Extract of the Report of the ICES Advisory Committee

North Atlantic Salmon Stocks

as reported to
the North Atlantic Salmon Conservation Organization

2008

ICES
International Council for the Exploration of the Sea
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Conseil International pour l'Exploration de la Mer

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Contents

Executive Summary

- In the North Atlantic, exploitation remains low and nominal catch of Atlantic salmon in 2007 was the lowest in the time-series.
- Marine survival indices remain low and are considered to be a key factor limiting salmon production. Research aimed at understanding this phenomena should be a high priority.
- Northern North-East Atlantic Commission stock complexes (1SW and MSW) are at full reproductive capacity prior to the commencement of distant water fisheries.
- The Southern North-East Atlantic Commission 1SW stock complex is at full reproductive capacity while the MSW stock complex is suffering reduced reproductive capacity prior to the commencement of distant water fisheries.
- No catch options for the fishery at the Faroes (2009–2011) would meet precautionary management objectives.
- A number of studies were reviewed that report on significant new or emerging threats to, or opportunities for, salmon conservation and management.

1 Introduction

1.1 Main tasks

At its 2007 Statutory Meeting, ICES resolved (C. Res. 2007/2/ACOM18) that the Working Group on North Atlantic Salmon [WGNAS] (Chair: T. Sheehan, USA) will meet in Galway, Ireland, from the 1st–10th April 2008 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organisation (NASCO). The terms of reference were met and the sections of the report which provide the answers are identified below:

With respect to Atlantic salmon in the North Atlantic Area:	Section 2
provide an overview of salmon catches and landings, including unreported catches by country and catch-and-release, and production of farmed and ranched Atlantic salmon in 2007;	2.1 and 2.2
report on significant new or emerging threats to, or opportunities for, salmon conservation and management;	2.3 and 2.7
examine and report on associations between changes in biological characteristics of all life stages of Atlantic salmon, environmental changes and variations in marine survival with a view to identifying predictors of abundance; [1]	2.4
describe the natural range of variability in marine survival with particular emphasis on partitioning mortality to the narrowest geographic scale possible (estuarine, near-shore, offshore, etc.); [2]	2.5
compile information on the marine migration and dispersal of escaped farmed salmon with particular emphasis on movements between countries; [3]	2.6
provide a compilation of tag releases by country in 2007 and advise on progress with compiling historical tag recovery data from oceanic areas; [4]	2.8
identify relevant data deficiencies, monitoring needs and research requirements; [5]	Sec 6

With respect to Atlantic salmon in the North-East Atlantic Commission area:	Section 3
1) describe the key events of the 2007 fisheries; [6]	3.8
provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved;	3.9
review and report on the development of age-specific stock conservation limits, where possible based upon individual river stocks;	3.3
describe the status of the stocks and provide annual catch options or alternative management advice for 2009-2011, if possible based on forecasts of PFA for northern and southern stocks, 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; [7]	3.4, 3.6, and 3.8
further develop methods to forecast PFA for northern and southern stocks with measures of uncertainty.	2.3.2 and 2.3.3

With respect to Atlantic salmon in the North American Commission area:	Section 4
2) describe the key events of the 2007 fisheries (including the fishery at St Pierre and Miquelon); [6]	4.2
report on the biological characteristics (size, age, origin) of the catch in coastal	4.2.4

fisheries and potential impacts on non-local salmon stocks;	
provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved;	4.3
update age-specific stock conservation limits based on new information as available;	4.1
In the event that NASCO informs ICES that the framework (FWI) indicates that re-assessment is required*: describe the status of the stocks and provide annual catch options or alternative management advice for 2008-2011 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; [7]	na
With respect to Atlantic salmon in the West Greenland Commission area:	Section 5
3) describe the key events of the 2007 fisheries; [6]	5.1
provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved;	5.2
In the event that NASCO informs ICES that the framework (FWI) indicates that re-assessment is required: describe the status of stocks and provide annual catch options or alternative management advice for 2008-2010 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. [7,8]	na

Notes:

1. *With regard to question 1.3, there is interest in determining whether declines in marine survival coincide with changes in the biological characteristics of juveniles in fresh water or whether they are modifying characteristics of adult fish (size at age, age at maturity, condition, sex ratio, growth rates, etc.) and with environmental changes. In the event that an annual measure is agreed for the West Greenland fishery, this question should be considered a lower priority than the other questions.*
2. *With regard to question 1.4, there is interest in determining the extent to which marine survival regimes are driven by factors in estuarine, nearshore, or offshore environments. To the extent possible, this assessment should focus on discrete stock complexes corresponding to NASCO management objectives. Characterizing these losses could provide regional and stock-specific context for ongoing research and upcoming research initiatives such as SALSEA.*
3. *A number of implementation plans presented by NASCO Parties raised concern about the occurrence in their marine fisheries and rivers of farmed salmon originating in other countries.*
4. *With regard to question 1.6 the data on tag recovery information should be compiled according to the format developed by the ICES Workshop on the Development and Use of Historical Salmon Tagging Information from Oceanic Areas.*
5. *NASCO's International Atlantic Salmon Research Board's inventory of on-going research relating to salmon mortality in the sea will be provided to ICES to assist it in this task.*
6. *In the responses to questions 2.1, 3.1 and 4.1 ICES is asked to provide details of catch, gear, effort, composition and origin of the catch and rates of exploitation. For 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, and 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.*
7. *In response to questions 2.4, 3.5 and 4.3 provide a detailed explanation and critical examination of any changes to the models used to provide catch advice.*
8. *In response to question 4.3, ICES is requested to provide a brief summary of the status of*

North American and North-East Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions 2.4 and 3.5.

*** NASCO should inform ICES by 31 January 2008 of the outcome of utilising the Framework of Indicators (FWI).**

At the 2006 Annual Meeting of NASCO, conditional multi-annual regulatory measures were agreed to in the West Greenland Commission and for the Faroe Islands in the Northeast Atlantic Commission. The measures were conditional on a Framework of Indicators (FWI) being provided by ICES and the acceptance of the FWI by the various parties of each commission (WGC(06)06, NEA(06)06). The FWI was delivered by ICES (ICES, 2007c) and was accepted by the Parties to the West Greenland Commission. As such, the multi-annual regulatory measures for the WGC continued and the decision to request that ICES undertake a full stock assessment and provide multi-annual catch advice for the 2008 fishing season was dependant on the outcome of the FWI. Denmark (in respect of the Faroe Islands and Greenland) opted out of the multi-annual regulatory measures as a FWI was not provided by ICES for the fishery in the Faroes (ICES, 2007c).

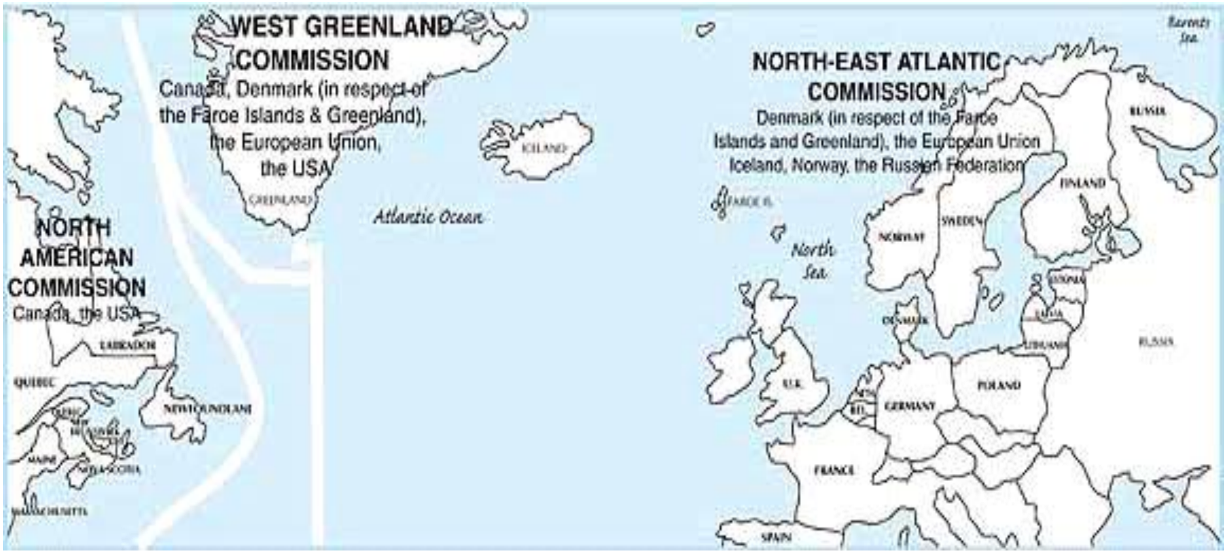
NASCO formed the West Greenland Framework of Indicators Coordination Group which applied the FWI and communicated the results that no change to the management advice previously provided by ICES is required for the 2008 fishery at West Greenland. NASCO communicated this outcome to ICES on February 1, 2008 via email with a copy to the Chair of the WGNAS. As a result, terms of reference c5 and d3 were not undertaken by the WGNAS.

A complete list of acronyms used in this document is provided in Annex 1. References are cited in Annex 2.

1.2 Management framework for salmon in the North Atlantic

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

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



1.3 Management objectives

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

> "To contribute through consultation and co-operation 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".

1.4 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.

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 boundary of the 95% 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 boundary 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.

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

For 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% (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

Nominal catches of salmon reported for countries in the North Atlantic are given in Table 2.1.1.1 for the years 1960 to 2007. These catches (in tonnes) are illustrated in Figure 2.1.1.1 for four North Atlantic regions. Catch statistics in the North Atlantic also include fish farm escapees and in some Northeast Atlantic countries also included ranched fish.

A significant change occurred in 2007 with the reporting of Icelandic catches. Traditionally, they have 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 stocking specifically for rod fisheries in two Icelandic rivers is considered as "ranching" as there are no wild salmon in the target river. This continued in 2007 (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.

Reported catches in tonnes for the three NASCO Commission Areas for 1996–2007 are provided below.

Area	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NEAC	2225	2073	2736	2876	2495	2303	1977	1999	1878	1394
NAC	159	154	155	150	150	144	164	142	140	114
WGC	11	19	21	43	9	9	15	15	22	25
Total	2396	2246	2913	3069	2654	2456	2156	2155	2040	1533

The provisional total nominal catch for 2007 was 1533 t, 507 t below the updated catch for 2006 (2040 t) and the lowest in the period 1960–2007. Catches were below the previous five- and ten-year averages in most countries, and were the lowest recorded in the time-series in six countries, four of these in Southern NEAC.

ICES recognises that mixed-stock fisheries present particular threats to stock status. These fisheries predominantly operate in coastal areas and NASCO specifically requests that the nominal catches in homewater fisheries be partitioned according to whether the catch is taken in coastal, estuarine, or riverine areas. The 2007 nominal catch (in tonnes) was partitioned accordingly and is shown below for the NEAC and NAC Commission Areas. It was not possible to apportion the small Danish catches in 2007 and therefore these have been excluded from the calculation. The catch accounted for by each fishery varied considerably between countries. In total, coastal fisheries accounted for 38% of the catches in Northeast Atlantic countries compared to 7% in North America, whereas in-river fisheries took 58% of the catches in Northeast Atlantic countries and 62% in North America. In most countries the majority of the catch is now taken in fresh water and the coastal catch has declined markedly.

Area	Coast	Estuary	River	Total

	Weight	%	Weight	%	Weight	%	Weight
NEAC	533	38	56	4	802	58	1391
NAC	8	7	36	31	70	62	114

In the NEAC Northern area, catches since 1995 have fluctuated with no apparent trend (Figure 2.1.1.2). Typically about half the catch has been taken in rivers and half in coastal waters (although there are no coastal fisheries in Iceland and Finland), with estuarine catches representing a negligible component of the catch in this area. In Southern Europe, catches in all fishery areas have declined over the period and, while coastal fisheries have historically made up the largest component of the catch, these fisheries have declined substantially, reflecting widespread measures to reduce exploitation in a number of countries. In 2007, the majority of the catch in this area was taken in fresh water. In North America, the total catch over the period 2000–2007 has been relatively constant. The majority of the catch in this area has been taken in riverine fisheries, while the catch in coastal fisheries has been relatively small in any year (11 t or less).

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 North America, 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. There are large differences in the percentage of the total rod catch that is released: in 2007 this ranged from 19% in UK (N. Ireland) to 90% in Russia, reflecting varying management practices and angler attitudes. Within countries, the percentage of fish released has tended to increase over time. Overall, over 178 500 salmon were reported to have been released around the North Atlantic in 2007, almost 11 000 more than in 2006. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller MSW fish.

2.1.3 Unreported catches

The total unreported catch in NASCO areas in 2007 was estimated to be 475 t. The unreported catch in the North East Atlantic Commission Area in 2007 was estimated at 465 t and that for the West Greenland Commission Area at 10 t. There was no estimate for the North American Commission Area (Table 2.1.1.1). The unreported catch, expressed as a percentage of the total North Atlantic catch (nominal and unreported), has fluctuated since 1987 (range 23–34%), but has remained fairly constant in the last three years at about 25%. Over recent years, efforts have been made to reduce the level of unreporting in a number of countries (e.g. through improved reporting procedures, carcase tagging, and logbook schemes). After 1994 there are no available data on the extent of possible salmon catches in international waters. Limited surveillance flights, which formed the basis of past estimates of catches in international waters, have not reported any such salmon fishing in recent years. Estimates (in tonnes) of unreported catches for the three Commission Areas for the period 1996–2007 are given below:

Area	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NEAC	1108	887	1135	1089	946	719	575	605	604	465
NAC	91	133	124	81	83	118	101	85	56	-
WGC	11	13	10	10	10	10	10	10	10	10
Int'l. waters				Not available						

Expressed as a percentage of the total North Atlantic catch, unreported catch estimates range from 0% to 15% for individual countries. However, it should be noted that methods of estimating unreported catch vary both within and among countries. The non-reporting rates range from 1% to 50% of the total national catch in individual countries.

2.2 Farming and sea ranching of Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2007 is 947 000 t. This represents an increase from 2006 (839 912 t) and is the highest in the time-series. Most of the North Atlantic production took place in Norway (73%) and UK (Scotland) (17%).

World-wide production of farmed Atlantic salmon has been in excess of one million tonnes since 2002. It is difficult to source reliable production figures for all countries outside the North Atlantic area and it has been necessary to use 2006 estimates for some countries in deriving a world-wide estimate for 2007. Noting this caveat, total production in 2007 is provisionally estimated at around 1 400 000 t (Figure 2.2.1) a 7% increase on 2006 and the highest in the time-series. Production outside the North Atlantic is dominated by Chile and is estimated to have accounted for 32% of the total in 2007. World-wide production of farmed Atlantic salmon in 2007 was over 900 times the reported nominal catch of Atlantic salmon in the North Atlantic.

The total harvest of ranched Atlantic salmon in countries bordering the North Atlantic in 2007 was 39 t, the majority of which (35 t) was taken in Icelandic "ranched" rod fisheries (Figure 2.2.2). Small catches of ranched fish were also recorded in three other countries (Ireland, UK (N. Ireland), and Norway); the data includes catches in net, trap, and rod fisheries.

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 Stock–recruitment models and developing conservation limits for Atlantic salmon populations in Norway

Conservation limits (CLs) have been developed for Atlantic salmon stocks in nine rivers in Norway which have sufficient data to fit stock–recruitment (*SR*) models. In these models, spawning stock and recruitment were measured as the number of eggs (*S*) and the density of juveniles (*R*), respectively. Based on the *SR*-relationships in these nine rivers, CLs for salmon populations in Norway were grouped into four categories of egg densities from <1.5 eggs m^{-2} to >5 eggs m^{-2} (group averages being, respectively, 1, 2, 4, and 6 eggs m^{-2}). Eighty major Norwegian rivers were then grouped into these four categories.

Wetted area was estimated by GIS methods from digital geographic data to a 1:50 000 scale, calculated from the river mouth to migratory barriers mapped by Norwegian management authorities. For most rivers productivity (i.e. category of egg density) was assessed based on catch statistics converted to catch per area, smolt age distribution, and other available information on the characteristics of each river. The number of eggs necessary to seed the whole river was estimated from the CL (eggs/m^2) and the number of females needed to meet that number. For some large watercourses, CLs were estimated by considering the tributaries separately. This must be considered *first-generation* CLs for the populations in question. The two major limitations to setting precise CLs are believed to be the estimation of productive area (as part of the wetted area) and estimation of the number of spawners extrapolated from catch statistics. CLs have been estimated for an additional 100 Norwegian rivers, but have as yet not been published.

2.3.2 Standardization of run-reconstruction models for NAC and NEAC areas

Run-reconstruction models are used in both the NAC and NEAC areas to estimate the pre-fishery abundance of 1SW salmon (Potter *et al.*, 1998; Rago *et al.*, 1993). The models work backwards from catches in homewaters or returns to rivers and progressively add in catches in the ocean at earlier periods of time, with adjustments for natural mortality, to develop estimates of abundance at a given point in the life cycle at sea prior to fisheries exploitation. In the interest of exploring Bayesian models for forecasting and for development of catch advice, the assumptions and data inputs of the run-reconstruction models were reviewed and differences in assumptions and data inputs between Commission areas were identified. The development of a standardized approach for the run-reconstruction models for each Commission will be pursued.

2.3.3 Modelling dynamics of Atlantic salmon in the NAC and NEAC areas

Forecast models and catch advice frameworks have not been developed for three of the four NEAC stock complexes, all of which were exploited in the Faroes fishery. For the provision of the catch advice for West Greenland, two forecast models are used in the risk analysis; one for the non-maturing 1SW salmon of North American origin, the other for 1SW non-maturing salmon from the southern NEAC complex. Both models are based on similar data, including a lagged spawner (LS) variable to define the spawning stock, and a recruitment variable termed the PFA (Pre-Fishery Abundance) with a function relating the spawning component to the recruitment.

The estimation of abundance prior to the fishery (PFA) is done using the run-reconstruction model developed by Rago *et al.* (1993) and Potter *et al.* (1998). A preliminary plot of the annual midpoint estimates of PFA relative to the LS for the southern NEAC non-maturing complex suggests two periods of productivity as noted for NAC: a high productivity period during 1979 to 1989 and a low productivity period during 1978 and 1990 to the present (Figure 2.3.3.1). For NAC, a series of models have been used to relate PFA to LS and to assess the presence of two phases of productivity. For the southern NEAC non-maturing 1SW complex, the WGNAS considered the development of a non-phase shift model to forecast the PFA (ICES, 2002, 2003).

Alternate models for NAC and NEAC

A number of functional relationships between PFA and spawners were explored:

a) a simple random walk through time (dynamic model of Prévost *et al.*, 2005);
b) a random shift with 2 production levels, but with autocorrelation regarding the probability of being in a high state or a lower state.

The phase shift model is slightly more optimistic for future PFA abundance for both NAC and NEAC, with no chance of further declines, whereas the dynamic model forecasts have greater uncertainty over the 4 years of forecast with increasing chance of further declines in the future.

The parallel declines in productivity for both the NAC and NEAC stock complexes during 1988 to 1993 are striking (Figure 2.3.3.1). The productivity parameter in the models explored does not allow a determination of whether the change in productivity has occurred in fresh water, in the first year at sea survival, or both.

Modelling under a Bayesian framework can include observation errors and should be considered as a next step. This will take into consideration the fact that both PFA and LS are estimated from a number of other data sources, each of which has associated uncertainties. To use these models in a catch advice framework, disaggregated data for PFA reconstruction must be used. Examples of such model structures were considered by ICES and will be further explored in the future.

2.3.4 Thermal habitat and depths experienced by Atlantic salmon kelts migrating from Newfoundland

In 2007, data storage tags (DSTs-LAT2510, manufactured by LOTEK Inc.) in a beta test format were applied to 26 Atlantic salmon kelts at an enumeration facility at Campbellton River, Newfoundland. The tags recorded date, time of day, internal and external temperatures, pressure, and light at four-minute intervals. The recording of light made estimation of geolocation possible. The time between release and recovery for 8 fish ranged from 45 to 81 days. Results from these eight recovered tags indicated considerable differences between external and internal temperatures. These differences occurred because the internally placed thermistor was insulated by the flesh of the fish surrounding the body cavity, whereas the external thermistor directly recorded the water temperature in the ocean where the fish was swimming. Depth profiles indicated that during the day salmon were frequently diving, possibly to feed on deeper occurring pelagic species, whereas at night they remained near the surface. Salmon in fresh water are visual feeders and if visual feeding carries over into the sea it would explain the observations of the frequent diving activities during the daylight hours, but little or no activity at night.

Light levels were used to determine daily times of sunrise, sunset, and day length, which were then used to determine latitude and longitude of the salmon. Preliminary results for the eight Campbellton River salmon indicate movement within Notre Dame Bay and in some cases out to 200 km into the Labrador Sea.

2.3.5 Stock size, catch, and effort in the salmon fishery in the River Ellidaar, SW Iceland

A study using fish counter information, rod catch data from logbooks, and effort data in the period 1935–2002 in River Ellidaar, Southwest Iceland showed high correlation between salmon run and catch ($R^2=0.68$; $p<0.001$). In the 68-year period, the catch varied from 414 to 2276 fish and the salmon run from 750 to 7184 fish (Figure 2.3.5.1) with an average exploitation rate of 40%. The fishing effort increased periodically from 180 rod/days in the beginning of the period to 520 in the latest years. There was a higher exploitation in the years when the run was low than when the run size was high as reflected in higher average number of fish caught per rod-day. With an increased number of rods, the catch per rod-day decreased, indicating that the rod catch reflected the salmon run at least within the observed effort range. There was no relationship between the number of rods used and the exploitation rate although the number of rods increased from 180 to 520 over the 68 years of the time-series. This suggests that within this range the exploitation rate is not sensitive to changes in number of rod-days. Based on this analysis, if the catch is to be reduced as a management measure, it would be necessary to decrease the numbers of rod-days to lower levels than the range already observed to reduce the exploitation rate significantly. However, other management measures such as shortening of the fishing season, closure of areas for fishing, or catch-and-release in the rod fishery may be more effective in this regard.

