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International Council for the Exploration of the Sea

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1 INTRODUCTION

1.1 Main Tasks

At its 2003 Statutory Meeting, ICES resolved (C. Res. 2003/2ACFM05) that the Working Group on North Atlantic Salmon [WGNAS] (Chair: Dr W Crozier, UK) will meet in Halifax, Canada, from the 28 March-8 April 2004 to consider questions posed to ICES by the North Atlantic Salmon Conservation Organisation (NASCO). The terms of reference and sections of the report in which the answers are provided, follow:

a) With respect to Atlantic salmon in the North Atlantic area:	Section 2
i. provide an overview of salmon catches and landings, including unreported catches by country and catch and release, and worldwide production of farmed and ranched salmon in 2003;	2.1 and 2.2
ii. report on significant developments which might assist NASCO with the management of salmon stocks;	2.4
iii. provide a compilation of tag releases by country in 2003.	2.7
iv. identify relevant data deficiencies, monitoring needs and research requirements, taking into account NASCOs International Atlantic Salmon Research Board's inventory of on-going research relating to salmon mortality in the sea.	6
b) With respect to Atlantic salmon in the North-East Atlantic Commission area:	Section 3
i. describe the key events of the 2003 fisheries and the status of the stocks;	3.9
ii. evaluate the extent to which the objectives of any significant management measures introduced during the last five years have been achieved;	3.10
iii. further develop the age-specific stock conservation limits where possible based upon individual river stocks;	3.3
iv. provide catch options or alternative management advice, if possible based on a forecast 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.	3.6
v. consider the report of the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries, provide estimates of by-catch of salmon in pelagic trawl fisheries and advise on their reliability.	3.11
c) With respect to Atlantic salmon in the North American Commission area:	Section 4
i. describe the key events of the 2003 fisheries and the status of the stocks;	4.9
ii. evaluate the extent to which the objectives of any significant management measures introduced during the last five years have been achieved;	4.10
iii. update age-specific stock conservation limits based on new information as available;	4.3
iv. provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these options for stock rebuilding.	4.6
v. provide an analysis of any new biological and/or tag return data, to identify the origin of Atlantic salmon caught at St Pierre and Miquelon;	4.11
vi. provide descriptions (gear type, and fishing depth, location and season) for all pelagic fisheries that may catch Atlantic salmon.	4.12

d) With respect to Atlantic salmon in the West Greenland Commission area:	Section 5
i. describe the events of the 2003 fisheries and the status of the stocks;	5.9
ii. evaluate the extent to which the objectives of any significant management measures introduced in recent years have been achieved;;	5.12
iii. provide information on the origin of Atlantic salmon caught at West Greenland at a finer resolution than continent of origin (river stocks, country or stock complexes);	5.9
iv. provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits and advise on the implications of these for stock rebuilding.	5.6
Notes: 1. *In the responses to questions b.i, c.i and d.i ICES is asked to provide details of catch, gear, effort, composition and origin of the catch and rates of exploitation. For homewater fisheries, the information provided should indicate the location of the catch in the following categories: in-river; estuarine; and coastal. Any new information on non-catch fishing mortality of the salmon gear used and on the bycatch of other species in salmon gear and of salmon in any existing and new fisheries for other species is also requested.* 2. *With regard to question d.i ICES is requested to provide a brief summary of the status of the North American and North-East Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions b.i and c.i.* 3. *In response to questions b.iv, c.iv and d.iv provide a detailed explanation and critical examination of any changes to the models used to provide catch advice. With respect to stock rebuilding, consider and evaluate various alternative baseline measures for use in the risk analysis.* 4. *With regard to b.v: the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries will facilitate further deliberations of the WGNAS on this topic.*	

The Working Group considered 44 Working Documents submitted by participants (Appendix 1); other references cited in the report are given in Appendix 2. A full address list for the participants is provided in Appendix 3.

1.2 Participants

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Caron, F.	Canada
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Hansen, L.P.	Norway
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MacLean, J.C.	UK (Scotland)
Meerburg, D.J.	Canada
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2 ATLANTIC SALMON IN THE NORTH ATLANTIC AREA

2.1 Catches of North Atlantic Salmon

2.1.1 Nominal catches of salmon

The nominal catch of a fishery is defined as the round, fresh weight of fish that are caught and retained. Total nominal catches of salmon reported by country in all fisheries for 1960-2003 are given in Table 2.1.1.1. Catch statistics in the North Atlantic also include fish farm escapees and, in some north-east Atlantic countries, relatively small numbers of ranched fish (see Section 2.2.2). Catch and release has become increasingly commonplace in some countries, but these fish do not appear in the nominal catches (see Section 2.1.2).

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

Figure 2.1.1.1 shows the nominal catch data grouped by the following areas: 'Northern Europe' (Norway, Russia, Finland, Iceland, Sweden and Denmark); 'Southern Europe' (Ireland, UK (Scotland), UK (England and Wales), UK (Northern Ireland), France and Spain); 'North America' (including Canada and USA); and 'Greenland and Faroes'. Catches for St Pierre et Miquelon (France) are normally included in North America, but no data were made available for 2003.

The provisional total nominal catch for 2003 was 2,461 tonnes, 179 t below the confirmed catch for 2002 (2,640 t). The 2003 catch was about 200 t below the average of the last five years (2,653 t), and over 500 t below the average of the last 10 years (3,003 t). For the majority of countries, catches in 2003 were lower than those in 2002, although in four countries catches rose slightly on the previous year. Catches were below the previous five- and ten-year averages in eleven countries. In three countries, the nominal catch in 2003 was the lowest recorded in the time series.

Nominal catches in homewater fisheries split, where available, by sea-age or size category are presented in Table 2.1.1.2 (weight only). The data for 2003 are provisional and, as in Table 2.1.1.1, include both wild and reared salmon and fish farm escapees in some countries. A more detailed breakdown, providing both numbers and weight for different sea-age groups for most countries, is provided at Appendix 4. Countries use different methods to partition their catches by sea-age class and these are outlined in the footnotes to Appendix 4. The composition of catches in different areas is discussed in more detail in Sections 3, 4, and 5.

Table 2.1.1.3 presents the nominal catch by country in homewater fisheries partitioned according to whether the catch was taken in coastal, estuarine or riverine areas. Overall, coastal fisheries accounted for 53% of catches in North East Atlantic countries in 2003, in-river fisheries 39% and estuarine fisheries 8%. In North America, coastal fisheries accounted for 12% of the catch in 2003, while in-river fisheries took 70% and estuarine fisheries 18%.

There is considerable variability in the percentage of the catch taken in different fisheries between individual countries. For some countries the entire catch is taken in freshwater, while in other countries the majority of the catch is taken in coastal waters (Figure 2.1.1.2). Data aggregated by region are presented in Figure 2.1.1.3. In the NEAC northern area (Iceland, Norway, Russia, Finland and Sweden) around half the catch over the period 1995 to 2003 has been taken in coastal waters and half in rivers; estuarine catches comprise no more than 2% of the total. There is no trend over the period in the percentages taken in each area. In the NEAC southern area (France, Ireland, Spain, UK (N. Ireland), UK (Scotland) and UK (England & Wales)) estuarine fisheries have comprised a small (<20%) and relatively stable part of the catch, whereas the percentage of the catch taken in coastal fisheries shows an increasing trend and that in river a decreasing trend. This is thought to reflect increasing use of catch and release, since catches and effort in coastal fisheries have also been reduced in many countries over the period. In North America, the majority of the catch has been taken in freshwater (69 to 77 % over the period).

2.1.2 Catch and release

The practice of catch and release (also termed hook and release or live release) in rod fisheries has become increasingly common as a salmon management/conservation measure in light of the widespread decline in salmon abundance in the North Atlantic. In some areas of Canada and USA, catch and release has been practiced since 1984, and in more recent years it has also been widely used in many NEAC countries both as a result of statutory regulation and through voluntary practice.

The nominal catches presented in Section 2.1.1 comprise fish which have been caught and retained and do not include salmon that have been caught and released. Table 2.1.2.1 presents catch-and-release information from 1991 to 2003 for six countries that have records; catch-and-release may also be practiced in other countries while not being formally recorded. There are large differences in the percentage of the total rod catch that is released: in 2003 this ranged from 16% in Iceland to 81% in Russia, reflecting varying management practices among these countries. Within countries, the percentage of fish released has tended to increase over time, and the rates in 2003 are the highest in the time series for three countries and among the highest for two other countries. Overall, almost 127,000 salmon were reported to have been released around the North Atlantic in 2003, an increase of 11% on 2002, and the highest in the time series. There is also evidence from some countries that larger MSW fish are released in higher proportions than smaller fish.

Concerns have been expressed about the survival of fish following catch and release. However, various research studies (detailed in ICES 2003/ACFM:19) have demonstrated that if fish are appropriately handled, mortality following capture is low and a large proportion of fish survive to spawn. It is recognised, however, that fish are more likely to die when water temperatures are high (>20^{o}C) or if fish are 'played' for an extended period. In deriving river-specific conservation limits, Canada (various regions) and UK (England & Wales) make a small allowance for catch-and-release mortality. These correction factors vary: up to10% for Canadian Regions and 20% for UK (England & Wales).

2.1.3 Unreported catches

Unreported catches by year (1987-2003) and Commission Area are presented in Table 2.1.3.1. A description of the methods used to evaluate the unreported catches was provided in ICES 2000/ACFM:13 and updated for the NEAC Region in ICES 2002/ACFM:14. In practice, the estimation methods used by each country have remained relatively unchanged and thus comparisons over time may be appropriate. However, the estimation procedures vary markedly between countries. For example, some countries include only illegally caught fish in the unreported catch, while other countries include estimates of unreported catch by legal gear as well as illegal catches in their estimates. For France, the illegal catch is included in the nominal catch. Over recent years efforts have been made to reduce the level of unreported catch in a number of countries (e.g. through improved reporting procedures). The introduction of carcass tagging programmes in Ireland and UK (N. Ireland) in recent years is also expected to lead to reductions in unreported catches.

The total unreported catch in NASCO areas in 2003 was estimated to be 847 t, a fall of 18% on 2002 (1,039 t). The unreported catch in the North East Atlantic Commission Area in 2003 was estimated at 719 t, that for the North American Commission Area 118 t, with 10 t estimated for the West Greenland Commission Area. The unreported catch, expressed as a percentage of the total North Atlantic catch (nominal and unreported), has fluctuated since 1987 (range 23–34%; 26% in 2003), but has declined over the past 5 years (Figure 2.1.3.1). Estimates for 2003 are presented by country in Table 2.1.3.2. Expressed as a percentage of the total unreported catch for the North Atlantic, these range from 0 to 13% for individual countries. Relative to national catches, unreported catches range between 1% and 54% of country totals.

In the past, salmon fishing by non-contracting parties is known to have taken place in international waters to the north of the Faroe Islands. Two surveillance flights were made over the area by the Icelandic coastguard in 2003; additional flights may have been made by the Norwegian coastguard, but no information was available. No sightings of vessels were made during the Icelandic flights, although the flights took place outside the period from mid-September to late March, which is the period when previous salmon fishing has been reported.

2.2 Farming and Sea Ranching of Atlantic Salmon

2.2.1 Production of farmed Atlantic salmon

The provisional estimate of farmed Atlantic salmon production in the North Atlantic area for 2003 is 761,752 t. This represents a 5% increase on 2002 (726,210 t) and a 16% increase on the 5-year mean (1998-2002) (Table 2.2.1.1 and Figure 2.2.1.1). Most of the North Atlantic production took place in Norway (61%) and UK (Scotland) (23%). Production in 2003 increased on 2002 in most countries, but fell a little in USA and by around a quarter in Ireland.

In 2002, world-wide production of farmed Atlantic salmon topped one million tonnes for the first time. Total production increased further in 2003 (up 2%) and is provisionally estimated at over 1.1 million tonnes (Table 2.2.1.1 and Figure 2.2.1.1). Production outside the North Atlantic increased by 74% between 2001 and 2002, but fell slightly in 2003 (down 4%) to 353,000 t. The largest contribution to the farmed production outside the North Atlantic area was in Chile (261,000 t). World-wide production of farmed Atlantic salmon in 2003 was over 450 times the reported nominal catch of Atlantic salmon in the North Atlantic. Farmed salmon therefore dominate world markets.

2.2.2 Production of ranched Atlantic salmon

Ranching has been defined as the production of salmon through smolt releases with the intent of harvesting the total population that returns to freshwater (harvesting can include fish collected for broodstock) (ICES 1994/Assess:16). The total production of ranched Atlantic salmon in countries bordering the North Atlantic in 2003 was 12 t, an increase of 2 t on 2002 (Figure 2.2.2.1). Salmon ranching (smolt releases) ceased in Iceland in 1998. Small catches of ranched fish were recorded in each of the three other countries reporting such fish (Ireland, UK(N. Ireland), and Norway), the data including catches in net, trap, and rod fisheries. Ranched fish comprised less than 2% of the nominal catches in each of these countries.

2.3 Update on the estimation of natural mortality at sea of Atlantic salmon

The Working Group was asked for clarification on the choice of the inverse weight method for estimating M in the second year at sea and used in the reconstruction models of the North American PFA and the NEAC PFA. A more detailed review of the methods and assumptions are provided by Chaput (2003) and Chaput et al. (2003).

In 2002, the Working Group reviewed theoretical and empirical methods for estimating M for Atlantic salmon and applied the inverse-weight model to observations from the River Bush (UK N. Ireland) as well as growth and abundance data of the River Trinité, LaHave River and Northwest Miramichi River (Canada) (ICES CM2002/ACFM: 14). The Working Group also considered a maturity schedule method to derive estimates of natural mortality at sea for stocks which mature at two or more different ages. The group determined that the most appropriate growth function for use with the inverse-weight method was linear rather than the previously used exponential function. This change in growth function, plus analysis of data from additional rivers, resulted in the instantaneous monthly mortality rate used in the run-reconstruction model for the North American and NEAC areas to be changed from 0.01 to 0.03.

In 2003, the Working Group reviewed an analysis of a more extensive data set from 5 rivers on the NEAC area and 6 rivers in the NAC area (ICES 2003/ACFM: 19). The rivers with suitable data extended from the Scorff (France) to the North Esk (Scotland) and North to the Vesturdalsa River (Iceland). On the North American side, hatchery and wild stock data sets extended from the Scotia-Fundy region to the north shore of the St. Lawrence (Quebec). The time period analysed was from 1981 to 1999 in the NEAC area and 1970 to 1999 in the NAC area. Both the inverse weight method and the maturity schedule method were applied to the sets with appropriate data. The analysis of the river-specific growth data supported the previous conclusion that a linear function characterized the observed weights at age in the marine phase better than the exponential function. The additional analyses confirmed the previous conclusion that monthly mortality in the second year at sea was greater than 1% and distributed around 3%, at least for the wild fish. There were important differences among stocks and even regions which were not accounted for in the generalization over the entire NEAC and NAC areas.

The data requirements of the methods and the assumptions are briefly reviewed below.

Data requirements

Both methods require estimates of return rates of salmon at two life stages, 1SW and 2SW (Table 2.3.1). The inverse weight method also requires measurements of weights at age for smolts, 1SW and 2SW salmon as well as dates of smolt migration and dates of return. These data are generally easy to obtain since weight and time of return data can be collected without sacrificing fish. On the other hand, the maturity schedule method requires sex ratios of smolts, 1SW and 2SW salmon although sex ratios of smolts can be used if return rate estimates are not available (i.e. no smolt production estimates but estimates of returns of 1SW and 2SW salmon). Chaput et al. (2003) show that the precision of the estimates from the maturity schedule method is poor when sample size is small. The data requirement for abundance at age by sex of the maturity schedule model can not always be realized especially in small populations. Adult sex ratios are generally easier to obtain since these fish are exploited in fisheries, however in some cases, adults are not harvested in fisheries. The sex ratio of smolts is more difficult to obtain since in many research and assessment activities, sacrificing of fish may not be an option. However, hatchery stocking programs should at least attempt to confirm the sex ratio of the released smolts as this information could greatly enhance the exploration of trends in mortality at sea.

Assumptions of the methods

Both methods utilize return rates at a given age to estimate the mortality between the time periods. If there are no fisheries on these age groups, then the mortality rates equate to natural mortality. If there are fisheries on the age groups and the removals are accounted for in the abundance at 1SW or 2SW, then the mortality estimates also equate to natural mortality. In cases where unaccounted removals of fish occur prior to enumeration (for ex. exploitation in marine fisheries) and these removals are not accounted for, then the mortality estimates equate to the sum of fishing mortality and natural mortality. An analysis of changes in total mortality over time may provide an indication of the changes in exploitation if natural mortality is assumed to be constant over time.

Two assumptions are inherent in both methods:

1. Mortality in the first year at sea is similar for maturing 1SW and non-maturing 1SW salmon

2. Mortality is similar for male and female fish.

The inverse-weight method further assumes that the mortality at sea is determined primarily by weight (or size) and the integral over time can be calculated if the growth function over time is defined. The integrated mortality is then a continuous and montonically increasing function of time. The maturity schedule method does not describe any time function of mortality other at than the end points defined by the 1SW and 2SW stages.

Differences in results

In 2004, the Working Group showed that there were large differences in the mortality rates estimated using the inverse-weight method and the maturity schedule method, in some cases by as much as seven times (R. Scorff, Figure 2.3.1). The maturity schedule method estimates were always greater than those from the inverse-weight method although the latter estimates were less variable when estimated for comparable stocks and time periods (Figure 2.3.1). For de la Trinite River, the inverse weight method failed to characterize the apparent average decrease in mortality associated with the closure of coastal interceptory fisheries in the 1990s (Figure 2.3.2). Any changes in integrated mortality are apportioned between the two age groups relative to the growth function. The maturity schedule method is not constrained by such a function and mortality estimates have been observed to be much more variable. It was noted however that in several situations, the maturity schedule estimates were biologically unfeasible with survival values greater than one. This was considered to be the result of violations of the assumptions of the model.

The reviews of natural mortality were undertaken by the Working Group to verify if the value assumed in the run reconstruction models was appropriate. This resulted in the value of M being changed from 0.01 to 0.03 per month in the second year at sea. The analysis of series of return rate data from several rivers in both NEAC and NAC suggested that M could be higher than 0.03 in the last decade and in several stocks was increasing. However, there were no historical data prior to the mid 1980s which could be used to verify whether the mortality had changed from the 1970s and 1980s. There were also fewer data with which to correct estimates of abundance at age for exploitation in fisheries and as a result, total mortality rather than M would have been estimated. This may still be a factor in some data sets in both NAC and NEAC areas although the interceptory fisheries have been essentially closed in the NAC area. In any case, return rates to many stocks in the NAC and NEAC areas are lower now under reduced exploitation than in the 1970s and 1980s when fisheries were more intensive suggesting that natural mortality must have increased as fishing mortality rate declined.

The choice of the inverse weight derived value for M was also motivated by the concern that the high mortality values from the maturity schedule method would unlikely have applied to the 1970s and mid 1980s period of higher salmon abundance. The inability at this time to model a temporally varying M in the run-reconstruction models of PFA adds to the uncertainty in the description of the recruitment and spawning stock functions. Large changes in mortality could however be detected under models with constant M as appears to be the case for the North American PFA dynamic.

2.4 Significant developments towards the management of salmon

2.4.1 Application of a Bayesian hierarchical approach to setting Conservation Limits in Ireland

Up until 2001, the Irish salmon fishery was managed by a combination of effort limitation and the restrictions on the size and type of fishing gear. While these measures regulate the effort in the fishery, they are not sensitive to the stock available and may allow the same level of exploitation even when stocks are low. A Salmon Management Task Force established in Ireland in 1996 (Anon. 1996) recommended a new rationale for management of salmon stocks based on achieving "spawning escapement targets" for each specific stock and maintaining stocks above conservation limits (CLs). The Task Force proposed the application of a Total Allowable Catch (TAC) to allow sufficient fish to spawn to meet the CL.

In order to provide catch advice for the 17 individual fishery district fisheries in Ireland, it is necessary to calculate both the Pre-fishery abundance (PFA) and CLs. The ICES models used to estimate the PFA of salmon from countries in the NEAC area (Section 3.3) employ a run-reconstruction approach similar to that described by Potter and Dunkley (1993) and Rago *et al.* (1993). The main inputs required for these models are the catch of salmon, the unreported catch and the exploitation rate. Catch records from commercial salmon dealer's registers of each of the 17 salmon fishing districts are available for the period 1971 to 2000. Following the implementation of a salmon carcass tagging and logbook scheme in 2001 (Ó Maoiléidigh *et al.*. 2001, Anon 2004) the catch data derive from the logbook returns of commercial and recreational fishermen. Exploitation rates derive from coded wire tag returns for 9 stocks, while unreported catches are based on best local knowledge or information obtained during catch scanning for coded wire tags.

Following Potter *et al.* (1998) and the methodology for establishing National Conservation Limits (Section 3.3) , estimates of spawning stocks in each district are derived as model outputs from the information on catches, unreported catch and exploitation rate. The lagged egg estimates provide a measure of the relative spawning level which gave rise to the recruitment estimates expressed above as the PFA. These data can then be plotted to provide a “pseudo” stock recruitment (PSR) relationship and a number of reference points can be derived.

Bayesian Hierarchal Stock and Recruitment Analysis/Wetted Area

The analysis of stock and recruitment (SR) data is the most widely used approach for deriving Biological Reference Points (BRPs) for salmon populations (Prévost *et al.*. 2001). While the conservation limits generated from PSR models are derived from the stock and recruitment data for each district, they are "pseudo" because they relate to geographic entities (i.e. the number of fish returning to that district) rather than true biological stocks. They are further complicated by the mixed stock nature of these district fisheries. Ó Maoiléidigh *et al.* (1994) and Browne *et al.* (1994) have shown that over 50% of fish tagged from specific rivers may be caught in districts other than the district in which they migrated as smolts.

Prévost *et al.*. (2003) have applied Bayesian hierarchical modeling of stock-recruitment (SR) relationships to estimate BRPs for European Atlantic salmon stocks. The structure of the hierarchical SR model developed distinguishes two nested levels of randomness, within-river and between-rivers. The parameters of the Ricker function are assumed to be different between rivers, but drawn from a common probability distribution depending on two primary covariates i.e. river size and river latitude. The Bayesian analysis of this hierarchical model has been developed using a set of 13 stock and recruitment data series from monitored salmon rivers located in the North East Atlantic (Crozier *et al.*., 2003). The outputs of interest are the posterior predictive distributions of the SR parameters and their associated BRPs for new rivers with no SR data provided information is available on wetted area and latitude. Posterior distributions are estimated by means of MCMC sampling (Gibbs algorithm) as implemented by the Winbugs software. Details of the model specification and its Bayesian treatment are given in Prévost *et al*. (2003).

The latitude value used for each river in Ireland in the analysis is the river catchment area mid-point and the size is quantified as the riverine wetted area accessible to salmon. The wetted area is computed from statistically combined parameters, the length of upstream river, upstream catchment area, stream order and local channel gradient, captured by aerial photography and extracted within a GIS platform (McGinnity *et al.* 2003). Given this latitude and wetted area information, the approach described in Prévost *et al.* (2003) was used to estimate new District CLs, defined as the sum of river specific CLs for each of the fishery districts.

There are 173 salmon rivers in Ireland located between 51.6° and 55.3° North. They vary in size from 3,700 to 8,800,000 m² of riverine wetted area accessible to salmon (median 183, 000 m^2). There is wide overlap in the size of the Irish rivers and the size range of the 13 monitored rivers used by Prévost *et al*. (2003) i.e. 10% of the Irish rivers are smaller than the smallest monitored river but none are bigger the largest one. The Irish rivers are grouped into the 17 salmon fishing plus that part of the River Foyle within the Republic of Ireland. The number of rivers in each fishery district varies from 1 to 30.

Due to the lognormal structure of the hierarchical SR model used, the posterior predictive distributions and median CLs are best examined on a log-scale (Figure 2.4.1.1). The resulting posterior predictive distributions (approximately 0.5 to 20 eggs m^2) for the egg deposition rates of the fishery district CLs vary more widely than the national CL (approximately 3 -7 eggs m^2). This compares with the egg deposition rates for the training set used to generate the posterior predictions, which range from 0.1 to 100 eggs m^2 (Prevost *et al.,* 2003). The difference is due to the narrower latitudinal range in Ireland. There are large variations in the precision of the individual district posterior predictive CLs (e.g. in the Drogheda district the posterior predictive distribution ranges from approximately 0.5 eggs m^2 to 16 eggs m^2). In those districts where several rivers are aggregated together the CLs provided are more precise e.g. the Kerry districts ranging from approximately 2 eggs m^2 to 8 eggs m^2. The variance reduction effect gained from the aggregation of several rivers under a regional entity is more pronounced when the number of rivers increases. This explains why the CL egg deposition rate at the national level is more precisely estimated than that of any individual fishery district. The relative size of the rivers within a fishery region also has an effect on the precision of the estimates. The CL of the Lismore fishery district, which is made of seven rivers with one large river accounting for more than 75% of the wetted area accessible to salmon in the district, is estimated with a similar level of precision as the Drogheda fishery district, which comprises only one river.

The posterior predictive distributions of CLs generally encompass the point estimate CLs derived from the PSR approach previously used for providing catch advice in Ireland (Figure 2.4.1.1). However the PSR CLs are over dispersed compared to their corresponding posterior predictions using the BHSRA/Wetted area approach: only 5 out of 17 are located in the inter-quartile interval and 11 out of 17 are within the 75% probability interval. There is also a tendency of the PSR estimates to be greater than the estimates derived from BHSRA/Wetted area values approach. Indeed 10 of 17 of the PSR based CL estimates are located in the upper half of their corresponding posterior distribution, while 6 are situated within or very close to lower half of their posterior distribution. The only exception is the Dublin fishery district where the previous estimate based on the PSR model was significantly underestimated. The national CL derived from the PSR model results in a mean value of approximately 7 eggs m^2 and is located in the upper part of the posterior predictive distribution close to the 90th percentile. This compares to the BHSRA/Wetted Area median value of approximately 4 eggs m^2.

Despite the two different approaches used, the national CL based on the PFA/PSR approach (209,000 1SW salmon) is not greatly different from the equivalent value using the BHSRA/Wetted Area approach (198,000 1SW salmon - see Section 3, Table 3.3.3.1). This tends to support the contention that the PSR models are robust for National CL estimation as all spawning stocks are included.

Catch advice and TACs for Irish salmon fisheries are expressed in terms of numbers of adult 1SW salmon. Conservation limits in eggs/m^2 are converted to total egg requirement for each river by multiplying by the total wetted area accessible to salmon. Subsequently, the egg deposition values are converted to adults and subsequently corrected for 1 SW fish only. Multi-sea winter (MSW) salmon are not included in the catch advice, principally because they are not exposed to a significant commercial fishery, angling pressure has been reduced and these fish represent less than 10% of the total population.

The status of the 1SW district stocks relative to their attainment of BHSRA/Wetted Area CLs in 2003 is shown in Figure 2.4.1.2. Of the 17 fisheries districts in Ireland only 6 are shown to be meeting their conservation limits, 6 are over 50% of CL, while the remaining districts fall as low as 15 % of CL. The national 1SW stock is slightly above CL despite being below for 4 of the previous 7 years.

Ideally, river specific stock and recruitment analysis would be the most accurate way to determine river specific conservation limits. However, given that river specific stock and recruitment studies are resource-intensive and take a long time to cover several generations and a wide range of stock levels, the BHSRA/Wetted Area method represents the most feasible method of deriving individual river CLs for the foreseeable future (Prevost *et al*.. 2001). The derivation of CL probability distributions by the BHSRA/Wetted Area approach is an improvement to the point estimates of district CLs obtained from the PFA/PSR catch based models as it reduces the uncertainty associated with the mixed stock nature of the district fisheries. It also allows for a more in-depth appraisal of the underlying biology of the individual stocks in relation to the productive capacity of the river producing them. Furthermore, these river CLs can potentially be refined with more information on the physical characteristics of the catchments (compromised water quality, gradient etc) to a higher level of precision.

2.4.2 DNA-based analysis of the composition of the Foyle fishery in Northeast Ireland

Within a mixed stock fishery, the identification of the origin and composition of the exploited salmon is important for responsible management of the shared resource (NASCO, 2002).The application of genetic stock identification (GSI) procedures has allowed the evaluation of mixed stock in a variety of species for several decades, initially based on use of protein polymorphisms as genetic tags (Taggart and Ferguson, 1984; Seeb *et al*. 1986; Crozier and Moffett, 1995;

Koljonen & McKinnell, 1996), though recent work has predominantly used minisatellite and microsatellite DNA variation (Galvin *et al* 1995; Beacham *et al.* 1999; Beacham & Wood, 1999; Beacham *et al.* 2002). Conditional maximum likelihood estimates (CMLE), are based on the expectation maximization algorithm described by Fournier *et al.* (1984) and work by sequentially improving a computed "guess" until convergence at a maximum likelihood perceived to be the best estimate. A pseudo-Bayesian analytical procedure recently implemented by Pella and Masuda (2001) uses Bayesian likelihood functions to generate a prior probability density, based on the relative frequencies of the alleles present in both the baseline samples and in the stock mixture. The incorporation of Bayesian assignment methods on the stock mixture generates a posterior probability for the origin of the unknowns, which is then used to determine the most likely mixture estimate.

In the northern part of Ireland, Atlantic salmon populations in the cross-border Foyle and Carlingford catchments are under the management of the Loughs Agency (LA), which forms part of the Foyle, Carlingford and Irish Lights Commission (FCILC). On an Irish and European scale, the Foyle mixed stock fishery is significant, with declared catches in the commercial fishery fluctuating around 25,000-40,000 fish in recent years (source, Loughs Agency, Annual Reports). Fishing takes place during a 6 week period from 15th June to 31st July and is directed at 1SW fish. A management target system operates in the Foyle fishery area, whereby closures of the angling and/or commercial fisheries take place if target numbers of fish have not been counted upstream at three Foyle rivers by certain specified dates during the season. Conversely, if the seasonal management targets have been met by the normal end of the commercial netting season, an extension is granted. The fished stocks are believed to mainly originate from rivers in the Foyle catchment, but may include some fish from stocks in neighbouring rivers and districts. A study was therefore carried out applying these techniques to analyse the composition of the mixed stock fishery in the Foyle area in 2003.

This investigation was based on the analysis of the variability at six microsatellite loci: Ssa202, Ssa197, Ssa171 (O'Reilly *et al.* 1996), Ssa406UOS, Ssa405UOS (Cairney *et al.* 2000) and One9ASC (Scribner *et al.* 1996).

In order to provide a baseline of potentially contributing stocks, sampling of putative river populations was carried out between 1999 and 2001, by electrofishing for juvenile salmon in rivers and tributaries at 19 sites throughout the Foyle catchment and including two neighbouring coastal rivers to the East of the Foyle area. (Grillagh and R. Bush) (n=966). For three sites in the surveyed area, samples were obtained over multiple years and multiple year classes, to test for short-term temporal stability, a pre-requisite for mixture analysis. Allele frequencies at all loci were seen to vary in both sample and region, with significant spatial heterogeneity among the baseline population samples; both at the drainage and tributary level. Where among-sample geographical differences were non-significant, baseline samples were then grouped together (Pella and Milner, 1987), in order to increase baseline sample sizes; resulting in 14 final freshwater juvenile baseline samples. The three temporal sample groups were tested for levels of temporal stability based on allelic heterogeneity, with non-significant heterogeneity being present in all pairwise comparisons. These samples were therefore pooled for subsequent analysis.

During summer of 2003, 840 samples of commercially-caught adult salmon were taken at Greencastle, the major landing point for commercially-caught salmon in the Foyle area, comprising fish mainly from drift nets in the estuary and near-sea coastal areas. In addition to these samples, 185 migrating wild smolts were sampled using a screw trap from the River Finn in the Foyle system during a three-week period in May 2002. This sample was screened in order to verify the accuracy of the proportional estimates attained from the mixture analysis. GSI precision for both methods was determined by examining variation in the standard error in proportional composition due to sample size. This was estimated using a simulated mixture file composed of 50, 100, 250, 500, 1000, 2500 and 5000 individuals. These mixtures then had the standard error calculated for 1000 iterations and 1000 bootstraps for the 14 baseline groups.

The observed precision of the GSI estimate was seen to improve significantly when the simulated admixture sample size was approximately 200-400 individuals, with mean standard error approximately 10% that of an admixture of 5 individuals, implying that, using the baseline dataset here, minimum mixture samples sizes of the order of 300 individuals should allow adequate composition analysis.

The absolute and relative accuracy of the two GSI techniques were tested using the sample of wild smolts from the R. Finn as a known-origin independent sample, together with the freshwater baseline set. It can be seen from Figure 2.4.2.1 that the pseudo-Bayesian approach produces the most accurate estimate of River Finn fish (84±8%). CMLE, on the other hand, estimates that a mixture made up entirely of River Finn smolts, is composed of only 58±2% River Finn salmon with significant representation of other rivers in the Foyle system. From this it can be concluded that the pseudo-Bayesian approach should be more powerful in discerning the composition of the Foyle fishery.

Results of the analysis of the 2003 mixed stock fishery are shown in Figure 2.4.2.2, with CMLE and Bayesian analyses being shown separately and split into the first, second and last (two week) periods of the fishery. Comparison of the two techniques shows that both detect the R. Finn as the main river contributing stock to the fishery in 2003, however the

CMLE technique records R. Finn salmon in the catch at a lower level and proportionately allocates more of the remainder over the other rivers. Taking the Bayesian analysis as potentially more accurate, it appears that this fishery comprised mainly R. Finn fish from the western part of the Foyle system, while the Cappagh Burn was the strongest contributor from the eastern Foyle rivers. Several other rivers in the eastern Foyle contributed at relativity high levels (Cashel Bridge, Owenreagh and Quiggery). However, two of the larger rivers appeared not to be contributing significantly to the 2003 fishery (R. Roe and R. Derg). The R. Finn was represented in the baseline by samples from the main stem, together with samples from its Reelin, Elatagh and Cummirk trubutaries. Although the main stem and the Elatagh contributed to the fishery, salmon from the Reelin and Cummirk tributaries were virtually absent. It is noted that the Reelin tributary has significant multi-sea-winter spring salmon stocks, thus these would not be expected to be detected in the summer grilse fishery.

In both analyses, the two rivers from outside the Foyle management area that were included in the baseline (R. Grillagh and R. Bush, combined here as North Coast group) were also detected in the fishery, though at a relatively low level (<5%). Both analyses indicate strong temporal variation in the composition of the fishery during the 2003 season. Referring to the Bayesian method, it is clear that R. Finn salmon were present in the fishery at the start of the season and tailed off significantly towards the end. In contrast, Cappagh Burn fish were more strongly represented at the end of the season, as was the case with Cashel Bridge and R. Roe fish. The Owenreagh and Quiggery salmon appear to be present at higher levels during the middle two weeks of the season.

Ideally, some form of independent validation of the results should always be sought, such as physical tagging of individuals from known locations, to ground-truth one or more of the estimates of contributing stocks. The genetic analysis indicated presence at low level (<5%) of fish from the two north coastal rivers outside the Foyle area in the 2003 fishery (Fig. 2.4.2.2). This is corroborated by tagged R. Bush fish that have been recorded during CWT recovery programmes in this area (Crozier and Kennedy, 1994, with Bush fish comprising an estimated 1.9% of the 2003 Foyle catch.

The current study reports the first comprehensive genetic analysis of the proportional composition of one of the largest mixed stock fisheries in Europe. The methods used produced estimates of the stock composition that would appear to make intuitive sense when spawning distributions for this region are considered. The contribution of the Foyle rivers and tributaries to the fishery also probably reflects the non-homogenous structure of suitable Atlantic salmon habitat within the Foyle area. The patchy distribution leads to certain areas driving the majority of yield to this fishery, while other areas are under-producing salmon relative to their available habitat areas. The significant differences among river stocks in the composition of this fishery could also partly reflect stock differences in timing of spawning runs, which results in uneven representation of the contributing freshwater stocks. Although the sampling carried out here was stratified to cover the whole period of the fishery, differences within the season were very clear and could conceivably arise if certain stocks or stock components were passing through the fishery at different times, or being caught in differing locations.

Results of this type of analysis may enable managers to regulate the fishery to achieve conservation in stocks, to ensure fishery sustainability, and to identify where specific action is needed to restore production in vulnerable or under-producing stocks.

2.4.3 Examining the effects of fisheries on biological characteristics of Atlantic salmon stocks

Increased occurrence, abundance and return rate of repeat spawning salmon

Atlantic salmon returning to the Narraguagus, Penoboscot, Saint John, Nashwaak, Magaguadavic, LaHave, Miramichi, Aux Rochers, de La Trinite, and St. Jean rivers in the North American Commission Area (NAC) and the Teno, North Esk and some rivers of France in the Northern European Area Commission (NEAC) have been sampled during their entire spawning migrations intermittently or in some cases continuously since 1971. In many cases fisheries management have instigated closures of commercial and recreational fisheries and mandatory release of large salmon in recreational fisheries. In many cases the relative proportion and the absolute abundance of repeat spawning salmon in the returns of large salmon have increased (Table 2.4.3.1). The working Group noted that increases in the relative contribution to egg depositions by repeat spawning salmon can influence the resilience and spawning requirements of a river stock.

In the southern regions of the NAC , USA and outer Bay of Fundy, the average incidence of repeat spawning is lower i.e. 1.2% to 6% than more northerly rivers where repeat salmon comprised 4.4% to 10%. These rates are variable and in the case of the outer Bay of Fundy and Scotia Fundy areas have declined since the mid 1990s. Some of the lower repeat spawning salmon frequency may be attributed to downstream passage inefficiencies. In the Gulf of St. Lawrence including Quebec, the proportion of repeat spawning has continued to increase and has reached 20% of the return in the Miramichi River in 1997 and 1998.

Average repeat spawning was highest in the Lahave River at 10%, peaked in 1986 at 24% and has since declined. The decline in the LaHave River was attributed to a change in the frequency of consecutive spawning salmon first spawned as 1SW salmon and a decline in the frequency of alternate spawning 1SW salmon. Consecutive spawning salmon first spawning as 2SW salmon have been non existent since 1997 while alternate spawning 2SW salmon declined from 10% in 1985 to 0% in 1995 but have since increased to 6% in 2000.

In the Gulf of St. Lawrence, including rivers in Quebec, the proportions of repeat spawning salmon have increased from less than 5% in the 1970s to about 20% in 1998 to 2002. In the Miramichi River the repeat spawning component of those fish that first spawned at age 1SW increased, although repeat spawning salmon that first spawned at age 2SW are now a higher proportion. Since 1995, salmon on their sixth spawning migration have been observed and salmon on the third to fifth spawning return are more abundant since 1992. In the recent three years, salmon undertaking a seventh spawning have been observed. Return rates to a second spawning for 2SW salmon were highest during 1992 to 2000, ranging between 10% and 35%. The return rate to a second spawning of 1SW maiden salmon varied between 2% and 9%, substantially lower than for 2SW salmon. This is expected as there is differential in-river harvest on small salmon. The return rates of 1SW repeat spawning salmon have increased over the past five years with the greatest increase in the return rate of consecutive spawners. A similar increase in return rate of 2SW salmon returning as consecutive spawners was also noted.

In the NEAC area the proportions of repeat spawning salmon have increased in the Teno River since 2000 but have remained low (< 1%) and variable in the North Esk. In the Teno River the proportion of repeat spawning salmon has increased substantially since 2000 from 2 to 4% to 10-15% in 2003 (Figure 2.4.3.1). Most (c. 65%) of the repeat spawning salmon in the River Teno are alternate 1SW salmon. In the rivers of France the proportion of repeat spawning salmon is low and the proportion of repeat spawning salmon that first spawned after 2SW has declined.

In northern Europe two major fishery management measures were introduced over the past 15 years that may have influenced the salmon stocks of the River Teno. First, the drift net fishery off the northern Norwegian coast was banned in 1989, and second, gill nets with less than 58 mm mesh size (knot to knot) have been banned for salmon fishing in the River Teno since 1990. The ban on at-sea drift netting was shown to improve the 1-2SW returns in other northern European salmon stocks (Jensen et al. 1999). The ban on smaller mesh sized drift nets in the River Teno was especially designed to better protect grilse stocks and consequently, grilse returns increased from 1990 onwards (Fig. 2.4.3.1). As the mean smolt age of the grilse stocks of the Teno system is between four and five years, the generation time from adults to adults is typically seven or eight years. As the high grilse returns resulted in high proportions of alternate repeat spawners only from 1999 onwards, and the corresponding grilse returns in early 1990's did not increase, improved oceanic conditions in the Barents Sea (2000-2002 vs. 1992-1994) could be a cofactor in explaining the high proportions and survival of repeat spawning salmon since 2000 (Niemelä et al.).

The Working Group also noted incidences of other changes in biological characteristics that were most likely associated with reductions in fishing mortality. For example, the proportion of female 2SW salmon increased in the LaHave River immediately following the closures in the local and interceptory commercial salmon fisheries in 1985. Coincident with this increase in the proportion of female 2SW salmon was an increase in the average length of 2SW salmon. These increases resulted in an increase in the number of eggs per retuning fish. However, these gains were offset by reductions in the numbers of salmon surviving after 2SW.

Modeling the effect of repeat spawning frequency on population size and fishery reference points

The proportion of repeat spawners, equilibrium population size and population persistence can be influenced by selective fishing. Additionally, changes in natural mortality can affect fishery yields and reference points. The effect of changes in the repeat spawning component (post-spawning natural mortality) of the population on equilibrium population size and fishery reference points is illustrated using a dynamic model for a hypothetical population (similar to the salmon population in the LaHave River). Two scenarios are contrasted. The first scenario assumes that post-spawning adult annual survival is 50% and adults can spawn up to 6 times in their lives. The second scenario is that salmon do not repeat spawn (a post-spawning adult mortality of 99.9%). These scenarios are shown with the LaHave River spawner-recruit relationship (1974 to 1986) in Figure 2.4.3.2. For the dynamics analysed here, the eggs per recruit in the repeat spawning scenario are about 3 times those in the absence of repeat spawning (Table 2.4.3.2). As a result, the equilibrium population size in the absence of repeat spawning is 1/3 the size of that for the repeat spawning population. Fishery reference points differ between the scenarios (Table 2.4.3.2). The fishing mortality rate at MSY decreases with increased repeat spawning, whereas the egg deposition at MSY is higher in the repeat spawning scenario. In this analysis, a Beverton-Holt model was used to model density dependence. Different results may be obtained if a different dynamical model is assumed.

The above example illustrates the sensitivity of reference points to changes in the number and frequency of repeat spawning. Its relationship to stock assessment depends on how conservation limits are derived, and how stock status is assessed. The status of populations in monitored rivers in the USA and Canada is assessed by comparing the egg deposition from the estimated spawning escapement with the conservation limits (required number of eggs) established for each river. Repeat spawners are included when calculating the annual egg deposition, and as a result, changes in the number of repeat spawners are included in the assessment of whether conservation limits are being met in these rivers. Higher proportions of repeat spawning fish increase the probability that conservation limits will be met.

The Working Group concluded that repeat spawning, persistence and reference points can be influenced by selective fishing, environmental and ecological conditions. However, increases in some biological characteristics such as eggs per fish can be offset by coincidental decreases in the number of fish surviving to spawn. Impacts on management options depend on how conservation limits (CLs) are derived. If CLs are derived from egg deposition rates then fewer spawning salmon would be required. However, if based on stock and recruitment (S/R) and repeat spawners are included, CLs could be underestimated and more salmon would be required.

2.4.4 Static vs. dynamic models for forecasting salmon pre fishery abundance

When catch levels are to be set annually in order to maintain escapement above a pre-determined threshold, a forecast of abundance is needed prior to fishery opening. A simple approach for forecasting PFA before a fishery opens is to use a measure of abundance of the stock available at the time the catch advice is elaborated (e.g. smolt counts) and, combined with knowledge about survival to derive an estimate of PFA. The Working Group adopted a Bayesian approach to compare a static (i.e. time invariant) vs a dynamic model in a simple real-world case based on River Bush (UK, Northern Ireland) data. The static model is a standard regression type model, i.e. the parameters associated to predictors are assumed fixed over-time, whereas the more flexible dynamic modelling allows parameters to vary over time. For this example, smolt counts from the period 1985-1990, together with PFA (calculated from run-reconstruction treatment of catch and exploitation data) were used to “condition” the models, resulting in forecasts of PFA for years 1991-2003, which were then compared against observed values.

The Working Group examined an application-oriented approach for the comparison of these models in relation to their management advice objectives: cross-validation techniques were used to assess the quality of PFA forecasts. Given a major reduction in marine survival in this stock starting in 1987 and subsequently falling to 25% of previous values, the challenge was to quickly detect this change and reflect this accurately in the PFA forecasts. An example of the evaluation of the relative performance of these two model approaches is illustrated in Figure 2.4.4.1, where the likelihood of the observed PFA given the forecast was assessed. This likelihood is distributed from 0-0.5, with a uniform distribution centred on 0.25, expected when observed PFA equates to the median of the forecast distribution. Both models were unable to predict the severe drop in marine survival that occurred between 1996 and 1997, both considering the probability of observing the extreme low PFA values in 1997 and 1998 as low (<10%). However, the static model did not perform as well as the dynamic one in forecasting PFA for 1998, and produced a particularly poor forecast for 2000, when marine survival dropped further. The dynamic model captured the further drop in 2002 satisfactorily, indicating that it was better able to adapt to the non-stationary time trend in marine survival in this stock , though at a price in terms of precision of the forecast.

Dynamic modelling appears as a valuable option for salmon PFA forecast, which should be considered more systematically, especially at single river level, where reliable measures of cohort abundance may be available. This application may be best developed to produce pre-season catch forecasts, perhaps leading to catch quotas, which could then be modified in-season, in the light of real time information on performance of the stock.

2.5 Long-term projections for stock rebuilding

In 2003, the Working Group provided information on long term trajectories for stock rebuilding for specific stocks with different productive capacities and under different conditions of exploitation and starting stock size (relative to CL). The data and analysis indicate that there is an increased probability of not achieving S_{lim} in low productivity rivers when exploitation was increased. Under these conditions recovery was unobtainable in fifty-year projections in a low productivity river and possibly unobtainable in a moderate productivity river. The analysis suggests that increased caution needs to be taken when assigning exploitation to low productivity stocks. It also suggested that current management strategies for mixed stock fisheries are likely to fail to protect “the weakest link” i.e. those stocks that are far below their S_{lim} and of low productivity. Similarly, expected contributions to rebuilding from restocking programmes may also be confounded by prevailing low levels of marine survival, high or variable exploitation rates and even negative interactions between hatchery reared fish and their wild counterparts.

The Working Group therefore cautions that further simulations should also reflect declining stock trajectories and population viability given that the probability of rebuilding in the short term is low in most areas and that the main result of recent management measures may have been to reduce this rate of decline rather than lead to any significant stock rebuilding.

2.5.1 Impact of mixed stock fisheries on stocks with different productivities

The recovery trajectory analyses conducted by the Working Group last year were extended with the river specific exploitation rates replaced by a total catch applied to three rivers in a mixed stock fishery. The simulations examined the ability to catch fish from high productivity stocks while still rebuilding low productivity stocks in a mixed stock fishery. The potential for extirpation when catch levels are set too high was also investigated.

Parameters for Ricker stock and recruitment functions were obtained from SALMODEL (Crozier *et al*. 2003, Table 4.2) for the rivers representing low, medium, and high productivity, as measured by the ability to support exploitation. The parameters H_{opt} (exploitation at optimum spawning stock abundance) and R_{opt} (recruitment at optimum spawning stock) were used to obtain the Ricker parameters alpha (α)and beta (β) for the formula;

$$R = \alpha * S * Exp(-\beta * S)$$

Alpha was calculated according to the formula

$$\alpha = Exp(Hopt/(1-Hopt))$$

and Beta was calculated as;

$$\beta = Hopt/((1-Hopt)*Ropt)$$

Spawning stock at optimum recruitment (S_{opt}) was

$$Sopt = (1-Hopt)*Ropt$$

Projections were dependant on partial recruitment vectors particular to each of the three example rivers. The partial recruitment vector was the proportioned product of matrices consisting of rows for proportional smolt age, sea age at maturity and relative fecundity at sea age.

Obtaining recruits for 7 years (the longest period required to obtain complete recruitment) initialized projections at the selected starting stock size before accumulating recruits for any trajectory. Error in trajectories was introduced by selecting a new value of alpha and beta for each river and simulation from the posterior distribution and applying a lognormal deviate each year with a common variance (posterior distributions of the SR parameters were kindly provided by È. Prèvost). This selection process mimics the model used in the original analysis which generated the posteriors (Crozier et al. 2003). The reported stock recruitment scale was eggs*m^{-2}. Spawning egg densities were converted to adults through the use of the river specific riverine wetted area, eggs per adult, and weight per adult.

A total catch was applied jointly to all three rivers assuming complete mixing of the stocks so that catch occurred in proportion to abundance in each river. The adults remaining after catch were removed were converted back to egg densities so that the stock recruitment relationship could be applied.

Starting spawning stock sizes were 10% of S_{opt} and 50% of S_{opt}. Projections were run using catches of zero to 5000 kg in steps of 1000 kg. The expected optimum catch for the three rivers combined, if each was exploited optimally, was always set to 4584 kg. This is the catch which would be generated if each of these rivers was fished at the optimum rate when they were at their optimum population size. Forward simulations of 50 years were run 10,000 times in an @Risk© framework in Excel©. The output collected was the number of years in the projection that each river was below its conservation limit (S_{opt}) and whether or not the three rivers were extirpated. In these simulations, 50 years below CL was taken as analogous with extirpation. Median values of the number of years below the conservation limit provide a measure of the ability to rebuild the stock given a total mixed fishery catch level where the greater the number of years below Sopt, the less likely the stock is to rebuild. The probability of extirpation was computed as the fraction of simulations in which all three rivers were extirpated and in this simulation is a measure of overfishing given both the total catch level and the initial population sizes. A number of scenarios were examined which varied the size of the rivers and the stock recruitment relationships.

The number of years below the conservation limit was always greatest for the low productivity stock, meaning the low productivity stock had the lowest probability of rebuilding at any catch level (Figure 2.5.1.1). Conversely, the high productivity stock always had the highest probability of rebuilding, as measured by the lowest number of years below the conservation limit, although high total catches could overfish even this stock. The medium productivity stock showed the greatest change in number of years below the conservation limit as catch was increased when the initial population sizes were set to half of Sopt. This occurred even though the medium productivity river contained approximately 60% of the total riverine habitat of the three rivers combined. The medium productivity stock also had the largest confidence intervals generally (Table 2.5.1.1), demonstrating the sensitivity of medium productivity stocks to relatively small changes in total catch when the stocks occur in a mixed stock fishery. Increasing the total catch not only increased the number of years below the conservation limit, but could drive the stocks to extirpation, especially when the initial populations were low.

In this simulation, stock productivity was the most important factor in determining the ability of a stock to rebuild in a mixed stock fishery. Changing the riverine wetted area so that each river was equal size did not produce a large change in results. Similarly, using three rivers with the same stock productivity but different riverine wetted area also demonstrated the dependence of the results on stock productivity instead of river size.

2.5.2 A Dennis-type Population Viability Analysis of North American and Northeast Atlantic Commission Groups

A simple Dennis-type population viability analysis (PVA, Dennis *et al*., 1991) was applied to abundance estimates for the North America (NA) and Northeast Atlantic Commission (NEAC) stock complexes. This PVA utilizes past observations of changes in population size to predict future trends. The approach is equivalent to a stochastic Leslie matrix projection without density dependent terms and has been widely used on the west coast of the US to establish the viability of Pacific salmon with regard to the endangered species listings. The basic data required are a time series for a stage in the life cycle of the animal. For these analyses, the pre-fishery abundance, returns, and spawners were examined and results compared in an attempt to detect the changes due to reductions in fishing in the past.

This PVA assumes that the population at time t is related to the population at time t-1 as follows:

$N(t)=N(t-1)\exp(u+\varepsilon)$,

where ε is distributed normally with a mean of zero and a variance equal to σ^2.

Estimates of the population growth rate (u) are calculated from the average of $\ln[N(t)/N(t-1)]$ over the time series. The variance of this measure is an estimate of σ^2 and used for stochastic projections. A positive growth rate implies the population will grow without bound in the future while a negative growth rate implies the population will decline exponentially in the future. However, the stochastic projections take into account the variance of the growth rate to produce distributions of abundance in the future such that populations with negative growth rates (i.e. are in decline) have a chance of increasing and populations with positive growth rates (i.e. are increasing) may actually decrease. These projected distributions can be used to estimate the probability of population persistence over a given time period. The main assumption with these projections is that the rate of change in the population observed in the past will continue into the future i.e. that non-stationarity is not an issue.

The time series examined from both the NAC and NEAC areas showed both positive and negative growth rates, with large variances in general (Table 2.5.2.1). The pre-fishery abundance growth rates were negative for all five groups examined, with the largest declines seen in North America and the NEAC southern multi sea winter series. The spawner growth rates were only negative for the two southern NEAC groups and positive for the other groups examined. The returns for North America had a negative growth rate as a whole as well as for five of the six regions within North America. Growth rates for returns to the NEAC area were all negative and followed the same patterns as seen in the PFA and spawners.

These difficulties in population growth rate by life stage can be explained by the reduction in fisheries during the time period used to estimate the growth rates. Since PFA is estimated prior to in-river, coastal, and the West Greenland fisheries, it has the largest observed decline due to the large catches that occurred early in the time series. The spawners are estimated after all the fisheries have occurred and so represent escapement. Since constant escapement is the desired management objective, the reduction in catches have been offset by other reductions in population productivity so that there is virtually no discernible trend in the spawner time series. The North America returns are estimated after the coastal and West Greenland fisheries but before the in-river fisheries and thus have a growth rate intermediate to the PFA and spawners growth rates. In North America nearly all the fisheries have been closed in recent years. In spite of these fishery closures, the populations have continued to decline at a similar rate as observed previously. Thus, a change in productivity must have occurred which offset the reduction in fishing mortality. Other sources of potential change in productivity such as hatchery supplementation and changes in freshwater survival due to water quality, passage, habitat modifications, etc. could increase or decrease the population growth rate. In this regard, non-stationarity is not considered to be an issue as there were no indications of changes in the population growth rate over the historic time period examined for any of the life stages or groups.

Projections were conducted using these mean growth rates, associated variances, and initial population sizes (Table 2.5.2.1). As management strategies have affected each of the abundance indices in different ways, the stock projection simulations should be considered independently and comparing the outputs of PFA, spawners and returns after each period may not be appropriate. Projections are affected by all three factors with larger negative growth rates, larger variance, and lower initial population size all increasing the probability of the population being below a given number of fish in the future. Despite this, the projected median population sizes for 12 years (approximately 3 generation) and 25 years (approximately 6 generations) suggests a significant decline in PFA in North America which have the largest negative growth rates and smallest current population sizes. Although the relative decline is smaller, there is a also decline in the PFA for Northern NEAC 1SW and MSW stocks, but an increase in the spawners. Declines in both PFA and spawners are indicated for southern NEAC stocks. Examination of the projected returns to individual areas in North America suggests declines in each stock complex although the relative size of these declines varies. Despite the large variances observed in all stock complexes and the large amount of heterogeneity among rivers within each group longer term forecasts suggest that some stocks, particularly individual rivers stocks, could face extirpation within 50 years.

2.6 Distribution, behaviour and migration of salmon

Historically, information on the migration phase of Atlantic salmon has been sparse, partially because the majority of this phase occurs in the marine environment, which has been difficult to study. Recent developments in tag type/techniques and fish capture techniques have vastly improved our ability to investigate salmon behaviour in the sea. These developments will allow researchers to further investigate the distribution, behaviour and migration of Atlantic salmon at sea.

A number of different “tags” are available (external tags (Carlin, Lea, Floy, etc.), visible implant tags, coded wire tags (CWT), passive integrated transponder (PIT) tags, sonic tags, data storage tags (DST), genetic tags, physiological tags (otolith marking, trace elements in bones and otoliths, fatty acids, etc.)) for investigating the migrational patterns of Atlantic salmon. Researchers have begun to use these techniques to investigate the distribution, behaviour and migration of Atlantic salmon.

Three areas of recent study have been: 1) the behaviour of escaped farmed salmon, 2) smolt/post-smolt emigration/migration and 3) post-smolt/adult marine behaviour.

Farmed salmon are taken in large numbers in Norwegian coastal commercial salmon fisheries (about 12% of total nominal catch in 2003). Tagging experiments have shown that farmed salmon from Norway have historically been caught in the Faroes’ fisheries (Hansen et al. 1987). Farmed fish have been captured at much lower frequencies in fisheries in UK Scotland, Ireland and UK Northern Ireland, despite the presence of extensive salmon farm production in these regions (ICES CM 2001/ACFM:15). This may be due to differences in the locations of salmon farms in relation to the salmon rivers and fisheries or it may be due to different dispersal patterns of the farmed fish after they escape. Regardless, farm escapees are caught in ocean fisheries, and should they mature while in the ocean they may move to freshwater to spawn (e.g. Hansen et al. 1987; Gausen & Moen 1991; Webb and Youngson, 1992; Youngson et al. 1997; Crozier 1998; Carr et al. 1998; Whoriskey & Carr 2001). This raises concerns as interbreeding between wild and cultured salmon can cause fitness reduction and potential extinction of wild stocks (McGinnity et al. 2003).

In the north east Atlantic, both smolt tagging experiments and post-smolt surveys have strongly indicated that ocean currents are the vectors that displace fish northwards (Holm et al. 2000). Results from experimental releases of large salmon from two farms on the south and mid-Norwegian coast also suggested that ocean movements of the farmed salmon may be controlled by prevailing currents (ICES CM 2001/ACFM:15; Hansen 2002) as well. Given this, the following hypothesis has been proposed: Farmed salmon escaping from cages in different countries are displaced with the currents, and any fish that become sexually mature when they are relatively close to the coast enter local fisheries and rivers. The significance of this is that escaped farmed salmon may spread into fisheries and rivers far away from where they escaped (Hansen 2002).

2.6.1 Sonic tracking of escaped farmed salmon in Maine (USA)

The Working Group reviewed preliminary results from an ultrasonic tracking study involving experimentally “escaped” farmed salmon from a sea-cage site in Maine. The study objectives are to document the dispersal and survival patterns of the escapees, and to help identify the most appropriate mitigation measures for future escape events in the region. Fish from the first release in January 2004 seemingly acted independently from each other and dispersed rapidly away from the farm site, out to the Bay of Fundy. Powerful tidal currents in this region affected fish movements. A second release is planned for spring 2004 and local rivers will be monitored to determine if any of these fish enter them to spawn in autumn 2004.

In addition, the Working Group noted that a proposed study to tag farmed salmon in various countries of the NEAC area, release them, and trace their movements from fishery recaptures, will be difficult to implement in the near future due to public concern over the impacts of farmed salmon upon wild populations.

2.6.2 Smolt migration/emmigration tracking studies

The Working Group reviewed preliminary results from two ultrasonic tracking studies involving emigrating smolts. The two studies used ultrasonic telemetry to document the movements of wild and hatchery smolts from the Miramichi (Canada) and Dennys (USA) Rivers respectively, through freshwater and out to sea. Survival from release to the head of tide was high (>90%) even though a subset of the Miramichi River released smolts travelled as far as 140 km during this transition. However in both studies, a major loss occurred in the estuary. These results are preliminary, but suggest that both hatchery and wild origin smolts from these two different river systems, which are spatially distant from each other, maybe experiencing similar influences affecting survival during their marine transition. The reasons for this are not clear and further investigations are planned for 2004.

The Working Group fully endorsed these types of telemetry studies and acknowledged their role in attempting to partition marine survival into discrete phases. The Working Group made a number of suggestions regarding data verification and analysis. In particular, information related to receiver unit detection efficiency should be presented with the results from any tracking study. These data can only be obtained through rigorous testing of field deployed units, but will greatly strengthen the conclusions made from any telemetry study. Without measures of detection efficiencies, survival estimates resulting from telemetry investigation should be considered minimum values. In general, the Working Group encourages these studies, which are likely to further contribute to our understanding of some key aspects of wild salmon biology.

2.6.3 Data Storage Tags (DST) tagging of pre-adult salmon

Within the framework of a Nordic DST tagging program started in 2002, a new salmon trawl design and “Fish-lifter” (after Holst & McDonald 2000) was developed for the live capture of fish in post-smolt and mackerel investigations in the Norwegian Sea. This allows most of the salmon to be taken with little or no external damage, making the catch fit for tagging and release.

In 2002, a total 76 post-smolts and adults captured within the Norwegian Sea (Figure 2.6.3.1) were tagged with DST tags. The DSTs were designed to record temperature and/or depth for two years. All tags contained a contact address and reward announcement. To date, only 1 DST tag has been return from that effort. The tag was returned 18 days after release from the bag net fishery in the Namsenfjord, Norway- a distance of ~ 480 km (Figure 2.6.3.1). The low return rate from this study is not unexpected as heavy scale loss was recorded on the fish prior to tagging.

The Working Group also reviewed preliminary results from a new tagging effort conducted within the Nordic Council of Ministers’ project "Distribution of salmon in relation to environmental parameters and origin in the North Atlantic" (NM 13.04.07). The tagging survey was conducted during October 2003, also within the Norwegian Sea (Figure 2.6.3.2). Salmon caught suitable for tagging were fitted with either a DST archival tag (temperature and depth) or an iButton archival tag (temperature only). These tags were inserted internally and a HallPrint spaghetti tag and adipose clip were applied as a secondary external mark. In total 116 salmon were tagged, 95 with DST tags and 21 with iButton tags. Most of the salmon were in their first winter at sea with a mean length of 40 cm (35-45 cm), but 4 larger 2SW salmon (60-68 cm) were also caught. Tag returns are expected in 2004.

It is anticipated that data generated from returned DSTs will provide new information on the marine phase of Atlantic salmon including temperature regimes in the salmon habitats during the first and possibly the second winter and temperature preferences at different times of the year. These recorded temperatures may then be relatable to individual growth trajectories. Vertical distribution in relation to temperature, diurnal vertical distribution and migration may also be detected. For the management of salmon, the vertical distributions and temperature/growth relationships will be particularly valuable for assessing the potential of salmon being intercepted by pelagic fisheries and for building predictive models.

2.7 Compilation of Tag Releases and Finclip Data by ICES Member Countries in 2003

Data on releases of tagged, fin-clipped, and otherwise marked salmon in 2003 were provided by the Working Group and are compiled as a separate report. In summary (see Table 2.7.1), about 3.9 million salmon were marked in 2003, a decrease from the 4.1 million fish marked in 2002. Primary marks are summarized in three classes: microtags (i.e., coded wire tag), external tags/marks, and adipose clips (without other external marks or fin clips). Secondary marks, primarily adipose clips on fish with coded wire tags, are also presented in the separate report. The adipose clip was the most used primary mark (2.7 million), with microtags (0.67 million) the next most common primary mark. Most marks were applied to hatchery-origin juveniles (3.8 million), while 69,124 wild juveniles and 17,905 adults were marked.

The Working Group has begun reporting information on the use of data storage tags (DST's) and sonic tags (also known as pingers). In 2003, 116 DST's were applied in the Faroes (see section 2.6.3), and 263 and 250 sonic tags for studies in Canada and the USA, respectively (see section 2.6.1 and 2.6.2 for information on some of this work). These recent technologies provide valuable and previously unobtainable information on salmon movements and the environmental conditions they are experiencing, and their use is expected to grow in the future.

In 2003, the Working Group began recording information on marks being applied to farmed salmon. These may help trace the origin of farmed salmon captured in the wild in the case of escape events. At this time, two jurisdictions (USA-Maine, and Iceland) require that some or all of the sea-cage farmed fish reared in their area be marked. In Maine, some firms have opted for a genetic "marking" procedure. The broodstock of these firms has been screened with molecular genetic techniques, which makes it feasible to trace an escaped farmed salmon back to its hatchery of origin through analysis of its DNA. One company has applied a left ventral fin clip, but has not reported numbers for reasons of commercial confidentiality. In Iceland, coded wire tags are being applied to about 10% of sea-cage farm production. The Icelandic data are included in the separate report mentioned above.

Table 2.1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-2003. (2003 figures include provisional data).

	NAC Area			NEAC (N. Area)							NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
Year	Canada (1)	USA	St. P&M (12)	Norway (2)	Russia (3)	Iceland Wild	Iceland Ranch	Sweden (West)	Den.	Finland	Ireland (4,5)	UK (E & W)	UK (N.Irl.) (5,6)	UK (Scotl.)	France	Spain (7)	Faroes (8)	East Grld.	West Grld. (9)	Other (10)	Reported Nominal Catch	NASCO Areas	International waters (11)
1960	1636	1	-	1659	1100	100		40	-	-	743	283	139	1443	-	33	-	-	60	-	7237	-	-
1961	1583	1	-	1533	790	127		27	-	-	707	232	132	1185	-	20	-	-	127	-	6464	-	-
1962	1719	1	-	1935	710	125		45	-	-	1459	318	356	1738	-	23	-	-	244	-	8673	-	-
1963	1861	1	-	1786	480	145		23	-	-	1458	325	306	1725	-	28	-	-	466	-	8604	-	-
1964	2069	1	-	2147	590	135		36	-	-	1617	307	377	1907	-	34	-	-	1539	-	10759	-	-
1965	2116	1	-	2000	590	133		40	-	-	1457	320	281	1593	-	42	-	-	861	-	9434	-	-
1966	2369	1	-	1791	570	104	2	36	-	-	1238	387	287	1595	-	42	-	-	1370	-	9792	-	-
1967	2863	1	-	1980	883	144	2	25	-	-	1463	420	449	2117	-	43	-	-	1601	-	11991	-	-
1968	2111	1	-	1514	827	161	1	20	-	-	1413	282	312	1578	-	38	5	-	1127	403	9793	-	-
1969	2202	1	-	1383	360	131	2	22	-	-	1730	377	267	1955	-	54	7	-	2210	893	11594	-	-
1970	2323	1	-	1171	448	182	13	20	-	-	1787	527	297	1392	-	45	12	-	2146	922	11286	-	-
1971	1992	1	-	1207	417	196	8	18	-	-	1639	426	234	1421	-	16	-	-	2689	471	10735	-	-
1972	1759	1	-	1578	462	245	5	18	-	32	1804	442	210	1727	34	40	9	-	2113	486	10965	-	-
1973	2434	2.7	-	1726	772	148	8	23	-	50	1930	450	182	2006	12	24	28	-	2341	533	12670	-	-
1974	2539	0.9	-	1633	709	215	10	32	-	76	2128	383	184	1628	13	16	20	-	1917	373	11877	-	-
1975	2485	1.7	-	1537	811	145	21	26	-	76	2216	447	164	1621	25	27	28	-	2030	475	12136	-	-
1976	2506	0.8	2.5	1530	542	216	9	20	-	66	1561	208	113	1019	9	21	40	<1	1175	289	9327	-	-
1977	2545	2.4	-	1488	497	123	7	10	-	59	1372	345	110	1160	19	19	40	6	1420	192	9414	-	-
1978	1545	4.1	-	1050	476	285	6	10	-	37	1230	349	148	1323	20	32	37	8	984	138	7682	-	-
1979	1287	2.5	-	1831	455	219	6	12	-	26	1097	261	99	1076	10	29	119	<0,5	1395	193	8118	-	-
1980	2680	5.5	-	1830	664	241	8	17	-	34	947	360	122	1134	30	47	536	<0,5	1194	277	10127	-	-
1981	2437	6	-	1656	463	147	16	26	-	44	685	493	101	1233	20	25	1025	<0,5	1264	313	9954	-	-
1982	1798	6.4	-	1348	364	130	17	25	-	54	993	286	132	1092	20	10	606	<0,5	1077	437	8395	-	-
1983	1424	1.3	3	1550	507	166	32	28	-	58	1656	429	187	1221	16	23	678	<0,5	310	466	8755	-	-
1984	1112	2.2	3	1623	593	139	20	40	-	46	829	345	78	1013	25	18	628	<0,5	297	101	6912	-	-
1985	1133	2.1	3	1561	659	162	55	45	-	49	1595	361	98	913	22	13	566	7	864	-	8108	-	-
1986	1559	1.9	2.5	1598	608	232	59	54	-	37	1730	430	109	1271	28	27	530	19	960	-	9255	315	-
1987	1784	1.2	2	1385	564	181	40	47	-	49	1239	302	56	922	27	18	576	<0,5	966	-	8159	2788	-
1988	1310	0.9	2	1076	420	217	180	40	-	36	1874	395	114	882	32	18	243	4	893	-	7737	3248	-
1989	1139	1.7	2	905	364	141	136	29	-	52	1079	296	142	895	14	7	364	-	337	-	5904	2277	-
1990	911	2.4	1.9	930	313	146	280	33	13	60	567	338	94	624	15	7	315	-	274	-	4924	1890	180-350

Table 2.1.1.1 continued

Year	NAC Area			NEAC (N. Area)							NEAC (S. Area)						Faroes & Greenland				Total	Unreported catches	
								Sweden				UK	UK	UK				East	West		Reported		
	Canada	USA	St. P&M	Norway	Russia	Iceland		(West)	Den.	Finland	Ireland	(E & W)	(N.Irl.)	(Scotl.)	France	Spain	Faroes	Grld.	Grld.	Other	Nominal	NASCO	International
	(1)		(12)	(2)	(3)	Wild	Ranch				(4,5)		(5,6)			(7)	(8)		(9)	(10)	Catch	Areas	waters (11)
1991	711	0.8	1.2	876	215	130	345	38	3.3	70	404	200	55	462	13	11	95	4	472	-	4106	1682	25-100
1992	522	0.7	2.3	867	167	175	461	49	10	77	630	171	91	600	20	11	23	5	237	-	4119	1962	25-100
1993	373	0.6	2.9	923	139	160	496	56	9	70	541	248	83	547	16	8	23	-	-	-	3696	1644	25-100
1994	355	0	3.4	996	141	141	308	44	6	49	804	324	91	649	18	10	6	-	-	-	3945	1276	25-100
1995	260	0	0.8	839	128	150	298	37	3.1	48	790	295	83	588	9	9	5	2	83	-	3628	1060	-
1996	292	0	1.6	787	131	122	239	33	1.7	44	685	183	77	427	14	7	-	0.1	92	-	3136	1123	-
1997	229	0	1.5	630	111	106	50	19	1.3	45	570	142	93	296	8	3	-	1	58	-	2364	827	-
1998	157	0	2.3	740	131	130	34	15	1.3	48	624	123	78	283	9	4	6	0	11	-	2397	1210	-
1999	152	0	2.3	811	103	120	26	16	0.5	62	515	150	53	199	11	6	0	0.4	19	-	2246	1032	-
2000	153	0	2.3	1176	124	83	2	33	5.2	95	621	219	78	274	11	7	8	0	21	-	2913	1269	-
2001	148	0	2.2	1267	114	88	0	33	6.4	126	730	184	53	251	11	13	0	0	43	-	3069	1180	-
2002	148	0	3.6	1019	118	97	0	28	5.3	93	682	161	64	191	12	9	0	0	9	-	2640	1039	-
2003	137	0	-	1071	107	108	0	18	3.6	76	575	88	48	201	14	6	0	0	9	-	2461	847	-
Average																							
1998-2002	152	0	3	1003	118	104	12	25	4	85	634	167	65	240	11	8	2	0	21	-	2653	1146	-
1993-2002	227	0	2	919	124	120	145	31	4	68	656	203	75	371	12	8	6	0	42	-	3003	1166	-

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 1994, includes increased reporting of rod catches.
5. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
6. Not including angling catch (mainly 1SW).
7. Weights estimated from mean weight of fish caught in Asturias (80-90% of Spanish catch).
8. 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 in 2001, 2002 or 2003.
9. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
10. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.
11. Estimates refer to season ending in given year.
12. No data available for 2003.

