), which is not entirely consistent with interpretation from the previous table. Within Canada, the IUCN categories of threat are considered to be far below the threshold delineating critical and cautious zones for fisheries management. Most of the categories in Table 2.5.3.2. are tied to assessments for fisheries decisions which in many cases have thresholds that are far higher than those considered at biological risk of extinction (Table 2.5.3.1).	Table 2.5.3.1 will be updated in the 2014 report, better aligning categories. It should be noted that their alignment is somewhat subjective as while the definitions within each classification system are clearly defined, they do not necessarily depend upon similar metrics and therefore direct comparisons are not always clear.
Section 3: Northeast Atlantic Commission area (NEAC)	
Section 3.1.2. The authors indicate that the dam removal in Sweden is expected to have "large positive effects" on adult returns to this system. While this may be the case, is there any evidence that mortality associated with this dam was high? The authors need to back this statement with solid data, as others may be tempted to make this recommendation elsewhere to improve salmon returns. This may be a costly alternative if the problem of poor return lies elsewhere (i.e. in the marine environment).	Acknowledged, this will be reviewed in the report.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Section 3.3.4. describes the derivation of national Conservation Limits, CLs, using pseudo stock–recruitment relationships. In many cases, there is no (or only very weak) evidence for a relationship between eggs and PFA at low spawner abundances, so the CL is estimated to be the minimum (or near the minimum) egg abundance observed in the historical record (e.g. Sweden, UK (Northern Ireland), UK (Scotland)). This analysis assumes that if the stock is depleted to these levels, intrinsic stock productivity will be sufficient to keep the stock from further depletion (i.e. future conditions will be like the past). However, given large-scale declines in marine survival, this assumption of stationarity may not be valid. A caveat on the application of these CLs, and implied assumptions is warranted.	The PFA/egg relationships resulting from S/R analyses are facets of the hockey-stick S/R relationship, which in light of no clear reduction towards the origin in the graphed points, the deflection point (which gives rise to the estimated CL) defaults to the lowest single or few points in the dataseries on the *x* (S) axis. This is a known trait of the hockey-stick S/R relationship, which when applied to systems with apparent complexity or no clearly definable structure, defaults to a low situation. As such, if stocks are depleted, the CL against which they are compared may be low also. To evaluate this, the years of occurrence of the lowest points in the time series should be included to evaluate if they are resulting form the most recent years in the time series, and possibly providing for lowering of the estimated CLs.
How do national-level CLs derived from pseudo stock-recruitment models compare to sum of river-specific CLs for countries where river-specific CLs exist? (e.g. for Norway)	Country CLs derived from river-specific CLs are not formally compared against their Country wide, hocky-stick derived CLs. The applied CLs and their origins, are listed in Table 3.2.2.1. There is general agreement that those derived from river-specific S-R analysis based upon river population and wetted area data will be more accurate than those derived at the Country level.
Is it possible to compute uncertainties in CLs, statistically in terms of the estimate of the breakpoint and/or by incorporating uncertainties in estimates of lagged egg abundances and PFAs? If confidence limits on CLs can be estimated, these could be integrated with uncertainties in abundances estimates to derive a more complete probability distribution for stock assessments. Prager *et al*. (2003) and Prager and Shertzer (2010) suggest identifying RPs by integrating uncertainties in current assessment and reference points.	This has been considered in the past. While CLs and SERs are implemented as limit reference points their point estimate values are still considered to be most appropriate in this instance with uncertainty in attainment coming from the variability in the estimates of PFA. It may be worth considering estimating their variability and including this in country Figures 3.3.4.1a to j and complex Figure 3.3.4.2 to indicate the precision in the estimate. This will be investigated for 2015.
How are river-specific CLs for a subset of rivers extrapolated to all rivers within a nation, for example, for Norway, where only <200 (of the 465) rivers are assessed annually (Table 3.3.5.1)?	No extrapolation is applied. In their presence, river CLs tend to be summed to give national CL. The rivers for which they are derived tend to be those that accounting for by and large the majority of the nationally productivity (supposed at +90% of national productivity).