2.3.6 The assessment of recent fishery management measures on salmon stocks in the River Bush and in UK (N. Ireland) with regard to adjacent regions

The River Bush represents the main indicator stock for monitoring Atlantic salmon populations in UK (N. Ireland) and long-term assessment work includes a CWT (coded wire tag) programme to examine exploitation and marine survival levels. Commercial catch information and CWT data were used to investigate the impact of a recent fishery management measure (voluntary net buyout) implemented in the Fisheries Conservancy Board area (FCB) of UK (N. Ireland) in 2002. The buyout resulted in a reduction in landings from a relatively stable mean of 10 263 salmon of all sea ages (1990–2001) to around 2826 fish (2002–07). This represents a mean reduction in landings of approximately 72.5%, or 7 437 fish. In addition, CWT data indicated reduced exploitation rates on 1SW R. Bush salmon in the FCB area following the buyout, with mean exploitation rates for the same period decreasing from around 43% to less than 17%. The potential impact of the FCB area buyout on the 1SW R. Bush stock was assessed by comparing the actual exploitation level as measured by annual microtag returns with the mean pre-buyout exploitation level for the fishery applied to the annual number of available R. Bush grilse returning to the coast. The estimated number of 1SW R. Bush salmon conserved by the measure averaged 460 fish per year (2002–2007) or approximately 42% of the R. Bush CL.

2.3.7 Red vent syndrome

For some countries in the NEAC area, salmon have been returning to rivers with swollen and/or bleeding vents. The condition, referred to as red vent syndrome, appears to be restricted to wild Atlantic salmon populations and has been noted since 2005. However, the condition has become more prevalent and, in 2007, was reported from a number of NEAC countries including Ireland, Iceland, UK (Scotland), UK (England & Wales), and UK (N. Ireland). The cause of the condition 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 anadromous species. Its life cycle may include more than one intermediary host with the final host being cetaceans. Man is reported as an accidental host, following ingestion of larvae in raw or undercooked fish (Gómez *et al.*, 2003) and press releases and information leaflets have been issued in a number of NEAC countries to advise anglers. The majority of fish showing symptoms are grilse, although smaller numbers of 2SW fish have also been found with the condition. In UK (N. Ireland), 50% to 60% of early run fish on the River Bush were affected. Both male and female adult salmon are affected; the problem has not been seen in parr or smolts. It is also unclear whether the condition affects the survival of the fish or their spawning success. However, there was no significant difference in the condition factor of affected and unaffected fish from monitored rivers in UK (England & Wales) and affected fish have also been successfully used as broodstock in a number of countries and stripped eggs have developed normally in hatcheries. In addition, an affected salmon tagged on the River Dee in UK (England & Wales) in 2006 was recaptured in spring 2007 as a kelt. The fish appeared to have spawned successfully.

2.3.8 Atlantic salmon stock assessment using DIDSON (Dual-Frequency Identification Sonar)

Dual-Frequency Identification Sonar (DIDSON), which uses acoustic lens technology to form acoustic images of near video quality, is being employed on several north Atlantic rivers to count salmon. Two specific projects have recently been initiated in Ireland and Canada to examine the application of this technology for counting salmon particularly in large rivers where other counting technologies (resistivity, infra-red and split-beam acoustic) are not suitable or effective. The Deel River is the largest tributary of the Moy catchment (Co. Mayo, Ireland), a large catchment area of 2108 km^2, with prolific salmon run (rod catches of 10 000 to 15 000 salmon/year) and good water quality. For similar reasons the Eagle River (Labrador, Canada) was chosen: catchment 10 824 km^2; potential production 35 000 adults/year.

2.3.9 Smolt migration on the River Rhine

The downstream migration of Atlantic salmon smolts was monitored in the River Rhine in 2007 using the NEDAP Trail system (Breukelaar *et al.*, 1998). The NEDAP trail system is based on inductive coupling between an antenna loop on the river bottom and a ferrite rod antenna within the transponder tags in the fish. When the fish passes each detection station the unique ID-number of the transponder is recorded. Overall, 78 tagged fish were released into one tributary of the River Rhine about 330 km from the sea. The tagged fish were detected by fixed antenna arrays when leaving the tributary and during their migration through the Rhine Delta to the sea. By the end of the migration period, 60 of the tagged fish (77%) were detected leaving the tributary and 36 (46%) were recorded reaching the sea after passage through the Rhine Delta. The losses of tagged fish occurred in both the German part of the Rhine (14 fish, 18%) and in the Delta itself in the Netherlands (10 fish, 13%). The study will be repeated after the re-opening of the Haringvliet dam, which is scheduled to occur by the end of 2008, and which is intended to facilitate passage of diadromous migratory fish species.

2.3.10 European regulations

The EU data collection regulation (EU DCR) has been updated and expanded recently to include both salmon and eels. This will have impacts at Community level relating specifically to the requirement for a multi-annual Community programme for collection, management and use of biological, technical, environmental, and socio-economic data concerning:

commercial fisheries carried out by Community fishing vessels:

- within Community waters, including commercial fisheries for eels and salmon in inland waters,
- outside Community waters;

recreational fisheries carried out within Community waters including recreational fisheries for eels and salmon in inland waters;

aquaculture activities related to marine species, including eels and salmon, carried out within the Member States and the Community waters;

industries processing fisheries products; shall be defined in accordance with the procedure referred to in Article 27(2).

2.4 NASCO has asked ICES to examine and report on associations between changes in biological characteristics of all life stages of Atlantic salmon, environmental changes and variations in marine survival with a view to identifying predictors of abundance

2.4.1 Biological characteristics of salmon across the North Atlantic area

The purpose of examining these associations was to determine whether declines in marine survival coincide with changes in the biological characteristics of juveniles in fresh water or whether they are related to characteristics of adult fish (size-at-age, age-at-maturity, condition, sex ratio, growth rates, etc.). Data were made available for six rivers from the Northern NEAC, seven rivers from the Southern NEAC, and seven from the NAC area. The data set includes information on time-series of variations in mean smolt age, proportions of maiden sea age groups, repeat spawners, sexes, and size-at-age of adult salmon. Preliminary analyses suggest a tentative association between the productivity index (PFA/lagged eggs) and the size of 1SW salmon in the Northern NEAC area, whereas the relationship was less clear for the Southern NEAC area (Figure 2.4.1.2). These preliminary results further suggest that associations between variations in marine survival and biological characteristics of salmon should be examined in more detail.

2.4.2 Size of 1SW fish returning to Norway

In 2007, the size of grilse from all parts of Norway was very small, and the number of grilse returning to Norwegian home waters was very low. The proportion of grilse among salmon smaller than 3 kg was the lowest in the time-series, thus the use of catch statistics to assess the grilse returns for 2007 may overestimate the returns of grilse and underestimate the number of MSW salmon. The mean weight of grilse in samples from Norwegian rivers decreased during the 1990s, increased around 2000, and has recently decreased again in more recent years (Figure 2.4.2.1). The mean grilse weight in 2007 was the lowest in the time-series. The pattern in the 1990s is mainly driven by data from river populations in the central and northern parts of Norway, while the decrease since 2000 is mainly driven by data from populations in the southern part. In all regions of Norway, the mean weight of grilse in 2007 was the lowest in the time-series. The mean standardized weights of grilse in 20 Norwegian rivers correlated positively with the estimated pre-fishery abundance (PFA) of the corresponding sea year class ($r^2 = 0.72$, $n = 19$ years, $p < 0.001$), and the annual mean weight of salmon smaller than 3 kg from the River Drammen correlated positively with the estimated survival of hatchery-reared smolts released in the same river ($r^2 = 0.26$, $n = 23$ years, $p = 0.013$). Growth of salmon during the first year at sea or grilse size provides an indirect measure of growth rate, and it may be that growth during the first period at sea is crucial for size-selective mortality. If the conditions that smolts experience during the first period in the sea are important for survival, measurements of circuli spacing on scales during this period may be better correlated with survival than growth during the whole period.

2.4.3 Decline in 2SW salmon in Iceland

In Iceland, a decline in the two-sea-winter (2SW) stock component is of major concern. For rivers with continuous salmon catch records from 1970, and which account for almost 90% of the total national rod catch, it is evident that similar numbers of 1SW and 2SW salmon were caught in the 1970s. However, in the early 1980s a steep decline was observed for all Icelandic salmon stocks. The 1SW fish recovered in the mid-1980s but the 2SW decline still continues (Figure 2.4.3.1). In

2002, voluntary release of rod-caught 2SW salmon and other restrictions on fishing were promoted. As well as the decline in the number of 2SW salmon caught, the average weight of 2SW also shows a declining trend over the same period. No such trends are apparent for the 1SW salmon. The low weight of 2SW salmon suggests poor conditions in the ocean, and that the 1SW and the 2SW salmon are at different feeding areas. While the 1SW salmon are returning at previous levels, many 2SW fish appear to be dying during their second year at sea. If the decline in the 2SW salmon stock component continues at the current rate, it is predicted that this will be down to very low levels by 2020.

2.4.4 Ecosystem-driven variations in return rates to a second spawning for Atlantic salmon from the Miramichi River

ICES reviewed an analysis of a 36-year time-series of salmon abundance, demographics and estimates of return rates of post-spawning salmon that explored a possible linkage between survival to a second spawning of Atlantic salmon and changes in the small fish community of the southern Gulf of St. Lawrence. An index of the catchability adjusted biomass of the small fish community (<20 cm length) in the southern Gulf of St. Lawrence was derived from the annual groundfish survey conducted since 1970. Since 1998, the small fish community index, which includes juveniles of many marine fish species such as capelin, smelt, shanny, and stickleback, has increased to the highest levels since the early 1970s.

The improved return rates of consecutive spawners is closely associated with the increase in the biomass index of small fish from the southern Gulf of St. Lawrence (Figure 2.4.4.1). Benoit and Swain (2008) attribute the increase in the small fish index to reduced predation pressure resulting from the collapse of the previously dominant groundfish stocks in this area (cod, skate, flatfish species). This increased biomass of small fish may have benefited salmon by providing a more abundant food source for reconditioning both for consecutive and alternate spawning strategies. The association between the variation in return rate of alternate spawners and the variations in the fish biomass index in either the first post-spawning year at sea or in the return year for alternates provides additional support that food supplies in the early period of return at sea may be beneficial to survival to a second spawning.

2.4.5 West Greenland biological characteristics database, 1968–2007

Assessment of the effects of the West Greenland salmon fishery on homewater stocks and fisheries requires biological characteristics data from the exploited population as well as estimation of the proportion of the catch that is North American and European in origin. Since about 1965, Canadian, Danish, American, and other researchers have been collecting biological data from catches in the Greenland commercial and local use fisheries at Greenland. The database now consists of 54 095 samples of individual fish with data on date, location of sample (NAFO Division or ICNAF squares), size (mainly fork length measured in cm with some gutted and whole weights in kg), river and sea ages, plus presence of spawning marks and origin. This database is available for use by researchers interested in ecological effects of salmon at sea as well as for modelling population parameters for prediction of numbers of salmon available for harvest.

2.5 NASCO has asked ICES to describe the natural range of variability in marine survival with particular emphasis on partitioning mortality to the narrowest geographic scale possible (estuarine, near-shore, offshore, etc.)

2.5.1 Variability in estuarine and early marine survival of smolts

ICES reviewed information from studies that have used sonic telemetry to assess the migratory behaviour of smolts in estuaries and the coastal zone to derive estimates of the mortality of smolts and post smolts. These studies were concentrated in the southern portions of Europe and North America, utilized both wild and hatchery smolts, and have been replicated for up to 5 years depending on the individual river. All the investigations provided estimates of smolt survival through estuaries. However, none of the studies in the NEAC area extended beyond the estuary mouth. In contrast, some North American studies have extended into coastal areas and across the Gulf of St. Lawrence. A summary of these studies, by region, is provided in Table 2.5.1.1. One of the investigations was conducted in an impounded estuary and this accounts for some of the lower observed values of survival through estuaries. Results from these studies suggest that smolt estuary mortality, although variable, is broadly similar in the NEAC and NAC regions, with no clear correlation with latitude (Figure 2.5.1.1). These studies also provided no evidence of either increasing or decreasing trends in survival to estuary exit over the time period in which they have been conducted and there was some indication that higher losses occurred in the longer estuaries (Figure 2.5.1.1), possibly a reflection of greater losses due to predation.

2.5.2 Ocean tracking network

A major Canadian-based initiative, the Ocean Tracking Network (OTN), commenced in 2008 with the aim of deploying sonic receiver arrays at key points in the globe's oceans. Some of these arrays will provide opportunities for long-range tracking of salmon post smolts in the marine environment, and in some instances for quantifying the numbers of post smolts surviving to various stages in their marine migration. In North America, sonic arrays, which will run perpendicular to the coast across the continental shelf, are planned for: the Gulf of Maine (2009) and Halifax, Nova Scotia (starting in April 2008 with completion in 2009), with further arrays across the Cabot Strait in the Gulf of St. Lawrence (2009) and off Greenland (2010). A seasonal receiver line has been deployed since 2006 in the northern exit from the Gulf of St. Lawrence (the Strait of Belle Isle) in early summer to autumn, and funding has been requested for two additional seasonal coastal shelf lines off Labrador (2008). Attempts are currently underway to find support for the establishment of additional arrays in Europe. OTN also aims to foster research and development of innovative technologies and strategies for acoustic telemetry. This includes the development of "bioprobes", where large mobile animals such as sharks or rays will carry receivers capable of downloading information from passing tagged animals, and uploading this via satellite to data compilers when these large animals break the surface. The OTN infrastructure should be maintained for at least a ten-year period, providing a long-term platform for marine work on Atlantic salmon.

2.5.3 Sonic tracking of North American Atlantic salmon smolts to sea

ICES reviewed the progress of one of the North American SALSEA initiatives, a multi-year programme of sonic telemetry of Atlantic salmon (*Salmo salar*) smolts from five Canadian rivers. This programme is documenting the migration patterns and survival of smolts from fresh-water release sites, through home river estuaries and across the Gulf of St. Lawrence to the Strait of Belle Isle (> 1000 km for some fish). The study rivers include four (Restigouche, Miramichi, Cascapedia, and St-Jean (North Shore)) which contain a high proportion of 2SW salmon expected to migrate to West Greenland, and one in Newfoundland (Western Arm Brook) where the vast majority of fish mature after one year at sea. The study rivers lie approximately on a 600 km latitudinal gradient. Survival patterns of smolts were similar among years for a given river, and differed consistently among these study rivers over time. Heavy losses (up to 54%) occurred in most river estuaries, although in the Miramichi and Restigouche estuaries the proportion of smolts surviving estuary transit increased as the smolt run size increased, possibly indicating predator swamping (Figure 2.5.3.1). Travel rates in the Gulf were estimated at 18–25 km d^{-1}; survival rates to the Strait of Belle Isle and travel speeds were not associated with fish body size. Significant numbers of smolts from the Miramichi, Restigouche, and Cascapedia rivers passed through the Strait of Belle Isle, showing that this is an important migration pathway for fish from these rivers. The timing of the passage of fish from these rivers through the Strait was synchronized, despite different entry times into the Gulf of St. Lawrence. This may indicate that aggregation of smolts occurs from multiple populations within the first 30 days of entering the sea. These results will be informative when planning North American SALSEA research cruises scheduled for 2008.

2.6 NASCO has asked ICES to compile information on the marine migration and dispersal of escaped farmed salmon with particular emphasis on movements between countries

2.6.1 Experimental tagging programme for investigating the behaviour of escaped farmed salmon from Norway and Scotland

In 2006, Norway and Scotland carried out an experiment releasing individually tagged large farmed salmon from farms on the coast. Farmed Atlantic salmon reared at Ardmair near Ullapool in Scotland and at Rognaldsvåg outside Florø in Norway were individually tagged with external Lea tags and released from the fish farms in the spring of 2006 (Ardmair: 678 with mean length of 719 mm; Rognaldsvåg: 597 with mean length of 721 mm). Most of the salmon were expected to be sexually mature in the autumn of 2006. Five tags from the releases in Scotland (0.7% of the total number released) and 42 tags from the releases in Norway were recovered (7% of the number released). Salmon released from the Norwegian fish farm showed a much higher survival (or detection) rate than the fish released at the Scottish farm and their migration pattern was very local. The migration pattern of the salmon released in Scotland can be plausibly explained by transport with the prevailing west to east Atlantic currents. The study has shown that large salmon escaping from fish farms in Scotland in the spring are capable of reaching Norwegian waters and the west coast of Sweden.

2.7 Update on marine research initiatives in the North Atlantic

2.7.1 Irish post-smolt survey in 2007

In May 2007, the Marine Institute of Ireland, funded under Ireland's National Development Plan (NDP) and the Atlantic Salmon Trust, organised a short, directed exploratory research cruise using a pelagic trawl net designed by Norwegian scientists for post-smolt fishing. Tissue samples of post-smolts captured at sea were provided for genetic analysis. The samples were divided by location resulting in four groups; Galway Bay, Killalla Bay, West Isle of Mull, and North West Isle of Lewis.

A summary of the sample locations and dates is shown in Figure 2.7.1.1. Overall, the majority of captures originated from large river systems in the vicinity of the individual trawling stations or from rivers to the south. However, it should be noted that a number of captures did originate from rivers believed to have migration routes that would likely not take them through these surveyed areas. As an example, of the 8 samples taken in Galway Bay, 2 fish were identified as having originated from rivers that are a considerable distance to the north of the sampling locations, indicating that these smolts had travelled in the opposite direction to that which may have been expected for ocean migrating post-smolts. These post-smolts may possibly have been influenced by local currents or circumstances. These types of results highlight the importance of marine surveys for salmon towards defining migration routes and may prove critical when developing large-scale marine survey programmes under the SALSEA initiative.

2.7.2 SALSEA

In 2006, NASCO adopted the Salmon at Sea ("SALSEA", An International Cooperative Research Programme on Salmon at Sea) conceptual programme of research into the causes of declines in marine survival of Atlantic salmon. The SALSEA programme contains a comprehensive mix of fresh water, estuarine, coastal, and offshore elements, ensuring a comprehensive overview of factors which may affect the marine mortality of Atlantic salmon. SALSEA offers a unique opportunity to increase understanding of how Atlantic salmon use the ocean: where they go; how they use ocean currents and the ocean's food resources; and what factors influence migration and distribution at sea.

In 2007, a significant element of the larger SALSEA project called "SALSEA Merge" (Advancing Understanding of Atlantic Salmon at Sea: Merging Genetics and Ecology to Resolve Stock-specific Migration and Distribution Patterns) was provided with funding support for 2008–2011 from the European Union 7th Framework (FP7), the Atlantic Salmon Trust, and the Total Fund. The overall objective of SALSEA-Merge is, by merging genetic and ecological investigations, to advance understanding of stock-specific migration and distribution patterns and overall ecology of the marine life of Atlantic salmon and to gain insight into the factors resulting in recent significant increases in marine mortality. The project will assemble and analyze data on the oceanographic and biological characteristics of the marine habitat of post-smolts in addition to obtaining biological material from three proposed annual cruises in 2008 and 2009. Significantly, material from marine salmon surveys carried out over the past two decades such as archived tissues for genetic stock identification to river/region of origin, salmon scales, and tag recovery information will form a major input to the project.

In 2008, Canada will make available a research vessel for 23 days, primarily in August, for the sampling of pelagic fishes including post smolts off the North American Coast. Objectives include documenting the distribution and abundance of salmon, and correlating these data with the abundance of other species including microplankton, and oceanographic conditions. Personnel from Canada and the USA will participate in the cruise, and sampling will be concentrated in the Labrador Sea. Survey transects are designed to document both nearshore and offshore distributions of post smolts, and any captured salmon will be extensively sampled for stomach contents, disease status, stable isotope content, etc. In addition, Canada and the USA will continue its life history monitoring on 16 index rivers. This work provides both short- and long-term information on the biological responses of salmon populations to changes in marine survival. Finally, North America is investing heavily in the development of electronic technologies for tracking the movements of salmon at sea. Descriptions of this work are provided in Sections 2.1.1 to 2.5.3 of this report.

SALSEA specifically identified an expanded sampling programme for the West Greenland fishery as one of its key goals. In total, 6 samplers would be required to be deployed across three sampling divisions over the course of the fishery. Prior arrangements will be made with fishers from these communities for the purchase and delivery of fresh whole Atlantic salmon throughout the sampling programme. These fish will be heavily sampled, including – but not limited to – various external characteristics, tags, tissue samples for genetic stock identification, age and growth, feeding, condition of fish through lipid content and RNA/DNA analysis, elemental analysis of otoliths, maturity status, trophic ecology through stable isotope signatures, heavy metal and pollutant loads, viral, bacterial, and parasite abundance. Paramount to the success of this programme is the genetic stock identification of all sampled fish to a scale finer than continent of origin to facilitate comparisons among and between various stock groupings. Annual operating costs (sampling supplies, purchase of fish, shipping costs, coordination...) for this programme will be supported by continued participation by the Parties and existing funds. External funding will need to be sought to support much of costs associated with sample processing. It is expected that some of the processing may be undertaken by the participating Parties as additional in-kind support. ICES supports the further development and implementation of an expanded West Greenland sampling programme in support of SALSEA as an extremely cost-effective means of sampling Atlantic salmon in the marine environment.