Table 2.1.1.2 Nominal catch of SALMON in homewaters by country (in tonnes round fresh weight), 1960-2003. (2003 figures include provisional data).
S = Salmon (2SW or MSW fish). G = Grilse (1SW fish). Sm = small. Lg = large; for definitions, see Section 4.1. T = S + G or Lg + Sm

	NAC Area				NEAC (N. Area)												NEAC (S. Area)										
								Russia	Iceland		Sweden					Ireland			UK	UK(N.I.)					Spain	
Year	Canada (1)			USA	Norway (2)			(3)	Wild	Ranch	(West)	Denmark	Finland			(4,5)			(E&W)	(4,6)	UK(Scotland)			France	(7)	Total
	Lg	Sm	T	T	S	G	T	T	T	T	T	T	S	G	T	S	G	T	T	T	S	G	T	T	T	T
1960	-	-	1,636	1	-	-	1,659	1,100	100	-	40	-	-	-	-	-	-	743	283	139	971	472	1,443	-	33	7,177
1961	-	-	1,583	1	-	-	1,533	790	127	-	27	-	-	-	-	-	-	707	232	132	811	374	1,185	-	20	6,337
1962	-	-	1,719	1	-	-	1,935	710	125	-	45	-	-	-	-	-	-	1,459	318	356	1,014	724	1,738	-	23	8,429
1963	-	-	1,861	1	-	-	1,786	480	145	-	23	-	-	-	-	-	-	1,458	325	306	1,308	417	1,725	-	28	8,138
1964	-	-	2,069	1	-	-	2,147	590	135	-	36	-	-	-	-	-	-	1,617	307	377	1,210	697	1,907	-	34	9,220
1965	-	-	2,116	1	-	-	2,000	590	133	-	40	-	-	-	-	-	-	1,457	320	281	1,043	550	1,593	-	42	8,573
1966	-	-	2,369	1	-	-	1,791	570	104	2	36	-	-	-	-	-	-	1,238	387	287	1,049	546	1,595	-	42	8,422
1967	-	-	2,863	1	-	-	1,980	883	144	2	25	-	-	-	-	-	-	1,463	420	449	1,233	884	2,117	-	43	10,390
1968	-	-	2,111	1	-	-	1,514	827	161	1	20	-	-	-	-	-	-	1,413	282	312	1,021	557	1,578	-	38	8,258
1969	-	-	2,202	1	801	582	1,383	360	131	2	22	-	-	-	-	-	-	1,730	377	267	997	958	1,955	-	54	8,484
1970	1,562	761	2,323	1	815	356	1,171	448	182	13	20	-	-	-	-	-	-	1,787	527	297	775	617	1,392	-	45	8,206
1971	1,482	510	1,992	1	771	436	1,207	417	196	8	18	-	-	-	-	-	-	1,639	426	234	719	702	1,421	-	16	7,575
1972	1,201	558	1,759	1	1,064	514	1,578	462	245	5	18	-	-	-	32	200	1,604	1,804	442	210	1,013	714	1,727	34	40	8,357
1973	1,651	783	2,434	3	1,220	506	1,726	772	148	8	23	-	-	-	50	244	1,686	1,930	450	182	1,158	848	2,006	12	24	9,768
1974	1,589	950	2,539	1	1,149	484	1,633	709	215	10	32	-	-	-	76	170	1,958	2,128	383	184	912	716	1,628	13	16	9,567
1975	1,573	912	2,485	2	1,038	499	1,537	811	145	21	26	-	-	-	76	274	1,942	2,216	447	164	1,007	614	1,621	25	27	9,603
1976	1,721	785	2,506	1	1,063	467	1,530	542	216	9	20	-	-	-	66	109	1,452	1,561	208	113	522	497	1,019	9	21	7,821
1977	1,883	662	2,545	2	1,018	470	1,488	497	123	7	10	-	-	-	59	145	1,227	1,372	345	110	639	521	1,160	19	19	7,756
1978	1,225	320	1,545	4	668	382	1,050	476	285	6	10	-	-	-	37	147	1,082	1,229	349	148	781	542	1,323	20	32	6,514
1979	705	582	1,287	3	1,150	681	1,831	455	219	6	12	-	-	-	26	105	922	1,027	261	99	598	478	1,076	10	29	6,341
1980	1,763	917	2,680	6	1,352	478	1,830	664	241	8	17	-	-	-	34	202	745	947	360	122	851	283	1,134	30	47	8,120
1981	1,619	818	2,437	6	1,189	467	1,656	463	147	16	26	-	-	-	44	164	521	685	493	101	844	389	1,233	20	25	7,352
1982	1,082	716	1,798	6	985	363	1,348	364	130	17	25	-	49	5	54	63	930	993	286	132	596	496	1,092	20	10	6,275
1983	911	513	1,424	1	957	593	1,550	507	166	32	28	-	51	7	58	150	1,506	1,656	429	187	672	549	1,221	16	23	7,298
1984	645	467	1,112	2	995	628	1,623	593	139	20	40	-	37	9	46	101	728	829	345	78	504	509	1,013	25	18	5,883
1985	540	593	1,133	2	923	638	1,561	659	162	55	45	-	38	11	49	100	1,495	1,595	361	98	514	399	913	22	13	6,668
1986	779	780	1,559	2	1,042	556	1,598	608	232	59	54	-	25	12	37	136	1,594	1,730	430	109	745	526	1,271	28	27	7,744
1987	951	833	1,784	1	894	491	1,385	564	181	40	47	-	34	15	49	127	1,112	1,239	302	56	503	419	922	27	18	6,615
1988	633	677	1,310	1	656	420	1,076	420	217	180	40	-	27	9	36	141	1,733	1,874	395	114	501	381	882	32	18	6,595
1989	590	549	1,139	2	469	436	905	364	141	136	29	-	33	19	52	132	947	1,079	296	142	464	431	895	14	7	5,201
1990	486	425	911	2	545	385	930	313	146	280	33	13	41	19	60	-	-	567	338	94	423	201	624	15	7	4,333
1991	370	341	711	1	535	342	876	215	130	345	38	3	53	17	70	-	-	404	200	55	285	177	462	13	11	3,534
1992	323	199	522	1	566	301	867	167	175	461	49	10	49	28	77	-	-	630	171	91	361	238	599	20	11	3,851
1993	214	159	373	1	611	312	923	139	160	496	56	9	53	17	70	-	-	541	248	83	320	227	547	16	8	3,670
1994	216	139	355	0	581	415	996	141	141	308	44	6	38	11	49	-	-	804	324	91	400	248	648	18	10	3,935
1995	153	107	260	0	590	249	839	128	150	298	37	3	37	11	48	-	-	790	295	83	364	224	588	9	9	3,537
1996	154	138	292	0	571	215	787	131	122	239	33	2	24	20	44	-	-	685	183	77	267	160	427	14	7	3,043
1997	126	103	229	0	389	241	630	111	106	50	19	1	30	15	45	-	-	570	142	93	182	114	296	8	3	2,303
1998	70	87	157	0	445	296	740	131	130	34	15	1	29	19	48	-	-	624	123	78	162	121	283	9	4	2,377
1999	64	88	152	0	493	318	811	103	120	26	16	1	29	33	62	-	-	515	150	53	142	57	199	11	6	2,225
2000	58	95	153	0	673	504	1,176	124	83	2	33	5	56	39	95	-	-	621	219	78	160	114	274	11	7	2,881
2001	61	86	148	0	850	417	1,267	114	88	0	33	6	105	21	126	-	-	730	184	53	150	101	251	11	13	3,024
2002	49	99	148	0	770	249	1,019	118	97	0	28	5	81	12	93	-	-	682	161	64	118	73	191	12	9	2,627
2003	60	77	137	0	708	363	1,071	107	108	0	18	4	61	15	76	-	-	575	88	48	127	74	201	14	6	2,452
Average																										
1998-2002	60	91	152	0	646	357	1003	118	104	12	25	4	60	25	85	-	-	634	167	65	146	93	240	11	8	2,627
1993-2002	117	110	227	0	597	322	919	124	120	145	31	4	48	20	68	-	-	656	203	75	227	144	370	12	8	2,962

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Before 1966, sea trout and sea charr included (5% of total).
3. Figures from 1991 to 2000 do not include catches of the recently developed recreational (rod) fishery.
4. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
5. From 1994, includes increased reporting of rod catches.
6. Not including angling catch (mainly 1SW).
7. Weights estimated from mean weight of fish caught in Asturias (80-90% of Spanish catch).

Table 2.1.1.3 The catch (tonnes round fresh weight) and % of the nominal catch by country taken in coastal, estuarine and riverine fisheries.

		Coast		Estuary		River		Total
Country	Year	Weight	%	Weight	%	Weight	%	Weight
Canada	1999	7	5	38	25	105	70	150
	2000	11	7	22	15	117	78	150
	2001	13	9	20	14	112	77	145
	2002	12	8	21	14	114	77	148
	2003	17	12	24	18	96	70	137
Finland	1995	0	0	0	0	48	100	48
	1996	0	0	0	0	44	100	44
	1997	0	0	0	0	45	100	45
	1998	0	0	0	0	48	100	48
	1999	0	0	0	0	62	100	62
	2000	0	0	0	0	95	100	95
	2001	0	0	0	0	126	100	126
	2002	0	0	0	0	93	100	93
	2003	0	0	0	0	76	100	76
France[1]	1995	-	-	2	20	8	80	10
	1996	-	-	4	31	9	69	13
	1997	-	-	3	38	5	63	8
	1998	1	13	2	25	5	63	8
	1999	0	0	4	35	7	65	11
	2000	0	4	4	35	7	61	11
	2001	0	4	5	44	6	53	11
	2002	1	5	6	48	6	47	12
	2003	-	-	-	-	-	-	14
Iceland	1995	20	13	0	0	130	87	150
	1996	11	9	0	0	111	91	122
	1997	0	0	0	0	106	100	106
	1998	0	0	0	0	130	100	130
	1999	0	0	0	0	120	100	120
	2000	0	0	0	0	83	100	83
	2001	0	0	0	0	88	100	88
	2002	0	0	0	0	97	100	97
	2003	0	0	0	0	108	100	108
Ireland	1995	566	72	140	18	84	11	790
	1996	440	64	134	20	110	16	684
	1997	380	67	100	18	91	16	571
	1998	433	69	92	15	99	16	624
	1999	335	65	83	16	97	19	515
	2000	440	71	79	13	102	16	621
	2001	551	75	109	15	70	10	730
	2002	514	75	89	13	79	12	682
	2003	403	70	92	16	79	14	574
Norway	1995	515	61	0	0	325	39	840
	1996	520	66	0	0	267	34	787
	1997	394	63	0	0	235	37	629
	1998	410	55	0	0	331	45	741
	1999	483	60	0	0	327	40	810
	2000	619	53	0	0	557	47	1176
	2001	696	55	0	0	570	45	1266
	2002	596	58	0	0	423	42	1019
	2003	597	56	0	0	474	44	1071
Russia	1995	43	33	9	7	77	60	128
	1996	64	49	21	16	46	35	131
	1997	63	57	17	15	32	28	111
	1998	55	42	2	2	74	56	131
	1999	48	47	2	2	52	51	102
	2000	64	52	15	12	45	36	124
	2001	70	74	0	0	24	26	95
	2002	62	64	0	0	35	36	96
	2003	58	71	0	0	24	29	81

Table 2.1.1.3 continued

Country	Year	Coast Weight	Coast %	Estuary Weight	Estuary %	River Weight	River %	Total Weight
Spain	1995	0	0	0	0	9	100	9
	1996	0	0	0	0	7	100	7
	1997	0	0	0	0	4	100	4
	1998	0	0	0	0	4	100	4
	1999	0	0	0	0	6	100	6
	2000	0	0	0	0	7	100	7
	2001	0	0	0	0	13	100	13
	2002	0	0	0	0	9	100	9
	2003	0	0	0	0	6	100	6
Sweden [4]	1995	24	65	0	0	13	35	37
	1996	19	58	0	0	14	42	33
	1997	10	56	0	0	8	44	18
	1998	5	33	0	0	10	67	15
	1999	5	31	0	0	11	69	16
	2000	10	30	0	0	23	70	33
	2001	9	27	0	0	24	73	33
	2002	7	25	0	0	21	75	28
	2003	4	23	0	0	14	77	18
UK	1995	200	68	45	15	49	17	295
England & Wales	1996	83	45	42	23	58	31	183
	1997	81	57	27	19	35	24	142
	1998	65	53	19	16	38	31	123
	1999	101	67	23	15	26	17	150
	2000	157	72	25	12	37	17	219
	2001	129	70	24	13	31	17	184
	2002	108	67	24	15	29	18	161
	2003	42	48	27	30	20	22	88
UK	1999	44	83	9	17	-	-	53
N. Ireland [2]	2000	63	82	14	18	-	-	77
	2001	41	77	12	23	-	-	53
	2002	48	74	17	26	-	-	64
	2003	28	58	20	42	-	-	48
UK	1995	201	34	105	18	282	48	588
Scotland	1996	129	30	80	19	218	51	427
	1997	79	27	33	11	184	62	296
	1998	60	21	28	10	195	69	283
	1999	35	18	23	11	141	71	199
	2000	76	28	41	15	157	57	274
	2001	77	30	22	9	153	61	251
	2002	55	29	20	10	116	61	191
	2003	83	41	32	16	86	43	201
Totals								
North East Atlantic [3]	2003	1214	53	171	8	887	39	2272
North America	2003	17	12	24	18	96	70	137

[1] An illegal net fishery operated from 1995 to 1998, catch unknown in the first 3 years but thought to be increasing. Fishery ceased in 1999. 2001/2 catches from the illegal coastal net fishery in Lower Normandy are unknown.

[2] No nominal catch data is collected for river (rod) fisheries in UK (NI).

[3] Data not available from Denmark & France.

[4] Estuarine catch included in coastal catch.

Table 2.1.2.1 Numbers of fish caught and released in rod fisheries along with the % of the total rod catch (released + retained) for countries in the North Atlantic where records are available, 1991-2003. Figures for 2003 are provisional.

Year	Canada		Iceland		Russia		UK (E&W)		UK (Scotland)		USA	
	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch
1991	28,497	33			3,211	51					239	50
1992	46,450	34			10,120	73					407	67
1993	53,849	41			11,246	82	1,448	10			507	77
1994	61,830	39			12,056	83	3,227	13	6,595	8	249	95
1995	47,679	36			11,904	84	3,189	20	12,133	14	370	100
1996	52,166	33	669	2	10,745	73	3,428	20	10,409	15	542	100
1997	57,251	49	1,558	5	14,823	87	3,132	24	10,906	18	333	100
1998	62,938	53	2,826	7	12,776	81	5,365	31	13,455	18	273	100
1999	55,335	50	3,055	10	11,450	77	5,447	44	14,839	28	211	100
2000	64,482	55	2,918	11	12,914	74	7,470	42	21,068	32	0	-
2001	59,387	55	3,607	12	16,945	76	6,143	43	27,699	38	0	-
2002	50,924	52	5,985	18	25,248	80	7,658	50	24,042	42	0	-
2003	51,442	56	5,357	16	33,862	81	5,981	55	30,156	55	0	-

Table 2.1.3.1 Estimates of unreported catches by various methods in tonnes within national EEZs in the North-East Atlantic, North American and West Greenland Commissions of NASCO, 1987-2003.

Year	North-East Atlantic	North-America	West Greenland	Total
1987	2,554	234	-	2,788
1988	3,087	161	-	3,248
1989	2,103	174	-	2,277
1990	1,779	111	-	1,890
1991	1,555	127	-	1,682
1992	1,825	137	-	1,962
1993	1,471	161	< 12	1,644
1994	1,157	107	< 12	1,276
1995	942	98	20	1,060
1996	947	156	20	1,123
1997	732	90	5	827
1998	1,108	91	11	1,210
1999	887	133	12.5	1,032
2000	1,135	124	10	1,269
2001	1,089	81	10	1,180
2002	946	83	10	1,039
2003	719	118	10	847
Mean 1998-2002	1,033	102	11	1,146

Table 2.1.3.2. Estimates of unreported catches by various methods in tonnes by country within national EEZs in the North-East Atlantic, North American and West Greenland Commissions of NASCO, 2003.

2003 Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Denmark	3	0.1	45
NEAC	Finland	19	0.5	20
NEAC	Iceland	2.2	0.1	2
NEAC	Ireland	58	1.6	9
NEAC	Norway	459	12.5	30
NEAC	Russia	125	3.4	54
NEAC	Sweden	4	0.1	18
NEAC	UK (E & W)	24	0.7	21
NEAC	UK (N.Ireland)	0.3	0.01	1
NEAC	UK (Scotland)	25	0.7	11
NAC	Canada	118	3.2	46
NAC	USA	0	0.0	0
WGC	West Greenland	10	0.3	53
	Total Unreported Catch	847	25.6	
	Total Reported Catch of North Atlantic salmon	2461		

Note: No unreported catch estimate for France, Spain & St. Pierre et Miquelon

Table 2.2.1.1 Production of farmed salmon in the North Atlantic area and in areas other than the North Atlantic (in tonnes round fresh weight), 1980-2003.

Year	North Atlantic Area										Outside the North Atlantic Area							World-wide
	Norway	UK (Scot.)	Faroes	Canada	Ireland	USA	Iceland	UK (N.Ire.)	Russia	Total	Chile	West Coast USA	West Coast Canada	Australia	Turkey	Other	Total	Total
1980	4,153	598	0	11	21	0	0	0	0	4,783	0	0	0	0	0	0	0	4,783
1981	8,422	1,133	0	21	35	0	0	0	0	9,611	0	0	0	0	0	0	0	9,611
1982	10,266	2,152	70	38	100	0	0	0	0	12,626	0	0	0	0	0	0	0	12,626
1983	17,000	2,536	110	69	257	0	0	0	0	19,972	0	0	0	0	0	0	0	19,972
1984	22,300	3,912	120	227	385	0	0	0	0	26,944	0	0	0	0	0	0	0	26,944
1985	28,655	6,921	470	359	700	0	91	0	0	37,196	0	0	0	0	0	0	0	37,196
1986	45,675	10,337	1,370	672	1,215	0	123	0	0	59,392	0	0	0	20	0	0	0	59,392
1987	47,417	12,721	3,530	1,334	2,232	365	490	0	0	68,089	3	0	0	50	0	0	53	68,142
1988	80,371	17,951	3,300	3,542	4,700	455	1,053	0	0	111,372	174	0	0	250	0	0	424	111,796
1989	124,000	28,553	8,000	5,865	5,063	905	1,480	0	0	173,866	1,864	1,100	1,000	400	0	700	5,064	178,930
1990	165,000	32,351	13,000	7,810	5,983	2,086	2,800	<100	5	229,035	9,500	700	1,700	1,700	0	800	14,400	243,435
1991	155,000	40,593	15,000	9,395	9,483	4,560	2,680	100	0	236,811	14,991	2,000	3,500	2,700	0	1,400	24,591	261,402
1992	140,000	36,101	17,000	10,380	9,231	5,850	2,100	200	0	220,862	23,769	4,900	6,600	2,500	0	400	38,169	259,031
1993	170,000	48,691	16,000	11,115	12,366	6,755	2,348	<100	0	267,275	29,248	4,200	12,000	4,500	1,000	400	51,348	318,623
1994	204,686	64,066	14,789	12,441	11,616	6,130	2,588	<100	0	316,316	34,077	5,000	16,100	5,000	1,000	800	61,977	378,293
1995	261,522	70,060	9,000	12,550	11,811	10,020	2,880	259	0	378,102	41,093	5,000	16,000	6,000	1,000	0	69,093	447,195
1996	297,557	83,121	18,600	17,715	14,025	10,010	2,772	338	0	444,138	69,960	5,200	17,000	7,500	1,000	600	101,260	545,398
1997	332,581	99,197	22,205	19,354	14,025	12,140	2,554	225	0	502,281	87,700	6,000	28,751	9,000	1,000	900	133,351	635,632
1998	361,879	110,784	20,362	16,418	14,860	13,166	2,686	114	0	540,269	125,000	3,000	42,300	7,068	1,000	400	178,768	719,037
1999	425,154	126,686	37,000	23,370	18,000	12,194	2,900	234	0	645,538	150,000	5,000	38,800	9,195	0	500	203,495	849,033
2000	440,861	128,959	32,000	29,095	17,648	16,400	2,600	250	0	667,813	176,000	5,670	39,300	10,906	0	500	232,376	900,189
2001	436,103	138,519	46,014	37,606	23,312	13,230	2,645	250	0	697,679	200,000	5,443	58,000	11,500	0	500	275,443	973,122
2002	462,495	145,609	45,150	42,131	22,294	6,810	1,471	250	0	726,210	273,000	5,000	72,800	11,000	0	1,000	362,800	1,089,010
2003	462,495	176,596	52,526	43,450	16,500	6,435	3,500	250	0	761,752	261,000	4,000	73,000	11,000	0	1,000	350,000	1,111,752
Mean 1998-2002	425,298	130,111	36,105	29,724	19,223	12,360	2,460	220	0	655,502	184,800	4,823	50,240	9,934	200	580	250,576	906,078
% change on 1998-2002	+9	+36	+45	+46	-14	-48	+42	+14	0	+16	+41	-17	+45	+11	-	+72	+40	+23

Notes:
Data for 2003 are provisional for many countries.
Where production figures were not available for 2003, values for 2002 were used (Norway & UK (N.Ireland)).
West Coast USA = Washington State.
West Coast Canada = British Columbia.
Australia = Tasmania.
Source of production figures for non-Atlantic areas: miscellaneous fishing publications & Government reports.
'Other' includes South Korea & China.

Table 2.3.1. Data requirements for the inverse-weight mortality model and the maturity schedule model. The common letters above the variable fields indicate the variables required to calculate mortality for each model. The maturity schedule can estimate mortality in the second year at sea if only sex ratio of smolts is known but mortality in the first year at sea can not be estimated.

Inverse-weight	A		A		A	A		A		A	A		A		A
Maturity schedule	B	B				B	B				B	B			
Maturity schedule		C				C	C				C	C			
	wild smolts					1SW returns in year + 1					2SW returns in year + 2				
Smolt cohort year	number	prop. female	mean wt (kg)	mean date to sea	days at large	return	prop. female	mean wt (kg)	mean date to sea	days at large	return	prop. female	mean wt (kg)	mean date to sea	days at large
						River					River				
1997	6331	0.687	0.025	Mid May	0	516	0.676	1.9	Mid July	420	7	0.71	3.99	End of April	720
1998	9588	0.562	0.023	Mid May	0	508	0.580	1.9	Mid July	420	6	1.00	3.99	End of April	720
1999	7118	0.620	0.027	Mid May	0	574	0.559	2.1	Mid July	420	4	0.75	3.99	End of April	720
2000	6400	0.593	0.030	Mid May	0	574	0.630	1.8	Mid July	420	1	1.00	3.99	End of April	720
2001	8600	0.637	0.041	Mid May	0	649	0.506	1.9	Mid July	420	12	0.67	3.99	End of April	720
2002	8423	0.586	0.029	Mid May	0	547	0.515	1.9	Mid July	420		0			720

Table 2.4.3.1 Percentage of repeat spawning salmon in the total returns to ten rivers in NAC and two rivers in NEAC areas.

Year	Penobscot	Narraguagus	Saint John	Naswaak	Magagudavic	LaHave	Miramichi	Rochers	Trinité	St. Jean	Teno	North Esk
1971							2.3%					
1972				3.1%			1.3%					
1973				13.0%			0.7%				3.6%	
1974				6.5%			2.6%				0.0%	
1975						0.0%	3.7%				3.3%	
1976						0.0%	2.2%				3.7%	
1977						0.0%	4.0%				2.5%	
1978	1.2%		4.8%			16.3%	6.6%				4.2%	
1979	2.4%		6.8%			1.5%	3.7%				2.1%	
1980	1.4%		5.9%			5.8%	2.3%				3.0%	
1981	2.6%		3.6%			9.9%	5.3%				1.3%	0.8%
1982	0.4%		9.9%			14.0%	5.1%				2.2%	0.9%
1983	0.8%		3.7%			19.8%	7.8%				3.1%	0.3%
1984	3.0%		2.8%			13.8%	3.5%		4.8%	4.0%	4.0%	0.4%
1985	0.4%		1.6%			12.5%	3.0%		4.0%	2.0%	3.6%	0.2%
1986	0.3%		5.0%			24.1%	3.0%		3.3%	7.9%	2.4%	0.6%
1987	5.2%		7.0%			16.2%	3.5%		3.6%	5.7%	1.3%	0.7%
1988	2.3%		2.7%			13.7%	2.7%		3.0%	5.6%	2.0%	0.9%
1989	1.4%		2.7%			11.9%	6.3%		4.6%	3.5%	1.8%	0.4%
1990	0.7%		3.6%			14.9%	9.5%		5.5%	7.4%	2.4%	0.7%
1991	1.4%		4.5%			16.4%	12.9%	1.2%	3.7%	4.0%	2.1%	0.4%
1992	0.4%	14.9%	1.1%		3.4%	5.3%	6.1%	1.9%	4.1%	3.5%	1.7%	0.6%
1993	1.0%	8.9%	1.9%	9.0%	4.2%	7.8%	7.8%	5.6%	4.8%	3.7%	2.9%	0.6%
1994	1.1%	6.9%	4.4%	7.4%	2.3%	17.4%	5.7%	7.5%	6.3%	5.5%	5.9%	0.6%
1995	0.8%	7.8%	2.3%	1.5%	1.3%	5.3%	6.0%	5.1%	4.9%	2.0%	4.8%	0.6%
1996	0.9%	8.9%	3.2%	5.8%	1.4%	9.0%	11.5%	6.2%	5.0%	5.2%	2.4%	0.2%
1997	1.1%	7.8%	7.1%	8.3%	1.7%	10.6%	20.4%	8.0%	20.6%	5.5%	2.8%	0.3%
1998	1.2%	10.8%	15.1%	7.1%	0.0%	8.6%	20.7%	6.7%	5.9%	3.0%	3.3%	0.4%
1999	2.1%	13.6%	1.8%	8.5%	0.0%	6.7%	19.5%	6.2%	5.4%	4.3%	2.3%	0.4%
2000	3.2%	3.1%	3.2%	5.2%	0.0%	6.6%	14.2%	10.1%	7.2%	3.3%	3.6%	0.5%
2001	0.4%	4.3%	1.9%	6.5%	0.0%	5.8%	14.1%	16.0%	17.4%	5.5%	9.0%	0.8%
2002	2.2%	3.1%	4.5%	6.7%	0.0%	12.3%	8.0%	21.6%	11.5%	7.4%	14.0%	0.8%
2003	0.4%	12.5%	2.6%	2.6%	0.0%	4.6%	13.2%	12.1%	4.6%	0.0%	15.0%	0.3%
Means	1.5%	8.6%	4.4%	6.5%	1.2%	10.0%	7.3%	8.3%	6.5%	4.4%	3.7%	0.5%

Table 2.4.3.2. Equilibrium population sizes at MSY and for an unfished population, and F_{msy} for a hypothetical salmon population (similar to the LaHave River, Nova Scotia) under 2 assumptions about repeat spawning. In scenario 1, a post-spawning annual mortality rate of 50% is assumed up to a maximum of 6 spawnings. In scenario 2, salmon spawn once and then die.

	Scenario	
Parameter	1. repeat spawning	2. semelparous
equilibrium (no fishing)	24 million eggs	8.3 million eggs
equilibrium (fishing at MSY)	5.3 million eggs	2.3 million eggs
F_{msy}	0.78	0.96
eggs per recruit no fishing	3,247 eggs	1,216 eggs

Table 2.5.1.1. Median and 80% confidence interval for the number of years below conservation limit for the three rivers with different productivity, six levels of catch in the mixed stock fishery, and two levels of initial population abundance (S_{init}) at 10% and 50%).

		S_{init} = 10% S_{opt}		S_{init} = 50% S_{opt}	
SR Productivity	Catch	Median	80% CI	Median	80% CI
Low	0	45	(17 , 50)	36	(9 , 50)
	1000	50	(29 , 50)	46	(16 , 50)
	2000	50	(44 , 50)	50	(26 , 50)
	3000	50	(50 , 50)	50	(38 , 50)
	4000	50	(50 , 50)	50	(47 , 50)
	5000	50	(50 , 50)	50	(49 , 50)
Medium	0	26	(12 , 50)	18	(6 , 43)
	1000	35	(14 , 50)	23	(8 , 50)
	2000	48	(16 , 50)	32	(11 , 50)
	3000	50	(17 , 50)	40	(14 , 50)
	4000	50	(19 , 50)	47	(16 , 50)
	5000	50	(21 , 50)	50	(18 , 50)
High	0	7	(3 , 14)	7	(0 , 14)
	1000	9	(4 , 16)	6	(0 , 15)
	2000	14	(6 , 50)	7	(0 , 16)
	3000	42	(8 , 50)	10	(0 , 30)
	4000	50	(10 , 50)	14	(1 , 41)
	5000	50	(12 , 50)	22	(3 , 45)

Table 2.5.2.1. Mean and variance of population growth rates for three life stages examined for North America and Northeast Atlantic Commission groups. Also shown are the range of initial population sizes used in projections (minimum, maximum, and midpoint) and the median number of fish projected 12 and 25 years into the future for each group

		Population	**Growth Rates**	**Initial Population Sizes**[1]			**Median No. Fish**	
Life Stage	Stock Complex	Mean	Variance	Min	Max	Midpoint	Year 12	Year 25
PFA	North America	-8.7%	0.090	54,615	111,372	82,994	28,631	9,351
PFA	NEAC North 1SW	-1.2%	0.038	643,937	810,018	726,977	626,602	541,306
PFA	NEAC North MSW	-1.0%	0.029	837,210	1,043,488	940,349	828,117	729,083
PFA	NEAC South 1SW	-2.8%	0.069	944,469	1,343,715	1,144,092	810,557	557,967
PFA	NEAC South MSW	-5.1%	0.047	466,833	627,045	546,939	295,088	152,749
Spawners	North America	1.3%	0.144	46,895	91,483	69,189	79,656	91,452
Spawners	NEAC North 1SW	1.4%	0.036	211,255	326,869	269,062	315,918	374,660
Spawners	NEAC North MSW	3.4%	0.037	174,033	273,577	223,805	334,064	527,200
Spawners	NEAC South 1SW	-1.3%	0.090	398,093	693,480	545,786	463,621	397,852
Spawners	NEAC South MSW	-2.0%	0.058	206,253	309,195	257,724	201,276	156,987
Returns	Labrador	-2.0%	0.204	8,133	9,691	8,912	6,884	5,397
Returns	Newfoundland	0.2%	0.218	2,054	10,078	6,066	5,841	6,044
Returns	Quebec	-2.1%	0.060	18,700	26,108	22,404	17,395	12,907
Returns	Gulf	-3.7%	0.295	6,950	17,042	11,996	7,323	4,573
Returns	Scotia-Fundy	-6.6%	0.198	1,399	2,141	1,770	809	335
Returns	USA	-0.8%	0.265	511	511	511	464	423
Returns	Whole NA	-2.7%	0.096	37,747	65,571	51,659	36,980	25,955

[1] Projections begin in 2001 for PFA and Spawners and begin in 2002 for Returns

Table 2.7.1. Summary of Atlantic Salmon Tagged and Marked in 2003. 'Hatchery' and 'Wild' refer to smolts or parr; 'Adult' refers to wild and hatchery fish. Data from France were not available. Fish were not tagged in Finland or Denmark. PIT tags were not included.

		Primary Tag or Mark			
Country	Origin	Microtag	External mark	Adipose clip	Total
Canada	Hatchery	0	31,048	2,014,223	2,045,271
	Wild	651	29,167	0	29,818
	Adult	0	6,388	0	6,388
	Total	651	66,603	2,014,223	2,081,477
	NB: Wild/Microtag fish had secondary adipose clip				
Iceland	Hatchery	239,879	290	0	240,169
	Wild	4,364	0	0	4,364
	Adult	0	608	0	608
	Total	244,243	898	0	245,141
Ireland	Hatchery	310,323	0	0	310,323
	Wild	8,063	0	0	8,063
	Adult	0	0	0	0
	Total	318,386	0	0	318,386
Norway	Hatchery	0	47,934	0	47,934
	Wild	0	2,887	0	2,887
	Adult	0	680	0	680
	Total	0	51,501	0	51,501
Russia	Hatchery	0	0	287,200	287,200
	Wild	0	0	0	0
	Adult	0	2,218	0	2,218
	Total	0	2,218	287,200	289,418
Spain	Hatchery	10,676	0	231,703	242,379
	Wild	0	0	0	0
	Adult	0	0	0	0
	Total	10,676	0	231,703	242,379
Sweden	Hatchery	0	4,000	20,580	24,580
	Wild	0	447	0	447
	Adult	0	0	0	0
	Total	0	4,447	20,580	25,027
UK (England & Wales)	Hatchery	59,840	17,920	50,750	128,510
	Wild	6,239	0	1,595	7,834
	Adult	0	2,185	0	2,185
	Total	66,079	20,105	52,345	138,529
UK (N. Ireland)	Hatchery	17,526	0	3,472	20,998
	Wild	2,507	0	0	2,507
	Adult	0	0	0	0
	Total	20,033	0	3,472	23,505
UK (Scotland)	Hatchery	7,500	0	0	7,500
	Wild	5,013	3,296	2,184	10,493
	Adult	0	737	0	737
	Total	12,513	4,033	2,184	18,730
USA	Hatchery	0	356,737	138,329	495,066
	Wild	0	2,301	410	2,711
	Adult	0	1,466	3,623	5,089
	Total	0	360,504	142,362	502,866
All Countries	Hatchery	645,744	457,929	2,746,257	3,849,930
	Wild	26,837	38,098	4,189	69,124
	Adult	0	14,282	3,623	17,905
	Total	672,581	510,309	2,754,069	3,936,959

Figure 2.1.1.1 Nominal catches of salmon in four North Atlantic regions, 1960-2003

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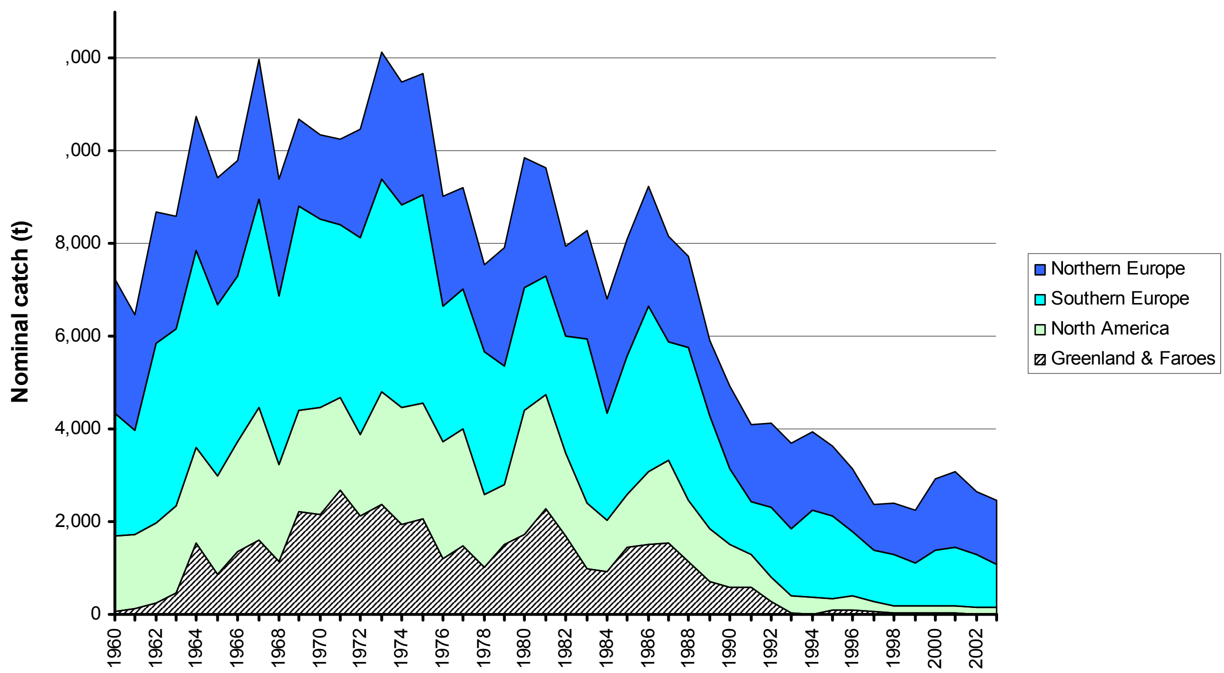


Figure 2.1.1.2. Percentage of nominal catch taken in coastal, estuarine and riverine fisheries by country for 1995-2003 (where available).

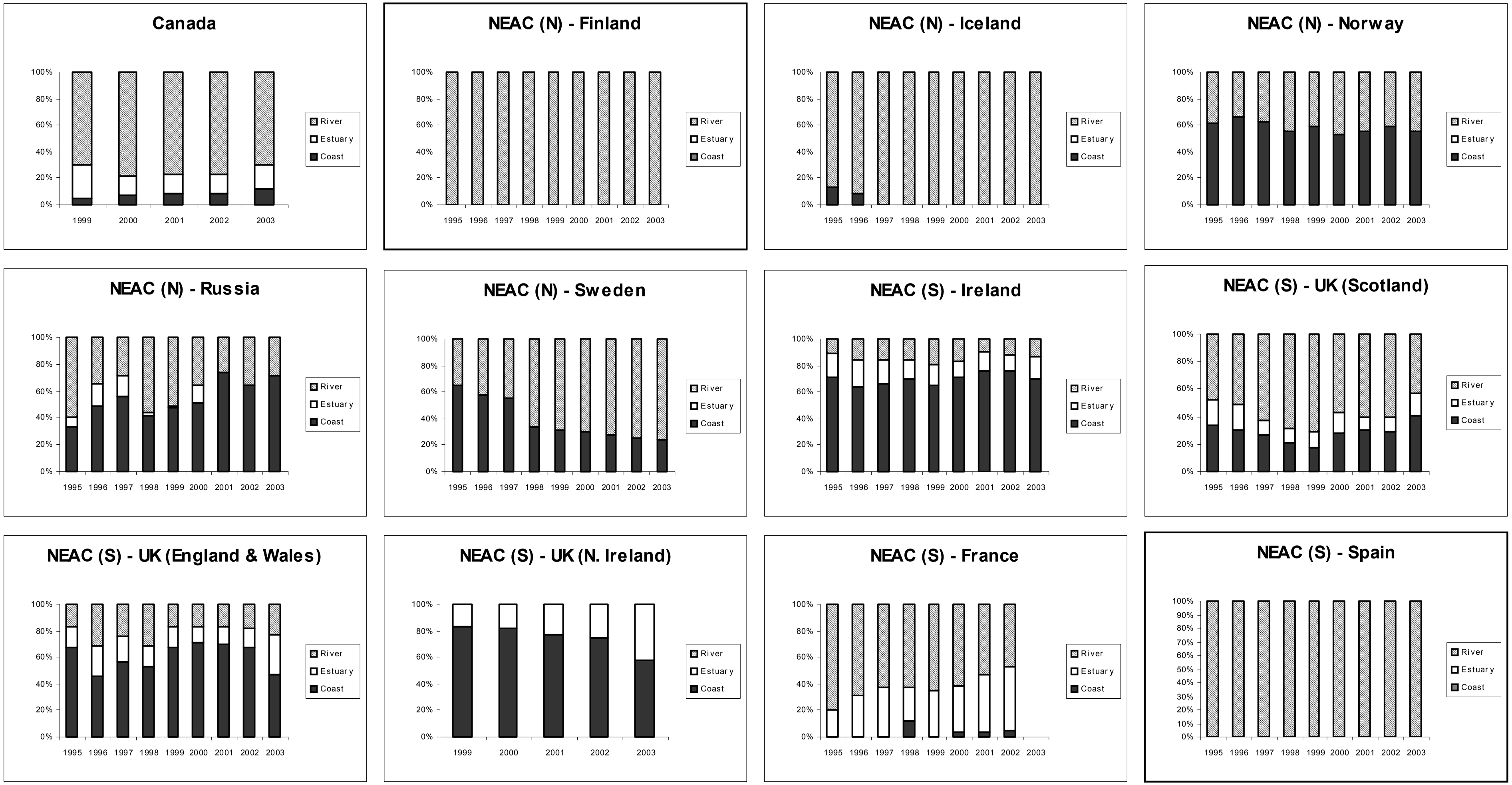


Figure 2.1.1.3 Percentages of nominal catch taken in coastal, estuarine and riverine fisheries for the NAC area (1999-2003) and for NEAC northern and southen areas (1995-2003).

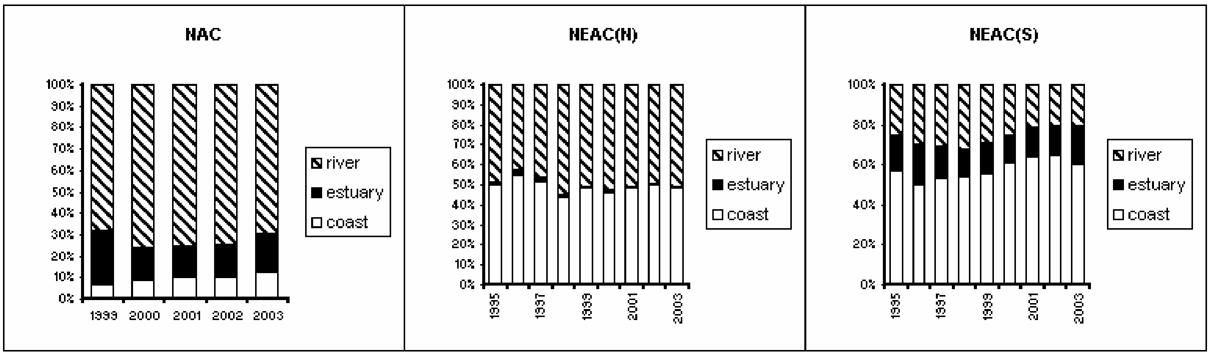


Figure 2.1.3.1 Nominal North Atlantic salmon catch, unreported catch and percentage unreported, expressed as % of total catch (nominal + unreported), in NASCO Areas, 1987-2003.

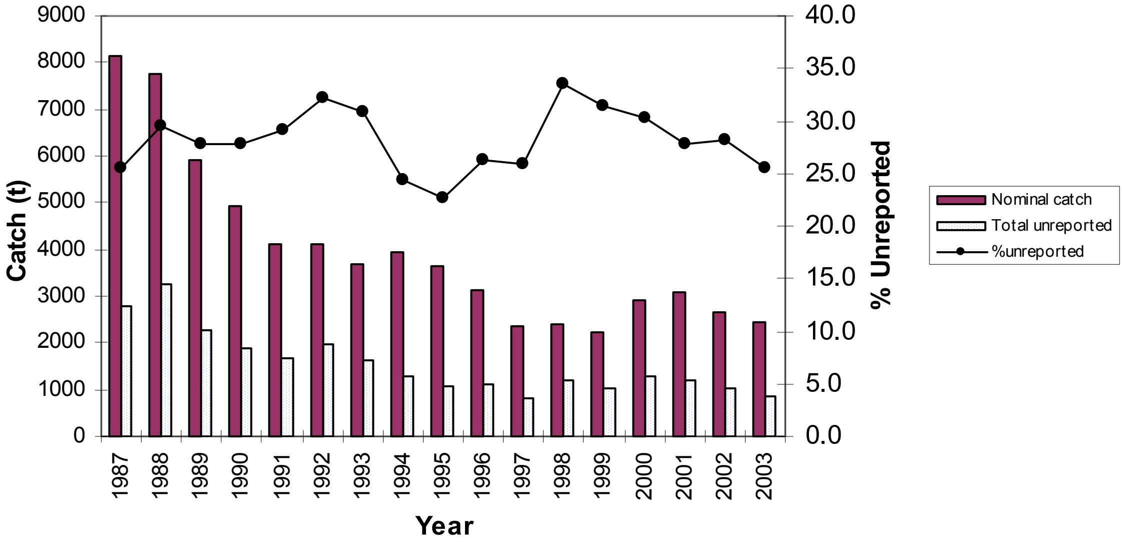


Figure 2.2.1.1. World-wide farmed Atlantic salmon production, 1980-2003.

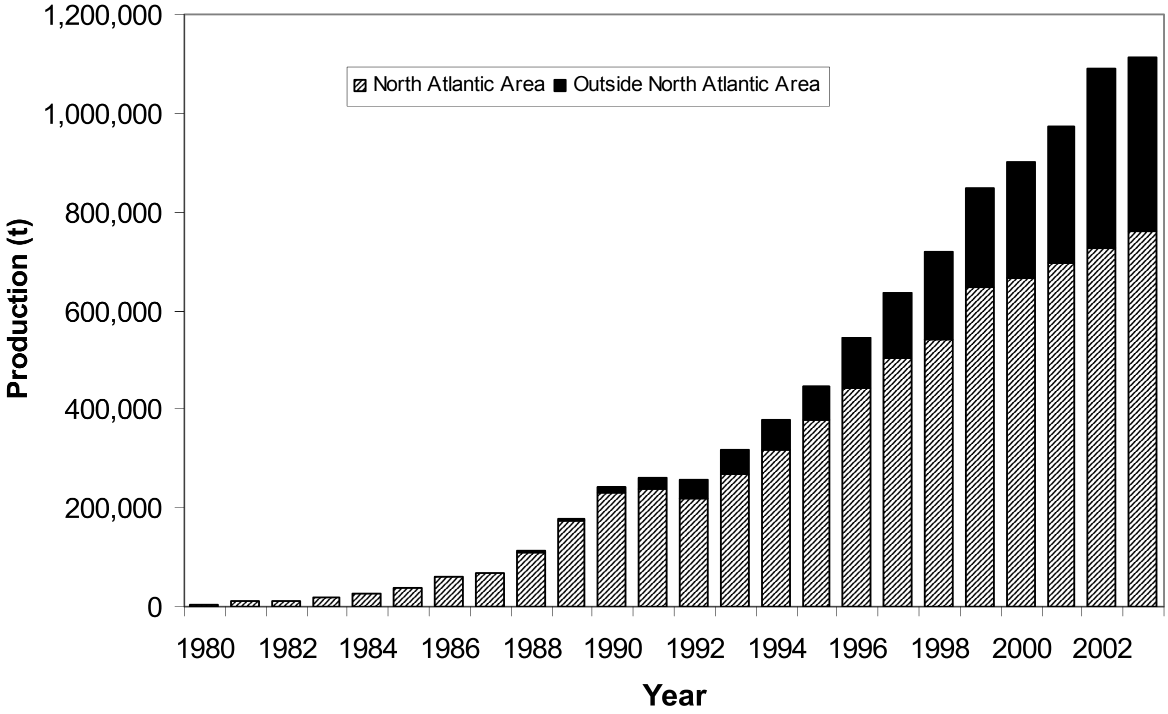


Figure 2.2.2.1. Production of ranched salmon (tonnes round fresh weight) as harvested at ranching facilities in the North Atlantic, 1980-2003.

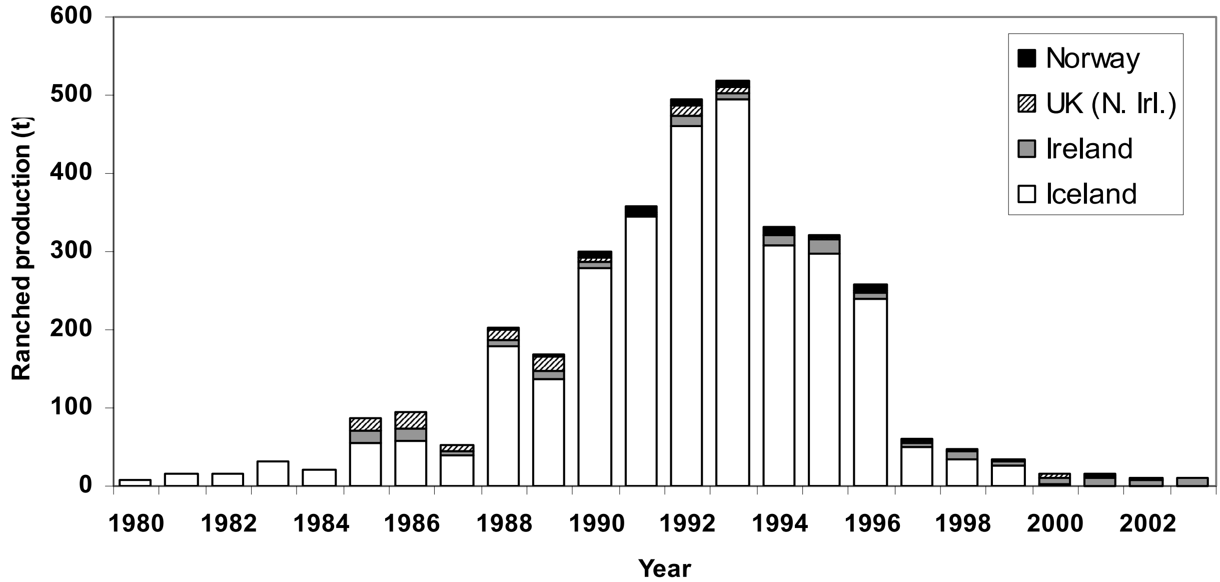


Figure 2.3.1. A comparison of the estimates of the mortality by month in the second year at sea for five rivers from the NEAC and NAC areas using the inverse weight and the maturity schedule methods. The symbols represent the median and the vertical bar the minimum and maximum values for at least five annual estimates.

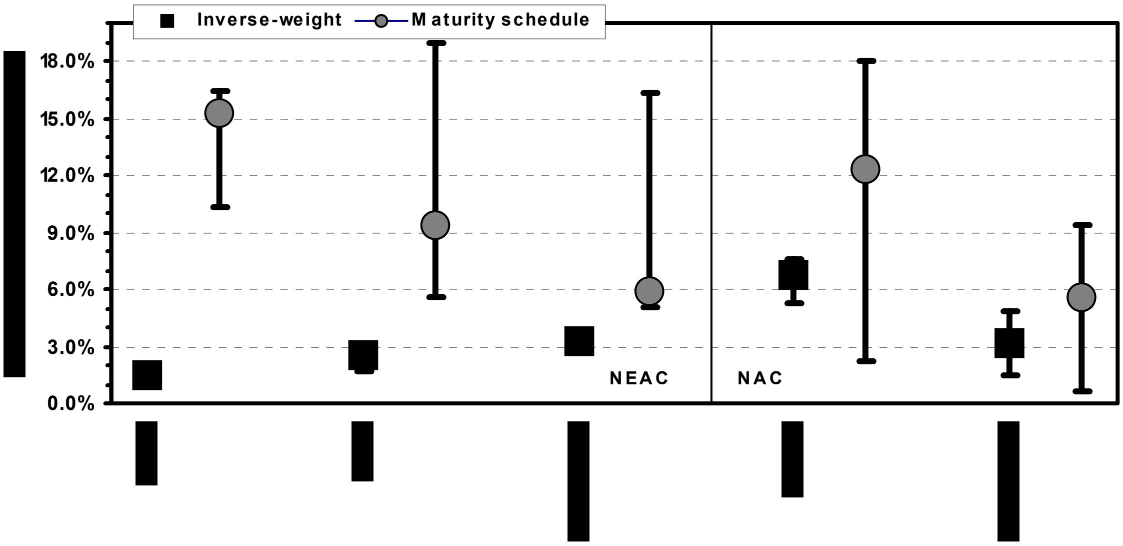


Figure 2.3.2. Monthly mortality rate in the second year at sea for salmon from de la Trinite River stock as estimated from the maturity schedule method and the inverse weight method (assuming linear growth function).

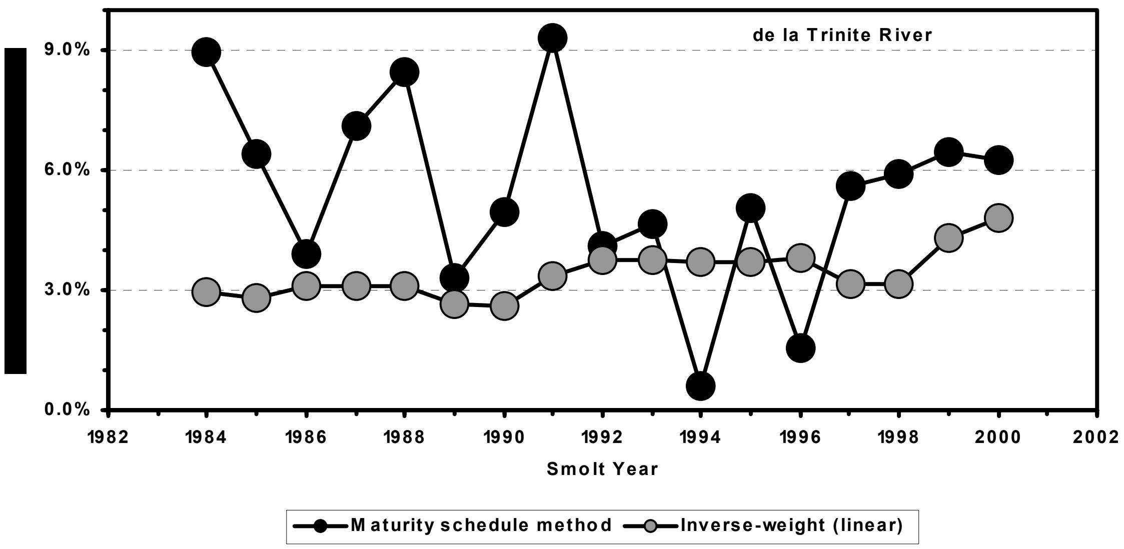


Figure 2.4.1.1. Posterior predictive distributions of the egg deposition rate per m² of riverine wetted area accessible to salmon corresponding to the CLs of the fishery districts and of Ireland as a whole. Each box plot displays on a log scale the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles. Black dots represent the currently used CLs for management advice in Ireland for the fisheries district and at ICES for the whole country. The Dublin fishery district CL does not appear on the graph because it is lower than the lower bound of the Y-axis.

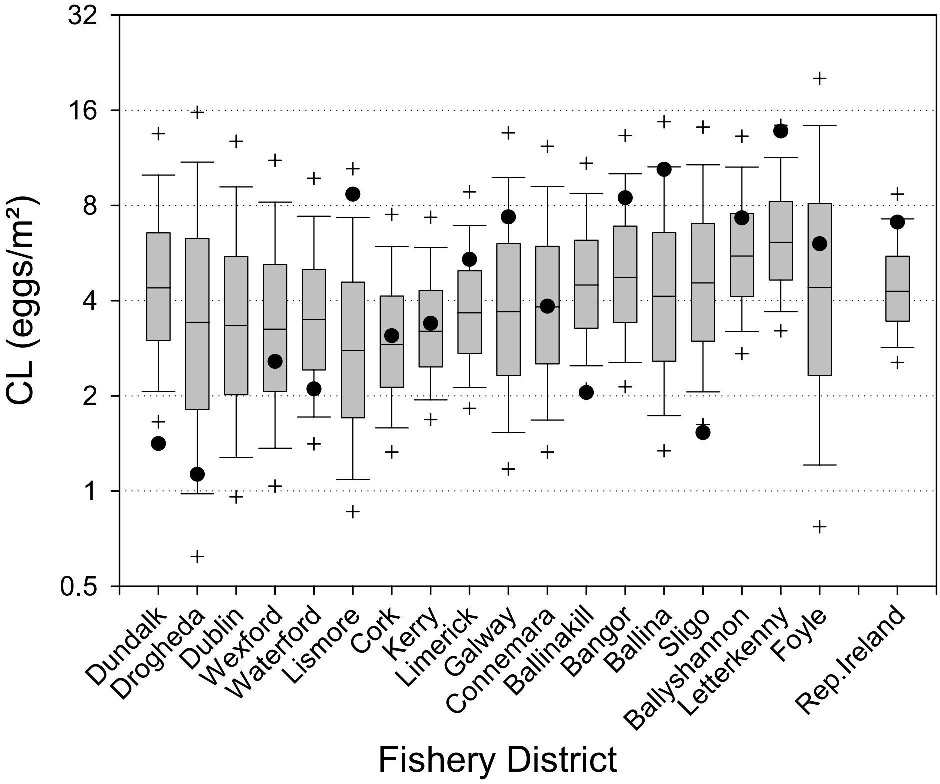


Figure 2.4.1.2. Average attainment of conservation limits (CL) based on the BHSRA/Wetted Area approach from 1997 to 2003 for Irish salmon fishing districts.

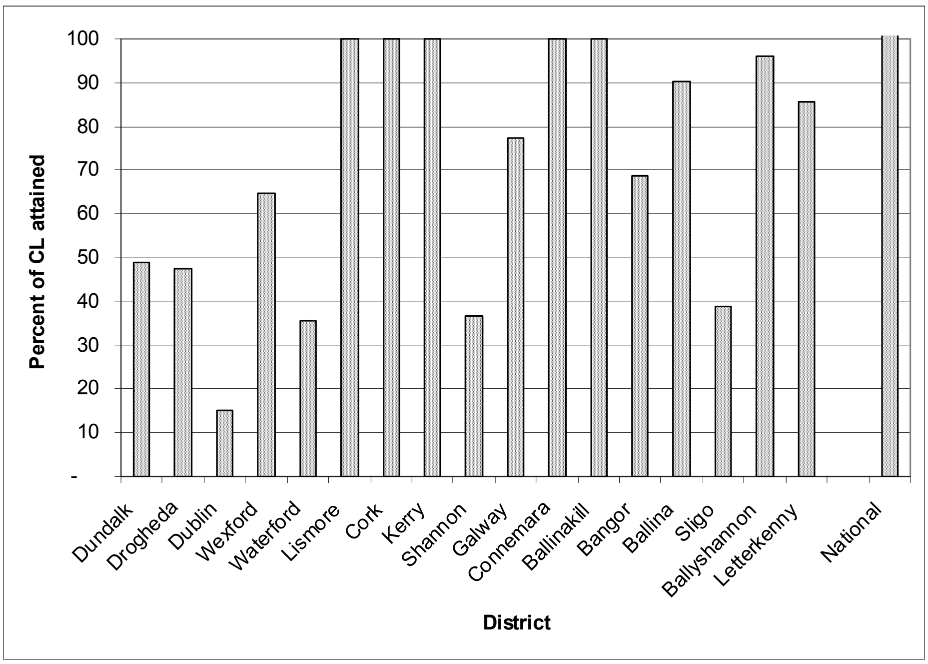


Figure 2.4.2.1. Composition of a known origin sample of wild smolts from the R. Finn, used together with the baseline samples in a test of relative accuracy of the CMLE and pseudo-Bayesian mixed stock fishery analyses.

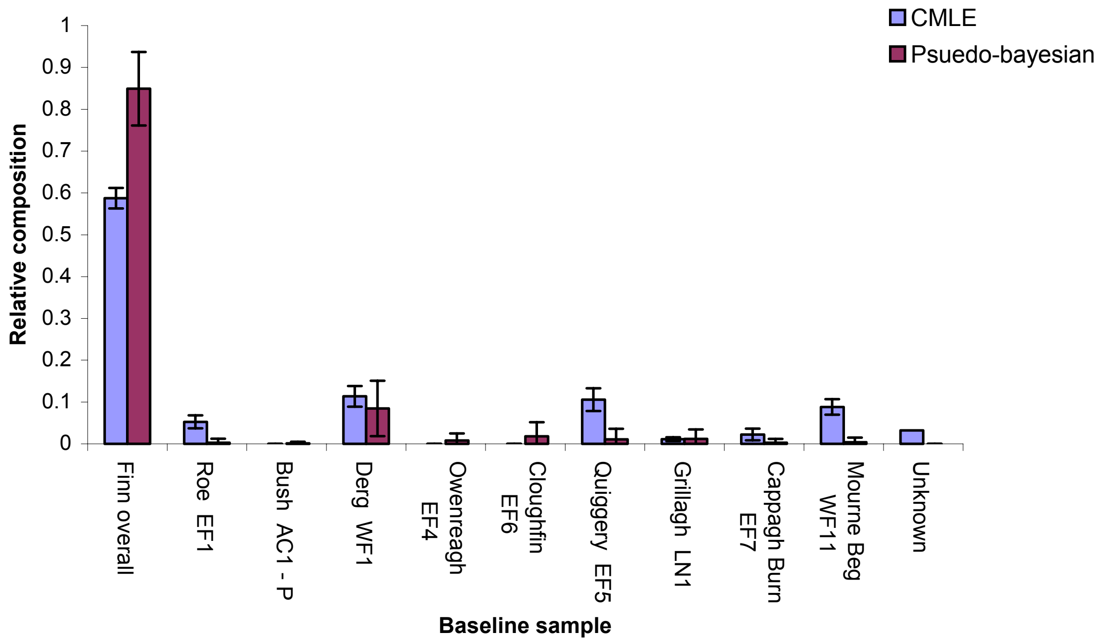
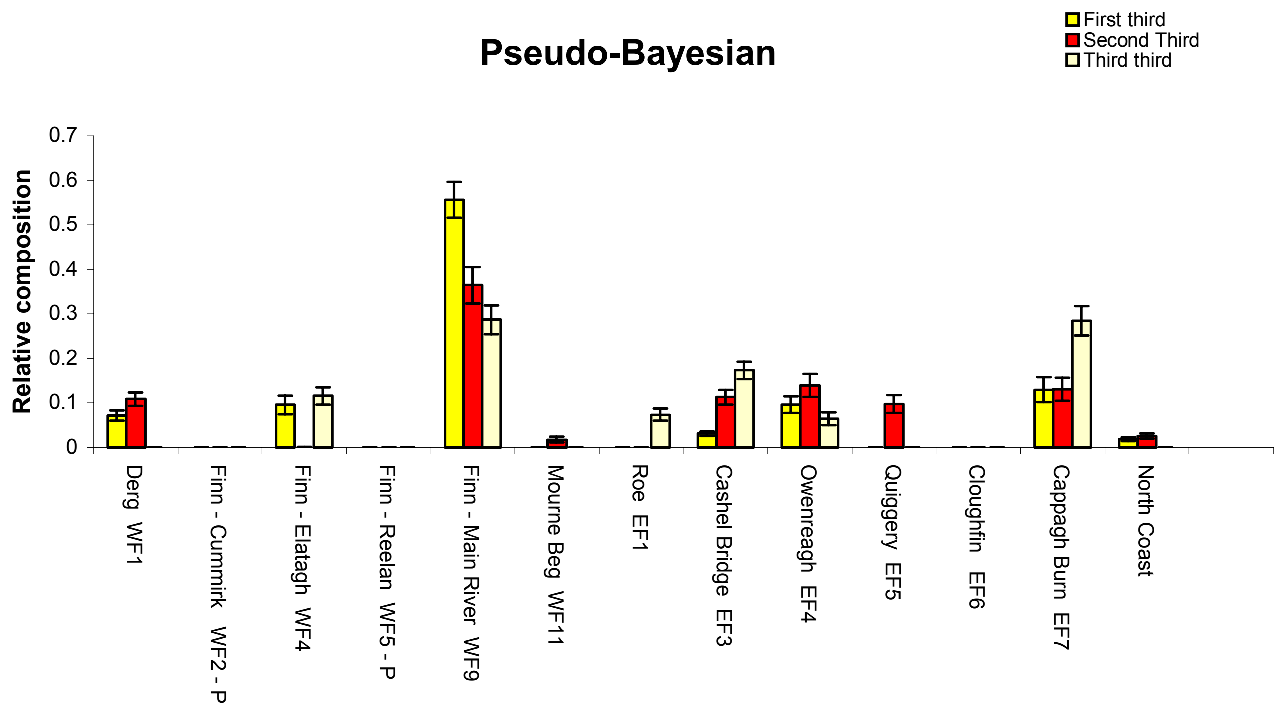


Figure 2.4.2.2. Estimated composition of the Foyle mixed stock salmon fishery in 2003, based on two mixture analysis techniques.



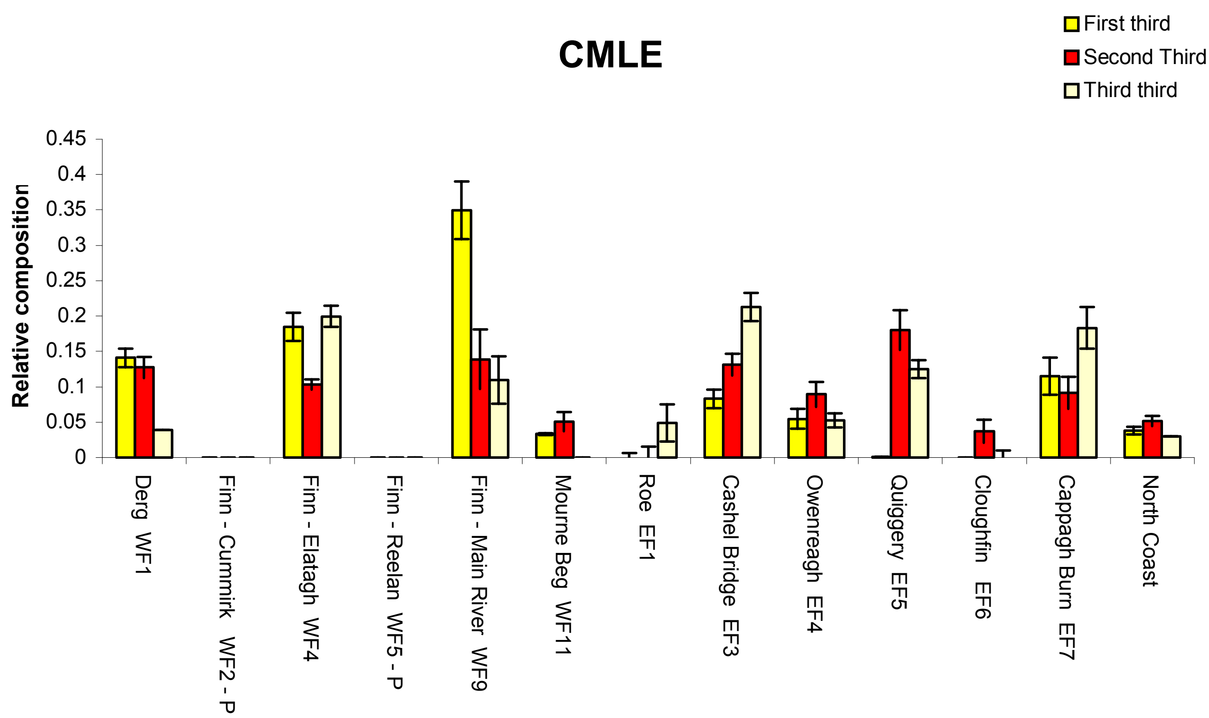


Figure 2.4.3.1. Proportions of repeat spawning salmon in the returns to two rivers in the NEAC area (top), five rivers in the mid (middle) and five rivers in the southern (bottom) NAC area.

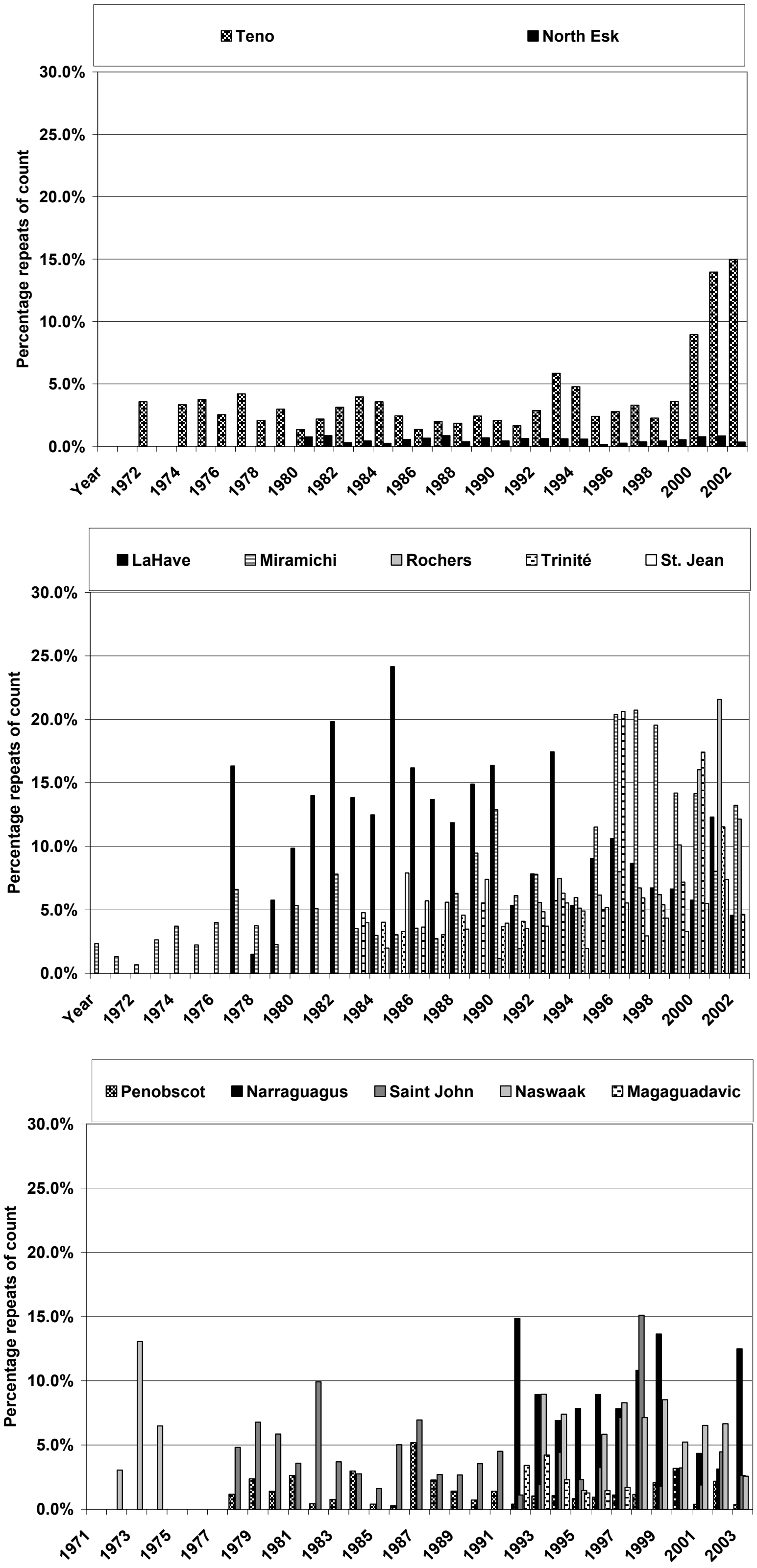


Figure 2.4.3.2. Changes in equilibrium population size in a hypothetical salmon population (similar to the LaHave River, Nova Scotia) in the absence of fishing (2) and fished at MSY (1) under two repeat spawning scenarios. The left plot assumes post-spawning mortality of 50% annually up to 6 spawnings. The right plot shows the equilibrium points in the absence of any repeat spawning. The SR data are from the LaHave River, but the remaining dynamics are hypothetical.

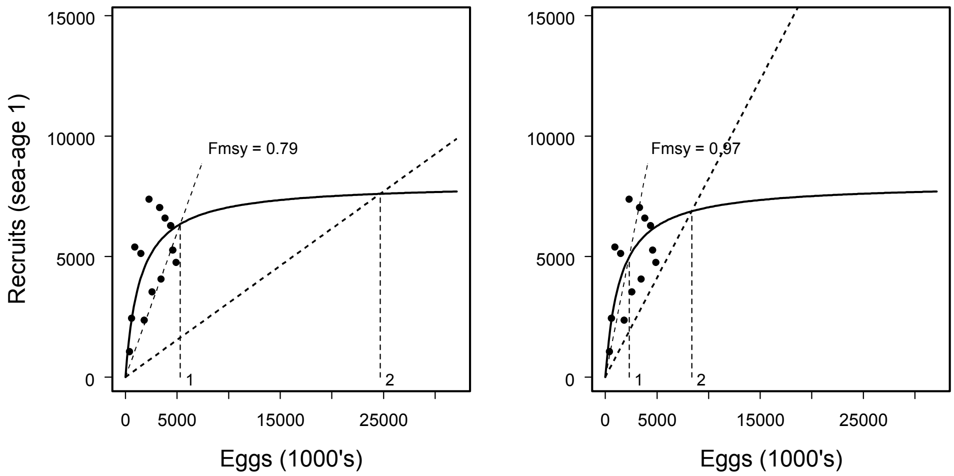


Figure 2.4.4.1: Dynamic vs static model likelihood of the observed PFA given the forecast. Each point is a smolt year for which a forecast has been derived conditionally on the smolt data from 1986 up to that year and on the PFA data from 1986 up to the year before.

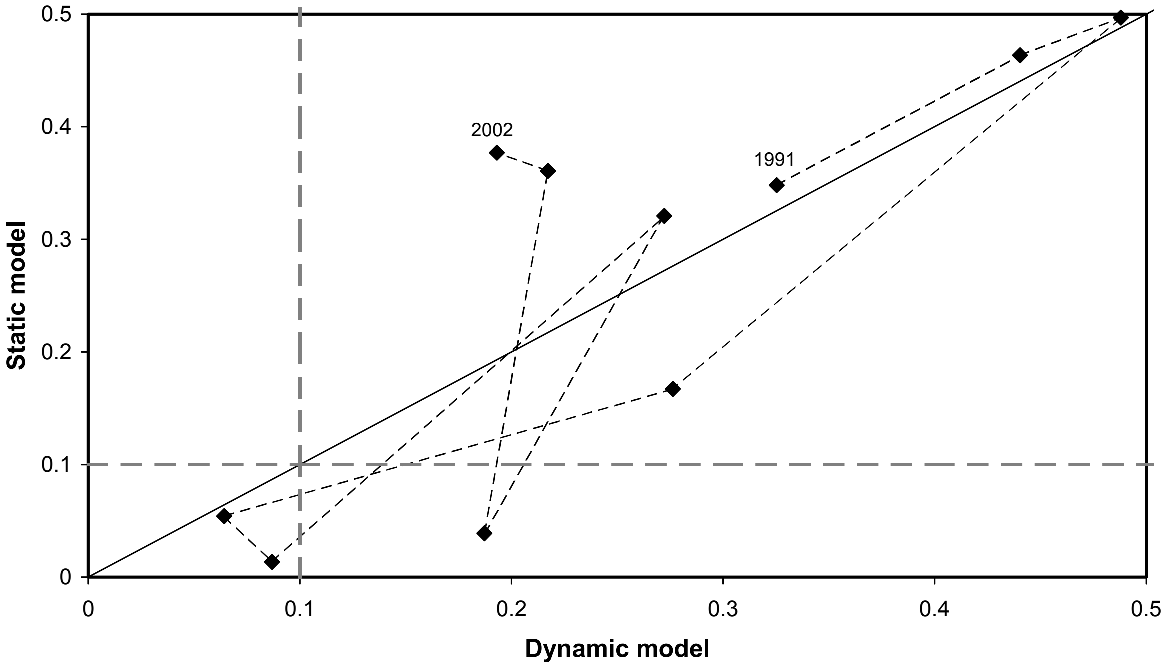


Figure 2.5.1.1. Median number of years below the conservation limit for three rivers with low, medium, and high productivity and two levels of initial population abundance.

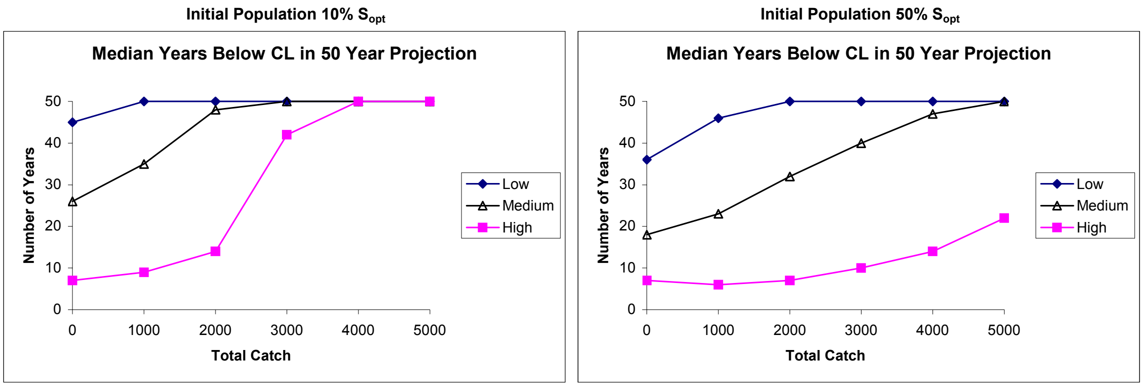


Figure 2.6.3.1. Positions and numbers of large post-smolts and salmon captured in surface trawl hauls for DST tagging in a Nordic project during the Norwegian survey, 21-June – 5 July 2002 west of the Vøring plateau.

