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

3–12 April 2013

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ICES
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Contents

Executive summary

Working Group on North Atlantic Salmon [WGNAS], ICES HQ, 3–12 April 2013.

Chair: Ian Russell (UK).

Number of participants: 20 representing eleven countries from North America (NAC) and the Northeast Atlantic (NEAC). Information was also provided by correspondence from Greenland, Sweden, Faroes, Denmark, and Spain for use by the Working Group.

WGNAS met to consider questions posed to ICES by the North Atlantic Salmon Conservation Organisation (NASCO). 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 2013 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 2013 in relation to the multi-annual agreement for the Faroes fishery. This indicated that the forecasted pre fishery abundance (PFA) for one of the stock complexes (Southern NEAC MSW fish) may have been overestimated; this triggered a request from NASCO for a reassessment of the stocks and an update to the catch advice.

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 2012 was 1409 t, the second 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. modelling developments, fish tracking technologies, genetic investigations) and potential threats (e.g. parasites, artificial light). The Working Group reviewed the potential threat to Atlantic salmon posed by exotic salmonid species.
- The four NEAC stock complexes had a greater than 95% probability of having exceeded their conservation limits (CLs) in 2012 and were therefore considered to be at full reproductive capacity prior to the commencement of distant water fisheries. However at a country level, stocks from several jurisdictions were below CLs.

- The risk based framework for the provision of catch advice for the Faroes Fishery developed in 2012 at the NEAC stock complex level was run at both stock complex and country level.
- There are no catch options for the Faroes fishery that would allow all national or stock complex management units to achieve their CLs with a greater than 95% probability in any of the seasons 2013/2014 to 2015/2016.
- The NEAC FWI was updated and the Working Group recommends that a slight change is made to its future operation; such that a one-tailed approach is used where the fishery is closed (i.e. no reassessment is signalled where the FWI suggests a further reduction in abundance). This would have avoided the need for a reassessment in 2013.
- North American 2SW spawner estimates were below their CLs in each of the six regions. Within each of the geographic areas there are also varying numbers of individual river stocks which are failing to meet CLs, particularly in the southern areas of Scotia-Fundy and the USA. In 2012, large declines in abundance were noted from the higher abundances noted in 2011 reflecting increased mortality at sea on 1SW and 2SW salmon.
- There was a catch of 33 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 six 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 2012 Statutory Meeting, ICES resolved (C. Res. 2012/2/ACOM09) that the **Working Group on North Atlantic Salmon** [WGNAS] (chaired by: Ian Russell, UK) will meet at ICES HQ, 3–12 April 2013 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organization (NASCO).

The terms of reference were met and the sections of the report which provide the answers 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, including unreported catches by country, catch and release, and production of farmed and ranched Atlantic salmon in 2012[1];	2.1 and 2.2 Annex 4
ii) report on significant new or emerging threats to, or opportunities for, salmon conservation and management[2];	2.3
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;	2.4
iv) advise on the potential threats to Atlantic salmon from exotic salmonids including brown trout and rainbow trout where appropriate;	2.5
v) provide a compilation of tag releases by country in 2012;	2.6
vi) identify relevant data deficiencies, monitoring needs and research requirements. Where relevant suggest improvement for the revision of the DCF, to be taken into account by WKESDCF.	2.7 Annex 8
b) With respect to Atlantic salmon in the Northeast Atlantic Commission area:	Section 3
i) describe the key events of the 2012 fisheries[3];	3.1
ii) review and report on the development of age-specific stock conservation limits;	3.2
iii) describe the status of the stocks;	3.3
iv) further develop a risk-based framework for the provision of catch advice for the Faroese salmon fishery reporting on the implications of selecting different numbers of management units[4];	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 2013-2016, 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[5];	3.5, 3.6
vi) update the Framework of Indicators used to identify any significant change in the previously provided multi-annual management advice.	3.7
c) With respect to Atlantic salmon in the North American Commission area:	Section 4
i) describe the key events of the 2012 fisheries (including the fishery at St Pierre and Miquelon)[3];	4.1
ii) update age-specific stock conservation limits based on new information as available;	4.2

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 2013-2016 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[5];	
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 2012 fisheries[3];	5.1
ii) Describe the status of the stocks[6];	5.2
*In the event that NASCO informs ICES that the Framework of Indicators (FWI) indicates that reassessment is required: **	
iii) provide catch options or alternative management advice for 2013–2015 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[5];	
iv) 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. 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. Any new information on non-catch fishing mortality of the salmon gear used, on the bycatch of other species in salmon gear, and on the bycatch of salmon in any existing and new fisheries for other species is also requested.

4. In response to question b) iv, ICES is asked to advise on the limitations for defining management units smaller than the current NEAC stock complexes, the implications of applying probabilities of achieving CLs to separate management units vs. the use of simultaneous probabilities and the choice of risk levels for achieving management objectives.

5. In response to questions b) v, c) iv and d) iii, provide a detailed explanation and critical examination of any changes to the models used to provide catch advice and report on any developments in relation to incorporating environmental variables in these models.

6. 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 FWI indicated that a reassessment was required (on the grounds that PFA had been overestimated for one stock complex), while the West Greenland FWI signalled no reassessment was necessary. Questions b) v and vi were therefore addressed by the Working Group during the 2013 meeting; there was no requirement to address questions c) iv and v or d) iii and iv.

In response to the Terms of Reference, the Working Group considered 38 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. 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
Ensing, D.	UK (N. Ireland)
Erkinaro, J.	Finland
Euzenat, G.	France
Fiske, P.	Norway
Gjøsæter, H.	Norway
Gudbergsson, G.	Iceland
Massiot-Granier, F.	France
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
White, J.	Ireland

1.3 Management framework for salmon in the North Atlantic

The advice generated by ICES is in response to Terms of Reference posed by the North Atlantic Salmon Conservation Organization (NASCO), pursuant to its role in international management of salmon. NASCO was set up in 1984 by international convention (the Convention for the Conservation of Salmon in the North Atlantic Ocean), with a responsibility for the conservation, restoration, enhancement, and rational management of wild salmon in the North Atlantic. 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 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 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 by ICES 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 suffer 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 agreed management plan. ICES applies the same level of risk aversion for catch advice for homewater fisheries on the North American stock complex.

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 1960–2012 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 only North Atlantic country where large-scale ranching has been undertaken with the specific intention of harvesting all returns at the release site. The release of smolts for commercial ranching purposes ceased in Iceland in 1998, but ranching for rod fisheries in two Icelandic rivers continued into 2012 (Table 2.1.1.1). While ranching does occur in some other countries, this is on a much smaller scale. Some of these operations are experimental and at others harvesting does not occur solely at the release site. The ranched component in these countries has therefore been included in the nominal catch.

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 (N. Ireland), France and Spain); 'North America' (Canada, USA and St Pierre et Miquelon (France)); and 'Greenland and Faroes'.

The provisional total nominal catch for 2012 was 1409 t, 220 t below the updated catch for 2011 (1629 t). The 2012 catch was below the average of the previous five years (1565 t) and below the average of the last ten years (1928 t). Catches were below the previous ten-year averages in the majority of Southern NEAC and Northern NEAC countries, except Sweden and Finland.

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 2012 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 recognizes 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, Finland and coastal fisheries ceased in Ireland in 2007. The coastal catch has declined markedly in UK (N. Ireland). In most countries the majority of the catch is now taken in freshwater except UK (England & Wales), 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 2002 to 2012 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 663 t in 2002 to 300 t in 2012. Freshwater catches have been relatively constant. At the beginning of the time-series about half the catch was taken in rivers and half in coastal waters. The proportion of the catch taken in coastal waters over the last five years represents only one third of the total. In southern Europe, catches in all fishery areas have declined dramatically over the period. While coastal fisheries have historically made up the largest component of the catch, these fisheries have declined the most from 718 t in 2002 to 68 t in 2012, reflecting widespread measures to reduce exploitation in a number of countries. In the last six years, the majority of the catch in this area has been taken in freshwater, though there was a slight increase in the proportion of the catch taken in coastal waters in 2010 and 2011.

In North America, the total catch has been fluctuating over the period 2002 to 2012. 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 2011 (14 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 in light of the widespread decline in salmon abundance in the North Atlantic. In some areas of Canada and USA, catch and release has been practiced since 1984, and in more recent years it has also been widely used in many European countries both as a result of statutory regulation and through voluntary practice.

The nominal catches 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 2012 for countries that have records. Catch and release may also be practiced in other countries while not being formally recorded. There are large differences in the percentage of the total rod catch that is released: in 2012 this ranged from 14% in Norway (this is a minimum figure) to 74% 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 countries in 2012. There is also evidence from some countries that larger MSW fish are released in larger proportions than smaller fish. Overall, over 173 000 salmon were reported to have been released around the North Atlantic in 2012, slightly below the average of the last five years (188 000).

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 2012) 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. Estimates for Canada in 2009 and 2010 were considered incomplete (information available for three of the four jurisdictions). There are also no estimates of unreported catch for Spain and St Pierre et Miquelon (NAC), where total catches are typically small. It has not typically been possible to separate the unreported catch into that taken in coastal, estuarine and riverine areas.

In general, the derivation methods used by each country have remained relatively unchanged and thus comparisons over time may be appropriate. 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 2012 was estimated to be 403 t. The unreported catch in the Northeast Atlantic Commission Area in 2012 was estimated at 363 t, and that for the West Greenland and North American Commission Areas at 10 t and 31 t, respectively. The 2012 unreported catch by country is provided in Table 2.1.3.2. Information on unreported catches was not 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. Typically, a number of surveillance flights have taken place over this area in recent years. In 2012, there were 15 surveillance flights by the Norwegian coastguard over the area of international waters in the Norwegian Sea between the beginning of April and end of October. As in past years there were no sightings of vessels fishing for salmon, although there have been extended periods over the winter period when no flights took place. This is a period when salmon fishing has previously been reported.

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 2012 is 1450 kt. The production of farmed Atlantic salmon in this area has been over one million tonnes since 2009. The 2012 total represents an 8% increase on 2011 and a 30% increase on the previous five-year mean (Table 2.2.1.1 and Figure 2.2.1.1) due to increased production in the majority of countries where farming occurs. 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 2012 was above the previous five-year average in all countries. Data for UK (N. Ireland) since 2001 and data for USA since 2011 are not publicly available.

Worldwide production of farmed Atlantic salmon has been over one million tonnes since 2002 and approached 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 2011 estimates for some countries in deriving a worldwide estimate for 2012. Noting this caveat, total production in 2012 is provisionally estimated at around 1961 kt (Table 2.2.1.1 and Figure 2.2.1.1), a 6% increase on 2011. Production of farmed Atlantic salmon outside the North Atlantic is estimated to have accounted for 26% of the total in 2012 (up from 20% in 2011). 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.

The worldwide production of farmed Atlantic salmon in 2012 was over 1300 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 practiced in two Icelandic rivers since 1990 and these data have now been included in the ranched catch (Table 2.1.1.1). The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2012 was 12 t, all taken by the Icelandic ranched rod fisheries (Table 2.2.2.1; Figure 2.2.2.1). Small catches of ranched fish from experimental projects were also known for Ireland but data were not available for 2012. No estimate of ranched salmon production was made in Norway in 2012 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 2012 due to a lack of microtag returns.

It was noted that a large proportion of the fish caught in Sweden in the last ten years (66% of the total catch in 2012 (20 t) and 69% of the previous ten-year average) originated from hatchery-reared smolts released under programmes to mitigate for hydropower development schemes. However, these fish do not fall within the agreed definition of ranched fish and are not included in Figure 2.2.2.1.

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 Dam Impact Analysis Model for Atlantic Salmon in the Penobscot River, Maine

The Dam Impact Analysis (DIA) model is a population viability analysis that was developed to help better understand the impacts of dams on the production potential of Atlantic salmon (Nieland *et al.*, 2013). Dams have been identified as a major contributor to the historic decline and current low abundance of salmon in the Gulf of Maine Distinct Population Segment, which was first listed as endangered in 2000 and then expanded in 2009. The DIA model specifically simulates the interactions of Atlantic salmon and 15 hydroelectric dams in the Penobscot River watershed in Maine, USA (Figure 2.3.1.1).

A life-history modelling approach was undertaken to incorporate life stage-specific information for Atlantic salmon. DIA model inputs (obtained from either field data or literature reports) were used to simulate the life cycle of Atlantic salmon in the Penobscot River (Figure 2.3.1.2). Most model inputs were year- and iteration-specific random draws from distributions to incorporate stochastic variation into the model, and Monte Carlo sampling was used to simulate many iterations of this population forward in time. Several modelling scenarios were run to reflect recent conditions in the Penobscot River (i.e. prior to the planned removal of specific dams) as well as possible future conditions. Adult abundance, distribution of adults throughout the watershed, and number and proportion of smolts killed by dam-induced mortality were used as performance metrics for each scenario.

The modelled population of Atlantic salmon in the Penobscot River decreased in abundance and distribution when DIA model inputs were set to reflect recent conditions (i.e. Base Case), whereas abundance increased and Atlantic salmon remained distributed throughout the Penobscot River watershed when marine and freshwater survival rates were increased by four and by two times recent levels (i.e. Recovery), respectively (Figure 2.3.1.3). The production potential of Atlantic salmon was also affected by mainstem dams more than tributary dams in the Penobscot River watershed (Figure 2.3.1.3). Sensitivity analyses were performed on all input values to determine which model inputs had the greatest impact on the results. The DIA model results were most sensitive to the marine survival and downstream dam passage survival rates.

The DIA model can project changes in future abundance and can provide information about model inputs that can help inform recovery efforts for the modelled population. The model is not meant to predict absolute abundance, distribution, or mortality but should instead be used to evaluate the relative changes in the Penobscot River population of Atlantic salmon under different modelling scenarios.

2.3.2 Marine influences on North American Atlantic salmon populations

The population abundance and marine survival rates of Atlantic salmon have declined throughout their range, and limitations in our understanding of factors responsible for these declines have been widely recognized (Hansen *et al.*, 2012). A new study investigating Atlantic salmon population declines across North America and how these declines have been shaped by marine ecosystem conditions has recently been completed (Mills *et al.*, 2013).

While patterns of declines in abundance and productivity appear similar (Figure 2.3.2.1), this study confirmed through dynamic factor analysis that abundance and productivity of Atlantic salmon populations changed in a coherent manner across major regions of North America from the US to Labrador. Populations showing coherent trends are likely to be responding to common factors, which North American Atlantic salmon would experience during the marine portion of their life. Thus, the observed coherence among populations points towards a likely shift in marine survival and strong influence of marine conditions.

Major changes in Atlantic salmon population characteristics were detected after 1990 and 1997 based on a chronological cluster analysis (Figure 2.3.2.2), and these population shifts could be linked to changes in climate, physical, and biological conditions in the marine ecosystem. The decline in salmon abundance after 1990 was preceded by a series of changes across multiple levels of the ecosystem, including climate indices (i.e. AMO and NAO); physical conditions such as temperature and salinity; and biological characteristics such as phytoplankton abundance, zooplankton community composition, and capelin size. A subsequent shift in salmon productivity in 1997 followed an unusually low NAO event in 1996.

Pairwise associations between Atlantic salmon population trends and a suite of climate, physical, and biological factors were further investigated to understand how marine ecosystem changes may be related to Atlantic salmon. Results of these analyses indicate that climate conditions can be directly linked to the abundance and productivity of North American Atlantic salmon populations; however, many climate and physical influences also act through lower biological trophic levels and thereby indirectly affect Atlantic salmon (Figure 2.3.2.3). The strongest correlations were between salmon and capelin, sea surface temperature, and zooplankton. These results suggest that poor trophic conditions and warming water temperatures throughout their marine habitat area are constraining productivity and recovery of North American Atlantic salmon populations.

2.3.3 West Greenland foraging ecology and implications for survival

Declining Atlantic salmon populations throughout the species range, despite diverse population structures and management regimes, suggests reduced productivity and survival during the marine phase. During this phase, fish from North America and Europe congregate at common feeding grounds (e.g. the Norwegian Sea, the Labrador Sea, West Greenland, etc.) to consume abundant energy rich prey that promote rapid growth and sexual maturity. Stomach samples were collected from a total of 1345 salmon from 2006–2007 and from 2009–2011 (as part of SALSEA West Greenland) from various communities along the west coast of Greenland. While annual variations in the stomach content weights and composition were documented, Atlantic salmon consumed primarily capelin and *Themisto* sp. (amphipod); a finding consistent with historic data collected from the offshore waters of West Greenland during the 1960s (Figure 2.3.3.1).

Energy equivalents (kJ/g wet weight) of the stomach contents were obtained from values in the literature (Thayer *et al.*, 1973; Steimle and Terranova, 1985; Lawson *et al.*, 1998; Hislop *et al.*, 1991) and were applied to the stomach contents of each individual fish to estimate the total energy content in a given stomach. These estimates were scaled to body weight for each fish (kJ•g^{-1}) at the time of sampling. The standardized energy content varied annually (Figure 2.3.3.2; ANOVA; $F_{[3, 887]} = 42.92$, $p < 0.001$). All *post hoc* pairwise comparison differences were highly significant between all pairs except differences between 2006 and 2010 ($p = 0.079$).

Since capelin is an important resource for Atlantic salmon, and the quality of this resource is decreasing (Figure 2.3.3.3), effects on potential 2SW spawners from southern populations that feed on capelin at Greenland may be exacerbated. These data provide insights into the current foraging conditions off West Greenland. They also complement the documentation of the sharp stock productivity reduction that began in the early 1990s, and provide an opportunity to explore various hypotheses to examine the role energy resources play in the viability of various life-history strategies in the marine phase.

2.3.4 Tracking and acoustic tagging studies in Greenland and Canada

2.3.4.1 Tagging adult Atlantic salmon at West Greenland with pop-up archival satellite tags (PSATs)

Return rates of the 2SW component of Atlantic salmon populations are decreasing, especially at southern latitudes and on both sides of the North Atlantic. These fish are present at West Greenland, foraging during summer/autumn, prior to initiating a return migration to homewaters to spawn. To investigate the migration dynamics of this population, pop-up archival satellite tags (PSATs) were attached to 25 Atlantic salmon near Nuuk, West Greenland in September 2010–2012, to track them over autumn and winter. Preliminary results suggest that two tags remained on the fish until the programmed pop-off date (April 1), three fish were predated, one tag popped-off due to exceeding the emergency pop-off depth, seven popped-off for unknown reasons and 12 did not transmit any data.

Detailed information on migration routes, migration rates, environmental conditions experienced and habitat preferences can be obtained from the gathered data. The one full term fish from 2010 moved north to Disko Bay immediately after tagging and its swimming depth was constrained while it remained over the shelf waters (Figure 2.3.4.1). After migrating into the Labrador Sea in February (as the sea ice progressed south or after it entered sub-0°C water) it began to dive to depths exceeding 750 m, possibly in search of food.

Three incidences of likely predation were also documented based on inferences from the data received and the capabilities of the tags themselves. It is hypothesized that a Greenland shark, a large Atlantic halibut and an unknown predator consumed three individual salmon (Figure 2.3.4.2). Evidence of predation was determined based on significant changes in the dive profiles, recorded temperatures and the absence of any light intensity records (i.e. the tags did not detect any light indicating they were in the stomach of an animal).

While fish generally used a broad area of the Labrador Sea, overall movement after tagging indicate both northerly and southerly movement patterns along the coast, possibly in search of capelin or other prey resources. Overall, it appears that salmon movements, behaviour, and thermal habitat requirements are either very individualistic or Atlantic salmon are capable of tolerating regimes well outside those believed optimal. Eight incidences of PSATs popping-off before the programmed release date were documented. These may have been the result of tag/bracket failure or predation events resulting from tag dislodgement given the relatively short duration they were on the fish.

PSAT technology is generally suitable for work with Atlantic salmon of the size range at West Greenland. Atlantic salmon were successfully captured, tagged, released and tracked over winter. High quality data on movement patterns, migration behaviours, winter locations, and conditions experienced at winter habitats were collected. Refining the catch methods to reduce stress, tagging techniques, and determining reasons for failures appears to be critical for long-term success of tagging based on some of these preliminary findings and the given cost of the equipment. These data are not obtainable by other means and may provide valuable information related to a critical understudied life stage of the species, aiding in the conservation and management of Atlantic salmon across the Northwest Atlantic.

2.3.4.2 Acoustic tracking update for Canada

The Working Group reviewed the results of ongoing projects, led by the Atlantic Salmon Federation (ASF), to assess estuarine and marine survival of tagged Atlantic salmon released in rivers of the Gulf of St Lawrence. A total of 291 smolts from four rivers in Canada (42 St Jean, 64 Cascapedia, 105 Restigouche, 80 Miramichi) and 35 Miramichi kelts were sonically tagged between April and June 2012. Of the 35 kelts tagged with acoustic tags, ten were 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 2012 from freshwater release points to the heads of tide, through the estuary and out of the Strait of Belle Isle was similar to previous years for the Cascapedia, Restigouche and Miramichi rivers; few St Jean fish were detected as previous years. As previously, smolts and kelts exited the Strait of Belle Isle together, however in 2012, the timing occurred approximately two weeks earlier (the last week of June and first week of July). Analysis is proceeding using modelling methodology to account for the variability in detection by receivers so stage survival estimates and their variability may be estimated (see Section 2.3.4.3).

The detector array across the Cabot Strait, between Cape Breton, Nova Scotia and Southwest Newfoundland was completed by the OCEAN Tracking Network (OTN) and functional in 2012 although few fish used this exit from the Gulf of St Lawrence (one Miramchi kelt in late May and one Miramichi smolt in mid-June). The satellite archival pop-up tags functioned well in 2012, with information from seven of the nine that left the Miramichi River being recovered. This information is still being analysed however preliminary results show evidence of predation on a kelt within the Gulf of St Lawrence (likely by a species such as a porbeagle shark) and one fish leaving the Gulf of St Lawrence through the Strait of Belle Isle. The remainder stayed within the Gulf, possibly as a result of predation, or they could be returning to spawn in the same year as they were tagged as consecutive repeat spawners. These salmon may not migrate far from their spawning river.

For the first time in 2012, new modes of detection of acoustically tagged salmon were investigated in the Gulf of St Lawrence in collaboration with the Ocean Tracking Network and DFO. Bioprobe receivers have been mounted on grey seals by DFO; these mammals return annually to Sable Island and at least one seal receiver had detected at least two of ASF's tagged salmon within the Gulf of St Lawrence. The Ocean Tracking Network released a Wave Glider into the Gulf of St Lawrence along the west coast of Newfoundland in late June 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. Detection of at least one of these fish did occur, however it is believed that the Wave Glider path may not have coincided with the migration as it seemed to occur about two weeks earlier as mentioned earlier.

As detailed in Section 2.8.1 relating to new marine research initiatives, the Working Group also 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.

2.3.4.3 Modelling inter-stage survival rates and detection probabilities for acoustically tracked Atlantic salmon smolts and post-smolts: model, assumptions, diagnostics, considerations for planning experiments

In Section 2.8, the Working Group was informed of the NASCO IASRB Subgroup report on Future Direction of Research on Marine Survival of Salmon. The subgroup indicated that consideration of studies to partition marine mortality of salmon among the phases of the marine migration remained a priority. An outline proposal for using acoustic technologies to tag emigrating smolts from NAC and NEAC as well as adults at West Greenland and to track their movements with detector arrays, and other novel detector systems, is described in Section 2.8.1. These data and appropriate models can provide information on key parameters of salmon life history including inter-stage survival rates, migration rates and behaviour.

A number of recent publications have used these technologies to address questions of marine mortality from estuarine and nearshore waters to large bays. As reported in ICES (2012a), Kocik *et al*. (2009) describe smolt migrations on the Narraguagus River (Maine, USA) based on six years of monitoring (1997–1999 and 2002–2004). Migrating smolts were captured in the lower river, surgically tagged and released. Receivers were deployed throughout the lower river, estuary and nearshore environment to estimate smolt survival to the Gulf of Maine, map migration paths and document emigration timing for this population. Estimates of overall survival indicated that for every 100 smolts exiting the river, 62–74 reached the Inner Bay, 41–54 reached the Middle Bay, and 36–47 reached the Outer Bay. While mortality decreased in the marine environment, analysis indicated that less than half the smolts survived the approximately ten day period of migration from the river to the Gulf of Maine.

Dempson *et al*. (2011) reported on a three year initiative to track Atlantic salmon and determine migration route, residency time and survival in a 50 km long estuarine fjord located on the south coast of Newfoundland, Canada. Migrating smolts from two rivers in the study used different routes to reach the outer areas of the fjord. Many smolts were resident for periods of 4–8 weeks moving back and forth in the outer part of the fjord where maximum water depths range from 300 to 700 m. Survival in the estuary zone was greater for smolts with prolonged residency in estuarine habitat. Overall smolt survival to the fjord exit was moderately high (54–85%), indicating that the initial phase of migration did not coincide with a period of unusually high mortality.

Halfyard *et al*. (2012) used acoustic tracking technologies to estimate mortality rates, assess the spatio-temporal dynamics of natural mortality and examine migratory behaviour during the fresh to saltwater transition of Atlantic salmon smolts from four river systems in the Southern Uplands area of Nova Scotia (Canada). They reported that the cumulative survival through the river, inner estuary, outer estuary and bay habitats averaged 59.6% (range = 39.4–73.5%).

Lacroix (2013) reported on research to describe the migration of wild and hatchery Atlantic salmon postsmolts across the Bay of Fundy (BoF), Canada. This followed on previous publications (Lacroix *et al*. 2005; Lacroix 2008) to estimate survivals of smolt and postsmolts from the same area.

Modelling detection and survival probabilities

Kocik *et al*. (2009) and Dempson *et al*. (2011) estimated detection and survival probabilities of tagged smolts using a variant of a Cormac-Jolly-Seber capture and recapture model in a program called MARK (White and Burnham, 1999). Lacroix (2008) and Halfyard *et al*. (2012) estimated detection probabilities independently of the tagged smolts and subsequently estimated survival probabilities outside a formal model structure.

An example of modelling individual fish detection data using smolts tagged from three rivers and six years and detected at arrays extending more than 800 km from the point of release was provided to the Working Group. A Bayesian state-space model variant of the Cormac-Jolly-Seber model described by Gimenez *et al*. (2007) and Royle (2008) was used. This model provides a means of disentangling the imperfect detection (p) of tagged smolts on the sonic arrays from apparent survival (Ø) during their out migration. The state process (survival) is represented by a binary variable z(i,j), which takes the value 1 if fish i is alive at the end of the j migration leg and 0 otherwise, with a probability of survival (Øj) that is similar for individual fish within a stage of migration *j*.

$$z[i,j] \mid z[i,j-1], Ø_j \sim \text{Bernoulli}(z[i,j-1]\ Ø_j)$$

The observation process (detection) is also modelled by a binary variable, where x(i,j) (observation) represents fish i being detected at array j conditional on z(i,j) (i.e. whether the fish is alive to be detected at array j) and the probability of detection (p_j) at the array for the migration leg j.

$$x[i,j] \mid z[i,j], p_j \sim \text{Bernoulli}(z[i,j]\ p_j)$$

In the first analysis, an annual model was considered in which the probabilities of detection and survival were assumed independent among rivers, years, and detection arrays (Figure 2.3.4.3.1). In the second analysis, a hierarchical structure was placed on the probabilities of detection at the arrays. In the hierarchical model, the probabilities of detection were considered exchangeable among years within a river, and among years and rivers for those which share a common bay or exit farther out at sea.

Data collected by the Atlantic Salmon Federation of smolts tagged from three rivers and six years and detected at three arrays extending more than 800 km from the point of release were used to illustrate how these data could be analysed using the Bayesian state–space model formulation. A total of 1279 smolts had been tagged and released with acoustic transmitters from three rivers over a period of six years. Acoustic arrays were monitored at the head of tide of each river, at the exit to the Gulf of St Lawrence (two outer arrays) and at the Strait of Belle Isle (one array) leading to the Labrador Sea. The detections of smolts at each array by river and year are shown in Figure 2.3.4.3.2.

The estimates of the probabilities of detection at each array for the annual model and for the hierarchical implementation of the Bayesian state–space model are shown in Figure 2.3.4.3.3. The most relevant features from these results are:

- There is large annual variation in the probabilities of detection among years within a river at the head of tide arrays and among years at arrays exiting to the Gulf of St Lawrence.
- The uncertainties in the estimation of probabilities of detection increase as the monitoring proceeds from the head of tide arrays, to exit to the bays to the Strait of Belle Isle. This is due mostly to the smaller number of detections of smolts at the progressively further downstream arrays associated in part with fewer number of tagged smolts available for detection (fish die over time).
- The probability of detections at the last array at the Strait of Belle Isle are confounded with the probabilities of survival through the Gulf of St Lawrence and cannot be appropriately estimated. The range of detection probabilities vary from a high of 1.0 (perfect detection) assuming that the total fish detected corresponds to the total fish surviving the migration from the exit of the bays to lows corresponding to the ratio of detections relative to the estimated number of smolts alive at the previous detection array (100% survival through the Gulf of St Lawrence).
- Assuming some degree of exchangeability between the probabilities of detection results in shrinkage (reduced uncertainty) and slight changes in expected values of the annual and river-specific detection probabilities at the head of tide and bay exit arrays. The posterior distribution of the Strait of Belle Isle array under the hierarchical distribution is the mean of the individual year and river distributions and the confusion between the probabilities of detection and survival persists.

The posterior distributions of the probabilities of detection at the Strait of Belle Isle array are entirely determined by the prior assumptions for this parameter (Figure 2.3.4.3.4). However, the probabilities of detection and the estimates of survival at all the prior/upstream arrays are insensitive and unaffected by the estimates of the probability of detection at the last array.

Experience from the last ten years of research with the use of acoustic technologies to track salmon smolts provides useful guidance in the design of such experiments and the treatment of data.

- The last array, in time and/or space is the weakest point in the experimental design. It is not possible to disaggregate the probabilities of detection from the probabilities of survival unless an informative prior is used for this parameter in the model or sampling efforts to detect tagged fish are expended downstream/later in time of the last array of interest. An informative prior could be developed by independently determining the probabilities of detection using sentinel tags (tags placed or transported across various parts of the array) as was done by Halfyard *et al*. (2012). Similar work has been initiated for the Strait of Belle Isle array.

- There will inherently be more uncertainty in estimating survival rates through the extended period of migration of salmon in the ocean as the sample size will decrease over time as fish die and fewer fish remain to be detected.
- Bayesian hierarchical models provide a flexible framework for analysing multiyear, multiarray, and multiriver designs. Bayesian models are flexible and additional variables can be introduced to further explore factors modifying detection and survival, for example by tag release group or date of release, by size of smolt, by incorporating indices of potential predators, etc.

In this example, hierarchical estimates of detection probabilities for the exit to the Miramichi Bay arrays can be used as informative priors to estimate survival rates to exit to the Gulf of St Lawrence in years when the Strait of Belle Isle array was not installed and operating (2004 to 2006).

2.3.5 The impact of artificial night light on Atlantic salmon fry dispersal and the onset of smolt migration

The use of artificial night light is continuing to increase both in previously unlit regions of the developing world, but also in already heavily developed countries. Different types of lights have varying spectral compositions. The most numerous current type of street lights emit light that is narrowly concentrated in the longer wavelengths of the visible spectrum, appearing yellow or orange to the eye. Modern, replacement, lights emit considerably more light across the visible spectrum especially at shorter wavelengths, providing high efficiency and superior colour rendering for human vision. However, these more natural whiter lights could lead to significant changes in the impact of artificial light on natural systems, particularly aquatic ecosystems where penetration through water will be increased.

In a recent investigation, the timing of Atlantic salmon fry dispersal from artificial redds (Riley *et al.* 2013; Riley *et al*. in prep); and the migratory timing and behaviour of wild smolts leaving their natal stream (Riley *et al.* 2012); were compared under both control and ecologically relevant broad spectrum street-lit intensities. The diel timing of both behaviours is considered to be a predator avoidance tactic for these critical life-history stages. Thus, any alteration or disruption to these processes may have a significant impact on recruitment.

Two experiments were conducted on fry dispersal, in 2011 and 2012. In the first experiment, fry dispersal occurred 2.8 days later ($p < 0.001$), and on average the fry were smaller at dispersal ($p < 0.001$), in the incubators exposed to a 12 lx light intensity compared to the 0.1 lx controls (Figure 2.3.5.1). In the second experiment, fry dispersal occurred 1.3 days later ($p < 0.01$) in incubators exposed to a 1.0 lx intensity compared to the 0.1 lx controls. In both experiments, significant disruption to the diel pattern of fry dispersal was also observed. For example, in 2011 fry dispersal under control conditions was significantly directed around a mean time of 4:17 h after dusk (p <0.001, r = 0.76, n = 1990) with very few fry (<2%) dispersing during daylight hours (Figure 2.3.5.2b). Under street lighting, the dispersal of fry was significantly delayed (mean time 6:38 h after dusk; p <0.001, r = 0.39, n = 2413) with a significant proportion (32%) dispersing during daylight hours (Figure 2.3.5.2a).

The migratory timing of smolts leaving their natal stream was determined using a PIT antennae system on the Brandy Stream, a tributary of the River Itchen in UK (England & Wales). Experiments compared the downstream migration of smolts under natural control conditions (2000–2006) with two years (2008 and 2009) when the downstream exit to the study site was subject to street-lit conditions every alternate night (maximum light intensity = 14 lx). Migration of smolts under control conditions was significantly (p < 0.01, n = 170) correlated with sunset. By contrast, street lighting resulted in the timing of migration being random (p = 0.11, n = 7; p = 0.76, n = 34, respectively) with respect to time of day. Furthermore, migration of smolts was significantly (p = 0.01, n = 19) correlated with the time of sunset for fish migrating when the lamp was off, but random (p = 0.36, n = 22) when the lamp had been on (2008 and 2009 data, combined) (Figure 2.3.5.3).

Systematic investigation is needed to determine the extent of this problem and the light intensities at which street lamps do not affect behaviour. Such information could then be used as a management tool to identify sites where potential problems currently exist and provide evidence-based information to guide the replacement of street lamps to lessen their impact.

2.3.6 Stock identification of salmon caught in the Faroes salmon fishery

Salmon originating in rivers from both Northern and Southern European stock complexes have been exploited in the longline fishery that operated within the Faroes EEZ in the 1980s and 1990s, and there is a potential for this fishery to reopen if stocks recover. NASCO has asked ICES to develop a risk-based framework for the provision of catch advice for this fishery (Section 3.4), but this has been complicated by lack of data on the stocks that the fishery exploits. Advances in microsatellite DNA profiling methodologies and statistical genetics approaches, including work undertaken under the SALSEA-Merge programme, provide the opportunity to obtain estimates of the stock composition in the fishery area for one or more baseline years.

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.

Approximately 750 scale samples collected from commercial and research catches in the fishery were selected from each of two periods comprising the 1983/1984 and 1984/1985 seasons and the 1991/1992 and 1992/1993 seasons respectively. Initial results have shown significant degradation of the DNA in some of the monthly samples, but much better results in others. Further investigations are being undertaken into the cause of the degradation, and initial trials with modified protocols suggest that it may be possible to improve the extraction of useable DNA. Although no assignment analysis has been undertaken yet, a number of samples have been identified with alleles that are only expected to occur in North American salmon.

2.3.7 Update on EU project ECOKNOWS

ECOKNOWS is an EU 7th framework project running from 2009 to 2014, comprising of 13 research organizations with the University of Helsinki (Finland) leading. The project is to develop methodologies using Bayesian approaches. Developments are demonstrated in case studies, one of which is the salmon case study. The participants of the salmon case study are Agrocampus Ouest (France), the Finnish Game and Fisheries Research Institute, Institute National de la Recherche Agronomique (France), the Marine Institute (Ireland) and the Department of Fisheries and Oceans (Canada). In this case study the salmon stock assessment models used in the Baltic (in WGBAST) and North Atlantic (in WGNAS) areas are being compared with the aim of harmonizing the two approaches into comparable structures, mathematically representing salmon life cycles with freshwater and sea age cohorts. Both approaches are being developed with emphasis on improving the use of ecological knowledge and available data in assessments and improving the predictive ability of models.

Models are being developed for North Atlantic salmon stocks that have the potential to provide improvements to the Pre Fishery Abundance stock assessment models. An integrated life cycle model has been developed in a Hierarchical Bayesian framework that brings a substantial contribution to Atlantic salmon stock assessment on a broad ocean scale. The approach also facilitates the harmonization of the stock assessment models used in the WGBAST and in WGNAS. One of the main deliverables will be progress towards embedding Atlantic salmon stock assessment at broad ocean scale within an integrated Bayesian life cycle modelling framework consisting of two main components, as outlined below.

2.3.7.1 An integrated life cycle model as an improvement to PFA modelling

A life cycle model has been developed in a Hierarchical Bayesian modelling framework. The existing biological and ecological knowledge of Atlantic salmon demography and population dynamics is first integrated into an age and stage-based life cycle population dynamic model, which explicitly separates the freshwater (egg-to-smolt) and marine phases (smolt-to-return), and incorporates the variability of life histories (river and sea ages). The marine phase accounts for natural and fishing mortality, and captures the sequential fisheries along the migration routes, including off shore, coastal and estuarine and freshwater fisheries. This body of prior knowledge forms the prior about the population dynamic, which is then updated through the model with assimilation of the available data.

The framework offers potential improvements to the PFA stock assessment approach. The current PFA models mainly rely on a stock–recruitment concept that considers a statistical relationship between a spawning potential (lagged eggs) and a recruitment variable (PFA), both derived from the same data sources (estimates of returns based on home water catches) by a mixture of forward (lagged eggs) and backward (run reconstruction) approaches. The freshwater phase is not explicitly represented in the model. More generally, many demographic hypotheses are obscured within the data assimilation procedure, making it difficult to assess how changes in models or data may impact the results.

The new modelling approach makes it easier to assess the consequences of any changes in the data and model structure. Different demographic hypotheses can be tested without changing the data assimilation scheme, and this would also offer multiple possibilities to extend the model by adding more sources of data (e.g. data on egg-to-smolt survival, post-smolt mark-recapture data, environmental variables). As a critical improvement to the PFA models, the life cycle model explicitly separates out the freshwater and the marine phases. This allows the effect of both freshwater and marine phases in the recruitment process to be separated, instead of considering a single productivity parameter that aggregates demographic processes of the different impacts encountered during the freshwater phase (from egg to smolt) and the first months of the post-smolt marine phase.

To illustrate the potential of the approach, the model has been applied to the stock complex of Eastern Scotland, the largest regional component of the southern NEAC stock complex. The model was fitted to the same data as used in the current PFA models. In addition to the hypotheses currently made in the current PFA model, the flexibility of the approach has been illustrated by testing different demographic hypotheses.

- Density-dependence in the freshwater phase has been considered by introducing a Beverton–Holt egg-to-smolt survival (Figure 2.3.7.1.1). This introduced non-linearity in the dynamics and modified the inferences made on the smolt-to-PFA survival (marine productivity). Indeed, the fluctuations in number of eggs spawned over the time-series induced fluctuations in the egg-to-smolt survival rate, which is balanced by changes in the smolt-to-PFA survival relationship. Hence, considering density-dependence in the freshwater phase leads to a different time-series of egg-to-smolt survival estimates. This in turn may change interpretation of changes in marine productivity and may also affect forecasts.
- The model was also used to contrast two hypotheses for the decline in return rates of 2SW fish (Figure 2.3.7.1.2): a constant natural mortality rate after the PFA stage and an increase in the proportion maturing (current hypothesis in PFA models); or an increase in the natural mortality rate of 2SW fish relative to 1SW, and a constant proportion maturing. Changing from one hypothesis to the other has no consequence on estimates of smolts return rates, but it supposes different demographic processes. It may also have management implications as a greater mortality on 2SW fish would result in a different risk to stock abundance in homewaters from high seas fisheries.

Proposed further work includes: (i) building a hierarchical model to jointly analyse the dynamics for all regions comprising the southern NEAC stock complex; (ii) enhancing the validation of the available data. Such a model has the potential to improve knowledge of the biology and ecology of Atlantic salmon. In particular, future development will consist of including region specific egg-to-smolt productivity parameters derived from meta-analyses based on index rivers (Section 2.3.7.2).

Such a model has the potential to provide tools for assessing the effect of management measures on mixed-stock high seas fisheries;

2.3.7.2 A meta-analysis of egg-to-smolt survival

A meta-analysis of egg-to-smolt relationships for Atlantic salmon has been carried out. Time-series of egg-to-smolt data on 21 index rivers across the Atlantic salmon range (12 rivers from North America; nine rivers in Europe), together with several covariates associated with the index rivers, were compiled for this study:

- Total egg deposition for each cohort, derived from estimates of the number of returning spawners combined with estimates of proportion of sea age classes, proportion of females and fecundity of each sea age class;
- The total smolt production by cohort including age-structure of the smolts;
- Associated covariates for each river: latitude (continuous), longitude (categorical with two groups, east and west side of the Atlantic Ocean), wetted and lacustrine area accessible to salmon.

The meta-analysis was carried out through a Hierarchical Bayesian model. The classical Beverton–Holt model was revisited through the explicit parameterization in terms of density-independent and density-dependent mortality rates. The duration of the freshwater phase (mean age of smolt, specific to each river) is explicitly used as a covariate. A partially exchangeable hierarchical model was built to incorporate covariates (such as the longitude and the latitude) to capture part of the between rivers variability.

Results highlight large between rivers variability in both the density-independent and dependent mortality rates (Figure 2.3.7.2.1). Latitude and the longitude explain a great part of this variability in the density-dependent mortality rate (Figure 2.3.7.2.1). No useful covariates were found however, to explain the variability in the density-dependent mortality rates. This approach offers an efficient framework to predict the parameters of density-dependent survival (and the associated uncertainty) for any new river for which the associated covariates of latitude, longitude, wetted area and mean smolt age are known.

Outcomes of this study offer useful prior information about freshwater productivity, which may be worked into the integrated life cycle model described above which is being developed in parallel with this process.

2.3.8 Diseases and parasites

2.3.8.1 Red vent syndrome

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 stock complex observed a notable increase in the incidence of salmon with RVS during 2007 (ICES, 2008a), but levels have been lower in some NEAC countries since 2008 (ICES, 2009a; ICES, 2010b; ICES, 2011b). Trapping records for rivers in UK (England & Wales) and France suggest a further reduction in 2012. The incidence of *Anisakis simplex* was considered to be much lower in 2012 compared to the previous four to five years in Ireland.

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.

2.3.8.2 Monitoring of sea lice burdens on wild returning adult Atlantic salmon

There remains a paucity of studies of sea lice prevalence and intensity on Atlantic salmon in areas prior to the development of aquaculture and in areas currently without aquaculture. Powell *et al.* (1999) reported on prevalence and abundance of sea lice on migrating Atlantic salmon monitored at a fishway near the head of tide in the Penobscot River (USA), as the aquaculture industry was developing in the area. Bjørn *et al.* (2001) report on the prevalence and abundance of sea lice from Atlantic salmon sampled from catches in various coastal and inshore fisheries in Norway from June and July 2001. Prevalence of lice on salmon ranged from 80% to 100% and the maximum numbers of lice on fish among locations ranged from 28 to over 1000 lice. Murray and Simpson (2006) reported on monitoring of sea lice from salmon in the estuary fishery of the North Esk river (UK Scotland) during 2001 to 2003. This river is distant from marine salmon farms and provides a source of data on background patterns in lice infestation on returning salmon. In this study, mobile lice had mean abundance of six to seven per fish and a prevalence of 80–90%. Jackson *et al.* (2013) reported on population structure, prevalence and intensity of lice from salmon sampled from the driftnet fishery and draft net fishery catches in Ireland. The authors noted that almost all fish examined in these fisheries had sea lice with abundance variable both within and between years with the maximum mean abundance of 25.8 lice per fish recorded in 2004. There was clear evidence of recent infestation with lice in the draft net samples (estuarine areas) (Jackson *et al.*, 2013).

Monitoring of sea lice burdens on wild returning adult Atlantic salmon from the Miramichi River, New Brunswick

Results from a monitoring program from 2005 to 2011 that developed indices of sea lice abundance on returning Atlantic salmon to the Miramichi River, southern Gulf of St Lawrence (Canada) were presented. There is no marine finfish aquaculture in the southern Gulf of St Lawrence. Salmon were captured at research and monitoring estuary trapnets operated during the entire migration period for salmon (late May to late October).

Captured fish were sampled for biological characteristics including origin (wild vs. hatchery), length, scales for age determination, sex, sea lice scarring, and sea lice load. Monitoring for sea lice began in 2005. Sea lice on salmon were enumerated in five categories of abundance (0, 1–5, 5–15, 15–50, and >50 lice). Sea lice prevalence (percentage of fish with sea lice present) was lowest in June, increased over summer to generally highest levels in August although in a few years, the percentage of salmon with sea lice was higher in September (Figure 2.3.8.2.1). Sea lice loads, expressed as the percentage of fish in the >15 sea lice category, were highest in September with as many as 5% of the sampled fish having greater than 50 lice per individual fish in some years.

Sea lice infection rates on returning wild adult salmon increase through summer and autumn, which could be explained by Atlantic salmon collectively returning to Miramichi Bay in late spring/early summer and staging in Miramichi Bay with salmon ascending the river in late summer and autumn having been exposed for a longer period of time to sea lice in a constrained area.

Sea lice have not been identified to species so the observations could be of either *Lepeophtheirus salmonis or Caligus* sp. Despite the absence of salmonids in the brackish and saltwater portions of the Miramichi River and bay which freeze over in winter, sea life cycles are maintained in this area. Sea lice infections on returning wild adult Atlantic salmon can be quite high in some years and increase through summer and autumn. This indicates a "natural" state of the association between the ectoparasite and Atlantic salmon in an area without marine salmonid aquaculture.

Monitoring of sea lice burdens on Atlantic salmon from the fishery at West Greenland

As part of the Enhanced Sampling Program (SALSEA Greenland; ICES 2012) information on the prevalence of sea lice on Atlantic salmon has been collected. Enhanced sampled fish provide a more unbiased estimate of sea lice prevalence at West Greenland than the Baseline sampled fish. Enhanced sampled fish were purchased directly from the fishers whereas fish sampled at the local market were sometimes cleaned prior to sampling at the local market, thereby removing most lice present. The fish samples from the Enhanced Sampling Programme at West Greenland may still be biased as sea lice are sometimes removed from individual fish due to abrasion against the gillnet during capture. As a result sea lice estimates from Greenland harvested fish should be considered minimum estimates. Samplers were instructed to document the presence and number of sea lice on each fish sampled. Subsamples of individual sea lice were also preserved in support of two ongoing studies: a Slice® resistance study and a population genetics study.

Information of sea lice prevalence is available from 1166 fish sampled between 2009 and 2011. On average, 30% of the sampled fish had no sea lice present (Table 2.3.8.2.1). Approximately 50% of the individuals had 1–5 lice, 12% had 6–10 lice fish and the remainder had eleven or more. Sea lice burden per fish ranged from 2.3 (2011) to 3.0 (2009 and 2010) with an overall burden of 2.7 lice per fish.

Summary and considerations for improving the monitoring

The principal concern for sea lice originating from aquaculture relates to the impact of lice on outmigrating post-smolts which are most susceptible to these infections. It is challenging, but not impossible, to sample smolts and early post-smolt stages as they migrate to the open ocean. Monitoring of sea lice burdens on adult salmon returning to rivers could be an alternate indicator of variations in abundance of sea lice among areas and among years. However, returning adults may be more indicative of the sea lice infestations in high seas than the sea lice infection pressure experienced by the outmigrating smolts.

Although sea lice infection rates can vary among locations due to differences in biological and oceanographic conditions, monitoring of sea lice infection rates on salmon populations in areas with and without salmon farms would provide information on the relative roles of salmon farms as a source of sea lice for wild salmonids. The "natural" state of the association between sea lice and Atlantic salmon in areas without marine salmonid aquaculture could be useful indicators of how these associations vary with factors unrelated to concerns about aquaculture. Sea lice development is temperature dependent and variations in lice loads on salmon may reflect variations in generation time for lice among different areas. The identification of the species and the life stage is important and in most studies, motile life stages are counted and mature females with egg cases are tabulated separately. Monitoring protocols have been developed by state agencies and industry and training courses for sea lice monitors are mandatory in some areas.

2.3.8.3 New parasite

In 2011, a parasite (*Paragnathia formica*, an estuarine crustacean isopod) was detected on 5% of salmon caught in the Scorff trap facility, France, located near the upper limit of the estuary. It was not clear whether this was a new infestation or one that had simply gone undetected until that point. Symptoms included inflammation in the genital zone and on the fins and could be mistaken for sea lice bites or red vent syndrome. It was also noted that sea lice and *Paragnathia formica* could be coexisting, and not known whether the parasite could survive in freshwater. *Paragnathia formica* was not detected in France in 2012.

2.3.9 Changing biological characteristics of salmon

The Working Group noted that various biological characteristics of salmon show continuing interesting trends, some of which have already been reported in the ICES SGBICEPS report (ICES, 2010a), such as decreasing mean fork lengths in returning adult 1SW fish in the River Bush in UK (N. Ireland) since 1973. This same trend has been observed for 1SW returning adults on the River Bann in UK (N. Ireland). For the same time period the mean fork length in 2SW fish in both rivers showed only a very small, non-significant, decrease.

Also notable, and first reported in ICES, 2011a, was the increase in both numbers of 2SW returns to the River Bush in UK (N. Ireland) as well as the increase in the relative proportion of 2SW vs. 1SW, since 2003. In 2012 this trend has become even more pronounced with the percentage of River Bush 1SW returning adults decreasing to the lowest point in the time-series at 66% (previous ten year average 91%). Survival to freshwater of River Bush 2SW fish has also seen a positive trend since 2001. This was also noted in the Norwegian PFA estimates for 1SW, 2SW, and 3SW returning adults. From the 2004 smolt cohort onwards, the estimates for 1SW fish have decreased to approximately 15% and have remained low. PFA estimates for 2SW and 3SW returning adults for the same period have shown an opposing trend with a 10–20% increase from 2004 (3SW) or 2005 (2SW). Angling catches in UK (England & Wales) have noted a marked increase in the proportion of 2SW salmon relative to 1SW salmon in the last two years. The above observations could indicate a shift in life-history strategy from 1SW to MSW in some Northern NEAC and Southern NEAC stocks, possibly due to poor growth in the first season at sea. A similar observation has been noted in the probability of maturing parameter in the stock and recruitment model the Northern NEAC model (Section 3.5).

Another possible change in biological characteristics has been observed in mean smolt age in UK (England & Wales). In rivers such as the Dee there has been a downward trend in smolt age since the late 1960s (ICES, 2010a) and similar decreases, over shorter timescales, were observed in other rivers in the same geographic area. However, since 2003–2004 this trend appears to have been reversed and mean smolt age on the Dee, and other monitored rivers, appears to be increasing again.

2.3.10 New initiatives in relation to management of mixed-stock coastal fisheries in northern Norway

SALSEA-Merge, and other projects, have contributed towards the establishment of a comprehensive genetic baseline for salmon populations in northern Europe. This baseline continues to be developed as a practical and useful tool for management of mixed-stock coastal fisheries in Norway and Russia. In 2010 the Working Group reported (ICES, 2010b) on a pilot project that expanded the baseline for a number of Russian rivers, and ongoing genetic analysis and assignment of samples from salmon caught in coastal fisheries in Norway. Power analysis of the genetic baseline developed indicated that with the baseline coverage, and number of genetic markers used, approximately 50% of the samples from coastal fisheries can be reliably assigned to river (probability >90%). A total of 1900 samples from adult salmon caught in coastal fisheries in 2008 in Finnmark county, northern Norway, were genetically analysed and assigned to defined geographical regions or rivers in the baseline (Svenning *et al*. 2011). The results demonstrated that the applied method can give reliable estimates of the proportion of Russian salmon in the catches as well as estimates of how salmon from different regions are exploited in the coastal fisheries (see Section 3.1.8).

However, it was also recognized that the spatial coverage of the baseline should be expanded, the number of genetic markers should be increased, and additional sampling should be conducted in a number of salmon rivers in Norway and Russia to improve the precision of the assignment of individuals. A further initiative to achieve this goal has been taken by Norway, the Russian Federation and Finland. In 2011 a new EU project "Trilateral cooperation on our common resource; the Atlantic salmon in the Barents region" (Kolarctic Salmon) was started. The project is supported by both EU-funding (Kolarctic ENPI CBC) and national funding from Norway, the Russian Federation and Finland.

In 2011 and 2012, the genetic baseline was expanded both in terms of spatial coverage and completeness, and it now contains genetic data from over 180 salmon populations in northern Norway, Finland and Russia. The number of genetic markers has been upgraded to 31 microsatellite loci. Over 17 000 samples were collected from coastal fisheries in northern Norway and Russia in 2011 and 2012, and analysis of these samples is now underway. Preliminary assignment of a subset of these samples has already provided valuable information on the composition of catches in time and space, and interesting patterns of coastal migration of different populations and sea age groups are beginning to emerge.

Moreover, the potential use of other genetic markers – single nucleotide polymorphisms (SNPs) – for genetic stock identification in Atlantic salmon was evaluated (Ozerov *et al*. 2013). This work demonstrates the possibility of cost-effective identification of dozens of informative SNPs (among thousands) for discrimination of populations at various geographical scales, as well as identification of loci controlling ecologically and economically important traits. Through the activities in this project, a foundation will be established on which a river-specific management regime for coastal and riverine fisheries for these northern populations can be implemented.

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) met for the first time in Belfast, UK (Northern Ireland), from the 18th to the 22nd of February 2013. The meeting was attended by 22 delegates from eleven countries. The ToRs were as follows:

1) Develop a classification system for recovery/re-building programmes for Atlantic salmon, including threats to populations, population status, life-history attributes, actions taken to re-build populations, program goals, and metrics for evaluating the success of re-building programmes.
2) Populate the system by collecting data on recovery/re-building programs for Atlantic salmon populations from around the North Atlantic.
3) Summarize the resulting dataset to determine the conditions under which various recovery/re-building actions are successful and when they are not.
4) Provide recommendations on appropriate recovery/rebuilding actions for Atlantic salmon given threats to populations, status and life history.

WGERAAS concluded that the most appropriate way to address the first and second TOR is to develop a database which lists threats to populations, population status, actions taken to rebuild populations, at river level. WGERAAS recommended this database be established through an update of the NASCO River Database by adding additional columns to this database. These columns will consist of: (1) 'population status' (this field already exists in the current version, but could usefully be updated), (2) ten columns of population 'stressors' or threats, and (3) ten columns of recovery actions. These columns will feature a drop-down menu with a limited choice of answers. For the 'stressors' columns for example, these answers will range from 'Very Strong' to 'Unknown'; the default (no information) will be to leave the field blank. WGERAAS recognized that these data would be best provided by regional or national experts. A guide on how to fill in this database (including examples) is being developed and will be provided to those people asked to populate the database with data. The data in the database will be used to provide a broad perspective of the scale of different stressors and recovery actions being applied around the North Atlantic. To address the third ToR these data will be analysed, and together with case-studies on the effectiveness of different recovery and restoration actions, discussed in the final report. From this discussion the conditions will be determined when recovery/rebuilding actions are successful, and when not. With this information the fourth ToR can be addressed i.e. producing recommendations on the appropriate recovery/rebuilding actions for Atlantic salmon populations. Therefore it was proposed that WGERAAS approach NASCO to allow the Group access to and utilize the existing NASCO rivers database.

In addition to the proposal outlined above, WGERAAS noted that a meta-analysis determining which factors influence the success of recovery and rebuilding actions for Atlantic salmon, could potentially prove informative in further evaluating the effectiveness of recovery actions and providing a broader perspective of the actions taken across the full range of the species. A more detailed questionnaire than the updated NASCO Database would be necessary for a high quality meta-analysis. Currently, WGERAAS sees no opportunity to conduct this meta-analysis within the group. A possible complementary initiative is currently being explored by several members of the WGERAAS group. A proposal has been submitted for an investigation supported by the EU entitled SALAWARE (Safeguarding our Atlantic Salmon Cultural Heritage–Europe's Oldest Natural Legacy). Such external funding could hopefully support a PhD or Post-Doc to conduct a more detailed analysis. WGERAAS is scheduled to meet again in January 2014 at ICES in Copenhagen. The Workshop on Wild Atlantic Salmon Recovery Programs (hosted by the Atlantic Salmon Federation) and scheduled for September 18th and 19th 2013 in St Andrews, New Brunswick, Canada, and a UK symposium on stocking (organized by the Atlantic Salmon Trust and The Loughs Agency and to be held in 27th and 28th November 2013 in Glasgow, Scotland) are also expected to inform WGERAAS deliberations. A final report is due before the 2014 meeting of WGNAS.

The Working Group on North Atlantic Salmon (WGNAS) welcomed the progress made by WGERAAS at its first meeting and noted that work to address the ToRs was at an early stage. WGNAS had some concerns that the time frame for WGERAAS to submit a final report might not be sufficient to gather all the data required to address the ToRs successfully. WGNAS suggests WGERAAS might want to consider an extra year to gather data and produce a final report. WGNAS also has some reservations regarding the database part of WGERAAS's chosen approach, specifically the scientific rigor of the method within and among contributors, potential issues with the quality and completeness of the answers, and how the data might be interpreted beyond the specific work of the WGERAAS. WGNAS suggests WGERAAS put more emphasis on developing the case-studies on recovery/restoration actions as a method for addressing the ToRs and in this regard offered to encourage the identification of case studies on recovery and restoration actions which may have occurred or are ongoing in their respective locations. The Working Group noted that NASCO has identified under its action plans that stock rebuilding programmes including habitat improvement, stock enhancement and fishery management actions should be considered for stocks which are below Conservation Limits (Section 1.4).

2.5 NASCO has asked ICES to advise on the potential threats to Atlantic salmon from exotic salmonids including rainbow trout and brown trout where appropriate

2.5.1 Introduction

The Working Group noted that salmonid species had been spread widely around the globe from their original native distributions. In particular, rainbow trout (*Oncorhynchus mykiss*) and different salmon species native to the Pacific have been introduced widely to other countries for use in aquaculture and in fisheries. Similarly, brown trout (*Salmo trutta*), native to Europe, have also been introduced widely to other countries, including North America. The extent to which these introduced species have established natural populations in new areas, or subsequently become invasive, has varied. However, concerns are often raised about the impact, or potential impact, which introduced species can have on native species and ecosystems. In considering this question on the potential threats from exotic salmonids, the Working Group noted that species translocated into waters where they previously didn't exist, but which fell within the biogeographical range of the species, might also pose a potential threat to established native populations, and thus be considered exotic.

The Working Group noted that the issue of threats to Atlantic salmon by introductions and transfers of salmonids had previously been reviewed by the NASCO North American Commission (NASCO, 1992) and that this included protocols for reducing the risk of ecological effects associated with such movements. The Working Group considered that the recommendations from this report remained valid.

2.5.2 Overview of current distribution of exotic salmonids

A broad overview of the current distribution and status of exotic salmonids in the main North Atlantic salmon producing countries is presented split into NEAC (Table 2.5.2.1a) and NAC (Table 2.5.2.1b) areas. Rainbow trout have been introduced throughout Europe and on the Atlantic coast of North America and are used extensively in both aquaculture and recreational fisheries. However, there are few records of the species establishing in NEAC areas. In contrast, Pacific pink salmon (*Oncorhynchus gorbuscha*) have been introduced and become established in Russia and parts of northern Norway. In the NAC area, brown trout introduced from Europe have become widely established and are spreading in many areas, and rainbow trout have also established in some areas. This section has focused largely on these three species; the other species referred to in the tables are not as widely distributed and only limited information was provided on these.

Rainbow trout

Rainbow trout, *Oncorhynchus mykiss,* have been introduced to Eastern Canada from the Northern Pacific Ocean for recreational fishing. Stocking in the upper Saint Lawrence started in 1893 and is still authorized in some of these upstream regions. However, an increasing prevalence of rainbow trout in Atlantic salmon Rivers in Eastern Québec, Canada, has been observed since 1980s, although stocking is strictly forbidden in these water systems.

Rainbow trout are now present in about fifty river systems in Eastern Quebec and evidence of reproduction was found on twelve of them, suggesting the presence of self-sustained populations. According to genetic analyses, these individuals would come from naturalised upstream populations following stocking conducted in the upper Saint-Lawrence in the provinces of Quebec, Ontario and in the United States (Thibault *et al.* 2009). Otolith Sr:Ca analyses also revealed that, although all fish captured in the upstream stocking regions were freshwater residents, both anadromous and freshwater resident phenotypes were observed downstream in Eastern Quebec (Thibault *et al.* 2010a). In fact, the proportion of fish exhibiting an anadromous phenotype increased with the distance from the stocking zone, suggesting that the development of the anadromous life cycle enables this species to colonize new rivers following long distance migration in the Saint Lawrence Estuary (Thibault *et al.* 2010a).

According to a modelling analysis on the physical characteristics of the colonized river systems, the presence of rainbow trout is associated with the number of tributaries, warm spring and summer temperature, and negatively related to peak flood during egg deposition in May (Thibault *et al.* 2010b). The spreading of rainbow trout is a subject of concern for the Quebec government because it represents a strong competitor and predator, which can affect indigenous species in a water system (e.g. Coghlan Jr *et al.* 2007). In this context, the Ministère du Développement Durable, de l'Environnement, de la Faune et des Parcs (MDDEFP) of Quebec developed an Action Plan to improve knowledge, revise stocking practices, increase total catch, limit propagation, and inform and educate citizens concerning the status of rainbow trout in the province. This Action Plan is currently in press and should be published at the end of 2013.

Rainbow trout are not widely established in NEAC countries (Table 2.5.2.1.a). For example, there is currently thought to be only one small self-sustaining population in England despite widespread use of the species in aquaculture and in recreational (put-and-take) fisheries dating back for more than one hundred and fifty years. A recent review of the risk of invasion of rainbow trout in the UK (Fausch, 2007) has indicated that the species has generally failed to establish. The primary abiotic factors (e.g. temperature and flow) that commonly influence the success of many stream fishes are not thought to have been limiting. Rather, the factors considered most likely to be constraining establishment in the UK, alone or in combination, are: biotic resistance from native salmonids, parasites and diseases, and angling mortality. However, an important consideration in assessing potential threats to Atlantic salmon from exotic salmonids is that these can change over time. Thus, Fausch (2007) cautions that the current lack of establishment of rainbow trout does not equate to the absence of risk. The situation could change in future as a result of factors such as: climate change; other changes in environmental conditions; introductions of new strains of rainbow trout; declines in native salmonids; or other anthropogenic changes to river environments.

Pink salmon

Pink salmon have the shortest life cycle among species of the genus *Oncorhynchus*, as they mature and reproduce after only two years. Therefore, there are two reproductively isolated populations spawning in alternate even and odd years (Heard, 1991).

In Russia, pink salmon were introduced to the White Sea basin in the 1950s with annual egg transfers from the Far East of Russia into hatcheries of Murmansk and Archangelsk regions (Gordeeva and Salmenkova, 2011). Despite over 20 years of introductions no consistent natural reproduction occurred and they disappeared when the introduction stopped in 1979. This failure was attributed to use of populations from the southern part of the native range. As time of spawning migration and spawning time are strictly fixed in salmonids, the introduced ''southern'' pink salmon began to spawn too late and eggs were lost as water temperatures in Autumn were colder than in their native habitat especially in even-year generations (Dyagilev and Markevich, 1979). Therefore successful natural reproduction took place only during some years of the North Atlantic warming (Karpevich *et al.* 1991).

The introduction of odd-year pink salmon to the White Sea basin was undertaken in 1985, when a new broodstock population was selected from the northern part of the species range (Okhotsk Sea basin, Loenko *et al*. 2000). This single pink salmon egg transfer from an odd-year population resulted in the establishment of local self-reproducing populations in the White sea rivers of Murmansk and Archangelsk regions of Russia with the adult returns fluctuating between 60 000 to 700 000 fish during the period 1989 through 2009 (Zubchenko *et al*. 2004; Gordeeva *et al*. 2005). Pink salmon introduced to Russia since 1930s have resulted in catches in Norwegian waters (up to 20 t in some years). The species has also now established in eleven rivers in N. Norway (Finnmark); Hesthagen and Sandlund (2007). The commercial fishery for pink salmon takes place in the coastal areas of the White Sea and with the same gears and in the same season as Atlantic salmon fisheries. The total declared pink salmon catch in 2009 was 139 t, twice as much as a declared Atlantic salmon catch (ICES, 2010).

At the same time, transfers of even-year-broodlines from the same river of the Okhotsk Sea basin were unsuccessful despite the large number of eggs that were transferred and the favourable rearing conditions at hatcheries. The last egg transfer of 1998 resulted in comparatively large return in the first generation, but the abundance of pink salmon declined subsequent generations and after that they appeared only in small numbers in even years. No commercial fishery for pink salmon is conducted in the White Sea in even years.

Brown trout

Brown trout are established in rivers in Newfoundland and Nova Scotia (2.5.1). Westley and Fleming (2011) looked at landscape factors that shaped the spread of brown trout in Newfoundland. Brown trout embryos were first shipped to Newfoundland from Scotland in 1883 and further importations continued until around 1906. The imported trout survived well and established populations in the watersheds surrounding St John's. It is believed that the trout escaped into watersheds with easy access to the sea around 1884 which provided a source of anadromous colonizers. Westley and Fleming (2011) concluded that brown trout had successfully invaded and established populations in watersheds in Newfoundland and that they were slowly expanding on the island. They also suggested that abiotic factors alone were not sufficient to prevent continued expansion and all watersheds in Newfoundland were potentially susceptible to successful invasion. Current distribution is estimated at 68 watersheds on the Avalon, Burin, and Bonavista peninsulas compared to 16 watersheds on the Avalon Peninsula in 1883. Westley *et al.* (2011) concluded that the mechanisms determining invasion success and failure remained largely unknown but that the outcome of interspecific competitive interactions was highly context specific, varying among habitats, continents, and scales of investigation.

Few studies on the ecological impact of brown trout on native salmonids have been carried out in Canada. However impacts are believed to include competition and displacement of native fish (Gibson and Cunjak, 1986; Van Zyll de Jong *et al*., 2004) and hybridization with Atlantic salmon (Verspoor, 1988; McGowan and Davidson, 1992).

2.5.3 Potential threats posed by exotic salmonids

Non-native and translocated species can pose threats to native species and ecosystems in a number of ways. These include predation, competition, hybridization, and introduction of novel diseases and parasites. The main effect of these interactions is often a general displacement or replacement of native salmonids over time. The Working Group noted that information presented on the effects of exotic salmonids derived from a small number of country specific reports and are largely based on incidental findings and observations rather than directed studies. Westley *et al*. (2011) produced a review and annotated bibliography of the impacts of invasive brown trout (*Salmo trutta)* on native salmonids, with an emphasis on Newfoundland waters.

Parasites and diseases

Exotic salmonids have the potential to transfer novel parasites or diseases to native Atlantic salmon populations. Rainbow trout have a high susceptibility to salmon lice (*Lepeophtheirus salmonis)* and where they co-occur also host parasites such as *Gyrodactylus salaris*.

The monogean *G. salaris* is a freshwater ecto-parasite of Atlantic salmon whose natural hosts are Baltic strains of Atlantic salmon. *G. salaris* was not found to cause host mortality on rainbow trout in Norway, but this species is a suitable host for the parasite, and capable of transmitting the parasite to new localities as a consequence of stocking programmes or migratory behaviour (Bakke *et al*. 1991). At present, *G. salaris* has been eliminated from all infected rainbow trout fish farms in Norway, and all farms producing rainbow trout in freshwater are inspected every two years for the occurrence of this parasite (Anon. 2011).

Rainbow trout may also disperse *G. salaris* between rivers through brackish water. Soleng and Bakke (1997) found *G. salaris* to survive and reproduce in 7.5‰ salinity for as long as 54 days at 12°C. Few studies have examined the behaviour and spread of escaped farmed rainbow trout at sea, but they generally conclude that they disperse relatively slowly, and they prefer the warmer freshwater surface layer (Skilbrei, 2012). Jonsson *et al*. (1993b) concluded that rainbow trout were usually recaptured in the fjord area where they were released/escaped, and Skilbrei and Wennevik (2006) observed that the geographical distribution of gillnet recaptures of escaped rainbow trout agreed well with the localization of the fish farms and with escape events. Hence, this behaviour of rainbow trout in the fjord areas increases the risk for spread of *G. salaris* between rivers.

Rainbow trout have a high susceptibility to salmon lice (Fast *et al.,* 2002; Gjerde and Saltkjelvik, 2009), and farming and escapees of rainbow trout may hence contribute to high infection rates of sea lice on wild salmonids. Holst (2004) observed a mean of 4.4 adult female sea lice on 115 rainbow trout captured with gillnets in late April/early May 1999 in the Osterøy Fjord System, Norway. Considering that escaped farmed rainbow trout disperse relatively slowly, and hence occupy the same coastal area for long periods, these high infection rates suggest that they may contribute significantly to the production of sea lice larvae in the area from which they have escaped (Skilbrei and Wennevik, 2006). This risk is especially high for Atlantic salmon in areas where farms are located at smolt migration routes (Krkosek *et al.*, 2009).

So far, no infections of other parasites or diseases have been reported in wild rainbow trout in Norway (Anon., 2011), although serious outbreaks of diseases like pancreas disease have been diagnosed in seawater fish farms (Taksdal *et al.*, 2007; Kristoffersen *et al.*, 2009).

Rainbow trout are suspected to be a host for *G. salaris* and in this regard future production of rainbow trout in aquaculture installations is of potential concern (Dagerman *et al.*, 2012).

Destruction of redds

Atlantic salmon spawn in autumn and the most common strains of rainbow trout spawn during spring. Thus, where rainbow trout do exhibit a degree of spawning behaviour, they may dig up and destroy salmon redds before the salmon fry emerge from the gravel. In Norway, rainbow trout have been filmed digging up redds of Atlantic salmon and/or brown trout (Anon. 2011). In Sweden, digging up of redds of brown trout by introduced rainbow trout has been considered a threat to brown trout populations (Landergren, 1999). In New Zealand, where rainbow trout populations have established, this behaviour has been an important mechanism in completely displacing brown trout populations (Hayes, 1987; Scott and Irvine, 2000).

Pink salmon migrate a shorter distance up rivers to spawn than most other salmonids (Heard 1991); in addition, spawning in pink salmon seems to be terminated before the spawning of Atlantic salmon starts. As such, there does not appear to be any evidence of interactions with Atlantic salmon at the spawning grounds, such as competition for spawning sites or destruction of redds.

Rainbow trout strains in North America may spawn in both spring and autumn so they may pose a higher risk to Atlantic salmon. While it is suggested that brown trout spawn prior to Atlantic salmon, redd superimposition is likely given that these species prefer similar spawning habitats (Heggberget *et al*., 1988; Louhi *et al*., 2008).

Competition for territory, area and resources

Rainbow trout are considered to be generalist feeders, consuming a variety of food organisms. It has the potential to have a negative influence on habitat use and nutrient availability of native fish species (Elliott, 1973; Crowl, Townsend and Macintosh, 1992; Hasegawa and Maekawa, 2006). Therefore, in localities where rainbow trout establish self-sustaining populations, competition between rainbow trout and Atlantic salmon for habitats and food is possible.

Pink salmon fry migrate to sea in early summer, shortly after emerging from the gravel. Due to their rapid exodus from streams at emergence, pink salmon fry feed less in freshwater than other Pacific salmon. Hence, any competition for food between pink salmon and Atlantic salmon may take place during a short period in early summer, only.

In North America, interactions between brown trout and Atlantic salmon are thought to be highest during the first year of life when density-dependent processes are most intense (Milner *et al*. 2003).

In Russia, the White Sea rivers have two distinct runs of Atlantic salmon. The summer run salmon ascend the river in June–July and spawn in autumn the same year. Autumn run fish start their migration in early August and continue entering the river until it freezes. They do not spawn in the year they arrive. Autumn run salmon overwinter and stay in the rivers until they spawn in autumn the following year. Summer running fish are less numerous than autumn run fish. Pink salmon also enter the White Sea rivers in July and spawn in August whereas Atlantic salmon spawn in September and October. Typically pink salmon prefer shallower areas and do not compete with Atlantic salmon for territory in big rivers but this competition can occur in small rivers and in tributaries of big river systems when pink salmon enter streams in large numbers and aggressively push overwintered autumn run Atlantic salmon out of holding pools to non-typical habitats (Zubchenko *et al.* 2004).

In Canada, displacement, decreases in abundance and local extinction of other species has been observed following introduction of rainbow trout in a new ecosystem.

Predation

Rainbow trout are an effective predator on fish, and several studies have demonstrated that rainbow trout have impacted local fish populations (Crowl *et al.*, 1992; Behnke, 2002; Fausch, 2008). Hence, it is possible that rainbow trout may feed on Atlantic salmon eggs, fry and parr when they are present.

Adult pink salmon do not feed after entering freshwater (Heard, 1991), and hence, predation on Atlantic salmon fry and parr is not expected to occur.

Hybridization

Hybridization rates between Atlantic salmon and brown trout are higher where one of the species is exotic than where both are native (Verspoor and Hammar, 1991; Allendorf *et al*., 2001). Factors influencing hybridization between Atlantic salmon and brown trout are poorly understood. However, hybrids are known to be viable (Day, 1884; Nygren *et al*., 1975; Hindar *et al.*, 1997; Castillo *et al.*, 2007). In North America, hybridization generally involves brown trout females (McGown and Davidson, 1992; Gephard *et al*., 2000) and mature male Atlantic salmon parr (Gephard *et al.*, 2000; GarciaVazquez *et al.*, 2001).

Hybridization between Atlantic salmon and rainbow trout is unlikely given that the species are from distinct genera and often have discrete spawning seasons.

The following table provides a general summary of potential threats to Atlantic salmon, and the relative likelihood of risk, from the presence of rainbow trout, pink salmon and brown trout where these occur as exotics:

Potential threat	From rainbow trout (outside their native range)	From pink salmon (outside their native range)	From brown trout (outside their native range)
Spread of parasites	Very likely	Not evidenced	Not evidenced
Spread of diseases	Likely	Not evidenced	Not evidenced
Destruction of redds	Evidenced	Unlikely	Unlikley
Competition for resources and areas	Likely	Likely, but for short periods	Likely
Predation	Likely	Unlikely	Likely
Hydridisation	Unlikely	Unlikely	Unlikely

2.6 Reports from ICES 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 the coordination of work on diadromous species. The role of the Group is to coordinate work on diadromous species, organize Expert Groups, Theme Sessions and Symposia, and help to deliver the ICES Science Plan.

WGRECORDS held an informal meeting on 6th June 2012, during the NASCO Annual Meeting in Edinburgh, UK Scotland. Discussions were held on the requirements for Expert Groups to address new and ongoing issues on Atlantic salmon including issues arising from the NASCO Annual Meeting. The annual meeting of WGRECORDS was held on the 19th and 20th September 2012, during the ICES Annual Science Conference in Bergen, Norway. The meetings were chaired by Niall Ó Maoiléidigh (Ireland) and Atso Romakkaniemi (Finland) and attended by ten participants from eight countries.

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 three four 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.

- Workshop on Age Determination in Salmon (WKADS)-Section 2.6.2;
- Workshop on Data Collection Framework for Eels and Salmon (WKDCEF)-Section 2.7.2;
- Workshop on Historical Tag Recovery Data (WKSTAR)-Section 2.6.3;
- Working Group on the Effectiveness of Recovery Actions for Atlantic Salmon (WGERAAS)-Section 2.4.

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 future theme sessions at the ICES ASC e.g.:

- Implication of climate change for diadromous and migratory species over broad geographic scales;
- Parasites and diseases in a changing environment;
- Drug resistance in fish parasites and diseases;
- Changes in distribution of fish in response to climate change;
- Long-term planning to respond to effects of climate change on diadromous fish stocks;
- Climate change processes and predictions of impacts on salmon and eels;
- Carrying capacity and ecosystem interactions associated with mariculture.

2.6.2 WKADS 2

A second Workshop on Age Determination of Salmon (WKADS 2) took place from September 4th to 6th, 2012 in Derry, Londonderry, UK (Northern Ireland). Attended by 12 people from six countries, representing nine laboratories, the meeting addressed recommendations made at the previous WKADS meeting (ICES, 2011a) 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 inter-laboratory QC were considered.

Information on scale reading errors and inaccuracies was presented, including:

- possible scale deformation from jewellers press;
- differences in circuli number and spacings, on scales from different locations on smolts;
- measurements of smolt and adult scales made by different scale readers;
- measurements of adult scales made by the same scale reader.

The image collection gathered during WKADS was augmented by addition of scale images showing complexities in their growth, including scales with growth checks and repeat spawners. Available material detailing scale preparation, reading (microfiche, microscope and digital reading) and storage was reviewed and itemized, detailing the best practice pertinent to Atlantic salmon in one place.

Recommendations arising from the workshop were endorsed by WGNAS i.e.:

- An inter-lab calibration exercise should be held remotely in the next two to four years.
- Reference scale images and accompanying details should be hosted on ICES age readers forum website supported by the ICES PGCCDBS.
- The importance of the initial positioning of the line on a scale along which measurement are made, should be emphasized to all readers.

The Working Group recognize that there is still scope for further work comparing scale readings from different locations on salmon.

2.6.3 WKSTAR

The Workshop on Salmon Tagging Archive (WKSTAR) worked by correspondence in 2010/2011 and met at ICES Headquarters, Copenhagen, Denmark, 19–21 June 2012. The purpose of the Workshop was to ensure that the data compiled by the previous Workshops (ICES, 2007a; ICES, 2008b and 2009b) was fully archived and documented. These reports have resulted in recent peer reviewed publications in the ICES Journal of Marine Science in November 2012 (Reddin *et al*., 2012; Jacobsen *et al*., 2012) and presentation of results at the NASCO/ICES Salmon Symposium held in La Rochelle, France in October 2011. A resolution to ICES to record a summary of the workshops, presentations and publications in a Cooperative Research Report was accepted by ICES and the Workshop has developed an outline of the CRR.

The Workshop also undertook further checking and tidying of the tag recovery databases for Faroes and Greenland to identify and correct and resolve various anomalies in the datasets. Both Greenland and Faroes databases were updated, but it was noted that there were some gaps in the database. It was agreed that key scientists should be asked to consult with the "data owners" in the actual countries to give permission to include the data in the ICES database. This was organized by the chair of the WKSTAR and all data holders granted permission to develop the database.

The Working Group noted that the contact list would require updating upon completion of the database.

2.7 NASCO has asked ICES to provide a compilation of tag releases by country in 2012

2.7.1 Compilation of tag releases and fin clip data by ICES Member Countries in 2012

Data on releases of tagged, finclipped and otherwise marked salmon in 2012 were provided to the Working Group and are compiled as a separate report (ICES, 2013). In summary (Table 2.7.1.1), about 3.69 million salmon were marked in 2012, a decrease from the 4,18 million fish marked in 2011. The adipose clip was the most commonly used primary mark (3.145 million), with coded wire microtags (0.486 million) the next most common primary mark and 45 582 fish were marked with external tags. Most marks were applied to hatchery origin juveniles (3.620 million), while 58 465 wild juveniles and 6800 adults were also marked. In 2012, 15 126 PIT tagged salmon, Data Storage Tags (DSTs), radio and/or sonic transmitting tags (pingers) were also used (Table 2.7.1.1).

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, coded wire tags have been applied to about 5–10% of sea cage farm production in certain areas. The use of genetic marked salmon will from 2012 gradually replace microtagged fish in aquaculture in Iceland. In USA, the industry has opted for a genetic "marking" procedure. 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 and its farm site 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 marine research

NASCO has asked ICES to identify relevant data deficiencies, monitoring needs and research requirements. In considering this question, the Working Group discussed the report of the NASCO Subgroup on the Future Direction of Research on Marine Survival of Salmon which met in London in December, 2012. This subgroup was convened by the International Atlantic Salmon Research Board to evaluate recent scientific progress in studies of marine mortality of salmon and to provide guidance on how the Board's Scientific Advisory Group can remain an effective and productive group in future.

The subgroup reviewed the findings of recent scientific investigations into the causes of increased mortality at sea and the implications of these findings for management. It noted that genetic stock identification and other advances in the field of genetics, migration modelling, tracking and studies of the diet of salmon at sea developed under the SALSEA programme all have considerable implications for salmon management. The subgroup also reviewed the Board's inventory of research and identified opportunities for enhanced collaboration, gaps in the research programme and future research needs to support management. It considered that analysing the remaining samples and data arising from the SALSEA-Merge, SALSEA West Greenland and SALSEA North America programmes should be a priority.

The subgroup also proposed that a particular focus for the IASRB should be studies to partition marine mortality of salmon among the phases of the marine migration, and it recommended that the IASRB should consider facilitating a meeting of scientists and external partners to further develop a collaborative international programme of research in this area. The subgroup also developed an outline proposal for acoustically tagging emigrating smolts and tracking their movements with detector arrays, and other novel detector systems, noting that analytical techniques were now being applied to such data collected in North America to partition the mortality during the early stages of the marine phase.

The Working Group considered these recommendations alongside their own evaluation of current research needs. They endorsed the view of the subgroup that analysis of outstanding samples during the marine surveys under the SALSEA programme should be a priority and that mechanisms should be sought to obtain funding to support this.

The Working Group reviewed the proposal outlining a collaborative international programme of research on marine mortality of salmon provided by the subgroup. The outline described a project to estimate stage-specific mortality rates of marine salmon by using acoustic technologies to monitor migrating Atlantic salmon. The project would build on the existing infrastructure and historical datasets from index rivers in NAC and NEAC areas, would apply knowledge gained from SALSEA activities on timing and migration corridors of post-smolts in southern NEAC and from advances in acoustic tracking technologies (Whoriskey, 2011; Lacroix, 2013), and would benefit from academic, industry and government partnerships. Emigrating smolts released from specific index rivers throughout the NAC and NEAC regions would be tagged with acoustic tags and tagged smolts would be tracked throughout the river, estuary and marine environments via strategically placed ultrasonic telemetry receiver arrays at identified choke points along the nearshore migration paths of post-smolts and at locations associated with other marine research and monitoring activities (e.g. buoy deployments for oceanographic monitoring, research survey cruises, wave gliders, etc.). Estimates of survival probabilities could be obtained by applying a variety of statistical methods and models to the resulting data (see Section 2.3.4.3).

The Working Group endorsed the proposed project outline. It was noted that this type of acoustic monitoring of marine phase salmon is currently underway in NAC. Large numbers of smolts are being tagged and their migration is being monitored via ultrasonic receiver arrays hundreds of kilometres into the marine environment in Canada (see Section 2.3.4.2) and US (ICES, 2012a).

The Working Group recommends that the IASRB support the further development of the project outlined by the NASCO Subgroup on the Future Direction of Research on Marine Survival of Salmon. A large international coordinated project monitoring the marine migration of many salmon stocks across the North Atlantic may provide stage-specific estimates of marine survival that would increase knowledge of marine ecology and better inform management. Stage-specific marine mortality estimates would help improve essential inputs in stock assessment models and would provide additional information for testing hypotheses on the causal mechanisms for the increase in marine mortality documented for most stocks across the North Atlantic in recent decades. These results would also be of benefits for managers trying to identify areas where action might be taken to mitigate current impacts. Detailed information on migration dynamics of salmon in nearshore waters will also aid managers involved in marine spatial planning to evaluate the impacts of alternative/renewable energy projects (e.g. wind energy, tidal energy, etc.) in marine waters.

The Working Group encourages the IASRB to consider expanding the focus of this research project beyond the scope of salmon. Integrating the research needs across different species would increase the benefit of an effort like this and increase the likelihood of successfully competing for funding support. The Working Group also encourages the IASRB to consider the wide variety of resources and experiences available for an endeavour such as this. Large-scale multinational tracking programmes are already underway in NAC and the experience gained from these efforts would increase the likelihood of success for any effort initiated in NEAC. It was noted that many tracking projects have previously been conducted in Norway and UK (Scotland) (for examples see Middlemas *et al.*, 2009; Thorstad *et al.*, 2012a; Thorstad *et al.*, 2012b; Davidsen *et al.*, 2013) although a large international collaborative effort has not been conducted to date.

The Working Group recognizes that consideration for ultrasonically tagging and releasing non-maturing salmon captured at Greenland. A significant ultrasonic array exists with the NAC area. Considering that the North American contribution to the Greenland harvest has averaged 80% since 2003 (Table 5.1.2.1), there is a high likelihood that any tagged salmon would be of NAC origin (with the potential for determining river of origin via genetic analysis) and may be detected during their return migration to their natal river depending on where they are migrating to and the mortality experienced from tagging to homewater. Tagging effort could be combined with future sampling satellite tagging efforts if undertaken (see Section 2.3.4.1). Information on survival during the second winter at sea may help improve essential inputs in stock assessment models and would provide additional information for testing hypotheses on the causal mechanisms for the increase in marine mortality documented for most stocks across the North Atlantic in recent decades.

The Working Group noted that the NASCO subgroup had advised that the SAG is the only body within NASCO that identifies research needs and addresses scientific coordination. It concluded that it is the most appropriate and effective forum in which to perform this important role. The Working Group endorsed this view, noting that the SAG provided an essential mechanism for scientists to collaboratively work with managers to develop scientific programmes to support the conservation, protection and enhancement of salmon stocks.

2.8.2 Workshop on Eel and Salmon Data Collection Framework (WKESDCF)

PGCCDS: The Workshop on Eel and Salmon Data Collection Framework met in Copenhagen in July 2012, under the co-chairmanship of Ted Potter (UK) and Alan Walker (UK) and was attended by 23 experts in eel and salmon assessment and management, representing nine EU Member States. Changes to the EU Data Collection Framework Data Collection - Multi-Annual Programme (DCF) in 2007 introduced requirements 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. The EC (DGMare) has indicated that they intend to simplify the rules and formats within DC-MAP and increase the flexibility for data collection programmes. Thus many of the details of the data collection programmes will be agreed by Regional Coordination Groups (RCG). There will be also greater focus on the needs of end-users (e.g. ICES) who will be asked to provide feedback on the quality of data provided for assessment purposes. The proposed development of the new Data Collection - Multi-Annual Programme (DC-MAP) in 2013–2014 provides the opportunity to coordinate and improve the collection of data used in assessments for these species.

The key tasks of the workshop were to:

- Determine the data required to support international obligations for the assessment of eel and salmon;
- Describe the national monitoring and survey programmes required to meet these data requirements; and
- Consider options for integrating salmon and eel surveys and monitoring.

For each species/area, the Workshop considered: the national/international management objectives; the assessments undertaken to support these objectives; the data required to undertake the assessments; and proposed changes to the DC-MAP to provide these data. The existing DCF also requires the collection of data on economics and aquaculture; these data are important in the management of diadromous species, but the workshop did not contain the expertise necessary to consider these elements in detail.

Eel and salmon differ markedly from marine species in their biology, the nature and distribution of their fisheries, and the methods used to assess stock status and provide management advice. As a result, the data collection requirements do not fit well into the 'standard' approaches used for marine species. In particular, much of the assessment of both species is conducted at a local and national level even when the results contribute to international assessments (e.g. development of Conservation Limits for salmon river stocks). These approaches may differ depending upon a range of factors including the practicalities of collecting particular data.

The Workshop made detailed recommendations for several tiers of data collection. Some data (e.g. catches) are required for all stock components and are of little value if they are not collected in a consistent way for all stocks/fisheries. The collection of other data may depend on local requirements and constraints, for example to support the local development of river-specific conservation limits. The Working Group endorsed the proposals for data collection on Atlantic salmon proposed by the workshop. The workshop report has also been considered by the EU Scientific, Technical and Economic Committee for Fisheries (STECF) as part of the review of the DC-MAP proposals. STECF endorsed the recommendation that DC-MAP should include the requirement to collect salmon data needed for stock assessment purposes and that, if possible, this should include data collected in inland waters including from recreational fisheries. However, they noted that the WKESDFC recommendations were too detailed to be included in the DC-MAP in full because the intention was to keep the DC-MAP simple and flexible. STECF therefore proposed that the details of the data collection for salmon, including the choice of index rivers and variables, should be agreed by appropriate RCGs. The Working Group were concerned that if these decisions were made by different RCGs for different regions, it would inevitably result in differences in the data collection procedures which may cause problems for subsequent assessment work. The Working Group therefore recommended the establishment of an RCG for diadromous species to consider the unified collection of data on all salmon stocks (as well as eel).

DGMare has also provided feedback on the workshop report, indicating that they found Table 4.2.3.1 of the WKESDCF report, which provides an overview of the compatibility of data collected under the DCF with the data needed for the assessment of Baltic salmon by ICES, particularly helpful. Following a request from ICES a table containing an overview of the compatibility of data currently collected under the DCF with the data available, reviewed, and needed for the annual assessment of North Atlantic salmon by ICES was compiled (Table 2.8.2.1).

The Workshop also identified a number of areas where coordinated data collection might offer opportunities for increased cost-effectiveness in some circumstances, including: electric fishing surveys; trapping programmes; operation of automatic counters; and habitat surveys.

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 WG reports and are intended to provide a complete description of the methodology used in conducting stock assessments and the provision of catch advice. These documents are intended to be informative for members of the WG and reviewers as well as aid communication with the general public. The Working Group noted that the Baltic Salmon Working Group (WGBAST) had developed such an annex as part of their recent Inter-Benchmark Protocol exercise (ICES, 2012b).

The Working Group agreed that the development of a specific Atlantic salmon stock annex would be helpful and to take forward this initiative. Initial progress was made in completing a first draft, largely by compiling information contained in earlier WGNAS reports and other sources. However, the Working Group had insufficient time to complete the task during the 2013 meeting. It further noted that aspects of the annex would require country-specific inputs. To develop these, the Working Group recommended that an Atlantic salmon stock annex should be developed using an agreed template and that country specific inputs should be prepared for the 2014 meeting with a view to finalizing the document at that time.

Table 2.1.1.1. Reported total nominal catch of salmon by country (in tonnes round fresh weight), 1960–2012. (2012 figures include provisional data).

	NAC Area			NEAC (N. Area)							NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
Year	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden (West)	Denmark	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1960	1,636	1	-	1,659	1,100	100	-	40	-	-	743	283	139	1,443	-	33	-	-	60	-	7,237	-	-
1961	1,583	1	-	1,533	790	127	-	27	-	-	707	232	132	1,185	-	20	-	-	127	-	6,464	-	-
1962	1,719	1	-	1,935	710	125	-	45	-	-	1,459	318	356	1,738	-	23	-	-	244	-	8,673	-	-
1963	1,861	1	-	1,786	480	145	-	23	-	-	1,458	325	306	1,725	-	28	-	-	466	-	8,604	-	-
1964	2,069	1	-	2,147	590	135	-	36	-	-	1,617	307	377	1,907	-	34	-	-	1,539	-	10,759	-	-
1965	2,116	1	-	2,000	590	133	-	40	-	-	1,457	320	281	1,593	-	42	-	-	861	-	9,434	-	-
1966	2,369	1	-	1,791	570	104	2	36	-	-	1,238	387	287	1,595	-	42	-	-	1,370	-	9,792	-	-
1967	2,863	1	-	1,980	883	144	2	25	-	-	1,463	420	449	2,117	-	43	-	-	1,601	-	11,991	-	-
1968	2,111	1	-	1,514	827	161	1	20	-	-	1,413	282	312	1,578	-	38	5	-	1,127	403	9,793	-	-
1969	2,202	1	-	1,383	360	131	2	22	-	-	1,730	377	267	1,955	-	54	7	-	2,210	893	11,594	-	-
1970	2,323	1	-	1,171	448	182	13	20	-	-	1,787	527	297	1,392	-	45	12	-	2,146	922	11,286	-	-
1971	1,992	1	-	1,207	417	196	8	18	-	-	1,639	426	234	1,421	-	16	-	-	2,689	471	10,735	-	-
1972	1,759	1	-	1,578	462	245	5	18	-	32	1,804	442	210	1,727	34	40	9	-	2,113	486	10,965	-	-
1973	2,434	3	-	1,726	772	148	8	23	-	50	1,930	450	182	2,006	12	24	28	-	2,341	533	12,670	-	-
1974	2,539	1	-	1,633	709	215	10	32	-	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	-	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	-	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	10	-	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	-	37	1,230	349	148	1,323	20	32	37	8	984	138	7,682	-	-
1979	1,287	3	-	1,831	455	219	6	12	-	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	17	-	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	26	-	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	25	-	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	28	-	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	40	-	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	45	-	49	1,595	361	98	913	22	13	566	7	864	-	8,108	-	-
1986	1,559	2	3	1,598	608	232	59	54	-	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	47	-	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	40	-	36	1,874	395	114	882	32	18	243	4	893	-	7,737	3,248	-
1989	1,139	2	2	905	364	141	136	29	-	52	1,079	296	142	895	14	7	364	-	337	-	5,904	2,277	-
1990	911	2	2	930	313	141	285	33	13	60	567	338	94	624	15	7	315	-	274	-	4,925	1,890	180-350

Table 2.1.1.1. Continued.

Year	NAC Area: Canada (1)	NAC Area: USA	NAC Area: St. P&M	NEAC (N. Area): Norway (2)	NEAC (N. Area): Russia (3)	NEAC (N. Area): Iceland Wild	NEAC (N. Area): Iceland Ranch (4)	NEAC (N. Area): Sweden (West)	NEAC (N. Area): Denmark	NEAC (N. Area): Finland	NEAC (S. Area): Ireland (5,6)	NEAC (S. Area): UK (E & W)	NEAC (S. Area): UK (N.Irl.) (6,7)	NEAC (S. Area): UK (Scotl.)	NEAC (S. Area): France (8)	NEAC (S. Area): Spain (9)	Faroes & Greenland: Faroes (10)	Faroes & Greenland: East Grld.	Faroes & Greenland: West Grld. (11)	Faroes & Greenland: Other (12)	Total Reported Nominal Catch	Unreported catches: NASCO Areas (13)	Unreported catches: International waters (14)
1991	711	1	1	876	215	129	346	38	3	70	404	200	55	462	13	11	95	4	472	-	4,106	1,682	25-100
1992	522	1	2	867	167	174	462	49	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	56	9	70	541	248	83	547	16	8	23	-	-	-	3,696	1,644	25-100
1994	355	0	3	996	141	136	313	44	6	49	804	324	91	649	18	10	6	-	-	-	3,945	1,276	25-100
1995	260	0	1	839	128	146	303	37	3	48	790	295	83	588	10	9	5	2	83	-	3,629	1,060	-
1996	292	0	2	787	131	118	243	33	2	44	685	183	77	427	13	7	-	0	92	-	3,136	1,123	-
1997	229	0	2	630	111	97	59	19	1	45	570	142	93	296	8	4	-	1	58	-	2,364	827	-
1998	157	0	2	740	131	119	46	15	1	48	624	123	78	283	8	4	6	0	11	-	2,395	1,210	-
1999	152	0	2	811	103	111	35	16	1	62	515	150	53	199	11	6	0	0	19	-	2,247	1,032	-
2000	153	0	2	1,176	124	73	11	33	5	95	621	219	78	274	11	7	8	0	21	-	2,912	1,269	-
2001	148	0	2	1,267	114	74	14	33	6	126	730	184	53	251	11	13	0	0	43	-	3,069	1,180	-
2002	148	0	2	1,019	118	90	7	28	5	93	682	161	81	191	11	9	0	0	9	-	2,654	1,039	-
2003	141	0	3	1,071	107	99	11	25	4	78	551	89	56	192	13	9	0	0	9	-	2,457	847	-
2004	161	0	3	784	82	111	18	20	4	39	489	111	48	245	19	7	0	0	15	-	2,157	686	-
2005	139	0	3	888	82	129	21	15	8	47	422	97	52	215	11	13	0	0	15	-	2,156	700	-
2006	137	0	3	932	91	93	17	14	2	67	326	80	29	192	13	11	0	0	22	-	2,029	670	-
2007	112	0	2	767	63	93	36	16	3	58	85	67	30	171	11	9	0	0	25	-	1,548	475	-
2008	158	0	4	807	73	132	69	18	9	71	89	64	21	161	12	9	0	0	26	-	1,721	443	-
2009	126	0	3	595	71	126	44	17	8	36	68	54	17	121	4	2	0	0	26	-	1,318	327	-
2010	153	0	3	642	88	147	42	22	13	49	99	109	12	180	10	2	0	0	40	-	1,610	367	-
2011	179	0	4	696	89	98	30	39	13	44	87	136	10	159	11	7	0	0	28	-	1,629	421	-
2012	135	0	1	696	82	53	12	30	2	64	88	57	9	130	10	8	0	0	33	-	1,409	403	-
Average																							
2007-2011	146	0	3	701	77	119	44	22	9	52	85	86	18	158	9	6	0	0	29	-	1,565	407	-
2002-2011	145	0	3	820	86	112	29	21	7	58	290	97	36	183	11	8	0	0	22	-	1,928	598	-

Key:

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

Table 2.1.1.2. Reported total nominal catch of salmon in home waters by country (in tonnes round fresh weight), 1960–2012. (2012 figures include provisional data). S = Salmon (2SW or MSW fish). G = Grilse (1SW fish). Sm = small. Lg = large; T = S + G or Lg + Sm.

Year	NAC Area				NEAC (N. Area)											NEAC (S. Area)										
	Canada (1)			USA	Norway (2)			Russia (3)	Iceland Wild	Iceland Ranch	Sweden (West)	Denmark	Finland			Ireland (4,5)			UK (E&W)	UK(N.I.) (4,6)	UK(Scotland)			France	Spain	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	-	-	-	-	-	-	743	283	139	971	472	1,443	-	33	7,177
1961	-	-	1,583	1	-	-	1,533	790	127	-	27	-	-	-	-	-	-	707	232	132	811	374	1,185	-	20	6,337
1962	-	-	1,719	1	-	-	1,935	710	125	-	45	-	-	-	-	-	-	1,459	318	356	1,014	724	1,738	-	23	8,429
1963	-	-	1,861	1	-	-	1,786	480	145	-	23	-	-	-	-	-	-	1,458	325	306	1,308	417	1,725	-	28	8,138
1964	-	-	2,069	1	-	-	2,147	590	135	-	36	-	-	-	-	-	-	1,617	307	377	1,210	697	1,907	-	34	9,220
1965	-	-	2,116	1	-	-	2,000	590	133	-	40	-	-	-	-	-	-	1,457	320	281	1,043	550	1,593	-	42	8,573
1966	-	-	2,369	1	-	-	1,791	570	104	2	36	-	-	-	-	-	-	1,238	387	287	1,049	546	1,595	-	42	8,422
1967	-	-	2,863	1	-	-	1,980	883	144	2	25	-	-	-	-	-	-	1,463	420	449	1,233	884	2,117	-	43	10,390
1968	-	-	2,111	1	-	-	1,514	827	161	1	20	-	-	-	-	-	-	1,413	282	312	1,021	557	1,578	-	38	8,258
1969	-	-	2,202	1	801	582	1,383	360	131	2	22	-	-	-	-	-	-	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	-	-	-	-	-	-	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	18	-	-	-	-	-	-	1,639	426	234	719	702	1,421	-	16	7,575
1972	1,201	558	1,759	1	1,064	514	1,578	462	245	5	18	-	-	-	32	200	1,604	1,804	442	210	1,013	714	1,727	34	40	8,357
1973	1,651	783	2,434	3	1,220	506	1,726	772	148	8	23	-	-	-	50	244	1,686	1,930	450	182	1,158	848	2,006	12	24	9,768
1974	1,589	950	2,539	1	1,149	484	1,633	709	215	10	32	-	-	-	76	170	1,958	2,128	383	184	912	716	1,628	13	16	9,567
1975	1,573	912	2,485	2	1,038	499	1,537	811	145	21	26	-	-	-	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	-	-	-	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	10	-	-	-	59	145	1,227	1,372	345	110	639	521	1,160	19	19	7,756
1978	1,225	320	1,545	4	668	382	1,050	476	285	6	10	-	-	-	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	12	-	-	-	26	105	922	1,027	261	99	598	478	1,076	10	29	6,341
1980	1,763	917	2,680	6	1,352	478	1,830	664	241	8	17	-	-	-	34	202	745	947	360	122	851	283	1,134	30	47	8,120
1981	1,619	818	2,437	6	1,189	467	1,656	463	147	16	26	-	-	-	44	164	521	685	493	101	844	389	1,233	20	25	7,352
1982	1,082	716	1,798	6	985	363	1,348	364	130	17	25	-	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	28	-	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	40	-	37	9	46	101	728	829	345	78	504	509	1,013	25	18	5,883
1985	540	593	1,133	2	923	638	1,561	659	162	55	45	-	38	11	49	100	1,495	1,595	361	98	514	399	913	22	13	6,668
1986	779	780	1,559	2	1,042	556	1,598	608	232	59	54	-	25	12	37	136	1,594	1,730	430	109	745	526	1,271	28	27	7,744
1987	951	833	1,784	1	894	491	1,385	564	181	40	47	-	34	15	49	127	1,112	1,239	302	56	503	419	922	27	18	6,615
1988	633	677	1,310	1	656	420	1,076	420	217	180	40	-	27	9	36	141	1,733	1,874	395	114	501	381	882	32	18	6,595
1989	590	549	1,139	2	469	436	905	364	141	136	29	-	33	19	52	132	947	1,079	296	142	464	431	895	14	7	5,201
1990	486	425	911	2	545	385	930	313	146	280	33	13	41	19	60	-	-	567	338	94	423	201	624	15	7	4,333

Table 2.1.1.2. Continued.