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
CLs for Scotland are very large (Table 3.2.2.1) compared with other nations, and dominate the NEAC totals, but these are described as unreliable in Section 3.2.3. What are the implications for the overall assessment for that stock complex (and fisheries advice for Faroes/West Greenland) of these large and unreliable CLs.	Scottish CLs and SERs are based upon the nationally reported catches and exploitation rates which are accurate in their reporting and hence these reference points are accurate and appropriate for this application. The question of them being unreliable is more the inverse of the ongoing development of more accurate (and hence more reliable) river specific CLs, which will be implemented when they are accepted at the national level.
Figure 3.3.6.1. provides a comparison of return rates for 1SW and 2SW smolts. However, it might be more informative to show the natural log-transformed rates of change, as in Figure 3.1.9.2 for exploitation rates. In the current figure the very large increases and decreases in return rates occur for stocks with low average return rates. In the suggested revised analyses, the rates of change are independent of absolute value. Alternatively, the average return rates could be provided in parentheses for each stock so analysts could see that relationship.	This will be reviewed and implemented in the 2015 WG.
Figure 3.3.6.3 shows survival rates time-series for northern and southern regions, with a steep decline in the northern region (wild) in ~1993, but a more gradual decline in southern region (wild) from late 1980s–late 1990s. Are there biological processes/hypotheses to support these divergent patterns? See also comment #2 from Section 4 below.	Survival indices for Northern NEAC wild salmon are based on adult returns of tagged smolts to three rivers (Vesturdalsa, Halselva and Imsa) and over the time series not all three rivers have datapoints. In 1993, two entries are present, the Halselva (2.1%) and the Imsa (15.6%) giving an average return rate of 8.85%. In 1994 only the Halselva is reported, with a return rate of 0.6% The observed rapid drop in 1994 is therefore both an effect of the datapoints upon which it is based and an apparent decline in return rates. The Figure reflects this to some degree by the very large confidence interval around this point. Though no ecological influence is postulated as causing this decrease, it is in general in line with the decreases observed over the time series. The dependence upon few rivers, and in this year one river, makes the analysis more sensitive to the influence of individual rivers.
Section 4 North American commission	
Section 4.1.4.: In this assessment, the WGNAS excluded unreported catches in the run-reconstruction model. Previous assessment included unreported catches only in Quebec. This was done for standardizing the run-reconstruction model across all management units. An alternative approach would have been to include unreported catches for all other management units. Is there a rationale for choosing one approach over the other?	To be reviewed.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
The number of adult returns to Labrador has increased significantly in the last three years (Figures 4.3.2.1 and 4.3.2.2). However, there are no data on return rates of Labrador salmon to support those observations (and those to Newfoundland show no increase over recent years) (Figure 4.3.5.1). Several previous studies have highlighted large (ocean basin) scale declines in productivity across the North Atlantic (Peyronnet *et al*., 2008; Chaput, 2012; Section 1.3 of Annex 1), but the inconsistent trends in adult returns noted above suggest possible regional differences in return rates (and productivity) that merit further exploration. Long time-series of return rates may currently be biased towards more southerly, easily accessible populations that show stationary or declining return rates.	This is acknowledged and will be further reviewed. Sampling issues could be impacting; however, estimates should be independent of sampling in such instances; this will be checked. As detailed in the report: "Since 2002, Labrador regional estimates are generated from data collected at four counting facilities, one in SFA 1 and three in SFA 2… The current method to estimate Labrador returns assumes that the total returns to the northern area are represented by returns at the single monitoring facility in SFA 1 and returns in the southerly areas (SFA2 and 14b) are represented by returns at the three monitoring facilities in SFA 2. The large increase in the estimated returns and spawners of large salmon and 2SW salmon for 2013 are a reflection of the high counts of large salmon noted in the single monitoring site in SFA 1 in 2013 and at two of three facilities in SFA 2… The uncertainty in the estimates of returns and spawners is high (coefficient of variation of > 40% in the recent three years). Further work is needed to understand the best use of these data in describing stock status and the Working Group recommends that additional data be considered in Labrador to better estimate salmon returns in that region. Nonetheless, the changes in abundance reported for Labrador were in line with changes observed elsewhere in North America and consistent with coherent patterns operating over a broad geographic scale."
Section 4.3.2. Newfoundland section: The results for the large salmon and 2SW seem conflicting. Whereas there is an increasing in large salmon return to Newfoundland since the 1990s, this pattern is not apparent for 2SW fish. Is there any explanation for this discrepancy?	Large salmon include repeat spanners which are not considered as part of the 2SW stock, hence the apparently greater increase in large salmon numbers.
Section 4.3.3. Gulf of St-Lawrence section: The five year mean is not a very useful metric here, as it is highly influenced by an extreme outlier.	Acknowledged, this will be reviewed.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Scotia-Fundy section: The high percentages may be misleading and may give the impression that conditions are improving significantly. This is because some values were very low in 2012, such that the changes that occurred in 2013 appeared to be a large increase, even though the conditions are not that great. I suggest removing the percentages in these cases to avoid giving the impression that the conditions are much better. Note that this is not unique to this section, but happens elsewhere in the document such as p. 149: marine survival have increased by 900%, though the change was from nearly 0% to 0.1%. In other words, the survival was still very low despite an apparent significant improvement (in that case, this was highlighted in the paragraph).	Acknowledged, this will be reviewed.
Section 4.3.5. The text describes % changes in return rates with large fluctuations (as high as 900%). These calculations are sensitive to the absolute return rates (where small changes to populations with low return rates can result in large % changes over time). Alternatively, the % change can be calculated and plotted on a natural logarithm scale (as in Figure 3.1.9.2) so that % changes are independent of absolute return rates. See also comment #7 from Section 3 above.	Agreed, this will be reviewed in the 2015 report.
To what extent does information on marine survival contribute to assessments, if at all? The current risk assessment framework considers abundances relative to CLs only, and not trends in abundances or marine survival. Note, for Pacific salmon in Canada, assessment methods have recently been developed to capture the multi-dimensional nature of assessment data (e.g. abundances relative to reference points, trends in abundances, distribution, and uncertainties on those metrics). (See http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2012/2012_106-eng.html)	Presently return/ marine survival indices are not directly incorporated in to the stock assessments. This is partially due to the data coming from relatively few rivers and the time-series' being inconsistent and partially due to a lack of obvious ways to incorporate such time-series in an objective manner. Incorporation of return rates in a qualitative review was discussed during the Review Group, with possible inclusion in the report for 2015 of a paragraph considering trends in the estimated PFA against return rates. The reference is appreciated.
Section 5 Atlantic salmon in the West Greenland Commission	
Section 5.1.1. The authors indicate that the factory landings are considered precise given the reporting structure. Yet, the authors highlight a number of issues with the data indicating that they are far from being precise with known misrepresentation in some cases inconsistencies. They further argue that there is a need for better data. Hence, I would argue that the factory landings should not be considered precise.	Acknowledged, this will be reviewed. Reported factory landings may still be precise, while may not be accurate, owing to the highlighted misrepresentation in some cases inconsistencies.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Section 5.1.2.2. The WGNAS recommends that "the longer time-series of sampling data from West Greenland should be analysed to further assess the extent of the variations in condition over the time period corresponding to the large variations in productivity identified by the NAC and NEAC assessment and forecast models." I'm not entirely sure I understand that the authors are trying to say here and why this is necessary either. This requires some clarification.	Comment?
Section 5.1.3. Due to uncertainty in assessing the continent of origin of the catches of West Greenland, the WGNAS recommends improving these estimates by sampling more fish for DNA. While improving these estimates is certainly desirable, it is unclear to me that this will substantially change the assessment of this fishery given that a large fraction of the reported catch has been analyzed. Moreover, it is unclear to me how these estimates are used for assessing the management advice to West Greenland. Presumably theses data are used to estimate the catch data for each continent in the run-reconstruction model? A sensitivity analysis may help to determine the effects of the uncertainty associated with DNA analyses on the outcome of the current assessment on Atlantic Salmon.	These data are used to apportion catch at West Greenland to NAC, North and South NEAC stock complexes. This varies annually, getting a better understanding of this variability and its uncertainty should improve accuracy, though to what extent this may be is not certain.
The recommendation for increasing the number of fish sampled in landings in West Greenland (including Nuuk) to improve biological characterization of the fish (including country of origin) is supported to the extent that it will improve the characterization of stock-of-origin. For example, if there is a spatial pattern in the capture of fish of different stocks of origin, and specific areas are not well sampled within West Greenland, then those sampling deficiencies should be addressed. A more accurate description of country of origin may allow for possible selective fisheries on populations from stocks/stock complexes that are abundant while avoiding those of conservation concern (e.g. Scotia-Fundy and US stock complexes).	Selective fisheries in West Greenland to target only stocks above conservation limits in NAC and NAEC areas are not presently seen as a possibility, owing to large spatial ranges, temporal mixing and a lack of specific stock identification samples. This may be further complicated owing to annual variability in distribution and ranges of salmon from different stock complexes. Continued sampling is necessary to provide reliable information of annual variability of stock complex proportions in the fishery and toward building a picture of how this may be changing.
Additional comments on Annex	
Section 1.3 describes ecosystem effects, and possible reasons for declines in abundances. Similar declines have been observed for Pacific salmon in Canada, resulting in the development of a "Cumulative Effects" research program to investigate the cumulative impacts of stressors on salmon throughout their lifecycle (freshwater, estuarine, marine, and return to freshwater). Are similar "cumulative effects" research programs underway for Atlantic salmon? The EU-ECOKNOWS study might be one example.	Such a "Cumulative Effects" study appears to be a sensible approach to trying to understand all impacts upon salmon during their life cycle. Such a study is not presently being proposed for Atlantic salmon, where over recent years the apparent most likely effects are being investigated, issue by issue. These have included a review of past and present biological characteristics (ICES Study Group on Biological Characteristics as Predictors of Salmon Abundance); distribution and survival of salmon at sea (SALSEA Merge) and bycatch is presently