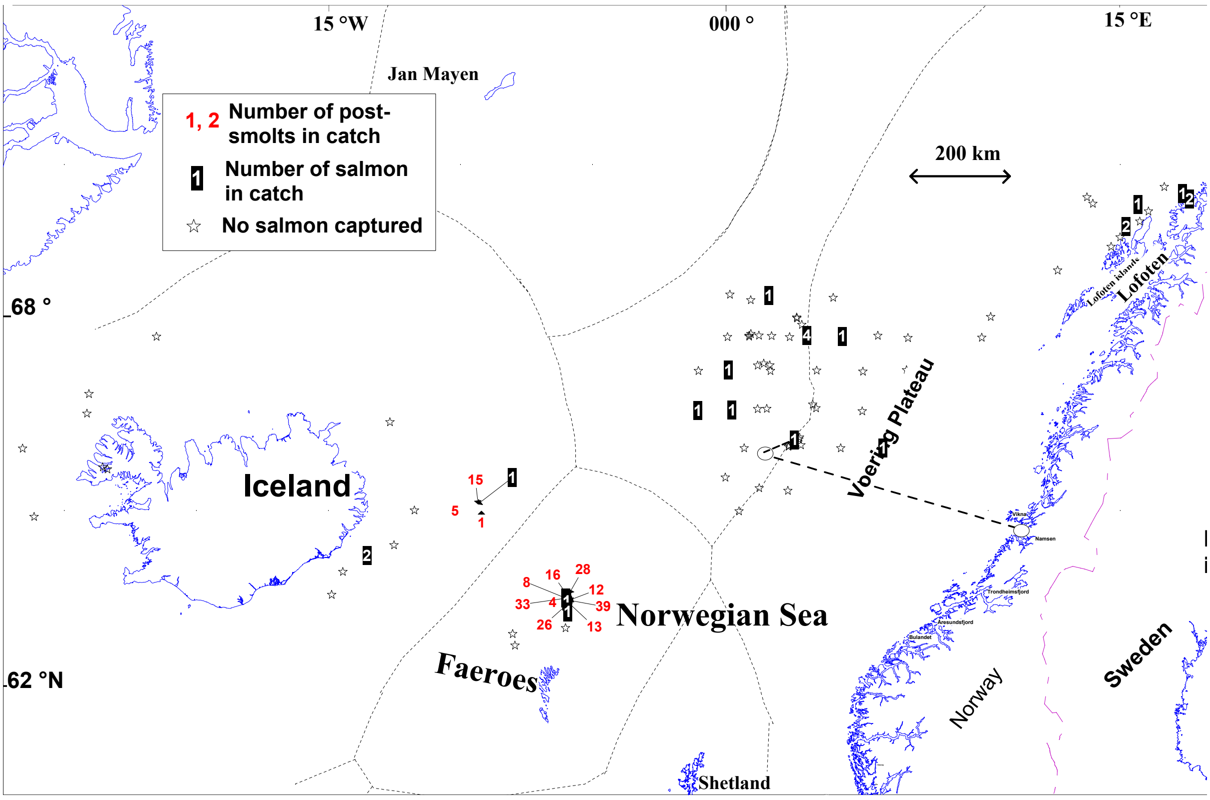
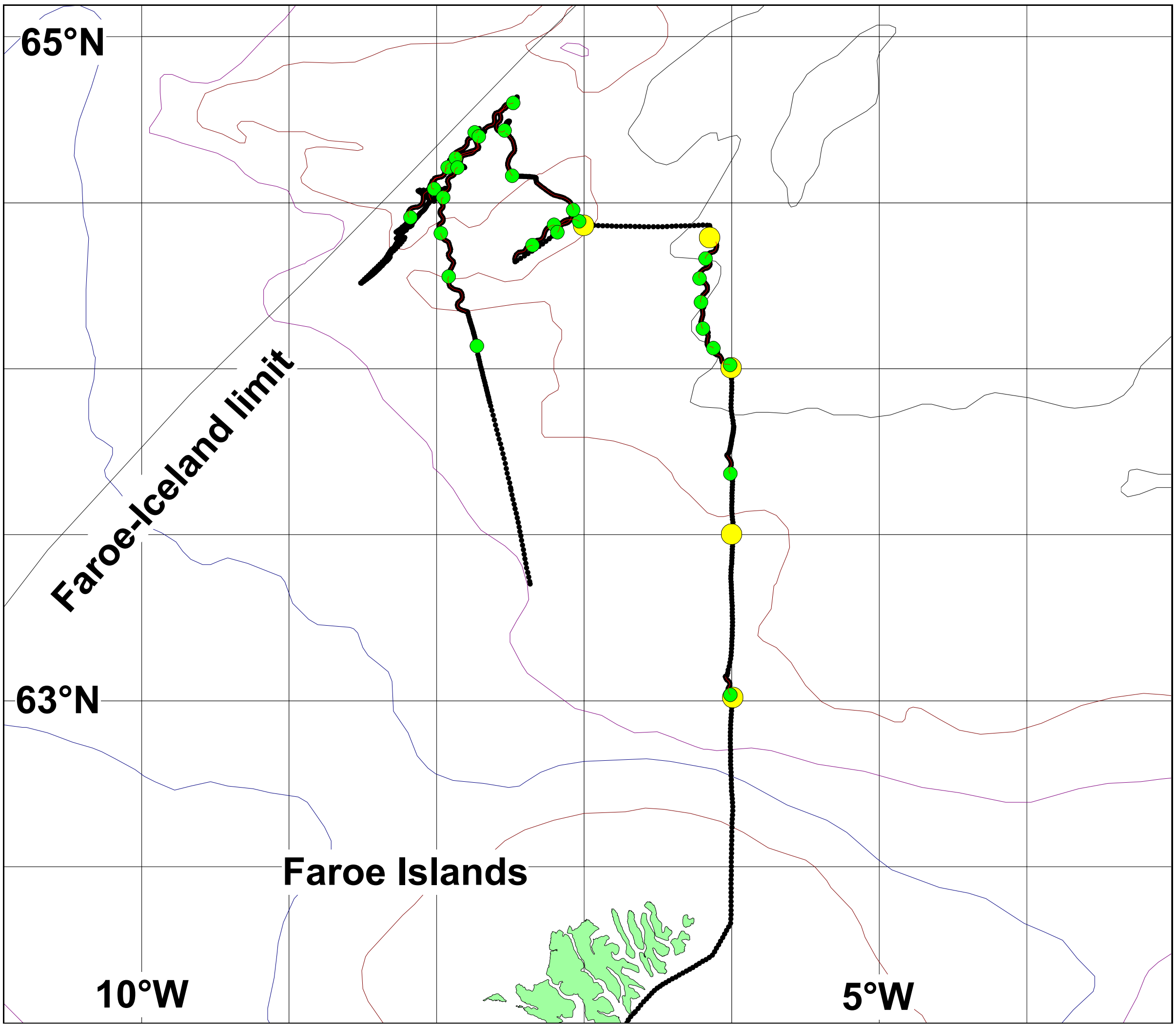


Figure 2.6.3.2. Cruise track of the R/V *Magnus Heinason* and trawl stations occupied for tagging salmon (cruise 0384) 22-29/10 2003. Highest concentrations of salmon were found in the colder area northwest towards the fishery limit, 64°20'N 8°00'W.



3 NORTH-EAST ATLANTIC COMMISSION

3.1 Status of stocks/exploitation

The status of stocks is considered with respect to the following guidance from ICES.

The interpretation of Conservation limits (CLs) have been defined by ICES as the level of stock that will achieve long term average maximum sustainable yield (MSY), as derived from the adult to adult stock and recruitment relationship. NASCO has adopted this definition of CLs (NASCO, 1998). The CL is a limit reference point (S_{lim}). However, management targets have not yet been defined for North Atlantic salmon stocks. ICES has interpreted stocks to be within safe biological limits only if the lower bound of the confidence interval of the most recent spawner estimate is above the CL.

The status of this stock complex with respect to conservation requirements is:

- Northern European 1SW stocks were above the Conservation limit (CL) in 2003 (as they were for 2002). However, these stocks are not considered to be within safe biological limits.

- Northern European MSW stocks were above the CL in 2003 (as they have been for the 4 previous years). These stocks are considered to be within safe biological limits.

- Southern European 1SW stocks were above the CL in 2003 (as they have been for the 3 previous years). However, these stocks are not considered to be within safe biological limits.

- Southern European MSW stocks were close to CL in 2003 (as they were in 2002). These stocks are not considered to be within safe biological limits.

Therefore, with the exception of the Northern European MSW stock, these stocks are considered to be outside safe biological limits.

The status of stocks is shown in Figure 3.1 and is elaborated upon in Section 3.9.

3.2 Management objectives

NASCO (NASCO CNL31.210) 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’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”.

3.3 Reference points

As precautionary reference points have not been developed for NEAC stock complexes, management advice is therefore referenced to the S_{lim} conservation limit. Thus, these limits should be avoided with high probability (ie. at least 75%).

3.3.1 Progress with setting river-specific conservation limits

Most NEAC countries have not yet developed river-specific CLs. In 2004, progress with setting river-specific conservation limits was reported for UK (England & Wales) and Ireland.

Conservation limits for all principal salmon rivers in UK (England & Wales) have been revised in 2003 to take account of the fact that levels of sea survival are currently much lower than those of 20 years ago. New default values of 11% for 1SW salmon and 5% for MSW fish (based on the latest 5-year mean rates for the North Esk) were therefore introduced in calculating CLs and in assessing compliance against these new CLs. Introducing marine survival rates which are intended to reflect those currently experienced by UK salmon stocks will reduce the effect of high natural mortality at sea as a cause of failing CLs. This will help managers focus on other issues over which they have more control (e.g. poor environmental quality in-river, over-exploitation by net and rod fisheries, etc.) when compliance failure occurs. The reduction in CLs means that lower levels of spawning escapement are accepted before the stock is considered to be threatened.

River specific conservation limits have been established for all rivers in Ireland using a Bayesian Hierarchical Stock Recruitment Analysis and transporting known stock and recruitment parameters from well monitored European rivers to all Irish rivers. The approach was not possible in the past due to a lack of information on wetted areas available to salmon, an important covariate in the analysis. In 2003, a special report was commissioned and funded by the Central Fisheries Board and the requisite information made available for analyses. A more thorough presentation of the methodology is provided in Section 2.4.1. The estimates of CL derived from the Bayesian approach (195,950 1SW and 17,960 2SW) are similar to the estimates derived from the National Conservation Limit model (210,588 1SW, 23,301 2SW) in 2004. While the differences at national level are small, the Bayesian approach can be applied to provide conservation limits for each of the 17 salmon fishing districts in Ireland, removing the uncertainty associated with applying the National Conservation Limit model to district mixed stock catch and exploitation rate data.

3.3.2 Description of the national Conservation limits model

Relatively few river-specific conservation limits have been developed for salmon stocks in the NEAC area. An interim approach has therefore been developed for estimating national conservation limits for countries that cannot provide one based upon river-specific estimates. The approach is based on establishing pseudo-stock-recruitment relationships for national salmon stocks in the North East Atlantic Commission (NEAC) area (Potter *et al*., 1998).

As described in 2002 (ICES 2002/ACFM:14), the model provides a means for relating estimates of the numbers of spawners and recruits derived from the PFA model. This is achieved by converting the numbers of 1SW and MSW spawners into numbers of eggs deposited, using the proportion of female fish in each age class and the average number of eggs produced per female. The egg deposition in year 'n' is assumed to contribute to the recruitment in years 'n+3' to 'n+8' in proportion to the numbers of smolts produced of ages 1 to 6 years. These proportions are then used to estimate the 'lagged egg deposition' contributing to the recruitment of maturing and non-maturing 1SW fish in the appropriate years. The plots of lagged eggs (stock) against the 1SW adults in the sea (recruits) have been presented as 'pseudo-stock-recruitment' relationships.

ICES and NASCO currently define the conservation limit for salmon as the stock size that will result in the maximum sustainable yield (MSY) in the long term (i.e. S_{lim}). However, it is not straightforward to estimate this point on the national stock-recruitment relationships because the replacement line (ie the line on which 'stock' equals 'recruits') is not known for the pseudo-stock-recruitment relationships established by the national model because the stock is expressed as eggs, while the recruits are expressed as adult salmon. In 2001 the Working Group adopted a method for setting biological reference points from "noisy" (uncertain) stock-recruitment relationships, such as provided by the national pseudo-stock-recruitment datasets (ICES CM2001/ACFM:15). This model assumes that there is a critical stock level below which recruitment decreases linearly towards zero stock and recruitment, and above which recruitment is constant. The position of the critical stock level is determined by searching for the value that minimises the residual sum of squares. This point is a proxy for S_{lim} and is therefore defined as the conservation limit for salmon stocks. A modified version of this method, which updates the approach first used by ICES in 2001, by allowing uncertainty around these estimates to be described was outlined in 2002 (ICES 2002/ACFM:14). This approach was again applied to the 2004 national stock-recruitment relationship assessment for countries where no river-specific conservation limits have been determined.

3.3.3 National Conservation Limits

The national model has been run for all countries. The outputs are illustrated in Figures 3.9.13.1(a-j). For Iceland, Russia, Norway, UK (Northern Ireland), and UK (Scotland) the input data for the PFA analysis (1971-2003 have been provided separately for more than one region; the lagged spawner analysis has therefore been conducted for each region separately and the estimated conservation limits summed for the country. The conservation limits derived from the national model are used for countries where no river-specific conservation limits have been developed. Where river-specific estimates have been derived (ie. France, Ireland and UK (England & Wales)) they are used to provide national estimates. These values are shown in Table 3.3.3.1. The Working Group has previously noted that outputs from the national model are only designed to provide a provisional guide to the status of stocks in the NEAC area. It will also be noted that the conservation limit estimates may alter from year to year as the input of new data affects the 'pseudo-stock-recruitment relationship'. This further emphasises the fact that this approach only provides a basis for qualitative catch advice.

The estimated national conservation limits have been summed for Northern and Southern Europe (Table 3.3.3.1) and are given on Figures 3.9.14.4 and 3.9.14.6 for comparison with the estimated spawning escapement. The conservation limits have been calculated as 309,831 1SW spawners and 152,155 MSW spawners for the northern NEAC grouping, and 499,695 1SW spawners and 267,894 MSW spawners for the southern NEAC grouping. The conservation limits have also been used to estimate the spawner escapement reserves (SERs) (i.e. the CL increased to take account of natural mortality between the recruitment date (1st Jan) and return to home waters) for maturing and non-maturing 1SW salmon from the Northern and Southern Europe stock complexes. The SERs are shown as horizontal lines in Figures 3.9.14.3 and 3.9.14.5. The Working Group also considers the current SER levels may be less appropriate for evaluating the historic status of stocks (e.g. pre-1985), that in many cases have been estimated with less precision.

3.4 Advice on management

ICES use the catch advice presented in this section to determine whether stock complexes are within safe biological limits according to the NASCO management objectives.

The Working Group 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 conservation limits in the NEAC area. The Working Group reiterated its concerns about harvesting salmon in mixed stock fisheries, particularly for fisheries exploiting individual river stocks and sub-river populations that are at unsatisfactorily low levels. Annual adjustments in quotas or effort regulations based on changes in the mean status of the stocks are unlikely to provide adequate protection to the individual river stocks that are most heavily exploited by the fishery or are in the weakest condition.

For all fisheries, the Working Group considers that management of single stock fisheries should be based upon local assessments of the status of stocks. Conservation would be best achieved by fisheries in estuaries and rivers targeting stocks that have been shown to be above biologically-based escapement requirements.

The Working Group also emphasised that the national stock conservation limits 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 conservation limits and because they will not take account of differences in the status of different river stocks or sub-river populations. Nevertheless, the Working Group agreed that the combined conservation limits 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.

Due to the preliminary nature of the conservation limit estimates, the Working Group is unable to provide quantitative catch options for most stock complexes at this stage. Furthermore, to do so requires predictive estimates of PFA which have not yet been developed for all stock complexes. However, a quantitative prediction of PFA for Southern European MSW stocks is again provided. The Working Group also notes that progress has been made in the development of an approach to derive predictive estimates of PFA for the Northern European PFA stocks (ICES 2003/ACFM 19). The Working Group considers that the following qualitative catch advice is appropriate based upon the PFA data and estimated SERs shown in Figures 3.9.14.3 and 3.9.14.5. [NB In the evaluation of the status of stocks, PFA or recruitment values should be assessed against the spawner escapement reserve values while the spawner numbers should be compared with the conservation limits.]

Based on recent work on resolving the most appropriate stock groupings for management advice for the distant water fisheries (ICES 2002/ACFM 14) the Working Group agreed that advice for the Faroes fishery (both 1SW and MSW) should be based upon all NEAC stocks. Advice for the West Greenland fishery should be based upon southern European MSW salmon stocks only (comprising UK, Ireland and France).

Northern European 1SW stocks: The PFA of 1SW salmon from the Northern European stock complex has been above the spawning escapement reserve throughout the time series (Figure 3.9.14.3a). However, the spawning escapement was at or below the conservation limit until 1997 (Figure 3.9.14.4a). Thereafter the spawning escapement has remained above the conservation limit. However, given the confidence limits on the spawner estimates, the Working Group considers that this stock complex is outside safe biological limits. The Working Group considers that the overall exploitation of the stock complex should decrease so that the conservation limit can be consistently met. In addition it should be noted, however, that the inclusion of farmed fish in the Norwegian data would result in the exploitable surplus being overestimated. Since very few of these salmon have been caught outside homewater fisheries in Europe, even when fisheries were operating in the Norwegian Sea, management of maturing 1SW salmon should be based upon local assessments of the status of river or sub-river stocks.

Northern European MSW stocks: The PFA of non-maturing 1SW salmon from the Northern European stock complex has been declining throughout the time series and the exploitable surplus has fallen from around 1.2 million recruits in the early 1980s to about 0.7 million in recent years (Figure 3.9.14.3b). The Working Group considers the Northern European MSW stock complex to be within safe biological limits, as spawners are currently above CL and trending in a positive direction (Figure 3.9.14.4b). However, it should be noted that the status of individual stocks may vary considerably. In addition, the inclusion of farmed fish in the Norwegian data will result in the exploitable surplus being overestimated. The Working Group therefore considers that caution should still be exercised in the management of these stocks particularly in mixed stock fisheries and exploitation should not be permitted to increase, until a clear pattern of status above SER is established.

Southern European 1SW stocks: Recruitment of maturing 1SW salmon in the Southern European stock complex has shown a strong decreasing trend throughout most of the time series (Figure 3.9.14.5a). Moreover the spawning escapement for the whole stock complex has fluctuated around the conservation limit in recent years, and was only marginally above the conservation limit in 2003 (3.9.14.6a). Despite a small surplus above SER of around 400,000 fish during the last five years, exploitation in these years was clearly high enough to prevent conservation limits being consistently met. The Working Group therefore considers that this stock complex is outside safe biological limits and further that, mixed stock fisheries present particular threats to conservation. Reductions in exploitation rates are required for as many stocks as possible, except those stocks shown to above conservation limits.

Southern European MSW stocks: The PFA of non-maturing 1SW salmon from Southern Europe has been declining steadily since the 1970s (Figure 3.9.14.5b) and the preliminary quantitative prediction of PFA for this stock complex in 2004 is 489,000 (Figure 3.6.1.1). There is evidence from the prediction that PFA will decrease in the near future and the spawning escapement has not been significantly above conservation limit for the last eight years (Figure 3.9.14.6b). The Working Group therefore considers that this stock complex is outside safe biological limits and further that, mixed stock fisheries present particular threats to conservation. Reductions in exploitation rates are required for as many stocks as possible, except those stocks shown to above conservation limits

With catch advice for three of the four stock groupings above still being provided on the basis of extrapolation from historical PFA data, the Working Group recommends that further progress be made with establishing PFA forecast methodologies. Catch advice would also be significantly enhanced if conservation limits were more certain for national stocks.

3.5 Relevant factors to be considered in management

For all fisheries, the Working Group considers that management of single stock fisheries should be based upon assessments of the status of individual stocks. Conservation would be best achieved if fisheries can be targeted at stocks that have been shown to be above biologically based escapement requirements. Fisheries in estuaries and rivers are more likely to fulfil this requirement.

3.5.1 Grouping of national stocks

National outputs of the NEAC PFA model are combined in the following groups to provide NASCO with catch advice or alternative management advice for the distant water fisheries at West Greenland and Faroes.

Southern European countries:	Northern European countries:
Ireland	Finland
France	Norway
UK(England & Wales)	Russia
UK(Northern Ireland)	Sweden
UK(Scotland)	Iceland

The groups were deemed appropriate by the Working Group as they fulfilled an agreed set of criteria for defining stock groups for the provision of management advice that were considered in detail at the 2002 meeting (ICES 2002/ACFM:14). Consideration of the level of exploitation of national stocks at both the distant water fisheries resulted in the proposal that that advice for the Faroes fishery (both 1SW and MSW) should be based upon all NEAC area stocks, but that advice for the West Greenland fishery should be based upon Southern European MSW salmon stocks only (comprising UK, Ireland, and France).

3.6 Catch forecast for 2004

3.6.1 Southern NEAC area

The Working Group has previously considered the development of a model to forecast the pre-fishery abundance of PFA of non-maturing (potential MSW) salmon from the Southern European stock group (comprising Ireland, France, and all parts of UK) (ICES 2002/ACFM:14 and ICES 2003/ACFM:19). Stocks in this group are the main European contributors to the West Greenland fishery (See Section 3.5.1). Model options were re-evaluated in 2004.

The full model considered was:

$$PFA = Spawners^{\lambda} \times e^{\beta_0 + \beta_1 Habitat + \beta_2 \log(PFAm) + \beta_3 Year + noise} \qquad \textit{Model 1}$$

where *Spawners* are expressed as lagged egg numbers, *PFAm* refers to pre-fishery abundance of maturing 1SW salmon and the habitat term is the same as that previously used in the North American model (ICES 2003/ACFM:19). Previous analysis suggested that the noise term was approximately Normally distributed with constant variance, so this assumption was used here.

To provide some guidance as to which of the variables in the model provided a significant contribution to predictions, the R squared values were calculated for a series of models. This indicated that *Year* provided the best fit of the 2-parameter models with only the subsequent addition of *Spawners* providing a significant improvement to the model. Therefore, the Working Group decided to apply a model that used only the *Year* and *Spawners* terms to predict the PFA of non-maturing salmon as in 2003. The model takes the form:

$$\log(PFA / Spawners) = -1.127 \log(Spawners) + 114.8 - 0.050\, Year$$

This is equivalent to:

$$PFA = Spawners^{-0.127} \times e^{114.8 - 0.050\, Year} \qquad \textit{Model 2}$$

The model was fitted to data from 1977-2002 (Table 3.6.1.1) to predict PFA in the subsequent years 2003-2004. The forecast used for 2003 was 525,000, this updates the previously given forecast (sec. 3.8). The forecasted value for 2004 was 489,000 (Figure 3.6.1.1).

The predictions using this model and the 95% confidence intervals are given in Table 3.6.1.2. It should be noted that the confidence intervals are wide and this reflects the uncertainty around the point estimate. These predictions have been used as an input to the provision of quantitative catch advice for this stock complex for 2004.

Alternative model inputs

The Working Group has previously discussed whether *Year* should be included because models with *Year* will be poor at detecting a change from a decreasing trend in *PFA non-m* to an increasing trend. An assessment of models without

Year were shown to be poor predictors of PFA, however using *PFAm* (PFA of maturing 1SW salmon) is better than *Habitat* or *Spawners*: indeed the fit increases very little on adding either of these to a model with *PFAm*. The advantage of such a model is that the inclusion of the PFA *m* utilises a further biological variable and thus should capture, to some degree, the effects of biological influences on the stock. However, the problem with using *PFAm* remains that, as predictions are required two years in advance to provide catch advice for the West Greenland fishery, the final value for the PFA of maturing 1SW salmon has to be estimated. The Working Group used the mean of the previous 3 years as an estimate of the PFA of maturing 1SW salmon. However, the Working Group agreed not to include this variable in the 2004 assessment.

3.6.2 Northern NEAC area

It has previously been noted that predicting PFA of non-maturing salmon based on the PFA of maturing 1SW salmon might be more appropriate in the Northern NEAC area, since the final input value of the PFA of maturing 1SW salmon might be obtained in time (e.g. from homewater fisheries). This might provide a basis for catch advice for the Faroes fishery that is believed to exploit salmon mainly from the northern NEAC area. A re-examination of the models indicated that PFA of maturing 1SW salmon provides the best fitting 2-parameter model, with a further improvement in fit from adding *Habitat*, but little further improvement from adding *Year* and *Spawners*. The chosen final model was:

$$\log(PFA / Spawners) = -7.048 - 0.272 Habitat + 0.597 \log(PFAm)$$

which is equivalent to:

$$PFA = Spawners \times e^{-7.048 - 0.272 Habitat + 0.597 \log(PFAm)} \qquad \textit{Model 3}$$

The Working Group noted that any prediction for 2004 may be poor as it is based on the PFA of maturing 1SW salmon and *Habitat* values, which would need to be averages of previous years. The habitat term (mean sea surface temperature (SST) in the month of February in the area 58-64ºN 10ºW -10ºE) has not been extracted for 2002 or 2003. The Working Group therefore did not make a northern area prediction for 2004, but recommended that such a model should be developed further.

3.7 Medium to long term projections

The quantitative prediction for the southern NEAC MSW stock component gives a projected PFA (at 1st January 2004) of 489,000 fish for catch advice in 2004. No projections are available beyond that, or for other stock components or complexes in the NEAC area.

3.8 Comparison with previous assessment

National PFA model and national conservation limit model

Several countries made changes to the input data to these models.

Data input for Norway has been restricted to the period 1983 to the present. As a result, the time series of PFA for both the NEAC area as a whole and for Northern Europe must be restricted to the same period.

Changes were made in the estimated contribution of UK (Scotland) origin fish to the UK (E&W) north east coast net fisheries. These reflected the reduction in effort of the fishery and change in the relative contribution of coastal and drift net fisheries. Catches of these UK (Scotland) origin fish were also raised to estimated numbers of returning fish using unreported catch and exploitation rate estimates appropriate for the UK (E&W) fishery.

Changes were made to the Russian Kola Peninsula: White Sea Basin input data for 2001 onwards. Catches taken in the recently developed recreational rod fishery were subdivided into fish which had entered freshwater in the year of catch and those which had entered the previous year. Fish entering in the year of catch were used to estimate numbers of returning fish and both categories used in the estimate of spawning escapement. The sea age composition of the estimated numbers of fish returning to freshwater in Russia (Pechora river) in 2001 was also revised using a salmon:grilse ratio averaged over the previous 10 years.

Catch from the Foyle system has been removed from the input data for Ireland as these were included in the input catch for UK (NI). Exploitation rate for 1SW salmon is now based on estimates of exploitation rates on wild fish (+/- 15%), unreported rates have been revised upwards for the period 1997 to 2000 to reflect new data available from the carcass tagging and log book scheme in Ireland..

The river age composition of smolts has been revised for Iceland.

The river specific conservation limits for UK (E&W) have been revised downwards. The river specific conservation limit formerly used for Sweden have been replaced by the limit estimated from the PFA model.

PFA forecast model

The revised forecast of the southern NEAC MSW PFA for 2003 provides a PFA mid-point of 525,000. This is very close to the value forecast last year at this time of 524,000.

3.9 NASCO has requested ICES to: describe the key events of the 2003 fisheries and the status of the stocks

3.9.1 Fishing at Faroes in 2002/2003

No fishery for salmon was carried out in 2002/2003 or, to date, in 2003/2004. Consequently, no sample data are available from the Faroese area for this season. No buyout arrangement has been arranged since 1999.

3.9.2 Significant events in NEAC homewater fisheries in 2003

In Russia in 2003, a commercial in-river fishery was restarted in the Pechora River after a prolonged ban implemented in 1989. The main purpose of the reopening was a wish to reduce the illegal fishery. In contrast, in the Kola Peninsula management activity aimed at reducing commercial in-river fishery and developing recreational fisheries was maintained. Barrier fences on a number of rivers of this region were, for the first time, used specifically for scientific purposes with no commercial harvest occurring in 2003.

Since 2001, all salmon fishermen in Ireland (commercial and rod) have been obliged to tag their catch with carcass tags indicating the region, year and method of capture and to record details of the catch in a logbook. An initial commercial TAC of 219,619 fish was imposed for the 2002 season as a method of limiting catches, followed by a reduced TACs of 182,000 fish for 2003. A TAC of 162,000 fish is currently being considered for the 2004 fishery based on the recommendations of the National Salmon Commission.

To reduce the mixed-stock fisheries on the north east UK(England) coast, only 16 drift net licences were issued in 2003 compared with 69 in 2002 (down by77%), and the number of drift net licences issued for the north east coast has now been reduced by 89% since 1992. The remaining drift nets took a catch of 5,511 salmon compared with 27,685 in 2002 (down by 80%). Some of these netsmen were able to remain in the fishery by switching to inshore T- or J- nets, which are known to exploit a higher proportion of local fish.

3.9.3 Gear and effort

In 2003 no significant changes in the type of gear used for salmon fishing were reported in the NEAC area.

The number of gear units licensed or authorised in several of the NEAC area countries provides a partial measure of effort, but does not take into account other restrictions, for example, closed seasons (Table 3.9.3.1). In addition, there is no indication from these data of the actual number of licences utilised or the time each licencee fished.

Trends in effort are shown in Figures 3.9.3.1 and 3.9.3.2 for the Northern and Southern NEAC countries respectively. In the Northern NEAC area, drift net effort in Norway accounted for the majority of the effort expended, in the early part of the time-series. However, this fishery closed in 1989, reducing the overall effort substantially. The liftnet fishery, which made a minor contribution to overall effort, showed a decreasing trend until it ceased to operate in 1993. The two remaining methods, bagnets and bendnets, show contrasting patterns of effort until the early 1990s when both show downward trends until the end of the time-series. In the Archangel region of Russia, the effort in the coastal and in the river fisheries shows a decline for the time series reported. In the Southern NEAC countries, net effort data show a downward trend of various degrees for UK (England & Wales), UK (N. Ireland), Ireland, France and UK (Scotland).

Rod effort, where available, show both upward and downward trends for the period reported. In the Northern NEAC area the catch and release rod fishery in the Kola Peninsula in Russia has increased from 1,711 fishing days in 1991 to 11,898 in 2003. In Finland there has been an increasing trend in the number of fishing days since 1997 although the 2003 value was slightly less than that recorded in 2002. In the Southern NEAC area rod fishing effort show a decreasing trend in UK (England & Wales) over the period presented. In Ireland, rod fishing effort increased in the early 1990s apparently due to the introduction of a one day license.

3.9.4 Catches

NEAC area catches are presented in Table 3.9.4.1. The provisional declared catch in the NEAC area in 2003 was 2,315 tonnes**,** down 7% on 2002, but representing 94% of the total North Atlantic nominal catch in 2003. The catch in the NEAC Southern area (932 t) fell by 17% on 2002 and was the lowest in the time series. In contrast, the catch in the NEAC Northern area (1,384 t) increased by 2%, a little above the 5-year mean and only 2% below the 10-year mean.

Figure 3.9.4.1 shows the trends in nominal catches of salmon in the Southern and Northern NEAC areas from 1971 until 2003. The catch in the Southern area declined from about 4,500 t in 1972-75 to below 1,500 t since 1986, and less than 1,000 t in 1999 and 2003. The catch features two sharp declines, one in 1976 and the other in 1989-91. The catch in the Northern area also shows an overall decline over the time series, but this is less steep than for the Southern area. The catch in the Northern area varied between 1,850 and 2,700 t from 1971 to 1986, and fell to a low of 962 t in 1997. However, since this time, the catch has increased and has fluctuated around 1,500 t over the last four years. Thus, the catch in the Southern area, which comprised around two-thirds of the NEAC total in the early 1970s, is now lower than that in the Northern area.

3.9.5 Catch per unit effort (CPUE)

CPUE is a measure that 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; the latter may be more affected by varying local factors, e.g. weather conditions, management measures and angler experience. Both may also be affected by many measures taken to reduce fishing effort, for example, changes in regulations affecting gear. If large changes occur for one or more factors a common pattern may not be evident over larger areas. It is, however, expected that for a relatively stable effort CPUE can reflect changes in the status of stocks and stock size. This can be seen in the changes in CPUE for the Norwegian marine fishery that is also reflected in catch (Section 3.9.4) as well as the estimated PFA values (Section 3.9.14).

An overview of the CPUE data for the NEAC area is presented in Figure 3.9.5.1. The CPUE values presented are standardized indices relative to the averages of the time series. The original, more detailed CPUE data are presented in Tables 3.9.5.1 - 3.9.5.5. The CPUE for rod fisheries have been collected by relating the catch to rod days or angler season, and that of net fisheries was calculated as catch per licence- day, trap month or crew month.

In Southern NEAC area, CPUE shows a general decrease in UK(Scotland) net and coble fisheries, whereas no trend was observed in UK(Scotland) fixed engine fisheries, UK(England & Wales) net fisheries and in France rod fisheries (Figure 3.9.5.1). In UK (England and Wales) CPUE for the net fishery decreased in most regions compared to 2002 (Table 3.9.5.3). The CPUE for the Scottish net fisheries was higher than in 2002 and the previous 5-year averages (Table 3.9.5.4). In UK(N-Ireland), the river Bush rod fishery CPUE showed a slight increase compared to the previous year (Table 3.9.5.1).

In most of the Northern NEAC area, there has been a general increasing trend in the CPUE figures for various fisheries in recent years, but the figures of 2002 and 2003 generally decreased from the previous years (Tables 3.9.5.1 & 3.9.5.5). In comparison with the previous year, half of the CPUE values for the rod fisheries in Russian rivers were down and the other half was up. The same pattern was true in comparison with the previous five-year means (Table 3.9.5.2). No long-term trend can be detected either on the White Sea rivers or the Barents Sea rivers (Figure 3.9.5.1).

3.9.6 Age composition of catches

The percentage of 1SW salmon in NEAC catches is presented in Table 3.9.6.1 and Figure 3.9.6.1 (Northern area) and Figure 3.9.6.2 (Southern area). The percentage of 1SW fish in the Northern area was 62 % in 2003, close to the 5- and 10-year mean. Since 1987, the overall proportion of 1SW fish has varied between 54 and 72 %. 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. The proportion of 1SW fish in the catch increased in 2003 in Finland and Norway, but decreased in other countries. On average, 1SW fish comprise a higher proportion of the catch (around 75-80%) in Iceland and Russia than in the other countries (60-65%).

For the Southern European countries (Figure 3.9.6.2), the overall percentage of 1SW fish in the catch was 55%, below both the 5- and 10-year mean. The overall percentage in the catch in 2003 has varied from 49 to 65% over the time series. The proportion of 1SW fish in the catch decreased in 2003 in all countries. On average, 1SW fish comprise a higher proportion of the catch (around 75%) in UK (England & Wales) than in the other southern countries (around 55% in UK (Scotland) and France, and 40% in Spain).

3.9.7 Farmed and ranched salmon in catches

The contribution of farmed and ranched salmon to national catches in the NEAC area in 2003 was again generally low (<2% in most countries) and is similar to the values that have been reported in previous reports (e.g. ICES 2003/ACFM:19). Thus, the occurrence of such fish is usually ignored in assessments of the status of national stocks (Section 3.9.13). However, in Norway farmed salmon continue to form a large proportion of the catch in coastal, fjordic and rod fisheries. An assessment of the likely effect of these fish on the output data from the PFA model was included in ICES 2001/ACFM:15.

3.9.8 National origin of catches

In 2003, a number of tags originating from fish released from other countries (58 from UK (N. Ireland), 27 from UK (England & Wales) and 17 from Spain) were recovered in Irish fisheries. A recent tagging study in Norway (1996-2001) confirmed previous observations that very few Norwegian salmon are intercepted in other countries.

3.9.9 Summary of homewater fisheries in the NEAC area

In the NEAC area, there has been a general reduction in catches since the 1980s. This reflects a decline in fishing effort, as a consequence of management as well as a reduction in the size of stocks. The overall nominal catch in the NEAC area in 2003 (2315t) represented a 7% decrease on both the catch for 2002 and on the average 1998-2002 catch. Catches in the Southern area decreased substantially compared to both the 2002 and the 1998-2002 mean values (by 17% in both comparisons). In contrast, in the Northern area, marginal increases in catch were recorded compared to both the 2002 and the 1998-2002 mean values (by 2% in both comparisons).

While there have been no major changes in the types of commercial fishing gear used, both northern and southern Europe have experienced general reductions in the number of licensed gear units. In contrast, there are no consistent trends for the rod fishing effort in NEAC countries.

CPUE data for various net and rod fisheries do not indicate any general pattern or trend in either the northern or southern NEAC areas. The Working Group noted that reduction in the number of fisheries operating can benefit those fisheries still in operation and that the lack of consistent trends in CPUE may reflect the imprecise nature of these indices.

The proportion of 1SW salmon in catches varies considerably both among countries and within countries among years. No general trend is apparent in either the northern or southern NEAC areas. In 2003, the proportion of 1SW salmon in catches increased in the northern area but decreased in the southern area in comparison to the 2002 values.

Despite the continued high levels of production in the salmon farming industry, the incidence of farmed and ranched salmon in NEAC homewater fisheries was generally low (<2%) and similar to recent years. The exception to this is Norway, where farmed salmon still comprise a large proportion of the catch in several of the coastal, fjordic and rod fisheries.

3.9.10 The NEAC-PFA model

The Working Group has previously developed a model to estimate the pre-fishery abundance (PFA) of salmon from countries in the NEAC area. PFA in the NEAC area is defined as the number of 1SW recruits on January 1st in the first sea winter. The method employs a basic run-reconstruction approach similar to that described by Rago *et al.* (1993) and Potter and Dunkley (1993). The model estimates the PFA from the catch in numbers of 1SW and MSW salmon in each country. These are raised to take account of minimum and maximum estimates of non-reported catches and exploitation rates of these two sea-age groups. Finally these values are raised to take account of the natural mortality between January 1st in the first sea winter and the mid-point of the respective national fisheries. As reported in 2002 (ICES 2002/ACFM:14), the Working Group has determined an ‘m’ value of 0.03 per month to be appropriate. A Monte Carlo simulation (1000 runs) using ‘Crystal Ball’ in Excel (Decisioneering, 1996) is used to estimate confidence limits on the PFA values. Potter et al. (1998) provides full details of the model. In estimating confidence intervals for output variables such as spawner escapement and 1SW recruits, the PFA model assumes that the results from the Monte Carlo simulations are normally distributed. Preliminary analysis showed that such assumptions were not fully met indicating that further work may be warranted in this area.

3.9.11 Sensitivity of the PFA model

A sensitivity analysis for the spreadsheet model which generates PFA estimates in the NEAC area was described in ICES 2002/ACFM:14.

The sensitivity of the overall assessment of PFA for the NEAC Area, and for the Northern and Southern European stock complexes, depends on the values of the various parameters provided for different countries, and these will also be weighted by the national catches. The analysis provided an evaluation of the effects (% change) on the assessment of PFA of maturing and non-maturing 1SW salmon from Northern and Southern Europe of making changes to the non-reporting rate (‘R’), the exploitation rate (‘U’) and the time of return to homewaters (‘t’).

Changes to the parameter values listed in the text table below had a greater than 5% effect on the respective (ie. Northern or Southern European) PFA estimates indicating that particular attention should be paid to ensuring that these parameter values are accurate:

Country (Region)	Sea-age	Parameter
Norway (mid)	1SW	Non-reporting rate
Norway (North)	MSW	Non-reporting rate
Ireland	1SW	Non-reporting rate
Ireland	1SW	Exploitation rate
Scotland (East)	1SW	Exploitation rate
Scotland (East & West)	MSW	Exploitation rate
Scotland (East)	MSW	Non-reporting rate

For the 2004 assessment, the time series of both 1SW non-reporting rate and of 1SW exploitation rates in Ireland were revised in accordance with a recent reappraisal of these values.

3.9.12 National input to the NEAC-PFA model

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

- Catch in numbers
- Unreported catch levels (min and max)
- Exploitation levels (min and max)

For some countries, the data is supplied in two or more regional blocks . In these instances, the model output is combined to provide one set of output variables per country. Descriptions of how the model input has been derived were presented in detail at the Working Group meeting in 2002 (ICES 2002/ACFM:14). Modifications are reported in the year in which they are first implemented and significant modifications undertaken in 2004 are indicated. The model input data are provided in Tables 3.9.12.1(a-t).

3.9.13 Status of national stocks as derived from the PFA model

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

The National Conservation limits model has been designed as a means to provide a preliminary S_{lim} reference point for countries where river-specific reference points have not been developed. These figures should also be regarded as uncertain and should only be used with caution in developing management options. A further limitation with a single national status of stocks analysis is that it does not capture variations in status in different fishery areas or stock complexes. This has been addressed, at least in part, by the area splits in some countries.

The model output for each country has been displayed as a summary sheet (Figures 3.9.13.1(a to j)) comprising the following:

- Estimated total returns and spawners (±SD)
- Estimated total catch (including non-reported) of 1SW and MSW salmon.
- Estimated pre-fishery abundance (PFA) of maturing 1SW and non-maturing 1SW salmon (labelled as 1SW and MSW).
- Total exploitation rate of 1SW and MSW salmon estimated from the total returns and total catches derived from the model.
- National stock-recruitment relationship (PFA against lagged egg deposition), with S_{lim} fitted by the method presented in ICES 2001/ACCESS:15.

The Working Group noted that CLs may not be appropriate for quantitative catch advice at national levels, however they are regarded as useful indicators of overall stock status. Stock status summaries are presented by country below:

Finland: Finnish salmon essentially comprise a single river stock, the River Teno (Tana). The data inputs include both Finnish and Norwegian rod catches for this river. The analysis suggests that the numbers of returns and spawners have fluctuated widely since 1971. The early part of the time-series (1971 to 1975) is characterised by a steep rise, followed by a sharp decline. Numbers of returns and spawners remained low until 1982, but have shown a steady increase since this time, reaching a peak in 2000. In the last three years both returns and spawners have again shown a steep decline. In 2003, 1SW spawners were below CL and MSW spawners were at or above CL.

France: Returns and spawners are estimated to have declined over the past 20 years, although there have been large annual fluctuations. Numbers have been particularly low in recent years, with the last nine years being the lowest in the time-series. There has also been a decline in the proportion of MSW salmon in the catch over the time-series. The current status of the stocks must therefore be considered to be low with no indication of a recovery. In 2003, both 1SW and MSW spawners were below their respective CLs.

Iceland: The assessment suggests that there has been an overall decline in total returns of salmon to Iceland, from around 120,000 in the 1970s to about 60,000 in 2003. However the values for both returns and spawners in 2002 and 2003 are greater than observed in the two previous years. Estimated returns showed an upward trend in the early part of the time-series (1971-78), followed by a sharp decline (1979-84) and a brief recovery to early levels in the late 1980s. There has been a clear downward trend since 1988. There has also been a marked decline in MSW salmon relative to 1SW fish in the catch. In 2003, both 1SW and MSW spawners were below their respective CLs.

Ireland: Estimates of PFA and spawning stocks for Ireland show significant fluctuations over time and three distinct periods are indicated with highest abundance in the 1970's, lower abundance in the 1980's, and the lowest abundance occurring from the early 1990's to the present. The early part of the time-series (1971 to 1981) is characterised by a steep rise to the maximum value for the time-series, followed by a sharp and prolonged decline. A subsequent recovery period is noted from 1981 to 1989, although the values did not rise to the levels observed in the earlier part of the time-series. A period of steep decline occurred over the period 1989 to 1992 with stock levels fluctuating around a new, lower, level for the remainder of the time series. The status of the stocks must therefore be considered to be low with no significant recovery in the last decade. However, in 2003, both 1SW and MSW spawners were at or above their respective CLs.

Norway: Before 1983 the catch data are considered to be unreliable and therefore, model input data is restricted to the period from 1983 to the present. In addition, the data for the Norwegian rod catch from the River Tana (Teno) are included in the Finnish PFA estimates. There was a decline in returns from the beginning of the time series until the late 1990s. Thereafter, a sustained increase in returns was observed over the period 1998-2001 but a decline was observed in 2002. The spawning stock has remained relatively stable throughout the period due to a reducing exploitation rate through the time period. In 2003, both 1SW and MSW spawners were at or above their respective CLs.

Russia: Total returns to Russia are estimated to have been at their highest in the early part of the time series followed by a sharp decline during the late 1970s and early 1980s. From this period onwards there has been a general upward trend in the number of returns although the estimates for last year show a decline. Estimates of spawners follow a similar pattern to that described for returns. There has been a marked reduction in the exploitation rate in the last decade. It should be noted that, for Russia in particular, year on year trends in estimated PFA may not be closely reflected in the subsequent year on year trend in the number of spawners. To account for biological reality, the model assigns a fixed proportion of potential spawners returning in a given year to the spawning numbers for the following year. In 2003, both 1SW and MSW spawners were at or above their respective CLs.

Sweden: Stocks in Sweden have fluctuated widely throughout the time-series. Following a substantial decline in the mid-1990s, there has again, been a rapid recovery followed by successive declines in the last three years. A feature of the latter half of the time-series is the increase in the proportion of the stock that is comprised of MSW salmon. The exploitation rate has remained high over the last 30 years although there has been a decline from 1990 onwards. In 2003, both 1SW and MSW spawners were at or above their respective CLs.

UK (England & Wales): Stocks are estimated to have declined over the past 30 years, although there have been large annual fluctuations. Since the early 1990s, the decline in spawner numbers is less marked than that for the returns, reflecting a reduction in the homewater exploitation rate. The estimated PFA has declined more rapidly for MSW than 1SW salmon. There has been a slight up-turn in overall PFA since 1997, the lowest in the time-series. In 2003, 1SW spawners were below CL and MSW spawners were at or above CL.

UK (Northern Ireland): Returns are estimated to have declined over the time series as a whole, albeit with considerable short-term fluctuations. The catch is dominated by 1SW fish, but there are uncertainties in the relative status of 1SW and MSW fish, as the data on catch composition by sea age are uncertain for most of the historical time-series. In 2003, both 1SW and MSW spawners were at or above their respective CLs.

UK (Scotland): The assessment indicates that stocks have fallen markedly since the early 1970s, although the decline in total spawner numbers has been less marked than those of homewater returns, reflecting the reduction in homewater exploitation rates. The estimated return rates for the last eight years are the lowest in the time series. In 2003, both 1SW and MSW spawners were below their respective CLs.

3.9.14 Trends in the PFA for NEAC stocks

Tables 3.9.14.1 to 3.9.14.6 show combined results from the PFA assessment for the Northern and Southern European groups and the whole NEAC area. The PFA of maturing and non-maturing 1SW salmon and the numbers of 1SW and MSW spawners for these areas are shown in Figures 3.9.14.1 to 3.9.14.6.

The 95% confidence limits (dotted lines for PFA and vertical bars for the spawning escapement) shown in Figures 3.9.14.1 to 3.9.14.6 indicate the high level of uncertainty in this assessment procedure. However, the Working Group recognised that the model provided an interpretation of our current understanding of national fisheries and stocks based upon simple parameters. Errors or inconsistencies in the output largely reflect uncertainties in our best estimates of these parameters. Furthermore, there are risks that progressive errors could occur if, for example, the rate that exploitation has been reduced over a period of years is underestimated. The results therefore need to be interpreted with caution.

Figure 3.9.14.1 shows that there has been a general decline in recruitment among 1SW and MSW salmon in the whole NEAC area over the past 30 years. In recent years, both age groups have been at the lowest levels observed. Numbers of 1SW and MSW spawners have also declined (Figure 3.9.14.2) over the past 30 years. The decline has been less severe than that observed in the recruits, however, indicating that reductions in exploitation have, to some extent, compensated for the decline in stocks. The general trends depicted are similar to those derived from the model run last year.

Figure 3.9.14.3 shows that recruitment of maturing 1SW salmon (potential grilse) in Northern Europe showed a steady decline from the mid-1980s to the mid-1990s. Following an upturn in the late 1990s, there has been a steep downturn in recent years followed by slight increase in 2003. In contrast, there is an increasing trend in the number of 1SW spawners (Figure 3.9.14.4) throughout the time-series, with escapement in 1997 to 2003 being above the conservation limit. This is consistent with a decline in exploitation. However, in 2002, there has been a marked drop in the number of 1SW spawners, which have remained at similar levels in 2003.

Numbers of non-maturing 1SW recruits (potential MSW returns) for Northern Europe (Figure 3.9.14.4) are also estimated to have fallen throughout the period from the early 1980s to the late 1990sThe numbers of MSW spawners, however, show no trend. The numbers show a general increase from the lowest estimated value in 1988, although estimates have fallen back in the last 2 years. . Despite the decline in the last two years the upward trend has been continued. It therefore appears that the decline in recruitment has been balanced by the reductions in exploitation both in homewater fisheries and at Faroes. These trends in recruitment for the Northern European stocks are broadly consistent with the limited data available on the marine survival of monitored stocks in the Northern area (Section 3.9.15).

In the Southern European stock complex (Figure 3.9.14.5), the numbers of maturing 1SW recruits are estimated to have fallen substantially since the 1970s. This pattern is consistent with the data obtained from a number of monitored stocks. Survival of wild smolts to return as 1SW fish fell to very low levels in the Southern European area for which data were available (Section 3.9.15).

The PFA estimates suggest that the number of non-maturing 1SW recruits in Southern Europe has also followed a fairly steady and substantial decline over the past 30 years (Figure 3.9.14.5). This is broadly consistent with the general pattern of decline in marine survival of 2SW returns in most monitored stocks in the area (Section 3.9.5). In more recent years, reductions in exploitation do not appear to have kept pace with the stock declines, and the spawning escapement suffered a substantial decline in the mid 1990s from which it has not recovered to date (Figure 3.9.15.6).

3.9.15 Survival indices NEAC stocks

An overview of the estimates of marine survival for wild and hatchery-reared smolts returning to homewaters (i.e. before homewater exploitation) for the 2002 and 2001 smolt year classes (returning 1SW and 2SW salmon, respectively) is presented in Figure 3.9.15.1. The survival values presented are standardized (Z-score) indices relative to the averages of the time series. The original survival indices for different rivers and experimental facilities are presented in Tables 3.9.15.1 and 3.9.15.2.

An overall trend in both Northern and Southern NEAC areas, both wild and hatchery smolts, show a constant decline in marine survival over the past 10-20 years (Figure 3.9.15.1). The steepest decline appears to for the wild smolts in Southern NEAC area. Survival indices of both wild and reared fish in Northern NEAC area, however, have generally shown lesser declines than those in Southern NEAC area (Figure 3.9.15.1).

In general, a majority of the survival indices for the latest smolt year classes for wild smolts returning as 1SW fish were below those of the previous year and the 5- and 10-year averages. However, the opposite was true for most of the indices of wild MSW returns (Table 3.9.15.1). A majority of the survival indices for the hatchery-reared smolts were below those of the previous year and the 5- and 10-year averages (Table 3.9.15.2). Return rates of hatchery released fish, however, may not always be a reliable indicator of marine survival of wild fish.

Results from these analyses are consistent with the information on estimated returns and spawners as derived from the PFA model (section 3.9.14).

3.10 NASCO has requested ICES to: evaluate the extent to which the objectives of any significant management measures introduced in the last five years have been achieved

The Working Group noted the ongoing reductions in the number of gear units deployed in most countries in the NEAC area since 1997 (Table 3.10.1). This is thought to reflect both management measures aimed at reducing levels of exploitation and the declining commercial viability of some fisheries. A number of other measures have also been introduced, or continued, in NEAC countries over this period. These include: restrictions on fishing seasons and gear, buy-out arrangements, voluntary restrictions, and increasing use of catch and release. Given the widely divergent measures introduced, variability in the timing of their introduction and duration, and the nature of the fisheries themselves, the Working Group recognised that it was not possible to quantify the effects of management measures on stocks and fisheries across the NEAC area in a consistent manner.

The effect of specific management measures on stocks and fisheries has been evaluated in a number of NEAC countries.

NEAC northern area

In Russia, commercial catches have been declining steadily as a result of various management changes, including the prohibition of some important in-river fisheries, aimed at reducing the fishing effort and enhancing the development of recreational catch-and-release fisheries. The mean commercial catch in the last five years (1999-2003) is 22% below that of the previous five years (1994-1998). Some new regulations have been introduced in Sweden in 2002 and 2003, with the establishment and extension of protected areas outside certain salmon rivers and the extension of the close season by one month (to the end of March). The impact of these measures has not been assessed, although the catch in 2003 was over 30% lower than that in 2002.

NEAC southern area

An appraisal of the earlier management changes in the commercial fishery in Ireland, introduced in 1997, was presented in ICES 2001/ACFM:15. More recently, there have been further substantial changes to the management of fisheries in Ireland, with the introduction of logbooks, carcass tagging and TACs, and these have also contributed to a reduction in both the overall catch and the exploitation rate on Irish stocks.

In UK (N. Ireland), significant management changes came into effect in the Fisheries Conservancy Board area in 2002, aimed at conservation of wild salmon stocks. For the 2001 season there was a voluntary agreement with licensed net operators that no net should operate until 1st June (season was previously 17th March to 15th September), with 8 license holders agreeing not to fish at all. Holders of drift net licenses agreed to operate for only eight weeks during the period 1st June to 15th September, split into two four-week periods. These voluntary agreements preceded a public:private sponsored voluntary buyout, which came into effect for the 2002 season, with funds being made available to purchase netting rights from a significant proportion of operators in the FCB area. This scheme has resulted in the buyout of some 18 commercial licence holders. The number of commercial licences issued in the FCB area fell to 14 in the 2002 season (in comparison to 23 in 2001 and 27 in 2000) and was further reduced to 8 licences for 2003. Accompanying measures to regulate angling, introduced into the FCB area on a voluntary code-of-practice basis in 2001, operated again in 2003, following introduction of appropriate byelaws. These included catch and release from the start of the season up to the end of May; a daily bag limit of two fish from 1st June to the end of the season. A ban on the sale of rod caught salmon is proposed. While the effects of these measures on stock status will require some years to fully evaluate, it is noted that the voluntary net buyout scheme probably contributed to the reduction in net catch in the FCB area from 23.4 t in 2001 to 9.4 t in 2002 and 6.3 t in 2003.

National measures were introduced in UK (England & Wales) in 1999 to protect spring salmon. In 2003, these are estimated to have saved around 1,200 salmon from capture by net fisheries and around 1,000 by rod fisheries before June 1. These estimates are based on the catch and the average proportion of fish taken in this period in the 5 years prior to the measures being introduced; the latter estimate has been adjusted for catch and release. A 5-year review of these measures, completed in 2003, found that spawning escapement of spring salmon may have increased by up to one third on some rivers as a result of the measures, but that spring salmon stocks are still seriously depleted on many rivers. The review concluded that the measures should remain in place until 2008.

Since 1993, there has also been a policy to phase out coastal mixed stock salmon fisheries in UK (England & Wales). In December 2000, the Government offered funds, subject to matching contributions from interested parties, to launch compensation arrangements designed to accelerate the phase out of mixed stock fisheries on a voluntary basis, with particular emphasis on the north east coast fishery. As a consequence, 52 drift net licensees in this fishery signed agreements with NASF(UK) to permanently relinquish their licences; this was effective for the 2003 season. The number of licences issued has now been reduced by 89% since 1992 and the drift net catch in 2003 fell to 5,511 compared with 27,685 in 2002 (down by 80%). Nine other small coastal mixed stock fisheries in UK (England & Wales) have also been identified in recent years, seven of which are no longer operating, while the remaining two are in the process of been phased out.

Although there have been large annual fluctuations in the declared catches in UK (England & Wales), the overall effect of these phase outs has been to reduce the catches in these coastal fisheries from an average of about 41,000 fish for the period 1988-92 to a little under 32,000 for the period 1998-2002 and to 10,526 fish in 2003. These measures have had more of an impact at the local level. For example, prior to the buy-off of the nets and fixed engines on the River Usk in 2000, this fishery took, on average, about 1,000 fish each year (~40% of the total net catch in Wales). The partial phase out of the Taw/Torridge fishery in 2002 resulted in a drop in the catch from a five-year mean (1997-2001) of 665 fish to 103 in 2002 and 276 in 2003.

In UK (Scotland), members of the Salmon Net Fishing Association, to which the majority of active net operators are affiliated, continued a voluntary agreement, introduced in 2000, to delay fishing until the beginning of April in order to protect early running MSW salmon. This has resulted in about an 80% reduction in the catch of MSW salmon by nets and fixed engines in the months of February and March, compared with the previous five years.

The above estimates and the overall reduction in gear units suggest that management measures introduced in the last 5 years have continued to reduce levels of exploitation on NEAC stocks.

Despite measures taken in relation to national and local objectives described here, the Working Group notes that three of the four NEAC stock complexes remain outside safe biological limits (sec. 3.1).

3.11 NASCO has requested ICES to: consider the report of the Study Group on the Bycatch of Salmon in Pelagic Trawl Fisheries, provide estimates of bycatch of salmon in pelagic fisheries, and advise on their reliability

3.11.1 Consideration of the report of SGBYSAL on the by-catch of salmon in pelagic trawl fisheries

The Terms of Reference of SGBYSAL were to:

a) work with WGMHNSA to disaggregate data on the commercial catches of mackerel and herring in the Norwegian Sea (ICES Divisions IIa and Vb), Northern North Sea (Division IVa), and the west of Ireland and Scotland (Divisions VI a & b; VII b,c,j & c) by ICES Division and standard week;

b) work with WGMHNSA to disaggregate data on the number of boats and gear types used in the commercial fishery of mackerel, herring and horse mackerel in the Norwegian Sea (ICES Divisions IIa and Vb), Northern North Sea (Division IVa), and the west of Ireland and Scotland (Divisions VI a & b; VII b,c,j & k) by ICES Division and standard week;

c) provide estimates of the by-catch of Atlantic salmon in the mackerel and herring fisheries in the Norwegian Sea with measures of their reliability;

d) explore analytical methods to allow catch rates of salmon in research surveys to be extrapolated to catch rates in commercial fisheries;

e) review methods used for intensive screenings of pelagic research hauls for the presence of post-smolts (small salmon in their 1st year at sea, generally < 45cm) and older salmon.

The Working Group considered that progress was made in clarifying the fisheries (including areas) and fishing gears where there was potential overlap with migrating post-smolt salmon in time and space. Table 3.11.1.1 summarises these fisheries while the SGBYSAL Report provides more specific details on each of the fisheries i.e. the countries participating and the times, areas and gears used. The ICES' areas and Divisions are shown in Figure 3.11.1.1. Potential fisheries are mackerel, herring (Norwegian spring spawning and North Sea herring), blue whiting, capelin. The horse mackerel fishery was not thought to coincide significantly in time and space with salmon migrations. Specific details are also available on the size of the catches by several countries by quarter and area, but disaggregated data were not available which limited the applicability of the catch data for assessment of post-smolt or adult by-catch.

The main gears considered to interact with migrating salmon were offshore pelagic trawls and purse seines. The Working Group noted that the gear used for surface and mid-water trawling was essentially the same and that they were deployed depending on where pelagic fish shoals were identified in the water. It was considered that the trawling on the surface was more likely to intercept post-smolt salmon than trawling lower in the water column. Purse seines probably did not have the same capacity to intercept smolts due to the smaller area fished by the individual nets compared to the towed gears.

SGBYSAL examined a number of potential methods for estimating by-catches of salmon, including:

- Extrapolation from research surveys

- Extrapolation from commercial fishery observer programme.

- Examination of all sources of catch rates for all years to establish a range of catch rates. (weighted by source/gear type) that are then applied to commercial catches.

- Others (e.g. large scale salmon tagging programmes and coordinated releases).

Information available from the first two techniques presented by SGBYSAL plus further information presented to the Working Group is examined further in Section 3.11.2.

SGBYSAL also considered existing screening programmes for pelagic fisheries as well as those directed specifically at identifying salmon in various countries and fisheries and noted the low incidence in the majority of these programmes.

These included :

- Research surveys (small catch, complete screening, different gear types)
    - Salmon targeted research surveys
    - General pelagic research surveys (e.g. Planning Group North East Atlantic Pelagic Ecosystems)
- Commercial fishery
- On-shore fish plants

The notable exception was information on landings recorded in the Netherlands of by-catches of salmon in the fisheries in the North Sea 1995 – 2003. A total of 5,851 salmon were recorded as a by-catch by Dutch vessels from 1995 to 2003 while 63 were reported by other vessels in the North sea. SGBYSAL noted that the highest densities of by-catches are recorded close to the coast with a peak occurring outside the Rhine estuary. It is also noted that the recorded by-catches were highest in June, with another peak occurring in October. In the absence of data on the fishery in these areas it is impossible to tell whether these peaks arise from higher fishing activity or whether they reflect a true spatial and temporal aggregation of salmon. . The Working Group noted that there is also a possibility of misclassifying sea trout as salmon in these Dutch fisheries and that this would need further clarification.

SGBYSAL recorded advantages and disadvantages in current screening programmes (research catch and commercial catch) providing data for estimation of by-catch. The following reservations were noted regarding by-catch estimates currently available.

Research catch screening

SGBYSAL considered that scanning research survey catches for salmon, although highly accurate, was not viable for the purpose of extrapolation to estimated by-catch in the commercial fishery, unless extensive inter-calibration trials of the research and commercial gear were carried out. It was felt that the resources involved in such inter-calibrations would be better expended on intensifying screening of commercial catches.

Commercial catch screening:

Clearly, commercial catch screening methods cannot examine all the catch, as numbers are large, thus it is necessary to sub-sample many of these hauls to provide coverage of the catch. As screening will necessarily involve slowing down the commercial operation (perhaps only half the tows normally undertaken would be possible), some payment may have to be made to achieve access to catches as there will be commercial penalties for the lower catches that result. This principle was applied in a large scale observer based screening programme of the mackerel fishery in the Norwegian Sea in 2002 as reported to ICES in 2003 (ICES 2003/ACFM:19). However, these estimates were not considered by SGBYSAL to be reliable as the data were presented based on quarterly catches and it was felt that weekly disaggregated catches would be a prerequisite.

However, SGBYSAL endorsed observer based screening programmes for pelagic fisheries and concluded that it should be possible to establish suitable protocols for such screening. For example, the analysis by SGBYSAL of the overlap in time and space between salmon and the mackerel fishery suggests that screening may only be required during a relatively restricted period of time in the fishery, thus a more intensive programme may be considered. The group noted that screening is most viable on board factory vessels, where fish pass along conveyor belts, in contrast to tank vessels where catch is pumped directly into holding tanks and screening is not possible.

The Working Group noted the recommendations made by the SGBYSAL in their report:

1. Methods of estimating salmon post-smolt by-catches should be developed primarily via observer screening programmes on commercial fishing vessels. This will minimise assumptions required to extrapolate from research surveys.

2. Screening of commercial catches on board commercial fishing vessels should be carried out in pelagic fisheries that are of relevance to potential salmon by-catch. Protocols should be established for screening herring and mackerel fisheries, as these are likely to require special screening methods.

3. Research catches should continue to be screened for presence of salmon, as this will add to the knowledge base on distribution of salmon at sea and will help refine the spatial and temporal coincidence of pelagic species and salmon.

4. Screening of discards from filleting factories should be explored.

5. It is recommended that detailed information about the fishery i.e. applied fishing gear, fishing depth, number of boats, weekly catches by statistical rectangles is provided by NEAFC and the different nations for the fisheries in the Divisions and time periods identified by SGBYSAL (in Table 3.6.1) before it is appropriate to hold any future SGBYSAL meeting. UK, Iceland, Norway and Germany provided some of these data for the present SG.

6. Regardless of whether research catches or screening of commercial catches is used to make estimates of captures of post smolts in the fishery, there is a requirement for the use of weekly catch data. The estimate presented by ICES in 2002 used quarterly data and thus is not viewed by the Group as reliable

7. SGBYSAL should reconvene when disaggregated catch data for the Mackerel fishery in the Norwegian Sea become available, in order to provide estimates of by-catch in this fishery.

8. Work should be carried out to apply a range of by-catch estimates to known data on salmon abundance and survival trends in the stocks in question (southern NEAC stock complex mainly) to determine whether the present preliminary and crude range of levels of potential by-catch can account for recent changes in abundance or survival at sea.

9. Work should be carried out, under a range of by-catch rate scenarios to determine the scale and nature of any tagging programme that would be required to yield reliable estimates of by-catch.

3.11.2 Estimates of by-catch of salmon in pelagic fisheries

Two methods have previously been used to estimate the level of by-catch in pelagic fisheries. The limitations of each have been reviewed by SGBYSAL and commented on above. The outputs from both of these approaches are presented here to illustrate how these methods have been applied generally and the widely different estimates of by-catch produced by each method. For this reason the estimates have not been scaled up to the commercial catch in specific areas or times and should not be used as an indication of the scale of by-catch in pelagic fisheries.

Extrapolation from research surveys

By-catches of salmon in pelagic fisheries, Norwegian surveys

Information is available on research cruises carried out between 2001 and 2003. These cruises were dedicated to salmon and mackerel investigations both in the international area and in the Norwegian EEZ west (2001-2003) and north of the Voering Plateau in the Norwegian Sea (2002 and 200, 61 – 73.3°N; 1.5°W- 13°E). During the by-catch investigations, 198, 590 and 436 post-smolts were taken respectively between 2001 and 2003 (Table 3.11.2.1). Starting from the north and moving southwards during the 2003 cruise, the post-smolt catches were medium to large at the beginning of the cruise and became smaller when approaching the 66°N. As in 2002, the captures in single tows were smaller in the Norwegian EEZ than in the international zone. This might be expected, as the strongest branch of the North Atlantic Current passes west of the Vøring Plateau into the international area. However, post-smolts were also captured consistently within the Norwegian EEZ along with large numbers of mackerel. The mackerel sometimes filled the cod end of the experimental "Fish lift" trawl completely, resulting in post-smolts being badly damaged.

Calculation of the total number of post-smolts per tonne mackerel captured in the international zone gave an estimate 26 in 2002 and 25 in 2003. This area was not surveyed in 2001. In the Norwegian EEZ, in 2001, this estimate was 16 post-smolts/tonne compared with 57 post-smolts/tonne in 2002 and 6 post-smolts/tonne of mackerel in 2003. The overlap in time with the salmon and the fisheries in this area may, however, be shorter than first anticipated but this would need to be verified with disaggregated data on the fisheries.

Extrapolation directly from commercial fishery observer programme

By-catches of salmon in pelagic fisheries, Russian surveys

In 2002 the Russian Federation started a comprehensive investigation of potential by-catch of Atlantic salmon and post-smolts in the Russian mackerel fishery in the Norwegian Sea. In 2003 the program was continued. Scientific observers and fisheries inspectors worked onboard Russian fishing vessels in both years. Their tasks included, *inter alia*, screening of pelagic catch for potential by-catch of Atlantic salmon and its post-smolts. The catches were scanned immediately after retrieval of the trawl while discharging the fish into bins and also at a ship factory during grading. The screening protocol was the same as in previous year. For catches of more than 10 t one to three samples of 3,000 kg each were taken for screening. Crew of the vessels assisted in this work. The total catch of vessels inspected was 3,800 t of mackerel and 3,400 t of blue-whiting. Total or partial screening of 416 hauls was carried out. 1 post-smolt and 15 adult salmon were recorded in July-August. Two of the adults were caught when the targeted fish was blue-whiting. Also one fish caught in late July was described as a sea trout.

The data collected in 2002-2003 in the Russian pelagic fish surveys and in the screening program are summarized in Tables 3.11.2.2 and 3.11.2.3. Estimates provided for the research fishery in 2002 suggest a post-smolt/mackerel ratio of 5.93 per tonne and an adult salmon/mackerel ratio of 0.56 per tonne. Calculation of the ratio of total number of post-smolts per tonne of mackerel in the international zone gave an estimate of 0.002 post-smolts per tonne captured in the commercial fishery in 2002 and 0.0003 in 2003. The ratio of total number of adults per tonne of mackerel in the international zone was 0.002 in 2002 and 0.004 in 2003. As in 2002, the results suggest very extremely low numbers of post-smolts and adult salmon caught in the mackerel fishery in July-August in the international waters of the Norwegian Sea.

Conclusions on estimating by-catch

Clearly there is a large discrepancy between the estimates derived from each of the methods. The highest value is 57 post-smolts/tonne of mackerel while the lowest values is 0.0003 post-smolts/tonne. Despite the surveys being carried out in areas where post-smolts and adults are known to occur, it is not possible to derive a single estimate due to the limitations of the methodologies previously noted.

3.11.3 Examination of time series of catches of herring, mackerel, blue whiting and capelin against PFA for Northern and Southern Europe stock complexes.

Historical trends in pre-fishery abundance of NEAC stock complexes have been examined to compare trends in relative abundance of pelagic stocks in specific areas and salmon stocks (Figure 3.11.3.1) . The ICES areas are shown in Figure 3.11.1.1.

Mackerel catch Catch in sub-area I, II & Divs. Vb

(ICES 2004/ACFM:08)

Herring catch Total catch of Norwegian spring-spawning herring

(ICES 2003/ACFM:23)

Blue-whiting catch Total catch in northern areas

(ICES 2003/ACFM:23)

Capelin catch Total catch in Iceland-East Greenland-Jan Mayen area

(ICES 2003/ACFM:23)

Mackerel fishery - The mackerel catches increased significantly from 1981. However, there was already a decline in PFA noted for the Southern NEAC stock complex. From 1981 on there is no overall trend in mackerel catches, while there is an obvious declining trend in PFA for NEAC stocks complexes (maturing and non-maturing).

Herring fishery - The main increase in catch occurred later in the time series than the mackerel catch. Again, while the fishery increased substantially from 1990 on, the decline in PFA was already clearly established before this time.

Blue-whiting fishery - The increase in the fishery from 1995 coincides with a relatively stable period in the PFA time series for all four NEAC stock complexes.

Capelin fishery - There is little common trend in catch of capelin and PFA of salmon from any of the four NEAC stock complexes.

A similar analysis should be carried out using disaggregated data when these become available.

3.11.4 Salmon surveys in the sea

Sampling of post-smolts and pre-adults in Norway and the Norwegian Sea

Since 1990 5,081 post-smolts and 246 older salmon have been captured in 2656 surface trawl hauls carried out during cruises for surveying pelagic fish as well as dedicated salmon surveys (Table 3.11.4.1). The geographical distribution of post-smolts captured in 2003 is shown in Figure 3.11.4.1.

The CPUE values for post-smolts (number of fish caught per trawl hour) (Table 3.11.4.1) were relatively high during the dedicated salmon cruises, perhaps reflecting favourable timing of the cruises in relation to the density of post-smolt cohorts passing through the area surveyed (west of the Vøring Plateau). The detection rate of smolts may also be higher when they are the target species of the cruise and experienced “salmon personnel” are on board.

The gear currently in use is thought to be more effective in catching post-smolts than larger salmon during the summer months. Thus, CPUEs for larger salmon have not been calculated. However, in a Nordic data storage tag (DST) tag and release experiment, described in Section 2, where a specially designed salmon trawl has been used, substantial numbers of pre-adult and adult salmon were captured in late autumn of 2002 and 2003. It is thought that the gear may be effective in catching larger fish at colder sea temperatures.

Pelagic fish survey in the international waters of the Norwegian Sea

In 2003, the Russian pelagic fish survey in the Norwegian Sea was carried out by the R/V "Smolensk" M-103 (cruise 50). This survey is a part of an international research programme to study commercial species in the Norwegian and Barents Seas and is conducted on a yearly basis from May to July. Its target species are herring, blue whiting and mackerel. One of the objectives of the survey was to map the distribution of post-smolts in the Norwegian Sea.

The area was surveyed from 64°45N to 68°30N between 03°E and 06°W (Figure 3.11.4.2, Table 3.11.4.2). Trawling was carried out using a TR-2492 midwater trawl with a 50-meter vertical and horizontal opening. This trawl is used in the commercial pelagic fishery, the only difference being a 16 mm mesh blinder net in the cod end. From 8 to 17 July 31 hauls were undertaken, of which 22 were with a headline at 0-5 m depth and 9 with a headline at 30-340 m depth.

At headline depths between 0 and 5m, the towing speed was from 3.9 to 5.2 knots, with haul duration of 30-90 min. The whole catch was screened and each fish was handled and identified individually. Mackerel were found in all trawls and catches varied from 5kg to 5,395 kg (average 429kg, total 13,293kg). Fish length varied between 32cm and 38 cm, weight between 370g and 670g.When towing was carried out with a headline depth of 30-340m, the catch consisted largely of blue-whiting.

Other species found in all trawls were lumpsucker, which were caught on regular basis, herring (15 individuals), saithe (1 individual) and angler fish (1 individual). No salmon (adults or post-smolts) were caught in any of the trawls.

Table 3.3.3.1 **Conservation limit options for NEAC stock groups estimated from national lagged egg deposition model and from river specific values (where available).**

	National Model CLs		River Specific CLs		Conservation Limit used	
	1SW	MSW	1SW	MSW	1SW	MSW
Northern Europe						
Finland	28,142	16,571			28,142	16,571
Iceland	41,412	8,891			41,412	8,891
Norway[1]	136,970	81,008			136,970	81,008
Russia	100,442	44,552			100,442	44,552
Sweden	2,865	1,133			2,865	1,133
Conservation Limit :					309,831	152,155
Spawner Escapement Reserve:					391,970	255,655

[1]Norwegian Conservation Limits calculated on data from 1983

	National Model CLs		River Specific CLs		Conservation Limit used	
	1SW	MSW	1SW	MSW	1SW	MSW
Southern Europe						
France			17,400	5,100	17,400	5,100
Ireland	210,588	23,301	194,950	17,960	194,950	17,960
UK (E&W)			37,677	13,748	37,677	13,748
UK (NI)	16,846	2,331			16,846	2,331
UK (Scot)	232,822	228,755			232,822	228,755
Conservation Limit :					499,695	267,894
Spawner Escapement Reserve:					635,237	452,576

Table 3.6.1.1. Southern NEAC input data (Spawners/eggs and year) used in PFA forecast model.

Year	Eggs(x10^3)
1977	5,586,325
1978	5,534,261
1979	5,223,240
1980	4,195,159
1981	3,701,509
1982	3,770,343
1983	3,567,144
1984	3,517,084
1985	3,572,419
1986	3,445,149
1987	4,298,094
1988	3,643,532
1989	3,790,052
1990	4,532,542
1991	4,435,278
1992	4,734,881
1993	4,730,640
1994	3,999,181
1995	3,270,875
1996	3,361,433
1997	3,595,631
1998	3,469,755
1999	3,537,399
2000	3,197,751
2001	2,624,551
2002	2,470,106
2003	2,294,264
2004	2,676,809

Table 3.6.1.2 Predictions and 95% confidence limits (all values in thousands) of *PFA non-maturing* salmon for Southern NEAC using *Spawners* (Eggs) and *Year*.

Year	Prediction	Lower limit	Upper limit
2003	525	321	859
2004	489	305	786

Table 3.9.3.1 Numbers of gear units licensed or authorised by country and gear type.

Year	England & Wales					UK (Scotland)		UK (N. Ireland)			Norway			
	Gillnet licences	Sweepnet	Hand-held net	Fixed engine	Rod & Line[1]	Fixed engine[2]	Net and coble[3]	Driftnet	Draftnet	Bagnets and boxes	Bagnet	Bendnet	Liftnet	Driftnet (No. nets)
1971	437	230	294	79	-	3,069	802	142	305	18	4,608	2,421	26	8,976
1972	308	224	315	76	-	3,437	810	130	307	18	4,215	2,367	24	13,448
1973	291	230	335	70	-	3,241	884	130	303	20	4,047	2,996	32	18,616
1974	280	240	329	69	-	3,182	777	129	307	18	3,382	3,342	29	14,078
1975	269	243	341	69	-	2,978	768	127	314	20	3,150	3,549	25	15,968
1976	275	247	355	70	-	2,854	756	126	287	18	2,569	3,890	22	17,794
1977	273	251	365	71	-	2,742	677	126	293	19	2,680	4,047	26	30,201
1978	249	244	376	70	-	2,572	691	126	284	18	1,980	3,976	12	23,301
1979	241	225	322	68	-	2,698	747	126	274	20	1,835	5,001	17	23,989
1980	233	238	339	69	-	2,892	670	125	258	20	2,118	4,922	20	25,652
1981	232	219	336	72	-	2,704	647	123	239	19	2,060	5,546	19	24,081
1982	232	221	319	72	-	2,415	647	123	221	18	1,843	5,217	27	22,520
1983	232	209	333	74	-	2,530	669.5	120	207	17	1,735	5,428	21	21,813
1984	226	223	354	74	-	2,443	653	121	192	19	1,697	5,386	35	21,210
1985	223	230	375	69	-	2,196	551	122	168	19	1,726	5,848	34	20,329
1986	220	221	368	64	-	1,996	618.5	121	148	18	1,630	5,979	14	17,945
1987	213	206	352	68	-	1,762	577	120	119	18	1,422	6,060	13	17,234
1988	210	212	284	70	-	1,577	402	115	113	18	1,322	5,702	11	15,532
1989	201	199	282	75	-	1,235	355.5	117	108	19	1,888	4,100	16	0
1990	200	204	292	69	-	1,280	339.5	114	106	17	2,375	3,890	7	0
1991	199	187	264	66	-	1,136	289	118	102	18	2,343	3,628	8	0
1992	203	158	267	65	-	850	292.5	121	91	19	2,268	3,342	5	0
1993	187	151	259	55	-	900	263.5	120	73	18	2,869	2,783	-	0
1994	177	158	257	53	37,278	752	243.5	119	68	18	2,630	2,825	-	0
1995	163	156	249	47	34,941	729	221.5	122	68	16	2,542	2,715	-	0
1996	151	132	232	42	35,281	644	200.5	117	66	12	2,280	2,860	-	0
1997	139	131	231	35	32,781	688	190	116	63	12	2,002	1,075	-	0
1998	130	129	196	35	32,525	545	143.5	117	70	12	1,865	1,027	-	0
1999	120	109	178	30	29,132	384	128.5	113	52	11	1,649	989	-	0
2000	110	103	158	32	30,139	385	119	109	57	10	1,557	982	-	0
2001	113	99	143	33	24,350	387	95	107	50	6	1,976	1,081	-	0
2002	113	94	147	32	29,407	427	101	106	47	4	1,666	917	-	0
2003	58	97	160	57	27,209	328	105	102	52	2	1,664	766	-	0
Mean 1998-2002	117	107	164	32	29,111	426	117	110	55	9	1,743	999		0
% change [4]	-50.5	-9.2	-2.7	75.9	-6.5	-22.9	-10.6	-7.6	-5.8	-76.7	-4.5	-23.3		
Mean 1993-2002	140	126	205	39	31759	584	171	115	61	12	2104	1725		0
% change [4]	-58.7	-23.1	-22.0	44.7	-14.3	-43.8	-38.5	-11.0	-15.3	-83.2	-20.9	-55.6		

[1] Total number of rods days fished, data for 2003 is provisional.
[2] Number of gear units expressed as trap months.
[3] Number of gear units expressed as crew months.
[4] (2003/mean - 1) * 100

Table 3.9.3.1 continued Number of gear units licensed or authorised by country and gear type.