Year	NAC Area				NEAC (N. Area)											NEAC (S. Area)											Total
	Canada (1)			USA	Norway (2)			Russia (3)	Iceland Wild	Iceland Ranch	Sweden (West)	Denmark	Finland			Ireland (4,5)			UK (E&W)	UK(N.I.) (4,6)	UK(Scotland)			France	Spain		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
1991	370	341	711	1	535	342	876	215	129	346	38	3	53	17	70	-	-	404	200	55	285	177	462	13	11		3,534
1992	323	199	522	1	566	301	867	167	174	462	49	10	49	28	77	-	-	630	171	91	361	238	599	20	11		3,851
1993	214	159	373	1	611	312	923	139	157	499	56	9	53	17	70	-	-	541	248	83	320	227	547	16	8		3,670
1994	216	139	355	0	581	415	996	141	136	313	44	6	38	11	49	-	-	804	324	91	400	248	648	18	10		3,934
1995	153	107	260	0	590	249	839	128	146	303	37	3	37	11	48	-	-	790	295	83	364	224	588	10	9		3,538
1996	154	138	292	0	571	215	787	131	118	243	33	2	24	20	44	-	-	685	183	77	267	160	427	13	7		3,042
1997	126	103	229	0	389	241	630	111	97	59	19	1	30	15	45	-	-	570	142	93	182	114	296	8	3		2,303
1998	70	87	157	0	445	296	740	131	119	46	15	1	29	19	48	-	-	624	123	78	162	121	283	8	4		2,376
1999	64	88	152	0	493	318	811	103	111	35	16	1	29	33	62	-	-	515	150	53	142	57	199	11	6		2,225
2000	58	95	153	0	673	504	1,176	124	73	11	33	5	56	39	95	-	-	621	219	78	161	114	275	11	7		2,882
2001	61	86	148	0	850	417	1,267	114	74	14	33	6	105	21	126	-	-	730	184	53	150	101	251	11	13		3,024
2002	49	99	148	0	770	249	1,019	118	90	7	28	5	81	12	93	-	-	682	161	81	118	73	191	11	9		2,643
2003	60	81	141	0	708	363	1,071	107	99	11	25	4	63	15	78	-	-	551	89	56	122	71	193	13	7		2,444
2004	68	94	161	0	577	207	784	82	111	18	19	4	32	7	39	-	-	489	111	48	159	88	247	19	7		2,140
2005	56	83	139	0	581	307	888	82	129	21	15	8	31	16	47	-	-	422	97	52	126	91	217	11	13		2,139
2006	55	82	137	0	671	261	932	91	93	17	14	2	38	29	67	-	-	326	80	29	118	75	193	13	11		2,005
2007	49	63	112	0	627	140	767	63	93	36	16	3	52	6	58	-	-	85	67	30	100	71	171	11	9		1,521
2008	57	100	157	0	637	170	807	73	132	69	18	9	65	6	71	-	-	89	64	21	110	51	161	12	9		1,691
2009	52	74	126	0	460	135	595	71	122	44	17	8	21	15	36	-	-	68	54	17	83	37	121	4	2		1,284
2010	53	100	153	0	458	184	642	88	124	36	22	13	-	-	49	-	-	99	109	12	111	69	180	10	2		1,538
2011	69	110	179	0	556	140	696	89	98	30	39	13	-	-	44	-	-	87	136	10	126	33	159	11	7		1,598
2012	55	80	135	0	534	162	696	82	53	12	30	2	-	-	64	-	-	88	57	9	88	42	130	10	8		1,375
Average																											
2007-2011	56	89	145	0	548	154	701	77	114	43	22	9	-	-	52	-	-	85	86	18	106	52	158	9	6		1526
2002-2011	57	89	145	0	605	216	820	86	109	29	21	7	-	-	58	-	-	290	97	36	117	66	183	11	8		1900

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, 1991–2012. Figures for 2012 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	5,959	40	21,072	32								
2001	59,387	55	0	-	3,611	12	16,945	76	4,869	41	27,724	38								
2002	50,924	52	0	-	5,985	18	25,248	80	5,910	47	24,058	42								
2003	53,645	55	0	-	5,361	16	33,862	81	4,943	53	29,170	55								
2004	62,316	57	0	-	7,362	16	24,679	76	11,516	46	46,279	50					255	19		
2005	63,005	62	0	-	9,224	17	23,592	87	10,554	54	46,165	55	2,553	12			606	27		
2006	60,486	62	1	100	8,735	19	33,380	82	9,955	55	47,669	55	5,409	22	302	18	794	65		
2007	41,192	58	3	100	9,691	18	44,341	90	9,942	53	55,660	61	13,125	40	470	16	959	57		
2008	54,887	53	61	100	17,178	20	41,881	86	11,918	54	53,347	62	13,312	37	648	20	2,033	71	5,512	5
2009	52,151	59	0	-	17,514	24	-	-	8,397	57	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	13,958	59	78,304	70	15,136	40	823	25	2,512	60	15,041	12
2011	71,358	57	0	-	18,593	32	-	-	13,471	61	64,669	73	12,753	39	1,197	36	2,153	55	14,303	12
2012	50,811	57	0	-	7,963	28	4,743	43	10,967	64	66,250	74	11,891	35	5,014	59	2,153	55	18,611	14
5-yr mean 2007-2011	55,096	56	0		16,890	24			11,537	57	60,080	66	12,918	39	797	24	1,873	59	10,388	9
% change on 5-year mean	-8	+2			-53	+14			-5	+13	+10	+12	-8	-9	+529	+151	+15	-7	+79	+63

Key: [1] No data were provided by the authorities for 2009 nor for 2011 and data for 2010 and 2012 were incomplete, however catch-and-release is understood to have remained at similar high levels.

[2] Data for 2006-2009 is for the DCAL area only; the 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, 1987–2012.

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
Mean 2007-2011	391		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, 2012.

Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Denmark	6	0.3	77
NEAC	Finland	7	0.4	10
NEAC	Iceland	5	0.3	8
NEAC	Ireland	9	0.5	9
NEAC	Norway	298	16.4	30
NEAC	Sweden	3	0.2	9
NEAC	France	2	0.1	14
NEAC	UK (E & W)	15	0.8	21
NEAC	UK (N.Ireland)	0	0.0	2
NEAC	UK (Scotland)	18	1.0	12
NAC	USA	0	0.0	0
NAC	Canada	31	1.7	18
WGC	West Greenland	10	0.6	23
	Total Unreported Catch *	403	22.3	
	Total Reported Catch of North Atlantic salmon	1,409		

* No unreported catch estimate available for Russia in 2012.
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), 1980–2012.

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	Other	Total	Total
1980	4,153	598	0	11	21	0	0	0	0	4,783	0	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	0	9,611
1982	10,266	2,152	70	38	100	0	0	0	0	12,626	0	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	0	19,972
1984	22,300	3,912	120	227	385	0	0	0	0	26,944	0	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	0	37,196
1986	45,675	10,337	1,370	672	1,215	0	123	0	0	59,392	0	0	0	20	0	0	0	59,392
1987	47,417	12,721	3,530	1,334	2,232	365	490	0	0	68,089	3	0	0	50	0	0	53	68,142
1988	80,371	17,951	3,300	3,542	4,700	455	1,053	0	0	111,372	174	0	0	250	0	0	424	111,796
1989	124,000	28,553	8,000	5,865	5,063	905	1,480	0	0	173,866	1,864	1,100	1,000	400	0	700	5,064	178,930
1990	165,000	32,351	13,000	7,810	5,983	2,086	2,800	<100	5	229,035	9,500	700	1,700	1,700	0	800	14,400	243,435
1991	155,000	40,593	15,000	9,395	9,483	4,560	2,680	100	0	236,811	14,991	2,000	3,500	2,700	0	1,400	24,591	261,402
1992	140,000	36,101	17,000	10,380	9,231	5,850	2,100	200	0	220,862	23,769	4,900	6,600	2,500	0	400	38,169	259,031
1993	170,000	48,691	16,000	11,115	12,366	6,755	2,348	<100	0	267,275	29,248	4,200	12,000	4,500	1,000	400	51,348	318,623
1994	204,686	64,066	14,789	12,441	11,616	6,130	2,588	<100	0	316,316	34,077	5,000	16,100	5,000	1,000	800	61,977	378,293
1995	261,522	70,060	9,000	12,550	11,811	10,020	2,880	259	0	378,102	41,093	5,000	16,000	6,000	1,000	0	69,093	447,195
1996	297,557	83,121	18,600	17,715	14,025	10,010	2,772	338	0	444,138	69,960	5,200	17,000	7,500	1,000	600	101,260	545,398
1997	332,581	99,197	22,205	19,354	14,025	13,222	2,554	225	0	503,363	87,700	6,000	28,751	9,000	1,000	900	133,351	636,714
1998	361,879	110,784	20,362	16,418	14,860	13,222	2,686	114	0	540,325	125,000	3,000	33,100	7,068	1,000	400	169,568	709,893
1999	425,154	126,686	37,000	23,370	18,000	12,246	2,900	234	0	645,590	150,000	5,000	38,800	9,195	0	500	203,495	849,085
2000	440,861	128,959	32,000	33,195	17,648	16,461	2,600	250	0	671,974	176,000	5,670	49,000	12,003	0	500	243,173	915,147
2001	436,103	138,519	46,014	36,514	23,312	13,202	2,645	-	0	696,309	200,000	5,443	68,000	13,815	0	500	287,758	984,067
2002	462,495	145,609	45,150	40,851	22,294	6,798	1,471	-	0	724,668	273,000	5,948	84,200	14,699	0	1,000	378,847	1,103,515
2003	509,544	176,596	52,526	38,680	16,347	6,007	3,710	-	298	803,708	261,000	10,329	65,411	13,324	0	1,000	351,064	1,154,772
2004	563,914	158,099	40,492	37,280	14,067	8,515	6,620	-	203	829,190	261,000	6,659	55,646	14,317	0	1,000	338,622	1,167,812
2005	586,512	129,588	18,962	45,891	13,764	5,263	6,300	-	179	806,459	385,000	6,123	63,369	16,827	0	1,000	472,319	1,278,778
2006	629,888	131,847	11,905	47,880	11,000	4,674	5,745	-	229	843,168	370,000	5,823	70,181	22,417	0	1,000	469,421	1,312,589
2007	744,222	129,930	22,305	36,368	9,923	2,715	1,158	-	280	946,901	371,809	6,261	70,998	23,982	0	1,000	474,050	1,420,951
2008	737,694	128,606	36,000	39,687	11,000	9,014	330	-	380	962,711	393,000	6,261	73,265	26,173	0	1,000	499,699	1,462,410
2009	862,908	144,247	51,500	43,101	13,000	6,028	742	-	55	1,121,581	200,000	7,930	68,662	32,819	0	1,000	310,411	1,431,992
2010	939,575	154,164	45,396	43,612	13,000	11,127	1,068	-	1,400	1,209,342	81,000	7,930	70,831	30,264	0	1,000	191,025	1,400,367
2011	1,065,974	158,018	60,500	41,448	14,000	-	1,083	-	4,000	1,345,023	385,000	8,014	74,880	35,685	0	1,000	504,579	1,849,602
2012	1,147,745	158,026	76,595	41,448	15,000	-	2,923	-	8,000	1,449,737	385,000	7,131	74,880	43,249	0	1,000	511,260	1,960,997
5-yr mean 2007-2011	870,075	142,993	43,140	40,843	12,185		876		1,223	1,117,112	286,162	7,279	71,727	29,785	0	1,000	395,953	1,513,064
% change on 5-year mean	+32	+11	+78	+1	+23		+234		+554	+30	+35	-2	+4	+45		0	+29	+30

Notes: Data for 2012 are provisional for many countries.
Where production figures were not available for 2012, values as in 2011 were assumed.
West Coast USA = Washington State.
West Coast Canada = British Columbia.
Australia = Tasmania. This is mostly Atlantic salmon, but includes a small component of trout
Source of production figures for non-Atlantic areas: miscellaneous fishing publications & Government reports
'Other' includes South Korea & China.
Data for UK (N. Ireland) since 2001 and data for USA since 2011 are not publicly available.

Table 2.2.2.1. Production of ranched salmon in the North Atlantic (tonnes round fresh weight), 1980–2012.

Year	Iceland (1)	Ireland (2)	UK(N.Ireland) River Bush (2,3)	Norway various facilities (2)	Total production
1980	8.0				8
1981	16.0				16
1982	17.0				17
1983	32.0				32
1984	20.0				20
1985	55.0	16.0	17.0		88
1986	59.0	14.3	22.0		95
1987	40.0	4.6	7.0		52
1988	180.0	7.1	12.0	4.0	203
1989	136.0	12.4	17.0	3.0	168
1990	285.1	7.8	5.0	6.2	304
1991	346.1	2.3	4.0	5.5	358
1992	462.1	13.1	11.0	10.3	497
1993	499.3	9.9	8.0	7.0	524
1994	312.8	13.2	0.4	10.0	336
1995	302.7	19.0	1.2	2.0	325
1996	243.0	9.2	3.0	8.0	263
1997	59.4	6.1	2.8	2.0	70
1998	45.5	11.0	1.0	1.0	59
1999	35.3	4.3	1.4	1.0	42
2000	11.3	9.3	3.5	1.0	25
2001	13.9	10.7	2.8	1.0	28
2002	6.7	6.9	2.4	1.0	17
2003	11.1	5.4	0.6	1.0	18
2004	18.1	10.4	0.4	1.0	30
2005	20.5	5.3	1.7	1.0	29
2006	17.2	5.8	1.3	1.0	25
2007	35.5	3.1	0.3	0.5	39
2008	68.6	4.4	-	0.5	74
2009	44.3	1.1	-	-	45
2010	42.3	2.5	-	-	45
2011	30.2	3.2	-	-	33
2012	11.7	-	-	-	12
5-yr mean 2007-2011	44.2	2.9			47
% change on 5-year mean	-74				-75

1 From 1990, catch includes fish ranched for both commercial and angling purposes.
2 Total yield in homewater fisheries and rivers, estimate for 2012 is not available.
3 The proportion of ranched fish was not assessed between 2008 and 2011 due to a lack of microtag returns.

Table 2.3.8.2.1. Summary of prevalence (% of sampled fish with sea lice) of sea lice on Atlantic salmon sampled at West Greenland in 2009 to 2011 and from the Miramichi River (Canada) in 2005 to 2011.

Lice categories	West Greenland				Miramichi River
	2009	2010	2011	mean	2005–2011
0	24.9%	27.1%	36.7%	29.6%	59.1%
1–5	57.3%	55.7%	50.5%	54.5%	21.3%
6–10	12.4%	13.1%	9.3%	11.6%	14.6%
11–15	4.4%	2.3%	2.6%	3.1%	
16–20	0.8%	1.1%	0.7%	0.9%	4.8%
21–50	0.3%	0.6%	0.2%	0.4%	
>50	0	0	0	0	0.3%

Table 2.5.2.1a. Distribution of exotic salmonids in NEAC Northern area.

Northern NEAC Country	Rainbow trout *Oncorhynchus mykiss*	American Brook Trout *Salvelinus fontinalis*	Lake Trout *Salvelinus namaycush*	Pink salmon *Oncorhynchus gorbuscha*	Coho Salmon *Oncorhynchus kisutch*	Chinook salmon *Oncorhynchus tshawytscha*	Landlocked Atlantic salmon *Salmo salar*	Brown trout *Salmo trutta*
Russia	Widely used in aquaculture in Karelia Republic, including farming in the White Sea. One freshwater farm in Tuloma River (Barents Sea basin) and a number of farms in inland waters of the Murmansk region. Limited production of rainbow trout in the lakes of the Archangelsk region. No population established in wild. Limited evidence of escapees.	No history of use	No history of use	Pink salmon was successfully introduced to salmon rivers of Murmansk and Archangelsk regions from the Russia's Far East from 1950 to 1990. Since 2003 no juvenile releases from hatcheries occured but pink salmon spawned naturally in salmon rivers. The commercial fishery for pink salmon is conducted in the coastal areas of the White Sea with the same gears and in the same period as for Atlantic salmon. The total declared pink salmon catch in 2009 was 139 t, twice as much as a declared Atlantic salmon catch.	Experiments with Coho salmon introductions were conducted in Murmansk region in 1930's. No evidence of adult returns.	Not present	There are wild landlocked populations of Atlantic salmon in big lakes of Karelia. Salmon population of Shuya River of Onega lake is widely used in recreational fisheries.	Native species. Widely used in commercial and recreational fisheries.
Iceland	Introduced in the mid 1950´s. Used in aquaculture in land based facitlities and in sea-cages. Production increasing to 400t/year. No evidence of impact.	Not present	Not present	Caught annually in Icelandic rivers, since the 1960´s, in low numbers 5-30/year. No evidence of impact.	Not present	Not present	Not present	Widely distrubuted native species, both resident and sea-run.
Finland	Not present	Not present	Not present	Caught occasionally in rivers. Not considered a threat currently	Not present		Not present	Native and widespread in Finland
Norway	In use for > 100 years. However, only 6 instances of natural production confirmed by mid 1990s, 2 in anadromous parts of rivers (Jonsson *et al*. 1993a; Hindar *et al*. 1996; Sægrov, Hindar & Urdal 1996; Hesthagen & Sandlund 2007)	Reported from at least 12 lakes in Norway, first reportsin 1974. Illegaly stocked; no natural spreading. Hesthagen & Sandlund, (2007).	It is at present assumed to be less than 50 populations in Norway, and the number of populations are decreasing. No information on potential	Pink salmon introduced to Russia since 1930s have resulted in catches in Norwegian waters (up to 20t in some years). The species has also now established in 11 rivers in N. Norway (Finnmark) - Hesthagen & Sandlund (2007)	Not present	Not present	Two-three stocks native to Norway	Native and widespread in Norway
Sweden	In Sweden since the 1880s. Occasional natural reproduction is rare (40 known occasions, none of which are on the Swedish west coast). No self-sustaining populations known.	Stocked since the late 1800s. Established self-reproducing populations (ca 1000) in headwaters (Öhlund et al. 2009), not in river sections with Atlantic salmon.	Stocked in the 1960s-1970s. Today self-reproducing in 16 lakes (all draining to the Baltic Sea). In some lakes, a fishery has started to deplete the	Not occurring.	Not occurring.	Not occurring.	Two indigenous stocks exist in Lake Vänern (Piccolo et al. 2012). River Klarälven stock with ca 1000 spawners annually, R. Gullspångsälven with less than 100 spawners. Stocking of reared salmon	Indigenous and widespread.

N.B. Table excludes grayling (*Thymallus thymallus*). This species is native to some NEAC areas, but not UK (Scotland) where it has been introduced over the past 160 years and established self-maintaining populations in several river systems.

Table 2.5.2.1a. Distribution of exotic salmonids in NEAC Southern area.

Southern NEAC Country	Rainbow trout *Oncorhynchus mykiss*	American Brook Trout *Salvelinus fontinalis*	Lake Trout *Salvelinus namaycush*	Pink salmon *Oncorhynchus gorbuscha*	Coho Salmon *Oncorhynchus kisutch*	Chinook salmon *Oncorhynchus tshawytscha*	Landlocked Atlantic salmon *Salmo salar*	Brown trout *Salmo trutta*
Ireland	Commonly used for small put and take fisheries. Possibly one spawning population. Not considered a threat	Not present	Not present	Not present	Not present	Not present	Not present	Native species
UK (Scotland) [1]	Reared in many fish farms and stocked into many sport fisheries for >100 years. Both stocking and the operation of fish farms is now regulated by Marine Scotland. No naturally self maintaining populations have established. Not currently stocked into rivers, but sometimes occur in rivers as a result of escapes from stocked fisheries or fish farms.	Reared in some fish farms and stocked into some sport fisheries for >100 years. Both stocking and the operation of fish farms is regulated by Marine Scotland. A few naturally self maintaining populations have established. Not currently stocked into rivers, and reports from rivers rare.	No history of presence, and not reared	Some reports of captures in the 1960s and 1970s (in net fisheries) and since 2003 (mainly by rod). No populations have established and not reared.	No history of presence, and not reared	Not present	Not currently present.	Native to all parts of Scotland. Also reared in many fish farms and stocked into many sport fisheries
UK (England & Wales)	Widely used in aquaculture and sport fisheries for >150 years. Only one small population established in wild. Limited evidence of impact.	Limited past use in aquaculture and sport fisheries, but not currently present. No evidence of impact.	No history of use	No history of use	No history of use	No history of use	Limited past use in aquaculture and sport fisheries, but not currently present. No evidence of impact.	Native species. Restrictions apply to release to minimise risk of impacts on existing wild populations
UK (N. Ireland)	Used in aquaculture and recreational put-and-take fisheries in lakes. No established self sustaining populations known. Escapees, both resident and sea-run, are occasionally encountered. Limited threat to native salmonid	No history of use	No history of use	No history of use. A few events of this species appearing in the River Bush adult trap have been documented in the recent past. These were probably strays from stocking activities of this species elsewhere in Europe	No history of use	No history of use	No history of use	Native species.
France	Widely used in farming and sport fisheries for >150 years, found in AS and Sea trout rivers. No population known to be established in wild. Some returns known in river Bresle of large steelhead, coming from rearing of Oregon steelhead strain for aqaculture. G. Euzenat, com pers)	introduced in 1876 and after.In 1930-50 in rivers and lakes in east, central, south-west. Currently present in theses areas. No incidence of reproduction have been investigated in rivers..	not present	not present	Not present currently. Escapees from hatcheries for aquaculture in 1970s and 80s in NW, W and SW rivers. Escaping fish investigated in R. Bresle (upper-Normandy) in 83s but very low returns noted. Establishment is not considered possible. Limited by failure to return due to adverse oceanic conditions.(1). No viable hybridization	Not present	not present	Native species. Wild pop. and stockings. No specific restrictions in salmon rivers. Possible problems with smolt catches by trout anglers in spring. Possible competition for food and space with sea trout in mixed pop.,especially in chalk streams where spawning grounds are limited.

Table 2.5.2.1b. Distribution of exotic salmonids in NAC area.

NAC Area	Rainbow trout	American Brook Trout	Lake Trout	Pink salmon	Coho Salmon	Chinook salmon	Landlocked Atlantic salmon	Brown trout
Country	*Oncorhynchus mykiss*	*Salvelinus fontinalis*	*Salvelinus namaycush*	*Oncorhynchus gorbuscha*	*Oncorhynchus kisutch*	*Oncorhynchus tshawytscha*	*Salmo salar*	*Salmo trutta*
Canada - Labrador	Not present.	Native	Native	No history of use, but incidental captures in north Labrador during the late 1970s.	No history of use.	No history of use.	Native	No history of use.
Canada - Nfld	First introduced in 1887 with stocking continuing through the first half of the 1900s. Self sustaining populations in eastern Nfld. Numerous occurrences have now been documented from various south and west coast rivers.	Native	Not present.	Introduced to Newfoundland from 1958-1966. No longer present.	No history of use.	No history of use.	Native	Introductions occurred from 1882-1906. Current distribution is estimated at 68 watersheds in eastern Nfld (2011).
Canada - Quebec	Introduced from Northern Pacific Ocean starting in 1893 for recreational fishing. Increasing prevalence in Eastern Québec since 1980s. Currently present in about 50 river systems.	Native	Native	Historically introduced in Newfoundland and some migrants were observed in Quebec. No longer present.	Historically introduced in the Great Lakes from 1873. Sometimes observed in the Saint Lawrence River.	Historically introduced in the Great Lakes from 1873. Sometimes observed in the Saint Lawrence River.	Native	Introduced in 1890. Now reproducing naturally in multiple watersheds.
Canada - Gulf	First introduced to Prince Edward Island in 1924 and self-sustaining populations now present in 18 watersheds. Observations in numerous other rivers in the region in many years. One reproducing population suspected but not confirmed in a tributary of the Restigouche River, New Brunswick.	Native, widely distributed in the region.	Native, found in a few inland lakes in New Brunswick.	No history of use.	No history of use.	No history of use.	Native in a few inland lakes of New Brunswick	Successfully introduced and self-sustaining populations found in most rivers in Nova Scotia flowing into the Gulf of St. Lawrence. Not reported from New Brunswick or Prince Edward Island rivers.
Canada - Scotia Fundy	Introduced from 1899 to early 1970s for recreational fishing. Self-sustaining populations in two sub-watersheds within the Inner Bay of Fundy New Brunswick. Direct stocking still occurs by the province of Nova Scotia in limited number of watersheds in Nova Scotia. No successful populations established in Nova Scotia. Juvenilesfound in many watersheds in the New Brunswick Bay of Fundy area.	Native	Native	Historically introduced in Newfoundland and some migrants were observed in Nova Scotia. No longer present.	Introduced in northeastern USA in early 1970s to 1990s and some successful reproductions occurred in mid-80s in Scotia Fundy. No self sustaining population present.	Historically introduced to New Brunswick. No established populations.	Native. Stocking programs occur in New Brunswick Bay of Fundy rivers.	Introduced in 1920s. Now reproducing naturally in multiple watersheds. Direct stocking still occurs by the province of Nova Scotia in limited number of watersheds in Nova Scotia. Successful populations established in Nova Scotia are rare.
USA	Stocked in lakes and rivers, produced naturalized populations, typically introduced in riverine habitat where ATS were extirpated, compete for food and space	Native in US Atlantic salmon habitat	Native to US Atlantic salmon habitat, populations in lakes, limited riverine presence	Stocked in the past in habitat where salmon were extirpated, never produced naturalized populations	Stocked in the past in habitat where salmon were extirpated, never produced naturalized populations		widely distributed outside landlocked salmon native range in Northeast US, hybridize with anadromous ATS, use same habitat as spawners and juveniles	Stocked in lakes and rivers, produced naturalized populations, typically introduced in riverine habitat where salmon were extirpated, compete for food and space, hybridize

Table 2.7.1.1. Summary of Atlantic salmon tagged and marked in 2012 ; 'Hatchery' and 'Wild' refer to smolts and parr; 'Adults' relates to both wild and hatchery-origin fish.

		Primary Tag or Mark				
Country	Origin	Microtag	External mark	Adipose clip	Other Internal[1]	Total
Canada	Hatchery Adult	0	2,164	0	1,949	4,113
	Hatchery Juvenile	0	1,292	383,332	39	384,663
	Wild Adult[2]	0	2,297	0	25	2,322
	Wild Juvenile[2]	0	15,098	10,661	640	26,399
	Total	**0**	**20,851**	**393,993**	**2,653**	**417,497**
Denmark	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	118,500	0	152,600	0	271,100
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**118,500**	**0**	**152,600**	**0**	**271,100**
France	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile[3]	0	0	619,901	0	619,901
	Wild Adult[3]	31	0	0	279	310
	Wild Juvenile	596		0	2,391	2,987
	Total	**627**	**0**	**619,901**	**2,670**	**623,198**
Germany	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	12,000	0	120,000	0	132,000
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	0	0	0	0
	Total	**12,000**	**0**	**120,000**	**0**	**132,000**
Iceland	Hatchery Adult	0	4	0	0	4
	Hatchery Juvenile	40,662		0	0	40,662
	Wild Adult		53	0	0	53
	Wild Juvenile	4,259		0	0	4,259
	Total	**44,921**	**57**	**0**	**0**	**44,978**
Ireland	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	196,293	0	0	0	196,293
	Wild Adult	0	0	0	0	0
	Wild Juvenile	92	0	0	0	92
	Total	**196,385**	**0**	**0**	**0**	**196,385**
Norway	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	91,878	13,296	91,000	0	196,174
	Wild Adult	0	739	0	0	739
	Wild Juvenile	0	2,286	0	2,746	5,032
	Total	**91,878**	**16,321**	**91,000**	**2,746**	**201,945**
Russia	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	1,022,514	0	1,022,514
	Wild Adult	0	2,282	0	0	2,282
	Wild Juvenile	0	0	0	0	0
	Total	**0**	**2,282**	**1,022,514**	**0**	**1,024,796**
Sweden	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	3000	180,343	0	183,343
	Wild Adult	0	0	0	0	0
	Wild Juvenile	0	500	0	0	500
	Total	**0**	**3,500**	**180,343**	**0**	**183,843**
UK (England & Wales)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	211,464	0	211,464
	Wild Adult	0	250	0	0	250
	Wild Juvenile	3,994	0	8,820	891	13,705
	Total	**3,994**	**250**	**220,284**	**891**	**225,419**
UK (N. Ireland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	15,671	0	30,442	0	46,113
	Wild Adult	0	0	0	0	0
	Wild Juvenile		0	0	0	0
	Total	**15,671**	**0**	**30,442**	**0**	**46,113**
UK (Scotland)	Hatchery Adult	0	0	0	0	0
	Hatchery Juvenile	0	0	49,163	786	49,949
	Wild Adult	0	626	42	166	834
	Wild Juvenile	2990	0	9	2,411	5,410
	Total	**2,990**	**626**	**49,214**	**3,363**	**56,193**
USA	Hatchery Adult	0	1,695	0	2,057	3,752
	Hatchery Juvenile	0	0	265,458	665	266,123
	Wild Adult	0	0	10	0	10
	Wild Juvenile	0	0	0	81	81
	Total	**0**	**1,695**	**265,468**	**2,803**	**269,966**
All Countries	Hatchery Adult	0	3,863	0	4,006	7,869
	Hatchery Juvenile	475,004	17,588	3,126,217	1,490	3,620,299
	Wild Adult	31	6,247	52	470	6,800
	Wild Juvenile	11,931	17,884	19,490	9,160	58,465
	Total	**486,966**	**45,582**	**3,145,759**	**15,126**	**3,693,433**

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

Table 2.8.2.1. Overview of current DCF and future data needs for Atlantic Salmon assessment/ scientific advice.

For more information about this table, see example of Table 4.2.3.1 of WKESDCF report.

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
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
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

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
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
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

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
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
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

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
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
Economic data	Not known **	No *	No	No - but data are of use to NASCO		Collection of economic data would be useful to managers

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
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.**

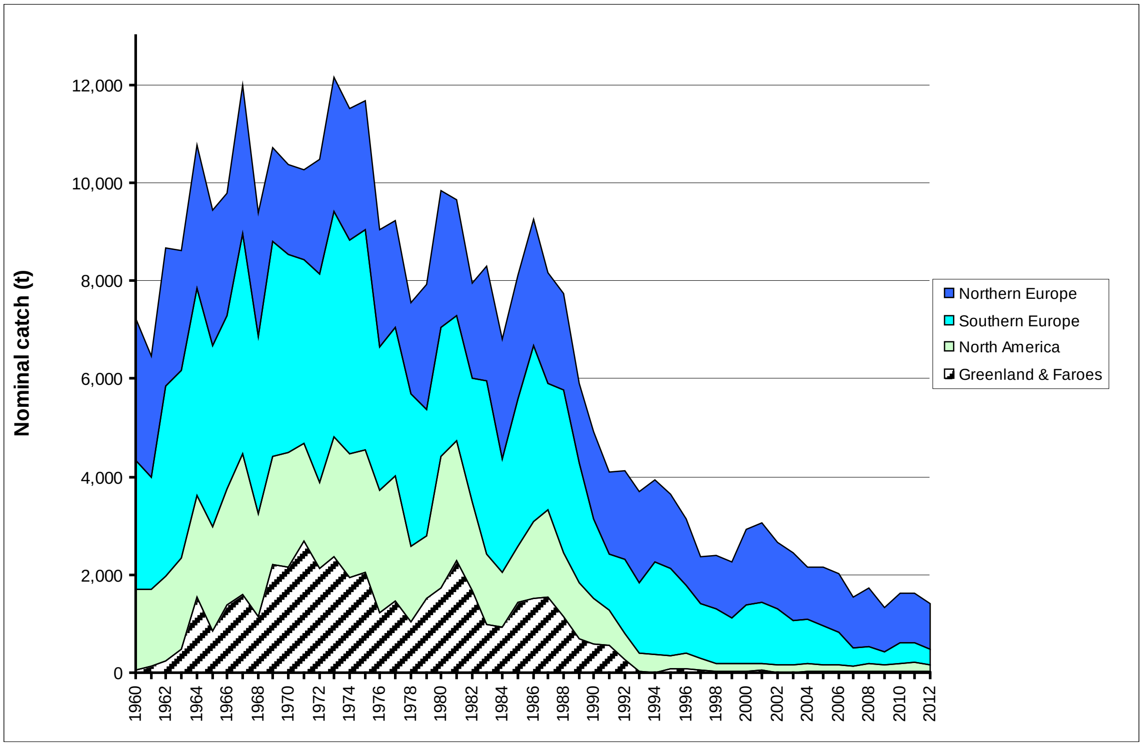


Figure 2.1.1.1. Total reported nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960–2012

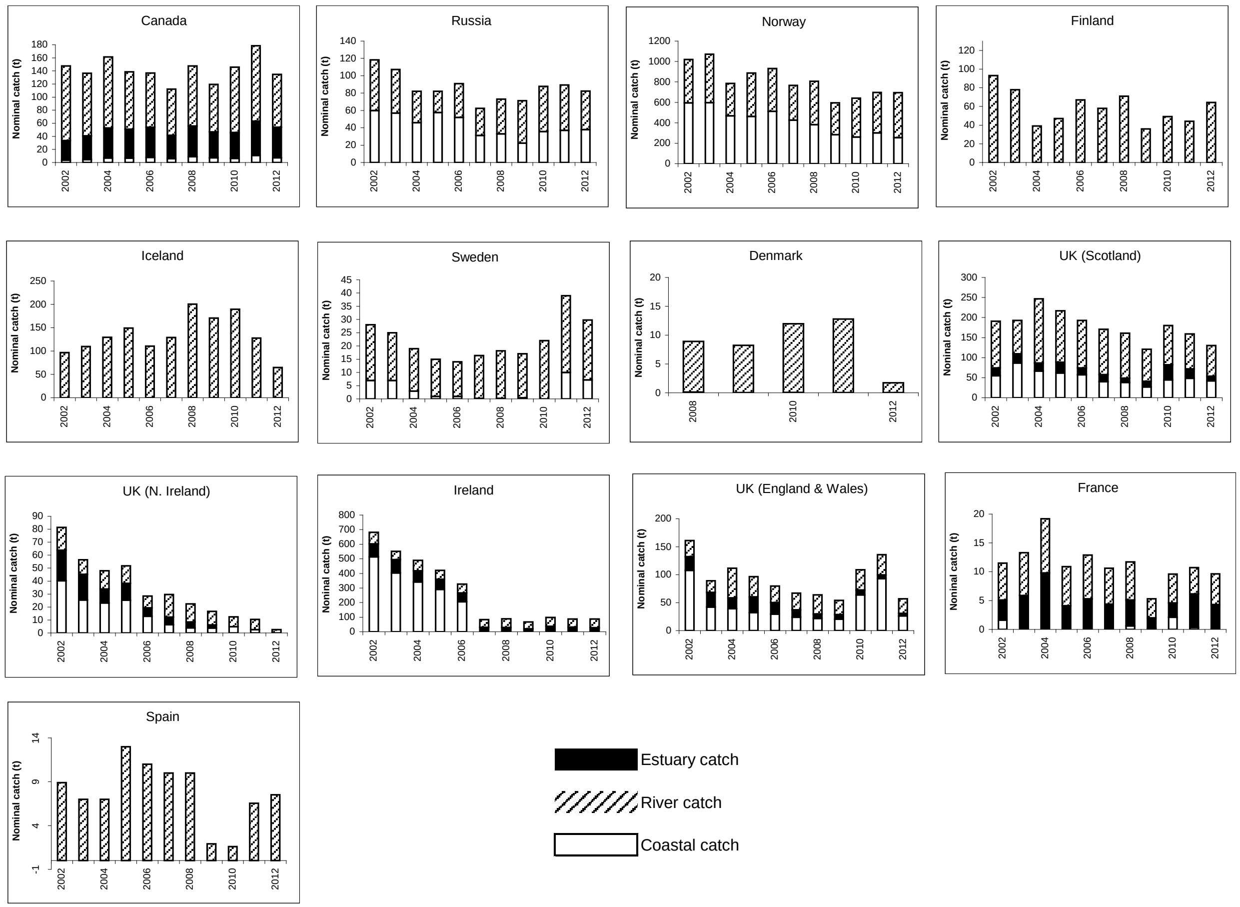


Figure 2.1.1.2. Nominal catch (tonnes) taken in coastal, estuarine and riverine fisheries by country. The way in which the nominal catch is partitioned among categories varies between countries, particularly for estuarine and coastal fisheries – see text for details. Note also that the y-axes scales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

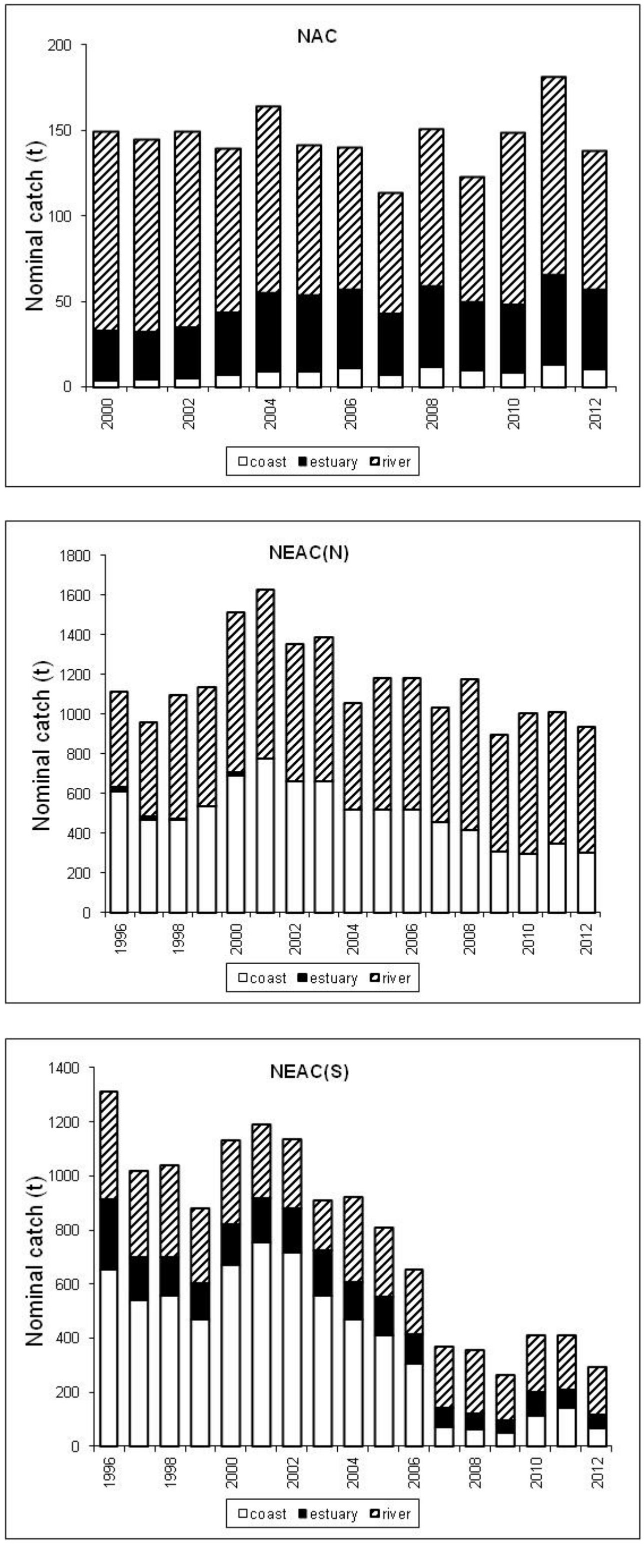


Figure 2.1.1.3. Nominal catch taken in coastal, estuarine and riverine fisheries for the NAC and NEAC northern and southern areas over available time-series. The way in which the nominal catch is partitioned among categories varies between countries, particularly for estuarine and coastal fisheries; see text for details. Note also that the y-axes scales vary.

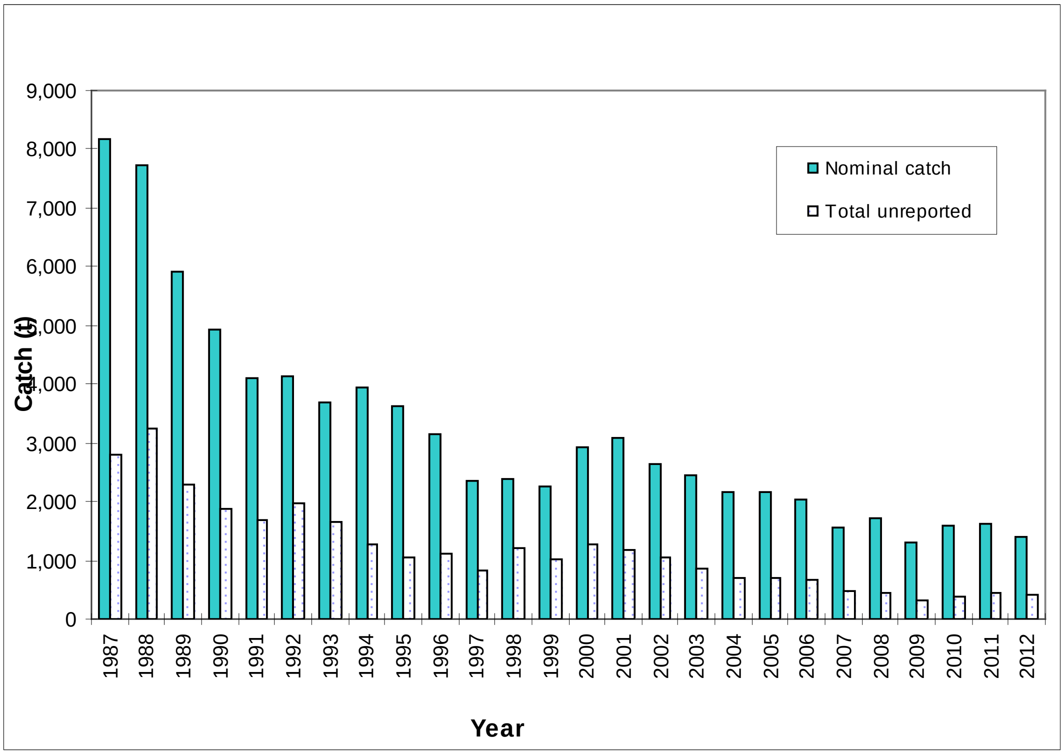


Figure 2.1.3.1. Nominal North Atlantic salmon catch and unreported catch in NASCO Areas, 1987–2012.

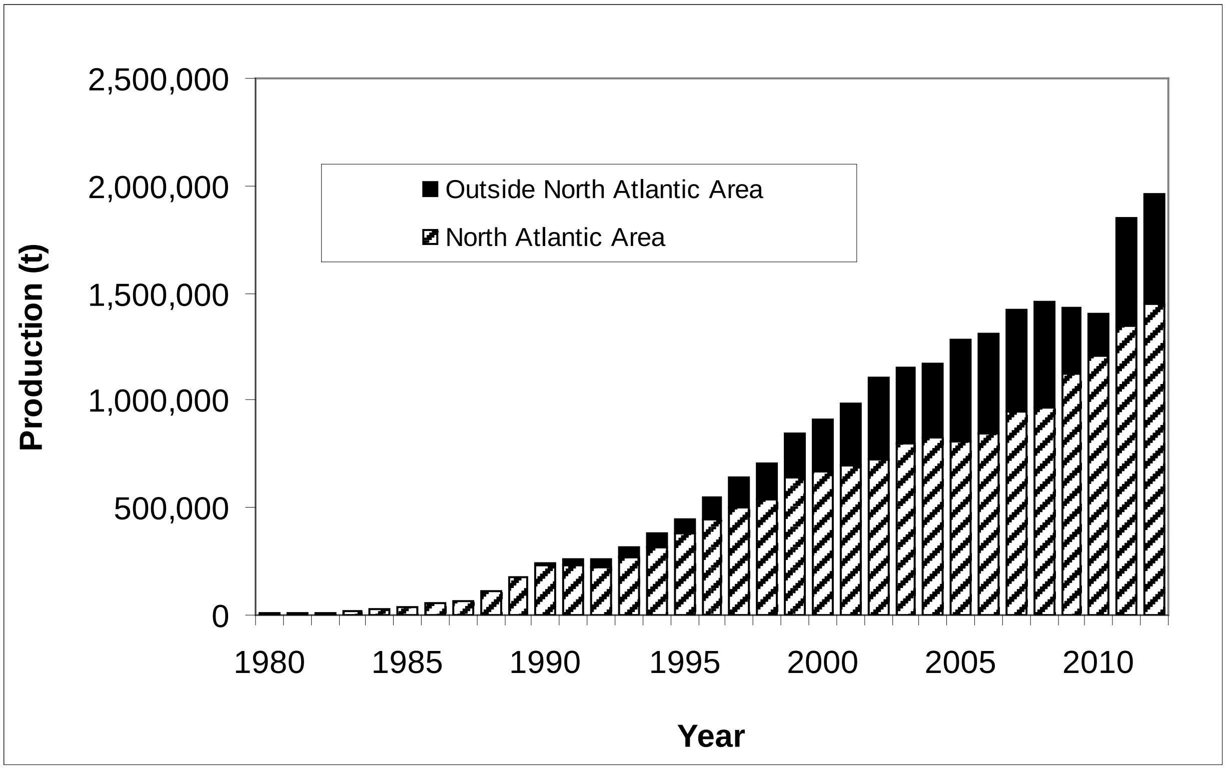


Figure 2.2.1.1. Worldwide farmed Atlantic salmon production, 1980–2012.

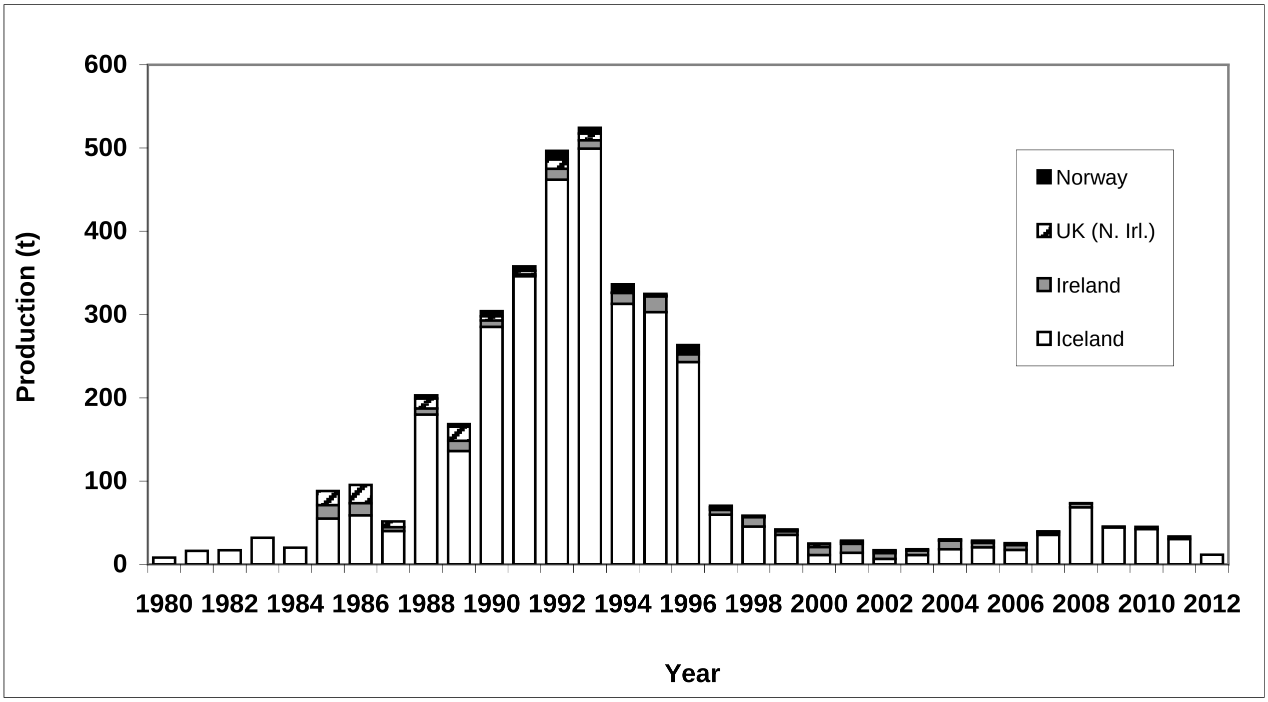


Figure 2.2.2.1. Production of ranched salmon (tonnes round fresh weight) in the North Atlantic, 1980–2012.

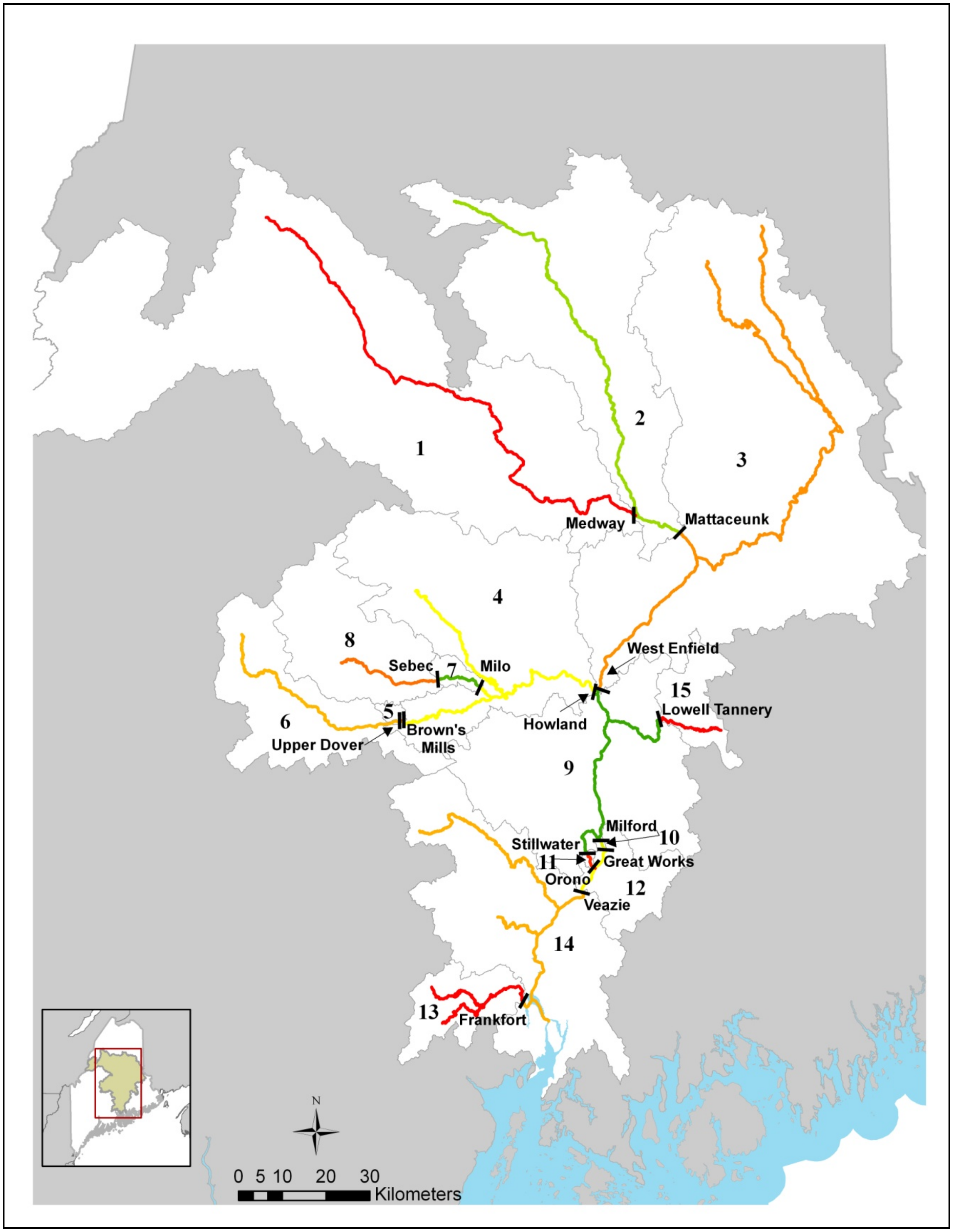


Figure 2.3.1.1. The Penobscot River watershed and major tributaries divided into 15 production units. Locations of the 15 hydroelectric dams included in the Dam Impact Analysis model are denoted by dashes and the name of each dam. The map inset is the Penobscot River watershed within the state of Maine, USA.

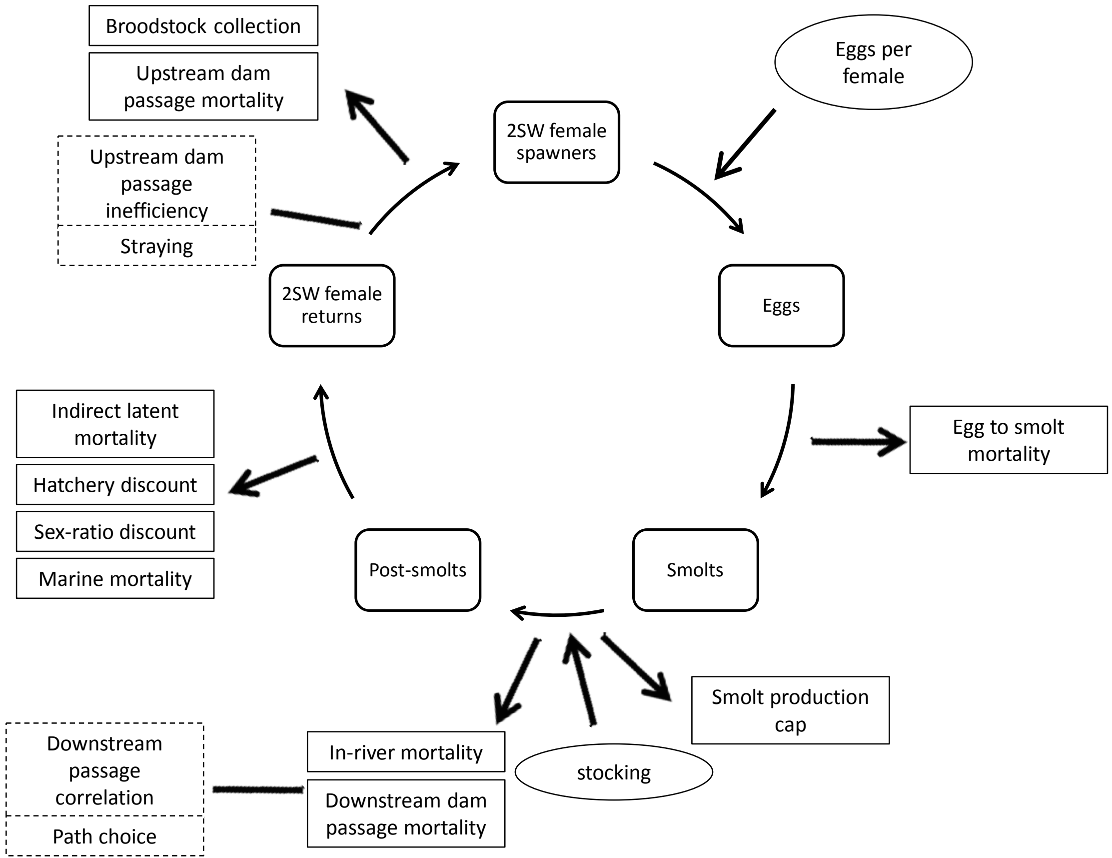
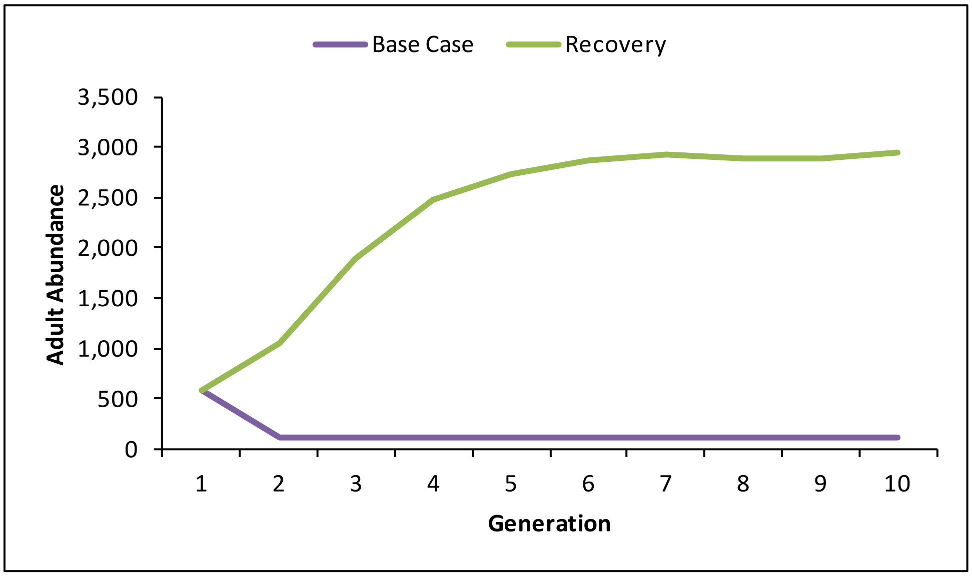


Figure 2.3.1.2. Schematic of the processes detailed within the DIA model. Rounded rectangles indicate life cycle stages, ovals indicate additions to the population, and rectangles indicate subtractions from the population. Dashed rectangles are neither additions to nor subtractions from the population, but represent dynamics incorporated into the model. All model runs simulated ten five-year generations (50 years) and consisted of 5000 iterations.



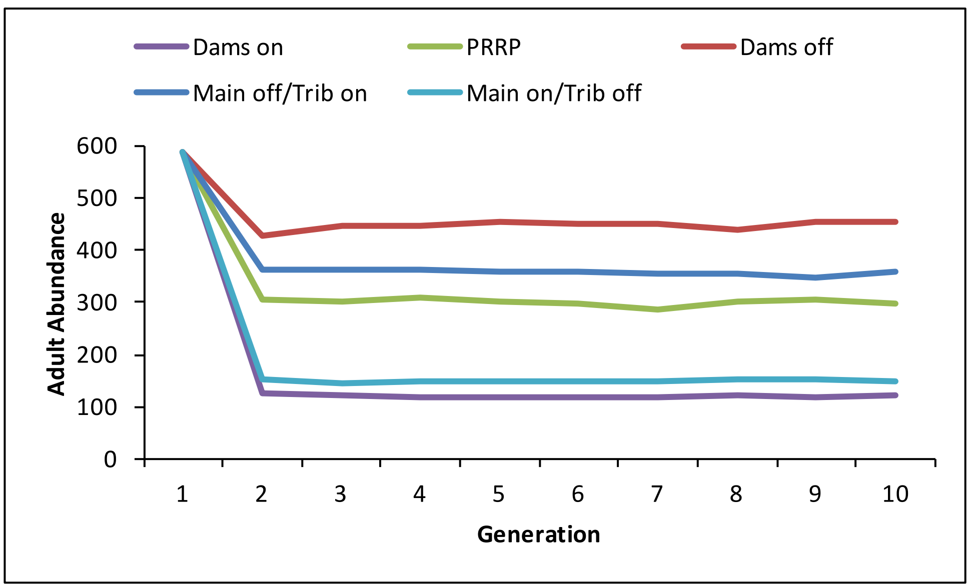


Figure 2.3.1.3. Median number of two sea-winter females (top) across all Penobscot River production units in generations 1–10 for scenarios with recent conditions (i.e. Base Case) and increased marine and freshwater survival rates (i.e. Recovery). Median number of two sea-winter females (bottom) across all Penobscot River production units in generations 1–10 for scenarios with all dams turned on, implementation of the PRRP (i.e. Penobscot River Restoration Project: removal of three lower river mainstem dams), all dams turned off, mainstem dams turned off and tributary dams turned on, and mainstem dams turned on and tributary dams turned off. Freshwater and marine survival rates were set at recent (i.e. Base Case) levels in all scenarios.

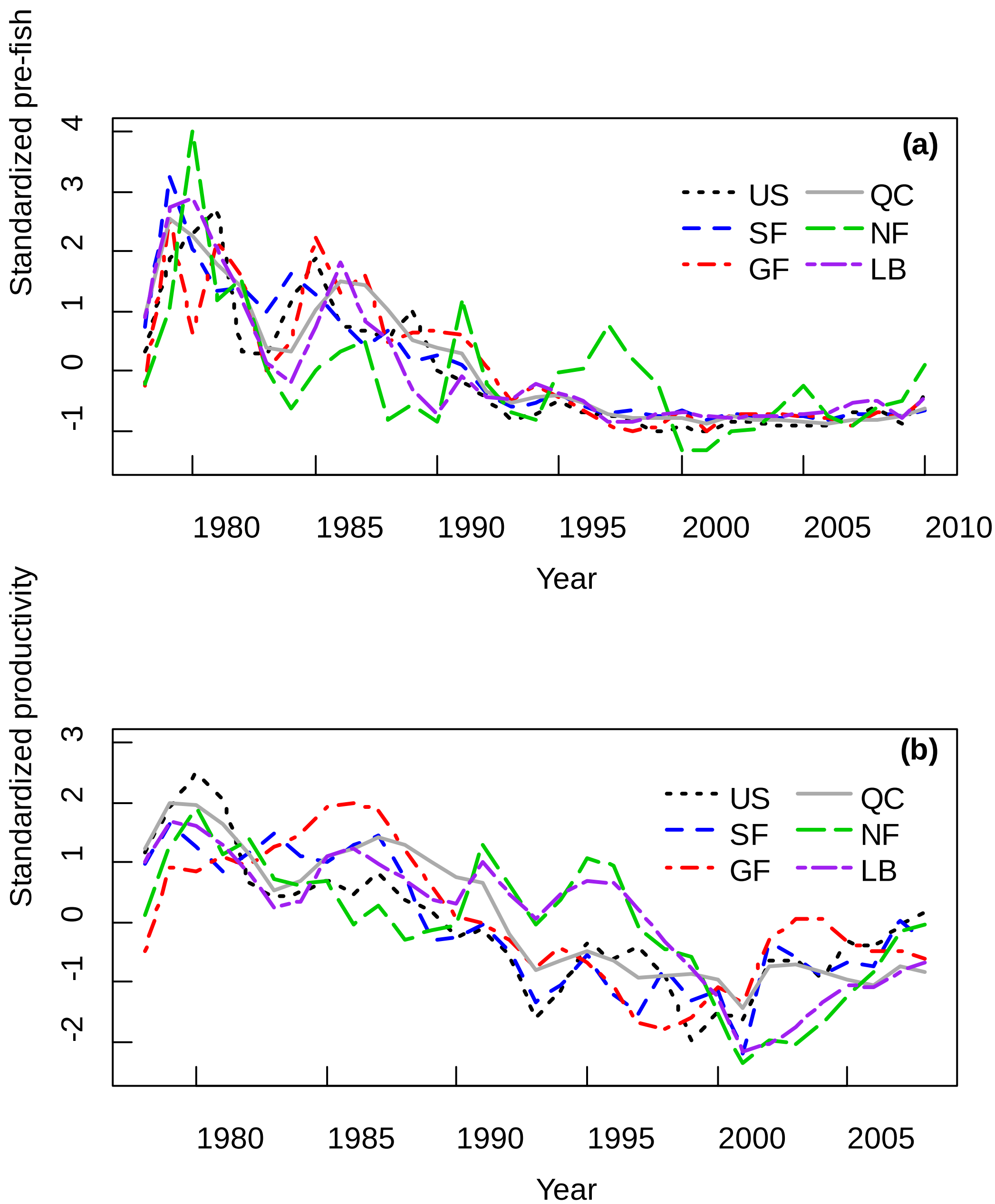


Figure 2.3.2.1. Standardized abundance (a) and productivity (b) of Atlantic salmon population complexes in six regions of North America: United States (US), Scotia-Fundy (SF), Gulf of St Lawrence (GF), Quebec (QC), Newfoundland (NF), and Labrador (LB).

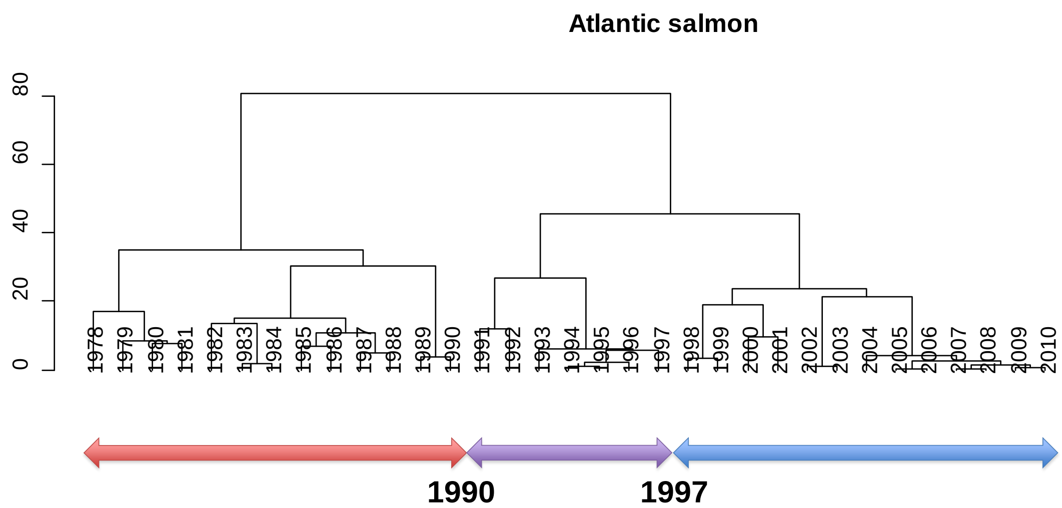


Figure 2.3.2.2. Chronological clustering of common trends in abundance and productivity of Atlantic salmon populations (identified from dynamic factor analysis) detects key change-points and distinguishes unique periods. The number of periods marked was determined by a broken stick model.

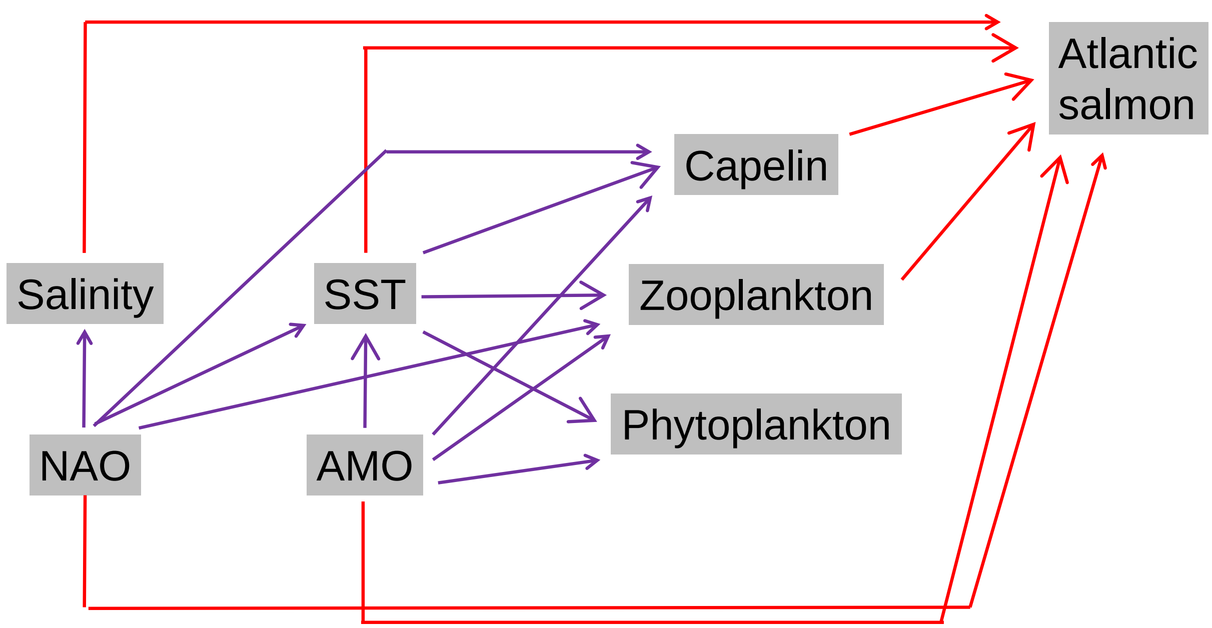


Figure 2.3.2.3. Synthesis of pairwise correlation results that shows direct (red) and indirect (purple) influences of climate, physical, and biological factors on Atlantic salmon population trends. The relative strength of the correlation is indicated by the width of the arrows (strong = thick, weaker = thin).

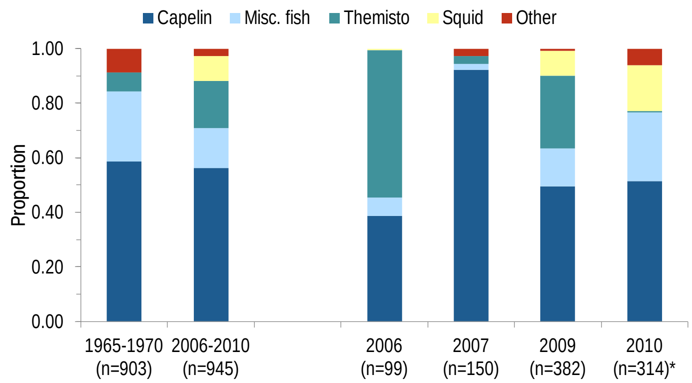


Figure 2.3.3.1. Proportion by mass (g) of primary prey items in the stomachs of Atlantic salmon sampled in research surveys from 1965–1971 and inshore fisheries from 2006–2010 (SALSEA NA). * Data from 2010 are incomplete and data from 2011 are currently being processed.

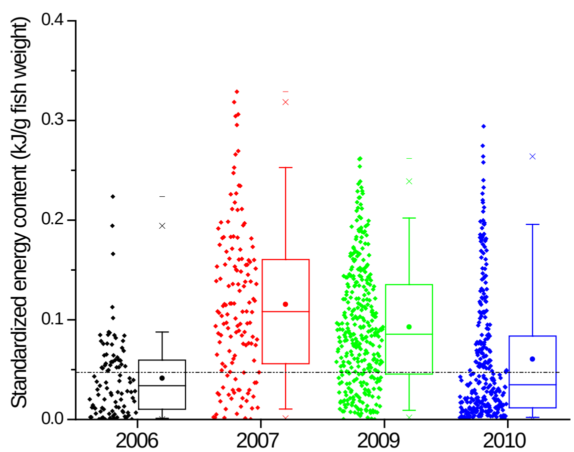


Figure 2.3.3.2. Standardized energy content (kJ/g fish weight) of stomach contents from Atlantic salmon sampled along West Greenland from 2006–2010 (SALSEA WG). Several sources were used to obtain the energy equivalents of various prey items (see text for details).

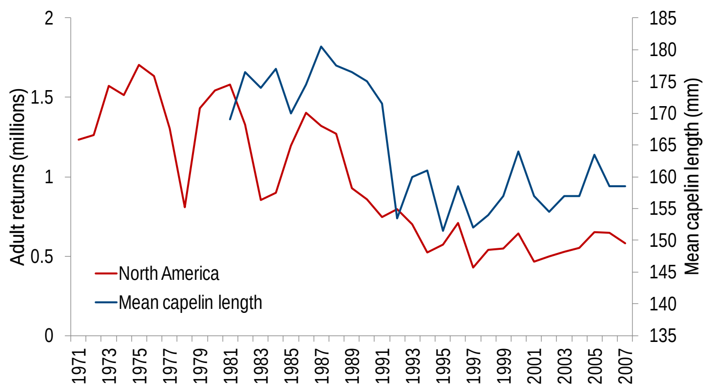


Figure 2.3.3.3. North American Atlantic salmon adult returns (ICES, 2012) and mean capelin length (data obtained from DFO, 2008) over time.

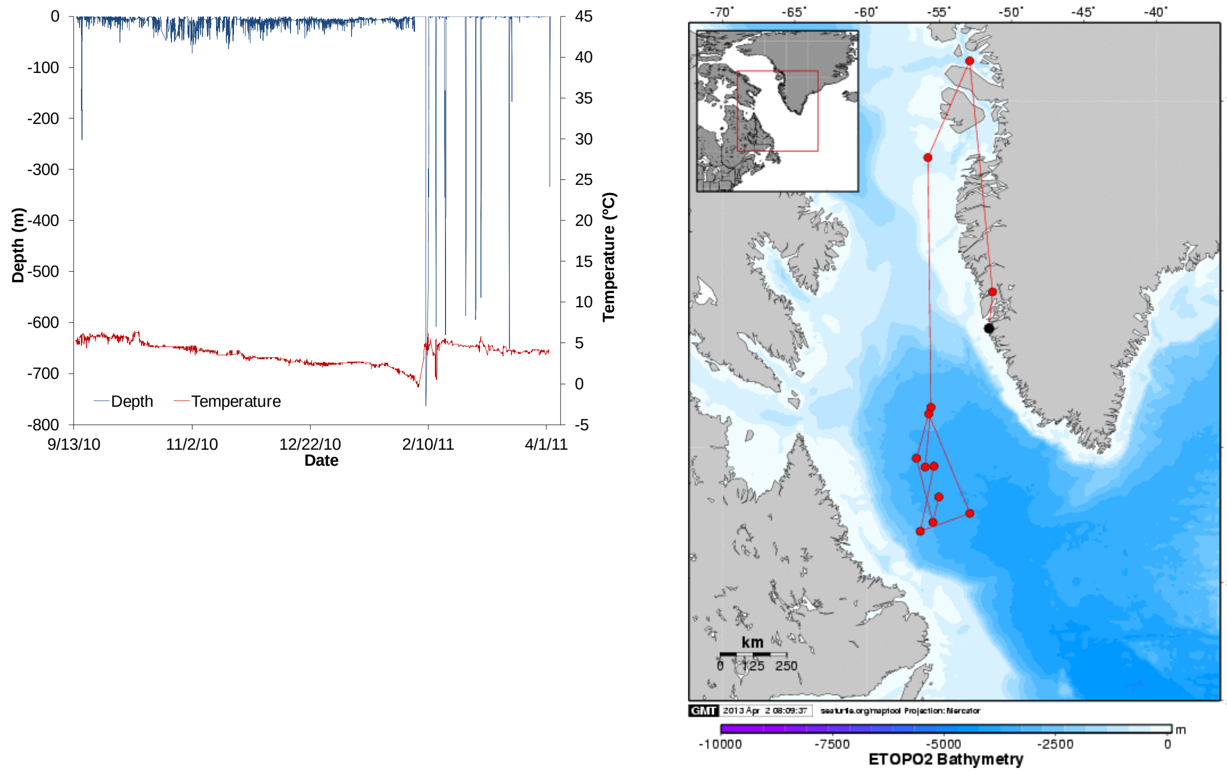


Figure 2.3.4.1. Geolocation positions (as determined by the methods detailed in Chittenden *et al.*, 2011) and environmental conditions experienced by an Atlantic salmon tagged at West Greenland in September 2010. The tag popped off as programmed on April 1st, approximately seven months after tagging (black circle indicated the release location). Swimming depth was constrained when the fish was over the shelf until eventually migrating into the Labrador Sea, at which time depths in excess of 750 m were achieved. The thermal habitat occupied decreased from approximately 5°C to less than 0°C, but the fish again occupied 5°C water upon entering the Labrador Sea.

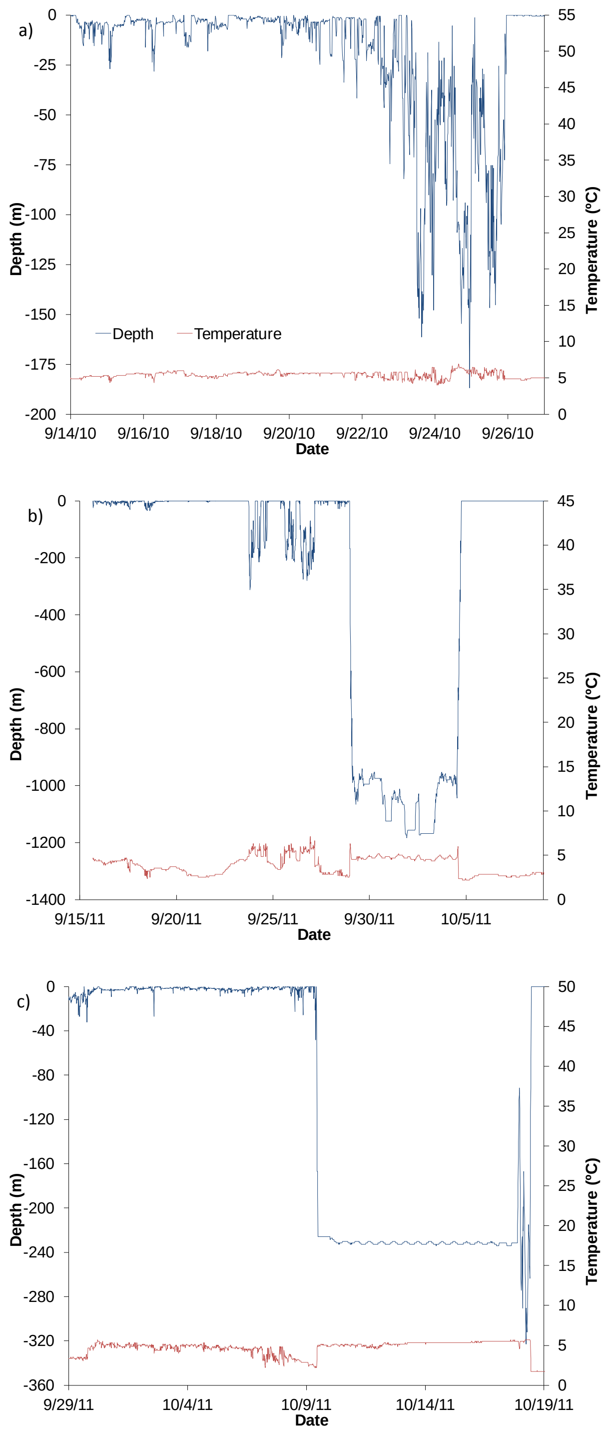


Figure 2.3.4.2. Temperature and depth profiles of Atlantic salmon potentially predated by a) an unknown predator, b) a Greenland shark and c) one scavenged by an Atlantic halibut in the Labrador Sea in 2010 (a) and 2011 (b and c).

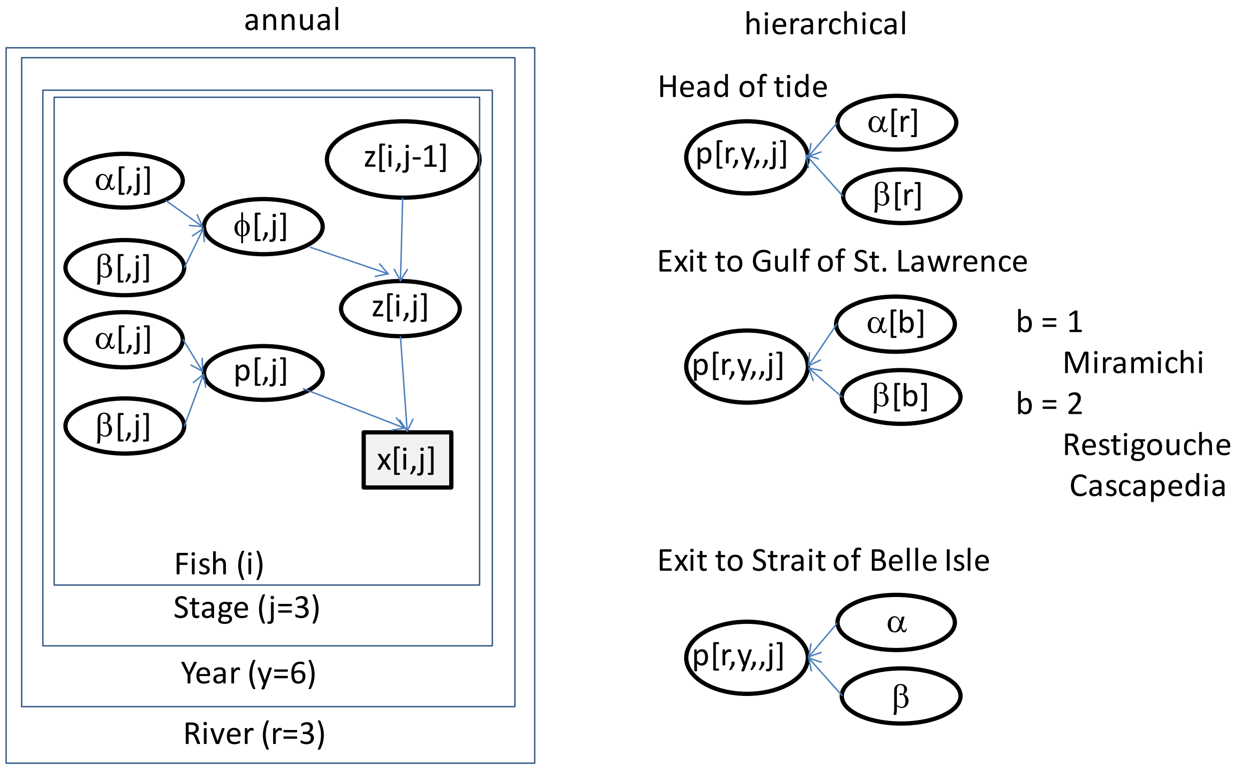


Figure 2.3.4.3.1. Directed Acyclic Graph (DAG) of the state–space implementation of the Cormac-Jolly-Seber model as an annual model (panel on the left) and the exchangeability assumptions for the probability of detections in the hierarchical Bayesian model (panel on the right).

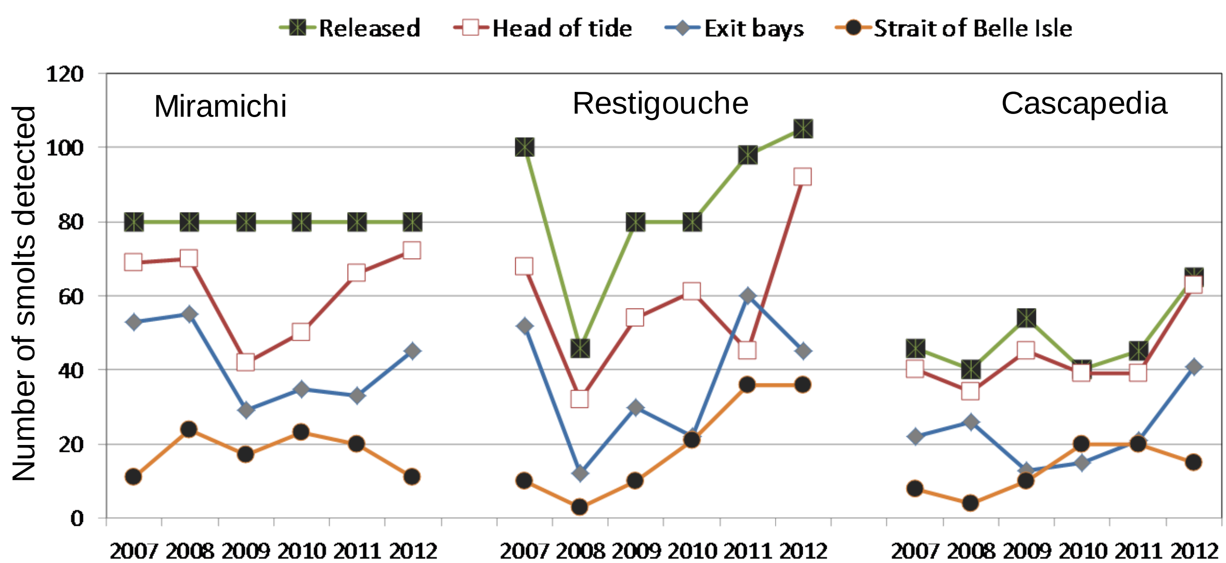


Figure 2.3.4.3.2. Number of smolts tagged and released from the Miramichi, Restigouche, and Cascapedia rivers, and subsequently detected at the head of tide, exit of bays, and Strait of Belle Isle arrays in 2007 to 2012.

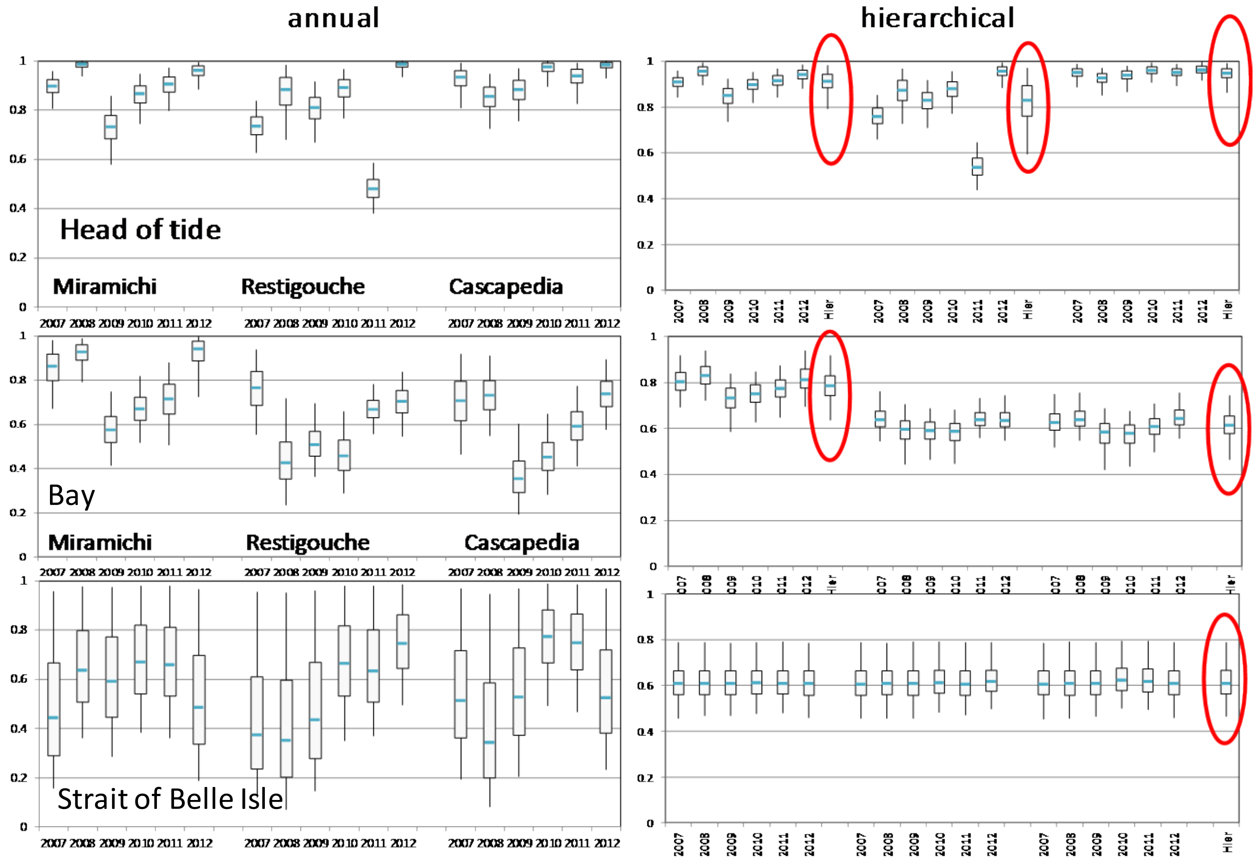


Figure 2.3.4.3.3. Posterior distributions of the annual and river origin probabilities of detection at the head of tide arrays (upper panels), the bay exit arrays (middle panel) and the Strait of Belle Isle array (lower panel). The left panels are for the annual model and the right panels are for the hierarchical model. The red ellipses in the hierarchical panels identify the posterior distributions of the hyperdistribution for the detection probabilities.

Prior assumptions for the probability of detection (*p*) at the Strait of Belle Isle array			
	P(*p*) ~ Beta(α, β)	E(*p*)	CV(*p*)
Uniformative	α = 1, β = 1	0.5	0.58
Informative	α = 9, β = 1	0.9	0.10
	α = 7, β = 3	0.7	0.20
	α = 50, β = 50	0.5	0.10
	α = 5, β = 5	0.5	0.30

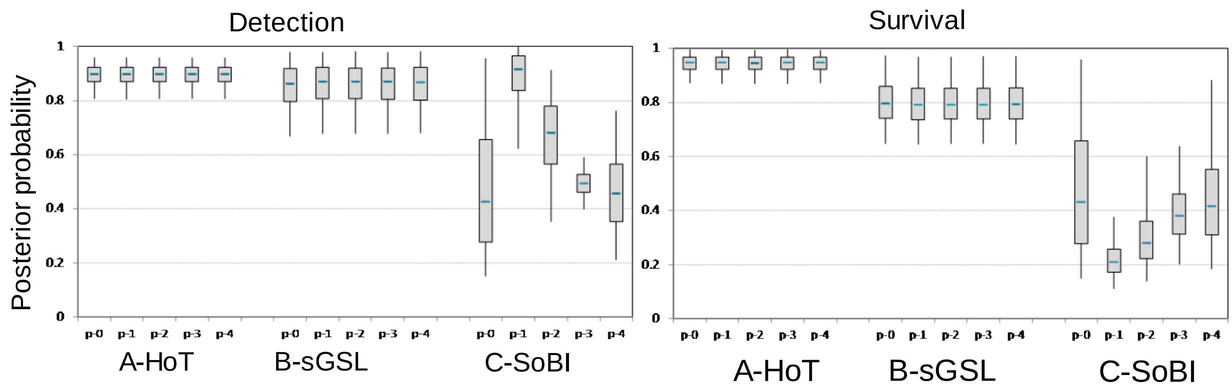


Figure 2.3.4.3.4. Prior assumptions for the probability of detection at the Strait of Belle Isle array (upper table) and the associated posterior distributions for the probabilities of detection and the probabilities of survival at the previous stages of the migration (lower panels). The example shown is for the smolts. [HoT = Head of Tide; GSL = Gulf of St Lawrence; SoBI = Strait of Belle Isle].

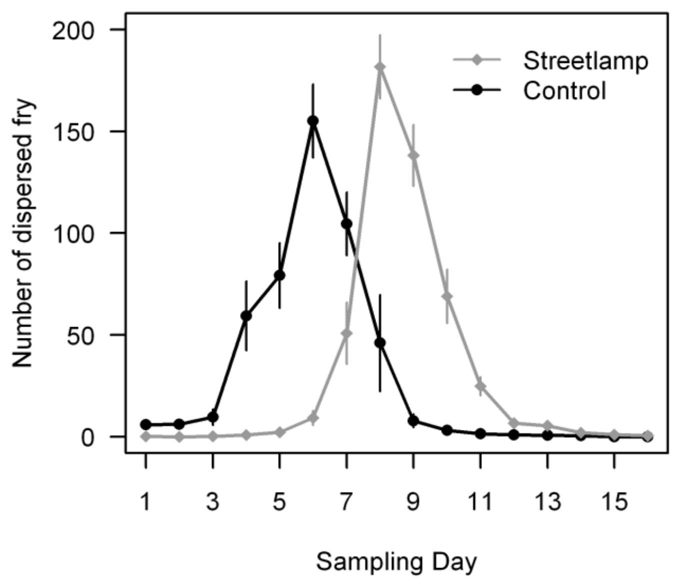


Figure 2.3.5.1. The mean number of fry dispersing each sampling day (24-h period) from the five control incubators and from the five incubators exposed to artificial night light in 2011, vertical bars show ±1 standard error.

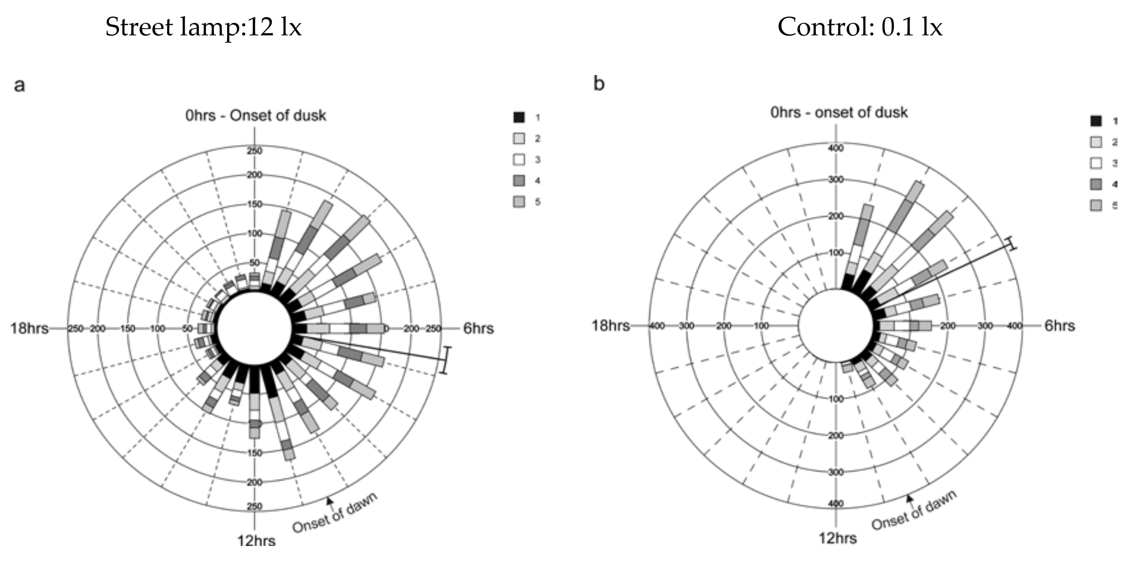


Figure 2.3.5.2. Circular plots of the diel patterns of fry dispersal in 2011in relation to hours following the onset of dusk. Data are presented for each incubator (1–5) for a) 12 lx artificial night lighting and b) 0.1 lx control conditions. Also indicated are the mean dispersal times (with 95% confidence limits) for each treatment and the onset of dawn.

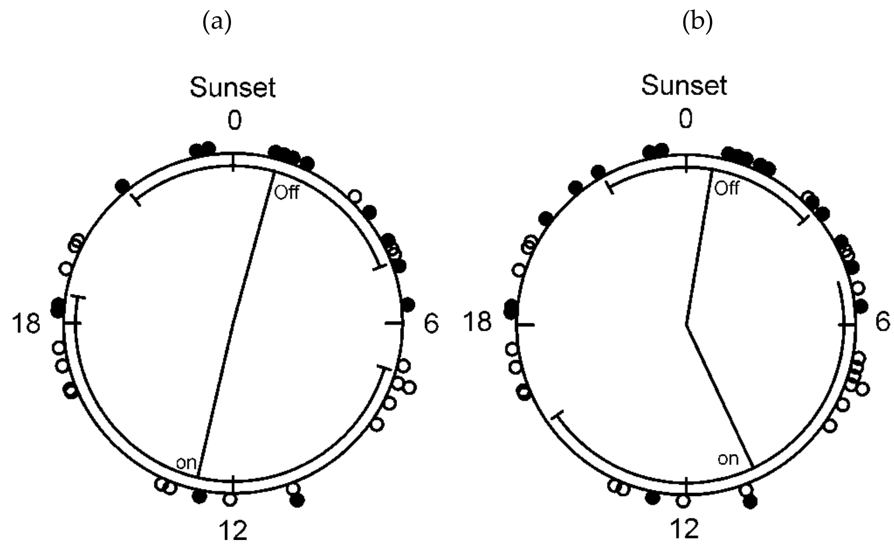


Figure 2.3.5.3. Circular plot of the time of migration of individual smolts permanently leaving the Brandy Stream, in relation to sunset, with the lamp either off (•) or on (○) (i.e. under street lit conditions) in (a) 2009 and (b) 2008/2009 (combined). The lines are the mean vectors (for both the light on and light off groups) and their direction indicates the mean time of downstream movement (with 95% confidence limits).

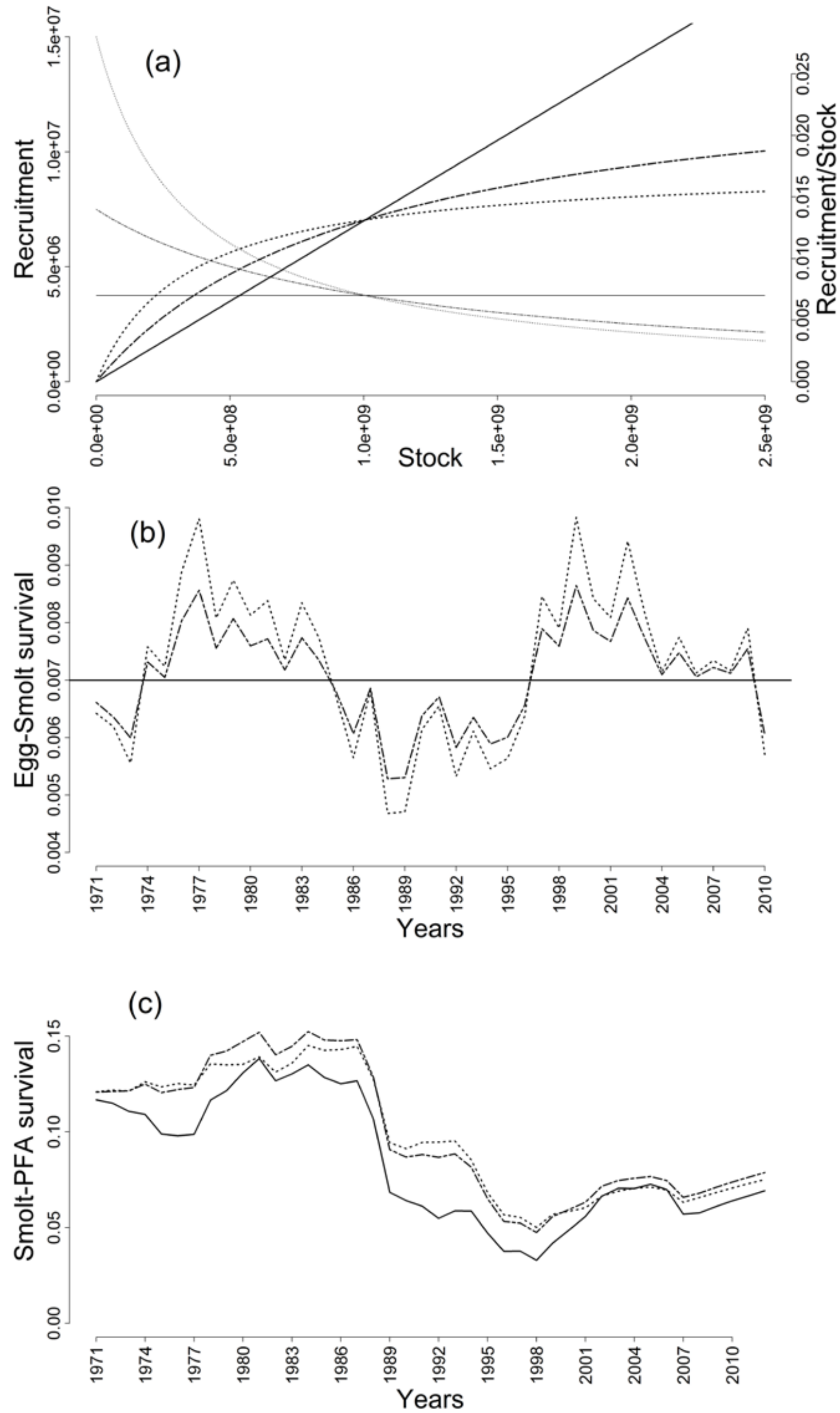


Figure 2.3.7.1.1. Sensitivity analysis to changes in egg-to-smolt survival. (a) Different egg-to-smolt survival functions tested (bold) and associated Recruitment/Stock ratio (faint). Solid line: average egg-to-smolt survival fixed at 0.7%; dotted and dashed-dotted lines: BH density-dependent function with gradient of uncertainty in density-dependence with α equal to 2.8% and 1.4%, respectively, and β equal to 3.0 10^{-9} and 9.9 10^{-10}, respectively. (b)-(c) Time-series of posterior median estimates of egg-to-smolt survival rate (b) and smolt-to-PFA survival rate (c); line patterns correspond to egg-to-smolt survival in (a).