2.7.3 Update on marine research in the Barents Sea

A collaborative research project (2007–2010) involving research institutions and universities from Norway, Finland, Russia, and Canada, co-funded by the Norwegian Research Council and other national institutions, aims at investigating various elements of the marine ecology of the northernmost European salmon populations in the Barents Sea area. The main goals of the project include assessment of long-term changes in the marine trophic ecology of salmon by analysis of stable isotope signatures, determining marine distribution patterns and ocean feeding areas by the use of archival data storage tags (DST’s) and satellite tags on kelts, developing a time-series of marine survival for one salmon stock, and examining long-term co-variation in abundance and survival of salmon stocks in different Barents Sea rivers.

A video monitoring site was established in a tributary of the River Teno (Finland) in 2002 for collection of data on the sea survival of salmon. This time-series will be continued in this project, at least until 2010. In 2007, 30 kelts were equipped with archival satellite “pop-up” tags and released in the River Teno, and more than 300 kelts tagged with DSTs were released in four different Barents Sea rivers in Norway, Finland, and Russia. Tagging with DSTs and conventional anchor tags will continue in 2008.

2.8 NASCO has asked ICES to provide a compilation of tag releases by country in 2007 and advise on progress with compiling historical tag recovery data from oceanic areas

2.8.1 Compilation of tag releases and finclip data by ICES member countries in 2007

Data on releases of tagged, fin-clipped, and otherwise marked salmon in 2007 were provided by ICES and are compiled as a separate report (ICES, 2007b). A summary of tag releases is provided in Table 2.8.1.1.

2.8.2 Workshop on Salmon Historical Information – New Investigations from Old Tagging Data (WKSHINI)

At the 2007 ICES Annual Science Conference it was decided that a Workshop on Salmon Historical Information – New Investigations from Old Tagging Data [WKSHINI] (Chair: Lars Petter Hansen, Norway) will be established (2007/2/DFC02), and will meet in Halifax, Canada, from 18–20 September 2008 to:

- build on progress made in WKDUHSTI (2007);
- provide further information from historical oceanic tagging and recovery programmes in the format agreed at WKDUHSTI;
- update the database of tagging and tag recovery information which was established in WKDUHSTI;
- develop testable hypotheses of salmon migration and behaviour;
- test these hypotheses using information compiled in WKDUHSTI and any new information which becomes available;
- use the information to describe distribution of salmon of different river (stock) origins and sea age in time and space and assess changes in the distribution over time in relation to hydrographical factors.

WKSHINI will report by 1 November 2008 for the attention of the Diadromous Fish Committee and WGNAS.

Table 2.1.1.1 Reported total nominal catch of salmon by country (in tonnes round fresh weight), 1960–2007. (2007 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)	Den.	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			NEAC (N. Area)							NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
	Canada (1)	USA	St. P&M	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch (4)	Sweden (West)	Den.	Finland	Ireland (5,6)	UK (E & W)	UK (N.Irl.) (6,7)	UK (Scotl.)	France (8)	Spain (9)	Faroes (10)	East Grld.	West Grld. (11)	Other (12)	Reported Nominal Catch	NASCO Areas (13)	International waters (14)
1991	711	1	1	876	215	129	346	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	3	-	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	-	2,396	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	106	11	25	4	78	551	89	56	192	13	7	0	0	9	-	2,462	847	-
2004	161	0	3	784	82	118	11	19	4	39	489	111	48	245	19	7	0	0	15	-	2,155	686	-
2005	139	0	3	888	82	132	17	15	8	47	422	97	52	215	11	13	0	0	15	-	2,156	700	-
2006	137	0	3	932	91	104	17	14	2	67	326	80	29	192	13	11	0	0	22	-	2,040	670	-
2007	112	0	2	767	63	87	35	16	3	58	85	76	24	159	11	10	0	0	25	-	1,533	475	-
Average																							
2002-2006	145	0	3	939	96	110	13	20	4	65	494	108	53	207	13	9	0	0	14	-	2,294	788	-
1997-2006	157	0	2	932	106	102	23	22	4	70	553	136	62	234	12	8	2	0	22	-	2,445	946	-

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 recently developed 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 for Canada in 2007.
14. Estimates refer to season ending in given year.

Table 2.5.1.1 Summary of acoustic smolt tracking studies, by region.

Region	No. rivers	No. of studies with wild smolts	No. of studies with hatchery smolts	Impounded rivers	No. of replicates	Estuary length (km)	Time period
S. NEAC	5	4	1	1	1 - 4	1.2 - 2.9	1992 - 2007
USA	4	3	3	0	2 - 7	2.0 - 47.5	1997 - 2006
Scotia Fundy	1	1	0	0	2	127	2002 - 2003
Gulf	4	0	4	0	3 - 5	2.5 - 122	2003 - 2007
Newfoundland	1	1	0	0	1	3	2007

Table 2.8.1.1 Summary of Atlantic salmon tagged and marked in 2007. '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	Pit tag[2]	Total
Belgium	Hatchery	11,800	0	0	0	11,800
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	11,800	0	0	0	11,800
Canada	Hatchery	0	4,360	768,978	157	773,495
	Wild	0	23,746	29,223	574	53,543
	Adult	0	4,308	1,226	311	5,845
	Total	0	32,414	799,427	1,042	832,883
France[1]	Hatchery	0	0	459,267	0	459,267
	Wild	0	0	746	1,881	2,627
	Adult	0	0	175	65	240
	Total	0	0	460,188	1,946	462,134
Germany	Hatchery	33,146	0	7765	0	40,911
	Wild	0	300	0	0	300
	Adult	0	0	0	0	0
	Total	33,146	300	7,765	0	41,211
Iceland	Hatchery	121,140	0	0	0	121,140
	Wild	2,360	0	0	0	2,360
	Adult	0	2,774	0	0	2,774
	Total	123,500	2,774	0	0	126,274
Ireland	Hatchery	227,531	0	0	0	227,531
	Wild	4,157	0	0	0	4,157
	Adult	0	0	0	0	0
	Total	231,688	0	0	0	231,688
Norway	Hatchery	19,425	43,928	0	0	63,353
	Wild	236	2,709	0	0	2,945
	Adult	0	1290	0	0	1,290
	Total	19,661	47,927	0	0	67,588
Russia	Hatchery	0	0	1,231,544	0	1,231,544
	Wild	0	2,975	263	135	3,373
	Adult	0	0	0	0	0
	Total	0	2,975	1,231,807	135	1,234,917
Spain	Hatchery	241,845	0	144,940	0	386,785
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	241,845	0	144,940	0	386,785
Sweden	Hatchery	0	3,000	192,261	0	195,261
	Wild	0	450	0	0	450
	Adult	0	0	0	0	0
	Total	0	3,450	192,261	0	195,711
UK (England & Wales)	Hatchery	27,371	0	151,732	0	179,103
	Wild	14,110	0	14,098	0	28,208
	Adult	0	1,937	0	0	1,937
	Total	41,481	1,937	165,830	0	209,248
UK (N. Ireland)	Hatchery	17,382	0	31,949		49,331
	Wild	1819	0	0	0	1,819
	Adult	0	0	0	0	0
	Total	19,201	0	31,949	0	51,150
UK (Scotland)	Hatchery	62,976	0	0	0	62,976
	Wild	9,005	3,874	0	9,252	22,131
	Adult	0	0	0	0	0
	Total	71,981	3,874	0	9,252	85,107
USA	Hatchery	0	105,577	277,162	37,377	420,116
	Wild	0	855	0	0	855
	Adult	0	2,145	929	811	3,885
	Total	0	108,577	278,091	38,188	424,856
All Countries	Hatchery	717,670	156,865	3,257,833	37,534	4,222,613
	Wild	31,687	34,609	44,330	11,842	122,768
	Adult	0	12,454	2,330	1,187	15,971
	Total	749,357	203,928	3,304,493	50,563	4,361,352

[1] does not include 87,155 juveniles marked with fluorescent pigments nor 865 adults marked by dermojet.

[2] includs pit tags or other internal tags

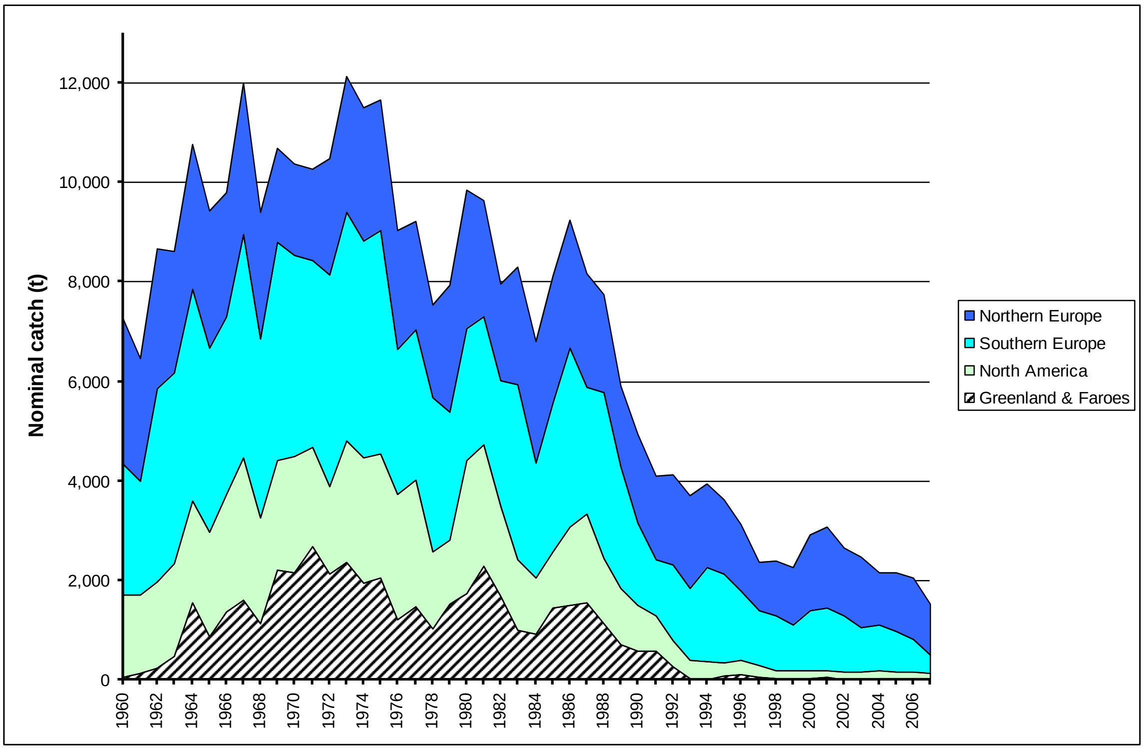


Figure 2.1.1.1 Reported total nominal catch of salmon (tonnes round fresh weight) in four North Atlantic regions, 1960–2007.

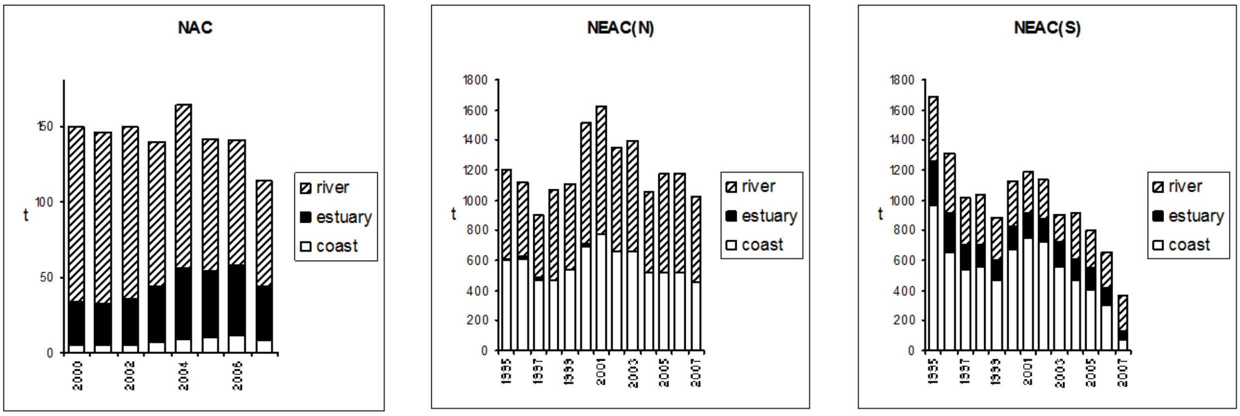


Figure 2.1.1.2 Nominal catch taken in coastal, estuarine, and riverine fisheries for the NAC area, and for the NEAC northern and southern areas. Note that time-series and y-axes vary.

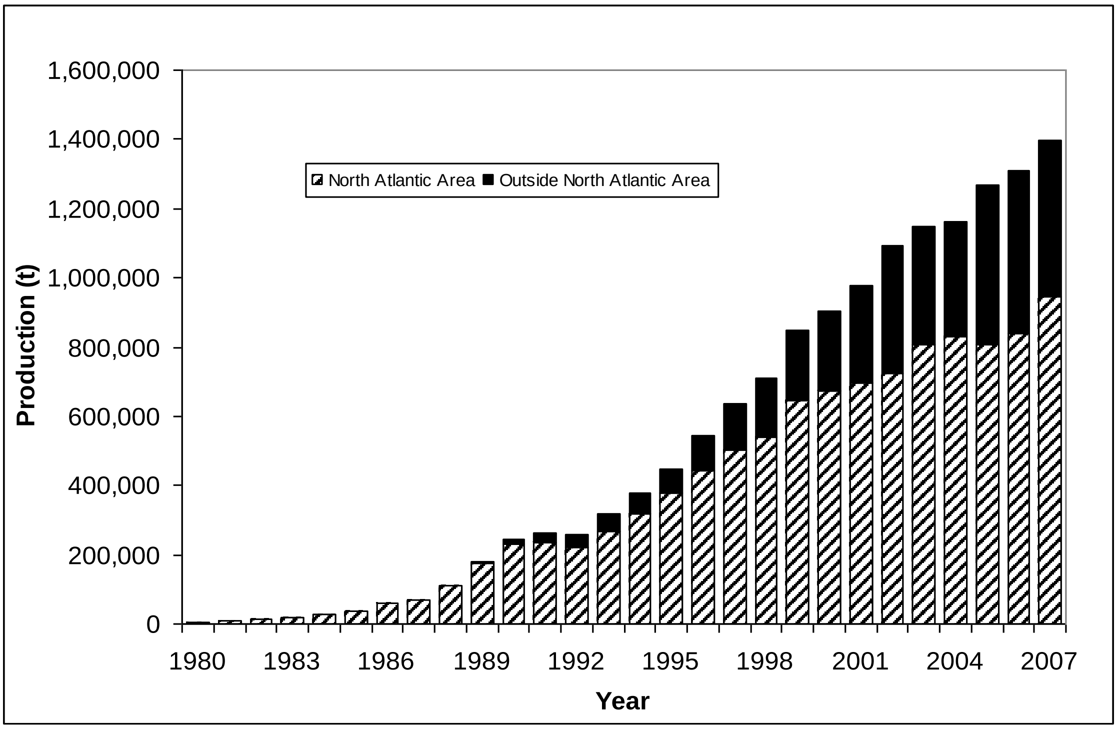


Figure 2.2.1 World-wide production of farmed Atlantic salmon, 1980–2007.

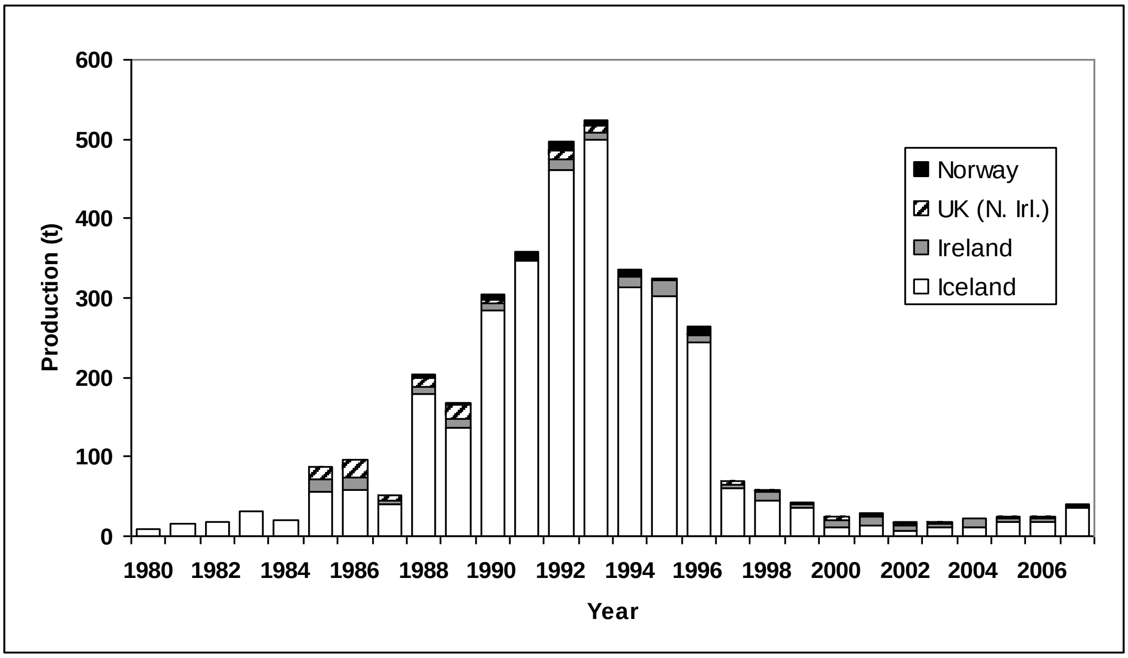


Figure 2.2.2 Production of ranched Atlantic salmon (tonnes round fresh weight) in the North Atlantic, 1980–2007.

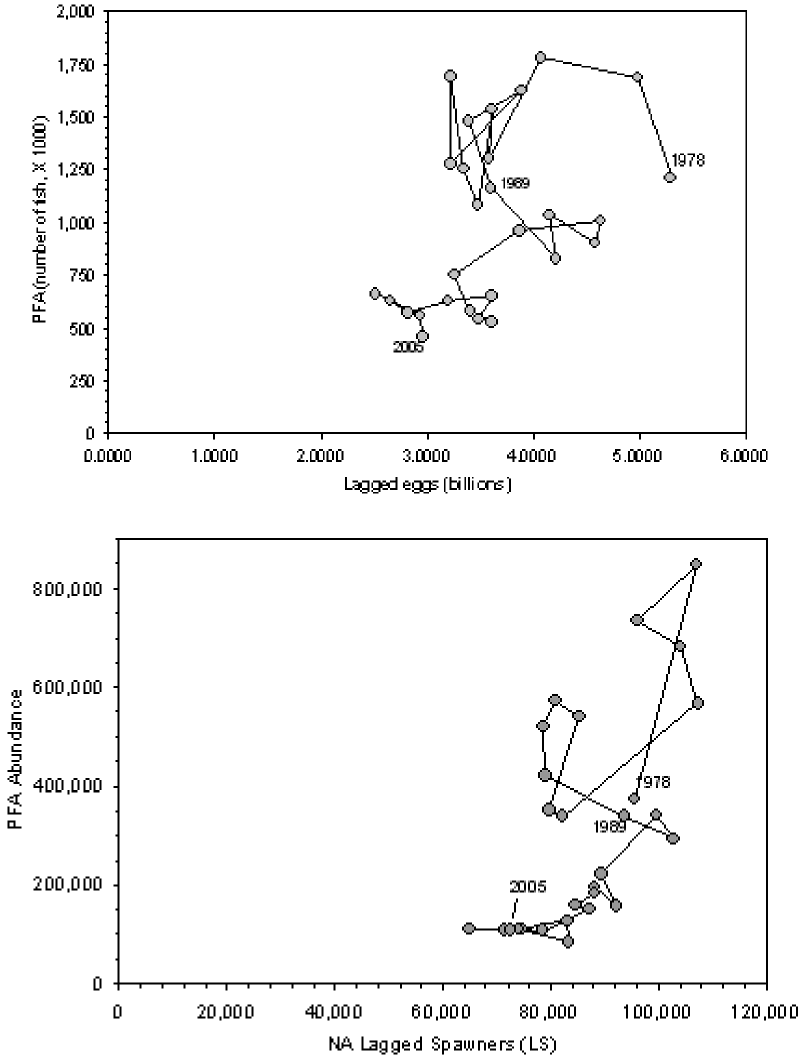


Figure 2.3.3.1 Relationship (based on midpoints) between PFA and lagged spawners for NAC (upper panel) and for southern NEAC non-maturing 1SW (lower panel), 1978 to 2006.

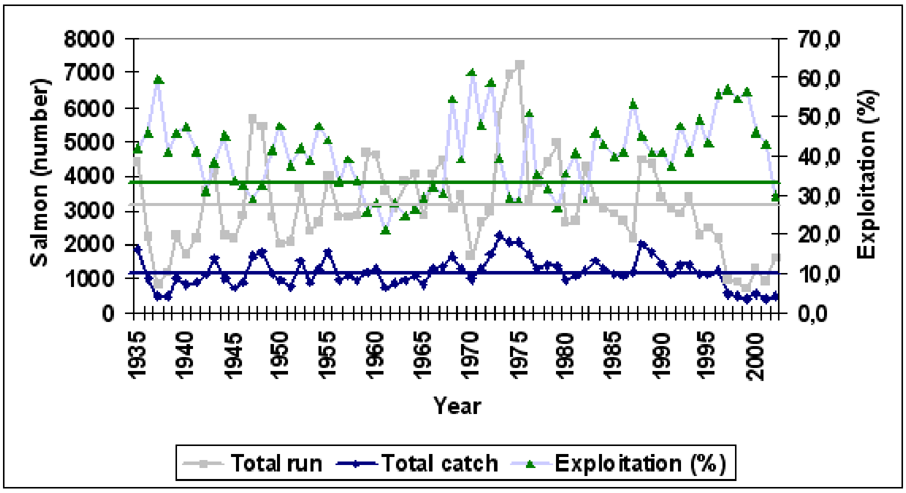


Figure 2.3.5.1 Total salmon run, catch, and exploitation in the salmon rod fishery in River Ellidaar 1935–2002.