	Ireland				Finland				France			Russia		
					The Teno River			R. Näätämö				Kola Peninsula	Archangel region	
	Driftnets No.	Draftnets	Other nets Commercial	Rod	Recreational fishery Tourist anglers		Local rod and net fishery	Recreational fishery	Rod and line licences	Com. nets in freshwater[4]	Licences in estuary[4,5]	Catch-and-release Fishing days	Commercial, number of gears	
Year					Fishing days	Fishermen	Fishermen	Fishermen					Coastal	In-river
1971	916	697	213	10,566	-	-	-	-	-	-	-			
1972	1,156	678	197	9,612	-	-	-	-	-	-	-			
1973	1,112	713	224	11,660	-	-	-	-	-	-	-			
1974	1,048	681	211	12,845	-	-	-	-	-	-	-			
1975	1,046	672	212	13,142	-	-	-	-	-	-	-			
1976	1,047	677	225	14,139	-	-	-	-	-	-	-			
1977	997	650	211	11,721	-	-	-	-	-	-	-			
1978	1,007	608	209	13,327	-	-	-	-	-	-	-			
1979	924	657	240	12,726	-	-	-	-	-	-	-			
1980	959	601	195	15,864	-	-	-	-	-	-	-			
1981	878	601	195	15,519	16,859	5,742	677	467	-	-	-			
1982	830	560	192	15,697	19,690	7,002	693	484	4,145	55	82			
1983	801	526	190	16,737	20,363	7,053	740	587	3,856	49	82			
1984	819	515	194	14,878	21,149	7,665	737	677	3,911	42	82			
1985	827	526	190	15,929	21,742	7,575	740	866	4,443	40	82			
1986	768	507	183	17,977	21,482	7,404	702	691	5,919	58 [1]	86			
1987	-	-	-	-	22,487	7,759	754	689	5,804 [1]	87 [2]	80			
1988	836	-	-	11,539	21,708	7,755	741	538	4,413	101	76			
1989	801	-	-	16,484	24,118	8,681	742	696	3,826	83	78			
1990	756	525	189	15,395	19,596	7,677	728	614	2,977	71	76			
1991	707	504	182	15,178	22,922	8,286	734	718	2,760	78	71	1,711		
1992	691	535	183	20,263	26,748	9,058	749	875	2,160	57	71	4,088		
1993	673	457	161	23,875	29,461	10,198	755	705	2,111	53	55	6,026	59	199
1994	732	494	176	24,988	26,517	8,985	751	671	1,680	17	59	8,619	60	230
1995	768	512	164	27,056	24,951	8,141	687	716	1,881	17	59	5,822	55	239
1996	778	523	170	29,759	17,625	5,743	672	814	1,806	21	69	6,326	85	330
1997	852	531	172	31,873	16,255	5,036	616	588	2,974	10	59	6,355	68	282
1998	874	513	174	31,565	18,700	5,759	621	673	2,358	16	63	6,034	66	270
1999	874	499	162	32,493	22,935	6,857	616	850	2,232	15	61	7,023	66	194
2000	871	490	158	33,527	28,385	8,275	633	624	2,745 [3]	16	35	7,336	60	173
2001	881	540	155	32,814	33,501	9,367	863	590	3,111 [7]	12	32	8,468	53	121
2002	833	544	159	32,814	37,491	10,560	853	660	na. [8]	20	58	9,624	63	72
2003	877	549	159	32,725	34,979	10,032	832	644	na. [8]	na. [8]	na. [8]	11,898	55	84
Mean 1998-2002	867	517	162	32,643	28,202	8,164	717	679				7,043	63	208
% change [6]	1.2	6.1	-1.6	0.3	24.0	22.9	16.0	-5.2				68.9	-12.1	-59.6
Mean 1993-2002	814	510	165	30,076	25,582	7,892	707	689				6,610	64	226
% change [6]	7.8	7.6	-3.7	8.8	36.7	27.1	17.7	-6.5				80.0	-13.5	-62.9

[1] Common licence for salmon and seatrout introduced in 1986 leading to a short-term increase in the number of licences issued.

[2] Since 1987 fishermen have been obliged to declare their catches.

[3] This figure is an estimate from a sample of anglers, the sea trout and salmon angling licenses being common since 2000

[4] The number of licences, 1999 included, indicates only the number of fishermen or boats allowed to fish for salmon. It overestimates the actual number of fishermen fishing for salmon up to 2 or 3 times.

[5] Adour estuary only southwest of France.

[6] (2003/mean - 1) * 100

[7] Estimated from from licences sold to migratory salmonid fisheries.

[8] Figures not avaliable

Table 3.9.4.1 Nominal catch of SALMON in NEAC Area (in tonnes round fresh weight), 1960-2003 (2003 figures are provisional).

Year	Southern countries	Northern countries	Faroes (1)	Other catches in international waters	Total Reported Catch	Unreported catches NEAC Area	Unreported catches International waters (2)
1960	2,641	2,899	-	-	5,540	-	-
1961	2,276	2,477	-	-	4,753	-	-
1962	3,894	2,815	-	-	6,709	-	-
1963	3,842	2,434	-	-	6,276	-	-
1964	4,242	2,908	-	-	7,150	-	-
1965	3,693	2,763	-	-	6,456	-	-
1966	3,549	2,503	-	-	6,052	-	-
1967	4,492	3,034	-	-	7,526	-	-
1968	3,623	2,523	5	403	6,554	-	-
1969	4,383	1,898	7	893	7,181	-	-
1970	4,048	1,834	12	922	6,816	-	-
1971	3,736	1,846	-	471	6,053	-	-
1972	4,257	2,340	9	486	7,092	-	-
1973	4,604	2,727	28	533	7,892	-	-
1974	4,352	2,675	20	373	7,420	-	-
1975	4,500	2,616	28	475	7,619	-	-
1976	2,931	2,383	40	289	5,643	-	-
1977	3,025	2,184	40	192	5,441	-	-
1978	3,102	1,864	37	138	5,141	-	-
1979	2,572	2,549	119	193	5,433	-	-
1980	2,640	2,794	536	277	6,247	-	-
1981	2,557	2,352	1,025	313	6,247	-	-
1982	2,533	1,938	606	437	5,514	-	-
1983	3,532	2,341	678	466	7,017	-	-
1984	2,308	2,461	628	101	5,498	-	-
1985	3,002	2,531	566	-	6,099	-	-
1986	3,595	2,588	530	-	6,713	-	-
1987	2,564	2,266	576	-	5,406	2,554	-
1988	3,315	1,969	243	-	5,527	3,087	-
1989	2,433	1,627	364	-	4,424	2,103	-
1990	1,645	1,775	315	-	3,735	1,779	180-350
1991	1,145	1,677	95	-	2,917	1,555	25-100
1992	1,523	1,806	23	-	3,352	1,825	25-100
1993	1,443	1,853	23	-	3,319	1,471	25-100
1994	1,896	1,685	6	-	3,587	1,157	25-100
1995	1,774	1,503	5	-	3,282	942	-
1996	1,393	1,358	-	-	2,751	947	-
1997	1,112	962	-	-	2,074	732	-
1998	1,121	1,099	6	-	2,226	1,108	-
1999	934	1,139	0	-	2,073	887	-
2000	1,210	1,518	8	-	2,736	1,135	-
2001	1,242	1,634	0	-	2,876	1,089	-
2002	1,119	1,360	0	-	2,479	946	-
2003	932	1,384	0	-	2,315	719	-
Means							
1998-2002	1,125	1,350	3	-	2,478	1,033	-
1993-2002	1,324	1,411	6	-	2,740	1,041	-

1. Since 1991, fishing carried out at the Faroes has only been for research purposes.
2. Estimates refer to season ending in given year.

Table 3.9.5.1 CPUE for salmon rod fisheries in Finland (Teno, Naatamo), France, and UK(N.Ireland)(Bush).

	Finland (R. Teno)		Finland (R. Naatamo)		France	UK(N.Ire.)(R.Bush)
	Catch per angler season	Catch per angler day	Catch per angler season	Catch per angler day	Catch per angler season	Catch per rod day
Year	kg	kg	kg	kg	Number	Number
1974		2.8				
1975		2.7				
1976		-				
1977		1.4				
1978		1.1				
1979		0.9				
1980		1.1				
1981	3.2	1.2				
1982	3.4	1.1				
1983	3.4	1.2				0.248
1984	2.2	0.8	0.5	0.2		0.083
1985	2.7	0.9	n/a	n/a		0.283
1986	2.1	0.7	n/a	n/a		0.274
1987	2.3	0.8	n/a	n/a	0.39	0.194
1988	1.9	0.7	0.5	0.2	0.73	0.165
1989	2.2	0.8	1.0	0.4	0.55	0.135
1990	2.8	1.1	0.7	0.3	0.71	0.247
1991	3.4	1.2	1.3	0.5	0.60	0.396
1992	4.5	1.5	1.4	0.3	0.94	0.258
1993	3.9	1.3	0.4	0.2	0.88	0.341
1994	2.4	0.8	0.6	0.2	2.31	0.205
1995	2.7	0.9	0.5	0.1	1.15	0.206
1996	3.0	1.0	0.7	0.2	1.57	0.267
1997	3.4	1.0	1.1	0.2	0.43 [1]	0.338
1998	3.0	0.9	1.3	0.3	0.67	0.569
1999	3.7	1.1	0.8	0.2	0.76	0.273
2000	5.0	1.5	0.9	0.2	0.79	0.259
2001	5.9	1.7	1.2	0.3	0.65	0.444
2002	3.1	0.9	0.7	0.2		0.184
2003	2.6	0.7	0.8	0.2		0.238
Mean 1998-02	4.1	1.2	1.0	0.2	0.7	0.3

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

Table 3.9.5.2 CPUE for salmon rod fisheries in the Barents Sea and White Sea basin in Russia.

	Barents Sea Basin, catch per angler day				White Sea Basin, catch per angler day			
Year	Rynda	Kharlovka	Varzina	Iokanga	Ponoy	Varzuga	Kitsa	Umba
1991					2.794	1.870		1.330
1992	2.370	1.454	1.070	0.135	3.489	2.261	1.209	1.366
1993	1.177	1.464	0.488	0.650	2.881	1.278	1.425	2.720
1994	0.710	0.847	0.548	0.325	2.332	1.596	1.588	1.436
1995	0.486	0.782	1.220	0.718	3.459	2.524	1.784	1.196
1996	0.703	0.845	1.502	1.398	3.503	1.444	1.761	0.930
1997	1.197	0.709	0.613	1.411	5.330	2.364	2.482	1.457
1998	1.010	0.551	0.441	0.868	4.544	2.284	2.784	0.979
1999	0.947	0.642	0.427	1.193	3.300	1.710	1.657	0.756
2000	1.348	0.769	0.565	2.283	3.494	1.526	3.018	1.245
2001	1.160	1.272	0.888	0.730	4.200	1.860	1.814	1.039
2002	2.390	0.993	0.794	2.822	5.807	1.436	2.108	0.360
2003	1.611	1.143	0.785	2.009	6.343			
Mean 1998-02	1.371	0.845	0.623	1.579	4.269	1.763	2.276	0.876

Table 3.9.5.3 CPUE data for net and fixed engine salmon fisheries by Region in UK (England & Wales). Data expressed as catch per licence-tide in all Regions except the North East, for which the data are recorded as catch per licence-day.

		Region (aggregated data, various methods)					
Year	North East drift nets	North East	Southern	South West	Midlands[1]	Wales	North West
1988		5.49	10.15			-	-
1989		4.39	16.80			0.90	0.82
1990		5.53	8.56			0.78	0.63
1991		3.20	6.40			0.62	0.51
1992		3.83	5.00			0.69	0.40
1993	8.23	6.43	No fishing			0.68	0.63
1994	9.02	7.53	-			1.02	0.71
1995	11.18	7.84	-			1.00	0.79
1996	4.93	3.74	-			0.73	0.59
1997	6.84	5.30	-	0.42		0.77	0.35
1998	6.49	5.12	-	0.56	0.25	0.69	0.32
1999	8.77	7.28	-	0.48	0.36	0.83	0.37
2000	12.21	10.50	-	0.69	0.43	0.40	0.64
2001	10.06	8.70	-	0.62	0.42	0.47	0.56
2002	8.23	7.00	-	0.62	0.34	0.53	0.63
2003	7.1	4.69	-	0.67	0.48	0.39	0.51
Mean 1998-02	9.15	7.72		0.59	0.38	0.58	0.50

[1]Seine nets and lave nets only

Table 3.9.5.4 CPUE data for Scottish net fisheries.
Catch in numbers of fish per unit effort.

Year	Fixed engine	Net and coble CPUE
	Catch/trap month (1)	Catch/crew month
1952	33.91	156.39
1953	33.12	121.73
1954	29.33	162.00
1955	37.09	201.76
1956	25.71	117.48
1957	32.58	178.70
1958	48.36	170.39
1959	33.30	159.34
1960	30.67	177.80
1961	31.00	155.17
1962	43.89	242.00
1963	44.25	182.86
1964	57.92	247.11
1965	43.67	188.61
1966	44.86	210.59
1967	72.57	329.80
1968	46.99	198.47
1969	65.51	327.64
1970	50.28	241.91
1971	57.19	231.61
1972	57.49	248.04
1973	73.74	240.60
1974	63.42	257.11
1975	53.63	235.71
1976	42.88	150.79
1977	45.58	188.67
1978	53.93	196.07
1979	42.20	157.19
1980	37.65	158.62
1981	49.60	183.86
1982	61.29	180.21
1983	55.84	203.59
1984	58.88	155.31
1985	49.60	148.88
1986	75.19	193.42
1987	61.83	145.61
1988	50.57	198.43
1989	71.04	262.35
1990	33.22	145.96
1991	35.87	106.35
1992	59.58	153.66
1993	52.84	125.23
1994	92.13	123.74
1995	75.60	142.27
1996	57.52	110.93
1997	32.96	57.79
1998	36.02	68.67
1999	21.94	58.78
2000	53.73	105.22
2001	60.26	76.14
2002	43.80	67.30
2003	84.40	100.30
Mean 1998-02	43.15	75.22

[1] Excludes catch and effort for Solway Region

Table 3.9.5.5 Catch per unit effort for the marine fishery in Norway. The CPUE is expressed as numbers of salmon caught per net day in bagnets and bendnets divided by salmon weight.

	Bagnet			Bendnet		
Year	**< 3kg**	**3-7 kg**	**>7 kg**	**< 3kg**	**3-7 kg**	**>7 kg**
1998	0.88	0.66	0.12	0.80	0.56	0.13
1999	1.16	0.72	0.16	0.75	0.67	0.17
2000	2.01	0.90	0.17	1.24	0.87	0.17
2001	1.52	1.03	0.22	1.03	1.39	0.36
2002	0.91	1.03	0.26	0.74	0.87	0.32
2003	1.57	0.9	0.26	0.84	0.69	0.28
Mean 1998-02	1.30	0.87	0.19	0.91	0.87	0.23

Table 3.9.6.1. Percentage of 1SW salmon in catches from countries in the North East Atlantic, 1987-2003

Year	Iceland	Finland	Norway	Russia	Sweden	**Northern countries**	UK (Scot)	UK (E&W)	France	Spain (1)	**Southern countries**
1987		66	61	71		**63**	61	68	77		**63**
1988		63	64	53		**62**	57	69	29		**60**
1989	69	66	73	73	41	**72**	63	65	33		**63**
1990	66	64	68	73	70	**69**	48	52	45		**49**
1991	72	59	65	70	71	**66**	53	71	39		**58**
1992	72	70	62	72	68	**65**	55	77	48		**59**
1993	76	58	61	61	62	**63**	57	81	74	64	**64**
1994	64	55	68	69	64	**67**	54	77	55	61	**61**
1995	72	59	58	70	78	**62**	53	72	60	22	**59**
1996	74	79	53	80	63	**61**	53	65	51	22	**56**
1997	73	69	64	82	54	**68**	54	73	51	22	**60**
1998	82	75	66	82	59	**70**	58	83	71	50	**65**
1999	71	83	65	78	71	**68**	45	70	27	13	**54**
2000	84	71	67	75	69	**69**	54	79	58	63	**65**
2001	81	48	58	74	55	**60**	55	75	51	36	**62**
2002	82	34	49	70	63	**54**	54	75	69	33	**63**
2003	76	51	61	67	57	**62**	52	66	45	15	**55**
Means											
1998-2002	80	62	61	76	63	**64**	53	76	55	39	**62**
1993-2002	76	63	61	74	64	**64**	54	75	57	39	**61**

1. Based on catches in Asturias (90 % of the Spanish catch).

Table 3.9.12.1a Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - River Teno (FINLAND/NORWAY)

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	8,422	8,538	30	40	30	40	40	60	40	70
1972	13,160	13,341	30	40	30	40	40	60	40	70
1973	11,969	15,958	30	40	30	40	40	60	40	70
1974	23,709	23,709	30	40	30	40	40	60	40	70
1975	16,527	26,417	30	40	30	40	40	60	40	70
1976	11,323	21,719	30	40	30	40	40	60	40	70
1977	5,807	13,227	30	40	30	40	40	60	40	70
1978	7,902	8,452	30	40	30	40	40	60	40	70
1979	9,249	7,390	30	40	30	40	40	60	30	60
1980	4,792	8,938	20	30	20	30	40	60	30	60
1981	7,386	9,835	20	30	20	30	40	60	30	60
1982	2,163	12,826	20	30	20	30	40	60	30	60
1983	10,680	13,990	20	30	20	30	40	60	30	60
1984	11,942	13,262	20	30	20	30	40	60	30	60
1985	18,039	10,339	20	30	20	30	40	60	30	60
1986	16,389	9,028	20	30	20	30	40	60	30	60
1987	20,950	11,290	20	30	20	30	40	60	30	60
1988	10,019	7,231	20	30	20	30	40	60	30	60
1989	28,091	10,011	20	30	20	30	50	70	40	70
1990	26,646	12,562	20	30	20	30	50	70	40	70
1991	32,423	15,136	20	30	20	30	50	70	40	70
1992	42,965	16,158	20	30	20	30	50	70	40	70
1993	30,197	18,720	20	30	20	30	50	70	40	70
1994	12,016	15,521	20	30	20	30	50	70	40	70
1995	11,801	9,634	20	30	20	30	50	70	40	70
1996	22,799	6,956	20	30	20	30	40	60	30	60
1997	19,481	10,083	20	30	20	30	40	60	30	60
1998	22,460	8,497	20	30	20	30	40	60	30	60
1999	38,687	8,854	20	30	20	30	50	70	40	60
2000	40,654	19,707	20	30	20	30	50	70	40	60
2001	18,372	28,337	20	30	20	30	50	70	40	60
2002	10757	22717	20	30	20	30	40	60	40	60
2003	12699	16093	20	30	20	30	40	60	40	60
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1b Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - FRANCE

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
	Non-reporting included in exploitation rates until 2002									
1971	1,740	4,060	0	0	0	0	2	5	25	50
1972	3,480	8,120	0	0	0	0	2	5	25	50
1973	2,130	4,970	0	0	0	0	2	5	25	50
1974	990	2,310	0	0	0	0	2	5	25	50
1975	1,980	4,620	0	0	0	0	2	5	25	50
1976	1,820	3,380	0	0	0	0	2	5	25	50
1977	1,400	2,600	0	0	0	0	2	5	25	50
1978	1,435	2,665	0	0	0	0	2	5	25	50
1979	1,645	3,055	0	0	0	0	2	5	25	50
1980	3,430	6,370	0	0	0	0	2	5	25	50
1981	2,720	4,080	0	0	0	0	2	5	20	50
1982	1,680	2,520	0	0	0	0	2	5	20	50
1983	1,800	2,700	0	0	0	0	2	5	20	50
1984	2,960	4,440	0	0	0	0	2	5	20	50
1985	1,100	3,330	0	0	0	0	2	5	20	50
1986	3,400	3,400	0	0	0	0	2	12	20	50
1987	6,000	1,800	0	0	0	0	2	12	20	50
1988	2,100	5,000	0	0	0	0	2	12	20	50
1989	1,100	2,300	0	0	0	0	2	12	20	50
1990	1,900	2,300	0	0	0	0	2	12	20	50
1991	1,400	2,100	0	0	0	0	2	12	20	50
1992	2,500	2,700	0	0	0	0	2	12	20	50
1993	3,600	1,300	0	0	0	0	2	12	20	50
1994	2,800	2,300	0	0	0	0	2	12	20	40
1995	1,669	1,095	0	0	0	0	5	20	20	40
1996	2,063	1,942	0	0	0	0	5	20	20	40
1997	1,060	1,001	0	0	0	0	5	20	20	40
1998	2,065	846	0	0	0	0	5	20	20	40
1999	690	1,831	0	0	0	0	5	20	20	40
2000	1,792	1,277	0	0	0	0	5	20	20	40
2001	1,544	1,489	0	0	0	0	5	20	20	40
2002	2,423	1,063	2	5	2	5	5	20	20	55
2003	1,531	1,834	2	5	2	5	5	20	20	55
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1c Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - ICELAND-WEST & SOUTH

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	30618	16749	1	3	1	3	40	60	50	70
1972	24832	25733	1	3	1	3	40	60	50	70
1973	26624	23183	1	3	1	3	40	60	50	70
1974	18975	20017	1	3	1	3	40	60	50	70
1975	29428	21266	1	3	1	3	40	60	50	70
1976	23233	18379	1	3	1	3	40	60	50	70
1977	23802	17919	1	3	1	3	40	60	50	70
1978	31199	23182	1	3	1	3	40	60	50	70
1979	28790	14840	1	3	1	3	40	60	50	70
1980	13073	20855	1	3	1	3	40	60	50	70
1981	16890	13919	1	3	1	3	40	60	50	70
1982	17331	9826	1	3	1	3	40	60	50	70
1983	21923	16423	1	3	1	3	40	60	50	70
1984	13476	13923	1	3	1	3	40	60	50	70
1985	21822	10097	1	3	1	3	40	60	50	70
1986	35891	8423	1	3	1	3	40	60	50	70
1987	22302	7480	1	3	1	3	40	60	50	70
1988	40028	8523	1	3	1	3	40	60	50	70
1989	22377	7607	1	3	1	3	40	60	50	70
1990	20584	7548	1	3	1	3	40	60	50	70
1991	22711	7519	1	3	1	3	40	60	50	70
1992	26006	8479	1	3	1	3	40	60	50	70
1993	25479	4155	1	3	1	3	40	60	50	70
1994	20985	6736	1	3	1	3	40	60	50	70
1995	25371	6777	1	3	1	3	40	60	50	70
1996	21913	4364	1	3	1	3	40	60	50	70
1997	16007	4910	1	3	1	3	40	60	50	70
1998	21900	3037	1	3	1	3	40	60	50	70
1999	17448	5757	1	3	1	3	40	60	50	70
2000	15502	1519	1	3	1	3	40	60	50	70
2001	13586	2707	1	3	1	3	40	60	50	70
2002	16952	2845	1	3	1	3	40	60	50	70
2003	18522	4530	1	3	1	3	40	60	50	70
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1d Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - ICELAND- North & East

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	4610	6625	1	3	1	3	40	60	50	70
1972	4223	10337	1	3	1	3	40	60	50	70
1973	5060	9672	1	3	1	3	40	60	50	70
1974	5047	9176	1	3	1	3	40	60	50	70
1975	6152	10136	1	3	1	3	40	60	50	70
1976	6184	8350	1	3	1	3	40	60	50	70
1977	8597	11631	1	3	1	3	40	60	50	70
1978	8739	14998	1	3	1	3	40	60	50	70
1979	8363	9897	1	3	1	3	40	60	50	70
1980	1268	13784	1	3	1	3	40	60	50	70
1981	6528	4827	1	3	1	3	40	60	50	70
1982	3007	5539	1	3	1	3	40	60	50	70
1983	4437	4224	1	3	1	3	40	60	50	70
1984	1611	5447	1	3	1	3	40	60	50	70
1985	11116	3511	1	3	1	3	40	60	50	70
1986	13827	9569	1	3	1	3	40	60	50	70
1987	8145	9908	1	3	1	3	40	60	50	70
1988	11775	6381	1	3	1	3	40	60	50	70
1989	6342	5414	1	3	1	3	40	60	50	70
1990	4752	5709	1	3	1	3	40	60	50	70
1991	6900	3965	1	3	1	3	40	60	50	70
1992	12996	5903	1	3	1	3	40	60	50	70
1993	10689	6672	1	3	1	3	40	60	50	70
1994	3414	5656	1	3	1	3	40	60	50	70
1995	8776	3511	1	3	1	3	40	60	50	70
1996	4681	4605	1	3	1	3	40	60	50	70
1997	6406	2594	1	3	1	3	40	60	50	70
1998	10905	3780	1	3	1	3	40	60	50	70
1999	5326	4030	1	3	1	3	40	60	50	70
2000	5595	2324	1	3	1	3	40	60	50	70
2001	4976	2587	1	3	1	3	40	60	50	70
2002	8437	2366	1	3	1	3	40	60	50	70
2003	4428	3367	1	3	1	3	40	60	50	70
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1e Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - All IRELAND.

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	417,428	46,381	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1972	449,160	49,907	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1973	460,665	51,185	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1974	561,324	62,369	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1975	616,250	68,472	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1976	420,509	46,723	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1977	368,580	40,953	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1978	324,350	36,039	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1979	289,539	32,171	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1980	237,561	37,890	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1981	157,713	29,205	30.00	45.00	30.00	45.00	50.00	75.00	35.00	60.00
1982	277,528	11,059	30.00	45.00	30.00	45.00	0.00	0.00	28.34	44.99
1983	463,603	27,161	30.00	45.00	30.00	45.00	0.00	0.00	10.34	45.41
1984	243,152	19,844	30.00	45.00	30.00	45.00	0.00	0.00	37.02	50.00
1985	456,437	17,960	30.00	45.00	30.00	45.00	0.00	0.00	32.75	39.45
1986	509,992	29,011	30.00	45.00	30.00	45.00	0.00	0.00	36.95	54.30
1987	344,067	26,472	20.00	40.00	20.00	40.00	0.00	0.00	27.50	36.86
1988	416,652	22,795	20.00	40.00	20.00	40.00	0.00	0.00	31.85	94.21
1989	316,537	25,776	20.00	40.00	20.00	40.00	0.00	0.00	38.35	78.00
1990	183,589	14,950	20.00	40.00	20.00	40.00	0.00	0.00	53.85	76.69
1991	116,924	9,521	20.00	40.00	20.00	40.00	0.00	0.00	30.47	61.54
1992	180,869	14,728	20.00	40.00	20.00	40.00	0.00	0.00	47.66	55.26
1993	152,577	12,425	15.00	35.00	15.00	35.00	0.00	0.00	23.59	56.43
1994	235,935	19,213	15.00	35.00	15.00	35.00	0.00	0.00	38.06	62.08
1995	233,314	18,999	15.00	35.00	15.00	35.00	0.00	0.00	40.65	88.47
1996	202,582	16,497	15.00	35.00	15.00	35.00	0.00	0.00	51.93	58.282798
1997	152,809	12,443	15.00	35.00	10.00	20.00	0.00	0.00	18.51	74.44
1998	162,055	13,196	15.00	35.00	10.00	20.00	0.00	0.00	60.47	63.25
1999	145,337	11,835	15.00	35.00	10.00	20.00	0.00	0.00	42.70	52.29
2000	180,823	14,725	15.00	35.00	10.00	20.00	0.00	0.00	26.51	35.48
2001	234,683	19,111	5	10	5	10	0.00	0.00	27	38
2002	198,634	16,175	5	10	5	10	0.00	0.00	20	35
2003	166152	13530	5	10	5	10	0.00	0.00	16	43
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1f Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - NORWAY-South

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	40,511	37,105	40	60	40	60	65	85	65	85
1984	34,248	38,614	40	60	40	60	65	85	65	85
1985	47,877	36,968	40	60	40	60	65	85	65	85
1986	51,839	41,890	40	60	40	60	65	85	65	85
1987	48,690	39,641	40	60	40	60	65	85	65	85
1988	53,775	37,145	40	60	40	60	65	85	65	85
1989	43,128	25,279	40	60	40	60	55	75	55	75
1990	44,259	25,907	40	60	40	60	55	75	55	75
1991	30,771	19,054	40	60	40	60	55	75	55	75
1992	32,488	24,124	40	60	40	60	55	75	55	75
1993	34,503	22,835	30	50	30	50	55	75	55	75
1994	42,551	20,903	30	50	30	50	55	75	55	75
1995	32,685	24,725	30	50	30	50	55	75	55	75
1996	27,739	26,029	30	50	30	50	55	75	55	75
1997	31,381	14,922	25	45	25	45	50	70	50	70
1998	38,299	16,966	25	45	25	45	50	70	50	70
1999	31,256	9,881	25	45	25	45	50	70	50	70
2000	54,671	22,208	25	45	25	45	50	70	50	70
2001	59,425	29,896	25	45	25	45	50	70	50	70
2002	39,068	21,513	25	45	25	45	50	70	50	70
2003	41,642	28,168	20	40	20	40	50	70	50	70
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1g Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - NORWAY-Mid

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	121,221	74,648	40	60	40	60	65	85	65	85
1984	94,373	67,639	40	60	40	60	65	85	65	85
1985	114,613	56,641	40	60	40	60	65	85	65	85
1986	106,921	77,225	40	60	40	60	65	85	65	85
1987	83,669	62,216	40	60	40	60	65	85	65	85
1988	80,111	45,609	40	60	40	60	65	85	65	85
1989	94,897	30,862	40	60	40	60	55	75	55	75
1990	78,888	40,174	40	60	40	60	55	75	55	75
1991	67,370	30,087	40	60	40	60	55	75	55	75
1992	51,463	33,092	40	60	40	60	55	75	55	75
1993	58,326	28,184	30	50	30	50	55	75	55	75
1994	113,427	33,520	30	50	30	50	55	75	55	75
1995	57,813	42,696	30	50	30	50	55	75	55	75
1996	28,925	31,613	30	50	30	50	55	75	55	75
1997	43,127	20,565	25	45	25	45	50	70	50	70
1998	63,497	26,817	25	45	25	45	50	70	50	70
1999	60,689	28,792	25	45	25	45	50	70	50	70
2000	109,278	42,452	25	45	25	45	50	70	50	70
2001	88,096	52,031	25	45	25	45	50	70	50	70
2002	42,669	52,774	25	45	25	45	50	70	50	70
2003	91,118	46,963	20	40	20	40	50	70	50	70
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1h Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - NORWAY-North

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0
1983	104,040	49,413	40	60	40	60	70	90	70	90
1984	150,372	58,858	40	60	40	60	70	90	70	90
1985	118,841	58,956	40	60	40	60	70	90	70	90
1986	84,150	63,418	40	60	40	60	70	90	70	90
1987	72,370	34,232	40	60	40	60	70	90	70	90
1988	53,880	32,140	40	60	40	60	70	90	70	90
1989	42,010	13,934	40	60	40	60	60	80	60	80
1990	38,216	17,321	40	60	40	60	60	80	60	80
1991	42,888	21,789	40	60	40	60	60	80	60	80
1992	34,593	19,265	40	60	40	60	60	80	60	80
1993	51,440	39,014	30	50	30	50	60	80	60	80
1994	37,489	33,411	30	50	30	50	60	80	60	80
1995	36,283	26,037	30	50	30	50	60	80	60	80
1996	40,792	36,636	30	50	30	50	60	80	60	80
1997	39,930	30,115	25	45	25	45	60	80	60	80
1998	46,645	34,806	25	45	25	45	60	80	60	80
1999	46,394	46,744	25	45	25	45	60	80	60	80
2000	61,854	51,569	25	45	25	45	60	80	60	80
2001	46,331	54,023	25	45	25	45	60	80	60	80
2002	38,101	43,100	25	45	25	45	60	80	60	80
2003	44,947	35,972	20	40	20	40	60	80	60	80
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

M(min)=	0.02	Return time (m)=	1SW(min)	7	MSW(min)	16
M(max)=	0.04		1SW(max)	9	MSW(max)	18

Table 3.9.12.1i Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - RUSSIA (Archangelsk & Karelia)

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	134	16,592	5	15	5	15	40	80	40	80
1972	116	14,434	5	15	5	15	40	80	40	80
1973	169	20924	5	15	5	15	40	80	40	80
1974	170	21137	5	15	5	15	40	80	40	80
1975	140	17398	5	15	5	15	40	80	40	80
1976	111	13781	5	15	5	15	40	80	40	80
1977	78	9722	5	15	5	15	40	80	40	80
1978	82	10134	5	15	5	15	40	80	40	80
1979	112	13903	5	15	5	15	40	80	40	80
1980	156	19397	5	15	5	15	40	80	40	80
1981	68	8394	5	15	5	15	40	80	40	80
1982	71	8797	5	15	5	15	40	80	40	80
1983	48	11938	5	15	5	15	40	80	40	80
1984	21	10680	5	15	5	15	40	80	40	80
1985	454	11183	5	15	5	15	40	80	40	80
1986	12	12291	5	15	5	15	40	80	40	80
1987	647	8734	5	15	5	15	40	80	40	80
1988	224	9978	5	15	5	15	40	80	40	80
1989	989	10245	5	15	5	15	40	80	40	80
1990	1418	8429	10	20	10	20	40	80	40	80
1991	421	8725	15	25	15	25	40	80	40	80
1992	1031	3949	20	30	20	30	40	80	40	80
1993	196	4251	25	35	25	35	40	80	40	80
1994	334	5631	30	40	30	40	40	80	40	80
1995	386	5214	40	50	40	50	40	80	40	80
1996	231	3753	50	60	50	60	40	80	40	80
1997	721	3351	50	60	50	60	40	80	40	80
1998	585	4208	50	60	50	60	40	80	40	80
1999	299	3101	50	60	50	60	40	80	40	80
2000	514	3382	50	60	50	60	40	80	40	80
2001	363	2348	50	60	50	60	40	80	40	80
2002	1676	2439	50	60	50	60	40	80	40	80
2003	893	2041	50	60	50	60	40	80	40	80
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1j Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - RUSSIA (Kola Peninsula; Barents Sea Basin)

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	4892	5979	10	20	10	20	40	50	40	50
1972	7978	9750	10	20	10	20	40	50	40	50
1973	9376	11460	10	20	10	20	35	45	35	45
1974	12794	15638	10	20	10	20	35	45	35	45
1975	13872	13872	10	20	10	20	40	50	40	50
1976	11493	14048	10	20	10	20	50	60	50	60
1977	7257	8253	10	20	10	20	45	55	45	55
1978	7106	7113	10	20	10	20	50	60	50	60
1979	6707	3141	10	20	10	20	35	45	35	45
1980	6621	5216	10	20	10	20	35	45	35	45
1981	4547	5973	10	20	10	20	35	45	35	45
1982	5159	4798	10	20	10	20	30	40	30	40
1983	8504	9943	10	20	10	20	30	40	30	40
1984	9453	12601	10	20	10	20	30	40	30	40
1985	6774	7877	10	20	10	20	30	40	30	40
1986	10147	5352	10	20	10	20	35	45	35	45
1987	8560	5149	10	20	10	20	35	45	35	45
1988	6644	3655	10	20	10	20	30	40	30	40
1989	13424	6787	10	20	10	20	35	45	35	45
1990	16038	8234	10	20	10	20	35	45	35	45
1991	4550	7568	10	20	10	20	25	35	25	35
1992	11394	7109	10	20	10	20	25	35	25	35
1993	8642	5690	10	20	10	20	25	35	25	35
1994	6101	4632	10	20	10	20	25	35	25	35
1995	6318	3693	10	20	10	20	25	35	25	35
1996	6815	1701	15	25	15	25	20	30	20	30
1997	3564	867	20	30	20	30	10	20	10	20
1998	1854	280	30	40	30	40	10	15	10	15
1999	1510	424	35	45	35	45	5	10	5	10
2000	805	323	45	55	45	55	4	8	4	8
2001	591	241	55	65	55	65	2	5	2	5
2002	1436	2478	40	60	40	60	5	15	15	25
2003	1938	1095	40	60	40	60	5	15	15	25
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1k Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - RUSSIA (Kola peninsula; White Sea Basin)

Year	Catch (numbers) **Current year returns**		Unrep. as % of 1SW		Unrep. as % of MSW		Exp. rate 1SW (%)		Exp. Rate MSW (%)		Catch (numbers) **Previous year returns**	
	1SW	MSW	min	max	min	max	min	max	min	max	1SW	MSW
1971	67845	29077	1	5	1	5	40	60	50	70		
1972	45837	19644	1	5	1	5	40	60	50	70		
1973	68684	29436	1	5	1	5	40	60	50	70		
1974	63892	27382	1	5	1	5	40	60	50	70		
1975	109038	46730	1	5	1	5	40	60	50	70		
1976	76281	41075	1	5	1	5	40	60	50	70		
1977	47943	32392	1	5	1	5	40	60	50	70		
1978	49291	17307	1	5	1	5	40	60	50	70		
1979	69511	21369	1	5	1	5	40	60	50	70		
1980	46037	23241	1	5	1	5	40	60	50	70		
1981	40172	12747	1	5	1	5	40	60	50	70		
1982	32619	14840	1	5	1	5	40	60	50	70		
1983	54217	20840	1	5	1	5	40	60	50	70		
1984	56786	16893	1	5	1	5	40	60	50	70		
1985	87274	16876	1	5	1	5	40	60	50	70		
1986	72102	17681	1	5	1	5	40	60	50	70		
1987	79639	12501	1	5	1	5	40	60	40	60		
1988	44813	18777	1	5	1	5	40	50	40	50		
1989	53293	11448	5	10	5	10	40	50	40	50		
1990	44409	11152	10	15	10	15	40	50	40	50		
1991	31978	6263	15	20	15	20	30	40	30	40		
1992	23827	3680	20	25	20	25	20	30	20	30		
1993	20987	5552	20	30	20	30	20	30	20	30		
1994	25178	3680	25	35	25	35	20	30	10	20		
1995	19381	2847	30	40	30	40	20	30	10	20		
1996	27097	2710	30	40	30	40	20	30	10	20		
1997	27695	2085	30	40	30	40	20	30	10	20		
1998	32693	1963	30	40	30	40	20	30	10	20		
1999	22330	2841	30	40	30	40	20	30	10	20		
2000	26376	4396	30	40	30	40	20	30	10	20		
2001	20483	3959	30	40	30	40	10	20	10	20	1215	663
2002	19174	3937	30	40	30	40	10	20	10	20	2176	784
2003	15687	3734	30	40	30	40	10	20	10	20	3717	1182
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1l Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - RUSSIA (Pechora River)

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	605	17,728	10	30	10	30	50	80	50	80
1972	825	24,175	10	30	10	30	50	80	50	80
1973	1,705	49,962	10	30	10	30	50	80	50	80
1974	1,320	38,680	10	30	10	30	50	80	50	80
1975	1,298	38,046	10	30	10	30	50	80	50	80
1976	991	34,394	10	30	10	30	50	80	50	80
1977	589	20,464	10	30	10	30	50	80	50	80
1978	759	26,341	10	30	10	30	50	80	50	80
1979	421	14,614	10	30	10	30	50	80	50	80
1980	1,123	39,001	10	30	10	30	50	80	50	80
1981	126	20,874	10	30	10	30	50	80	50	80
1982	54	13,546	10	30	10	30	50	80	50	80
1983	598	16,002	10	30	10	30	50	80	50	80
1984	1,833	15,967	10	30	10	30	50	80	50	80
1985	2,763	29,738	10	30	10	30	50	80	50	80
1986	66	32,734	10	30	10	30	50	80	50	80
1987	21	21,179	10	30	10	30	50	80	50	80
1988	3,184	12,816	10	30	10	30	50	80	50	80
			Input data for analisis of total adult returns to Home Waters				**Input data for spawner abundance analysis**			
	Estimated numbers of adult returns to fresh water		**Marine Unrep. as % of adult returns to FW 1SW**		**Marine Unrep. as % of adult returns to FW MSW**		**Freshwater Unrep. as % of adult returns to FW 1SW**		**Freshwater Unrep. as % of adult returns to FW MSW**	
	1SW	**MSW**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
1989	24,596	27,404	5	15	5	15	50	80	50	80
1990	50	49,950	5	15	5	15	50	80	50	80
1991	7,975	47,025	5	15	5	15	50	80	50	80
1992	550	54,450	5	15	5	15	50	80	50	80
1993	68	67,932	5	15	5	15	50	80	50	80
1994	3,900	48,100	5	15	5	15	50	80	50	80
1995	9,280	70,720	5	15	5	15	50	80	50	80
1996	8,664	48,336	5	15	5	15	50	80	50	80
1997	1,440	38,560	5	15	5	15	50	80	50	80
1998	780	59,220	5	15	5	15	50	80	50	80
1999	2,120	37,880	5	15	5	15	50	80	50	80
2000	84	83,916	5	15	5	15	50	80	50	80
2001	2,244	41,756	5	15	5	15	50	80	50	80
2002	405	44,595	5	15	5	15	50	80	50	80
2003	0	21,000	5	15	5	15	50	80	50	80
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

M(min)= 0.020 Return time (m)= 1SW(min) 7 MSW(min) 19

M(max)= 0.040 1SW(max) 8 MSW(max) 21

Table 3.9.12.1m Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - SWEDEN

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	6,330	420	15	45	15	45	40	65	45	70
1972	5,005	295	15	45	15	45	40	65	45	70
1973	6,210	1,025	15	45	15	45	40	65	45	70
1974	8,935	660	15	45	15	45	40	65	45	70
1975	9,620	160	15	45	15	45	40	65	45	70
1976	5,420	480	15	45	15	45	40	65	45	70
1977	2,555	360	15	45	15	45	40	65	45	70
1978	2,917	275	15	45	15	45	40	65	45	70
1979	3,080	800	15	45	15	45	40	65	45	70
1980	3,920	1,400	15	45	15	45	40	65	45	70
1981	7,095	407	15	45	15	45	40	65	45	70
1982	6,230	1,460	15	45	15	45	40	65	45	70
1983	8,290	1,005	15	45	15	45	40	65	45	70
1984	11,680	1,410	15	45	15	45	40	65	45	70
1985	13,890	590	15	45	15	45	40	65	45	70
1986	14,635	570	15	45	15	45	40	65	45	70
1987	11,860	1,700	15	45	15	45	40	65	45	70
1988	9,930	1,650	15	45	15	45	40	65	45	70
1989	3,180	4,610	15	45	15	45	40	65	45	70
1990	7,430	3,135	5	25	5	25	30	60	35	65
1991	8,990	3,620	5	25	5	25	30	60	35	65
1992	9,850	4,655	5	25	5	25	30	60	35	65
1993	10,540	6,370	5	25	5	25	30	60	35	65
1994	8,035	4,660	5	25	5	25	30	60	35	65
1995	9,761	2,770	5	25	5	25	25	50	30	55
1996	6,008	3,542	5	25	5	25	25	50	30	55
1997	2,747	2,307	5	25	5	25	25	50	30	55
1998	2,421	1,702	5	25	5	25	25	50	30	55
1999	3,573	1,460	5	25	5	25	25	50	30	55
2000	7,103	3,196	5	25	5	25	25	50	30	55
2001	4,634	3,853	5	25	5	25	25	50	30	55
2002	4733	2826	5	25	5	25	25	50	30	55
2003	2701	2062	5	25	5	25	25	50	30	55
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1n Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(England and Wales).

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	28,915	23,611	29	48	29	48	36	56	31	51
1972	24,613	34,364	29	49	29	49	35	55	30	50
1973	28,989	26,097	29	48	29	48	35	55	29	49
1974	35,431	18,776	29	49	29	49	35	55	29	49
1975	36,465	25,819	29	48	29	48	35	55	29	49
1976	25,422	14,113	28	46	28	46	36	56	30	50
1977	27,836	17,260	29	49	29	49	37	57	31	51
1978	31,397	14,228	29	48	29	48	36	56	30	50
1979	29,030	6,803	29	48	29	48	35	55	30	50
1980	26,997	22,019	29	49	29	49	36	56	30	50
1981	28,414	31,115	29	48	29	48	36	56	30	50
1982	24,139	12,003	29	48	29	48	37	57	31	51
1983	35,903	13,861	28	46	28	46	37	57	31	51
1984	31,923	11,355	27	46	27	46	37	57	31	51
1985	30,759	16,020	29	49	29	49	37	57	31	51
1986	35,695	21,822	28	47	28	47	37	57	31	51
1987	36,339	17,101	29	48	29	48	37	57	31	51
1988	47,989	21,560	30	50	30	50	37	57	31	51
1989	33,610	18,098	28	46	28	46	38	58	32	52
1990	24,152	22,294	28	46	28	46	38	58	32	52
1991	23,018	9,402	28	47	28	47	37	57	31	51
1992	22,787	6,806	30	50	30	50	37	57	31	51
1993	30,526	7,160	29	48	29	48	34	54	28	48
1994	41,662	12,444	18	30	18	30	35	55	29	49
1995	30,148	11,724	17	28	17	28	32	52	26	46
1996	21,848	11,764	15	26	15	26	31	51	25	45
1997	18,690	6,913	14	24	14	24	27	47	22	42
1998	19,466	3,987	14	24	14	24	25	45	20	40
1999	15,032	6,442	13	22	13	22	20	40	12	32
2000	23,116	6,145	12	21	12	21	20	40	8	28
2001	18,867	6,289	12	20	12	20	18	38	7	27
2002	17,443	5,814	12	20	12	20	19	39	7	27
2003	10,164	5,236	12	20	12	20	16	36	6	26
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

M(min)=	0.020	Return time (m)=	1SW(min)	7	MSW(min)	17
M(max)=	0.040		1SW(max)	9	MSW(max)	19

Table 3.9.12.1o Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(Northern Ireland)- Foyle Fisheries area

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	79,715	4,196	10	33	10	33	75	85	45	55
1972	66,054	3,477	10	33	10	33	75	85	45	55
1973	58,705	3,090	10	33	10	33	75	85	45	55
1974	74,148	3,903	10	33	10	33	75	85	45	55
1975	52,159	2,745	10	33	10	33	75	85	45	55
1976	36,984	1,947	10	33	10	33	75	85	45	55
1977	37,295	1,963	10	33	10	33	75	85	45	55
1978	45,515	2,396	10	33	10	33	75	85	45	55
1979	35,153	1,850	10	33	10	33	75	85	45	55
1980	46,762	2,461	10	33	10	33	75	85	45	55
1981	33,042	1,739	10	33	10	33	75	85	45	55
1982	57,149	3,008	10	33	10	33	75	85	45	55
1983	79,089	4,163	10	33	10	33	75	85	45	55
1984	28,055	1,477	10	33	10	33	75	85	45	55
1985	38,495	2,026	10	33	10	33	75	85	45	55
1986	44,036	2,318	10	33	10	33	75	85	45	55
1987	17,559	924	10	33	10	33	62	76	41	51
1988	44,920	2,364	10	33	10	33	58	71	32	40
1989	61,585	3,241	10	37	10	37	80	98	54	66
1990	40,732	2,144	10	17	10	17	56	68	34	42
1991	22,176	1,167	10	17	10	17	58	71	39	47
1992	40,144	2,113	10	23	10	23	50	62	30	36
1993	36,127	1,901	10	17	10	17	37	45	11	13
1994	36,921	1,943	10	28	10	28	63	77	36	44
1995	34,116	1,796	10	17	10	17	60	74	38	46
1996	29,017	1,527	10	20	10	20	47	67	24	44
1997	41,765	2,198	5	15	5	15	50	70	24	44
1998	37,953	1,998	5	15	5	15	20	30	15	30
1999	22,126	1,165	5	15	5	15	58	68	25	40
2000	31,038	1,634	5	15	5	15	53	63	25	40
2001	21,827	1,149	0	10	0	10	45	55	25	35
2002	38730	2038	0	5	0	5	45	65	25	35
2003	31643	1665	0	0	0	0	47	67	25	35
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1p Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(Northern Ireland)-FCB area

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	36,270	1,909	10	33	10	33	75	85	45	55
1972	35,293	1,858	10	33	10	33	75	85	45	55
1973	29,858	1,571	10	33	10	33	75	85	45	55
1974	22,787	1,199	10	33	10	33	75	85	45	55
1975	27,275	1,436	10	33	10	33	75	85	45	55
1976	18,270	962	10	33	10	33	75	85	45	55
1977	17,139	902	10	33	10	33	75	85	45	55
1978	25,391	1,336	10	33	10	33	75	85	45	55
1979	14,631	770	10	33	10	33	75	85	45	55
1980	16,310	858	10	33	10	33	75	85	45	55
1981	16,338	860	10	33	10	33	75	85	45	55
1982	14,370	756	10	33	10	33	75	85	45	55
1983	21,293	1,121	10	33	10	33	75	85	45	55
1984	11,348	597	10	33	10	33	75	85	45	55
1985	12,635	665	10	33	10	33	75	85	45	55
1986	13,443	708	10	33	10	33	75	85	45	55
1987	9,439	497	10	33	10	33	62	76	41	51
1988	14,628	770	10	33	10	33	58	71	32	40
1989	15,405	811	10	37	10	37	80	98	54	66
1990	9,703	510	10	17	10	17	56	68	34	42
1991	7,137	376	10	17	10	17	58	71	39	47
1992	9,546	502	10	23	10	23	50	62	30	36
1993	8,075	425	10	17	10	17	37	45	11	13
1994	11,446	602	10	28	10	28	63	77	36	44
1995	11,887	625	10	17	10	17	60	74	38	46
1996	10,606	558	10	20	10	20	47	67	24	44
1997	10,705	563	5	15	5	15	50	70	24	44
1998	9,577	504	5	15	5	15	20	30	15	30
1999	9,205	484	5	15	5	15	58	68	25	40
2000	10,826	570	5	15	5	15	53	63	25	40
2001	8278	436	0	10	0	10	45	55	25	35
2002	3314	174	0	5	0	5	45	65	25	35
2003	2244	118	0	5	0	5	47	67	25	35
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1q Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(Scotland)-East

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	216,873	135,527	15	35	15	35	62.8	87.9	39.9	59.9
1972	220,106	183,872	15	35	15	35	64.0	89.6	41.2	61.7
1973	259,773	204,825	15	35	15	35	62.4	87.4	39.9	59.8
1974	245,424	158,951	15	35	15	35	68.3	95.6	45.1	67.6
1975	181,940	180,828	15	35	15	35	67.1	93.9	44.0	66.1
1976	150,069	92,179	15	35	15	35	63.8	89.3	40.5	60.8
1977	154,306	118,645	15	35	15	35	67.9	95.0	44.6	66.9
1978	158,844	139,688	15	35	15	35	63.0	88.2	40.8	61.2
1979	160,791	116,514	15	35	15	35	65.3	91.4	43.1	64.6
1980	101,665	155,646	10	25	10	25	64.0	89.6	41.6	62.4
1981	129,690	156,683	10	25	10	25	63.3	88.6	41.0	61.4
1982	175,355	113,180	10	25	10	25	59.2	82.9	36.2	54.3
1983	170,843	126,104	10	25	10	25	64.2	89.8	39.5	59.3
1984	175,675	90,829	10	25	10	25	58.4	81.8	35.1	52.7
1985	133,073	95,012	10	25	10	25	51.5	72.2	31.1	46.7
1986	180,276	128,813	10	25	10	25	49.6	69.4	30.0	45.1
1987	139,252	88,519	10	25	10	25	53.8	75.3	32.4	48.6
1988	118,580	91,068	10	25	10	25	33.6	47.0	23.4	35.0
1989	142,992	85,348	5	15	5	15	31.3	43.8	22.4	33.5
1990	63,297	73,954	5	15	5	15	33.2	46.5	23.0	34.5
1991	53,835	53,676	5	15	5	15	30.7	42.9	22.0	32.9
1992	79,883	67,968	5	15	5	15	26.8	37.5	20.7	31.0
1993	73,396	60,496	5	15	5	15	29.4	41.2	21.5	32.3
1994	80,498	72,523	5	15	5	15	27.6	38.6	20.9	31.3
1995	72,961	69,047	5	15	5	15	25.8	36.1	20.3	30.5
1996	56,610	50,356	5	15	5	15	24.0	33.6	19.6	29.4
1997	37,468	34,845	5	15	5	15	25.5	35.7	20.1	30.2
1998	44,952	32,231	5	15	5	15	20.2	28.3	18.3	27.5
1999	20,907	27,014	5	15	5	15	20.7	28.9	18.7	28.0
2000	36,871	31,280	5	15	5	15	18.2	25.5	17.8	26.7
2001	36,646	30,470	5	15	5	15	17.0	23.8	17.1	26.1
2002	26,579	21,720	5	15	5	15	16.1	22.5	16.9	25.4
2003	27,863	25,802	5	15	5	15	16.1	22.5	16.9	25.4
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1r Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(Scotland)-West

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	45,287	26,074	25	45	25	45	31	44	20	30
1972	31,359	34,151	25	45	25	45	32	45	21	31
1973	33,317	33,095	25	45	25	45	31	44	20	30
1974	43,992	29,406	25	45	25	45	34	48	23	34
1975	40,424	27,150	25	45	25	45	34	47	22	33
1976	38,423	22,403	25	45	25	45	32	45	20	30
1977	39,958	20,342	25	45	25	45	34	48	22	33
1978	45,626	23,266	25	45	25	45	31	44	20	31
1979	26,445	15,995	25	45	25	45	33	46	22	32
1980	19,776	16,942	20	35	20	35	32	45	21	31
1981	21,048	18,038	20	35	20	35	32	44	20	31
1982	32,706	15,062	20	35	20	35	30	41	18	27
1983	38,774	19,857	20	35	20	35	32	45	20	30
1984	37,404	16,384	20	35	20	35	29	41	18	26
1985	24,939	19,636	20	35	20	35	26	36	16	23
1986	22,579	19,584	20	35	20	35	25	35	15	23
1987	25,533	15,475	20	35	20	35	27	38	16	24
1988	30,518	21,094	20	35	20	35	17	24	12	18
1989	31,949	18,538	15	25	15	25	16	22	11	17
1990	17,797	13,970	15	25	15	25	17	23	11	17
1991	19,773	11,517	15	25	15	25	15	21	11	16
1992	21,793	14,873	15	25	15	25	13	19	10	16
1993	21,121	11,230	15	25	15	25	15	21	11	16
1994	18,277	12,295	15	25	15	25	14	19	10	16
1995	16,843	9,141	15	25	15	25	13	18	10	15
1996	9,559	7,472	15	25	15	25	12	17	10	15
1997	9,066	5,509	15	25	15	25	13	18	10	15
1998	8,369	6,150	15	25	15	25	10	14	9	14
1999	4,149	3,589	15	25	15	25	10	14	9	14
2000	6,974	5,301	15	25	15	25	9	13	9	13
2001	5,603	4,194	15	25	15	25	9	12	9	13
2002	4,691	4,548	15	25	15	25	8	11	8	13
2003	2,433	2,449	15	25	15	25	4	6	4	7
2004	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0

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

Table 3.9.12.1s Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - FAROES

Year n/n+1	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	2620	105796	5	15	0	0	100	100	100	100
1972	2754	111187	5	15	0	0	100	100	100	100
1973	3121	126012	5	15	0	0	100	100	100	100
1974	2186	88276	5	15	0	0	100	100	100	100
1975	2798	112984	5	15	0	0	100	100	100	100
1976	1830	73900	5	15	0	0	100	100	100	100
1977	1291	52112	5	15	0	0	100	100	100	100
1978	974	39309	5	15	0	0	100	100	100	100
1979	1736	70082	5	15	0	0	100	100	100	100
1980	4523	182616	5	15	0	0	100	100	100	100
1981	7443	300542	5	15	0	0	100	100	100	100
1982	6859	276957	5	15	0	0	100	100	100	100
1983	15861	215349	5	15	0	0	100	100	100	100
1984	5534	138227	5	15	0	0	100	100	100	100
1985	378	158103	5	15	0	0	100	100	100	100
1986	1979	180934	5	15	0	0	100	100	100	100
1987	90	166244	5	15	0	0	100	100	100	100
1988	8637	87629	5	15	0	0	100	100	100	100
1989	1788	121965	5	15	0	0	100	100	100	100
1990	1989	140054	5	15	0	0	100	100	100	100
1991	943	84935	5	15	0	0	100	100	100	100
1992	68	35700	5	15	0	0	100	100	100	100
1993	6	30023	5	15	0	0	100	100	100	100
1994	15	31672	5	15	0	0	100	100	100	100
1995	18	34662	5	15	0	0	100	100	100	100
1996	101	28381	5	15	0	0	100	100	100	100
1997	0	0	10	20	0	0	100	100	100	100
1998	339	1,424	10	20	0	0	100	100	100	100
1999	0	0	10	20	0	0	100	100	100	100
2000	225	1,765	10	20	0	0	100	100	100	100
2001	0	0	10	20	0	0	100	100	100	100
2002	0	0	0	0	0	0	100	100	100	100
2003	0	0	0	0	0	0	100	100	100	100
2004	0	0	0	0	0	0	100	100	100	100
2005	0	0	0	0	0	0	100	100	100	100

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

Return time (m)= 1SW(min) 0 MSW(min) 1
1SW(max) 1 MSW(max) 2

Prop'n 1SW returning as grilse = min 0.170
max 0.270

Table 3.9.12.1t Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - WEST GREENLAND.

Year	Catch (numbers)		Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	0	856369	0	0	5	15	100	100	100	100
1972	0	614244	0	0	5	15	100	100	100	100
1973	0	560048	0	0	5	15	100	100	100	100
1974	0	535475	0	0	5	15	100	100	100	100
1975	0	650641	0	0	5	15	100	100	100	100
1976	0	386513	0	0	5	15	100	100	100	100
1977	0	442368	0	0	5	15	100	100	100	100
1978	0	293731	0	0	5	15	100	100	100	100
1979	0	417665	0	0	5	15	100	100	100	100
1980	0	370807	0	0	5	15	100	100	100	100
1981	0	398738	0	0	5	15	100	100	100	100
1982	0	346302	0	0	5	15	100	100	100	100
1983	0	100000	0	0	5	15	100	100	100	100
1984	0	95498	0	0	5	15	100	100	100	100
1985	0	301045	0	0	5	15	100	100	100	100
1986	0	316832	0	0	5	15	100	100	100	100
1987	0	305696	0	0	5	15	100	100	100	100
1988	0	280818	0	0	5	15	100	100	100	100
1989	0	117422	0	0	5	15	100	100	100	100
1990	0	101859	0	0	5	15	100	100	100	100
1991	0	178113	0	0	5	15	100	100	100	100
1992	0	84342	0	0	5	15	100	100	100	100
1993	0	2,000	0	0	-25	25	100	100	100	100
1994	0	2,000	0	0	-25	25	100	100	100	100
1995	0	32422	0	0	5	15	100	100	100	100
1996	0	31944	0	0	0	0	100	100	100	100
1997	0	21402	0	0	0	0	100	100	100	100
1998	0	3957	0	0	0	0	100	100	100	100
1999	0	6169	0	0	0	0	100	100	100	100
2000	0	8171	0	0	30	50	100	100	100	100
2001	0	14,333	0	0	14	24	100	100	100	100
2002	0	3,369	0	0	43	63	100	100	100	100
2003	0	4,050	0	0	35	55	100	100	100	100
2004	0	0	0	0	0	0	100	100	100	100
2005	0	0	0	0	0	0	100	100	100	100

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

Table 3.9.14.1 **Estimated number of RETURNING 1SW salmon by NEAC country and year**

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	26,436	72,592		155,317	17,759			53,103	1,084,571	103,412	185,698	669,193	**2,095,977**
1972	41,089	60,007		119,035	14,088			106,760	1,169,750	92,372	162,305	577,570	**2,108,756**
1973	37,435	65,463		175,482	17,561			65,448	1,193,936	107,490	142,436	704,086	**2,213,396**
1974	74,134	49,810		175,027	25,123			30,579	1,468,592	134,201	154,917	673,700	**2,461,989**
1975	51,381	73,469		266,708	27,218			60,293	1,601,133	135,885	127,744	553,440	**2,478,495**
1976	35,479	60,786		185,126	15,296			56,330	1,096,065	89,395	88,535	452,103	**1,782,427**
1977	18,003	67,196		119,020	7,194			43,040	957,133	100,438	87,499	495,901	**1,684,011**
1978	24,579	82,671		119,631	8,176			43,533	839,483	113,135	114,477	567,585	**1,678,213**
1979	28,954	76,978		166,122	8,640			50,223	748,039	106,292	80,142	475,611	**1,460,306**
1980	12,994	29,618		118,542	11,003			104,804	618,653	98,852	101,195	300,421	**1,223,925**
1981	19,838	48,503		97,693	20,045			82,841	408,345	101,734	78,992	372,786	**1,044,699**
1982	5,865	42,026		85,616	17,618			51,640	615,449	86,578	114,567	515,738	**1,383,972**
1983	28,927	54,364	703,898	142,793	23,653	**953,636**	63,528	55,134	1,172,311	124,022	161,671	551,563	**2,064,701**
1984	32,315	31,344	734,208	154,377	32,966	**985,209**	68,501	90,683	619,267	108,638	63,435	559,047	**1,441,070**
1985	49,035	67,761	745,595	212,908	39,144	**1,114,443**	67,615	33,627	990,142	109,016	82,123	466,527	**1,681,435**
1986	44,576	103,175	643,886	181,546	41,241	**1,014,425**	57,227	60,769	1,210,666	124,782	92,466	572,236	**2,060,918**
1987	56,791	62,814	543,316	194,381	33,913	**891,215**	50,668	107,026	785,378	128,170	50,447	433,430	**1,504,452**
1988	27,359	107,580	502,676	132,400	27,927	**797,942**	44,158	37,640	1,067,833	170,480	118,766	650,737	**2,045,456**
1989	63,339	59,583	558,224	197,200	8,897	**887,242**	54,237	19,524	727,226	113,515	114,049	701,263	**1,675,578**
1990	60,138	52,470	496,970	163,297	20,055	**792,931**	47,380	33,273	463,283	82,604	94,560	350,316	**1,024,035**
1991	72,993	61,336	435,031	139,173	24,655	**733,188**	41,592	25,478	316,982	79,016	52,676	337,070	**811,223**
1992	97,257	81,216	364,807	173,032	26,780	**743,092**	38,171	44,931	413,897	82,770	106,823	481,045	**1,129,466**
1993	68,135	75,065	367,445	148,450	28,768	**687,863**	34,472	63,341	349,570	113,722	125,326	456,165	**1,108,124**
1994	27,096	50,422	497,663	175,690	22,300	**773,170**	48,575	50,943	449,190	125,227	85,780	484,078	**1,195,218**
1995	26,712	70,370	323,340	157,412	32,079	**609,913**	31,517	15,498	476,782	95,149	79,870	481,585	**1,148,883**
1996	62,125	54,911	247,279	214,908	19,793	**599,017**	30,161	19,222	486,790	69,178	82,581	329,313	**987,084**
1997	52,770	46,388	283,575	211,164	8,831	**602,728**	32,442	9,582	374,874	63,370	98,099	248,424	**794,349**
1998	60,960	67,677	369,683	232,458	7,908	**738,686**	40,102	18,986	383,160	70,680	214,172	333,696	**1,020,695**
1999	87,017	47,062	343,131	177,707	11,556	**666,473**	34,089	6,401	376,123	61,934	55,454	188,224	**688,137**
2000	91,167	43,778	565,578	195,201	22,981	**918,705**	53,019	16,588	450,266	94,230	80,592	357,121	**998,797**
2001	41,429	38,422	486,594	269,162	15,218	**850,824**	62,666	14,016	533,478	83,917	63,774	344,865	**1,040,051**
2002	29,124	52,557	298,474	244,570	15,503	**640,228**	49,648	22,775	432,546	75,643	79,272	278,334	**888,570**
2003	34,489	47,364	413,631	212,688	8,867	**717,038**	50,737	14,737	421,923	49,492	60,345	245,910	**792,406**
10yr Av.	51,289	51,895	382,895	209,096	16,504	**711,678**	43,296	18,875	438,513	78,882	89,994	329,155	**955,419**

Table 3.9.14.2 **Estimated number of RETURNING MSW salmon by NEAC country and year**

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	24,399	40,087		133,339	1,071			11,217	161,535	97,733	15,696	618,437	**904,618**
1972	38,063	61,993		134,703	754			22,313	171,986	146,661	13,765	791,865	**1,146,590**
1973	46,210	56,366		224,002	2,640			13,760	179,401	110,167	11,976	864,391	**1,179,695**
1974	68,014	49,986		212,378	1,690			6,441	215,745	81,828	13,086	609,128	**926,228**
1975	76,189	53,896		226,231	409			12,803	237,943	109,800	10,772	672,487	**1,043,805**
1976	62,669	45,834		195,125	1,224			9,363	163,690	57,042	7,476	404,296	**641,867**
1977	37,883	50,891		134,693	925			7,231	143,083	71,386	7,380	467,181	**696,261**
1978	24,511	65,321		117,148	715			7,402	125,403	59,128	9,568	567,205	**768,706**
1979	26,402	42,563		101,995	2,069			8,608	111,611	28,522	6,729	414,897	**570,367**
1980	27,616	59,457		170,479	3,618			17,757	130,936	92,634	8,543	521,277	**771,148**
1981	30,374	32,221		97,157	1,034			12,495	100,345	128,267	6,692	582,021	**829,821**
1982	39,553	26,305		86,181	3,664			7,669	49,244	49,337	9,664	448,699	**564,613**
1983	42,641	35,592	429,897	124,683	2,595	**635,408**	38,252	8,304	187,826	54,954	13,579	487,433	**752,097**
1984	41,560	33,224	438,103	124,282	3,611	**640,779**	37,417	13,574	73,337	44,421	5,345	404,378	**541,055**
1985	31,888	23,379	404,098	135,533	1,515	**596,413**	35,790	10,358	80,282	65,290	6,945	496,905	**659,780**
1986	27,831	30,765	486,841	134,739	1,461	**681,638**	43,261	10,289	104,533	88,702	7,753	637,632	**848,909**
1987	35,028	29,844	363,084	100,412	4,388	**532,756**	33,581	5,556	119,066	69,357	3,976	406,520	**604,475**
1988	22,248	25,642	307,493	100,005	4,233	**459,621**	26,310	15,223	56,979	89,602	11,191	628,679	**801,675**
1989	24,870	22,392	216,153	97,714	11,839	**372,967**	20,585	6,985	65,944	70,650	8,924	547,407	**699,909**
1990	31,466	22,824	259,453	124,917	7,702	**446,362**	24,246	7,027	33,190	87,357	8,100	474,674	**610,348**
1991	37,537	19,682	218,888	122,373	8,791	**407,271**	20,695	6,541	30,833	37,259	4,157	343,177	**421,967**
1992	40,174	24,696	236,444	116,418	11,277	**429,008**	22,656	8,209	41,096	28,645	9,530	453,530	**541,010**
1993	46,752	18,612	227,770	138,228	15,291	**446,653**	20,389	3,904	44,296	31,218	22,453	378,336	**480,208**
1994	38,702	21,260	223,036	123,240	11,466	**417,704**	20,472	7,977	52,283	43,312	7,895	459,002	**570,470**
1995	24,126	17,658	238,183	139,197	7,879	**427,043**	20,545	3,811	42,066	43,329	6,674	434,861	**530,740**
1996	21,350	15,408	239,213	105,422	10,029	**391,421**	20,048	6,706	40,291	44,015	7,450	324,248	**422,710**
1997	31,092	12,805	159,606	85,454	6,587	**295,545**	14,846	3,490	36,219	27,654	9,275	227,128	**303,767**
1998	26,079	11,690	192,593	105,806	4,884	**341,052**	16,313	2,948	25,116	17,106	12,817	234,340	**292,326**
1999	23,889	16,742	205,310	93,014	4,203	**343,157**	18,080	6,333	29,480	38,516	5,725	200,481	**280,535**
2000	53,289	6,588	284,040	162,992	9,247	**516,157**	24,445	4,446	56,365	47,458	7,698	257,795	**373,761**
2001	77,051	9,104	335,416	116,094	11,063	**548,729**	29,464	5,111	65,442	52,745	5,582	250,771	**379,653**
2002	61,557	8,925	288,566	162,003	8,110	**529,160**	26,209	3,157	64,833	46,313	7,640	204,411	**326,354**
2003	43,428	13,560	256,277	99,242	5,895	**418,402**	21,964	5,498	53,698	47,071	5,994	213,510	**325,770**
10yr Av.	40,056	13,374	242,224	119,246	7,936	**422,837**	21,239	4,948	46,579	40,752	7,675	280,655	**380,609**

Table 3.9.14.3 **Estimated pre-fishery abundance of MATURING 1SW salmon (potential 1SW returns) by NEAC country and year**

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	33,734	92,341		200,585	22,783			67,491	1,379,860	131,884	237,190	844,868	**2,661,293**
1972	52,375	76,330		153,066	18,103			135,578	1,488,358	117,892	207,332	728,907	**2,678,066**
1973	47,735	83,265		225,701	22,561			83,191	1,519,330	137,146	182,023	888,289	**2,809,980**
1974	94,312	63,374		224,483	32,153			38,895	1,868,739	171,017	197,837	850,325	**3,126,813**
1975	65,458	93,462		343,388	34,869			76,637	2,037,277	173,250	163,268	699,104	**3,149,536**
1976	45,185	77,333		238,331	19,601			71,604	1,394,639	113,961	113,143	571,291	**2,264,638**
1977	22,958	85,471		153,191	9,242			54,665	1,217,951	128,043	111,765	626,296	**2,138,721**
1978	31,294	105,171		154,024	10,477			55,288	1,068,210	144,197	146,184	716,901	**2,130,780**
1979	36,889	97,907		214,042	11,114			63,831	951,559	135,497	102,418	600,090	**1,853,396**
1980	16,758	37,681		152,724	14,273			133,174	787,432	126,291	129,492	379,915	**1,556,304**
1981	25,594	61,687		126,434	25,950			105,480	520,382	130,340	101,393	471,594	**1,329,189**
1982	7,814	53,457		110,538	22,807			65,923	783,864	110,968	146,688	652,117	**1,759,560**
1983	37,177	69,174	897,727	183,971	30,561	**1,218,610**	84,673	70,336	1,492,029	158,721	206,859	697,477	**2,625,422**
1984	41,266	39,884	935,701	198,255	42,237	**1,257,343**	94,545	115,203	788,406	138,685	81,236	706,118	**1,829,649**
1985	62,462	86,187	949,586	274,350	50,062	**1,422,647**	91,955	42,800	1,260,043	139,081	105,003	589,097	**2,136,024**
1986	56,860	131,231	820,384	233,704	52,761	**1,294,940**	77,760	77,341	1,540,665	159,247	118,287	722,100	**2,617,641**
1987	72,351	79,900	692,328	250,459	43,408	**1,138,446**	69,281	135,972	999,910	163,501	64,637	547,378	**1,911,398**
1988	34,944	136,820	640,815	170,189	35,772	**1,018,540**	60,709	47,913	1,358,970	217,442	151,774	822,361	**2,598,460**
1989	80,633	75,811	711,068	252,070	11,460	**1,131,041**	73,762	24,896	925,139	144,743	145,658	885,600	**2,126,037**
1990	76,561	66,752	632,822	208,744	25,659	**1,010,538**	63,991	42,321	589,530	105,333	120,769	442,576	**1,300,530**
1991	92,835	78,008	553,767	178,822	31,494	**934,925**	56,167	32,354	403,443	100,717	67,281	426,157	**1,029,951**
1992	123,608	103,285	464,460	221,299	34,178	**946,829**	52,387	57,139	526,633	105,411	136,342	607,642	**1,433,167**
1993	86,604	95,485	467,683	190,182	36,730	**876,684**	47,121	80,432	444,729	144,806	159,923	576,035	**1,405,924**
1994	34,457	64,166	633,273	225,883	28,463	**986,243**	66,287	64,701	571,467	159,494	109,470	610,998	**1,516,130**
1995	33,977	89,525	411,589	201,923	40,945	**777,958**	43,325	19,694	606,573	121,170	101,958	607,841	**1,457,237**
1996	78,954	69,851	314,720	275,864	25,262	**764,652**	41,902	24,420	619,296	88,090	105,410	415,443	**1,252,659**
1997	67,055	58,990	360,880	271,308	11,262	**769,495**	45,207	12,172	476,747	80,666	125,172	313,529	**1,008,287**
1998	77,456	86,084	470,420	299,444	10,088	**943,491**	55,543	24,109	487,336	90,005	273,322	420,988	**1,295,759**
1999	110,592	59,875	436,525	227,891	14,731	**849,613**	46,755	8,123	478,387	78,845	70,761	237,372	**873,488**
2000	115,864	55,683	719,607	251,035	29,308	**1,171,496**	72,460	21,037	572,716	119,979	102,844	450,446	**1,267,023**
2001	52,676	48,853	619,067	345,690	19,412	**1,085,697**	84,216	17,779	678,547	106,807	81,374	434,799	**1,319,306**
2002	37,018	66,842	379,839	314,524	19,765	**817,988**	67,018	28,915	550,129	96,291	101,129	350,992	**1,127,456**
2003	43,838	60,250	526,274	272,615	11,305	**914,282**	67,536	18,694	536,649	63,022	76,957	310,287	**1,005,609**
10yr Av.	65,189	66,012	487,219	268,618	21,054	**908,092**	59,025	23,964	557,785	100,437	114,840	415,270	**1,212,295**

Table 3.9.14.4 **Estimated pre-fishery abundance of NON-MATURING 1SW salmon (potential MSW returns) by NEAC country and year**