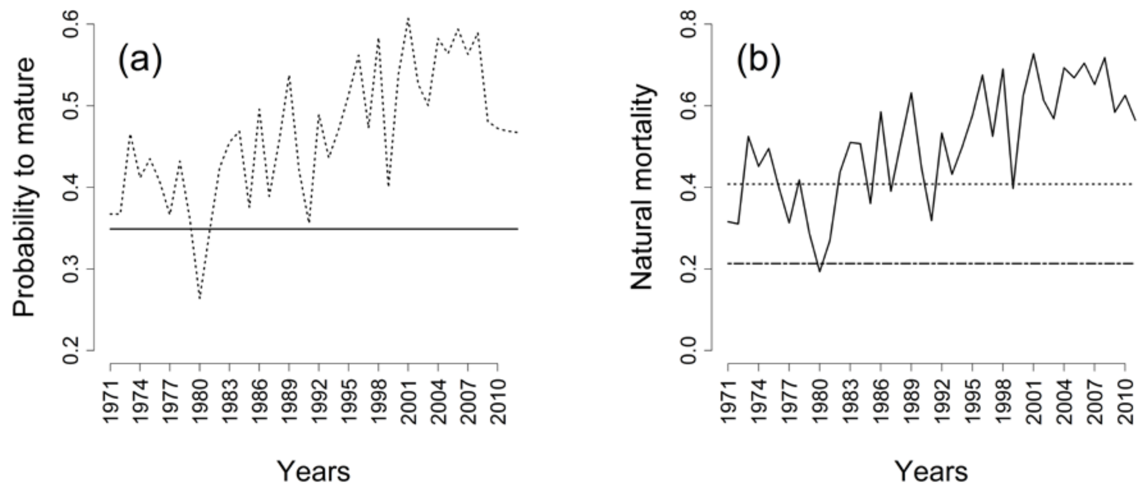
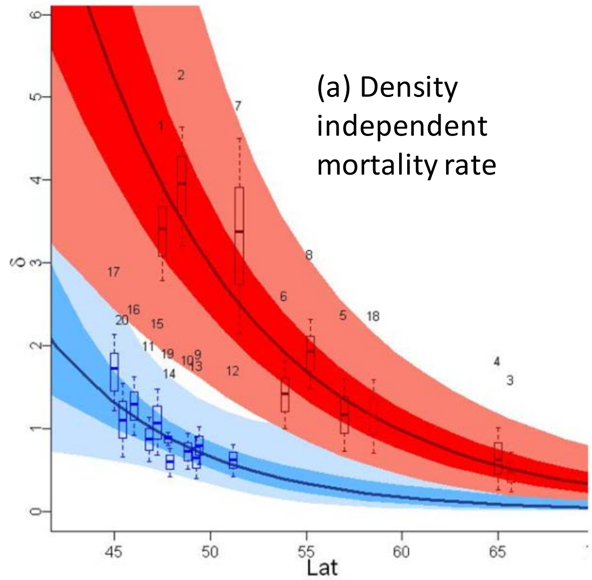


Figure 2.3.7.1.2. Sensitivity to the hypothesis for the PFA-to-return phase. (a) Time-series of posterior median estimates of the probability of maturing in the first year at sea obtained under the constant M_{2SW} / variable proportion maturing (p.mat) hypothesis (dotted line) and under the variable M_{2SW} / constant p.mat hypothesis (bold line). (b) Total natural mortality (%) of 1SW fish (dashed-dotted) and 2SW fish under the constant M_{2SW} / variable p.mat hypothesis (dotted line) and variable M_{2SW} / constant p.mat hypothesis (bold line).



Index	Area	River	Country/Region
1	NEAC	Scoff	France
2	NEAC	Oir	France
3	NEAC	Vesturdalsa	Iceland
4	NEAC	Elidaar	Iceland
5	NEAC	North Esk	UK(Scotland)
6	NEAC	Burrishole	Ireland
7	NEAC	Frome	UK(England&Wales)
8	NEAC	Bush	UK(N.Ireland)
9	NAC	dela Trinite	Quebec
10	NAC	St Jean	Quebec
11	NAC	Northeast Brook	Newfoundland
12	NAC	Western Arm Brook	Newfoundland
13	NAC	Campbellton	Newfoundland
14	NAC	Conne	Newfoundland
15	NAC	Rocky	Newfoundland
16	NAC	Pollett	New Brunswick
17	NAC	Nashwaak	New Brunswick
18	NEAC	Imsa	Norway
18	NAC	Little Codroy	Newfoundland
19	NAC	Big Salmon	New Brunswick

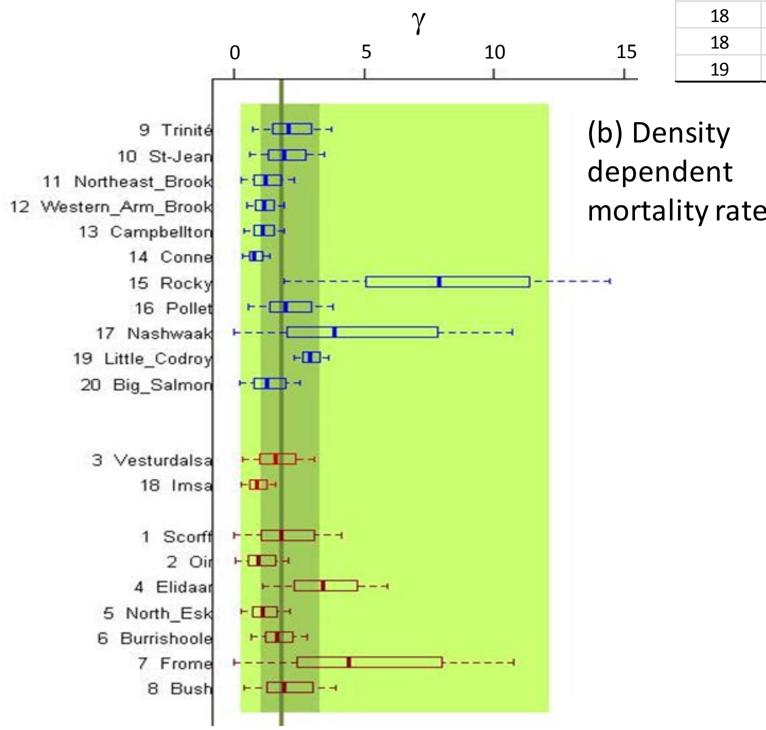


Figure 2.3.7.2.1. Boxplots : Marginal posterior distribution of: (a) the density-dependent mortality rate as a function of the latitude and longitude, and (b) the density-dependent mortality rate for 20 index rivers. Shaded areas correspond to the posterior predictive distribution of the parameters. Solid lines: posterior median; light shaded areas are 50% posterior probability intervals; and dark shaded areas 95% posterior probability intervals.

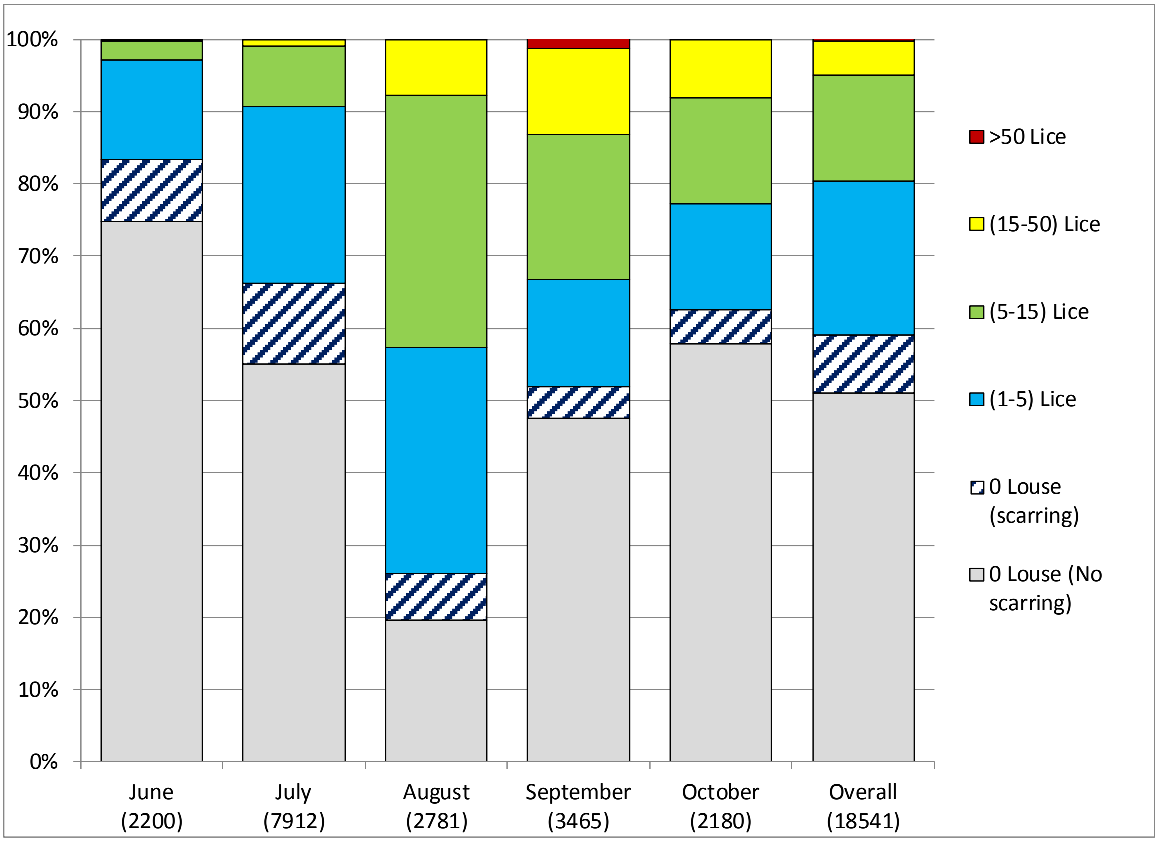


Figure 2.3.8.1. Percentage of fish sampled, by relative abundance category of sea lice, by month from salmon sampled in the Miramichi River, 2005 to 2011. The numbers in parentheses below the month labels are the number of fish sampled.

3 Northeast Atlantic Commission area

3.1 NASCO has requested ICES to describe the key events of the 2012 fisheries

3.1.1 Fishing at Faroes in 2011/2012

No fishery for salmon has been prosecuted since 2000.

3.1.2 Key events in NEAC homewater fisheries in 2012

The new coastal fishery by Sami communities of the Murmansk region of the Russian Federation was started in 2010 in the White Sea, where it has never been recorded in the past. The fishery continued in the coastal areas of the White Sea in 2011 and 2012. There were no other new key events reported by NEAC countries in 2012.

3.1.3 Gear and effort

No significant changes in gear type used were reported in 2012, 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, these data do not indicate the number of licences that were 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.

The numbers of gear units in UK (England & Wales) and in UK (Scotland) (Table 3.1.3.1) were among the lowest reported in the time-series. In Norway, the numbers of bag nets and bendnets have decreased for the past 15–20 years and 2012 numbers are the lowest in the time-series. The numbers of driftnets, draftnets, bag nets and boxes for UK (N. Ireland) for 2012 were the lowest in the time-series with only four units licensed.

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, but in 2012 remained close to the previous year and to the 5-year mean. In the Southern NEAC area, rod licence numbers have generally increased since 2001 in UK (England & Wales), although rod licence numbers in 2012 were lower than in 2011 and lower than the 5-year average. In Ireland, there was an apparent increase in the early 1990s due to the introduction of one day licences, after which licence numbers 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 two years.

3.1.4 Catches

NEAC area catches are presented in Table 3.1.4.1. The provisional declared catch in the NEAC area in 2012 was 1240 t, 179 t below the updated catch for 2011 (1419 t) and 11% and 30% below the previous 5-year and 10-year averages respectively.

The provisional total nominal catch in Northern NEAC for 2012 (939 t) was 71 t below the updated catch for 2011 (1009 t) and 8% and 17% below the previous five and ten year averages respectively. Catches in 2012 were below long-term averages in most Northern NEAC countries except Sweden and Finland. The catch in Iceland in 2012 was almost half the catch in 2011 and was the smallest in the time-series.

In the Southern NEAC area the provisional total nominal catch for 2012 (301 t) fell by 109 t from 2011 and was 17% and 52% below the previous 5-year and 10-year averages respectively. Catches in 2012 were below long-term averages in most Southern NEAC countries. There was a noticeable decrease (79 t) in the catch taken in UK (England & Wales) in 2012 compared to 2011.

Figure 3.1.4.1 shows the trends in nominal catches of salmon in the Southern and Northern NEAC areas from 1971 until 2012. 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 250–450 t over the last five years. The catch showed marked declines in 1976 and in 1989 to 1991 and continues to show a steady decline over the last ten years. The catch in the Northern area also indicated an overall decline 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 measures 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 data 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 UK (England & Wales) and UK (Scotland) net fisheries (Figure 3.1.5.1). Cpue values for net fisheries in these countries were mostly lower figures compared to 2011 and also to the previous 5-year averages (Table 3.1.5.3 and 3.1.5.5). The cpue values for rod fisheries in UK (England & Wales) and France in 2012 decreased from 2011 and were lower or close to the previous 5-year mean (Table 3.1.5.1 and Table 3.1.5.4). In UK (N. Ireland), the River Bush rod fishery Cpue showed an increase from 2011 but was lower than the 5-year average (Table 3.1.5.1). Overall, there is little change in cpue levels despite major reductions in fishing effort.

In the Northern NEAC area, there has been an increasing trend in cpue figures for the Russian rod fisheries in the White Sea rivers (Figure 3.1.5.1). This trend is pronounced in the River Ponoi, the only White Sea river with reported cpue for the whole dataseries (Table 3.1.5.2). The cpue for the commercial coastal and in-river net fisheries in the Archangelsk area, Russia, showed an increase from 2011 and higher values than the 5-year average (Table 3.1.5.2). A slight decreasing trend was noted for rod fisheries in Finland (River Teno and River Naatamo) over the time-series (Figure 3.1.5.1), although in 2012, both rivers showed an increase from 2011 and to the 5-year average (Table 3.1.5.1). An increasing trend was observed for the Norwegian net fisheries (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 in Figures 3.1.6.1 (Northern NEAC) and 3.1.6.2 (Southern NEAC). The overall percentage of 1SW fish in the Northern NEAC area catch remained reasonably consistent in the period 1987 to 2000 (range 61% to 72%), but has fallen in more recent years (range 49% to 69%), when greater variability among countries has also been evident. In the Northern NEAC area, the percentage of 1SW fish in the catch in 2012 (55%) was higher than in 2011 (49%), but equal to the previous 5-year average and lower than the previous 10-year average (58%). 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). The percentage of 1SW fish in catches in Iceland, Finland, Russia and Norway were higher in 2012 than in 2011, while in Sweden, the percentage of 1SW fish in catches was lower in 2012 than in 2011 (Figure 3.1.6.1).

In the Southern NEAC area, the percentage of 1SW fish in the catch in 2012 (49%) was higher than in 2011 (45%), but lower than the previous 5-year and 10-year averages (56% and 58% respectively). The percentage of 1SW salmon in the Southern NEAC area remains reasonably consistent over the time-series (range 45% to 65%), although with considerable variability among individual countries (Figure 3.1.6.2). 1SW fish typically comprise a larger proportion of the catch in UK (England & Wales) than in the other Southern NEAC countries for which data are available, although this proportion declined in 2011 and 2012.

The percentage of 1SW salmon in 2012 was among the lowest in the time-series for both the Northern and Southern NEAC areas (55% and 49% respectively). It should be noted that the data presented in Figures 3.1.6.1 and 3.1.6.2 may be influenced by various management measures and represent variation in age composition among years rather than within cohorts.

3.1.7 Farmed and ranched salmon in catches

The contribution of farmed and ranched salmon to national catches in the NEAC area in 2012 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 2012 was among the lowest on record (5%), whereas the proportion in samples taken from Norwegian rivers in autumn was at a similar level to previous years (12%). In a Kolarctic sampling programme (Section 2.3.10) (19 489 scale samples in 2011–2012, from 58 seafishers; Niemelä *et al*., unpublished) from the northern part of Norway (Northern-Nordland, Troms and Finnmark counties), 11% of the salmon collected between early May and late September were escaped farmed salmon. Escaped salmon occurred within the Kolarctic area during the entire summer (May: 6%; June: 22%; July: 41%; August: 30%; September: 1%). Numbers and proportions of escaped salmon increased towards the end of August in all counties. Mean weights of escaped salmon were larger than the mean weights of wild salmon in the sea catches in all counties. During the official sea fishing season, escaped salmon comprised 40%, 20% and 5% of the reported salmon catches in Northern-Nordland, Troms and Finnmark respectively. In a sample of 138 individuals of Atlantic salmon captured on the west coast of the Spitsbergen Island at Svalbard in the period 2008–2010, 11 individuals (8%) were classified as escaped farmed salmon based on genetic analysis and scale characteristics. The size of these escaped fish and their growth while at sea were similar to those of wild fish captured at the same time in the same area. This suggests that escaped farmed salmon may grow, migrate, and disperse throughout the ocean like their wild counterparts, and survive to adulthood (Jensen *et al*., in press).

The number of farmed salmon that escaped from Norwegian farms in 2012 is reported to be 38 000 fish (provisional figure), the lowest on record. An assessment of the likely effect of these fish on the output data from the PFA model 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 2012. Icelandic catches have traditionally been split into two separate categories, wild and ranched. In 2012, 12 t were reported as ranched salmon in contrast to 53 t harvested as wild. Similarly, Swedish catches have been split into two separate categories, wild and ranched, although ranched salmon are not reported separately as they are for Iceland (Table 2.1.1.1). In 2012, 20 t were reported as ranched salmon in contrast to 10 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

Evidence of Russian origin salmon being caught in coastal mixed-stock fisheries in northernmost Norway has been reported in previous years (e.g. ICES, 2009a). 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 results of a pilot study initiated in 2009 by Norway, Russia and Finland showed that coastal catches taken in northern Norway in 2008 consisted of a mix of salmon from a number of rivers in both Russia and Norway, with the Russian component in Finnmark increasing from west to east (Svenning *et al*. 2011). On average, through the whole sampling period from May to August, and across all sampling localities, the proportion of Russian salmon in the catches was 20%. Between regions and seasons, the proportion varied, reaching levels of up to 70% of Russian salmon in catches in the Varanger area, close to the Russian border, early in the season. There were also differences in regional and temporal distributions of different sea age groups. Through the season the proportion of Russian salmon decreased in all sampling areas. The results also demonstrated that bag nets and bendnets located near the coast catch fish from a larger number of stocks than nets located in the fjords (Svenning *et al*. 2011).

This work is continuing 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) (Section 2.3.11).

3.1.8.2 Regulation of the salmon fishery on the English northeast coast

In UK (England & Wales), a recent genetic analysis was used to help inform decisions about the future regulation of the salmon fishery on the English northeast coast. Samples were collected from almost two thousand salmon in 2011 and analysed by applying a genetic assignment approach. This relied on a baseline of genetic information in respect of populations of fish expected to contribute to the fishery; i.e. primarily rivers in northeast England and eastern Scotland. The ability to assign fish successfully depends on the baseline containing sufficient genetic variation to allow differentiation among the rivers/regions of interest. In practice, it was not possible to assign individual fish to their specific river of origin. However, it was possible to determine the proportions of the net catch that were from northeast English and Scottish rivers as regional groups. This confirmed the previous results from the tagging studies.

3.1.9 Exploitation indices for NEAC stocks

Exploitation estimates have been plotted for 1SW and MSW salmon from the Northern NEAC (1983 to 2012) and Southern NEAC (1971 to 2012) areas (Figures 3.1.9.1 and 3.1.9.2).

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.

Data gathered prior to the 1980s represent estimates of national exploitation rates while post 1980s exploitation rates have often been subject to more robust analysis informed by projects such as the national coded wire tagging programme in Ireland. The overall rate of change of exploitation within the different countries in the NEAC area is presented as a plot of the % change in exploitation rate per year (derived from the slope of the linear regression between time and natural logarithm transformed exploitation rate) over the time-series (Figure 3.1.9.3).

In 2012, exploitation of northern NEAC 1SW stocks was higher than exploitation of southern NEAC 1SW stocks. The exploitation of 1SW salmon in both northern NEAC and southern NEAC areas has shown a general decline over the time-series (Figures 3.1.9.1 and 3.1.9.2), with 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 of 1SW salmon in the Northern NEAC area was 40% in 2012 representing a slight decline from the previous 5-year (41%) and 10-year (43%) averages. Exploitation of 1SW fish in the southern NEAC complex was 12% in 2012 indicating a decrease from both the previous 5-year (15%) and 10-year (24%) averages. The current estimates for both stock complexes are at or among the lowest in the time-series.

Exploitation of northern NEAC MSW stocks was also higher than exploitation of southern NEAC MSW stocks in 2012. The exploitation rate of MSW fish also exhibited an overall decline over the time-series in both northern NEAC and southern NEAC areas (Figures 3.1.9.1 and 3.1.9.2), with a notable sharp decline in the northern NEAC area in 2008 as a result of significant changes in the Norwegian fisheries. Exploitation of MSW salmon in the northern NEAC area was 44% in 2012, lower than the previous 5-year (49%) and 10-year (53%) averages. Exploitation of MSW fish in southern NEAC was 11% in 2012, lower than the previous 5-year (13%) and 10-year (15%) averages.

The relative rate of change of exploitation over the entire time-series indicates an overall reduction in exploitation in most northern NEAC countries for 1SW and MSW salmon (Figure 3.1.9.3). 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 3.1.9.3) for both 1SW and MSW components. The greatest rate of decrease shown for both 1SW and MSW fish was in UK (Scotland) whilst Iceland (SW) showed relative stability in exploitation rates for both 1SW and MSW salmon during the time-series. 1SW exploitation rates in France showed a long-term increase, although the exploitation rate has been relatively stable over the past 18 years.

3.1.10 Bycatch of salmon in pelagic fisheries

The Icelandic Directorate of Fisheries (IDF) started a screening programme to investigate the incidence of salmon bycatch in mackerel/herring fisheries in 2010. In that year the programme was limited to 1000–3000 t multi-gear vessels, which fished with a midwater trawl and landed their catch in processing factories and freezing plants. In 2011 and 2012 the screening programme continued and included larger processing and factory vessels. The screening period lasted from early June to late September and was conducted by IDF inspectors. The Icelandic mackerel/herring fishery took place from northeastern to western areas with salmon caught as bycatch in all the areas. In addition to the salmon detected and sampled by the IDF personnel, Icelandic fishermen voluntarily provided salmon to samplers. The total catch screened was recorded by the IDF as well as the number of salmon provided by fishermen and the total catch of mackerel and herring caught by each of the ships returning salmon. The IDF screened catch and the catch from ships voluntarily providing salmon is regarded as total catch screened.

In 2010, 170 salmon were recovered from a total of 35 403 tonnes of mackerel and herring, an average of 4.8 salmon/1000 t. In 2011, a total of 40 804 t were screened and 249 salmon were recovered (6.1 salmon/1000 t). The total catch screened in 2012 was 37 349 t with a bycatch of 48 salmon (1.3 salmon/1000 t). Four tagged salmon caught in 2010 were from Norway and one from Ireland. In 2011, one Norwegian and one Irish tagged salmon were caught. The Norwegian salmon originated from rivers in West Norway, Daleelva, Vosso (2) and Imsa. The Irish fish were from River Shannon and River Bundorraghe, West Ireland. In these three years, no Icelandic tagged salmon have been recovered. For each salmon, information has been recorded on the date and place (coordinates) of capture, along with the length, weight and sex of the fish and details of any tags recovered. From 2011, additional samples were taken for sex and maturity determination, stomachs were retained for diet analyses and tissue was taken for DNA analyses. The head of each fish was also retained. Further screening of salmon bycatch in the Icelandic pelagic fishery is planned in 2013 as well as further analyses of existing samples.

In 2012, no information related to the pelagic fishery, screening, or bycatch of salmon was reported from the Faroes. The Working Group noted that screening of salmon as bycatch in pelagic fisheries as well as collecting of biological samples will increase the knowledge of salmon in these areas.

The Working Group recommended that similar sampling should continue in order to provide further information on the bycatch of salmon in pelagic fisheries in these areas.

3.2 Management objectives and reference points

Management objectives for North Atlantic salmon stocks are outlined in Section 1.4. Section 1.5 describes the derivation of reference points for these stocks and stock complexes.

The current status of the NEAC stock complexes is considered here with respect to ICES guidance. Conservation limits (CLs) have been defined by ICES as the stock level that will achieve long-term average maximum sustainable yield (MSY). NASCO has adopted this definition of CLs (NASCO 1998). The CL is a limit reference point; having populations fall below these limits should be avoided with high probability. Historically, stock complexes in the NEAC area have been interpreted to be at full reproductive capacity only if the lower bound of the 95% confidence interval of the most recent spawner estimate is above the CL. In a similar manner, the status of stocks prior to the commencement of distant water fisheries has been interpreted to be at full reproductive capacity only if the lower bound of the 95% confidence interval of the most recent pre-fishery abundance (PFA) estimate is above the Spawner Escapement Reserve (SER).

Previously, ICES (2011b) assessed the status of stocks and provided advice on management of the stock complexes in the NEAC area based on the uncertainties in the estimates of spawners relative to CLs. Specifically, if the lower bound of the 95% confidence interval (i.e. 97.5% probability) of the current estimate of spawners was above the CL, then the stock was considered at full reproductive capacity. When the lower bound of the confidence limit was below the CL, but the midpoint was above, the stock was considered to be at risk of suffering reduced reproductive capacity. Finally, when the midpoint was below the CL, the stock was considered to be suffering reduced reproductive capacity.

The risk assessment framework in this current report directly evaluates the risk of meeting or exceeding the stock complex objectives. Managers can choose the risk level which they consider appropriate. ICES considers however that to be consistent with the MSY and the precautionary approach, and given that the CLs are considered to be limit reference points 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). As such, the following terminology is used in this year's report to characterize stock status at the stock complex and country levels:

- 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.
- Finally, when the midpoint is below the CL, ICES considers the stock to be suffering reduced reproductive capacity.

ICES has also indicated that for the implementation of the risk framework for the provision of catch advice for the NEAC area, management objectives should be defined for each salmon management unit. Such management objectives have yet to be agreed by NASCO and are discussed further in Section 3.4.

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 (Potter *et al*., 2004).

As described previously (ICES, 2002), the NEAC-PFA run reconstruction model (Section 3.3.1) 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 (Section 3.3.4) as 'pseudo stock–recruitment' relationships for each homewater country unable to provide river-specific CLs.

ICES currently define the CL for salmon as the stock size that will result in the maximum sustainable yield (MSY) in the long term. It is not straightforward to estimate this point on the stock–recruitment relationships established by the national PFA run-reconstruction models, however, 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. The Working Group has previously adopted a method for setting biological reference points from the national 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. This approach was again applied to the 2012 national stock–recruitment relationship assessment for countries where no river-specific CLs have been determined.

3.2.2 National conservation limits

Where river-specific estimates of CL have been derived for the country as a whole (France, Ireland, UK (England & Wales) and Norway), these are used to provide national estimates. For countries where the development of river-specific CLs has not been completed, the method based on the PFA run-reconstruction model and described above has been used (Table 3.2.2.1). The estimated national CLs have been summed for northern and southern NEAC stock complexes (Table 3.2.2.1).

The CLs have also been used to estimate the SERs (the CL increased to take account of natural mortality between the recruitment date, 1st January, and return to homewaters) for maturing and non-maturing 1SW salmon from the 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 for 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

In Finland, information has been collated to set CLs for two tributary systems of the River Teno/Tana in addition to the five Norwegian tributaries where CL attainment has been evaluated in recent years. There is also work in progress in Norway in cooperation with Finland to revise the CLs for the Teno/Tana river system based on new information on habitat distribution and revised GIS-estimates of wetted area.

In UK (Scotland), CLs and associated measures of spawning escapement and returns to homewaters will be available for salmon stocks by summer of 2013. This information will be used to inform the management of stocks objectively, consistently and in line with NASCO guidance. CLs are derived from stock and recruitment data from the River North Esk and transported to other areas based on estimates of the relative wetted area and productivity of the salmon habitat. Estimates of stock abundance are derived primarily from fishery returns. Assessment will generally be possible down to the fishery District scale, the lowest scale at which fishery data are routinely available. Districts correspond either to a single river catchment together with adjacent coast or to groups of neighbouring river catchments and associated coastline (Scottish Government, 2012). Much of the data used to derive these models has been derived from long-term monitoring undertaken by Marine Scotland Science (MSS) on the River North Esk together with additional information from a limited number of other rivers. Biological data from a wider range of stocks is required to increase the robustness of the assessments of Scottish stocks at the District scale. Further development is also required to allow assessment at sub-catchment scales, for example to inform management of spring salmon stocks.

In UK (N. Ireland), in addition to progress previously reported (ICES, 2012a), the River Clady has been surveyed and a CL for that river stock established.

In Ireland, CLs for salmon stocks were updated in 2012 for calculation of 2013 catch advice. This was undertaken for a number of reasons:

- to update reference rivers providing stock–recruitment indices to a more Irish focused set in light of new Irish river counter data;
- to ensure that CLs are based on up-to-date, river-specific biological information;
- in light of updated river wetted areas.

A full description of the changes proposed was provided in ICES (2012a). In summary, prior to the 2012 analyses for 2013, the Bayesian Hierarchical Stock and Recruitment Analysis (BHSRA) model was developed for a set of 13 stock and recruitment dataseries from monitored salmon rivers located in the Northeast Atlantic. For the 2012 analyses for the 2013 season the index rivers were updated, to a more Irish focused series comprising 22 rivers, of which 17 are in the island of Ireland, four in UK (England & Wales) and one in UK(Scotland). The time-series of spawner–recruits for each river was updated and the model re-run. This yields a set of predicted stock and recruitment parameters for new rivers, provided information is available on the size of the river (in this case usable habitat or wetted area is used) and on the river's latitude.

The most current biological information was used in estimating river salmon populations, in terms of the ratio of 1SW to MSW fish; the weights of each and their associated fecundities. Prior to the 2012 analyses these values were estimated and set nationally based upon best available information. For the 2012–2013 analyses, values are river-specific where catches of salmon less than 4 kg and greater than 4 kg were each above 50 fish between 2006 and 2011; for rivers with smaller catches, national averages were applied.

The previous sums of CLs for individual rivers in Ireland indicated a requirement of 236 044 1SW fish and 15 334 MSW fish (251 378 total CL). The new estimates are 211 471 1SW and 46 943 MSW fish (258 415 total CL). The new output indicates a much higher MSW requirement than previously. This is due principally to the following factors:

- The breakdown of 1SW and MSW is more specific to a particular river and stock i.e. in general the age distribution is based on catch weights split (>4 kg is the cut-off for MSW salmon) or catches made in spring/summer (i.e. all fish caught up to the end of May are considered MSW fish).
- The new fecundity estimates are now based on contemporary analysis of field and literature studies and indicate a lower fecundity of 6000 eggs per 2SW female compared to the previous value of 8000 eggs per 2SW female. This in turn will result in a higher requirement of individual fish to meet the same CL than previously.

- Estimates from the new wetted area analysis include a requirement for spawners in the upstream portions of large impounded rivers. These have now been included in the assessment of CL nationally.

3.3 NASCO has requested ICES to describe the status of stocks

3.3.1 Development of 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. The original model was described by Potter *et al*. (2004) and modifications have been described in subsequent Working Group reports. PFA in the NEAC area is defined as the number of 1SW recruits on January 1st in the first sea winter. The model is 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. 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 the period over which the respective national fisheries operate. 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 (12 000 trials) is used to estimate confidence intervals on the stock estimates.

The model has previously been run using ‘Crystal Ball’ (CB) in Excel (Decisioneering 1996). An updated version of the model which runs in the ‘R’ programming language (R Development Core Team, 2007) was developed in 2011 (ICES, 2011b). The objective was to provide 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. In 2012, the outputs of the CB and ‘R’ models were compared to examine the approaches taken and validate the outputs (ICES, 2012a). The run-reconstruction analysis in 2013 was completed using the ‘R’ program.

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

To run the NEAC PFA run-reconstruction model, countries are generally required to input the following time-series of information, beginning in 1971, for both 1SW and MSW salmon (Annex 5):

Catch in numbers;

Unreported catch levels (minimum and maximum); and

Exploitation levels (min and max).

These inputs have been described in detail previously (ICES, 2002). Modifications to these inputs are reported in the year in which they are first implemented and modifications undertaken in 2012 are provided in Section 3.3.3.

For some countries, the data are provided in two or more regional blocks. In these instances, model output is provided for the regions and is also combined to provide 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. The Norwegian catches from the River Tana/Teno are not included in the input data for Norway.

With the implementation of the model in 'R', it has been agreed that where the above data are themselves derived from other data sources, the raw data should be included in the model. This will permit the uncertainty in these analyses to be incorporated into the modelling approach. Currently the model input data for UK (England & Wales) and Greenland have been modified in this way. For UK (England & Wales) the changes address the estimation of the catches of Scottish fish in the northeast English coastal fishery, which are incorporated into the assessment for 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.

For countries where fishery data were supplied disaggregated by region, the CB model previously estimated the national CL using the total national estimates of lagged eggs and PFA (see 3.2.1). However, it was considered more appropriate (ICES, 2012a) to apply this analysis to each region and then sum the resulting estimates to provide a national figure. This was implemented in the 'R' code.

3.3.3 Changes to the NEAC-PFA run-reconstruction model

Provisional catch data for 2011 were updated where appropriate and the assessment extended to include data for 2012.

For Ireland, changes in the CLs used in the model are described in Section 3.2.3.

For UK (England & Wales), exploitation rates were recalculated using days fished as the basis for estimating these data rather than licences issued as previously.

Estimates of CLs for the northern NEAC stock complexes in 2012 were similar to those reported in 2011, declining by 5.6% for 1SW salmon stocks while increasing by 2.0% for MSW stocks. Estimates for southern NEAC stock complexes declined compared to 2011 estimates by 5.7% for 1SW salmon stocks and increased by 14.2% for MSW stocks. Much of the change in CL estimates for the southern NEAC stock complex may be attributed to the changes in the methodology used to estimate CLs for Irish salmon stocks.

3.3.4 Description of national stocks as derived from the NEAC-PFA run-reconstruction model

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).

3.3.5 Trends in the abundance of NEAC stocks

Tables 3.3.5.1–3.3.5.6 summarize 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 3.3.5.1.

The 5th and 95th percentiles indicated by the whiskers in each of the plots (Figure 3.3.5.1) indicate the uncertainty in the data. The Working Group recognized that the model provides an index of the current and historical status of stocks based upon fisheries data. Errors or inconsistencies in the output largely reflect uncertainties in the estimates of these data. It should also 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 abundances of both maturing 1SW and of non-maturing 1SW recruits for northern NEAC (Figure 3.3.5.1) show a general decline over the time period, the decline being more marked in the maturing 1SW stock. Both stock complexes have, however, been at full reproductive capacity (see Section 3.2) prior to the commencement of distant water fisheries throughout the time-series.

1SW spawners in the northern stock complexes 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 recruits for southern NEAC (Figure 3.3.5.1) demonstrate broadly similar declining trends over the time period. Both stock complexes 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 1997. 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 all NEAC stock complexes, prior to the commencement of distant-water fisheries, in the latest available PFA year was considered to be at full reproductive capacity.

3.3.6 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 3.3.6.1. 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 is for the MSW component and data for Norway relate to 2011. Of the seven countries, the proportion of rivers assessed for compliance with CLs ranges from 0% to 88%.

3.3.7 Survival indices 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 Figure 3.3.7.1 and Figure 3.3.7.2. The survival indices are the percent change in return rate between five-year averages for the periods 2002 to 2006 and 2007 to 2011 for 1SW salmon, and 2001 to 2005 and 2006 to 2010 for 2SW salmon. The annual survival indices for different rivers and experimental facilities are presented in Tables 3.3.7.1 and 3.3.7.2. Return rates of hatchery released fish, however, may not always be a reliable indicator of marine survival of wild fish.

The overall trend for hatchery smolts in northern and southern NEAC areas is generally indicative of a decline in marine survival. For the wild smolts this 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 means of the five-year periods varied from an 84% decline to a 111% increase in one river (Figure 3.3.7.1). 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 survival indices for wild and reared smolts displayed a mixed picture with some rivers above and some below the previous 5 and 10-year averages (Tables 3.3.7.1 and 3.3.7.2). The return of wild 1SW 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 2SW wild salmon to the Rivers Frome and Tamar in UK (England & Wales) were above the 5-year and 10-year averages. An increase in survival for hatchery reared fish was detected in Norway for 2SW salmon on the Imsa River, and on the Ranga River in Iceland for 1SW fish (Table 3.3.7.2).

Comparison of survival indices for the 2010 and 2011 smolt years show a general decrease for 2011 compared to 2010 for wild 1SW smolts in Northern and Southern NEAC areas, with the exception of the River Imsa in Norway, and the River Burrishoole in Ireland. Increased survival for 2SW returns from the 2010 smolt year compared to 2009 was also noted in most rivers that reported MSW survival in Southern NEAC for those years. Only the River Dee in UK (England & Wales) showed a decrease in survival of 2SW relative to the year before for the 2010 smolt cohort. This could however be a result of poor sampling conditions due to consistently high flows that prevailed in UK (England & Wales) throughout 2012 and relatively small numbers of tagged smolts in 2010. Survival indices for hatchery smolts in the northern NEAC area for the 2011 smolt year showed a decrease relative to 2010. In the southern NEAC area survival indices for hatchery smolts decreased in the same period, except for the Irish River Burrishoole, for which the survival index was slightly higher in 2010 compared to 2009. The only available MSW survival index for the 2009 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 standardized to provide indices of survival for Northern and Southern 1SW and 2SW returning adult wild and hatchery salmon in the NEAC area (Figure 3.3.7.3). In summary:

- 1SW return rates of wild smolts to the northern NEAC area (three river indices) although varying annually, have generally decreased since 1980 ($p<0.05$). However, a slight improvement has been noted in recent years. This declining trend is not evident for the 2SW wild component (three river indices) and recent return rates have shown some improvement.
- Similarly, 1SW return rates of wild smolts (seven river indices) to the southern NEAC area have generally decreased since 1980 ($p<0.05$). Apart from return rates in 2010 (2009 smolt year), eight of the previous ten years values were the lowest in the time-series indicating a persistent period of poor marine survival. While this declining trend is not evident for the 2SW wild component (five river indices), recent returns have also been amongst the lowest in the time-series.
- 1SW return rates of hatchery smolts to the northern NEAC area (four river indices) although varying annually, have generally decreased since 1980 ($p<0.05$). However, a slight improvement has been noted in recent years. This declining trend is not evident for the 2SW hatchery component (four river indices) and recent return rates have shown an increase.
- 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 2012 returns (2011 smolt year), six of the most recent years' values are amongst 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 3.3.5), and suggest that returns are strongly influenced by factors in the marine environment.

3.4 NASCO has asked ICES to further develop a risk-based framework for the provision of catch advice for the Faroese salmon fishery reporting on the implications of selecting different numbers of management units

In responding to this question, NASCO has specifically asked ICES to advise on:

- the limitations for defining management units smaller than the current NEAC stock complexes;
- the implications of applying probabilities of achieving CLs to separate management units vs. the use of simultaneous probabilities; and
- the choice of risk levels for achieving management objectives.

3.4.1 Background to the risk framework model

For a number of years, NASCO has asked ICES 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. ICES (2010b) described a risk-based framework that could be used to evaluate catch options for the Faroes fishery based on the method applied for the West Greenland fishery since 2003 (ICES, 2012a).

ICES (2011b) provided a more detailed evaluation of the choice of appropriate management units to be used in the risk-based framework, taking into account relevant biological and management considerations. ICES noted that breaking the stock complexes down to at least the national level was desirable because so many river stocks are exploited by the fishery. ICES also indicated that NASCO would need to agree upon the following issues before the risk-framework could be finalized:

- season 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 the absence of feedback from NASCO, ICES (2012a) made pragmatic decisions on these questions in order to provide full catch advice for the 2012/2013 to 2014/2015 fishing seasons. The advice was provided on the basis of the four management units comprising two age groups for each of two stock complexes because it was not possible to provide stock forecasts at a more detailed (e.g. country) level at that time. However, ICES proposed that if the risk framework was run at the stock complex level then the proportion of rivers within each country meeting their CLs should also be considered when evaluating catch options.

The following sections provide a further discussion on the implications of basing the risk framework on different management units and management objectives to assist managers in agreeing on the risk framework to be employed in future.

3.4.2 Management units and management objectives

Homewater fisheries

NASCO defines the basic unit for salmon management as the river 'stock', which comprises all salmon originating from a single catchment. NASCO also recommends that salmon fisheries should be managed on the basis of river and age-specific conservation limits (CL). These CLs should therefore define the minimum numbers of 1SW and MSW spawners required in each river each year, and these may be treated as separate management units (for convenience these are referred to as 'stocks' below). Fisheries should therefore be regulated to ensure that these stocks have a high probability of meeting or exceeding their CLs. The probability level chosen varies among countries but has generally been above 75%. In the case of a 75% probability choice, the management objective for the fishery would be that '*there should be a greater than 75% probability of each management unit exceeding its CL*'. There would be no catch options for a fishery consistent with the objective of the stock exceeding the CL if the probability falls below 75%.

Probabilities of attaining the CL in a given year should not be confused with the expected performance of the stock over many years. For example, if a stock annually has a probability of 75% of exceeding its CL, then over a sequence of four years, there is a 69% chance that the stock will fail to meet its CL in at least one of the four years, a 28% chance that it will fail to meet its CL in two or more years, and a 6% chance that it will fail to meet its CL in three or more years (i.e. meet the CL in only one year or fail all together). At the 95% probability level of meeting the CL, the probabilities of meeting the CL in all four years is 80% and the probability of meeting the CL in two or fewer years decreases to 2%. Therefore, the choice of the risk level of meeting the CL has important implications in the risk to the stock in its year on year performance.

	Probability of meeting the CL	
Single-stock example: Probability over four years of meeting CL	0.75	0.95
All four years	31%	80%
In three or fewer years	69%	20%
In two or fewer years	28%	2%
In one or fewer years	6%	< 1%
In none of the four years	1%	Near zero

NASCO (2009) accepts that different jurisdictions may express their management objectives for salmon fisheries in different ways, and a number manage their stocks on the basis of an egg deposition conservation limit for each river. NASCO has also conceded that for severely depleted stocks, or in the absence of river and age-specific CLs, alternative management objectives might be adopted. However, these should ideally operate in a similar way and be based on the probability of attaining a reference level.

NASCO has advised that the above principles should apply equally to single-stock and mixed-stock fisheries (MSFs), with MSFs being managed to protect the weakest stocks. This means that a homewater MSF should not operate if one or more of the individual stocks (e.g. one age group from one river stock) is not expected to achieve its management objective. For any fishery to operate, the harvest or the fishery effort should be limited to ensure that the management objective is still achieved for all stocks (e.g. the probability of exceeding the CL for each stock is still greater than the values set by management, e.g. 75% or 95%).

Achieving this overall management objective for the MSF should be guaranteed by limiting the harvest to the exploitable surplus in the weakest stock. However, this may result in a very small fishery. It would also be possible to use information on the composition of the catch in the MSF and its variability over time, to set a harvest limit that would still ensure that each stock meets its management objective.

In practice, there is a huge variation is the size of salmon river stocks, with the largest stocks being several orders of magnitude larger than the smallest. Stock status also varies considerably, with the 'healthiest' stocks exceeding their CLs by a factor of two or more. Thus a large healthy stock may mask the shortfall in a number of weaker small stocks (or *vice versa*). Risks to individual stocks will also be affected by the relative variability of stocks of different sizes. Thus if large stocks are more variable (i.e. have higher CVs) relative to small stocks, it will increase the risks to the smaller stocks.

This means that as the number of stocks exploited by a fishery increases, it becomes more difficult to achieve the management objectives in all contributing stocks. This is not only because of the practical difficulties of establishing the numbers of fish from each river that are taken, but also because as the number of stocks increases it becomes less and less likely that they will all be achieving their management objectives simultaneously. Such fisheries might be managed on the basis of a single composite CL (e.g. the sum of all CLs of the contributing stocks). However, in such a case, a higher probability limit would need to be set for the combined stock in order to protect the individual stocks. In a fishery exploiting a large number of stocks (e.g. tens to hundreds) the probability of simultaneously achieving river-specific management objectives becomes very unlikely.

Comparing MSFs that exploit different numbers of stocks, the effects of a MSF depends in part on the management strategy adopted. If the overall exploitation rate (i.e. weighted mean exploitation rate for all contributing stocks) is the same in each fishery, the risks to individual stocks will be higher for the MSFs exploiting more stocks. But if the overall harvest in each fishery is kept constant, the risk to individual stocks may decrease as the number of stocks exploited in the fishery increases (effectively because the exploitation rate will decrease), although this is predicated in part on the status of the individual stocks. In practice, management strategies for MSFs are likely to fall between these extremes.

Distant water fisheries

The distant water fishery at Faroes caught salmon originating from both northern and southern European rivers, and the fishery at West Greenland catches salmon principally from North American and southern European rivers. Both fisheries may exploit fish from well over 1000 different river stocks. If management of the fisheries at Faroes and Greenland were based on the principles described above for homewater fisheries (i.e. all contributing river stocks exceeding their river-specific CLs with a high level of probability), there would probably be no chance of a fishery being advised. This is because the probability of all potentially exploited stocks meeting their management objectives becomes highly unlikely with such a large numbers of stocks exposed to the fishery, in addition to the wide range of stock status of rivers across the North Atlantic.

Although not formally examined, even if all the over 1000 river stocks potentially contributing to these fisheries had received spawners in excess of their CLs and were producing recruitment in excess of parental stock (i.e. surplus), there is a very high probability that an important proportion of these stocks would fail to meet their CLs in any given year. In addition, productive capacity of rivers in both NAC and NEAC has been impacted by anthropogenic factors for several hundred years and many rivers are not producing recruitment at rates expected under pristine conditions. As such, the likelihood of meeting the CLs in the 1000+ rivers in the Northwest Atlantic in the past and presently is nil.

NASCO has agreed that for the management of the distant water fisheries, 'stock complexes' should be defined, which include larger numbers (100s) of rivers. ICES currently provides advice on the basis of six North American stock complexes (i.e. five Canadian provinces and USA) and up to 19 European stock complexes (i.e. countries and regions). For the management of the West Greenland fishery, it is only necessary to consider MSW stocks, and so management decisions are based on the status of seven management units, comprising the MSW salmon in each of the six North American stock complexes and in the whole of southern Europe. For the management of the Faroes salmon fishery, management decisions take account of the status of both 1SW and MSW salmon stocks. Catch advice is currently based on the status of 1SW and MSW stocks in southern and northern Europe, making a total of four management units.

The main effect of managing on the basis of stock complexes is that an MSF can (and normally will) operate when some river stocks are not expected to achieve their management objectives. This can occur when the expected shortfall of fish in one or more stocks is compensated for by an excess in the more healthy stocks. Given the large variability in size and status of individual river stocks, this can result in the operation of the MSF when some stocks are in a severely depleted state, although the harvest from these stocks may be small.

The current risk framework for the provision of advice for the West Greenland fishery includes two mechanisms for mitigating (in part) this risk to weak stocks. First, the Greenland fishery is allocated only a proportion (currently 40%) of the exploitable surplus in the North American stock complexes. This means that homewater fisheries, which are allocated the balance (60%) of the available surplus, can be targeted at stocks that are above their CL, or the catches may be foregone to allow stock rebuilding.

In addition, the overall management objective for the provision of advice for the West Greenland fishery requires that there should be a greater than 75% probability of the stock complexes meeting or exceeding their CLs simultaneously. For the seven stock complexes used in the assessment, this is equivalent to each stock complex having approximately a 96% probability of exceeding its reference level independently (assuming all stock complexes have the same probability) (i.e. 0.96 to the power of seven is approximately equal to 0.75). This is consistent with ICES (2012c) advice that a 95% probability should be set for achieving the CL in each management unit. Based on the simultaneous attainment threshold only, a fishery may still be permitted if one complex has only a 75% probability of achieving its reference level as long as all others are certain (100% probability) of achieving theirs. It also means that if any one stock complex falls below the 75% probability limit then no fishery would be permitted.

3.4.3 Implications for the Faroes fishery

Limitations for defining management units smaller than the current NEAC stock complexes

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 a wide variation in the size and status of stocks both within and among the NEAC national stock groups. ICES (2012a) has therefore recommended that the NEAC catch advice should be based on more management units than are used at present.

The Working Group noted that the use of the share allocation provides a mechanism by which risks to individual stocks may be mitigated by managers in homewaters. Since such management decisions would need to be taken at (or below) the national level, this means that it would be appropriate to disaggregate the assessment to at least the national level.

However, ICES (2012a) also noted that there are practical limitations on the extent to which the assessments can be disaggregated. The principal requirement is for information on the composition of the potential catch at Faroes by management unit. ICES proposed a method to estimate the stock composition of the Faroes catch at a national level based on tag returns and the PFA estimates. This is inevitably an approximation and the Working Group did not consider it appropriate to apply it to smaller stock complexes than countries. Genetic stock assignment studies are underway to analyse scale samples collected at Faroes (Section 2.3.6), but these are also expected to identify no more than about ten stock complexes. Other parameter values used in the assessment are currently only available for the total fishery and not smaller stock complexes.

The Working Group therefore considered that it would be informative to managers to provide the catch options tables for the four stock complexes as well as for the ten NEAC countries.

Implications of applying probabilities of achieving CLs to separate management units vs. the use of simultaneous probabilities

ICES tabulates the catch advice for the West Greenland fishery to show the probability of each management unit achieving its CL (or alternative reference level) and the probability that this will be achieved by all management units simultaneously. This allows managers to evaluate both individual and simultaneous attainment levels in making their management decisions. As indicated above, the probability of simultaneous attainment of management objectives in a number of separate management units is roughly equal to the product of the probabilities in each management unit. The probability threshold in 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 (2012a) recommended that an appropriate probability level for individual stock complexes would be 95% and this is approximately equivalent to the current management objective for the West Greenland fishery. This probability level can be applied to each management unit regardless of the number being used.

Management decisions for the West Greenland fishery have also been based on a 75% probability of simultaneous attainment of CLs. Note that for a given level of probability of achieving individual stock CLs, the probability of simultaneous attainment decreases rapidly as the number of management units increases (Figure 3.4.3.1). For the example of

20 management units (e.g. two age groups from each of ten countries), the use of the same simultaneous probability used for West Greenland (75%) would require that the probability of individual stocks meeting the CLs be 98.6% or higher (rather than the approximately 96% value that would apply in the case of West Greenland with seven stock complexes). The use of a 95% probability level for meeting the CLs in the 20 management unit example, equates to a simultaneous attainment probability of about 36%; i.e. there is a 64% chance that one or more stocks would fail to meet their CL by chance alone. Also note that the use of a 75% simultaneous objective could result in a fishery being advised when the probability of one management unit out of 20 being above its CL is as low as 75% if all the other management unit have a 100% chance of meeting the CL. This may not be an acceptable risk for managing multiple river stocks.

The Working Group considered that the probability of simultaneous attainment calculation provides useful information to managers of the risk of failing to meet CLs in one or more of the stocks in the mixed-stock fishery. However, as the management units being considered by NASCO for managing the mixed-stock fisheries at Faroes are still very large and each encompasses a large number of individual river stocks, choosing a high probability level (such as 95%) of attaining CLs in individual stocks 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.

Choice of risk levels for achieving management objectives

On the basis of the above considerations, the Working Group agreed to provide both individual and simultaneous probabilities in the catch options tables. They also noted that management decisions should be based principally on a 95% probability of attainment of CLs in each stock complex individually. The simultaneous probability may also be used as a guide, but managers should be aware that these will generally be quite low when large numbers of management units are used.

3.4.4 Modelling approach for the catch options risk framework

The process for assessing each catch option within the risk framework was described by ICES (2012a). The main changes to the approach in 2013 relate to its application at a country level, although the basic model is the same. The PFA forecasts derived in the Winbugs model (See Section 3.5) 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 x 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.

3.4.5 Input data for the risk framework

The analysis estimates probability of each management unit achieving its SERs (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 assessment requires input data for the catch that would occur at the Faroes if a TAC was allocated (e.g. mean ages and weights, discard rates, etc.). In most cases the only data available to estimate these parameters come from sampling programmes conducted in commercial and research fisheries in Faroese waters in the 1980s and 1990s.

Mean weights: Mean weights of salmon caught in the commercial and research fisheries operating in Faroese waters between 1983/1984 and 1995/1996 varied between 3.06 and 5.23 kg (Table 3.4.5.1) (ICES, 1997a). However, high values were observed at the beginning of the time-series when part of the catch was taken to the north of the Faroes Exclusive Economic Zone (EEZ), and the values for the latter part of the series are based on relatively small catches in a research fishery which may not be as representative of a full commercial fishery. As a result, mean weights have been drawn randomly from the observed values of the 1985/1986 to 1990/1991 fishing seasons.

Proportion by sea age: The age composition of catches in the Faroes fishery has been estimated from samples collected in the 1983/1984 to 1994/1995 fishing seasons (Table 3.4.5.2) (ICES, 1996). The samples taken between 1991/1992 and 1994/1995 were from the research fishery and included potential discards but excluded farm escapees. As a result, values have been drawn from the observations between 1985/1986 and 1990/1991 to provide a probability distribution for this parameter. However, the age composition of the catches may be expected to be related to the mean weight. To take account of this relationship, the values of mean weight and age composition used in each sample run have been drawn from the same years.

Discards: Discard rates have been estimated from the proportions of fish less than 60 cm in catch samples between the 1982/1983 and 1994/1995 seasons (ICES, 1996) (Table 3.4.5.3); 80% of these fish were expected to die (ICES, 1986). A probability distribution for the discard rate has been estimated by sampling at random from the annual values seen over the same period as for the other parameters above.

Proportions of fish-farm escapees: The proportion of fish-farm escapees in the catches at Faroes has also been estimated from samples taken in the 1980/1981 to 1994/1995 fishing season (ICES, 1996). However, the Working Group is aware that there have been substantial changes in the production of farmed fish and in the incidence of escape events. Data were also available to the Working Group on the proportion of farm escapees in Norwegian coastal waters between 1989 and 2008; the proportion in recent years (2002–2008) was 63% of the proportion during the period 1989/1990 to 1994/1995 when the sample time-series overlap (Table 3.4.5.4). The probability distributions of proportion of farm escapees used in the risk framework has therefore been generated by multiplying the rates observed in the Faroes fishery between 1988/1989 to 1994/1995 by 0.63 and then drawing sample values at random.

Proportions of catches by management unit: The origin of the stocks exploited at Faroes has previously been estimated from smolt and adult tagging studies and an approximate split between jurisdictions has been employed in the NEAC run reconstruction model (ICES, 2010b). ICES (2012a) reviewed this approach and proposed an alternative method for estimating the split of the catches. Other input parameters are shown in Table 3.4.5.5.

3.5 Pre-fishery abundance forecasts

The Working Group used a forecast model developed in a Bayesian framework (ICES, 2011b) to estimate PFA for all four NEAC stock complexes.

3.5.1 Description of the forecast model

In 2013, the Working Group ran forecast models for the southern NEAC and northern NEAC complexes. The model was run for each stock complex independently.

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*).

$$PFA_t = LE_t * exp(a_t)$$

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*.

$$a_{t+1} = a_t + \varepsilon; \quad \varepsilon \sim N(0, a.\sigma^2)$$

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*.

$$logit.p.PFAm_{t+1} \sim N(logit.p.PFAm_t, p.\sigma^2)$$

$$logit.p.PFAm_t = logit\ (p.PFAm_t)$$

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.

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 were available for a 35-year time-series of lagged eggs and returns (1978 to 2012). For northern NEAC, data were available for a 22-year time-series, 1991 to 2012. The models were fitted and forecasts were derived in a consistent Bayesian framework.

For both southern and northern NEAC complexes, forecasts for maturing and non-maturing stocks were derived for five years, from 2012 to 2016. Risks were defined each year as the posterior probability that the PFA would be above the age and stock complex specific SER levels. For illustrative purposes, risk analyses were derived based on the probability that the maturing and non-maturing PFAs would be greater than or equal to the maturing and non-maturing Spawner Escapement Reserves (SERs) under the scenario of no exploitation, for both the northern and southern complexes. These were calculated for each of the five forecast years, 2012 to 2016.

A country disaggregated version of the Bayesian NEAC inference and forecast model was run on country level data, for both southern and northern NEAC. This incorporated country specific catch proportions at Faroes, lagged eggs and returns of maturing and non-maturing components. The model was again run at the complex levels, incorporating individual country inputs of 1SW and MSW lagged eggs, 1SW and MSW returns, and SERs. 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.

3.5.2 Results of the NEAC Bayesian forecast models

The trends in the posterior estimates of PFA for both the southern NEAC and northern NEAC complexes closely match the PFA estimates derived from the run reconstruction model (Section 3.3.5).

For the southern NEAC stock complex, maturing and non-maturing PFAs showed a general switch in 1988–1990 from a level of around 2 million maturing and 1.5 million non-maturing fish to lower levels, declining in the maturing component from around 1.5 million maturing in 1992–1995 to less than 1 million in 2009 (Figure 3.5.2.1). The non-maturing component fell from around 1 million in 1990 to 1994 to a low of around 520 000 in the late 2000s. The maturing component showed an increase in 2009 to 2010 which again fell in 2011, following the general slow decline from the 1990s. The non-maturing component has followed a similar pattern in recent years, with the increase from 2008 to 2010 falling in 2011. These levels of PFA are carried forward into the five forecast years 2012 to 2016. Uncertainty increases as prediction year progresses and the forecast projects forwards, mostly notably in their upper ranges.

The productivity parameter peaked in 1985 and 1986, and reached the lowest values in 1997 and 1999 (Figure 3.5.2.1). There was a sharp drop in the productivity parameter during 1989 to 1991 and the values post-1991 are all lower than during the previous time period. Between 2003 and 2009, productivity was declining. In 2010, however, productivity rose to the 2002 to 2003 level and the highest level since the 1989 to 1991 drop, although fell again in 2011. The 2012 to 2016 values are projected from this 2011 point, with increasing uncertainty as prediction years increase.

Over the entire time-series, the maturing proportions averaged about 0.6, being lowest in 1980 and highest in 1998 (Figure 3.5.2.1). An increasing trend in the proportion maturing (eight of 13 values below the average during 1978 to 1990 compared with four of 17 values between 1991 and 2007) is followed by a decline from 2008 which continues into 2011. The five forecast years 2012 to 2016 are projected from the 2011 value with uncertainty increasing with prediction years.

For the northern NEAC complex, peak PFA abundances were estimated in the year 2000, (ca. 1.1 million maturing and 900 000 non-maturing fish) with the lowest values of the maturing series occurring between 2007 and 2009 at around 440 000 fish. The lowest abundance of the non-maturing age group was estimated during 1996 to 1998 (ca. 500 000). An increase in the year 2000 to 900 000 fish was followed by a period of decline and variation with an increase from 2008 (600 000) to 2010 (800 000) (Figure 3.5.2.2). The 2012 forecasts of 466 900 maturing and 675 000 non-maturing fish are similar to 2011 values, with subsequent small increases predicted in the forecasts for 2013 to 2016 and increasing error bounds as forecast years progress.

Lagged eggs of both maturing and non-maturing peaked in 2007–2008 before declining to a minimum in 2010–2011 (Figure 3.5.2.2). Lagged eggs from the maturing component are estimated to continue falling during 2012 to 2016, while non-maturing are predicted to increase to above the 1996 to 2000 levels by 2015.

The proportion maturing has varied around 0.55 over the time-series, but in 2007 there was an abrupt drop in the proportion maturing to below 0.37 (Figure 3.5.2.2). Some recovery occurred in 2008 to around 0.43; however levels from 2009 to 2011 were around 0.40, notably below the 1991 to 2006 levels (Figure 3.5.2.2).

Productivity improved in 2009 and 2010 from the 2008–2009 low in the northern NEAC complex, becoming comparable to the pre-2004 values, but dropped slightly for 2011 (Figure 3.5.2.2). An increase was also observed in the southern complex in 2010; however this fell again in 2011 closer to 2008 and 2009 values (Figure 3.5.2.1).

Forecasts from these models for the 2012 to 2016 years for the non-maturing and maturing age groups were developed within the Bayesian model framework. Variations in the median abundance over the forecasts are related to variations in lagged eggs as the productivity parameter values are set at the level of the last year with available data. The variability in the productivity parameters increased sequentially over the forecasts.

3.5.3 Probability of attaining PFA above SER

Probabilities of meeting age and complex specific SERs in PFA years 2012 to 2016 do not exceed 85.3% in the southern NEAC region. For the northern NEAC stock complex, probabilities of exceeding SER are above 94.6% in all instances (Table 3.5.3.1).

3.5.4 Bayesian forecast models at the country level

Country specific model results of maturing and non-maturing PFA, 1SW and MSW lagged eggs, proportion of PFA maturing and productivity parameters are presented in Figures 3.5.4.1 to 3.5.4.11 for southern and northern NEAC countries. Country specific summary text-tables of the probabilities of PFAs meeting or exceeding SERs in the forecast years (2012 to 2016) are also presented in the figures. While country forecasts differ they tend to follow similar patterns to those observed in their respective stock complexes and in relation to their SERs.

Of note in these forecasts for southern NEAC countries:

- France maturing PFA is well below the SER while median non maturing PFA estimates are similar to the SER and the annual proportions maturing have high uncertainties.
- Ireland: the median estimates of maturing PFA are at or around the SER, while non-maturing PFAs are below SER. Estimates of proportion maturing are high at around 0.9.
- UK(N. Ireland): PFA maturing median estimates are at or around the SER. Estimated 25th BCIs of non-maturing PFAs are above the SER, although the probability of the non-maturing PFA achieving or exceeding the SER is above 95% in only 2012. Upper estimates are extremely variable for the forecast years of both maturing and non-maturing PFA.
- UK(England & Wales): maturing PFA median estimates are at or around the SER and the estimated 25th BCIs of non-maturing PFAs are above the SER although the highest probability of attaining/exceeding an SER is only 0.87 (non-maturing in 2012). The proportions maturing are approximately 0.4 although BCIs are wide.
- UK(Scotland): Patterns of maturing and non-maturing PFA in relation to their SERs and proportions maturing follow similar trends to those seen for UK(England & Wales). Highest probability of attaining or exceeding SER is only 0.79 (for non-maturing PFA in 2012).
- Iceland (south and west): For both maturing and non-maturing PFAs the forecasts are above the respective SERs and probabilities of exceeding SERs are greater than 0.95 for maturing PFA from 2012 to 2015 and at 0.95 for non-maturing PFA in 2012.

Of note in these forecasts for northern NEAC countries:

- Russia: For maturing PFAs the forecasts are above the SERs though the bottom of the 95% BCI range falls below the SER while for the non-maturing estimates the lower 25th BCI is close to the SER. Only maturing PFA in 2012 has a 0.95 probability of exceeding SER. The proportion maturing appears to have risen from ca. 0.4 around 2007–2010 to ca. 0.6 in 2011, which is forecast forwards at this level to 2016.

- Finland: Both maturing and non-maturing SERs are close to the lower 25th BCIs of the PFA estimates; however a 0.95 probability of achieving SER is only seen in the maturing PFA in 2012. 1SW lagged eggs are being estimated at an all-time low between 2013 and 2016.
- Norway: There is a 0.95 probability that forecasts of non-maturing PFAs are above the SER for all forecast years (2012 and 2016). Maturing PFA achieves SER with a 0.95 probability in 2012 and 2013. MSW lagged eggs are being estimated to rise from 2013 and 2016, while the proportion maturing is being forecast forward from the 2011 level of around 0.3.
- Sweden: Maturing and non-maturing PFA estimates are above respective SERs with greater than 0.95 probability in all years for both maturing and non-maturing PFAs. Similar to Norway MSW lagged eggs are estimated to increase from 2013 to 2016.
- Iceland (north/east regions): Maturing and non-maturing PFA forecasts are above the SERs though the probability of exceeding SER is only greater than 0.95 in 2012 and 2013 for the maturing component of the stock and 2012 for the non-maturing fish. MSW lagged eggs are estimated to increase from 2013 to 2016.

3.6 NASCO has asked ICES to provide catch options or alternative management advice for 2012–2015, with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding

3.6.1 Catch advice for Faroes

The risk framework described in Section 3.4 has been used to evaluate catch options for the Faroes fishery in the 2013/2014, 2014/2015 and 2015/2016 fishing seasons (October to May). The assumptions and data used in the catch options assessment are described in Section 3.4.5 and the details of the forecasting methodology is described in Section 3.5.

The Working Group applied the risk framework model to the four management units previously used for the provision of catch advice (maturing and non-maturing 1SW recruits for northern and southern NEAC) and also for the two age groups in each NEAC country (i.e. 20 management units). The risk framework estimates the uncertainty in meeting defined management objectives at different catch levels (TAC options), and the catch advice tables display the probability of the total number of fish in each of the management units exceeding the combined SERs for those units.

As an example, taking the 20 t TAC option, the assessment estimates that this would result in a catch of about 5000 fish at Faroes. The great majority (>97.5%) of these would be expected to be MSW fish. Once the sharing allocation is applied, and the numbers are adjusted for natural mortality to the same seasons as the PFA, this equates to about 650 maturing and 84 000 non-maturing 1SW fish equivalents lost to all fisheries. The maturing 1SW component is split equally between northern NEAC and southern NEAC, while the non-maturing 1SW fish are split 0.44 to 0.54 between northern and southern areas (with a small unaccounted proportion). These values are deducted from the PFA values which are then are compared with the following SERs:

Northern NEAC maturing 1SW–	201 014
Northern NEAC non-maturing 1SW–	222 888
Southern NEAC maturing 1SW–	715 358
Southern NEAC non-maturing 1SW–	463 566

The probability of the northern and southern NEAC stock complexes achieving their CLs for different catch options are shown in Table 3.6.1.1 and Figure 3.6.1.1. The probabilities with a zero TAC are the same as the values generated directly by the forecast model (Section 3.5). The catch option table indicates that the northern NEAC management units have a high probability (>95%) of achieving their CLs for TACs at Faroes of up to ~60 t in the 2013/2014 season and up to ~40 t in 2014/2015 to 2015/2016. However, the southern NEAC stock complexes all have less than 95% probability of achieving their CLs in each year and at every TAC option. There are therefore no catch options that ensure a greater than 95% probability of each stock complex achieving its CL, and none that gives a greater than 60% probability of simultaneous attainment of CLs in all four stock complexes.

The slope of the curves in the catch option figures (Figure 3.6.1.1) is a function of the uncertainty in the estimates and the level of exploitation on the stocks resulting from a particular TAC in the Faroes fishery (Table 3.6.1.2); more uncertain data and lower exploitation rates generate flatter profiles. The flatness of the risk curves for the 1SW stocks indicates 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).

In 2012 (ICES, 2012a), the forecast model gave optimistic estimates of abundance for 2012 to 2015 because a high productivity was estimated for 2010; the model applied this value forward in forecasting the PFA in 2011 to 2015 (Section 3.5.2). In the 2013 forecasts, these productivity estimates have been reduced by the 2011 value, thus giving lower stock forecasts for 2012 to 2016.

The catch options for the country level management units are shown in Tables 3.6.1.3 and 3.6.1.4 for maturing 1SW and non-maturing 1SW salmon respectively from each NEAC country. The probabilities of maturing 1SW national stocks achieving their CLs in 2013/2014 vary between 28% and 98% with no TAC at Faroes, and these probabilities are hardly affected by any of the TAC options. The probabilities for the two subsequent seasons are similar. The probabilities of the non-maturing 1SW national stocks achieving their CLs in 2013/2014 varies between 27% and 100% and show decreasing probabilities for increasing TAC options at Faroes. The probability of simultaneous attainment of CLs in all of the ten maturing 1SW national stock complexes is less than 2% in every year regardless of any harvest at Faroes, and for the ten non-maturing 1SW stock complexes is less than 5% in every year.

ICES (2012a) emphasized the problem of basing the risk analysis on management units comprising large numbers of river stocks and recommended that in providing catch advice at the age and stock complex levels for Northern and Southern NEAC, consideration should be given to the recent performance of the river stocks within individual countries. At present, insufficient data are available to the Working Group to assess performance of individual stocks in all countries in the NEAC area. In some instances CLs are in the process of being developed (UK(Scotland) and Iceland). The status of river stocks within each country in the NEAC area for which data are available with respect to the attainment of CLs before homewater fisheries is given in Table 3.6.1.5 for 2012 (except Norway where the data relate to 2011). The total number of rivers in each country and the number which can be assessed against river-specific CLs are also shown. Numerical evaluations can only be provided for three countries where individual rivers are assessed for compliance prior to homewater fisheries taking place. In two countries in northern NEAC with available information, 86% and 88% of the monitored rivers would have met their river-specific CLs before any homewater exploitation, whereas only 41% of assessed rivers met their CLs in one country in Southern NEAC (Table 3.6.1.5). So, despite the absence of a fishery at Faroes since 1999, and reduced exploitation at West Greenland on the MSW southern NEAC component, the abundance at the PFA stage in several countries in NEAC has been below the country-specific SERs.

The Working Group therefore notes that there are no catch options for the Faroes fishery that would allow all national or stock complex management units to achieve their CLs with a greater than 95% probability in any of the seasons 2013/2014 to 2015/2016. While stocks remain in a depleted state and in the absence of a fishery at Faroes, particular care should be taken to ensure that fisheries in homewaters are managed to protect stocks that are below their CLs.

3.6.2 Relevant factors to be considered in management

The management of a fishery should ideally be based upon the status of all river stocks exploited in the fishery. Fisheries on mixed-stocks pose particular difficulties for management, when they cannot target only stocks that are at full reproductive capacity. Management objectives would be best achieved if fisheries target stocks that are at full reproductive capacity. Fisheries in estuaries and especially rivers are more likely to meet this requirement. The Working Group also emphasized that the national stock CLs are not appropriate to the management of homewater fisheries. This is because fisheries in homewaters usually target individual or smaller groups of river stocks and can therefore be managed on the basis of their expected impact on the status of the separate stocks. Nevertheless, the Working Group agreed that the combined CLs for national stocks exploited by the distant water fisheries could be used to provide general management advice at the level of the stock complexes. As noted in previous years, the inclusion of farmed fish in the Norwegian catches could result in the stock status being overestimated (Potter and Hansen, 2001).

3.7 NASCO has asked ICES to update the framework of indicators used to identify any significant change in previously provided multiannual management advice

3.7.1 Background

In 2012 a Framework of Indicators (FWI) for the NEAC area was provided to NASCO (ICES, 2012a). The FWI was applied in January 2013, and the indicators suggested that the PFA for non-maturing 1SW salmon from the southern NEAC area had been overestimated by the forecast model and a full reassessment was suggested for the NEAC stocks. Comparing the forecast from last year to the realized median PFA (see Section 3.3.5), all stock complexes and age groups were lower than the median of the forecasted values (80–94% of the forecasted value), but all were well within the 95% confidence intervals of the forecasts. This was in line with what was suggested by the FWI. The reassessment carried out in 2013 also suggested no catch options at Faroes for the coming three year period (see Section 3.6.1). Thus, carrying out the reassessment did not change the previously provided advice.

3.7.2 Progress in 2013

In 2012, it was agreed that the 75% confidence interval range for the mean of the indicator prediction, relative to the median forecast value, be used to compute thresholds for whether the indicator suggests a reassessment or not (ICES, 2012a). The limits should be computed at the median values of the PFA forecasts in each of the years in multiyear advice. The Working Group further agreed that if the FWI suggests that the forecasted PFA is either an underestimation or an overestimation of the realized PFA in any of the four stock complexes, then this should trigger a reassessment.

When the stocks are divided into alternative, 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. This approach was continued in 2013. Since the indicators suggested that the forecasts were slightly higher than the realized PFA and no catch options were given in the multiyear advice for the Faroes fishery, the change indicated by the FWI did not alter the current catch advice. Therefore, in 2013, the Working Group suggests a slight change to the operation of the FWI. In the event of a closed fishery, the indicators should be compared only to the upper 75% confidence limit, and in the event of an open fishery they should be compared to both the upper and lower 75% confidence limits. This implies going from a two-sided approach to a one-sided approach in the case of a closed fishery. Had this approach been used in 2012, the reassessment would not have been suggested.

In 2013, the Working Group further updated the FWI for the NEAC area. The Working Group considered 53 possible indicator datasets, and 26 of them fulfilled the previous criteria (ICES, 2012a) for inclusion in the FWI (five for northern NEAC 1SW PFA, three for northern NEAC MSW PFA, five for southern NEAC 1SW PFA and 13 for southern NEAC MSW PFA).

In 2013, the Working Group further assessed the effects of applying stricter criteria than $r^2 \geq 0.2$ for inclusion in the FWI. As stricter criteria are used, the number of indicators included reduces rapidly (Figure 3.7.2.1). It was 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 metaanalysis (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 (see Annex 9).

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 ≥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.

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

Year	England & Wales					UK (Scotland)		UK (N. Ireland)			Norway			
	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)
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
1986	220	221	368	64	-	1955	591	121	148	18	1630	5979	14	17945
1987	213	206	352	68	-	1679	564	120	119	18	1422	6060	13	17234
1988	210	212	284	70	-	1534	385	115	113	18	1322	5702	11	15532
1989	201	199	282	75	-	1233	353	117	108	19	1888	4100	16	0
1990	200	204	292	69	-	1282	340	114	106	17	2375	3890	7	0
1991	199	187	264	66	-	1137	295	118	102	18	2343	3628	8	0
1992	203	158	267	65	-	851	292	121	91	19	2268	3342	5	0
1993	187	151	259	55	-	903	264	120	73	18	2869	2783	-	0
1994	177	158	257	53	37278	749	246	119	68	18	2630	2825	-	0
1995	163	156	249	47	34941	729	222	122	68	16	2542	2715	-	0
1996	151	132	232	42	35281	643	201	117	66	12	2280	2860	-	0
1997	139	131	231	35	32781	680	194	116	63	12	2002	1075	-	0
1998	130	129	196	35	32525	542	151	117	70	12	1865	1027	-	0
1999	120	109	178	30	29132	406	132	113	52	11	1649	989	-	0
2000	110	103	158	32	30139	381	123	109	57	10	1557	982	-	0
2001	113	99	143	33	24350	387	95	107	50	6	1976	1081	-	0
2002	113	94	147	32	29407	426	102	106	47	4	1666	917	-	0
2003	58	96	160	57	29936	363	109	105	52	2	1664	766	-	0
2004	57	75	157	65	32766	450	118	90	54	2	1546	659	-	0
2005	59	73	148	65	34040	381	101	93	57	2	1453	661	-	0
2006	52	57	147	65	31606	364	86	107	49	2	1283	685	-	0
2007	53	45	157	66	32181	238	69	20	12	2	1302	669	-	0
2008	55	42	130	66	33900	181	77	20	12	2	957	653	-	0
2009	50	42	118	66	36461	162	64	20	12	2	978	631	-	0
2010	51	40	118	66	36159	189	66	2	1	2	760	493	-	0
2011	53	41	117	66	36991	201	74	2	1	2	767	506	-	0
2012	51	34	115	74	34665	251	83	1	1	2	749	448	-	0
Mean 2007-2011	52	42	128	66	35 060	194	70	13	8	2	953	590		0
% change [3]	-2,7	-19,0	-10,2	12,1	-1,1	29,3	19,4	-92,2	-86,8	0,0	-21,4	-24,1		
Mean 2002-2011	60	61	140	61	33 345	295	86	57	30	2	1 238	664		0
% change [3]	-15,1	-43,8	-17,8	20,5	4,0	-15,1	-3,5	-98,2	-96,6	-9,1	-39,5	-32,5		

[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 authorised 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	n/a	82	53
2008	0	160	0	20061	31143	8111	756	694	2401	12	56	n/a	66	62
2009	0	146	38	18314	29641	7676	761	656	2421	12	37	n/a	79	72
2010	0	166	40	17983	30646	7814	756	615	2200	12	33	n/a	55	66
2011	0	154	91	19899	31269	7915	776	767	2540	12	29	n/a	78	52
2012	0	149	86	19588	32614	7930	785	781	2799	12	25	n/a	72	53
Mean 2007-2011	0	192	54	19 249	31 273	8 056	766	690	2 399	12	43		72	61
% change [6]	0,0	-19,9	69,1	3,4	0,0	-1,7	1,3	11,2	5,9	-1,6	-32,2		8,3	-14,8
Mean 2002-2011	429	358	104	24 996	31 547	8 517	794	667	2 291	14	52	13 766	70	66
% change [6]	-100,0	-57,0	-12,8	-20,4	-0,9	-7,1	-2,2	15,1	10,9	-14,3	-43,9		12,2	-21,0

[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 NEAC Area (in tonnes round fresh weight), 1960-2012 (2012 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	1 058	0	-	1 977	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	301	939	0	-	1 240	363	
Average							
2007-2011	363	1025	0	-	1388	391	-
2002-2011	624	1134	0	-	1758	540	-

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, Naatamo), 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	n/a		0.283
1986	2.1	0.7	n/a	n/a		0.274
1987	2.3	0.8	n/a	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
Mean 2007-11	3.0	0.8	1.0	0.2	0.7	0.3

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

Table 3.1.5.2 CPUE for salmon rod fisheries in the Barents Sea and White Sea basin and commercial catches in Archangelsk region in Russia.

	Barents Sea Basin, catch per angler day					White Sea Basin, catch per angler day				Archangelsk region Commercial fishery (tonnes/gear)	
Year	Rynda	Kharlovka	E. Litsa	Varzina	Iokanga	Ponoi	Varzuga	Kitsa	Umba	Coastal	In-river
1991						2.79	1.87		1.33		
1992	2.37	1.45	2.95	1.07	0.14	4.50	2.26	1.21	1.37		
1993	1.18	1.46	1.59	0.49	0.65	3.57	1.28	1.43	2.72	0.34	0.04
1994	0.71	0.85	0.79	0.55	0.33	3.30	1.60	1.59	1.44	0.35	0.05
1995	0.49	0.78	0.94	1.22	0.72	3.77	2.52	1.78	1.20	0.22	0.08
1996	0.70	0.85	1.31	1.50	1.40	3.78	1.44	1.76	0.93	0.19	0.02
1997	1.20	0.71	1.09	0.61	1.41	6.09	2.36	2.48	1.46	0.23	0.02
1998	1.01	0.55	0.75	0.44	0.87	4.52	2.28	2.78	0.98	0.24	0.03
1999	0.95	0.77	0.93	0.43	1.19	3.30	1.71	1.66	0.76	0.22	0.04
2000	1.35	0.77	0.89	0.57	2.28	3.55	1.53	3.02	1.25	0.28	0.03
2001	1.48	0.92	1.00	0.89	0.73	4.35	1.86	1.81	1.04	0.21	0.04
2002	2.39	0.99	0.89	0.80	2.82	7.28	1.44	2.11	0.36	0.21	0.11
2003	1.61	1.14	1.04	0.79	2.01	8.39	1.17	1.61	0.36	0.16	0.05
2004	1.07	0.98	1.31	0.65	1.00	5.80	1.14	1.10	0.36	0.25	0.08
2005	1.09	0.82	1.45	0.46	0.88	4.42	0.57	0.89	0.28	0.17	0.08
2006	0.98	1.49	1.49	1.45		6.28	2.23		0.73	0.19	0.05
2007	0.92	0.78	1.43	1.16		5.96				0.14	0.09
2008						5.73				0.12	0.08
2009						5.72				0.09	0.05
2010						4.78				0.21	0.08
2011						4.01				0.15	0.07
2012						5.56				0.17	0.09
Mean											
Data available	1.22	0.96	1.24	0.82	1.17	4.89	1.70	1.80	1.03	0.21	0.06
2007-11						5.24				0.14	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 NE, 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	n/a	0.21	0.31
Mean 2007-11	10.74	5.87	0.62	0.93	0.07	0.48

Table 3.1.5.4 Catch per unit of effort (CPUE) for salmon rod fisheries in each Region in UK (England & Wales), 1997-2012. [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	9.3	9.3	6.5	6.6	9.1	10.9
Mean (2007-2011)	13.6	0.6	17.0	8.9	5.2	5.9	13.2	9.6

Table 3.1.5.5 CPUE data for Scottish net fisheries.
Catch in numbers of fish per unit 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
Mean		
2007-11	57.1	95.5

[1] Excludes catch and effort for Solway Region

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

Year	Bagnet < 3kg	Bagnet 3-7 kg	Bagnet >7 kg		Bendnet < 3kg	Bendnet 3-7 kg	Bendnet >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
Mean 2007-11	1.00	1.21	0.36		0.62	0.94	0.39

Table 3.1.6.1. Percentage of 1SW salmon in catches from countries in the North East Atlantic, 1987-2012.

Year	Iceland	Finland	Norway	Russia	Sweden	**Northern countries**	UK (Scot)	UK (E&W)	France (1)	Spain (2)	**Southern countries**
1987		66	61	71		**63**	61	68	77		**63**
1988		63	64	53		**62**	57	69	29		**60**
1989	69	66	73	73	41	**72**	63	65	33		**63**
1990	66	64	68	73	70	**69**	48	52	45		**49**
1991	71	59	65	70	71	**66**	53	71	39		**58**
1992	72	70	62	72	68	**65**	55	77	48		**59**
1993	76	58	61	61	62	**63**	57	81	74	64	**64**
1994	63	55	68	69	64	**67**	54	77	55	69	**61**
1995	71	59	58	70	78	**62**	53	72	60	26	**59**
1996	73	79	53	80	63	**61**	53	65	51	34	**56**
1997	73	69	64	82	54	**68**	54	73	51	28	**60**
1998	82	75	66	82	59	**70**	58	82	71	54	**65**
1999	70	83	65	78	71	**68**	45	68	27	14	**54**
2000	82	71	67	75	69	**69**	54	79	58	74	**65**
2001	78	48	58	74	55	**60**	55	75	51	40	**62**
2002	83	34	49	70	63	**54**	54	76	69	38	**64**
2003	75	51	61	67	47	**62**	52	66	51	16	**55**
2004	86	47	52	68	52	**58**	51	81	40	67	**59**
2005	87	72	67	66	55	**69**	58	76	41	15	**61**
2006	84	73	54	77	56	**60**	57	78	50	15	**61**
2007	91	30	42	69	33	**50**	57	78	45	26	**61**
2008	90	34	46	58	30	**54**	48	76	42	11	**55**
2009	91	62	49	63	34	**59**	49	72	42	30	**54**
2010	82	50	56	58	41	**60**	55	78	67	32	**63**
2011	85	61	41	58	32	**49**	36	57	35	2	**45**
2012	87	73	47	70	28	**55**	50	51	38	18	**49**
Means											
2007-2011	88	47	47	61	34	55	49	72	46	20	56
2002-2011	85	52	52	65	44	58	52	74	48	25	58

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.

	National Model CLs		River Specific CLs			Conservation limit used	
	1SW	MSW	1SW	MSW		1SW	MSW
Northern Europe							
Finland	13,083	16,695				13,083	16,695
Iceland (north & east)	6,457	1,617				6,457	1,617
Norway[1]			70,619	69,878		70,619	69,878
Russia	66,622	41,916				66,622	41,916
Sweden	1,364	1,302				1,364	1,302
			Conservation limit			158,145	131,408
			Spawner Escapement Reserve			200,910	222,975

	National Model CLs		River Specific CLs			Conservation limit used	
	1SW	MSW	1SW	MSW		1SW	MSW
Southern Europe							
France			17,400	5,100		17,400	5,100
Iceland (south & west)	20,210	1,316				20,210	1,316
Ireland			211,471	46,943		211,471	46,943
UK (E&W)			54,491	29,605		54,491	29,605
UK (NI)	18,761	1,858				18,761	1,858
UK (Sco)	242,541	190,589				242,541	190,589
			Conservation limit			564,874	275,411
			Spawner Escapement Reserve			714,972	463,332

Table 3.3.5.1 Estimated number of RETURNING 1SW 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	25,922	9,401		154,435	17,451				50,011	62,520	1,055,511	82,561	181,588	620,892	1,835,337	**2,064,901**	2,354,934			
1972	40,474	8,620		117,498	13,816				100,300	50,769	1,124,390	79,581	158,788	542,701	1,832,389	**2,073,072**	2,379,487			
1973	36,851	10,338		173,692	17,158				60,473	54,316	1,222,672	93,855	138,706	651,601	1,970,596	**2,238,654**	2,572,489			
1974	73,075	10,269		172,536	24,646				28,248	38,774	1,391,967	117,252	151,559	620,088	2,072,457	**2,359,710**	2,727,432			
1975	50,868	12,567		264,634	26,587				56,590	59,911	1,540,374	120,126	124,462	505,054	2,107,267	**2,419,250**	2,824,148			
1976	34,955	12,588		183,990	14,986				51,724	47,345	1,047,950	80,333	86,710	433,790	1,538,875	**1,758,352**	2,040,583			
1977	17,910	17,539		117,481	7,092				40,069	48,547	903,324	91,313	85,298	453,323	1,440,088	**1,630,121**	1,876,174			
1978	24,399	17,803		118,893	8,079				41,004	63,630	789,930	104,459	111,265	519,911	1,466,326	**1,640,214**	1,858,218			
1979	28,512	17,085		165,134	8,521				47,289	58,896	730,271	99,469	77,834	428,293	1,292,097	**1,452,784**	1,650,180			
1980	12,804	2,583		117,131	10,763				97,876	26,671	553,289	93,387	98,889	266,489	1,025,807	**1,149,538**	1,305,021			
1981	19,720	13,309		96,542	19,571				76,975	34,540	290,830	98,209	77,376	328,725	839,646	**916,801**	1,004,447			
1982	5,790	6,145		84,867	17,225				48,380	35,380	604,459	83,197	111,923	472,717	1,240,741	**1,364,626**	1,506,568			
1983	28,560	9,089	699,564	141,907	22,879	809,162	**904,551**	1,013,270	51,445	44,752	1,066,455	121,959	156,858	482,392	1,742,051	**1,935,984**	2,163,466	2,619,032	**2,840,069**	3,093,756
1984	31,851	3,288	728,594	152,732	32,202	850,252	**951,397**	1,069,869	84,664	27,538	559,007	106,650	61,670	510,099	1,237,135	**1,361,569**	1,502,930	2,154,026	**2,317,161**	2,492,987
1985	48,122	22,745	741,727	209,048	38,476	962,716	**1,065,049**	1,176,868	31,688	44,647	928,636	106,994	80,053	422,523	1,453,751	**1,620,802**	1,827,843	2,491,693	**2,690,540**	2,920,016
1986	43,822	28,263	646,466	179,363	40,496	854,523	**941,727**	1,040,146	48,380	73,341	1,039,344	123,926	89,812	523,701	1,717,952	**1,915,227**	2,151,951	2,644,946	**2,859,648**	3,113,772
1987	55,804	16,590	543,391	191,351	32,774	768,877	**843,267**	930,196	86,740	45,507	668,665	128,469	49,166	404,823	1,249,743	**1,404,261**	1,607,184	2,076,935	**2,251,147**	2,466,684
1988	26,762	24,023	499,271	131,925	27,547	649,846	**711,598**	783,380	29,257	81,517	909,270	176,564	115,867	611,568	1,750,813	**1,940,973**	2,164,376	2,451,167	**2,653,503**	2,888,079
1989	62,585	12,986	548,990	196,898	8,788	755,865	**831,632**	922,988	16,080	45,685	649,338	118,373	111,531	670,238	1,476,773	**1,623,273**	1,797,974	2,290,150	**2,458,741**	2,649,359
1990	59,283	9,696	491,249	163,341	19,562	678,399	**745,070**	824,726	26,758	42,019	407,593	84,815	92,224	320,661	895,049	**984,174**	1,088,153	1,617,130	**1,732,713**	1,857,975
1991	71,970	14,113	429,150	138,779	23,728	620,099	**680,527**	751,235	19,591	46,426	290,956	84,087	51,483	319,236	749,487	**819,616**	900,413	1,408,011	**1,502,944**	1,607,505
1992	95,447	26,524	361,201	171,414	25,868	628,101	**684,749**	748,026	35,702	52,994	421,994	87,963	104,483	465,556	1,079,082	**1,181,790**	1,300,906	1,746,352	**1,869,066**	1,999,952
1993	67,178	21,799	363,173	147,164	27,624	580,859	**630,337**	686,798	50,940	52,091	343,489	121,885	122,280	418,356	1,029,666	**1,125,468**	1,242,569	1,647,803	**1,757,231**	1,886,456
1994	26,700	6,978	491,611	173,473	21,046	652,710	**722,561**	805,454	40,192	42,727	439,899	135,754	83,916	445,734	1,096,872	**1,203,956**	1,328,518	1,797,513	**1,930,740**	2,075,239
1995	26,281	20,062	320,702	156,278	30,603	511,244	**557,528**	609,543	13,263	57,980	491,194	103,755	77,941	436,555	1,084,260	**1,189,364**	1,310,074	1,632,528	**1,747,108**	1,879,069
1996	60,980	10,704	244,566	212,063	18,902	505,646	**550,611**	602,463	16,546	50,166	457,514	76,770	80,471	313,171	908,870	**1,003,220**	1,113,825	1,447,693	**1,555,958**	1,674,972
1997	51,985	14,660	282,653	208,116	8,658	520,617	**569,049**	623,473	8,546	36,676	456,108	68,753	95,653	225,754	808,917	**897,300**	1,003,516	1,367,726	**1,468,454**	1,584,324
1998	60,032	24,861	368,874	228,187	7,626	632,076	**693,432**	760,066	16,675	50,116	478,388	75,528	207,890	307,340	1,045,374	**1,146,650**	1,264,395	1,720,966	**1,841,845**	1,977,840
1999	85,938	12,676	342,879	176,844	11,265	578,666	**632,611**	690,989	5,548	40,703	445,968	60,031	54,147	152,408	679,427	**763,091**	866,026	1,296,552	**1,397,704**	1,514,299
2000	90,688	13,312	563,974	192,546	22,397	809,781	**887,085**	976,135	14,430	36,156	619,127	91,357	78,688	297,578	1,027,924	**1,145,490**	1,289,953	1,890,113	**2,035,397**	2,199,454
2001	40,933	12,091	485,990	260,232	14,588	731,895	**820,223**	928,698	12,289	32,373	492,605	79,443	62,176	291,291	899,162	**979,525**	1,072,115	1,679,162	**1,803,139**	1,943,790
2002	28,712	20,965	297,616	236,586	14,841	535,897	**603,162**	695,441	28,004	40,512	430,206	75,245	123,106	234,744	868,351	**944,371**	1,029,549	1,444,025	**1,551,632**	1,673,183
2003	33,714	11,134	411,882	211,641	9,131	607,748	**682,638**	772,856	18,478	48,535	420,970	58,455	80,443	266,731	833,522	**905,588**	988,404	1,481,874	**1,591,239**	1,708,982
2004	13,153	30,066	250,021	147,794	7,866	407,168	**451,894**	509,646	22,005	48,423	310,109	104,246	71,642	316,409	812,020	**888,680**	979,005	1,251,643	**1,343,117**	1,447,666
2005	33,483	26,733	370,001	167,867	6,673	550,333	**610,824**	683,363	14,451	71,265	309,196	85,250	91,253	343,655	854,306	**928,346**	1,011,624	1,443,803	**1,541,041**	1,648,117
2006	63,470	28,229	300,080	203,587	8,065	546,745	**607,301**	684,571	20,242	50,314	237,036	84,587	58,133	332,716	725,998	**797,247**	881,220	1,309,591	**1,408,289**	1,519,392
2007	11,775	20,899	167,702	110,069	3,838	283,449	**316,531**	356,723	15,878	57,841	271,895	80,365	94,785	326,611	756,579	**868,260**	1,071,886	1,067,836	**1,187,119**	1,390,865
2008	12,126	19,114	210,252	114,542	4,970	325,710	**364,142**	410,152	15,565	70,276	267,404	78,737	56,640	281,738	681,494	**795,623**	993,227	1,040,162	**1,162,613**	1,362,225
2009	24,710	30,818	168,343	108,622	5,278	306,041	**340,075**	379,526	5,587	79,216	220,020	49,251	43,146	240,772	564,557	**657,657**	816,863	897,935	**1,000,243**	1,162,614
2010	23,071	24,696	249,554	123,776	8,845	390,238	**433,217**	482,094	18,932	80,946	279,976	98,082	39,540	440,563	843,942	**995,448**	1,225,239	1,271,659	**1,430,029**	1,660,304
2011	28,290	20,324	175,720	131,423	7,320	329,234	**365,510**	408,449	13,338	57,145	247,440	56,824	34,167	234,624	561,304	**663,195**	857,331	920,489	**1,031,917**	1,226,828
2012	61,214	8,316	195,651	152,538	7,896	386,746	**429,062**	482,818	11,579	35,677	252,034	35,002	42,991	328,367	609,083	**736,068**	937,401	1,031,442	**1,168,728**	1,376,404
10yr Av.	30,501	22,033	249,921	147,186	6,988	413,341	460,120	517,020	15,605	59,964	281,608	73,080	61,274	311,219	724,280	**823,611**	976,220	1,171,643	**1,286,434**	1,450,340

Table 3.3.5.2 Estimated number of RETURNING MSW salmon 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	23,975	9,667		132,797	1,058				10,825	24,387	157,476	90,670	21,918	567,909	781,633	**878,474**	995,713			
1972	37,414	15,070		134,665	744				21,535	37,462	169,264	150,146	19,122	731,177	1,006,433	**1,137,847**	1,292,236			
1973	44,746	14,089		222,757	2,581				13,255	33,834	183,556	114,508	16,732	804,762	1,036,567	**1,173,408**	1,340,088			
1974	66,536	13,378		209,676	1,661				6,210	29,215	206,560	84,432	18,287	569,348	815,078	**921,572**	1,046,745			
1975	73,894	14,795		225,188	402				12,288	30,998	231,473	114,883	14,990	626,889	917,315	**1,042,857**	1,188,220			
1976	60,884	12,156		194,865	1,210				8,986	26,790	160,133	60,268	10,441	390,985	585,755	**664,745**	752,483			
1977	37,202	16,930		134,427	909				6,964	26,150	139,455	76,591	10,285	427,516	614,650	**693,969**	787,743			
1978	23,670	21,839		115,986	694				7,117	33,829	120,591	64,405	13,401	533,374	686,419	**778,610**	888,193			
1979	25,296	14,411		101,438	2,016				8,120	21,637	109,132	31,847	9,397	395,351	507,698	**579,742**	666,298			
1980	26,463	20,064		168,999	3,529				17,055	30,387	119,991	103,798	11,907	483,147	689,980	**774,062**	875,850			
1981	29,170	7,043		96,572	1,022				11,620	20,288	88,752	145,209	9,325	518,670	711,504	**803,097**	909,395			
1982	38,211	8,078		85,292	3,685				7,255	14,322	51,687	56,375	13,509	417,891	501,807	**563,981**	646,372			
1983	41,214	6,155	428,870	124,130	2,538	548,299	**604,904**	671,526	7,734	23,930	154,218	64,361	18,977	452,652	629,011	**737,860**	935,912	1,221,079	**1,347,548**	1,550,814
1984	39,177	7,945	439,174	123,807	3,553	558,996	**616,043**	680,524	12,551	20,252	76,464	51,557	7,446	377,198	491,776	**548,844**	616,701	1,084,028	**1,167,298**	1,258,442
1985	30,629	5,124	405,090	135,422	1,484	527,051	**579,419**	638,846	9,509	14,700	83,680	75,900	9,642	463,287	591,139	**660,647**	743,618	1,153,669	**1,241,581**	1,342,068
1986	26,762	13,921	486,655	133,699	1,434	601,567	**664,851**	736,928	9,740	12,270	94,635	103,167	10,865	593,310	738,552	**830,181**	940,805	1,381,701	**1,497,727**	1,627,887
1987	33,412	14,440	367,065	99,367	4,300	473,915	**520,902**	576,206	5,137	10,891	117,707	83,164	5,534	387,818	548,764	**615,204**	692,280	1,053,565	**1,137,291**	1,231,735
1988	21,716	9,313	306,088	99,762	4,168	404,042	**442,174**	485,823	14,243	12,440	84,933	108,256	15,662	601,153	751,315	**842,747**	951,924	1,185,239	**1,286,478**	1,401,418
1989	24,336	7,908	219,835	97,409	11,612	332,594	**362,355**	395,401	6,493	11,086	77,536	86,109	12,453	524,551	646,949	**723,111**	812,649	1,002,558	**1,086,670**	1,181,563
1990	30,495	8,321	260,039	124,651	7,430	397,817	**431,976**	473,069	6,693	10,980	37,168	106,903	11,327	439,482	548,664	**617,445**	696,197	972,668	**1,051,480**	1,140,157
1991	36,578	5,775	220,247	122,316	8,570	364,284	**395,439**	430,238	6,045	10,952	56,016	46,883	5,812	331,894	413,268	**460,737**	518,534	798,191	**856,964**	924,466
1992	39,145	8,616	239,432	116,453	11,019	383,835	**416,153**	453,166	7,573	12,352	42,996	35,696	13,315	443,558	498,337	**557,735**	632,141	905,669	**975,689**	1,056,781
1993	45,379	9,724	229,330	137,665	15,035	408,938	**439,551**	472,133	3,577	6,052	42,160	39,479	31,440	363,735	437,687	**491,869**	557,318	868,374	**932,895**	1,004,406
1994	37,650	8,266	224,469	121,800	11,040	374,343	**405,608**	440,343	7,633	9,812	67,511	55,496	11,042	442,520	533,612	**598,330**	673,389	931,782	**1,004,888**	1,087,161
1995	23,409	5,716	240,538	138,927	7,710	386,650	**417,903**	453,196	3,641	11,077	65,224	55,669	9,357	408,961	498,350	**557,521**	630,060	907,450	**976,874**	1,057,352
1996	20,557	7,538	241,608	104,418	9,898	355,607	**386,113**	419,181	6,454	7,136	43,565	57,461	10,217	312,220	391,999	**441,959**	500,891	769,587	**828,749**	896,242
1997	29,775	4,230	159,340	85,330	6,375	264,432	**287,127**	311,884	3,339	8,006	56,562	35,924	12,724	215,669	297,283	**338,387**	387,141	578,282	**626,078**	680,509
1998	25,336	6,170	191,388	105,483	4,729	309,799	**334,886**	363,004	2,807	4,965	32,885	23,214	17,483	227,752	279,119	**311,973**	351,857	604,496	**647,897**	694,973
1999	23,661	7,094	204,260	93,153	4,071	305,489	**333,443**	365,543	6,101	9,685	51,197	46,722	7,985	176,189	262,866	**307,907**	363,429	586,781	**642,375**	706,067
2000	52,693	4,162	282,034	162,211	8,870	474,562	**512,599**	555,451	4,248	2,631	63,883	48,181	10,625	225,003	319,536	**360,664**	410,717	817,784	**874,550**	936,620
2001	75,743	4,769	333,548	114,801	10,677	498,662	**541,995**	590,481	4,988	4,615	56,711	52,024	7,814	214,447	304,294	**347,005**	398,605	826,455	**890,544**	959,285
2002	60,451	4,508	289,370	125,075	7,827	449,251	**489,248**	534,577	4,619	4,993	65,579	46,828	9,267	175,450	275,832	**313,746**	358,652	747,963	**803,516**	867,904
2003	43,008	4,737	255,438	87,213	8,897	369,216	**401,199**	437,096	6,637	7,988	69,261	60,082	6,044	218,311	327,497	**375,615**	434,278	718,655	**778,224**	844,778
2004	20,646	4,651	231,629	67,252	6,491	303,460	**331,788**	365,008	12,358	6,456	38,000	51,498	5,398	282,011	352,156	**402,610**	462,471	678,305	**735,308**	801,673
2005	15,924	5,784	213,001	80,584	4,924	295,457	**321,198**	350,162	7,628	5,692	49,240	55,365	6,880	222,990	310,324	**353,585**	407,192	625,367	**675,407**	735,054
2006	27,779	5,534	270,422	77,243	4,915	355,219	**387,146**	422,943	7,730	4,726	35,763	50,108	4,396	231,175	296,198	**342,604**	397,358	672,739	**730,160**	795,478
2007	39,813	5,293	230,280	80,540	6,800	336,496	**363,857**	394,482	7,255	2,908	15,846	48,672	6,050	221,844	266,325	**308,871**	361,168	621,705	**673,059**	732,846
2008	37,915	6,823	265,318	125,920	9,768	409,815	**448,680**	492,255	8,047	3,321	23,998	53,727	3,648	249,639	300,300	**349,472**	411,157	734,516	**799,568**	872,637
2009	17,553	5,513	207,982	107,000	8,780	318,278	**348,711**	384,081	4,215	5,152	27,014	40,759	4,787	211,569	256,676	**299,541**	350,981	594,859	**649,553**	711,483
2010	27,891	7,833	229,078	132,362	10,755	374,259	**410,331**	449,227	3,557	10,664	17,417	60,625	4,370	278,651	324,595	**383,248**	457,997	724,596	**795,077**	877,266
2011	21,906	8,726	318,725	131,895	14,038	451,842	**497,778**	550,480	9,228	5,420	20,137	87,759	11,420	313,606	386,813	**459,861**	555,115	870,116	**959,608**	1,065,974
2012	28,360	4,267	279,528	65,039	16,436	357,995	**395,360**	438,426	7,210	4,649	20,726	70,760	14,206	260,554	324,260	**388,630**	469,655	708,546	**785,663**	875,645
10yr Av.	28,079	5,916	250,140	95,505	9,180	357,204	**390,605**	428,416	7,386	5,698	31,740	57,936	6,720	249,035	314,514	**366,404**	430,737	694,940	**758,163**	831,283