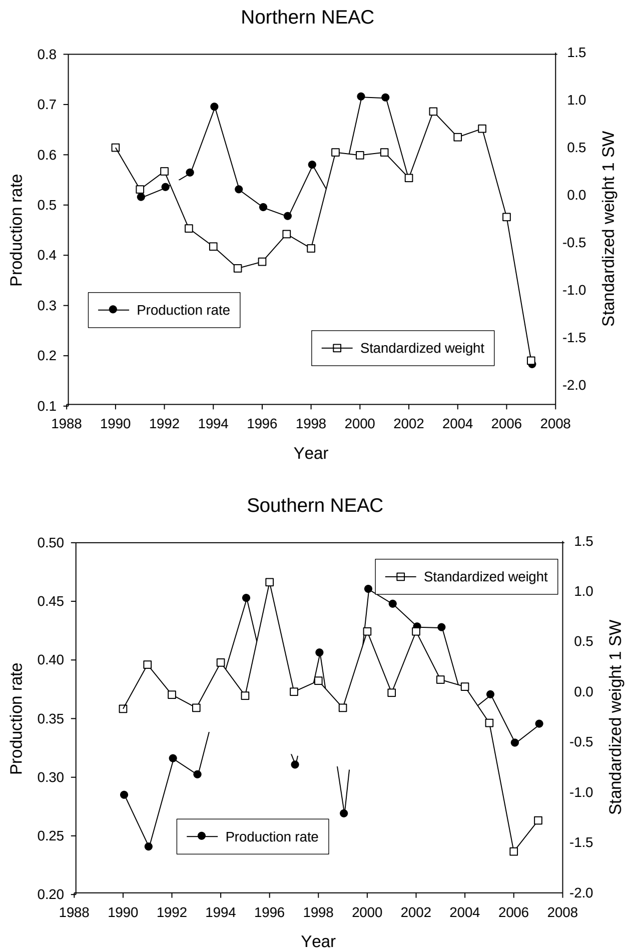


Figure 2.4.1.2 Production rate (calculated as PFA abundance divided by lagged eggs) and mean standardized (Z-score) weight of 1SW salmon (from 6 rivers in Northern and 7 rivers in Southern NEAC) plotted by year for Northern and Southern NEAC.

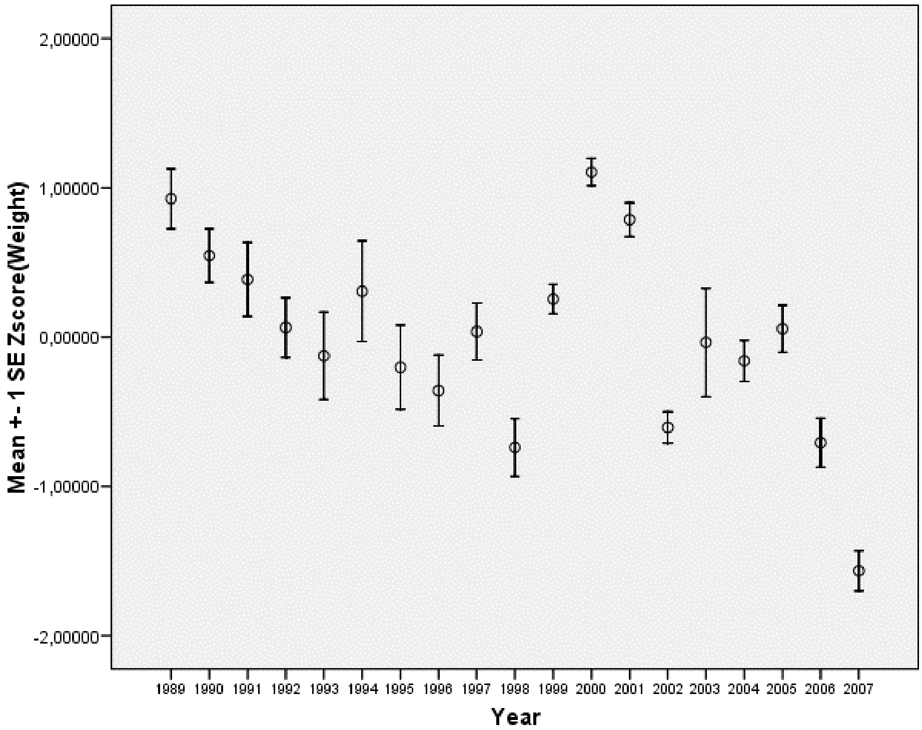


Figure 2.4.2.1 Mean standardized weight of 1 SW salmon in 20 Norwegian rivers in the period 1989–2007. The total number of 1 SW salmon analysed was 21 054.

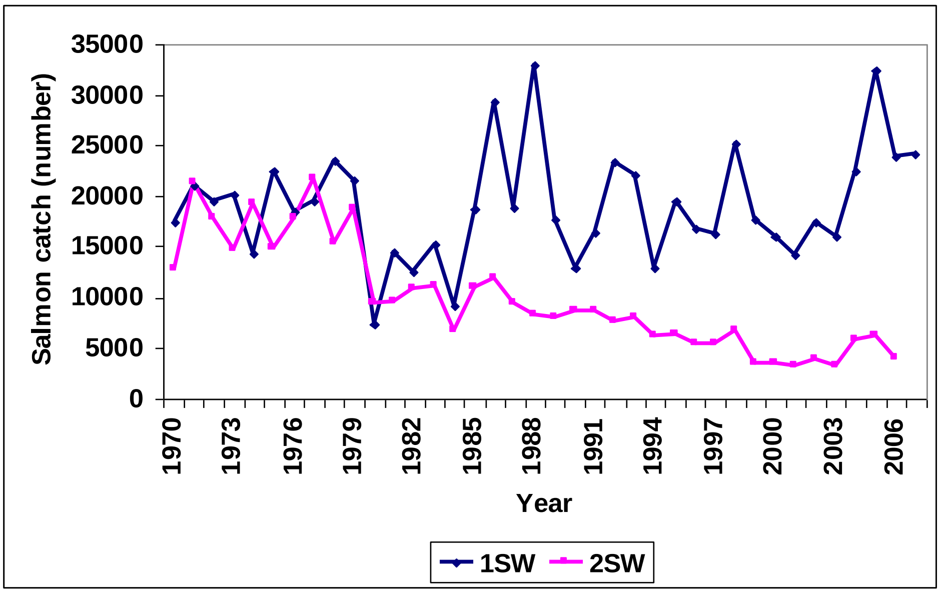
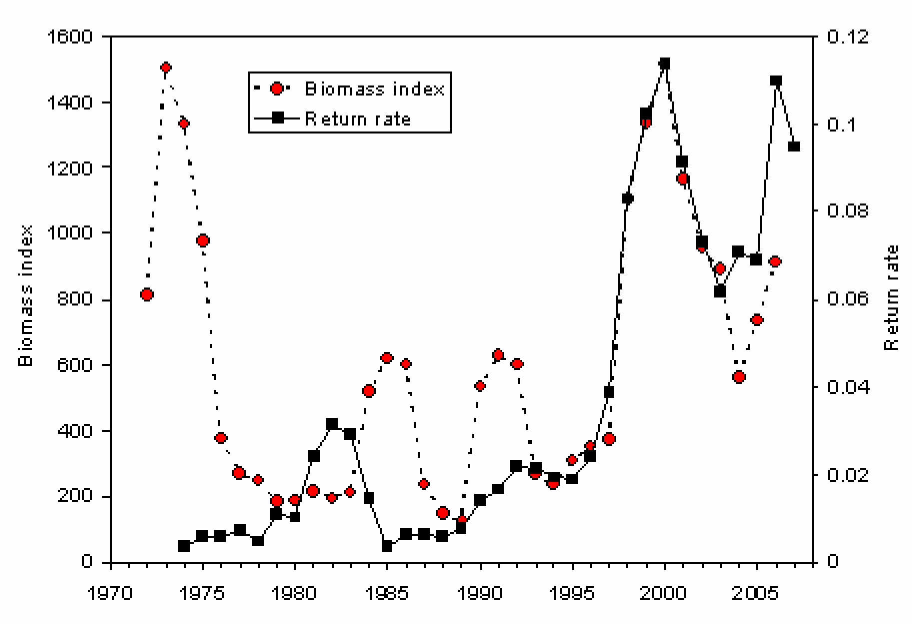


Figure 2.4.3.1 Sea-age composition of Icelandic salmon stocks in rod fisheries from 1970–2007.



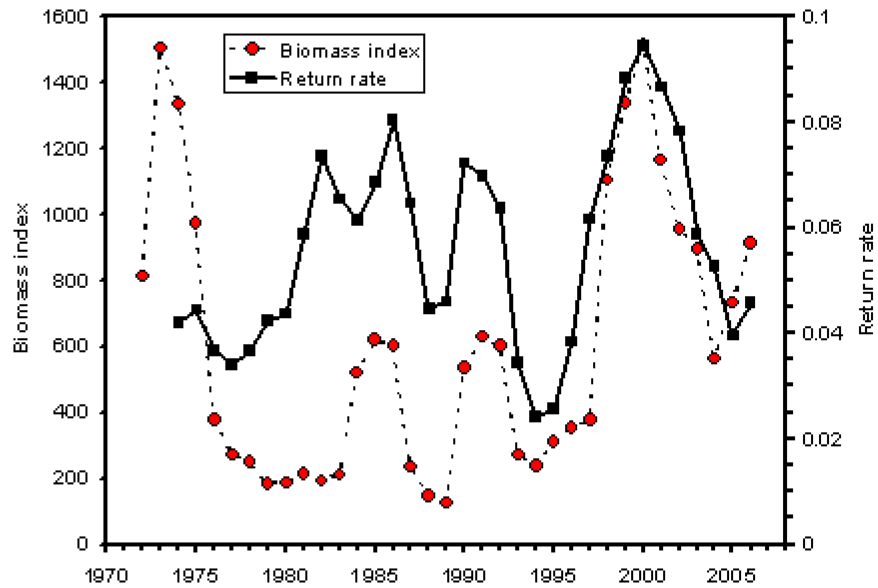


Figure 2.4.4.1 Trends in the biomass index of small fish from the southern Gulf of St. Lawrence and return rates to a second spawning of 1SW and 2SW salmon combined as consecutive spawners (upper panel) and alternate spawners (lower panel). The year corresponds to the year of the September groundfish survey for biomass and the year of reconditioning in the first return year at sea post-spawning for consecutives, in the second year at sea post spawning for alternates. All series are smoothed using 3-year running averages.

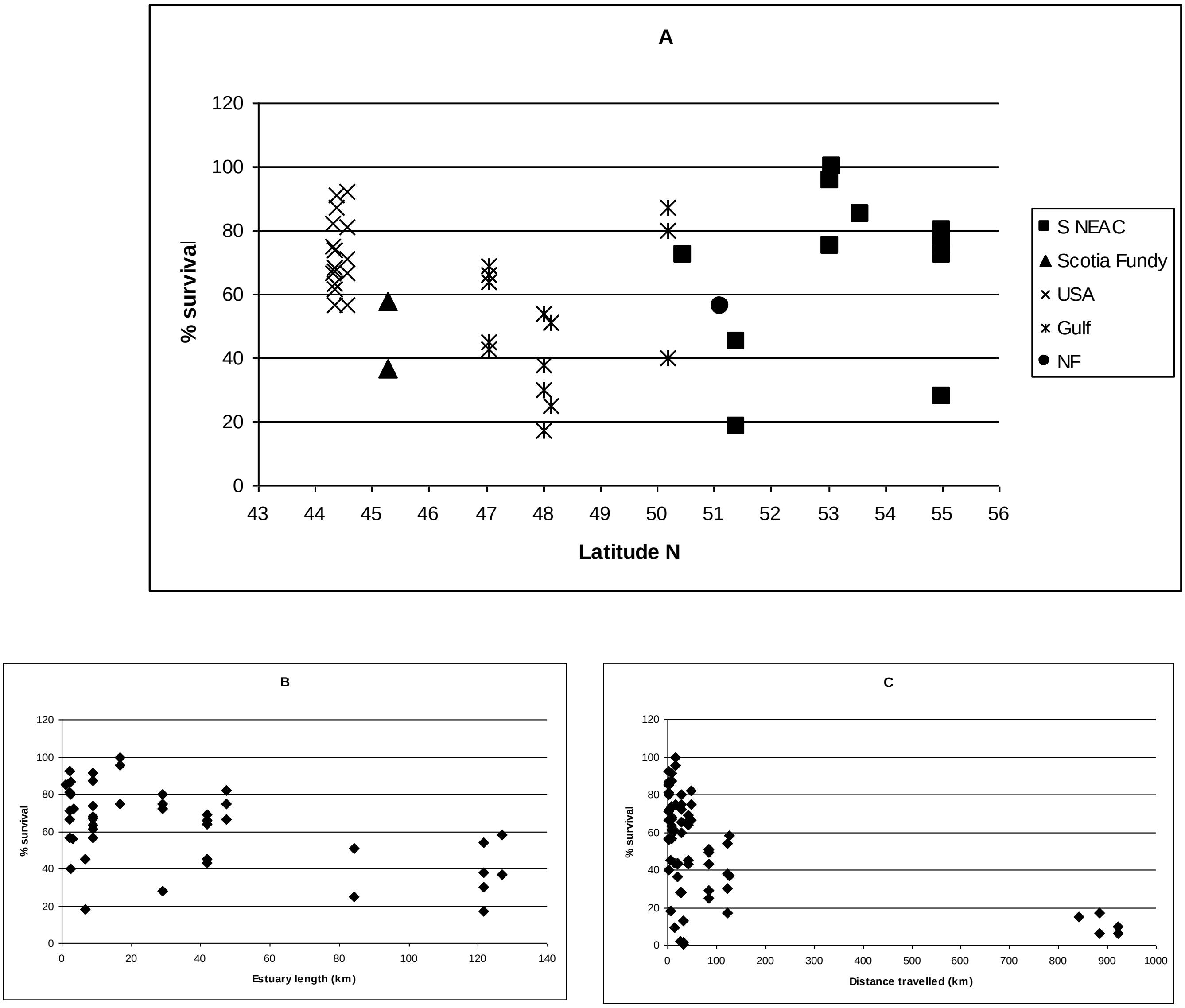


Figure 2.5.1.1 Plots of the percentage of sonically tagged smolts surviving to exit home river estuaries. Plots include data from studies in the NAC and NEAC areas and wild and hatchery origin smolts. Estimates from the same river in different years have been treated as independent observations. A: % survival vs. latitude. B: % survival vs. estuary length C: % of smolts from North American rivers known to be alive at various points in the coastal and ocean migration.

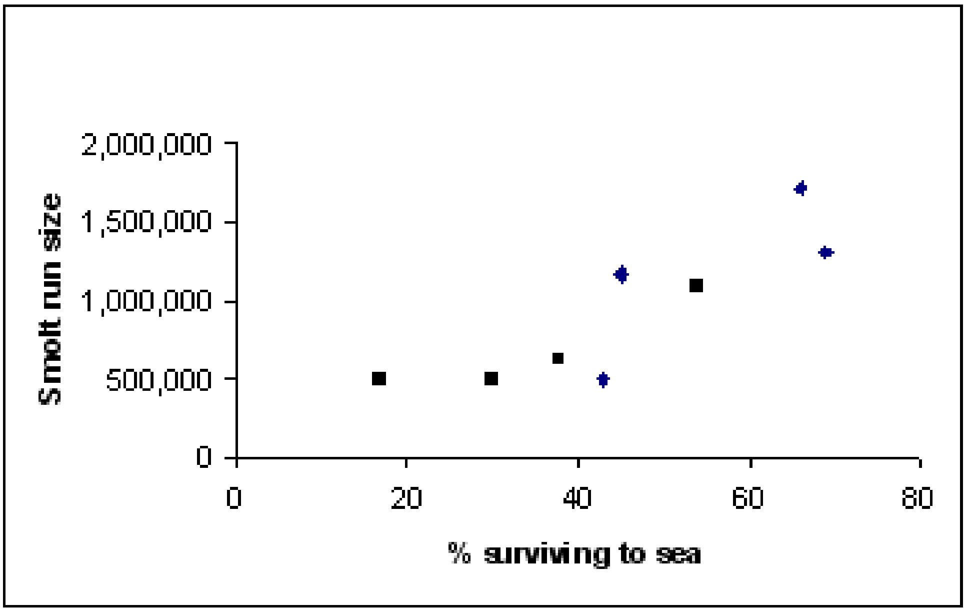


Figure 2.5.3.1 Relation between the percentage of the sample of sonically tagged salmon surviving estuary transit to enter the sea, and the midpoint estimate of the size of the smolt run from which the sample was drawn. Data come from the years 2003–2007 and are for the Miramichi (diamonds) and Restigouche (squares) Rivers.

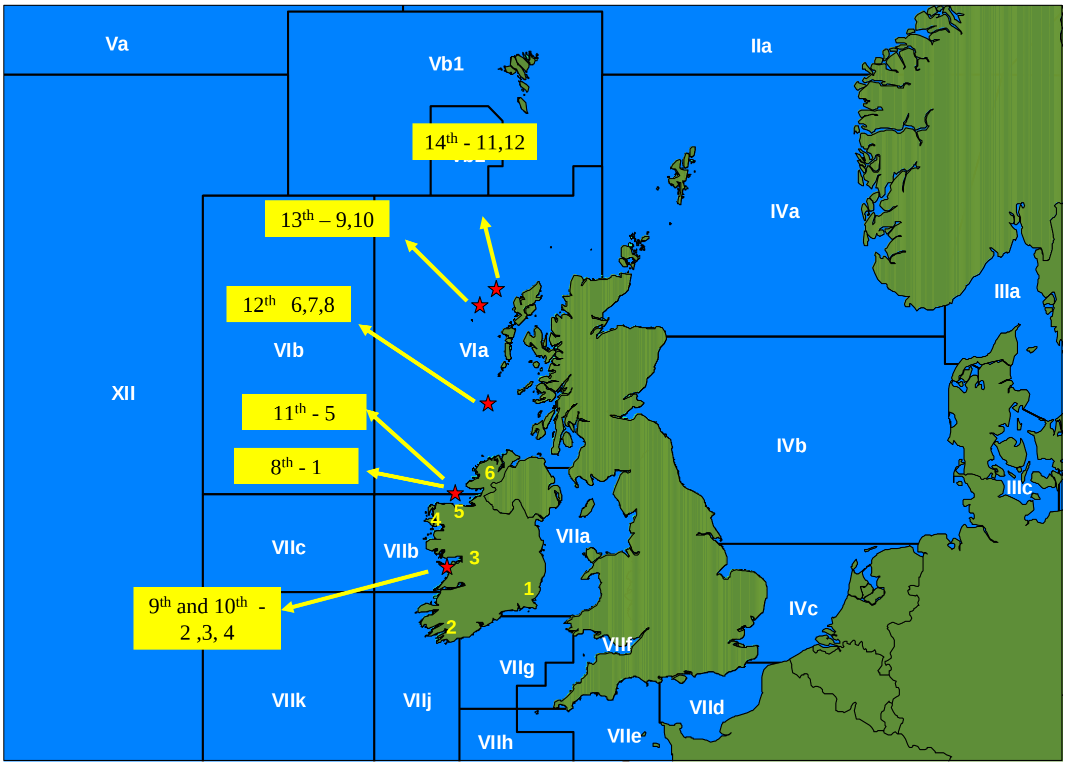


Figure 2.7.1.1 Location of post-smolt trawling locations and trawl numbers in May 2007. The rivers of origin of the Irish fish sampled based on the genetic stock identification are as follows: 1 = South Eastern Population Complex (SEPC), 2 = Roughty River (Kerry), 3 = River Corrib (Galway), 4 = Owenmore River (Mayo), 5 = Moy River (Mayo), Foyle River (Donegal/Derry).

3 North East Atlantic Commission

Conservation limits (CLs) have been defined by ICES as the level of stock 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. However, management targets have not yet been defined for all Atlantic salmon stocks.

Therefore:

ICES considers homewater stocks in the NEAC Commission to be at full reproductive capacity only if the lower boundary of the 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 boundary of the confidence interval of the most recent PFA estimate is above the Spawner Escapement Reserve (SER).

ICES considers a stock to be at risk of suffering reduced reproductive capacity when the lower boundary of the confidence limit is below the CL/ SER, but the midpoint is above.

ICES considers a stock to be suffering reduced reproductive capacity when the midpoint is below the CL/SER.

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 used the risk level of 75% that is part of the agreed management plan (ICES, 2003).

For stock assessment purposes, ICES groups NEAC stocks into two stock groupings: Northern and Southern NEAC stocks. The composition of these groups is shown below:

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

3.1 Status of stocks/exploitation

The status of stocks is shown in Figure 3.1.1.

ICES classifies the status of stock complexes prior to the commencement of distant water fisheries with respect to the SER requirements as follows:

Northern European 1SW stock complex is considered to be at full reproductive capacity.

Northern European MSW stock complex is considered to be at full reproductive capacity.