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	64,169	105,013		268,100	6,045			53,894	387,163	349,576	23,163	1,774,075	**2,587,871**
1972	77,613	95,504		434,237	9,059			35,003	374,462	260,604	20,143	1,786,341	**2,476,552**
1973	113,967	84,534		404,968	6,460			21,737	427,126	204,785	22,002	1,318,884	**1,994,534**
1974	127,572	91,221		434,409	4,768			31,861	463,147	250,915	18,114	1,420,561	**2,184,598**
1975	104,942	77,578		370,959	5,501			28,395	348,793	171,411	12,572	1,008,847	**1,570,019**
1976	63,522	85,637		256,012	3,815			19,651	284,437	166,906	12,414	988,369	**1,471,776**
1977	41,247	109,683		222,075	3,229			21,032	259,947	151,313	16,092	1,181,216	**1,629,601**
1978	44,256	71,781		200,011	5,870			19,867	221,403	81,765	11,320	853,183	**1,187,537**
1979	46,381	100,847		347,499	11,553			37,788	275,333	210,027	14,359	1,122,478	**1,659,984**
1980	50,972	56,146		237,469	10,209			28,388	228,267	271,412	11,256	1,236,631	**1,775,954**
1981	66,255	46,054		213,635	14,056			19,206	135,350	128,090	16,242	977,296	**1,276,184**
1982	71,429	61,165		270,877	10,600			19,020	357,061	129,213	22,821	1,000,512	**1,528,626**
1983	69,428	56,637	803,240	255,673	10,251	**1,195,229**	77,504	24,928	145,380	93,777	8,987	776,790	**1,049,862**
1984	53,294	40,181	747,034	278,175	6,728	**1,125,413**	75,066	19,145	154,432	127,228	11,670	922,081	**1,234,556**
1985	46,672	52,715	894,779	279,819	7,367	**1,281,352**	90,772	23,035	217,792	190,444	13,036	1,261,414	**1,705,721**
1986	58,599	51,105	685,012	216,026	12,148	**1,022,890**	68,226	14,610	238,687	153,740	6,686	853,855	**1,267,578**
1987	37,346	43,631	559,946	200,337	9,986	**851,246**	55,716	30,311	128,035	184,519	18,822	1,203,701	**1,565,388**
1988	41,747	38,428	419,970	201,322	23,630	**725,097**	43,259	17,910	152,095	159,915	15,000	1,105,413	**1,450,332**
1989	52,636	38,974	487,402	250,722	16,142	**845,876**	50,839	13,725	73,953	165,211	13,615	880,152	**1,146,657**
1990	62,713	33,264	389,208	232,199	16,160	**733,544**	44,073	11,929	60,392	71,425	6,989	618,115	**768,849**
1991	67,152	41,518	408,225	215,904	19,827	**752,625**	48,231	16,256	84,347	64,421	16,016	836,224	**1,017,264**
1992	78,171	31,256	391,453	255,742	26,444	**783,067**	45,368	8,331	85,285	64,580	37,744	690,696	**886,635**
1993	64,598	35,662	383,157	228,870	19,864	**732,151**	44,354	13,313	89,040	75,512	13,276	785,664	**976,804**
1994	40,337	29,687	409,906	259,339	13,893	**753,163**	46,095	6,364	72,140	75,670	11,221	746,112	**911,507**
1995	35,624	25,902	411,115	197,216	17,515	**687,371**	43,258	11,563	71,086	79,001	12,525	566,234	**740,410**
1996	51,956	21,421	268,111	156,348	11,163	**508,998**	31,858	6,176	62,664	49,786	15,574	395,252	**529,453**
1997	43,538	19,536	323,109	194,113	8,272	**588,569**	36,950	5,089	43,068	30,611	21,539	402,506	**502,814**
1998	39,880	27,969	343,906	169,701	7,085	**588,540**	39,984	10,576	49,552	66,808	9,626	342,219	**478,781**
1999	88,939	11,010	476,408	298,176	15,605	**890,138**	56,540	7,446	94,663	82,340	12,939	439,943	**637,331**
2000	128,659	15,212	561,847	211,225	18,643	**935,587**	62,712	8,649	110,320	92,062	9,390	430,627	**651,048**
2001	102,833	14,919	483,499	295,015	13,669	**909,936**	58,431	5,467	109,637	81,058	12,833	349,919	**558,914**
2002	72,522	22,662	429,307	180,820	9,928	**715,239**	47,424	9,164	90,308	81,641	10,069	363,710	**554,892**
10yr Av.	66,889	22,398	409,037	219,082	13,564	**730,969**	46,761	8,381	79,248	71,449	12,899	482,219	**654,196**

Table 3.9.14.5 Estimated number of 1SW SPAWNERS by NEAC country and year

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	13,448	36,636		43,169	8,639			51,363	413,201	56,100	37,289	307,561	**865,514**
1972	20,822	30,363		72,234	6,803			103,280	447,071	51,671	32,594	233,618	**868,234**
1973	18,952	33,131		79,009	8,528			63,318	453,794	60,082	28,630	303,127	**908,951**
1974	37,630	25,295		94,728	12,171			29,589	564,567	75,277	30,956	275,997	**976,386**
1975	25,832	37,155		112,798	13,278			58,313	610,491	76,135	25,670	245,886	**1,016,495**
1976	18,006	30,763		109,340	7,437			54,510	419,667	48,902	17,753	191,329	**732,161**
1977	9,054	34,130		74,516	3,504			41,640	364,683	54,364	17,592	227,743	**706,023**
1978	12,388	41,920		59,026	3,968			42,098	318,149	61,671	23,115	283,967	**729,000**
1979	14,663	39,057		75,124	4,168			48,578	283,620	58,767	16,089	219,659	**626,713**
1980	6,579	14,981		73,922	5,335			101,374	237,836	53,965	20,198	149,466	**562,838**
1981	9,996	24,607		54,047	9,754			80,121	154,834	55,379	15,870	185,862	**492,067**
1982	2,979	21,268		49,790	8,585			49,960	170,251	47,153	22,847	257,318	**547,528**
1983	14,687	27,467	166,172	64,812	11,611	**284,749**	50,325	53,334	427,798	66,685	32,425	290,477	**870,720**
1984	16,361	15,948	167,499	80,636	16,028	**296,473**	52,689	87,723	228,384	58,112	12,826	294,541	**681,586**
1985	24,960	34,144	174,981	93,997	18,922	**347,003**	53,532	32,527	257,949	58,336	16,490	270,116	**635,419**
1986	22,694	52,450	151,551	103,792	20,104	**350,591**	45,676	57,369	390,542	66,711	18,565	321,202	**854,388**
1987	28,781	31,747	128,263	97,091	16,626	**302,507**	41,353	101,026	288,921	69,013	15,776	228,517	**703,253**
1988	13,963	54,708	121,348	88,228	13,567	**291,814**	35,535	35,540	468,915	90,368	42,515	464,226	**1,101,564**
1989	25,814	30,279	193,225	96,478	4,321	**350,117**	46,831	18,424	272,031	59,693	12,865	502,055	**865,068**
1990	24,573	26,620	170,288	97,035	11,253	**329,769**	41,166	31,373	199,991	44,074	36,192	257,514	**569,143**
1991	29,612	31,117	148,797	83,211	14,035	**306,772**	36,263	24,078	149,569	42,084	18,779	252,442	**486,952**
1992	39,815	41,417	124,954	116,475	15,195	**337,856**	34,326	42,431	152,826	44,316	47,262	365,012	**651,848**
1993	27,832	38,161	124,280	114,309	16,318	**320,900**	31,398	59,741	145,072	63,887	74,214	348,081	**690,994**
1994	11,065	25,523	172,481	116,488	12,772	**338,328**	43,819	48,143	133,117	70,297	25,779	371,845	**649,181**
1995	10,936	35,536	110,275	121,862	20,502	**299,110**	28,931	13,829	163,280	56,357	26,633	379,462	**639,559**
1996	31,592	27,764	83,019	139,102	12,717	**294,195**	28,560	17,159	215,227	41,651	36,005	254,332	**564,373**
1997	26,771	23,513	106,570	159,594	5,594	**322,043**	31,020	8,522	169,431	40,307	39,685	195,426	**453,370**
1998	31,002	34,202	139,634	164,941	5,040	**374,819**	38,102	16,921	165,560	46,637	161,283	273,210	**663,610**
1999	35,312	23,823	128,755	164,060	7,346	**359,296**	32,018	5,711	181,253	43,711	20,607	159,779	**411,061**
2000	36,886	22,252	215,569	141,711	14,615	**431,032**	49,324	14,796	207,251	66,529	34,032	307,398	**630,007**
2001	16,841	19,483	186,474	201,174	9,742	**433,714**	60,443	12,472	279,751	61,356	32,011	297,110	**682,700**
2002	14,767	26,648	112,655	211,989	9,893	**375,951**	48,681	20,263	217,774	54,751	36,159	242,872	**571,819**
2003	17,506	23,940	158,221	178,946	5,676	**384,289**	49,000	13,150	242,368	37,337	26,399	211,906	**531,161**
10yr.av.	23,268	26,268	141,365	159,987	10,390	**361,278**	40,990	17,097	197,501	51,893	43,859	269,334	**579,684**

Table 3.9.14.6 **Estimated number of MSW SPAWNERS by NEAC country and year**

Year	Northern Europe							Southern Europe					
	Finland	Iceland	Norway	Russia	Sweden	Total		France	Ireland	UK(EW)	UK(NI)	UK(Scot)	To
						Est.	SD						Est.
1971	11,234	16,235		38,903	461			7,157	87,008	59,113	7,885	395,862	**557,025**
1972	17,520	25,180		59,208	327			14,193	91,911	89,970	6,920	492,075	**695,068**
1973	21,594	22,842		66,161	1,158			8,790	96,972	67,516	6,009	539,044	**718,331**
1974	31,442	20,202		99,934	731			4,131	115,108	50,632	6,554	349,681	**526,105**
1975	35,461	21,852		88,628	178			8,183	127,731	67,623	5,396	387,900	**596,833**
1976	29,241	18,558		87,266	533			5,983	88,449	34,697	3,749	245,688	**378,566**
1977	17,481	20,736		71,804	403			4,631	77,304	42,631	3,711	275,904	**404,181**
1978	11,453	26,363		50,835	312			4,737	67,386	35,831	4,793	342,799	**455,546**
1979	15,022	17,319		45,386	906			5,553	59,772	17,400	3,374	233,405	**319,505**
1980	15,679	24,106		48,353	1,575			11,387	69,840	56,112	4,283	309,048	**450,670**
1981	17,246	13,089		67,238	445			8,415	53,526	77,431	3,358	366,664	**509,394**
1982	22,428	10,629		41,234	1,564			5,149	31,468	29,711	4,851	290,470	**361,649**
1983	23,974	14,527	103,413	49,896	1,135	**192,944**	30,355	5,604	143,996	32,793	6,799	306,920	**496,113**
1984	23,793	13,459	103,743	62,542	1,563	**205,100**	29,354	9,134	41,500	26,424	2,685	271,208	**350,951**
1985	18,067	9,490	95,227	51,630	660	**175,075**	28,306	7,028	51,420	38,846	3,485	354,140	**454,919**
1986	15,776	12,405	115,698	52,323	630	**196,833**	34,075	6,889	57,786	53,025	3,874	454,047	**575,621**
1987	19,980	12,098	88,182	54,022	1,911	**176,194**	27,212	3,756	80,912	41,511	2,156	277,878	**406,213**
1988	12,602	10,436	74,633	45,633	1,841	**145,145**	21,006	10,223	24,223	53,295	7,175	488,784	**583,700**
1989	11,498	9,102	74,373	51,122	5,156	**151,251**	17,796	4,685	28,835	41,624	3,589	429,322	**508,055**
1990	14,687	9,296	89,510	48,450	4,001	**165,943**	20,477	4,727	11,739	51,804	5,035	374,999	**448,303**
1991	17,291	7,963	74,706	60,377	4,521	**164,858**	17,640	4,441	17,167	22,156	2,373	269,113	**315,250**
1992	18,605	10,019	81,111	58,226	5,779	**173,739**	19,433	5,509	19,968	17,183	6,393	359,278	**408,330**
1993	21,733	7,563	76,237	56,030	7,787	**169,351**	17,577	2,604	27,640	19,535	19,761	296,910	**366,451**
1994	17,982	8,616	74,924	65,457	5,966	**172,946**	18,066	5,677	26,626	26,949	4,741	362,940	**426,933**
1995	11,262	7,162	81,039	64,958	4,612	**169,034**	17,208	2,716	16,620	28,202	3,876	346,733	**398,148**
1996	12,078	6,257	80,734	63,518	5,853	**168,441**	17,322	4,764	18,104	29,185	4,995	258,968	**316,015**
1997	17,650	5,146	58,028	53,127	3,864	**137,815**	13,313	2,489	21,539	19,122	6,208	181,502	**230,860**
1998	14,734	4,732	70,650	41,954	2,879	**134,949**	13,932	2,102	9,578	12,184	10,037	190,823	**224,724**
1999	12,085	6,755	73,177	54,363	2,483	**148,861**	16,002	4,502	15,503	30,706	3,891	165,931	**220,533**
2000	27,000	2,667	103,344	58,592	5,463	**197,065**	21,003	3,169	39,023	40,100	5,245	216,383	**303,920**
2001	39,232	3,700	124,034	89,499	6,507	**262,973**	26,896	3,622	44,795	45,218	3,912	211,635	**309,182**
2002	31,242	3,607	106,994	78,498	4,782	**225,124**	23,849	2,056	47,353	39,359	5,370	174,538	**268,676**
2003	21,940	5,503	96,729	93,975	3,459	**221,607**	20,421	3,597	39,062	40,800	4,208	181,732	**269,399**
10yr.av.	20,631	5,610	85,990	65,452	4,878	**182,561**	18,690	3,391	27,804	30,124	6,568	235,281	**303,167**

Table 3.9.15.1 Estimated survival of wild smolts (%) to return to homewaters (prior to coastal fisheries) for various monitored rivers in the NE Atlantic area.

Smolt	Iceland[1]					Ireland		(N.Irelar	Norway[2]		UK (Scotland)[2]		France	
migration	Ellidaar	R.Vesturdalsa[4]		R.Midfjardara[4]		R. Corrib	R. Corrib	R. Bush	R. Imsa		North Esk		Nivelle[6]	Bresle
year	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW[3]	1SW	2SW	1SW	MSW	All ages	All ages
1975	20.8													
1980						17.9	1.1							
1981						7.6	3.8		17.3	4.0	11.6	5.2		
1982						20.9	3.3		5.3	1.2	10.5	5.0		
1983		2.0				10.0	1.8		13.5	1.3	-	-		
1984						26.2	2.0		12.1	1.8	7.8	3.5		
1985	9.4					18.9	1.8		10.2	2.1	19.9	5.8		
1986						-	-	31.3	3.8	4.2	-	-	15.1	
1987				2.4	1.4	16.6	0.7	35.1	17.3	5.6	11.9	3.1	2.6	
1988	12.7			0.6	0.9	14.6	0.7	36.2	13.3	1.1	-	-	2.4	
1989	8.1	1.1	2.0	0.2	0.7	6.7	0.7	25.0	8.7	2.2	7.0	4.2	3.5	
1990	5.4	1.0	1.0	1.2	1.3	5.0	0.6	34.7	3.0	1.3	6.4	2.9	1.8	
1991	8.8	4.2	0.6	1.1	0.5	7.3	1.3	27.8	8.7	1.2	9.6	4.2	9.2	
1992	9.6	2.4	0.8	1.4	0.5	7.3	-	29.0	6.7	0.9	-	-	8.9	6.9 [7]
1993	9.8	-	-	1.0	1.1	10.8	0.1	-	15.6		-	-	8.3 [7]	10.3 [7]
1994	9.0	-	-	1.4	0.6	9.8	1.4	27.1	-	-	13.7	2.3	7.2 [7]	7.5 [7]
1995	9.4	1.6	1.2	0.3	0.9	8.4	0.1	n/a	1.8	1.5	9.8	3.7	2.3	-
1996	4.6	1.4	0.3	1.2	0.7	6.3	1.2	31.0	3.5	0.9	9.3	3.4	4.4	-
1997	5.3	0.7	0.5	2.4	0.5	12.7	0.8	19.8	1.7	0.3	9.6	4.4	3.4	4.8
1998	5.3	1.0	1.0	1.3	-	5.5	1.1	13.4	7.2	1.0	-	-	2.7	-
1999	7.7	1.3	0.9	-	-	6.4	0.9	16.5	4.0	2.2	-	-	2.9	-
2000	6.3	0.8	0.5	-		9.4	0.0	10.1	11.9	1.7	5.9	2.3	2.7	-
2001	5.1	2.8	1.1			7.2	1.1	12.4	3.6	1.8	9.0	3.2	2.8	
2002	4.4	0.8				6.1		13.9	5.3		3.2			
Mean														
(5-year)	5.9	1.3	0.7	-	-	8.2	0.7	14.4	5.7	1.3	8.2	3.5	3.1 #	-
(10-year)	7.2	1.5	0.7	1.3	0.7	8.4	0.7	19.9	6.2	1.2	9.6	3.4	5.2 #	-

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

Table 3.9.15.2 Estimated survival of hatchery smolts (%) to adult return to homewaters, (prior to coastal fisheries) for monitored rivers and experimental facilities in the NE Atlantic area.

Smolt year	Iceland[1] R. Ranga		UK (N. Ireland)[1] R. Bush (1SW)		Norway[2] R. Imsa		Norway[2] R. Drammen		Sweden[2] R. Lagan	
	1SW	2SW	1+ smolts	2+ smolts	1SW	2SW	1SW	2SW	1SW	2SW
1981					10.1	1.3				
1982					4.2	0.6				
1983			1.9	8.1	1.6	0.1				
1984			13.3	-	3.8	0.4	3.5	3.0	11.8	1.1
1985			15.4	17.5	5.8	1.3	3.4	1.9	11.8	0.9
1986			2.0	9.7	4.7	0.8	6.1	2.2	7.9	2.5
1987			6.5	19.4	9.8	1.0	1.7	0.7	8.4	2.4
1988			4.9	6.0	9.5	0.7	0.5	0.3	4.3	0.6
1989	1.63	0.08	8.1	23.2	3.0	0.9	1.9	1.3	5.0	1.3
1990	0.93	0.19	5.6	5.6	2.8	1.5	0.3	0.4	5.2	3.1
1991	0.09	0.04	5.4	8.8	3.2	0.7	0.1	0.1	3.6	1.1
1992	0.43	0.05	6.0	7.8	3.8	0.7	0.4	0.6	1.5	0.4
1993	0.90	0.05	1.1	5.8	6.5	0.5	3.0	1.0	2.6	0.9
1994	1.21	0.16	1.6		6.2	0.6	1.2	0.9	4.0	1.2
1995	0.91	0.10	3.1	2.4	0.4	0.0	0.7	0.3	3.9	0.6
1996	0.13	0.03	2.0	2.3	2.1	0.2	0.3	0.2	3.5	0.5
1997	0.24	0.06	no release	4.1	1.0	0.0	0.5	0.2	0.6	0.5
1998	0.49	0.02	2.3	4.5	2.4	0.1	1.9	0.7	1.6	0.9
1999	0.59	0.04	2.7	5.8	6.7	0.5	2.0	1.8	2.1	
2000	1.01	0.06	2.8	4.4	6.8	0.0	1.3	0.7		
2001	0.24	0.03	1.1	2.2	2.4	0.1	2.5	1.0		
2002	0.48		0.68	3.07	2		1.1			
Mean										
(5-year)	0.51	0.04	2.2	4.2	3.9	0.2	1.6	0.7	2.0	0.6
(10-year)	0.62	0.06	2.5	4.4	3.8	0.3	1.4	0.7	2.6	1.0

[1]Microtagged.

[2] Carlin tagged, not corrected for tagging mortality.

Table 3.9.15.2 Cont'd. Estimated survival of hatchery smolts (%) to 1SW adult return to homewaters, (prior to coastal fisheries) for monitored rivers and experimental facilities in Ireland.

Smolt year	R. Shannon	R. Screebe	R. Burrishoole[1]	R. Delphi	R. Bunowen	R. Lee	R. Corrib Cong.[2]	R. Corrib Galway[2]	R. Erne
1980	8.6		3.3			8.3	0.9		
1981	2.8		6.9			2.0	1.2		
1982	4.1		8.2			16.3	2.7	16.1	
1983	3.9		2.3			2.0	1.7	4.1	
1984	4.9	10.4	23.5			2.3	5.2	13.2	9.2
1985	4.8	12.3	26.3			14.7	1.4	14.4	7.9
1986	9.1	0.4	7.6			16.4	-	7.6	10.1
1987	4.7	8.3	11.2			8.8	-	2.2	7.0
1988	4.9	9.2	13.8			5.5	4.2	-	2.6
1989	5.0	1.6	7.9			1.7	6.0	4.9	1.2
1990	1.3	0.0	7.1			2.5	0.2	2.3	2.5
1991	4.1	0.2	11.4	9.7		0.8	3.5	4.0	1.3
1992	4.3	1.3	5.3	9.8	4.2	-	0.9	0.6	-
1993	2.9	2.2	12.0	13.0	5.4	-	1.0	-	-
1994	5.1	1.9	14.3	3.9	8.1	-	-	5.3	-
1995	3.6	4.1	6.6	3.4	3.5	-	2.4	-	-
1996	2.9	1.8	5.3	9.8	3.4	-	-	-	-
1997	6.0	0.4	13.3	15.8	5.3	7.0	-	-	7.6
1998	3.1	1.3	5.6	6.9	2.7	4.6	3.3	2.9	2.5
1999	1.0	2.8	8.2	14.5	1.5	-	-	3.6	3.5
2000	1.2	3.8	11.8	14.2	4.1	3.5	6.7	-	4.0
2001	2.0	2.5	8.7	17.0	3.0	2.0	3.4	-	5.9
2002	0.7	3.8	4.8	9.6	1.8	2.0	-	1.9	2.5
Mean									
(5-year)	2.7	2.2	9.5	13.7	3.3	3.8	4.5	3.3	4.3
(10-year)	3.2	2.2	9.1	10.8	4.1	4.3	3.0	3.1	4.7

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

[2] Different release sites

Table 3.10.1. Percentage change in gear units over the period 1998-2003 for countries where such data are available (excludes rod fisheries).

Country	Type of gear units	% Change in gear units from 1998 to 2003
Russia	Coastal nets In-river nets	-17 -69
Norway	Bag net Bend net	-11 -25
UK (England & Wales)	Gill net Sweep net Hand-held net Fixed engine	-55 -25 -18 -9
UK (Scotland)	Fixed engine Net and coble	-40 -27
UK (N. Ireland)	Drift net Draft net Bag nets and boxes	-10 -26 -83
Ireland	Drift net Draft net Other nets	0 +7 -9

Table 3.11.1.1. Summary of countries and type of fishing gear in fisheries with potential overlap with salmon distribution. Italic text indicates peak salmon migration time (mid May-early August). (Areas refer to ICES fishing areas; Q is the quarter of the year.

	Weeks 16-25						Weeks 20-26				Weeks 27-36			
Fishery	IVb 2Q	VIa 2Q	VIIb 2Q	VIIc 2Q	VIIj 2Q	VIIk 2Q	***IVa*** ***2Q***	Gear type	***Vb*** ***2Q***	Gear type	***IIa*** ***3Q***	Gear type	***IIb*** ***3 Q***	Gear type
Mackerel	Denmark Norway	England Scotland Ireland Germany	England Scotland Ireland	Ireland	England Scotland France Ireland Germany Netherlands		**England** **Scotland**	Midwater trawl Midwater trawl	**Russia**	Midwater trawl	**Norway** **Russia** **Faroes**	Purse seine Midwater trawl Midwater trawl		
Herring		Scotland					**Norway** **Scotland** **Germany** **Denmark**	Purse seine Midwater trawl Purse seine Midwater trawl Purse seine Midwater trawl Purse seine Midwater trawl	**Germany**	Purse seine Midwater trawl	**Iceland** **Faroes** **Russia**	Purse seine Midwater trawl Purse seine Midwater trawl Midwater trawl	**Iceland** **Faroes** **Russia**	Purse seine Midwater trawl Purse seine Midwater trawl
Blue- whiting		Netherlands Norway Germany		Netherlands Germany					**Russia** **Iceland** **Faroes** **Norway**	Midwater trawl Midwater trawl Midwater trawl Midwater trawl	**Russia** **Norway** **Faroes** **Germany**	Midwater trawl Midwater trawl Midwater trawl Purse seine Midwater trawl		
Capelin (Iceland, East Greenland, Jan Mayen)											**Iceland** **Norway** **Faroes**	Purse seine Purse seine Purse seine	**Iceland** **Norway**	Purse seine Purse seine
Horse- mackerel					England Ireland Netherlands									

Table 3.11.2.1 Number of post-smolts, and ratio of post-smolts per metric tonne of mackerel in Salmon surveys in Norwegian and International zone in the Norwegian Sea, 2001 - 2003

No. of post-smolts caught and CPUE			No. of post-smolts caught per tonne of mackerel	
	Norwegian EEZ	International zone	Norwegian EEZ	Internternational zone
YEAR	No. of post-smolts	No. of post-smolts	Post-smolts/tonne mackerel	Post-smolts/tonne mackerel
2001	198	-	16	-
2002	159	431	57	26
2003	66	370	6	25

Table 3.11.2.2 Summarized data from the pelagic fish surveys conducted in the Norwegian Sea in June-July 2002-2003 by Russian research vessels.

Year	No. of hauls taken	Total catch (t)	Mackerel catch (t)	No. of Salmon caught		No. of salmon caught per tonne of mackerel	
				Adults	Post-smolt	Adults	Post-smolt
2002	82	13.7	5.4	3	32	0.56	5.93
2003	31	15.6	13.3	0	0	0	0

Table 3.11.2.3 Summarized data of the screening of catches from the Russian mackerel fishery in the Norwegian Sea in June-August 2002-2003.

Year	No of hauls screened	Total catch, t	Mackrel catch, t	No of Salmon found		No. of salmon caught per tonne of mackerel	
				Adults	Post-smolt	Adults	Post-smolt
2002	1070	10,921	7,760	15	12	0.002	0.002
2003	416	7,200	3,800	15	1	0.004	0.0003

Table 3.11.4.1. Cruises with surface trawling (flotation on trawl wings), captures of post-smolts and older salmon and post-smolt catch per unit of effort (CPUE, trawl hours) in 2003 and summary of catches, 1990 – 2003.

Year and Cruise	Gear	Dates	Total number of surface hauls	% hauls with post-smolt captures	Number of post-smolts captured	Number of salmon captured	Mean CPUE Post-smolts	Area surveyed
2003-1[SS]	*Salmon trawl* [A]*; Fish lift*	*17.5 - 24.05*[SS]	*35*	*47*	*475*	*55*	*9.3*	*Mid Norwegian coast- west of the mid-Norwegian shelf edge (63.4-65.4°N; 8.0-11.1°E*
2003- 2[SS]	Salmon trawl [A]; Fish lift	*16.06- 07.07*[SS]	*81*	*44*	*436*	*16*	*8.4*	*Norwegian Sea east (Norway's EEZ and International zone, mackerel by-catch investigations) , 61 – 73.3°N; 1.5°W- 13°E*
2003-3	*Åkra trawl*[B]	*01 – 22.07*	*34 (74)*	*0*	*0*	*2*	*	*North Sea-Norwegian Sea (south), Herring & Blue whiting Pelagic survey*
2003-4	*Midwater trawl*	*15 – 29.07*	*47 (57)*	*7*	*6*	*1*	*0. 5*	*Norwegian Sea 62.7=>71.0 °N; 5 °W – 15°E, Mackerel survey*
2002-5	*Midwater trawl*	*18 – 30.07*	*21 (33)*	*0*	*0*	*1*	*	Norwegian Sea, 69.5 => 62.7°N; *5 °W - 14* °E
		TOTAL 2003	***218 (280)***		***917***	***75***		
		1990 - 2002	***2438***		***4164***	***171***		
TOTAL	**1990 - 2003**		**2656**		**5081**	**246**		

(..) total nr of trawl hauls deeper hauls included
[A] Dimensions of trawl opening 10 x 40

* CPUE not calculated, because no smolts were captured
[B] Dimensions of the Åkra trawl opening 25 x 25 m

[SS] Cruises dedicated to salmon investigations

Table 3.11.4.2. Results of the pelagic fish survey conducted by R/V "Smolensk" M-103 (cruise 50) in 08-17 July 2003 in the international waters of the Norwegian Sea.

Trawl #	Date	Stop in	Stop out	Lat	Long	Speed , kn	Headline depth, m	Total catch, kg	Mackerel catch, kg	No of post-smolts	No of salmon
108	8.7	1614	1635	6820N	152W	4,1	300	311	0	0	0
109	8.7	2029	2120	6820N	27W	4,2	1	61	57	0	0
110	9.7	444	510	6819N	225E	4,2	3	84	84	0	0
111	9.7	1123	1230	6755N	58E	4,2	5	233	228	0	0
112	9.7	1937	2032	6755N	135W	4,4	117	235	0	0	0
113	10.7	330	400	6748N	414W	4,4	33	20	0	0	0
114	10.7	1021	1054	6731N	522W	4,5	0	12	5	0	0
115	10.7	2104	2132	6730N	226W	4,5	1	14	11	0	0
116	11.7	734	748	6730N	47E	4,9	2	15	15	0	0
117	11.7	943	1013	6730N	102E	4,7	0	5395	5395	0	0
118	11.7	1906	2007	6659N	257E	4,3	175	94	10	0	0
119	12.7	132	200	6700N	55E	4,1	0	178	175	0	0
120	12.7	717	745	6701N	104W	4,3	0	146	144	0	0
121	12.7	1515	1611	6701N	338W	4,0	102	434	380	0	0
122	13.7	158	248	6640N	549W	3,9	83	131	13	0	0
123	13.7	1015	1039	6640N	249W	5,0	1	876	876	0	0
124	13.7	1659	1727	6641N	21W	4,3	1	1232	1225	0	0
125	14.7	28	100	6639N	157E	4,9	0	208	208	0	0
126	14.7	820	849	6610N	53E	4,7	0	728	725	0	0
127	14.7	1532	1621	6611N	106W	3,9	87	730	602	0	0
128	14.7	2218	2243	6611N	321W	4,8	5	55	54	0	0
129	15.7	415	441	6611N	513W	4,6	30	972	5	0	0
130	15.7	1039	1103	6545N	427W	5,0	1	126	124	0	0
131	15.7	1754	1815	6545N	216W	4,3	1	10	5	0	0
132	16.7	19	102	6545N	17W	4,2	0	2578	2382	0	0
133	16.7	816	843	6544N	156E	4,5	0	78	77	0	0
134	16.7	1405	1431	6521N	32E	4,6	2	347	346	0	0
135	16.7	1922	1952	6520N	112W	4,1	1	47	45	0	0
136	17.7	304	328	6510N	224W	5,0	0	77	60	0	0
137	17.7	914	937	6450N	26E	5,2	0	43	43	0	0
138	17.7	1140	1226	6451N	4E	3,9	340	118	0	0	0
				Total catch, kg				**15 588**	**13 293**	**0**	**0**

Figure 3.1 Status of stocks in NEAC

Estimated recruitment (PFA), with 95% confidence limits, and Spawning Escapement Reserve for maturing and non-maturing salmon in Northern & Southern Europe.

Estimated spawning escapement with 95% confidence limits, and conservation limits for 1SW and MSW salmon in Northern & Southern Europe.

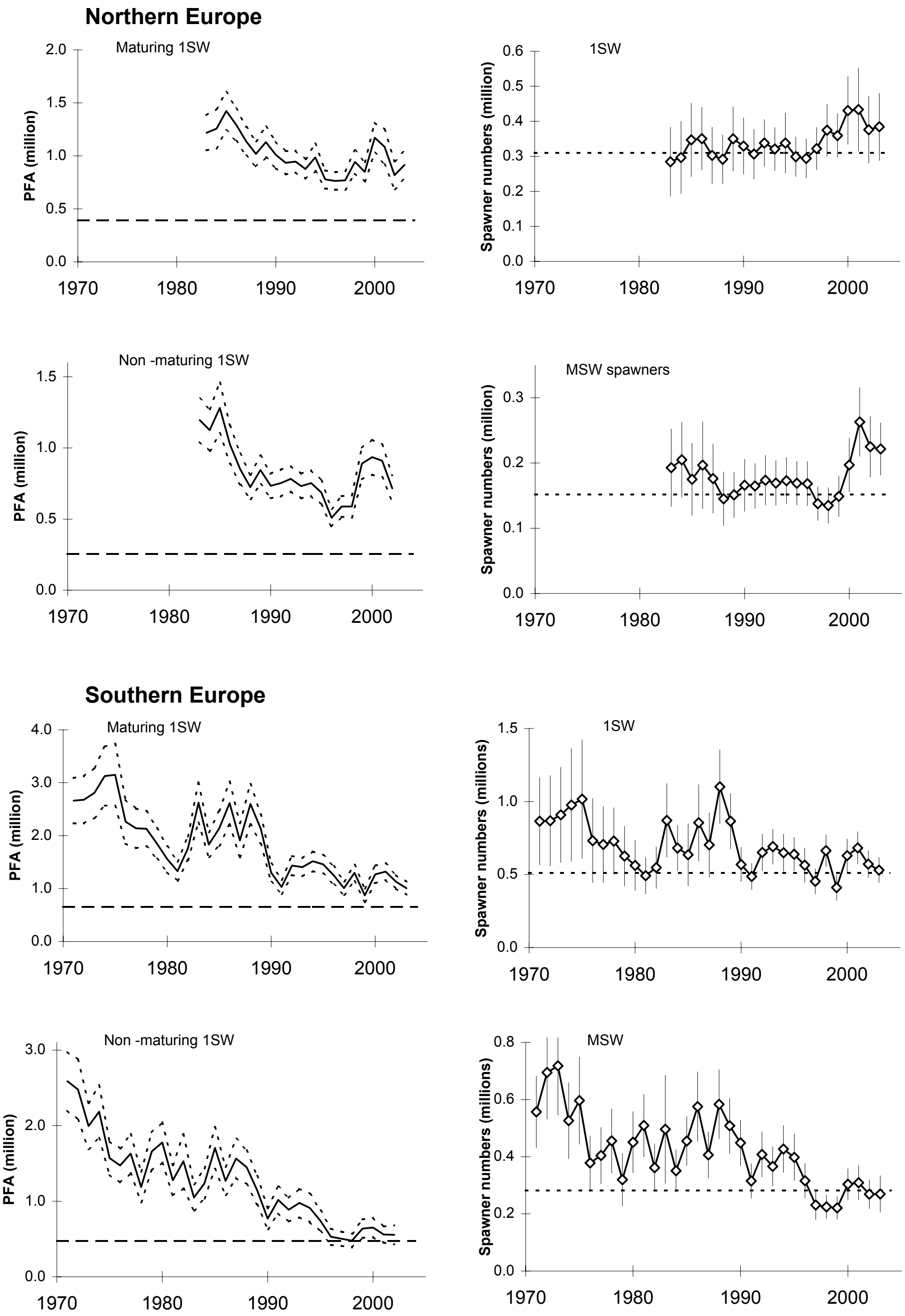


Figure 3.6.1.1 PFA trends and predictions (+/- 5% confidence intervals) for non-maturing 1SW Southern European stock

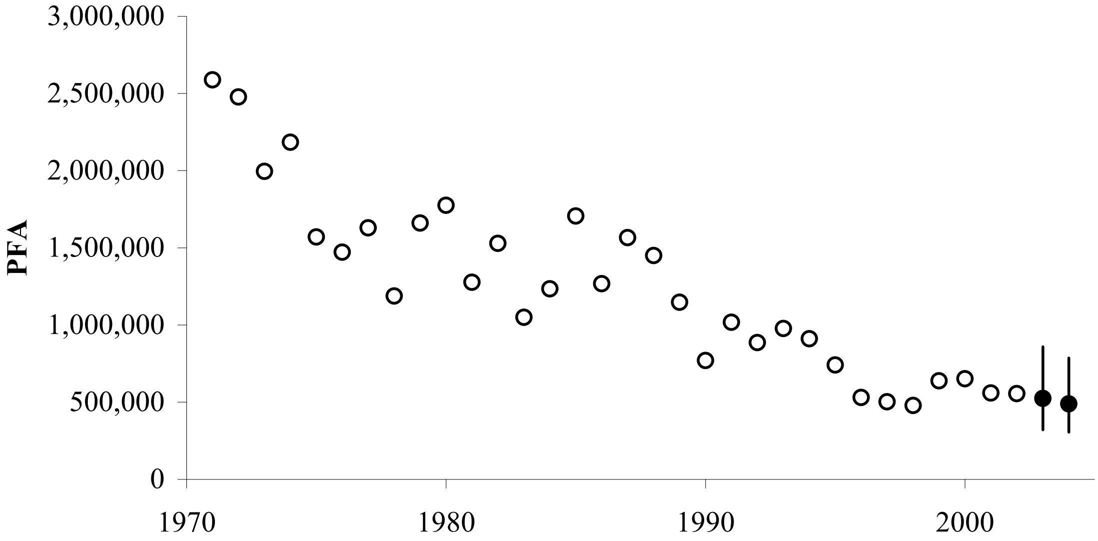


Figure 3.9.3.1 Overview of effort as reported for various fisheries and countries 1971-2003 in the Northern NEAC area.

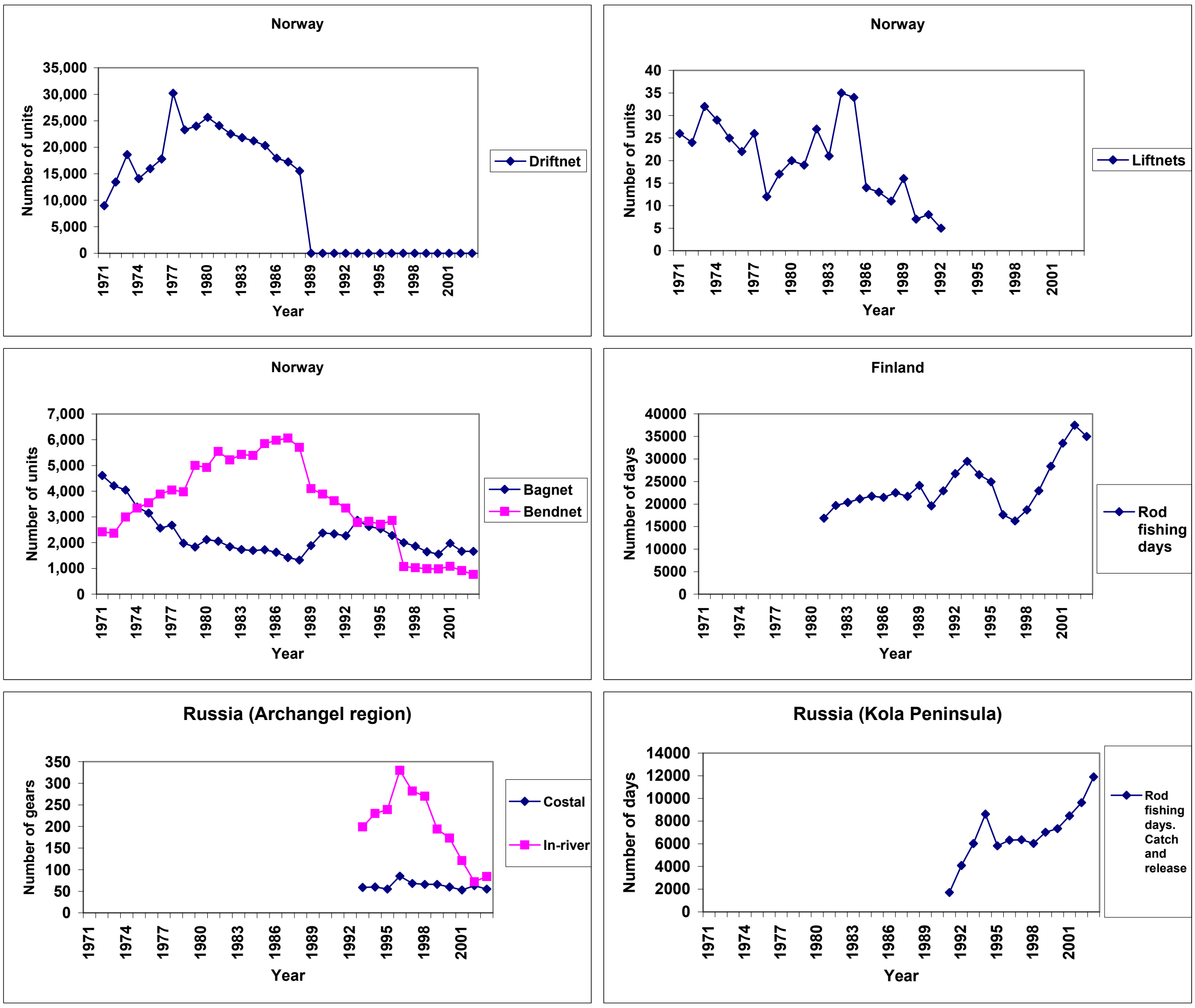


Figure 3.9.3.2 Overview of effort as reported for various fisheries and countries 1971-2003 in the Southern NEAC area.

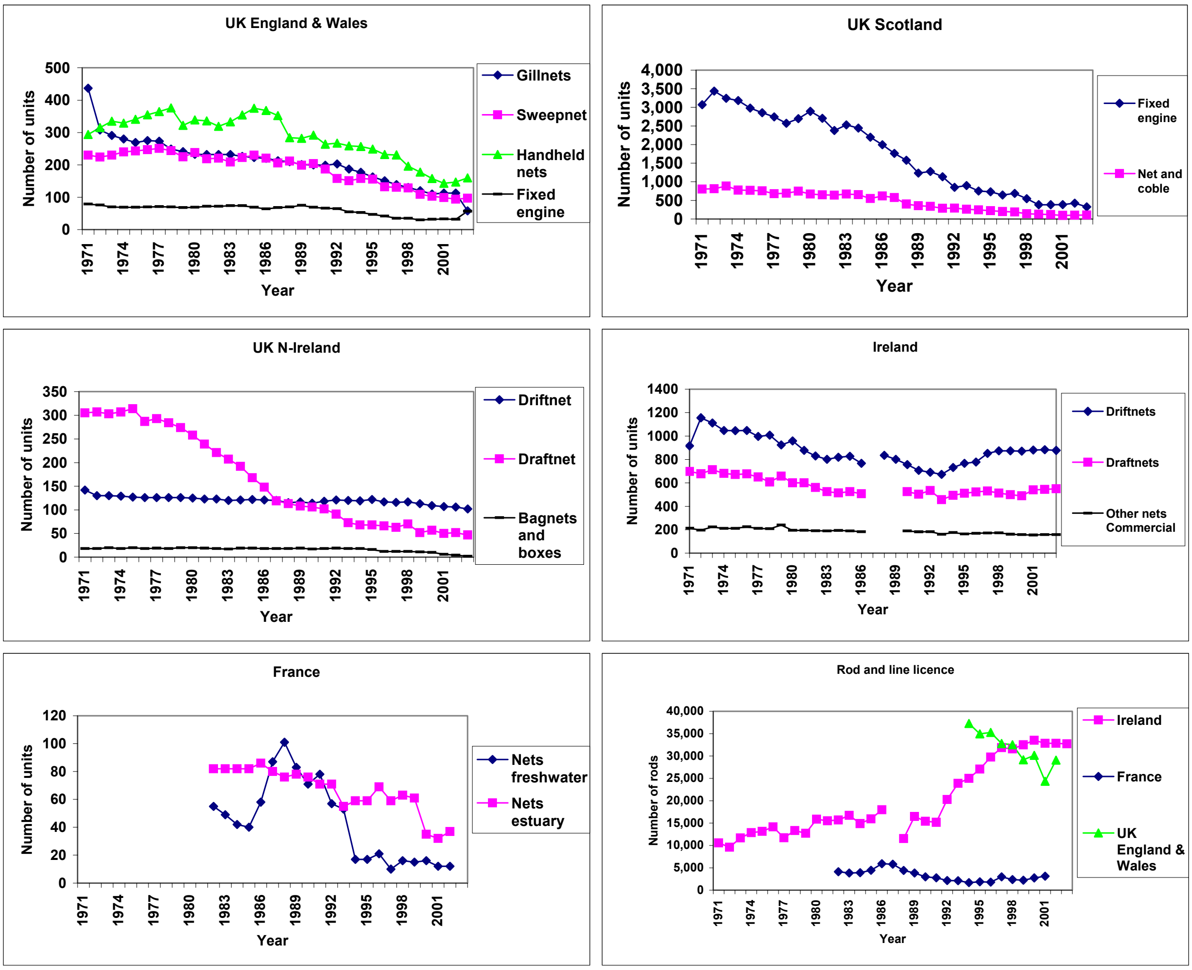


Figure 3.9.4.1. Nominal catches of salmon and 5-year running mean in the Southern and Northern NEAC Areas, 1971-2003.

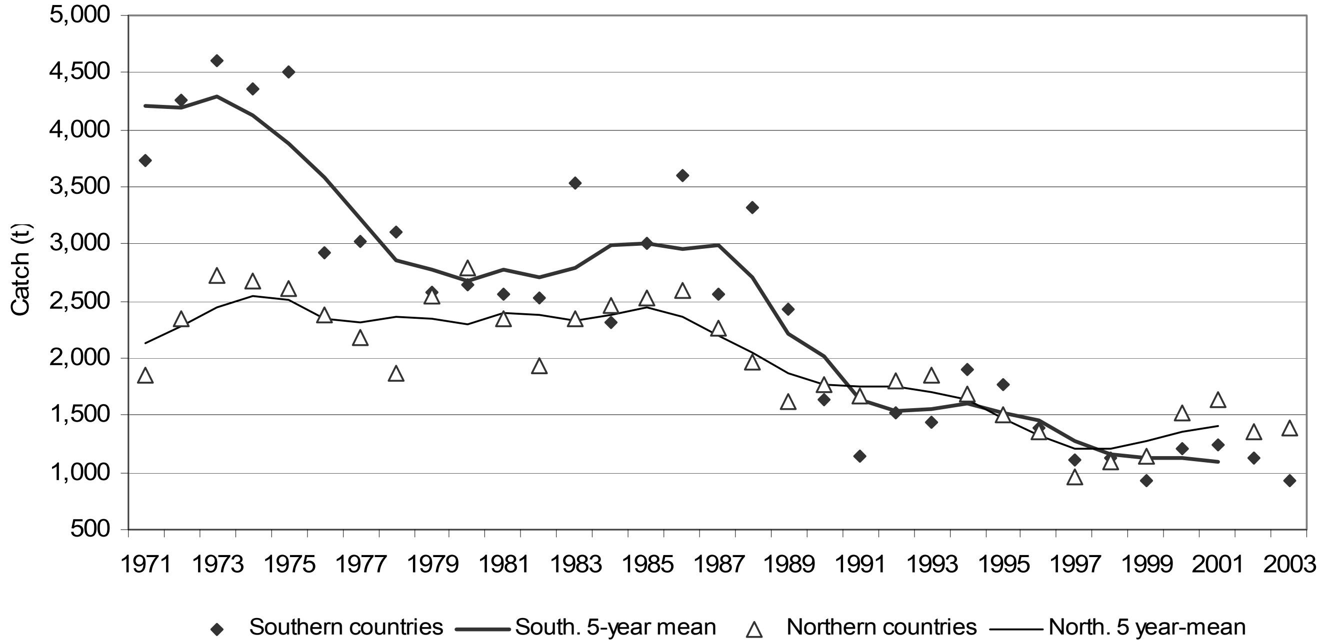
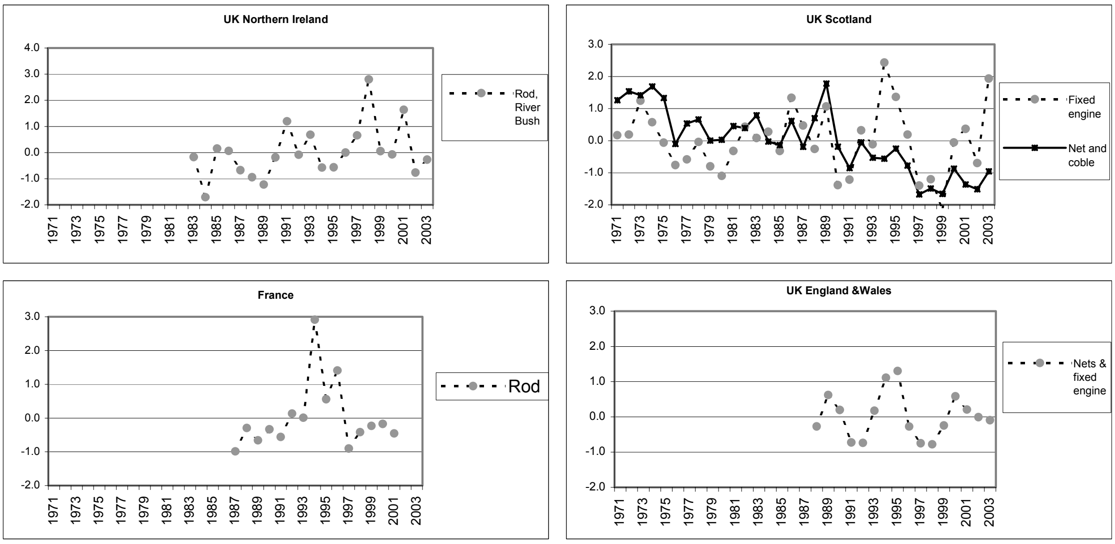


Figure. 3.9.5.1. CPUE indices in various fisheries of the NEAC countries. Vertical axes represent standardized (Z-score) index values, or averages of several series, relative to the average of the time series (0.0).

Southern NEAC area



Northern NEAC area

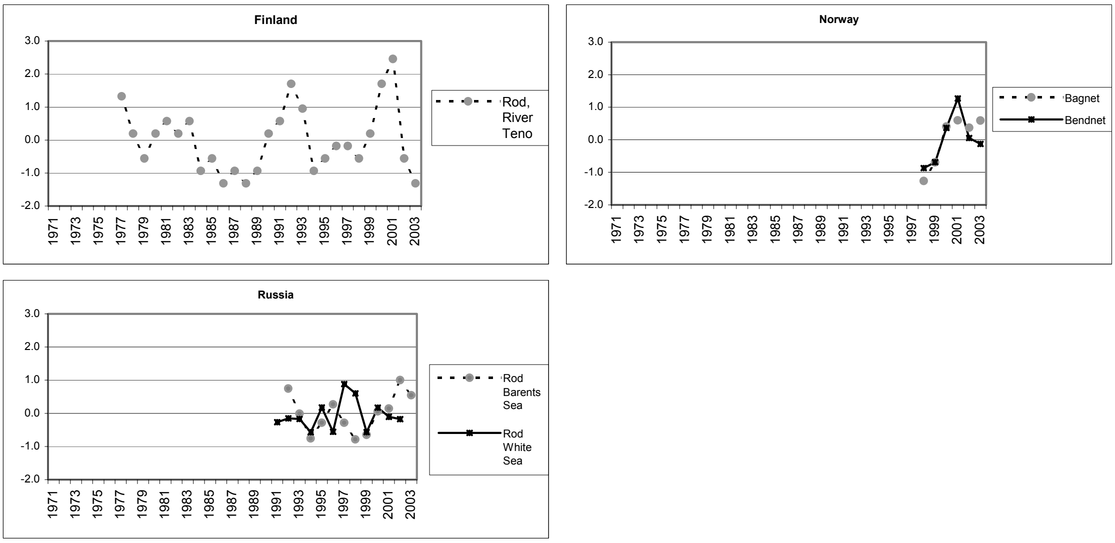


Figure 3.9.6.1. Percentage of 1 SW salmon in the reported catch for Northern NEAC countries, 1987-2003.

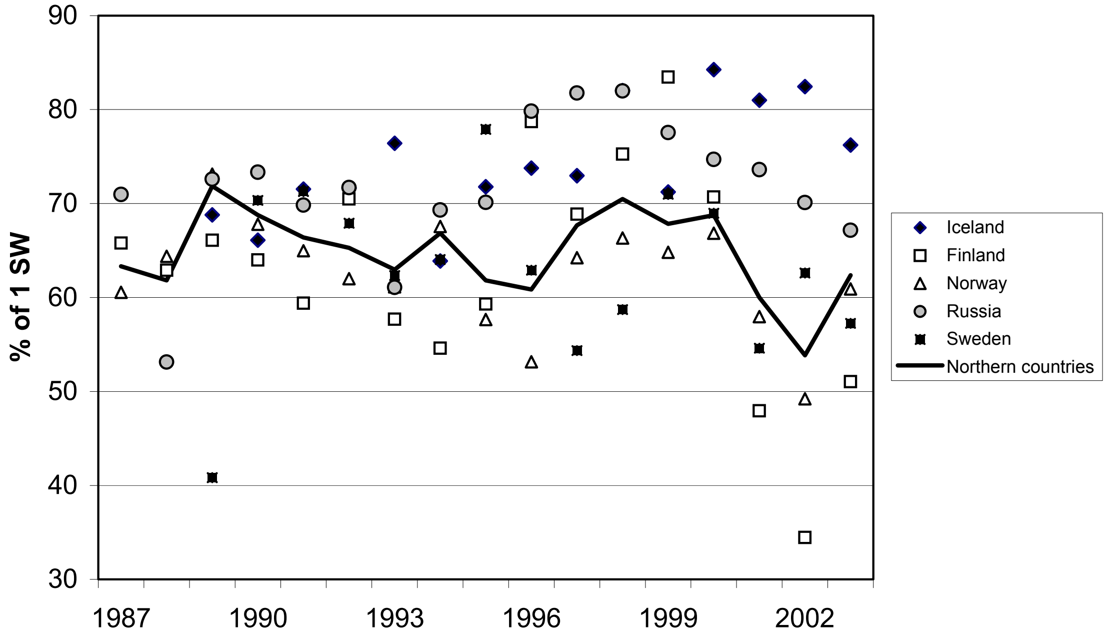


Figure 3.9.6.2. Percentage of 1 SW salmon in the reported catch for Sorthern NEAC countries, 1987-2003.

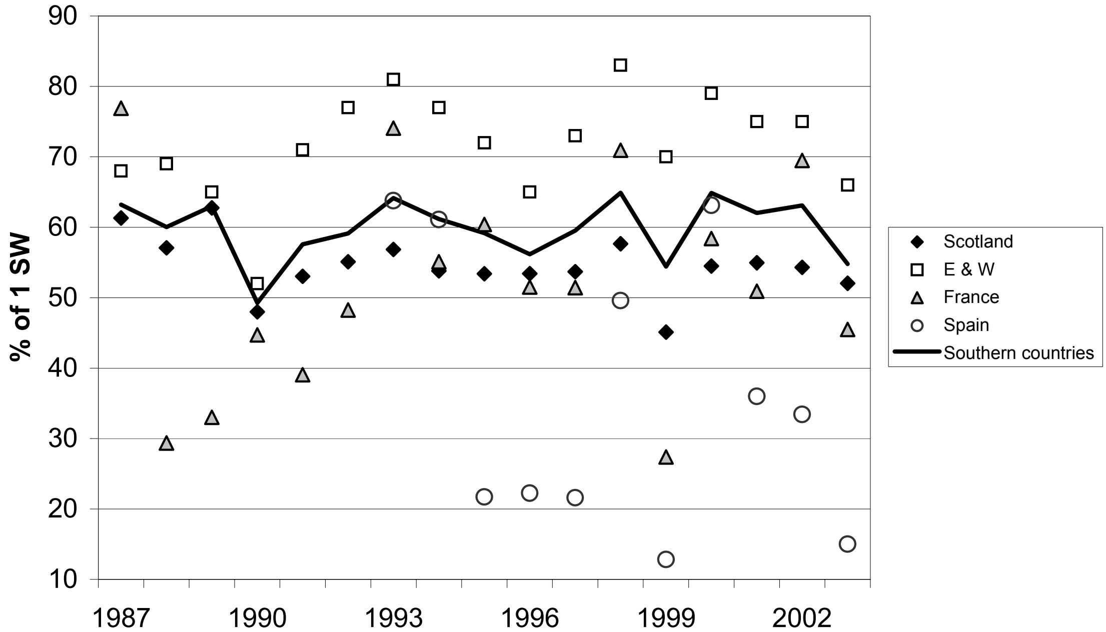
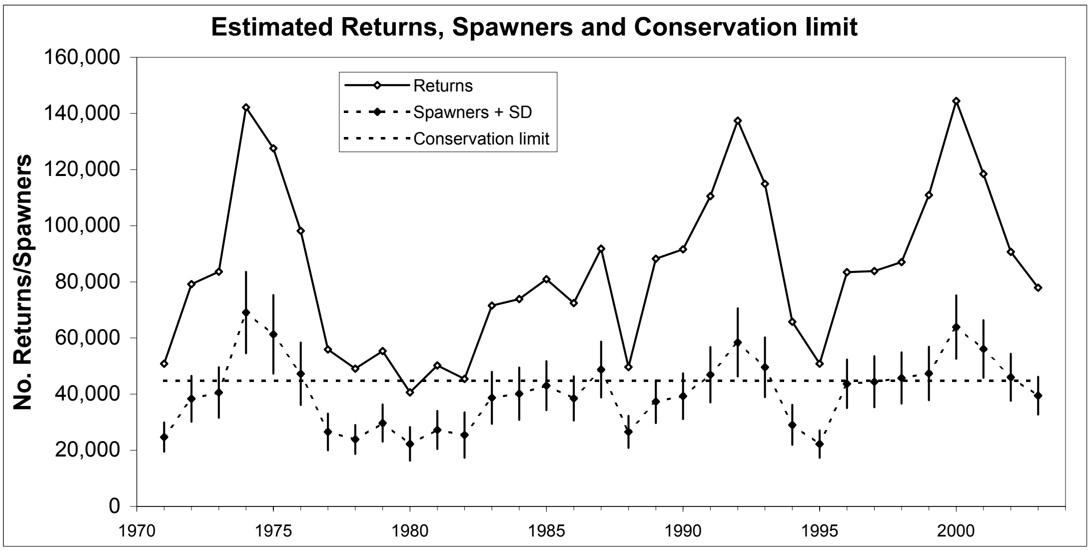
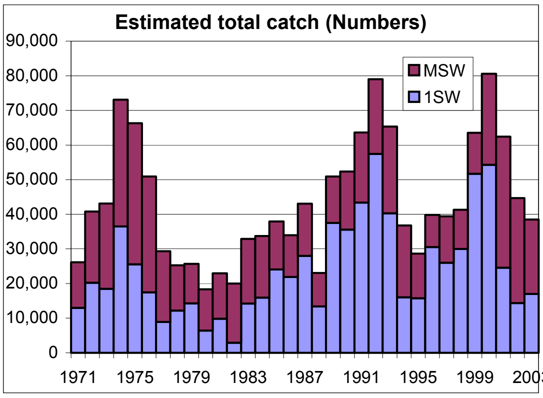


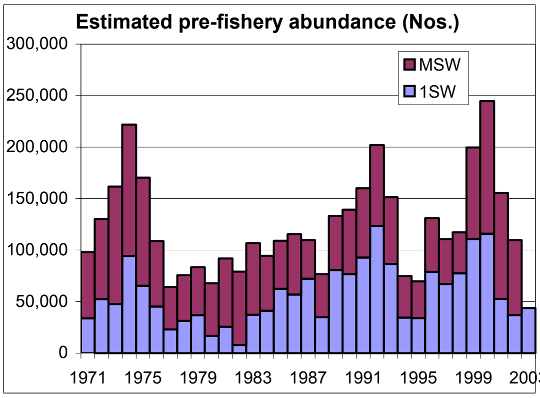
Figure 3.9.13.1a

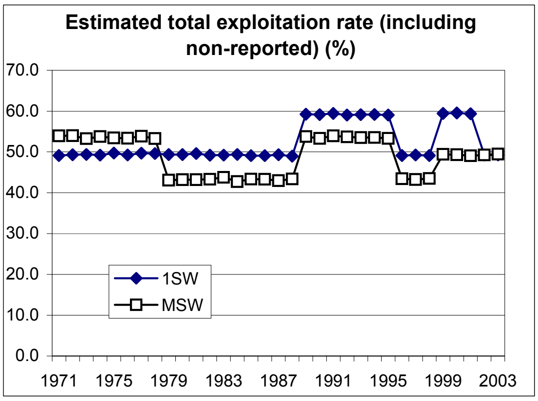
SUMMARY OF FISHERIES AND STOCK DESCRIPTION

FINLAND (including Norwegian R. Teno catch)









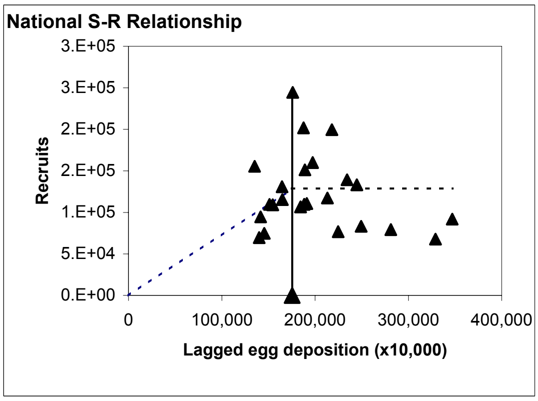


Figure 3.9.13.1b
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
France

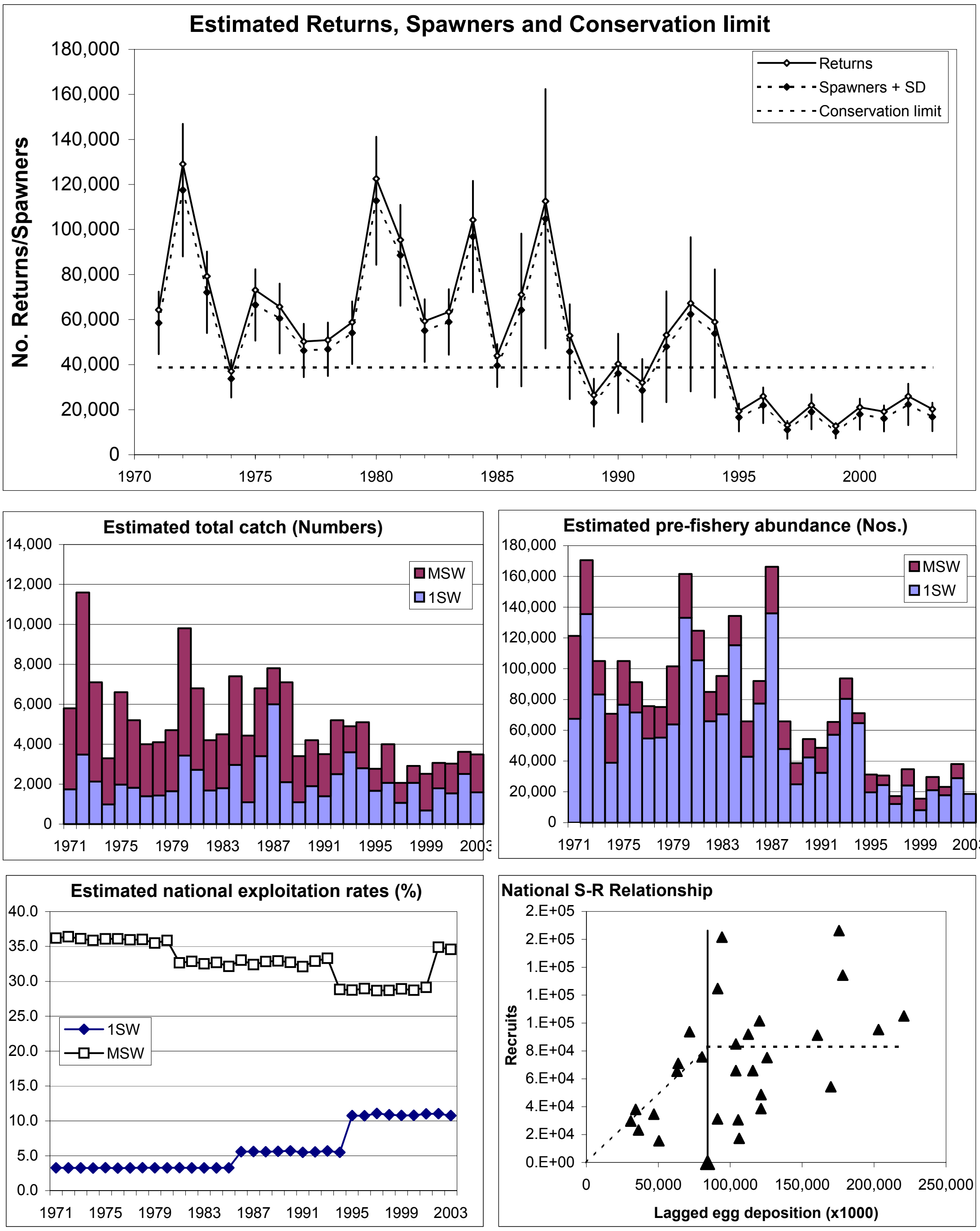
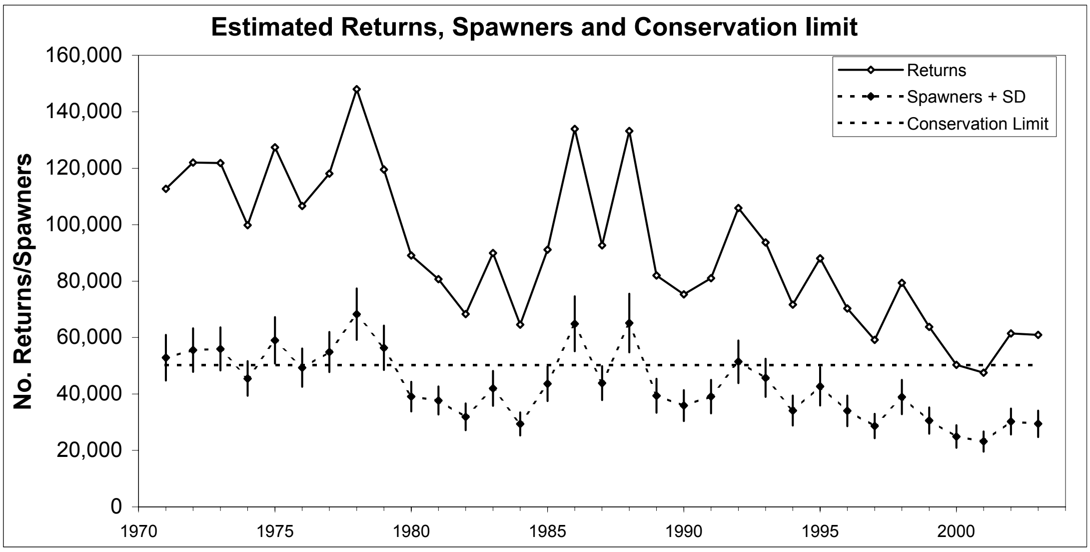
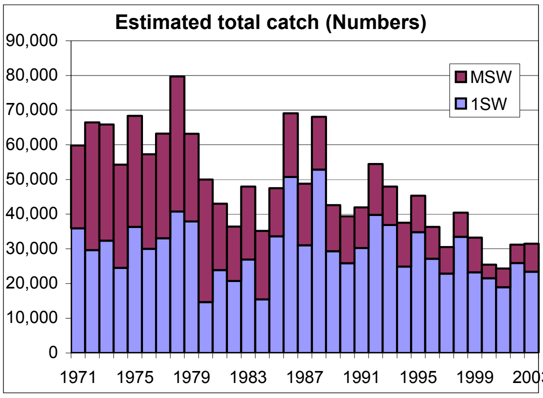
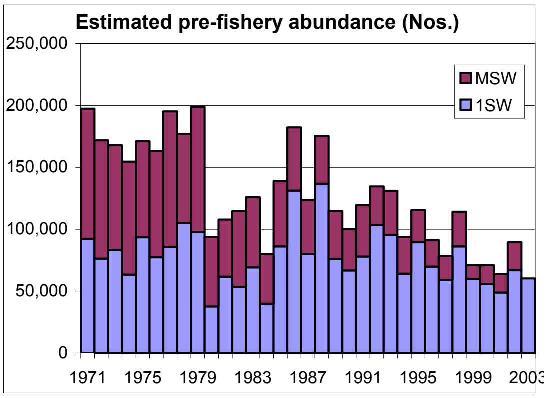
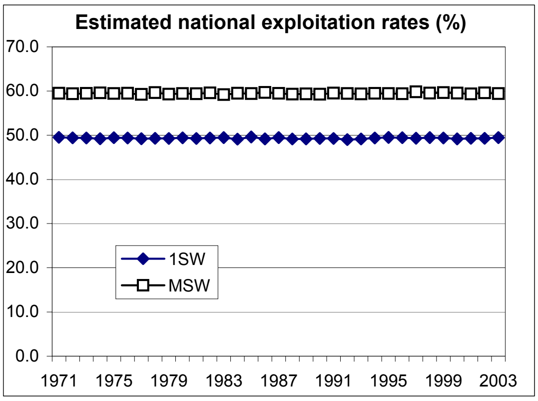


Figure 3.9.13.1c
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
ICELAND









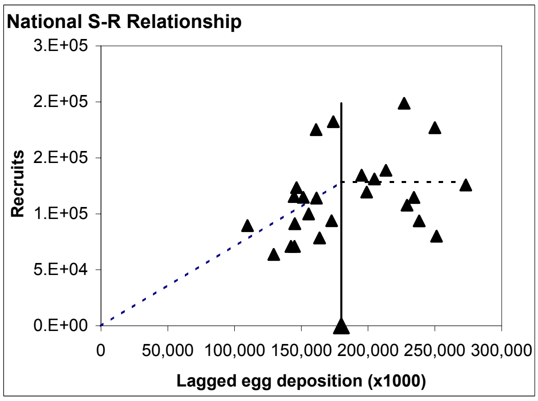
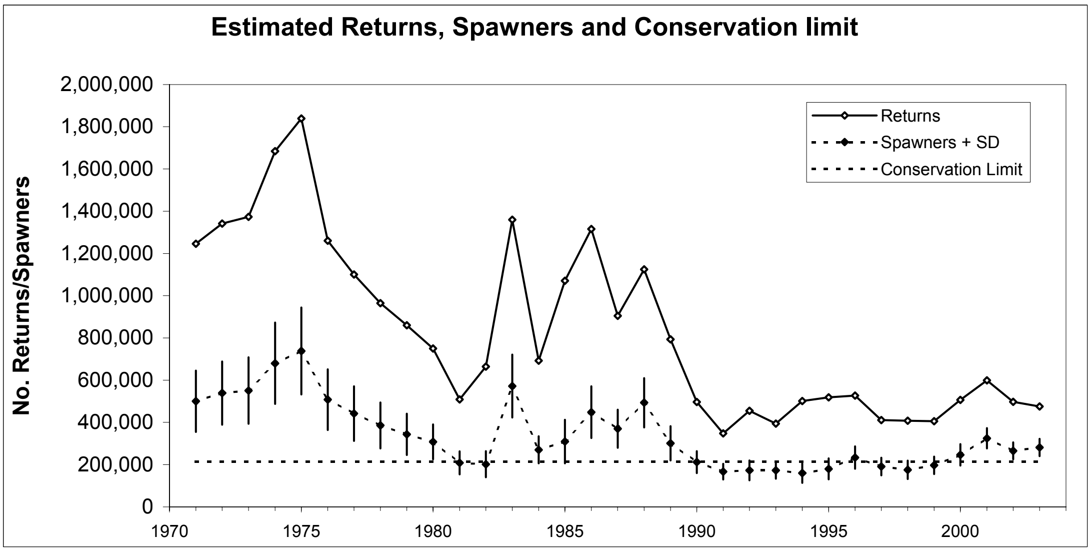
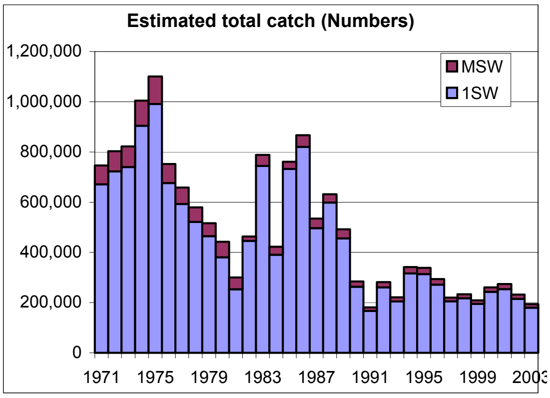
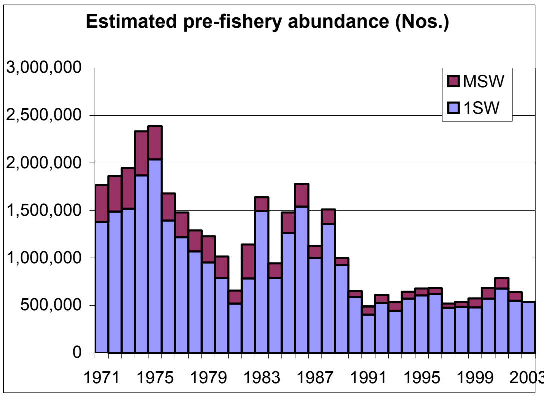
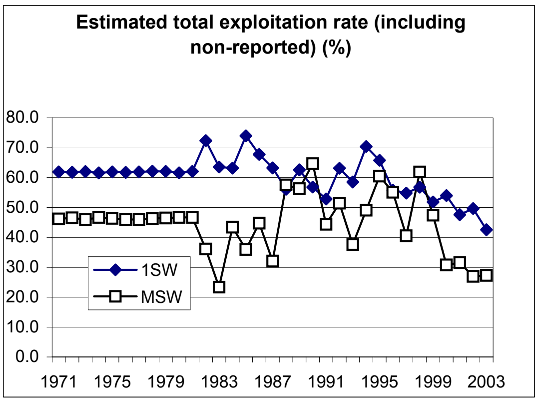


Figure 3.9.13.1d
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
IRELAND









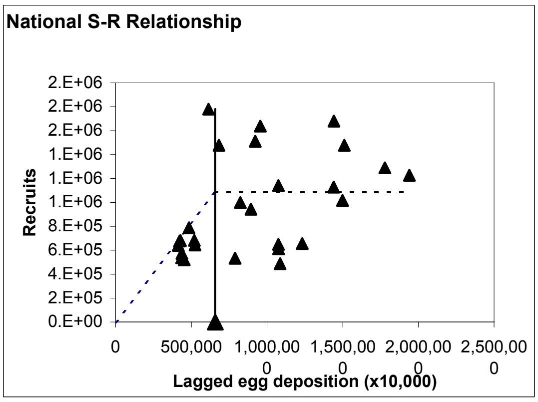


Figure 3.9.13.1e
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
NORWAY (minus Norwegian rod catches from the R. Teno)