Table 3.3.5.3 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	33,545	12,094		NA	22,279				63,680	79,581	1,344,969	105,202	231,178	783,005	2,272,283	**2,622,949**	3,045,619			
1972	51,958	11,092		151,275	17,659				127,611	64,806	1,427,891	101,388	202,207	683,229	2,273,962	**2,628,999**	3,086,322			
1973	47,287	13,251		223,861	21,931				76,976	69,272	1,561,580	119,489	176,586	818,985	2,443,862	**2,836,888**	3,323,639			
1974	93,670	13,254		222,530	31,449				36,228	49,587	1,774,547	149,571	193,486	781,025	2,573,849	**3,001,384**	3,531,743			
1975	65,162	16,083		340,869	33,891				72,113	76,401	1,963,846	152,978	158,674	636,008	2,624,550	**3,073,860**	3,654,325			
1976	44,934	16,150		237,065	19,205				65,917	60,402	1,335,632	102,772	110,520	548,068	1,915,099	**2,233,631**	2,642,125			
1977	23,186	22,416		151,521	9,135				51,065	61,850	1,147,164	116,360	108,769	571,532	1,789,105	**2,069,616**	2,431,613			
1978	31,303	22,772		153,140	10,356				52,340	81,015	1,007,321	133,148	141,662	654,926	1,814,605	**2,082,162**	2,415,707			
1979	36,735	21,878		212,912	10,962				60,327	74,966	930,902	126,790	99,438	539,777	1,601,026	**1,845,464**	2,137,336			
1980	17,122	3,512		151,679	13,945				124,706	34,327	707,742	119,489	126,224	337,655	1,273,286	**1,465,250**	1,698,014			
1981	26,726	17,370		127,279	25,409				98,494	44,505	374,509	126,153	99,707	418,108	1,047,724	**1,174,504**	1,317,751			
1982	8,587	8,148		111,063	22,230				61,959	45,550	771,386	106,657	143,283	597,748	1,539,868	**1,737,600**	1,963,855			
1983	37,726	11,932	895,529	184,774	29,576	1,015,958	**1,162,491**	1,332,641	65,931	57,558	1,360,399	156,317	200,326	611,390	2,161,066	**2,464,818**	2,824,543	3,247,194	**3,628,731**	4,079,555
1984	41,046	4,333	928,372	196,771	41,094	1,061,649	**1,215,676**	1,397,807	107,956	35,269	711,747	136,112	78,831	642,945	1,532,145	**1,726,587**	1,958,795	2,656,584	**2,946,593**	3,277,789
1985	61,513	28,974	944,167	269,475	48,997	1,197,824	**1,356,907**	1,547,129	40,353	56,851	1,180,700	136,450	102,145	532,277	1,800,918	**2,057,295**	2,367,564	3,067,818	**3,419,983**	3,831,519
1986	56,721	36,255	825,263	231,437	51,736	1,071,115	**1,207,354**	1,370,843	62,033	93,709	1,320,206	158,471	115,146	660,789	2,136,004	**2,439,336**	2,804,964	3,273,439	**3,651,207**	4,087,224
1987	71,562	21,293	692,725	246,317	41,952	955,930	**1,079,081**	1,221,569	110,205	58,145	850,014	163,833	62,888	510,299	1,554,607	**1,786,541**	2,081,943	2,569,259	**2,871,309**	3,227,374
1988	34,784	30,720	637,761	170,207	35,176	810,824	**911,189**	1,031,715	37,550	104,061	1,155,072	224,673	148,019	771,888	2,164,091	**2,461,118**	2,818,590	3,025,291	**3,376,883**	3,784,649
1989	80,278	16,683	700,565	252,459	11,370	941,715	**1,064,071**	1,212,042	20,724	58,322	826,033	151,186	142,436	845,082	1,827,382	**2,058,520**	2,338,339	2,822,039	**3,129,731**	3,475,861
1990	75,789	12,426	626,698	208,281	24,966	841,732	**950,600**	1,079,351	34,157	53,508	517,547	108,018	117,378	404,572	1,105,859	**1,249,138**	1,422,368	1,988,195	**2,202,641**	2,448,820
1991	91,730	17,986	545,306	178,085	30,272	770,204	**868,399**	983,364	25,074	59,177	370,250	106,811	65,611	402,321	925,226	**1,039,975**	1,176,317	1,733,913	**1,910,813**	2,114,740
1992	121,328	33,759	460,052	218,914	32,841	776,117	**872,214**	978,937	45,298	67,442	535,873	111,592	132,729	586,452	1,329,785	**1,498,163**	1,689,902	2,144,276	**2,370,101**	2,619,193
1993	85,557	27,701	461,831	188,279	35,297	717,501	**802,746**	903,033	64,900	66,333	436,160	155,024	155,518	526,015	1,269,074	**1,427,038**	1,617,808	2,020,962	**2,231,558**	2,474,740
1994	34,122	8,912	624,066	222,790	26,848	810,072	**922,727**	1,054,550	51,268	54,324	559,600	172,792	106,748	561,071	1,351,841	**1,527,357**	1,727,595	2,211,472	**2,451,959**	2,720,742
1995	33,509	25,530	407,767	200,378	38,986	631,453	**710,958**	800,232	16,863	73,791	623,375	132,015	99,017	549,907	1,335,827	**1,505,330**	1,703,831	2,000,345	**2,218,771**	2,466,790
1996	77,670	13,641	311,239	272,052	24,009	624,990	**702,275**	791,213	21,006	63,712	581,856	97,759	102,430	394,827	1,120,850	**1,271,152**	1,445,824	1,778,707	**1,977,088**	2,195,101
1997	66,109	18,651	358,917	266,938	11,016	644,004	**725,216**	818,928	10,832	46,640	579,835	87,484	121,693	284,381	999,263	**1,139,233**	1,303,129	1,677,495	**1,865,951**	2,077,904
1998	76,404	31,578	468,531	292,477	9,680	784,344	**883,567**	998,879	21,282	63,713	607,831	96,501	264,724	386,983	1,288,734	**1,451,796**	1,644,930	2,115,731	**2,339,437**	2,596,095
1999	109,190	16,102	435,452	226,187	14,291	716,860	**804,074**	905,993	7,061	51,717	565,615	76,285	68,754	191,831	841,670	**968,857**	1,119,872	1,596,492	**1,774,687**	1,979,683
2000	115,262	16,967	716,003	246,935	28,465	1,002,249	**1,129,735**	1,281,016	18,380	45,931	786,005	116,286	99,981	374,316	1,270,571	**1,451,111**	1,670,686	2,324,523	**2,587,684**	2,880,808
2001	52,170	15,380	617,427	333,014	18,526	909,342	**1,045,340**	1,210,145	15,655	41,148	626,389	101,052	79,036	366,463	1,105,307	**1,240,359**	1,398,736	2,062,515	**2,288,219**	2,550,331
2002	36,524	26,677	378,003	303,392	18,892	666,778	**769,689**	906,536	35,589	51,487	547,562	95,518	156,360	295,512	1,067,617	**1,196,382**	1,346,033	1,772,980	**1,971,660**	2,197,600
2003	42,880	14,173	523,821	270,156	11,612	755,413	**869,085**	1,005,513	23,495	61,710	535,916	74,284	102,298	335,746	1,023,088	**1,147,994**	1,288,631	1,817,428	**2,020,808**	2,243,810
2004	16,683	38,241	317,729	188,898	10,025	504,851	**575,963**	664,574	28,096	61,493	394,457	132,837	91,130	398,857	999,534	**1,124,900**	1,273,737	1,536,578	**1,704,229**	1,895,595
2005	42,502	34,068	470,470	215,551	8,490	682,656	**777,704**	892,001	18,411	90,741	394,244	108,382	116,004	432,647	1,051,910	**1,174,652**	1,319,335	1,772,082	**1,955,792**	2,169,424
2006	80,805	35,892	381,191	259,942	10,254	678,102	**774,458**	893,536	25,756	63,982	301,754	107,291	74,019	419,235	895,161	**1,008,784**	1,143,607	1,611,407	**1,786,903**	1,990,255
2007	14,960	26,606	213,046	140,489	4,875	352,004	**402,926**	465,545	20,262	73,602	345,331	101,960	120,318	411,514	938,809	**1,102,597**	1,369,678	1,322,194	**1,511,251**	1,790,576
2008	15,396	24,322	266,897	146,326	6,306	404,024	**463,352**	535,297	19,845	89,279	340,347	100,281	72,051	355,559	845,070	**1,010,048**	1,269,876	1,284,160	**1,479,699**	1,752,742
2009	31,416	39,223	214,053	137,400	6,724	378,272	**431,555**	493,193	7,123	100,756	280,015	62,853	54,682	303,320	699,644	**834,237**	1,046,344	1,108,830	**1,270,789**	1,497,160
2010	29,320	31,442	317,260	156,751	11,223	482,475	**550,298**	629,039	24,041	102,983	357,136	124,852	50,319	554,961	1,048,289	**1,259,296**	1,567,547	1,569,645	**1,814,632**	2,140,422
2011	35,990	25,821	223,284	166,719	9,308	407,397	**464,263**	531,184	16,960	72,672	314,478	72,330	43,586	295,744	698,598	**843,064**	1,095,288	1,136,871	**1,313,648**	1,578,571
2012	78,015	10,587	248,611	194,063	10,038	478,316	**546,557**	630,002	14,704	45,205	320,690	44,519	54,498	414,460	758,880	**932,133**	1,205,844	1,275,909	**1,485,806**	1,775,052
10yr Av.	38,797	28,038	317,636	187,630	8,885	512,351	**585,616**	673,988	19,869	76,242	358,437	92,959	77,891	392,204	895,898	**1,043,771**	1,257,989	1,443,510	**1,634,356**	1,883,361

Table 3.3.5.4 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	71,642	27,304		262,326	5,888				54,723	63,966	385,078	361,141	34,188	1,706,302	2,211,494	**2,621,181**	3,114,208			
1972	85,035	25,819		416,715	8,857				36,778	57,936	387,828	277,581	30,494	1,742,261	2,133,614	**2,545,763**	3,038,110			
1973	118,310	23,955		387,219	5,957				20,338	49,779	400,882	200,820	32,340	1,224,912	1,626,892	**1,940,617**	2,323,575			
1974	132,943	26,771		420,624	4,625				32,178	53,173	452,287	263,424	27,375	1,370,700	1,851,248	**2,211,672**	2,655,530			
1975	107,882	21,781		358,508	5,155				27,618	45,725	337,893	173,512	18,983	979,657	1,350,596	**1,590,410**	1,875,349			
1976	66,435	29,277		248,124	3,663				19,854	44,392	279,324	177,873	18,219	934,438	1,244,998	**1,483,213**	1,771,116			
1977	42,886	37,239		211,108	2,856				18,774	56,978	239,781	149,041	23,130	1,073,242	1,307,737	**1,570,450**	1,893,733			
1978	47,692	25,304		195,502	5,638				19,415	36,910	214,905	87,133	17,124	825,847	1,005,510	**1,207,628**	1,461,069			
1979	58,678	36,673		338,621	11,067				36,692	52,685	249,761	226,476	23,678	1,073,123	1,404,331	**1,670,122**	2,001,610			
1980	71,461	16,735		240,497	9,526				27,987	37,094	201,349	299,904	21,754	1,177,592	1,489,098	**1,775,952**	2,121,774			
1981	85,067	18,153		216,893	13,373				19,719	26,898	134,290	141,749	28,298	977,060	1,124,377	**1,332,259**	1,588,506			
1982	85,464	13,918	812,981	269,475	9,875	1,001,338	**1,195,711**	1,427,316	18,962	42,276	295,953	146,278	36,096	975,721	1,264,546	**1,548,446**	1,962,953	2,307,851	**2,752,651**	3,313,079
1983	76,161	15,543	794,064	249,544	9,455	959,603	**1,147,564**	1,371,177	24,172	35,239	147,570	107,252	15,254	755,358	910,515	**1,089,767**	1,307,372	1,898,937	**2,241,462**	2,641,896
1984	62,459	11,001	740,397	270,632	6,194	918,590	**1,091,964**	1,307,897	18,597	26,118	157,438	147,136	19,156	894,363	1,052,266	**1,267,670**	1,528,349	2,000,229	**2,363,531**	2,798,288
1985	58,157	26,208	890,452	274,491	7,130	1,057,562	**1,259,598**	1,511,373	22,475	22,396	195,512	213,690	21,709	1,204,730	1,409,384	**1,687,721**	2,031,303	2,501,965	**2,952,064**	3,489,227
1986	68,501	26,896	688,984	212,506	11,706	851,138	**1,012,488**	1,210,956	15,508	19,974	237,376	182,458	12,672	869,565	1,135,596	**1,344,232**	1,602,699	2,015,133	**2,357,233**	2,778,674
1987	42,626	16,961	549,394	195,616	9,348	683,811	**816,017**	975,578	28,459	21,621	168,330	212,541	27,813	1,150,895	1,347,670	**1,617,210**	1,952,278	2,060,212	**2,432,257**	2,891,393
1988	48,770	14,943	415,549	195,507	22,286	589,629	**699,000**	831,758	16,857	19,666	164,146	182,337	22,867	1,058,317	1,232,015	**1,467,945**	1,762,075	1,843,577	**2,167,454**	2,566,086
1989	56,815	15,218	469,182	234,577	14,487	666,103	**792,189**	945,774	13,613	19,170	76,935	198,126	20,488	823,094	959,165	**1,157,089**	1,408,529	1,650,726	**1,952,323**	2,321,702
1990	64,820	10,428	387,579	223,135	15,551	591,818	**704,006**	840,655	11,452	18,758	101,354	88,323	10,661	605,171	695,371	**840,715**	1,020,033	1,306,448	**1,546,201**	1,834,314
1991	67,178	14,747	410,256	204,959	19,206	602,102	**719,086**	859,225	14,772	20,931	83,728	73,475	22,650	805,022	845,534	**1,024,021**	1,243,881	1,469,088	**1,740,799**	2,074,874
1992	77,287	16,609	392,064	241,168	25,732	637,603	**755,187**	900,180	7,533	10,336	79,188	76,858	52,763	657,438	735,268	**891,669**	1,086,335	1,391,930	**1,648,193**	1,958,535
1993	64,793	14,140	383,175	217,553	18,974	586,875	**701,254**	839,079	12,964	16,602	114,395	97,200	18,868	758,631	839,297	**1,022,546**	1,256,958	1,448,657	**1,727,111**	2,068,673
1994	41,279	10,006	413,071	246,055	13,582	608,134	**725,029**	866,981	6,359	18,735	110,967	97,693	16,123	703,821	787,551	**959,806**	1,180,353	1,417,034	**1,685,894**	2,018,806
1995	35,983	12,912	411,427	186,380	17,124	558,555	**666,407**	796,101	11,418	12,147	76,565	102,859	17,599	548,870	635,770	**774,765**	950,737	1,213,779	**1,443,386**	1,719,943
1996	49,825	7,068	265,729	147,792	10,700	404,358	**484,018**	578,717	5,922	13,377	96,028	63,737	21,244	371,845	472,352	**581,321**	719,143	892,495	**1,065,987**	1,274,632
1997	42,438	10,321	318,594	181,145	7,944	471,631	**562,554**	676,343	4,851	8,299	55,594	41,074	29,267	388,717	434,671	**532,048**	651,437	923,280	**1,095,776**	1,304,774
1998	39,433	11,824	340,502	161,922	6,800	468,296	**561,659**	675,349	10,256	16,148	86,031	80,846	13,356	298,758	413,789	**520,153**	659,954	900,798	**1,085,010**	1,308,535
1999	87,876	6,966	468,876	281,128	14,865	723,903	**861,467**	1,031,507	7,140	4,401	107,100	83,707	17,769	381,360	496,637	**608,684**	750,356	1,240,744	**1,471,499**	1,754,641
2000	126,391	7,975	554,777	199,715	17,966	760,963	**909,479**	1,094,119	8,768	7,719	97,477	91,781	13,010	372,226	486,706	**599,678**	742,425	1,272,210	**1,510,129**	1,804,231
2001	101,035	7,539	481,777	217,989	13,107	685,566	**825,068**	987,963	7,877	8,358	110,813	81,776	15,493	300,306	433,673	**535,062**	659,579	1,141,171	**1,358,997**	1,620,059
2002	71,841	7,918	425,506	152,242	14,875	563,882	**674,173**	807,421	11,360	13,304	117,115	105,170	10,119	372,391	517,849	**641,155**	797,158	1,103,019	**1,314,931**	1,574,677
2003	34,449	7,783	385,145	117,912	10,852	464,324	**557,193**	672,499	20,831	10,778	63,783	88,835	9,040	477,156	549,773	**679,614**	844,352	1,033,883	**1,239,768**	1,489,625
2004	26,578	9,654	355,166	140,680	8,232	452,535	**541,595**	648,474	12,813	9,480	82,605	95,977	11,469	375,695	484,254	**598,027**	743,554	955,969	**1,140,240**	1,366,181
2005	46,428	9,252	450,428	133,960	8,229	542,061	**650,036**	780,406	12,976	7,894	60,085	86,948	7,316	391,310	463,025	**577,776**	723,003	1,026,287	**1,230,183**	1,477,048
2006	66,497	8,851	382,963	137,972	11,371	512,433	**608,924**	727,538	12,218	4,849	27,180	84,402	10,074	375,941	418,353	**523,071**	657,016	947,329	**1,134,508**	1,358,597
2007	63,259	11,413	441,948	220,260	16,366	626,290	**755,533**	909,462	13,577	5,549	40,694	92,901	6,096	422,123	471,206	**590,627**	744,807	1,127,436	**1,349,848**	1,622,784
2008	29,447	9,211	346,777	185,339	14,631	487,426	**587,723**	709,347	7,124	8,603	45,623	70,653	7,943	357,835	402,914	**505,209**	638,388	911,126	**1,094,230**	1,320,006
2009	46,446	13,084	380,639	230,462	17,946	576,274	**690,764**	834,884	5,976	17,768	29,332	104,232	7,329	470,984	510,450	**646,728**	827,886	1,112,264	**1,342,629**	1,630,912
2010	36,678	14,607	530,311	229,083	23,359	692,941	**837,350**	1,013,814	15,549	9,042	34,314	152,102	19,148	534,375	610,891	**780,108**	1,001,921	1,338,563	**1,618,983**	1,960,017
2011	47,311	7,136	464,174	112,495	27,550	548,660	**660,922**	801,781	12,092	7,747	34,862	122,047	23,715	439,323	512,724	**657,023**	841,650	1,092,602	**1,319,950**	1,602,844
10yr Av.	46,893	9,891	416,306	166,040	15,341	546,682	**656,421**	790,562	12,452	9,501	53,559	100,327	11,225	421,713	494,144	**619,934**	781,974	1,064,848	**1,278,527**	1,540,269

Table 3.3.5.5 **Estimated number of 1SW SPAWNERS by NEAC country or region and year**

Year	Northern Europe								Southern Europe									NEAC Area		
	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	12,950	4,697			8,182				48,271	31,265	394,571	35,189	36,435	213,877	583,042	**770,899**	1,023,905			
1972	20,180	4,312		72,085	6,501				96,820	25,444	419,154	38,701	31,780	167,785	593,796	**798,737**	1,065,598			
1973	18,380	5,174		78,472	8,112				58,343	27,153	457,879	46,364	27,801	204,435	616,949	**835,701**	1,126,239			
1974	36,472	5,117		94,029	11,605				27,258	19,418	516,786	58,058	30,393	172,975	601,687	**834,826**	1,162,005			
1975	25,364	6,287		111,983	12,508				54,610	29,875	575,301	60,084	24,912	154,958	658,403	**910,056**	1,267,006			
1976	17,536	6,285		109,539	7,085				49,904	23,642	391,847	39,711	17,360	159,403	511,829	**691,112**	938,437			
1977	8,957	8,764		74,428	3,356				38,669	24,222	336,520	45,045	17,079	140,180	453,352	**608,590**	825,532			
1978	12,196	8,896		58,932	3,840				39,569	31,802	294,294	52,895	22,296	188,282	493,734	**637,230**	830,287			
1979	14,256	8,544		75,257	4,006				45,644	29,492	275,131	51,656	15,584	124,529	417,969	**551,397**	725,077			
1980	6,395	1,289		73,550	5,055				94,446	13,325	207,380	48,549	19,805	81,850	368,313	**478,467**	616,524			
1981	9,851	6,655		53,779	9,208				74,255	17,290	70,030	51,796	15,529	98,594	270,162	**337,926**	414,185			
1982	2,898	3,076		49,742	8,074				46,700	17,692	169,148	43,511	22,486	170,591	380,306	**479,978**	596,421			
1983	14,315	4,565	160,753	64,867	10,805	202,548	**256,512**	320,281	49,645	22,385	361,624	64,250	31,411	149,393	536,788	**687,624**	874,907	782,264	**947,755**	1,145,367
1984	15,907	1,646	163,518	80,587	15,101	219,453	**278,397**	345,663	81,704	13,786	197,172	56,079	12,317	188,972	455,513	**562,610**	682,582	718,770	**843,566**	977,666
1985	23,996	11,398	171,329	92,776	18,210	259,749	**320,464**	387,124	30,588	22,354	236,835	55,972	16,006	178,938	417,703	**547,097**	709,642	723,947	**870,848**	1,043,099
1986	21,911	14,147	151,941	102,392	19,068	257,799	**311,991**	372,218	44,980	36,718	324,800	65,747	17,949	223,789	574,933	**735,174**	932,409	879,787	**1,050,053**	1,251,489
1987	27,783	8,269	127,306	95,726	15,490	231,086	**276,901**	328,759	80,727	22,766	199,545	68,965	15,265	169,575	453,027	**582,102**	756,577	721,531	**860,613**	1,040,716
1988	13,326	11,995	117,323	86,823	13,059	205,030	**245,206**	290,318	27,194	40,655	343,644	95,542	41,242	383,623	796,006	**950,741**	1,132,735	1,036,848	**1,197,204**	1,382,397
1989	25,063	6,507	184,803	96,355	4,137	267,822	**318,517**	380,243	14,956	22,814	220,991	64,333	12,382	440,331	664,742	**789,281**	933,686	974,083	**1,110,832**	1,263,177
1990	23,749	4,846	164,869	97,173	10,736	258,404	**303,256**	357,070	24,872	20,997	158,878	46,281	35,052	197,476	420,682	**495,236**	581,340	711,125	**801,305**	900,583
1991	28,693	7,064	144,138	83,245	13,094	237,648	**278,544**	325,700	18,229	23,268	117,542	46,831	18,296	215,054	387,452	**448,830**	518,209	652,895	**728,593**	810,750
1992	37,931	13,247	121,535	116,239	14,155	267,267	**306,627**	349,249	33,212	26,469	158,716	49,429	46,063	333,392	573,212	**661,567**	765,112	871,322	**969,598**	1,078,476
1993	26,893	10,899	120,760	113,882	15,133	252,912	**290,062**	331,683	47,359	26,101	141,025	72,078	72,250	275,490	565,873	**651,946**	758,546	847,956	**942,995**	1,056,254
1994	10,648	3,489	166,026	115,975	11,554	261,595	**309,537**	369,039	37,382	21,287	125,515	80,551	25,178	298,743	511,111	**605,440**	714,663	809,869	**917,916**	1,038,560
1995	10,504	10,034	107,985	121,496	18,998	236,417	**271,472**	310,367	11,594	29,001	178,918	64,831	25,809	298,492	529,298	**617,517**	720,081	793,947	**890,039**	998,959
1996	30,448	5,353	80,594	138,539	11,788	237,228	**268,983**	304,135	14,483	25,108	183,566	49,233	34,737	227,564	464,913	**543,735**	635,799	725,578	**814,422**	911,633
1997	25,893	7,329	105,152	158,309	5,406	266,473	**304,401**	345,076	7,486	18,346	226,390	45,732	38,490	158,702	429,392	**501,583**	590,932	724,416	**807,238**	904,865
1998	30,051	12,375	138,416	163,034	4,751	306,240	**351,168**	399,884	14,610	25,075	220,388	51,833	156,208	233,414	624,496	**713,473**	815,028	964,726	**1,066,027**	1,176,555
1999	34,351	6,574	128,344	162,781	7,038	297,429	**341,153**	389,292	4,858	20,757	232,224	42,319	20,053	107,933	364,933	**433,104**	519,208	692,273	**776,449**	871,865
2000	36,497	6,908	213,843	141,438	13,938	356,100	**415,387**	483,921	12,638	18,401	350,533	64,226	33,133	218,889	607,035	**706,176**	831,569	1,005,927	**1,124,512**	1,262,689
2001	16,369	6,404	185,803	198,255	9,121	357,579	**419,627**	491,101	10,745	16,836	256,145	57,373	31,132	220,887	523,016	**602,799**	692,896	920,458	**1,024,173**	1,138,376
2002	14,356	11,324	111,867	211,069	9,224	304,090	**359,539**	426,163	24,470	21,099	215,192	54,423	70,184	179,510	502,450	**577,322**	662,121	842,096	**938,890**	1,043,251
2003	16,696	6,017	156,299	199,140	5,696	324,644	**387,506**	458,646	16,193	25,364	246,544	45,900	41,243	228,216	544,032	**615,696**	698,073	907,066	**1,005,212**	1,113,663
2004	6,592	16,532	94,026	145,987	4,921	229,347	**269,644**	317,994	19,247	25,178	156,351	80,943	40,839	267,169	529,533	**605,419**	695,016	789,341	**876,664**	976,395
2005	16,774	14,950	140,069	132,829	4,163	265,329	**311,317**	363,055	12,640	36,989	171,727	66,566	55,590	293,942	577,031	**650,445**	733,233	875,531	**963,152**	1,057,897
2006	31,719	15,569	111,147	161,956	4,999	279,371	**328,322**	383,539	17,652	26,127	126,666	68,156	38,313	286,810	507,468	**578,429**	661,759	819,998	**908,237**	1,006,826
2007	5,890	11,690	61,869	122,760	2,385	173,407	**206,199**	246,987	13,869	30,651	251,219	66,028	75,189	285,228	631,887	**743,134**	947,044	833,487	**952,338**	1,155,632
2008	6,046	11,078	87,973	93,257	3,589	173,146	**203,737**	237,234	13,609	37,449	245,225	64,882	43,695	251,479	567,390	**681,428**	879,013	767,933	**887,062**	1,083,689
2009	12,349	18,475	71,264	100,857	3,816	178,703	**209,016**	245,126	4,879	41,304	203,631	40,616	34,896	217,663	469,441	**562,972**	721,921	673,452	**773,506**	935,463
2010	11,553	14,827	115,899	92,556	6,433	208,546	**243,809**	283,732	16,508	42,876	257,911	80,816	32,204	391,691	708,336	**859,613**	1,088,911	948,261	**1,104,333**	1,334,069
2011	14,127	12,605	80,386	102,550	4,024	185,699	**215,400**	248,904	11,640	30,363	227,170	44,952	28,362	206,916	467,408	**568,936**	763,230	678,281	**786,470**	981,319
2012	30,689	4,824	90,171	109,583	5,732	209,805	**243,422**	280,030	10,090	18,539	230,049	29,160	37,810	302,500	531,785	**658,798**	859,867	770,531	**903,561**	1,109,216
10yr Av.	15,244	12,657	100,910	126,148	4,576	222,800	**261,837**	306,525	13,633	31,484	211,649	58,802	42,814	273,161	553,431	**652,487**	804,807	806,388	**916,053**	1,075,417

Table 3.3.5.6 Estimated number of MSW SPAWNERS 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 N&E	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	10 789	2 905		NA	444				6 765	7 287	82 117	52 014	10 991	306 687	386 943	**474 087**	577 548			
1972	16 831	4 530		59 083	313				13 415	11 212	88 679	92 879	9 594	388 784	499 583	**615 322**	752 434			
1973	20 058	4 219		66 122	1 083				8 285	10 193	96 422	71 563	8 380	436 521	518 379	**640 325**	789 200			
1974	29 906	4 011		98 388	702				3 900	8 786	108 329	52 866	9 131	284 175	381 865	**476 317**	588 192			
1975	33 286	4 454		86 775	167				7 668	9 301	121 625	72 189	7 507	311 047	428 952	**541 550**	671 436			
1976	27 314	3 628		86 244	511				5 606	8 023	83 999	37 701	5 233	224 978	301 606	**372 708**	452 379			
1977	16 769	5 063		71 674	383				4 364	7 868	73 307	48 068	5 153	208 770	284 486	**355 052**	438 938			
1978	10 650	6 524		50 573	294				4 452	10 168	62 695	40 901	6 709	287 365	337 764	**419 889**	517 009			
1979	13 885	4 311		44 365	848				5 065	6 490	57 519	20 543	4 704	202 385	238 626	**301 575**	378 815			
1980	14 531	6 011		47 703	1 489				10 685	9 101	62 906	66 983	5 959	242 791	329 441	**406 651**	503 557			
1981	16 017	2 116		66 054	430				7 540	6 090	46 623	94 265	4 664	255 922	339 448	**424 557**	524 969			
1982	21 158	2 423		40 652	1 558				4 735	4 299	32 709	36 696	6 755	237 138	268 959	**325 779**	403 186			
1983	22 477	1 847	101 267	49 141	1 068	142 935	**178 501**	218 920	5 034	7 176	111 954	41 965	9 489	243 457	330 428	**435 297**	631 108	502 797	**616 015**	814 188
1984	21 418	2 384	103 995	62 180	1 492	157 626	**193 580**	233 864	8 111	6 050	43 138	33 432	3 719	223 924	269 433	**322 333**	385 269	452 863	**517 354**	591 901
1985	16 822	1 542	95 793	51 199	624	135 591	**167 309**	202 557	6 179	4 404	53 412	49 212	4 830	296 310	353 413	**417 893**	496 938	512 509	**586 747**	672 686
1986	14 660	4 151	115 156	52 222	604	149 543	**188 827**	232 783	6 340	3 672	51 048	67 371	5 434	379 843	434 094	**520 415**	626 439	614 212	**710 003**	822 602
1987	18 280	4 325	89 795	53 178	1 814	137 749	**169 718**	206 292	3 331	3 263	79 647	55 123	2 993	244 470	331 710	**394 079**	466 714	493 340	**565 684**	645 985
1988	12 060	2 802	72 290	44 822	1 767	111 116	**135 245**	163 017	9 279	3 741	53 160	71 967	10 046	442 765	510 793	**596 951**	701 724	641 454	**733 191**	840 838
1989	10 956	2 379	77 794	50 856	4 880	126 808	**148 345**	172 604	4 211	3 325	40 876	57 102	4 992	389 772	431 811	**505 326**	593 292	576 271	**654 129**	745 363
1990	13 726	2 501	91 137	48 257	3 719	135 760	**160 762**	189 884	4 361	3 276	14 906	71 161	7 024	311 274	350 606	**417 473**	494 108	506 892	**579 565**	659 623
1991	16 354	1 728	76 485	60 517	4 279	137 984	**161 194**	186 992	3 920	3 275	41 168	31 705	3 315	249 857	290 029	**336 299**	393 170	445 549	**497 985**	559 946
1992	17 623	2 593	84 500	58 618	5 474	146 406	**170 315**	197 506	4 902	3 700	20 871	24 225	8 915	344 188	351 251	**409 438**	482 756	516 693	**581 030**	657 573
1993	20 397	2 919	78 173	55 922	7 459	142 410	**166 793**	193 204	2 323	1 812	24 442	27 644	27 666	273 997	310 668	**363 966**	428 345	471 694	**531 308**	600 814
1994	16 944	2 493	76 900	65 296	5 537	144 498	**168 525**	194 497	5 343	2 937	40 170	39 199	6 624	335 903	371 340	**434 087**	507 993	535 203	**603 497**	681 633
1995	10 501	1 704	83 514	64 449	4 422	141 214	**165 903**	193 764	2 546	3 325	37 969	40 631	5 440	306 798	342 269	**400 087**	471 517	502 354	**566 694**	643 183
1996	11 273	2 272	83 038	63 445	5 697	142 312	**167 144**	193 821	4 511	2 144	19 580	42 577	6 776	241 212	272 680	**321 091**	379 022	433 652	**489 337**	553 529
1997	16 340	1 268	57 823	52 666	3 662	113 571	**133 438**	155 554	2 338	2 391	39 204	27 400	8 421	164 793	209 920	**250 983**	299 105	338 740	**384 857**	437 621
1998	13 947	1 855	69 775	41 824	2 707	111 049	**131 691**	154 079	1 961	1 493	12 544	18 005	13 586	181 317	199 195	**231 575**	270 794	324 439	**364 313**	408 711
1999	11 837	2 484	72 209	54 654	2 331	121 751	**144 001**	169 040	4 270	3 109	33 726	38 337	5 416	133 942	184 006	**229 121**	284 207	322 482	**373 839**	434 459
2000	26 395	1 504	102 507	58 877	5 102	167 025	**195 914**	228 237	2 971	898	44 010	40 986	7 186	175 979	237 346	**278 054**	327 296	423 374	**474 923**	532 077
2001	37 870	1 813	122 415	89 635	6 122	222 967	**259 929**	300 592	3 499	1 517	36 725	44 608	5 474	167 809	223 618	**266 311**	317 515	468 393	**527 920**	591 455
2002	30 033	1 806	107 133	74 466	4 472	188 004	**219 715**	256 655	3 232	1 745	47 471	40 197	5 284	139 332	206 609	**244 362**	289 217	414 658	**465 034**	522 180
2003	21 513	2 231	95 610	63 369	5 085	162 260	**189 846**	220 017	4 638	2 557	54 415	53 637	3 095	184 750	262 860	**310 431**	368 696	444 916	**501 401**	565 419
2004	10 302	2 095	87 575	48 196	3 728	129 568	**153 219**	180 534	8 624	2 129	24 727	46 037	3 080	238 605	280 003	**330 089**	389 422	428 046	**484 123**	548 343
2005	7 956	2 667	79 267	36 445	2 834	109 381	**129 757**	152 520	5 309	1 987	37 627	49 465	4 194	188 774	250 206	**293 259**	346 535	376 312	**423 597**	480 674
2006	13 774	3 042	101 037	46 489	2 816	142 595	**168 570**	197 597	5 430	1 651	25 234	45 516	2 906	198 926	242 163	**288 302**	342 602	403 373	**457 328**	519 600
2007	19 905	3 376	84 031	39 782	3 925	129 595	**152 053**	176 533	5 077	986	14 158	44 619	4 800	193 231	226 881	**269 309**	321 396	372 985	**421 662**	479 222
2008	19 021	3 749	125 852	47 364	6 588	173 333	**204 001**	240 190	5 629	1 426	21 223	49 347	2 777	219 208	257 869	**306 829**	368 205	452 041	**512 771**	581 566
2009	8 762	3 533	100 318	69 891	5 919	162 052	**190 857**	223 951	2 945	1 902	23 503	37 408	3 869	188 547	221 592	**264 313**	315 597	403 074	**455 952**	516 989
2010	13 917	4 849	122 947	60 858	7 229	180 809	**211 566**	245 297	2 488	3 729	15 111	55 772	3 556	244 716	275 224	**333 757**	407 867	478 898	**546 269**	626 921
2011	10 922	5 760	178 797	72 588	6 999	234 896	**276 784**	324 242	6 468	2 064	17 379	78 825	9 483	274 152	327 901	**400 463**	495 720	592 713	**678 972**	784 021
2012	14 165	2 821	156 484	64 324	11 069	214 910	**251 039**	291 568	5 046	1 907	17 645	65 175	12 482	234 750	283 044	**347 497**	428 407	524 247	**600 008**	689 126

Table 3.3.7.1. 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		
migration	Ellidaar	R.Vesturdalsa[4]		R. Halselva		R. Imsa		R. Corrib		B'shoole
year	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW
1975	20.8									
1980								17.9	1.1	3.1
1981						17.3	4.0	9.2	3.8	5.4
1982						5.3	1.2	20.9	3.3	5.8
1983						13.5	1.3	10.0	1.8	3.4
1984						12.1	1.8	26.2	2.0	7.8
1985	9.4					10.2	2.1	18.9	1.8	7.9
1986						3.8	4.2			8.7
1987				2.0	0.3	17.3	5.6	16.6	0.7	12.0
1988	12.7			5.8	0.7	13.3	1.1	14.6	0.7	10.1
1989	8.1			2.1	1.0	8.7	2.2	6.7	0.7	3.5
1990	5.4			3.9	1.6	3.0	1.3	5.0	0.6	9.2
1991	8.8			2.1	0.3	8.7	1.2	7.3	1.3	9.5
1992	9.6			2.1	0.4	6.7	0.9	7.3		7.6
1993	9.8			2.1	0.0	15.6		10.8	0.1	9.5
1994	9.0			0.6	0.4			9.8	1.4	9.4
1995	9.4		1.5	0.9	0.0	1.8	1.5	8.4	0.1	6.8
1996	4.6	2.5	0.4	2.8	0.6	3.5	0.9	6.3	1.2	9.2
1997	5.3	1.0	1.5	0.8	0.0	1.7	0.3	12.7	0.8	8.2
1998	5.3	1.5	1.0	1.5	0.6	7.2	1.0	5.5	1.1	5.3
1999	7.7	1.3	1.2	1.3	0.0	4.2	2.2	6.4	0.9	8.1
2000	6.3	1.1	0.7	0.4	1.1	12.5	1.7	9.4	0.0	9.0
2001	5.1	3.4	1.3	2.5	2.5	3.6	2.2	7.2	1.1	7.6
2002	4.4	1.1	2.3	0.8	0.6	5.5	0.9	6.0	0.5	6.5
2003	9.1	5.5	0.6	4.9	1.6	3.5	0.7	8.3	2.1	8.3
2004	7.7	5.7	0.6	3.5	1.2	5.9	1.4	6.3	0.8	5.8
2005	6.4	2.5	0.9	3.0	1.0	3.7	1.8		0.0	5.3
2006	7.1	1.8	1.0	0.8	0.8	0.8	5.8	1.2	0.9	13.0
2007	19.3	0.9	0.3	0.3	0.0	0.8	0.6	0.9	0.0	8.4
2008	14.9	2.6	1.1	0.2	0.2	1.1	2.3	1.7	1.03	8.22
2009	14.2	1.3	1.6	1.1	0.6	2.4	3.1	6		8.85
2010	8.6	2.0	1.1	0.4	0.4	1.7	1.3			7.49
2011	6.1	1.3		0		4.5				10.81
Mean										
(5-year)	12.8	1.7	1.0	0.6	0.5	1.4	2.7	2.5	0.5	8.7
(10-year)	9.7	2.7	1.0	1.8	1.0	2.9	2.1	4.7	0.7	8.1

[1] Microtags.
[2] Carlin tags, not corrected for tagging mortality.
[3] Microtags, corrected for tagging mortality.
[4] Assumes 50% exploitation in rod fishery.
[5] From 0+ stage in autumn.
[6] Incomplete returns.
[7] Assumes 30% exploitation in trap fishery.
[8] France data based on retruns to freshwater

Table 3.3.7.1. Cont'd. Estimated survival of wild smolts (%) to return to homewaters (prior to coastal fisheries) for various monitored rivers in the NE Atlantic Area.

Smolt	UK (Scotland)[2]		UK (NI)[7]	UK (E & W)						France[8]			
migration	North Esk		R. Bush	R. Dee		R. Tamar		R. Frome		Nivelle[5]	Scorff	Oir	Bresle
year	1SW	MSW	1SW[3]	1SW	MSW	1SW	MSW	1SW	MSW	All ages	All ages	All ages	All ages
1975													
1980													
1981	8.2	3.8											
1982	11.2	5.0											
1983													
1984	6.0	4.0											
1985	13.6	5.4											
1986			31.3										
1987	10.4	3.9	35.1										
1988			36.2										
1989	6.6	4.2	25.0										
1990	6.0	3.1	34.7										
1991	7.6	3.1	27.8										
1992	10.9	6.5	29.0							6.83		5.30	
1993	14.5	6.1		6.3	2.5					4.80		17.00	5.80
1994	10.9	3.6	27.1	1.3	1.2					5.37		3.54	3.60
1995	8.4	3.8		2.7	0.4					3.77	11.75	4.99	
1996	5.9	2.7	31.0	4.8	2.1					2.42	15.06	4.83	
1997	7.2	4.2	19.8	6.2	3.4					2.09	5.76	14.01	4.70
1998	2.6	1.4	13.4	2.3	3.7					2.27	6.73	6.58	*2.20*
1999	6.8	3.8	16.5	5.0	12.4					2.49	15.93		
2000	6.0	2.8	10.1	2.0	0.9					3.08	10.58	2.38	
2001	4.7	2.9	12.4	4.3	0.0					0.37	6.15	3.68	
2002	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			6.8	2.6	0.4	6.1	1.8	4.8	0.9	1.23	12.02	5.70	2.99
2004			6.8	4.5	1.0	6.0	1.5	5.3	2.9	1.07	6.47	4.00	4.43
2005	6.7	2.8	5.9	5.1	0.5	6.4	1.2			0.99	8.50	6.60	3.09
2006	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	5.0	4.0		1.3	0.7	3.5	3.4	5.7	1.3	2.14	4.42	4.00	3.47
2008	6.4			2.5	1.3	1.7	0.9	3.1	1.6	2.85	3.03		1.92
2009	9	8.65		4.8	1.1	8.2	1.9	7.7	2.6	0.92	6.78		17.5
2010				1.9	0 [9]	3.4	2.1 [9]	8.6	3.8 [9]		4.45		4.90
2011			2.67	0.7 [9]		0.5 [9]		1.7 [9]			3.81		2.40
Mean													
(5-year)	5.9	4.7	14.0	3.0	1.0	4.1	2.0	6.0	1.9	2.1	5.2		6.3
(10-year)	5.3	3.8	9.5	3.4	0.8	4.7	1.8	5.7	1.9	1.4	8.2		5.2

[1] Microtags.
[2] Carlin tags, not corrected for tagging mortality.
[3] Microtags, corrected for tagging mortality.
[4] Assumes 50% exploitation in rod fishery.
[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 3.3.7.2. Estimated survival of hatchery smolts (%) to return to homewaters (prior to coastal fisheries) for monitored rivers and experimental facilities in the NE Atlantic Area.

	Iceland[1]		Norway[2]							Sweden[2]	
Smolt year	R. Ranga		R. Halselva			R. Imsa		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		0.0		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	0.0		0		0	1.3	3.3	0	0		
2010	0.5		0.8			3.7	1.8	0			
2011	0.5					2.3					
Mean											
(5-year)	1.2		0.2			1.5	1.8	0.1	0.3		
(10-year)	0.8		0.6			2.5	1.2	0.5	0.5		

Table 3.3.7.2. 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]	
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
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
1990	1.3		11.4		0.2		2.5	0.2	16.1	2.6	5.6	5.6
1991	4.2	0.3	13.6	10.8	6.2		0.8	4.9	4.1	1.3	5.4	8.8
1992	4.4	1.3	7.4	10.0	1.7	4.2		0.9	13.2		6.0	7.8
1993	2.9	3.4	12.0	14.3	6.5	5.4		1.0	14.5		1.1	5.8
1994	5.2	1.9	14.3	3.9	2.7	10.8			7.7		1.6	
1995	3.6	4.1	6.6	3.4	1.7	3.5		2.4	2.2		3.1	2.4
1996	2.9	1.8	5.3	10.6	6.7	3.4					2.0	2.3
1997	6.0	0.4	13.3	17.3	5.6	5.3	7.0		4.8	7.7	-	4.1
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
1999	1.0	2.8	8.2	19.9	8.2	2.0			4.0	3.3	2.7	5.8
2000	1.2	3.8	11.8	19.5	13.2	5.4	3.55	6.7		4.0	2.8	4.4
2001	2.0	2.5	9.7	17.2	7.4	3.2	1.95	3.4		6.0	1.1	2.2
2002	1.0	4.1	9.2	12.6	4.9	2.0	1.93		5.3	1.9	0.7	3.1
2003	1.2		6.0	3.7	1.5	1.6	4.31			1.0	2.5	1.9
2004	0.4	1.8	9.4	7.6	2.3	1.8	2.23			3.1	0.7	1.9
2005	0.6	3.4	4.9	11.0		1.0	0.96			0.9	1.8	1.7
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
2007	0.5	0.8	7.1	0.0	3.6				3.6	0.7		
2008		0.2	1.3	0.0	1.4		0.05					
2009	0.3	0.2	2.3	0.0	1.5		0.07			1.1		
2010	0.4	0.4	2.8		3.6		0.13		2.0	0.9		
2011			4.7								0.8	1.86
Mean												
(5-year)	0.4	0.6	3.8	0.9	2.3	0.0	0.1	0.4	2.8	0.9	2.0	3.8
(10-year)	0.7	1.6	5.8	6.2	3.1	1.6	1.3	1.9	3.4	1.8	1.5	2.4

1 Return rates to rod fishery with constant effort.

2 Different release sites

3 Microtagged.

4 Delphi fish released at Burrishoole

Table 3.3.6.1. Compliance with river-specific conservation limits for individual river stocks, after homewater fisheries, by jurisdiction in the NEAC area in 2012 (except Norway where data are for 2010). Data for France are for MSW fish only.

Country	No. rivers	No. with CL	No. asessed for compliance	No. attaining CL	% attaining CL
Northern NEAC					
Russia	112	80	7	6	86
Finland/Norway (Tana/Teno)	1	1	1	0	0
Norway (2011)	481	439	186	146	78
Sweden (2011)	23	17	0	NA	NA
Iceland	100	0	NA	NA	NA
Southern NEAC					
UK Scotland	383	0	0	NA	NA
UK N. Ireland	15	10	10	4	40
UK England/Wales	78	64	64	32	50
Ireland	141	141	141	58	41
France (MSW)	35	31	28	12	43

Table 3.4.5.1. Catch in weight (t) and numbers, mean weights and mean age of catch in the 1983/1984 to 1995/1996 fishing seasons.

	Season	Catch (t)	Catch (number)	Mean wt (kg)	Mean sea age
Commercial fishery	**1983/84**	651	124509	5.23	2.07
	1984/85	598	135777	4.40	2.07
	1985/86	545	154554	3.53	2.02
	1986/87	539	140304	3.84	2.05
	1987/88	208	65011	3.20	1.96
	1988/89	309	93496	3.30	2.04
	1989/90	364	111515	3.26	2.04
	1990/91	202	57441	3.52	2.07
Research fishery	**1991/92**	31	8464	3.66	2.09
	1992/93	22	5415	4.06	2.14
	1993/94	7	2072	3.38	2.03
	1994/95	6	1963	3.06	1.98
	1995/96	1	282	3.55	

Table 3.4.5.2. Catch in numbers and percentages by sea age and mean age in the Faroes salmon fishery in the 1983/1984 to 1994/1995 seasons.

Fishery	Season	1SW	2SW	3SW	MSW	%1SW	%2SW	%3SW	Mean Age
Commercial fishery	1983/84	5142	135718	16401	152178	3.3%	86.3%	10.4%	2.07
	1984/85	381	138375	11358	149733	0.3%	92.2%	7.6%	2.07
	1985/86	2021	169461	5671	175219	1.1%	95.7%	3.2%	2.02
	1986/87	71	124628	6621	131324	0.1%	94.9%	5.0%	2.05
	1987/88	5833	55726	3450	59176	9.0%	85.7%	5.3%	1.96
	1988/89	1351	110717	5728	116445	1.1%	94.0%	4.9%	2.04
	1989/90	2155	102800	6473	109273	1.9%	92.3%	5.8%	2.04
	1990/91	632	52419	4390	56809	1.1%	91.3%	7.6%	2.07
Research fishery	1991/92	248	4686	743	5429	4.4%	82.5%	13.1%	2.09
	1992/93	521	2646	1120	3766	12.2%	61.7%	26.1%	2.14
	1993/94	320	1288	376	1664	16.1%	64.9%	19.0%	2.03
	1994/95	206	1585	166	1751	10.5%	81.0%	8.5%	1.98
	Totals	18881	900049	62497	962767	1.9%	91.7%	6.4%	2.04

1991/92 to 1994/95 include discards and exclude reared fish.

Table 3.4.5.3. Estimates of discard rates in the Faroes fishery in the 1982/1983 to 1994/1995 fishing seasons.

	Season	Number of samples	Number sampled	Number < 60 cm TL	Discard rate (%)	Range %
Commercial fishery	1982/83	7	6820	472	6.9%	0.0% - 10.4%
	1983/84	5	4467	176	3.9%	-
	1984/85	12	9546	1289	13.5%	3.0% - 32.0%
	1985/86	7	14654	286	2.0%	0.6% - 13.8%
	1986/87	13	39758	2849	7.2%	0.0% - 71.3%
	1987/88	2	1499	235	15.7%	-
	1988/89	9	17235	1804	10.5%	0.4% - 31.9%
	1989/90	5	16375	1533	9.4%	3.6% - 18.5%
	1990/91	3	4615	681	14.8%	9.9% - 17.5%
Research fishery	1991/92	6	9350	825	8.8%	2.4% - 15.9%
	1992/93	3	9099	853	9.4%	5.1% - 32.3%
	1993/94	4	3035	436	14.4%	1.5% - 48.6%
	1994/95	5	4187	634	15.1%	5.0% - 39.7%

Table 3.4.5.4. Percentages of farm escapees observed in catch samples taken in the Faroes fishery (1981/1982 to 1995/1996) and the Norwegian coastal fisheries (1989 to 2008).

Year	Norway coastal fisheries	Season	Faroes fishery (ICES 1996)
1981		1981/82	2
1982		1982/83	2
1983		1983/84	1
1984		1984/85	4
1985		1985/86	7
1986		1986/87	4
1987		1987/88	1
1988		1988/89	8
1989	45	1989/90	17
1990	48	1990/91	43
1991	49	1991/92	42
1992	44	1992/93	37
1993	47	1993/94	27
1994	34	1995/95	17
1995	42	1995/96	19
1996	54		
1997	47		
1998	45		
1999	35		
2000	31		
2001	27		
2002	33		
2003	21		
2004	27		
2005	23		
2006	33		
2007	32		
2008	26		

Table 3.4.5.5. Additional parameter values used in the example catch advice for the Faroes fishery.

Minimum TAC option (t)	0
Maximum TAC option (t)	200
TAC steps (t)	20
Faroes share allocation	0.084
TAC in current year (t)	0
Proportion of 1SW salmon not maturing	0.22
Mortality of discards	0.8
Monthly rate of natural mortality	0.03

Table 3.5.3.1. Probabilities that the forecast PFA for 1SW maturing and 1SW non-maturing fish will be greater than the age specific Spawner Escapement Reserves (SER) for the PFA years 2012 to 2016 for the southern NEAC complex (upper table) and the northern NEAC complex (lower table).

Southern NEAC		
	1SW Maturing	**1SW Non-maturing**
Spawner Escapement Reserve (SER)	715 358	463 566
PFA Year	Probability of PFA meeting or exceeding SER	
2012	0.767	0.853
2013	0.673	0.756
2014	0.743	0.795
2015	0.753	0.797
2016	0.701	0.749

Northern NEAC		
	1SW Maturing	**1SW Non-maturing**
Spawner Escapement Reserve (SER)	201 014	222 888
PFA Year	Probability of PFA meeting or exceeding SER	
2012	0.995	1.000
2013	0.979	0.998
2014	0.962	0.992
2015	0.946	0.985
2016	0.946	0.983

Table 3.6.1.1 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 2013/14 to 2015/16 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 simultaneous
	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 simultaneous
	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 simultaneous
	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%

Table 3.6.1.2 Forecast exploitation rates for 1SW and MSW salmon from Northern and Southern NEAC areas in all fisheries (assuming full catch allocations are taken) for different TAC options in the Faroes fishery in the 2013/14 to 2015/16 fishing seasons.

Catch options for 2013/14 season:	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW
	0	0.0%	0.0%	0.0%	0.0%
	20	0.0%	0.3%	0.0%	0.3%
	40	0.0%	0.6%	0.0%	0.5%
	60	0.0%	0.9%	0.0%	0.8%
	80	0.0%	1.2%	0.0%	1.0%
	100	0.1%	1.5%	0.0%	1.3%
	120	0.1%	1.8%	0.0%	1.5%
	140	0.1%	2.1%	0.0%	1.8%
	160	0.1%	2.5%	0.0%	2.0%
	180	0.1%	2.8%	0.1%	2.3%
	200	0.1%	3.1%	0.1%	2.6%

Catch options for 2014/15 season:	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW
	0	0.0%	0.0%	0.0%	0.0%
	20	0.0%	0.3%	0.0%	0.2%
	40	0.0%	0.6%	0.0%	0.5%
	60	0.0%	0.9%	0.0%	0.7%
	80	0.0%	1.2%	0.0%	0.9%
	100	0.0%	1.5%	0.0%	1.2%
	120	0.1%	1.7%	0.0%	1.4%
	140	0.1%	2.0%	0.0%	1.6%
	160	0.1%	2.3%	0.0%	1.9%
	180	0.1%	2.6%	0.0%	2.1%
	200	0.1%	2.9%	0.1%	2.3%

Catch options for 2015/16 season:	TAC option (t)	NEAC-N-1SW	NEAC-N-MSW	NEAC-S-1SW	NEAC-S-MSW
	0	0.0%	0.0%	0.0%	0.0%
	20	0.0%	0.3%	0.0%	0.2%
	40	0.0%	0.5%	0.0%	0.5%
	60	0.0%	0.8%	0.0%	0.7%
	80	0.0%	1.0%	0.0%	0.9%
	100	0.0%	1.3%	0.0%	1.2%
	120	0.1%	1.5%	0.0%	1.4%
	140	0.1%	1.8%	0.0%	1.7%
	160	0.1%	2.0%	0.0%	1.9%
	180	0.1%	2.3%	0.0%	2.1%
	200	0.1%	2.5%	0.1%	2.4%

Table 3.6.1.3 **Probability (%) of National NEAC - 1SW stock complexes achieving their SERs individually and simultaneously for different catch options for the Faroes fishery in the 2013/14 to 2015/16 fishing seasons.**

Catch options for 2013/14 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	86.6%	84.7%	92.8%	97.7%	75.5%	54.5%	50.4%	57.0%	58.5%	27.8%	1.4%
	20	86.6%	84.6%	92.7%	97.7%	75.4%	54.5%	50.4%	57.0%	58.5%	27.7%	1.4%
	40	86.5%	84.5%	92.6%	97.6%	75.3%	54.5%	50.3%	57.0%	58.4%	27.7%	1.4%
	60	86.4%	84.4%	92.6%	97.6%	75.2%	54.4%	50.2%	56.9%	58.4%	27.7%	1.4%
	80	86.4%	84.4%	92.5%	97.5%	75.1%	54.4%	50.1%	56.9%	58.3%	27.7%	1.4%
	100	86.3%	84.3%	92.4%	97.5%	75.1%	54.3%	50.1%	56.9%	58.3%	27.6%	1.4%
	120	86.3%	84.3%	92.4%	97.4%	75.0%	54.3%	50.0%	56.8%	58.3%	27.6%	1.4%
	140	86.3%	84.2%	92.3%	97.3%	74.9%	54.3%	49.9%	56.8%	58.3%	27.6%	1.4%
	160	86.2%	84.1%	92.2%	97.3%	74.9%	54.2%	49.8%	56.8%	58.2%	27.6%	1.4%
	180	86.2%	84.0%	92.2%	97.2%	74.8%	54.2%	49.8%	56.7%	58.2%	27.5%	1.4%
	200	86.1%	83.9%	92.1%	97.1%	74.7%	54.2%	49.7%	56.7%	58.2%	27.5%	1.4%

Catch options for 2014/15 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	83.2%	73.8%	92.0%	96.6%	75.5%	57.7%	55.2%	54.0%	58.4%	25.8%	1.2%
	20	83.2%	73.7%	92.0%	96.6%	75.4%	57.6%	55.2%	54.0%	58.4%	25.8%	1.2%
	40	83.1%	73.6%	91.9%	96.5%	75.3%	57.6%	55.1%	54.0%	58.4%	25.7%	1.2%
	60	83.1%	73.4%	91.8%	96.4%	75.2%	57.5%	55.0%	54.0%	58.4%	25.7%	1.2%
	80	83.0%	73.4%	91.7%	96.4%	75.1%	57.5%	55.0%	54.0%	58.3%	25.7%	1.2%
	100	83.0%	73.3%	91.7%	96.3%	75.1%	57.5%	54.9%	53.9%	58.3%	25.7%	1.2%
	120	83.0%	73.1%	91.6%	96.2%	75.0%	57.5%	54.9%	53.9%	58.3%	25.7%	1.2%
	140	82.9%	73.1%	91.6%	96.1%	74.9%	57.5%	54.8%	53.9%	58.3%	25.6%	1.2%
	160	82.9%	73.0%	91.5%	96.0%	74.9%	57.5%	54.8%	53.9%	58.2%	25.6%	1.2%
	180	82.8%	72.9%	91.5%	96.0%	74.8%	57.4%	54.7%	53.9%	58.2%	25.6%	1.2%
	200	82.8%	72.8%	91.4%	95.9%	74.7%	57.4%	54.7%	53.9%	58.2%	25.5%	1.2%

Catch options for 2015/16 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	83.0%	72.7%	92.0%	96.2%	75.5%	54.8%	61.6%	52.9%	51.2%	26.3%	1.1%
	20	82.9%	72.6%	92.0%	96.1%	75.4%	54.8%	61.6%	52.9%	51.2%	26.2%	1.1%
	40	82.9%	72.5%	92.0%	96.0%	75.3%	54.8%	61.5%	52.9%	51.2%	26.2%	1.1%
	60	82.8%	72.5%	91.9%	96.0%	75.2%	54.7%	61.5%	52.9%	51.1%	26.2%	1.1%
	80	82.8%	72.3%	91.9%	95.9%	75.1%	54.7%	61.4%	52.8%	51.1%	26.2%	1.1%
	100	82.7%	72.2%	91.8%	95.8%	75.1%	54.7%	61.4%	52.8%	51.1%	26.1%	1.1%
	120	82.7%	72.1%	91.8%	95.7%	75.0%	54.7%	61.3%	52.8%	51.1%	26.1%	1.1%
	140	82.6%	72.1%	91.8%	95.7%	74.9%	54.7%	61.3%	52.8%	51.1%	26.1%	1.1%
	160	82.6%	72.0%	91.7%	95.6%	74.9%	54.6%	61.2%	52.7%	51.0%	26.1%	1.1%
	180	82.5%	71.9%	91.7%	95.5%	74.8%	54.6%	61.2%	52.7%	51.0%	26.1%	1.1%
	200	82.5%	71.8%	91.6%	95.4%	74.7%	54.6%	61.1%	52.7%	51.0%	26.1%	1.1%

Table 3.6.1.4 Probability (%) of National NEAC - MSW stock complexes achieving their SERs individually and simultaneously for different catch options for the Faroes fishery in the 2013/14 to 2015/16 fishing seasons.

Catch options for 2013/14 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	78%	81%	99%	100%	100%	72%	88%	28%	85%	57%	5.1%
	20	69%	77%	98%	100%	100%	68%	82%	27%	83%	55%	3.4%
	40	60%	73%	97%	99%	100%	63%	77%	26%	82%	54%	2.3%
	60	52%	69%	96%	98%	99%	59%	73%	25%	81%	52%	1.5%
	80	44%	66%	94%	97%	99%	55%	68%	24%	80%	51%	0.9%
	100	37%	62%	92%	96%	98%	51%	64%	23%	78%	50%	0.5%
	120	31%	59%	89%	95%	98%	48%	61%	22%	77%	48%	0.4%
	140	25%	56%	86%	93%	97%	44%	58%	21%	75%	47%	0.2%
	160	21%	54%	83%	92%	95%	40%	55%	20%	74%	45%	0.2%
	180	17%	51%	80%	90%	94%	37%	52%	20%	73%	44%	0.1%
	200	14%	48%	77%	88%	93%	34%	50%	19%	71%	43%	0.1%

Catch options for 2014/15 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	75%	69%	99%	100%	100%	73%	87%	29%	82%	52%	3.9%
	20	67%	64%	98%	99%	100%	70%	82%	28%	81%	50%	2.7%
	40	59%	60%	97%	98%	100%	66%	78%	27%	80%	49%	1.8%
	60	51%	56%	95%	97%	99%	63%	74%	26%	78%	47%	1.2%
	80	44%	53%	93%	96%	99%	59%	71%	25%	77%	46%	0.8%
	100	38%	50%	91%	95%	98%	56%	68%	25%	76%	45%	0.5%
	120	32%	47%	89%	94%	98%	53%	65%	24%	75%	44%	0.3%
	140	27%	44%	87%	92%	97%	50%	62%	23%	74%	43%	0.2%
	160	23%	41%	84%	90%	95%	47%	60%	22%	72%	42%	0.1%
	180	20%	39%	81%	89%	94%	44%	57%	22%	71%	41%	0.1%
	200	17%	37%	78%	87%	93%	41%	55%	21%	70%	40%	0.0%

Catch options for 2015/16 season:	TAC option (t)	Russia	Finland	Norway	Sweden	Iceland	Scotland	N. Ireland	Ireland	England & Wales	France	All MUs simultaneous
	0	75%	68%	99%	100%	100%	69%	88%	30%	75%	50%	3.3%
	20	68%	64%	98%	99%	100%	65%	84%	29%	74%	49%	2.2%
	40	61%	60%	97%	98%	100%	62%	80%	28%	72%	47%	1.5%
	60	55%	57%	95%	97%	99%	59%	77%	27%	71%	46%	1.0%
	80	48%	54%	94%	96%	99%	56%	74%	26%	70%	45%	0.7%
	100	43%	51%	92%	95%	98%	53%	71%	26%	68%	44%	0.5%
	120	38%	48%	90%	93%	98%	50%	69%	25%	67%	43%	0.3%
	140	33%	46%	88%	92%	97%	47%	67%	24%	66%	42%	0.2%
	160	29%	44%	86%	90%	95%	44%	64%	24%	65%	41%	0.2%
	180	25%	41%	84%	89%	94%	41%	63%	23%	63%	40%	0.1%
	200	22%	40%	82%	87%	93%	39%	61%	22%	62%	39%	0.1%

Table 3.6.1.5. Compliance with river-specific conservation limits for individual river stocks, before homewater fisheries, within each jurisdiction in the NEAC area in 2012 (except Norway where data are for 2011). NA = not available.

Country	No. rivers	No. with CL	No. asessed for compliance	No. attaining CL	% attaining CL
Northern NEAC					
Russia	112	80	7	6	86
Finland/Norway (Tana/Teno)	1	1	NA	NA	NA
Norway (2011)	481	439	186	163	88
Sweden	23	17	NA	NA	NA
Iceland	100	0	NA	NA	NA
Southern NEAC					
UK Scotland	383	0	0	NA	NA
UK N. Ireland	15	10	NA	NA	NA
UK England/Wales	78	64	NA	NA	NA
Ireland	141	141	141	58	41
France (MSW)	35	31	NA	NA	NA

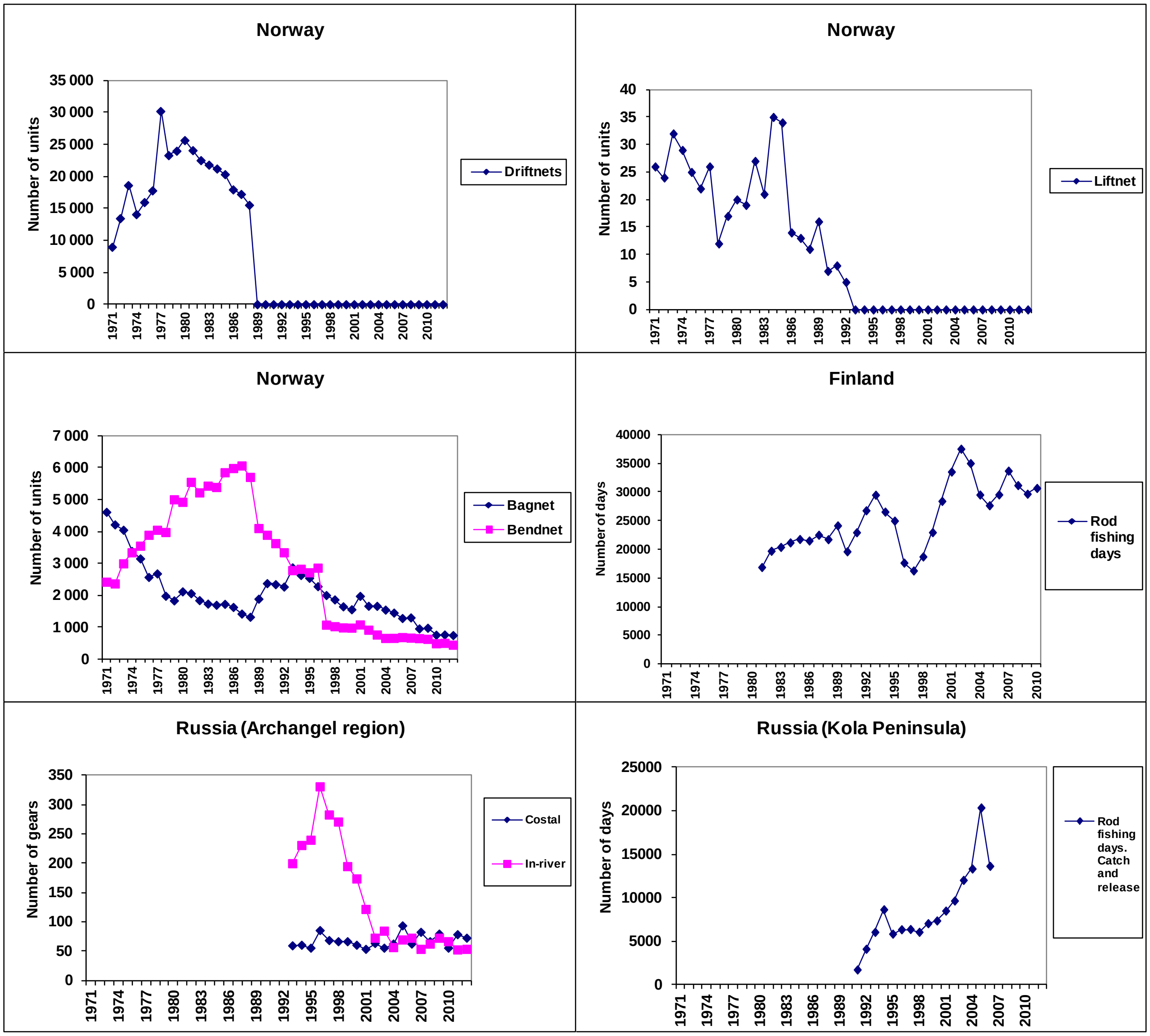


Figure 3.1.3.1. Overview of effort as reported for various fisheries and countries 1971–2012 in the northern NEAC area.

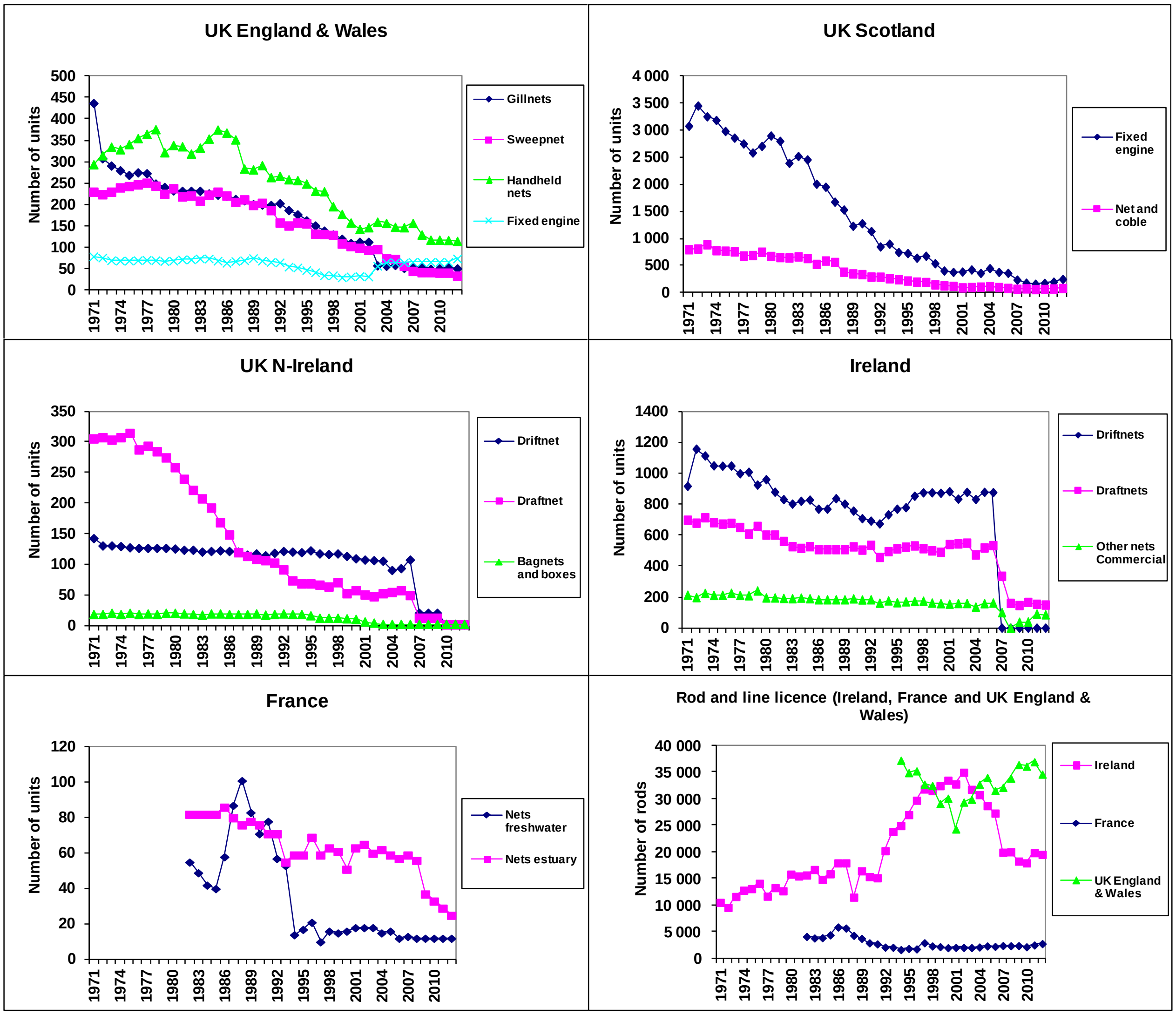


Figure 3.1.3.2. Overview of effort as reported for various fisheries and countries 1971–2012 in the southern NEAC area.

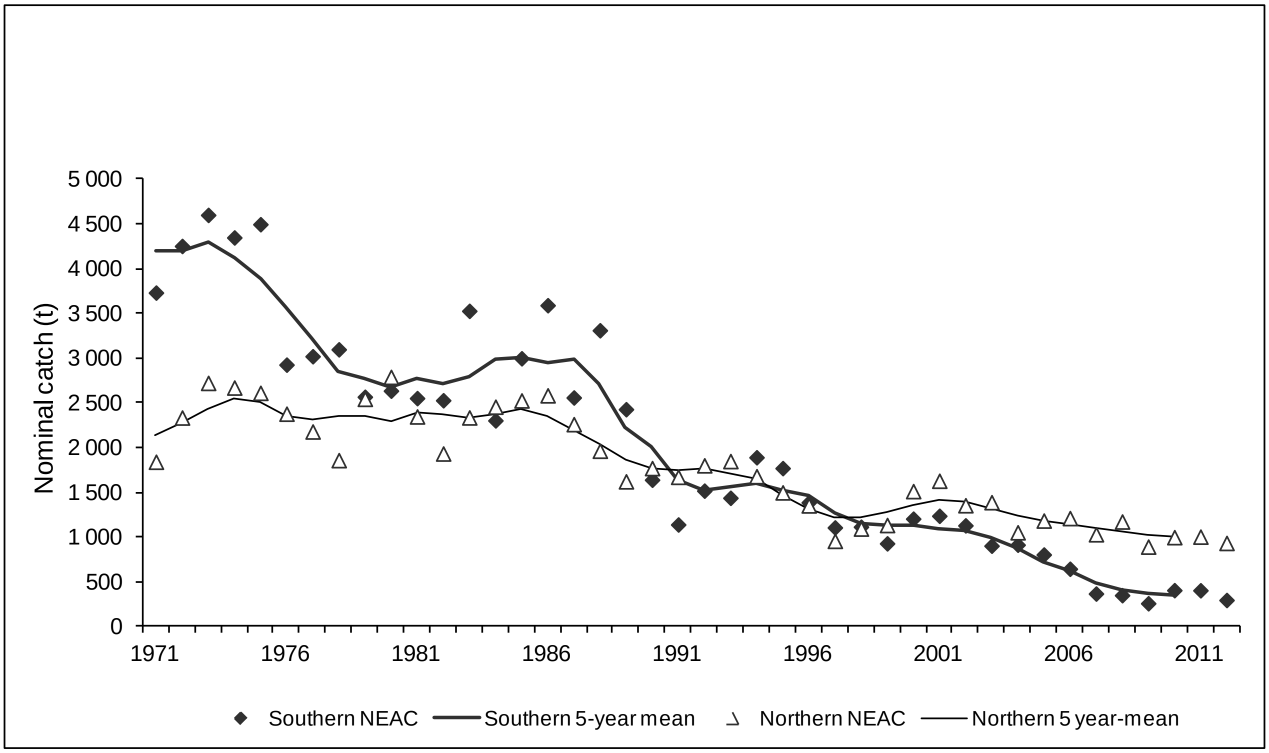


Figure 3.1.4.1. Nominal catches of salmon and 5-year running means in the southern and northern NEAC areas, 1971–2012.

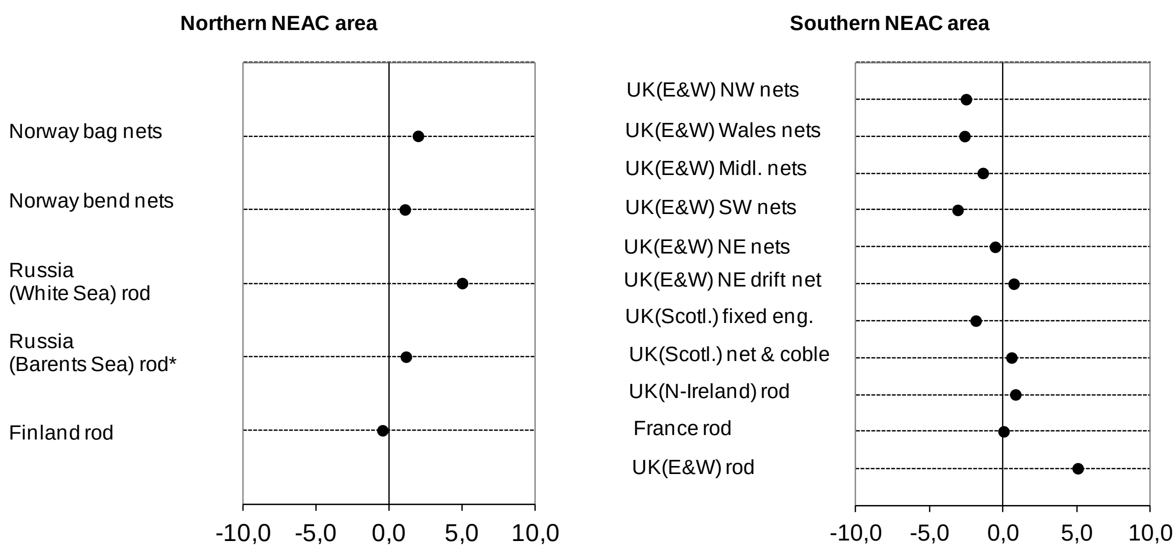


Figure 3.1.5.1. Proportional change (%) over years in cpue estimates in various rod and net fisheries in northern and southern NEAC area (* Information on cpue in Barents Sea rivers in Russia to 2008).

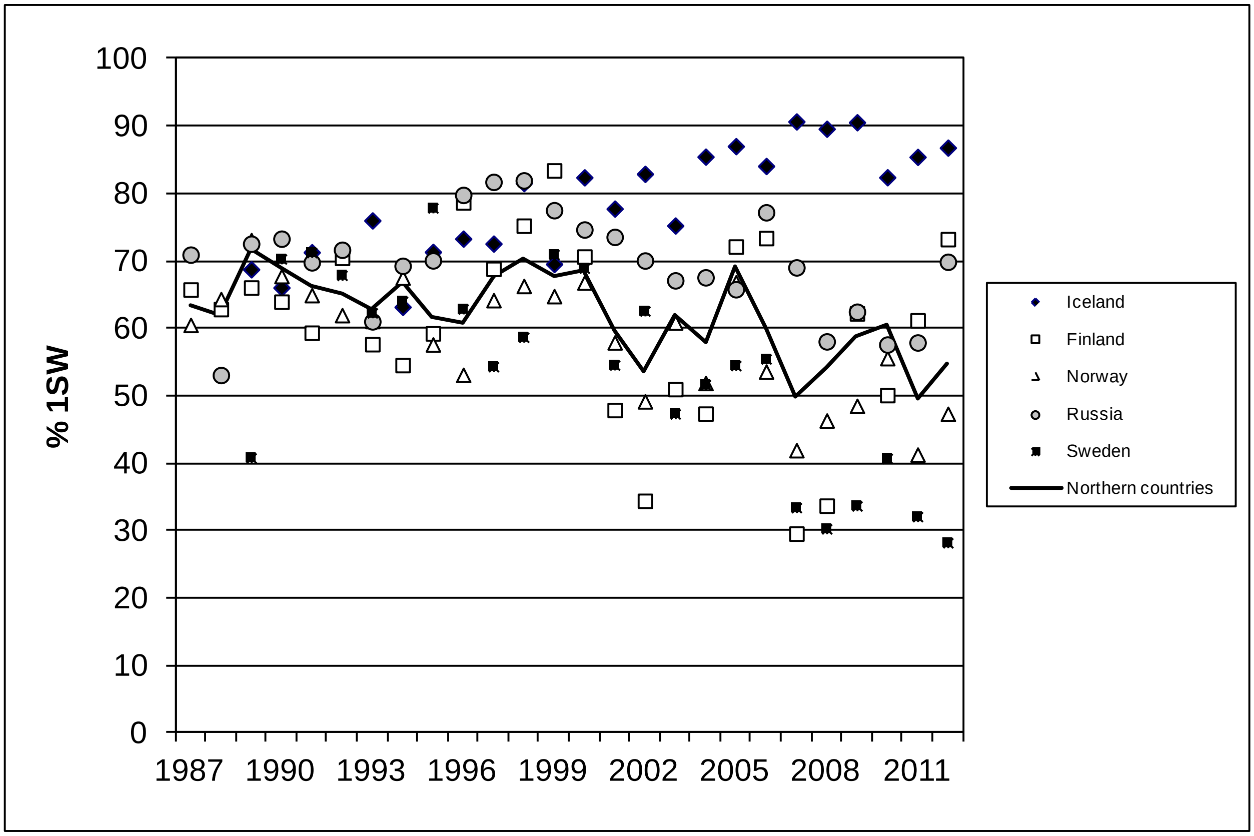


Figure 3.1.6.1. Percentage of 1SW salmon in the reported catch for northern NEAC countries, 1987–2012.

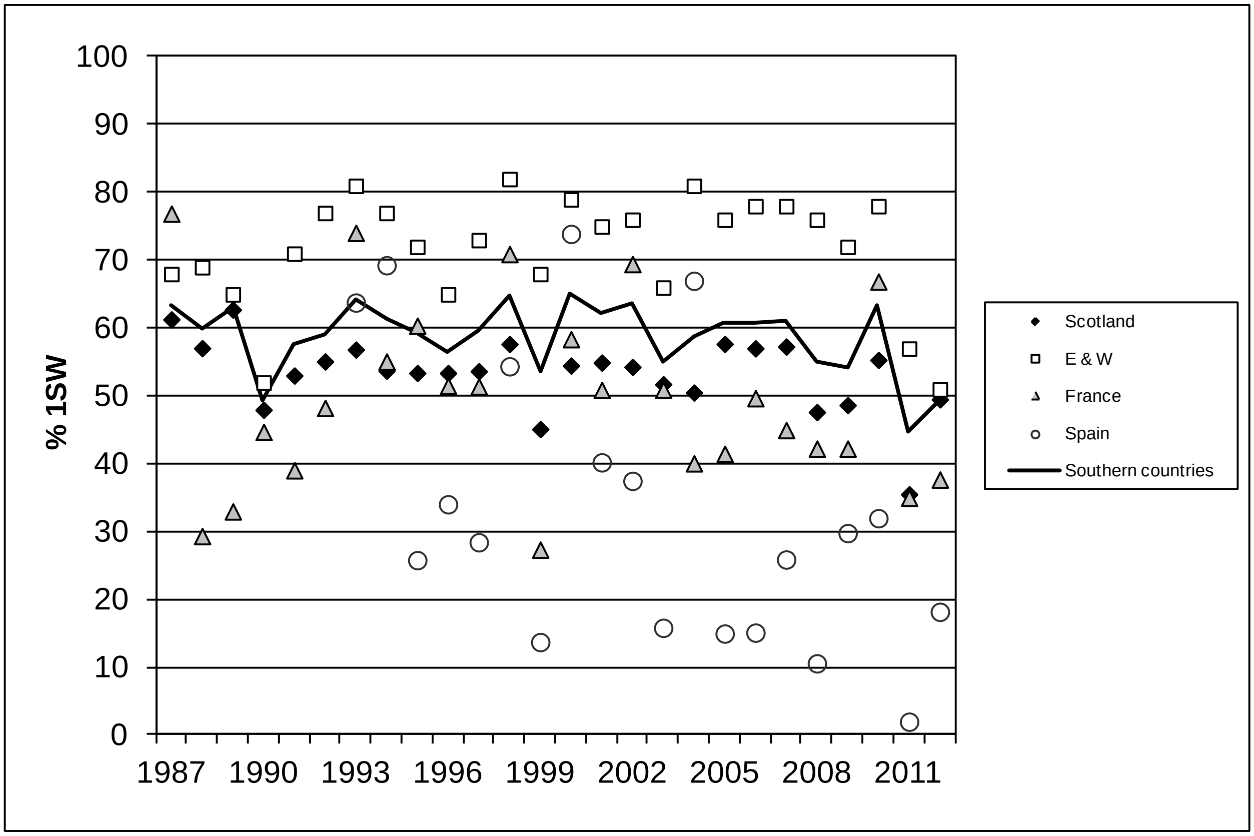


Figure 3.1.6.2. Percentage of 1SW salmon in the reported catch for southern NEAC countries, 1987–2012.

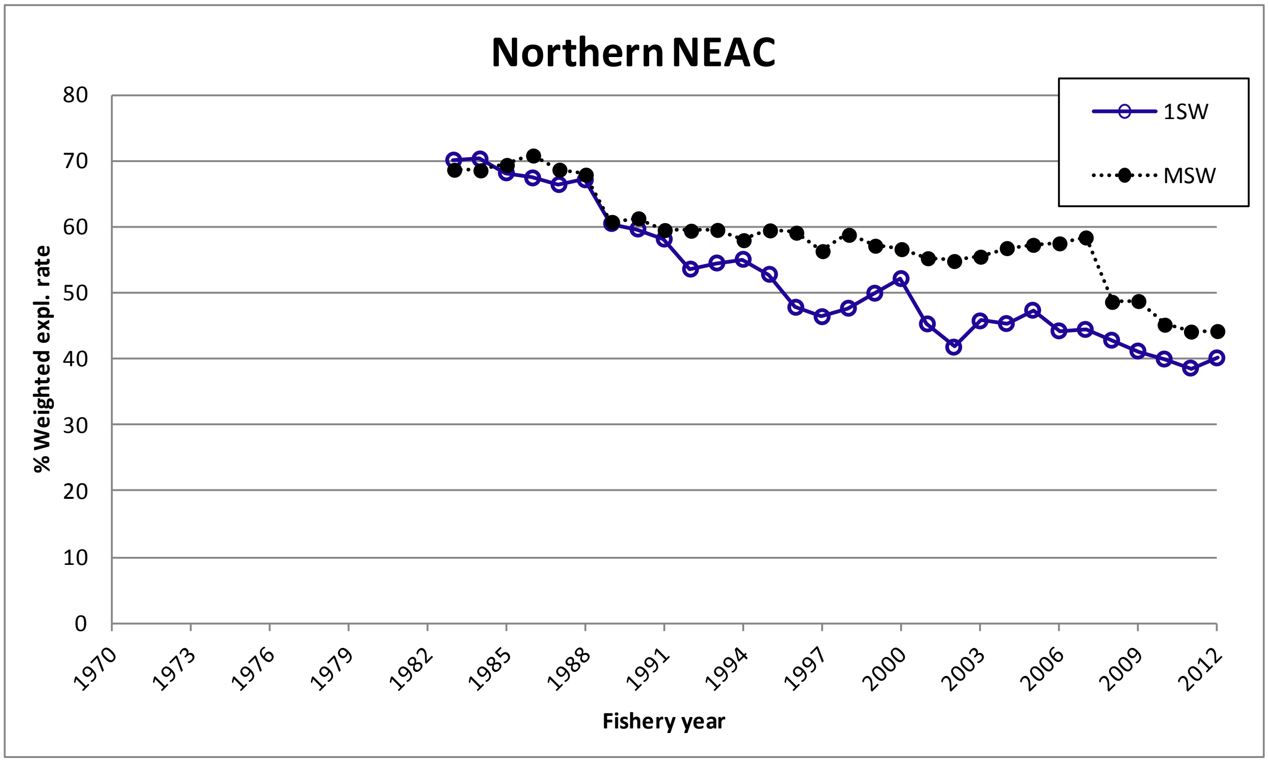


Figure 3.1.9.1. Mean annual exploitation rate of wild 1SW and MSW salmon by combined commercial and recreational fisheries in northern NEAC countries from 1983 to 2012.

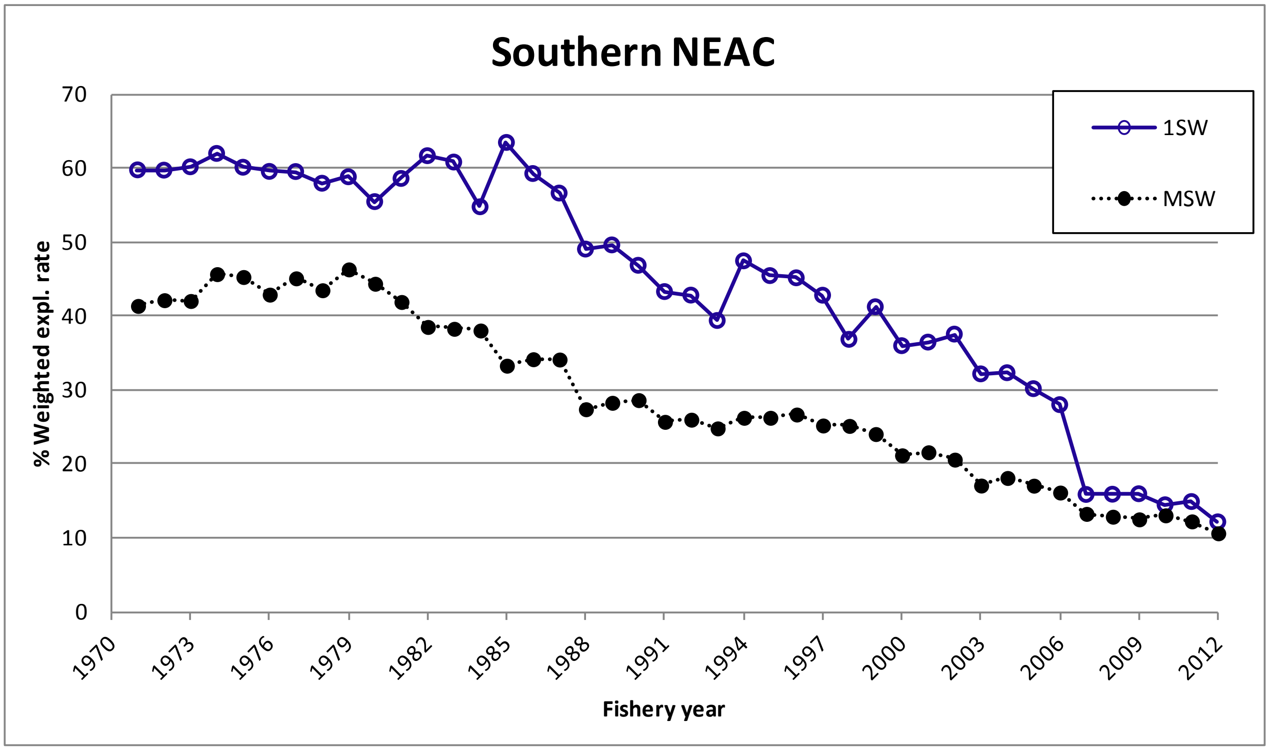


Figure 3.1.9.2. Mean annual exploitation rate of wild 1SW and MSW salmon by combined commercial and recreational fisheries in southern NEAC countries from 1971 to 2012.

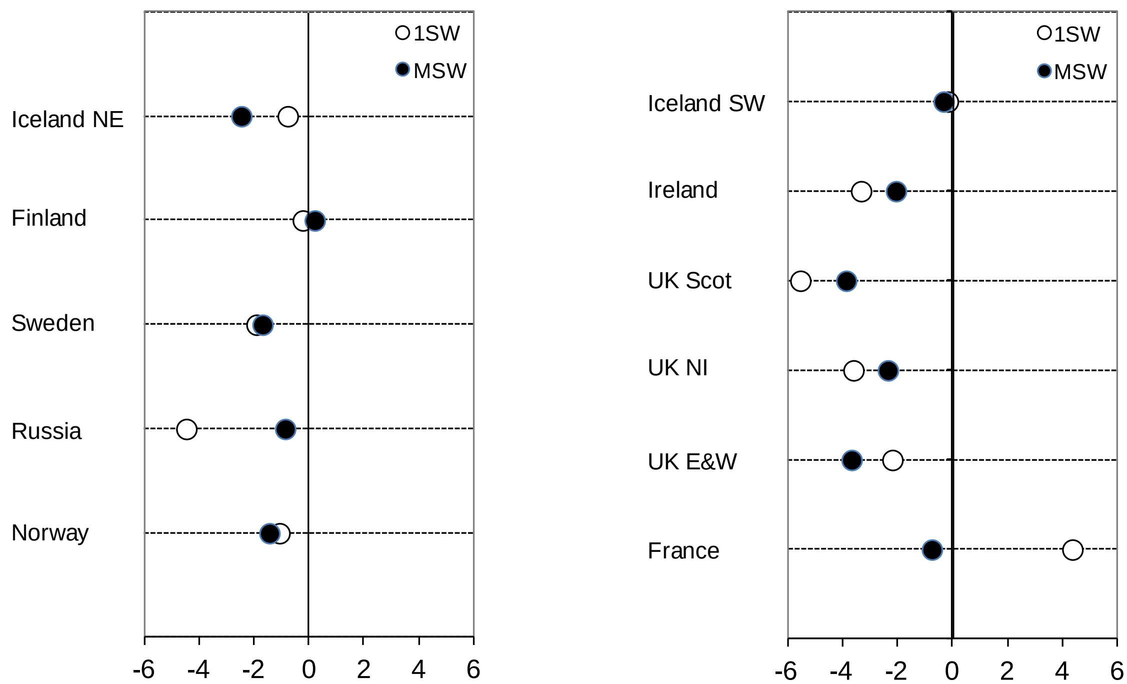


Figure 3.1.9.3. The rate of change of exploitation of 1SW and MSW salmon in northern NEAC (left) and southern NEAC (right) countries.

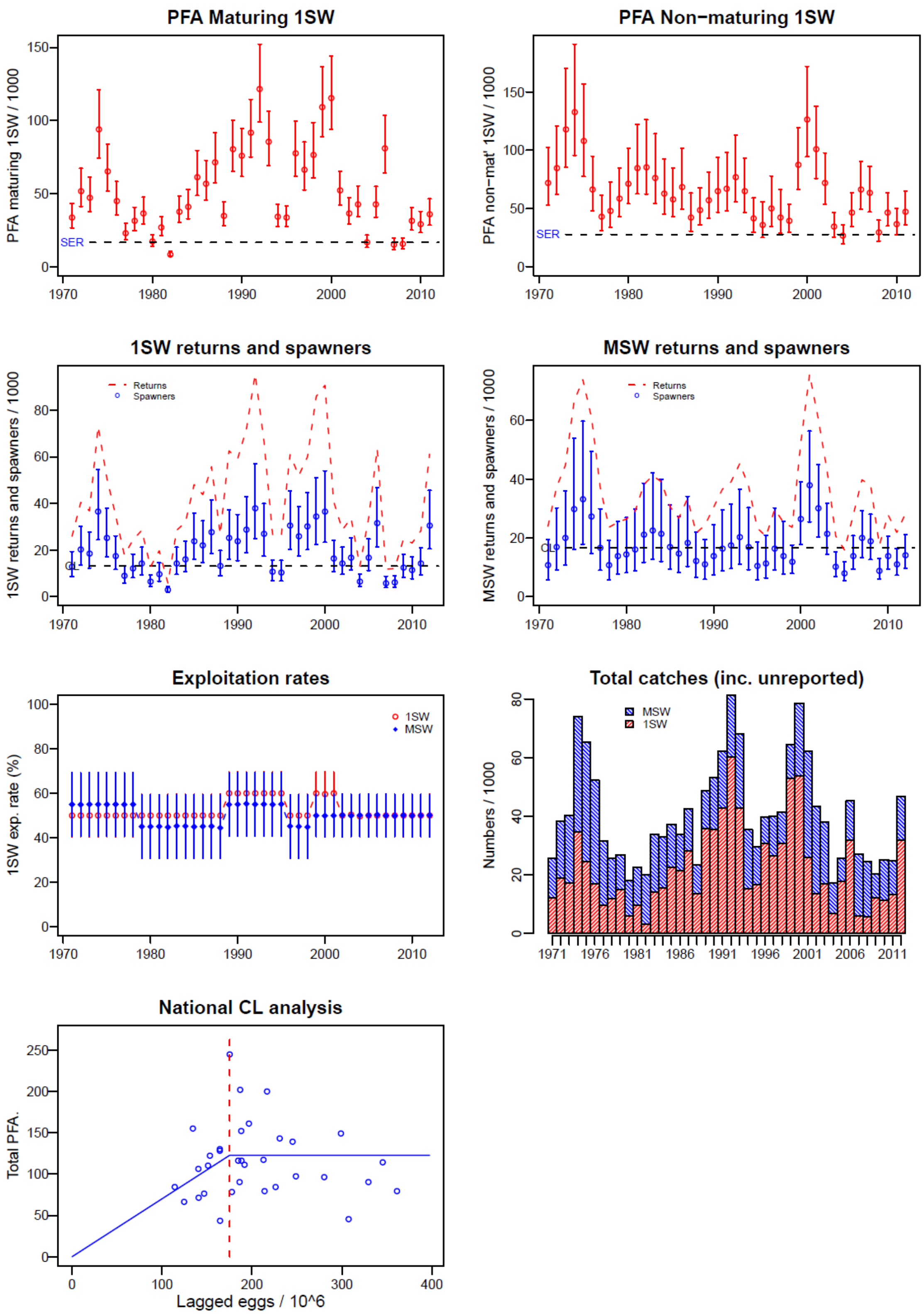


Figure 3.3.4.1a. Summary of fisheries and stock description, River Teno/Tana (Finland and Norway combined).

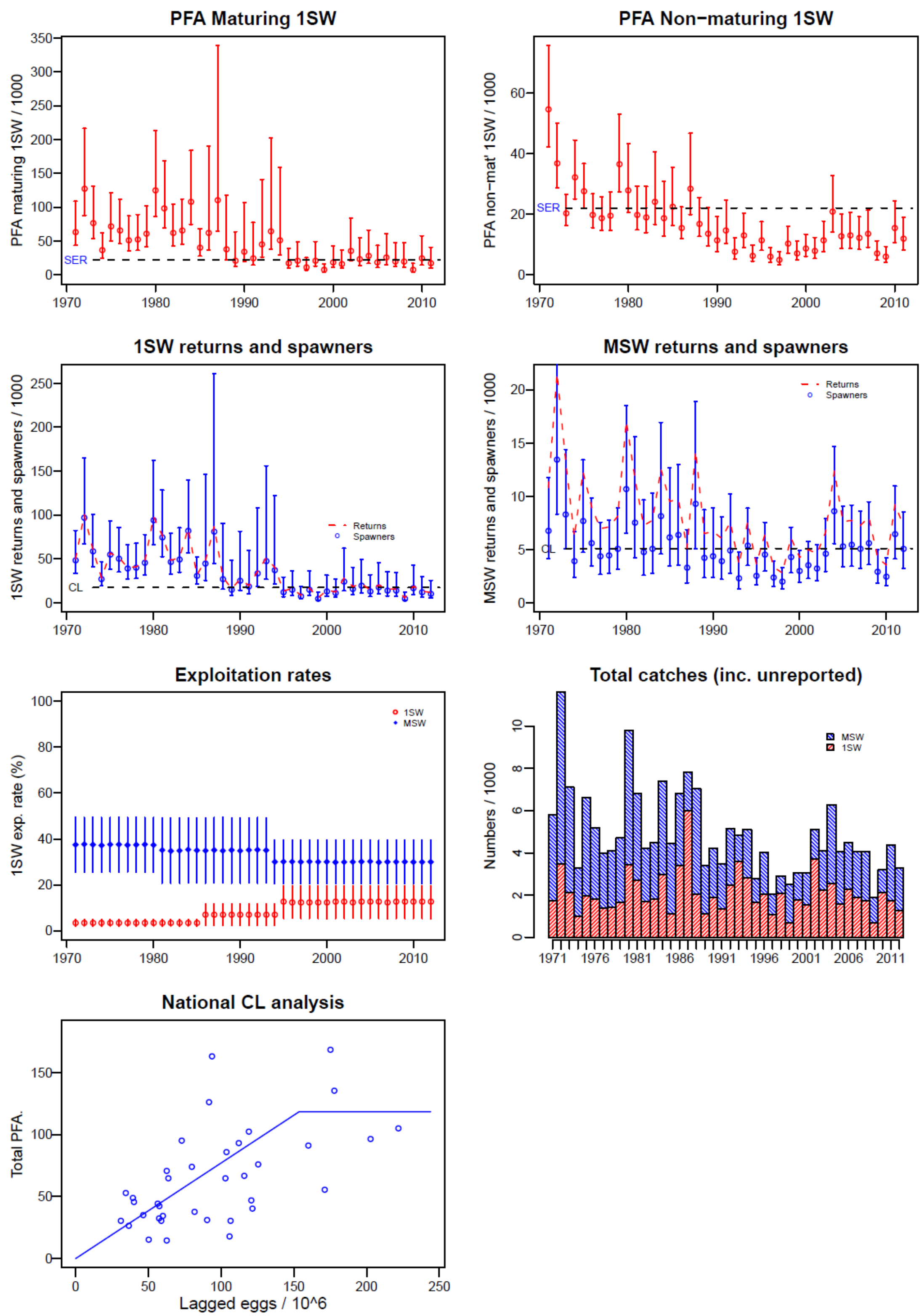


Figure 3.3.4.1b. Summary of fisheries and stock description, France. The national CL analysis is shown for information only. A river-specific CL is used for the assessment.