[1] The Iceland stock complex was spilt into two separate complexes for stock assessment purposes in 2005. Prior to 2005, all regions of Iceland were considered to contribute to the Northern European stock complex.

Southern European 1SW stock complex is considered to be at full reproductive capacity.

Southern European MSW stock complex is considered to be suffering reduced reproductive capacity.

Estimated exploitation rates have generally been decreasing over the time period for both 1SW and MSW stocks in Northern and Southern NEAC areas (Figures 3.1.2 and 3.1.3). Exploitation on Northern 1SW stocks is higher than on Southern 1SW and considerably higher for MSW stocks. However, the current estimates for both stock complexes are amongst the lowest in the time-series.

3.2 Management objectives

This Commission area is subject to the general NASCO management objectives as outlined in Section 1.3.

3.3 Reference points

Section 1.4 describes the derivation of reference points for these stocks and stock complexes.

3.3.1 National conservation limits

The national model has been run for all countries that do not have river-specific CLs (i.e. all countries except France, Ireland, and UK (England & Wales)).

Iceland, Russia, Norway, UK (N. Ireland), and UK (Scotland) have provided regional input data for the PFA analysis (1971–2007). For these countries the lagged spawner analysis has been conducted by region. The regional results were combined to estimate CLs based on a pseudo stock–recruitment relationship for the country. Outputs from the national model are only designed to provide a provisional guide to the status of stocks in the NEAC area.

To provide catch options to NASCO, CLs are required for stock complexes. These have been derived either by summing of individual river CLs to national level, or by taking overall national CLs, as provided by the national model and then summing to the level of the 4 NEAC stock complexes. For the NEAC area, the CLs have been calculated by ICES as:

Northern NEAC 1SW spawners – 242 688

Northern NEAC MSW spawners – 126 398

Southern NEAC 1SW spawners – 662 652

Southern NEAC MSW spawners – 294 638

3.3.2 Progress with setting river-specific conservation limits

Specific progress in individual countries is summarized below:

In UK (England and Wales), where river-specific CLs have been in use for a number of years, effort data derived from the catch returns is used to estimate angling exploitation on salmon, and to derive estimates of egg deposition for use in the CL compliance procedure. As many anglers fish for both salmon and sea trout, it is important to understand what proportion of the total effort is targeted at each species. To this end, a short questionnaire was sent to all holders of a migratory salmonid fishing licence in 2006 (approximately 22 000 anglers). The results of this survey indicate that around a quarter (27%) of angler effort nationally is directed at sea trout only. These results will be used to refine effort data and assessments in the future.

In UK (Scotland), work has continued to develop procedures for setting catchment-specific CLs. GIS applications, in conjunction with field-based observation and a literature review of salmon distribution, have been used to develop a map-based useable wetted area model for salmon which can be used to transport CLs among catchments. A CL has been derived for the North Esk and this has been transported, using the useable wetted area model, to each of the 109 defined salmon fishery districts in Scotland to provide provisional CLs. Estimates of spawning escapement in each of these catchments are being developed in order to assess compliance with respect to the CLs. Refinements to the useable wetted area transport model will be undertaken over the next year. Estimates of spawning escapement in each of these catchments are being developed in order to assess compliance with respect to the CLs.

In Iceland, work is progressing on several rivers to derive river-specific CLs. Several datasets and techniques (catch data, counter data, habitat mapping, wetted area and juvenile surveys) are being used to estimate salmon production, run size, and spawning escapement. To date work has indicated highly variable spawning reference levels. The next stage of the work will explore if and how CLs can be transported to recipient rivers.

In Norway, CLs have been set for 180 rivers. This work is based on stock–recruitment relationships in nine rivers, and further transportation to data-poor rivers based on similarities in productivity and stock age structure. Productivity is mostly based on catch statistics, and scale samples used to assess the river and sea age structure in a sub set of the populations. To derive the CLs, wetted area has been computed for the rivers based on digital maps and knowledge of how far salmon can migrate in the rivers. Spawning targets for salmon populations in Norway was grouped into four categories of egg densities being, respectively, approximately 1, 2, 4, and 6 eggs m^{-2} wetted area. Most of the rivers fall into the 2 and 4 eggs m^{-2} wetted area categories.

So far only France, Ireland, and UK (England & Wales) have implemented river-specific CLs.

3.4 Management advice

ICES has been asked to provide catch options or alternative management advice, if possible based on a forecast of PFA, with an assessment of risks relative to the objective of exceeding stock CLs in the NEAC area.

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

Given the status of the stocks ICES provides the following advice on management:

Northern European 1SW stocks: ICES considers that in the absence of specific management objectives for this stock complex the precautionary approach is to fish only on maturing 1SW salmon from rivers where stocks have been shown to be at full reproductive capacity. ICES considers that reductions in exploitation are required for as many stocks as possible, to increase the probability of the complex meeting CLs. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

Northern European MSW stocks: ICES considers that in the absence of specific management objectives for this stock complex the precautionary approach is to fish only on non-maturing 1SW salmon from rivers where stocks have been shown to be at full reproductive capacity. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

Southern European 1SW stocks: ICES considers that in the absence of specific management objectives for this stock complex the precautionary approach is to fish only on maturing 1SW salmon from rivers where stocks have been shown to be at full reproductive capacity. ICES considers that reductions in exploitation are required for as many stocks as possible, to increase the probability of the complex meeting CLs. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

Southern European MSW stocks: The quantitative PFA midpoint forecasts for 2008–2011 are below the SER and therefore there should be no fishing on this complex at West Greenland or Faroes. ICES considers that in the absence of specific management objectives for this stock complex, with the exception of the West Greenland fishery, the precautionary approach is to fish only on non-maturing 1SW salmon from rivers where stocks have been shown to be at full reproductive capacity. ICES considers that reductions in exploitation are required for as many stocks as possible, to increase the probability of the complex meeting CLs. Furthermore, due to the different status of individual stocks within the stock complex, mixed-stock fisheries present particular threats to stock status.

3.5 Relevant factors to be considered in management

ICES considers that management for all fisheries should be based on assessments of the status of individual stocks. Fisheries on mixed stocks, either in coastal waters or distant waters, pose particular difficulties for management as they cannot target stocks that are at full reproductive capacity. Conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity. Fisheries in estuaries and rivers are more likely to meet this requirement. It should be noted that the inclusion of farmed fish in the Norwegian data would result in the stock status being overestimated.

NEAC PFAs from the national models are combined to provide NASCO with catch advice or alternative management advice for the distant water fisheries at West Greenland and Faroes. These groups were deemed appropriate by ICES as they fulfilled an agreed set of criteria established to define stock groups for the provision of management advice, criteria that were considered in detail at the 2002 meeting (ICES, 2002) and re-evaluated at the 2005 meeting (ICES, 2005).

Consideration of the level of exploitation of national stocks in the Faroes and the West Greenland fisheries resulted in the proposal that advice for the Faroes fishery (both 1SW and MSW) should be based on all NEAC area stocks, but that advice for the West Greenland fishery should be based on Southern European MSW salmon stocks only (comprising UK, Ireland, France, and Iceland (south/west regions)).

3.6 Pre-Fishery Abundance forecast for 2008–2011

To develop quantitative catch options for NEAC stock complexes, forecasts of PFA are required for each stock complex and for each sea age component. These are currently only available for the non-maturing 1SW component of the Southern European stock complex. The forecast of this PFA for 2008 has been used to provide management advice for West Greenland and Faroes (Section 3.4) for 2008. ICES has adopted a model to forecast the pre-fishery abundance (PFA) of non-maturing (potential MSW) salmon from the Southern European stock group (ICES, 2002, 2003). Model options were re-evaluated in 2008 when ICES explored the relative contribution of several variables to predictions of PFA. As in the past three years, ICES decided to apply a model that uses only the *Year* and *Spawner* terms to predict the PFA of non-maturing salmon. This model was fed data from 1978–2006 and used to update the PFA in 2007 and to forecast the PFA in 2008–2011 (Figure 3.6.1).

Provision of 3-year management advice for the Faroese fishery requires that PFA forecasts be extended to 2011. This has been achieved by estimating the *Spawner* term for the 1-year old smolts in 2011 for each homewater country as the average of the previous five years. The quantitative prediction for the Southern NEAC MSW stock component gives a projected PFA (at 1st January each year) for catch advice in 2007–2011 (Figure 3.6.1). No projections are available for other stock components or complexes in the NEAC area.

The midpoint forecasts and 95% confidence limits of the projections are shown below:

YEAR	PFA	LOWER	UPPER	SER
2007	465 300	311 582	694 854	498 216
2008	445 204	297 331	666 617	498 216
2009	423 444	281 978	635 883	498 216
2010	410 961	272 969	619 330	498 216
2011	389 742	257 969	588 829	498 216

All PFA midpoint estimates are less than the SER and therefore there is no surplus available for exploitation.

3.7 Comparison with previous assessment

3.7.1 National PFA model and national conservation limit model

With the closure of the marine mixed-stock fishery in Ireland the majority of the reported catch in 2007 is accounted for by the rod fisheries. Consequently, the method for estimating returns and spawners is now based on rod catch as opposed to the previously used nominal catch.

Provisional catch data for 2006 were updated where appropriate. In addition, changes were made to the input data from Iceland. In 2007, exploitation rates were reduced in recent years to take into account the increasing practice of catch-and-release in the rod fishery (ICES, 2007). These data were further modified in 2008 in light of new information.

Unreported rates for Greenland were modified to standardize run-reconstruction analyses between commission areas, as were estimates of the proportion of the Greenland catch originating from countries in the Northeast Atlantic (Section 2.3.2).

3.7.2 PFA forecast model

The midpoints of updated forecasts of the Southern NEAC MSW PFA for the years 2007 to 2010 were all within 3% of the forecasts provided last year (ICES, 2007).

3.8 NASCO has requested ICES to describe the key events of the 2007 fisheries and the status of the stocks

3.8.1 Fishing at Faroes in 2006/2007

No fishery for salmon has been carried out since 2000. No buyout arrangement has been in force since 1999.

3.8.2 Significant events in NEAC homewater fisheries in 2007

In several countries, measures aimed at reducing exploitation were implemented or strengthened in 2007. These include a reduction of net fisheries in UK (England & Wales), a reduction in the extent of mixed-stock interceptory fisheries and the introduction of bag limits in some districts in UK (N. Ireland), and the closure of the driftnet fishery in Ireland.

3.8.3 Gear and effort

No significant changes in the types of gear used for salmon fishing were reported in the NEAC area in 2007. The number of licensed gear units has, in most cases, continued to fall, and in the case of Ireland, where the driftnet fishery was closed, effort was completely removed for this fishery. There are no such consistent trends for the rod fishing effort in NEAC countries over this period.

3.8.4 Catches

The NEAC area has seen a general reduction in catches since the 1980s (Section 2.1.1). This reflects the decline in fishing effort as a consequence of management measures as well as a reduction in the size of stocks. The provisional reported catch in the NEAC area in 2007 was 1394 tonnes, substantially lower than both the 2006 value (1878 t) and the previous 5-year mean. The catch in the Southern area has declined over the period from about 4500 t in 1972–1975 to below 1500 t since 1986, and is now below 400 t. The catch declined particularly sharply in 1976 and again in 1989–91. The catch in the Northern area also shows an overall decline over the time-series, but this decline is less pronounced than for the Southern area. The catch in the Northern area varied between 1850 t and 2700 t from 1971 to 1986, fell to a low of 962 t in 1997, and then increased to over 1600 t in 2001. Since then the catch has again shown a downward trend. The catch in the Southern area, which in the early 1970s comprised around two-thirds of the NEAC total, has thus since 1999 been lower than the catch in the Northern area.

3.8.5 Catch per unit effort (cpue)

Cpue can be influenced by various factors, and it is assumed that the cpue of net fisheries is a more stable indicator of the general status of salmon stocks than rod cpue since the latter may be more affected by varying local factors.

An overview of the cpue data for the NEAC area was undertaken. In the Southern NEAC area, cpue show a general decrease in UK (Scotland) and UK (England &

Wales) net fisheries. Cpue for the net fishery showed mostly lower values compared to 2006 and the previous 5-year averages. In the Northern NEAC area, there has been an increasing trend in the cpue values for Norwegian net fisheries and Russian rod fisheries in Barents Sea rivers. A decreasing trend was noted for rod fisheries in Finland (River Teno). In comparison with the previous year, most cpue values were down and lower than the previous 5-year means.

3.8.6 Age composition of catches

1SW salmon comprised 50% of the total catch in the Northern area in 2007 which was below the 5- and 10-year means (61% and 64%, respectively). In general, there has been greater variability in the proportion of 1SW fish between countries in recent years (since 1994) than prior to this time. For the Southern European countries, the overall percentage of 1SW fish in the catch (60%) is the same as the 5- and 10-year mean (60% in both cases).

3.8.7 Farmed and ranched salmon in catches

The contribution of farmed and ranched salmon to national catches in the NEAC area in 2007 was again generally low (<2% in most countries) and is similar to the values stated in previous reports (eg. ICES, 2007). Thus, the occurrence of such fish is usually ignored in assessments of the status of national stocks. However, in Norway farmed salmon continued to form a large proportion of the 2007 catch in coastal (29%), fjordic (30%), and rod fisheries (9%). An assessment of the likely effect of these fish on the output data from the PFA model has been reported previously (ICES, 2001).

3.8.8 National origin of catches

In the course of collecting coded wire tagged salmon from Irish tagging programmes, tags have also been recovered from salmon that originate from other countries where coded wire tagging takes place. However, with the closure of the Irish driftnet fishery in 2007, the recovery of tags originating from fish released in other countries largely ceased. In 2007, just one tag originating from UK (N. Ireland) was recovered in Irish fisheries.

3.8.9 Trends in the PFA for NEAC stocks

In the evaluation of the status of stocks in Figure 3.1.1, estimated recruitment (PFA) values should be assessed against the SER values, while the estimated spawning escapement values should be compared with the CL.

Northern European 1SW and MSW stocks: Recruitment patterns of maturing 1SW salmon and of non-maturing 1SW recruits for Northern Europe (Figure 3.1.1) show broadly similar patterns. The general decline over the time period is interrupted by a short period of increased recruitment from 1998 to 2003. Both stock complexes have been at full reproductive capacity prior to the commencement of distant water fisheries throughout the time-series. Trends in spawner number for the Northern stock complexes for both 1SW and MSW are similar. Throughout most of the time-series, both 1SW and MSW spawners have been either at full reproductive capacity or at risk of reduced reproductive capacity. However, in 2007, the 1SW spawner estimate indicated that the stock complex was suffering reduced reproductive capacity for the first time in the series. This is broadly consistent with the general pattern of decline in marine survival of 1SW and 2SW returns in most monitored stocks in the area (Section 3.8.10).

Southern European 1SW and MSW stocks: Recruitment patterns of maturing 1SW salmon and of non-maturing 1SW recruits for Southern Europe (Figure 3.1.1) show broadly similar declining trends over the time period. The maturing 1SW stock complex has been at full reproductive capacity over the time period with the exception of 2006 when it was at risk of suffering reduced reproductive capacity before homewater fisheries took place. The non-maturing 1SW stock has been at full reproductive capacity over most of the time period, but in five of the nine years between 1997 and 2005 it was at risk of suffering reduced reproductive capacity after homewater fisheries took place and it was suffering reduced reproductive capacity for the first time in 2006. Declining trends in spawner number are evident in the Southern stock complexes for both 1SW and MSW. However, the 1SW stock has been at risk of reduced reproductive capacity or suffering reduced reproductive capacity for most of the time-series. In contrast, the MSW stock has been at full reproductive capacity for most of the time-series until 1997 when the stock was either at risk of reduced reproductive capacity or suffering reduced reproductive capacity. This is broadly consistent with the general pattern of decline in marine survival of 1SW and 2SW returns in most monitored stocks in the area (Section 3.8.10).

3.8.10 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) for the 2005 and 2004 smolt year classes (returning 1SW and 2SW salmon, respectively) is presented in Figure 3.8.10.1. The survival indices presented are the annual rates of change in marine survival.

An overall trend in both Northern and Southern NEAC areas, both wild and hatchery smolts, show a decline in marine survival with the annual decline varying between 1% and 20% (Figure 3.8.10.1). When looking at the individual river data, most of the survival indices for wild and reared smolts were lower than those of the previous year and below the previous 5- and 10-year averages. One of the few exceptions was the River Bush (UK, N. Ireland) where both wild and reared smolts showed higher survival rates than in the previous year and the 5- and 10-year average values. Results from these analyses are consistent with the information on estimated returns and spawners as derived from the PFA model (Section 3.8.9), and suggest that returns are strongly influenced by factors in the marine environment.

3.9 NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

Most management measures introduced in recent years in relation to international, national, and local objectives have aimed to reduce levels of exploitation on NEAC stocks, to increase fresh-water escapement, and in some countries specifically to meet river-specific CLs. Many of the inputs relate specifically to national plans or strategies or to commitments under National or EU directives. Although some local measures have had notable success (Table 3.9.1), ICES notes that three of the four NEAC stock complexes are currently either suffering, or at risk of suffering, reduced reproductive capacity after homewater fisheries have taken place (Figure 3.1.1).

3.10 Bycatch of salmon in non-targeted catches in 2007

Although not specifically directed at salmon, pelagic research fishing was carried out by Norwegian vessels in 2007. Only 5 adult salmon (farm escapees) and 1 post-smolt were captured as a bycatch in 4 separate pelagic research cruises in the Northern parts of the Norwegian Sea between 25th July and 23rd August, 2007. There were no reports of salmon captures from the commercial fisheries in Norway in 2007, nor were there any reports from Russian research or commercial vessels in the Norwegian or Barents Sea.

Table 3.9.1 Summary of national objectives, recent management measures, and attainment of management objectives.

Country	Objective	Introduced	Assessed	Measure	Assessment	Outcome/extent achieved	Further consideration
Russia	Reduce commercial fishing effort and enhance recreational catch and release fisheries	1997 - 2001	2002-2006	Various management measures including prohibition of some important commercial in-river fisheries and allocation quotas for fisheries	Examination of catch statistics	Mean total commercial catch reduced by 38% and mean in-river commercial catch reduced by 67% (2002-2006 compared to 1997-2001). Catch and release increased twice in past 5 years	Further reductions unlikely to be introduced. However, restrictions to fisheries which take mixed stocks and stocks below their CLs will be considered.
Ireland	Reduce exploitation rates and increase freshwater returns leading to simultaneous attainment of CLs in all rivers	2002	2002 to 2006	TAC imposed in 2002 which has been reduced by 17%, 11%, 14% and 35% annually or 58% in total. Restrictions in angling catch including bag limits and mandatory catch and release operated from the 1st of September in 8 fishery districts which were assessed as being below their CLs	Fish counter data for 19 rivers. Mandatory logbooks for all fishing methods. Coded wire tagging returns to Irish and UK rivers pre and post imposition of TACs. Juvenile indices of salmon abundance	Exploitation rate reduced from 61% (pre-2002) to 46% (post 2002) for wild salmon, 82% to 69% for hatchery salmon. Exploitation rate on UK stocks reduced by up to 50% following management measures in 1997 and imposition of TACs	Mixed stock marine fisheries will not operate in 2008 and hereafter.
	Maintain salmon stocks in SAC rivers at favorable conservation status			As above	Examination of counter (14 rivers) or rod catch (16 rivers) data to assess CL compliance for 30 SAC rivers.	Following re-appraisal in 2007 and with the closure of the Irish coastal and marine mixed stock fishery, 19 of 30 SAC rivers are estimated to be meeting CLs	Under the EU Water Framework Directive water quality and fish passage are expected to improve
	As above	2006	post 2006	Closure of mixed stock fishery in marine and coastal waters	As above	Commercial catch reduced from over 70% of total catch. Rod catch now 63% of total catch. Catch and release 41% of total rod catch. Increase in river returns and spawners in virtually all rivers with counters or traps.	53 of 150 rivers only meeting CL. Specific in-river problems need to be examined.
UK (England & Wales)	Meet objectives of National Salmon Management Strategy (launched 1n 1996) and ensure stocks meet or exceed CLs in at least 4 years out of 5.	1996	annually	Programme of Salmon Action Plans (SAPs) for each of the 64 principal salmon rivers to provide prioritized list of actions for each river.	Examination of catch statistics, monitoring data and completion of annual compliance assessment	Programme of SAPs was finalized in 2004 and these are now subject to review to ensure they match current circumstances and provide a realistic programme to address issues facing each river.	Continue with targeted actions identified in SAPs and review annually.
	Safeguard MSW stock component	1999	2007	National spring salmon measures introduced in 1999 (restricted net fishing before June and required compulsory catch & release by anglers up to June 16)	Estimated 800 salmon saved from net fisheries and 1,600 saved from rod fisheries in 2007 due to these measures	Spawning escapement of spring salmon may have increased by up to one third on some rivers due to measures	Measures will remain in place until at least 2008. Proposals for continuation to be advertised in 2008.
	Phase out mixed stock fisheries	1993	annually	Mixed stock fishery measures imposed since 1993, including phase outs, closures, buy outs and reductions in fisheries.	Examination of catch statistics, monitoring data and completion of annual compliance assessment	Coastal fishery catch reduced from average of 41,000 (88-92) to under 32,000 (98-02) and to about 9,000 (03-07) Declared rod catch in 5 north east rivers 56% higher on average in the 5 years since net buy out in 2003, relative to average of 5 years before buy out. Recorded runs (salmon & sea trout) into the Tyne 87% higher since NE net buy out in 2003 compared with mean of previous 5 years.	Continuing to phase out remaining mixed stock fisheries and focus on other limiting factors. Annual application of decision structure to assess need for effort controls.
	Reduce exploitation rates and increase freshwater returns leading to compliance with CLs.	1993	annually	Promote catch and release (mainly voluntary), including 100% catch and release in some catchments.	Examination of catch statistics, release rates and annual compliance	Catch and release increased to over 50% of rod caught fish in recent years & 100% C&R on some catchments. Estimated to have contributed an extra 31 million eggs in 2007.	Continuing promotion of C&R at national and local levels.