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
	being considered. ECOKNOWS is developing a life cycle model for Atlantic salmon, which is intended to provide the basic frame work for scenario testing of impacts at different stages of the life cycle and could be developed for evaluation of cumulative effects.
Section 3.1 of the annex describes a variety of ICES reference points. A figure would be helpful here to guide readers through this confusing nomenclature (especially the difference between MSY $B_{escapement}$ and B_{pa}).	Agreed, this will be investigated for inclusion in 2015.
Section 3.2 describes the run-reconstructions and the uncertain parameters included in those analyses. In particular, for the NEAC model (Section 3.2.1), a range of instantaneous mortalities from 0.02 to 0.04 are considered in Monte Carlo simulation. Is the distribution assumed to be uniform over that range? What is the justification for the distribution? The min/max values and the type of distribution considered for this uncertain parameter, and all other uncertain parameters have a direct influence on the resulting confidence intervals on abundances (and hence assessment outcomes according to the ICES's precautionary approach described in Section 3.1.1 of the Annex). These should be clearly documented and justified. Why was the instantaneous mortality set at a constant 0.03 for the NAC model (Section 3.2.2) instead of assuming a range as in the NEAC model?	A similar question was asked by the RG in 2012 and 2013, and the detailed response from the WG can be found in Annex 9 of the 2013 and 2014 report. For NEAC a uniform distribution of mortality is included ranging from 0.02 to 0.04. This was chosen as a way of acknowledgment that specific detail of the instantaneous mortality rate is not known, beyond it being in this range. In the NAC run reconstruction model instantaneous mortality is modelled as a broad, minimally-informative normal distribution, with a mean of 0.03 and standard deviation of 0.005 (giving 2.5th and 97.5th percentiles of: 0.020 and 0.039 respectively). This was felt to be a fair representation of knowledge of instantaneous mortality at the time it was written.
Further; In the run reconstruction, natural mortality is set to 0.03/month for all stocks and years. Given that marine survival (or return rates) has declined for most stocks (return rate/ survival indices in the main body of the report), is this a realistic assumption to make in the model?	As previously noted, return rates are not incorporated into the run reconstruction (or forecast) models. While one method to do this would be to link it with instantaneous mortality M, this information comes from relatively few rivers and tags, most of which are from hatchery origin. Presently it is considered that a qualitative check should be included to consider the trends in return rates and PFA estimates. An investigation of the influence of M in the NEAC run-reconstruction was implemented and is noted in the 2014 WG report.