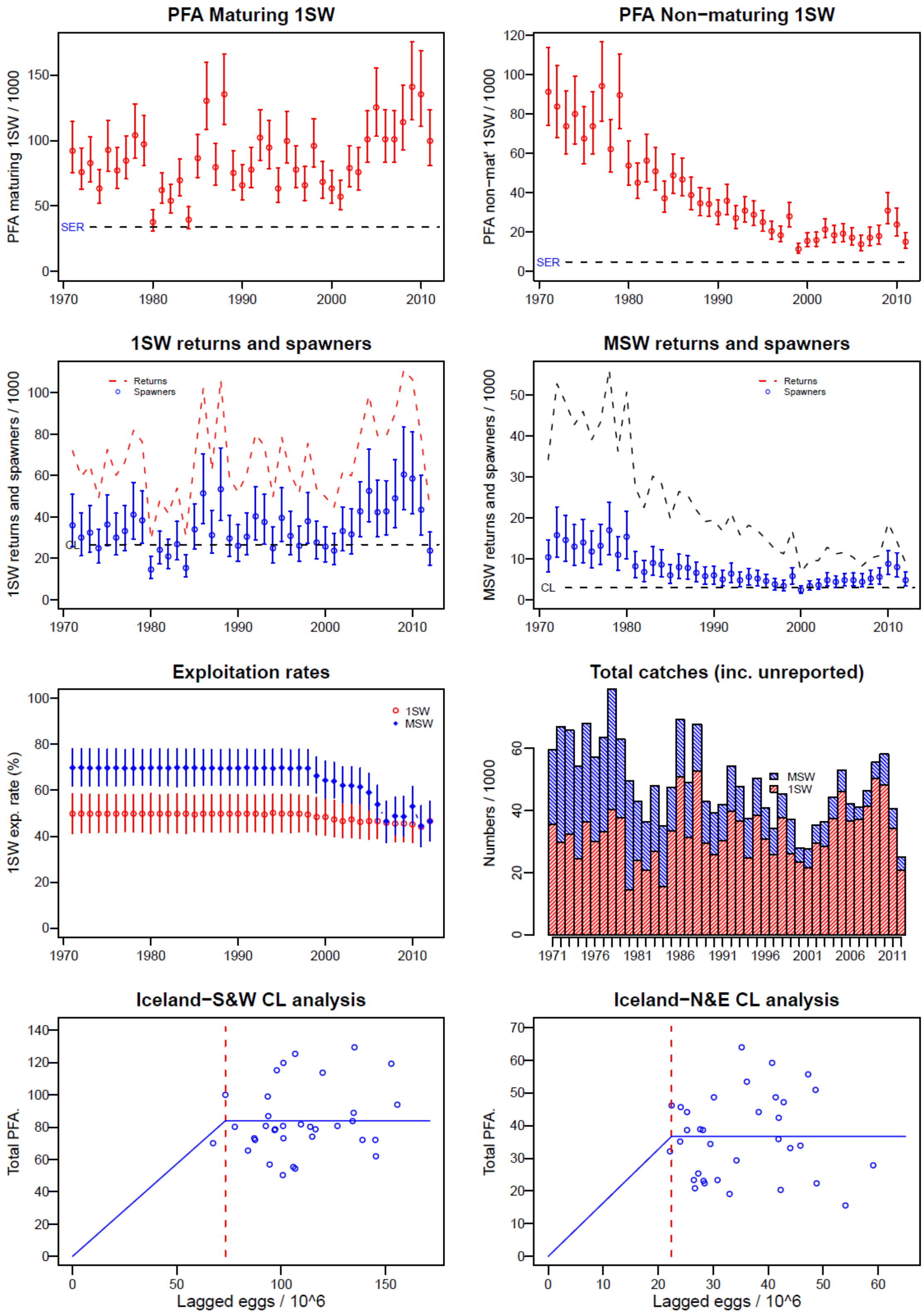


Figure 3.3.4.1c. Summary of fisheries and stock description, Iceland.

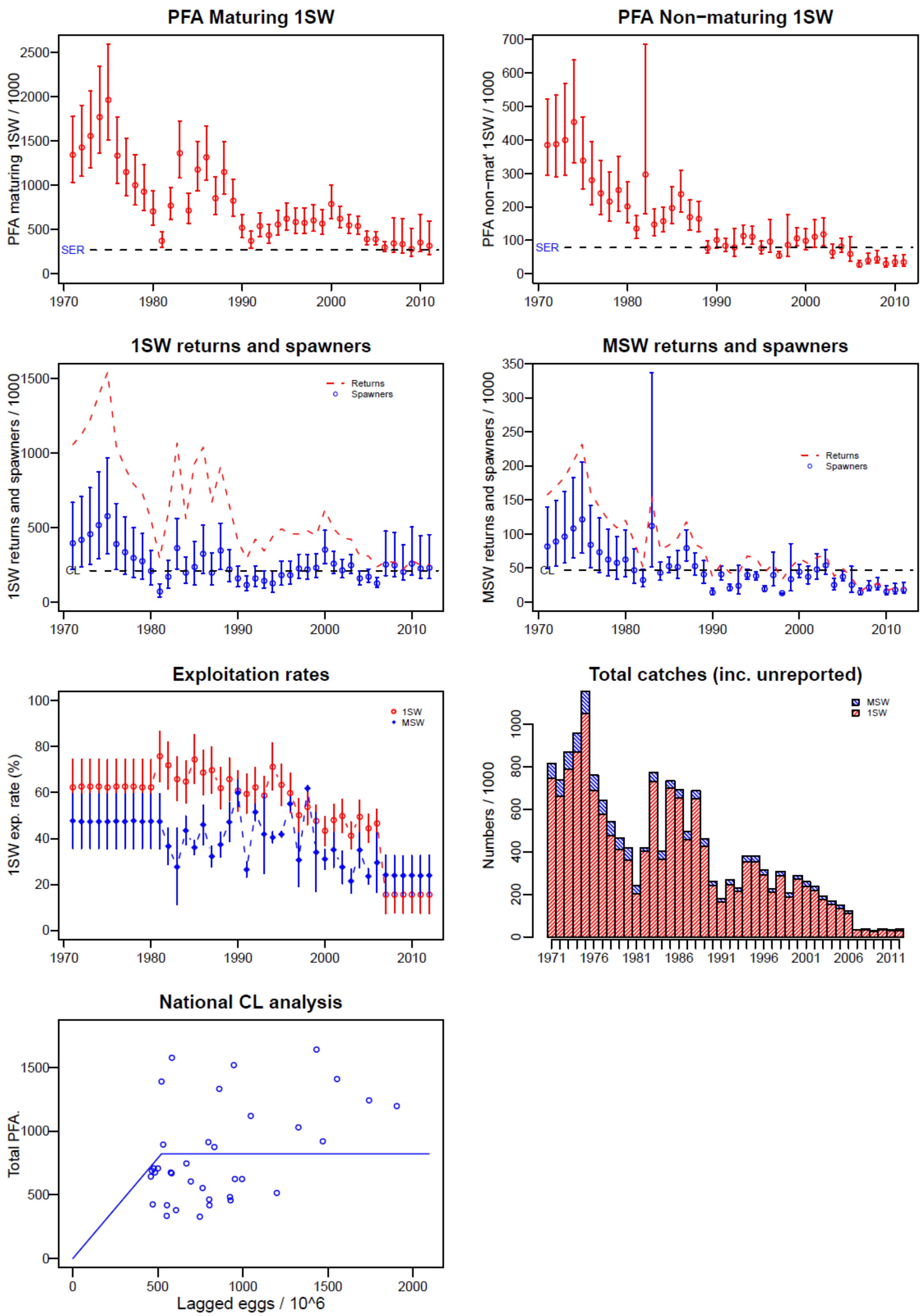


Figure 3.3.4.1d. Summary of fisheries and stock description, Ireland. The national CL analysis is shown for information only. A river-specific CL is used for the assessment.

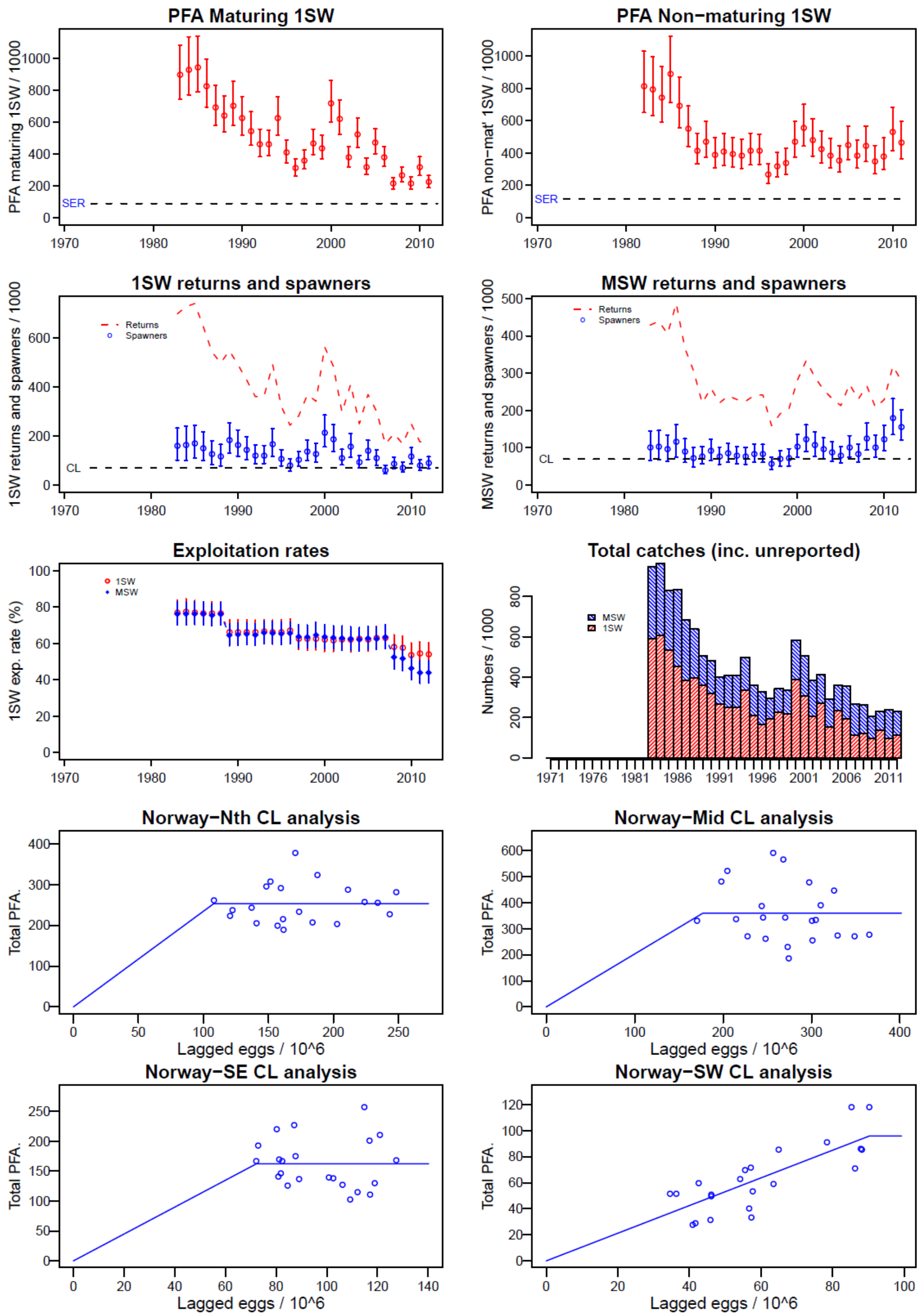


Figure 3.3.4.1e. Summary of fisheries and stock description, Norway (minus Norwegian catches from the R. Teno/Tana). The regional CL analyses is shown for information only. A river-specific CL is used for the assessment.

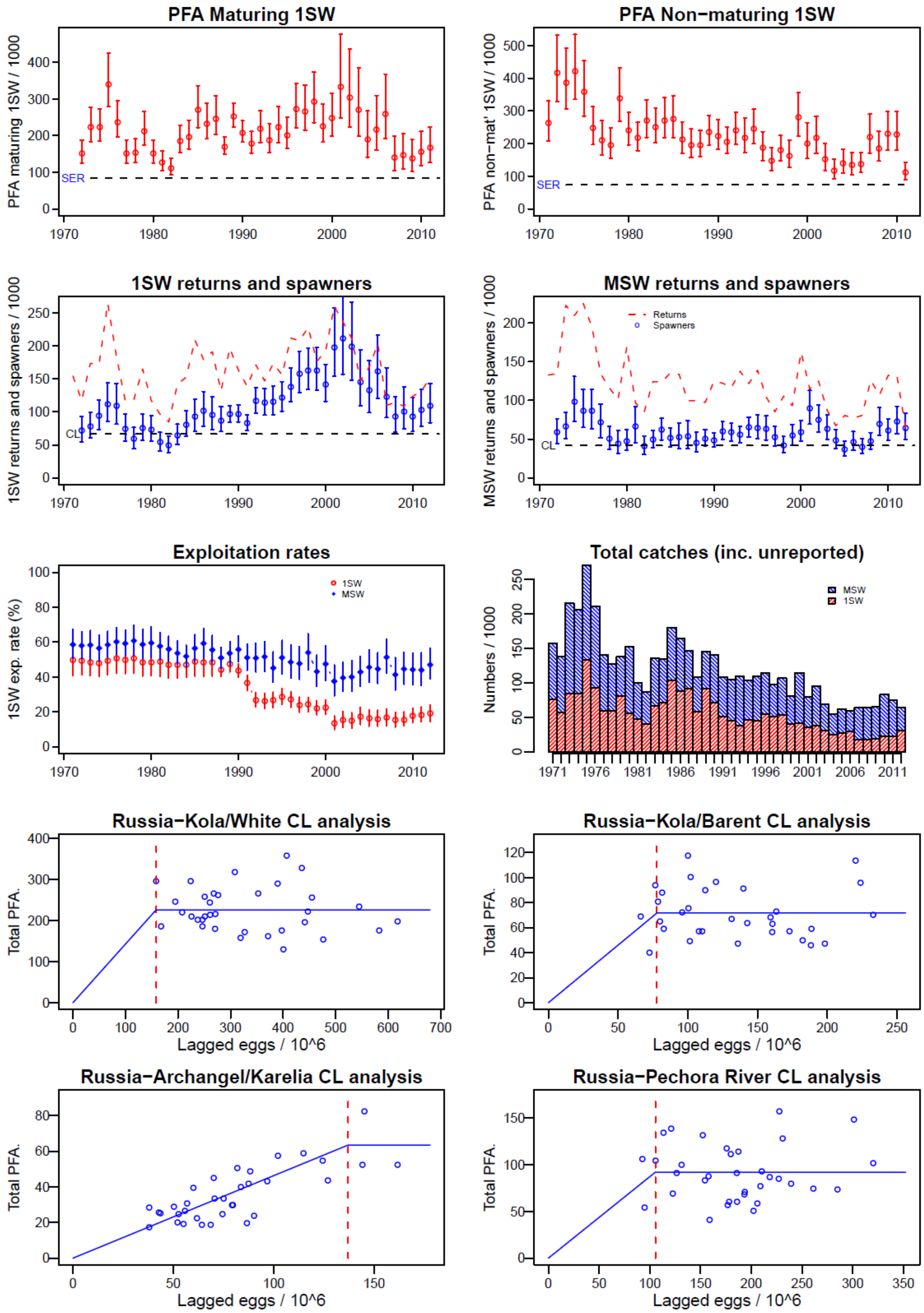


Figure 3.3.4.1f. Summary of fisheries and stock description, Russia.

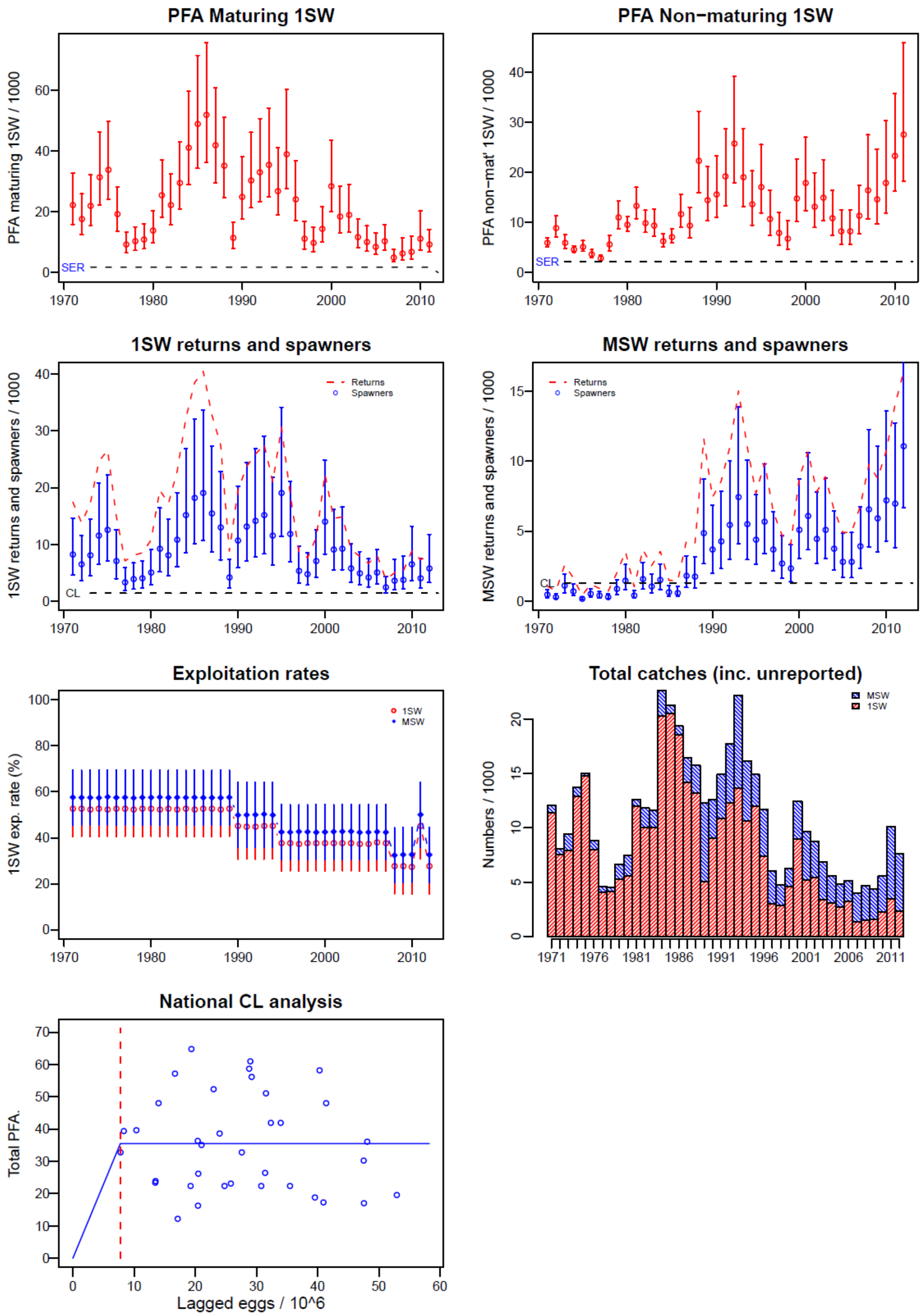


Figure 3.3.4.1g. Summary of fisheries and stock description, Sweden.

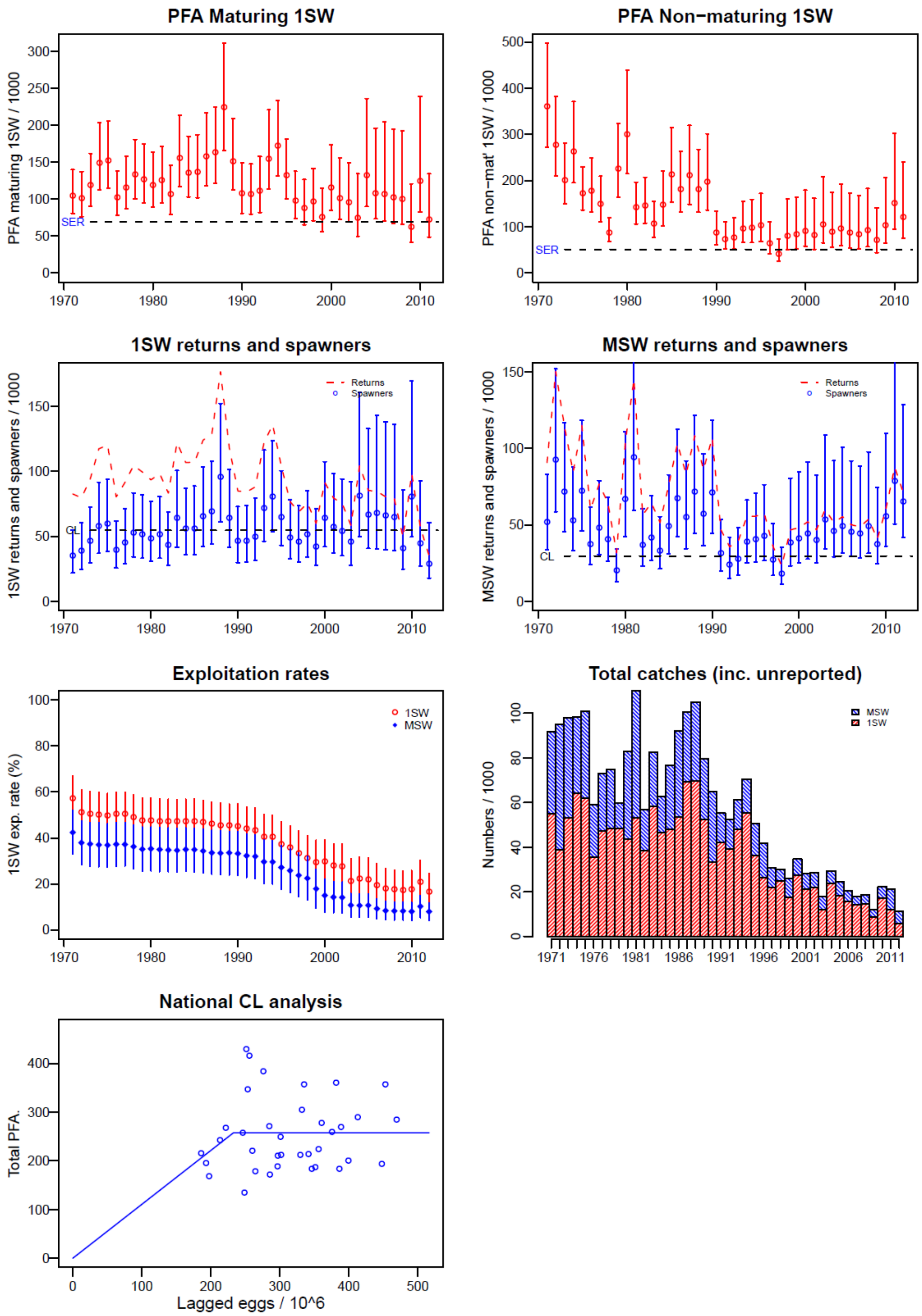


Figure 3.3.4.1h. Summary of fisheries and stock description, UK(England & Wales). The national CL analysis is shown for information only. A river-specific CL is used for the assessment.

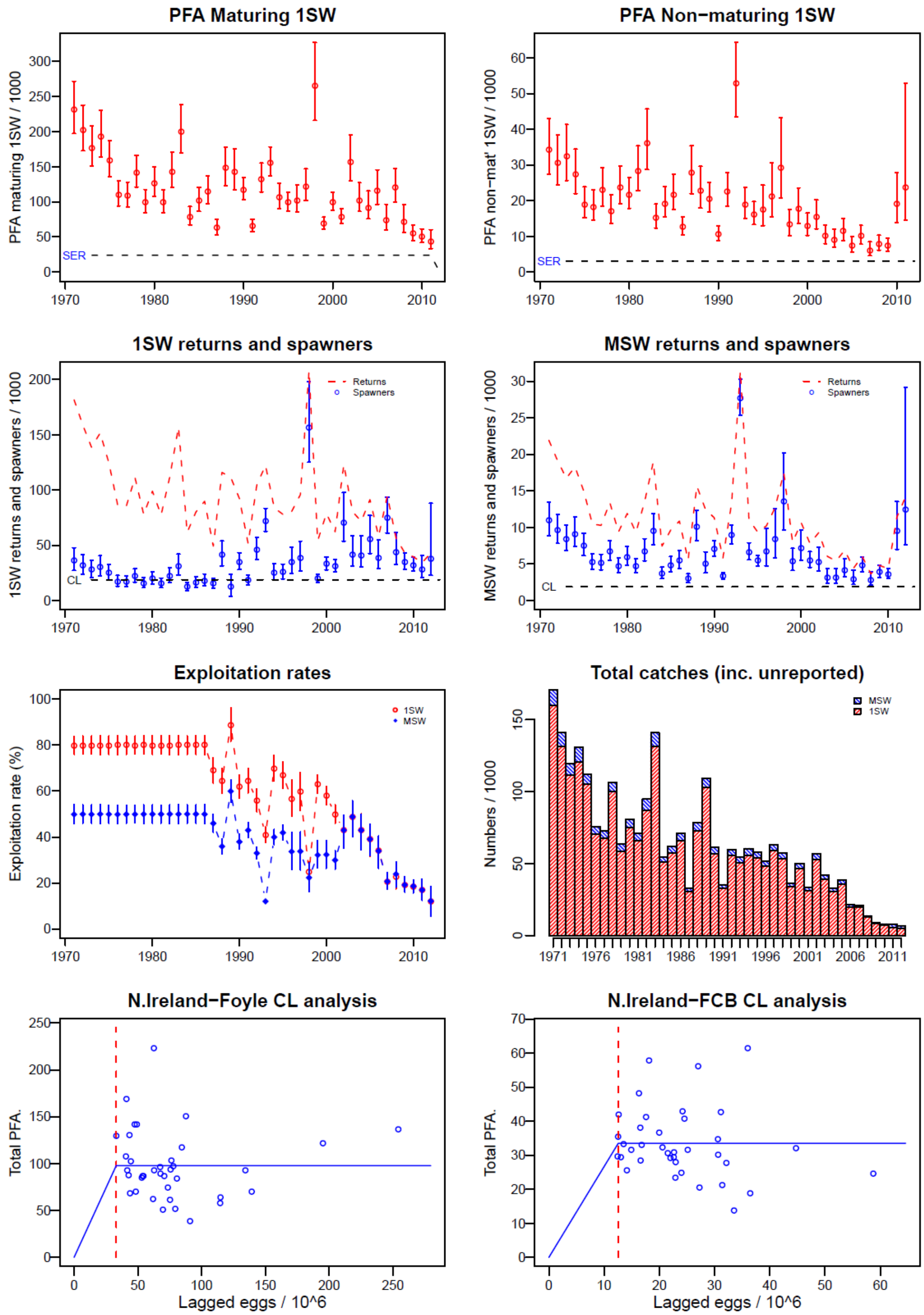


Figure 3.3.4.1i. Summary of fisheries and stock description, UK(N.Ireland).

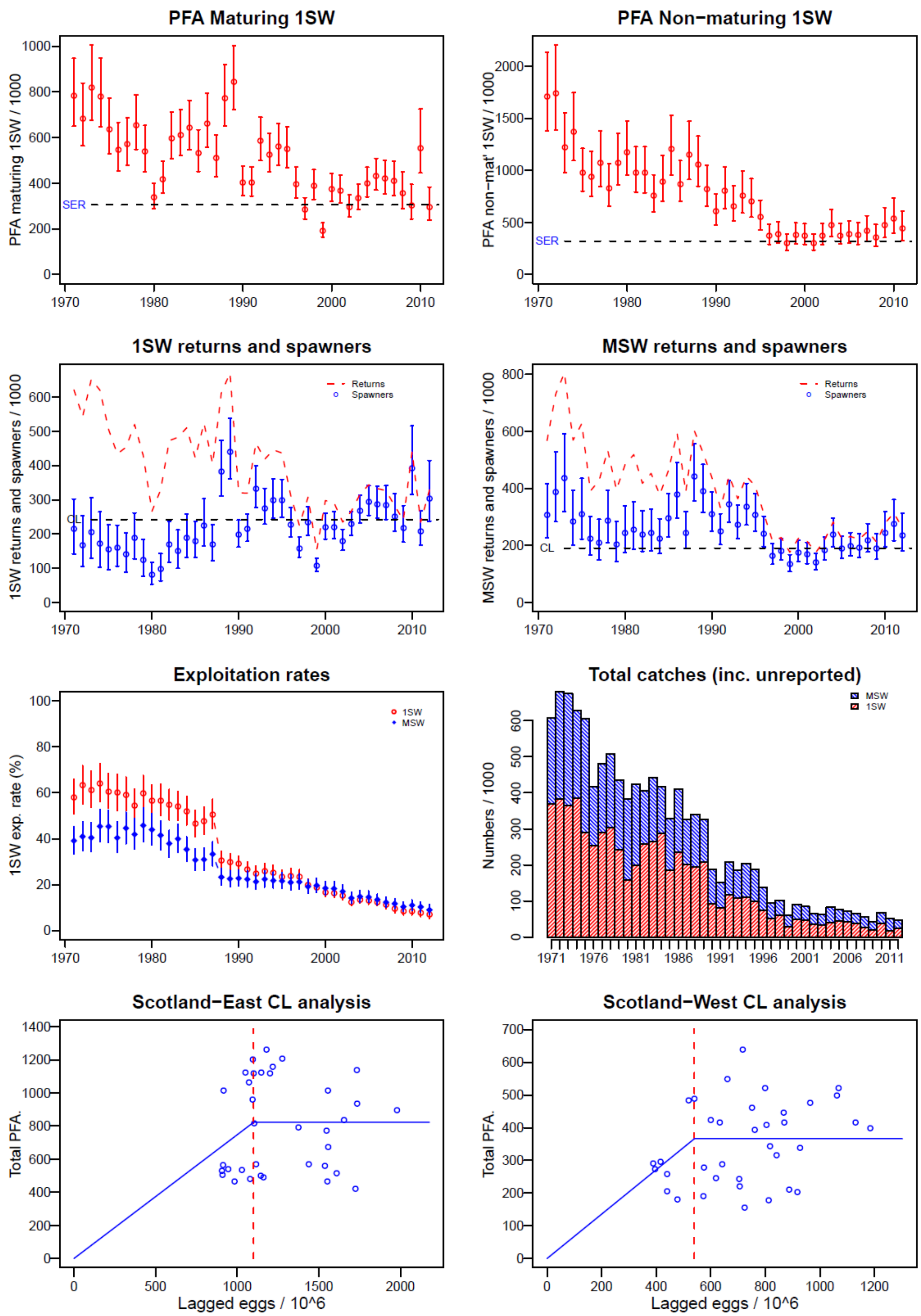


Figure 3.3.4.1j. Summary of fisheries and stock description, UK(Scotland).

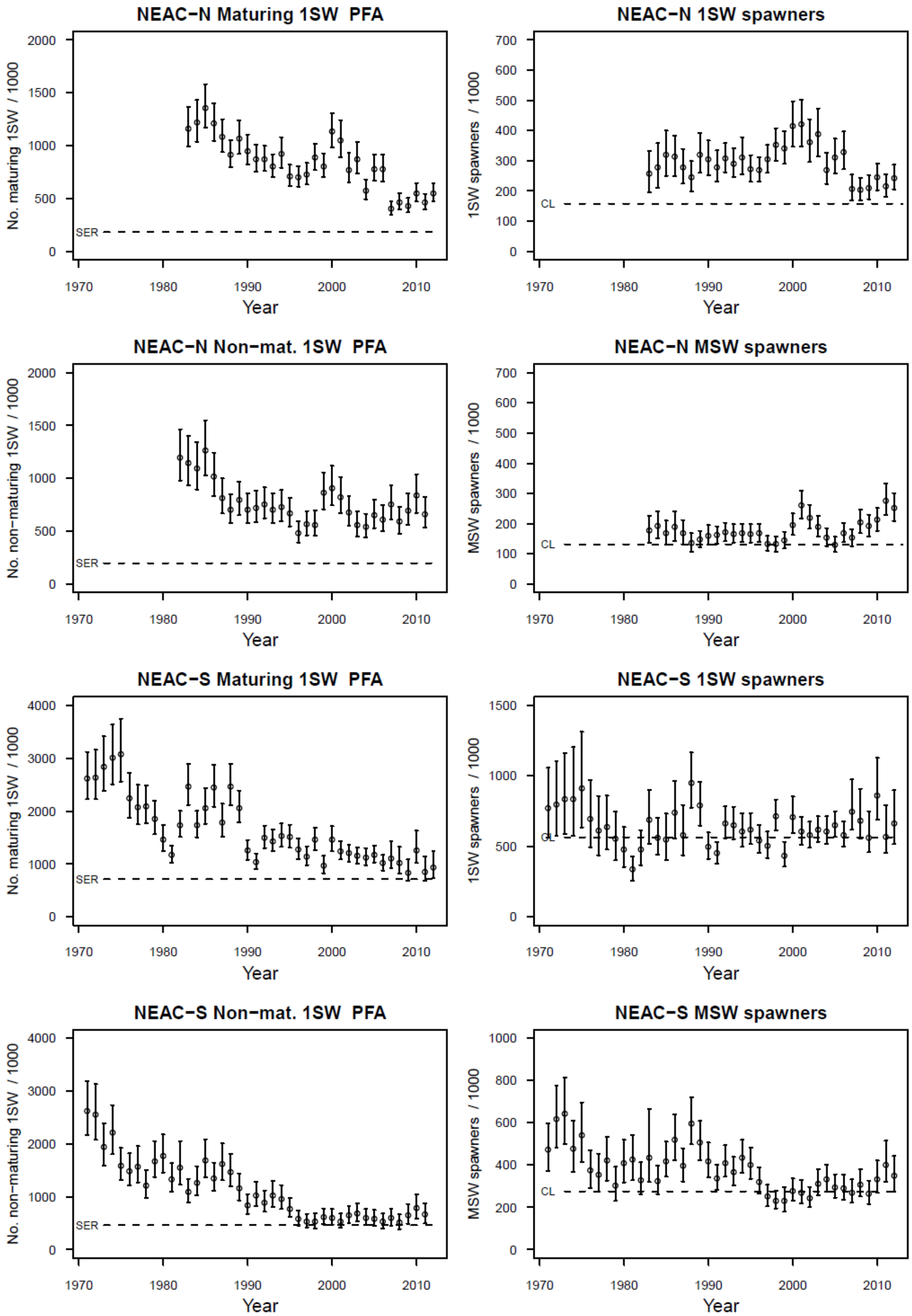
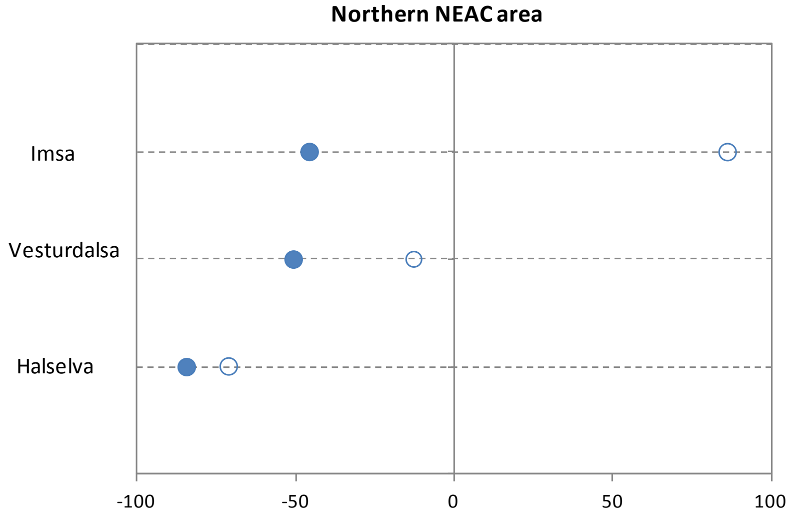


Figure 3.3.5.1. Estimated PFA (left panels) and spawning escapement (right panels) with 95% confidence limits, for maturing 1SW (1SW spawners) and non-maturing 1SW (MSW spawners) salmon in northern (NEAC-N) and southern (NEAC-S) NEAC stock complexes.



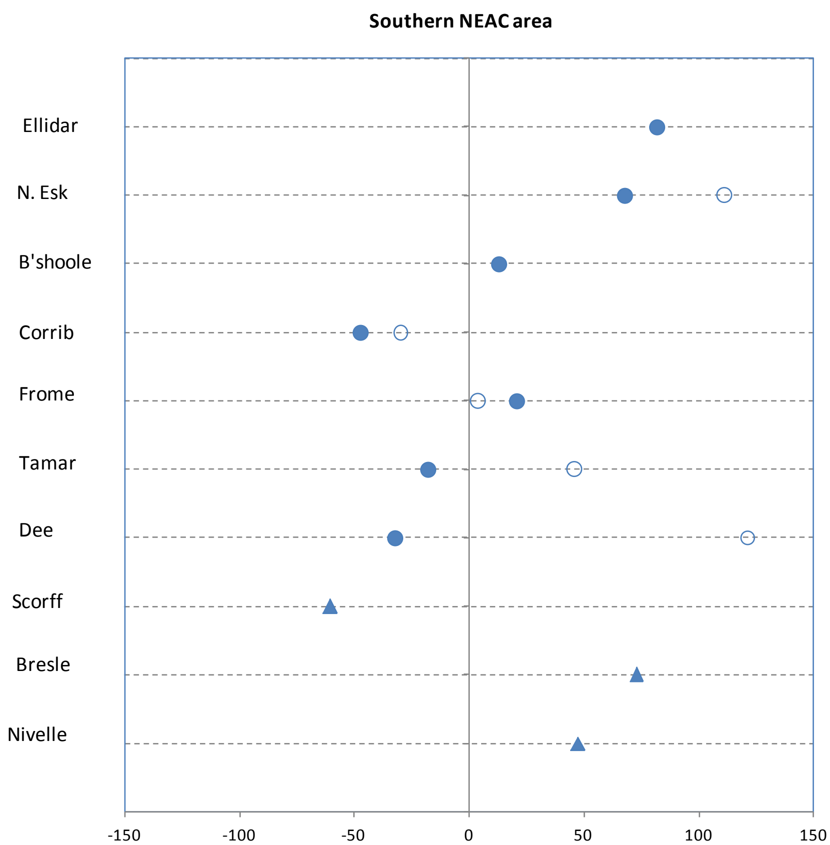
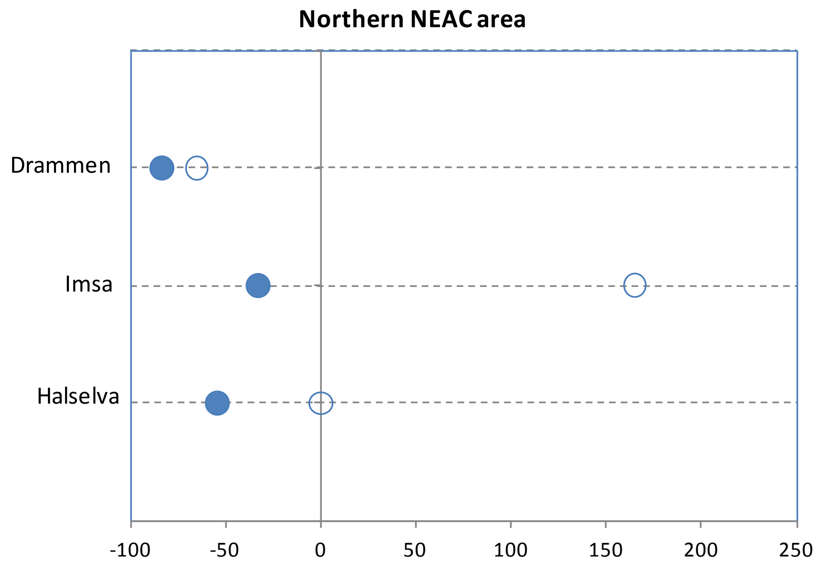


Figure 3.3.7.1. Comparison of the percent change in the five year mean return rates for 1SW and 2SW wild salmon smolts to rivers of northern (top) and southern NEAC (bottom) areas for the 2002 to 2006 and 2007 to 2011 smolt years (2001 to 2005 and 2006 to 2010 for 2SW salmon). Filled circles are for 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.



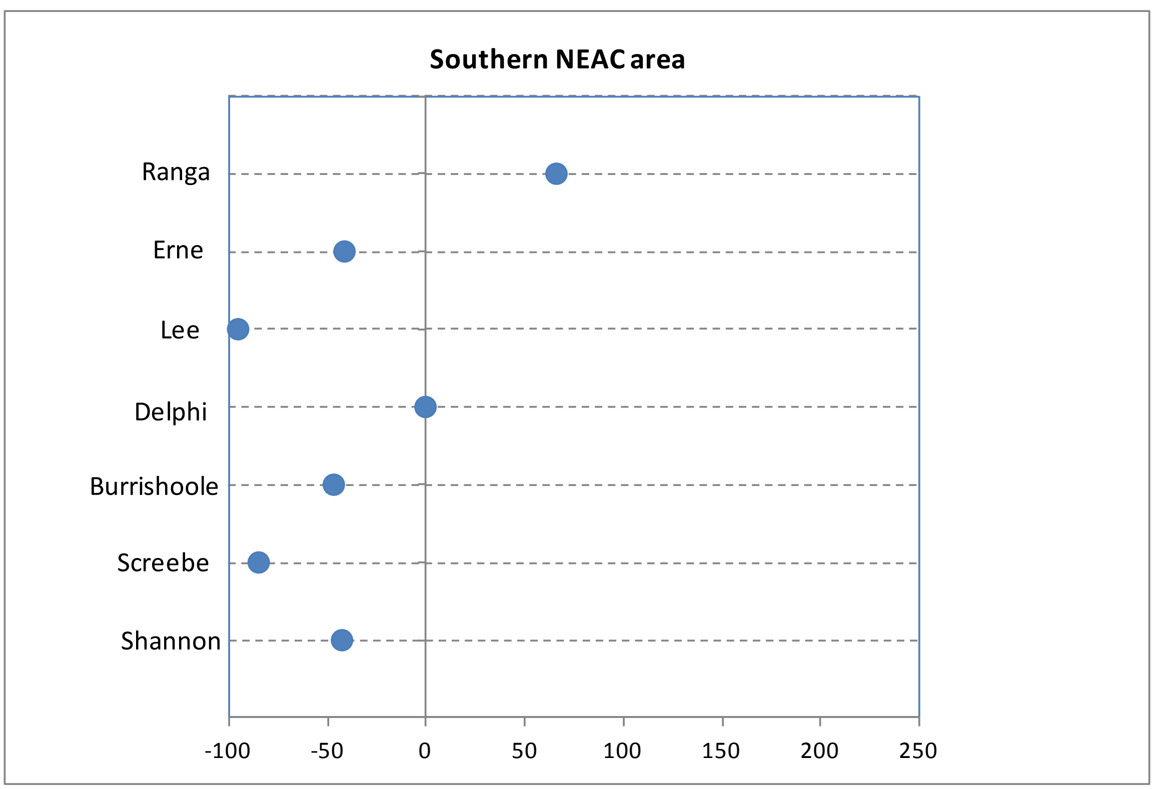


Figure 3.3.7.2. Comparison of the percent change in the five-year mean return rates for 1SW and 2SW hatchery salmon smolts to rivers of northern (top) and Southern NEAC (bottom) areas for the 2002 to 2006 and 2007 to 2011 smolt years (2001 to 2005 and 2006 to 2010 for 2SW salmon). Filled circles are 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.

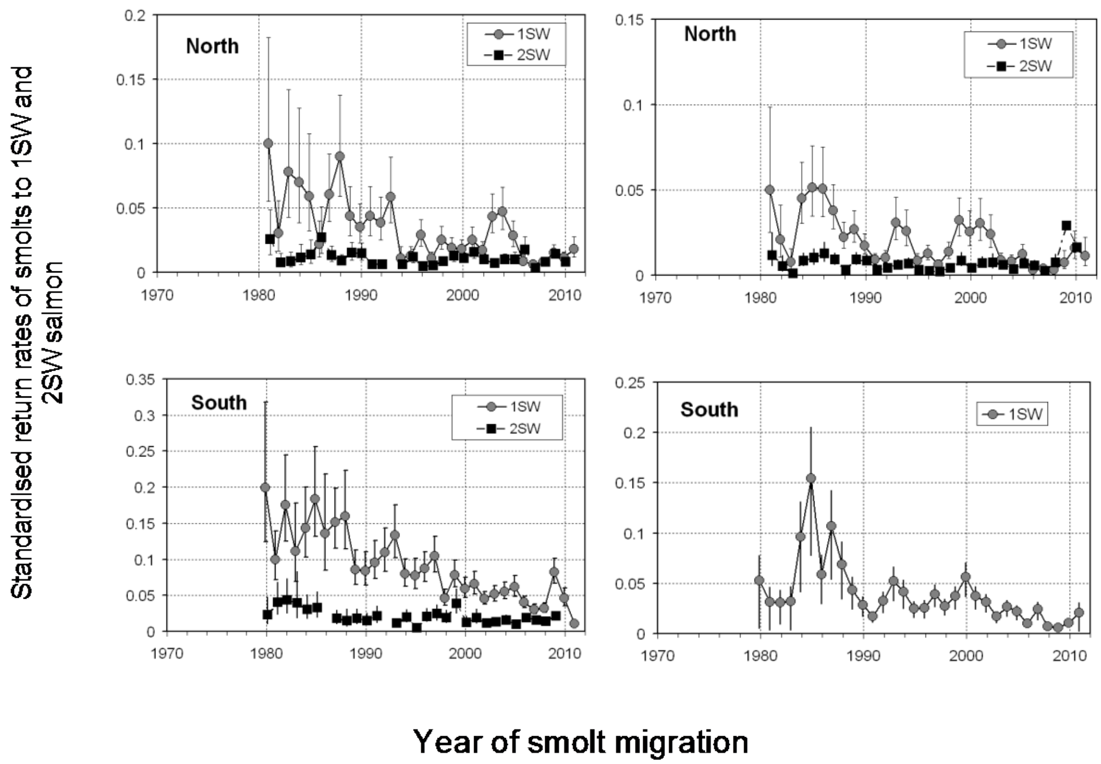


Figure 3.3.7.3. Standardized mean (one standard error bars) annual return rates of wild (left hand panels) and hatchery origin (right hand panels) smolts to 1SW and 2SW salmon to northern and southern areas. The standardized values are annual means derived from a general linear model analysis of rivers in a region. Survival rates were log transformed prior to analysis. Note y-scale differences among panels.

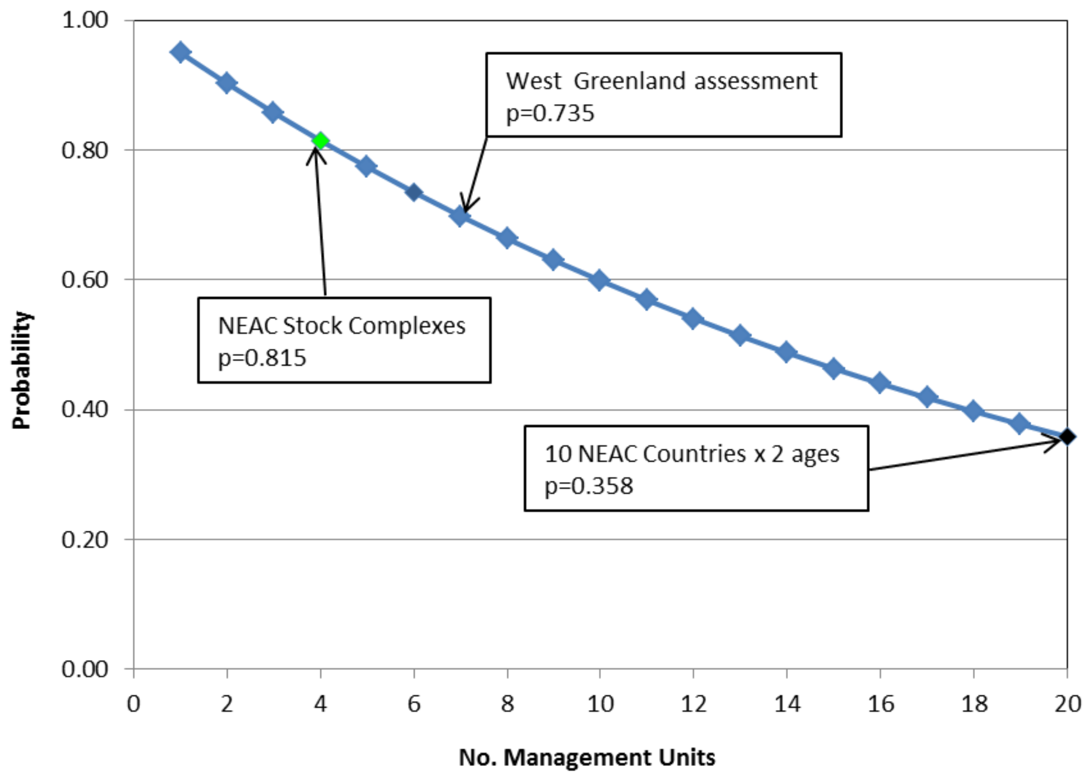


Figure 3.4.3.1. Probability of simultaneous attainment of CLs for different numbers of management units with a 95% chance of attainment in each management unit independently.

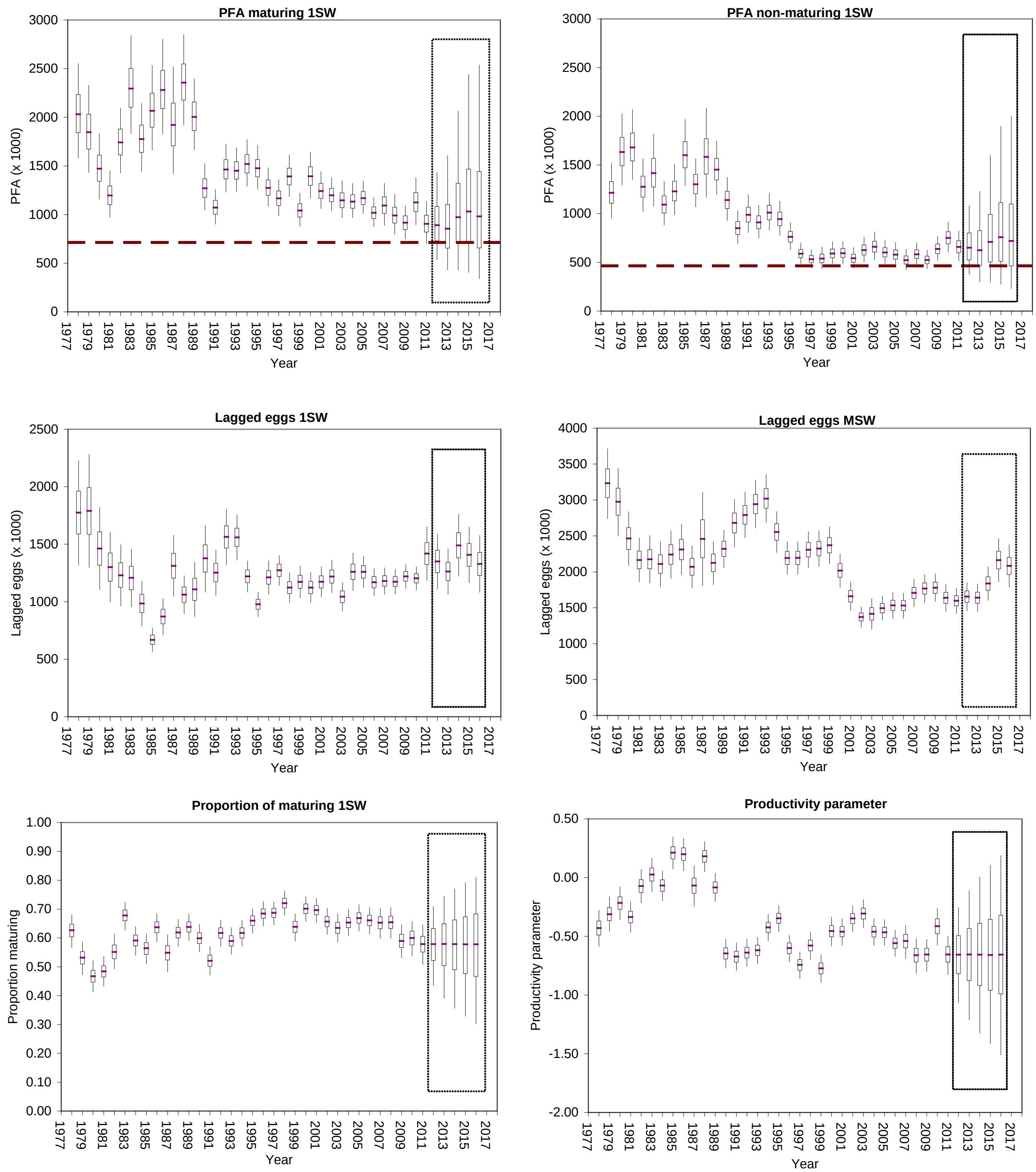


Figure 3.5.2.1. Southern NEAC PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th Bayesian credibility intervals (BCIs).

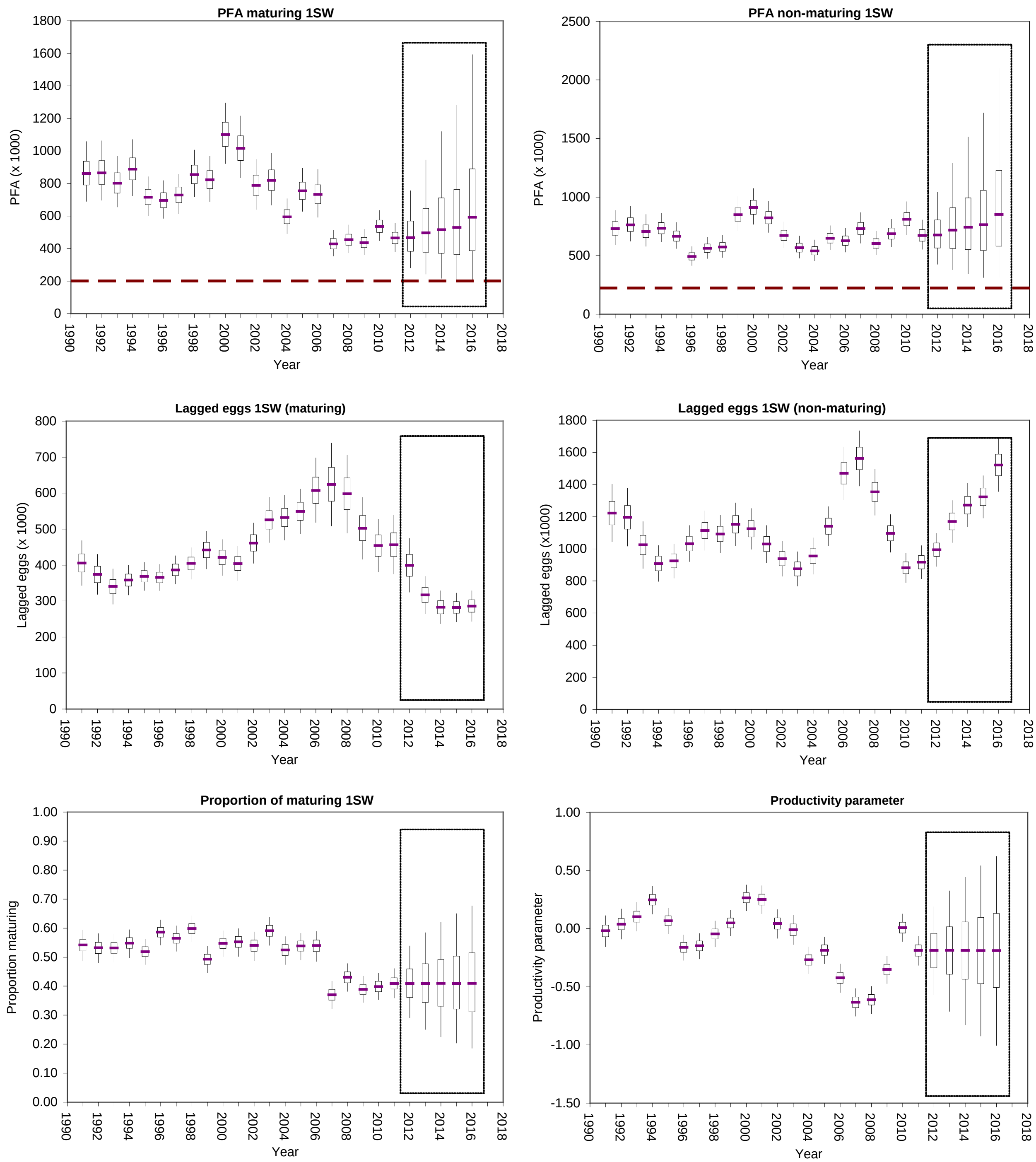
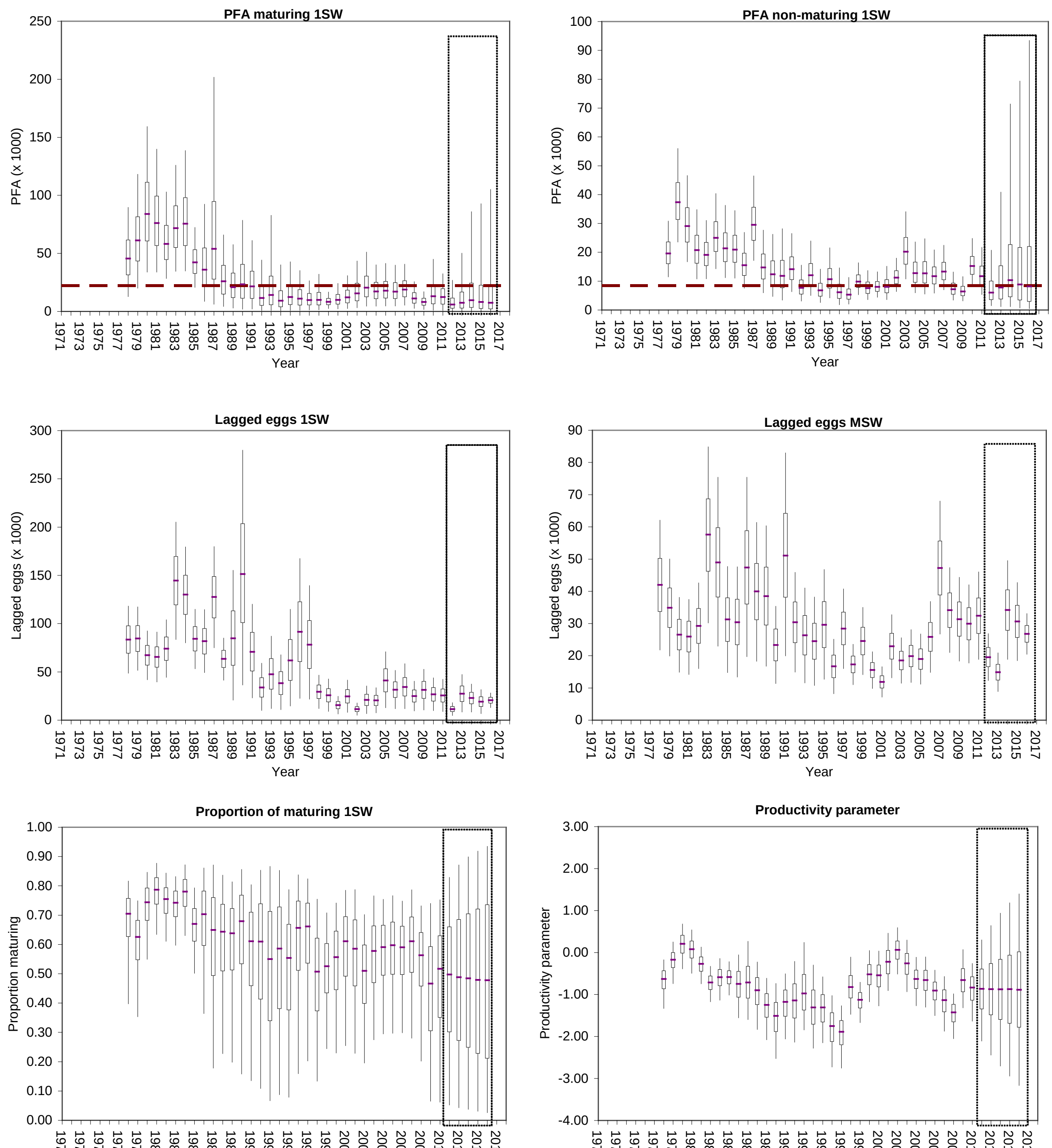
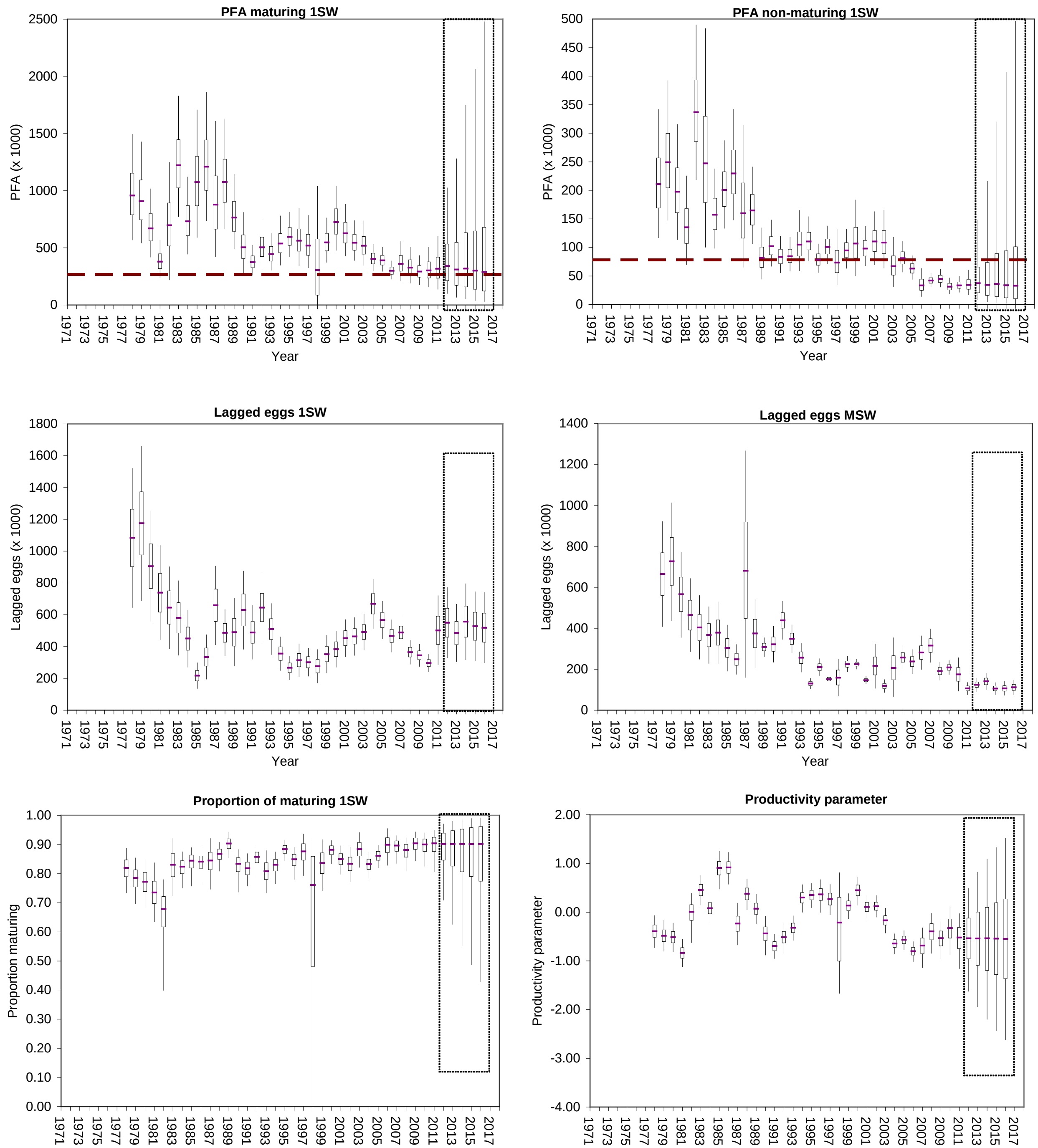


Figure 3.5.2.2. Northern NEAC PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th Bayesian credibility intervals (BCIs).


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

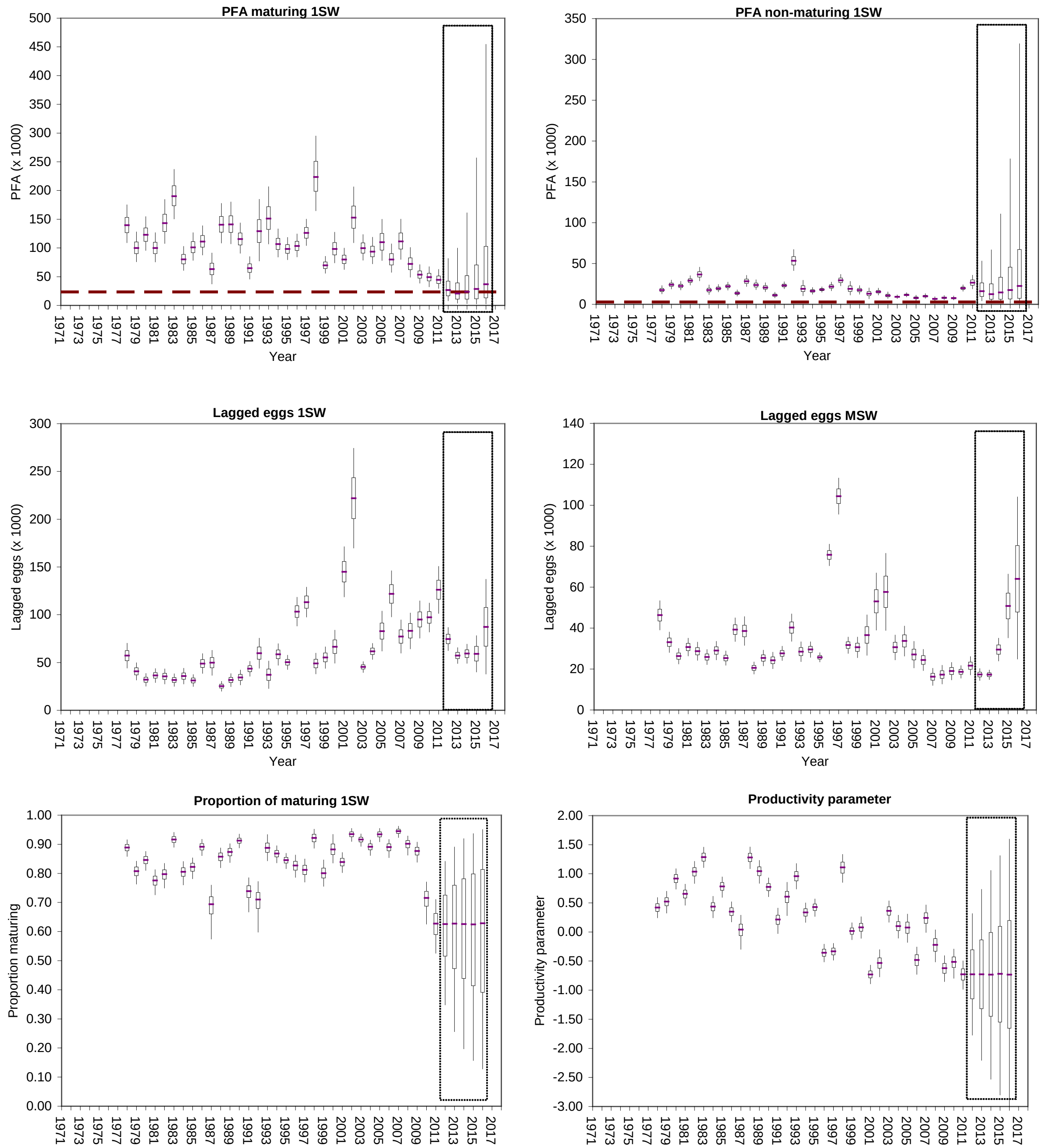
Probability that PFAs will be greater than or equal to country and age specific SERs			
		Maturing	Non-maturing
France	SER	22 120	8493
Year		*p*	*p*
2012		0.079	0.324
2013		0.181	0.466
2014		0.274	0.568
2015		0.255	0.512
2016		0.255	0.490

Figure 3.5.4.1. France: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

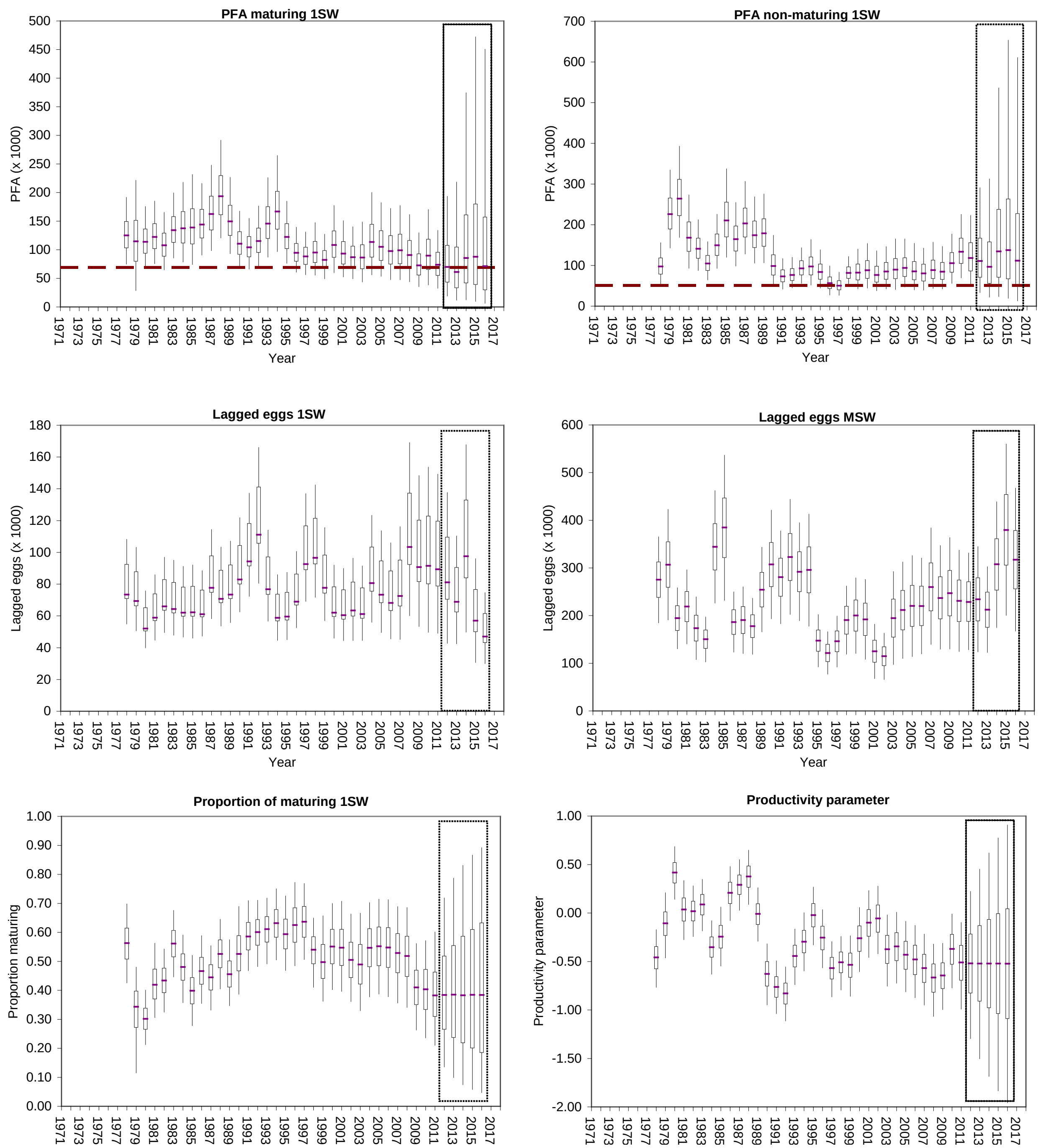
Probability that PFAs will be greater than or equal to country and age specific SERs			
		Maturing	Non-maturing
Ireland	SER	268 832	78 174
Year		*p*	*p*
2012		0.631	0.188
2013		0.567	0.232
2014		0.566	0.281
2015		0.538	0.290
2016		0.521	0.304

Figure 3.5.4.2. Ireland: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

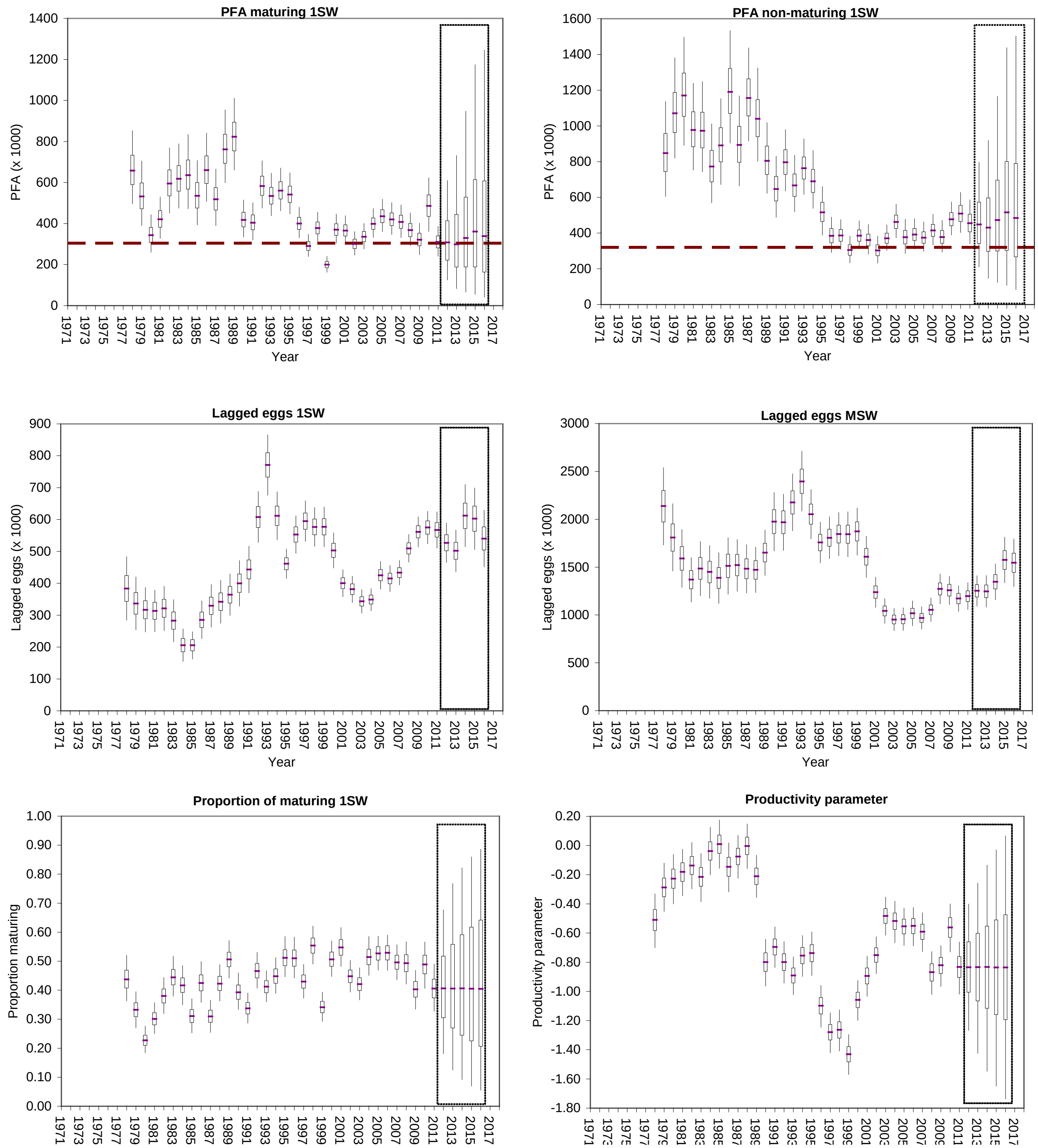
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
UK (N. Ireland)	SER	23 850	3093
Year		*p*	*p*
2012		0.561	0.977
2013		0.441	0.897
2014		0.498	0.875
2015		0.552	0.868
2016		0.611	0.871

Figure 3.5.4.3. UK(N. Ireland): PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

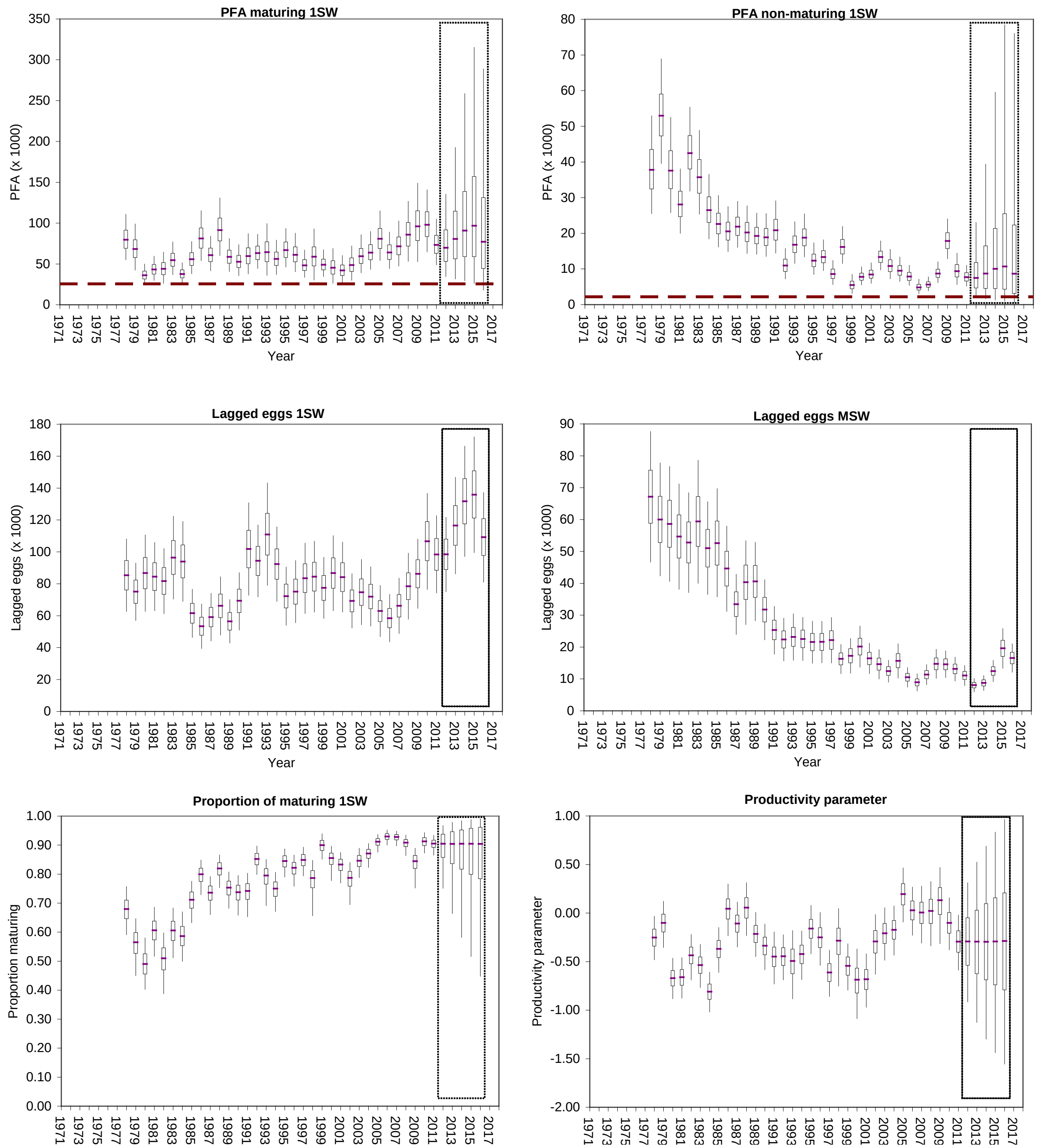
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
UK (England & Wales)	SER	69 272	50 802
Year		*p*	*p*
2012		0.505	0.871
2013		0.438	0.783
2014		0.583	0.840
2015		0.582	0.819
2016		0.508	0.750

Figure 3.5.4.4. UK(England & Wales): PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

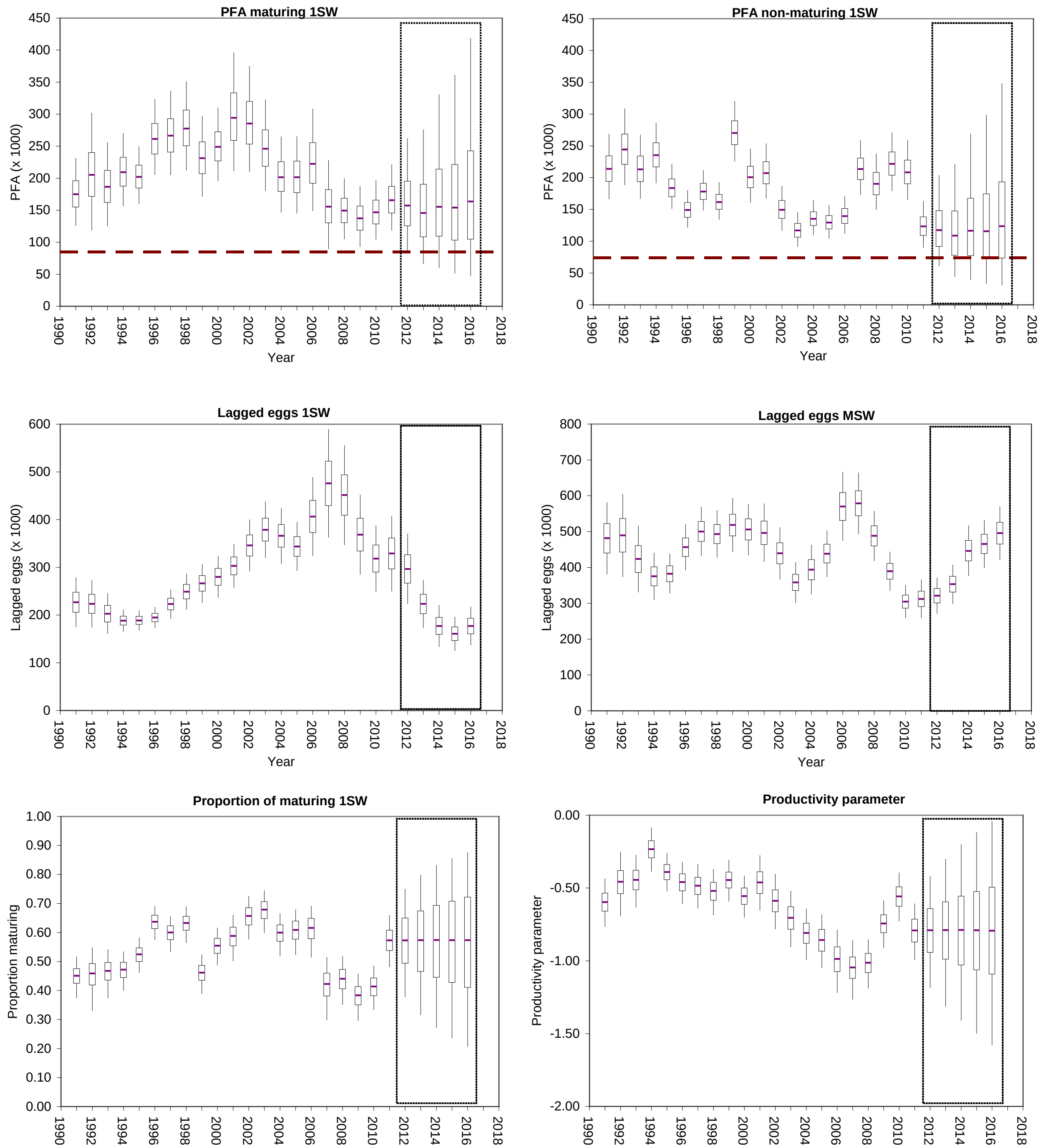
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
UK (Scotland)	SER	305 206	320 577
Year		*p*	*P*
2012		0.507	0.790
2013		0.485	0.706
2014		0.541	0.718
2015		0.573	0.729
2016		0.543	0.685

Figure 3.5.4.5. UK(Scotland): PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

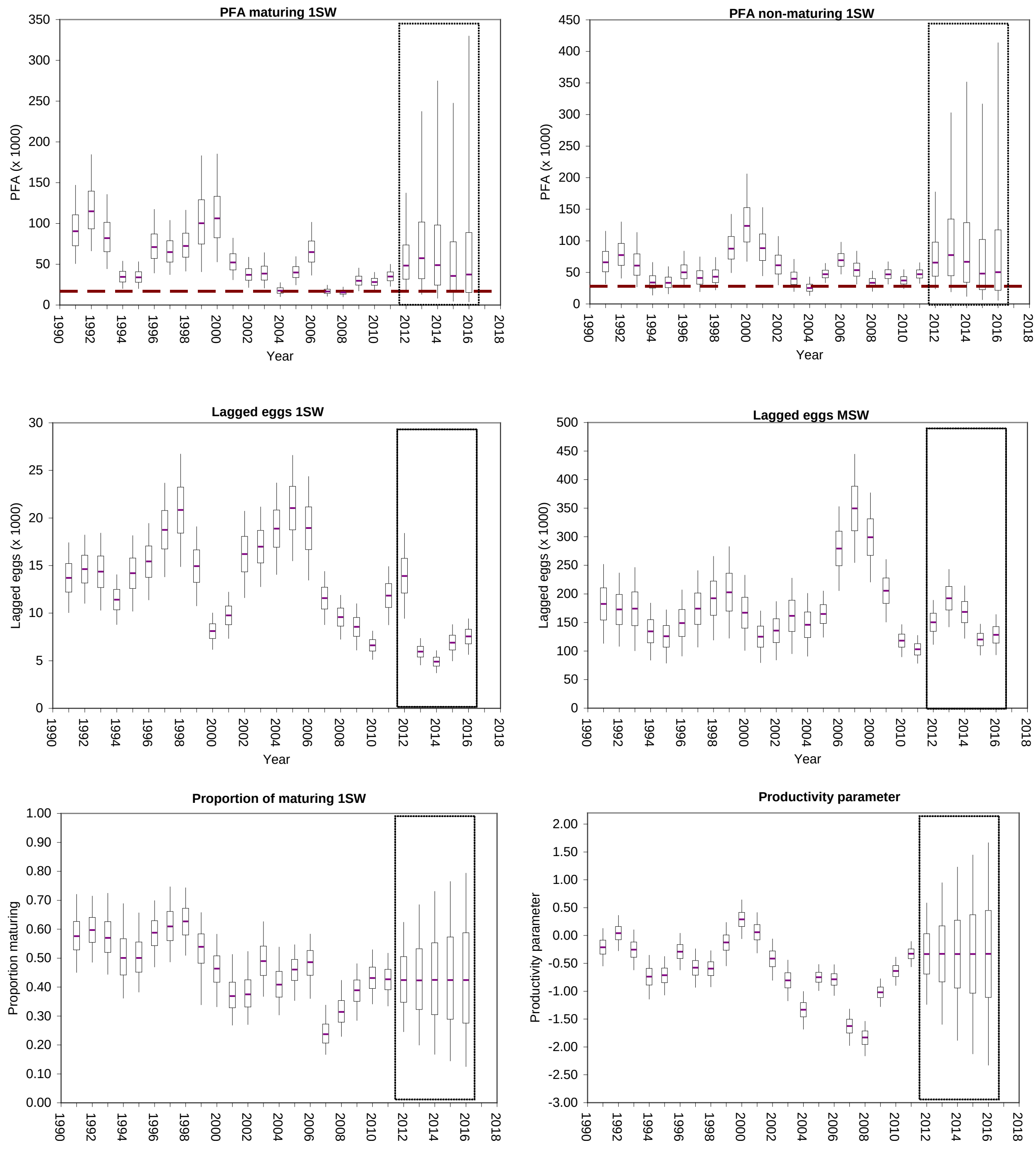
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
Iceland - SW	SER	25 692	2192
Year		*p*	*P*
2012		0.988	0.949
2013		0.974	0.915
2014		0.965	0.894
2015		0.952	0.874
2016		0.902	0.815

Figure 3.5.4.6. Iceland (south/west regions): PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1978 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

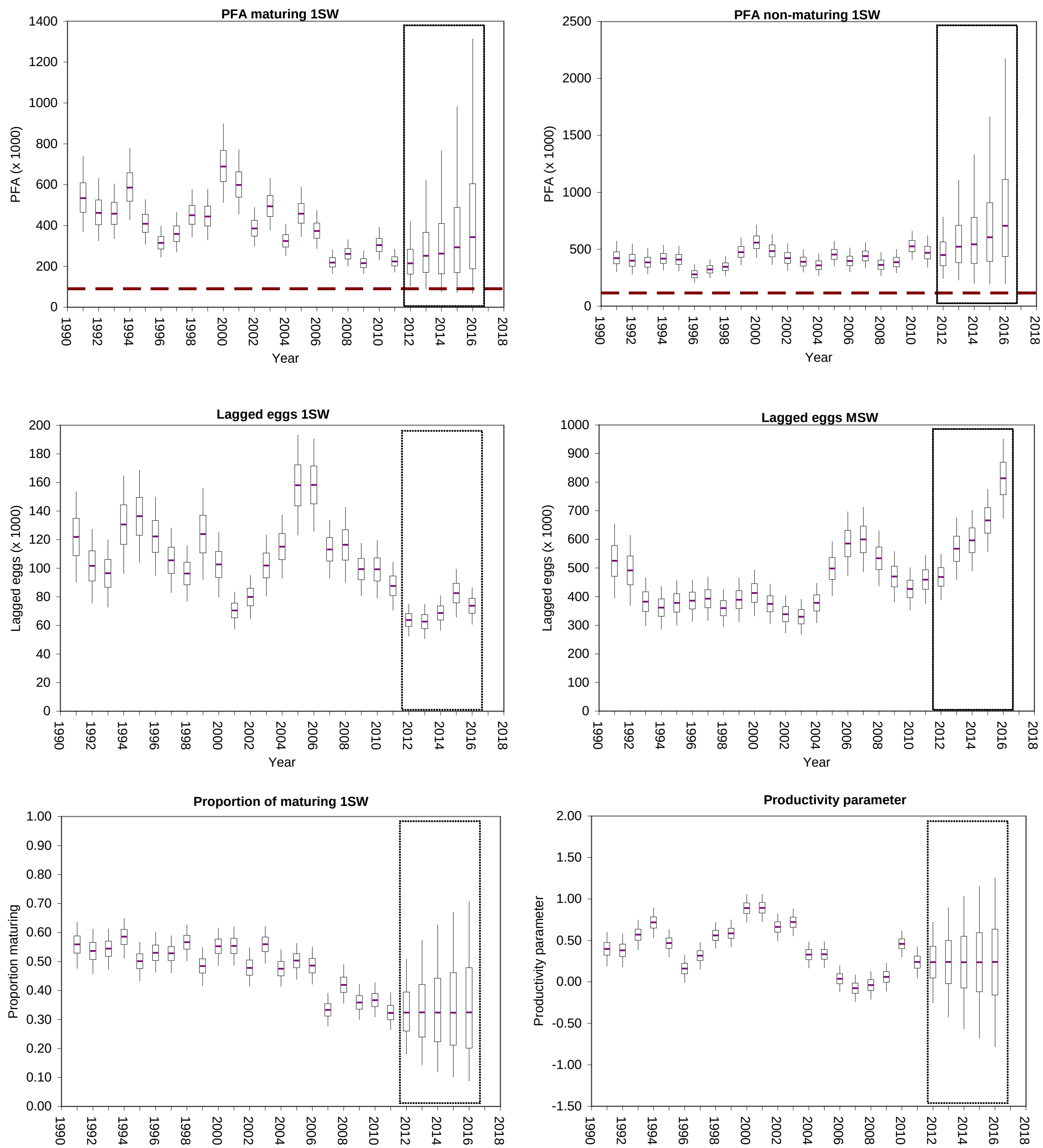
Probability that PFAs will be greater than or equal to country and age specific SERs			
		Maturing	Non-maturing
Russia	SER	84 628	73 894
Year		*p*	*P*
2012		0.956	0.887
2013		0.880	0.780
2014		0.868	0.772
2015		0.835	0.745
2016		0.832	0.747

Figure 3.5.4.7. Russia: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

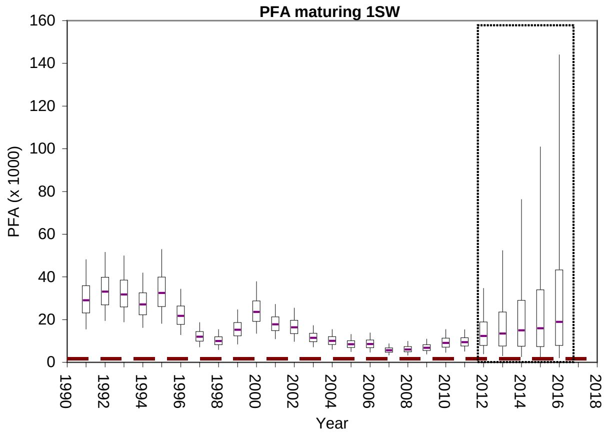
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
Finland	SER	16 662	27 772
Year		*p*	*P*
2012		0.947	0.920
2013		0.919	0.890
2014		0.846	0.809
2015		0.738	0.686
2016		0.728	0.681

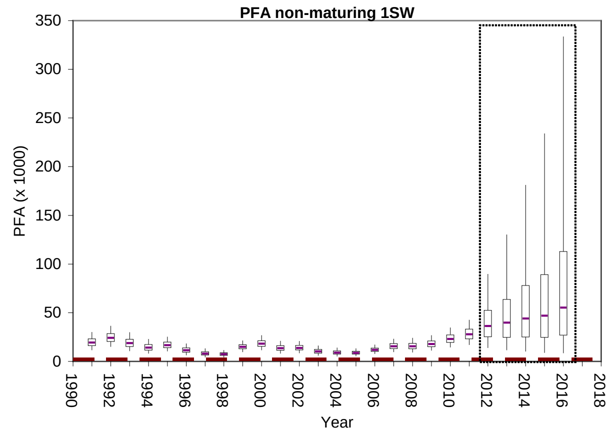
Figure 3.5.4.8. Finland: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.

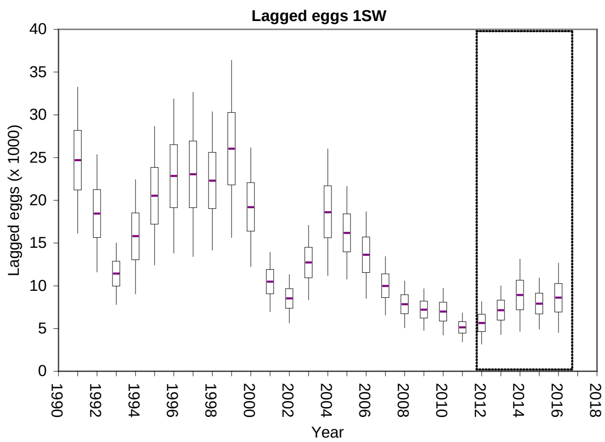

PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

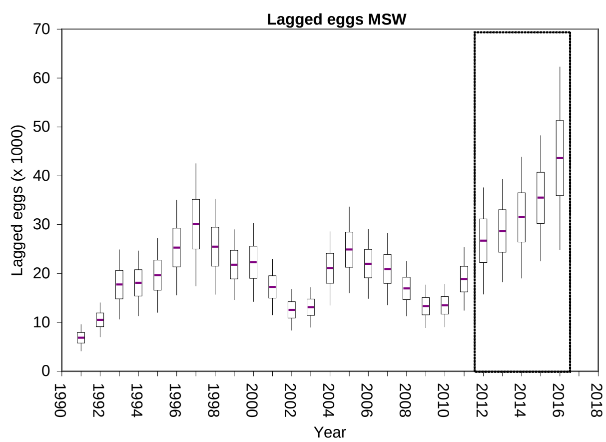
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
Norway	SER	89 774	116 367
Year		*p*	*P*
2012		0.972	0.999
2013		0.951	0.997
2014		0.926	0.992
2015		0.918	0.987
2016		0.920	0.986

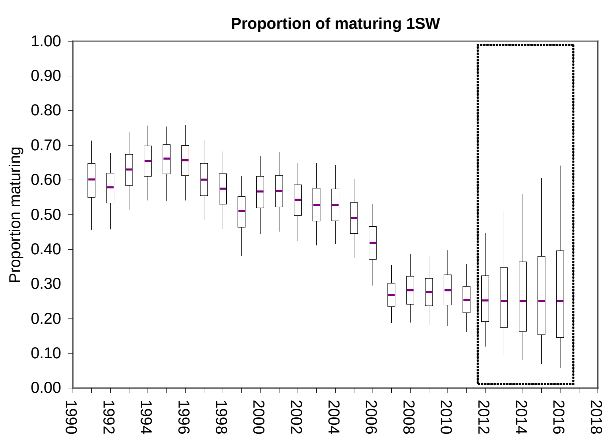
Figure 3.5.4.9. Norway: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.