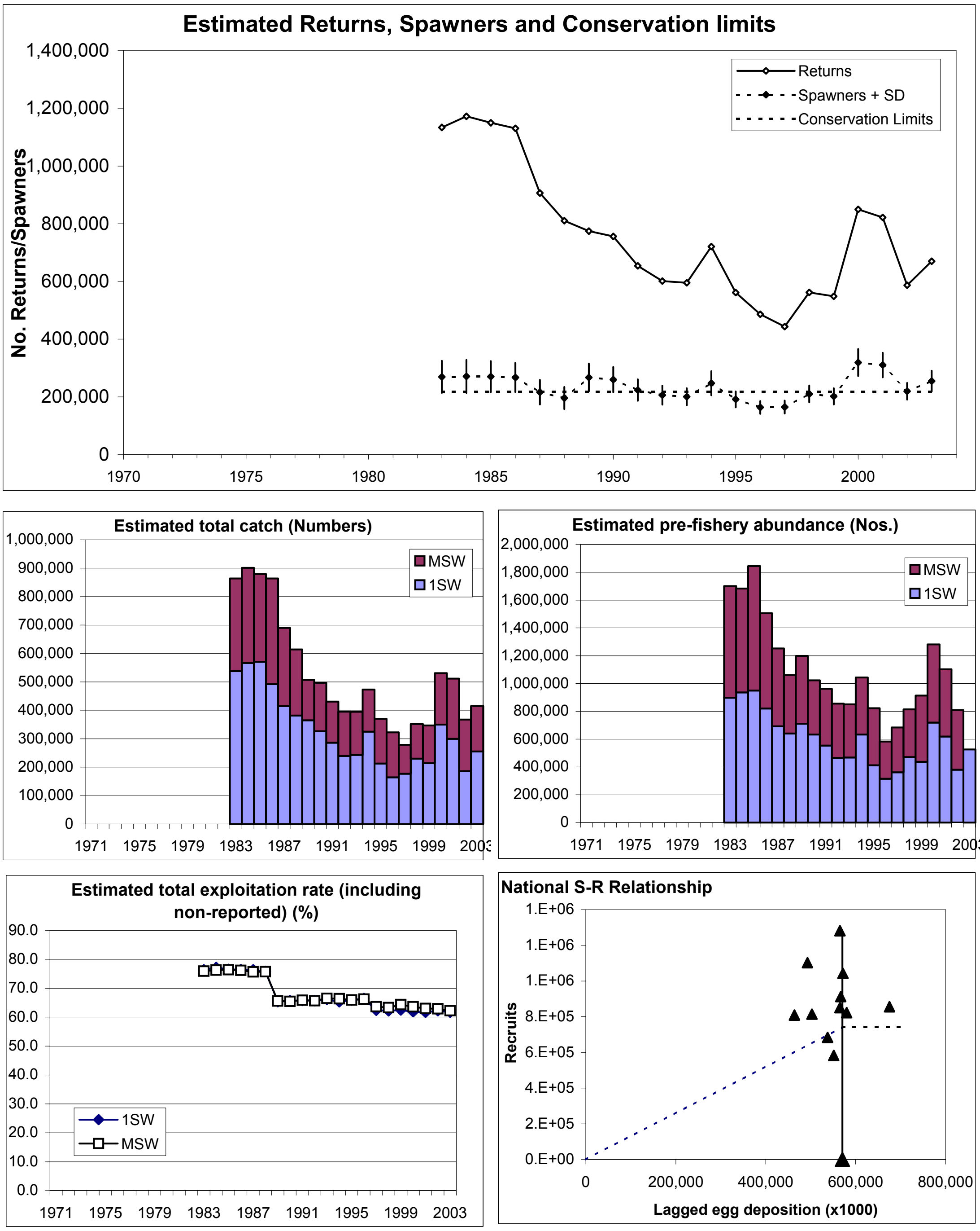
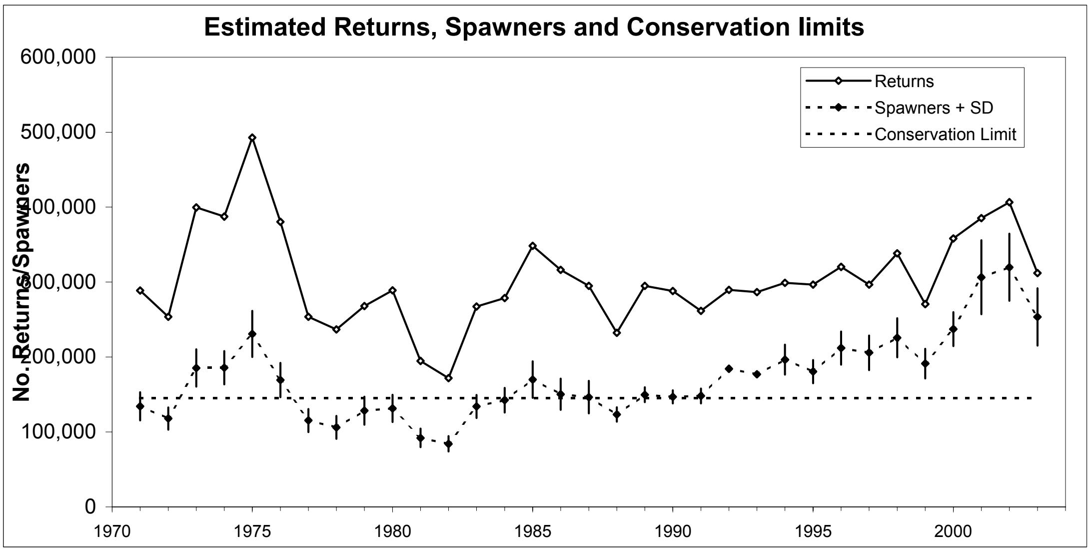
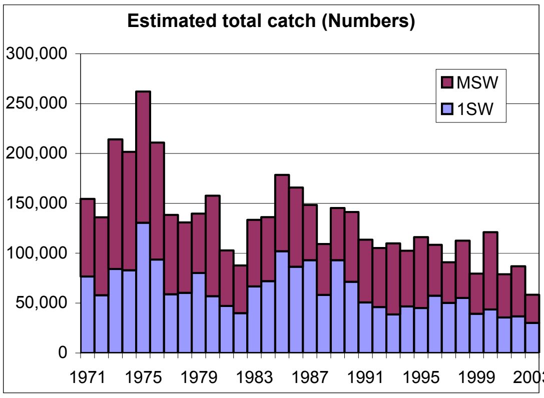
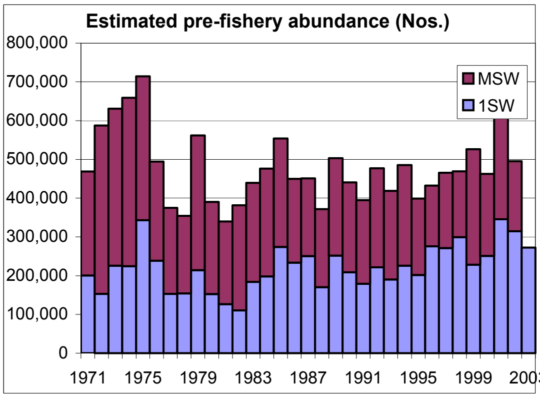
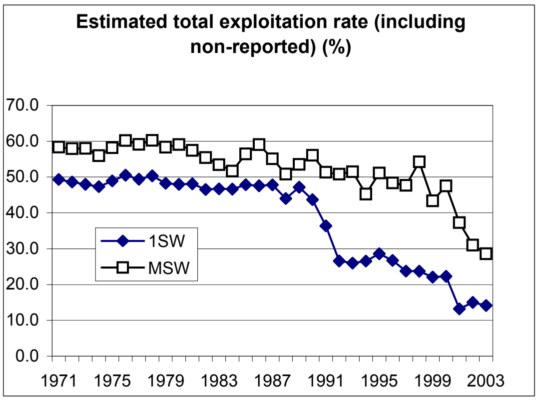


Figure 3.9.13.1f
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
RUSSIA









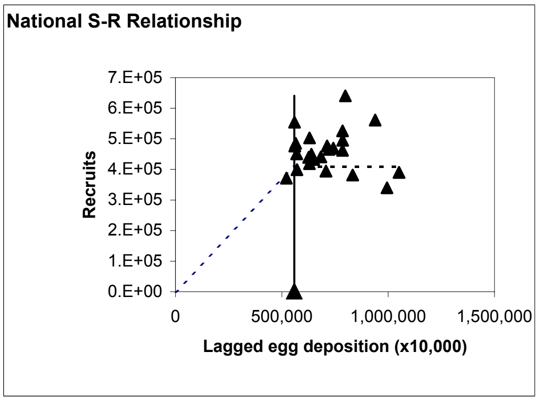


Figure 3.9.13.1g
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
SWEDEN

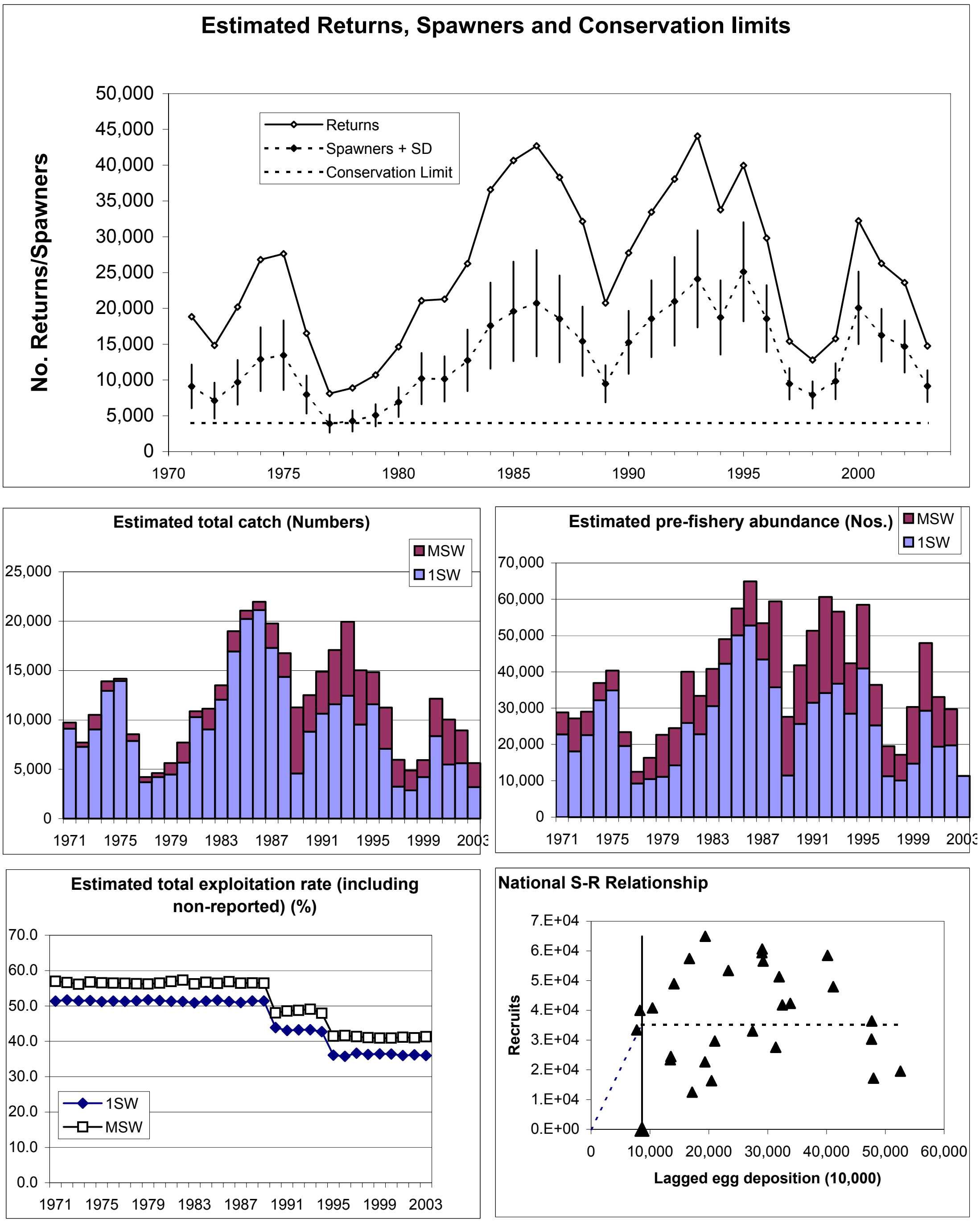


Figure 3.9.13.1h
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
UK (E&W)

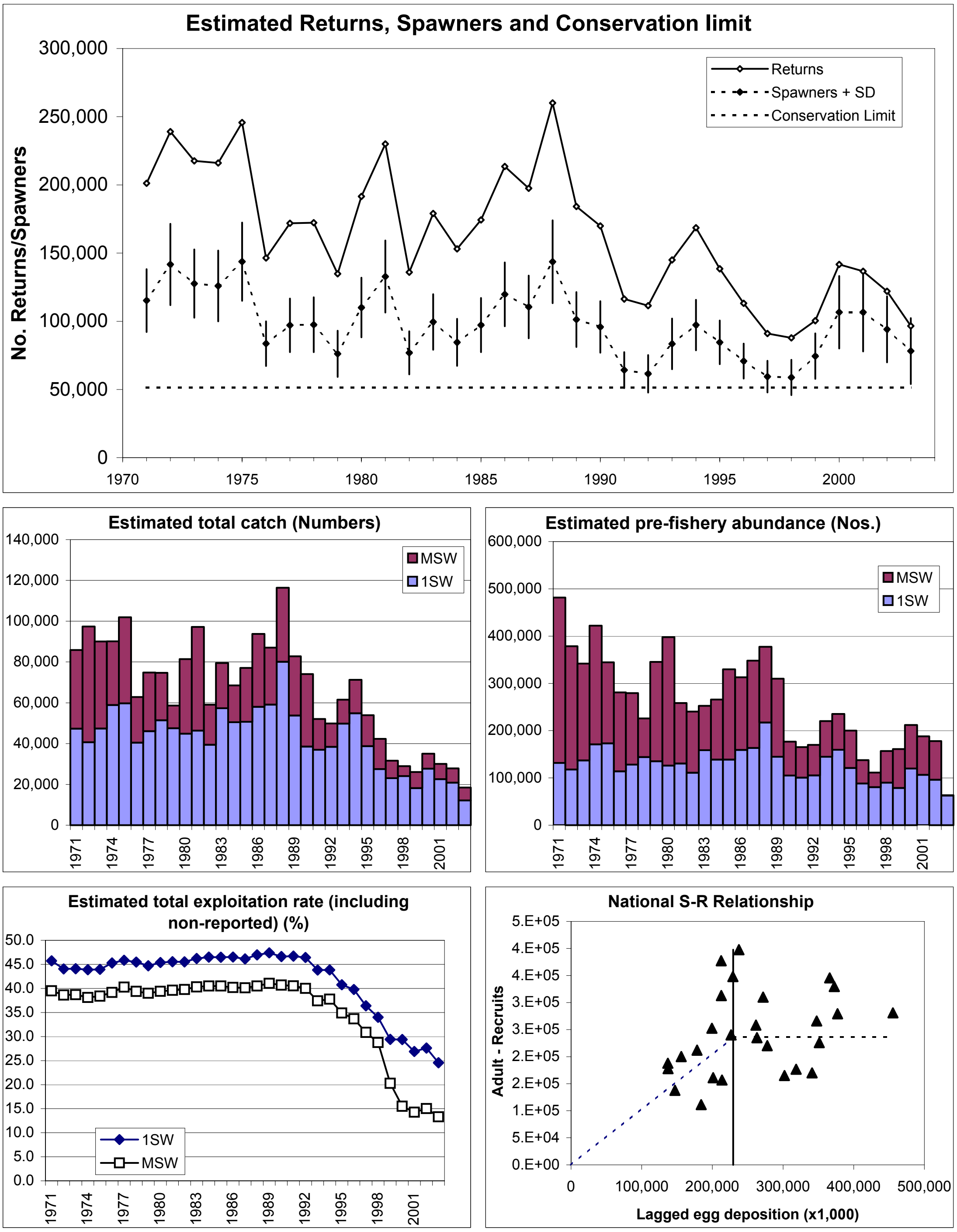


Figure 3.9.13.1i
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
UK(Northern Ireland)

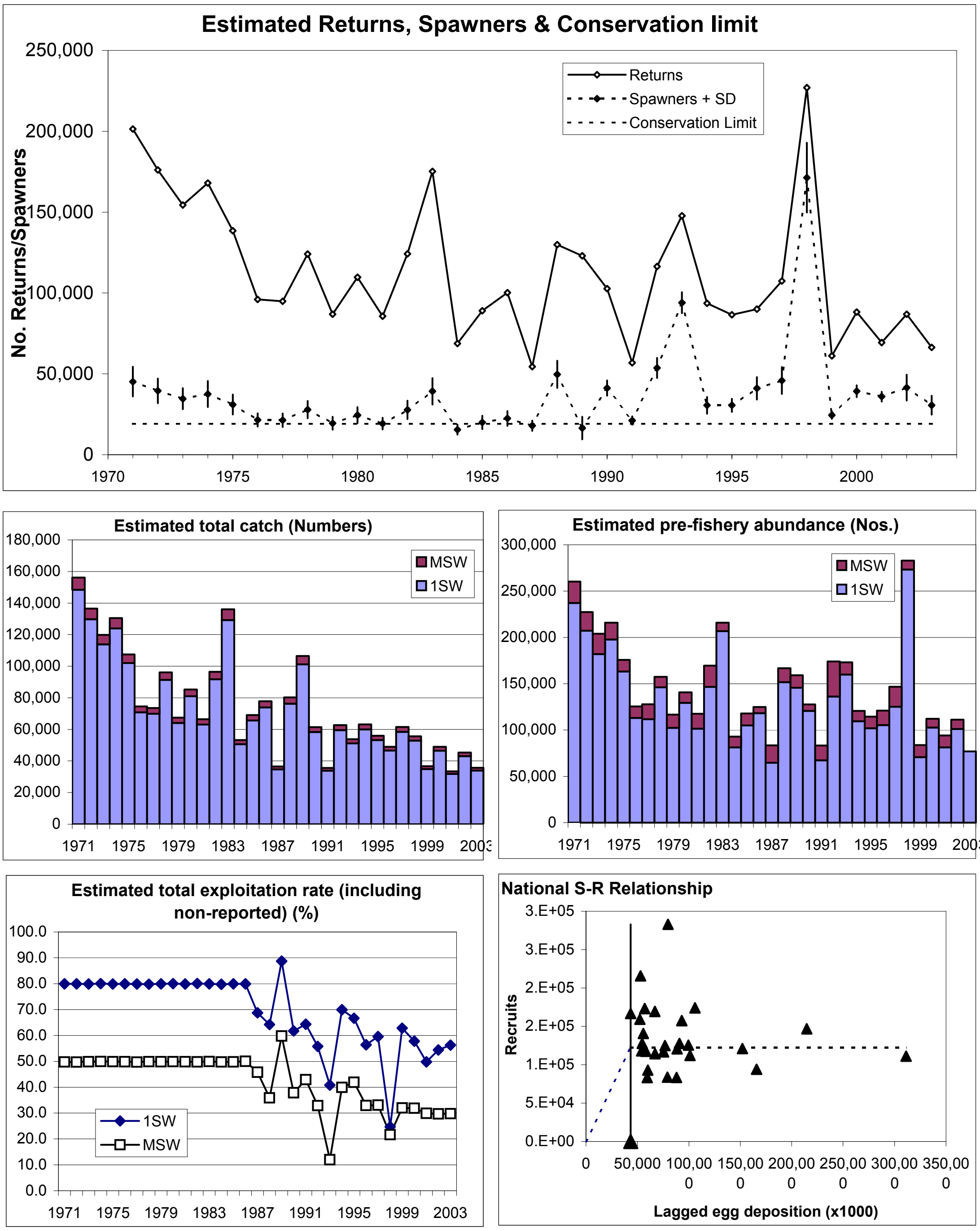


Figure 3.9.13.1j
SUMMARY OF FISHERIES AND STOCK DESCRIPTION
UK(Scotland)

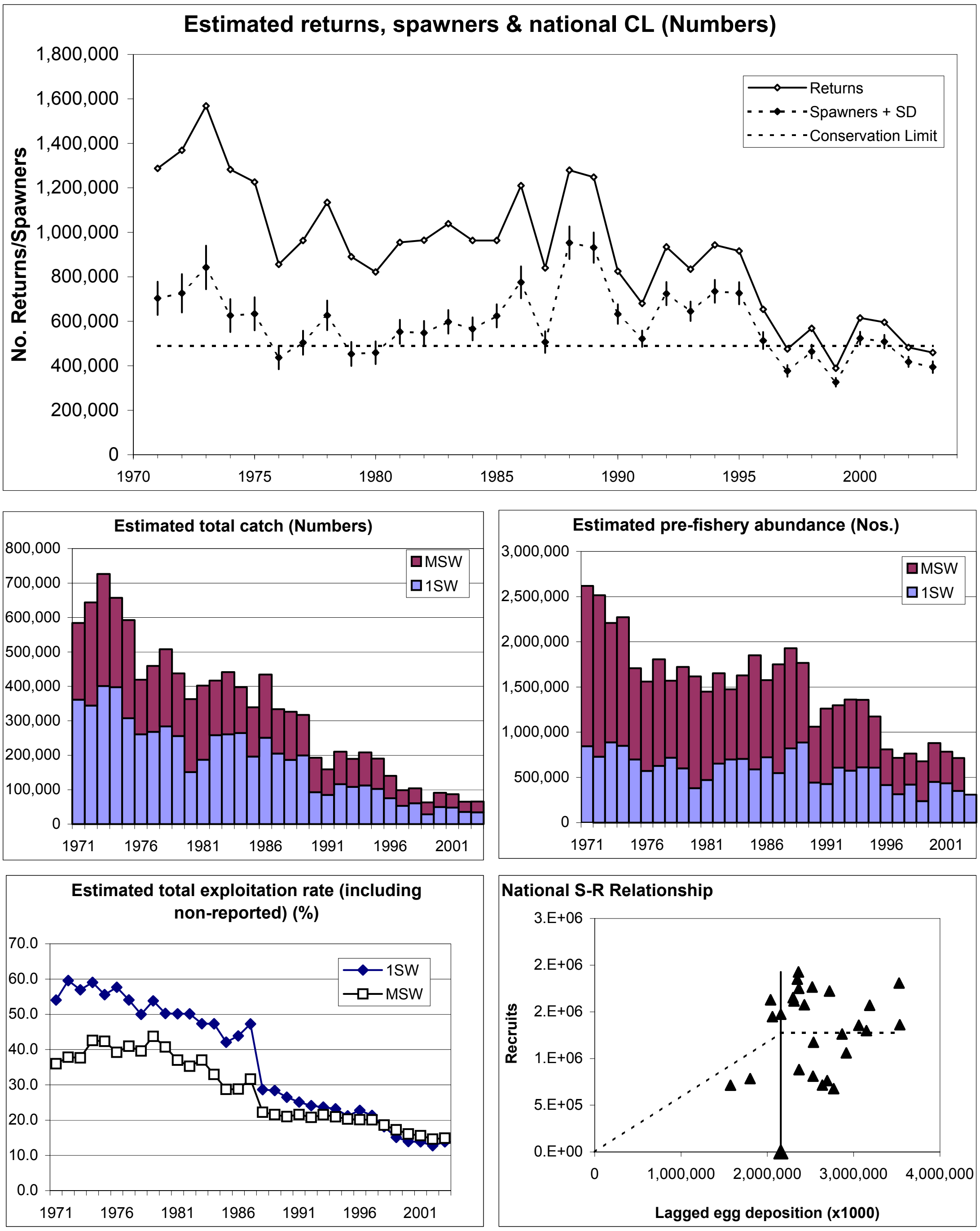
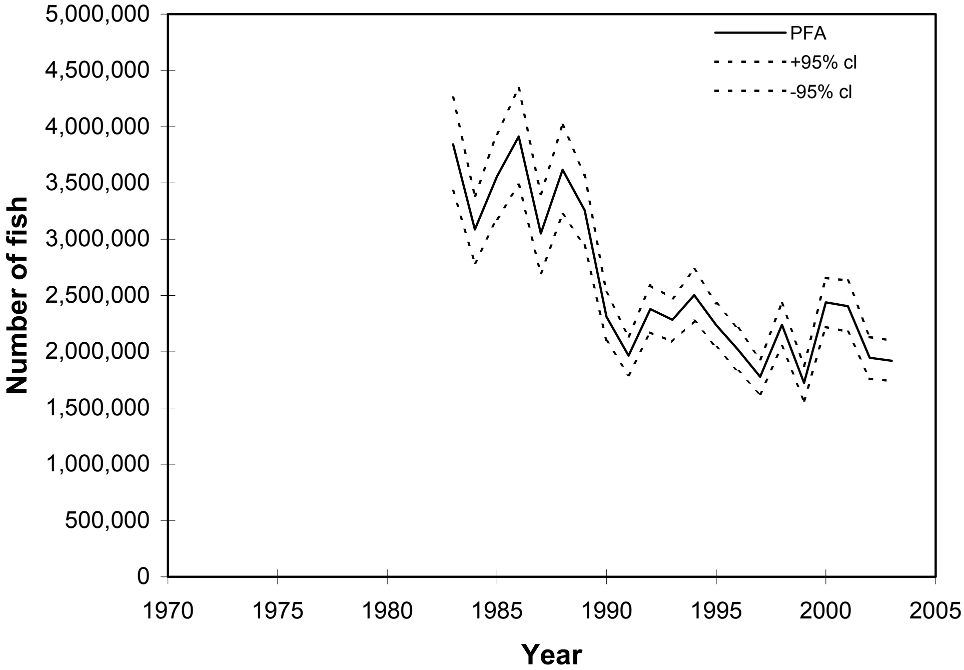


Figure 3.9.14.1 Estimated recruitment (PFA) in the NEAC area

a) Maturing 1SW recruits (potential 1SW returns)

(Recruits in Year N become spawners in Year N)



b) Non-maturing 1SW recruits (potential MSW returns)

(Recruits in Year N become spawners in Year N+1)

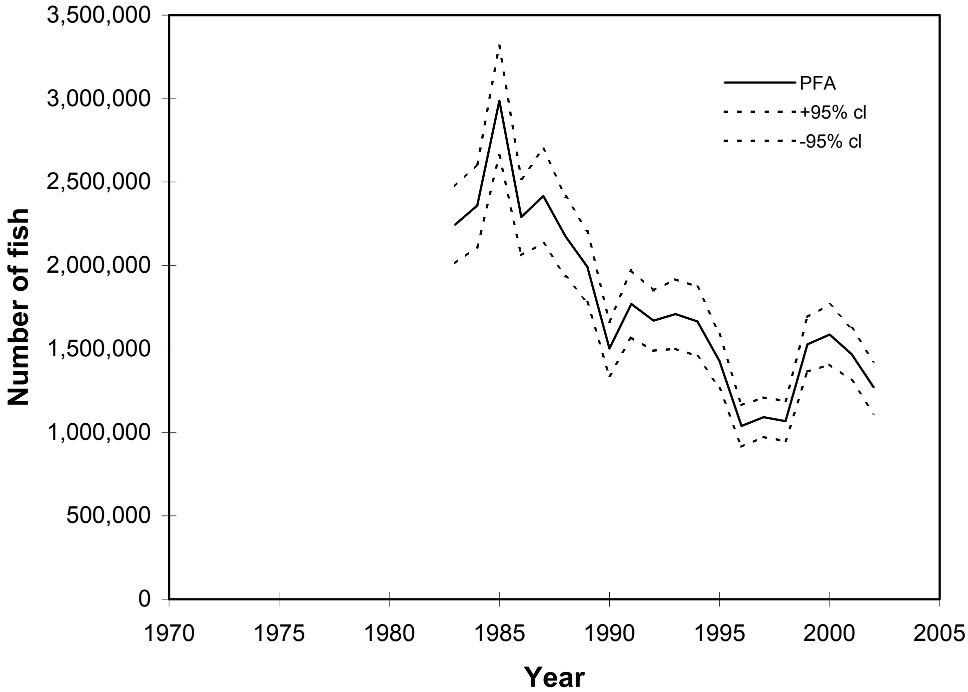
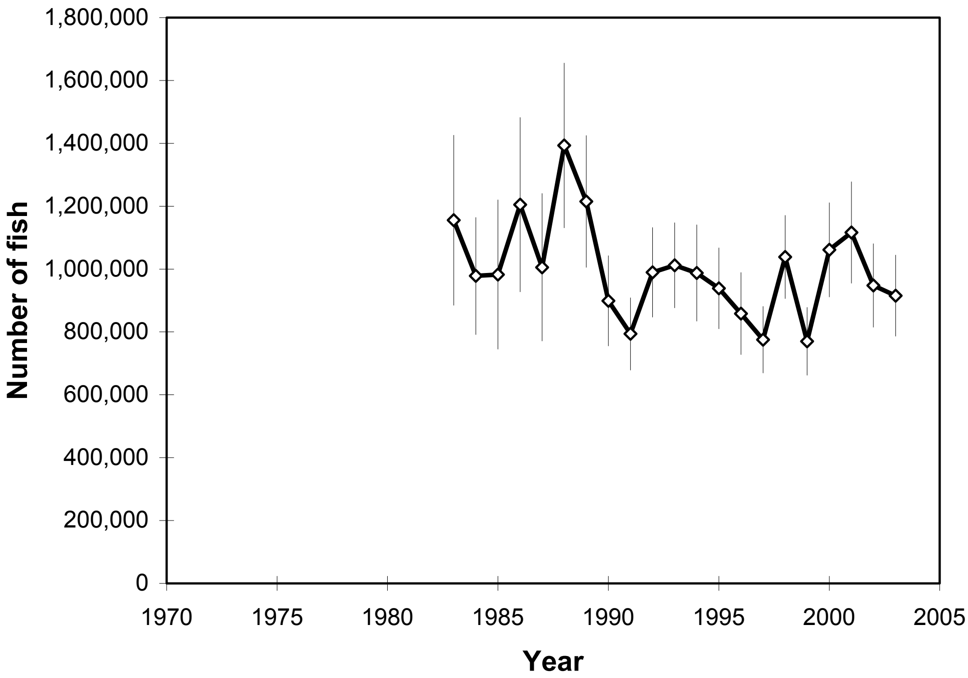


Figure 3.9.14.2 Estimated spawning escapement in the NEAC area

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

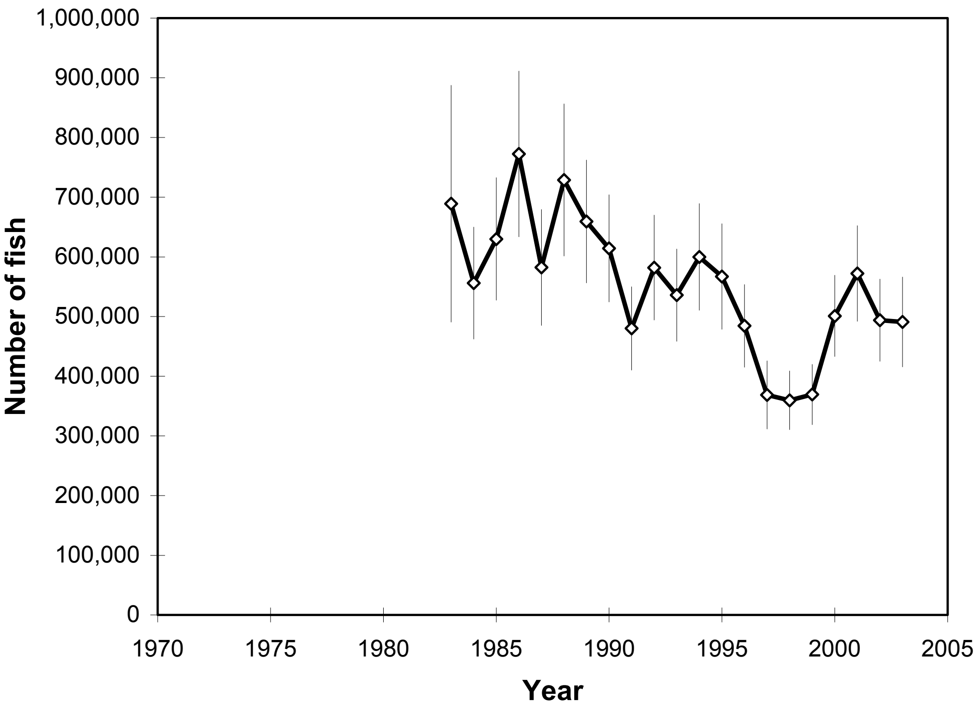
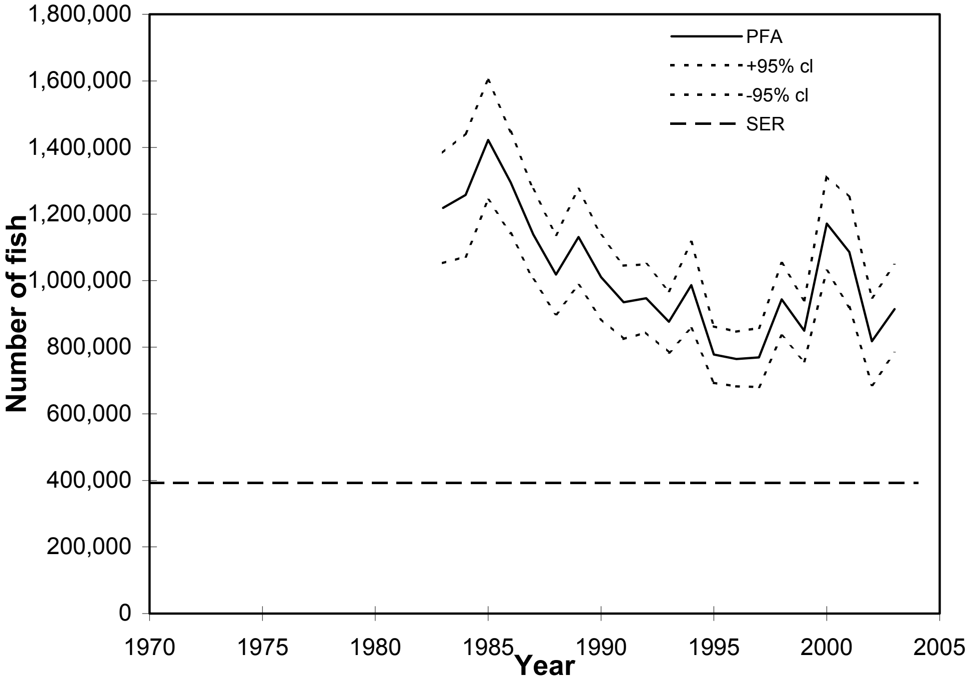


Figure 3.9.14.3 Estimated recruitment (PFA) and Spawning Escapement Reserve (SER) for maturing and non-maturing salmon in Northern Europe.

a) Maturing 1SW recruits (potential 1SW returns)

(Recruits in Year N become spawners in Year N)



b) Non-maturing 1SW recruits (potential MSW returns)

(Recruits in Year N become spawners in Year N+1)

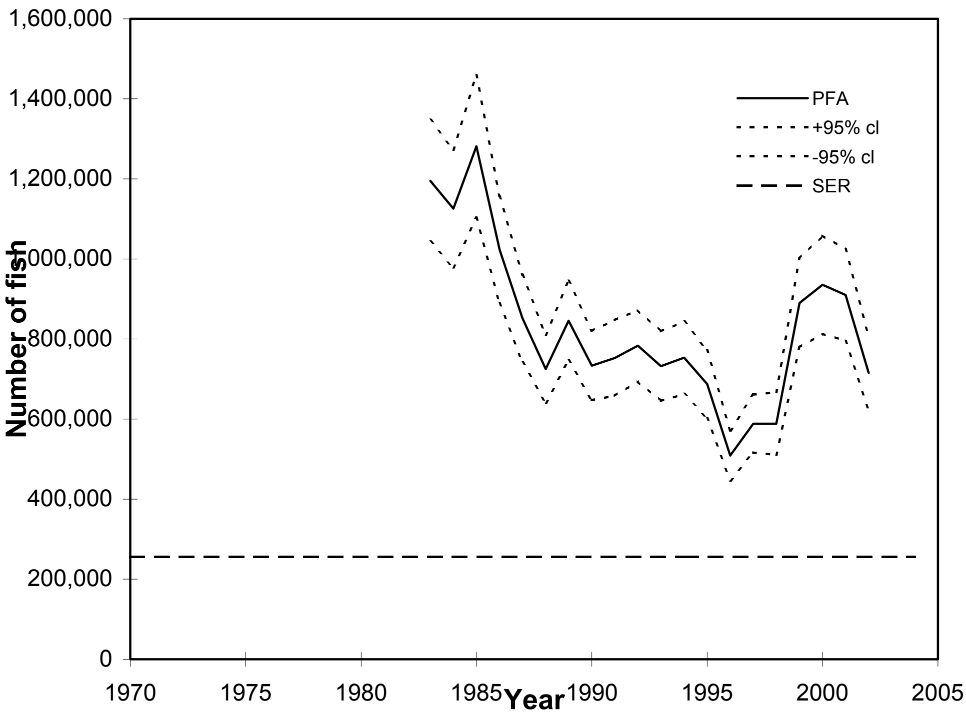
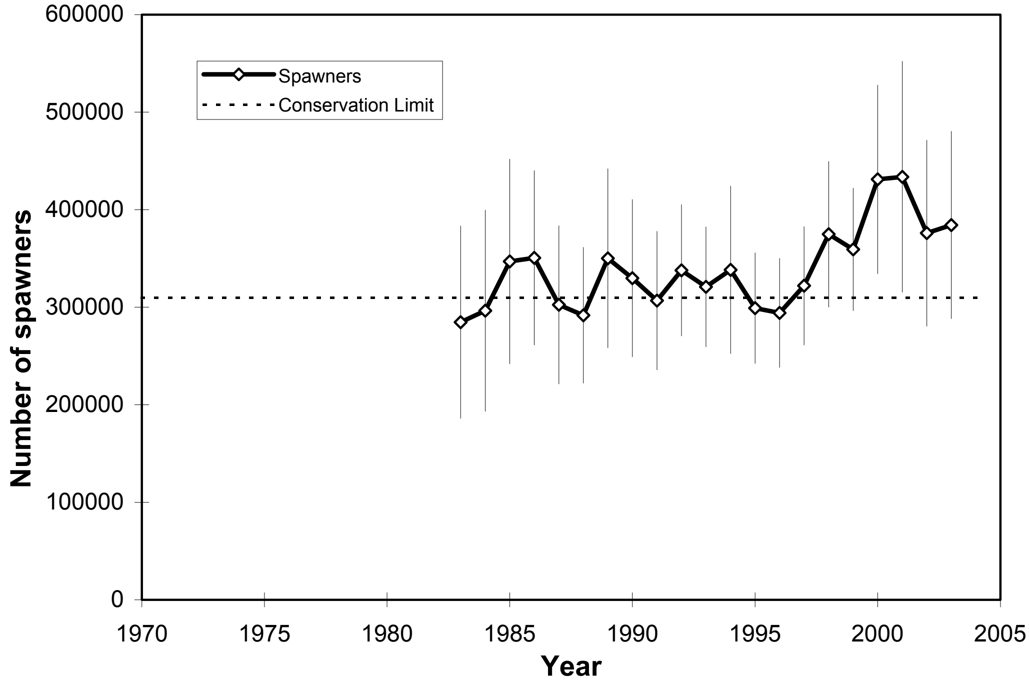


Figure 3.9.14.4 Estimated spawning escapement of maturing and non-maturing salmon in Northern Europe.

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

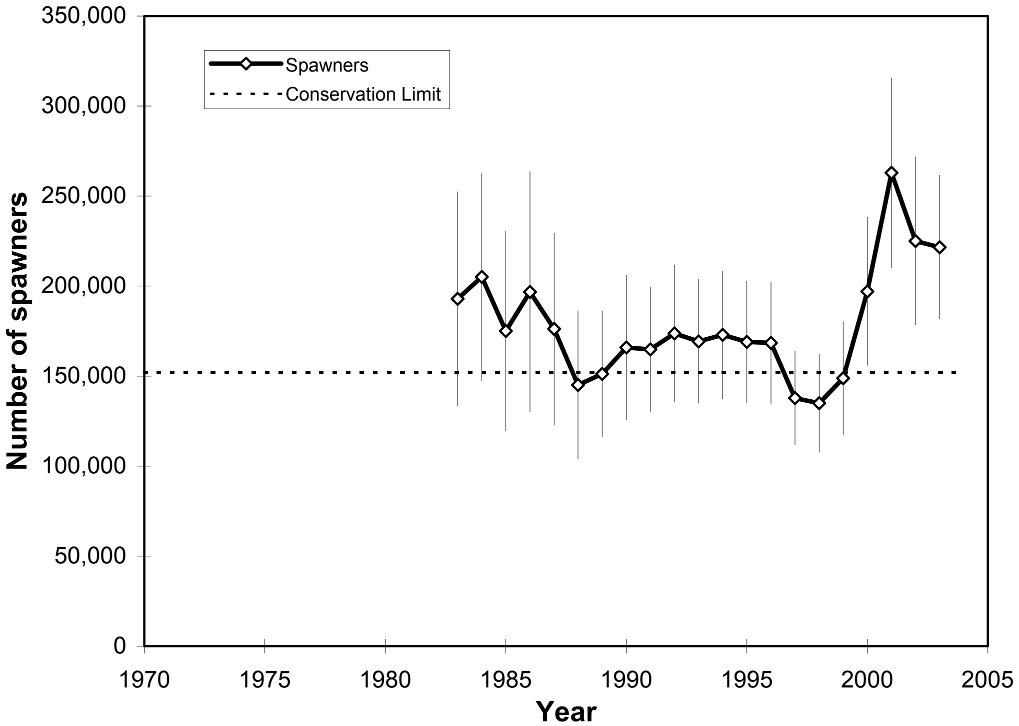
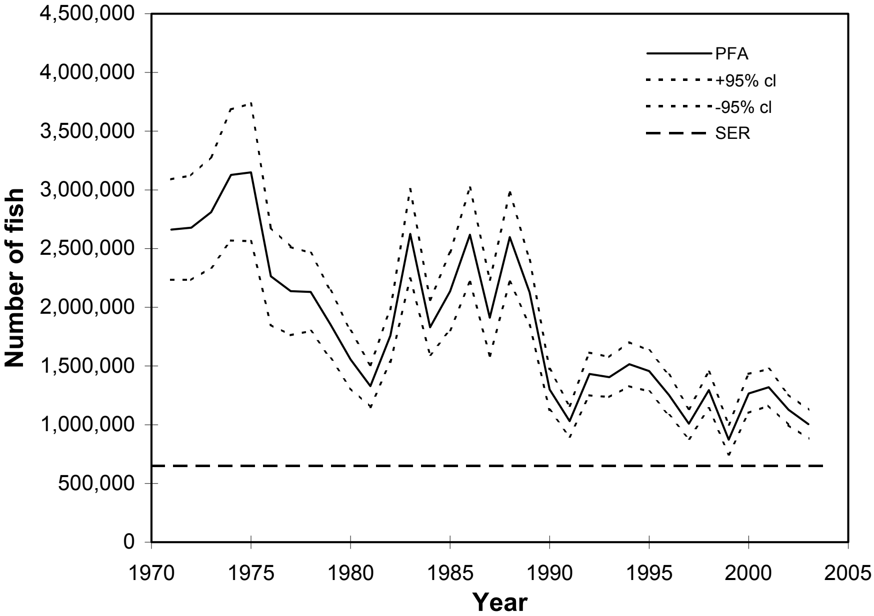


Figure 3.9.14.5 Estimated recruitment (PFA) and Spawning Escapement Reserve (SER) for maturing and non-maturing salmon in Southern Europe.

a) Maturing 1SW recruits (potential 1SW returns)

(Recruits in Year N become spawners in Year N)



b) Non-maturing 1SW recruits (potential MSW returns)

(Recruits in Year N become spawners in Year N+1)

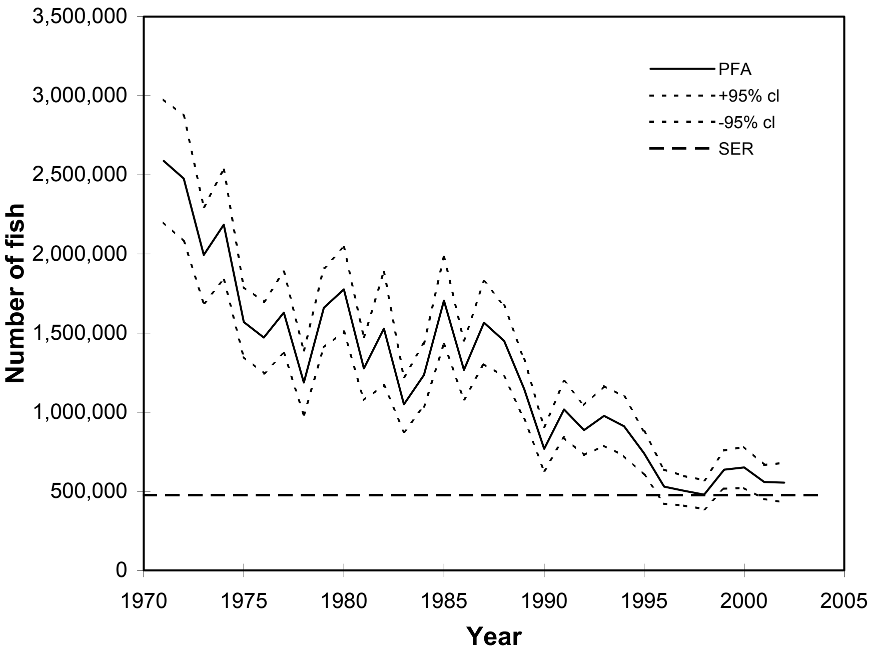
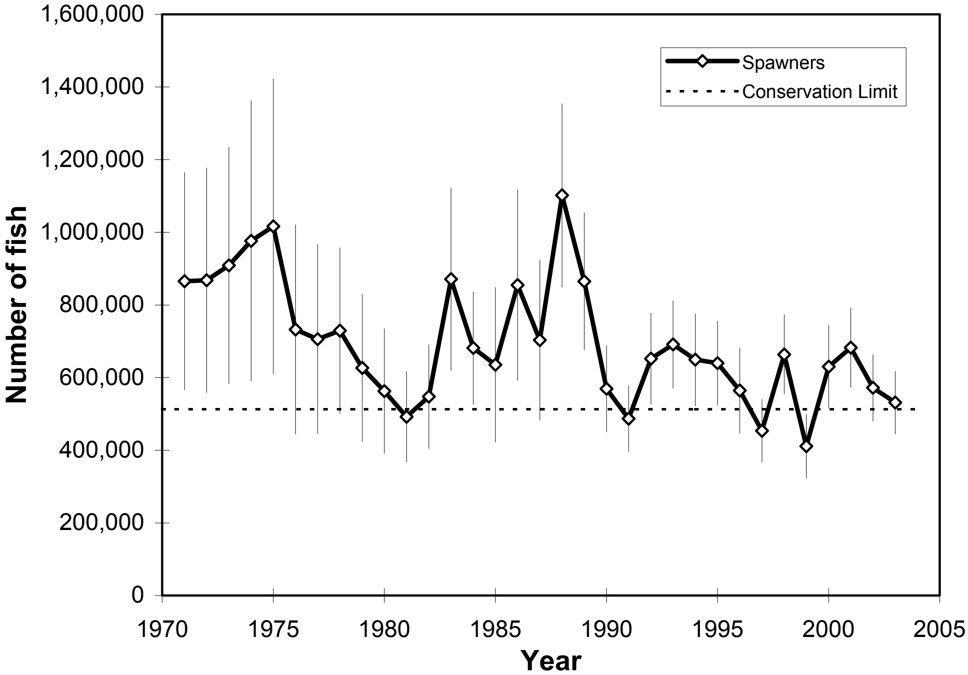


Figure 3.9.14.6 Estimated spawning escapement of maturing and non-maturing salmon in Southern Europe.

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

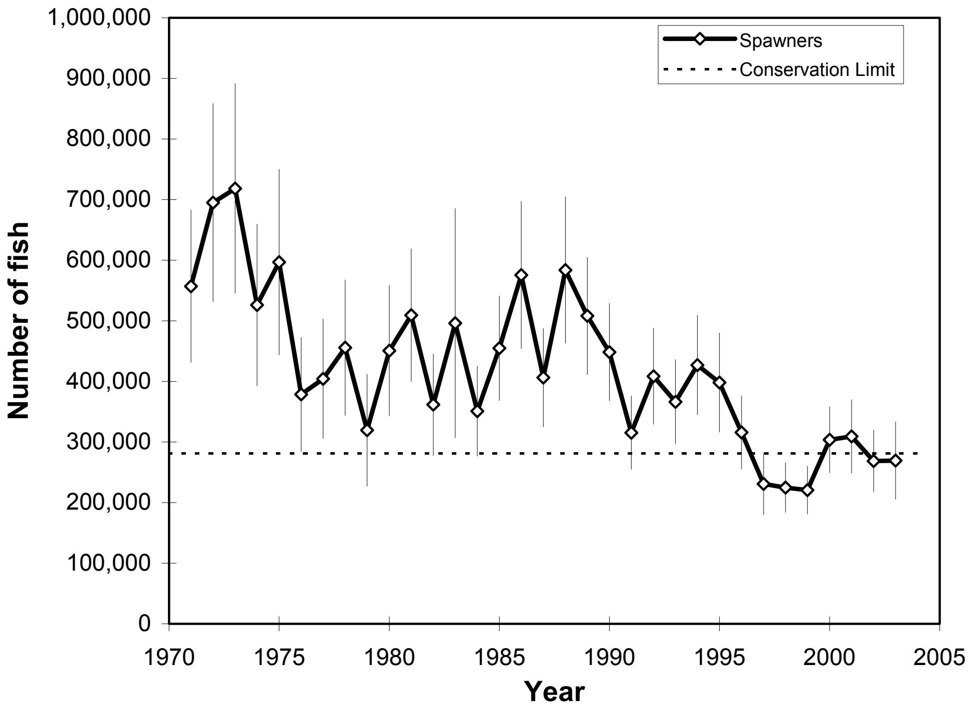


Figure 3.9.15.1. An overview of the estimated survival indices of wild and hatchery smolts to adult returns to homewaters (prior to coastal fisheries) in Northern and Southern NEAC area.
Index values represent averages of standardized (Z-score) survival estimates for monitored rivers and experimental facilities, and are relative to the average of the time series (0).
The number of rivers included are indicated in each panel legend.

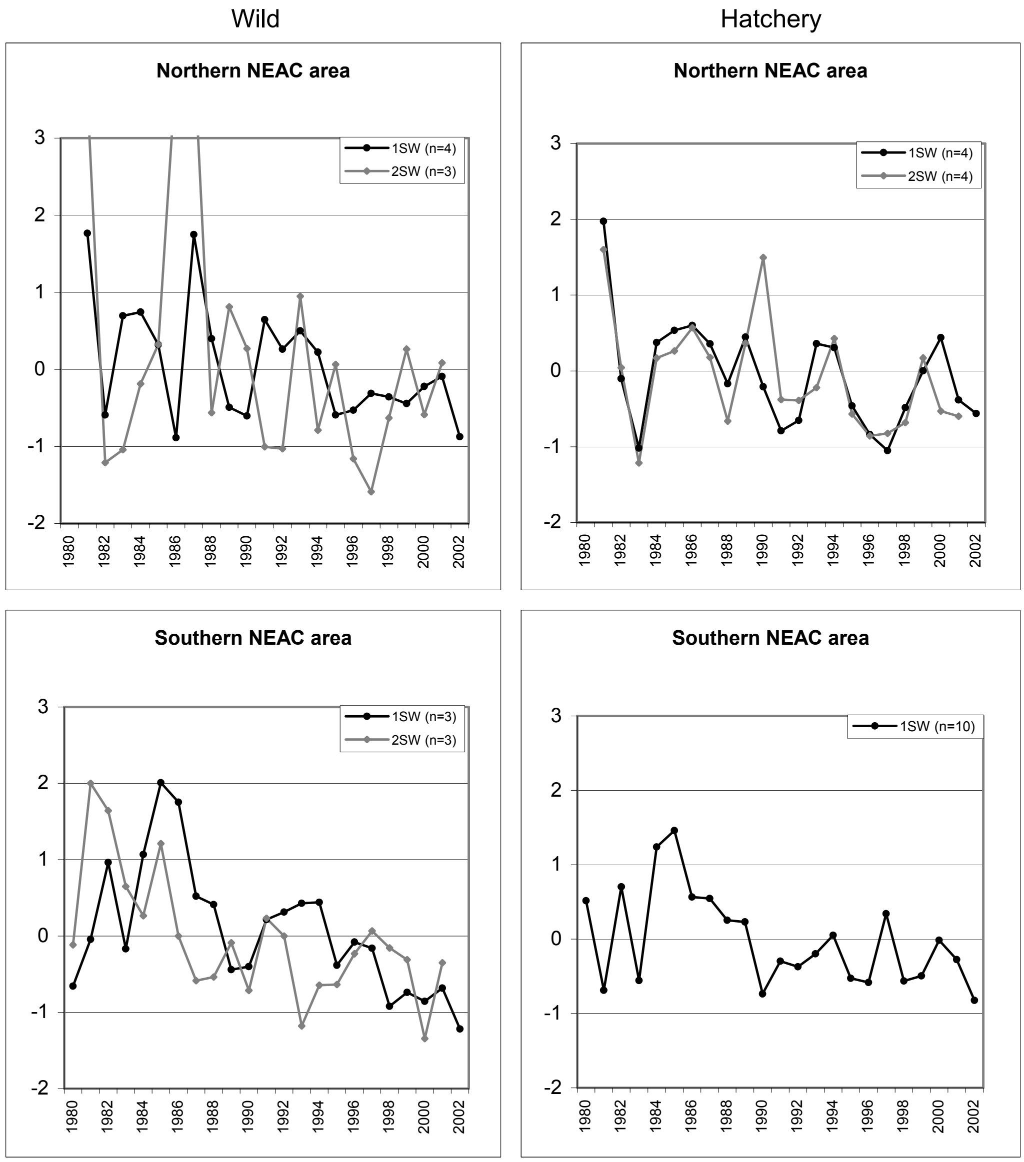


Figure 3.11.1.1 The ICES' Areas and Divisions

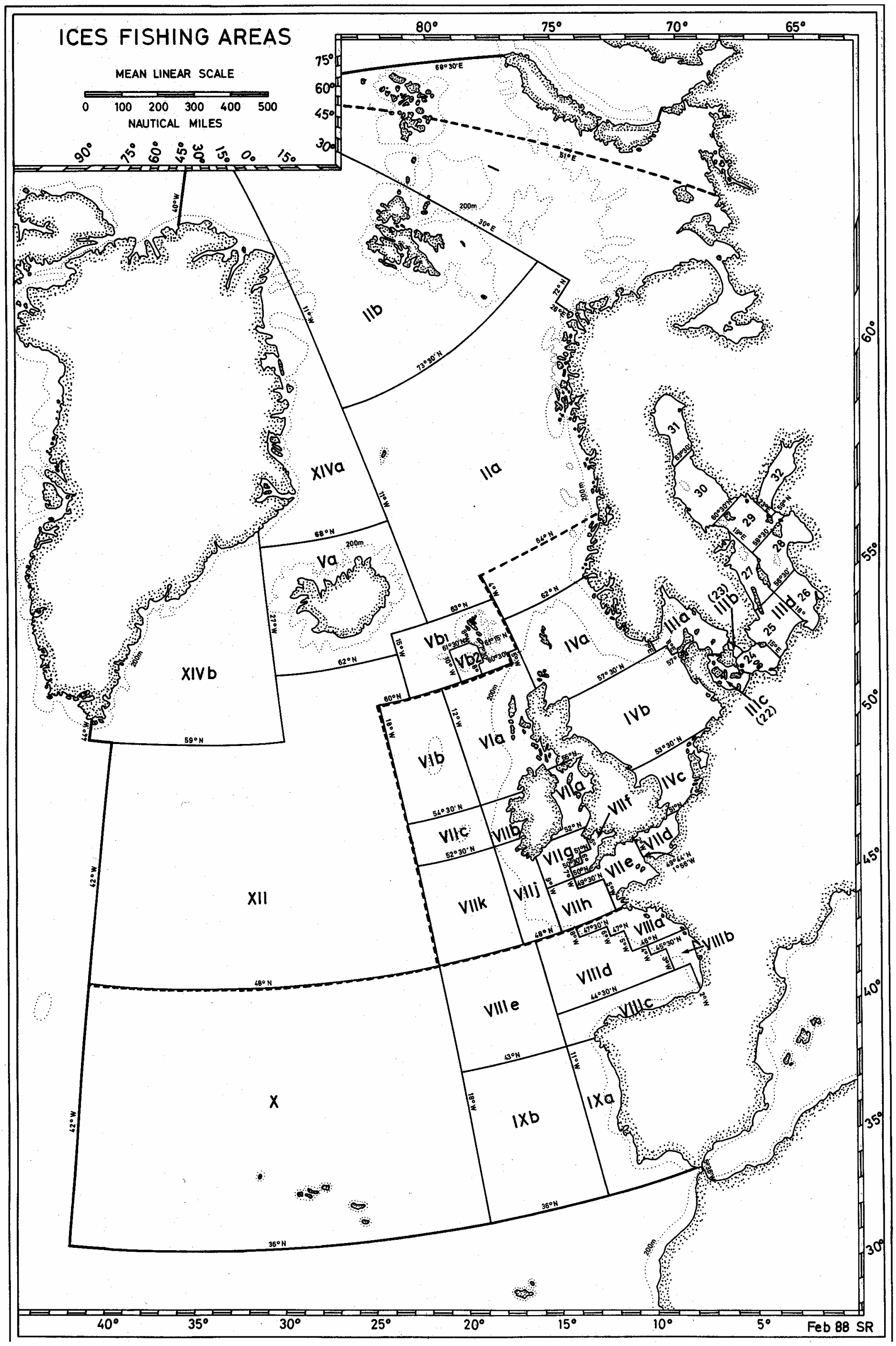


Figure 3.11.3.1 Time series of pelagic fisheries catches and PFAA for southern and northern NEAC complexes

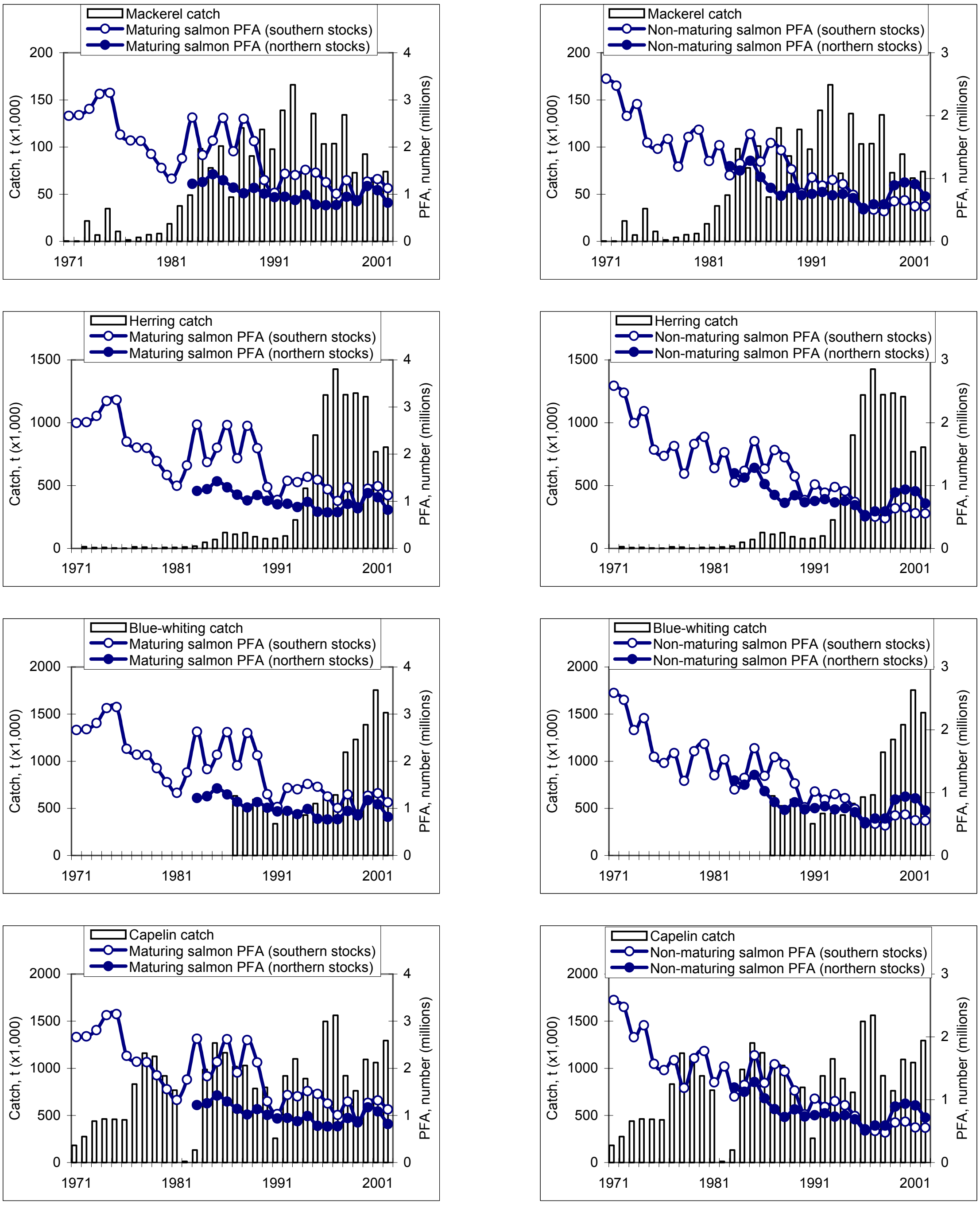


Figure 3.11.4.1. Pelagic trawl sites May – late July 2003, with salmon captures (legends in figure) and without salmon captures (stars).

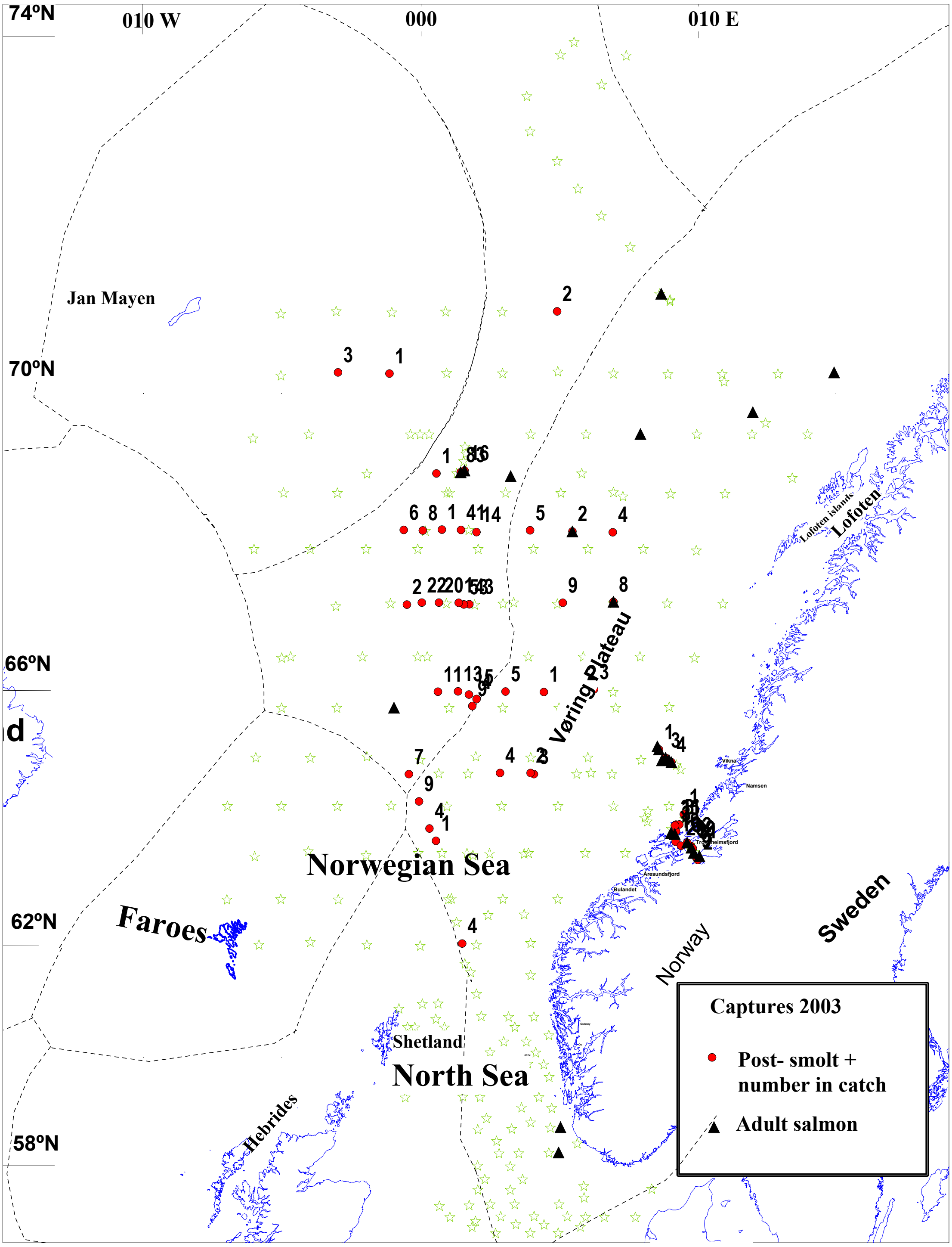
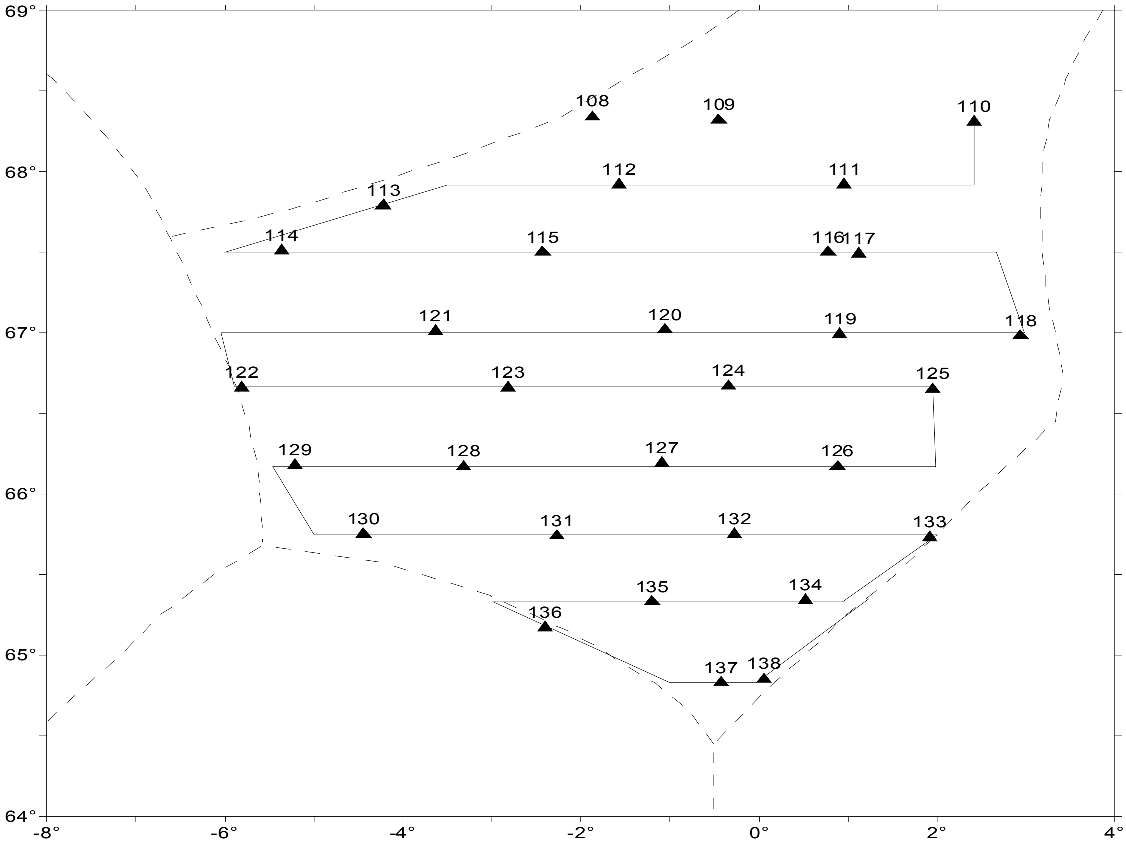


Figure 3.11.4.2. Positions of trawl hauls in the pelagic fish survey conducted by R/V “Smolensk” M-103 (cruise 50) in 08-17 July 2003 in the international waters of the Norwegian Sea.



4 NORTH AMERICAN COMMISSION

4.1 Status of stocks/exploitaton

In 2003, the overall conservation limit (S_{lim}) for 2SW salmon was not met in any area, therefore the stock complexes in these regions are considered to be outside safe biological limits.

The stock status is elaborated in section 4.9.

4.2 Management objectives

The conservation limits (CLs) have been defined by ICES as the level of stock that will achieve long term average maximum sustainable yield (MSY), as derived from the adult to adult stock and recruitment relationship. NASCO has adopted this definition of CLs (NASCO, 1998). The CL is a limit reference point (S_{lim}). However, management targets have not yet been defined for North Atlantic salmon stocks. ICES has interpreted stocks to be within safe biological limits only if the lower bound of the confidence interval of the most recent spawner estimate is above the CL.

4.3 Reference points

As precautionary reference points have not been developed for these stocks, management advice is therefore referenced to the S_{lim} conservation limit. Thus, these limits should be avoided with high probability (i.e. at least 75%). In Atlantic Canada, CLs have been set on the basis of stock and recruitment studies which provided for MSY on a limited number of river stocks where data was available, and these derived egg deposition rates were used on the remainder of rivers where only habitat area and spawner demographics were available, as documented in O'Connell, et al. (1997). The added production from lacustrine areas in Labrador and Newfoundland was also accommodated. In USA, conservation limits were set following a similar approach. Recently, for stocks in Quebec, stock-recruitment analysis for six local rivers was used to define the CL, defined as the S_{MSY} level at 75% probability level, calculated by Bayesian analysis. For the purposes of management, egg deposition requirements are converted into 2SW fish equivalents. These are presented by fishery management zone in Table 4.3.1.

There are no changes recommended in the 2SW salmon conservation limits (S_{lim}) from those recommended previously. Conservation limits for 2SW salmon for Canada now total 123,349 and for the USA, 29,199 for a combined total of 152,548.

4.4 Advice on management

As the biological objective is to have all rivers reaching their conservation requirements, river-by-river management is necessary. On individual rivers where spawning requirements are being achieved, there are no biological reasons to restrict the harvest. Advice regarding management of this stock complex in the fishery at West Greenland is provided in Section 5.

4.5 Relevant factors to be considered in management

For all fisheries, ICES considers that management of single stock fisheries should be based upon assessments of the status of individual stocks. Conservation would be best achieved if fisheries can be targeted at stocks that have been shown to be above biologically-based escapement requirements. Fisheries in estuaries and rivers are more likely to fulfil this requirement.

Reduced exploitation on large salmon in the in-river and estuarine fisheries of the Miramichi has resulted in an expanded age structure in which repeat spawners have comprised as much as 50% of the large salmon returns. It is therefore necessary to consider that if this is a widespread response to fishery closures, a large proportion of the actual egg deposition may in future be provided by fish which are not presently considered in setting CLs and assessing whether CLs have been achieved. The contribution of all sea-age categories of females is however considered when assessing whether the eggs deposited in a river reach the total egg requirements for each assessed river.

4.6 Catch forecast for 2004

Catch options are only provided for the non-maturing 1SW and maturing 2SW components as the maturing 1SW component is not fished outside of home waters, and in the absence of significant marine interceptory fisheries, is managed in homewaters by the producing nations.

It is possible to provide catch advice for the North American Commission area for two years. The revised forecast for 2004 for 2SW maturing fish is based on a new forecast of the 2003 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 2003 as 1SW non-maturing fish. The second is a new estimate for 2005 (see section 4.7) based on the pre-fishery abundance forecast for 2004 from Section 5. A consequence of these annual revisions is that the catch options for 2SW equivalents in North America may change compared to the options developed the year before.

Catch advice for 2004 fisheries on 2SW maturing salmon

The revised forecast of the pre-fishery abundance for 2003 provides a PFA mid-point of 90,700.

In order to compare the PFA to conservation limits, the pre-fishery abundance of 90,700 can be expressed as 2SW equivalents by considering natural mortality of 3% per month for 11 months (a factor of 0.72), resulting in 65,304 2SW salmon equivalents. There have already been harvests of this cohort as 1SW non-maturing salmon in 2003 for both the Labrador (358) and Greenland (1,958) fisheries (Tables 4.9.1.1 and 4.9.1.2) for a total of 2,316 2SW salmon equivalents already harvested, when the mortality factor is considered, leaving 62,988 2SW salmon returning to North America.

As the predicted number of 2SW salmon returning to North America (62,988) in 2004 is substantially lower than the 2SW conservation limit (S_{lim}) of 152,548, there are no harvest possibilities at forecasted levels considered risk-averse (at probability levels of 75% and below). Harvest possibilities refer to the composite North American fisheries. As the biological objective is to have all rivers reaching their conservation requirements, river-by-river management is necessary. On individual rivers, where spawning requirements are being achieved, there are no biological reasons to restrict the harvest.

Regional assessments in some areas of eastern North America provide a more detailed consideration of expectations for 2004, taking into consideration the contribution of all sea ages of salmon to the spawning population. By area, these are:

<u>Labrador:</u>

As there has been a lack of long-term monitoring facilities in Labrador, there is little information available to comment on expectations for 2004 and beyond.

<u>Newfoundland:</u>

There are no forecasts available for returns of small and large salmon in 2004. The majority of returns are small salmon and their return depends mainly on marine survival which has been quite variable. Exploitation in Newfoundland occurs primarily on maturing 1SW salmon.

<u>Gulf:</u>

In all rivers of the Gulf Region, large salmon returns and spawners in 2003 improved from 2002 and spawning escapement was above or appoximated the conservation requirement. Small salmon abundance was down from 2002 but within the previous five year average abundance. Exploitation on salmon in the Gulf region is restricted to retention of small salmon in the recreational fisheries and an allocation of large salmon to the native fisheries. Harvest rates on large salmon resulting from catch and release mortality and native fisheries has been rarely above 10% and usually less than 5%. The majority of the egg depositions come from large salmon which are predominantly females with some additional eggs from the small salmon which can be comprised of upwards of 25% female but are more often less than 10% female. The largest salmon producing river, the Miramichi, almost met the conservation requirements in 2003. The outlook for 2004 is for a lower return of large salmon relative to 2003, with a small chance (28%) of meeting the conservation requirement in the

Miramichi River overall. Because the majority of salmon returning to the Morell (91% in 2002) and to other PEI rivers (SFA 17) are of hatchery origin, current fisheries have little impact on future runs. In all areas of the Gulf, with the exception of the southeast New Brunswick rivers which are closed to salmon fishing, juvenile abundance in rivers declined in 2003 but remains at historical high levels.

Scotia-Fundy:

Expectations that salmon returns in 2004 will meet or exceed conservation limits among twelve assessed rivers of the Atlantic coast of Nova Scotia and southern New Brunswick range from zero to about 45%, with most rivers at zero (exceptions being two rivers in Cape Breton, North at 45% and Middle at 14% and the LaHave River in SFA 21at 20%). Harvest in home waters is dependent on bi-weekly in-season assessments beginning June 15, at two monitoring facilities, Morgans Falls fishway on the LaHave River and at Mactaquac dam fishway on the Saint John River. Under the existing fisheries management strategy, harvest fisheries including aboriginal, hook and release recreational fishery or retention of small salmon in the recreational fishery would only be considered if the probability of achieving the conservation limit was greater than 75%. Supportive rearing programs are expected to move away from fisheries support objectives and toward population maintenance by rearing parr to mature adult spawners, pedigree breeding and earlier ages for stocking.

Québec:

There were 19% less 1SW returns in 2003 than in 2002, and the 2003 value was 5% less than the 1998-2002 mean. Returns of large salmon in 2004 are expected to decrease by a range of 15% to 25% over 2003 and be less than the previous 5 year mean. This level of returns should be sufficient for attainment of conservation limits on rivers south of the St. Lawrence, zones Q1 to Q3, but not on the majority of rivers on the north shore. Consequently, retention of large salmon is not expected to be permitted on any river of the zone Q5, Q6 and Q10 and on the majority of rivers of the zones Q7.

USA:

Salmon returns (both large and small) in 2004 are not expected to be sufficient to meet conservation limits in any river, including those receiving hatchery stocking.

4.7 Medium to long term projections

Catch advice for 2005 fisheries on 2SW maturing salmon

Most catches (88%) in North America now take place in rivers or in estuaries. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located close to river mouths and likely harvest few salmon from other than local rivers. Fisheries are principally managed on a river-by-river basis and, in areas where retention of large salmon is allowed, it is closely controlled.

Catch options which could be derived from the pre-fishery abundance forecast for 2004 (100,400 at the 50% probability level) would apply principally to North American fisheries in 2005 and hence the level of fisheries in 2004 needs to be accounted for before providing them.

Accounting for mortality and the conservation limit and considering an allocation of 60% of the surplus to North America, the only risk averse catch option for 2SW salmon in 2005 is “zero” catch. This “zero” catch option refers to the composite North American fisheries. As the biological objective is to have all rivers reaching or exceeding their conservation limits, river-by-river management will be necessary. On individual rivers, where conservation limits are being achieved, there are no biological reasons to restrict the harvest.

4.8 Comparison with previous assessment and advice

The revised forecast of the pre-fishery abundance for 2003 provides a PFA mid-point of 90,700. This is about 18% lower than the value forecast last year at this time of 111,042. This is mainly due to slight changes in the input values and changes to the model used to forecast PFA for these stocks, as detailed in Section 5.