RG COMMENT	INITIAL WGNAS RESPONSE DURING RG/ADG MEETING
Section 3.3.4 provides a useful comparison of NAC and NEAC forecast models. An additional section that lists assumptions (e.g., NAC's assumption of common variation in productivity among stocks, that is not included in the NEAC model) would be valuable within the table. Both forecast models include time-varying productivity (a parameter that varies over years), but not time-varying proportion of smolts at age. This assumption should also be clearly documented.	The inclusion of a table is being discussed to itemise assumptions and settings around modelled variables and would document such issue. This would also act as an historical documentation of changes/ updates as they are implemented.

Review of ICES WGNAS Report 2014

Report of the Working Group on North Atlantic Salmon (April 23, 2014)

Carrie Holt, Fisheries and Oceans Canada

In general, the ICES WGNAS Report 2014 is a well-written report, which addresses all questions highlighted in the Terms of Reference. Given results from the Framework of Indictors, the assessments relative to CLs for stock complexes impacted by fisheries at West Greenland and Faroes, and the sensitivity analyses considered (e.g. for revised US management objectives), there is no evidence that catch options for fisheries at West Greenland or the Faroes should be re-assessed.

One theme that is mentioned throughout the document is the spatial scale of assessments and the possibility of matching to scales that are relevant to the biology and management of the species. The evolution from assessments at the level of the stock complex, to countries, to individual rivers reflects progress towards increased relevancy for biology (and to some extent management). Further work on identifying river-specific CLs and assessments for all countries is recommended. However, in the absence of such fine-scale assessments given current practical constraints, precautionary management (as is currently in place) is recommended. Annex 1 (Section 1.1.2) refers to Crozier *et al*. (2003) to justify the application of relatively large stock groupings in assessments, given difficulties in collecting data across jurisdictions. Given changes in data availability over the past eleven years, might this be reconsidered? The report refers to the difficulty in simultaneously achieving river-specific CLs when fine spatial scales are considered. However, if more rivers are considered in assessment, it may be possible to relax objectives to a lower probability of achieving CLs on all rivers simultaneously (<75%), or include additional specifications for the number of rivers (e.g. 16 of 20 rivers) that must achieve their respective CLs with a given probability (e.g. 75%). In this way, the level of precaution can be adjusted according to additional fishery objectives.

The inclusion of the Stock Annex and model code are significant improvements over previous years' WGNAS reports. The Annex allows for comparison of models and data inputs among regions (especially NAC and NEAC). Further streamlining would be valuable, by, for example, using similar notation in model descriptions, and same levels of detail in model/data description among regions. Indeed, differences in assessment among regions may occur not only because of differences in biological status, but also differences models used or data inputted; this section should be able to highlight where and how those differences occur in a clear way. Further, the Annex provides a thorough introduction and overview of the assessment approaches, and it may be useful for reviewers to read this document first, before the main report. I suggest referring to the Annex (especially Section 1 of the Annex) early in the text of the main report to help guide reviewers (and other non-specialist readers) through the complex information in the report. Also, would it be possible to shorten the text of the main document and/or provide summaries at the beginning of sections to facilitate review? For example, many sections of the text describe figures in detail (as in Section 3.1), often drowning out the main message (e.g., that recent exploitation rates and catches have remained low for most regions for that section).

The specific suggestions described below may be considered for future assessments, but are unlikely to change the advice to NASCO described above.

Section 1: Introduction

3) Section 1.5 states that in many regions in North America, CLs are calculated as the number of spawners required to fully seed the wetted area of a river, which is not consistent with the MSY approaches used elsewhere. Given that ICES has requested that advice be provided according to MSY approaches by 2015 ("General Context of ICES Advice", June 2013), how will these differences be reconciled, if at all?