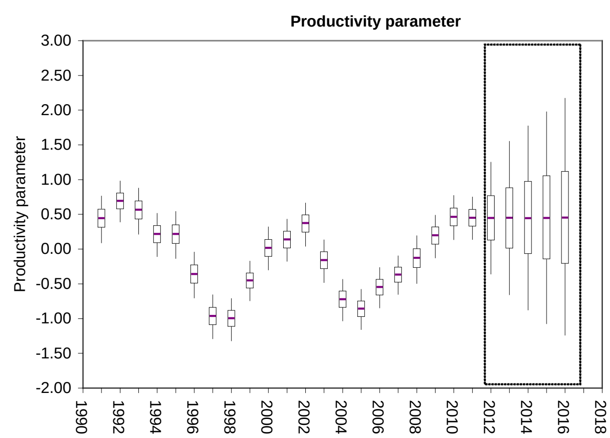

PFA maturing 1SW
PFA (x 1000)
Year


PFA non-maturing 1SW
PFA (x 1000)
Year


Lagged eggs 1SW
Lagged eggs (x 1000)
Year

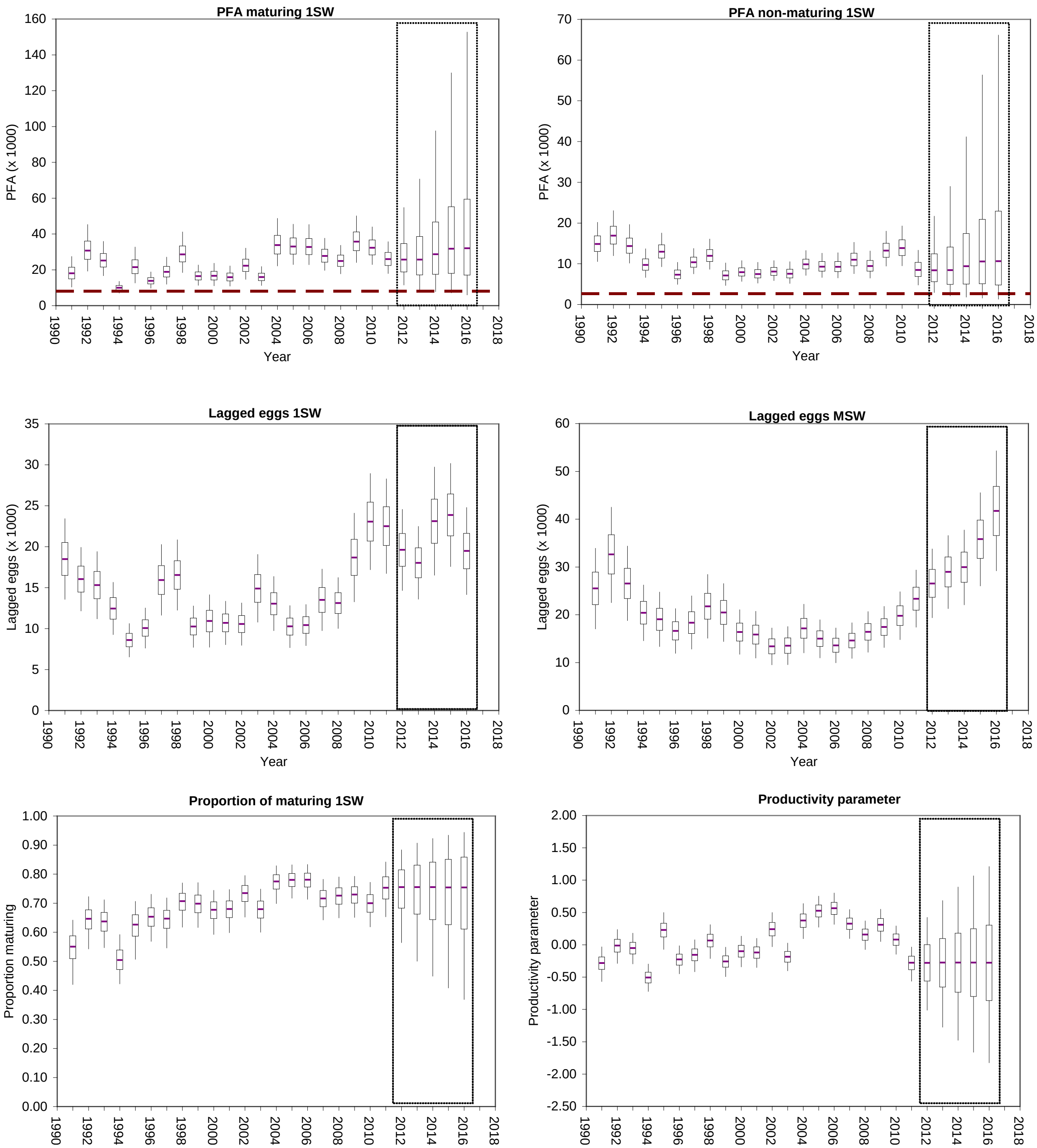

Lagged eggs MSW
Lagged eggs (x 1000)
Year


Proportion of maturing 1SW
Proportion maturing


Productivity parameter
Productivity parameter

Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	Non-maturing
Sweden	SER	1741	2169
Year		p	p
2012		0.996	1.000
2013		0.988	1.000
2014		0.977	0.999
2015		0.967	0.997
2016		0.963	0.996

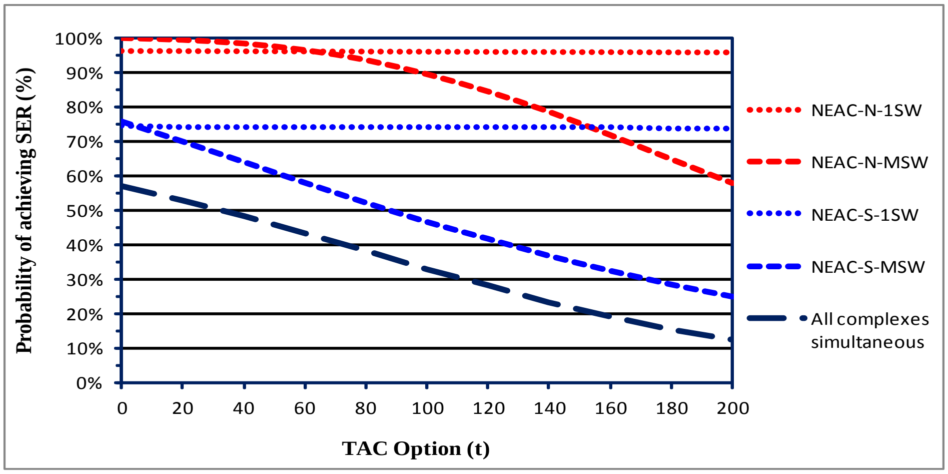
Figure 3.5.4.10. Sweden: PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.


PFA maturing 1SW
PFA (x 1000)
Year
PFA non-maturing 1SW
PFA (x 1000)
Year
Lagged eggs 1SW
Lagged eggs (x 1000)
Year
Lagged eggs MSW
Lagged eggs (x 1000)
Year
Proportion of maturing 1SW
Proportion maturing
Productivity parameter
Productivity parameter

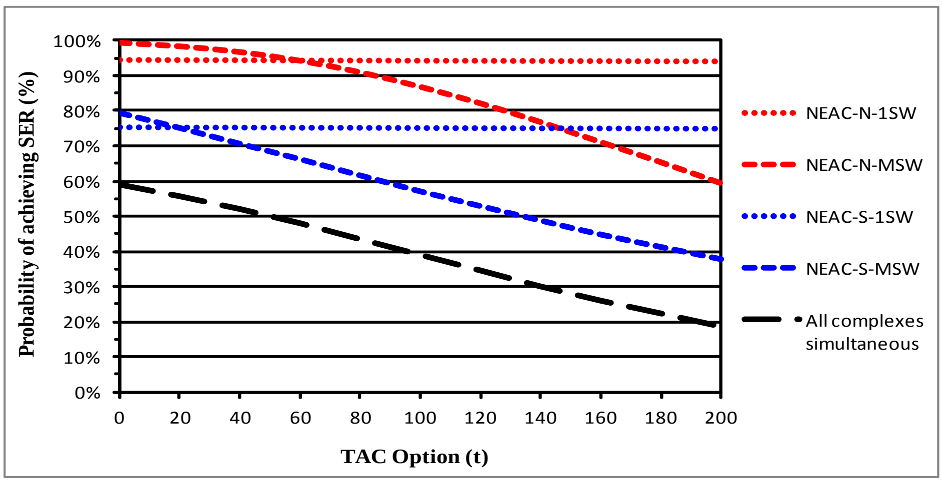
Probability that PFAs will be greater than or			
equal to country and age specific SERs			
		Maturing	**Non-maturing**
Iceland-NE	**SER**	**8209**	**2686**
Year		*p*	*p*
2012		0.988	0.962
2013		0.960	0.917
2014		0.944	0.900
2015		0.934	0.888
2016		0.915	0.868

Figure 3.5.4.11. Iceland (north/east regions): PFA maturing and non-maturing, lagged eggs from 1SW and MSW, proportion 1SW maturing, and the productivity parameter values for PFA years 1991 to 2016. The last five years (2012 to 2016) are forecasts in all cases. The dashed horizontal lines in the upper panels are the age-specific SER values. Box and whiskers show the 5th, 25th, 50th, 75th and 95th BCIs.

Catch options for 2013/14 season:



Catch options for 2014/15 season:



Catch options for 2015/16 season:

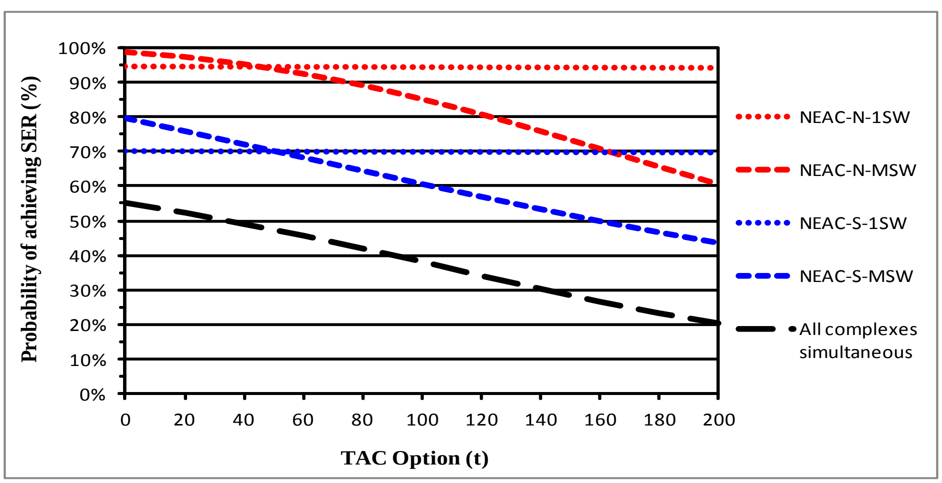


Figure 3.6.1.1. Probability of northern and southern NEAC - 1SW and MSW stock complexes, and all stock complexes simultaneously, achieving their SERs for different catch options for the Faroes fishery in the 2013/14 to 2015/16 fishing seasons.

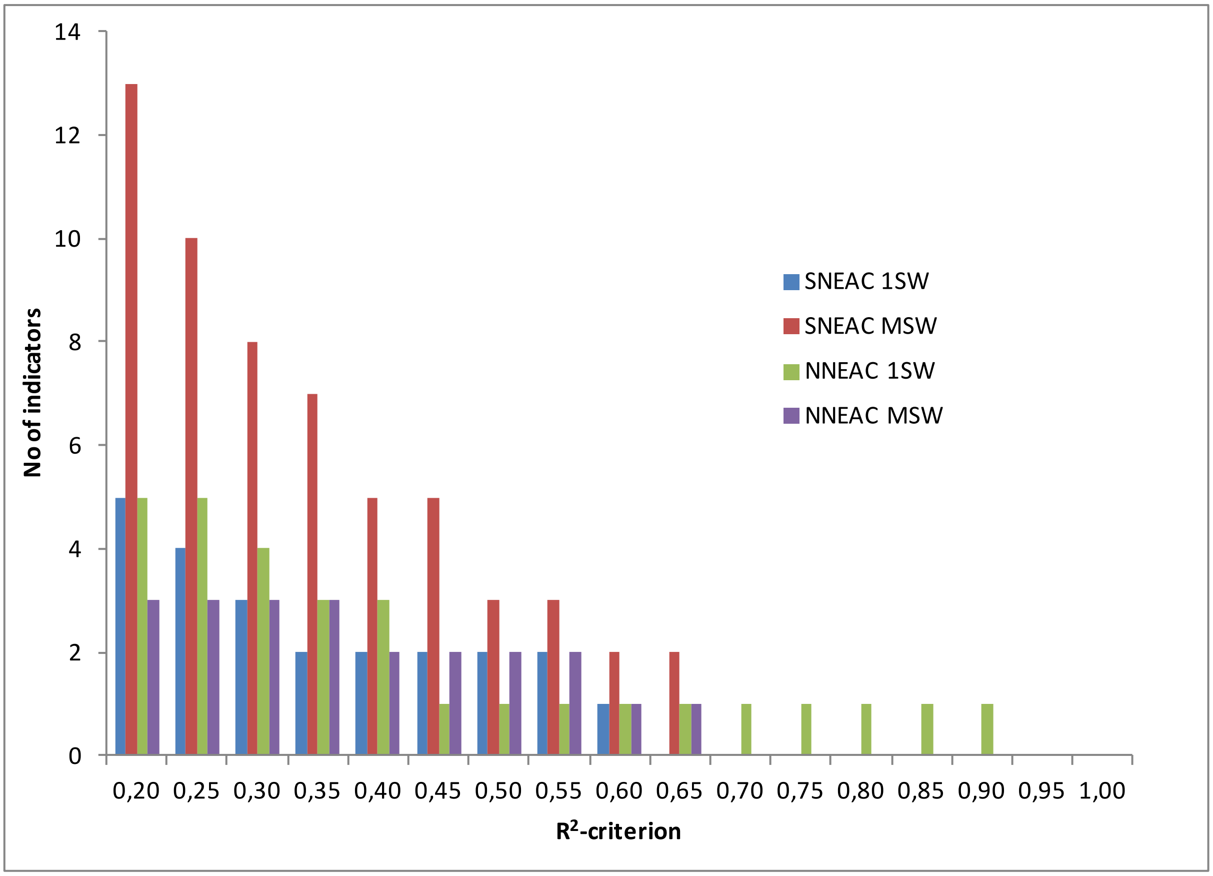


Figure 3.7.2.1. Number of retained indicators within each stock complex as a function of the R^2 criterion chosen to select the indicators for the Faroes FWI.

4 North American commission

The previous advice provided by ICES (2009a) indicated that there were no mixed-stock fishery catch options on the 1SW non-maturing salmon component for the 2009 to 2011 PFA years, and this year's assessment confirms that advice. The NASCO Framework of Indicators of North American stocks for 2012 did not indicate the need for a revised analysis of catch options and no new management advice for 2013 is provided. The assessment was updated to 2012 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 2012 fisheries

4.1.1 Key events of the 2012 fisheries

- There were no new significant events reported for 2012 in the NAC area.
- The majority of harvest fisheries were directed to small salmon.
- The 2012 provisional harvest was 134.7 t, comprised of 46 891 small salmon and 11 671 large salmon, 27% fewer small salmon and 15% fewer large salmon compared to 2011.
- Overall, catches remain very low relative to pre-1990 values.

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 Quebec, the management is delegated to the province of Quebec (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 2012; Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. There were no commercial fisheries in Canada in 2012.

In 2012, 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 multifilament 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 (95%, 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 and, in areas where retention of large salmon is allowed, are closely controlled. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located in bays generally inside the headlands. Sampling of this fishery occurred in 2012 with the intent of using genetic markers to identify the origin of harvested salmon.

The following management measures were in effect in 2012.

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

In Quebec, Aboriginal peoples' fisheries took place subject to agreements or through permits issued to the bands. There are ten bands 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 have to be reported collectively by each Aboriginal user group. However, if reports are not available, the catches are estimated. In the Maritimes (SFAs 15 to 23), FSC agreements were signed with several Aboriginal peoples' groups (mostly First Nations) in 2012. 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 2012. 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 2012, a licensed subsistence trout 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 2012 varied by area and large portions of the southern areas remained closed to all directed salmon fisheries (Figure 4.1.2.2). Large salmon were no longer permitted to be retained in Labrador as of 2011. Except for 42 rivers in Quebec, only small salmon could be retained in the recreational fisheries.

In 2012, on Prince Edward Island, there was no directed Atlantic salmon recreational fishery as no recreational fishery licence for Atlantic salmon was issued by the province of Prince Edward Island. The recreational catch of Atlantic salmon for Prince Edward Island for 2012 is recorded as zero. As in other 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 2012.

France (Islands of Saint-Pierre et Miquelon)

Nine professional and 60 recreational gillnet licences were issued in 2012, an increase of four recreational licences from 2011. 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. The time-series of available effort data (licence numbers) is in Table 4.1.2.1.

4.1.3 Catches in 2012

Canada

The provisional harvest of salmon in 2012 by all users was 134.7 t, about 25% lower than the 2011 harvest of 179 t (Table 2.1.1.2; Figure 4.1.3.1). The 2012 harvest was 46 981 small salmon and 11 671 large salmon, 27% fewer small salmon and 15% fewer large salmon compared to 2011. This is the third lowest catch in the time-series since 1960:, 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 Quebec commercial fishery in 2000.

Aboriginal peoples' FSC fisheries

The total harvest by Aboriginal people in 2012 was 60.5 t (Table 4.1.3.1). Harvest (by weight) decreased by 14% from 2011. The reported catch in 2012 was the fifth highest value in the time-series.

Residents fishing for food in Labrador

The estimated catch for the fishery in 2012 was 1.7 t. This represents approximately 650 fish, 32% of which were large (Table 4.1.3.2).

Recreational fisheries

Harvest in recreational fisheries in 2012 totalled 37 720 small and large salmon (approximately 72 t), decreased 30% from the 2011 harvest level and 14% 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 35 040 fish was 30% lower than the 2011 harvest. The large salmon harvest of 2680 fish was 35% lower than the 2011 harvest and occurred only in Quebec. 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 2012, approximately 50 800 salmon (about 32 500 small and 18 300 large) were caught and released (Table 4.1.3.4), representing about 57% of the total number caught (including retained fish). For Prince Edward Island in 2012, there were no recreational fishery salmon licences issued and hence no catch-and-release values to report. There is some mortality on these released fish, which is accounted for in the spawner estimates.

Recreational catch statistics for Atlantic salmon are not collected regularly in Canada and there is no mechanism in place that requires anglers to report their catch statistics, except in Quebec. The 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, except for 2011 and 2012 where there is no estimate made for release of salmon kelts. 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 30.5 t in 2012, a value similar to that reported for 2011. 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 (14.7 t), 9.4 t was considered to have occurred in inland waters and 5.4 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 1.5 t was reported in the professional and recreational fisheries in 2012, a decrease of 61% from the 2011 reported harvest of 3.8 t, and the lowest value since 1997 (Table 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 2012) 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 terminal fisheries areas in Canada were summed with those of USA to estimate total 2SW equivalent mortalities 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 14 000 2SW salmon equivalents since 1999 (Table 4.1.4.1).

In the most recent year, the harvest of cohorts destined to be 2SW salmon in terminal fisheries of North America was 64% of the total North American catch of 2SW salmon. The percentages of harvests occurring in terminal fisheries ranged from 19 to 32% during 1972 to 1990 and 61 to 89% during 1993 to 2012 (Table 4.1.4.1). Percentages increased significantly since 1992 with the reduction and closures of the Newfoundland and Labrador commercial mixed-stock fisheries.

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. However, in 2009 to 2012, there were no reports of tagged salmon from other areas in these fisheries. Also none of the salmon sampled during the Food Fishery Sampling Programme in those years were carrying a tag or mark. No tags were reported from the fishery in Saint-Pierre et Miquelon. No tagged salmon of USA origin were reported in Canadian fisheries in 2012.

Results of sampling programme for Labrador subsistence fisheries

A sampling programme of the subsistence fisheries in Labrador continued in 2012, 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 fin clip was taken for genetic analysis. Fish were also examined for the presence of external tags, brands or elastomer marks.

In 2012, a total of 420 samples were collected from the Labrador subsistence fisheries, 151 from northern Labrador (SFA 1A), 42 from Lake Melville (SFA 1B) and 227 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, 10% were 2SW, and 11% were previously spawned salmon. One fish was 3SW. The majority of salmon sampled were river ages 3 to 5 years (96%) (modal age 4). There were very few river age 1 (0.2%) or river age 2 (1.9%) salmon sampled suggesting, as in previous years (2006 to 2011), 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							
Area	Number of Samples	River Age					
		1	2	3	4	5	6
Northern Labrador (SFA 1A)	149	0.7	3.4	19.5	56.4	18.1	2.0
Lake Melville (SFA 1B)	40	0.0	5.0	15.0	67.5	12.5	0.0
Southern Labrador (SFA 2)	225	0.0	0.4	23.6	54.2	20.4	1.3
All areas	414	0.2	1.9	21.3	56.3	18.8	1.4

A collaborative project between the DFO, the Atlantic Salmon Federation, the Nunatsiavut Government and the NunatuKavut Community Council was initiated in 2011 to examine the stock composition of the subsistence catch of salmon in Labrador. This project involved collection of genetic samples from the 2011 catch and examination of scales collected in the 2006–2010 period. Samples were also collected in 2012. 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. Salmon baseline data for Newfoundland and Labrador (approximately 80 rivers) collected by DFO has been completed and will be integrated into the Canadian Atlantic salmon genetic database being produced by the collaborative research group led by Laval University. Incorporation of the USA salmon baseline into the analyses is ongoing. Standardization and integration of the regional components of the Canadian baseline are underway and once completed the analysis of fishery composition will be conducted and the project report is expected in 2013.

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

Sampling programme for Saint-Pierre et Miquelon

No sampling of the salmon catches was conducted in 2012. The Working Group had previously been informed of the results of genetic stock identification of samples collected in 2010 and 2011.

The Working Group had previously identified a number of issues with the sampling programme that if accounted for, would greatly increase the value of the data (ICES, 2011b). Future genetic analyses should use the extensive baselines of Canadian and USA salmon populations.

The Working Group welcomed the past efforts to sample the catches at Saint-Pierre et Miquelon. The 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 would address the gaps identified in the previous sampling activities (ICES, 2011b).

Recommendations for future activities

The Working Group recommends that sampling 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, exploitation rates for retained small salmon ranged from a high of 19% on Exploits River to a low of 5% on Terra Nova River. Overall, exploitation rates of small salmon in these rivers declined from 30% in 1986 to approximately 14% in 2012. In Sand Hill River, Labrador, exploitation rate on small salmon was 2.6% and no large salmon were reported as retained in 2012.

In Quebec, the 2012 total fishing exploitation rate was about 18%, similar to the average of the five previous years. Native peoples' fishing exploitation rate was 7% of the total return. Recreational fishing exploitation rate was 11% on the total run, 16% for the small and 7% for the large salmon, slightly 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 2012 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 4.1.5.1). 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 13.5% for large salmon and 15.7% 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
	Quebec	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. Assessments were reported for 74 of these rivers in 2012.

4.3.1 Smolt abundance

Canada

Wild smolt production was estimated in eleven rivers in 2012. Smolt production increased from 2011 in three rivers (range 19% to 95%), decreased in three rivers (range 34% to 44%) and remained unchanged (within +/-10%) in four rivers. There was no 2011 estimate for one of the eleven rivers. The relative smolt production, scaled to the size of the river using the conservation egg requirements, was highest in the Gulf region and lowest in the southern rivers of the Scotia-Fundy region (Figure 4.3.1.1). Significant linear declines in smolt production ($p<0.05$) have been observed in St Jean (1989–2012) and de la Trinite (1984–2012) (Quebec), whereas production has increased significantly in Western Arm Brook (Newfoundland) (1971–2012).

USA

Wild salmon smolt production has been estimated on the Narraguagus River from 1997 to 2012 (16 years) (Figure 4.3.1.1). Smolt production in 2012 was 31% less than in 2011 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, 4.3.2.2 and 4.3.2.3; and Annex 6) were originally estimated by the methods and variables developed by Rago *et al*. (1993) and reported by ICES (1993). 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 2012 to Labrador (172 800) was 36% lower than the previous year and 1% higher than the previous five year mean (170 336, Figure 4.3.2.1). The median of the estimated 2SW returns in 2012 to Labrador (22 060) was 22% lower than the previous year and 17% higher than the previous five year mean (18 846, Figure 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). In 2010 and 2012, only two of three facilities in SFA 2 were operational. 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 monitoring facilities in SFA 2. 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 2011 was used to update estimates of salmon returns in that year. The median of the estimated returns of small salmon in 2012 to Newfoundland (242 300) was approximately equal to the previous year and 4% higher than the previous five year mean (232 980, Figure 4.3.2.1). The median (3329) of the estimated 2SW returns in 2012 to Newfoundland was 9% lower than the previous year and 21% lower than the previous five year mean (4197, Figure 4.3.2.3).

Quebec

The median of the estimated returns of small salmon in 2012 to Quebec (25 240) was 34% lower than the previous year and 15% lower than the previous five year mean (29 776, Figure 4.3.2.1). The median of the estimated returns of 2SW in 2012 to Quebec (27 040) was 28% lower than the previous year and 8% lower than the previous five year mean (29 256, Figure 4.3.2.3).

Gulf of St Lawrence

The median of the estimated returns of small salmon in 2012 to the Gulf (17 670) was 77% lower than the previous year and 68% lower than the previous five year mean (55 970, Figure 4.3.2.1). The median of the estimate of 2SW returns in 2012 to the Gulf (19 260) was 67% lower than the previous year and 34% lower than the previous five year mean (29 096, Figure 4.3.2.3).

Scotia–Fundy

The median of the estimated returns of small salmon in 2012 to Scotia-Fundy (609) was 94% lower than the previous year and 94% lower than the previous five year mean (10 334, Figure 4.3.2.1). The median of the estimated 2SW returns in 2012 to Scotia-Fundy (1082) was 77% lower than the previous year and 61% lower than the previous five year mean (2753, Figure 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 (ICES, 2010b). 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 returns of small salmon in 2012 to USA (24) were 98% lower than the previous year and 96% lower than the previous five year mean (591, Figure 4.3.2.1). The estimated returns of 2SW in 2012 to USA (881) were 71% lower than the previous year and 51% lower than the previous five year mean (1782, Figure 4.3.2.3).

4.3.3 Estimates of spawning escapements

Updated estimates for small, large and 2SW spawners (1971 to 2012) were derived for the six geographic regions. 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 (21 970) was 22% lower than the previous year and 18% higher than the previous five year mean (18 642). The 2012 2SW spawners achieved 63% of the 2SW CL for Labrador (Figure 4.3.2.3). The 2SW CL has not been met during the time-series. The median of the estimated numbers of small spawners (170 700) was 37% lower than the previous year and 1% higher than the previous five year mean (168 228, Figure 4.3.2.1).

Newfoundland

Finalized angling information from 2011 was used to update estimates of salmon spawners in that year. The median of the estimated numbers of 2SW spawners in 2012 (3304) was 9% lower than the previous year and 20% lower than the previous five year mean (4125). The 2012 2SW spawners achieved 82% of the 2SW CL for Newfoundland. The 2SW CL has been met or exceeded in five out of the last ten years (Figure 4.3.2.3). The median of the estimated number of small spawners (213 800) was equal to the previous year and 4% higher than the previous five year mean (206 340, 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.

Quebec

The median of the estimated numbers of 2SW spawners (20 740) was 29% lower than the previous year and 8% lower than the previous five year mean (22 544). The 2012 2SW spawners achieved 68% of the 2SW CL for Quebec (Figure 4.3.2.3). The median of the estimated number of small spawners (18 410) was 34% lower than the previous year and 15% lower than the previous five year mean (21 590, Figure 4.3.2.1).

Gulf of St Lawrence

The median of the estimated numbers of 2SW spawners (18 570) was 67% lower than the previous year and 34% lower than the previous five year mean (28 112). The 2012 2SW spawners achieved 63% 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 (10 650) was 79% lower than the previous year and 71% lower than the previous five year mean (36 186, Figure 4.3.2.1).

Scotia–Fundy

The median of the estimated numbers of 2SW spawners (1030) was 77% lower than the previous year and 61% lower than the previous five year mean (2645). The 2012 2SW spawners achieved 4% of the 2SW CL for Scotia-Fundy (Figure 4.3.2.3). The median of the estimated number of small spawners (590) was 94% lower than the previous year and 94% lower than the previous five year mean (10 174, 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 (2056) was 47% lower than the previous year and 12% lower than the previous five year mean (2329). The 2012 2SW spawners achieved 7% of the 2SW CL for USA (Figure 4.3.2.3). The estimated number of small spawners (24) was 98% lower than the previous year and 96% lower than the previous five year mean (591, Figure 4.3.2.1).

4.3.4 Egg depositions in 2012

Egg depositions by all sea ages combined in 2012 exceeded or equalled the river-specific CLs in 31 of the 74 assessed rivers (42%) and were less than 50% of CLs in 21 rivers (28%) (Figure 4.3.4.1).

- One of the three (33%) assessed rivers in Labrador exceeded its CL.
- In Newfoundland, 43% (six of 14) of assessed rivers exceeded their CLs. Three rivers (upper Exploits River, Rocky River and Little River) were below 50% of their CLs.
- Two of the three (67%) assessed rivers in the Gulf exceeded their CLs.
- In Quebec, 53% (21 of 40) of assessed rivers exceeded their CLs. Seven rivers were below 50% of their CLs.
- One of the seven (14%) assessed rivers (North River) in Scotia-Fundy exceeded its CL. Four rivers were below 50% of CLs.
- Large deficiencies in egg depositions were noted in the USA. All seven assessed rivers were below 15% of their CLs.

4.3.5 Marine survival (return rates)

In 2012, return rate data were available from nine wild and four hatchery populations from rivers distributed among Newfoundland, Quebec, Scotia-Fundy, and USA (Tables 4.3.5.1 to 4.3.5.4). Wild return rates to 1SW fish in 2012 decreased (range 10% to 96%) relative to 2011 for eight of the nine assessed populations and increased (44%) for one population (Conne River, Newfoundland). Large (>85%) decreases were noted in 1SW return rates for the hatchery populations from 2011 to 2012.

Return rates in 2012 for wild 2SW salmon from the 2010 smolt class decreased relative to the 2009 smolt class on all the rivers (range 18% to 99%). Similarly, return rates for 2SW salmon decreased for the hatchery populations (range 35% to 94%).

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.
- 1SW and 2SW return rates in 2012 decreased relative to 2011 for all areas for both wild and hatchery populations.
- Five year average return rates for 1SW wild salmon smolts returning to rivers of Newfoundland (Nfld) in 2008 to 2012 were similar to the averages for the previous period (2003 to 2007) for three monitored rivers and increased (25% and 70%) on the other two.
- Five year average return rates for 1SW wild and hatchery salmon smolts returning to rivers of eastern North America (excluding Nfld) in 2008 to 2012 increased (range 8% to 313%) compared to the previous period (2003 to 2007) for all rivers monitored.
- Five year average return rates for 2SW wild and hatchery salmon smolts returning to rivers of eastern North America (excluding Nfld) in 2008 to 2012 increased (range 10% to 72%) compared to the previous period (2003 to 2007) for six of the seven MSW rivers monitored.

Trends based on standardized return rates from the period 1970 to 2012 (Figure 4.3.5.1) include [N.B.no trend data are provided for Gulf, since there were no return rate data available for 2012]:

- 1SW return rates of wild smolts to insular Newfoundland vary annually and have no temporal trend over the period 1970 to 2012 ($p>0.05$).
- 1SW and 2SW return rates of wild smolts to Quebec, although varying annually, have declined over the period 1983/84 to 2012 ($p<0.05$).
- 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 2012 ($p>0.05$).
- In Scotia Fundy and USA, hatchery smolt return rates to 2SW salmon have decreased over the period 1970 to 2012 ($p<0.05$). 1SW return rates for Scotia Fundy stocks 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 (3% to 10%) in 2012 were greater than those for other populations in eastern North America (0.2% to 0.6%).
- 1SW return rates in MSW salmon populations were greater than those of 2SW salmon within a smolt cohort for all monitored populations with the exception of one Quebec population (St Jean).

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, 2009a). Following on the recommendations from ICES (2008a), the run–reconstruction model for 2009 was developed using Monte Carlo simulation (OpenBUGS) similar to the approach applied for the NEAC area (Section 3.3.1). Estimates of returns and spawners to regions were provided for the time-series to 2012. The full set of data inputs and the summary output tables of catches, returns and spawners by sea age or size group are provided in Annex 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 2011. This is because pre-fishery abundance estimates for 2012 require 2SW returns to rivers in North America in 2013.

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 2012 was about 73 680 fish (95% C.I. range 57 280 to 90 500). The median estimate for 2012 is 45% lower than the previous year and 14% lower than the previous five year average (85 942). The 2012 estimate ranks 35th (descending) out of the 43 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 4.3.6.2.1. The median of the estimates of non-maturing 1SW salmon in 2011 was 116 800 fish (95% C.I. range 91 770 to 144 800). This value is 43% lower than the previous year (205 800) and 13% lower than the previous five year average (134 140). The estimated non-maturing 1SW salmon in 2011 ranks 30th (descending) out of the 41 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 2012 (458 500) was 28% lower than the previous year's estimate (640 000) and 8% lower than the previous five year mean (500 020). While there was no estimated change to the levels of 1SW returns to Newfoundland in 2012 relative to 2011, decreases in 2012 were realized in Labrador (36%), Quebec (34%), Gulf (77%), Scotia Fundy (94%) and USA (98%) relative to 2011. 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.

The reconstructed distribution of the PFA of the 1SW maturing cohort of North American origin is shown in Figure 4.3.6.2.1. The estimated PFA of the maturing component in 2012 was 483 000 fish, 28% lower than the previous year and 8% lower than the previous five year average (525 780). Maximum abundance of the maturing cohort was estimated at over 910 000 fish in 1981 and the recent estimate ranks 29th (descending) out of the 42 year time-series.

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 1971–2011 (2012 PFA requires 2SW returns in 2013) were combined to give total recruits of 1SW salmon (Figure 4.3.6.2.1). The PFA of the 1SW cohort, estimated for 2011, was 788 800 fish, 11% higher than the 2010 PFA value (711 000), 24% higher than the previous five year average (635 500). The 2011 PFA estimate ranks 22nd (descending) of the 41 year time-series. The abundance of the 1SW cohort has declined by 68% over the time-series from a peak of 1 705 000 fish in 1975.

4.3.7 Summary on status of stocks

In 2012, the midpoints of the spawner abundance estimates for all regions of NAC were below the CLs for 2SW salmon (Figure 4.3.2.3).

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 2012 declined by 28% relative to 2011 and within the range of values for this age group over the period 1990 to 2012 (Figure 4.3.6.2.1). The non-maturing 1SW PFA for 2011 decreased by 43% from 2010 and remains among the lowest in the time-series.

Large declines of 1SW, 2SW, and large salmon returns were noted in almost all areas in 2012 relative to 2011. The returns of 2SW fish in 2012 decreased from 2011 in all six geographic areas. Large declines (range 67% to 77%, and levels among the lowest of the time-series to 1971) were estimated for the three southern areas (USA, Scotia-Fundy, Gulf) and declines of 28%, 22% and 9% were estimated for Quebec, Labrador, and Newfoundland, respectively. Returns in 2012 of 1SW salmon relative to 2011 also decreased in all areas except for Newfoundland, and very large declines (range 77% to 98%) were estimated along a north to south latitude gradient from Gulf to Scotia-Fundy to USA. Returns of 1SW salmon to Newfoundland in 2012 were similar to 2011.

The rank of the estimated returns in the 1971 to 2012 time-series and the proportions of the 2SW CLs achieved in 2012 for six regions in North America are shown below:

Region	Rank of 2012 returns in 1971 to 2012, (42=LOWEST)		Rank of 2012 returns in 2003 to 2012 (10=LOWEST)		Median estimate of 2SW spawners as percentage of Conservation Limit
	1SW	2SW	1SW	2SW	(%)
Labrador	7	4	6	3	63
Newfoundland	7	31	5	9	82
Quebec	29	39	7	8	68
Gulf	42	36	10	9	63
Scotia-Fundy	42	41	10	10	4
USA	40	38	10	10	7

Egg depositions by all sea ages combined in 2012 exceeded or equalled the river-specific CLs in 45 of the 74 assessed rivers (61%) and were less than 50% of CLs in 15 other rivers (20%, 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 threatened with extirpation. In 2012, large declines in abundance from the higher abundances noted in 2011, were noted, reflecting an important mortality at sea on 1SW and 2SW salmon. The estimated PFA of 1SW non-maturing salmon ranked 30th (descending) of the 41-year time-series and the estimated PFA of 1SW maturing salmon ranked 29th (descending) of the 42-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	0.28	1.17	1.45

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	60.5	66	44

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	48	32

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 2012. The values for 2012 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	35 040	2 680	37 720	7%

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	27,629	5,759	33,388	272	1,017	1,289		2,504		5,330	7,834			0	2,126	6,174	8,300	**32,531**	**18,280**	**50,811**

Table 4.1.4.1. Reported harvests expressed as 2SW salmon equivalents in North American salmon fisheries. Only midpoints of the estimated values have been used.

	CANADA																		
	MIXED STOCK					TERMINAL FISHERIES IN (Year i)													
Year (i)	NF-LAB Comm / Food 1SW (Year i-1)	% 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 Fisheries 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	20122	0.12	153816	173938	0	430	594	27400	20260	5610	54294	345	228577	24	198063	426640	54	302400	0.76
1973	17448	0.07	219224	236671	0	1010	770	32730	15460	6211	56181	327	293179	19	148170	441350	66	377000	0.78
1974	23731	0.09	235915	259646	0	810	496	47540	18090	13040	79976	247	339869	24	186561	526430	65	449500	0.76
1975	23467	0.09	237565	261032	0	330	504	41080	14050	12510	68474	389	329895	21	154569	484463	68	416500	0.79
1976	35044	0.12	256586	291630	323	830	378	42110	16160	11120	70598	191	362742	20	194397	557139	65	431500	0.84
1977	26757	0.10	241253	268010	0	1280	781	42270	29170	13440	86941	1355	356306	25	112871	469177	76	473400	0.75
1978	26994	0.15	157309	184303	0	770	536	37430	20340	9361	68437	894	253634	27	142706	396341	64	317400	0.80
1979	13501	0.13	92066	105567	0	609	126	25240	6253	3831	36059	433	142059	26	103741	245799	58	172100	0.83
1980	20623	0.09	217186	237809	0	890	641	53570	25350	17370	97821	1533	337163	29	141844	479007	70	451800	0.75
1981	33738	0.14	201367	235105	0	520	438	44400	14625	12850	72833	1267	309205	24	120923	430128	72	365500	0.85
1982	33596	0.20	134407	168002	0	620	396	35300	20780	8927	66023	1413	235438	29	161183	396621	59	291200	0.81
1983	25254	0.18	111601	136855	323	428	423	34440	17330	12270	64891	386	202455	32	145870	348325	58	237200	0.85
1984	19052	0.19	82808	101860	323	510	183	24820	3560	3960	33033	675	135891	25	26837	162729	84	204900	0.66
1985	14340	0.15	78761	93101	323	294	15	27820	990	5060	34179	645	128248	27	32431	160679	80	218100	0.59
1986	19601	0.16	104905	124506	269	467	34	34220	1650	2940	39311	606	164692	24	99140	263832	62	273300	0.60
1987	24801	0.16	132175	156975	215	640	16	34220	2000	1440	38316	300	195807	20	123511	319318	61	267200	0.73
1988	31578	0.28	81139	112717	215	710	18	34630	1370	1460	38188	248	151368	25	123799	275167	55	222300	0.68
1989	21910	0.21	81362	103272	215	461	4	29320	1230	330	31345	397	135229	23	84905	220134	61	201400	0.67
1990	19289	0.25	57363	76652	205	357	22	28430	1100	660	30569	695	108121	29	43646	151767	71	181500	0.60
1991	11842	0.23	40438	52280	129	93	12	29650	830	1380	31965	231	84605	38	52223	136828	62	154500	0.55
1992	9851	0.28	25105	34957	248	782	0	30480	1180	1150	33592	167	68963	49	79585	148548	46	152300	0.45
1993	3110	0.19	13276	16385	312	387	0	23540	560	1158	25645	166	42509	61	29807	72315	59	126800	0.34
1994	2077	0.15	11936	14014	366	490	0	24580	710	777	26557	2	40939	65	1890	42829	96	112300	0.36
1995	1183	0.12	8678	9861	86	460	0	23700	530	365	25055	0	35002	72	1890	36892	95	139900	0.25
1996	1033	0.15	5646	6679	172	380	0	22690	860	819	24749	0	31600	78	19181	50781	62	120200	0.26
1997	943	0.15	5391	6334	161	210	0	18620	820	600	20250	0	26745	76	19332	46077	58	98300	0.27
1998	1131	0.39	1761	2892	248	203	0	11280	490	331	12304	0	15444	80	13048	28492	54	68110	0.23
1999	175	0.17	842	1017	250	270	0	9190	790	460	10710	0	11977	89	4322	16299	73	71090	0.17
2000	151	0.13	1050	1201	244	260	0	8890	600	200	9950	0	11395	87	6444	17838	64	72820	0.16
2001	285	0.18	1336	1621	232	320	0	9660	930	264	11174	0	13027	86	5933	18960	69	83970	0.16
2002	261	0.20	1078	1340	210	200	0	6200	540	183	7123	0	8673	82	8606	17279	50	53640	0.16
2003	310	0.16	1689	1998	311	233	0	8510	820	207	9770	0	12080	81	3224	15303	79	81320	0.15
2004	352	0.11	2870	3222	300	270	0	8410	850	116	9646	0	13167	73	3475	16642	79	79290	0.17
2005	465	0.18	2187	2652	354	280	0	7460	960	107	8807	0	11813	75	4338	16151	73	80690	0.15
2006	560	0.19	2399	2959	383	220	0	7140	820	151	8331	0	11673	71	4181	15853	74	76940	0.15
2007	560	0.21	2059	2619	210	230	0	6700	860	109	7899	0	10728	74	4935	15662	68	72220	0.15
2008	496	0.14	3035	3531	381	230	0	6470	850	0	7550	0	11462	66	6616	18078	63	78870	0.15
2009	540	0.17	2596	3136	372	220	0	6510	890	0	7620	0	11129	68	7549	18678	60	92060	0.12
2010	441	0.13	2892	3333	299	198	0	5870	830	0	6898	0	10530	66	6671	17201	61	72840	0.14
2011	540	0.14	3453	3993	404	140	0	8010	1490	0	9640	0	14038	69	8764	22801	62	143000	0.10
2012	613	0.16	3284	3897	156	90	0	6300	690	0	7080	0	11133	64	6331	17464	64	79470	0.14
2013	552																		

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

NF-Lab comm as 1SW = NC1(mid-pt) * 0.677057 (M of 0.03 per month for 13 months to July for Canadian terminal fisheries)

NF-Lab comm as 2SW = NC2 (mid-pt) * 0.970446 (M of 0.03 per month for 1 month to July of Canadian terminal fisheries)

Terminal fisheries = 2SW returns (mid-pt) - 2SW spawners (mid-pt) (excludes Saint-Pierre and Miquelon and NF-Lab Comm fisheries)

a - starting in 1998, there was no commercial fishery in Labrador; numbers reflect size of aboriginal fish harvest in 1998-2012 and resident food fishery harvest in 2000-2012

Table 4.3.1.1. Estimated smolt production by smolt migration year in monitored rivers of eastern North America, 1991 to 2012.

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	2170	12 500		16 215				2 165 000	636 600	108 600
2011	1404	8 750					768 000		792 000	275 178
2012	969	11 060							842 000	155 012

Table 4.3.1.1 (continued). Estimated smolt production by smolt migration year in monitored rivers of eastern North America, 1991 to 2012.

Smolt Migration Year	Quebec		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	
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

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 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				QUEBEC				NFLD					
	Narraguagus	**Nashwaak**	**LaHave**	**St.Mary's**	**Margaree**	**NWMiramichi**	**SW Miramcihi**	**Miramichi**	**à la barbe**	**Saint Jean**	**Bec scie**	**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

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 2010. 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				Quebec				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													

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 2011. 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				Quebec
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								

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 2010. 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				QUEBEC
	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												

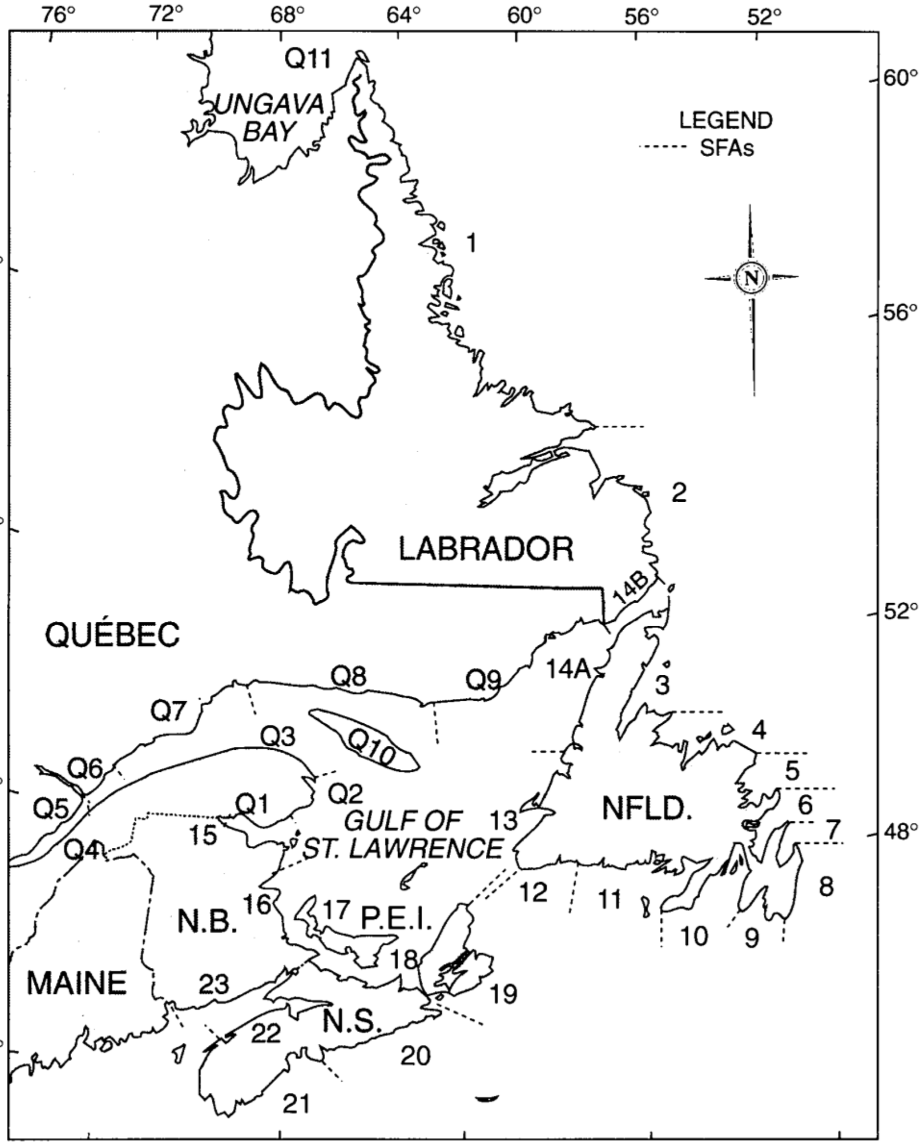


Figure 4.1.2.1. Map of Salmon Fishing Areas (SFAs) and Quebec Management Zones (Qs) in Canada.

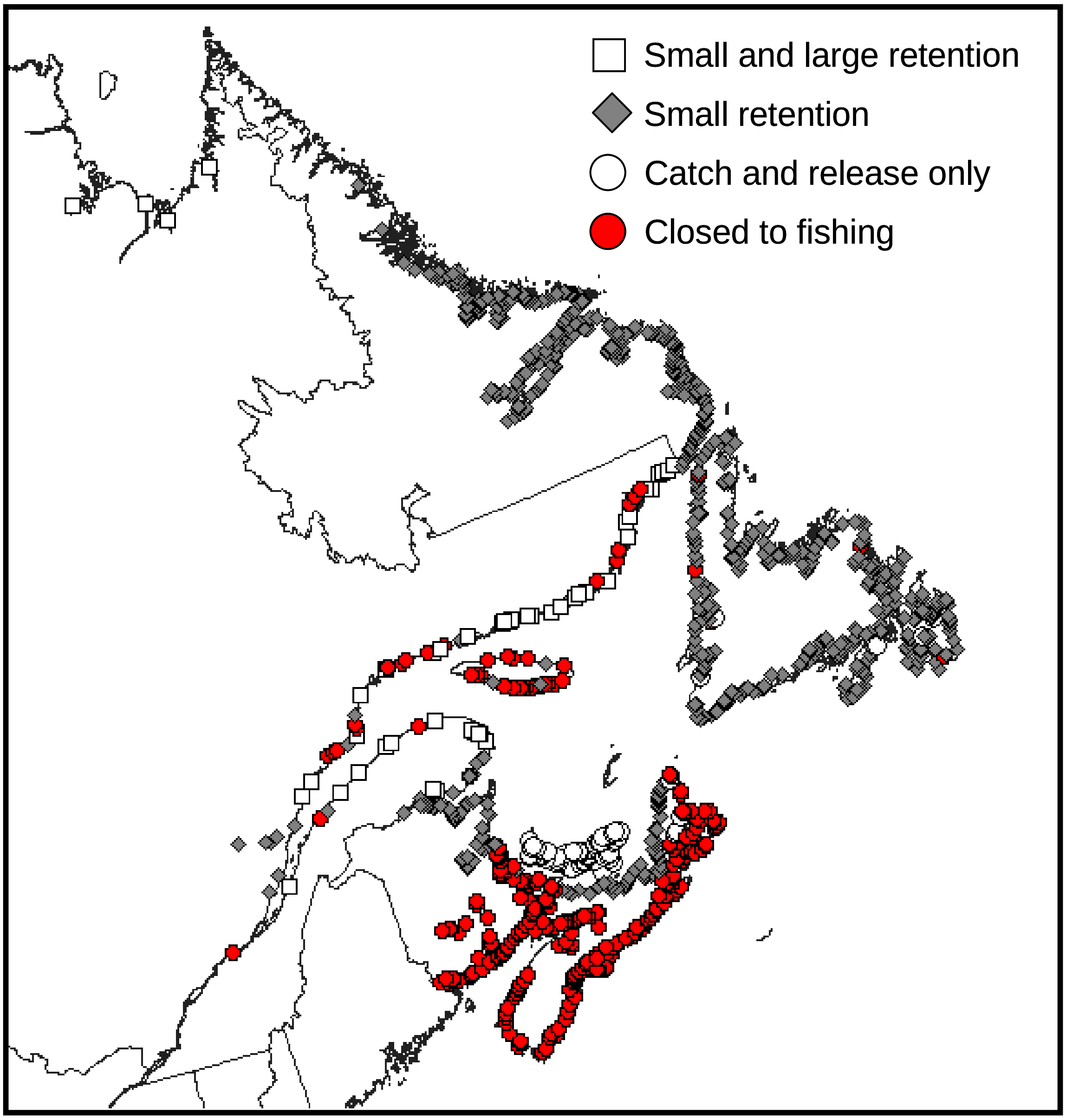


Figure 4.1.2.2. Summary of recreational fisheries management measures in Canada in 2012.

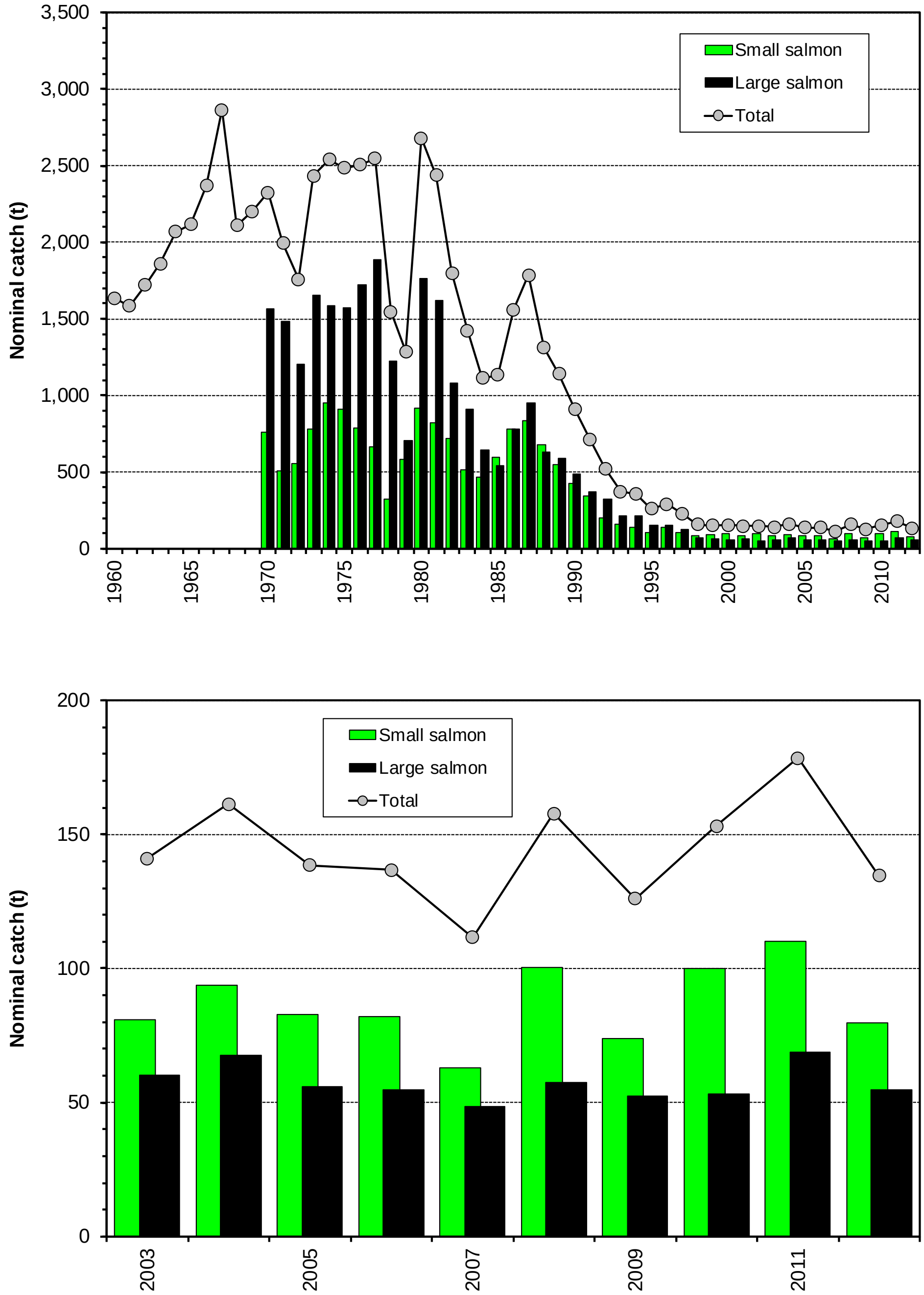


Figure 4.1.3.1. Harvest (t) of small salmon, large salmon and both sizes combined for Canada, 1960 to 2012 (top panel) and 2003 to 2012 (bottom panel) by all users.

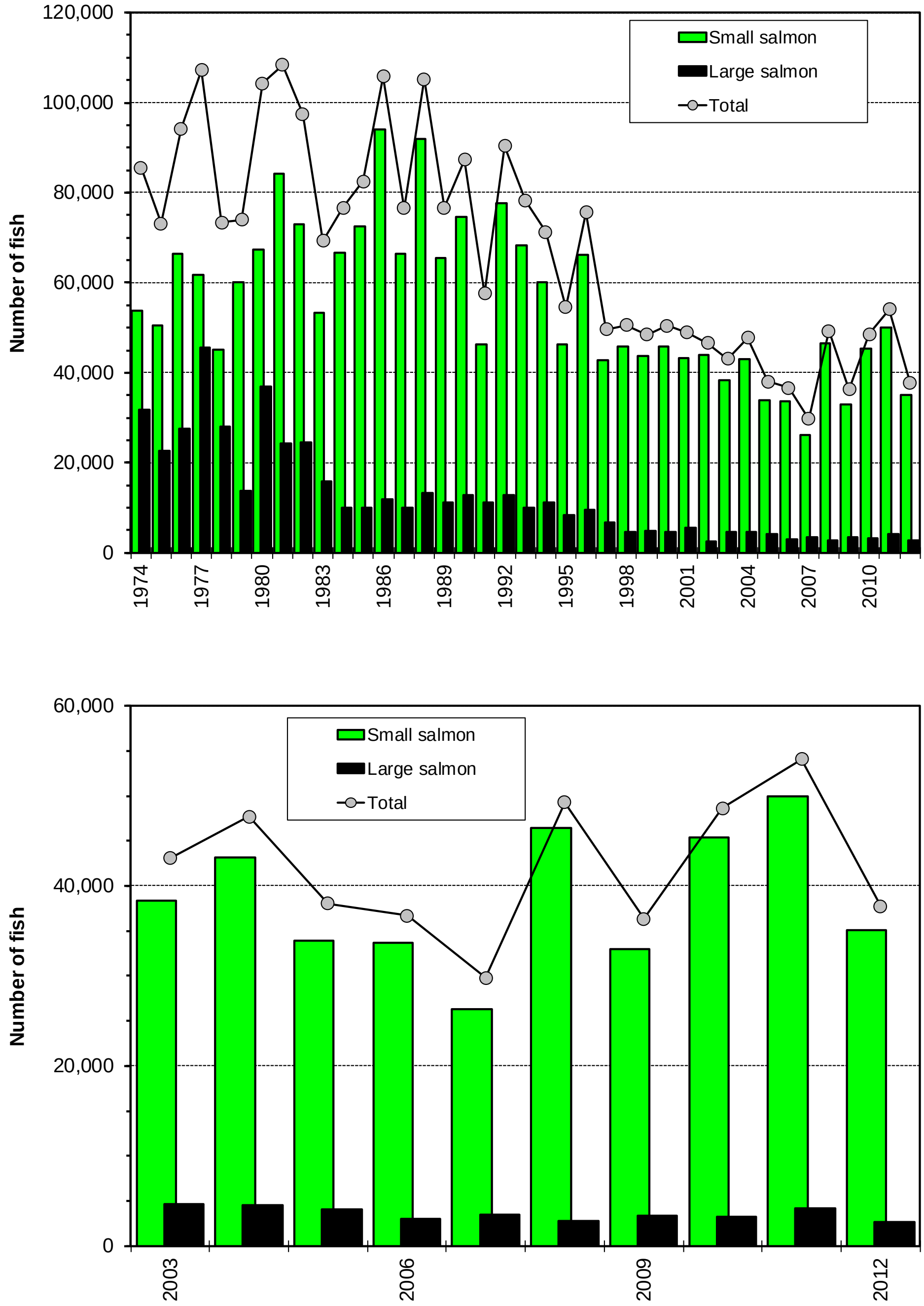


Figure 4.1.3.2. Harvest (number) of small salmon, large salmon and both sizes combined in the recreational fisheries of Canada, 1974 to 2012 (top panel) and 2003 to 2012 (bottom panel).

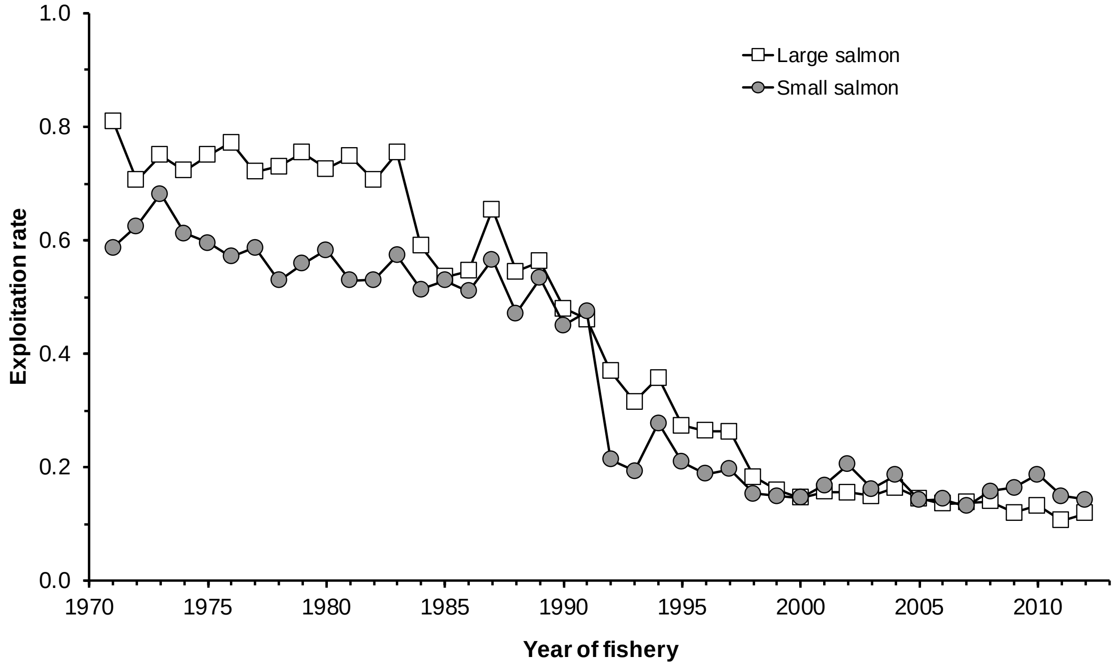


Figure 4.1.5.1. Exploitation rates in North America on the North American stock complex of small and large salmon, 1971 to 2012.

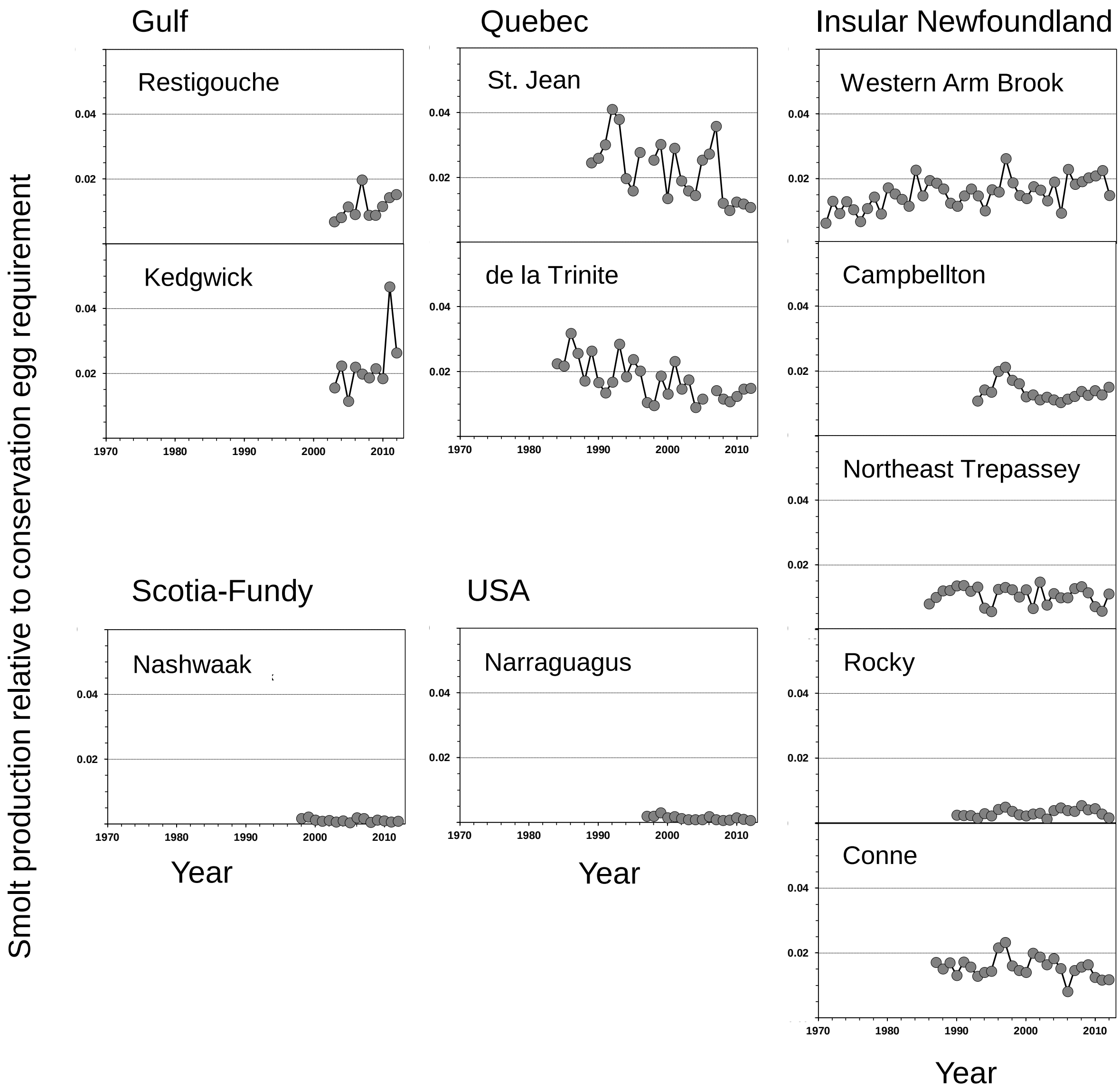


Figure 4.3.1.1 Time-series of wild smolt production from ten monitored rivers in eastern Canada and one river in eastern USA, 1970 to 2012. Smolt production is expressed as a proportion of the conservation egg requirements for the river.

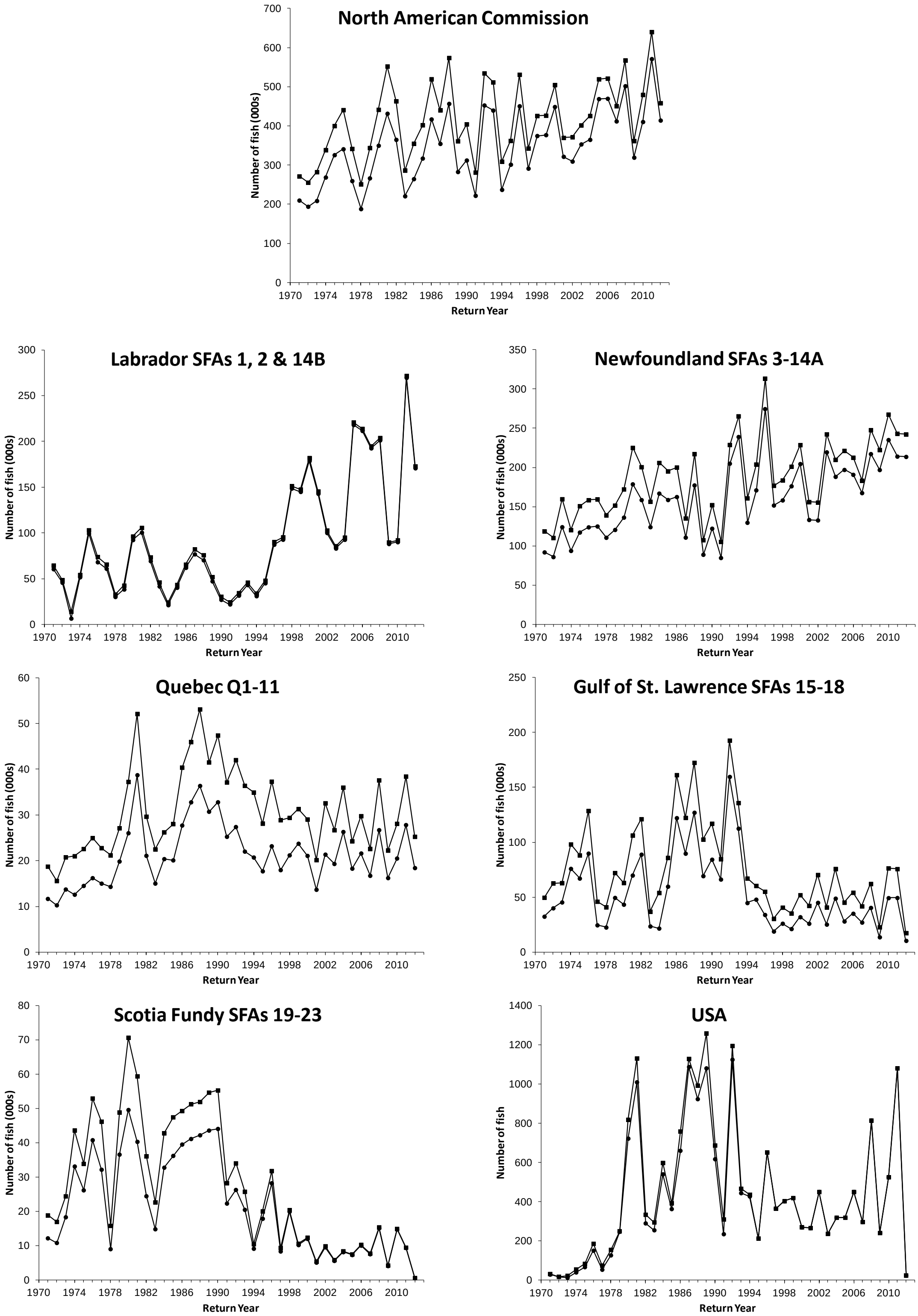


Figure 4.3.2.1. Comparison of estimated medians of small returns (squares) to and small spawners (circles) in six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Note the difference in scale for USA.

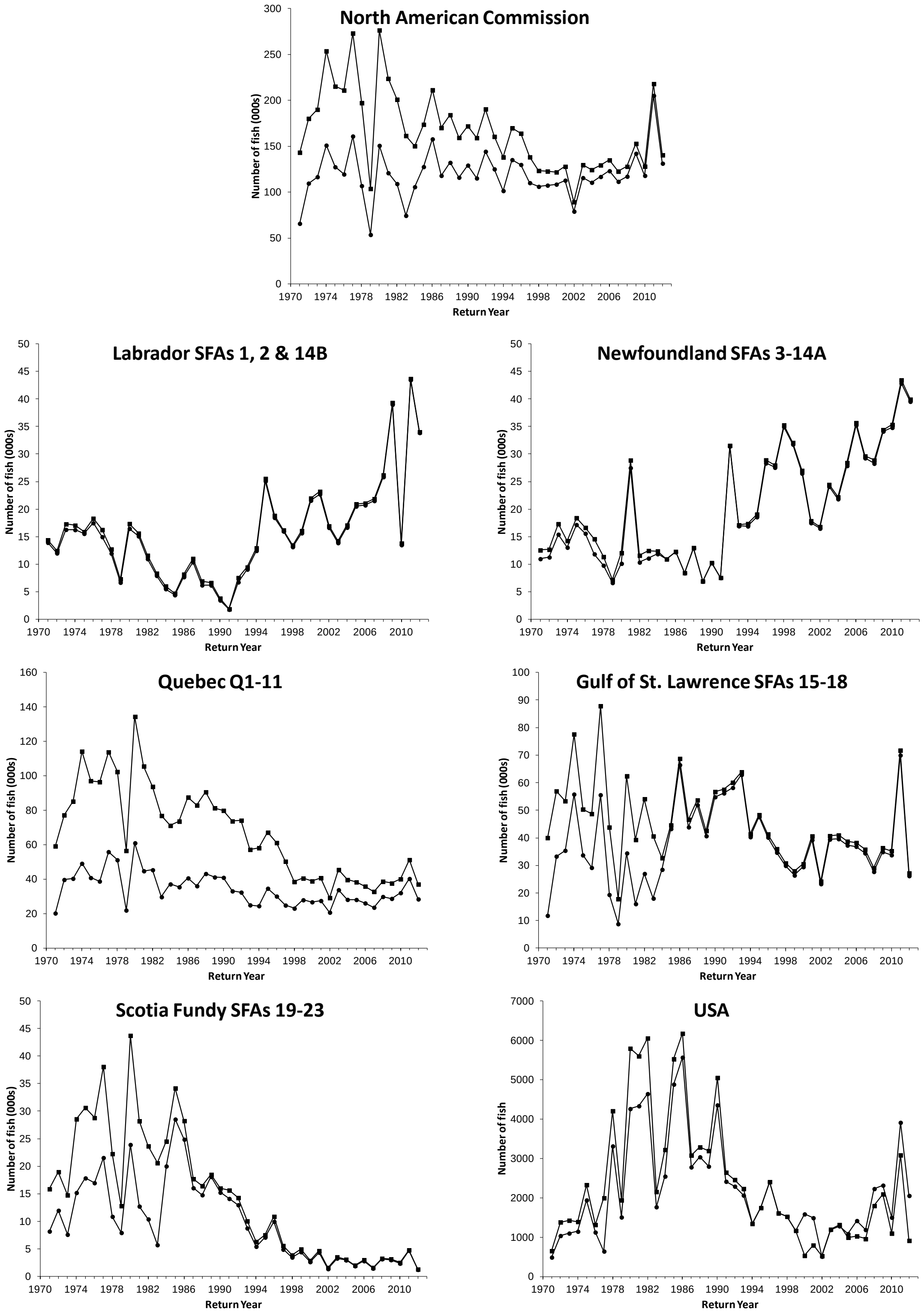


Figure 4.3.2.2. Comparison of estimated medians of large returns (squares) to and large spawners (circles) in six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. For USA estimated spawners exceed the estimated returns due to adult stocking restoration efforts. Also note the difference in scale for USA.

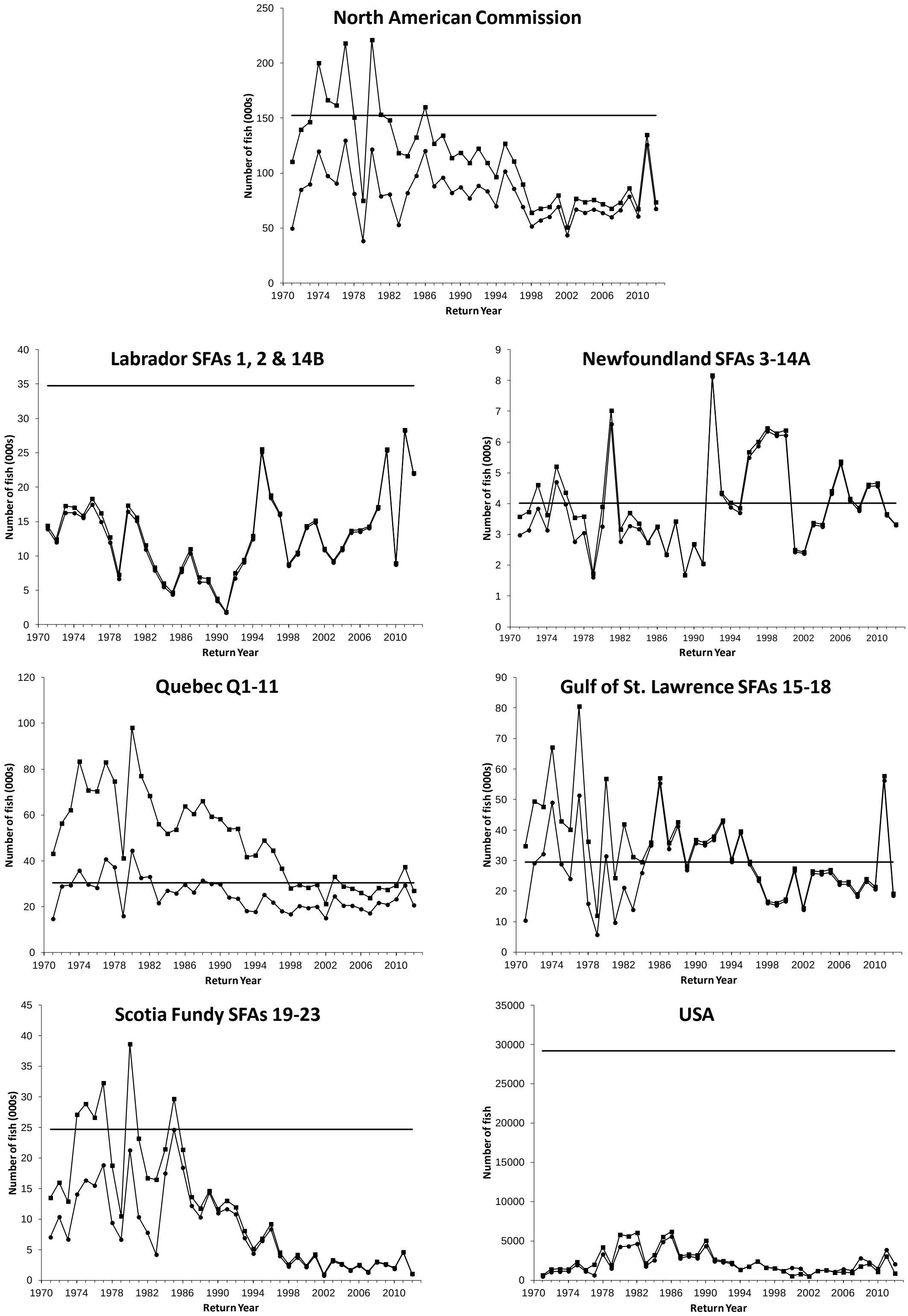


Figure 4.3.2.3. Comparison of the 2SW conservation limits to the estimated medians of 2SW returns (squares) and 2SW spawners (circles) in six geographic areas of North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. For USA estimated spawners exceed the estimated returns due to adult stocking restoration efforts. Also note the difference in scale for USA.

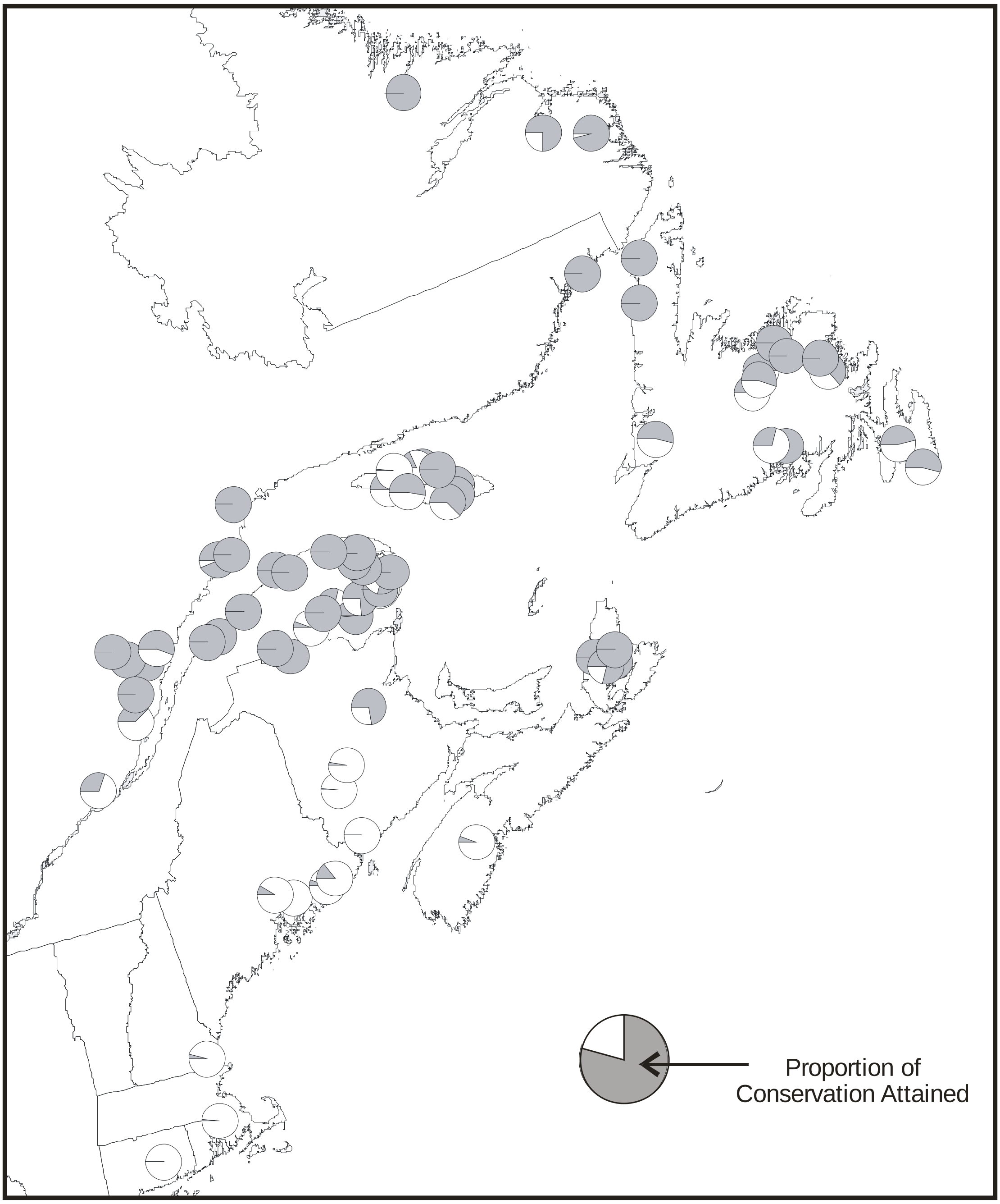


Figure 4.3.4.1. Proportion of the conservation requirement attained in the 74 assessed rivers of the North American Commission area in 2012.

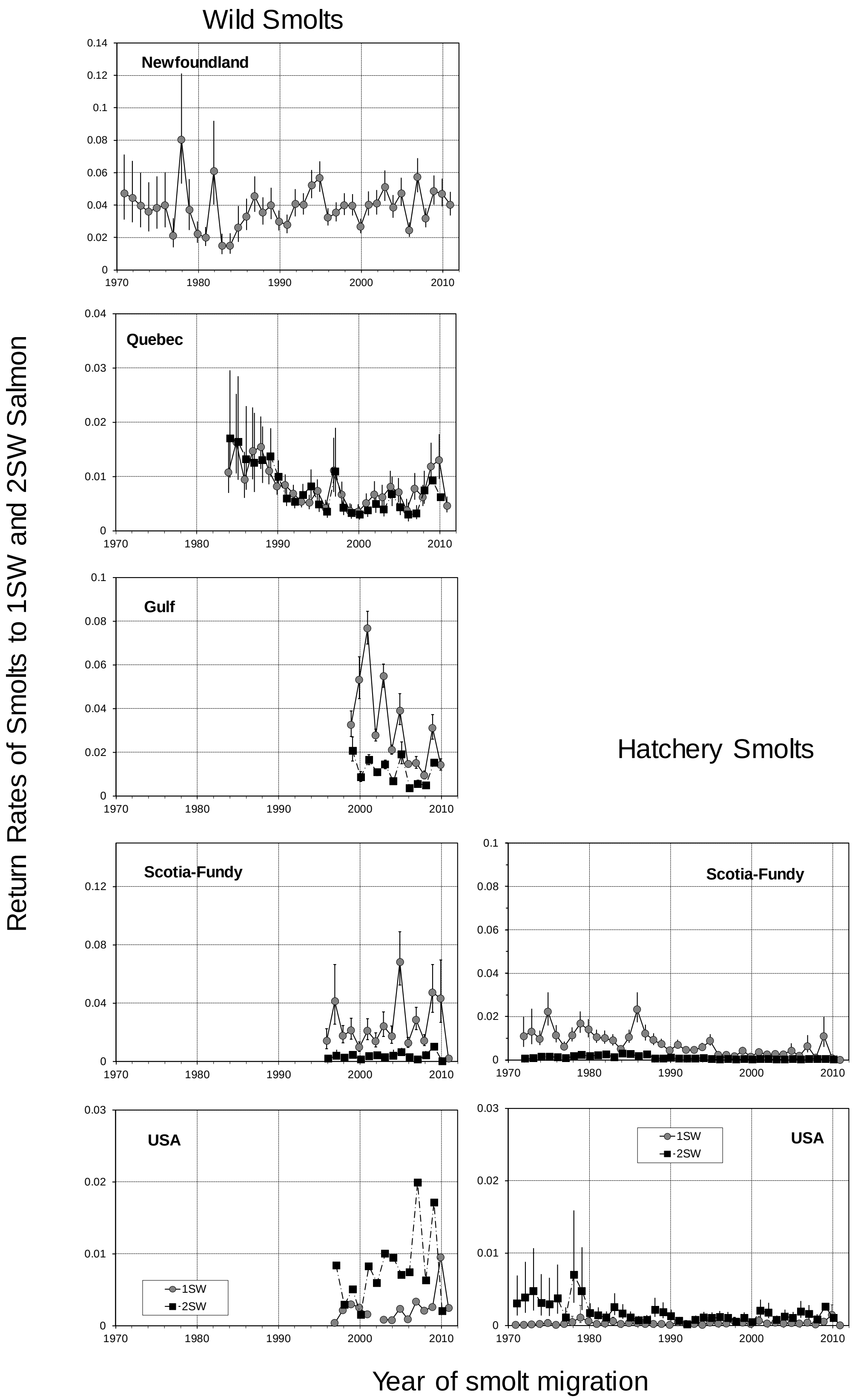


Figure 4.3.5.1. Standardized mean (one standard error bars) annual return rates of wild and hatchery origin smolts to 1SW and 2SW salmon to the geographic areas of North America. The standardized values are annual means derived from a general linear model analysis of rivers in a region. Survival rates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

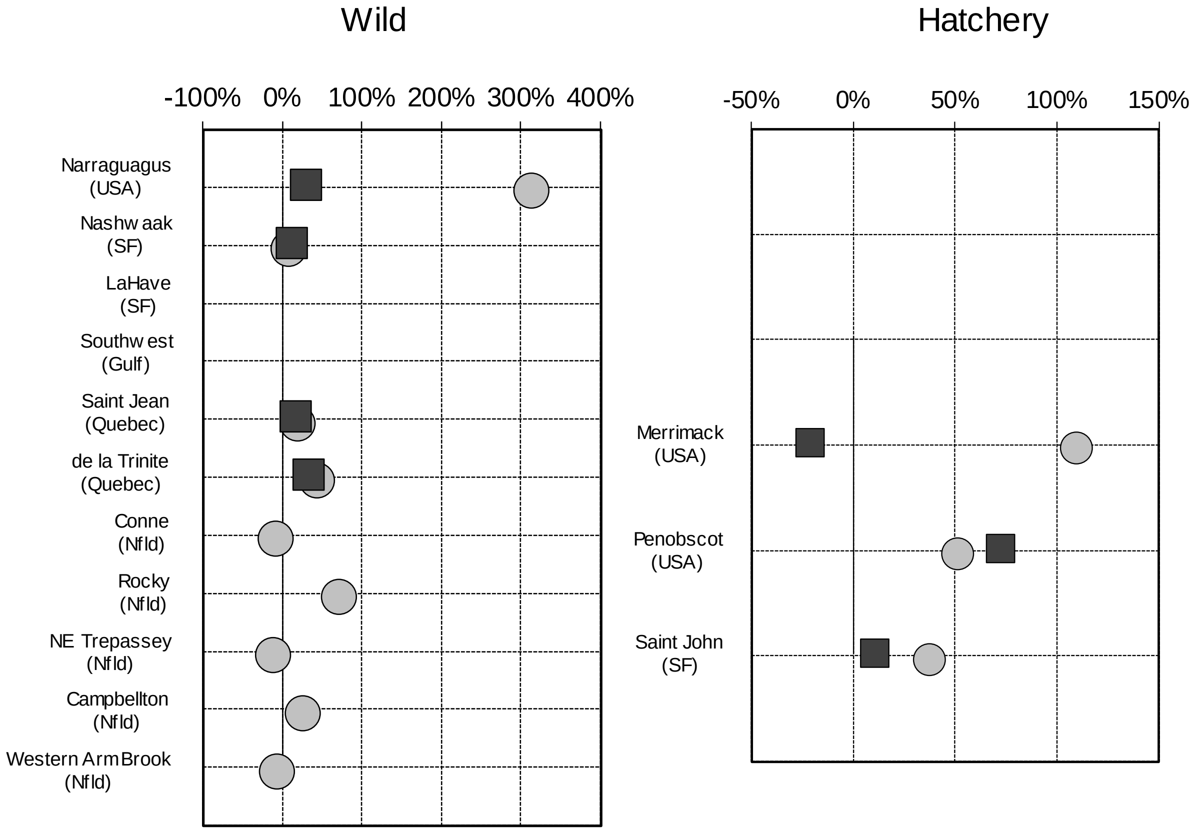


Figure 4.3.5.2. The percent change in the five-year mean return rates for 1SW and 2SW salmon smolts returning to rivers of eastern North America in 2008 to 2012 compared to the previous period (2003 to 2007). Grey circles are for 1SW and dark squares are for 2SW dataseries. Populations with at least three datapoints in each of the two time periods are included in the analysis.

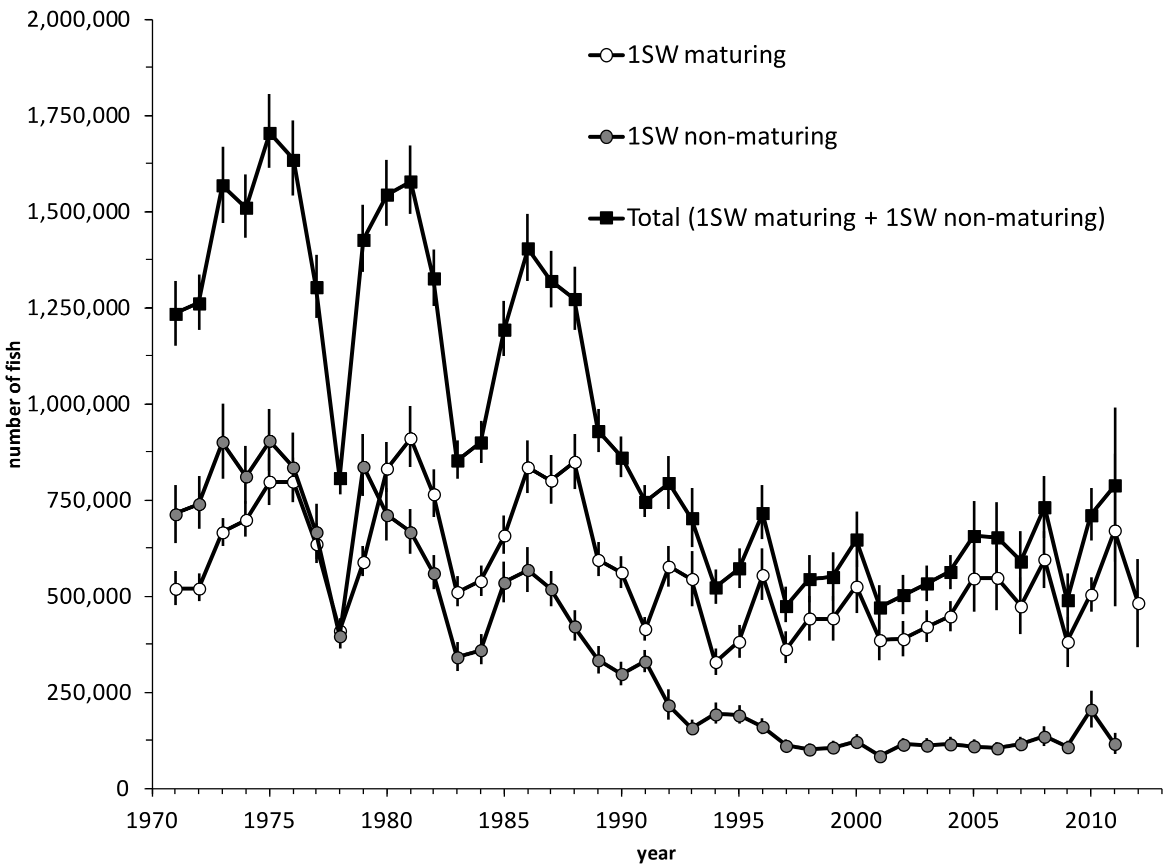


Figure 4.3.6.2.1. Estimates of PFA for 1SW maturing salmon, 1SW non-maturing salmon and the total cohort of 1SW salmon based on the Monte Carlo simulations of the run-reconstruction model for NAC. Median and 95% CI interval ranges derived from Monte Carlo simulations are shown.

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 2013 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 2012 fishery and status of the stocks

5.1.1 Catch and effort in 2012

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 2011 PFA years (Figure 5.1.1.1). The most recent estimate of exploitation available is for the 2011 fishery as the 2012 exploitation rate estimates are dependent on the 2013 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 2011 NAC exploitation rate was 7.5% and is an increase from the previous year's estimate (5.9%), is approximate to the previous five-year mean (7.3%), and remains among the lowest in the time-series. NAC exploitation rate peaked in 1971 at 38.6%. The 2011 NEAC exploitation rate was 0.1% and is a decrease from the previous year's estimate (0.5%), is below the previous five-year mean (0.5%), and also remains among the lowest in the time-series. NEAC exploitation rate peaked in 1975 at 28.8%.

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 regulations is that fishermen 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. 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 2012 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 5.1.1.2). In 2012, 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 5.1.1.3). A total catch of 33.1 t of salmon was reported for the 2012 fishery compared to 27.5 t of salmon in the 2011 fishery, an increase of 20% from 2011. A harvest of 0.5 t was reported from East Greenland in 2012, accounting for approximately 1.4% of the total reported catch at Greenland. Harvest reported for east Greenland is not included in assessments of the contributing stock complexes.

With the closure of the commercial fishery since 1998, with the exception of 2001, the export of Atlantic salmon has been banned. From 2002 to 2011, licensed fishermen have been allowed to sell salmon to hotels, institutions and local markets only. In 2012 licensed fishermen were also allowed to land to factories, although the export ban persisted and the landed salmon could only be sold within Greenland.

Reported landings to factories in 2012 occurred in four communities (three communities in NAFO Division 1C and one in NAFO Division 1D) and amounted to 13.7 t. If landings to factories continue in future years, there may be a possibility to place samplers in the 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. 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 2013.

ICES (2012a) previously identified issues with underreporting of harvest data and it is unclear if the initiation of factory landings and reporting will improve or reduce the accuracy of these data. Landings reported through more centralized sources may help increase the accuracy of the reported landings or over-reporting of landings may occur if fisherman and the factory both make reports.

It is unclear what effect the new landings option had on the effort and total harvest at Greenland. In 2012, a total of 40 fishermen provided 216 reports for a total reported harvest of 19.5 t in the four communities where landings to factories were reported (3.2, 2.7 and 13.7 t for commercial, private and factory landings respectively). In 2011, when there were no landings to factories in these same communities, there were 35 fishermen who provided 151 reports for a total reported harvest of 13.3 t. This represents an increase in five fishermen, 65 reports and 5.8 t of landings from 2011 vs. 2012. Additionally, two of the communities that reported factory landings in 2012 had a total of 20 salmon reported in 2011. However, 15 t of landings were reported for Division 1C, of which 12 t were landings to factories. This is the highest reported landings for Division 1C since 1997. The increase in reported landings could be due to increased effort, catch per unit of effort or reporting rates.

There is currently no quantitative approach for estimating the unreported catch but the 2012 value is likely to have been at the same level proposed in recent years (10 t).

Of the total catch, 14.1 t was reported as being for private consumption, 5.5 t as commercial and 13.7 t as factory landings. However, 9.9 t of the private consumption catch was reported by licensed fishers.

In recent years there seems to have been almost no transport of salmon from the settlements to the cities and instead, the fisheries have been conducted in close proximity to the cities. Additionally, commercial catches are highest in the cities and lowest around settlements where the private fishery is more prevalent. This dynamic may change if landings to factories continue and salmon are shipped from processing plants to various communities for sale.

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 reveals that a large number of fishers report their total catch in only one report for the entire season.

The Greenland Authorities received 553 reports of salmon catches from 122 fishers in 2012 compared to 394 reports from 117 fishers in 2011 (Table 5.1.1.3). The number of fishers was similar although the number of reports increased significantly. 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 as well as the catches in each of the NAFO Divisions 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 2011 will help to improve the quality of the reported catch statistics.

The logbook instructions requested that fishers provide more detailed information related to their salmon fishing activities than required under their licence conditions. Logbooks were only provided to fishers holding commercial licences, and not to private fishers. The data requested were:

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

It was noted that factory landing reports contain similar information to that requested in the 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. More detailed information on the nature and extent of the fishery will allow for better management of this resource. Catch per unit of effort (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.

5.1.2 Biological characteristics of the catches

The international sampling programme for the fishery at West Greenland agreed by the parties at NASCO continued in 2012. The sampling was undertaken by participants from Canada, Ireland, UK(Scotland), UK(England&Wales), and USA. Sampling began in August and continued through October. Additionally, staff from the Greenland Institute of Natural Resources assisted with coordination of the programme.

Samplers were stationed in three different communities (Figure 5.1.1.3) 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. In this Baseline Sampling Programme, tissue and biological samples were collected.

In total 1378 individual salmon were sampled representing ~14% by weight of the reported landings. Of these, 1372 fork lengths were measured (Table 5.1.2.1). Scale samples were taken from 1371 salmon for age determination and 1373 tissue samples were collected for DNA analysis and continent of origin assignment.

A total of 17 adipose finclipped fish were recovered, but none of these carried tags. However, a total of six tags were recovered during the fishing season: no tags were recovered by the sampling programme and all six tags were returned directly to the Nature Institute. Five tags came from Canadian origin fish: four from incoming 'bright' adult salmon tagged and released in the Mirimachi River (Gulf Region) in 2011 and one from an outmigrating kelt tagged and released on the Campbellton River (Newfoundland) in 2012. One tag came from Sweden: a smolt tagged and released in 2011.

In all years since 2002, except for 2006 and in 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 weight 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. The time-series of reported landings and subsequent adjusted landings for 2002–2012 are presented in Table 5.1.2.2. The 2012 adjusted landings represented a 2 t increased over the reported landings.

As reported previously (ICES, 2012a), access to fish in support of the Baseline Sampling Programme in Nuuk has been compromised. No solution to this issue was reached prior to the 2012 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 severe practical problems for the sampling teams. Despite these constraints, the sampling programme successfully sampled the Greenland catch, both temporally and spatially. The need to obtain samples from fish landed in Nuuk, should be reiterated. Nuuk accounted for 13% of the adjusted landings in 2012, 29% in 2011 and 19% for the period 2003–2012 (range 12–29%). Not being able to sample fish landed 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 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.

The mean length and whole weight of North American 1SW salmon was 65.5 cm and 3.34 kg weight and the means for European 1SW salmon were 64.9 cm and 3.38 kg (Table 5.1.2.3). The North American and European 1SW whole weight estimates increased slightly from 2011 values and are greater than the ten year mean. The North

American 1SW fork length remained approximately the same as the 2011 estimate and was greater than the ten year mean. The European 1SW fork length remained approximately the same as the 2011 value and the ten year mean.

Over the period of sampling (1969 to 2012) the mean weight 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 previously examined the changing weights and condition factors of 1SW non-maturing salmon at West Greenland (ICES, 2011b). The analysis of condition of salmon over the period 2002 to 2010 (time period of data available) contrasts with the interpretation of salmon size at West Greenland based entirely on weights or lengths unadjusted for the period of sampling or for the length of the fish (ICES, 2011b). With few exceptions, there was no apparent change in condition of 1SW non-maturing salmon at West Greenland. The trend in increasing weights from the samples can be attributed to both increasing length and variations in sampling period.

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 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 2014 Working Group meeting.

North American salmon up to river age six years were sampled from the fishery at West Greenland (Table 5.1.2.4), comprised predominantly of two year old (29.8%), three year old (39.4%) and four year old (23.3%) smolts. The river ages of European salmon ranged from one to four years (Table 5.1.2.5). Of these, 9.3% were river age one, 63.0% were river age two, and 24.0% were river age three.

As expected, the 1SW age group dominated the 2012 sample collection for both the North American and European origin fish (93.2% and 98.0% respectively, Table 5.1.2.6).

As part of the sampling programme sex was determined by gonadal examination of only 16 salmon. They were comprised of 25.0% males and 75.0% females.

5.1.3 Continent of origin of catches at West Greenland

A total of 1373 samples were collected from salmon from three communities representing three NAFO Divisions: Sisimiut (1B, n=464), Maniitsoq (1C, n=585), and Qaqortoq (1F, n=324). DNA isolation and the subsequent microsatellite analysis were 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. In total, 81.6% of the salmon sampled were 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 recent 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 reported harvest from ICES Area XIV) are provided in Table 5.1.3.2 and Figure 5.1.3.2. Approximately 7800 (~27.2 t) North American origin fish and approximately 2100 (~7.3 t) European origin fish were harvested in 2012. These remain among the lowest in the time-series, but the second highest in the past ten years (2003–2012).

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

Six out of the seven stock complexes exploited at West Greenland are below conservation limits. In European and North American areas, the overall abundance of stocks contributing to the West Greenland fishery has recently increased, however the abundance of salmon within the West Greenland area 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 in all six regions (Figure 4.3.2.3) in 2012. Within each of the geographic areas there are varying numbers of 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 4.1.5.1) from approximately 68% in 1973 to 14.3% in 2012 for 1SW salmon and over 84% in 1981 to 11.9% in 2012 for 2SW salmon. The 2012 exploitation rates on 1SW and 2SW salmon both remained close to the 2011 estimates (14.9% and 10.6% 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. All four stock complexes (Northern NEAC 1SW and MSW and Southern NEAC 1SW and MSW) were considered to be at full reproductive capacity prior to the commencement of distant-water fisheries, in the latest available PFA year (2011) (Figure 3.3.5.1). However, at a country level, stocks from several jurisdictions were 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). Exploitation rates on these four stock complexes (Northern NEAC 1SW and MSW and Southern NEAC MSW) are shown in Figures 3.1.9.1 and 3.1.9.2. Exploitation rates on 1SW salmon in the Northern and Southern NEAC areas were 40% and 12% in 2012; both representing declines from the previous five year averages (41% and 15% respectively). Exploitation rates on MSW salmon in the Northern and Southern NEAC areas were 44% and 11% in 2012; both representing declines from the previous five year averages (49% and 13% respectively). These current estimates for both stock complexes are at or among the lowest in the time-series.