4.9 NASCO has requested ICES to describe key events of the 2003 fisheries and the status of the stocks

4.9.1 Catch of North American salmon, expressed as 2SW salmon equivalents

Catch histories of salmon,expressed as 2SW salmon equivalents, which could have been available to the Greenland fishery, 1972-2003, are provided in Tables 4.9.1.1 and 4.9.1.2 and. The Newfoundland-Labrador commercial fishery historically was a mixed stock fishery and harvested both maturing and non-maturing 1SW salmon as well as 2SW maturing salmon. The harvest in these fisheries of repeat spawners and older sea-ages was not considered in the run reconstructions. Harvests of 1SW non-maturing salmon in Newfoundland-Labrador commercial fisheries have been adjusted by natural mortalities of 3 % per month for 13 months, and 2SW harvests in these same fisheries have been adjusted by one month to express all harvests as 2SW equivalents in the year and time they would reach rivers of origin. Starting in 1998, the Labrador commercial fishery was closed. An Aboriginal Peoples' fishery occurred in 1998 - 2003 that may have harvested, to some degree, mixed stocks, and catches for this fishery have been included (Tables 4.9.1.1, 4.9.1.2). As well, a residents' food fishery in Labrador which started in 2000 is included. Mortalities (principally in fisheries) in mixed stock and terminal fisheries areas in Canada are summed with those of USA to estimate total 2SW equivalent mortalities in North America (Table 4.9.1.1). The terminal fisheries areas included coastal and river catches of all areas, except Newfoundland and Labrador where only river catches were included. Catch equivalents within North America peaked at about 365,000 in 1976 and are now about 11,800 2SW salmon equivalents. In the most recent five years estimated (that is those since the closure of the Labrador commercial fishery), those taken as non-maturing fish in Labrador comprise 3%, or less, of the total in North America.

Of the North American fisheries on the cohort destined to be 2SW salmon, 82% of the catch comes from terminal fisheries in the most recent year. This value has ranged from as low as 20% in 1973, 1976 and 1987 to values of 77-91% in 1996-2003 fisheries (Table 4.9.1.1). The percentage increased significantly since 1992 with the reduction and closures of the Newfoundland and Labrador commercial mixed stock fisheries.

Table 4.9.1.2 shows the mortalities expressed as 2SW equivalents in Canada, USA, and Greenland for 1972–2003, by applying a mortality of 3 % per month for 11 months to the estimates of harvests of 1SW non-maturing North American salmon in the Greenland fishery. Harvests within the USA of the total within North America approached 0.6% on a few occasions in the time-series and as recently as in 1990. As well as these harvests in the USA, USA-origin salmon were also harvested in Canada during the time period indicated. The percentage of the total 2SW equivalents that have been harvested in North American waters has ranged from 48-100%, with the most recent year estimated at 88%. The two years when 100% of the mortality occurred in North America were the years when the Greenland commercial fishery did not operate.

4.9.2 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 Société de la Faune et des Parcs du Québec and the fishing areas are designated by Q1 through Q11 (Figure 4.9.2.1). 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 are greater than or equal to 63 cm fork length and in commercial fisheries refer to salmon greater than or equal to 2.7 kg whole weight.

Three user groups exploited salmon in Canada in 2003: Aboriginal peoples, residents fishing for food in Labrador, and recreational fishers. Commercial quotas normally fished by Aboriginal peoples in Ungava Bay (zone Q11) remained closed. Hence there were no commercial fisheries in Canada in 2003.

The following management measures were in effect in 2003:

<u>Aboriginal peoples' food fisheries</u>

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 for subsistence fisheries have to be reported collectively by each Aboriginal user group. However, if reports are not available, the catches are estimated. In the Maritimes and Newfoundland (SFAs 1 to 23), food fishery harvest agreements were signed with several Aboriginal peoples groups (mostly First Nations) in 2003. The signed agreements often included allocations of small and large salmon and the area of fishing was usually in-river or estuaries, except in Labrador. Harvests which occurred both within and outside agreements were obtained directly from the Aboriginal peoples. In Labrador (SFAs 1 and 2), food fishery arrangements with the Labrador Inuit Association and the Innu resulted in fisheries in estuaries and coastal areas. There were no food fisheries on the island of Newfoundland in 2003. Under agreements reached in 2003, several Aboriginal communities in Nova Scotia agreed to retain only "adipose clipped" 1SW salmon from nine Atlantic coast rivers in SFA's 20 and 21, using methods that allowed live release of wild fish. Harvest by Aboriginal peoples with recreational licenses are reported under the recreational harvest categories.

Residents food fisheries in Labrador

In the Lake Melville (SFA 1) and the coastal southern Labrador (SFA 2) areas, DFO allowed a food fishery, using gillnets, for local residents. 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 to complete logbooks.

Recreational fisheries

Unless otherwise determined by management authorities, 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 2003 varied by area (Figure 4.9.2.2). Except in Québec and Labrador (SFA 1 and some rivers of SFA 2), only small salmon could be retained in the recreational fisheries.

The seasonal bag limits in the recreational fishery remained at eight small salmon in New Brunswick and in Nova Scotia. In SFA 16 and in Nepisiquit River (SFA 15) of New Brunswick, the small salmon daily retention limit remained at one fish. In the remainder of SFA 15 and in Nova Scotia (SFA 18), the daily retention limits were two small salmon. The maximum daily catch limit was four fish daily. In SFA 17 (PEI), the season and daily bag limits were seven and one respectively. Catch-and-release fishing only for all sizes of Atlantic salmon was in effect in SFA 19 of Nova Scotia. In SFAs 20-23 of Nova Scotia and New Brunswick, most rivers were closed to all salmon angling, except for four acid-impacted rivers on the Atlantic coast of Nova Scotia, where retention of small salmon was allowed. As well, five other eastern and southern shore (SFA 20,21) rivers and all but one river of eastern Cape Breton (SFA19) were opened for a hook and release fishery from June 1 to July 15 in 2003.

A five-year (2002-2006) management plan was introduced in Newfoundland and Labrador in 2002, based upon the river classification system utilized for SFAs 3-14B in 1999-2001. For insular Newfoundland (SFAs 3 to 14A) and the Strait of Belle Isle and southern Labrador (SFA2,14B), retention limits ranged from a seasonal limit of six fish on Class I rivers, to no retention and catch-and-release only on Class IV rivers . Some rivers were closed to all angling and were not assigned a class number. In SFA 1 and some rivers of SFA 2 of Labrador, there was a seasonal limit of four fish, only one of which could be a large salmon, except in those rivers (now Class II) of SFA 2 crossed by the new Trans Labrador Highway, where a seasonal retention limit of two small salmon and no large salmon was imposed.

In Québec, three different fishing permits are sold. The first allows a retention of seven salmon for the season. The second is a one day permit and allows a retention of two salmon. The third type of permit is for catch and release only. In the northern zones, the management regimes for Q8, Q9 and Q11 (44 rivers) were applied uniformly to rivers within each zone. Retention of both small and large salmon was generally allowed throughout these northern zones. The daily limit was two fish in Q8 and Q11, and three fish in zone Q9. In some rivers, stricter limits were applied by local groups. Also, in Q11, if the first fish caught was a large salmon, fishing stopped for the day. Release of large salmon occurred mainly on a voluntary basis in these zones. The 74 rivers of the southern zones were managed river by river. Fishing was not allowed on 31 rivers, retention of small salmon only was in force on 24 rivers, and retention of small and large salmon (maximum of one large salmon daily) was allowed on 19 rivers at the start of the season. However, on these 19 rivers, 3 were further restricted to retention of small salmon only after mid-season reviews.

USA

There was no fishery for sea-run Atlantic salmon in the USA in 2003 as a result of angling closures in 1999. Therefore effort measured by license sales, was 0.

France (Islands of Saint-Pierre and Miquelon)

There was no information available to the Working Group describing the Saint-Pierre and Miquelon fisheries in 2003.

In 2002, there were 12 professional and 42 recreational gillnet licenses issued. Since 1997, the number of professional fishermen has doubled from six to 12 and the number of recreational licenses has increased by six to 42.

Year	Number of Professional Licenses	Number of Recreational Licenses
1995	12	42
1996	12	42
1997	6	36
1998	9	42
1999	7	40
2000	8	35
2001	10	42
2002	12	42
2003	unknown	unknown

There is no legal limit on the number of professional and recreational licences. However, local authorities have restricted these numbers to 12 (professional) and 42 (recreational) so far, based on the maxima observed since the beginning of the statistics recording on salmon fishing at SPM in 1990.

Due to a sharp decline in other fish resources exploited by the professional fishermen (lumpfish, snow crab and cod), more of them have expressed interest in having salmon licenses and have asked for an increase in the number of licences that could be compensated by a reduction in the number of recreational licences.

4.9.3 Catches in 2003

Canada

The provisional harvest of salmon in 2003 by all users was 137 t, about 7% lower than the 2002 harvest (Table 2.1.1.1; Figure 4.9.3.1). The 2003 harvest was 44,426 small salmon and 11,172 large salmon, 17% fewer small salmon and 32% more large salmon, compared to 2002 (Table 4.9.3.1). The dramatic decline in harvested tonnage since 1988 is in large part the result of the reductions in commercial fisheries effort, the closure of the insular Newfoundland commercial fishery in 1992, the closure of the Labrador commercial fishery in 1998, and the closure of the Québec commercial fishery in 2000 (Figure 4.9.3.1). These reductions were introduced as a result of declining abundance of salmon.

The 2003 harvest of small and large salmon, by number, was divided among the three user groups in different proportions depending on the province and the fish-size group exploited (Table 4.9.3.1). Newfoundland reported the largest proportion of the total harvest of small salmon and Québec reported the greatest share of the large salmon harvest. Recreational fisheries exploited the greatest number of small salmon in each province, accounting for 81% of the total small salmon harvests in eastern Canada. Unlike years previous to 1999 when commercial fisheries took the largest share of large salmon and the years 2000-2002 when food fisheries (including the Labrador resident food fishery) accounted for the largest share, the recreational fishery took the largest share in 2003 (52% by number).

Aboriginal peoples' food fisheries

Harvests in 2003 (by weight) were down 5 % from 2002 and 4 % lower than the previous 5-year average harvest.

Aboriginal peoples' food fisheries			
		% large	
Year	**Harvest (t)**	**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	43.8	71	49

Residents fishing for food in Labrador

The estimated catch for the entire fishery in 2003 was 6.8t, about 3,000 fish (79 % small salmon by number).

Recreational fisheries

Harvest in recreational fisheries in 2003 totaled 40,692 small and large salmon, 5 % below the previous 5-year average, 4 % below the 2002 harvest level, and the lowest total harvest reported (Figure 4.9.3.2). The small salmon harvest of 35,994 fish was 19% below the previous 5-year mean. The large salmon harvest of 4,698 fish was about 5% greater than the previous five-year mean. Small and large salmon harvests were down 18% and up 179% from 2002, respectively. The small salmon size group has contributed 87% 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 (Figure 4.9.3.2).

In 1984, anglers were required to release all large salmon in the Maritime provinces and insular Newfoundland. In more recent years, anglers have been required to release all salmon on some rivers for conservation reasons and, on others, they are voluntarily releasing angled fish. In addition, numerous areas in the Maritimes Region in 2003 were closed to retention of all sizes of salmon (Figure 4.9.2.2).

In 2003, about 51,400 salmon (about 22,900 large and 28,500 small) were caught and released (Table 4.9.3.2), representing about 56 % of the total number caught, including retained fish. This was a 1% increase from the number released in 2002. Most of the fish released were in Newfoundland (51 %), followed by New Brunswick (27%), Québec (16%), Nova Scotia (5%), and Prince Edward Island (0.6%). Expressed as a proportion of the fish caught, that is, the sum of the retained and released fish, Nova Scotia released the highest percentage (91%), followed by New Brunswick (60%), Newfoundland (55%), Prince Edward Island (53%), and Québec (47%). As has been mentioned in Section 2.1.2, there is some mortality on these released fish, which is accounted for when individual rivers are assessed for their attainment of conservation limits.

Commercial fisheries

All commercial fisheries for Atlantic salmon remained closed in Canada in 2003 and the catch therefore was zero. Catches have decreased from a peak in 1980 of almost 2,500 t to zero currently as a result of effort reductions, low abundance of stocks, and closures of fisheries.

Unreported catches

Canada's unreported catch estimate for 2003 was about 118 t. Estimates were included for all five provinces and within each province for all salmon fishing areas (SFA), with the exception of Nova Scotia were estimates were available for two of five SFAs. Estimates were provided mainly by enforcement staff. In all areas, most unreported catch arises from illegal fishing or illegal retention of bycatch of salmon.

By stock groupings used for Canadian stocks throughout the report, the unreported catch estimates for 2003 were:

Stock Area	Unreported Catch (t)
Labrador	2
Newfoundland	42
Gulf	39
Scotia-Fundy	1
Québec	34
Total	118

USA

All fisheries (commercial and recreational) for sea-run Atlantic salmon within the USA remained closed, including rivers previously open to catch-and-release fishing. Thus, there was no harvest of sea-run Atlantic salmon in the USA in 2003.

Unreported catches in the USA were estimated to be 0 t. There was likely an illegal harvest of at least five 2SW salmon in 2003 from the federally endangered Gulf of Maine Distinct Population Segment (DPS). Management measures have been implemented to help prevent illegal take from occurring in the future.

France (Islands of Saint-Pierre and Miquelon)

There was no information available to the Working Group describing the Saint-Pierre and Miquelon fisheries in 2003.

The harvest in 2002 was reported to be 3.6 t from professional and recreational fishermen, 67% higher than in 2001 and the largest catch recorded since before 1960 (Table 2.1.1.1). Professional and recreational fishermen reported catching 2,437 kg and 1,153 kg of salmon, respectively.

Year	Catch by Professional Licenses (kg)	Catch by Recreational Licenses (kg)	Total (kg)
1990	1,146	734	1,880
1991	632	530	1,162
1992	1,295	1,024	2,319
1993	1,902	1,041	2,943
1994	2,633	790	3,423
1995	392	445	837
1996	951	617	1,568
1997	762	729	1,491
1998	1,039	1,268	2,307
1999	1,182	1,140	2,322
2000	1,134	1,133	2,267
2001	1,544	611	2,155
2002	2,437	1,153	3,590
2003	Unknown	Unknown	Unknown

4.9.4 Origin and composition of catches

In the past, salmon from both Canada and the USA were taken in the commercial fisheries of eastern Canada. These fisheries have been closed. The Aboriginal Peoples' and resident food fisheries that exist in Labrador may intercept some salmon from other areas of North America although there are no reports of tagged fish being captured there in 2003. The fisheries of Saint-Pierre and Miquelon catch salmon of both Canadian and US origin (section 4.11). Sampling was carried out on this fishery in 2003 but results were not available to the Working Group.

Fish designated as being of wild origin are defined as the progeny of fish where mate selection occurred naturally (eggs not stripped and fertilized artificially) and whose life cycle is completed in the natural environment (ICES 1997/Assess:10). Hatchery-origin fish, designated as fish introduced into the rivers at any life stage, were identified on the basis of the presence of marks or an adipose clip, from fin deformations, and/or from scale characteristics. Not all hatchery fish could be identified as such in the returns because of stocking in the early life stages. Commercial fish-farm escapees were differentiated from hatchery fish on the basis of scale characteristics and fin erosion (especially of the tail), although the identification of early life stage escapees is also problematic.

The returns in 2003 to the majority of the rivers in Newfoundland and to most rivers of the Gulf of St. Lawrence and Québec were comprised exclusively of wild salmon (Figure 4.9.4.1). Hatchery-origin salmon made up varying proportions of the total returns and were most abundant in the rivers of the Bay of Fundy, the Atlantic coast of Nova Scotia and the

USA. Aquaculture escapees were noted in the returns to four rivers of the Bay of Fundy and the coast of USA (Saint John, Magaguadavic, St. Croix, Dennys).

Aquaculture production of Atlantic salmon in eastern Canada has increased annually, exceeding 10,000 t in 1992 and rising to about 43,450 t in 2003 (Table 2.2.1.1). Escapes of Atlantic salmon have occurred annually. Reports of these escapes have not been made available to the Working Group.

In the Magaguadavic River (SFA 23; Table 4.9.4.1), which is located in close proximity to the center of both the Canadian and USA east coast salmon farming areas, the proportion of the adult run composed of fish farm escapees has been high (greater than 50%) since 1994. Escaped fish were not observed between 1983 and 1988. Since 1992, escaped fish have comprised between 33% and 90% of adult salmon counts. However, while fish farm escapees have dominated the run in terms of percentages, in absolute terms, their numbers have been trending downwards (Table 4.9.4.1). Fish farm escapees were also monitored in the St. Croix River (Canada/USA border), and Maine's Dennys, Narraguagus and Union rivers. The St. Croix and Dennys rivers are also in close proximity to the principal USA and Canadian salmon farming areas, whereas the Narraguagus and Union are more to the south, but have a few farm sites located in their vicinity. Percentages of returns that were fish farm escapees in the returns to the St. Croix and Dennys rivers in 2003 were 38% and 18% respectively. In both the Union and Narraguagus rivers, no fish farm escapees were observed in 2003.

4.9.5 Elaboration on status of stocks

There are approximately 550 Atlantic salmon rivers in eastern Canada and 21 rivers in eastern USA each of which could contain at least one population of salmon. Assessments are prepared for a limited number of specific rivers, because they compose significant fractions of the salmon resource or are indicators of patterns within a region, or because of the demands by user groups, or as a result of requests for biological advice from fisheries management. The status is evaluated by examining trends in returns and escapement relative to the conservation requirements.

Measures of abundance in monitored rivers

Canada

1985-2003 patterns of adult returns

The returns represent the size of the population before any in-river and estuarine removals (Figure 4.9.5.1). These returns can include returns from hatchery stocking but do not account for commercial fisheries removals in Newfoundland, Labrador, Québec, and Greenland. A gradual moratorium closed the Newfoundland, Labrador and Québec commercial salmon fisheries in Canada between 1992 and 2000.

Annual returns of salmon by size group are available for 21 rivers in eastern Canada since 1985. Peak return years differed for regions within eastern Canada (Figure 4.9.5.1). For rivers in Scotia-Fundy, Gulf, and Québec regions, the returns have been generally decreasing since the closures of the Newfoundland and Québec commercial fisheries, showing that factors other than fisheries are influencing marine mortality. Alternatively, the returns to six rivers in Newfoundland have generally increased since the commercial fisheries closures there in 1992. These Newfoundland stocks mainly mature at 1SW age and seem to have been more heavily affected by the local commercial fisheries. The large salmon are mostly repeat-spawning 1SW fish. The total returns of these six Newfoundland rivers doubled during 1993 to 2003 from the low levels observed during 1989 to 1991 period (Figure 4.9.5.1).

As estimated on these 21 rivers, the returns for 2003 of large salmon in Scotia-Fundy, Gulf, Québec and Newfoundland were increased from 2002 by 114%, 68%, 109% and 10% respectively. As compared to the 5-year average, these 2003 returns increased by 26% and 70% for the Gulf and Québec rivers, but are lower by 17% and 26% for the Scotia-Fundy and Newfoundland rivers (Figure 4.9.5.1). Returns of small salmon in 2003 relative to 2002 were lower by 50%, 40% and 24% in the Scotia-Fundy, Gulf and Québec rivers respectively, and were higher by 48% in Newfoundland. As compared to the 5-year average, small salmon returns were lower by 57% and 12 % in the Scotia-Fundy and Gulf rivers, about average in Québec, and higher by 22% in Newfoundland (Figure 4.9.5.1).

Smolt and juvenile abundance

Counts of smolts provide direct measurements of the outputs from the freshwater habitat. Previous reports have documented the high annual variability in the annual smolt output. In tributaries, smolt output can vary by five times but in the counts for entire rivers, annual smolt output has generally varied by a factor of three. Wild smolt production was estimated in 12 rivers of eastern Canada in 2003. Of these, nine rivers have several years of data (Figure 4.9.5.2). In numerous other rivers, juvenile abundance surveys have been conducted.

In 2003, smolt production decreased from the previous year in four of five monitored rivers in Newfoundland, in one of two rivers of Québec, and in two of three rivers in the Maritimes Provinces (Figure 4.9.5.2). Comparing the 2003 smolt production estimates to the previous five-year mean for the 9 rivers monitored during that time period, two of these rivers were unchanged (+ or – 10%) while production decreased in the seven other rivers.

Juvenile salmon abundance has been monitored annually since 1971 in the Miramichi (SFA 16) and Restigouche (SFA 15) rivers and for shorter and variable time periods in other rivers (Figure 4.9.5.3). In the rivers of the southern Gulf, densities of young-of-the-year (fry) and parr (juveniles of one or more years old) have increased since 1985 in response to increased spawning escapements (Figure 4.9.5.3). Densities of parr remained at high values in the Gulf rivers in 2003. The mean density values were similar to the previous year and down slightly from the previous 5-year mean. Fry densities decreased from the previous year on all four monitored rivers. Rivers of SFAs 20 and 21 along the Atlantic coast of Nova Scotia are generally organic stained, of lower productivity, and when combined with acid precipitation, can result in acidic conditions lethal to salmon. In the low-acidified St. Mary's River, fry (age 0+) density was low (similar to 2002) and older parr (age-1+ and 2+) densities remain low (Figure 4.9.5.3). Trends in densities of age-1+ and older parr in the outer Bay of Fundy (SFA 23) have varied since 1980. Parr densities in the Nashwaak River and Saint John River above Mactaquac Dam have generally declined in accordance with reduced spawning escapements. In 2003, parr densities increased on the Saint John River and declined on the Nashwaak River from the previous year. For the salmon stock in 33 rivers of the inner Bay of Fundy (SFA22 and a portion of SFA 23), juvenile densities remained critically low in 2003.

USA

Total estimated return to USA rivers was 1,436, a 46% increase from the 2002 total (985). These are the sum of documented returns to traps and returns estimated using redd counts on selected Maine rivers. However, the documented return of Atlantic salmon as determined strictly from returns to traps and weirs to rivers in New England was 1,396. Returns of 1SW salmon were 232, a 53% decrease from the 436 in 2002. Returns from MSW were 1,157, a 120% increase from the 526 in 2002.

Total salmon returns to the rivers of New England continued the downward trend that began in the mid-1980s, and were lower than the previous 5-year and 10-year averages (Figure 4.9.5.4). These are minimal estimates, since many rivers in Maine do not contain fish counting facilities, and where counting facilities exist; they do not count 100% of the returns.

For five of the eight rivers that comprise the federally endangered Gulf of Maine Distinct Population Segment (DPS), redd counts were used in a linear regression model to estimate returns because traps or weirs were not present. The total estimated returns for the entire DPS was 72 fish(95% CI = 61-86) originating either from natural spawning or hatchery fry, with no rivers having an estimate of zero. These estimates are up from the 2002 estimates of 33 fish (95% CI = 26-41) when two rivers had a zero estimate.

The majority of the returns were recorded in the rivers of Maine, with the Penobscot River accounting for nearly 77% of the total New England returns. Connecticut River returns accounted for 3.0% of the total returns. Overall, 16.5% of the adult returns were 1SW salmon and 83.2% were MSW salmon. Most returns (86%) originated from hatchery smolts and the balance (14%) originated from either natural spawning or hatchery fry.

Wild salmon production has been estimated on the Narraguagus River for seven years (Figure 4.9.5.2). Smolt production in 2003 decreased both from 2002 and the previous five-year mean.

The mean parr density in 2003 from 37 sites on the Narraguagus River was low (less than 5 fish/100m^2) and similar to the values observed since 1990 (Figure 4.9.5.3).

Estimates of total abundance by geographic area

For assessment purposes, the following regions were considered: Labrador (SFA 1, 2, & 14B), Newfoundland (SFA 3−14A), Québec (Q1-Q11), Gulf of St. Lawrence (SFA 15-18), Scotia-Fundy (SFA 19-23), and USA. Returns of 1SW and 2SW salmon to each region (Tables 4.9.5.1 and 4.9.5.2; Figures 4.9.5.5 and 4.9.5.6; and Appendix 5) were estimated by updating the methods and variables used by Rago *et al.* (1993b) and reported in ICES 1993/Assess:10. The returns for both sea-age groups were derived by applying a variety of methods to data available for individual river systems and management areas. These methods included counts of salmon at monitoring facilities, population estimates from mark-recapture studies, and the application of angling and commercial catch statistics, angling exploitation rates, and measurements of freshwater habitat (Appendix 5). The 2SW component of the MSW returns was determined using the sea-age composition of one or more indicator stocks.

In the context used here "returns" are the number of salmon that returned to the geographic region, including homewater commercial fisheries, except in the case of the Newfoundland and Labrador regions where returns do not include commercial fisheries. This was done to avoid double counting of fish when commercial catches in Newfoundland and Labrador are added to returns of all geographic areas in North America to estimate the PFA of North American salmon.

Canada

Labrador

The basis for estimates of 2SW and 1SW salmon returns and spawners for Labrador (SFAs 1, 2 & 14B) prior to 1998 are catch data from angling and commercial fisheries. In 1998-2003, there was no commercial fishery in Labrador and although counting projects took place in 2003 on four Labrador rivers, out of about 100 salmon rivers that exist, it is not possible to extrapolate from these rivers to unsurveyed ones. For Labrador, returns were previously estimated from commercial catches and exploitation rates. As there was no commercial fishery since 1998, it was not possible to estimate the returns or spawners to Labrador for these years.

While total returns and spawners could not be determined for Labrador, there were four monitored rivers in Labrador in 2003 with known numbers of returning adults. Sand Hill River in SFA 2 has the longest time series albeit broken into three time periods, 1970-1973, 1994-1996 and 2002-2003. Returns of small and large salmon in 2003 were 3,157 and 621 large salmon, respectively. Small salmon returns were the 5th highest on record and returns of large salmon were the 2nd highest. Returns of small salmon in 2003 were similar to the mean of the returns in all other years; while returns of large salmon were approximately 50% higher then average returns of all other years. There are three other rivers in Labrador with counts although the time series are relatively short. At Southwest Brook in SFA 2, a tributary of Paradise River, returns of small and large salmon have declined steadily over the last four years but remain higher than in 1998, the first year of operation. At Muddy Bay Brook in SFA 2, where information is available for only two years (2002, 2003), returns of small and large salmon increased considerably in 2003 over the previous year. At English River in SFA 1 where a counting fence has been operated since 1999, returns of small salmon have declined from a high of 367 in 2000 to a low of 133 in 2003. Large salmon have varied over the same time with no apparent trend.

Newfoundland

The estimates of 1SW and 2SW returns and spawners for insular Newfoundland (SFAs 3−12 & 14A) are updated for the entire time-series. Prior to 1999, they were derived from exploitation rates estimated from rivers with counting facilities which were subsequently applied to angling catches of small salmon, adjusted for the proportions of large:small salmon at counting facilities, and finally the proportion of large salmon that were 2SW. Beginning in 1999, the method used in previous years was modified to take into consideration the changes implemented in the 1999-2002 Salmon Management Plan. The Management Plan introduced, for the first time, a river classification scheme with different season limits for each of classes I-IV and, in addition, some other rivers were placed in a special class with a different management plan for each river. Returns and spawners were estimated as documented previously (ICES 2002/ ACFM:14). Catches in 1994-2002 and the calculated exploitation rates and large:small salmon ratios were updated to reflect changes made to catch statistics in Newfoundland from the Licence Stub Return System and catches in 2003 and exploitation rates were calculated.

The mid-point of the estimated returns (185,300) of 1SW salmon to Newfoundland rivers in 2003 is 15% higher than in 2002 and 4% higher than the average 1SW returns (178,800) for the past five years (Figure 4.9.5.1, Appendix 5). The mid-point (3,900) of the estimated 2SW returns to Newfoundland rivers in 2003 was 11% higher than in 2002 and 94% lower than the recent 5-year average of 5,600 (Figure 4.9.5.6, Appendix 5).

Québec

The mid-point (27,500) of the estimated returns of 1SW salmon to Québec in 2003 is 19% lower than that observed in 2002 and is 5% lower than the previous five-year mean (Figure 4.9.5.1, Appendix 5).The mid-point (34,200) of the estimated returns of 2SW salmon in Québec in 2003 is 52% higher than that observed for 2002 (Figure 4.9.5.2).

Gulf of St. Lawrence, SFAs 15–18

The mid-point (41,000) of the estimated returns in 2003 of 1SW salmon returning to the Gulf of St. Lawrence was a 39% decrease from 2002. The values noted in 1997 through 2003 are low relative to the values observed during 1985-1994 (Figure 4.9.5.5, Appendix 5).

The mid-point (25,000) of the estimate of 2SW returns in 2003 is 93% higher than the estimate for 2002 (Figure 4.9.5.6, Appendix 5), and similar to 2001. Returns of 2SW salmon have declined since 1995 with only slight improvement shown in 2001 and 2003, relative to the years prior to 1995.

Scotia-Fundy, SFAs 19-23

The mid-point (9,500) of the estimate of the 1SW returns in 2003 to the Scotia-Fundy Region was a 25% decrease from the 2002 estimate, and the third lowest value in the time-series, 1971-2003. Returns have generally been low since 1990 (Figure 4.9.5.5, Appendix 5). The mid-point (3,800) of the 2SW returns in 2003 is 114% higher than the returns in 2002 but still the third lowest value in the time-series, 1971–2003 (Figure 4.9.5.6, Appendix 5). A declining trend in returns has been observed from 1985 to 2003.

USA

Total salmon returns for USA rivers in 2003 were based on trap and weir catches (documented returns). Because many of the Maine rivers do not have fish counting facilities total abundance continue to be underestimated. The 1SW returns and spawners to USA rivers in 2003 were 237 fish (Figure 4.9.5.5). This was a decrease from the 2002 estimate and lower than both the previous 5-year (343) and 10-year (356) averages. The 2SW returns in 2002 to USA rivers were 1192 fish, an increase over the 5-year (856) average, but a decrease compared to the 10-year (1267) average (Figure 4.9.5.6). There were only 7 3SW and repeat spawners compared to 22 in 2002.

Run-reconstruction estimates of spawning escapement

Updated estimates for 1SW spawners were derived for the six geographic regions (Table 4.9.5.3). Estimates of 2SW spawners, 1971-2003 are provided in Table 4.9.5.4. These estimates were derived by subtracting the in-river removals from the estimates of returns to rivers. A comparison between the numbers of spawners, returns, and conservation limits (S_{lim}) for 2SW salmon is shown in Figure 4.9.5.6 (there are no spawning requirements defined specifically for 1SW salmon).

Labrador

As previously explained, it was not possible to estimate spawners in Labrador in 1998 - 2003 due to lack of assessment information.

Newfoundland

The mid-point of the estimated numbers of 2SW spawners (3,900) in 2003 was 14% above that estimated in 2002 (3,400) and was 96% of the total 2SW conservation limit (S_{lim}) for all rivers. The 2SW spawner limit has been met or exceeded in nine years since 1984 (Figure 4.9.5.6). The 1SW spawners (164,600) in 2003 were 19% higher than the 138,300 1SW spawners in 2002. The 1SW spawners since 1992 were higher than the spawners in 1989–91 and similar to levels in the late 1970s and 1980s (Figure 4.9.5.5), although in 1995-1996 they were unusually high. There had been a general increase in both 2SW and 1SW spawners during the period 1992–96 and 1998-2001, and this is consistent with the closure of the commercial fisheries in Newfoundland. For 1997, decreases occurred most strongly in the 1SW spawners.

Québec

The mid-point of the estimated numbers of 2SW spawners (25,300) in 2003 was 67% higher than that observed for 2002 and was about 86% of the total 2SW conservation limit (S_{lim}) for all rivers (Figure 4.9.5.6). The spawning escapement in 2003 ranked approximately in the middle of the range in the time-series (1971-2003), with 1971 having been the lowest and the 2003 value was the highest since 1997. Estimates of the numbers of spawners approximated the spawner limit from 1971 to 1990; however, they have been below the limit since 1990. The mid-point of the estimated 1SW spawners in 2003 (19,300) was about 9% lower than in 2002 (Figure 4.9.5.5) and similar to the mean value of the previous ten years.

Gulf of St. Lawrence

The mid-point of the estimated numbers of 2SW spawners (24,700) in 2003 was about 93% higher than estimated in 2002 (12,800) and was about 81% of the total 2SW conservation limits (S_{lim}) for all rivers in this region (Figure 4.9.5.6). This is the eighth time in ten years that these rivers have not exceeded their 2SW spawner limits. The mid-point of the estimated spawning escapement of 1SW salmon (31,600) decreased by 39% from 2002 and was approximately the average of the last ten years. The abundance remains low relative to the peak (154,000) observed in 1992 (Figure 4.9.5.5). Spawning escapement has on average been higher in the mid-1980s than it was before and after this period.

Scotia-Fundy

The mid-point of the estimated numbers of 2SW spawners (3,600) in 2003 is a 127% increase from 2002 (the lowest in the time series, 1971-2003) and is about 15% of the total 2SW conservation limits (S_{lim}) for rivers in this region (Figure 4.9.5.6). Neither the spawner estimates nor the conservation limits include rivers of the inner Bay of Fundy (SFA 22 and part of SFA 23) as these rivers do not contribute to distant water fisheries and spawning escapements are extremely low. The 2SW spawning escapement in the rest of the area has been generally declining since 1985. The mid-point of the estimated 1SW spawners (9,200) in 2003 is a 25% decrease from 2002 and is the seventh lowest in the time-series, 1971-2003. There has been a general downward trend in 1SW spawners since 1990 (Figure 4.9.5.5).

USA

All age classes of spawners (1SW, 2SW, 3SW, and repeat) in 2003 (1,436 salmon) represented 4.9% of the 2SW spawner requirements for all USA rivers combined. Spawning 2SW salmon, expressed as the percentage of conservation requirement was only 4.1% for all USA rivers combined (Figure 4.9.5.6). On an individual river basis, the Penobscot River met 13.2% of its spawner requirement while all the other US rivers met between 0.4-5.2% of their 2SW requirements.

4.9.6 Exploitation rates

Canada

There is no exploitation by commercial fisheries and the only remaining fisheries are for recreation and food.

In the Newfoundland recreational fishery, exploitation rates were available for 12 rivers in 2003. For those rivers with retention of small salmon, exploitation rates ranged from 3% to 38% with a mean value of 12%. Declines were noted in exploitation for several river from those of 2002.

In the Québec recreational fishery, exploitation rates were available for 37 rivers in 2003. Exploitation rates of small salmon ranged from 4% to 69% with a mean value of 24%. Retention of large salmon was permitted on 18 of those rivers; exploitation rate for large salmon ranged from 1% to 29% with a mean value of 11%. Overall exploitation rates by the Québec recreational fishery, using mid-point estimates of total returns and recreational landings, were 18% for small salmon and 10% for large salmon.

In previous years, overall Canadian exploitation rates were calculated as the harvest of salmon divided by the estimated returns to North America. No estimates of returns to Labrador are possible for 1998 - 2003, as there was no commercial fishery and there was insufficient information collected on freshwater escapements to extrapolate to other Labrador rivers. For this reason, exploitation rates cannot be calculated for 1998 - 2003. Harvests of 44,426 small and 11,172 large salmon in 2003 were less than those of 1997, substantially in the case of large salmon. Exploitation rates in 1997 were estimated to be between 14% and 26% for small and between 15% and 25% for large salmon.

USA

There was no exploitation of USA salmon in home waters, and no salmon of USA origin were reported in Canadian fisheries in 2003.

4.9.7 Pre-Fisheries Abundance

North American run-reconstruction model

The Working Group has used the North American run-reconstruction model to estimate pre-fishery abundance, which serves as the basis of abundance forecasts used in the provision of catch advice. The catch statistics used to derive returns and spawner estimates have been updated from those used in ICES 2003/ACFM:19 (Table 4.9.7.1). The North American run-reconstruction model has also been used to estimate the fishery exploitation rates for West Greenland and in homewaters.

Non-maturing 1SW salmon

The non-maturing component of 1SW fish, destined to be 2SW returns (excludes 3SW and previous spawners) is represented by the pre-fishery abundance estimator for year i designated as [NN1(i)]. Definitions of the variables are given in Table 4.9.7.2. It is constructed by summing 2SW returns in year i+1 [NR2(i+1)], 2SW salmon catches in commercial and Aboriginal peoples' food fisheries in Canada [NC2(i+1)], and catches in year i from fisheries on non-maturing 1SW salmon in Canada [NC1(i)] and Greenland [NG1(i)]. In Labrador, Aboriginal peoples' food harvests of small (AH_s) and large salmon (AH_l) were included in the reported catches for 1999-2003. Because harvests occurred in both Lake Melville and coastal areas of northern Labrador, the fraction of these catches that are immature was labeled as af_imm. This was necessary because non-maturing salmon do not occur in Lake Melville where approximately half the catch originated. However, non-maturing salmon may occur in coastal marine areas in the remainder of northern Labrador. Consequently, af_imm for the fraction of Aboriginal peoples' harvests that was non-maturing was set at 0.05 to 0.1 which is half of f_imm from commercial fishery samples. The equations used to calculate NC1 and NC2 are as follows:

Eq. 4.9.7.1 $NC1(i) = [(H\_s(i)_{\{1\text{-}7,14b\}} + H\_l(i)_{\{1\text{-}7,14b\}} * q) * f\_imm]$

$+ [(AH\_s(i) + AH\_l(i) * q) * af\_imm]$, and

Eq. 4.9.7.2 $NC2(i+1) = [H\_l(i+1)_{\{1\text{-}7,14b\}} * (1-q)] + [AH\_l(i+1) * (1-q)]$

As in 1998-2002, the commercial fishery in Labrador remained closed in 2003. In past reports, salmon returns and spawners for Labrador, which make up one of the six geographical areas contributing to NR2 for Canada, were based on commercial fishery data. Since the commercial fishery was closed in Labrador beginning in 1998, the time-series also ended. However, in order to estimate pre-fishery abundance it was still necessary to include Labrador returns for 1998-2003. Consequently, a raising factor was developed by dividing returns to North America without Labrador into returns to North America with Labrador based on the time-series from 1971-97. The raising factor (RFL2) to estimate returns to Labrador for 1998-2003 for 2SW salmon was set to the low and high range of values in the time-series which was 1.05 to 1.27. An assumed natural mortality rate [M] of 0.03 per month is used to adjust the numbers between the salmon fisheries on the 1SW and 2SW salmon (10 months) and between the fishery on 2SW salmon and returns to the rivers (1 month) as shown below:

Eq. 4.9.7.3 $NN1(i) = RFL2*[(NR2(i+1) / S1+ NC2(i+1))/S2 + NC1(i)] + NG1(i)$

where the parameters S1 and S2 are defined as exp(-M *1) and exp(-M *10), respectively. A detailed explanation of the model used to determine pre-fishery abundance is given in Rago *et al*. (1993a).

This estimated pre-fishery abundance represents the extant population and does not account for the fraction of the population present in a given fishery area. The model does not take into account non-catch fishing mortality in any of the fisheries. This is because rates for non-catch fishing mortality are not available on an annual basis and are not well described for some of the fisheries harvesting potential or actual 2SW salmon. Commercial catches were not included in the run-reconstruction model for the West Greenland fishery (1993 and 1994), Newfoundland fishery (1992–2003), and Labrador fishery (1998-2003), as these fisheries were closed.

As the pre-fishery abundance estimates for potential 2SW salmon requires estimates of returns to rivers, the most recent year for which an estimate is available is 2002. This is because pre-fishery abundance estimates for 2003 require 2SW returns to rivers in North America in the year 2004, which are not yet available. The minimum and maximum values of the catches and returns for the 2SW cohort are summarized in Table 4.9.7.3. The 2002 abundance estimates ranged between 77,291 and 159,558 salmon. The mid-point of this range (118,400) is 47% higher than the 2001 value (80,400) and is the 5th lowest in the 31-year time-series (Figure 4.9.7.1). The most recent six years are shown with hollow symbols as no Labrador values were estimated for these years and the raising factor described previously was used. Even though the 2002 value has increased considerably from the previous year, the general trend towards lower values in recent years is still evident and current year values are still much lower than the 917,300 in 1975. Despite the increase in the 2002 value, the Working Group expressed concern over the continued low numbers which remain considerably lower than the conservation limit.

Maturing 1SW salmon

Estimation of an aggregate measure of abundance has utility for identifying trends, evaluating management measures, and investigating the influence of the marine environment on survival, distribution, and abundance of salmon. Maturing 1SW salmon are in some areas a major component of salmon stocks, and measuring their abundance is important to provide measures of abundance of the entire cohort from a specific smolt class.

For the commercial catches in Newfoundland and Labrador, all small salmon are assumed to be 1SW fish based on catch samples, which show the percentage of 1SW salmon to be in excess of 95%. Large salmon are primarily MSW salmon, but some maturing and non-maturing 1SW are also present in commercial catches in SFAs 1–7, 14B. Estimates of fractions of non-maturing salmon present in the Newfoundland and Labrador catch were presented in ICES 1991/Assess:12. The large category in SFAs 1–7 and 14B consists of 0.1–0.3 1SW salmon (Rago *et al*. 1993a; ICES 1993/Assess:10). Salmon catches in SFAs 8–14A are mainly maturing salmon (Idler *et al*. 1981). These values were assumed to apply to the Aboriginal food fishery catches in marine coastal areas of northern Labrador.

Similar to calculations to determine non-maturing 1SW salmon, a raising factor was also required to include Labrador returns in the maturing component of pre-fishery abundance necessitated by the closure of the commercial fishery in Labrador in 1998. Consequently, a raising factor was developed by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time-series of Labrador recruit estimates and pre-fishery abundance data from 1971-97. The raising factor (RFL1) to estimate returns to Labrador for 1998-2003 for 1SW salmon was set to the low and high range of values in the time-series, which were 1.04 to 1.59.

The maturing 1SW component is represented by the pre-fishery abundance estimator for year i [MN1(i)]. It is constructed by summing maturing 1SW returns in year i [MR1(i)] in Canada and the USA and catches in year i from commercial and food fisheries on maturing 1SW salmon in Newfoundland and Labrador [MC1(i)]. An assumed natural mortality rate [M] of 0.03 per month is used to adjust the numbers between the fishery on 1SW salmon and returns to the rivers (1 month) as shown below:

Eq. 4.9.7.4 $\quad MN1(i) = [MR1(i) / S1 + MC1(i)] * RFL1$

where the parameter S1 is defined as exp(-M * 1).

Eq. 4,9.7.5 $\quad MC1(i) = [(1\text{-}f\_imm)(H\_s(i)_{\{1\text{-}7,14b\}} + q*H\_l(i)_{\{1\text{-}7,14b\}})] + H\_s(i)_{\{8–14a\}}$

$$+ [(1\text{-}af\_imm)(AH\_s(i) + q*AH\_l(i))]$$

This estimated pre-fishery abundance represents the extant population and does not account for the fraction of the population present in a given fishery area. The model does not take into account non-catch fishing mortality in any of the fisheries. This is because rates for non-catch fishing mortality are not available on an annual basis and are not well described for the fisheries harvesting 1SW salmon. Thus, catches used in the run-reconstruction model for the Newfoundland commercial fishery were set to zero for 1992–2003 and for Labrador for 1998-2003 to remain consistent with catches used in other years in these areas (Section 4.9.1).

The minimum and maximum values of the catches and returns for the 1SW cohort are summarized in Table 4.9.7.4 and the mid-point values are shown in Figure 4.9.7.1. The most recent six years are shown with hollow symbols as no Labrador values were estimated for these years and the raising factor described previously was used. The mid-point of the range of pre-fishery abundance estimates for 2003 (380,547) is 3% lower than in 2002 (393,100) and had increased considerably from the low 1994 value of 309,000, the lowest estimated in the time-series 1971-2003. The reduced values observed in 1978 and 1983–84 and 1994 were followed by large increases in pre-fishery abundance.

Total 1SW recruits (maturing and non-maturing)

Figure 4.9.7.1 shows the pre-fishery abundance of 1SW maturing for the 1971-2003 and 1SW non-maturing salmon from North America for 1971-2002. Figure 4.9.7.2 shows these data combined to give the total 1SW recruits. While maturing 1SW salmon in 1998-2003 have increased over the lowest value achieved in 1994, the non-maturing portion of these cohorts remained unchanged since 1997. As the prefishery abundance of the non-maturing portion (potential 2SW salmon) has been consistently well below the Spawning Escapement Reserve (derived from S_{lim}) since 1993, this situation is considered to be very serious. The decline in recruits in the time-series is alarming. Although the declining trend appears common to both maturing and non-maturing portions of the cohort, non-maturing 1SW salmon have declined further. The Working Group expressed concerns about these stock trends and recommended further investigation into their causes.

Escapement variability in North America

The projected numbers of potential 2SW spawners that could have returned to North America in the absence of fisheries can be computed from estimates of the pre-fishery abundance taking into consideration the 11 months of natural mortality at 3% per month. These values, termed potential 2SW recruits, along with total North American 2SW returns, spawners, and conservation limits (S_{lim}) are shown in Figure 4.9.7.3 and indicate that the overall North American conservation limit could have been met, in the absence of all fisheries prior to, but not since 1994. The difference between the potential 2SW recruits and actual 2SW returns reflect the extent to which mixed stock fisheries at West Greenland and in SFAs 1–14 have reduced the populations.

Similarly, the impact of the Greenland fishery can be considered by subtracting the non-maturing 1SW salmon (accounting for natural mortality) harvested there from the total potential 2SW recruits. These values, termed 2SW recruits to North America, are also shown in Figure 4.9.7.3. The difference between the 2SW recruits to North America and the 2SW returns reflects the impact of removals by the commercial fisheries of Newfoundland and Labrador when they were open and the Labrador food fisheries since reports began in 1998. The 2SW recruits to North America indicate that, even if there had not been a West Greenland commercial fishery, conservation limits could not have been met since 1992. The difference between the actual 2SW returns and the spawner numbers reflects in-river removals throughout North America and coastal removals in Québec, Gulf, and Scotia Fundy regions.

Following on the technique outlined in previous reports (ICES 1994/Assess:16, ICES 1995/Assess:14), the spawners in each geographic area were allocated (weighted forward) to the year of the non-maturing 1SW component in the Northwest Atlantic using the weighted smolt age proportions from each area (Table 4.9.7.5). The smolt age distribution for the USA area was updated with 1990-2003 age and return data. The original USA smolt age distributions are used to allocate the USA spawners for years 1971-1989 and the new distribution for 1990 onward. Changes were made to the USA portion of the table due to declines in natural spawning for US Atlantic salmon populations and changes in hatchery and stocking practices. The total spawners for a given recruitment year in each area is the sum of the lagged spawners. Because the smolt age distributions in North America range from one to six years and the time-series of estimated 2SW spawners to North America begins in 1971, the first recruiting year for which the total spawning stock size can be estimated is 1979 (although a value for 1978 was obtained by leaving out the 6-year old smolt contribution which represents 4% of the Labrador stock complex (Table 4.9.7.5). Furthermore, for 1977, a value was obtained by estimating contributions from Québec and Newfoundland where five year old smolts exist, representing about 9% of the spawners from these two areas.

After consideration of the changes in North American Atlantic salmon dynamics, and, the modifications made to the US smolt age distribution at this years meeting, the Working Group recommended that Canadian smolt age distributions be examined and if necessary updated in 2005. Furthermore, the smolt age distributions for the six North American areas should be re-evaluated on a five-year schedule, beginning in 2009.

Except for Labrador, the 2SW spawners to North America have been estimated to 2006. In Labrador, the spawning stock is only known to 1997 and therefore lagged spawners contributing to the pre-fishery abundance can only be completely assembled to the 2002 pre-fishery abundance (Figure 4.9.7.4, Table 4.9.7.6). In Labrador, age-3 smolts contribute about 7% to 2SW returns six years later, or five years later to the pre-fishery abundance.

Spawning escapement of 2SW salmon to several stock complexes has been below S_{lim} (Labrador, Québec, Scotia-Fundy, USA) since at least the 1980s (Figure 4.9.7.4). In the last four years, lagged spawner abundance has been increasing in Labrador and Newfoundland, but decreasing in all other areas. Only the Newfoundland stock complex has received spawning escapements that have exceeded the area's requirements, all other complexes were below requirement, although most increased slightly in 2003.

The relative contributions of the stocks from these six geographic areas to the total spawning escapement of 2SW salmon has varied over time (Figure 4.9.7.5). The reduced potential contribution of Scotia-Fundy stocks and the initial increased proportion of the spawning stock from the Gulf of St. Lawrence and, more recently, from Labrador rivers to future recruitment is most noticeable.

4.9.8 Egg depositions in 2003

Egg depositions by all sea-ages combined in 2003 exceeded or equaled the river specific conservation limits in 34 of the 83 assessed rivers (41%) and were less than 50% of conservation limits in 24 other rivers (29%) (Figure 4.9.8.1). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 8 of the 12 rivers assessed (67%) had egg depositions that were less than 50% of conservation limits. Proportionally fewer rivers in Gulf (0%) and Québec (16%) had egg depositions less than 50% of conservation limits. For 80% of the Gulf rivers and 52% of the Quebec rivers, egg depositions equaled or exceeded conservation limits (Figure 4.9.8.1). In Newfoundland, 33% of the rivers assessed met or exceeded the conservation limits and 14% had egg depositions that were less than 50% of limits. Most of the deficits occurred in the east and southwest rivers of Newfoundland (SFA 13). All age classes of spawners (1SW, 2SW, 3SW, and repeat) in 2003 (1,436 salmon) represented 4.9% of the 2SW spawner requirements for all USA rivers combined. Spawning 2SW salmon exclusively, expressed as the percentage of conservation requirement was 4.1% for all USA rivers combined. On an individual river basis, the Penobscot River met 13.2% of its spawner requirement while all the other US rivers met between 0.4-5.2% of their 2SW requirements (Figure 4.9.8.1).

Egg depositions by all sea-age groups in the Bay of Fundy/Atlantic coast of Nova Scotia, Gulf and Newfoundland areas were mostly stable whereas Québec regions increased relative to the previous year (Figure 4.9.8.2). The proportion of the conservation limits achieved on two Bay of Fundy/Atlantic coast of Nova Scotia rivers has severely declined, especially since 1989. For the Québec rivers, spawning escapements declined continually from a peak median value in 1989. With the exception of one year (2002) in Québec, the median proportion of conservation requirements achieved has been at or above the requirements. In 2003, the median proportion doubled from the previous year which was the lowest value of the time series at 64% of the conservation limit. This reflects the good returns of the 2SW salmon observed for all of the Québec areas in 2003. The rivers of the Gulf of St. Lawrence have also previously been quite consistent in equalling or exceeding the conservation limits. The median escapements from the 3 Gulf rivers were at conservation limits in 2003. Newfoundland rivers in 2003 observed another small increase from the previous year to be slightly above the conservation limit. The exceeding of limits encountered in Newfoundland from 1992 to 2000 corresponded to the commercial salmon and groundfish moratoria initiated in 1992.

4.9.9 Marine survival rates

With the closure of most sea fisheries, counts of smolts and returning adult salmon can provide indices (% smolt survival) of natural survival at sea. These estimates are potentially influenced by annual variation in the size, age and sex composition of smolts leaving freshwater and possibly, annual variation in sea-age at maturity. Data available in 2003 on rivers with smolt counts and corresponding adult counts were from eleven wild and four hatchery populations distributed among Newfoundland (SFAs 4, 9, 11, 13, and 14a), Québec (Q2 and Q7), Nova Scotia (SFA 21), New Brunswick (SFA 16, 23) and Maine (USA), Penobscot and Narraguagus rivers.

Plots of percent returns of 1SW and 2SW adults over time (Figures 4.9.9.1 to 4.9.9.5) provide insight into the impact of changes in management measures and possible changes in marine survival of wild and hatchery 1SW and 2SW stocks. In general the plots suggest:

- Survival of North American stocks to home waters has not increased as expected after closure of the commercial fisheries in 1984 and 1992,
- 1SW survival greatly exceeded that of 2SW fish (except for Maine, where survival of 2SW fish generally exceeds that of 1SW fish),
- Survival of wild stocks exceeded that of hatchery stocks by roughly a factor of 10, and
- Survival of fish from many rivers in North America is low compared to historic levels, especially in the south.

In 2003, estimated return rates for 1SW fish improved somewhat for 5 stocks, declined in eight, and was unchanged (+ or – 10%) in one compared to 2002. By contrast, 2SW fish estimated return rates in 2003 improved in nine stocks and decreased in one, compared to 2002.

There have been no significant increasing trends ($p \leq 0.05$) in survival indices of any of the stock components since commercial closures in 1992.

Sea-age & stock	Province/region	Number of stocks: Relative to 2002 ⇧	⇔	⇩	10-Year Trend ⇧	⇔	⇩
1SW Wild	West & North Nfld	1	1			2	
	South Nfld	1		2		3	
	Québec	2				2	
	NS/NB			3			
Hatchery	Québec	1				1	
	NS			1		1	
	NB			1		1	
	Maine			1		1	
	Total	5	1	8	0	11	0
2SW Wild	NS/NB	3					
	Québec	1		1		2	
	Maine	1					
Hatchery	Québec	1				1	
	NS	1					1
	NB	1				1	
	Maine	1				1	
	Total	9	0	1	0	5	1

4.9.10 Endangered populations of Atlantic Salmon

Salmon populations in the southern portion of the range in North America and in isolated locations throughout the range have diminished to levels that require actions to prevent their extirpation. Two population segments in North America have been listed as Endangered by their respective national legislation, one listing consists of eight rivers in Maine, USA and the other consists of thirty-three rivers of the inner Bay of Fundy, Canada. Within the USA, a team is reviewing the status of stocks in other rivers within the Gulf of Maine for future consideration as either threatened or endangered. A similar process is occurring for Outer Bay of Fundy and Atlantic coast of Nova Scotia stocks in Canada.

In addition to historic extirpations, no spawning occurred on two of the eight listed rivers in the USA in 2001 and 2002. In two areas in Canada, the Atlantic coast of Nova Scotia (approximately 50 of 65 rivers) and the outer Bay of Fundy (11of 11 rivers) have salmon populations that have been extirpated or are perilously close to extirpation. Population viability modeling in both the USA and Canada has predicted that many of the river populations are not sustainable, possibly even when supportive breeding and rearing programs are used.

Currently, these programs for listed populations rely on annual collections of parr or smolt being raised as captive brood. Brood fish are genetically characterized prior to sexual maturity to guide hatchery-spawning operations and either ensures siblings or closely related individuals are not mated or mated according to a designed pedigree. These measures are taken to reduce inbreeding, loss of genetic diversity and fitness.

Stocking into the natal rivers include fry, parr, limited numbers of smolts and redundant mature fish.

4.9.11 Summary on status of stocks

Estimates of pre-fishery abundance suggest a continuing decline of North American adult salmon over the last 10 years. The total population of 1SW and 2SW Atlantic salmon in the northwest Atlantic has oscillated around a generally declining trend since the 1970s, and the abundance recorded in 1993–2002 was the lowest in the time-series (Figure 4.9.7.2). During 1993 to 2000, the total population of 1SW and 2SW Atlantic salmon was about 600,000 fish, about half of the average abundance during 1972 to 1990. A 21% increase however has occurred between 2001 and 2002, the most recent year for which it is possible to estimate the total population. The decline from earlier higher levels of abundance has been more severe for the 2SW salmon component than for the small salmon (maturing as 1SW salmon) age group.

In most regions, the returns in 2003 of 2SW fish increased substantially from 2002 however they are still close to the lower end of the 33-year time-series (1971-2003). In Newfoundland, the 2 SW salmon are a minor age group component of the stocks in this area and even here, decreases of about 30% have occurred from peak levels of a few years ago. Returns of 1SW salmon generally decreased from 2002 in all areas except Newfoundland.

The rank of the estimated returns in 2003 in the 1971–2003 time-series for six regions in North America is shown below:

Region	Rank of 2003 returns in 1971-2003 (1=highest)		Rank of 2003 returns in 1994-2003 (1=highest)		Mid-point estimate of 2SW spawners as proportion of conservation limit (S_{lim})
	1SW	2SW	1SW	2SW	(%)
Labrador	Unknown	Unknown	Unknown	Unknown	Unknown
Newfoundland	13	19	5	8	96
Québec	21	19	9	4	86
Gulf	28	18	7	4	81
Scotia-Fundy	31	31	9	8	15
USA	24	25	9	8	4

Trends in abundance of small salmon and large salmon within the geographic areas show a general synchronicity among the rivers. Returns of large salmon in North America were generally increased from 2002 often from record low values, while small salmon returns decreased. Decreases in small salmon returns were often to low values similar to 2001. For the rivers of Newfoundland, both small and large salmon returns increased from 2002, and remained high relative to the years before the closure of the commercial fisheries. Large salmon in Newfoundland are predominantly repeat-spawning 1SW salmon, while in other areas of eastern Canada, 2SW and 3SW salmon make up varying proportions of the returns.

Egg depositions in 2003 exceeded or equaled the river-specific conservation limits (S_{lim} for eggs) in 34 of the 83 assessed rivers (41%), a significant improvement since 2002 when only 27% reached this criterion. In 2003, however egg depositions were less than 50% of conservation limits in 24 other rivers (29%). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 8 of the 12 rivers assessed (67%) had egg depositions that were less than 50% of conservation limits. Proportionally fewer rivers in Gulf (0%) and Québec (16%) had egg depositions less than 50% of conservation. For 80% of the Gulf rivers and 52% of the Quebec rivers, egg depositions equaled or exceeded conservation limits. In Newfoundland, 33% of the rivers assessed met or exceeded the conservation egg limits, and 14% had egg depositions that were less than 50% of limits. The deficits mostly occurred in the east and southwest rivers of Newfoundland (SFA 13). All USA rivers had egg depositions less than 5% of conservation limits. The Penobscot River in the USA met 13.2% of its egg deposition requirements while all the other US rivers were 5% or less of their requirements.

In 2003, the overall conservation limit (S_{lim}) for 2SW salmon was not met in any area. The overall 2SW conservation limit for Canada could have been met or exceeded in only nine (1974-78, 1980-82 and 1986) of the past 31 years (considering the mid-points of the estimates) by reduction of terminal fisheries (Figures 4.9.5.6 and 4.9.7.3). In the remaining years, conservation limits could not have been met even if all terminal harvests had been eliminated. It is only within the last decade that Québec and the Gulf areas have failed to achieve their overall 2SW salmon conservation limits.

Measures of marine survival rates over time indicate that survival of North America stocks to home waters has not increased as expected as a result of fisheries changes**.** There have been no significant increasing trends in survival indices of any of the stock components since commercial closures in 1992.

Substantive increases in spawning escapements in recent years in northeast coast Newfoundland rivers and high smolt and juvenile production in many rivers, in conjunction with suitable ocean climate indices, were suggestive of the potential for improved adult salmon returns for 1998 through 2003. Colder oceanic conditions both nearshore and in the Labrador Sea in the early 1990s are thought to have contributed to lower survival of salmon stocks in eastern Canada during that period.

Based on the genera1ly decreased 1SW returns in 2003, some modest decrease is expected for large salmon in 2004. An additional concern is the low abundance levels of many salmon stocks in rivers in eastern Canada, particularly in the Bay of Fundy and Atlantic coast of Nova Scotia. USA salmon stocks exhibit these same downward trends. Most salmon rivers in the USA are hatchery-dependent and remain at low levels compared to conservation requirements. Despite major changes in fisheries management, returns have continued to decline in these areas and many populations are currently threatened with extirpation.

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

The management of Atlantic salmon in eastern North America has focused on the management of spawning escapement to meet or exceed conservation limits. Significant measures introduced in the last 18 years in order to meet this objective have included the closure of all commercial fisheries in eastern Canada as of 2000, the complete closure of numerous rivers to any fishing including Native and recreational fisheries, and the imposition of catch and release only access in others. However increased escapements were not realized in all areas (Fig. 4.9.5.1) and in some areas, increased escapements from fisheries did not always result in increased smolt production (Figure 4.9.5.2). These observations indicate that factors other than fishing are impacting survival of Atlantic salmon at sea.

Management measures can have impacts on Atlantic salmon stocks beyond changes in abundance of returning and spawning Atlantic salmon. The Working Group reviewed some examples of biological characteristics of stocks which may change as a consequence of changes in fishing exploitation. These included changes in spawning escapement (Section 2.4.3), juvenile abundance (Section 4.9.5), age structure and composition, as well as marine survival rates. Over three decades some stocks responded initially to the 1984 management plan (closure of commercial fisheries and mandatory catch and release of large salmon throughout the Maritimes) but the higher escapements were not sustained into the 1990s (Fig. 4.9.5.1). Juvenile abundance generally increased in response to these changes but declined in the early 1990s and again in 2001 when escapements declined (Fig. 4.9.5.3). Collectively these data indicate that freshwater habitats generally have remained productive over the time period of the management actions but an increase in marine mortality continues to impact yield in the more productive areas and persistence in some lower productive areas.

4.11 NASCO has asked ICES to provide an analysis of any new biological and/or tag return data to identify the origin and biological characteristics of Atlantic salmon caught at St. Pierre and Miquelon

The Working Group is aware that the fishery was sampled in 2003 by the local government and that over 300 fish were examined. No further details on the sampling program are available.

The following types of data are essential to gaining a better understanding of the composition of the Saint-Pierre and Miquelon Atlantic salmon fishery and for determining the effect that this fishery has on the Atlantic salmon resources of North America.

A biological sampling program for the Saint-Pierre and Miquelon gillnet fishery should be an international cooperative effort between USA, Canada, France and the local government of Saint-Pierre and Miquelon. At a minimum, an individual sampler needs to be coupled with a local contact and stationed in Saint-Pierre for a period of 2-3 weeks during the period when the fishery is expected to be prosecuted (June through August). The local contact would be essential for connecting the sampler with individuals who would likely be gillnetting during this period. The sampler would collect information related to fishing effort (description of gear, number of nets fished, soak time etc.) as well as catch (type and amount of species caught). In addition, detailed biological data needs to be collected for each individual Atlantic salmon sampled: including individual length and individual weight data plus a scale and genetic sample (to provide data on origin). The presence or absence of any external tags, clips or marks should also be noted for each individual as well as any abnormal physical features. Additional support from the countries involved could result in an increase of the number of sampling teams. This increase could be used to widen the sampling coverage in both time and space. Increased sampling may be valuable, depending on the spatial and temporal occurrence of the fishery, which is currently unknown.

4.12 NASCO has asked ICES to provide descriptions (gear type; and fishing depth, location and season) for all pelagic fisheries that may catch Atlantic salmon

The Working Group examined the potential for Atlantic salmon to be taken as by-catch in pelagic fisheries in the North Atlantic by reviewing existing data about the fisheries and gear that have reported salmon by-catch in the past, and by reviewing research survey data and observer data to identify gear known to have captured salmon.

4.12.1 Database Queries

Observer databases

Observer databases maintained by both the Northeast Fisheries Science Center (NEFSC) of the National Marine Fisheries Service (USA) and the Department of Fisheries and Oceans (DFO, Canada) were examined for records of Atlantic salmon catch. Direct observations of Atlantic salmon catch in the observer database are rare. With the NEFSC observer database, there were a total of five trips which occurred in the early 1990's that recorded a total of 12 kg of Atlantic salmon catch. In 1990 one gillnet trip discarded one pound of Atlantic salmon. In 1992, one otter trawl trip discarded 1 kg of Atlantic salmon. In 1992, three separate (but close in time) gillnet trips discarded 7 kg and kept 3 kg of Atlantic salmon. Given that the level of observer coverage has increased in recent years for both USA gillnet and trawl fisheries and that no reports have been made of Atlantic salmon catch in recent years, these fisheries are not thought to be causing a large amount of Atlantic salmon bycatch. Observer coverage for gillnet fisheries in Maine during the summer of 1996 was approximately 9%. There are no salmon bycatch records associated with these observer trips.

The search of the DFO observer database yielded similar results. This observer program covers waters off most of Atlantic Canada and has reported catches since 1977. A total of 15 records of salmon catches, all prior to 1994, were found in the database (Table 4.12.1.1.). Twelve of these records are for bottom trawls, one for a midwater trawl, one for longline and one for a scallop dredge. The total combined catch was 156 kg. All records of salmon catches came from the Gulf of Maine-Scotian Shelf, except one from the Grand Banks (Figure 4.12.1.1). Thirteen of the fifteen records occurred between mid-April and mid-June. Between 1995 and 2002, Canadian observers covered 628 gillnet sets (mostly for groundfish) off southwestern Nova Scotia. No salmon catches were reported.

Commercial Landings Databases

The NEFSC vessel trip report (VTR) database was queried to determine the time and location of midwater trawl, midwater paired trawl and purse seine (herring targeted) activities. These gears were selected under the assumption that these would be the only gears with potential Atlantic salmon bycatch due to salmon's pelagic nature. This database does not contain records of salmon catches, or even a code for Atlantic salmon. The purse seine fishery targeting herring occurs predominantly in the summer along the coast of Maine (Figure 4.12.1.2, 4.12.1.3), with most recent effort in area 512 (Table 4.12.1.2). Since there are no observer records and only a total of eight species were recorded in the VTR database for this gear (all pelagic), no conclusions can be drawn definitively about whether this gear catches salmon. However, given the location and timing of catch and the targeting of herring, there is a possibility that both salmon post-smolts and adults could be captured by this gear. The low number of trips reported for this gear means that there is only a relatively small amount of fishing effort exerted by this gear. The midwater otter trawl and midwater paired trawl fisheries both operate slightly south of the purse seine fishery in general, area 513, and have a larger area of coverage (Table 4.12.1.2, Figure 4.12.1.4). These fisheries operate throughout the Gulf of Mexico, on Georges Bank, and in Southern New England waters. Southern areas are winter fisheries while the northern areas are summer fisheries. Both types of gear target herring and Atlantic mackerel, but do have occasional records of bottom fish including monkfish, summer flounder, and croakers demonstrating that at least some sets are made close to or on the bottom. There is an overlap in the timing and location of the fishing operations and the spatial and temporal distribution of Atlantic salmon that has the potential to cause bycatch. Midwater trawl catches are sometimes quite large (Figure 4.12.1.4). Recent herring landings in southern New Brunswick, Georges Bank and Gulf of Maine are low relative to the late 1960's primarily due to high levels caught historically by the foreign fleet operating on Georges Bank (Figure 4.12.1.5). The recent increase is due to an increase in the number of paired trawlers operating in the fishery (Bisack, 2002).

The Canadian equivalent to the NEFSC VTR database is the DFO ZIFF database. This database contains primarily logbook data, but also contains some data from other sources (e.g. reports filed by fisheries officers). The database covers the time period from 1986 to 2003. Total landings of salmon reported in this database are 6,672 t, in comparison with the commercial landings of salmon reported by Canada to the Working Group of 6,943 t during this time period. Therefore, most, if not all, of the salmon reported within this database are from past legal commercial salmon fisheries. This database was queried to determine the type of gear and the main species landed when salmon was reported in the catch. The query was restricted to landings with known vessel numbers to avoid potential errors resulting from data aggregation. Vessel numbers are known for 14.7 % (987 t) of the total landings of salmon reported in the database. More than 99% of the salmon landings were taken with gillnets (Table 4.12.1.3). The main species captured is unknown for 29.1 % of these landings (Table 4.12.1.3). Where the "main species captured" is known, 91.5% of the salmon catch occurred where salmon was reported as the main species captured (Table 4.12.1.3), followed by cod (6.9%), herring (1.1%) and trout (0.2%).

The DFO research survey database was also queried for records of salmon catch. These are groundfish surveys conducted with bottom trawls, covering the southern Gulf and Scotia-Fundy regions from 1970 to 2003. Two records of salmon catches in the research trawls were found, one in the southern Gulf and one in the Bay of Fundy, both in 1983. The catches were likely one fish in each case.

4.12.2 Fisheries with Bycatch Potential

The following are the principal fisheries that are likely to account for most of the salmon bycatch in the NAC area. Smaller more localized fisheries also exist that have the potential to affect local populations.

Mackerel fishery (Gulf of St. Lawrence, Canada)

The mackerel fishery in the Gulf of St. Lawrence is executed by over 15,000 commercial licensees. They fish mainly inshore using gillnets, jiggers, purse seines and traps. The timing of the fishery varies with location: most landings in 4X come from traps in May to July, from gillnets and jiggers in 4T from August to October and from purse seines in 4R and 3K in August to October. Mackerel landings by Canadian fisheries are generally stable and have averaged about 20,000 t annually from 1990 to 2002. Close to 70% of the landings are made in a fall purse seine fishery in Newfoundland, mostly off the islands west coast (DFO 2003).

In 2000, there were 2 salmon marked in Miramichi River that were recaptured at sea in mackerel drift nets. Both were recaptured 20-30 km NNE of Cape North, Prince Edward Island. The first of these fish was recaptured on June 5 and had been tagged as a 1SW adult in the fall of 1999. The second was recaptured on June 23 and had been tagged as a smolt in the spring of 1999. A third recapture from the Miramichi River occurred off the coast of Newfoundland (fishery unknown) at Lance aux Meadows on September 12 and had been tagged as a 1SW adult in the fall of 1999.

Midwater Trawl Fisheries (USA)

This fishery, primarily for herring, is described above and has the potential to catch salmon. Increased observer coverage in this fishery is anticipated in 2004 by the National Marine Fisheries Service due mainly to anecdotal reports of groundfish bycatch. These observers should be able to provide the most direct method to determine if bycatch of Atlantic salmon in the midwater trawl fishery for herring is a large problem or not.

Capelin Fishery (Newfoundland, Canada)

DFO evaluated the potential for bycatch in the Newfoundland capelin fishery in 1985 by examining the landings at five fish plants. No postsmolts were found in 90,859 kg of capelin examined. Additionally, all pelagic offshore fisheries for capelin in the Northwest Atlantic and, in particular in the Newfoundland and Labrador Region, were closed in 1992, including a Russian fishery for capelin for industrial use. The remaining fisheries are inshore and in recent years catches have been restricted to less then 25,000 tonnes due mainly to a lack of markets (Figure 4.12.2.1).

Fisheries for Bait (Newfoundland, Canada)

As of April 2001, there were 3,538 bait net licenses issued by DFO in Newfoundland, of which about 46% were fished (Reddin et al. 2002). These are distributed around the island of Newfoundland and along the coast of southern Labrador. In order to receive a license to fish for bait, the individual must hold a license for a species requiring bait. Each licensee is permitted to fish two nets of maximum length of 40 fathoms and a maximum mesh size of 67 mm. In 2001, DFO carried out an assessment of bycatch in this fishery using telephone surveys, surveys by enforcement staff, examination of bycatch in herring index fisheries and experimental fishing. The overall conclusion was that some salmon are caught in this fishery but the overall number captured and its effect is low (Reddin et al. 2002).

Herring Fisheries (Gulf of St. Lawrence, Canada)

Herring stocks on the west coast of Newfoundland (Division 4R) are harvested by both large and small seines and by a large number of boats using gillnets (DFO 2002a). Herring landings in this area averaged 16,593 t per year, with about 75% of the catch being taken by large purse seiners. The average catch by gillnetters during this time period was 1,512 t. The season is April to December. Herring in the southern Gulf of St. Lawrence (4T) are harvested by an inshore gillnet fishery and an offshore purse seine fishery (vessels >65ft.). Both spring and fall spawning herring are harvested. From 1988 to 1997, landing of spring and fall spawning herring averaged 17,700 t and 51,000 t respectively (DFO 2002b).

The Working Group discussed potential salmon bycatch in the Northwest Atlantic area. At present, there is insufficient information to quantify bycatch although, based on information reviewed so far, there was no obvious concern about bycatch of salmon in these fisheries. The Working Group made the following observations:

- The gears with the greatest potential to catch salmon in the NAC area are seines, midwater trawls and gillnets.

- Technologies available to quantify bycatch amount are similar on both sides of the Atlantic and include observer programs, experimental fishing and tagging studies with automated detection systems that allow large catches to be scanned automatically.

- Historical data may provide some evidence of potential for bycatch, and salmon have been reported in commercial landings when the main species captured was not salmon. Based on the Canadian landings data, this occurs most frequently in gillnet fisheries, and the numbers of salmon captured are very low relative to targeted salmon fisheries. No landings from purse seines or trawls are reported in the DFO ZIFF database.

- Salmon abundance in waters off the USA, southern Nova Scotia and southern New Brunswick is presently low enough that quantifying bycatch rates may be difficult in these areas.

4.13 Data deficiencies and research needs

Data deficiencies and research needs for the NAC area are presented in Section 6.

Table 4.3.1. 2SW spawning requirements for North America by country, management zone and overall. Management zones are shown in Figure 4.9.2.1.

Country	Stock Area	Management zone	2SW spawner requirement	
Canada	Labrador	SFA 1	7,992	
		SFA 2	25,369	
		SFA 14B	1,390	
	Subtotal			34,746
	Newfoundland	SFA 3	240	
		SFA 4	488	
		SFA 5	233	
		SFA 6 to 8	13	
		SFA 9 to 12	212	
		SFA 13	2,544	
		SFA 14A	292	
	Subtotal			4,022
	Gulf of St. Lawrence	SFA 15	5,656	
		SFA 16	21,050	
		SFA 17	537	
		SFA 18	3,187	
	Subtotal			30,430
	Québec	Q1	2,532	
		Q2	1,797	
		Q3	1,788	
		Q5	948	
		Q6	818	
		Q7	2,021	
		Q8	11,195	
		Q9	3,378	
		Q10	1,582	
		Q11	3,387	
	Subtotal			29,446
	Scotia-Fundy	SFA 19	3,138	
		SFA 20	2,691	
		SFA 21	5,817	
		SFA 22	0	
		SFA 23	13,059	
	Subtotal			24,705
Total				123,349
USA	Connecticut		9,727	
	Merrimack		2,599	
	Penobscot		6,838	
	Other Maine rivers		9,668	
	Paucatuck		367	
Total				29,199
North American Total				152,548

Table 4.9.1.1. Catches expressed as 2SW salmon equivalents in North American salmon fisheries, 1972-2004.
Only mid-points of the estimated values have been used.

	CANADA										USA	Total
	MIXED STOCK				TERMINAL FISHERIES IN YEAR i							
Year i	NF-LAB Comm 1SW (Year i-1) (b)	Year i % 1SW of total 2SW equivalents	Year i NF-LAB Comm 2SW (b)	Year i NF-Lab comm total	Labrador rivers (a)	Nfld rivers (a)	Quebec Region	Gulf Region	Scotia - Fundy Region	Canadian total		
1972	20,857	9	153,775	174,632	314	633	27,417	22,389	6,801	232,186	346	232,532
1973	17,971	6	219,175	237,146	719	895	32,751	17,914	6,680	296,105	327	296,433
1974	24,564	7	235,910	260,475	593	542	47,631	21,430	12,734	343,405	247	343,652
1975	24,181	7	237,598	261,779	241	528	41,097	15,677	12,375	331,696	389	332,085
1976	35,801	10	256,586	292,388	618	412	42,139	18,090	11,111	364,758	191	364,949
1977	27,519	8	241,217	268,736	954	946	42,301	33,433	15,562	361,932	1,355	363,287
1978	27,836	11	157,299	185,135	580	559	37,421	23,806	10,781	258,281	894	259,175
1979	14,086	10	92,058	106,144	469	144	25,234	6,300	4,506	142,798	433	143,231
1980	20,894	6	217,209	238,103	646	699	53,567	29,832	18,411	341,257	1,533	342,789
1981	34,486	11	201,336	235,822	384	485	44,375	16,329	13,988	311,383	1,267	312,650
1982	34,341	14	134,417	168,757	473	433	35,204	25,709	12,353	242,929	1,413	244,342
1983	25,701	12	111,562	137,263	313	445	34,472	27,097	13,515	213,105	386	213,491
1984	19,432	14	82,807	102,238	379	215	24,408	5,997	3,971	137,210	675	137,884
1985	14,650	11	78,760	93,410	219	15	27,483	2,708	4,930	128,765	645	129,410
1986	19,832	12	104,890	124,723	340	39	33,846	4,542	2,824	166,313	606	166,919
1987	25,163	13	132,208	157,371	457	20	33,807	3,757	1,370	196,781	300	197,082
1988	32,081	21	81,130	113,211	514	29	34,262	3,832	1,373	153,220	248	153,468
1989	22,197	16	81,355	103,551	337	9	28,901	3,426	265	136,488	397	136,886
1990	19,577	18	57,359	76,937	261	24	27,986	2,700	593	108,501	696	109,197
1991	12,048	14	40,433	52,481	66	16	29,277	1,777	1,331	84,949	231	85,180
1992	9,979	14	25,108	35,087	581	67	30,016	2,673	1,114	69,539	167	69,706
1993	3,229	8	13,273	16,502	273	63	23,153	1,211	1,110	42,312	166	42,478
1994	2,139	5	11,938	14,077	365	165	24,052	2,206	756	41,621	1	41,622
1995	1,242	3	8,677	9,918	420	155	23,331	2,007	330	36,162	0	36,162
1996	1,075	3	5,646	6,721	320	183	22,413	2,389	766	32,793	0	32,793
1997	969	4	5,390	6,360	175	157	18,574	1,849	581	27,695	0	27,695
1998	1,155	7	1,872	3,027	276	112	11,256	2,204	322	17,197	0	17,197
1999	179	1	894	1,073	311	72	9,032	1,446	450	12,383	0	12,383
2000	152	1	1,115	1,267	404	218	9,425	1,761	193	13,267	0	13,267
2001	286	2	1,380	1,666	336	102	10,104	1,624	255	14,086	0	14,086
2002	263	3	1,185	1,448	221	152	7,297	174	179	9,471	0	9,471
2003	312	3	1,806	2,118	221	57	8,870	348	189	11,803	0	11,803
2004	358			358						358		358

NF-Lab comm as 1SW = NC1(mid-pt) * 0.677057 (M of 0.03 per month for 13 months to July for Canadian terminal fisheries)
NF-Lab comm as 2SW = NC2 (mid-pt) * 0.970446 (M of 0.03 per month for 1 month to July of Canadian terminal fisheries)
Terminal fisheries = 2SW returns (mid-pt) - 2SW spawners (mid-pt)
a - starting in 1993, includes estimated mortality of 10% on hook and released fish
b - starting in 1998, there was no commercial fishery in Labrador; numbers reflect size of aboriginal fish harvest in 1998-2002 and resident food fishery harvest in 2000-2002

Table 4.9.1.2. Catches of North American salmon expressed as 2SW salmon equivalents, 1972-2004, in North America and Greenland.