Table 3.9.1 Cont'd. Summary of national objectives, recent management measures, and attainment of management objectives.

Country	Objective	Introduced	Assessed	Measure	Assessment	Outcome/extent achieved	Further consideration
UK (England & Wales)	To meet a management target on the River Lune of 14.4 million eggs or about 5,000 adults	2000	annually	Regulations on River Lune introduced in 2000 to reduce exploitation in net and rod fisheries by 50% and 25% respectively.	Assessment of counter data, catch statistics and juvenile monitoring data	Increase in salmon spawning and management target exceeded in all years since the regulation. Increases in juvenile production and net catch.	Continue to meet management objectives
	Maintain salmon stocks in SAC rivers at favorable conservation status	1996	annually	Fishing controls, catch and release and addressing issues identified in Salmon Action Plans as appropriate.	Examination of counter/rod data to assess CL compliance for 18 rivers designated as SACs	2 rivers are currently considered to be complying with the management objective of passing the CL 4 years out of 5.	Continue with management plan to meet management objectives. Targeted actions as identified in Salmon Action Plans.
UK (Northern Ireland)	To conserve, enhance, restore and manage salmon stocks in catchments throughout UK (NI) through two salmon management plans (FCB and Loughs Agency areas).	2001-07	2002-07	Voluntary net buyout scheme initiated in FCB area in 2001/2. Cessation of coastal fisheries in LA area in 2007.	Examination of fish counter & rod catch data to assess spawning escapement on index rivers with defined CLs. Examination of CWT data to assess exploitation / survival rates. Assessment of commercial exploitation through a carcass tagging scheme in both LA and FCB areas.	FCB buyout decreased salmon catch by 73% during 2002-07. Analysis of CWT data indicated the FCB measure conserved 1SW R. Bush salmon to a level of around 42% of the R. Bush CL between 2002-07. Netting restrictions in coastal areas of LA area reduced catch in 2007 by around 80% on previous 5 year average. Most monitored rivers in FCB and LA areas exhibited increased escapement in 2007	Continue monitoring and management protocols under the salmon management plans.
		2007	Not yet evaluated	Introduction of conservation policies in angling byelaws. New byelaws in LA area in 2007 include limit of 1 salmon per day between 1st March and 31st May, 2 salmon per day thereafter and no more than 25 salmon or sea trout per season.	Assessment of recreational exploitation through a carcass tagging scheme in both FCB and Loughs Agency areas.	Ongoing	Further develop monitoring mechanisms and define/refine CLs.
		2005-07	2008-2010	Habitat enhancement measure funded by European Economic Area (EEA) on several selected catchments in Loughs Agency and FCB areas.	Fully quatitative electro-fishing	Ongoing	Monitor effect of habitat enhancement schemes.
UK (Scotland)	Improve status of early running MSW salmon	2000	2007	Agreement by Salmon Net Fishing Association (most, but not all, net fishing operations are members) to delay fishing until the beginning of April. Introduced in 2000	Examination of catch statistics	Annual assessment. Reduction in MSW net fishery catch in February to March relative to period prior to 2000.	Further reduction in exploitation
		2003	Not yet evaluated	Bervie, N.and S. Esk salmon district net fishery delayed until 1st May with catch and release only in the rod fishery until 1st June	Examination of catch statistics	Exploitation removed for both nets and rods for respective periods.	Measure in place for 5 years. Re-evaluation after this period

Table 3.9.1 Cont'd. Summary of national objectives, recent management measures, and attainment of management objectives.

Country	Objective	Introduced	Assessed	Measure	Assessment	Outcome/extent achieved	Further consideration
France	Reduce exploitation on MSW in particular and increase escapement and compliance with river specific CLs	1994	2007	Closure since 1994 of Loire-Allier sport and commercial fisheries	Measured against compliance objectives for the area	This did not seem to enhance salmon numbers to the expected level	Physical obstructions (noticeably Poutès-Monistrol Hydropower Dam) and other environmental factors, including higher temperatures, also being considered
		1996, 2000	2000 to 2003	TACs introduced in 1996 in Brittany and Lower Normandy and MSW TACs introduced in 2000 that have lead to temporary closures on some rivers	Examination of catch statistics	Reduced catch have probably increased spawning numbers. Reduced catch in MSW catch in Brittany since 2000 and Lower Normandy since 2003 but MSW TACS are exceeded each year on some rivers.	Monitored river (Scorff) has failed to meet CL consistently since 1994. However, the Scorff is non typical of exploitation pattern in the area (small fishery)
		1999	2007	Closure for two days each week with days varying since 1999	Examination of catch statistics	Some reduction in rod catch but current regulations have been unable to reduce the exploitation rate on MSW stocks as expected	Specific limitations on MSW catches should be considered
Germany	Reintroduction of Atlantic salmon stocks extinct since the middle of 20th century but improvements in conditions and water quality were thought to be sufficient to support salmon	1988	Annually	Restocking of rivers running into North Sea (Rhine, Ems, Weser and Elbe). 2 million juveniles (mainly fry) released annually	Trap and counter data (Sieg, upper Rhine)	300-700 adults recorded annually. Return rates of less than 1%. Records of natural production in some tributaries show an Increase.	Low return rates thought to reflect obstructions to upstream and downstream migration in the Rhine and its delta as well as spawning tributaries and probably due to bye-catch in non-target fisheries
	Establish free migration routes for salmon and other migratory fishes, protection of downstream migrants at power plants and rehabilitation of habitat in rivers basins	1988	Annually	Collaborative programme has started e.g. Rheinprogramm 2020 (ICPR) International Commission for the Protection of the River Rhine	Assessment in progress	Assessment in progress	

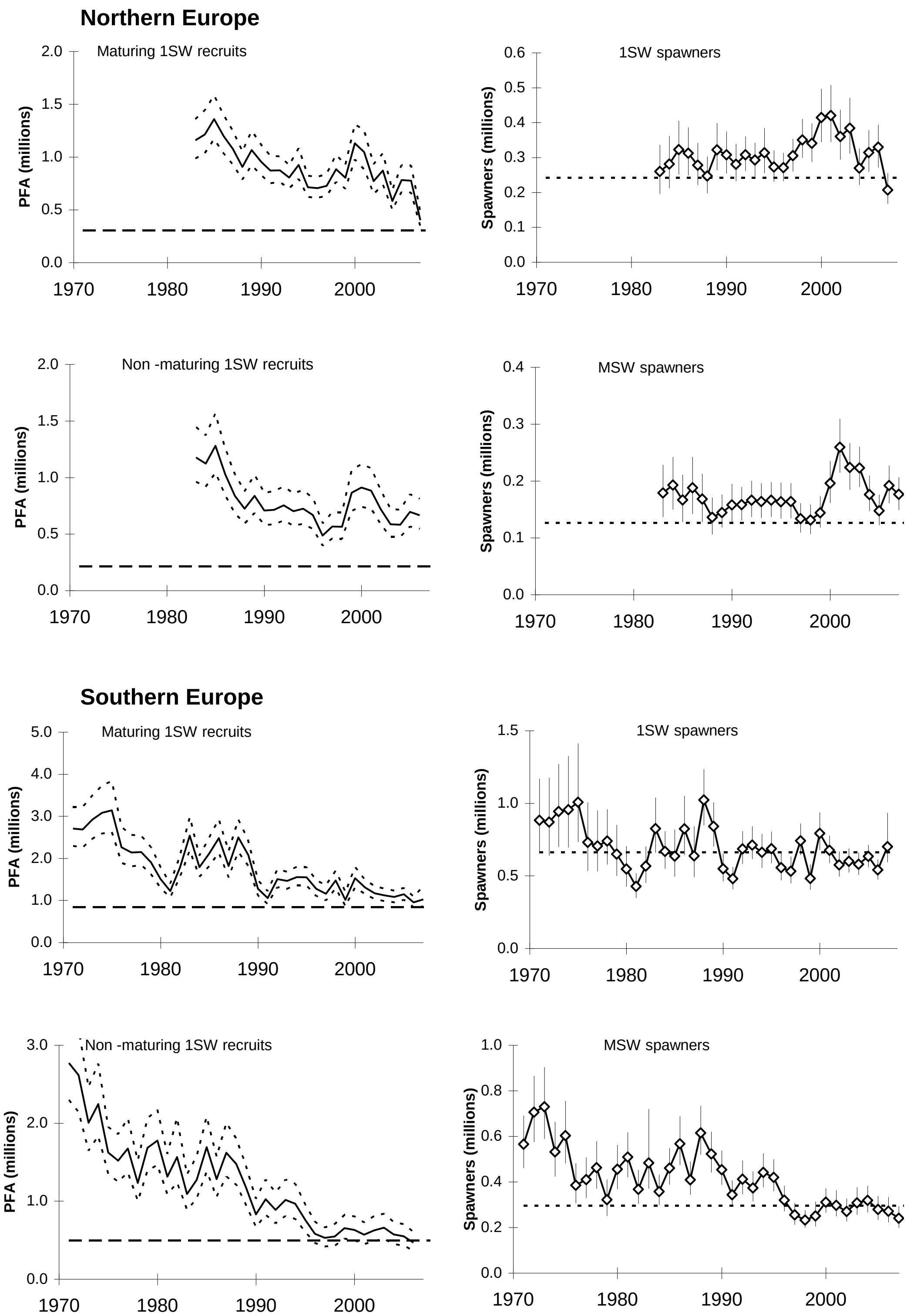


Figure 3.1.1 Estimated PFA (recruits, left panels) and spawning escapement (right panels), with 95% confidence limits, for maturing 1SW and non-maturing 1SW salmon in Northern and Southern Europe.

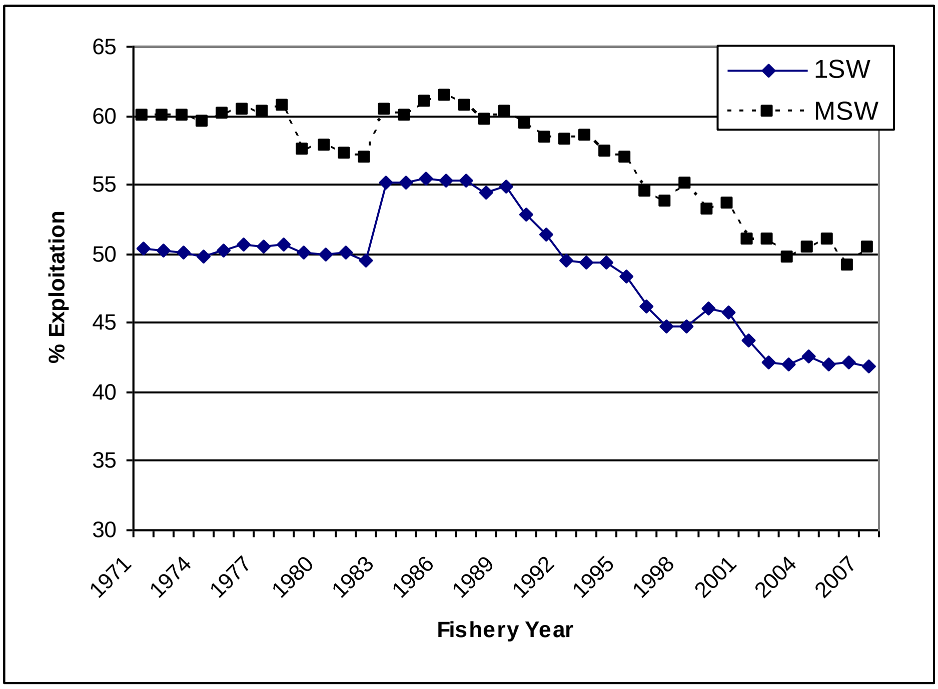


Figure 3.1.2 Exploitation rates of wild 1SW and MSW salmon by commercial and recreational fisheries in the Northern NEAC area 1971–2007.

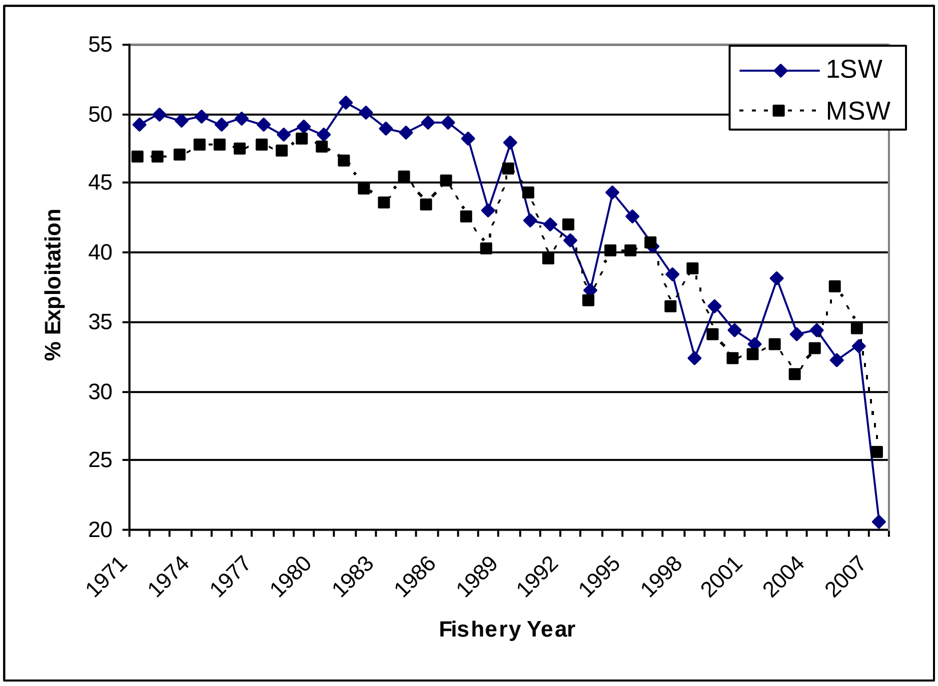


Figure 3.1.3 Exploitation rates of wild 1SW and MSW salmon by commercial and recreational fisheries in the Southern NEAC area 1971–2007.

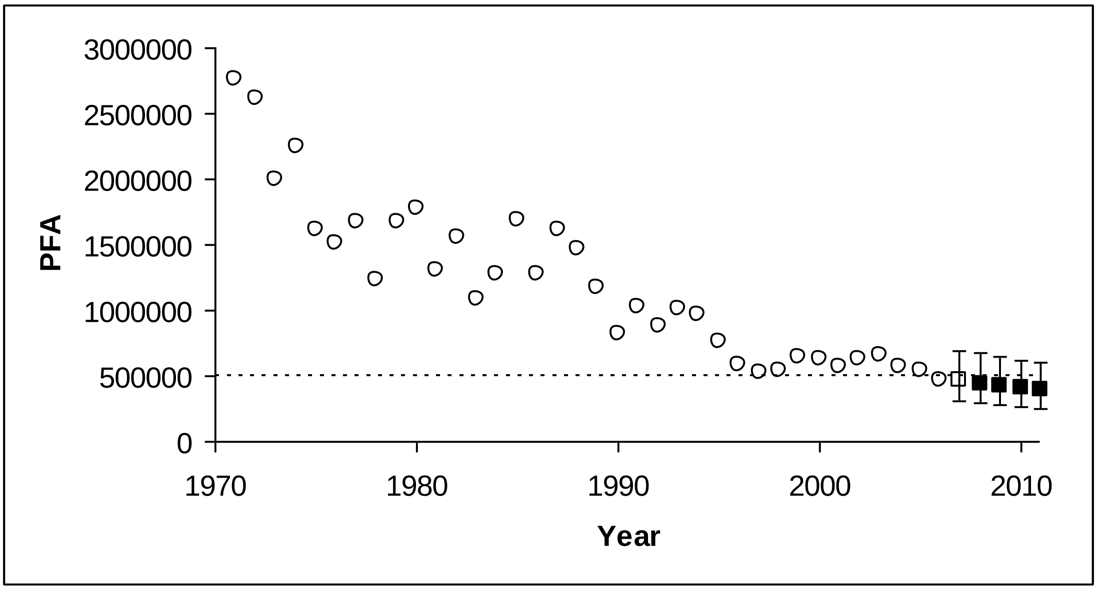


Figure 3.6.1 PFA estimates and predictions (95% confidence limits) for non-maturing 1SW European stock. Note: open square is 2007 update and blocked squares are 2008 to 2011 forecasts.

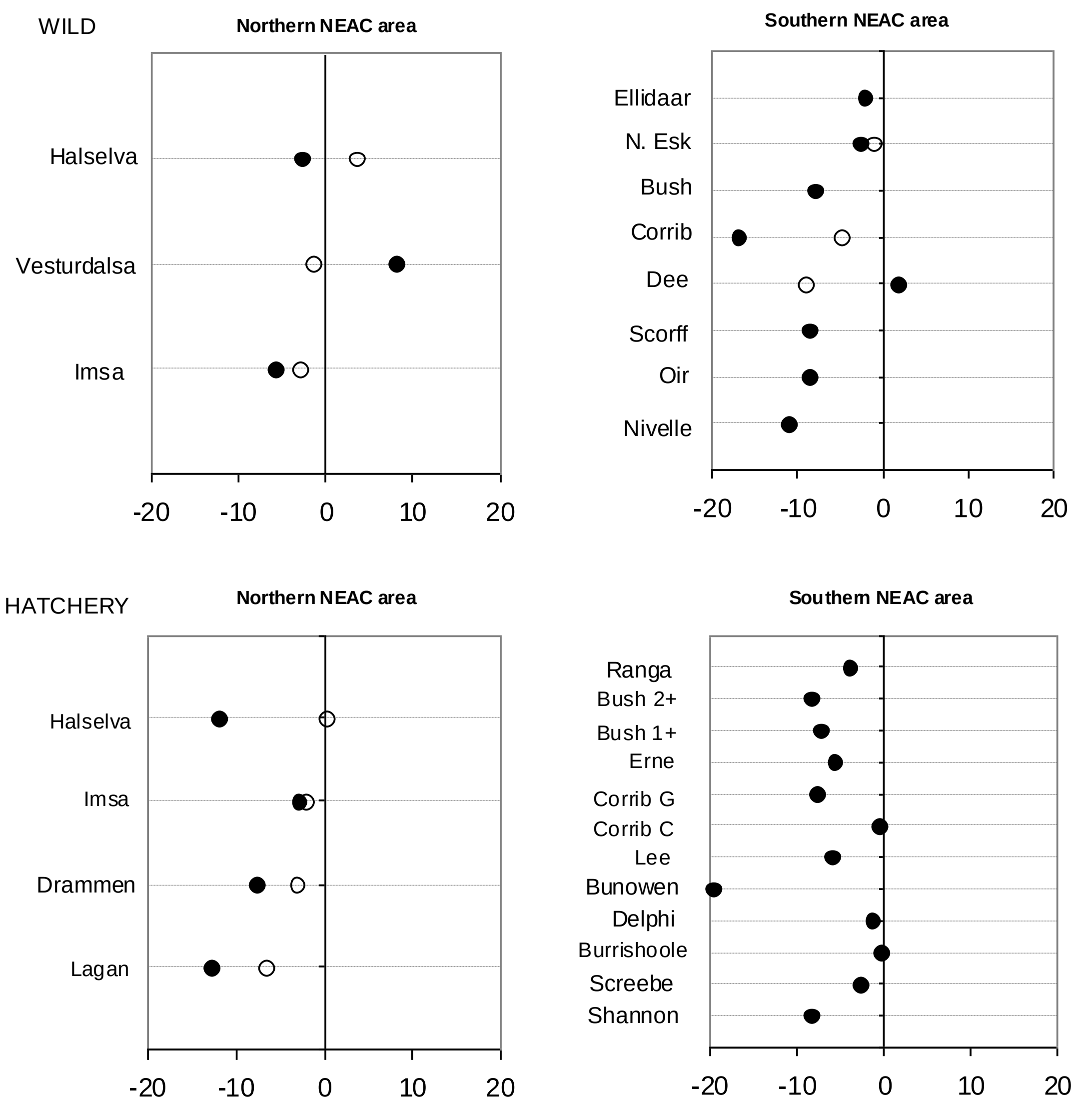


Figure 3.8.10.1 Annual rates of change (%) in marine survival indices of wild and hatchery smolts to adult returns to homewaters (prior to coastal fisheries) in different rivers in Northern and Southern NEAC areas. Filled circle = 1SW salmon; open circle = 2SW salmon. NB. The annual rates of change presented come from data sets of variable durations. Therefore comparisons between rivers are not appropriate.

4 North American Commission

4.1 NASCO has requested ICES to update age-specific stock conservation limits based on new information as available

There are no changes recommended in the 2SW salmon conservation limits (CLs) from those identified previously. CLs for 2SW salmon are 123 349 for Canada and 29 199 for the USA, giving a combined total of 152 548.

4.2 NASCO has requested ICES to describe the key events of the 2007 fisheries (including the fishery at St Pierre and Miquelon)

4.2.1 Key events of the 2007 fisheries

The majority of the harvest fisheries were directed at small salmon;

The total harvest was 47 796 salmon in 2007, down 21% from the five-year mean;

Catches remain low relative to pre-1990 values.