4) ICES considers a stock complex to be at full reproductive capacity when the lower confidence interval of the abundance estimate exceeds the Conservation Limit. However, the width of the confidence interval depends on which sources of uncertainty are included in the abundance estimates, and how they are included. Although details on those uncertainties are mentioned in various places in the Annex (Section 3), including a concise description of the sources of uncertainty considered when providing status advice would be beneficial. As the model evolves over years, and different uncertainties (or levels of uncertainties) are considered, the confidence intervals will change, and clear documentation of historical assumptions will be valuable.

Section 2: Atlantic Salmon in the North Atlantic area

7) (From Section 2.1.1). What are the implications of the relatively large component of the catch in UK (England and Whales), UK (Scotland), Norway, and Russia being taken in coastal waters (instead of freshwater) for mixed-stock fisheries. Bycatches in Norway/Russia are noted in Section 3.4, but no information is provided for the UK.

8) (From Section 2.3.1). I agree that the quantification of uncertainty requires more attention than has been given so far. The NUSAP approach has the advantage of including the "spread" of the data (e.g. confidence intervals) as well as qualitative judgments about the data. Currently, these additional uncertainties are often captured in the text of the report (e.g. some regions may not be well represented by the single river for which there are data), but this information is not translated into concrete assessment advice. However, there may be additional ways of capturing those added dimensions of uncertainty (beyond NUSAP). For example, quantitative estimates of uncertainty on a variety of dimensions (data representativeness, data quality derived from survey methods, and confidence intervals from models) may be accounted for, by standardizing each to common scale (e.g. 1–5, low to high) and combining in a rule-based approach (like the rule-based approach for Norwegian Quality norm classification system in Figure 2.3.6.1). For Pacific salmon assessments in Canada, quantitative information on a variety of dimensions of uncertainties are included, and these are combined qualitatively by stock assessment experts to provide an overall stock assessment (categorized into healthy, cautious, and critical zones) that account for those uncertainties.

9) (From Section 2.3.9). The EU ECOKNOWS model provides improved approaches for considering uncertainties when estimating PFA. Documentation on prior and posterior distributions of uncertain parameters used in the Bayesian integrated life cycle provides important information on uncertainties considered in the derivation of confidence (or credible) intervals that could be used in assessments. Will this approach be considered in the

near-term by WGNAS? If so, will both models be run simultaneously at first to assess differences in outputs?

10) Section 2.5.3 provides a comparison of NASCO River Database categories with other classification systems. Table 2.5.3.1 suggests that NASCO's category, "Threatened with loss" is equivalent with IUCN categories "Critically endangered" through "near threatened". Table 2.5.3.2 suggests that the same NASCO category, "Threatened with loss", is equivalent to all ICES statuses less than the CL (and >"Lost"), which is not entirely consistent with interpretation from the previous table. Within Canada, the IUCN categories of threat are considered to be far below the threshold delineating critical and cautious zones for fisheries management. Most of the categories in Table 2.5.3.2 are tied to assessments for fisheries decisions which in many cases have thresholds that are far higher than those considered at biological risk of extinction (Table 2.5.3.1).

Section 3: Northeast Atlantic Commission area (NEAC)

9) Section 3.3.4 describes the derivation of national Conservation Limits, CLs, using pseudo stock–recruitment relationships. In many cases, there is no (or only very weak) evidence for a relationship between eggs and PFA at low spawner abundances, so the CL is estimated to be the minimum (or near the minimum) egg abundance observed in the historical record (e.g. Sweden, UK (Northern Ireland), UK (Scotland)). This analysis assumes that if the stock is depleted to these levels, intrinsic stock productivity will be sufficient to keep the stock from further depletion (i.e. future conditions will be like the past). However, given large-scale declines in marine survival, this assumption of stationarity may not be valid. A caveat on the application of these CLs, and implied assumptions is warranted.

10) How do national-level CLs derived from pseudo stock–recruitment models compare to sum of river-specific CLs for countries where river-specific CLs exist? (e.g. for Norway).

11) Is it possible to compute uncertainties in CLs, statistically in terms of the estimate of the breakpoint and/or by incorporating uncertainties in estimates of lagged egg abundances and PFAs? If confidence limits on CLs can be estimated, these could be integrated with uncertainties in abundances estimates to derive a more complete probability distribution for stock assessments. Prager *et al*. (2003) and Prager and Shertzer (2010) suggest identifying RPs by integrating uncertainties in current assessment and reference points.

- Prager *et al*., 2003. Target and limits for management of fisheries: a simple probability based approach. NAJFM 23, 349–361;
- Prager, M.H. and Shertzer, K.W. 2010. Deriving Acceptable Biological Catch from the Overfishing Limit: Implications for Assessment Models. North American Journal of Fisheries Management. 30:289–294.

12) How are river-specific CLs for a subset of rivers extrapolated to all rivers within a nation, for example, for Norway, where only <200 (of the 465) rivers are assessed annually (Table 3.3.5.1)?