Table 5.1.1.1. Nominal catches of salmon at West Greenland since 1971 (metric tons round fresh weight).

Year	Total	Quota	Comments
1971	2689	-	
1972	2113	1100	
1973	2341	1100	
1974	1917	1191	
1975	2030	1191	
1976	1175	1191	
1977	1420	1191	
1978	984	1191	
1979	1395	1191	
1980	1194	1191	
1981	1264	1265	Quota set to a specific opening date for the fishery
1982	1077	1253	Quota set to a specific opening date for the fishery
1983	310	1191	
1984	297	870	
1985	864	852	
1986	960	909	
1987	966	935	
1988	893	840	Quota for 1988-90 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	900	
1990	274	924	
1991	472	840	
1992	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	77	Quota advised by NASCO
1996	92	174	Quota set by Greenland authorities
1997	58	57	Private (non-commercial) catches to be reported from now
1998	11	20	Fishery restricted to catches used for internal consumption in Greenland
1999	19	20	
2000	21	20	
2001	43	114	Final quota calculated according to the ad hoc management system
2002	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		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		same as previous year

Year	Total	Quota	Comments
2005	15		same as previous year
2006	22		Quota set to nil (no factory landing allowed) and fishery restricted to catches used for internal consumption in Greenland
2007	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		same as previous year
2009	26		same as previous year
2010	40		same as previous year
2011	28		same as previous year
2012	33		Quota set to nil (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

Table 5.1.1.2. Distribution of nominal catches (metric tons) by Greenland vessels since 1977. NAFO Division is represented by 1A–1F.

Year	1A	1B	1C	1D	1E	1F	Unk.	West Greenland	East Greenland	Total
1977	201	393	336	207	237	46	-	1 420	6	1426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1 395	+	1395
1980	52	275	404	231	158	74	-	1 194	+	1194
1981	105	403	348	203	153	32	20	1 264	+	1264
1982	111	330	239	136	167	76	18	1 077	+	1077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993 [1]	-	-	-	-	-	-	-	-	-	-
1994 [1]	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19
2000	+	+	1	7	+	13	-	21	-	21
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9
2004	3	1	4	2	3	2	-	15	-	15
2005 *	1	3	2	1	3	5	-	15	-	15
2006 *	6	2	3	4	2	4	-	22	-	22
2007 *	2	5	6	4	5	2	-	25	-	25
2008 *	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	26.4
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

[1] The fishery was suspended.

+ Small catches <5 t.

- No catch.

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

Table 5.1.1.3. Number of people (licensed and unlicensed) reporting catches of Atlantic salmon in the Greenland fishery and the total number of licences issued by NAFO (1A-1F)/ICES Divisions. Reports received by fish plants prior to 1997 and to the Licence Office from 1998 to present.

Year	1A	1B	1C	1D	1E	1F	ICES	Unk.	Licences	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	2	7	13	15	6	37		0	452	76
2002	1	1	9	13	9	8		0	479	41
2003	11	1	4	4	12	10		0	150	42
2004	20	2	8	4	20	12		0	155	66
2005	11	7	17	5	17	18		0	185	75
2006	43	14	17	20	17	30		0	159	141
2007	29	12	26	10	33	22		0	260	132
2008	44	8	41	10	16	24		0	260	143
2009	19	11	35	15	25	31	9	0	294	145
2010	86	17	19	16	30	27	13	0	309	208
2011	25	9	20	15	20	23	5	0	234	117
2012	35	9	32	8	16	16	6	0	279	122

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	

[1] CI - confidence interval calculated by method of Pella and Robertson (1979) for 1984-86 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	14991	4564	3993	2951	32 636
	Adjusted		2001				3694	34 596

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

	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
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	65.5	64.9	75.9	70.4	72.8	68.9
10-yr mean	3.16	3.17	7.11	5.60	4.54	4.11	3.26	3.28	3.26	65.0	64.9	82.6	77.6	74.2	72.5
Overall mean	2.85	3.17	6.61	6.24	4.10	4.70	3.00	3.25	3.12	63.3	65.3	81.9	81.2	71.8	75.9

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 2001 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
10-yr mean	1.6	25.4	43.9	22.0	6.5	0.7	0.0	0.0
Overall Mean	2.6	31.6	39.6	18.3	6.7	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 2001 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	18.3	54.9	25.4	1.4	0	0	0	0
2012	9.3	63.0	24.0	3.7	0	0	0	0
10-yr mean	13.9	58.6	23.4	3.7	0.4	0.0	0.0	0.0
Overall Mean	17.6	60.9	18.5	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

Table 5.1.3.1. The number of samples and continent of origin of Atlantic salmon by NAFO Division sampled at West Greenland in 2012. NA = North America, E = Europe.

		Numbers			Percentages	
NAFO Div	Sample dates	NA	E	Totals	NA	E
1B	September 3–October 1	442	22	464	95.3	4.7
1C	September 21–October 7	431	154	585	73.7	26.3
1F	August 28–September 19	248	76	324	76.5	23.5
Total		1121	252	1373	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.

	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	90	10	7000	800
2010	81	19	10 000	2600
2011	91	9	6800	600
2012	79	21	7800	2100

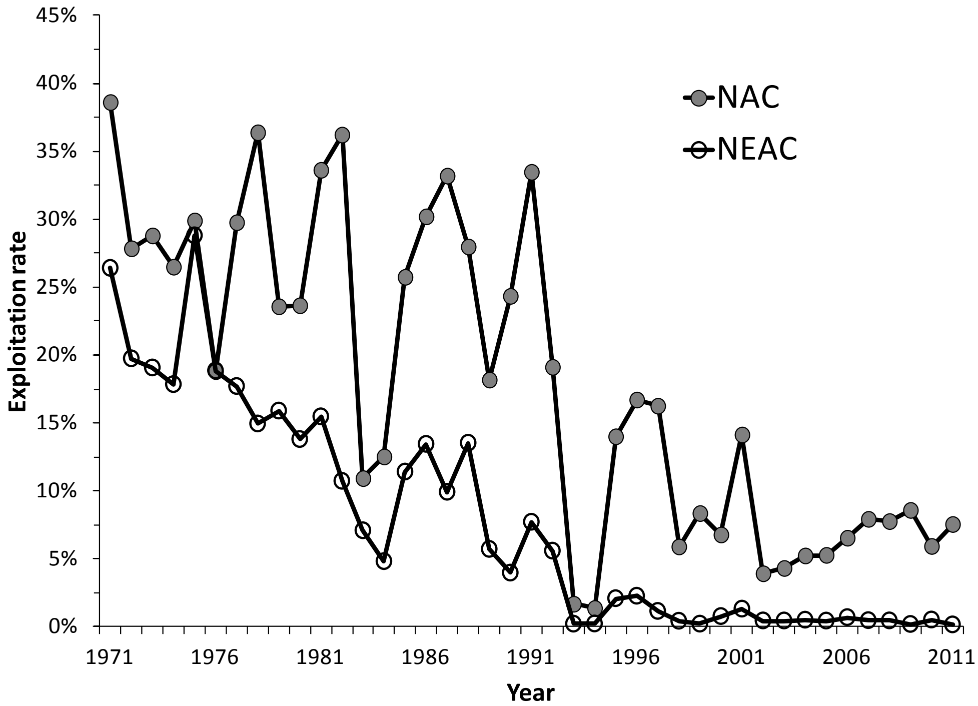


Figure 5.1.1.1. Exploitation rate (%) for NAC 1SW non-maturing and southern NEAC non-maturing Atlantic salmon at West Greenland, 1971–2011. Exploitation rate estimates are only available to 2011, as 2012 exploitation rates are dependent on 2013 2SW NAC or MSW (NEAC) returns.

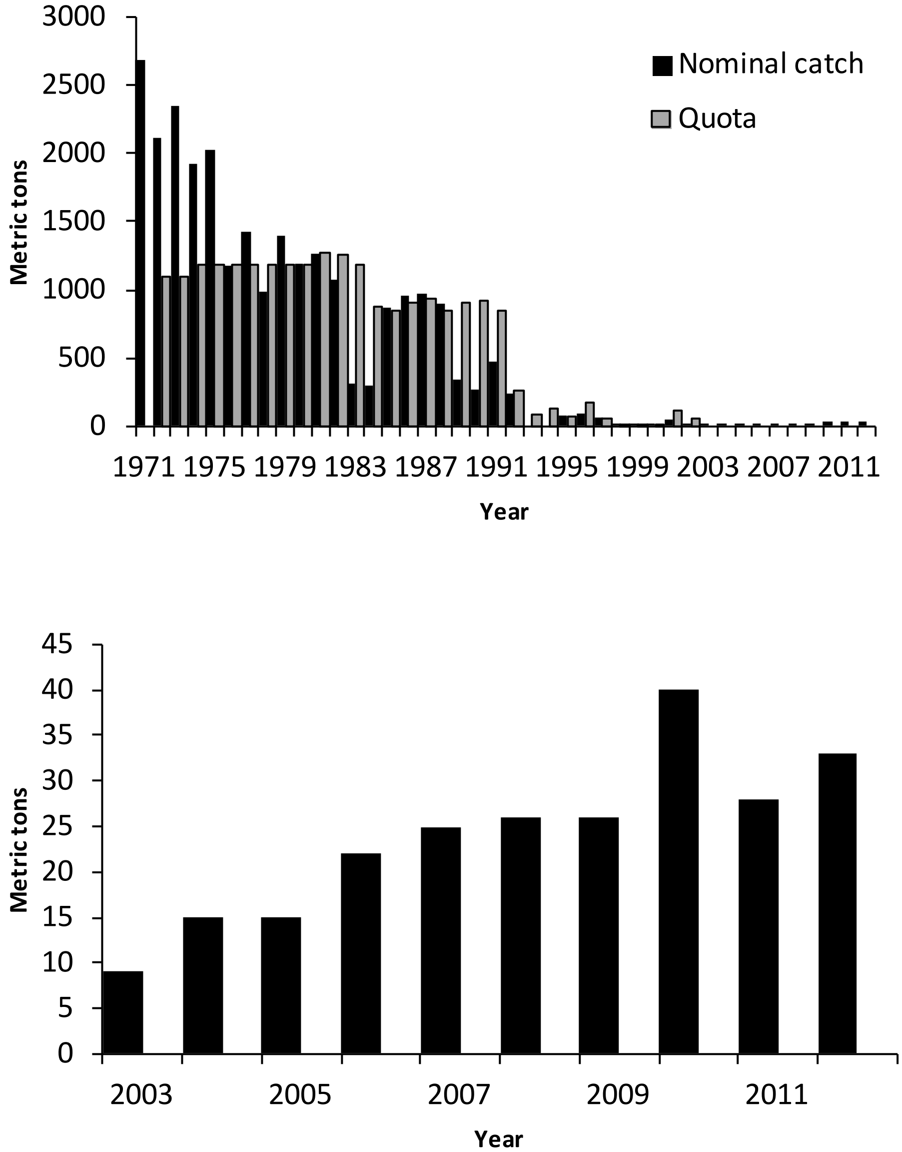


Figure 5.1.1.2. Nominal catches and commercial quotas (metric tonnes, round fresh weight) of salmon at West Greenland for 1971–2012 (top panel) and 2003–2012 (bottom panel). The quota has been set to nil since 2003.

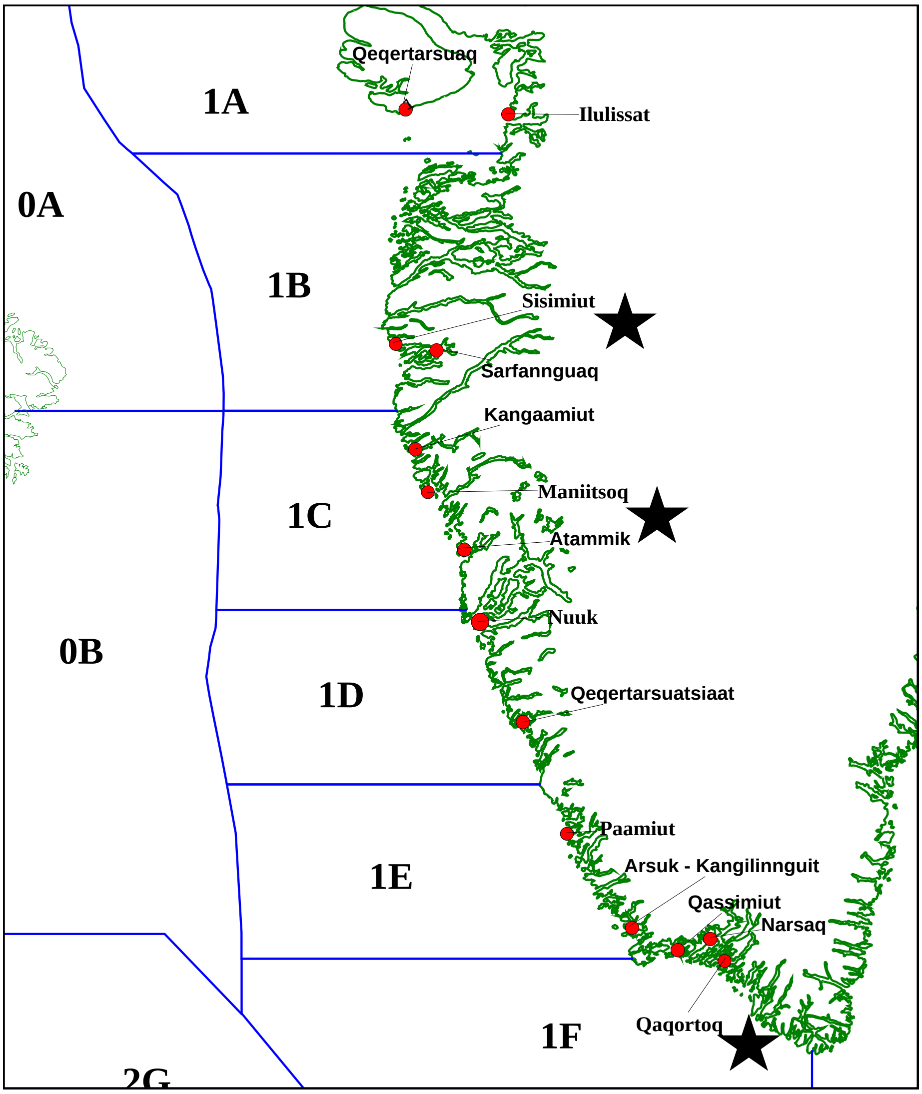


Figure 5.1.1.3. Location of NAFO divisions along the coast of West Greenland. Stars identify the communities where biological sampling occurred (Sisimiut, Maniitsoq and Qaqortoq).

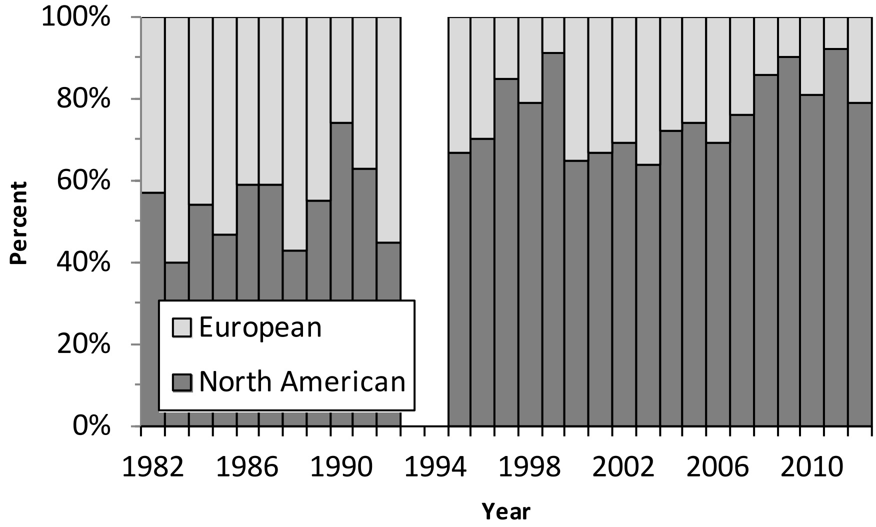


Figure 5.1.3.1. Percent of the sampled catch by continent of origin for the 1982 to 2012 Atlantic salmon West Greenland fishery.

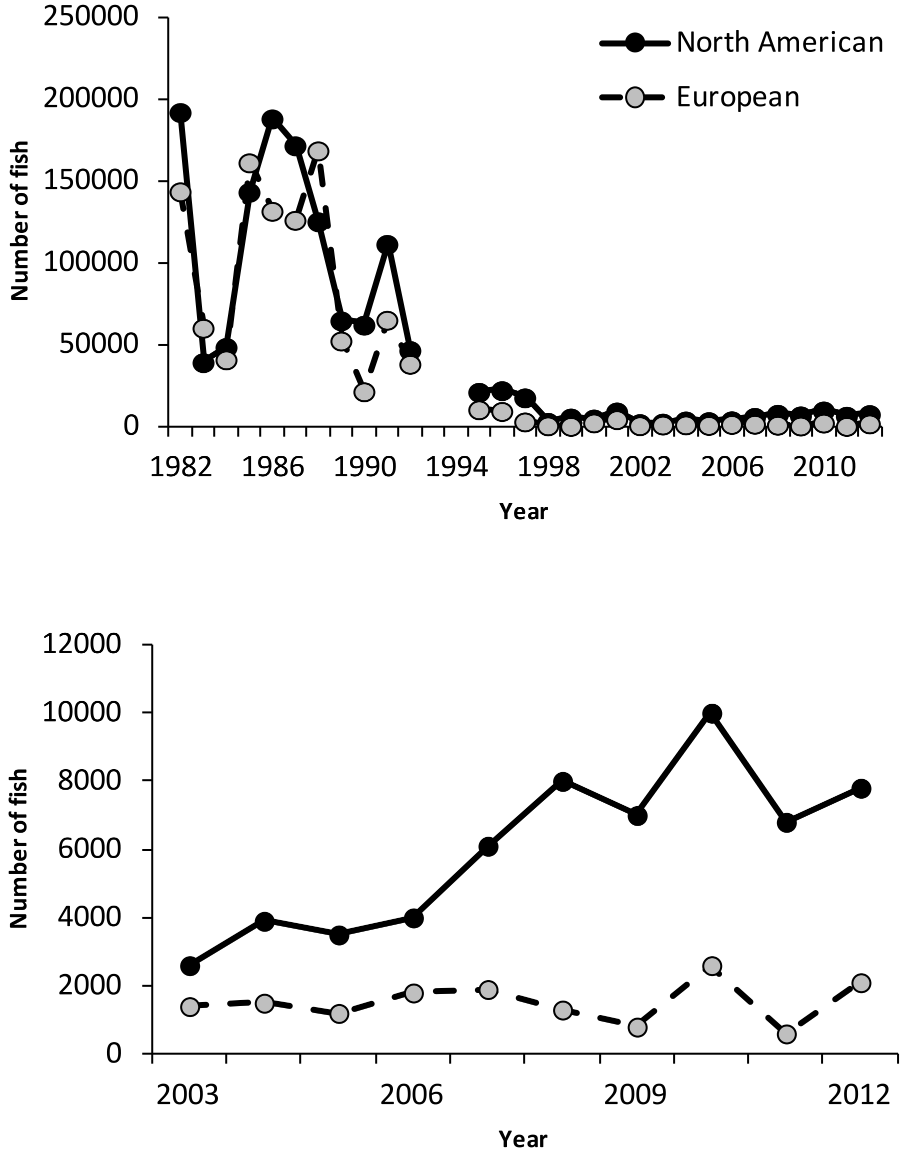


Figure 5.1.3.2. Number of North American and European Atlantic salmon caught at West Greenland from 1982 to 2012 (upper panel) and 2003 to 2012 (lower panel).

Annex 1: Working documents submitted to the Working Group on North Atlantic Salmon, 3–12 April, 2013

WP No.	Authors	Title
1	Trial, J., Sweka, J., Kocik, J., Sheehan, T., Freidland, K. and Letcher, B.	National Report for the United States, 2012.
2	Sheehan, T. F., Assunção, M. G. L., Deschamps, D., Laughton, B., Ó Cuaig, M., Nygaard, R., King, T. L., Robertson, M. J. and O' Maoiléidigh, N.	The International Sampling Programme: Continent of Origin and Biological Characteristics of Atlantic Salmon Collected at West Greenland in 2012.
3	Sheehan, T. F., Assunção, M. G. L., Chisholm, N., Deschamps, D., Dixon, H., Renkawitz, M. Rogan, G., Nygaard, R., King, T. L., Robertson, M. J. and O' Maoiléidigh, N.	The International Sampling Programme: Update of the Continent of Origin and Biological Characteristics of Atlantic Salmon Collected at West Greenland in 2011.
4	Nieland, J. L., Sheehan, T. F., Saunders, R., Murphy, J. S., Trinko Lake, T. and Stevens, J. R.	Dam Impact Analysis Model for Atlantic Salmon in the Penobscot River, Maine.
5	Mills, K. E., Pershing, A. J., Sheehan, T. F. and Mountain, D.	Climate and ecosystem linkages explain the widespread decline in North American Atlantic salmon populations.
6	Renkawitz, M. D. and Sheehan T. F.	West Greenland foraging ecology and implications for survival.
7	Renkawitz, M. D., Sheehan, T. F., Rikardsen, A., Chittenden, C. Nygaard, R. and Righton, D.	Tagging adult Atlantic salmon at West Greenland with pop-up archival satellite tags.
8	Ó Maoiléidigh, N., Cullen, A., Bond, N., McLaughlin, D., Rogan, G., Cotter, D., White, J., O'Higgins, K., Gargan, P. and Roche, W.	National report for Ireland - the 2012 Salmon Season.
9	Meerburg, D.	Atlantic Salmon Federation tracking studies
10	Potter, E.C.E.	Preliminary results from genetic analysis of scales from Faroes.
11	MacLean, J.C., Smith, G.W. and Orpwood, J.E.	National Report for UK (Scotland): 2012 season.
12	Ensing, D.	National report for UK (N. Ireland) for 2012.
13	Erkinaro, J.	Teno River report for 2012.
14	Gudbergson, G., Antonsson, Th. and Jonsson, I.R.	National report for Iceland for 2012.
15	Prusov, S.	National report for Russia for 2012.
16	Fiske, P., Hansen, L.P., Jensen, A.J., Sægrov, H., Wennevik, V., Gjøsæter, H., and Jonsson, N.	National report for Norway for 2012.
17	Jensen, A.J., Sægrov, H., Hansen, L.P., Fiske, P., and Gjøsæter, H.	Rainbow trout and pink salmon in Norway, and their potential threat to Atlantic salmon
18	Cefas and Environment Agency	Salmon Stocks and Fisheries in UK (England & Wales), 2012 - Preliminary assessment prepared for ICES, April 2013.
19	Riley, W.D., Davison, P.I., Maxwell, D.L., Bendall. B., Ives, M.J. and Russell, I.C.	The impact of artificial night light on Atlantic salmon (*Salmo salar* L.) fry dispersal and the onset of smolt migration.
20	Euzenat, G.	National report for France for 2012.
21	de la Hoz, J.	Salmon fisheries and status of stocks in Spain (Asturias, 2012). Report for 2013

WP No.	Authors	Title
		Meeting WGNAS.
22	Jacobsen, J.A.	Status of the fisheries for Atlantic salmon and production of farmed salmon in 2012 for the Faroe Islands.
23	Degerman, E., Persson, J., Sers, B. and Östergren, J.	Fisheries management and status of Atlantic salmon stocks in Sweden: National Report for 2012.
24	Rasmussen, G.	Catch data for Denmark for 2012.
25	Nygaard, R.	The salmon fishery in Greenland, 2012.
26	White, J.	ECOKNOWS update.
27	Chaput, Potter, Saunders and Gauldbek	NASCO West Greenland Commission - Report of the Framework of Indicators Working Group 2013 .
28	Russell, I.C., Fiske, P., Prusov, S. and Jacobsen, J-A.	NASCO North East Atlantic Commission - Report of the Framework of Indicators Working Group 2013.
29	Levy, A. L., R. A. Jones, S. C. Hansen and A. J. F. Gibson	Status of Atlantic salmon in Canada's MaritImes region (Salmon Fishing Areas 19 to 23)
30	Robertson, M., Poole, R., Levy, A., Jones, R., Douglas, S., Dionne, M., Cameron, P., Cairns, D., Breau, C., and Chaput, G.	Catch Statistics and Aquaculture Production Values for Canada: preliminary 2012 and final 2011.
31	Breau, C., Cameron, P., Douglas, S., and Chaput, G.	Stock status update for Gulf Region - Salmon Fishing Areas 15 to 18.
32	Chaput, G.	Monitoring of sea lice burdens on wild returning adult Atlantic salmon from the Miramichi River, New Brunswick.
33	Chaput, G., Carr, J., Jonsen, I., and Whoriskey, F.	Modelling inter-stage survival rates and dectection probabilities for acoustically tracked Atlantic salmon smolts and post-smolts: model, assumptions, diagnostics, considerations for planning experiments.
34	Dionne, M.	Stock status of Atlantic salmon in Quebec for 2012.
35	Dionne, M.	Index rivers monitoring programme for Quebec to 2012.
36	Massiot-Granier, F., Prévost, E., Chaput, G., Potter, E.C.E., Smith, G., White, J., Mäntyniemi, S. and Rivot, E.	Embedding Atlantic salmon stock assessment at broad ocean scale within an integrated Bayesian life cycle modelling framework.
37	"White, J., Ó Maoiléidigh, N., Gargan, P., De Eyto, E., McGinnity, P., Roche, W., Lawlor, I., Kennedy, B. and, Doherty, D.	Updating River Conservation Limits for Irish Salmon Rivers.
38	Robertson, M. *et al*.	Stock status update for Newfoundland and Labrador.

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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 2012 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13655	33

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	46891	80	-	-	-	-	-	-	-	-	11671	55	-	-	58562	135

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

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

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	3849	7	1425	6	1152	11	251	3	6	1	-	-	1404	11	8087	39
	2005	9216	16	1027	5	1575	16	90	1	66	1	3595	-	837	8	12812	47
	2006	17758	29	4166	18	1369	13	66	1		-	6370	-	770	5	24128	67
	2007	3250	6	5329	21	2423	23	23	1	7	-	9038	-	1255	8	12288	59
	2008	3347	6	1848	8	4394	41	235	4		-	8378	-	1901	11	11726	71
	2009	6727	-	1531	-	1408	-	262	-		-	4077	-	876	-	10804	36
	2010	6361	-	3687	-	1345	-	322	-	12	-	6322	-	957	-	12684	49
	2011	7782	-	2078	-	1725	-	190	-	22	-	4926	-	911	-	12709	44
	2012	15331	31	3108	12	1302	12	188	3	10	0	5592	33	984	6	20923	64

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	18033	39	2732	18	-	-	-	-	-	-	-	-	-	-	20765	57

Sweden

Sweden	1990	7428	18	-	-	-	-	-	-	-	-	3133	15	-	-	10561	33
	1991	8987	20	-	-	-	-	-	-	-	-	3620	18	-	-	12607	38
	1992	9850	23	-	-	-	-	-	-	-	-	4656	26	-	-	14506	49
	1993	10540	23	-	-	-	-	-	-	-	-	6369	33	-	-	16909	56
	1994	8304	18	-	-	-	-	-	-	-	-	4661	26	-	-	12965	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	2211	4	-	-	-	-	-	-	-	-	1772	10	-	-	3983	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

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

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

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

UK(England and Wales)

UK	1985	62815	-	-	-	-	-	-	-	-	-	32716	-	-	-	95531	361
(England & Wales)	1986	68759	-	-	-	-	-	-	-	-	-	42035	-	-	-	110794	430
Wales	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	30641	-	-	-	-	-	-	-	-	-	6276	-	-	-	36917	123
	1999	27944	-	-	-	-	-	-	-	-	-	13150	-	-	-	41094	150
	2000	48153	-	-	-	-	-	-	-	-	-	12800	-	-	-	60953	219
	2001	38993	-	-	-	-	-	-	-	-	-	12314	-	-	-	51307	184
	2002	34708	-	-	-	-	-	-	-	-	-	10961	-	-	-	45669	161
	2003	14878	-	-	-	-	-	-	-	-	-	7328	-	-	-	22206	89
	2004	24753	-	-	-	-	-	-	-	-	-	5806	-	-	-	30559	111
	2005	19622	-	-	-	-	-	-	-	-	-	6541	-	-	-	26162	97
	2006	16983	-	-	-	-	-	-	-	-	-	5073	-	-	-	22056	80
	2007	15540	-	-	-	-	-	-	-	-	-	4383	-	-	-	19923	67
	2008	14277	-	-	-	-	-	-	-	-	-	4759	-	-	-	19036	64
	2009	10015	-	-	-	-	-	-	-	-	-	3895	-	-	-	13910	54
	2010	25502	-	-	-	-	-	-	-	-	-	7193	-	-	-	32695	109
	2011	19708	-	-	-	-	-	-	-	-	-	14867	-	-	-	34575	136
	2012	7496	-	-	-	-	-	-	-	-	-	7203	-	-	-	14699	57

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	20429	42	-	-	-	-	-	-	-	-	20824	88	-	-	41253	130

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

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	1195	3	-	-	-	-	-	-	-	-	589	3	-	-	1784	6
	2005	412	1	-	-	-	-	-	-	-	-	2336	11	-	-	2748	12
	2006	335	1	-	-	-	-	-	-	-	-	1879	9	-	-	2214	10
	2007	520	1	-	-	-	-	-	-	-	-	1487	7	-	-	2007	8.507
	2008	520	1	-	-	-	-	-	-	-	-	1487	7	-	-	1966	9
	2009	106	0	-	-	-	-	-	-	-	-	250	1	-	-	356	1
	2010	81	0	-	-	-	-	-	-	-	-	166	1	-	-	247	1
	2011	21	0	-	-	-	-	-	-	-	-	1024	5	-	-	1045	5
	2012	237	1	-	-	-	-	-	-	-	-	1064	5	-	-	1301	6

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; mis-classification 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 data are used.

Annex 5: Input data for NEAC Pre Fishery Abundance analysis using Monte Carlo simulation

Finland

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	8,422	8,538	35	5	35	5	50	10	55	15
1972	13,160	13,341	35	5	35	5	50	10	55	15
1973	11,969	15,958	35	5	35	5	50	10	55	15
1974	23,709	23,709	35	5	35	5	50	10	55	15
1975	16,527	26,417	35	5	35	5	50	10	55	15
1976	11,323	21,719	35	5	35	5	50	10	55	15
1977	5,807	13,227	35	5	35	5	50	10	55	15
1978	7,902	8,452	35	5	35	5	50	10	55	15
1979	9,249	7,390	35	5	35	5	50	10	45	15
1980	4,792	8,938	25	5	25	5	50	10	45	15
1981	7,386	9,835	25	5	25	5	50	10	45	15
1982	2,163	12,826	25	5	25	5	50	10	45	15
1983	10,680	13,990	25	5	25	5	50	10	45	15
1984	11,942	13,262	25	5	25	5	50	10	45	15
1985	18,039	10,339	25	5	25	5	50	10	45	15
1986	16,389	9,028	25	5	25	5	50	10	45	15
1987	20,950	11,290	25	5	25	5	50	10	45	15
1988	10,019	7,231	25	5	25	5	50	10	45	15
1989	28,091	10,011	25	5	25	5	60	10	55	15
1990	26,646	12,562	25	5	25	5	60	10	55	15
1991	32,423	15,136	25	5	25	5	60	10	55	15
1992	42,965	16,158	25	5	25	5	60	10	55	15
1993	30,197	18,720	25	5	25	5	60	10	55	15
1994	12,016	15,521	25	5	25	5	60	10	55	15
1995	11,801	9,634	25	5	25	5	60	10	55	15
1996	22,799	6,956	25	5	25	5	50	10	45	15
1997	19,481	10,083	25	5	25	5	50	10	45	15
1998	22,460	8,497	25	5	25	5	50	10	45	15
1999	38,687	8,854	25	5	25	5	60	10	50	10
2000	40,654	19,707	25	5	25	5	60	10	50	10
2001	18,372	28,337	25	5	25	5	60	10	50	10
2002	10,757	22,717	25	5	25	5	50	10	50	10
2003	12,699	16,093	25	5	25	5	50	10	50	10
2004	4,912	7,718	25	5	25	5	50	10	50	10
2005	12,499	5,969	25	5	25	5	50	10	50	10
2006	23,727	10,473	25	5	25	5	50	10	50	10
2007	4,407	14,878	25	5	25	5	50	10	50	10
2008	4,539	14,165	25	5	25	5	50	10	50	10
2009	9,260	6,600	25	5	25	5	50	10	50	10
2010	8627	10434	25	5	25	5	50	10	50	10
2011	10554	8204	25	5	25	5	50	10	50	10
2012	22902	10649	25	5	25	5	50	10	50	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

France

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	1,740	4,060					3.5	1.5	37.5	12.5
1972	3,480	8,120					3.5	1.5	37.5	12.5
1973	2,130	4,970					3.5	1.5	37.5	12.5
1974	990	2,310					3.5	1.5	37.5	12.5
1975	1,980	4,620					3.5	1.5	37.5	12.5
1976	1,820	3,380					3.5	1.5	37.5	12.5
1977	1,400	2,600					3.5	1.5	37.5	12.5
1978	1,435	2,665					3.5	1.5	37.5	12.5
1979	1,645	3,055					3.5	1.5	37.5	12.5
1980	3,430	6,370					3.5	1.5	37.5	12.5
1981	2,720	4,080					3.5	1.5	35	15
1982	1,680	2,520					3.5	1.5	35	15
1983	1,800	2,700					3.5	1.5	35	15
1984	2,960	4,440					3.5	1.5	35	15
1985	1,100	3,330					3.5	1.5	35	15
1986	3,400	3,400					7	5	35	15
1987	6,013	1,806					7	5	35	15
1988	2,063	4,964					7	5	35	15
1989	1,124	2,282					7	5	35	15
1990	1,886	2,332					7	5	35	15
1991	1,362	2,125					7	5	35	15
1992	2,490	2,671					7	5	35	15
1993	3,581	1,254					7	5	35	15
1994	2,810	2,290					7	5	30	10
1995	1,669	1,095					12.5	7.5	30	10
1996	2,063	1,943					12.5	7.5	30	10
1997	1,060	1,001					12.5	7.5	30	10
1998	2,065	846					12.5	7.5	30	10
1999	690	1,831					12.5	7.5	30	10
2000	1,792	1,277					12.5	7.5	30	10
2001	1,544	1,489					12.5	7.5	30	10
2002	2,423	1,065	30	10	23	8	13	8	30	10
2003	1,598	1,540	30	10	23	8	13	8	30	10
2004	1,927	2,880	30	10	23	8	13	8	30	10
2005	1,256	1,771	30	10	23	8	13	8	30	10
2006	1,763	1,785	30	10	23	8	13	8	30	10
2007	1,378	1,685	30	10	23	8	13	8	30	10
2008	1,365	1,865	30	10	23	8	13	8	30	10
2009	487	975	30	10	23	8	13	8	30	10
2010	1658	821	30	10	23	8	13	8	30	10
2011	1162	2142	30	10	23	8	13	8	30	10
2012	1010	1669	30	10	23	8	13	8	30	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Iceland (South and West)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	30,618	16,749	2	1	2	1	50	10	70	10
1972	24,832	25,733	2	1	2	1	50	10	70	10
1973	26,624	23,183	2	1	2	1	50	10	70	10
1974	18,975	20,017	2	1	2	1	50	10	70	10
1975	29,428	21,266	2	1	2	1	50	10	70	10
1976	23,233	18,379	2	1	2	1	50	10	70	10
1977	23,802	17,919	2	1	2	1	50	10	70	10
1978	31,199	23,182	2	1	2	1	50	10	70	10
1979	28,790	14,840	2	1	2	1	50	10	70	10
1980	13,073	20,855	2	1	2	1	50	10	70	10
1981	16,890	13,919	2	1	2	1	50	10	70	10
1982	17,331	9,826	2	1	2	1	50	10	70	10
1983	21,923	16,423	2	1	2	1	50	10	70	10
1984	13,476	13,923	2	1	2	1	50	10	70	10
1985	21,822	10,097	2	1	2	1	50	10	70	10
1986	35,891	8,423	2	1	2	1	50	10	70	10
1987	22,302	7,480	2	1	2	1	50	10	70	10
1988	40,028	8,523	2	1	2	1	50	10	70	10
1989	22,377	7,607	2	1	2	1	50	10	70	10
1990	20,584	7,548	2	1	2	1	50	10	70	10
1991	22,711	7,519	2	1	2	1	50	10	70	10
1992	26,006	8,479	2	1	2	1	50	10	70	10
1993	25,479	4,155	2	1	2	1	50	10	70	10
1994	20,985	6,736	2	1	2	1	50	10	70	10
1995	25,371	6,777	12.5	2.5	12.5	2.5	50	10	70	10
1996	21,913	4,364	12.5	2.5	12.5	2.5	50	10	70	10
1997	16,007	4,910	12.5	2.5	12.5	2.5	50	10	70	10
1998	21,900	3,037	12.5	2.5	12.5	2.5	50	10	70	10
1999	17,448	5,757	12.5	2.5	12.5	2.5	49	10	68	10
2000	15,502	1,519	12.5	2.5	12.5	2.5	49	10	66	10
2001	13,586	2,707	12.5	2.5	12.5	2.5	48	10	67	10
2002	16,952	2,845	13	3	13	3	48	10	65	10
2003	20,271	4,751	13	3	13	3	48	10	68	10
2004	20,319	3,784	13	3	13	3	48	10	67	10
2005	29,969	3,241	13	3	13	3	48	10	65	10
2006	21,153	2,689	13	3	13	3	48	10	65	10
2007	23,728	1,679	13	3	13	3	47	9	66	10
2008	28,774	1,659	13	3	13	3	47	10	57	10
2009	33,190	2,838	13	3	13	3	48	10	63	10
2010	33,318	6,061	13	3	13	3	47	10	65	10
2011	23436	2934	13	3	13	3	47	10	62	10
2012	14975	2398	13	3	13	3	48	10	59	10

M(min)= 0.020 Return time (m)= 1SW(min) 7 MSW(min) 16
M(max)= 0.040 1SW(max) 9 MSW(max) 18

Iceland (North and East)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	4,610	6,625	2	1	2	1	50	10	70	10
1972	4,223	10,337	2	1	2	1	50	10	70	10
1973	5,060	9,672	2	1	2	1	50	10	70	10
1974	5,047	9,176	2	1	2	1	50	10	70	10
1975	6,152	10,136	2	1	2	1	50	10	70	10
1976	6,184	8,350	2	1	2	1	50	10	70	10
1977	8,597	11,631	2	1	2	1	50	10	70	10
1978	8,739	14,998	2	1	2	1	50	10	70	10
1979	8,363	9,897	2	1	2	1	50	10	70	10
1980	1,268	13,784	2	1	2	1	50	10	70	10
1981	6,528	4,827	2	1	2	1	50	10	70	10
1982	3,007	5,539	2	1	2	1	50	10	70	10
1983	4,437	4,224	2	1	2	1	50	10	70	10
1984	1,611	5,447	2	1	2	1	50	10	70	10
1985	11,116	3,511	2	1	2	1	50	10	70	10
1986	13,827	9,569	2	1	2	1	50	10	70	10
1987	8,145	9,908	2	1	2	1	50	10	70	10
1988	11,775	6,381	2	1	2	1	50	10	70	10
1989	6,342	5,414	2	1	2	1	50	10	70	10
1990	4,752	5,709	2	1	2	1	50	10	70	10
1991	6,900	3,965	2	1	2	1	50	10	70	10
1992	12,996	5,903	2	1	2	1	50	10	70	10
1993	10,689	6,672	2	1	2	1	50	10	70	10
1994	3,414	5,656	2	1	2	1	50	10	70	10
1995	8,776	3,511	12.5	2.5	12.5	2.5	50	10	70	10
1996	4,681	4,605	12.5	2.5	12.5	2.5	50	10	70	10
1997	6,406	2,594	12.5	2.5	12.5	2.5	50	10	70	10
1998	10,905	3,780	12.5	2.5	12.5	2.5	50	10	70	10
1999	5,326	4,030	12.5	2.5	12.5	2.5	48	10	65	10
2000	5,595	2,324	12.5	2.5	12.5	2.5	48	10	64	10
2001	4,976	2,587	12.5	2.5	12.5	2.5	47	10	62	10
2002	8,437	2,366	13	3	13	3	46	10	60	10
2003	4,478	2,194	13	3	13	3	46	10	53	10
2004	11,823	2,239	13	3	13	3	45	10	55	10
2005	10,297	2,726	13	3	13	3	44	10	54	10
2006	11,082	2,179	13	3	13	3	45	10	45	10
2007	8,046	1,672	13	3	13	3	44	10	36	10
2008	7,021	2,693	13	3	13	3	42	10	45	10
2009	10,779	1,735	13	3	13	3	40	10	36	10
2010	8,621	2,602	13	3	13	3	40	10	38	10
2011	6759	2596	13	3	13	3	38	10	34	10
2012	3058	1265	13	3	13	3	42	10	34	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Ireland

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)		Net catch		Catch & Release		Spawner numbers - small rivers		Spawner numbers - closed rivers	
	1SW	MSW	est	error	est	error	est	error	est	error	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
1971	409,965	46,594	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1972	437,089	49,863	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1973	476,131	54,008	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1974	542,124	60,976	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1975	598,524	68,260	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1976	407,018	47,358	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1977	351,745	41,256	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1978	307,569	35,708	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1979	282,700	32,144	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1980	215,116	35,447	37.5	7.5	37.5	7.5	62.5	12.5	47.5	12.5								
1981	137,366	26,101	37.5	7.5	37.5	7.5	75.7	11.4	47.5	12.5								
1982	269,847	11,754	37.5	7.5	37.5	7.5	71.9	10.8	36.7	8.3								
1983	437,751	26,479	37.5	7.5	37.5	7.5	66.1	9.9	27.9	17.5								
1984	224,872	20,685	37.5	7.5	37.5	7.5	64.6	9.7	43.5	6.5								
1985	430,315	18,830	37.5	7.5	37.5	7.5	74.6	11.2	36.1	3.4								
1986	443,701	27,111	37.5	7.5	37.5	7.5	68.7	10.3	46.0	9.0								
1987	324,709	26,301	30	10	30	10	69.8	10.5	32.2	4.7								
1988	391,475	22,067	30	10	30	10	62.0	9.3	37.4	5.6								
1989	297,797	25,447	30	10	30	10	65.7	9.9	47.2	8.8								
1990	172,098	15,549	30	10	30	10	60.7	9.1	59.9	6.1								
1991	120,408	10,334	30	10	30	10	59.5	8.9	26.5	3.5								
1992	182,255	15,456	30	10	30	10	62.1	9.3	51.5	3.8								
1993	150,274	13,156	25	10	25	10	58.6	8.8	42.0	18.0								
1994	234,126	20,506	25	10	25	10	71.4	10.7	40.5	2.5								
1995	232,480	20,454	25	10	25	10	63.5	9.5	41.8	1.2								
1996	203,920	18,021	25	10	25	10	59.9	9.0	55.1	3.2								
1997	170,774	14,724	25	10	15	5	50.1	7.5	30.8	12.2								
1998	191,868	17,269	25	10	15	5	53.7	8.1	61.9	1.4								
1999	158,818	14,801	25	10	15	5	47.8	7.2	34.1	18.1								
2000	199,827	16,848	25	10	15	5	43.2	6.5	31.0	4.5								
2001	218,715	18,436	7.5	2.5	7.5	2.5	48	7.2	35	8								
2002	198,719	16,702	8	3	8	3	50	7	28	8								
2003	161,270	13,745	8	3	8	3	41	6	22	6								
2004	142,251	12,299	8	3	8	3	50	8	35	8								
2005	127,371	10,716	8	3	8	3	45	7	24	4								
2006	101,938	9,740	8	3	8	3	47	7	30	14								
2007	30,418	2,477	8	3	8	3	16	8	24	9	8334	679	12137	988	9548	777	40255	3278
2008	30,257	3,935	8	3	8	3	16	8	24	9	8253	650	10485	1492	12206	961	34382	4580
2009	24,184	4,756	8	3	8	3	16	8	24	9	6264	493	9799	1623			46570	4964
2010	33,211	3,297	8	3	8	3	16	8	24	9	13125	1034	13903	1255			35804	1504
2011	29117	3970	8	3	8	3	16	8	24	9	11071	902	11222	1530			33251	1208
2012	29979	4198	8	3	8	3	16	8	24	9	9542	777	10429	1463			32070	993

M(min)= 0.020 Return time (m)= 1SW(min) 7 MSW(min) 16
M(max)= 0.040 1SW(max) 9 MSW(max) 18

Note: Net catch and spawner numbers from 2007 only (zero values for spawner numbers in small rivers from 2009 as these included in closed rivers).

Norway (Southeast)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971										
1972										
1973										
1974										
1975										
1976										
1977										
1978										
1979										
1980										
1981										
1982										
1983	9,039	9,004	50	10	50	10	70	10	65	10
1984	11,402	11,527	50	10	50	10	70	10	65	10
1985	18,699	11,883	50	10	50	10	70	10	65	10
1986	23,089	12,077	50	10	50	10	70	10	65	10
1987	19,601	14,179	50	10	50	10	70	10	65	10
1988	17,520	9,443	50	10	50	10	70	10	65	10
1989	23,965	12,254	50	10	50	10	65	10	60	10
1990	25,792	11,502	50	10	50	10	65	10	60	10
1991	21,064	10,753	50	10	50	10	65	10	60	10
1992	26,044	15,332	50	10	50	10	65	10	60	10
1993	23,070	12,596	40	10	40	10	65	10	60	10
1994	23,987	9,988	40	10	40	10	65	10	60	10
1995	21,847	11,630	40	10	40	10	65	10	60	10
1996	20,738	13,538	40	10	40	10	65	10	60	10
1997	21,121	7,756	35	10	35	10	60	10	60	10
1998	32,586	10,396	35	10	35	10	60	10	60	10
1999	23,904	6,664	35	10	35	10	60	10	60	10
2000	43,151	14,261	35	10	35	10	60	10	60	10
2001	47,339	19,210	35	10	35	10	60	10	60	10
2002	33,087	14,400	35	10	35	10	60	10	60	10
2003	33,371	20,648	30	10	30	10	60	10	60	10
2004	28,506	15,948	30	10	30	10	60	10	60	10
2005	40,628	14,628	30	10	30	10	60	10	60	10
2006	30,979	21,192	30	10	30	10	60	10	60	10
2007	15,735	18,130	30	10	30	10	60	10	60	10
2008	15,696	16,678	30	10	30	10	55	10	50	10
2009	15,584	11,995	30	10	30	10	55	10	50	10
2010	22,139	12,175	30	10	30	10	55	10	50	10
2011	15773	28589	30	10	30	10	50	10	40	10
2012	18582	23389	30	10	30	10	50	10	40	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Norway (Southwest)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971										
1972										
1973										
1974										
1975										
1976										
1977										
1978										
1979										
1980										
1981										
1982										
1983	31,845	28,601	50	10	50	10	80	10	80	10
1984	23,428	27,641	50	10	50	10	80	10	80	10
1985	29,857	25,515	50	10	50	10	80	10	80	10
1986	29,894	30,769	50	10	50	10	80	10	80	10
1987	30,005	26,623	50	10	50	10	80	10	80	10
1988	36,976	28,255	50	10	50	10	80	10	80	10
1989	19,183	13,041	50	10	50	10	70	10	65	10
1990	18,490	14,423	50	10	50	10	70	10	65	10
1991	9,759	8,323	50	10	50	10	70	10	65	10
1992	6,448	8,832	50	10	50	10	70	10	65	10
1993	11,433	10,239	40	10	40	10	70	10	65	10
1994	18,597	10,961	40	10	40	10	70	10	65	10
1995	10,863	13,122	40	10	40	10	70	10	65	10
1996	7,048	12,546	40	10	40	10	70	10	65	10
1997	10,279	7,194	35	10	35	10	60	10	60	10
1998	5,726	6,583	35	10	35	10	60	10	60	10
1999	7,357	3,219	35	10	35	10	60	10	60	10
2000	11,538	7,961	35	10	35	10	60	10	60	10
2001	12,109	10,716	35	10	35	10	60	10	60	10
2002	6,000	7,145	35	10	35	10	60	10	60	10
2003	8,269	7,602	30	10	30	10	60	10	60	10
2004	7,180	6,420	30	10	30	10	60	10	60	10
2005	10,370	7,334	30	10	30	10	60	10	60	10
2006	5,173	9,381	30	10	30	10	60	10	60	10
2007	2,630	6,011	30	10	30	10	60	10	60	10
2008	3,143	4,807	30	10	30	10	55	10	50	10
2009	3,069	3,792	30	10	30	10	55	10	50	10
2010	3,450	2,447	30	10	30	10	55	10	50	10
2011	2888	4409	30	10	30	10	50	10	35	10
2012	4171	5733	30	10	30	10	45	10	30	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Mid-Norway

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971										
1972										
1973										
1974										
1975										
1976										
1977										
1978										
1979										
1980										
1981										
1982										
1983	121,221	74,648	50	10	50	10	75	10	75	10
1984	94,373	67,639	50	10	50	10	75	10	75	10
1985	114,613	56,641	50	10	50	10	75	10	75	10
1986	106,921	77,225	50	10	50	10	75	10	75	10
1987	83,669	62,216	50	10	50	10	75	10	75	10
1988	80,111	45,609	50	10	50	10	75	10	75	10
1989	94,897	30,862	50	10	50	10	65	10	65	10
1990	78,888	40,174	50	10	50	10	65	10	65	10
1991	67,370	30,087	50	10	50	10	65	10	65	10
1992	51,463	33,092	50	10	50	10	65	10	65	10
1993	58,326	28,184	40	10	40	10	65	10	65	10
1994	113,427	33,520	40	10	40	10	65	10	65	10
1995	57,813	42,696	40	10	40	10	65	10	65	10
1996	28,925	31,613	40	10	40	10	65	10	65	10
1997	43,127	20,565	35	10	35	10	60	10	60	10
1998	63,497	26,817	35	10	35	10	60	10	60	10
1999	60,689	28,792	35	10	35	10	60	10	60	10
2000	109,278	42,452	35	10	35	10	60	10	60	10
2001	88,096	52,031	35	10	35	10	60	10	60	10
2002	42,669	52,774	35	10	35	10	60	10	60	10
2003	91,118	46,963	30	10	30	10	60	10	60	10
2004	38,286	49,760	30	10	30	10	60	10	60	10
2005	63,749	37,941	30	10	30	10	60	10	60	10
2006	46,495	47,691	30	10	30	10	60	10	60	10
2007	26,608	33,106	30	10	30	10	60	10	60	10
2008	31,936	34,869	30	10	30	10	60	10	60	10
2009	26,267	30,715	30	10	30	10	55	10	45	10
2010	37,557	30,524	30	10	30	10	55	10	45	10
2011	20932	37272	30	10	30	10	50	10	45	10
2012	22368	28265	30	10	30	10	50	10	45	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Norway North

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971										
1972										
1973										
1974										
1975										
1976										
1977										
1978										
1979										
1980										
1981										
1982										
1983	104,040	49,413	50	10	50	10	80	10	80	10
1984	150,372	58,858	50	10	50	10	80	10	80	10
1985	118,841	58,956	50	10	50	10	80	10	80	10
1986	84,150	63,418	50	10	50	10	80	10	80	10
1987	72,370	34,232	50	10	50	10	80	10	80	10
1988	53,880	32,140	50	10	50	10	80	10	80	10
1989	42,010	13,934	50	10	50	10	70	10	70	10
1990	38,216	17,321	50	10	50	10	70	10	70	10
1991	42,888	21,789	50	10	50	10	70	10	70	10
1992	34,593	19,265	50	10	50	10	70	10	70	10
1993	51,440	39,014	40	10	40	10	70	10	70	10
1994	37,489	33,411	40	10	40	10	70	10	70	10
1995	36,283	26,037	40	10	40	10	70	10	70	10
1996	40,792	36,636	40	10	40	10	70	10	70	10
1997	39,930	30,115	35	10	35	10	70	10	70	10
1998	46,645	34,806	35	10	35	10	70	10	70	10
1999	46,394	46,744	35	10	35	10	70	10	70	10
2000	61,854	51,569	35	10	35	10	70	10	70	10
2001	46,331	54,023	35	10	35	10	70	10	70	10
2002	38,101	43,100	35	10	35	10	70	10	70	10
2003	44,947	35,972	30	10	30	10	70	10	70	10
2004	34,640	28,077	30	10	30	10	70	10	70	10
2005	45,530	33,334	30	10	30	10	70	10	70	10
2006	48,688	39,508	30	10	30	10	70	10	70	10
2007	28,748	44,550	30	10	30	10	70	10	70	10
2008	34,338	40,553	30	10	30	10	65	10	65	10
2009	22,511	28,241	30	10	30	10	65	10	65	10
2010	29,836	28,611	30	10	30	10	65	10	65	10
2011	26813	27233	30	10	30	10	65	10	55	10
2012	28289	28000	30	10	30	10	65	10	55	10

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Russia (Archangelsk and Karelia)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	134	16,592	10	5	10	5	60	20	60	20
1972	116	14,434	10	5	10	5	60	20	60	20
1973	169	20,924	10	5	10	5	60	20	60	20
1974	170	21,137	10	5	10	5	60	20	60	20
1975	140	17,398	10	5	10	5	60	20	60	20
1976	111	13,781	10	5	10	5	60	20	60	20
1977	78	9,722	10	5	10	5	60	20	60	20
1978	82	10,134	10	5	10	5	60	20	60	20
1979	112	13,903	10	5	10	5	60	20	60	20
1980	156	19,397	10	5	10	5	60	20	60	20
1981	68	8,394	10	5	10	5	60	20	60	20
1982	71	8,797	10	5	10	5	60	20	60	20
1983	48	11,938	10	5	10	5	60	20	60	20
1984	21	10,680	10	5	10	5	60	20	60	20
1985	454	11,183	10	5	10	5	60	20	60	20
1986	12	12,291	10	5	10	5	60	20	60	20
1987	647	8,734	10	5	10	5	60	20	60	20
1988	224	9,978	10	5	10	5	60	20	60	20
1989	989	10,245	10	5	10	5	60	20	60	20
1990	1,418	8,429	15	5	15	5	60	20	60	20
1991	421	8,725	20	5	20	5	60	20	60	20
1992	1,031	3,949	25	5	25	5	60	20	60	20
1993	196	4,251	30	5	30	5	60	20	60	20
1994	334	5,631	35	5	35	5	60	20	60	20
1995	386	5,214	45	5	45	5	60	20	60	20
1996	231	3,753	55	5	55	5	60	20	60	20
1997	721	3,351	55	5	55	5	60	20	60	20
1998	585	4,208	55	5	55	5	60	20	60	20
1999	299	3,101	55	5	55	5	60	20	60	20
2000	514	3,382	55	5	55	5	60	20	60	20
2001	363	2,348	55	5	55	5	60	20	60	20
2002	1,676	2,439	55	5	55	5	60	20	60	20
2003	893	2,041	55	5	55	5	60	20	60	20
2004	990	3,761	55	5	55	5	60	20	60	20
2005	1,349	4,915	55	5	55	5	60	20	60	20
2006	2,183	2,841	55	5	55	5	60	20	60	20
2007	1,618	2,621	55	5	55	5	60	20	60	20
2008	332	2,496	55	5	55	5	60	20	60	20
2009	252	2,214	55	5	55	5	60	20	60	20
2010	397	3,823	55	5	55	5	60	20	60	20
2011	313	2585	55	5	55	5	60	20	60	20
2012	1332	2446	55	5	55	5	60	20	60	20

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	19
M(max)=	0.040		1SW(max)	8	MSW(max)	21

Russia (Kola Peninsula: Barents Sea Basin)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	4,892	5,979	15	5	15	5	45	5	45	5
1972	7,978	9,750	15	5	15	5	45	5	45	5
1973	9,376	11,460	15	5	15	5	40	5	40	5
1974	12,794	15,638	15	5	15	5	40	5	40	5
1975	13,872	13,872	15	5	15	5	45	5	45	5
1976	11,493	14,048	15	5	15	5	55	5	55	5
1977	7,257	8,253	15	5	15	5	50	5	50	5
1978	7,106	7,113	15	5	15	5	55	5	55	5
1979	6,707	3,141	15	5	15	5	40	5	40	5
1980	6,621	5,216	15	5	15	5	40	5	40	5
1981	4,547	5,973	15	5	15	5	40	5	40	5
1982	5,159	4,798	15	5	15	5	35	5	35	5
1983	8,504	9,943	15	5	15	5	35	5	35	5
1984	9,453	12,601	15	5	15	5	35	5	35	5
1985	6,774	7,877	15	5	15	5	35	5	35	5
1986	10,147	5,352	15	5	15	5	40	5	40	5
1987	8,560	5,149	15	5	15	5	40	5	40	5
1988	6,644	3,655	15	5	15	5	35	5	35	5
1989	13,424	6,787	15	5	15	5	40	5	40	5
1990	16,038	8,234	15	5	15	5	40	5	40	5
1991	4,550	7,568	15	5	15	5	30	5	30	5
1992	11,394	7,109	15	5	15	5	30	5	30	5
1993	8,642	5,690	15	5	15	5	30	5	30	5
1994	6,101	4,632	15	5	15	5	30	5	30	5
1995	6,318	3,693	15	5	15	5	30	5	30	5
1996	6,815	1,701	20	5	20	5	25	5	25	5
1997	3,564	867	25	5	25	5	15	5	15	5
1998	1,854	280	35	5	35	5	12.5	2.5	12.5	2.5
1999	1,510	424	40	5	40	5	7.5	2.5	7.5	2.5
2000	805	323	50	5	50	5	6	2	6	2
2001	591	241	60	5	60	5	3.5	1.5	3.5	1.5
2002	1,436	2,478	50	10	50	10	10	5	20	5
2003	1,938	1,095	50	10	50	10	10	5	20	5
2004	1,095	850	50	10	50	10	10	5	20	5
2005	859	426	60	10	60	10	10	5	20	5
2006	1,372	844	60	10	60	10	10	5	20	5
2007	784	707	60	10	60	10	10	5	20	5
2008	1,446	997	60	10	60	10	15	5	20	5
2009	2,882	1,080	60	10	60	10	15	5	20	5
2010	3,884	1,486	60	10	60	10	20	5	25	5
2011	3861	1407	60	10	60	10	20	5	25	5
2012	2708	1027	60	10	60	10	20	5	25	5

M(min)=	0.020	Return time (m)=	1SW(min)	6	MSW(min)	17
M(max)=	0.040		1SW(max)	8	MSW(max)	20

Russia (Kola Peninsula: White Sea Basin)

Year	Catch (numbers)		Catch (numbers) previous year		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	1SW	MSW	est	error	est	error	est	error	est	error
1971	67,845	29,077	0	0	3	2	3	2	50	10	60	10
1972	45,837	19,644	0	0	3	2	3	2	50	10	60	10
1973	68,684	29,436	0	0	3	2	3	2	50	10	60	10
1974	63,892	27,382	0	0	3	2	3	2	50	10	60	10
1975	109,038	46,730	0	0	3	2	3	2	50	10	60	10
1976	76,281	41,075	0	0	3	2	3	2	50	10	60	10
1977	47,943	32,392	0	0	3	2	3	2	50	10	60	10
1978	49,291	17,307	0	0	3	2	3	2	50	10	60	10
1979	69,511	21,369	0	0	3	2	3	2	50	10	60	10
1980	46,037	23,241	0	0	3	2	3	2	50	10	60	10
1981	40,172	12,747	0	0	3	2	3	2	50	10	60	10
1982	32,619	14,840	0	0	3	2	3	2	50	10	60	10
1983	54,217	20,840	0	0	3	2	3	2	50	10	60	10
1984	56,786	16,893	0	0	3	2	3	2	50	10	60	10
1985	87,274	16,876	0	0	3	2	3	2	50	10	60	10
1986	72,102	17,681	0	0	3	2	3	2	50	10	60	10
1987	79,639	12,501	0	0	3	2	3	2	50	10	50	10
1988	44,813	18,777	0	0	3	2	3	2	45	5	45	5
1989	53,293	11,448	0	0	7.5	2.5	7.5	2.5	45	5	45	5
1990	44,409	11,152	0	0	12.5	2.5	12.5	2.5	45	5	45	5
1991	31,978	6,263	0	0	17.5	2.5	17.5	2.5	35	5	35	5
1992	23,827	3,680	0	0	22.5	2.5	22.5	2.5	25	5	25	5
1993	20,987	5,552	0	0	25	5	25	5	25	5	25	5
1994	25,178	3,680	0	0	30	5	30	5	25	5	15	5
1995	19,381	2,847	0	0	35	5	35	5	25	5	15	5
1996	27,097	2,710	0	0	35	5	35	5	25	5	15	5
1997	27,695	2,085	0	0	35	5	35	5	25	5	15	5
1998	32,693	1,963	0	0	35	5	35	5	25	5	15	5
1999	22,330	2,841	0	0	35	5	35	5	25	5	15	5
2000	26,376	4,396	0	0	35	5	35	5	25	5	15	5
2001	20,483	3,959	0	0	35	5	35	5	15	5	15	5
2002	19,174	3,937	0	0	35	5	35	5	15	5	15	5
2003	15,687	3,734	0	0	35	5	25	5	15	5	15	5
2004	10,947	1,990	0	0	35	5	35	5	15	5	15	5
2005	13,172	2,388	1212	878	35	5	35	5	15	5	15	5
2006	15,004	2,071	3852	399	35	5	35	5	15	5	15	5
2007	7,807	1,404	2264	852	35	5	35	5	15	5	15	5
2008	8,447	4,711	3175	832	35	5	35	5	15	5	15	5
2009	5,351	3,105	5130	1710	35	5	35	5	15	5	15	5
2010	6,731	4,158	3684	1228	35	5	35	5	15	5	15	5
2011	7363	4325	3082	1027	35	5	35	5	15	5	15	5
2012	10398	1431	2267	756	35	5	35	5	15	5	15	5

M(min)= 0.020 Return time (m)= 1SW(min) 7 MSW(min) 18
M(max)= 0.040 1SW(max) 10 MSW(max) 21

Russia (Pechora River)

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	605	17,728	20	10	20	10	65	15	65	15
1972	825	24,175	20	10	20	10	65	15	65	15
1973	1,705	49,962	20	10	20	10	65	15	65	15
1974	1,320	38,680	20	10	20	10	65	15	65	15
1975	1,298	38,046	20	10	20	10	65	15	65	15
1976	991	34,394	20	10	20	10	65	15	65	15
1977	589	20,464	20	10	20	10	65	15	65	15
1978	759	26,341	20	10	20	10	65	15	65	15
1979	421	14,614	20	10	20	10	65	15	65	15
1980	1,123	39,001	20	10	20	10	65	15	65	15
1981	126	20,874	20	10	20	10	65	15	65	15
1982	54	13,546	20	10	20	10	65	15	65	15
1983	598	16,002	20	10	20	10	65	15	65	15
1984	1,833	15,967	20	10	20	10	65	15	65	15
1985	2,763	29,738	20	10	20	10	65	15	65	15
1986	66	32,734	20	10	20	10	65	15	65	15
1987	21	21,179	20	10	20	10	65	15	65	15
1988	3,184	12,816	20	10	20	10	65	15	65	15

Russia (Pechora River) Continued.

	Estimated numbers of adult returns to fresh water		Input data for analysis of total adult returns to homewaters — Marine unreported as % of adult returns to freshwater				Input data for spawner abundance analysis — Freshwater unreported as % of adult returns to freshwater			
			1SW		MSW		1SW		MSW	
	1SW	MSW	est	error	est	error	est	error	est	error
1989	24596	27404	10	5	10	5	65	15	65	15
1990	50	49950	10	5	10	5	65	15	65	15
1991	7975	47025	10	5	10	5	65	15	65	15
1992	550	54450	10	5	10	5	65	15	65	15
1993	68	67932	10	5	10	5	65	15	65	15
1994	3900	48100	10	5	10	5	65	15	65	15
1995	9280	70720	10	5	10	5	65	15	65	15
1996	8664	48336	10	5	10	5	65	15	65	15
1997	1440	38560	10	5	10	5	65	15	65	15
1998	780	59220	10	5	10	5	65	15	65	15
1999	2120	37880	10	5	10	5	65	15	65	15
2000	84	83916	10	5	10	5	65	15	65	15
2001	2244	41756	10	5	10	5	65	15	65	15
2002	405	44595	10	5	10	5	65	15	65	15
2003	1650	31350	10	5	10	5	65	15	65	15
2004	6075	20925	10	5	10	5	65	15	65	15
2005	2852	28148	10	5	10	5	65	15	65	15
2006	1472	30528	10	5	10	5	65	15	65	15
2007	817	42183	10	5	10	5	65	15	65	15
2008	300	49700	10	5	10	5	65	15	65	15
2009	1116	47385	10	5	10	5	65	15	65	15
2010	1096	53704	10	5	10	5	65	15	65	15
2011	2990	56810	10	5	10	5	65	15	65	15
2012	4424	27176	10	5	10	5	65	15	65	15

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	19
M(max)=	0.040		1SW(max)	8	MSW(max)	21

Sweden

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	6,330	420	30	15	30	15	52.5	12.5	57.5	12.5
1972	5,005	295	30	15	30	15	52.5	12.5	57.5	12.5
1973	6,210	1,025	30	15	30	15	52.5	12.5	57.5	12.5
1974	8,935	660	30	15	30	15	52.5	12.5	57.5	12.5
1975	9,620	160	30	15	30	15	52.5	12.5	57.5	12.5
1976	5,420	480	30	15	30	15	52.5	12.5	57.5	12.5
1977	2,555	360	30	15	30	15	52.5	12.5	57.5	12.5
1978	2,917	275	30	15	30	15	52.5	12.5	57.5	12.5
1979	3,080	800	30	15	30	15	52.5	12.5	57.5	12.5
1980	3,920	1,400	30	15	30	15	52.5	12.5	57.5	12.5
1981	7,095	407	30	15	30	15	52.5	12.5	57.5	12.5
1982	6,230	1,460	30	15	30	15	52.5	12.5	57.5	12.5
1983	8,290	1,005	30	15	30	15	52.5	12.5	57.5	12.5
1984	11,680	1,410	30	15	30	15	52.5	12.5	57.5	12.5
1985	13,890	590	30	15	30	15	52.5	12.5	57.5	12.5
1986	14,635	570	30	15	30	15	52.5	12.5	57.5	12.5
1987	11,860	1,700	30	15	30	15	52.5	12.5	57.5	12.5
1988	9,930	1,650	30	15	30	15	52.5	12.5	57.5	12.5
1989	3,180	4,610	30	15	30	15	52.5	12.5	57.5	12.5
1990	7,430	3,135	15	10	15	10	45	15	50	15
1991	8,990	3,620	15	10	15	10	45	15	50	15
1992	9,850	4,655	15	10	15	10	45	15	50	15
1993	10,540	6,370	15	10	15	10	45	15	50	15
1994	8,035	4,660	15	10	15	10	45	15	50	15
1995	9,761	2,770	15	10	15	10	37.5	12.5	42.5	12.5
1996	6,008	3,542	15	10	15	10	37.5	12.5	42.5	12.5
1997	2,747	2,307	15	10	15	10	37.5	12.5	42.5	12.5
1998	2,421	1,702	15	10	15	10	37.5	12.5	42.5	12.5
1999	3,573	1,460	15	10	15	10	37.5	12.5	42.5	12.5
2000	7,103	3,196	15	10	15	10	37.5	12.5	42.5	12.5
2001	4,634	3,853	15	10	15	10	37.5	12.5	42.5	12.5
2002	4,733	2,826	15	10	15	10	38	13	43	13
2003	2,891	3,214	15	10	15	10	38	13	43	13
2004	2,494	2,330	15	10	15	10	38	13	43	13
2005	2,122	1,770	15	10	15	10	38	13	43	13
2006	2,585	1,772	15	10	15	10	38	13	43	13
2007	1,228	2,442	15	10	15	10	38	13	43	13
2008	1,197	2,752	13	8	13	8	28	13	33	13
2009	1,269	2,495	13	8	13	8	28	13	33	13
2010	2,109	3,066	13	8	13	8	28	13	33	13
2011	2726	5759	18	8	18	8	45	15	50	15
2012	1900	4826	13	8	8	5	28	13	33	13

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

UK (England and Wales)

Year	Total catch (numbers)	Prop'n 1SW in catch	NE coast catch				Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)		NE - unrep	Proportion Scottish in:		
			Total	Drift nets	T/J nets	Prop'n 1SW - NE	est	error	est	error	est	error	est	error		Total	Drift	T/J
1971	109,861	0.55	60,353			0.55	38.5	9.5	38.5	9.5	48	10	35	10	32.6	0.95		
1972	108,074	0.42	51,681			0.42	39	10	39	10	47	10	35	10	32.6	0.95		
1973	114,786	0.53	62,842			0.53	38.5	9.5	38.5	9.5	47	10	35	10	32.6	0.95		
1974	104,325	0.65	52,756			0.65	39	10	39	10	47	10	35	10	32.6	0.95		
1975	113,062	0.59	53,451			0.59	38.5	9.5	38.5	9.5	47	10	35	10	32.6	0.95		
1976	54,294	0.64	15,701			0.64	37	9	37	9	48	10	36	10	32.6	0.94		
1977	94,282	0.62	52,888			0.62	39	10	39	10	49	10	36	10	32.6	0.93		
1978	93,125	0.69	51,630			0.69	38.5	9.5	38.5	9.5	49	10	36	10	32.6	0.92		
1979	75,386	0.81	43,464			0.81	38.5	9.5	38.5	9.5	48	10	35	10	32.6	0.91		
1980	90,218	0.55	45,780			0.55	39	10	39	10	48	10	36	10	32.6	0.9		
1981	121,039	0.48	69,113			0.48	38.5	9.5	38.5	9.5	48	10	36	10	32.6	0.89		
1982	80,289	0.67	50,167			0.67	38.5	9.5	38.5	9.5	48	10	36	10	32.6	0.88		
1983	116,995	0.72	77,277			0.72	37	9	37	9	49	10	36	10	32.7	0.87		
1984	94,271	0.74	59,295			0.74	36.5	9.5	36.5	9.5	49	10	36	10	32.6	0.86		
1985	95,531	0.66	57,356			0.66	39	10	39	10	49	10	36	10	32.6	0.85		
1986	110,794	0.62	63,425			0.62	37.5	9.5	37.5	9.5	49	10	36	10	32.6	0.84		
1987	83,439	0.68	36,143			0.68	38.5	9.5	38.5	9.5	49	10	36	10	32.6	0.83		
1988	110,163	0.69		47,465	3,384	0.69	40	10	40	10	48	10	36	10	32.6		0.82	0.5
1989	83,668	0.65		36,236	5,217	0.65	37	9	37	9	49	10	36	10	32.6		0.81	0.5
1990	86,676	0.52		48,219	3,311	0.52	37	9	37	9	49	10	36	10	31.6		0.8	0.5
1991	51,649	0.71		22,463	2,966	0.71	37.5	9.5	37.5	9.5	48	10	36	10	29.3		0.79	0.5
1992	44,586	0.77		17,574	2,570	0.77	40	10	40	10	48	10	36	10	26.9		0.78	0.5
1993	69,177	0.81		39,224	2,576	0.81	37.5	9.5	37.5	9.5	45	10	33	10	24.6		0.77	0.5
1994	88,121	0.77		41,298	5,256	0.77	24	6	24	6	45	10	33	10	22.4		0.76	0.5
1995	80,478	0.72		48,005	5,205	0.72	22.5	5.5	22.5	5.5	42	10	30	10	20.1		0.75	0.5
1996	46,696	0.65		15,172	3,409	0.65	20.5	5.5	20.5	5.5	41	10	30	10	17.9		0.75	0.5
1997	41,374	0.73		19,241	2,681	0.73	19	5	19	5	38	10	27	10	15.7		0.75	0.5
1998	36,917	0.82		17,328	937	0.82	19	5	19	5	35	10	25	10	15.7		0.75	0.5
1999	41,094	0.68		24,812	2,021	0.68	17.5	4.5	17.5	4.5	32	10	18	9	14.7		0.75	0.5
2000	60,953	0.79		40,059	3,295	0.79	15	4	15	4	32	10	15	8	6		0.75	0.5
2001	51,307	0.75		32,374	3,741	0.75	14.5	3.5	14.5	3.5	30	10	14	7	6		0.75	0.5
2002	45,669	0.76		27,685	3,295	0.76	15	4	15	4	30	10	14	7	6		0.75	0.5
2003	22,206	0.66		5,511	4,924	0.66	18	5	18	5	25	10	12	6	15		0.75	0.5
2004	30,559	0.81		5,921	5,096	0.81	18	5	18	5	28	10	12	6	15		0.75	0.5
2005	26,162	0.76		5,607	3,380	0.76	18	5	18	5	27	10	12	6	15		0.75	0.5
2006	22,056	0.78		4,040	3,526	0.78	18	5	18	5	25	10	11	5	15		0.75	0.5
2007	19,923	0.78		4,894	2,197	0.78	18	4	18	4	23	10	10	5	15		0.75	0.5
2008	19,036	0.76		3,649	2,592	0.76	18	4	18	4	23	10	10	5	15		0.75	0.5
2009	13,910	0.72		2,590	2,805	0.72	11	3	11	3	23	10	10	5	5		0.75	0.5
2010	32,695	0.78		12,214	7,768												0.75	0.5
2011	34575	0.57		15,517	8,631	0.78	11	3	11	3	23	10	10	5	5		0.75	0.5
2012	14699	0.51		3,805	3,471	0.57	11	3	11	3	25	10	12	6	5		0.75	0.5

M(min)= 0.020 Return time (m)= 1SW(min) 7 MSW(min) 17

M(max)= 0.040 1SW(max) 9 MSW(max) 19

UK (N. Ireland)-Foyle Fisheries Area

Year	Reported net catch (numbers)		Rod catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	1SW	MSW	est	error	est	error	est	error	est	error
1971	78,037	5,874			21.5	11.5	21.5	11.5	80	5	50	5
1972	64,663	4,867			21.5	11.5	21.5	11.5	80	5	50	5
1973	57,469	4,326			21.5	11.5	21.5	11.5	80	5	50	5
1974	72,587	5,464			21.5	11.5	21.5	11.5	80	5	50	5
1975	51,061	3,843			21.5	11.5	21.5	11.5	80	5	50	5
1976	36,206	2,725			21.5	11.5	21.5	11.5	80	5	50	5
1977	36,510	2,748			21.5	11.5	21.5	11.5	80	5	50	5
1978	44,557	3,354			21.5	11.5	21.5	11.5	80	5	50	5
1979	34,413	2,590			21.5	11.5	21.5	11.5	80	5	50	5
1980	45,777	3,446			21.5	11.5	21.5	11.5	80	5	50	5
1981	32,346	2,435			21.5	11.5	21.5	11.5	80	5	50	5
1982	55,946	4,211			21.5	11.5	21.5	11.5	80	5	50	5
1983	77,424	5,828			21.5	11.5	21.5	11.5	80	5	50	5
1984	27,465	2,067			21.5	11.5	21.5	11.5	80	5	50	5
1985	37,685	2,836			21.5	11.5	21.5	11.5	80	5	50	5
1986	43,109	3,245			21.5	11.5	21.5	11.5	80	5	50	5
1987	17,189	1,294			21.5	11.5	21.5	11.5	69	7	46	5
1988	43,974	3,310			21.5	11.5	21.5	11.5	64.5	6.5	36	4
1989	60,288	4,538			23.5	13.5	23.5	13.5	89	9	60	6
1990	39,875	3,001			13.5	3.5	13.5	3.5	62	6	38	4
1991	21,709	1,634			13.5	3.5	13.5	3.5	64.5	6.5	43	4
1992	39,299	2,958			16.5	6.5	16.5	6.5	56	6	33	3
1993	35,366	2,662			13.5	3.5	13.5	3.5	41	4	12	1
1994	36,144	2,720			19	9	19	9	70	7	40	4
1995	33,398	2,514			13.5	3.5	13.5	3.5	67	7	42	4
1996	28,406	2,138			15	5	15	5	57	10	34	10
1997	40,886	3,077			10	5	10	5	60	10	34	10
1998	37,154	2,797			10	5	10	5	25	5	23	8
1999	21,660	1,630			10	5	10	5	63	5	33	8
2000	30,385	2,287			10	5	10	5	58	5	33	8
2001	21,368	1,608			5	5	5	5	50	5	30	5
2002	37,914	2,854	9,163	690	3	2	3	3	15	3	15	3
2003	30,441	2,291	4,576	344	1	0	1	0	15	3	15	3
2004	20,730	1,560	4,570	344	1	0	1	0	15	3	15	3
2005	23,746	1,787	7,079	533	1	0	1	0	15	3	15	3
2006	11,324	852	4,886	368	1	0	1	0	15	3	15	3
2007	5,050	322	9,530	608	1	1	1	1	15	3	15	3
2008	3,880	292	4,755	304	1	0	1	0	15	3	15	3
2009	1,743	194	3,640	405	1	0	1	0	15	3	15	3
2010	0	0	4,257	473	1	0	1	0	15	3	15	3
2011	0	0	3770	1256	1	0	1	0	15	5	15	5
2012	0	0	4687	1563	1	0	1	0	13	8	13	8

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Note Assessment based on net catches for the period 1971 to 2001 and rod catches thereafter

UK (N. Ireland)-DCAL area

Year	Reported net catch (numbers)		Rod catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	1SW	MSW	est	error	est	error	est	error	est	error
1971	35,506	2,673			21.5	11.5	21.5	11.5	80	5	50	5
1972	34,550	2,601			21.5	11.5	21.5	11.5	80	5	50	5
1973	29,229	2,200			21.5	11.5	21.5	11.5	80	5	50	5
1974	22,307	1,679			21.5	11.5	21.5	11.5	80	5	50	5
1975	26,701	2,010			21.5	11.5	21.5	11.5	80	5	50	5
1976	17,886	1,346			21.5	11.5	21.5	11.5	80	5	50	5
1977	16,778	1,263			21.5	11.5	21.5	11.5	80	5	50	5
1978	24,857	1,871			21.5	11.5	21.5	11.5	80	5	50	5
1979	14,323	1,078			21.5	11.5	21.5	11.5	80	5	50	5
1980	15,967	1,202			21.5	11.5	21.5	11.5	80	5	50	5
1981	15,994	1,204			21.5	11.5	21.5	11.5	80	5	50	5
1982	14,068	1,059			21.5	11.5	21.5	11.5	80	5	50	5
1983	20,845	1,569			21.5	11.5	21.5	11.5	80	5	50	5
1984	11,109	836			21.5	11.5	21.5	11.5	80	5	50	5
1985	12,369	931			21.5	11.5	21.5	11.5	80	5	50	5
1986	13,160	991			21.5	11.5	21.5	11.5	80	5	50	5
1987	9,240	695			21.5	11.5	21.5	11.5	69	7	46	5
1988	14,320	1,078			21.5	11.5	21.5	11.5	64.5	6.5	36	4
1989	15,081	1,135			23.5	13.5	23.5	13.5	89	9	60	6
1990	9,499	715			13.5	3.5	13.5	3.5	62	6	38	4
1991	6,987	526			13.5	3.5	13.5	3.5	64.5	6.5	43	4
1992	9,346	703			16.5	6.5	16.5	6.5	56	6	33	3
1993	7,906	595			13.5	3.5	13.5	3.5	41	4	12	1
1994	11,206	843			19	9	19	9	70	7	40	4
1995	11,637	876			13.5	3.5	13.5	3.5	67	7	42	4
1996	10,383	781			15	5	15	5	57	10	34	10
1997	10,479	789			10	5	10	5	60	10	34	10
1998	9,375	706			10	5	10	5	25	5	23	8
1999	9,011	678			10	5	10	5	63	5	33	8
2000	10,598	798			10	5	10	5	58	5	33	8
2001	8,104	610			5	5	5	5	50	5	30	5
2002	3,315	249	2,218	167	3	3	3	3	14	9	14	9
2003	2,236	168	1,884	141	3	3	3	3	12	7	12	7
2004	2,411	181	3,053	230	1	1	1	1	18	10	18	10
2005	3,012	227	1,791	135	1	1	1	1	12	7	12	7
2006	2,288	172	1,289	97	1	1	1	1	12	8	12	8
2007	2,533	162	2,427	155	1	1	1	1	11	4	11	4
2008	1,825	116	2,444	156	1	0	1	0	14	7	14	7
2009	1,383	154	1,457	162	1	0	1	0	10	3	10	3
2010	1,723	191	1,327	147	1	0	1	0	15	3	15	3
2011	857	285	1132	378	1	0	1	0	15	5	15	5
2012	15	5	427	143	1	0	1	0				

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Note Assessment based on net catches for the period 1971 to 2001 and rod catches thereafter

UK (Scotland)-East

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	216,873	135,530	25	10	25	10	75	13	50	10
1972	220,106	183,875	25	10	25	10	77	13	51	10
1973	259,773	204,826	25	10	25	10	75	12	50	10
1974	245,424	158,959	25	10	25	10	82	14	56	11
1975	181,940	180,828	25	10	25	10	80	13	55	11
1976	150,069	92,179	25	10	25	10	77	13	51	10
1977	154,306	118,645	25	10	25	10	81	14	56	11
1978	158,859	139,763	25	10	25	10	76	13	51	10
1979	160,796	116,559	25	10	25	10	78	13	54	11
1980	101,665	155,646	17.5	7.5	17.5	7.5	77	13	52	10
1981	129,690	156,683	17.5	7.5	17.5	7.5	76	13	51	10
1982	175,374	113,198	17.5	7.5	17.5	7.5	71	12	45	9
1983	170,843	126,104	17.5	7.5	17.5	7.5	77	13	49	10
1984	175,675	90,829	17.5	7.5	17.5	7.5	70	12	44	9
1985	133,119	95,044	17.5	7.5	17.5	7.5	62	10	39	8
1986	180,292	128,654	17.5	7.5	17.5	7.5	59	10	38	8
1987	139,252	88,519	17.5	7.5	17.5	7.5	65	11	41	8
1988	118,614	91,151	17.5	7.5	17.5	7.5	40	7	29	6
1989	143,049	85,385	10	5	10	5	38	6	28	6
1990	63,318	73,971	10	5	10	5	40	7	29	6
1991	53,860	53,693	10	5	10	5	37	6	27	5
1992	79,883	67,968	10	5	10	5	32	5	26	5
1993	73,396	60,496	10	5	10	5	35	6	27	5
1994	80,429	72,758	10	5	10	5	33	6	26	5
1995	72,973	69,051	10	5	10	5	31	5	25	5
1996	56,627	50,365	10	5	10	5	29	5	24	5
1997	37,448	34,850	10	5	10	5	31	5	25	5
1998	44,952	32,231	10	5	10	5	24	4	23	5
1999	20,907	27,011	10	5	10	5	25	4	23	5
2000	36,871	31,280	10	5	10	5	22	4	22	4
2001	36,646	30,470	10	5	10	5	20	3	22	5
2002	26,616	21,740	10	5	10	5	19	3	21	4
2003	25,871	24,270	10	5	10	5	17	3	19	4
2004	31,667	30,773	10	5	10	5	17	3	19	4
2005	31,597	23,676	10	5	10	5	17	3	19	4
2006	30,739	22,954	10	5	10	5	15	3	17	4
2007	26,015	19,444	10	5	10	5	14	3	15	4
2008	18,586	20,757	10	5	10	5	11	3	14	4
2009	14,863	15,042	10	5	10	5	10	3	13	4
2010	28,252	22,908	10	5	10	5	10	3	13	4
2011	12485	24213	10	5	10	5	9	3	13	4
2012	17026	17046	10	5	10	5	8	3	12	4

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	17
M(max)=	0.040		1SW(max)	8	MSW(max)	18

UK (Scotland)-West

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	est	error	est	error	est	error	est	error
1971	45,287	26,071	35	10	35	10	38	6	25	5
1972	31,358	34,148	35	10	35	10	38	6	26	5
1973	33,317	33,094	35	10	35	10	37	6	25	5
1974	43,992	29,369	35	10	35	10	41	7	28	6
1975	40,424	27,145	35	10	35	10	40	7	28	6
1976	38,409	22,367	35	10	35	10	38	6	25	5
1977	39,952	20,335	35	10	35	10	41	7	28	6
1978	45,611	23,191	35	10	35	10	38	6	25	5
1979	26,440	15,950	35	10	35	10	39	7	27	5
1980	19,776	16,942	27.5	7.5	27.5	7.5	38	6	26	5
1981	21,048	18,038	27.5	7.5	27.5	7.5	38	6	26	5
1982	32,687	15,044	27.5	7.5	27.5	7.5	36	6	23	5
1983	38,774	19,857	27.5	7.5	27.5	7.5	39	6	25	5
1984	37,404	16,384	27.5	7.5	27.5	7.5	35	6	22	4
1985	24,861	19,571	27.5	7.5	27.5	7.5	31	5	19	4
1986	22,546	19,543	27.5	7.5	27.5	7.5	30	5	19	4
1987	25,533	15,475	27.5	7.5	27.5	7.5	32	5	20	4
1988	30,484	21,011	27.5	7.5	27.5	7.5	20	3	15	3
1989	31,892	18,501	20	5	20	5	19	3	14	3
1990	17,776	13,953	20	5	20	5	20	3	14	3
1991	19,748	11,500	20	5	20	5	18	3	14	3
1992	21,793	14,873	20	5	20	5	16	3	13	3
1993	21,121	11,230	20	5	20	5	18	3	13	3
1994	18,234	12,304	20	5	20	5	17	3	13	3
1995	16,831	9,137	20	5	20	5	15	3	13	3
1996	9,537	7,463	20	5	20	5	14	2	12	2
1997	9,059	5,504	20	5	20	5	15	3	13	3
1998	8,369	6,150	20	5	20	5	12	2	11	2
1999	4,147	3,587	20	5	20	5	12	2	12	2
2000	6,974	5,301	20	5	20	5	11	2	11	2
2001	5,603	4,191	20	5	20	5	10	2	11	2
2002	4,691	4,548	20	5	20	5	10	2	11	2
2003	3,536	3,061	20	5	20	5	5	1	5	1
2004	5,836	6,024	20	5	20	5	7	1	8	2
2005	7,428	4,913	20	5	20	5	7	1	8	2
2006	5,767	4,403	20	5	20	5	7	1	8	2
2007	6,178	4,470	20	5	20	5	7	1	8	2
2008	4,740	4,853	20	5	20	5	7	1	8	2
2009	3,250	4,095	20	5	20	5	6	1	7	2
2010	5,107	4,052	20	5	20	5	6	1	7	2
2011	3206	4246	20	5	20	5	6	1	6	2
2012	3388	3537	20	5	20	5	5	1	5	2

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.040		1SW(max)	9	MSW(max)	18

Faroes

Year	Catch (numbers)		Unreported as % of total 1SW		Unreported as % of total 1SW		Exp. rate 1SW (%)		Exp. rate MSW (%)		Prop'n wild
	1SW	MSW	est	error	est	error	est	error	est	error	
1971	2,620	105,796	10	5	0	0	100	100	100	100	1
1972	2,754	111,187	10	5	0	0	100	100	100	100	1
1973	3,121	126,012	10	5	0	0	100	100	100	100	1
1974	2,186	88,276	10	5	0	0	100	100	100	100	1
1975	2,798	112,984	10	5	0	0	100	100	100	100	1
1976	1,830	73,900	10	5	0	0	100	100	100	100	1
1977	1,291	52,112	10	5	0	0	100	100	100	100	1
1978	974	39,309	10	5	0	0	100	100	100	100	1
1979	1,736	70,082	10	5	0	0	100	100	100	100	1
1980	4,523	182,616	10	5	0	0	100	100	100	100	1
1981	7,443	300,542	10	5	0	0	100	100	100	100	0.98
1982	6,859	276,957	10	5	0	0	100	100	100	100	0.98
1983	15,861	215,349	10	5	0	0	100	100	100	100	0.98
1984	5,534	138,227	10	5	0	0	100	100	100	100	0.96
1985	378	158,103	10	5	0	0	100	100	100	100	0.92
1986	1,979	180,934	10	5	0	0	100	100	100	100	0.96
1987	90	166,244	10	5	0	0	100	100	100	100	0.97
1988	8,637	87,629	10	5	0	0	100	100	100	100	0.92
1989	1,788	121,965	10	5	0	0	100	100	100	100	0.82
1990	1,989	140,054	10	5	0	0	100	100	100	100	0.54
1991	943	84,935	10	5	0	0	100	100	100	100	0.54
1992	68	35,700	10	5	0	0	100	100	100	100	0.62
1993	6	30,023	10	5	0	0	100	100	100	100	0.69
1994	15	31,672	10	5	0	0	100	100	100	100	0.72
1995	18	34,662	10	5	0	0	100	100	100	100	0.8
1996	101	28,381	10	5	0	0	100	100	100	100	0.75
1997	0	0	15	5	0	0	100	100	100	100	0.8
1998	339	1,424	15	5	0	0	100	100	100	100	0.8
1999	0	0	15	5	0	0	100	100	100	100	0.8
2000	225	1,765	15	5	0	0	100	100	100	100	0.8
2001	0	0	15	5	0	0	100	100	100	100	0.8
2002	0	0	15	5	0	0	100	100	100	100	0.8
2003	0	0	15	5	0	0	100	100	100	100	0.8
2004	0	0	15	5	0	0	100	100	100	100	0.8
2005	0	0	15	5	0	0	100	100	100	100	0.8
2006	0	0	15	5	0	0	100	100	100	100	0.8
2007	0	0	15	5	0	0	100	100	100	100	0.8
2008	0	0	15	5	0	0	100	100	100	100	0.8
2009	0	0	15	5	0	0	100	100	100	100	0.8
2010	0	0	15	5	0	0	100	100	100	100	0.8
2011	0	0	15	5	0	0	100	100	100	100	0.8
2012	0	0	15	5	0	0	100	100	100	100	0.8

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

M(min)= 0.020
M(max)= 0.040

Return time (m)= 1SW(min) 0 MSW(min) 13
1SW(max) 1 MSW(max) 14

Proportion of 1SW returning as grilse = min 0.730
max 0.830

West Greenland

Year	Catch (t)	Unreported catch (t)	Mean weight (kg)	Proportion NAC		Proportion 1SW		Sample size		Stock composition	
				min	max	NAC	NEAC	NAC	NEAC	Country	MSW
1971	2,689	0	3.14	0.28	0.4	0.95	0.96	0	0	France	0.027
1972	2,113	0	3.44	0.34	0.37	0.95	0.96	0	0	Finland	0.001
1973	2,341	0	4.18	0.39	0.59	0.95	0.96	0	0	Iceland	0.001
1974	1,917	0	3.58	0.39	0.46	0.95	0.96	0	0	Ireland	0.147
1975	2,030	0	3.12	0.4	0.48	0.95	0.96	0	0	Norway	0.027
1976	1,175	0	3.04	0.38	0.48	0.95	0.96	0	0	Russia	0.000
1977	1,420	0	3.2125	0.38	0.57	0.95	0.96	0	0	Sweden	0.003
1978	984	0	3.35	0.47	0.57	0.95	0.96	0	0	UK (E&W)	0.149
1979	1,395	0	3.34	0.48	0.52	0.95	0.96	0	0	UK (NI)	0.000
1980	1,194	0	3.22	0.45	0.51	0.95	0.96	0	0	UK (Sc)	0.645
1981	1,264	0	3.17	0.58	0.61	0.95	0.96	0	0		
1982	1,077	0	3.11	0.6	0.64	0.95	0.96	0	0	Other	
1983	310	0	3.1	0.38	0.41	0.95	0.96	0	0		
1984	297	0	3.11	0.47	0.53	0.95	0.96	0	0	Total	1
1985	864	0	2.87	0.46	0.53	0.93	0.95	0	0		
1986	960	0	3.03	0.48	0.66	0.95	0.98	0	0		
1987	966	0	3.16	0.54	0.63	0.96	0.98	0	0		
1988	893	0	3.18	0.38	0.49	0.97	0.98	0	0		
1989	337	0	2.87	0.52	0.6	0.92	0.96	0	0		
1990	274	0	2.69	0.7	0.79	0.96	0.96	0	0		
1991	472	0	2.65	0.61	0.69	0.96	0.93	0	0		
1992	237	0	2.81	0.5	0.57	0.92	0.98	0	0		
1993	0	12	2.725	0.5	0.76	0.95	0.96	0	0		
1994	0	12	2.725	0.5	0.76	0.95	0.96	0	0		
1995	83	20	2.56	0.65	0.72	0.97	0.97	0	0		
1996	92	20	2.88	0.71	0.76	0.94	0.96	0	0		
1997	58	5	2.71	0.75	0.84	0.98	0.99	0	0		
1998	11	11	2.78	0.73	0.84	0.97	0.99	0	0		
1999	19	13	3.08	0.84	0.97	0.97	1.00	0	0		
2000	21	10	2.57	0	0	0.97	1.00	344	146		
2001	43	10	3	0.67	0.71	0.98	0.98	1	1		
2002	10	10	3	0	0	0.97	1.00	338	163		
2003	12	10	3	0	0	0.97	0.99	1212	567		
2004	17	10	3	0	0	0.97	0.97	1192	447		
2005	17	10	3	0	0	0.92	0.97	585	182		
2006	23	10	3	0	0	0.93	0.99	857	326		
2007	25	10	3	0	0	0.97	0.96	917	206		
2008	29	10	3	0	0	0.97	0.99	1593	260		
2009	28	10	4	0	0	0.93	0.89	1483	138		
2010	43	10	3	0	0	0.98	0.98	991	249		
2011	27	10	4	0	0	0.94	0.83	888	72		
20`12	35	10	3	0	0	0.93	0.98	1121	252		

M(min)=	0.020	1SW(min)	7	MSW(min)	8
M(max)=	0.040	1SW(max)	8	MSW(max)	10

Annex 6: Input data for run-reconstruction of Atlantic salmon in the NAC area used to do the run-reconstruction and estimates of returns and spawners by size group and age group for North America

6.i. Input data for the fishery at West Greenland used in the run reconstruction model.

				Genetic samples				Prop. 1SW salmon in the	
Year of the fishery	Reported harvest (t)	Unreported harvest estimate (t)	Mean weight of salmon (all age groups, kg)	NAC origin	NEAC origin	Prop. NAC minimum	Prop. NAC maximum	NAC	NEAC
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	3.69	888	72	0	0	0.939	0.831
2012	34.5	10	3.44	1121	252	0	0	0.932	0.980
Winbugs labels	WGHarv[]	WGUnHarv[]	WGMeanWt[]	WGSampleNAC[	WGSampleNE/	WGPropNAC	WGPropNACM	WGProp1SWNAC[]	WGProp1SWNEAC[]

6.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.

Year of the fishery	Catches of large salmon			Catches of small salmon		
	SFA 1 to 7	SFA 8 to 14A	FSC Labrador	SFA 1 to 7	SFA 8 to 14A	FSC Labrador
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	4447	0	0	11142
2012	0	0	4230	0	0	9988
Winbugs labels	Nlg_LBandNF1to7[]	Nlg_NF8to14a[]	Nlg_LBFSC[]	Nsm_LBandNF1to7[]	Nsm_NF8to14a[]	Nsm_LBFSC[]

6.iii. Input data for sea fisheries on large salmon and small salmon from St-Pierre and Miquelon used in the run reconstruction model.

Year of the fishery	Reported harvest (kg)	Catch in number (all sizes)	Catch in number (large)	Catch in number (small)
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
Winbugs labels	SPMHarv[]	Nall_StP&M	SPMNLarge[]	SPMNSmall[]

6.iv. Input data for large salmon for Labrador used in the run reconstruction.

	Large salmon																
	Commercial harvest			Proportion Labrador origin						Exploitation rate		Prop. 2SW or 1-fimm		Returns to Labrador		Angling catches all	
Year of fishery	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		All SFAx				Large		Large	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Released
* 1970	17633	45479	9595	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	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	486	0
* 1972	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	424	0
* 1973	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	1009	0
1974	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	803	0
1975	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	327	0
1976	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	830	0
1977	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	1286	0
1978	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	767	0
1979	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	609	0
1980	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	889	0
1981	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	520	0
1982	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	621	0
1983	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	428	0
1984	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	510	0
1985	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	294	0
1986	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	467	0
1987	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	633	0
1988	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	710	0
1989	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	461	0
1990	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	357	0
1991	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	93	0
1992	9981	19608	2752	0.6	0.8	0.6	0.8	0.6	0.8	0.5802858	0.8295805	0.70	0.90	0	0	781	10
1993	3825	9651	3620	0.6	0.8	0.6	0.8	0.6	0.8	0.381506	0.6232943	0.70	0.90	0	0	378	91
1994	3464	11056	857	0.6	0.8	0.6	0.8	0.6	0.8	0.2931677	0.5039819	0.70	0.90	0	0	455	347
1995	2150	8714	312	0.6	0.8	0.6	0.8	0.6	0.8	0.1421433	0.2513478	0.70	0.90	0	0	408	508
1996	1375	5479	418	0.6	0.8	0.6	0.8	0.6	0.8	0.1269629	0.2285846	0.70	0.90	0	0	334	489
** 1997	1393	5550	263	0.6433	0.7247	0.8839	0.9521	0.6	0.8	0.1700	0.3000	0.70	0.90	0	0	158	566
1998	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	7374	19486	231	814
1999	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	8827	23328	320	931
2000	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	12052	31850	262	1446
2001	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	12744	33677	338	1468
2002	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	9076	24769	207	978
2003	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	6676	21689	222	1326
2004	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	10964	23092	259	1519
2005	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	11159	30796	291	1290
2006	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	12414	29783	227	1133
2007	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	11887	31913	235	1222
2008	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.71	14700	37677	200	1461
2009	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.70	18643	60062	216	1219
2010	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.70	7498	20099	197	1080
2011	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.70	8994	78695	0	2114
2012	0	0	0	1	1	1	1	1	1	0.17	0.3	0.60	0.70	10054	57905	0	1440
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[]

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6.iv. Continued. Input data for small salmon for Labrador used in the run reconstruction.