4.2.2 Gear and effort

Canada

The 23 areas for which the Department of Fisheries and Oceans (DFO) manages the salmon fisheries are called Salmon Fishing Areas (SFAs); for Québec, the management is delegated to the Ministère des Ressources Naturelles et de la Faune and the fishing areas are designated by Q1 through Q11 (Figure 4.2.2.1). Harvest (fish which are 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 refer to salmon 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 2007; (1) Aboriginal peoples, (2) residents fishing for food in Labrador, and (3) recreational fishers. There were no commercial fisheries in Canada in 2007.

In 2007, four subsistence fisheries harvested salmonids 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) Labrador residents fishing in Lake Melville and coastal communities in southern Labrador from Cartwright to Cape St. Charles, and (4) LMN (Labrador Métis Nation) members fishing in southern Labrador from Fish Cove Point to Cape St. Charles. The NG, Innu, and LMN fisheries were jointly regulated by Aboriginal Fishery Guardians administered under the Aboriginal Fisheries Strategy Program with the Department of Fisheries and Oceans (DFO) as well as by DFO Fishery Officers and Guardian staff. The new 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 in length of a stretched mesh size ranging from 3 to 4 inches. Although nets are mainly set in estuarine waters some nets are also set in coastal areas, usually within bays. However, most catches (>90%, Figure 2.1.1.2) in North America now take place in rivers or in estuaries and fisheries are principally managed on a river-by-river basis. Catch statistics are based on logbook reports and fisheries guardians. The overall reporting rate for subsistence fisheries was 79% in 2005 and 2006. To date, reporting rates for 2007 are 66%.

The following management measures were in effect in 2007:

Aboriginal peoples' food fisheries

In Québec, Aboriginal peoples' food fisheries took place subject to agreements or through permits issued to the bands. There are 10 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 in food fisheries 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), food fishery harvest agreements were signed with several Aboriginal peoples groups (mostly First Nations) in 2007. 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), food fishery arrangements with the Nunatsiavut Government, the Innu First Nation, and the LMN Nation, resulted in fisheries in estuaries and coastal areas. There are further details on the Labrador Aboriginal fisheries in Section 4.2.4.1. By agreement with First Nations there were no food fisheries for salmon in Newfoundland in 2007. Harvest by Aboriginal peoples with recreational licenses is reported under the recreational harvest categories.

Residents food fisheries in Labrador

In 2007, a licensed food fishery for local residents took place, using gillnets, in Lake Melville (SFA 1) and in estuary and coastal areas of southern Labrador (SFA 2). Residents who requested a license were permitted to retain a maximum of four salmon of any size while fishing for trout and charr; four salmon tags accompanied each license. All licensees were requested to complete logbooks. DFO is responsible for regulating the Resident Fishery.

Recreational fisheries

Licenses are required for all persons fishing recreationally for Atlantic salmon. Gear is generally restricted to fly fishing and there are restrictive daily/seasonal bag limits. Recreational fisheries management in 2007 varied by area and large portions of the southern areas remained closed to all directed salmon fisheries. Except in Québec and Labrador (SFA 1 and some rivers of SFA 2), only small salmon could be retained in the recreational fisheries.

USA

In the USA there was a one-month fall catch-and-release recreational fishery for sea-run Atlantic salmon on a 2 km reach on one river. This was the second year for this fishery which re-opened in 2006 after closure from 1999 to 2005. A total of 90 licenses were sold and 83 angler trips were reported.

France (Islands of Saint-Pierre and Miquelon)

ICES received no information on the number of professional and recreational gillnet licenses issued in 2007 at Saint-Pierre and Miquelon.

4.2.3 Catches in 2007

Canada

The provisional harvest of salmon in 2007 by all users was 112 t, about 18% lower than the 2006 harvest (Table 2.1.1.1; Figure 4.2.3.1). The 2007 harvest was 37 540 small salmon and 10 256 large salmon, 20% less small salmon and 7% less large salmon, compared to 2006.

Aboriginal peoples' food fisheries

The total harvest by Aboriginal people in 2007 was 47.6 tonnes (Table 4.2.3.1). Harvests (by weight) were down 22% from 2006 and 12% lower than the previous 5-year average harvest.

Residents fishing for food in Labrador

The estimated total catch for the fishery in 2007 was 1.7 t, about 733 fish (13% large salmon by number).

Recreational fisheries

Harvest in recreational fisheries in 2007 totalled 30 247 small and large salmon (approximately 63 t), 18% below the previous 5-year average, 18% below the 2006 harvest level, and the lowest total harvest reported (Figure 4.2.3.2). The small salmon harvest of 26 750 fish was 21% below 2006 and 31% below the previous 5-year mean. The large salmon harvest of 3497 fish was 8% below the previous five-year mean and 16% above 2006. The small salmon size group has contributed 88% on average of the total 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 2007, about 42 820 salmon (about 23 134 large and 19 686 small) were caught and released (Table 4.2.3.2), representing about 59% of the total number caught, including retained fish. This was a 29% decrease from the number released in 2006. There is some mortality on these released fish, which is accounted for in rivers assessed for their attainment of CLs.

Commercial fisheries

All commercial fisheries for Atlantic salmon remained closed in Canada in 2007 and the catch therefore was zero.

Unreported catches

There was no total unreported catch estimate available for Canada in 2007.

USA

There are no commercial 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 and Miquelon) harvests

The harvest of 1.95 t of salmon in 2007 was the lowest annual total since 1997 and the 5th lowest in the 18-year time-series (Table 2.1.1.1).

There are no unreported catch estimates for France (Islands of Saint-Pierre and Miquelon).

4.2.4 NASCO has requested ICES to report on the biological characteristics (size, age, origin) of the catch in coastal fisheries and potential impacts on non-local salmon stocks

The Aboriginal Peoples’ and resident food fisheries that exist in Labrador intercepted one salmon originally tagged in the Miramichi River as a returning 1SW salmon tagged on September 23, 2006 and reported caught at Makkovik (Labrador) on August 23, 2007. Only twelve fish (all >71 cm) were sampled in 2007 from the Saint-Pierre and Miquelon landings. None were reported to have been tagged and their country of origin is unknown.

Results of a sampling programme for Labrador subsistence fisheries

A sampling programme was in place for the subsistence fisheries in Labrador in 2007. Landed fish were sampled opportunistically for fork length, weight, sex (if possible), scales, and marks or tags. In southern Labrador, Aboriginal Fishery Guardians hired by the LMN conducted the sampling. In northern Labrador, Conservation Officers of the Nunatsiavut Government conducted the sampling.

In total, 196 samples were collected. Scale reading indicated that the sample consisted of 82% 1SW, 10% 2SW, and 8% previously spawned salmon. Small and large salmon based on a 2.7 kg cut-off, similar to that used in the Aboriginal fishery, indicated small salmon were 97% 1SW, 1% 2SW, and 2% previously spawned salmon and large salmon were 36% 1SW, 40% 2SW, and 24% previously spawned salmon.

The river ages (Figure 4.2.4.1) for the subsistence fisheries (for food, social, and ceremonial purposes (FSC)) samples were compared to ages from scales obtained from adults at four assessment facilities in Labrador. Fresh-water assessment facility samples numbered 1946 from north Labrador and 975 in south Labrador.

There was a difference in river age distribution of adults from fisheries compared to returns to rivers in North (Chi-square=23.10, P=0.0003) but possibly not South Labrador (Chi-square=10.61, P=0.06). Further, the fresh-water age distribution did not differ (Chi-square=2.32, P=0.80) between the two regions of Labrador.

The absence of age 1 and rarity of age 2 smolts in the catches in 2007 suggests that these fisheries did not exploit southern North America stocks to any great extent. The presence of river age 5 to 7 years in the samples provides evidence that the fisheries are exploiting northern area (predominantly Labrador) stocks. However, the presence of a relatively higher number of river age 3 salmon compared to the fresh-water samples suggests that salmon from other regions of Canada were exploited in northern Labrador in 2007.

ICES notes that the sampling programme conducted in 2007 provided biological characteristics of the harvest and that the information may be useful for updating parameters used in the Run-reconstruction Model for North America. In addition it provides material to assess the origin of salmon in this fishery. ICES recommends that sampling be continued and expanded.

4.2.5 Exploitation rates

Canada

In the Newfoundland recreational fishery, exploitation rates for retained small salmon ranged from a high of 16% on Middle Brook to a low of 5% on Gander River. Overall, exploitation of small salmon in these rivers declined from 30% in 1986 to 11% in 2007 and was the second lowest in 24 years. In Labrador, exploitation on small salmon was 4% at Sand Hill River. Exploitation on large salmon was zero as no large salmon were retained.

In Quebec for 2007, the total fishing exploitation rate was around 20%, about the average of the five previous years. Native peoples' fishing exploitation rate was 7% of the total return. Recreational fishing exploitation rate was 13% on the total run, 16% for the small and 10% for the large salmon, down from the previous five-year average of 18% for small salmon and 9% for large salmon.

USA

There was no exploitation of USA salmon in home waters, and no tagged salmon of USA origin were reported in Canadian fisheries in 2007.

4.3 NASCO has requested ICES to evaluate the extent to which the objectives of any significant management measures introduced in recent years have been achieved

No significant management measures have been introduced within the NAC in recent years.

Table 4.2.3.1 Aboriginal peoples' food fishery harvests (t) and percentage of large salmon by weight and by number, 1990 to 2007.

Aboriginal peoples' food 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	47.6	61	40

Table 4.2.3.2. The numbers of caught and released salmon in the angling fisheries of Eastern Canada.

Year	Newfoundland			Nova Scotia			New Brunswick					Prince Edward Island			Quebec			CANADA*		
	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	17,011							**2,451**	**17,154**	**19,605**
1985		315	315	1,323	6,346	7,669	1,098	3,963	3,809	17,815	26,685			67				**6,384**	**28,285**	**34,669**
1986		798	798	1,463	10,750	12,213	5,217	9,333	6,941	25,316	46,807							**16,013**	**43,805**	**59,818**
1987		410	410	1,311	6,339	7,650	7,269	10,597	5,723	20,295	43,884							**19,177**	**32,767**	**51,944**
1988		600	600	1,146	6,795	7,941	6,703	10,503	7,182	19,442	43,830	767	256	1,023				**19,119**	**34,275**	**53,394**
1989		183	183	1,562	6,960	8,522	9,566	8,518	7,756	22,127	47,967							**19,646**	**37,026**	**56,672**
1990		503	503	1,782	5,504	7,286	4,435	7,346	6,067	16,231	34,079			1,066				**13,563**	**28,305**	**41,868**
1991		336	336	908	5,482	6,390	3,161	3,501	3,169	10,650	20,481	1,103	187	1,290				**8,673**	**19,824**	**28,497**
1992	5,893	1,423	7,316	737	5,093	5,830	2,966	8,349	5,681	16,308	33,304			1,250				**17,945**	**28,505**	**46,450**
1993	18,196	1,731	19,927	1,076	3,998	5,074	4,422	7,276	4,624	12,526	28,848							**30,970**	**22,879**	**53,849**
1994	24,442	5,032	29,474	796	2,894	3,690	4,153	7,443	4,790	11,556	27,942	577	147	724				**37,411**	**24,419**	**61,830**
1995	26,273	5,166	31,439	979	2,861	3,840	770	4,260	880	5,220	11,130	209	139	348		922	922	**32,491**	**15,188**	**47,679**
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	20,987	210	118	328	182	1,643	1,825	**34,748**	**22,504**	**57,252**
1998	31,368	4,375	35,743	688	2,476	3,164	3,154	5,760	3,452	8,298	20,664	233	114	347	297	2,680	2,977	**41,500**	**21,395**	**62,895**
1999	24,567	4,153	28,720	562	2,186	2,748	3,155	5,631	3,456	8,281	20,523	192	157	349	298	2,693	2,991	**34,405**	**20,926**	**55,331**
2000	29,705	6,479	36,184	407	1,303	1,710	3,154	6,689	3,455	8,690	21,988	101	46	147	445	4,008	4,453	**40,501**	**23,981**	**64,482**
2001	22,348	5,184	27,532	527	1,199	1,726	3,094	6,166	3,829	11,252	24,341	202	103	305	809	4,674	5,483	**33,146**	**26,241**	**59,387**
2002	23,071	3,992	27,063	829	1,100	1,929	1,034	7,351	2,190	5,349	15,924	207	31	238	852	4,918	5,770	**33,344**	**17,580**	**50,924**
2003	21,379	4,965	26,344	626	2,106	2,732	1,555	5,375	1,042	7,981	15,953	240	123	363	1,238	7,015	8,253	**30,413**	**23,232**	**53,645**
2004	23,430	5,168	28,598	828	2,339	3,167	1,050	7,517	4,935	8,100	21,602	135	68	203	1,291	7,455	8,746	**34,251**	**28,065**	**62,316**
2005	33,129	6,598	39,727	933	2,617	3,550	1,520	2,695	2,202	5,584	12,001	83	83	166	1,116	6,445	7,561	**39,476**	**23,529**	**63,005**
2006	30,491	5,694	36,185	1,014	2,408	3,422	1,071	4,186	2,638	5,538	13,433	128	42	170	1,091	6,185	7,276	**37,981**	**22,505**	**60,486**
2007	17,168	3,892	21,060	883	1,471	2,354	1,106	2,963	1,850	7,040	12,959	63	41	104	951	5,392	6,343	**23,134**	**19,686**	**42,820**

* totals for all years prior to 1997 are incomplete and are considered minimal estimates
blank cells indicate no information available

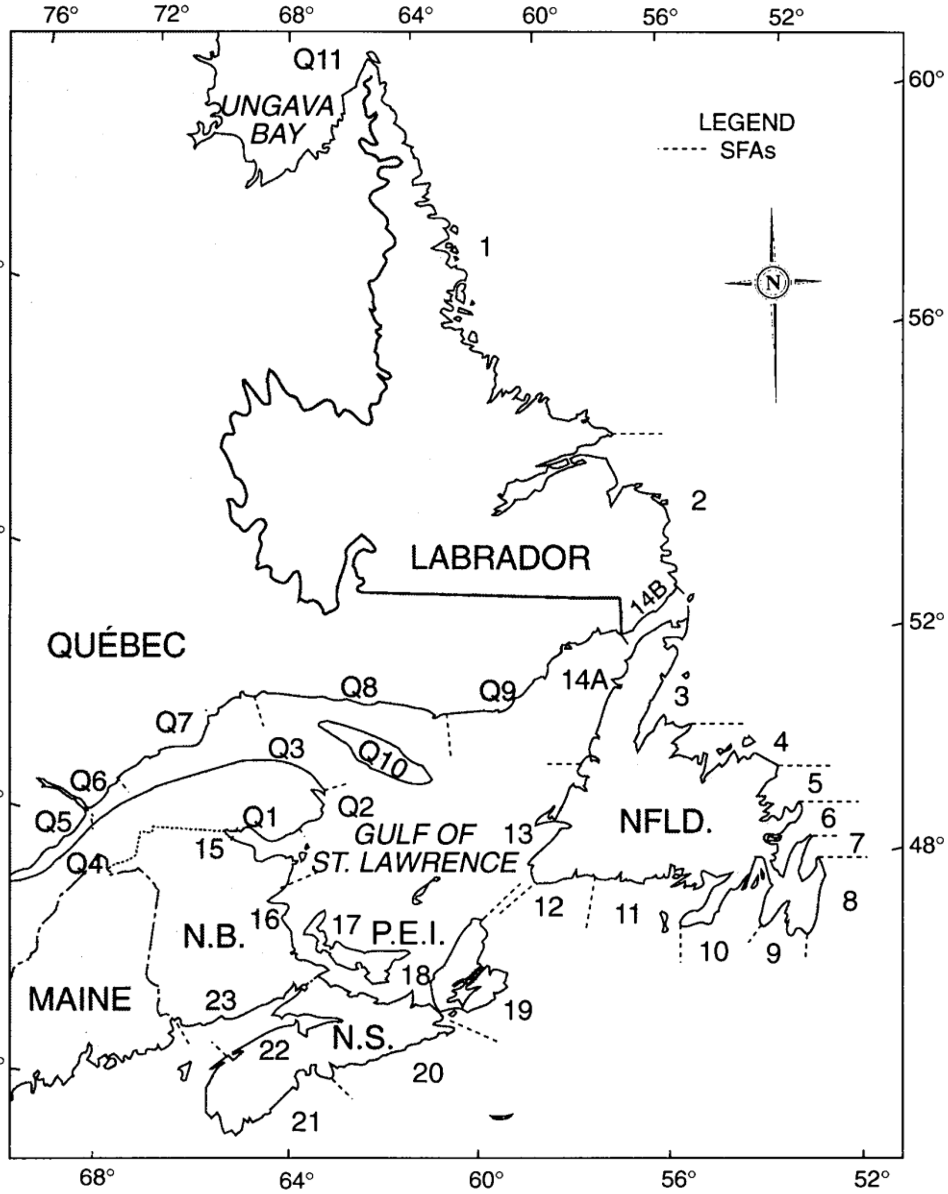


Figure 4.2.2.1 Map of Salmon Fishing Areas (SFAs) and Québec Management Zones (Qs) in Canada (NFLD. = Newfoundland, P.E.I. = Prince Edward Island, N.B. = New Brunswick, and N.S. = Nova Scotia).

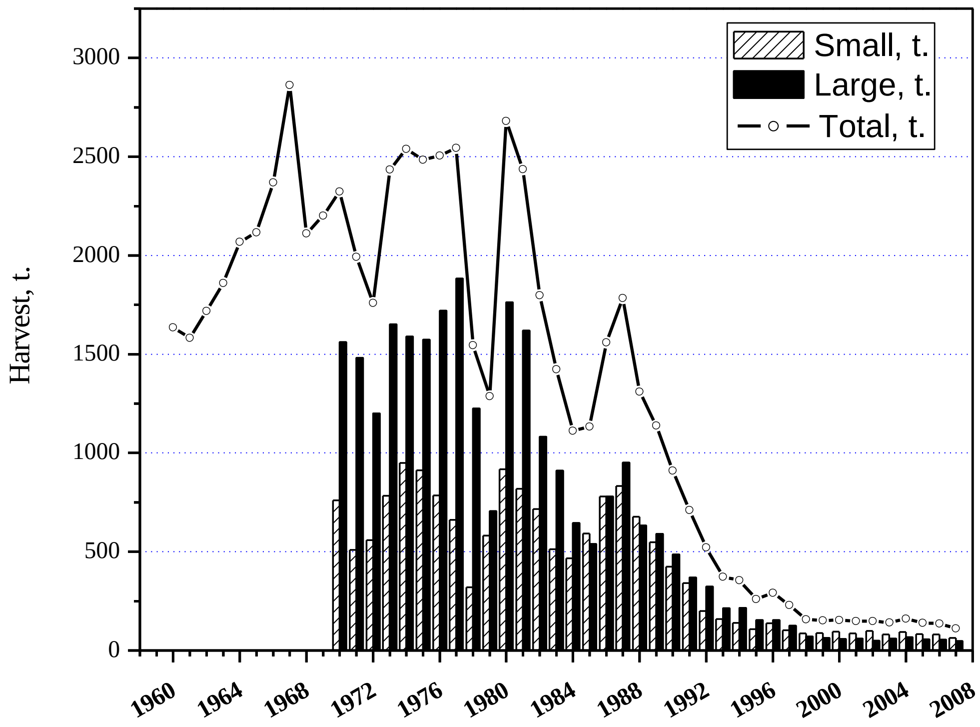


Figure 4.2.3.1 Harvest (t) of small salmon, large salmon, and both sizes combined for Canada, 1960–2007 by all users.

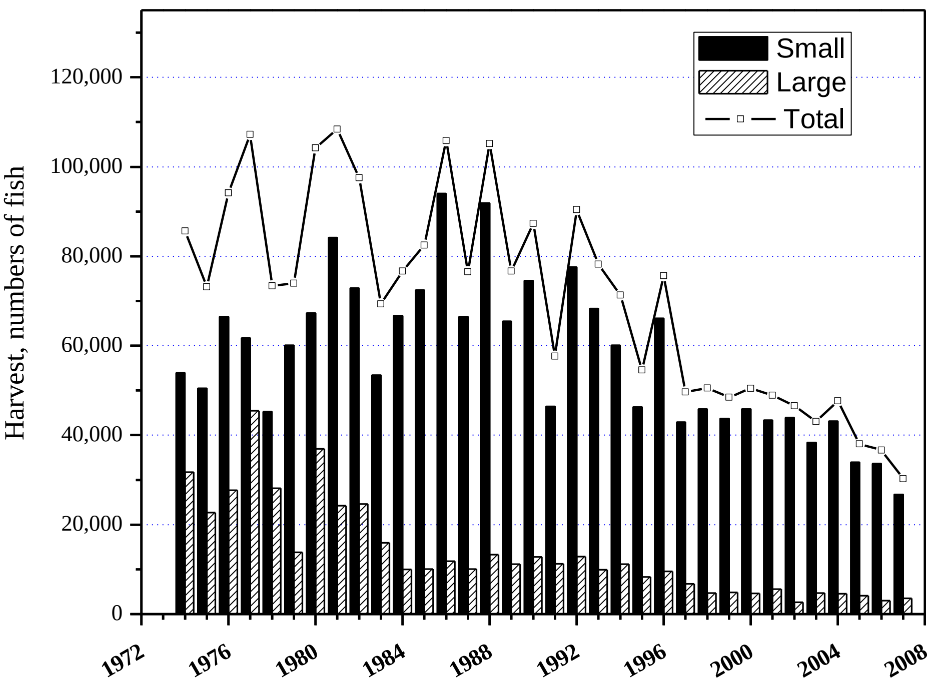


Figure 4.2.3.2 Harvest (number) of small salmon, large salmon, and both sizes combined in the recreational fisheries of Canada, 1974–2007.