13) CLs for Scotland are very large (Table 3.2.2.1) compared with other nations, and dominate the NEAC totals, but these are described as unreliable in Section 3.2.3. What are the implications for the overall assessment for

that stock complex (and fisheries advice for Faroes/West Greenland) of these large and unreliable CLs.

14) Figure 3.3.6.1 provides a comparison of return rates for 1SW and 2SW smolts. However, it might be more informative to show the natural log-transformed rates of change, as in Figure 3.1.9.2 for exploitation rates. In the current figure the very large increases and decreases in return rates occur for stocks with low average return rates. In the suggested revised analyses, the rates of change are independent of absolute value. Alternatively, the average return rates could be provided in parentheses for each stock so analysts could see that relationship.

15) Figure 3.3.6.3 shows survival rates time-series for northern and southern regions, with a steep decline in the northern region (wild) in ~1993, but a more gradual decline in southern region (wild) from late 1980s–late 1990s. Are there biological processes/hypotheses to support these divergent patterns? See also comment #2 from Section 4 below.

Section 4 North American commission

1) The number of adult returns to Labrador has increased significantly in the last three years (Figures 4.3.2.1 and 4.3.2.2). However, there are no data on return rates of Labrador salmon to support those observations (and those to Newfoundland show no increase over recent years) (Figure 4.3.5.1). Several previous studies have highlighted large (ocean basin) scale declines in productivity across the North Atlantic (Peyronnet *et al.*, 2008; Chaput, 2012; Section 1.3 of Annex 1), but the inconsistent trends in adult returns noted above suggest possible regional differences in return rates (and productivity) that merit further exploration. Long-time series of return rates may currently be biased towards more southerly, easily accessible populations that show stationary or declining return rates.

2) In Section 4.3.5, the text describes % changes in return rates with large fluctuations (as high as 900%). These calculations are sensitive to the absolute return rates (where small changes to populations with low return rates can result in large % changes over time). Alternatively, the % change can be calculated and plotted on a natural logarithm scale (as in Figure 3.1.9.2) so that % changes are independent of absolute return rates. See also comment #7 from Section 3 above.

3) To what extent does information on marine survival contribute to assessments, if at all? The current risk assessment framework considers abundances relative to CLs only, and not trends in abundances or marine survival. Note, for Pacific salmon in Canada, assessment methods have recently been developed to capture the multidimensional nature of assessment data (e.g. abundances relative to reference points, trends in abundances, distribution, and uncertainties on those metrics). (See http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2012/2012_106-eng.html)

Section 5 Atlantic salmon in the West Greenland Commission

5) The recommendation for increasing the number of fish sampled in landings in West Greenland (including Nuuk) to improve biological characterization of the fish (including country of origin) is supported to the extent

that it will improve the characterization of stock-of-origin. For example, if there is a spatial pattern in the capture of fish of different stocks of origin, and specific areas are not well sampled within West Greenland, then those sampling deficiencies should be addressed. A more accurate description of country of origin may allow for possible selective fisheries on populations from stocks/stock complexes that are abundant while avoiding those of conservation concern (e.g. Scotia-Fundy and US stock complexes).

Additional comments on Annex

5) Section 1.3 describes ecosystem effects and possible reasons for declines in abundances. Similar declines have been observed for Pacific salmon in Canada, resulting in the development of a "Cumulative Effects" research programme to investigate the cumulative impacts of stressors on salmon throughout their life cycle (freshwater, estuarine, marine, and return to freshwater). Are similar "cumulative effects" research programmes underway for Atlantic salmon? The EU-ECOKNOWS study might be one example.

6) Section 3.1 of the annex describes a variety of ICES reference points. A figure would be helpful here to guide readers through this confusing nomenclature (especially the difference between MSY $B_{escapement}$ and B_{pa}).

7) Section 3.2 describes the run-reconstructions and the uncertain parameters included in those analyses. In particular, for the NEAC model (Section 3.2.1), a range of instantaneous mortalities from 0.02 to 0.04 are considered in Monte Carlo simulation. Is the distribution assumed to be uniform over that range? What is the justification for the distribution? The min/max values and the type of distribution considered for this uncertain parameter, and all other uncertain parameters have a direct influence on the resulting confidence intervals on abundances (and hence assessment outcomes according to the ICES' precautionary approach described in Section 3.1.1 of the Annex). These should be clearly documented and justified. Why was the instantaneous mortality set at a constant 0.03 for the NAC model (Section 3.2.2) instead of assuming a range as in the NEAC model?

8) Section 3.3.4 provides a useful comparison of NAC and NEAC forecast models. An additional section that lists assumptions (e.g. NAC's assumption of common variation in productivity among stocks that is not included in the NEAC model) would be valuable within the table. Both forecast models include time-varying productivity (a parameter that varies over years), but not time-varying proportion of smolts at age. This assumption should also be clearly documented.

Minor editorial

- Figures do not match up with the section numbers in some cases (e.g., Figure 2.3.6.1, referred to in Section 2.3.5, and not Section 2.3.6.1);
- Figure missing: Figure 2.3.7.1, referred to in Section 2.3.7;
- The header on all pages states "ICES WGNAS Report 2013". The year should be changed to 2014.