	Small salmon														
	Commercial harvest			Proportion Labrador origin						Exploitation rate		Returns		Angling catches all	
Year of fishery	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		All SFAs		Small		Small	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Released
* 1970	14666	29441	8605	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4013	0
* 1971	19109	38359	11212	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3934	0
* 1972	14303	28711	8392	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2947	0
* 1973	3130	6282	1836	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	7492	0
1974	9848	37145	9328	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2501	0
1975	34937	57560	19294	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3972	0
1976	17589	47468	13152	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5726	0
1977	17796	40539	11267	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4594	0
1978	17095	12535	4026	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2691	0
1979	9712	28808	7194	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4118	0
1980	22501	72485	8493	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3800	0
1981	21596	86426	6658	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5191	0
1982	18478	53592	7379	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4104	0
1983	15964	30185	3292	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4372	0
1984	11474	11695	2421	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2935	0
1985	15400	24499	7460	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3101	0
1986	17779	45321	8296	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3464	0
1987	13714	64351	11389	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5366	0
1988	19641	56381	7087	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	5523	0
1989	13233	34200	9053	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	4684	0
1990	8736	20699	3592	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	3309	0
1991	1410	20055	5303	0.6	0.8	0.6	0.8	0.6	0.8	0.3	0.5	0	0	2323	0
1992	9588	13336	1325	0.6	0.8	0.6	0.8	0.6	0.8	0.219466	0.392801	0	0	2738	251
1993	3893	12037	1144	0.6	0.8	0.6	0.8	0.6	0.8	0.131858	0.245508	0	0	2508	1793
1994	3303	4535	802	0.6	0.8	0.6	0.8	0.6	0.8	0.098572	0.185922	0	0	2549	3681
1995	3202	4561	217	0.6	0.8	0.6	0.8	0.6	0.8	0.069899	0.132759	0	0	2493	3302
1996	1676	5308	865	0.6	0.8	0.6	0.8	0.6	0.8	0.035497	0.06772	0	0	2565	3776
** 1997	1728	8025	332	0.3557	0.4163	0.748	0.85	0.6	0.8	0.045	0.082	0	0	2365	2187
1998	0	0	0	1	1	1	1	1	1	0.045	0.082	97408	205197	2131	3758
1999	0	0	0	1	1	1	1	1	1	0.045	0.082	94894	199901	2076	4407
2000	0	0	0	1	1	1	1	1	1	0.045	0.082	117063	246602	2561	7095
2001	0	0	0	1	1	1	1	1	1	0.045	0.082	93660	197301	2049	4640
2002	0	0	0	1	1	1	1	1	1	0.045	0.082	62321	142951	2071	5052
2003	0	0	0	1	1	1	1	1	1	0.045	0.082	48256	122813	2112	4924
2004	0	0	0	1	1	1	1	1	1	0.045	0.082	69808	120244	1808	5968
2005	0	0	0	1	1	1	1	1	1	0.045	0.082	160038	281401	2007	7120
2006	0	0	0	1	1	1	1	1	1	0.045	0.082	132205	294669	1656	5815
2007	0	0	0	1	1	1	1	1	1	0.045	0.082	131895	257360	1762	4641
2008	0	0	0	1	1	1	1	1	1	0.045	0.082	142851	264694	1936	5917
2009	0	0	0	1	1	1	1	1	1	0.045	0.082	38031	140890	1355	3396
2010	0	0	0	1	1	1	1	1	1	0.045	0.082	55949	127622	1477	4704
2011	0	0	0	1	1	1	1	1	1	0.045	0.082	78531	466737	1628	5340
2012	0	0	0	1	1	1	1	1	1	0.045	0.082	64227	281051	1606	5169
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[]

6.v. 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
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	15959	26803	1355	5694	67241	112926	5709	23991	14079	23645	1195	5023	737	1238	63	263	103	174	9	37	365	613	31	130
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_L	SFA6Sm_H	SFA6Lg_L[	SFA6Lg_H	SFA7Sm_L	SFA7Sm_H	SFA7Lg_L[	SFA7Lg_H	SFA8Sm_L	SFA8Sm_H	SFA8Lg_L[	SFA8Lg_H

6.v. 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
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	3396	5703	288	1212	6943	11660	589	2477	5924	9948	503	2114	2363	3968	201	843	36183	60766	3072	12910	27566	46295	2340	9835
Bugs label	SFA9Sm_L	SFA9Sm_H	SFA9Lg_L[	SFA9Lg_H	SFA10Sm_	SFA10Sm_	SFA10Lg_L	SFA10Lg_H	SFA11Sm_	SFA11Sm_	SFA11Lg_L	SFA11Lg_H	SFA12Sm_	SFA12Sm_	SFA12Lg_L	SFA12Lg_H	SFA13Sm_	SFA13Sm_	SFA13Lg_L	SFA13Lg_H	SFA14ASm_L	SFA14ASm_H[	SFA14ALg_L[	SFA14ALg_H[]

6.vi. 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
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	13455	24298	1324	5664	56715	102401	5596	23878	11844	21410	1175	5003	618	1119	61	261	86	156	8	36	301	549	31	130
nbugs labe	SFA3SSm_L[]	SFA3SSm_H[]	SFA3SLg_l	SFA3SLg_I	SFA4SSm_	SFA4SSm_	SFA4SLg_l	SFA4SLg_I	SFA5SSm_	SFA5SSm_	SFA5SLg_l	SFA5SLg_I	SFA6SSm_	SFA6SSm_	SFA6SLg_l	SFA6SLg_I	SFA7SSm_	SFA7SSm_	SFA7SLg_l	SFA7SLg_I	SFA8SSm_	SFA8SSm_	SFA8SLg_l	SFA8SLg_

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6.vi (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
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	2824	5131	280	1203	5780	10497	559	2447	4943	8968	494	2105	1990	3595	198	840	30562	55146	2914	12752	23237	41966	2283	9778
inbugs lab	SFA9SSm_	SFA9SSm_	SFA9SLg_L	SFA9SLg_H	SFA10SSm	SFA10SSm	SFA10SLg_	SFA10SLg_	SFA11SSm	SFA11SSm	SFA11SLg_	SFA11SLg_	SFA12SSm	SFA12SSm	SFA12SLg_	SFA12SLg_	SFA13SSm	SFA13SSm	SFA13SLg_	SFA13SLg_	SFA14ASSm_	SFA14ASSm_H	SFA14ASLg_L	SFA14ASLg_H

6.vii. 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
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	58	530	57	527	245	2231	241	2221	51	467	51	465	3	24	3	24	0	3	0	3	1	12	1	12
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

6.vii. 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
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	12	113	12	112	25	230	24	228	22	197	21	196	9	78	9	78	132	1201	125	1186	101	915	98	909
Bugs labels	SFA9R2_L[	SFA9R2_H	SFA9S2_L[	SFA9S2_H	SFA10R2_	SFA10R2_	SFA10S2_	SFA10S2_	SFA11R2_	SFA11R2_	SFA11S2_	SFA11S2_	SFA12R2_	SFA12R2_	SFA12S2_	SFA12S2_	SFA13R2_	SFA13R2_	SFA13S2_	SFA13S2_	SFA14AR2_L[	SFA14AR2_H[]	SFA14AS2_L[	SFA14AS2_H[]

6.viii. Input data for small salmon returns to Quebec 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
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	510	3600	1314	0	0	10038	0	7332	850	6000	2191	0	0
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[]

6.viii. Continued. Input data for large salmon returns to Quebec by category of data used in the run reconstruction.

	Large returns Minimum								Large returns Maximum							
Year	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**FN Harvest**	**Other rivers**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**FN Harvest**	**Other rivers**
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	17917	0	3665	787	4490	367	0	0	18836	0	7434	1311	7483	612	0	0
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[]

6.viii. Continued. Input data for small salmon spawners to Quebec 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
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	489	3020	1220	7092	0	6869	829	5420	2097
Bugs labels	QCSSmC1_L[]	QCSSmC2_L[]	QCSSmC3_L[]	QCSSmC4_L[]	QCSSmC5_L[]	QCSSmC6_L[]	QCSSmC1_H[]	QCSSmC2_H[]	QCSSmC3_H[]	QCSSmC4_H[]	QCSSmC5_H[]	QCSSmC6_H[]

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6.viii. Continued. Input data for large salmon spawners to Quebec by category of data used in the run reconstruction.

	Large spawners Minimum						Large spawners Maximum					
Year	C1	C2	C3	C4	C5	C6	C1	C2	C3	C4	C5	C6
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	751	3739	367	17017	0	6990	1275	6732	612
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[

6.viii. Continued. Year specific harvest data (1984 to 2009) and returns and spawners data for Quebec 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
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
Bugs labels	QCSportSm[	QCFnSm[]	QCCmSm[]	QCSportLg[]	QCFnLg[]	QCCmLg[]	QCSm_L[]	QCSm_H[]	QCLg_L[]	QCLg_H[]	QCSSm_L[]	QCSSm_H[]	QCSLg_L[]	QCSLg_H[]

6.ix. 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
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	10206	3748	6591	6922	10043	3081
1988	7152	13998	14384	36938	96	185	2533	9993	4393	7735	4716	6697	3286
1989	4390	8492	9113	23385	149	287	2108	8422	4808	8469	6560	9437	3197
1990	4326	8369	14269	36639	284	545	1893	7524	3591	6320	5486	7918	5051
1991	2387	4668	14685	37736	188	361	2350	9428	2960	5213	7337	10563	2647
1992	4002	7787	21381	30728	95	183	2374	9378	2633	4634	6878	9809	2459
1993	1395	2684	15579	60246	22	43	1341	5207	2542	4470	4345	4820	2231
1994	3960	7745	13652	24887	169	310	1981	7926	1360	2396	3084	3495	1346
1995	2713	5333	25593	37215	384	576	1498	6032	2253	3969	3439	3998	1748
1996	3917	7754	11126	19117	394	591	3247	13227	3000	5278	4729	5397	2407
1997	2488	4898	8545	14244	387	581	3421	13958	1163	2045	2769	3176	1611
1998	1687	3260	6113	10797	385	577	2055	8382	924	1270	1372	1642	1526
1999	1780	3425	7081	11123	383	575	1557	6459	1419	1951	2375	2640	1168
2000	2270	4410	7458	11944	378	566	1467	6171	1078	1483	988	1206	533
2001	3779	7442	14477	19582	376	564	1689	7101	1822	2506	1938	2279	788
2002	2335	4540	5514	9233	372	557	1228	5197	382	525	483	548	504
2003	3947	7778	10958	17083	371	557	2380	9995	1854	2548	1056	1198	1192
2004	3005	5886	10641	18494	367	550	2639	11160	1028	1413	1335	1605	1283
2005	3422	6725	11151	20487	373	560	2217	9101	662	906	809	1012	984
2006	2551	4973	9714	16854	392	587	2114	8823	1263	1734	922	1171	1023
2007	4267	8422	9444	15438	412	618	1463	6144	603	825	616	736	954
2008	2848	5572	5839	11213	429	644	2189	9425	1793	2465	812	1042	1764
2009	3948	7781	10531	17041	402	602	1378	6389	827	1135	1485	1886	2069
2010	2978	5831	8082	13461	439	658	2151	9418	934	1277	829	992	**1078**
2011	7265	14445	21506	50014	653	980	3749	16967	1489	2044	2486	3259	3045
2012	3230	6338	7909	15473	415	622	748	3780	662	903	268	331	881
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[]**

6.ix. 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
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	11731	5950	10462	7865	11116	3081
1988	9933	19441	17627	45267	96	185	3289	11486	7321	12891	5360	7312	3286
1989	7701	14898	13955	35812	149	287	2738	9680	6969	12275	7393	10380	3197
1990	6362	12307	23164	59479	284	545	2458	8649	6191	10897	6235	8710	5051
1991	4773	9335	24273	62373	188	361	3052	10837	4112	7240	8312	11659	2647
1992	7411	14420	34573	49686	95	183	3083	10780	3657	6437	7749	10726	2459
1993	3487	6711	22602	87407	22	43	1742	5985	3218	5658	5260	5980	2231
1994	6600	12908	18098	32992	169	310	2573	9110	1743	3071	3659	4155	1346
1995	4171	8199	30324	44094	384	576	1946	6934	2532	4460	3728	4289	1748
1996	6026	11929	16317	28035	394	591	4217	15204	3571	6283	5535	6365	2407
1997	3828	7535	14711	24521	387	581	4443	16044	1550	2726	3210	3678	1611
1998	2595	5015	14774	26094	385	577	2669	9634	1359	1867	2032	2437	1526
1999	2738	5269	14550	22855	383	575	2022	7424	1709	2350	2734	3090	1168
2000	3493	6785	15734	25199	378	566	1905	7093	1315	1809	1189	1430	533
2001	5815	11449	22423	30330	376	564	2194	8162	1980	2724	2113	2501	797
2002	3592	6985	10980	18385	372	557	1595	5974	749	1029	639	752	526
2003	6072	11966	18726	29192	371	557	3091	11489	1952	2682	1128	1289	1199
2004	4623	9055	18669	32446	367	550	3427	12828	1302	1789	1402	1698	1316
2005	5265	10346	16769	30808	373	560	2879	10461	860	1177	890	1121	994
2006	3924	7651	18680	32412	392	587	2746	10142	1559	2141	997	1276	1030
2007	6565	12957	16007	26166	412	618	1900	7062	701	959	689	841	958
2008	4382	8572	10427	20023	429	644	2843	10834	1928	2650	858	1105	1799
2009	6074	11970	16985	27486	402	602	1789	7344	1034	1418	1678	2158	2095
2010	4581	8972	15848	26394	439	658	2793	10825	1061	1451	1117	1398	**1098**
2011	11177	22223	25301	58840	653	980	4869	19502	1504	2065	2598	3421	3087
2012	4969	9750	11299	22105	415	622	972	4344	786	1073	335	422	915
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[]**

6.ix. 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
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	22898	34218	508	762	633	2419	8833	11927	9203	10801	403
1999	4936	10929	21596	29150	413	620	705	2681	3971	5337	5508	6366	419
2000	7459	16520	32469	43811	395	593	615	2428	6155	8312	4796	5453	270
2001	4947	10953	27156	36712	415	622	822	3205	2326	3138	2513	2862	266
2002	11719	25958	42116	56132	390	585	844	3319	5197	7015	3501	3991	450
2003	3119	6904	27349	39602	515	773	773	3088	2844	3837	2292	2716	237
2004	12091	26783	44448	62457	330	495	1092	4339	3847	5192	3454	4297	319
2005	4117	9116	28180	44676	343	514	781	3015	2870	3871	3597	4640	319
2006	8724	19322	28362	47383	331	497	869	3406	5144	6940	3720	4743	450
2007	4259	9430	24130	42059	275	413	718	2820	4198	5664	2466	3136	297
2008	13601	30129	26780	45210	298	447	1508	6890	7282	9831	5924	7691	814
2009	5169	11445	9479	17611	233	350	302	1400	2066	2788	1603	2027	241
2010	8187	18132	49010	72514	258	387	864	3677	3686	4975	9114	11994	**525**
2011	10234	22668	39636	72082	291	436	1248	5175	3615	4878	4466	5943	1080
2012	4350	9631	6785	12901	279	419	144	839	350	470	178	219	24
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[]**

6.ix. 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
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	9977	3676	6519	5628	8597	2781
1988	6582	13386	13801	36355	96	185	2451	9748	4322	7664	3420	5248	3038
1989	3944	8021	8466	22739	149	287	2042	8222	4735	8396	6310	9158	2800
1990	3886	7903	13669	36039	284	545	1829	7336	3530	6260	4926	7292	4356
1991	2193	4460	14200	37251	188	361	2275	9204	2912	5165	6080	9158	2416
1992	3639	7400	20770	30116	95	183	2291	9131	2588	4589	5826	8633	2292
1993	1239	2521	15239	59907	22	43	1296	5072	2493	4421	3291	3654	2065
1994	3639	7401	13418	24653	166	307	1920	7743	1339	2375	2387	2680	1344
1995	2519	5124	25326	36949	380	576	1453	5897	2218	3934	3126	3652	1748
1996	3688	7502	10743	18662	388	591	3166	12987	2946	5224	4009	4585	2407
1997	2316	4710	8106	13754	385	581	3334	13698	1140	2022	2219	2565	1611
1998	1512	3076	5921	10562	382	577	2000	8216	915	1261	1068	1302	1526
1999	1581	3217	6572	10578	379	575	1523	6359	1409	1941	1934	2181	1168
2000	2057	4184	7160	11606	376	566	1438	6085	1072	1477	805	1004	1587
2001	3521	7161	13906	18965	374	564	1654	6995	1812	2497	1699	2008	1491
2002	2120	4312	5275	8961	371	557	1203	5121	378	521	317	356	511
2003	3683	7491	10560	16629	368	557	2333	9854	1834	2528	878	998	1192
2004	2770	5633	10189	17971	365	550	2581	10986	1017	1401	1238	1492	1283
2005	3175	6457	10597	19849	371	560	2162	8935	646	890	726	914	1088
2006	2329	4737	9271	16348	390	587	2062	8667	1248	1720	796	1023	1419
2007	3994	8124	8956	14896	409	618	1431	6047	587	809	530	633	1189
2008	2618	5325	5404	10730	429	644	2131	9252	1778	2450	736	953	2809
2009	3684	7494	10013	16465	401	602	1335	6263	811	1118	1391	1774	2292
2010	2743	5580	7611	12941	438	658	2100	9266	910	1253	726	877	**1482**
2011	6902	14038	20732	48983	652	980	3659	16698	1467	2023	2430	3196	3872
2012	2988	6077	7525	15021	414	622	733	3735	641	883	238	298	2056
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[]

6.ix. 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
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	11468	5835	10347	6343	9594	2781
1988	9141	18592	16913	44553	96	185	3183	11204	7203	12773	3835	5787	3038
1989	6919	14072	12965	34822	149	287	2652	9451	6862	12168	7099	10086	2800
1990	5715	11623	22190	58504	284	545	2376	8432	6087	10793	5576	8051	4356
1991	4386	8920	23472	61572	188	361	2955	10579	4045	7173	6833	10180	2416
1992	6738	13704	33583	48697	95	183	2976	10495	3594	6374	6511	9488	2292
1993	3099	6302	22109	86914	22	43	1683	5830	3156	5596	4026	4746	2065
1994	6065	12334	17787	32682	166	307	2493	8900	1717	3045	2827	3273	1344
1995	3873	7877	30007	43778	380	576	1887	6778	2492	4420	3362	3923	1748
1996	5674	11541	15755	27367	388	591	4112	14928	3507	6219	4688	5497	2407
1997	3563	7247	13955	23677	385	581	4330	15744	1520	2696	2565	3028	1611
1998	2326	4732	14309	25526	382	577	2597	9443	1346	1854	1675	2074	1526
1999	2433	4948	13505	21735	379	575	1979	7309	1697	2338	2251	2601	1168
2000	3165	6437	15106	24487	376	566	1867	6994	1307	1801	975	1216	1587
2001	5417	11018	21539	29374	374	564	2148	8040	1970	2714	1831	2210	1491
2002	3261	6633	10504	17843	371	557	1562	5887	741	1021	442	542	511
2003	5666	11525	18045	28418	368	557	3029	11327	1931	2661	919	1074	1192
2004	4261	8666	17875	31528	365	550	3351	12627	1287	1774	1287	1574	1283
2005	4884	9934	15936	29848	371	560	2807	10270	839	1156	791	1012	1088
2006	3583	7288	17830	31438	390	587	2678	9963	1541	2123	847	1113	1419
2007	6145	12498	15180	25248	409	618	1858	6950	683	941	586	726	1189
2008	4028	8192	9650	19160	429	644	2767	10634	1912	2634	767	1007	2231
2009	5668	11529	16150	26556	401	602	1734	7198	1014	1398	1565	2034	2318
2010	4221	8584	14923	25375	438	658	2727	10650	1034	1424	996	1275	**1502**
2011	10619	21597	24391	57627	652	980	4752	19193	1482	2043	2532	3353	3914
2012	4597	9349	10750	21459	414	622	952	4293	761	1048	300	387	2056
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[]

6.ix. 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
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	14650	22573	255	382	228	1464	8818	11912	8775	10348	403
1999	2465	7646	12265	17553	253	380	347	1837	3895	5261	5196	6048	419
2000	3727	11560	19220	27159	252	378	314	1717	6148	8305	4455	5087	270
2001	2470	7663	16165	22854	250	376	403	2217	2315	3127	2210	2530	266
2002	5857	18166	26637	36448	249	373	426	2334	5180	6998	3232	3689	450
2003	1557	4829	16300	24877	248	371	396	2201	2829	3822	2069	2469	237
2004	6043	18744	28270	40876	246	369	496	2934	3833	5178	3229	4039	319
2005	2056	6377	16882	28429	246	368	300	1881	2854	3855	3433	4450	319
2006	4359	13522	18147	31462	247	370	358	2201	5119	6915	3528	4501	450
2007	2127	6597	15184	27735	248	372	330	1905	4176	5642	2305	2937	297
2008	6798	21086	17040	29941	249	373	714	5018	7252	9801	5729	7467	814
2009	2581	8007	4929	10621	233	350	102	931	2051	2773	1472	1864	241
2010	4090	12688	31127	47580	256	384	374	2521	3674	4963	9032	11901	**525**
2011	5114	15864	25352	48064	290	435	562	3558	3601	4864	4391	5867	1080
2012	2172	6738	3367	7648	246	370	75	676	343	463	167	208	24
Winbugs labels	SF15SS m_L[]	SF15SS m_H[]	SF16SS m_L[]	SF16SS m_H[]	SF17SS m_L[]	SF17SS m_H[]	SF18SS m_L[]	SF18SS m_H[]	SF19_21 SSm_L[]	SF19_21 SSm_H[]	SF23SS m_L[]	SF23SS m_H[]	USASSm []

6.x. Estimated SMALL salmon returns for the six North American regions and North American total from the run reconstruction model.

Return	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA			North America		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	49310	34190	72900	135600	120200	150900	23630	19380	27880	62990	53910	72010	26530	22790	30310				299100	272900	328600
1971	64350	44690	95180	118800	105600	132000	18720	15340	22070	49860	42660	56960	18850	16050	21660	32	32	32	271400	244400	305400
1972	48540	33710	71630	110600	97640	123400	15600	12780	18390	62840	53690	72010	16960	14070	19840	18	18	18	255500	231500	283300
1973	13960	9439	19810	159900	142000	177700	20750	17000	24460	63160	54160	72200	24400	20750	28070	23	23	23	282400	260800	304100
1974	54100	37550	79620	120500	106700	134200	21000	17210	24770	98300	83720	112900	43610	37170	49980	55	55	56	338700	309000	371400
1975	103000	71440	153400	151000	133100	168900	22570	18510	26650	88390	75570	101200	33860	30440	37270	84	83	85	400100	358400	454700
1976	73760	51260	109000	158600	139100	178100	24950	20460	29430	128800	110800	146800	52910	46620	59180	186	184	188	440800	401900	484600
1977	65530	45660	96880	159600	140200	179100	22770	18650	26830	46260	39930	52630	46140	40250	52060	75	74	76	341700	309700	378900
1978	32800	22900	47940	139400	121800	157000	21200	17390	25030	41100	36190	46020	15800	14480	17130	155	154	156	251300	228800	274900
1979	42370	29250	62890	151800	133000	170700	27100	22220	31980	72320	62520	82150	48850	42270	55400	250	248	252	344000	315700	373800
1980	96090	66250	142900	172400	152200	192300	37240	30530	43930	63240	54520	71980	70620	62700	78560	818	811	825	441600	400200	493400
1981	105600	72590	157700	225300	197700	253400	52090	42700	61470	106400	85480	127400	59360	51000	67740	1130	1120	1140	552300	497900	615000
1982	73340	50570	109000	200700	177500	224100	29630	24280	34970	121300	96160	146400	36050	31330	40830	334	331	337	463300	417800	512900
1983	45970	31780	68210	156700	137800	175600	22490	18440	26530	37170	29620	44740	22620	19830	25390	295	292	298	286400	259100	316200
1984	24080	16770	35620	206100	179500	233000	26220	23920	28520	54230	44690	63830	42760	36580	48920	598	593	603	355000	324200	386100
1985	43260	29840	64430	195400	168300	222800	28020	25540	30480	86150	68180	104200	47430	40140	54750	392	389	396	402200	363700	441500
1986	65430	45100	97560	200300	175000	225600	40350	37340	43360	161400	127200	195600	49260	41640	56850	758	751	765	519700	467700	573100
1987	82050	56410	122500	135400	118500	152400	45940	42140	49730	122500	97220	147400	51240	43330	59220	1128	1118	1138	440200	395300	490800
1988	75720	51820	113000	217300	189900	244700	53080	48970	57160	172600	136700	208300	51900	44140	59660	992	983	1001	573900	517400	632600
1989	51830	35750	77210	107700	94730	120500	41490	38300	44680	102800	81070	124700	54620	46470	62750	1258	1247	1269	361200	326900	397800
1990	30260	20880	45030	152400	138200	166500	47380	44000	50750	117200	92840	141300	55250	46450	64080	687	681	693	404300	371100	437600
1991	24250	16590	36440	105600	96390	114800	37110	34530	39720	84980	67320	102600	28220	24520	31950	310	307	313	281300	257900	305200
1992	34310	24190	51160	229000	199900	258000	42000	38940	45060	192800	164400	221200	34010	29350	38640	1194	1183	1205	534600	490200	579200
1993	45800	33250	66820	265500	235200	295700	36390	33860	38930	136000	89020	183500	25720	21910	29500	466	462	470	511600	451500	572300
1994	33880	25150	48330	161000	138800	183200	34920	32520	37310	67310	57200	77490	10460	9358	11570	436	432	440	309100	282000	337000
1995	47870	35880	66930	204100	173400	234600	28110	26200	30020	60590	51900	69430	20000	17470	22530	213	211	215	362200	326500	398300
1996	90150	67780	127500	313500	269400	357600	37280	34800	39770	55310	47250	63400	31770	27490	36070	651	645	657	531100	477900	587600
1997	95270	73620	130900	177000	159200	194900	28870	26750	30990	30590	24730	36390	9380	8254	10500	365	362	368	342700	311700	382000
1998	151200	102900	199800	183800	171300	196200	29380	26890	31900	40840	34240	47430	20380	18740	22020	403	399	407	425900	375600	476600
1999	147400	100100	194700	201300	185700	216900	31290	28780	33790	35520	30790	40260	10590	9819	11360	419	415	423	426600	376000	477100
2000	181900	123600	240100	228800	216800	240700	29030	25960	32140	52160	45120	59220	12360	11330	13380	270	268	272	504700	444700	564300
2001	145400	98920	192000	156300	148100	164500	20150	18410	21890	42430	36950	47910	5417	5006	5831	266	264	268	369900	322600	417300
2002	102600	66300	138900	155600	143300	167900	32570	30300	34850	70550	60790	80220	9851	8996	10710	450	446	454	371500	331400	411700
2003	85600	51930	119000	242500	232800	252100	26680	24610	28730	41020	35100	47040	5844	5341	6348	237	235	239	401800	366100	437500
2004	95000	72320	117800	210100	192100	228200	35990	32470	39520	76030	64650	87360	8394	7635	9151	319	316	322	425900	393800	458000
2005	220800	166300	275200	221500	176600	266500	24270	22080	26450	45360	37450	53310	7488	6788	8188	319	316	322	519600	446300	593000
2006	213700	140400	286600	212800	194300	231400	29750	27550	31960	54380	44070	64840	10270	9293	11260	450	446	454	521300	445200	597300
2007	194700	138200	251100	183500	158700	208600	22600	20600	24620	42000	33460	50620	7733	6979	8486	297	294	300	451000	387600	513900
2008	203800	148900	258600	247800	222200	273300	37570	34560	40590	62400	50210	74610	15370	13880	16860	814	807	821	567800	504700	630700
2009	89670	43140	135800	222600	194200	250900	22230	20330	24110	22980	18040	27980	4241	3844	4639	241	239	243	361700	305300	418100
2010	91910	59550	124000	267700	256200	279300	28080	25680	30470	76560	64580	88490	14880	13410	16350	525	520	530	479600	442400	516700
2011	271600	97590	447100	243300	216200	270300	38400	35540	41270	75910	59700	92110	9448	8511	10390	1080	1070	1090	640000	463500	817500
2012	172800	75060	270300	242300	215100	269300	25240	23050	27440	17670	13760	21600	609	550	667	24	24	24	458500	357100	560200

6.xi. Estimated SMALL salmon spawners for the six North American regions and North American total from the run reconstruction model.

Spawner	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA			North America		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	45290	30180	68890	105200	89920	120600	13820	11330	16290	39330	30330	48340	18400	14630	22150						
1971	60420	40750	91250	92190	78940	105400	11670	9571	13770	32620	25500	39700	12170	9347	14970	29	29	29	209900	183000	244000
1972	45590	30770	68680	86200	73380	99060	10270	8423	12120	40250	31020	49350	10820	7939	13700	17	17	17	194100	170200	221700
1973	6463	1947	12320	124300	106500	142200	13730	11270	16210	45590	36630	54570	18310	14650	21950	13	13	13	208700	187400	230100
1974	51600	35050	77120	94080	80410	107700	12590	10320	14850	76140	61610	90770	33100	26690	39530	40	40	40	268800	239500	301300
1975	99080	67470	149500	117500	99710	135500	14510	11900	17120	67310	54530	80130	26160	22770	29570	67	66	68	325800	284200	380400
1976	68030	45530	103300	124100	104400	143700	16210	13310	19140	90030	72140	107900	40770	34470	47020	151	150	152	340900	302100	384800
1977	60930	41070	92290	125200	105800	144700	15010	12300	17700	24770	18670	30900	32160	26250	38020	54	54	54	259600	227800	296600
1978	30100	20210	45250	110800	93190	128400	14300	11730	16870	22770	17970	27600	9019	7699	10350	127	126	128	188100	165700	211300
1979	38250	25130	58770	120800	101800	139600	19840	16270	23400	49710	40130	59270	36560	29950	43130	247	245	249	266600	238600	296300
1980	92290	62450	139100	136500	116500	156600	26030	21320	30700	43540	35040	51940	49570	41610	57510	722	716	729	349900	309100	401200
1981	100400	67400	152500	178900	151000	206600	38710	31740	45660	70080	49320	90690	40280	31900	48650	1009	1000	1018	431600	377500	493800
1982	69230	46470	104900	158800	135500	182200	21090	17290	24890	89050	64200	114200	24440	19710	29170	290	287	293	364900	319400	414200
1983	41600	27410	63840	124300	105300	143100	15020	12320	17740	23730	16220	31280	14820	12040	17600	255	253	257	220800	193600	250500
1984	21140	13830	32690	167100	140500	193800	20370	18080	22690	21820	12340	31280	32760	26590	38900	540	535	545	264600	233800	295500
1985	40160	26740	61330	158900	131700	186200	20090	17630	22560	59940	42290	77810	36190	28890	43460	363	360	366	317200	278700	356300
1986	61960	41640	94090	162700	137100	188100	27710	24750	30680	122300	88290	156100	39500	31910	47130	660	654	666	417100	365100	470600
1987	76690	51040	117100	111000	94040	127900	32780	29040	36530	89960	65170	114800	41120	33170	49110	1087	1077	1097	354600	310000	404900
1988	70200	46300	107500	177500	150400	204700	36360	32320	40430	127200	91860	163000	42190	34450	49970	923	915	931	456800	400900	515500
1989	47150	31070	72530	89160	76270	101900	30720	27530	33870	69500	47840	91230	43570	35460	51620	1080	1070	1090	282800	248300	319200
1990	26950	17570	41720	122400	108200	136600	32790	29470	36130	84490	60320	108600	44050	35250	52850	617	611	623	312200	279400	345700
1991	21930	14270	34120	85070	75840	94300	25240	22670	27770	66430	48860	84000	22300	18560	26000	235	233	237	222000	198800	245900
1992	31550	21430	48390	205200	176200	234400	27380	24350	30380	159800	131600	187900	26270	21640	30940	1124	1114	1134	452700	408500	497300
1993	43110	30560	64140	239200	208900	269400	22010	19520	24490	112700	65610	160100	20470	16690	24260	444	440	448	439700	379400	500300
1994	30960	22230	45420	129900	107500	152100	20720	18380	23070	45030	35330	54710	9133	8046	10220	427	423	431	237200	210400	264900
1995	45040	33060	64110	171200	140500	201900	17700	15830	19590	48110	39410	56770	17870	15340	20390	213	211	215	301500	266000	337800
1996	87210	64840	124500	274700	230900	318800	23180	20750	25600	34190	28250	40130	28220	23960	32530	651	645	657	450700	397900	507000
1997	92680	71040	128300	151900	134000	169700	17960	15890	20030	19110	14680	23560	8344	7222	9468	365	362	368	291400	260700	330600
1998	148600	100400	197300	158400	145900	170800	21190	18700	23680	26250	21240	31200	19920	18280	21550	403	399	407	374700	324400	425500
1999	144900	97570	192200	176400	160700	192100	23730	21240	26220	21380	17730	25010	10200	9434	10970	419	415	423	377000	326500	427400
2000	178600	120400	236800	204700	192700	216700	21070	18000	24130	32160	26740	37620	12000	10970	13030	270	268	272	448800	389200	508500
2001	142800	96400	189500	133500	125300	141700	13670	12130	15220	26200	22040	30350	5089	4687	5497	266	264	268	321600	274500	369100
2002	99990	63720	136300	132900	120600	145200	21350	19130	23560	45260	37640	52930	9549	8699	10400	450	446	454	309400	270000	349100
2003	83000	49330	116400	219600	209900	229200	19310	17270	21360	25420	21070	29730	5590	5096	6091	237	235	239	353200	317600	388400
2004	92590	69910	115400	188400	170500	206500	26300	22800	29790	49050	40310	57720	8140	7389	8888	319	316	322	364900	333500	396200
2005	218000	163500	272500	197200	152100	241900	18280	16140	20440	28240	22530	34000	7296	6608	7989	319	316	322	469000	396100	542300
2006	211500	138200	284400	191000	172400	209600	21600	19420	23780	35310	27540	43110	10030	9066	11000	450	446	454	469800	393800	545400
2007	192500	136000	248900	167700	142800	192800	16720	14720	18700	27270	21040	33480	7527	6786	8276	297	294	300	412000	348800	474900
2008	201200	146400	256100	217400	191900	243000	26700	23730	29680	40620	31100	50100	15120	13650	16600	814	807	821	501900	439400	564500
2009	87980	41450	134100	197100	168700	225600	16220	14350	18090	13880	10060	17690	4080	3692	4469	241	239	243	319400	263100	375600
2010	89960	57600	122100	235300	223700	246900	20500	18140	22870	49530	40650	58360	14780	13310	16250	525	520	530	410500	374500	446400
2011	269500	95430	445000	214200	187200	241100	27810	24970	30650	49630	37820	61480	9362	8419	10300	1080	1070	1090	571100	396000	748500
2012	170700	72940	268200	213800	186700	241200	18410	16240	20560	10650	7616	13680	590	532	649	24	24	24	414200	312600	515600

6.xii. Estimated LARGE salmon returns for the six North American regions and North American total from the run reconstruction model.

Return	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA			North America		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	10120	4969	17000	14870	11820	17890	103400	84770	122000	69570	67140	71990	20280	17980	22610				218600	198200	238900
1971	14410	7068	24290	12570	10010	15120	59160	48520	69820	40050	37600	42490	15880	14120	17650	653	647.1	658.9	143200	128300	158500
1972	12440	6098	20850	12670	10110	15220	77220	63310	91110	56970	48950	65050	18980	17110	20840	1383	1371	1395	180100	161300	198800
1973	17300	8494	29170	17330	13780	20900	85200	69920	100600	53370	45550	61170	14760	13430	16090	1427	1414	1440	190000	168700	211400
1974	17060	8365	28790	14260	12680	15850	114200	93730	134900	77610	65910	89260	28580	26300	30830	1394	1381	1407	253700	226900	280700
1975	15890	7810	26830	18420	16110	20710	97070	79580	114600	50360	43020	57760	30630	28020	33230	2331	2310	2352	215200	192800	237800
1976	18320	9003	30800	16640	14640	18650	96450	79160	113900	48750	41370	56130	28800	25970	31630	1317	1305	1329	210900	188100	234100
1977	16250	7979	27390	14600	12950	16250	113800	93350	134300	87840	75210	100400	38080	34600	41540	1998	1980	2016	273000	246000	300400
1978	12740	6259	21450	11350	10340	12340	102400	84000	120900	43840	38800	48930	22260	20560	23960	4208	4170	4246	197300	176100	218500
1979	7299	3569	12250	7198	6297	8100	56530	46310	66690	17850	15670	20030	12810	11600	14030	1942	1925	1959	103800	92130	115600
1980	17360	8521	29320	12050	11110	12990	134400	110200	158600	62460	54620	70290	43730	39580	47890	5796	5744	5848	276400	247700	305100
1981	15620	7668	26300	28880	25300	32450	105600	86560	124600	39320	32940	45710	28210	25460	30980	5601	5551	5651	223700	200400	247100
1982	11590	5670	19530	11600	10090	13110	93720	76770	110500	54130	42800	65380	23670	21520	25810	6056	6002	6111	201000	178200	223900
1983	8353	4112	14070	12460	11280	13640	76860	63030	90670	40630	33740	47590	20600	18380	22820	2155	2136	2174	161400	144200	178500
1984	6028	2957	10110	12390	9150	15630	71110	67670	74520	32750	23460	41990	24530	21150	27860	3222	3193	3251	150200	138200	162100
1985	4715	2318	7958	10940	7681	14180	73540	69250	77870	44580	31930	57200	34180	29340	39030	5529	5479	5579	173700	158500	188700
1986	8162	4010	13690	12300	9452	15150	87490	82860	92140	68760	49300	88040	28250	23810	32680	6176	6120	6231	211300	189800	232800
1987	11030	5423	18570	8435	6454	10420	82930	78650	87190	46660	34170	59070	17700	15020	20360	3081	3053	3109	170200	154800	185700
1988	6916	3377	11620	12980	9886	16080	90600	85440	95730	53700	39590	67680	16440	13710	19170	3286	3256	3316	184100	167800	200400
1989	6651	3256	11170	6915	5387	8446	81310	77140	85460	42570	31500	53710	18500	15630	21390	3197	3168	3226	159300	146200	172600
1990	3824	1875	6443	10270	8359	12200	79860	75120	84600	56710	39810	73450	16020	13500	18540	5051	5005	5096	171900	153600	189900
1991	1877	920.5	3148	7567	6154	8987	73690	69470	77910	57550	40020	75240	15650	13430	17870	2647	2623	2671	159100	140600	177600
1992	7534	3982	12740	31550	22170	40850	74120	69690	78560	60110	51470	68790	14280	12310	16260	2459	2437	2481	190400	175900	204800
1993	9464	5911	15070	17120	13800	20430	57200	54830	59570	63890	34830	93130	10060	8898	11210	2231	2211	2251	160500	130400	190300
1994	12950	8481	20330	17360	13820	20930	58130	55780	60480	41430	33220	49560	6312	5657	6969	1346	1334	1358	138000	127100	149400
1995	25550	18140	37410	19050	14690	23410	67090	64440	69720	48320	41270	55360	7507	6588	8423	1748	1732	1764	169800	157400	184200
1996	18830	13380	27640	28920	23750	34090	61130	58330	63940	41330	33160	49550	10880	9586	12170	2407	2385	2429	164000	151900	176900
1997	16190	11580	23740	27980	22950	33050	50320	48040	52610	36020	28550	43550	5585	4996	6169	1611	1597	1626	138200	127300	149700
1998	13460	7982	18890	35260	27430	43080	38490	36330	40660	30850	24450	37280	3848	3535	4160	1526	1512	1540	123400	111500	135300
1999	16080	9547	22610	32080	24940	39280	40500	38160	42830	27950	23030	32790	4942	4593	5289	1168	1157	1178	122700	111300	134100
2000	21990	13030	30870	27000	22990	31040	38890	35900	41900	30560	25220	35930	2871	2614	3130	533	528.2	537.8	121800	110000	133700
2001	23210	13800	32620	17870	15160	20550	40700	37620	43790	40650	35190	46110	4657	4265	5056	797	789.8	804.2	127900	116000	139800
2002	16940	9866	23980	16800	13690	19910	29200	26770	31630	24240	19840	28600	1585	1444	1725	526	521.3	530.7	89270	79800	98710
2003	14230	7422	20930	24460	19410	29540	45420	42070	48810	40740	33710	47700	3526	3188	3862	1199	1188	1210	129600	117900	141200
2004	17090	11590	22500	22200	16980	27360	39660	37000	42300	41000	32740	49250	3095	2825	3368	1316	1304	1328	124300	112700	135900
2005	20940	12150	29830	28430	20520	36300	38300	35910	40670	38740	30830	46660	2024	1835	2212	994	985	1003	129400	114700	144200
2006	21070	13280	28890	35680	29990	41470	35850	33540	38160	38270	30700	45800	2987	2683	3291	1030	1021	1039	134900	122100	147700
2007	21870	12890	30870	29630	23430	35800	32760	30530	34990	35830	29630	42090	1595	1453	1737	958	949.4	966.6	122600	109600	135700
2008	26190	15850	36500	28890	22550	35190	38680	35430	41910	29070	22770	35380	3270	2920	3621	1799	1783	1815	127900	113500	142300
2009	39330	20720	57980	34410	23900	44970	37630	35120	40130	36340	30060	42620	3144	2849	3440	2095	2076	2114	152900	129900	176100
2010	13820	8126	19480	35350	28690	41980	40070	37430	42680	35280	28590	41940	2513	2283	2744	1098	1088	1108	128100	116600	139600
2011	43680	12370	75170	43420	31290	55510	51240	48090	54350	71770	53960	89700	4794	4317	5272	3087	3059	3115	218000	178600	257700
2012	34010	12510	55510	39940	29070	50780	37050	34590	39510	27220	21510	32990	1307	1171	1445	915	906.8	923.2	140400	115100	165900

6.xiii. Estimated LARGE salmon spawners for the six North American regions and North American total from the run reconstruction model.

Spawner	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	9563	4407	16440	12740	9711	15790	39140	32090	46170	11900	9635	14150	7888	5567	10200			
1971	13930	6582	23800	10980	8435	13520	20230	16590	23890	11820	9427	14220	8191	6429	9960	490	486	494
1972	12010	5674	20430	11280	8722	13830	39680	32520	46810	33310	25470	41150	11980	10120	13850	1038	1029	1047
1973	16290	7485	28160	15420	11860	18980	40370	33080	47620	35410	27770	42990	7607	6271	8948	1100	1090	1110
1974	16250	7562	27980	13050	11480	14620	49090	40250	57880	55820	44400	67260	15200	12940	17480	1147	1137	1157
1975	15560	7483	26500	17170	14870	19440	40800	33440	48130	33740	26450	40950	17850	15250	20460	1942	1925	1960
1976	17490	8173	29970	15590	13580	17610	38770	31810	45750	29200	22140	36240	16980	14150	19800	1126	1116	1136
1977	14970	6693	26110	11850	10190	13510	55870	45780	65850	55590	43250	67910	21550	18110	25010	643	637	649
1978	11970	5492	20680	9786	8780	10780	51140	42000	60390	19390	14620	24180	10870	9160	12570	3314	3284	3344
1979	6690	2960	11650	6636	5733	7542	21940	17990	25880	8798	6674	10890	7939	6711	9159	1509	1495	1523
1980	16470	7632	28430	10130	9188	11070	61010	49970	71900	34460	26870	41980	23920	19760	28060	4263	4225	4301
1981	15100	7148	25780	27500	23940	31060	44750	36680	52810	16060	9831	22250	12730	9968	15480	4334	4295	4373
1982	10970	5049	18900	10350	8850	11860	45360	37190	53530	27020	15760	38330	10400	8262	12530	4643	4601	4685
1983	7925	3684	13650	11080	9899	12260	29680	24300	34980	18060	11190	24900	5721	3517	7952	1769	1753	1785
1984	5518	2447	9596	11870	8628	15100	37110	34120	40080	28510	19190	37800	20020	16660	23360	2547	2524	2570
1985	4421	2024	7664	10910	7658	14180	35440	31560	39330	43290	30640	55950	28530	23670	33380	4884	4840	4928
1986	7695	3543	13230	12220	9387	15080	40610	36600	44680	66470	47180	85780	24880	20460	29340	5570	5520	5620
1987	10390	4790	17940	8391	6404	10370	36050	32580	39500	43910	31580	56330	16060	13410	18730	2781	2756	2806
1988	6206	2667	10910	12910	9795	16010	43160	38590	47740	51950	37910	65970	14790	12080	17510	3038	3011	3065
1989	6190	2795	10710	6888	5359	8423	41150	37470	44830	40700	29600	51740	18100	15210	21010	2800	2775	2825
1990	3467	1518	6086	10230	8310	12140	40920	36550	45260	54840	38050	71620	15250	12740	17760	4356	4317	4395
1991	1784	828	3055	7538	6118	8953	33070	29390	36740	56220	38640	73860	14120	11900	16330	2416	2394	2438
1992	6752	3200	11950	31410	22070	40730	32360	28480	36230	58200	49590	66850	12980	11010	14950	2292	2271	2313
1993	9077	5524	14690	16940	13610	20270	24960	23130	26770	62900	33810	92200	8760	7601	9922	2065	2046	2084
1994	12460	7991	19840	16910	13350	20470	24460	22700	26220	40340	32210	48490	5431	4791	6078	1344	1332	1356
1995	25090	17680	36950	18580	14210	22960	34610	32670	36530	47600	40590	54610	7102	6186	8011	1748	1732	1764
1996	18450	13000	27260	28350	23190	33530	30050	27830	32250	40190	32060	48260	9961	8667	11250	2407	2385	2429
1997	15980	11370	23530	27560	22520	32620	24830	23040	26630	34700	27340	42100	4904	4317	5491	1611	1597	1626
1998	13150	7670	18570	34930	27090	42780	23040	21230	24820	29920	23620	36270	3474	3162	3786	1526	1512	1540
1999	15660	9134	22200	31760	24610	38920	27910	25750	30080	26420	21620	31230	4443	4098	4790	1168	1157	1178
2000	21580	12620	30460	26490	22490	30540	26720	23850	29600	29480	24210	34780	2649	2392	2908	1587	1573	1601
2001	22720	13310	32140	17500	14790	20190	27470	24870	30080	39260	33850	44660	4362	3968	4756	1491	1478	1504
2002	16640	9562	23680	16500	13390	19610	20710	18440	23010	23300	18980	27650	1373	1236	1511	511	506	516
2003	13880	7067	20570	24090	19060	29160	33760	30500	37050	39460	32520	46410	3292	2956	3629	1192	1181	1203
2004	16680	11180	22090	21840	16640	27020	28140	25630	30670	39620	31440	47720	2961	2692	3230	1283	1271	1295
2005	20520	11730	29410	27870	19990	35790	28080	25820	30360	37300	29440	45060	1900	1714	2084	1088	1078	1098
2006	20730	12940	28550	35250	29500	40970	26070	23920	28220	36860	29410	44340	2813	2513	3112	1419	1406	1432
2007	21520	12530	30510	29270	23090	35420	23580	21460	25680	34460	28330	40610	1468	1329	1607	1189	1178	1200
2008	25850	15500	36150	28290	21950	34650	29820	26650	32970	27740	21530	33950	3161	2811	3509	2231	2211	2251
2009	38990	20380	57650	34130	23610	44660	28710	26290	31140	34920	28690	41160	3005	2713	3296	2318	2297	2339
2010	13510	7821	19180	34800	28160	41470	32030	29480	34590	33780	27180	40390	2365	2135	2595	1502	1488	1515
2011	43460	12160	74950	42840	30730	54930	40260	37220	43280	69980	52220	87550	4709	4228	5181	3914	3879	3949
2012	33870	12360	55360	39540	28650	50400	28410	26050	30770	26220	20530	31900	1247	1110	1385	2056	2038	2074

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6.xiv. Estimated 2SW salmon returns for the six North American regions and North American total from the run reconstruction model.

Return	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA			North America		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	10120	4969	17000	4133	3084	5181	75470	61880	89020	59590	57550	61630	17130	15030	19250				166800	151200	182400
1971	14410	7068	24290	3582	2606	4567	43190	35420	50970	34810	32630	37010	13520	11880	15140	653	647	659	110500	98260	123600
1972	12440	6098	20850	3735	2718	4746	56370	46220	66510	49460	42400	56440	15990	14280	17690	1383	1371	1395	139700	124600	155100
1973	17300	8494	29170	4612	3467	5771	62200	51040	73420	47670	40640	54690	12910	11690	14140	1427	1414	1440	146600	129200	164700
1974	17060	8365	28790	3636	2860	4417	83380	68420	98460	67150	57030	77350	27120	24880	29370	1394	1381	1407	200300	178500	222500
1975	15890	7810	26830	5210	3871	6533	70860	58090	83630	42950	36640	49310	28870	26280	31450	2331	2310	2352	166600	148600	185200
1976	18320	9003	30800	4363	3312	5398	70410	57780	83110	40240	34240	46280	26630	23830	29440	1317	1305	1329	161800	143200	181100
1977	16250	7979	27390	3549	2861	4238	83050	68140	98010	80560	68950	92180	32290	28930	35660	1998	1980	2016	218200	195700	241000
1978	12740	6259	21450	3588	2929	4252	74760	61320	88250	36300	32180	40430	18780	17170	20390	4208	4170	4246	150800	134100	167600
1979	7299	3569	12250	1742	1341	2142	41260	33810	48690	12020	10590	13440	10510	9415	11610	1942	1925	1959	74980	65820	84270
1980	17360	8521	29320	3903	3187	4616	98110	80440	115700	56860	49800	63990	38660	34750	42590	5796	5744	5848	221300	198300	244500
1981	15620	7668	26300	7027	5475	8577	77070	63190	90930	24360	20360	28340	23210	20770	25630	5601	5551	5651	153400	135300	171800
1982	11590	5670	19530	3165	2516	3809	68410	56040	80660	41950	32780	51060	16740	14850	18620	6056	6002	6111	148300	130400	166100
1983	8353	4112	14070	3702	3018	4384	56110	46010	66190	31290	25740	36800	16480	14510	18470	2155	2136	2174	118400	105100	131800
1984	6028	2957	10110	3362	2447	4278	51910	49400	54400	29590	20800	38250	21470	18330	24610	3222	3193	3251	115700	105000	126400
1985	4715	2318	7958	2743	1914	3572	53690	50550	56840	36020	25280	46710	29700	25400	34000	5529	5479	5579	132600	119900	145100
1986	8162	4010	13690	3263	2381	4141	63870	60490	67260	57060	40690	73550	21380	18130	24630	6176	6120	6231	160200	142100	178200
1987	11030	5423	18570	2351	1657	3047	60540	57410	63650	35870	25880	45910	13640	11610	15690	3081	3053	3109	126900	114100	139900
1988	6916	3377	11620	3430	2442	4422	66140	62370	69880	42680	31230	54070	11780	9924	13620	3286	3256	3316	134400	121300	147500
1989	6651	3256	11170	1685	1245	2128	59360	56310	62380	28170	20660	35700	14640	12390	16880	3197	3168	3226	113900	104500	123400
1990	3824	1875	6443	2691	2008	3370	58300	54840	61760	36870	26270	47600	11660	9885	13420	5051	5005	5096	118600	106800	130300
1991	1877	921	3148	2057	1566	2546	53790	50720	56880	35900	24820	46920	13040	11150	14940	2647	2623	2671	109400	97600	121100
1992	7534	3982	12740	8169	5447	10880	54100	50870	57350	37980	32120	43830	11970	10260	13680	2459	2437	2481	122500	113900	131400
1993	9464	5911	15070	4359	3237	5494	41760	40030	43480	43220	23110	63290	8089	7189	8990	2231	2211	2251	109500	88610	130400
1994	12950	8481	20330	4038	2903	5179	42440	40720	44150	30340	24070	36570	5167	4650	5683	1346	1334	1358	96700	88040	106200
1995	25550	18140	37410	3857	2582	5119	48970	47040	50900	39660	33760	45570	6830	6004	7655	1748	1732	1764	127000	116500	140200
1996	18830	13380	27640	5679	4053	7290	44620	42580	46680	29710	23280	36080	9200	8117	10290	2407	2385	2429	110800	101400	121700
1997	16190	11580	23740	6013	4248	7790	36740	35070	38410	24260	18490	30000	4575	4121	5032	1611	1597	1626	89840	81420	99180
1998	8795	5219	12510	6456	4513	8404	28100	26520	29680	16610	12780	20480	2604	2393	2814	1526	1512	1540	64100	58180	70090
1999	10510	6240	14970	6283	4354	8209	29560	27860	31260	16180	13040	19340	4192	3914	4472	1168	1157	1178	67900	61830	74050
2000	14360	8529	20440	6379	4521	8233	28390	26210	30580	17330	14050	20610	2378	2161	2595	533	528	538	69380	61930	77000
2001	15180	9012	21600	2505	1696	3305	29710	27470	31970	27500	23540	31460	4273	3912	4634	788	781	795	79930	72030	88040
2002	11070	6456	15880	2427	1594	3253	21320	19550	23090	14490	11690	17300	969	896	1042	504	500	509	50770	44860	56800
2003	9302	4852	13820	3381	2229	4539	33160	30710	35630	26550	21530	31590	3327	3009	3647	1192	1181	1203	76910	69460	84380
2004	11150	7552	14940	3319	2084	4555	28950	27010	30880	26390	20620	32120	2691	2465	2917	1283	1271	1295	73780	66530	81110
2005	13690	7934	19730	4410	2549	6291	27960	26210	29690	27010	21220	32750	1695	1542	1848	984	975	993	75770	67030	84690
2006	13760	8680	19130	5373	3555	7199	26170	24480	27860	23010	18170	27860	2545	2292	2797	1023	1014	1032	71900	64250	79690
2007	14300	8423	20420	4163	2631	5690	23920	22290	25540	23100	18950	27240	1389	1270	1509	954	945	963	67810	60080	75750
2008	17130	10360	24200	3870	2445	5311	28240	25870	30600	19090	14580	23570	3056	2728	3383	1764	1748	1780	73140	64300	82140
2009	25520	13430	37950	4618	2790	6452	27470	25640	29290	24030	19700	28380	2666	2423	2911	2069	2050	2088	86370	73150	99950
2010	8958	5270	12790	4669	3133	6198	29250	27330	31160	21500	17000	26050	2015	1838	2194	1078	1068	1088	67490	61020	74000
2011	28320	8011	48970	3663	2370	4949	37400	35110	39680	57760	42690	72780	4639	4183	5095	3045	3018	3072	134900	108300	161600
2012	22060	8110	36220	3329	2142	4501	27040	25250	28840	19260	15190	23350	1082	968	1195	881	873	889	73680	58860	88800

6.xv. Estimated 2SW salmon spawners for the six North American regions and North American total from the run reconstruction model.

Spawner	Labrador			Newfoundland			Quebec			Gulf			Scotia-Fundy			USA			North America		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1970	9563	4407	16440	3236	2306	4167	28570	23420	33700	9978	8169	11780	6500	4695	8294						
1971	13930	6582	23800	2982	2085	3876	14770	12110	17440	10440	8282	12560	7061	5598	8520	490	486	494	49750	41020	60390
1972	12010	5674	20430	3141	2208	4073	28970	23740	34170	29200	22330	36050	10380	8736	12030	1038	1029	1047	84990	73160	97440
1973	16290	7485	28160	3842	2783	4891	29470	24150	34770	32210	25340	39080	6699	5541	7858	1100	1090	1110	89950	76320	104900
1974	16250	7562	27980	3140	2427	3847	35840	29380	42250	49060	38990	58990	14080	11940	16200	1147	1137	1157	119900	103600	137000
1975	15560	7483	26500	4706	3451	5960	29780	24410	35130	28900	22670	35160	16360	13870	18850	1942	1925	1960	97550	84590	111700
1976	17490	8173	29970	3985	3001	4966	28300	23220	33400	24080	18330	29860	15510	12920	18100	1126	1116	1136	90760	77430	105800
1977	14970	6693	26110	2768	2182	3354	40780	33420	48070	51390	39990	62750	18850	15710	21950	643	637	649	129800	112300	147800
1978	11970	5492	20680	3052	2467	3640	37330	30660	44080	15960	12060	19850	9419	7934	10890	3314	3284	3344	81330	70210	93240
1979	6690	2960	11650	1616	1236	1999	16020	13130	18900	5767	4389	7154	6679	5650	7713	1509	1495	1523	38390	32930	44440
1980	16470	7632	28430	3262	2641	3887	44540	36480	52490	31510	24600	38380	21290	17690	24920	4263	4225	4301	121700	106200	138200
1981	15100	7148	25780	6589	5104	8078	32670	26780	38550	9735	5835	13640	10360	8249	12480	4334	4295	4373	79050	67140	92270
1982	10970	5049	18900	2769	2167	3369	33110	27150	39080	21170	12120	30290	7813	6185	9436	4643	4601	4685	80800	67160	94760
1983	7925	3684	13650	3279	2655	3907	21670	17740	25530	13960	8497	19420	4210	2662	5744	1769	1753	1785	53040	44090	62220
1984	5518	2447	9596	3179	2286	4068	27090	24910	29260	26030	17330	34750	17510	14540	20460	2547	2524	2570	82060	71540	92620
1985	4421	2024	7664	2728	1906	3557	25870	23040	28710	35030	24300	45750	24640	20490	28760	4884	4840	4928	97710	85290	110200
1986	7695	3543	13230	3229	2350	4103	29650	26720	32620	55410	38920	71780	18440	15290	21600	5570	5520	5620	120300	102300	138200
1987	10390	4790	17940	2335	1642	3028	26320	23790	28840	33870	23910	43800	12200	10210	14190	2781	2756	2806	88240	75650	101100
1988	6206	2667	10910	3412	2426	4393	31510	28170	34850	41310	29960	52650	10320	8525	12130	3038	3011	3065	96000	83040	108900
1989	6190	2795	10710	1681	1241	2119	30040	27350	32720	26940	19450	34450	14310	12060	16540	2800	2775	2825	82150	72920	91550
1990	3467	1518	6086	2669	1991	3346	29870	26680	33040	35770	25130	46410	11000	9249	12750	4356	4317	4395	87270	75620	98920
1991	1784	828	3055	2045	1557	2534	24140	21450	26820	35070	23980	46090	11660	9824	13490	2416	2394	2438	77190	65510	88790
1992	6752	3200	11950	8117	5413	10830	23620	20790	26450	36800	31000	42620	10820	9165	12470	2292	2271	2313	88650	80260	97390
1993	9077	5524	14690	4315	3191	5438	18220	16890	19540	42660	22590	62750	6931	6049	7811	2065	2046	2084	83670	62730	104500
1994	12460	7991	19840	3886	2771	5002	17860	16570	19140	29630	23420	35840	4390	3899	4880	1344	1332	1356	70010	61460	79490
1995	25090	17680	36950	3706	2460	4956	25270	23850	26670	39130	33220	44990	6465	5645	7287	1748	1732	1764	101700	91340	114800
1996	18450	13000	27260	5498	3911	7091	21930	20320	23540	28850	22520	35160	8381	7320	9449	2407	2385	2429	85900	76730	96610
1997	15980	11370	23530	5872	4136	7622	18120	16820	19440	23440	17740	29130	3975	3535	4414	1611	1597	1626	69420	61110	78740
1998	8592	5015	12290	6352	4425	8272	16820	15500	18120	16120	12340	19920	2273	2073	2474	1526	1512	1540	51680	45830	57610
1999	10240	5972	14690	6206	4291	8122	20370	18800	21960	15390	12270	18490	3732	3457	4006	1168	1157	1178	57110	51110	63180
2000	14100	8264	20160	6221	4387	8048	19500	17410	21600	16730	13500	19970	2178	1966	2392	1587	1573	1601	60330	52900	67930
2001	14860	8696	21270	2432	1645	3224	20050	18160	21960	26570	22660	30510	4009	3656	4360	1491	1478	1504	69430	61650	77400
2002	10870	6256	15670	2381	1562	3200	15120	13460	16800	13950	11170	16750	786	718	853	511	506	516	43630	37750	49590
2003	9069	4620	13580	3307	2170	4452	24650	22260	27050	25730	20770	30690	3120	2803	3435	1192	1181	1203	67070	59700	74440
2004	10880	7288	14670	3255	2032	4466	20540	18710	22390	25540	19840	31170	2575	2353	2795	1283	1271	1295	64060	56900	71280
2005	13410	7659	19450	4325	2479	6172	20500	18850	22170	26050	20350	31750	1588	1440	1736	1088	1078	1098	67000	58260	75820
2006	13540	8461	18900	5290	3485	7099	19030	17460	20600	22190	17370	27010	2394	2147	2639	1419	1406	1432	63880	56250	71640
2007	14070	8189	20180	4097	2593	5622	17220	15670	18750	22240	18120	26330	1280	1165	1395	1189	1178	1200	60080	52380	67940
2008	16900	10130	23960	3772	2368	5188	21770	19450	24070	18240	13830	22690	2958	2636	3282	2809	2784	2834	66440	57700	75390
2009	25300	13210	37720	4559	2748	6371	20960	19190	22730	23140	18850	27410	2548	2310	2784	2292	2271	2313	78820	65570	92320
2010	8760	5072	12580	4570	3047	6081	23380	21520	25250	20670	16210	25150	1883	1708	2058	1482	1469	1495	60770	54340	67220
2011	28180	7873	48830	3625	2342	4904	29390	27170	31600	56270	41400	71200	4557	4103	5013	3872	3837	3907	125900	99560	152700
2012	21970	8017	36120	3304	2127	4479	20740	19020	22460	18570	14510	22610	1030	917	1143	2056	2038	2074	67640	52870	82680

6.xvi. North American pre-fishery abundance (PFA) estimates from the run reconstruction model.

	PFA 1SW non-maturing			PFA 1SW maturing			PFA total (maturing and non-maturing)		
Year	Median	5th perc.	95th perc	Median	5th perc.	95th perc	Median	5th perc.	95th perc
1971	713700	650100	778700	520000	484700	560500	1235000	1165000	1306000
1972	740400	684800	801400	520700	491300	553700	1262000	1203000	1325000
1973	901600	820700	986000	666900	635800	698800	1569000	1487000	1654000
1974	811900	750700	877700	699100	662100	739300	1511000	1446000	1582000
1975	904800	839300	974600	798500	746300	861100	1705000	1627000	1790000
1976	835500	765700	910500	798400	751500	849900	1635000	1556000	1720000
1977	667100	606900	729800	636300	594900	682100	1304000	1236000	1376000
1978	396700	368200	426800	410700	383000	439400	807500	770800	846100
1979	837200	772100	908700	589500	557400	623400	1427000	1356000	1504000
1980	711400	655100	771500	832400	781000	892700	1545000	1475000	1621000
1981	667000	620900	716000	911400	849000	981700	1579000	1506000	1658000
1982	560400	523600	599900	765800	715300	820300	1327000	1267000	1390000
1983	341900	311900	374700	511400	479900	545400	853700	812600	897700
1984	360500	328800	395100	539700	506100	573900	900400	854800	948100
1985	535800	492300	582700	658700	617000	701300	1194000	1135000	1257000
1986	569100	521100	619500	835800	779300	893900	1405000	1334000	1479000
1987	518900	481400	558800	801100	749600	858000	1320000	1261000	1385000
1988	422300	389500	457100	850000	789500	912700	1273000	1205000	1343000
1989	334100	305300	365100	595000	557300	635300	929600	883500	978100
1990	298500	273300	326000	562400	527200	597900	861100	817300	906100
1991	330800	308100	355600	415400	390300	441100	746300	712400	782200
1992	217000	184900	252400	577700	531700	624200	795100	737000	854600
1993	157300	139800	177200	545500	483300	608200	703300	637300	769900
1994	193400	171600	219200	329600	301500	358600	523500	486400	563000
1995	190600	171500	212300	382200	345300	419700	573100	530500	617200
1996	161000	144800	179400	555700	500600	614200	716900	658700	778700
1997	111700	100500	124000	363100	330900	403900	475200	440000	518000
1998	102100	90550	115000	442800	390900	495300	545200	491000	600000
1999	107400	94180	122000	443100	390800	495300	550500	495800	605600
2000	121900	107500	138100	525900	464000	587700	648100	583200	713100
2001	84720	74560	95920	386500	337800	435600	471400	420800	522600
2002	114600	100900	129600	389100	347700	430600	503900	459200	549200
2003	112300	98940	127100	421400	384400	458400	533900	493200	575000
2004	115500	100500	132100	448200	415000	481500	564000	526300	601900
2005	110400	96920	125300	546700	471100	622400	657400	579700	735100
2006	105100	91740	119800	548500	470000	627000	653600	573300	734500
2007	116200	101400	133000	474300	408800	539400	590900	522500	659100
2008	135400	114400	158700	596100	530900	661200	731800	661900	802100
2009	108200	96070	121500	381900	323800	440100	490200	430500	550500
2010	205800	166200	248200	504900	466400	543300	711000	653500	769800
2011	116800	94540	141100	671700	489900	854900	788800	605000	974000

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 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 *(Baltic Salmon and Trout Assessment Working Group).* WGBAST took place in Uppsala, Sweden, 15–23 March 2012, chaired by Johan Dannewitz (Sweden). Main tasks of group are: address generic ToRs for Fish Stock Assessment Working Groups; evaluate estimates of salmon misreporting by Poland based on new data from Poland, from the EC inspections, logbooks, VMS and other relevant data sources; evaluate the possible reasons for the low at-sea survival of salmon stocks, including new information from the 2011 Salmon Summit; prepare for a benchmark assessment of the salmon stocks in autumn 2012 and others.

WGERAAS *(Working Group on Effectiveness of Recovery Actions for Atlantic Salmon).* WGERAAS had been established by ICES. The task of the study 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 has had its first meeting in Belfast in February 2013. The next meeting is scheduled for February 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 inter-laboratory 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 Workshop 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, but chiefly the EU SALMODEL report (Crozier *et al.*, 2003).

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 2014 to address questions posed by ICES, including those posed by NASCO. The Working Group intends to convene in the headquarters of ICES in Copenhagen, Denmark from 18 to 27 March 2014.

List of recommendations

1) The Working Group recommends that further work be undertaken to address the issues raised by the second Workshop on Age Determination of Salmon (WKADS 2). The following issues were identified and the Working Group recommended that these should be followed up:

   1.1) An inter-lab calibration exercise should be held remotely in the next two to four years.

   1.2) Reference scale images and accompanying details should be hosted on ICES age readers forum website.

   1.3) The importance of the initial positioning of the line on a scale along which measurement are made, should be emphasized to all readers.

2) The Working Group recommended the establishment of a Regional Coordination Group (RCG) for diadromous species to consider the unified collection of data on all salmon stocks (as well as eel).

3) The Working Group recommended that an Atlantic salmon stock annex should be developed using an agreed template and country specific inputs should be prepared for the 2014 meeting with a view to finalizing the document at that time.

4) The Working Group recommends that the IASRB support the further development of the project outlined by the NASCO Sub-Group on the Future Direction of Research on Marine Survival of Salmon.

5) The Working Group welcomed the opportunistic assessment of the incidence of salmon bycatch in pelagic fisheries at Iceland and recommends that similar sampling should continue in order to provide further information on the bycatch of salmon in pelagic fisheries in this area.

6) The Working Group recommends that consideration be given to further investigations involving ultrasonic tagging and release of non-maturing salmon captured at Greenland.

7) The Working Group recommends that sampling 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.

8) The Working Group recommends that additional data collection be considered in Labrador to better estimate salmon returns in that region.

9) The Working Group supports the efforts of the Geenlandic authorities to improve catch data collection and recommends that the authorities facili-

tate the coordination of sampling within factories receiving Atlantic salmon, if landings at factories are allowed in 2013.

10) 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 voluntary logbook system. Detailed statistics related to catch and effort should be made available to the Working Group for assessment.

11) The Working Group recommends that arrangements be made to enable sampling in Nuuk as a significant amount of salmon is landed in this community on an annual basis.

12) The Working Group recommends that the longer time-series of sampling data from West Greenland should be analysed to assess the extent of the variation in condition over the time period corresponding to the large variation in productivity as identified by the NAC and NEAC assessment and forecast models.

13) 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 Greenland mixed-stock fishery.

Annex 9: Response of WGNAS 2013 to Technical Minutes of the Review Group (ICES 2012a)

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 (2012a). The points are addressed in the same order as they were listed in the Technical Minutes. This section also provides a response to some additional comments and questions from the Chair of the RG, which were received by WGNAS prior to its 2013 meeting:

Report structure

The RG commented that it would help reviewers as well as communication with the general public if a stock annex was provided, detailing the methodology used to conduct stock assessment and to provide catch advice (similar to how it is done in other ICES assessment WG reports).

The Working Group considered this request informed by the progress made by the Baltic Salmon Group in developing such an annex as part of their recent Inter-Benchmark Protocol exercise (ICES 2012b) and further examples provided by ICES. The Working Group agreed to take forward the development of a specific Atlantic salmon stock annex, but had insufficient time to complete the task during the 2013 meeting. Initial progress was made in completing sections of a draft, by compiling information contained in earlier WGNAS reports and from other sources. The Working Group recommended that the provision of country-specific inputs would be best addressed by identifying this as a specific requirement for the 2014 meeting, using an agreed template. This will be developed by correspondence over the year in advance of the 2014 meeting.

Section 3: Northeast Atlantic Commission

RG COMMENT	WGNAS RESPONSE
Two assumptions used in the NEAC model were a bit surprising: (1) the use of a constant mortality rate of 0.03 per month for non-mature 1SW, and (2) constant maturation rate for 1SW of 78% (Table 3.6.4.5). The percentage of 1SW in the reported catch for the northern and southern NEAC countries varied among years and reached the lowest value in 2011 for both regions (Figures 3.1.6.1 and 3.1.6.2), which suggests that mortality rates of immature 1SW fish or maturation rate (or both) changed during the time period, possibly in monotonic fashion. The effects of violating these assumptions should be evaluated.	1. Mortality rate: The natural mortality rate for salmon after they recruit to the distant water fisheries has been the subject of much discussion. The Working Group originally used a value of 0.01, but this was modified to 0.03 following a detailed review as part of the EU SALMODEL project (Crozier *et al*., 2003; ICES, 2002). While mortality may be expected to vary among years and may also be different for maturing and non-maturing 1SW recruits, the WG 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. 2. Maturation rate: Maturation rate is handled differently in different models. Run-reconstruction model: Maturation rate is not an input to the model. Forecast model: The proportion maturing and

RG COMMENT	WGNAS RESPONSE
	the mortality rate in the second year at sea are confounded parameters in the model and a strong prior, such as mortality rate known or proportion maturing known, must be set to resolve the other. Some consequences on model inferences are discussed in Section 2 in this year's report. Catch option model: The maturation rate is applied only to the 1SW catch to determine the (very small) numbers that remain at sea for another year. The value used (0.78) is based upon analysis of vitelogenin in blood samples collected from salmon caught in the Faroes fishery in about 1984. No other estimates have been obtained (and no fishery has operated for at least 10 years), and so no information is available on variation between years. The WG has therefore agreed to use a value of 0.78 +/- 0.1
The pseudo-stock–recruitment relationship (hockey-stick) between Pre-fishery Abundance (PFA) and lagged-egg (used for the derivation of provisional national conservation limits) is assumed to be static over time. Is this a reasonable assumption given the observed declining trends in marine survival? It was also unclear from the WG report whether or not the lagged-egg deposition accounted for in-river mortality associated with catch-and-release. A table presenting the model parameters would be useful.	The WG has previously discussed issues on non-stationary in the pseudo-stock and recruitment relationship. For most countries the S-R relationship is very weak resulting in the hockey-stick model selecting the min or max value previously recorded. If the time-series is reduced to the period since the decline in stocks (probably the 1990s), the time-series will become very short. There are also differing views about how changes in the S-R relationship should be accommodated in the CL estimation - i.e. if the decline in production is due to factors operating at sea, is it appropriate to change the CL for egg deposition, and hence production, in freshwater? Some countries that have developed river-specific CLs have already taken the change in marine mortality into account (e.g. UK (England and Wales)). However, we agree that this could be explored Mortality associated with catch and release is not currently incorporated into the model. Data on C&R are currently incomplete. This could be explored further.
It seems surprising that retention fisheries still occurred in some countries despite the fact that returns and spawner abundance were lower than the conservation limits set by these countries (e.g. Figures 3.3.3.1b and 3.3.3.1h). Presumably this is because the target escapement was met for some river systems, even if not for the country as a whole. It would be useful if the WG report could be more explicit concerning this point.	Most fisheries in home waters operate within rivers or estuaries and therefore catch salmon predominantly from a single stock. As a result, they can be targeted at stocks that are meeting their CLs - even if the national CL is not being met. Some countries permit fisheries on stocks that are not meeting their CLs (e.g. for socio-economic reasons). In addition, many countries apply regulations on a multi-annual basis and take account of socio-economic factors in balancing the controls affecting different stakeholder groups and the rate of stock recovery that is planned. This means that fishing on some stocks may be permitted in years when these are not expected to meet their CL. This is an issue for managers and is being considered by NASCO within the current round of Implementation Plans.

RG COMMENT	WGNAS RESPONSE
	This is discussed in Section 3.4 in relation to the risk-based framework for provision of catch advice for Faroes
The RG understood that the run reconstruction model was run for each country (or region within country, e.g. in Russia or in UK(Scotland)) separately. In this way, a PFA was estimated for each country (or region within country), and the national PFAs were subsequently added to obtain a PFA estimate at the stock complex level. In the Monte Carlo procedure applied to estimate PFA for each country (or region within country), uncertainty in natural mortality was incorporated by simulating its value in each iteration from a Uniform (0.02,0.04) distribution. If the intention of WG experts is that natural mortality in a given year should be the same for all countries, even if its value is uncertain, then the same value of natural mortality should be used in the same iteration for all countries. The RG understood that this is not done at present, treating each country separately in the run reconstruction model. This will probably lead to underestimating the uncertainty of PFA estimates at the stock complex level (because when adding up the PFAs of each iteration across countries, some countries will have a low value and other countries a high value of natural mortality in that iteration, hence cancelling the effects of a low or high natural mortality for all countries), potentially affecting conclusions about the stock complex status and ensuing management recommendations.	The same distribution of M is used for all national/regional assessments. The 'R' model originally used a different distribution of M for each year (but not each country/region within each year), but this has now been brought in line with the CB model (i.e. use of a single distribution throughout).
To determine if significant changes occurred in previously provided multiannual management advice, the WGNAS developed a Framework of Indicators (FWI). Within this FWI, a dataset was considered informative and kept when sample size was greater than or equal to 10 and R^2 was greater than or equal to 20%. It is unclear how a R^2 of 20% would be considered informative? Prairie (1996. Evaluating the predictive power of regression models. Can. J. Fish. Aquat. Sci. 53: 490–492) developed a simple method to assess the predictive power of regression model based on the R^2 of the model. His analysis indicates that we could start distinguishing two groups when the R^2 exceeded approximately 60%. Hence, the likelihood of arriving at a different conclusion using the current criteria of the FWI appears to be low, simply because a R^2 of 20% is not very informative. Consideration should be given to weighting the indicators taking their predictive ability into account, for example, based on the R^2 of the relationship and averaging the weighted indicator states.	The purpose of the FWI is to provide an initial appraisal of whether the previously provided multiannual management advice may have been incorrect. The Working Group recognizes that it would have been better to apply a more rigorous statistical level in selecting datasets for inclusion in the FWI. However, the decision to adopt a 20% was a pragmatic one, balancing strength of associations between indicators and PFA and a broad range of indicators over the four stock complexes. Use of a more stringent R^2 criterion for selecting indicators to retain would have reduced the number of indicator stocks retained for the indicator (See Figure 3.7.2.1). As the PFA represents abundance integrated over a large number of river-specific stocks, the choice of criteria that resulted in a larger number of indicators per stock complex was favoured. It was 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 FWIs even in the event of one or more indicators being unavailable at the time the FWIs are being applied. 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

RG comment	WGNAS response
	alone (Prairie 1996), our approach with a suite of indicators is more similar to meta-analysis (Rosenthal 1984). Thus the outcome of the FWIs is not dependent on the result of one indicator in isolation, but rather on the combined performance of the indicator set.
Given that mixed-stocked fisheries can lead to the extirpation of weak stocks (Ricker. 1958. J. Fish. Res. Board Can. 15: 991–1006), alternative management options that minimize fishery impacts on weak stocks should be evaluated. A possibility could be assessing the spatio-temporal distribution of weak stocks in the Faroes Islands and West Greenland using DNA analyses. This may help to determine periods and areas that can be fished to avoid weak stocks in near real time (for instance, see Shaklee *et al*., 1999. Fish. Res. 43: 45–78).	Studies have been undertaken on the spatial and temporal distribution of salmon stocks from different countries at West Greenland and Faroes (e.g. Reddin *et al*., 2012 and Jacobsen *et al*., 2012). These studies indicate small differences in the distribution of different stock complexes (e.g. European fish tend to be caught further south than North American fish at West Greenland; and the proportion of maturing 1SW salmon from Southern Europe in catches at Faroes tended to be greater towards the south and early in the season). However, we do not know whether these trends apply to all river stocks. Given the very large number of stocks exploited in these mixed-stock fisheries, substantial interannual variation in the areas prosecuted by these fisheries, and the wide distribution of weak stocks across the range of the species, the Working Group would not be able to provide advice to managers on differences in stocks being exploited at Faroes by season or other factors. DNA analysis of historic scale samples is currently underway to further investigate the composition of catches at West Greenland and Faroes, but this may not provide the level of resolution to identify stocks below the region level.
Management objectives should be clarified for mixed-stock fisheries, which take catch from different stocks. For a given probability "*p*" (e.g. *p*=0.95), the objective (a) that "all stocks taken by the fishery are above conservation limits with probability *p*" is less stringent than the objective (b) "that there is a probability *p* that all stocks taken by the fishery are *simultaneously* above conservation limits". Depending on the degree of correlation between the status of different stocks caught in the mixed fishery, the two potential management objectives can be quite different. Thinking for the sake of argument in an equilibrium situation, objective (b) essentially means that there is at most a proportion 1- *p* of years where some stocks may fail to reach conservation limits, whereas objective (a) allows for some stocks to be below conservation limits in all years provided that the proportion of years below conservation limits does not exceed 1- *p* for any stock. Management objectives for individual stocks have often been expressed as 95% probabilities (i.e. using *p*=0.95). However, requiring 95% for objectives expressed *simultaneously* for a collection of stocks can be much more stringent. It is important that this issue is understood and clarified as appropriate. The RG noted that for the West Greenland Commission, NASCO has agreed to a	This is discussed in Section 3.4. WGNAS has agreed that the catch options table should show the probability that each management unit will achieve its CL/SER under different catch options. The WG considers that it is the responsibility of managers to determine the probabilities that they wish to adopt and they can then read off the appropriate catch option that meets this requirement. Managers may be more familiar with the concept of individual stocks (or stock complexes) achieving their reference levels than simultaneous attainment. However, the concept of simultaneous attainment may be informative to managers because 1-probability of simultaneous attainment quantifies the chance that one or more stocks or complexes in the coming year will fail to meet its conservation objective by chance alone, and not due to management failure or other changes in vital rates that may affect the abundance of salmon in a given year.

RG COMMENT	WGNAS RESPONSE
75% chance of simultaneously meeting or exceeding the management objectives. The use of the word "simultaneous", although not new in the way ICES has provided advice for the salmon fishery at West Greenland, is new in the context of stock assessments for other species. In a mixed-stock fishery, even if advice is provided based on a probability *p* (e.g. *p*=0.95) that each individual stock is above its conservation limit, it is nevertheless also informative to examine what this implies in terms of the probability that all stocks are simultaneously above conservation limits. The latter probability will decrease as the number of stocks exploited by the fishery increases. Hence, reducing the number of stocks exploited by the mixed fishery (e.g. by considering area and time specific management, if such information is available) is a way to increasing probability of the simultaneous event	

Section 4: North American Commission

RG COMMENT	WGNAS RESPONSE
In the NEAC assessment all the data that were used in the figures were readily available in tables. Although this increased the length of the chapter, it made it easier to compare the numbers presented in the text with those presented in the figures. The RG recommends that a similar approach be adopted for the North American assessment. In the latter, results were generally presented only as figures or tables, but not as both.	The Working Group has addressed this issue. All data summarized in figures are presented in tables, in some cases as annexes.
Some of the information presented in Section 4.3.6 was already presented in previous sections (i.e. Section 4.3.2). Was this repetition necessary?	The Working Group has addressed this issue.
In the management advice (Section 4.4), WGNAS recommended habitat restoration in some areas as an alternative conservation action for wild populations that are critically low (Scotia-Fundy and USA). Although this is a common practice in several systems with stocks of conservation concerns, these measures have often failed to re-establish natural runs due to poor marine survival. Before recommending any costly restoration activities, it would be beneficial to estimate by how much freshwater survival/smolt output need to increase to achieve the target escapement goals. And then ask if these levels can be realistically attained?	The Working Group believes that freshwater restoration activities are commonly prioritized on a cost–benefit basis, but recognizes that more might be done to quantify the potential benefits that might arise from specific activities. The Working Group is aware that modelling approaches are being developed by a number of jurisdictions to assist this process. The dam impact analysis model for Atlantic Salmon in the Penobscot River, Maine (reported at Section 2.3 of this report) provides such an example.
The Bayesian inference and forecast model used to provide PFA forecasts (and used in the risk framework for the provision of catch advice) assumes heritability of age at maturity. Hence, the lagged eggs used in the model for the 2SW stock complex arose exclusively from 2SW spawners.	The differences are due to convenience and determined by the age groups which are exploited in each of the fisheries. North American salmon are mostly caught at West Greenland and at the 1SW non-maturing stage (fish destined to become 2SW salmon). This contrasts with the Faroes

RG COMMENT	WGNAS RESPONSE
The opposite approach appears to have been used in the Northeast Atlantic, where lagged eggs arose from both 1SW and MSW spawners. Clarification on why different assumptions are made for NEAC and NAC areas would be useful	fishery where both 1SW maturing, 1SW non-maturing, and 2SW fish are captured. For pragmatic purposes, the use of a single age group for the spawners was considered reasonable, and consideration of two age groups was more appropriate to the Faroes fishery.
In the Bayesian inference and forecast model used to provide PFA forecasts, a time-varying productivity parameter to go from lagged eggs (or lagged spawners) to PFA is used. The actual modelling details are a bit different for NEAC (where each stock complex is modelled as a single unit) and NAC, where six management units are distinguished within the complex and this is taken into account in the specification of the productivity parameter. Nevertheless, the essential modelling mechanism is a random walk over time for productivity in both cases. In the forecasts, the uncertainty associated with productivity quickly increases as a consequence of the random walk assumption, which translates into large uncertainty in the PFA forecasts. Alternative modelling assumptions on productivity might lead to lower uncertainty in the forecasts, although it is not clear what alternatives might exist to the currently used random walk. Some alternative models may reduce uncertainty at the cost of increasing bias. Hence, if alternative models are developed, their performance relative to the currently used random walk should be explored. This could be done by applying each model in forecasts starting from some year back in the past and checking their relative performance based on the currently estimated PFA values for those past years. A way to reduce the uncertainty in the productivity parameter would be by incorporating an auxiliary variable that can explain the annual variations in the productivity value. This is not obvious in the present structure that integrates the freshwater portion of the life cycle, where density-dependence is expressed, and the first year (post-smolt) survival at sea. The RG noted the proposed approach by ECOKNOWS to develop a full life cycle model that would separate these two phases of the life cycle and allow then an exploration of physical and biological covariates that could provide some correlation with variations in productivity. Although potentially useful in an inference sense, such covariates would only be useful for forecasting if the state of the covariates in the forecast years was known or could be equally forecasted. In that case the RG agrees with WGNAS that the models should appropriately incorporate the uncertainties associated with the covariates and the Bayesian framework developed for these models is the appropriate approach.	The issue of verifying by retrospective analysis the changes to model parameters and structures is noted. We agree with the considerations noted by the Review Group on appropriately incorporating uncertainty in all the input variables to any model.

Section 5: West Greenland Commission

RG comment	WGNAS response
WGNAS documented that there were some issues in obtaining samples from Nuuk and argued that the Enhance Sampling Programme was compromised as >20% of the fish harvested in West Greenland are landed in Nuuk. Although the RG agrees that obtaining unbiased samples from this area is desirable, the WGNAS should run a series of simulations to determine how critical this information is for their assessment. In particular, how precise do they need to be before it becomes a serious impediment to the interpretation of the data?	WGNAS recognizes that sampling bias needs to be further explored, but since this was a non-assessment year this wasn't considered at the 2013 meeting. There are proposals to address this prior to 2014. The Working Group notes that there are significant quantities of reported harvest 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.
Based on the run reconstruction, it was concluded that none of the stated management objectives would be met in a mixed fishery off West Greenland, primarily because there was a low probability of achieving the conservation limits for most regions in North America (there were no issue for reaching the conservation limits of the southern NEAC stock complex). Are there alternative management scenarios that should be considered? For instance, is there a way to target this fishery on NEAC stocks, and thereby reducing the fishing pressure on North American stocks? This strategy was used successfully in the Chinook salmon fishery off western Canada (i.e. Beacham *et al*., 2008. North American Journal of Fisheries Management 28: 849–855).	The Working Group has previously recommended changes in fishery management practices (mesh sizes) to modify the proportions of different stock complexes exploited by the fishery. The Working Group has also documented differences in the spatial and temporal distribution of fish from different stock complexes in the West Greenland area. However, there has been substantial variation over time and between years in the proportions of fish from different complexes / continents of origin taken in different areas. In addition, there is marked interannual variability in the distribution of catches and effort in the different NAFO areas in this relatively small subsistence fishery. The Working Group considers that these factors would make the development of effective alternative management scenarios particularly challenging
For the MSW Southern NEAC stock complex, a discrepancy was detected between the probabilities presented in Table 3.4.1.1 under no fishing (87.2%, 88.5%, 88.5%) and in Table 5.4.1 under no fishing (0.978, 0.949, 0.944). Upon checking by the WG chair, it was found that the values in Table 5.4.1 were incorrect, due to having used a wrong SER value; a corrected table was provided for use in the ICES advice sheet. Please ensure that values are correct in future years and cross-check results between different tables and figures in the WG report. Additionally, it would help to clarify in Table 3.4.1.1 that e.g. the 2012/2013 Faroes fishing season corresponds to PFA in 2013 (2014 returns), whereas in Table 5.4.1 the 2012 catch year corresponds to the PFA in 2012 (2013 returns). A modified version of Table 3.4.1.1 was provided by the WG chair, clarifying the PFA year. This is useful for outside readers, so please make sure that this clarification remains in place in future years. Finally, the WG chair also explained that some minor numerical differences remained because the Faroes fishery risk analysis employed the PFA results from the WinBUGS run directly, whereas the West Greenland fishery risk analysis employed a (lognormal) approximation to the PFA distribution. It would be good if con-	The Working Group has noted these errors and inconsistencies and will look to ensure that the clarification provided in 2012 is carried forward in future reports. The WINBUGS issue may have arisen from modelling two PFAs in the Faroes fishery risk assessment and catch options whereas the Open BUGS predictions are for single PFAs. The issue is thought to have been addressed, as the same CODA output streams are used in each summary.

RG COMMENT	WGNAS RESPONSE
sistency could be gained between the two analyses, presumably by using the results from the WinBUGS run in both cases.	

Follow-up comments from Review Group Chair

FOLLOW-UP COMMENTS FROM RG CHAIR	WGNAS RESPONSE
Section 3.6.3 of WGNAS 2012 report (Modelling approach for the Faroes catch options risk framework): In the definition of Nw1SW, pD* is defined as the "proportion of total catch that is discarded". Shouldn't this instead be: "proportion of catch that is discarded divided by proportion of catch that is landed"? When harvest rates are calculated as Hij = Nwij/S (to calculate the probability that PFA is above the SER): Shouldn't the calculation take into account the M that occurs in the elapsed months between the Faroes fishery and homewaters fisheries? (at the moment it seems as though all catch is taken at the same time… ?)	The equation [*Nw1SW = Nwtotal x pA1SW + (Nwtotal x pD x 0.8)*] should read [*Nw1SW = Nwtotal x pA1SW* + (Nwtotal x pD* / (1 - pD*) x 0.8)*] and has been corrected in this report M is taken into account but this was omitted from the model description. The whole catch option assessment is calculated back to the time of recruitment to the Faroes fishery (i.e. the dates to which the PFA and SERs refer). Thus the status of the stocks in each management unit (i.e. complex of country) is assessed by comparing the forecast PFA with the Spawner Escapement Reserve (i.e. the CL raised back to the time of the Faroes fishery). This is now included in the model description in Section 3.4.4
Catch options in Table 10.4.1 of 2012 West Greenland Commission advice sheet: As the catch in Greenland increases, the probability of the Southern NEAC MSW stock complex achieving the conservation objective hardly changes. What's the explanation for this? (has the 40:60 sharing arrangement between Greenland and NEAC areas, indicated in Sect 5.8.3 of WGNAS 2012 report, not been applied?)	The exploitation rate at West Greenland for the catch options current shown in Table 10.4.1 is very low. This is partly because a smaller proportion of the southern European stocks is actually available to the fishery than for North American stocks and also because the European stocks currently comprise only about 10% of the catch (these factors are, of course related). NASCO agreed the 40:60 sharing arrangement for NAC stocks before the NEAC stocks were introduced to the assessment (in 200?). As the fishery cannot target NAC vs. NEAC stocks therefore a similar sharing arrangement formula was used in both cases. In the risk assessment, the sharing arrangement is taken on the total catch option for Greenland and then the raised catch is partitioned into NAC and NEAC fish based on the predicted proportion of the catch by continent of origin based on a uniform distribution of proportion NAC bounded by min and max values for the previous five years. That catch of NEAC fish is then subtracted from the PFA at that point in time and evaluated relative to the CLs for the fish discounted to the time of return to homewaters.
Since the Southern NEAC MSW stock complex is present both in West Greenland and Faroes, catch options in these mixed-stock fisheries should be calculated jointly rather than separately, correct? I	This is correct and has been considered by the WG, although as noted it is not a significant issue while ICES is advising that there is no catch option available for either fishery. Howev-

Follow-up comments from RG chair	WGNAS response
think the present calculation of West Greenland catch options assumes there is no catch of this stock complex in the Faroes and vice versa…? (of course, this is not a concern if the catch advice is 0 for both fisheries, but I imagine this matters if we start to give catch advice > 0 at some point ?)	er, formally incorporating this into the advice is currently hampered by the lack of any feedback from NASCO on the proposed establishment of the risk based framework for provision of catch advice for Faroes.
Last year we had a lot of discussion in the RG/ADG about the probability values on which catch advice should be based (whether 95% probability of being above the CL, or 75%, or 80%, or something else). And also on whether this probability should be achieved jointly for all management units considered in the mixed fishery, or separately for each of them, the interplay of the various probability measures with the number of management units on which the objective wants to be achieved, etc. There seemed to be quite a few issues around this and some confusion in terms of understanding and interpretation of the meaning of this by different people. Of course, these choices should mainly be made by managers, but they may need feedback from scientists in order to make their choices in an informed way. The RG technical minutes capture some of that discussion in one of the bullet points (Gérald Chaput was at the RG/ADG and I suspect he remembers this – I suggest you could discuss this with him). Additional thoughts and consideration of these issues by WGNAS this year would be very useful (I expect this will come up in the RG/ADG this year again).	NASCO has also sought advice on this and it is discussed in section 3.4?
Definition/calculation of CLs seems rather different in different places, see e.g. 2nd paragraph in Section 5.2 of WGNAS 2012 report. My understanding is that the calculation based on the hockey-stick inflection point would be akin to what ICES calls Blim for other stocks (hence, a limit point to avoid with very high probability, at least 95%), but in other cases the paragraph says that the CL corresponds, essentially, to Bmsy (?). If the latter is true, this would suggest that ICES would normally provide advice in line with being above CL with at least 50% probability (that's essentially what we do for other stocks, although the advice relates to Fmsy not to spawning targets, but we don't select a specific probability value above 50%, unless managers indicate they require something else). The fact that the CL has been derived as akin to Blim in some cases, but akin to Bmsy in other cases, seems rather problematic when it comes to establish a required probability of being above it for giving catch advice. Of course, I understand the salmon situation is rather complicated, with all the different rivers, nations, management units, homewaters and mixed fisheries. Anyway, I'm just raising this for you to be aware of it and to see if WGNAS has any additional thoughts on this.	NASCO (1998) and ICES (1997) have agreed that the limit reference point for individual salmon river stocks (i.e. the CL) as defined is synonymous with Bmsy. Because this is a limit it should be avoided with a high probability. NASCO has also agreed that jurisdictions should use management targets (MTs) to help in maintaining stocks above the CLs; this is a target and so there should be a 50% probability of exceeding it. WGNAS has previously (on more than one occasion) discussed this with the ICES Fisheries Sec and concluded that it was consistent with what ICES advises for some marine fisheries. In particular, the current ICES advice for short-lived stocks which uses a Bescapement reference point is relevant in the context of salmon as the majority of the spawners in most stocks in NAC and NEAC are from new recruitment. As such, the use of a Bescapement reference would be appropriate and there should be a low probability of falling below this reference point to preclude recruitment failure. Finally, NASCO fully understands and has endorsed the concept of conservation limits as currently defined. There will be some resistance and communication difficulties to changing the generalized approach for salmon because it is now embedded in the

Follow-up comments from RG chair	WGNAS response
	management in many countries.

Annex 10: Technical minutes from the Salmon Review Group

- RGSalmon
- ICES HQ, Copenhagen, 22–25 April, 2013.
- Participants: Carmen Fernández (Chair), Carrie Holt (WGNAS reviewer), Kjell Leonardsson (reviewer), Tapani Pakarinen (WGBAST chair), Ian Russell (WGNAS chair), Henrik Sparholt (Secretariat), Jonathan White (WGNAS).
- Review of ICES Working Group on Baltic Salmon and Trout (WGBAST).

General

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 North Atlantic. The RG concludes that the information and analyses detailed in the WGNAS report provide an appropriate basis to respond to the NASCO request for advice.

The RG also acknowledges the detailed response to the previous year's RG technical minutes (provided as Annex 9 of WGNAS 2013 report) and appreciates its insightfulness.

As with the previous year, although for different reasons, the compiled report was achieved at a late date giving little time for review. This year this was largely due to the short time period between the WG and the RG/ADG. A fully compiled report draft for the reviewers in advance of the RG/ADG meeting (at least one week in advance) would facilitate the review and advice drafting process significantly. The RG considers that a minimum of two working weeks between WG and RG/ADG would be required in order to give the WG members and chair enough time to complete their report, while also ensuring that the reviewers have adequate time to prepare for the RG/ADG.

This review report merges the comments of all reviewers involved in the process this year. The review focuses on three sections of the WGNAS report, pertaining to the Northeast Atlantic Commission area, North American Commission area, and the West Greenland Commission area (with an emphasis on the first).

The remaining sections of the WGNAS report provide a general introduction, an overview of salmon catches, landings and tag releases, and descriptions of new or emerging threats, successes and failures of restoration projects, threats of exotic species, Expert Group reports relevant to North Atlantic salmon, data deficiencies, monitoring needs, and research requirements. This was presented by the WG chair during the RG meeting, so reviewers are informed and aware, but no specific review of those aspects was undertaken by the RG.

Comments by the reviewers on the WGNAS Report

Section 3: Atlantic salmon in the North-East Atlantic Commission Area

1) In general, the analyses are technically correct, and the scope and depth of those analyses are appropriate to generate advice required. The comments pertain to aspects of the analyses that likely would not result in a change in advice for the current period, but may be useful in future.

2) Section 3.1.6 describes a general downward trend in 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 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*, pg. 116, Section 3.5.1) affect forecasts of PFA in the Risk Framework (which currently assumes constant mean *PFAm* 2012–2016 at 2011 levels)? See also comment 9 below.

WG response at the RG-meeting: WGNAS is aware of the changes in age composition of stocks and agrees that this could reflect a variety of factors including changing environmental conditions at sea and management actions. Need to check this in future.

3) 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 multi-stock 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 on p. 99 (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.

WG response at the RG-meeting: CL being used as fixed, but uncertainty could be included in future. Possibly a management issue, whether they want a fixed CL or uncertain CL's. Suggested to be brought up in the WG for discussion on how to deal with this.

** 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 for 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.*

4) 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.

WG response at the RG-meeting: Both PFA/SER and Spawners/CLs are needed; the former is aimed at assessment of stock status at sea to inform management decisions on the *high seas fisheries; the latter provide an assessment of national stock status for individual countries/regions. The differences noted between the two reflect exploitation in homewater fisheries. The WG recognize that there is now some duplication of abundance in the summaries of stocks (Figure 3.3.4.1a–j) and the new country forecasts (Figures 3.5.4.1–3.5.4.11). Duplication may be skipped in future.*

** Comment from RG chair: (just a minor addition to this discussion, in case it helps to clarify the point about "inconsistency") My understanding is that SERs are the CLs (which refer to spawning time) corrected for the natural mortality that occurs between PFA time (before fishing exploitation begins) and spawning time. Hence, it may well happen that the PFA is above the SER (as this is before exploitation begins) but the number of spawners is below the CL (as this is after exploitation has occurred). If the PFA of a stock complex is found to be below the SER in a given year, no mixed-stock fisheries are possible on the complex.*

5) 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?).

WG response at the RG-meeting: River-specific CLs were re-calculated in 2012–2013 for Irish national stock assessments. The recalculated CLs were based on up to date biology and catch data. The stock–recruitment approach used was not the hockey-stick approach used for other regions of the NEAC assessment, which may impose some inconsistencies with the country/stock-complex analyses based on the hockey-stick approach.

** 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.*
** 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 relationships (e.g. Ricker). Does this matter for the consistency of the results? (Please see also additional comment on stock–recruit analysis discussed at the end of this report). 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).*

6) Although the updates to the run-reconstruction model seem reasonable (Section 3.3.3), the model itself is not provided, so cannot be reviewed (and has already been 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).

6.1) 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).

WG response at the RG-meeting: The model is mainly an accounting tool. Uncertainties (max–min expert estimates of the exploitation). That is not so much model errors as uncertainties from input estimates.

Ambition to provide a Stock Annex in future versions of the report, where methodology will be detailed or pointers given for finding the appropriate method description.

6.2) 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.

WG response at the RG-meeting: OK, will be done.

7) 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., p.107). 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).

WG response at the RG-meeting [N.B. the reviewer indicated this was intended as more of a comment than a suggested action]: NASCO is aware of the difficulties of extending the river-specific approach to the management of mixed-stock high seas fisheries where over 1000 individual stocks can be exploited, and have accepted that management decisions on these fisheries should be based on assessment of stock complexes. The WG noted the comments. The WG also advised that it has previously advised on the use of different management strategies to target specific stock complexes in high seas fisheries (e.g. changes in mesh sizes) and has documented spatial and temporal differences in the distribution of fish in the sea, which might provide a basis for future management. The WG intends to continue to incorporate emerging information on stock identification/distribution in its advice.

8) 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.

WG response at the RG-meeting [N.B. the reviewer indicated this was intended as more of a comment than a suggested action]: The WG noted that NASCO recognizes the need for socio-economic factors to be considered in management, but that this was not considered explicitly in their work. It was noted that societal values were often acknowledged in management (e.g. Aboriginal and food fisheries in Canada).

9) 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?

9.1) 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.

9.2) 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).

WG response at the RG-meeting: Valuable comments. WG provided some explanations about the forecast model, and agreed it might be useful to reexamine the productivity parameter and to explore additional sensitivity analysis.

** 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.*

10) 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?

10.1) 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 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.

A similar question was asked by the RG in 2012, and the response from the WG can be found in Annex 9 of this year's report. Mortality at sea is an ongoing issue and efforts are being made to better partition the at sea mortality. The issue has been subject to detailed investigation in the past and 0.03 identified as the most suitable current value. Its continued use was essentially a pragmatic decision; in the absence of suitable information to vary this parameter there was no basis to change it. The alternative method for apportioning catch referred to was a genetic analysis of historic scales. This work had not proceeded as well as possible (degradation of DNA in the samples) but work was continuing and it was hoped results would better inform future management.

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 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.

11) 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.

WG response at the RG-meeting: Welcomed supportive comments.

12) 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.

WG response at the RG-meeting: Parallel runs (Crystal ball and R) for control purposes this year, but the ambition is to shift to R.

Minor comments on formatting

1) The inclusion of Equation numbers would aid in the review process when comments refer to specific parameters or equations.

WG noted the suggestion. Future development of stock annex should help with this.

2) 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).

WG noted the suggestions. The code was available on the WGNAS SharePoint site but in a different location. Future development of stock annex should help with this.

3) 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 to consider.

Section 4. North American Commission

1) 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 is not reviewed here.

2) 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.

3) However, 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).

WG response at the RG-meeting: 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 from a broad geographic area. Thus, other big changes in the region as a whole (North America) indicates that the variability could be explained without addressing the uncertainty/variability.

4) 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.

WG response at the RG-meeting: Will add a line or two in the report to clarify this issue. Clarification has already been sought from Canadian colleagues and clarification will be included in 2013 report before it is finalised.

5) In Section 4.3.4. (Egg deposition), for what portion of rivers have CLs been identified?

WG response at the RG-meeting: CLs are only presented for 74 (of ~1000 rivers) where detailed monitoring takes place, although CLS have been determined for over 400 (ca. 40%) Canadian rivers many of which are relatively small (CLs of around 200–300 spawners).

6) 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**.

6.1) Are the declines in Gulf region significant? Results are not provided in the text, but are presented in Figure 4.3.5.1.

WG response at the RG-meeting: Will add a line or two in the report to clarify this issue. Clarification has already been sought from Canadian colleagues and clarification will be included in 2013 report before it is finalised.

Section 5. West Greenland Commission

1) 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).

2) 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.

Response by the WG: This question is similar to that asked in the last year's TM, see Annex 9 in the report.

WG response at the RG-meeting: Samples are also collected in the surrounding region so there are data to provide a reasonable description of stock composition both temporally and spatially. However, the WG continues to note this issue and to recommend that action is taken to resolve the difficulties at Nuuk. The WG will consider the possibility of including confidence intervals in the figure in future.

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 wet area approach).

Reference Cited

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.