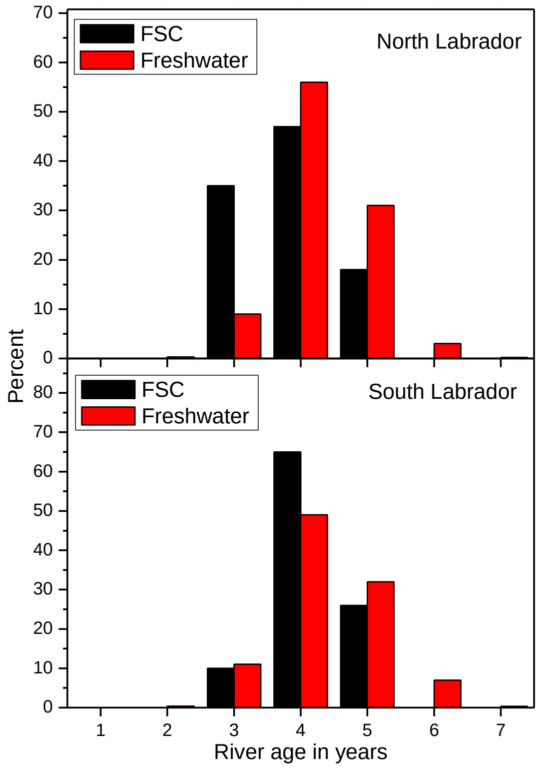


Figure 4.2.4.1 A comparison of the river age distribution of river ages of salmon from FSC fisheries in North and South Labrador in 2007 to those at assessment facilities in 2000–2005.

5 Atlantic salmon in the West Greenland Commission

5.1 NASCO has requested ICES to describe the key events of the 2007 fishery

At its annual meeting in June 2007, NASCO agreed to restrict the fishery at West Greenland to the amount used for internal subsistence consumption. This assumed that the Framework of Indicators would determine that no change to the management advice previously provided by ICES was required. Consequently, the Greenlandic authorities set the commercial quota to nil, i.e. landings to fish plants, resale in grocery shops/markets, and commercial export of salmon from Greenland was forbidden. Licensed fishers were allowed to sell salmon at the open markets, to hotels, restaurants, and institutions. A private fishery for personal consumption without a license was allowed. All catches, licensed and private were to be reported to the License Office on a daily basis. In agreement with the Organization for Fishermen and Hunters in Greenland the fishery for salmon was allowed from August 1 to October 31.

5.1.1 Catch and effort in 2007

A total of 24.6 t of landed salmon were reported during the 2007 fishery (Table 5.1.1.1). Catches were distributed among the six NAFO divisions at West Greenland (Figure 5.1.1.1), with approximately 80% of the catches coming from Divisions 1B–1E (Table 5.1.1.2). The 2005 and 2006 landings data reported previously (ICES, 2007) were mistakenly reported as gutted weights instead of whole weights. This error was corrected and all the landings data reported in Tables 5.1.1.1 and 5.1.1.2 represent whole weight. There is currently no quantitative approach to estimating the unreported catch. However, in 2007 it is likely to have been at the same level proposed in recent years (10 t).

Seasonal distribution of catches has previously been reported through ICES. However, it has become clear that the data to support this breakdown is no longer available. The reporting of fishing date is not required and some reported landings represent catches occurring on multiple days. As such, the seasonal distribution of reported landings is no longer provided.

In total, 234 reports were received in 2007; the same number received in 2006. A total of 132 people landed salmon as compared to the 136 in 2006. The number of fishers reporting catches over the past few years has steadily increased from a low of 41 in 2002 to the current level. These levels remain well below the 400 to 600 people reporting landings in the commercial fishery from 1987 to 1991.

5.1.2 Biological characteristics of the catches

The international sampling programme at West Greenland initiated by NASCO in 2001 was continued in 2007. The sampling teams from Canada, Greenland, Ireland, UK (Scotland), UK (England & Wales), and United States were in place at the start of the fishery and throughout the fishing season. Tissue and biological samples were collected from five landing sites: Qaqortoq (NAFO Division 1F), Paamiut (1E), Nuuk (1D), Maniitsoq (1C), and Ilulissat/Qeqertarsauq (1A) (Figure 5.1.1.1). In total, 1162 salmon were inspected, which represents 16% of the reported landings (by weight). Of these, 1116 were measured for fork length, 880 measured for gutted weight, 236 for whole weight, scales were collected from 1119, and tissue samples were taken from 1126 salmon for DNA analysis. The broad geographic distribution of the subsistence fishery caused practical problems for the sampling teams. However, the spatial and temporal coverage of the sampling programme was adequate to assess the fishery. As in previous years, ICES did need to adjust the total landings by replacing the reported catch with the weight of fish sampled for use in assessment calculations (Table 5.1.2.1). In 2007 this adjustment was limited to one division only (1F) and represented a very small proportion of the reported landings (~150 kg).

The average whole weight of a fish from the 2007 catch was 2.98 kg across all ages, with North American 1SW fish averaging 63.5 cm and 2.89 kg and European 1SW salmon averaging 63.3 cm and 2.87 kg (Table 5.1.2.2). The mean lengths and mean weights for the 2007 samples dropped from the 2006 values but remained close to the 10-year mean. It should be noted that these average weights are not adjusted for the time of sampling and may not represent the true trend across the time-series.

North American salmon up to river age 6 were caught at West Greenland in 2007 (Table 5.1.2.2), with >70% being river age 3 or older. The river ages of European salmon ranged from 1 to 5 (Table 5.1.2.2). Almost half (48.5%) of the European fish in the catch were river-age 2 and 33.0% were river age 3.

In 2007, 1SW salmon dominated (96.5%) the North American component, with previous spawners decreasing to 2.5% from the 2006 value of 5.6% (Table 5.1.2.2). 95.6% of the European samples were 1SW salmon, with previous spawners representing 1.5% of the samples (Table 5.1.2.2).

As part of the sampling programme, whole fresh fish were obtained to support a variety of complementary sampling efforts. In total, 150 fish were obtained from Nuuk (1D) and sampled for sex identification, disease (kidney tissue samples), feeding and parasites (stomach and intestines), and lipid/stable isotope analysis (liver, caudal, and muscle tissue). Sex was determined through direct gonad examination; 19 (12.7%) were males and 131 (87.3%) were females. All disease samples were tested for the presence of ISAv by RT-PCR assay and all test results were negative. Stomach, parasite, and lipid/stable isotope samples are currently being processed and analyzed.

Of the 1126 samples collected for genetic characterization, three samples were removed from the analysis. The remaining samples were either genotyped at three (n=8) or four (n=1115) microsatellites. A database of approximately 5000 Atlantic salmon genotypes of known origin was used as a baseline to assign these salmon to continent of origin. In total, 81.7% of the salmon sampled from the 2007 fishery were of North American origin and 18.3% of the fish were of European origin.

The continent of origin proportions of the samples varied among the divisions (see table below). ICES recommends the continuation of a broad geographic sampling programme (multiple NAFO divisions) to accurately estimate the continent of origin in this mixed-stock fishery.

	North America		**Europe**	
NAFO division	Number	%	Number	%
1A	5	50.0%	5	50%
1C	128	70.7%	53	29.3%
1D	462	88.3%	61	11.7%
1E	112	65.5%	59	34.5%
1F	210	88.2%	28	11.8%
Total	917	81.7%	206	18.3%

Applying the continental percentages for the NAFO division catches resulted in estimates of 18.5 t of North American origin and 6.3 t of European origin fish (6100 and 1900 individuals rounded to the nearest 100 fish, respectively) landed in West Greenland in 2007 (Table 5.1.2.3).

5.2 NASCO has requested ICES to provide any new information on the extent to which the objectives of any significant management measures introduced in recent years have been achieved

NASCO's present management is directed towards reducing exploitation to increase spawning escapement to allow river-specific CLs to be achieved. It is not possible to evaluate the extent to which the objectives of any significant management measures for the West Greenland Commission have been achieved, as an assessment of the status of the stocks for the North American Commission in 2007 was not performed. A full assessment is scheduled to occur in 2009 and the extent to which the objectives of any significant management measures for the West Greenland Commission have been achieved can be evaluated at that time. The North American stock complex is the primary contributor to the West Greenland fishery.

Table 5.1.1.1 Nominal catches of salmon, West Greenland 1971–2007 (metric tonnes 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 2 520 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		895	The fishery was suspended.
1994		137	The fishery was suspended and the quotas were bought out.
1995	83	77	
1996	92	174	Quota set by Greenland authorities.
1997	58	57	
1998	11	206	
1999	19	206	
2000	21	206	
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		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.

YEAR	TOTAL	QUOTA	COMMENTS
2005	15		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.
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.

Table 5.1.1.2 Distribution of nominal catches (rounded to nearest metric tonne) by Greenland vessels (1977-2007).

	NAFO DIVISION							TOTAL		
YEAR	1A	1B	1C	1D	1E	1F	NK	West Greenland	East Greenland	Greenland
1977	201	393	336	207	237	46	-	1 420	6	1 426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1 395	+	1 395
1980	52	275	404	231	158	74	-	1 194	+	1 194
1981	105	403	348	203	153	32	20	1 264	+	1 264
1982	111	330	239	136	167	76	18	1 077	+	1 077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993[1]	-	-	-	-	-	-	-	-	-	-
1994[1]	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19
2000	+	+	1	7	+	13	-	21	-	21
2001	+	1	4	5	3	28	-	43	-	43
2002	+	+	2	4	1	2	-	9	-	9
2003	1	+	2	1	1	5	-	9	-	9
2004	3	1	4	2	3	2	-	15	-	15
2005[2]	1	3	2	1	3	5	-	15	-	15
2006[2]	6	2	3	4	2	4	-	22	-	22
2007	2	5	6	4	5	2	-	25	-	25

[1] The fishery was suspended.

[2] Values reported in ICES (2007) were gutted weight. Values have been corrected to represent whole weight.

+ Small catches <0.5 t.

- No catch.

Table 5.1.2.1 Reported landings (kg) for the West Greenland Atlantic salmon fishery (2002–2007) by NAFO Division as reported by the Home Rule Government and the division-specific adjusted landings where the sampling teams observed more fish landed than were reported.

		NAFO Division						
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[1]	Reported	1294	3120	2240	756	2937	4956	15 303
	Adjusted				2730			17 276
2006[1]	Reported	5427	2611	3424	4731	2636	4192	23 021
	Adjusted							
2007	Reported	2019	5089	6148	4470	4828	2093	24 647
	Adjusted						2252	24 806

[1] Values reported in ICES (2007) were gutted weight. Values have been corrected to represent whole weight.

Table 5.1.2.2 Biological characteristics of Atlantic salmon sampled during the 2007 West Greenland Atlantic salmon fishery.

RIVER AGE DISTRIBUTION (%) OF ATLANTIC SALMON BY ORIGIN SAMPLED FROM THE 2007 WEST GREENLAND FOOD FISHERY

	1	2	3	4	5	6	7	8
NA	1.6	27.7	34.5	26.2	9.2	0.9	0	0
E	7	48.5	33	10.5	1	0	0	0

BIOLOGICAL CHARACTERISTICS OF ATLANTIC SALMON SAMPLED FROM THE 2007 WEST GREENLAND FOOD FISHERY

Continent of Origin (%)	
North America	Europe
81.7	18.3

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

	Sea-age composition (%)		
	1SW	2SW	Previous Spawners
NA	96.5	1.0	2.5
E	95.6	2.5	1.5

LENGTH AND WEIGHT OF ATLANTIC SALMON BY ORIGIN AND SEA AGE. FROM THE 2007 WEST GREENLAND FOOD FISHERY

	1 SW		2 SW		Previous spawners		All sea ages	
	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)	Fork length (cm)	Whole weight (kg)
NA	63.5	2.89	80.9	6.19	76.7	4.94	64.1	2.98
E	63.3	2.87	80.6	6.47	71.3	3.57	63.9	2.99

Table 5.1.2.3 The catch weighted numbers of North American (NA) and European (E) Atlantic salmon caught at West Greenland 1971-1992 and 1995–2007 and the proportion of the catch by weight. Numbers are rounded to the nearest hundred fish.

YEAR	NUMBERS OF		PROPORTION WEIGHTED	
	Salmon caught		by catch in number	
	NA	E	NA	E
1971	291 166	565 204	34	66
1972	221 128	393 116	36	64
1973	274 423	285 624	49	51
1974	230 254	305 221	43	57
1975	286 282	364 359	44	56
1976	166 201	220 313	43	57
1977	199 065	243 302	45	55
1978	126 304	167 427	43	57
1979	208 832	208 832	50	50
1980	192 820	177 988	52	48
1981	235 256	163 483	59	41
1982	130 900	204 700	57	43
1983	314 900	302 500	40	60
1984	229 000	425 300	54	46
1985	291 200	56 5300	47	53
1986	221 200	393 200	59	41
1987	274 500	285 700	59	41
1988	230 300	305 300	43	57
1989	286 300	364 400	55	45
1990	166 300	220 400	74	26
1991	199 100	243 400	63	37
1992	126 400	167 500	45	55
1993	-	-	-	-
1994	-	-	-	-
1995	22 100	10 400	67	33
1996	23 400	8700	70	30
1997	17 200	4300	85	15
1998	3200	900	79	21
1999	5600	700	91	9
2000	5800	2500	65	35
2001	9900	4500	67	33
2002	2300	1100	72	28
2003	2800	1300	65	35
2004	4000	1500	72	28
2005	3700	1200	76	24
2006	4000	1800	69	31
2007	6100	1900	76	24

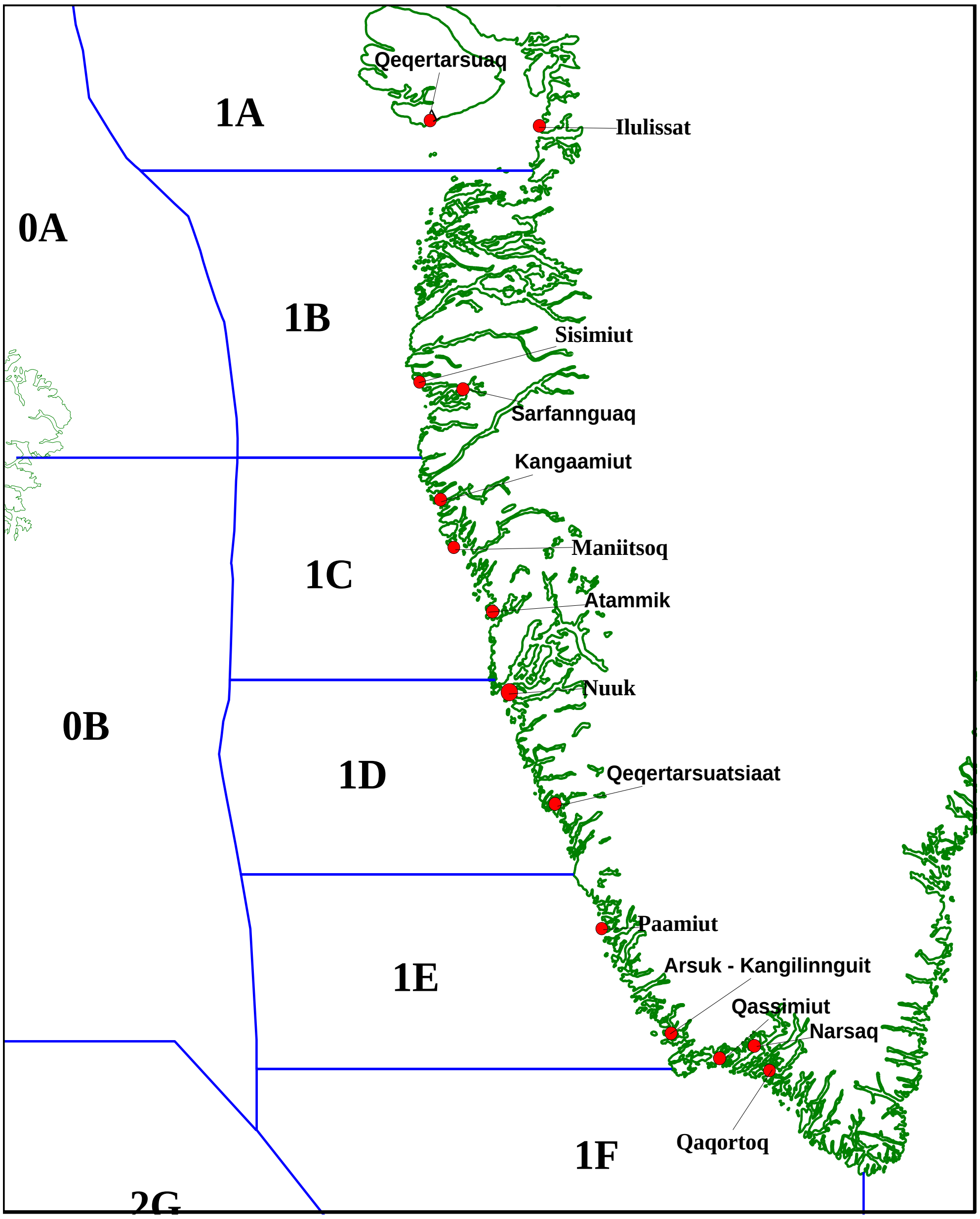


Figure 5.1.1.1 Location of NAFO divisions along the west coast of Greenland.

6 NASCO has requested ICES to identify relevant data deficiencies, monitoring needs, and research requirements, taking into account NASCO's international Atlantic salmon research board's inventory of on-going research relating to salmon mortality in the sea

ICES recommends that the Working Group on North Atlantic salmon should meet in 2009 to address questions posed by ICES and NASCO. ICES intends for the Working Group to convene in the headquarters of the **ICES in Copenhagen, Denmark from 30th March to 8th April 2009**.

6.1 Prioritized list of recommendations

1) ICES recommends that efforts are continued to identify and collate further information on biological characteristics from river populations and fisheries throughout the North Atlantic. It is proposed that a study group be commissioned to facilitate a unified effort to further develop and investigate these datasets for changes in biological characteristics and stock performance.

2) ICES recommends a study group be commissioned to facilitate the development of PFA modeling approaches for both NAC and NEAC prior to the 2009 WGNAS.

3) ICES recognises that river-specific management requires extensive monitoring and recommends expanded monitoring programmes across both stock complexes.

4) ICES recommends the completion of a metadata directory of datasets from the West Greenland fishery, which should be referenced in the quality handbook. This data would be informative to the study group on biological characteristics recommended above.

5) ICES recommends that the data which forms the allocation of the Faroese catch amongst home water countries be re-examined, some progress towards this action will be generated from the WKSHINI (Section 2.8.2).

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.

ASAP *(The Atlantic Salmon Arc Project)* The initial aim of ASAP is to collect samples from the majority of salmon rivers on the Western Atlantic coast of Europe and use methods of Genetic Stock Identification (GSI).

BHSRA *(Bayesian Hierarchical Stock and Recruitment Approach)* Models for the analysis of a group of related stock–recruit data sets. Hierarchical modeling is a statistical technique that allows the modeling 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.

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

Cpue *(Catch per unit 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.

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

FV *(Fishing Vessel)* A vessel that undertakes cruise for commercial fishing purposes.

GIS *(Geographic Information Systems)* A computer technology that uses a geographic information system as an analytic framework for managing and integrating data.

GSI *(Genetic Stock Identification)* Methods used to 'genetically type' salmon from particular regions and rivers across Atlantic.

ISAV *(Infectious Salmon Anemia Virus)* ISA is a highly infectious disease of Atlantic salmon caused by an enveloped virus.

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

MSW *(Multi-Sea-Winter)* An adult salmon which has spent two or more winters at sea or a repeat spawner.

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

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.

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.

Q Areas for which the Ministère des Ressources Naturelles et de la Faune manages the salmon fisheries in Québec.

RT-PCR *(Reverse Transcription-Polymerase Chain Reaction)* is the most sensitive technique for mRNA detection and quantitation currently available. Compared to the two other commonly used techniques for quantifying mRNA levels, Northern blot analysis and RNase protection assay, RT-PCR can be used to quantify mRNA levels from much smaller samples.

RV *(Research Vessel)* A vessel that undertakes cruises to conduct scientific research.

SER *(Spawning Escapement Reserve)* The CL increased to take account of natural mortality between the recruitment date (1st January) and return to home waters.

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

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)* A Study Group established by ICES which met in November 2006.

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

SAC *(Special Areas of Conservation)* To comply with the EU Habitats Directive (92/43/EEC) on Conservation of Natural Habitat and of Wild Fauna and Flora, which stipulates that member states maintain or restore habitats and species to favourable conservation status, a number of rivers in the NEAC area that support important populations of vulnerable qualifying species have been designated SACs. Where salmon is a "qualifying species", additional protection measures specifically for salmon are required.

TAC *(Total Allowable Catch)* The quantity of fish that can be taken from each stock each year.

VHSV *(Viral Haemorrhagic Septicaemia Virus)* VHS is a highly infectious virus disease caused by the virus family *Rhabdoviridae*, genus *Novirhabdovirus*.

VIE *(Visual Implant Elastomer)* The VIE tags consist of fluorescent elastomer material which is subcutaneously injected as a liquid into transparent or translucent tissue via a hand-held injector.

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.

WKDUHSTI *(Workshop on the Development and Use of Historical Salmon Tagging Information from Oceanic Areas)* The Workshop established by ICES was held in February 2007.

WKSHINI (*Workshop on Salmon historical information – new investigations from old tagging data*) The Workshop is set to meet from 18–20 September 2008 in Halifax, Canada.

This glossary has been extracted from various sources, but chiefly the EU SALMODEL report (Crozier *et al*.., 2003).

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