Report of the Working Group on North Atlantic Salmon (WGNAS)

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In this report, the Working Group on North Atlantic Salmon was commissioned by ICES and NASCO to assess the status of Atlantic salmon in North America, Greenland, and Europe. This information is required to determine the potential for salmon fisheries in the NASCO Convention Area (the Faroes and West Greenland). Overall, the report is well written, and the advice for catch management is sound and based on the best available data. The main take home message is that: 1) no mixed-stock fishery options are recommended for NAC due to low returns for most designated units, 2) no catch options are recommended for the West Greenland and the Faroes fisheries as there is very low probability of simultaneously meeting all the management objectives set by NASCO for these areas.

General observations and conclusions of the report

Overall, retention catches (i.e. nominal catches) of Atlantic salmon were the lowest of the time-series in 2013. This is a continuation of a long-term declining trend in Atlantic salmon catches throughout the North Atlantic. Declines have been most pronounced in North America, Greenland, and in the southern Northeast Atlantic, and to a lesser extent in the northern Northeast Atlantic. The Atlantic salmon fisheries have been closed in the Faroes since 2000. Exploitation rates have also declined in most areas. Estimates of unreported catches remain low for most areas.

Northeast Atlantic Commission

Run-reconstruction models indicate that the pre-fishery abundance has declined for both the northern and southern NEAC. For the northern NEAC, the 1SW and MSW have generally been at full reproductive capacity prior to the commencement of distant water fisheries. In contrast, the pre-fishery abundance has been at risk of suffering reduced capacity for 50% of the years for 1SW since the 1990s and since 2009 for MSW for the southern NEAC.

The spawning abundance has been at full reproductive capacity for 1SW and MSW for most years in the northern NEAC, whereas it has been at risk of suffering reduced reproductive capacity or suffering reduced reproductive capacity in most years of the time-series for 1SW and most years since 1996 for MSW for the southern NEAC stocks.

Although the return rates differ among stocks and between wild and hatchery fish, there is generally an overall decline in marine survival (or return rates) for most stocks (though there are some exceptions) and have been generally low in recent years. These results suggest that adult returns are strongly influenced by factors in the marine environment such as interception in non-salmon fisheries, changes in maturation schedule, and changes in environmental conditions. In the Northeast Atlantic, there is an overall decline in the proportion of 1SW (though this varies by country), suggesting that, overall, maturation has been delayed for many stocks, and may have contributed to the decline in the pre-fishery abundance of these stocks. Bycatch of salmon in the pelagic fisheries is currently highly uncertain. As a consequence, the effects of these fisheries on the return of Atlantic salmon cannot be currently evaluated.

North Atlantic Commission

The previous advice provided by ICES indicated that there were no mixed-stock fishery options on the non-maturing 1SW component. The NASCO Framework on indicators of North American stocks did not indicate the need for a revised catch analysis of catch options and no new management advice for 2014 is provided.

Overall, catches and exploitation rates of Atlantic salmon have declined in North America since the late 1980s and have remained relatively stable and low since 2000. The fishery has been closed in the US since the mid-1990s due to low returns.

Pre-fishery abundance of small and large Atlantic salmon have increased in Labrador and Newfoundland during the last 5–10 years, but have exceeded the conservation limits for 2SW only for Labrador in 2013. Elsewhere, pre-fishery abundance has been generally low and declining, and below the conservation limits for 2SW. As with the NEAC, the low and declining trends in Atlantic salmon in NAC appear to be associated to low marine survival, though the marine survival time-series are generally short and frequently started after these stocks had already declined to low levels.

West Greenland Commission

The previous advice provided by ICES indicated that there were no catch options for the West Greenland fishery for 2012–2014. The NASCO Framework on indicators for the West Greenland fishery did not indicate the need for a revised catch analysis of catch options and no new management advice for 2014 is provided. This was confirmed by the current assessment.

Overall, catches off West Greenland have been low but steadily increasing from about 15 t to 45 t between 2004 and 2013. The level of unreported catch is unknown, and the WGNAS recommend improving the reporting of Atlantic salmon catches in this area.

DNA analyses performed on 9% of the catch indicate that most of the fish that were landed originated from North America (approximately 80%). Exploitation rates on North American and European stocks are low (6.2% and 0.4%).

Lastly, new management objectives are currently being developed for the USA stocks and Scotia-Fundy. At the time of this report, the WGNAS had not been able to incorporate the revised management objectives for Scotia-Fundy. Based on the revised management objectives for the USA, there was a very low probability of simultaneously meeting the seven management objectives for the NAC and southern NEAC. Hence, ICES did not recommend any catch options for West Greenland.

Specific comments

p. 11, Section 1.5. B_{PA} is not defined in the text or Annex 7 (glossary).

p. 12, last paragraph, 3rd line: exploited is misspelled

p. 15, Section 2.1.3, first paragraph: The authors indicate that there were no estimate of unreported catch for Spain and St-Pierre and Miquelon where catch is typically. Are they authors implying that the unreported catch should also be low for these areas?

p. 16, Section 2.2.1, first paragraph, line 2. I presume here that the authors meant 1548 kt not 1548 t?

p. 19, line 3: There is a coma hanging by itself between “and” and “about”

p. 20. One fish was diagnosed with ISAv. Although this fish was assigned to North America (based on DNA analysis), the strain of the virus originated from Scotland. The authors conclude that this fish may have been infected by another fish originating from Europe while they were feeding in the Labrador Sea or West Greenland. While this is certainly a possibility, it is also possible that this fish may have been incorrectly classified as a North American fish. It should be remembered that classification errors do occur. For Chinook salmon, an independent evaluation of the genetic baseline with fish of known origin indicated that 96% of the fish were correctly classified to basin of origin. Another way of looking at this is that about one out of every 20 fish is misclassified. And it is not possible to tell which fish is actually misclassified. With 1284 fish, approximately 51 fish would be misclassified (for Chinook salmon). This illustrates that we have to be careful when conclusions are based on only very few fish.

p. 27, first bullet: Density-dependent (not Density dependant).

p. 71, Section 3.1.2, second paragraph. The authors indicate that the dam removal in Sweden is expected to have "large positive effects" on adult returns to this system. While this may be the case, is there any evidence that mortality associated with this dam was high? The authors need to back this statement with solid data, as others may be tempted to make this recommendation elsewhere to improve salmon returns. This may be a costly alternative if the problem of poor return lies elsewhere (i.e. in the marine environment).

p. 78, Section 3.3.1 (and elsewhere): In the run-reconstruction, natural mortality is set to 0.03/month for all stocks and years. Given that marine survival (or return rates) has declined for most stocks, is this a realistic assumption to make in the model?

p. 84, first paragraph: "The period 2006 to 2012 has shown a slight improvement in survival (average of 1.4%) to a level similar to that seen in the first half of the 1994 to 2005 period." I can't see this from the data. It looks like the levels are about half of the 1994–2000 period.

p. 129, Figure 3.3.6.1: Should the legend indicate top–bottom rather than left–right?

p. 141, third paragraph: In this assessment, the WGNAS excluded unreported catches in the run-reconstruction model. Previous assessment included unreported catches only in Québec. This was done for standardizing the run-reconstruction model across all management units. An alternative approach would have been to include unreported catches for all other management units. Is there a rationale for choosing one approach over the other?

p. 145, Section 4.3.2, line 3 of the first paragraph in the Labrador section: The "f101%" needs to be corrected.

p. 146, Newfoundland section: The results for the large salmon and 2SW seem conflicting. Whereas there is an increasing in large salmon return to Newfoundland since the 1990s, this pattern is not apparent for 2SW fish. Is there any explanation for this discrepancy?

p. 147, line 3 of the USA section: there appears to be an extra space between "2013 is" and "and 84%".

p. 148, Gulf of St-Lawrence section: The five year mean is not a very useful metric here, as it is highly influenced by an extreme outlier.

p. 148, Scotia-Fundy section: The high percentages may be misleading and may give the impression that conditions are improving significantly. This is because some values were very low in 2012, such that the changes that occurred in 2013 appeared to be a large increase, even though the conditions are not that great. I suggest removing the percentages in these cases to avoid giving the impression that the conditions are much better. Note that this is not unique to this section, but happens elsewhere in the document such as p. 149: marine survival have increased by 900%, though the change was from nearly 0% to 0.1%. In other words, the survival was still very low despite an apparent significant improvement (in that case, this was highlighted in the paragraph).

p. 152, first paragraph, next to last line: The figure number should be 4.3.6.1 not 4.3.6.2.1.

p. 190: In the 2nd and 4th paragraph, the authors indicate that the factory landings are considered precise given the reporting structure. Yet, the authors highlight a number of issues with the data indicating that they are far from being precise with known misrepresentation in some cases inconsistencies. They further argue that there is a need for better data. Hence, I would argue that the factory landings should not be considered precise.

p. 193, Section 5.1.2.2, next to last paragraph: The WGNAS recommends that "the longer time-series of sampling data from West Greenland should be analysed to further assess the extent of the variations in condition over the time period corresponding to the large variations in productivity identified by the NAC and NEAC assessment and forecast models." I'm not entirely sure I understand that the authors are trying to say here and why this is necessary either. This requires some clarification.

p. 194, Section 5.1.3, second and last paragraph: Due to uncertainty in assessing the continent of origin of the catches of West Greenland, the WGNAS recommends improving these estimates by sampling more fish for DNA. While improving these estimates is certainly desirable, it is unclear to me that this will substantially change the assessment of this fishery given that a large fraction of the reported catch has been analysed. Moreover, it is unclear to me how these estimates are used for assessing the management advice to West Greenland. Presumably this data is used to estimate the catch data for each continent in the run-reconstruction model? A sensitivity analysis may help to determine the effects of the uncertainty associated with DNA analyses on the outcome of the current assessment on Atlantic salmon.

p. 196, Section 5.3.1, 10th line: the word "acknowledgethat" needs to be split into "acknowledge" and "that".