Year	Canadian Total	USA Total	North America Total	% USA of Total North American	Greenland Total	NW Atlantic Total	Harvest in homewaters as % of total NW Atlantic
1972	232,186	346	232,532	0.15	206,814	439,346	53
1973	296,105	327	296,433	0.11	144,348	440,781	67
1974	343,405	247	343,652	0.07	173,615	517,267	66
1975	331,696	389	332,085	0.12	158,583	490,668	68
1976	364,758	191	364,949	0.05	200,464	565,413	65
1977	361,932	1,355	363,287	0.37	112,077	475,364	76
1978	258,281	894	259,175	0.34	136,386	395,561	66
1979	142,798	433	143,231	0.30	85,446	228,677	63
1980	341,257	1,533	342,789	0.45	143,829	486,618	70
1981	311,383	1,267	312,650	0.41	135,157	447,807	70
1982	242,929	1,413	244,342	0.58	163,718	408,060	60
1983	213,105	386	213,491	0.18	139,985	353,476	60
1984	137,210	675	137,884	0.49	23,897	161,781	85
1985	128,765	645	129,410	0.50	27,978	157,388	82
1986	166,313	606	166,919	0.36	100,098	267,017	63
1987	196,781	300	197,082	0.15	123,472	320,553	61
1988	153,220	248	153,468	0.16	124,868	278,336	55
1989	136,488	397	136,886	0.29	83,947	220,832	62
1990	108,501	696	109,197	0.64	43,634	152,831	71
1991	84,949	231	85,180	0.27	52,560	137,740	62
1992	69,539	167	69,706	0.24	79,571	149,277	47
1993	42,312	166	42,478	0.39	30,091	72,569	59
1994	41,621	1	41,622	0.00	0	41,622	100
1995	36,162	0	36,162	0.00	0	36,162	100
1996	32,793	0	32,793	0.00	15,343	48,135	68
1997	27,695	0	27,695	0.00	15,776	43,471	64
1998	17,197	0	17,197	0.00	12,088	29,285	59
1999	12,383	0	12,383	0.00	2,175	14,558	85
2000	13,267	0	13,267	0.00	3,863	17,131	77
2001	14,086	0	14,086	0.00	4,005	18,092	78
2002	9,471	0	9,471	0.00	6,989	16,461	58
2003	11,803	0	11,803	0.00	1,627	13,430	88
2004	358	-	358	-	1,958	-	-

Greenland harvest of 2SW equivalents = NG1 * 0.718924 (M of 0.03 per month for 11 months to July of Canadian terminal fisheries)

Table 4.9.3.1. Percentages by user group and province of small and large salmon harvested (by number) in the Atlantic salmon fisheries of eastern Canada during 2003.

	% of provincial harvest			% of eastern Canada	Number of fish
	Aboriginal peoples' food fisheries	**Recreational fisheries**	**Resident food fisheries**		
		Small salmon			
Newfoundland / Labrador	15.1	76.4	8.5	62.4	27,721
Québec	16.1	83.9	0.0	13.0	5,790
New Brunswick	8.9	91.1	0.0	23.2	10,327
P.E.I.	5.7	94.3	0.0	0.6	280
Nova Scotia	9.7	90.3	0.0	0.7	308
		Large salmon			
Newfoundland / Labrador	64.8	9.4	25.8	21.6	2,414
Québec	45.6	54.4	0.0	73.5	8,217
New Brunswick	100.0	0.0	0.0	4.8	541
P.E.I.	-	-	-	0.0	0
Nova Scotia	-	-	-	0.0	0
Eastern Canada		**% by user group**			
Small salmon	13.7	81.0	5.3		44,426
Large salmon	42.1	52.4	5.6		11,172

Table 4.9.3.2. Hook-and-release Atlantic salmon caught by recreational fishermen in Canada, 1984 – 2003.

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	717	3,358	4,075	3,457	4,870	3,786	8,874	20,987	210	118	328	182	1,643	1,825	**34,752**	**22,499**	**57,251**
1998	31,368	4,375	35,743	687	2,520	3,207	3,154	5,760	3,452	8,298	20,664	233	114	347	297	2,680	2,977	**41,499**	**21,439**	**62,938**
1999	24,567	4,153	28,720	591	2,161	2,752	3,155	5,631	3,456	8,281	20,523	192	157	349	298	2,693	2,991	**34,434**	**20,901**	**55,335**
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	21,599	4,637	26,236	618	2,092	2,710	1,618	3,253	1,089	7,981	13,941	177	125	302	1,238	7,015	8,253	**28,503**	**22,939**	**51,442**

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

Table 4.9.4.1. Counts of wild/hatchery and escaped farm salmon (AQ) at counting facilities in rivers of eastern Maine, USA, and the Magaguadavic River (SFA 23, Canada).

	Dennys			*Narraguagus*			*St Croix*			*Union*			*Magaguadavic*		
Year	*1SW*	*MSW*	*AQ*	*1SW*	*MSW*	*AQ*	*1SW*	*MSW*	*AQ*	*1SW*	*MSW*	*AQ*	*1SW*	*MSW*	*AQ*
1992													155	138	148
1993													113	124	154
1994				4	47	1	47	37	97	0	0		43	88	1200
1995				0	56	0	15	31	14	0	0		50	29	712
1996				10	54	8	23	109	20	6	63		21	48	240
1997				1	36	0	26	2	42	0	8		33	26	119
1998				1	21	0	32	9	25	2	11		27	4	222
1999				6	26	3	8	5	23	3	6	63	12	12	90
2000	1	1	28	13	10	0	10	10	30	1	1	3	14	0	30
2001	4	13	62	5	27	1	13	7	58	0	0	2	11	6	130
2002	2	0	4	4	4	0	14	6	5	0	5	6	7	0	35
2003	3	6	2	0	21	0	6	9	9	1	0	0	3	3	22

Data from fishway traps except Dennys weirs
Blanks are no data

Table 4.9.5.1 Estimated numbers of 1SW returns in North America by geographic regions, 1971 – 2003.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy		USA	North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Mid-points
1971	32,966	115,382	112,644	226,129	14,969	22,453	33,115	57,968	11,515	19,525	32	205,241	441,490	323,365
1972	24,675	86,362	109,282	219,412	12,470	18,704	42,195	73,700	9,522	16,915	18	198,161	415,112	306,637
1973	5,399	18,897	144,267	289,447	16,585	24,877	43,653	77,061	14,766	24,823	23	224,693	435,128	329,910
1974	27,034	94,619	85,216	170,748	16,791	25,186	65,663	114,068	26,723	44,336	55	221,481	449,011	335,246
1975	53,660	187,809	112,272	225,165	18,071	27,106	58,607	101,878	25,940	36,316	84	268,633	578,358	423,496
1976	37,540	131,391	115,034	230,595	19,959	29,938	90,292	155,669	36,931	55,937	186	299,942	603,716	451,829
1977	33,409	116,931	110,114	220,501	18,190	27,285	31,311	56,070	30,860	48,387	75	223,959	469,250	346,605
1978	16,155	56,542	97,375	195,048	16,971	25,456	26,003	45,407	12,457	16,587	155	169,117	339,195	254,156
1979	21,943	76,800	107,402	215,160	21,683	32,524	50,771	93,190	30,875	49,052	250	232,923	466,976	349,950
1980	49,670	173,845	121,038	242,499	29,791	44,686	45,688	81,695	49,925	73,560	818	296,929	617,103	457,016
1981	55,046	192,662	157,425	315,347	41,667	62,501	70,085	128,432	37,371	62,083	1,130	362,724	762,155	562,440
1982	38,136	133,474	141,247	283,002	23,699	35,549	79,756	143,370	23,839	38,208	334	307,011	633,938	470,474
1983	23,732	83,061	109,934	220,216	17,987	26,981	25,325	43,905	15,553	23,775	295	192,826	398,233	295,530
1984	12,283	42,991	130,836	262,061	21,566	30,894	37,670	63,906	27,954	47,493	598	230,907	447,943	339,425
1985	22,732	79,563	121,731	243,727	22,771	33,262	61,215	110,517	29,410	51,983	392	258,250	519,444	388,847
1986	34,270	119,945	125,329	251,033	33,758	46,937	114,665	204,378	30,935	54,678	758	339,715	677,730	508,722
1987	42,938	150,283	128,578	257,473	37,816	54,034	86,492	155,985	31,746	55,564	1,128	328,698	674,466	501,582
1988	39,892	139,623	133,237	266,895	43,943	62,193	123,472	223,211	32,992	56,935	992	374,529	749,850	562,189
1989	27,113	94,896	60,260	120,661	34,568	48,407	72,906	129,462	34,957	59,662	1,258	231,063	454,347	342,705
1990	15,853	55,485	99,543	199,416	39,962	54,792	84,934	161,505	33,939	60,828	687	274,918	532,713	403,816
1991	12,849	44,970	64,552	129,308	31,488	42,755	56,479	108,066	19,759	31,555	310	185,437	356,964	271,200
1992	17,993	62,094	118,778	237,811	35,257	48,742	150,290	234,582	22,832	37,340	1,194	346,344	621,764	484,054
1993	25,186	80,938	134,150	268,550	30,645	42,156	75,124	195,457	16,714	27,539	466	282,284	615,107	448,696
1994	18,159	56,888	91,495	189,808	29,667	40,170	50,402	83,027	8,216	11,583	436	198,375	381,912	290,144
1995	25,022	76,453	167,485	301,743	23,851	32,368	46,511	72,939	14,239	21,822	213	277,321	505,537	391,429
1996	51,867	153,553	200,277	422,635	32,008	42,558	40,140	70,561	22,795	36,047	651	347,737	726,005	536,871
1997	66,812	155,963	118,973	192,852	24,300	33,018	22,183	41,835	7,173	10,467	365	239,806	434,500	337,153
1998	-	-	150,644	202,611	24,495	34,301	28,890	53,032	16,770	26,481	403	-	-	-
1999	-	-	163,417	215,042	25,880	36,679	27,725	44,762	10,556	16,901	419	-	-	-
2000	-	-	148,710	254,736	24,129	35,070	37,847	55,675	10,997	18,343	270	-	-	-
2001	-	-	136,949	194,299	16,931	24,437	33,924	55,311	6,752	11,746	266	-	-	-
2002	-	-	134,679	187,273	28,609	39,275	51,148	83,432	9,207	15,870	450	-	-	-
2003	-	-	143,456	227,146	23,103	31,928	30,454	51,595	6,794	12,138	237	-	-	-

Labrador : SFAs 1,2&14B
Newfoundland: SFAs 3-14A
Gulf of St. Lawrence: SFAs 15-18
Scotia-Fundy: SFAs 19-23 (SFA 22 is not included as it does not produce 2SW salmon)
Quebec: Q1-Q11

Table 4.9.5.2 Estimated numbers of 2SW returns in North America by geographic regions, 1971 – 2003.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy		USA	North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Mid-points
1971	4,312	29,279	2,388	8,923	34,568	51,852	29,450	46,846	11,187	16,410	653	81,905	153,310	117,607
1972	3,706	25,168	2,511	9,003	45,094	67,642	35,604	59,953	14,028	19,731	1,383	102,328	182,881	142,604
1973	5,183	35,196	2,995	11,527	49,765	74,647	34,871	59,568	10,359	14,793	1,427	104,600	197,158	150,879
1974	5,003	34,148	1,940	6,596	66,762	100,143	49,044	83,418	21,902	29,071	1,394	146,045	254,771	200,408
1975	4,772	32,392	2,305	7,725	56,695	85,042	31,153	51,874	23,944	31,496	2,331	121,200	210,860	166,030
1976	5,519	37,401	2,334	7,698	56,365	84,547	29,238	51,439	21,768	29,837	1,317	116,541	212,240	164,390
1977	4,867	33,051	1,845	6,247	66,442	99,663	58,774	100,788	28,606	39,215	1,998	162,533	280,963	221,748
1978	3,864	26,147	1,991	6,396	59,826	89,739	30,411	51,505	16,946	22,561	4,208	117,247	200,555	158,901
1979	2,231	15,058	1,088	3,644	32,994	49,491	8,643	14,337	8,962	12,968	1,942	55,860	97,440	76,650
1980	5,190	35,259	2,432	7,778	78,447	117,670	43,359	73,863	31,897	44,823	5,796	167,121	285,189	226,155
1981	4,734	32,051	3,451	12,035	61,633	92,449	17,695	29,615	19,030	28,169	5,601	112,144	199,921	156,033
1982	3,491	23,662	2,914	9,012	54,655	81,982	31,591	51,156	17,516	24,182	6,056	116,222	196,049	156,136
1983	2,538	17,181	2,586	8,225	44,886	67,329	28,987	46,897	14,310	20,753	2,155	95,462	162,540	129,001
1984	1,806	12,252	2,233	7,060	44,661	59,160	20,437	34,150	17,938	27,899	3,222	90,298	143,743	117,020
1985	1,448	9,779	958	3,059	45,916	61,460	22,965	43,606	22,841	38,784	5,529	99,657	162,218	130,937
1986	2,470	16,720	1,606	5,245	55,159	72,560	35,866	71,110	18,102	33,101	6,176	119,379	204,912	162,145
1987	3,289	22,341	1,336	4,433	52,699	68,365	22,289	48,137	11,529	20,679	3,081	94,223	167,036	130,629
1988	2,068	14,037	1,563	5,068	56,870	75,387	25,976	50,039	10,370	19,830	3,286	100,134	167,646	133,890
1989	2,018	13,653	697	2,299	51,656	67,066	17,094	35,461	11,939	21,818	3,197	86,602	143,493	115,047
1990	1,148	7,790	1,347	4,401	50,261	66,352	23,152	51,735	10,248	18,871	5,051	91,207	154,201	122,704
1991	548	3,740	1,054	3,429	46,841	60,724	19,711	42,977	10,613	17,884	2,647	81,415	131,401	106,408
1992	2,515	15,548	3,111	10,554	46,917	61,285	30,396	59,868	9,777	16,456	2,459	95,174	166,171	130,673
1993	3,858	18,234	1,499	5,094	37,023	46,484	18,731	74,077	6,764	11,087	2,231	70,106	157,208	113,657
1994	5,653	24,396	1,495	5,226	37,703	47,180	20,372	43,698	4,379	6,908	1,346	70,947	128,754	99,851
1995	12,368	44,205	2,243	7,535	43,755	54,186	29,885	50,879	4,985	8,317	1,748	94,984	166,871	130,927
1996	9,113	32,759	2,964	8,832	39,413	49,846	17,775	37,200	7,227	12,054	2,407	78,898	143,097	110,998
1997	9,384	23,833	3,469	8,538	32,443	41,017	14,774	37,114	3,645	5,922	1,611	65,326	118,034	91,680
1998	-	-	4,280	8,813	24,358	31,832	8,447	26,746	2,728	6,003	1,526	-	-	-
1999	-	-	2,599	9,661	25,415	33,710	9,475	20,747	3,482	7,107	1,168	-	-	-
2000	-	-	2,022	12,023	24,317	33,992	10,451	20,965	2,038	5,079	533	-	-	-
2001	-	-	1,614	7,832	25,562	35,398	17,049	30,844	3,099	6,902	788	-	-	-
2002	-	-	1,268	5,796	18,714	26,135	7,071	18,912	1,399	2,141	511	-	-	-
2003	-	-	1,266	6,586	29,209	39,132	15,308	34,767	2,705	4,887	1,192	-	-	-

Labrador : SFAs 1,2&14B
Newfoundland: SFAs 3-14A
Gulf of St. Lawrence: SFAs 15-18
Scotia-Fundy: SFAs 19-23 (SFA 22 is not included as it does not produce 2SW salmon)
Quebec: Q1-Q11

Table 4.9.5.3. Estimated numbers of 1SW spawners in North America by geographic regions, 1971-2003.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy		USA	North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Mid-points
1971	29,032	111,448	85,978	199,463	9,338	14,007	18,714	35,529	4,800	12,810	29	147,891	373,287	260,589
1972	21,728	83,415	84,880	195,010	8,213	12,320	22,883	43,310	2,992	10,385	17	140,713	344,457	242,585
1973	0	11,405	108,785	253,965	10,987	16,480	26,468	51,224	8,658	18,715	13	154,911	351,802	253,356
1974	24,533	92,118	58,731	144,263	10,067	15,100	45,426	84,673	16,209	33,822	40	155,005	370,016	262,511
1975	49,688	183,837	78,882	191,775	11,606	17,409	40,108	74,913	18,232	28,608	67	198,582	496,608	347,595
1976	31,814	125,665	80,571	196,132	12,979	19,469	52,720	99,791	24,589	43,595	151	202,825	484,803	343,814
1977	28,815	112,337	75,762	186,149	12,004	18,006	13,339	27,572	16,704	34,231	54	146,679	378,350	262,514
1978	13,464	53,851	68,756	166,429	11,447	17,170	13,008	25,469	5,678	9,808	127	112,480	272,854	192,667
1979	17,825	72,682	76,233	183,991	15,863	23,795	28,073	57,265	18,577	36,754	247	156,817	374,732	265,774
1980	45,870	170,045	85,189	206,650	20,817	31,226	25,014	50,265	28,878	52,513	722	206,490	511,420	358,955
1981	49,855	187,471	110,755	268,677	30,952	46,428	37,218	77,324	18,236	42,948	1,009	248,026	623,858	435,942
1982	34,032	129,370	99,376	241,131	16,877	25,316	48,992	96,935	12,179	26,548	290	211,746	519,591	365,668
1983	19,360	78,689	77,514	187,796	12,030	18,045	12,821	24,669	7,747	15,969	255	129,726	325,423	227,574
1984	9,348	40,056	91,505	222,730	16,316	24,957	16,981	33,633	17,964	37,503	540	152,655	359,420	256,037
1985	19,631	76,462	85,179	207,175	15,608	25,140	37,301	73,871	18,158	40,731	363	176,240	423,742	299,991
1986	30,806	116,481	87,833	213,537	22,230	33,855	77,403	149,553	21,204	44,947	660	240,135	559,033	399,584
1987	37,572	144,917	104,096	232,991	25,789	40,481	56,009	110,287	21,589	45,407	1,087	246,141	575,169	410,655
1988	34,369	134,100	93,396	227,054	28,582	44,815	80,832	159,806	23,288	47,231	923	261,391	613,930	437,660
1989	22,429	90,212	41,798	102,199	24,710	37,319	42,161	81,697	23,873	48,578	1,080	156,051	361,086	258,568
1990	12,544	52,176	69,576	169,449	26,594	39,826	49,760	124,531	22,753	49,642	617	181,844	436,243	309,043
1991	10,526	42,647	44,023	108,779	20,582	30,433	36,475	87,038	13,814	25,610	235	125,655	294,741	210,198
1992	15,229	59,331	95,096	214,129	21,754	33,583	106,918	192,842	15,125	29,633	1,124	255,247	530,642	392,945
1993	22,499	78,251	107,816	242,217	17,493	27,444	50,042	169,880	11,539	22,252	444	209,834	540,487	375,160
1994	15,228	53,958	60,194	158,507	16,758	25,642	27,038	56,937	6,918	10,218	427	126,563	305,689	216,126
1995	22,144	73,575	134,676	268,934	14,409	21,548	21,202	46,851	12,114	19,697	213	204,758	430,818	317,788
1996	48,362	150,048	161,780	384,138	18,923	27,805	13,691	41,225	19,253	32,472	651	262,661	636,339	449,500
1997	64,049	153,200	93,841	167,720	14,724	22,210	7,109	25,768	6,143	9,428	365	186,232	378,692	282,462
1998	-	-	125,215	177,182	16,743	25,730	16,076	39,975	16,342	26,028	403	-	-	-
1999	-	-	138,692	190,317	18,969	28,808	15,010	32,343	10,177	16,516	419	-	-	-
2000	-	-	124,643	230,669	16,444	25,865	21,381	40,263	10,656	17,977	270	-	-	-
2001	-	-	111,756	169,106	10,829	16,974	21,064	43,166	6,449	11,414	266	-	-	-
2002	-	-	111,970	164,564	17,070	25,625	34,620	69,340	8,937	15,567	450	-	-	-
2003	-	-	122,742	206,433	15,406	23,222	19,952	43,210	6,571	11,891	237	-	-	-

Labrador : SFAs 1,2&14B
Newfoundland: SFAs 3-14A
Gulf of St. Lawrence: SFAs 15-18
Scotia-Fundy: SFAs 19-23 (SFA 22 is not included as it does not produce 2SW salmon)
Quebec: Q1-Q11

Table 4.9.5.4. Estimated numbers of 2SW spawners in North America by geographic regions, 1971-2003.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy		USA	North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Mid-points
1971	4,012	28,882	1,817	8,055	11,822	17,733	4,270	8,251	4,496	9,032	490	26,907	72,444	49,675
1972	3,435	24,812	2,008	8,240	23,160	34,741	17,768	33,012	7,459	12,699	1,038	54,868	114,541	84,705
1973	4,565	34,376	2,283	10,449	23,564	35,346	20,469	38,143	3,949	7,844	1,100	55,929	127,256	91,593
1974	4,490	33,475	1,510	5,942	28,657	42,985	31,661	57,942	9,526	15,979	1,147	76,991	157,470	117,231
1975	4,564	32,119	1,888	7,086	23,818	35,726	18,450	33,223	11,861	18,830	1,942	62,522	128,926	95,724
1976	4,984	36,701	2,011	7,198	22,653	33,980	14,787	29,709	11,045	18,337	1,126	56,608	127,051	91,829
1977	4,042	31,969	1,114	5,088	32,602	48,902	32,485	60,210	13,578	23,119	643	84,462	169,932	127,197
1978	3,361	25,490	1,557	5,712	29,889	44,834	11,446	22,859	6,517	11,428	3,314	56,085	113,637	84,861
1979	1,823	14,528	980	3,463	12,807	19,210	3,541	6,839	4,683	8,234	1,509	25,343	53,783	39,563
1980	4,633	34,525	1,888	6,925	35,594	53,390	19,884	37,673	14,270	25,628	4,263	80,533	162,404	121,468
1981	4,403	31,615	3,074	11,442	26,132	39,199	4,599	10,054	5,870	13,353	4,334	48,412	109,997	79,205
1982	3,081	23,127	2,579	8,481	26,492	39,738	10,965	20,363	5,656	11,335	4,643	53,416	107,687	80,551
1983	2,267	16,824	2,244	7,677	17,308	25,963	7,375	14,316	1,505	6,529	1,769	32,468	73,078	52,773
1984	1,478	11,822	2,063	6,800	22,345	32,659	15,308	27,285	14,245	23,650	2,547	57,986	104,763	81,374
1985	1,258	9,530	946	3,042	20,668	31,742	21,057	40,100	18,185	33,580	4,884	66,997	122,877	94,937
1986	2,177	16,334	1,575	5,198	24,088	35,939	32,682	65,210	15,435	30,120	5,570	81,526	158,371	119,949
1987	2,895	21,821	1,320	4,409	21,723	31,727	19,532	43,380	10,235	19,233	2,781	58,487	123,351	90,919
1988	1,625	13,452	1,540	5,033	25,390	38,343	23,296	45,055	9,074	18,381	3,038	63,963	123,303	93,633
1989	1,727	13,270	690	2,289	25,016	35,905	14,604	31,099	11,689	21,539	2,800	56,526	106,901	81,713
1990	923	7,493	1,327	4,372	24,422	36,219	21,030	48,457	9,688	18,245	4,356	61,745	119,142	90,443
1991	491	3,665	1,041	3,410	19,959	29,052	18,294	40,840	9,356	16,479	2,416	51,558	95,862	73,710
1992	2,012	14,889	3,057	10,474	19,337	28,833	28,297	56,620	8,725	15,280	2,292	63,720	128,388	96,054
1993	3,624	17,922	1,449	5,017	15,774	21,428	17,721	72,665	5,710	9,921	2,065	46,343	129,017	87,680
1994	5,339	23,981	1,368	5,024	15,631	21,147	18,718	40,940	3,682	6,093	1,344	46,082	98,529	72,305
1995	12,006	43,726	2,125	7,343	22,575	28,703	28,275	48,475	4,672	7,971	1,748	71,401	137,967	104,684
1996	8,838	32,395	2,824	8,605	19,010	25,421	15,946	34,250	6,507	11,242	2,407	55,532	114,320	84,926
1997	9,221	23,646	3,348	8,346	15,531	20,780	13,317	34,873	3,095	5,311	1,611	46,123	94,567	70,345
1998	-	-	4,195	8,674	14,240	19,439	6,710	24,074	2,424	5,663	1,526	-	-	-
1999	-	-	2,551	9,565	17,250	23,811	8,291	19,038	3,041	6,648	1,168	-	-	-
2000	-	-	1,829	11,781	16,128	23,331	8,833	19,060	1,855	4,877	1,587	-	-	-
2001	-	-	1,534	7,709	16,696	24,056	15,777	28,869	2,860	6,631	1,491	-	-	-
2002	-	-	1,175	5,586	12,467	17,787	6,926	18,708	1,233	1,949	511	-	-	-
2003	-	-	1,229	6,510	21,161	29,441	15,012	34,366	2,527	4,687	1,192	-	-	-

Labrador : SFAs 1,2&14B
Newfoundland: SFAs 3-14A
Gulf of St. Lawrence: SFAs 15-18
Scotia-Fundy: SFAs 19-23 (SFA 22 is not included as it does not produce 2SW salmon)
Quebec: Q1-Q11

Table 4.9.7.1 Run reconstruction data inputs for harvests used to estimate pre-fishery abundance of maturing and non-maturing 1SW salmon of North American origin (terms defined in Table 4.9.7.2).

	{1}			{1-7, 14b}		{8-14a}		{1-7, 14b}
1SW Year (i)	AH_Small (i)	AH_Large (i+1)	AH_Large (i)	H_Small (i)	H_Large (i)	H_Small (i)	H_Large (i+1)	H_Large (i+1)
1971	0	0	0	158896	199176	70936	42861	144496
1972	0	0	0	143232	144496	111141	43627	227779
1973	0	0	0	188725	227779	176907	85714	196726
1974	0	0	0	192195	196726	153278	72814	215025
1975	0	0	0	302348	215025	91935	95714	210858
1976	0	0	0	221766	210858	118779	63449	231393
1977	0	0	0	220093	231393	57472	37653	155546
1978	0	0	0	102403	155546	38180	29122	82174
1979	0	0	0	186558	82174	62622	54307	211896
1980	0	0	0	290127	211896	94291	38663	211006
1981	0	0	0	288902	211006	60668	35055	129319
1982	0	0	0	222894	129319	77017	28215	108430
1983	0	0	0	166033	108430	55683	15135	87742
1984	0	0	0	123774	87742	52813	24383	70970
1985	0	0	0	178719	70970	79275	22036	107561
1986	0	0	0	222671	107561	91912	19241	146242
1987	0	0	0	281762	146242	82401	14763	86047
1988	0	0	0	198484	86047	74620	15577	85319
1989	0	0	0	172861	85319	60884	11639	59334
1990	0	0	0	104788	59334	46053	10259	39257
1991	0	0	0	89099	39257	42721	0	32341
1992	0	0	0	24249	32341	0	0	17096
1993	0	0	0	17074	17096	0	0	15377
1994	0	0	0	8640	15377	0	0	11176
1995	0	0	0	7980	11176	0	0	7272
1996	0	0	0	7849	7272	0	0	6943
1997	0	2269	0	9753	6943	0	0	0
1998	2988	1084	2269	0	0	0	0	0
1999	2739	1352	1084	0	0	0	0	0
2000	5323	1673	1352	0	0	0	0	0
2001	4789	1437	1673	0	0	0	0	0
2002	5806	2189	1437	0	0	0	0	0
2003	6534	0	2189	0	0	0	0	0

Table 4.9.7.2 Definitions of key variables used in continental run-reconstruction models for North American salmon.

i	Year of the fishery on 1SW salmon in Greenland and Canada
M	Natural mortality rate (0.03 per month)
t1	Time between the mid-point of the Canadian fishery and return to river = 1 months
S1	Survival of 1SW salmon between the homewater fishery and return to river {exp(-M t1)}
H_s(i)	Number of “Small” salmon caught in Canada in year i; fish <2.7 kg
H_l(i)	Number of “Large” salmon caught in Canada in year i; fish >=2.7 kg
AH_s	Aboriginal and resident food harvests of small salmon in northern Labrador
AH_l	Aboriginal and resident food harvest of large salmon in northern Labrador
f_imm	Fraction of 1SW salmon that are immature, i.e. non-maturing: range = 0.1 to 0.2
af_imm	Fraction of 1SW salmon that are immature in native and resident food fisheries in N Lab
q	Fraction of 1SW salmon present in the large size market category; range = 0.1 to 0.3
MC1(i)	Harvest of maturing 1SW salmon in Newfoundland and Labrador in year i
i+1	Year of fishery on 2SW salmon in Canada
MR1(i)	Return estimates of maturing 1SW salmon in Atlantic Canada in year i
NN1(i)	Pre-fishery abundance of non-maturing 1SW + maturing 2SW salmon in year i
NR(i)	Return estimates of non-maturing + maturing 2SW salmon in year i
NR2(i+1)	Return estimates of maturing 2SW salmon in Canada
NC1(i)	Harvest of non-maturing 1SW salmon in Nfld + Labrador in year i
NC2(i+1)	Harvest of maturing 2SW salmon in Canada
NG(i)	Catch of 1SW North American origin salmon at Greenland
S2	Survival of 2SW salmon between Greenland and homewater fisheries
MN1(i)	Pre-fishery abundance of maturing 1SW salmon in year i
RFL1	Labrador raising factor for 1SW used to adjust pre-fishery abundance
RFL2	Labrador raising factor for 2SW used to adjust pre-fishery abundance

Table 4.9.7.3 Run reconstruction data inputs used to estimate pre-fishery abundance of non-maturing (NN1) 1SW salmon of North American origin (terms defined in Table 4.9.7.2).

1SW Year (i)	NG1 (i)	NC1 min (i)	max (i)	NC2 min (i+1)	max (i+1)	NR2 min (i+1)	max (i+1)	NN1 min (i)	max (i)	mid-point (i)
1971	287672	17881	43730	144008	172907	102328	182881	642279	819184	730732
1972	200784	15768	37316	203072	248628	104600	197158	636167	847954	742060
1973	241493	21150	51412	223422	262767	146045	254771	767376	1001982	884679
1974	220584	21187	50243	223332	266337	121200	210860	711821	923643	817732
1975	278839	32385	73371	243315	285486	116541	212240	801769	1032796	917282
1976	155896	24285	57005	225424	271703	162533	280963	710550	970471	840510
1977	189709	24323	57902	146535	177644	117247	200555	574920	766372	670646
1978	118853	11796	29813	86644	103079	55860	97440	325305	423344	374325
1979	200061	19478	42242	202634	245013	167121	285189	725526	969725	847626
1980	187999	31132	70739	186367	228568	112144	199921	626689	845357	736023
1981	227727	31000	70441	125578	151442	116222	196049	589902	775292	682597
1982	194715	23583	52338	104116	125802	95462	162540	491624	642955	567290
1983	33240	17688	39712	76554	94103	90298	143743	279866	399920	339893
1984	38916	13255	30019	74062	88256	99657	162218	290764	413708	352236
1985	139233	18582	40002	97329	118841	119379	204912	455247	624679	539963
1986	171745	23343	50988	121610	150859	94223	167036	490306	658712	574509
1987	173687	29639	65127	74996	92205	100134	167646	443842	596469	520156
1988	116767	20709	44860	75300	92364	86602	143493	359581	485900	422740
1989	60693	18139	39691	53173	65040	91207	154201	277474	402667	340070
1990	73109	11072	24518	37739	45590	81415	131401	248369	341942	295155
1991	110680	9302	20175	22639	29107	95174	166171	282926	401284	342105
1992	41855	2748	6790	11967	15386	70106	157208	158272	288085	223179
1993	0	1878	4441	10764	13839	70947	128754	115094	202214	158654
1994	0	1018	2651	7823	10058	94984	166871	143698	248340	196019
1995	21341	910	2267	5090	6545	78898	143097	138867	231486	185177
1996	21944	858	2006	4860	6249	65326	118034	120228	196567	158398
1997	16814	1045	2367	1588	2269	41340	74920	80488	155420	117954
1998	3026	161	367	759	1084	42138	72393	65806	133135	99470
1999	5374	142	306	946	1352	39362	72593	64346	136235	100291
2000	5571	273	573	1171	1673	48112	81764	77772	153450	115611
2001	9722	248	529	1006	1437	28963	53494	53696	107214	80455
2002	2263	297	624	1532	2189	49680	86564	77291	159558	118425
2003	2724	338	719	0	0	0	0	3062	3443	3252

Table 4.9.7.4 Run reconstruction data inputs and estimated pre-fishery abundance for maturing (MN1) 1SW salmon (grilse) of North American origin (terms defined in Table 4.9.7.2).

1SW Year (i)	MC1 min (i)	max (i)	MR1 min (i)	max (i)	MN1 min (i)	max (i)	mid-point (i)
1971	213987	267720	205241	441490	425478	722655	574067
1972	237286	279064	198161	415112	441483	706818	574150
1973	346109	408260	224693	435128	577645	856639	717142
1974	322772	379370	221481	449011	550998	842055	696527
1975	351015	422105	268633	578358	627830	1018077	822953
1976	313060	375300	299942	603716	622137	997402	809769
1977	252058	318032	223959	469250	482838	801573	642205
1978	132546	172340	169117	339195	306813	521865	414339
1979	218442	252711	232923	466976	458459	733909	596184
1980	343344	412617	296929	617103	649316	1048513	848915
1981	308670	377651	362724	762155	682441	1163018	922729
1982	265678	312538	307011	633938	582039	965782	773910
1983	197184	234389	192826	398233	395882	644750	520316
1984	158852	187900	230907	447943	396791	649485	523138
1985	227928	259284	258250	519444	494043	794548	644295
1986	278654	321357	339715	677730	628714	1019727	824221
1987	319510	375472	328698	674466	658218	1070479	864349
1988	240291	276488	374529	749850	626226	1049175	837700
1989	205998	239495	231063	454347	444099	707679	575889
1990	134630	156382	274918	532713	417921	705319	561620
1991	117141	133509	185437	356964	308225	501344	404784
1992	21986	30556	346344	621764	378878	671255	525067
1993	15027	19983	282284	615107	305908	653822	479865
1994	8142	11928	198375	381912	212559	405471	309015
1995	7278	10200	277321	505537	293044	531133	412088
1996	6861	9028	347737	726005	365188	757143	561166
1997	8358	10652	239806	434500	255467	458385	356926
1998	3054	3302	221202	316828	240232	522400	381316
1999	2705	2758	227997	313803	247152	516900	382026
2000	5185	5156	221953	364094	243254	601695	422474
2001	4708	4762	194823	286060	213683	473448	343566
2002	5652	5613	224093	326299	246033	540229	393131
2003	6415	6472	204044	323044	225340	535754	380547

Table 4.9.7.5. Smolt age distributions in six stock areas of North America used to weight forward the spawning escapement in the current year to the year of the non-maturing 1SW component in the Northwest Atlantic.

	Smolt age (years)					
Stock area	1	2	3	4	5	6
Labrador	0.0	0.0	0.077	0.542	0.341	0.040
Newfoundland	0.0	0.041	0.598	0.324	0.038	0.0
Québec	0.0	0.058	0.464	0.378	0.089	0.010
Gulf of St. Lawrence	0.0	0.398	0.573	0.029	0.0	0.0
Scotia-Fundy	0.0	0.600	0.394	0.006	0.0	0.0
USA, 1971-1989	0.377	0.520	0.103	0.0	0.0	0.0
USA, 1990-2003	0.6274	0.3508	0.0218	0.0	0.0	0.0

Table 4.9.7.6 The mid-point of 2SW spawners and lagged spawners for North America and to each of the geographic areas. Lagged refers to the allocation of spawners to the year in which they would have contributed to the year of prefishery abundance.

	North America		Prefishery	Recruits/	Labrador (L)		Newfoundland (N)		Quebec (Q)		Gulf of St. Lawrence (G)		Scotia-Fundy (S)		USA (US)	
Year	Total 2SW spawners	Lagged 2SW spawners	abundance recruits	2SW lagged spawner	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged
1971	33229		730732		16447		4936		14777		6261		6764		490	
1972	70581		742060		14124		5124		28951		25390		10079		1038	
1973	72122		884679		19470		6366		29455		29306		5896		1100	
1974	98248		817732		18982		3726		35821		44802		12752		1147	
1975	77383		917282		18341		4487		29772		25836		15345		1942	
1976	70987		840510		20842		4605		28316		22248		14691		1126	
1977	109191		670646		18006		3101		40752		46347		18348		643	
1978	70436	95524	374325	3.92	14425	14759	3635	5802	37362	28128	17152	35360	8973	10034	3314	1442
1979	31387	107013	847626	7.92	8175	17486	2221	4664	16008	32232	5190	36809	6459	14270	1509	1553
1980	101889	96086	736023	7.66	19579	18903	4406	4316	44492	31940	28779	24963	19949	14937	4263	1029
1981	61196	104065	682597	6.56	18009	18795	7258	4472	32666	30266	7327	31944	9612	16888	4334	1699
1982	67448	107269	567290	5.29	13104	19695	5530	3661	33115	34821	15664	34034	8496	12699	4643	2358
1983	43227	82167	339893	4.14	9546	18710	4961	3440	21636	36526	10845	13244	4017	7514	1769	2733
1984	74725	79786	352236	4.41	6650	15422	4432	2801	27502	28065	21296	14925	18947	14569	2547	4006
1985	89543	85392	539963	6.32	5394	11576	1994	3786	26205	32359	30578	19559	25882	13668	4884	4443
1986	110693	80959	574509	7.10	9255	15361	3386	6075	30013	35728	48946	11269	22777	8998	5570	3528
1987	78561	78592	520156	6.62	12358	17772	2865	6023	26725	33119	31456	13506	14734	5813	2781	2359
1988	86094	79004	422740	5.35	7538	14762	3287	5209	31866	27538	34176	15145	13728	13002	3038	3347
1989	74215	93796	340070	3.63	7498	10875	1490	4544	30461	25762	22851	24688	16614	23026	2800	4901
1990	86236	102732	295155	2.87	4208	7799	2850	2951	30320	26580	34744	37620	13966	23978	4356	3805
1991	71632	99735	342105	3.43	2078	6285	2225	2953	24506	28072	29567	41457	12917	17965	2416	3003
1992	87603	89423	223179	2.50	8451	8072	6765	3018	24085	28227	42459	33050	12002	14173	2292	2883
1993	76907	92185	158654	1.72	10773	10649	3233	3080	18601	29616	45193	29594	7816	15464	2065	3781
1994	57646	88099	196019	2.22	14660	9247	3196	2178	18389	30646	29829	27915	4888	15007	1344	3105
1995	76818	88063	185177	2.10	27866	7453	4734	2400	25639	30138	38375	32341	6322	13350	1748	2381
1996	64310	84548	158398	1.87	20617	5299	5714	2585	22216	27289	25098	34850	8875	12373	2407	2152
1997	53912	87352	117954	1.35	16434	3511	5847	5004	18155	24550	24095	43176	4203	9493	1611	1618
1998	44236	78632	99470	1.27		6285	6435	4337	16839	21312	15392	39005	4044	6080	1526	1613
1999	46266	74389	100291	1.35		9930	6058	3404	20531	19459	13665	33680	4845	5764	1168	2152
2000	45435	82958	115611	1.39		14098	6805	4219	19730	22055	13947	32847	3366	7845	1587	1893
2001	53557	83042	80455	0.97		22118	4622	5307	20376	22898	22323	25088	4746	6056	1491	1575
2002	33427	74697	118425	1.59		22527	3381	5786	15127	20286	12817	20664	1591	4133	511	1303
2003	58658						3870	6202	25301	18121	24689	14960	3607	4525	1192	1439
2004								6202		18894		13829		3952		1518
2005								6460		19796		17273		4202		878
2006								5331		19806		18299		2844		960

Spawners lagged by:

Labrador = 0.0768 x i-5 spawners + 0.542 x i-6 + 0.341 x i-7 + 0.0401 x i-8

Newfoundland = 0.0408 x i-4 spawners + 0.5979 x i-5 + 0.3237 x i-6 + 0.0375 x i-7

Quebec = 0.0577 x i-4 spawners + 0.4644 x i-5 + 0.3783 x i-6 + 0.0892 x i-7 + 0.0104 x i-8

Gulf = 0.3979 x i-4 spawners + 0.5731 x i-5 + 0.0291 x i-6

Scotia-Fundy = 0.6002 x i-4 spawners + 0.3942 x i-5 + 0.0055 x i-6

USA = 0.3767 x i-3 spawners + 0.520 x i-4 + 0.1033 x i-5, 1971-1989

& 0.6274 x i-3 spawners + 0.3508 x i-4 + 0.0218 x i-5, 1990-2003.

Table 4.12.1.1. Records of Atlantic salmon catches by the Department of Fisheries and Oceans (Canada) observer program.

Date	Gear	Main Species Caught	Long.	Lat.	Salmon Catch (kg)
18/09/1978	Bottom otter trawl (side)	RESERVED	66.45	42.05	16
16/05/1980	Bottom otter trawl (stern)	RESERVED	50.03	44.25	3
24/05/1981	Bottom otter trawl (stern)	SILVER HAKE	62.68	42.87	2
02/05/1982	Bottom otter trawl (stern)	COD(ATLANTIC)	57.85	44.80	10
02/05/1982	Bottom otter trawl (stern)	COD(ATLANTIC)	58.00	44.65	25
20/02/1985	Bottom otter trawl (stern)	COD(ATLANTIC)	59.03	44.38	20
31/10/1987	Longline (type unspecified)	BIGEYE TUNA	60.55	42.35	20
15/04/1989	Bottom otter trawl (stern)	SILVER HAKE	62.08	42.98	20
19/05/1998	Dredge (boat)	SEA SCALLOP	67.13	44.10	20
02/06/1991	Bottom otter trawl (stern)	SILVER HAKE	64.15	42.73	3
27/05/1991	Bottom otter trawl (stern)	SILVER HAKE	59.33	43.67	3
27/05/1991	Bottom otter trawl (stern)	RESERVED	59.91	43.57	5
27/05/1991	Bottom otter trawl (stern)	SILVER HAKE	59.95	43.57	2
16/04/1993	Bottom otter trawl (stern)	SILVER HAKE	60.43	43.43	4
14/06/1993	Midwater trawl (stern)	REDFISH (UNSEP.)	57.78	45.55	3

Table 4.12.1.2. Number of Trips Reported in VTR dataset by gear, area, and month (2000 – 2003).

Purse Seine

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
511						4	12	19	12	10	1		58
512		1		9	21	123	248	260	206	109	18		995
513				23	51	62	33	45	26	40	14		294
514							4	2	2				8
515					4	1	1						6
521						1	5	5	11				22
526								1					1
612						34	67	12					113
614						39	71	96	47	20			273
615						1							1
621					2	42	38	101	90	67			340
Total		1		32	78	307	479	541	394	246	33		2111

Midwater Trawl

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
511						5	3	4	8	2			22
512					12	82	78	63	64	30	3		332
513	8	3	19	78	210	319	274	239	140	161	36	1	1488
514	23	40	38	34	19		3	9	1	45	86		298
515					9	1	8	2	2	2	15		39
521	21	9	10	9					4	7	100	78	238
522	3		4	6	12	20	126	107	148	38	5		469
523							3						3
525				1	1				3	2			7
533	1												1
537	6	18	45	7	2				1		6	4	89
539	162	74	19						1			38	294
543				1									1
561					4		43	38	52	38			175
611	12												12
612	33	41	20	1									95
613	124	160	68	17				1	1			5	376
614			1					3				1	5
615	43	39	18	5								2	107
616	1	19	62	17							1		100
621	1	3	8	5	2	2	2	6	1	8		5	43
622	2	10	9	7	1	4	5	3	2				43
625		3											3
626		2	4	2		4		3		2	1	1	19
630	1												1
631	1	3	2							1	3	1	11
632	3	4	3			2						1	13
635	9	31	7							6	3	3	59
639		1											1
Total	454	460	337	190	272	439	545	478	428	342	259	140	4344

Table 4.12.1.3. Commercial landings (mt) of Atlantic salmon from the ZIF (Canada) database by main species caught and gear type. Only records with known vessel numbers were included in the query.

	Gear	Type			
Main species caught	gillnet	handline	rod+reel	trap	Total
code-0 (NA)	286.147				286.147
cod	48.15			0.049	48.199
rock cod	0.056				0.056
halibut	0.474				0.474
plaice	0.042	0.181			0.223
yellowtail	0.534				0.534
winter flounder	0.084				0.084
turbot	0.022				0.022
white hake	0.031				0.031
herring	7.379				7.379
Atlantic salmon	637.387	3.446	0.045	0.266	641.144
shad	0.006				0.006
smelt	0.033	0.235			0.268
trout	1.659	0.018			1.677
silverside	0.030				0.03
winkle				0.123	0.123
missing	0.145				0.145
Total	982.179	3.88	0.045	0.438	986.542

Figure 4.9.2.1. Map of Salmon Fishing Areas (SFAs) and Quebec Management Zones (Qs) in Canada.

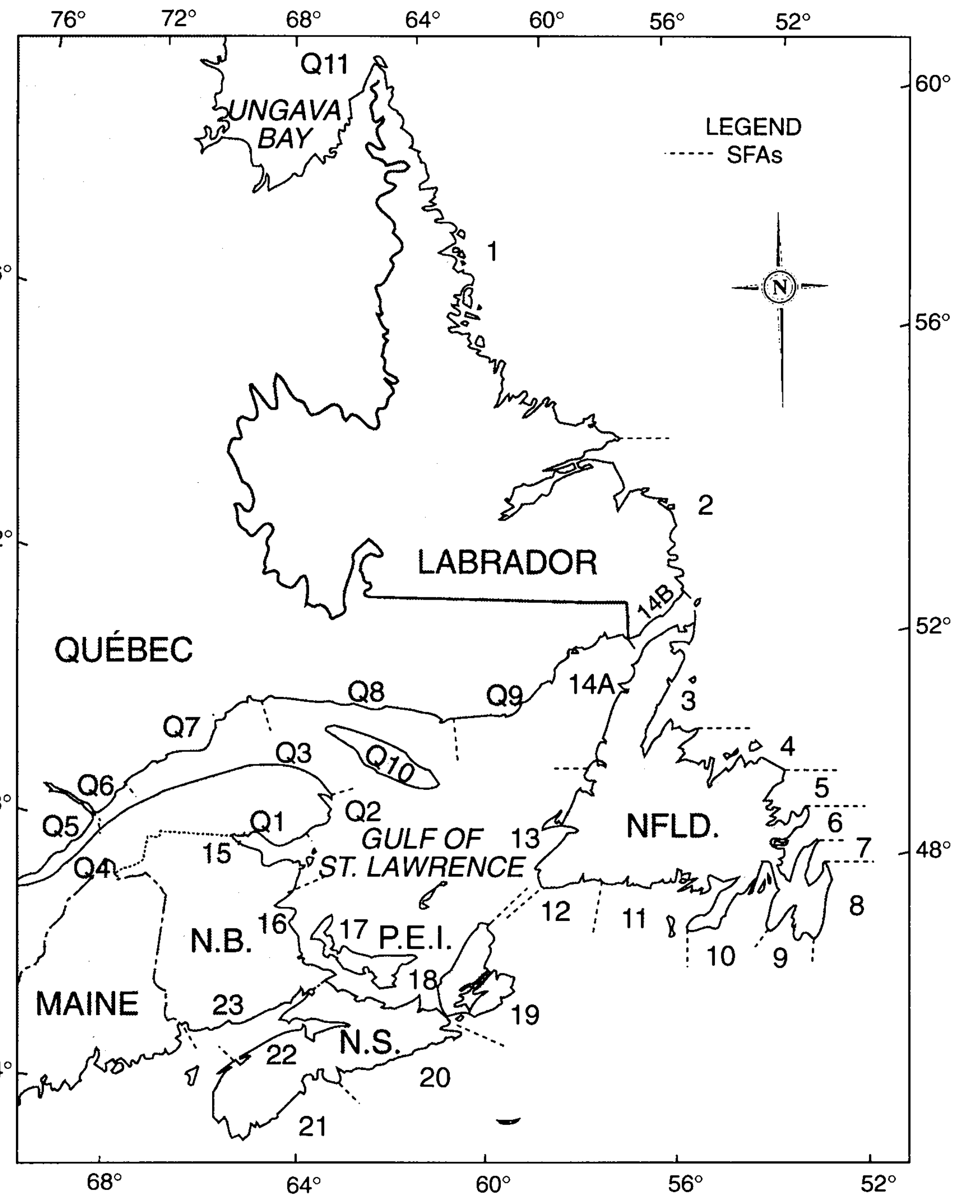


Figure 4.9.2.2. Summary of recreational fisheries management in eastern Canada and Maine (U.S.A.) during 2003.

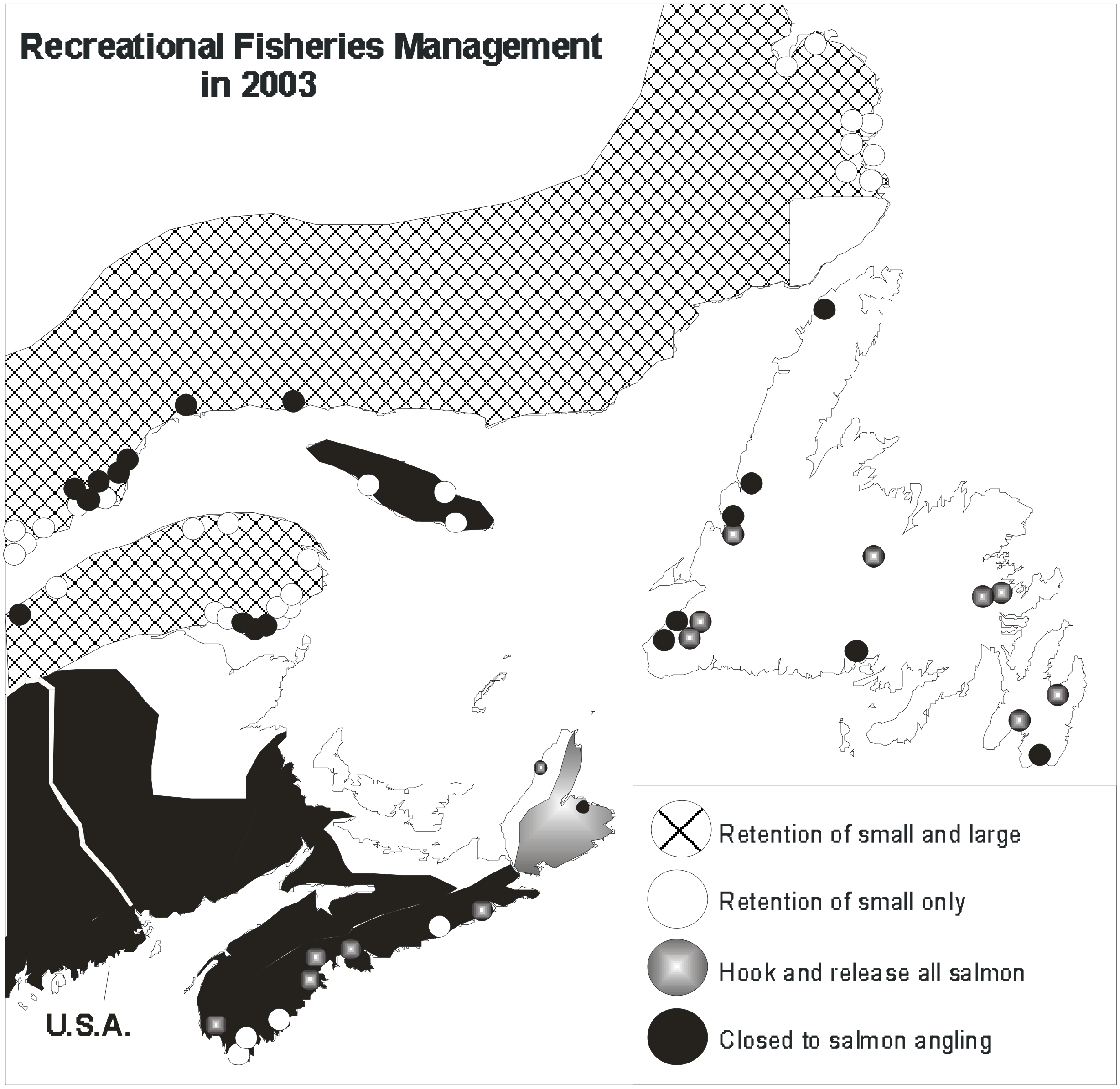


Figure 4.9.3.1. Harvest (t) of small salmon, large salmon, and combined in Canada, 1960-2003 by all users.

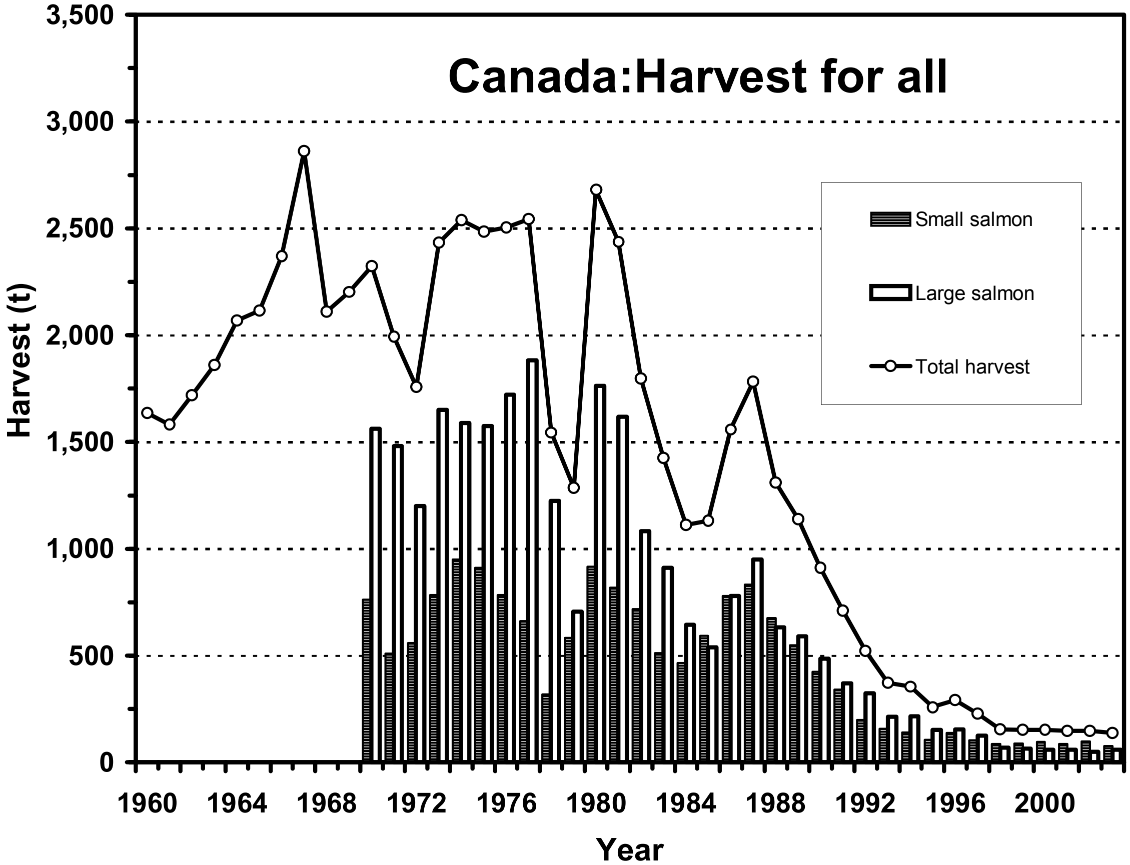


Figure 4.9.3.2. Harvest (number) of small and large salmon and both sizes combined in the recreational fisheries of Canada, 1974 to 2003.

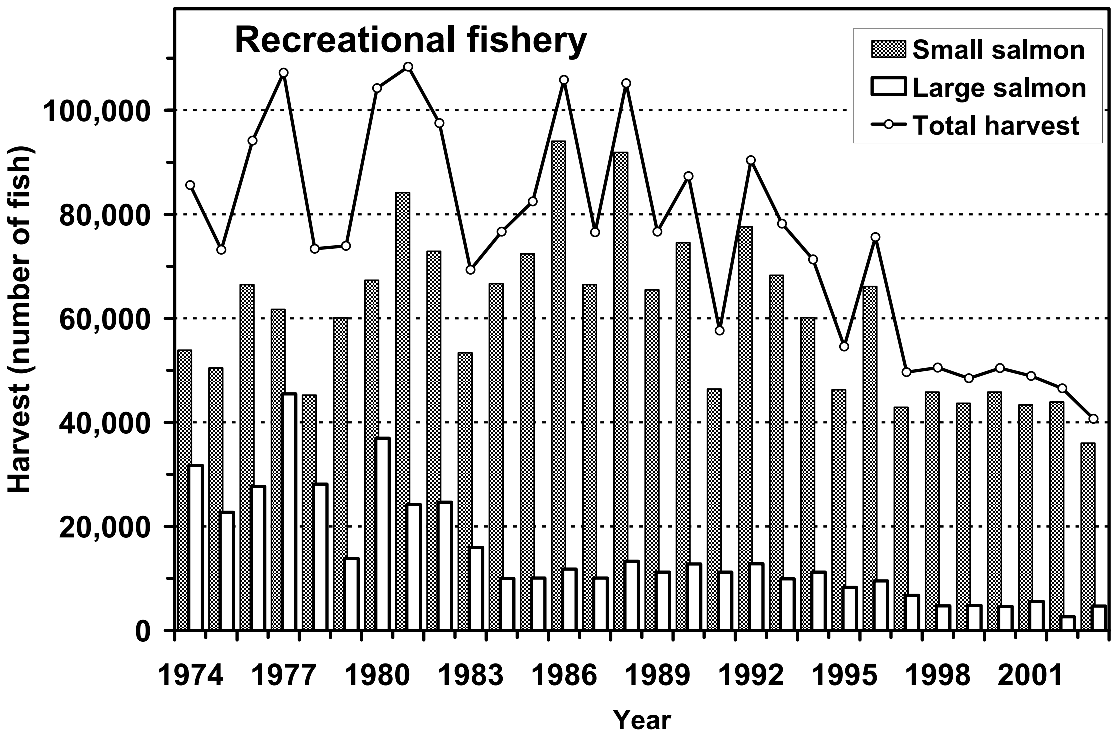


Figure 4.9.4.1. Origin (wild, hatchery, farmed) of Atlantic salmon returning to monitored rivers of eastern North America in 2003.

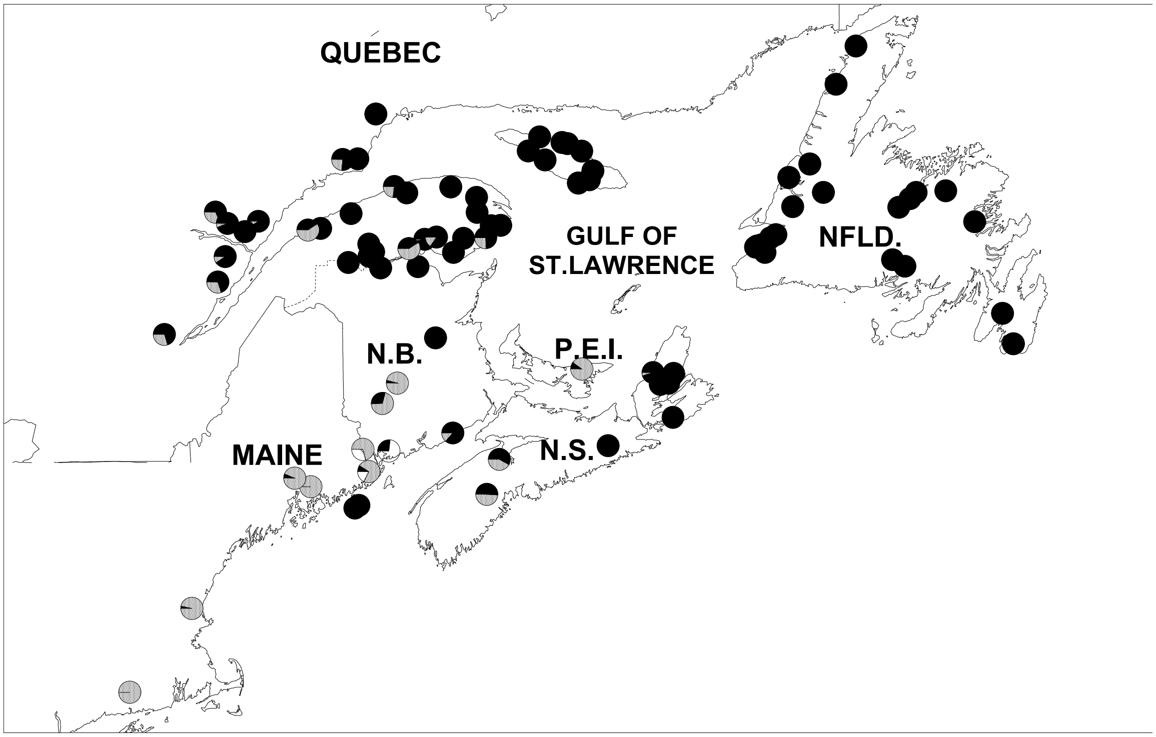


Figure 4.9.5.1. In-river returns of small salmon and large salmon for 21 monitored rivers in four geographic areas of eastern Canada from 1985 to 2003. The in-river returns do not account for removals in marine fisheries. Rivers by area are: Newfoundland (Conne, Exploits, Middle Brook, Northeast Trepassey, Torrent, Western Arm Brook), Québec (Bonaventure, Cascapédia, Port-Daniel Nord, Grande Rivière, St-Jean, York, Dartmouth, Madeleine, Matane, de la Trinité), Gulf (Restigouche, Miramichi, Margaree), and Scotia-Fundy (LaHave, Saint John at Mactaquac).

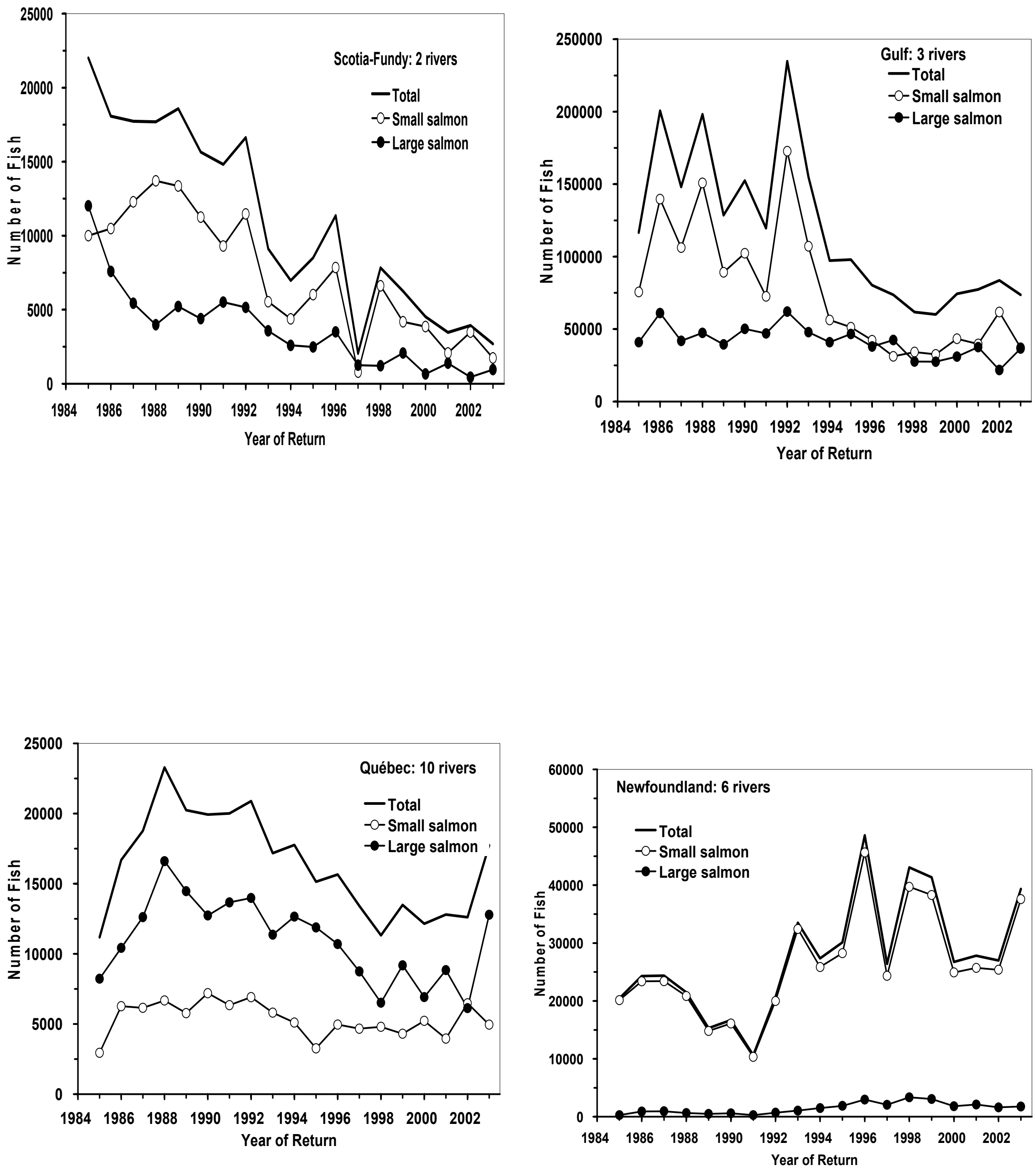


Figure 4.9.5.2. Wild smolt production from twelve rivers of eastern Canada and one river of Eastern USA, 1971 to 2003. Smolt production is expressed relative to the conservation egg requirements for each river (smolt output / conservation egg requirements).

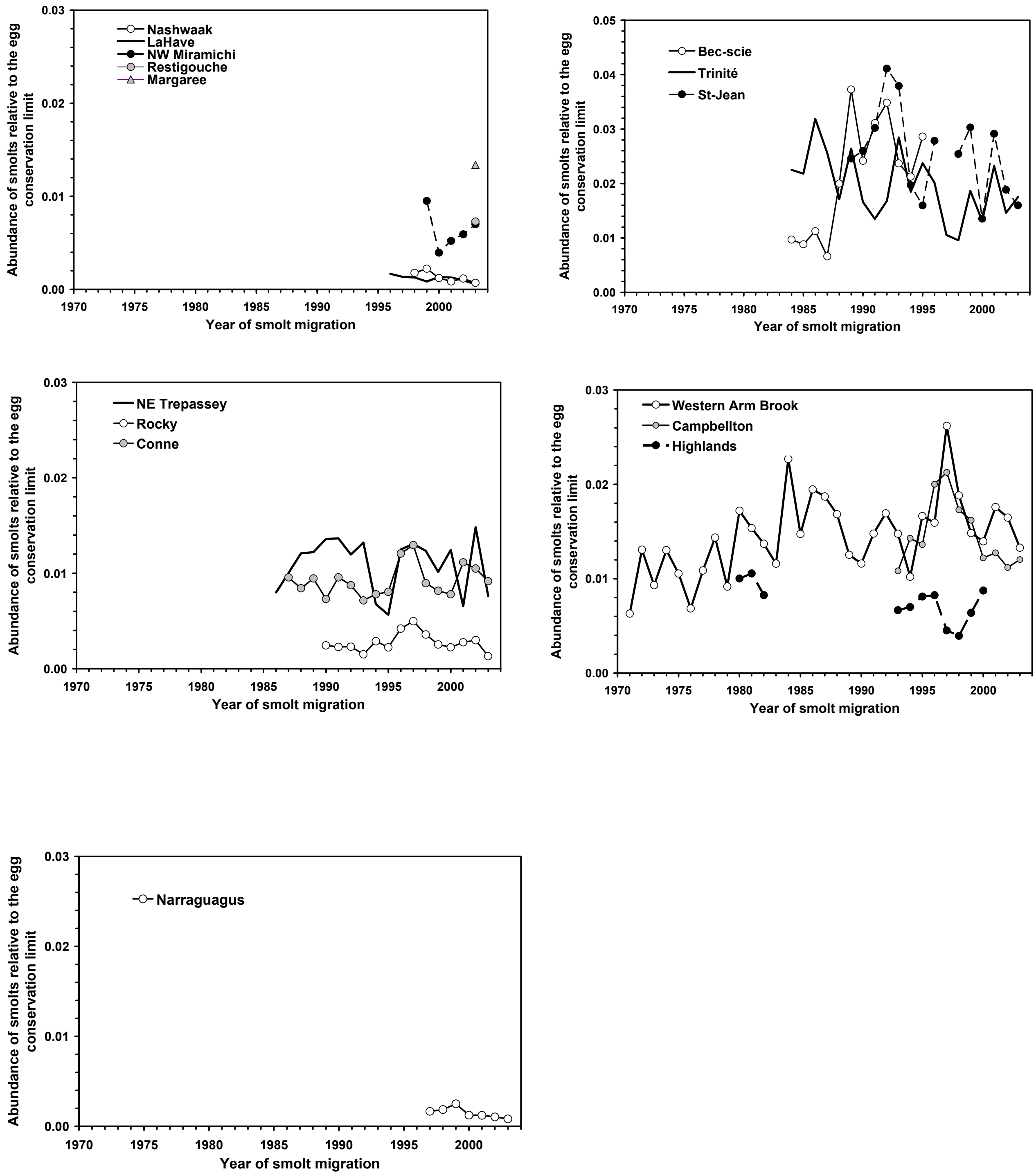


Figure 4.9.5.3 Atlantic salmon juvenile densities in eight rivers of the Maritime provinces (Restigouche SFA 15; Margaree SFA 18; Miramichi SFA 16; St. Mary's SFA 20; Nashwaak and upstream of Mactaquac, Saint John River SFA 23) and the United States (Narraguagus).

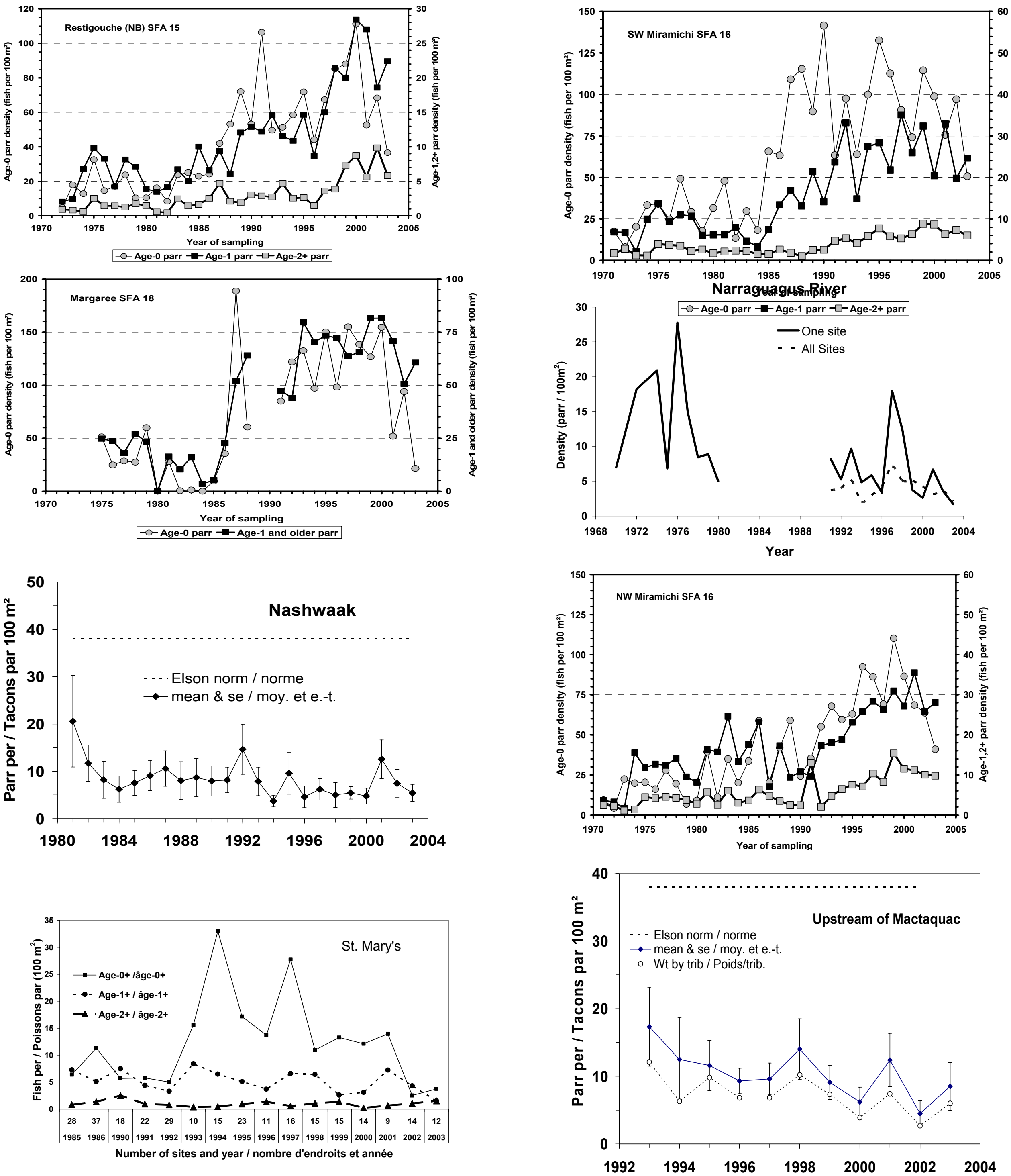


Figure 4.9.5.4. Documented returns of Atlantic salmon to USA rivers, 1967 to 2003. Natural refers to fry stocked or wild individuals.

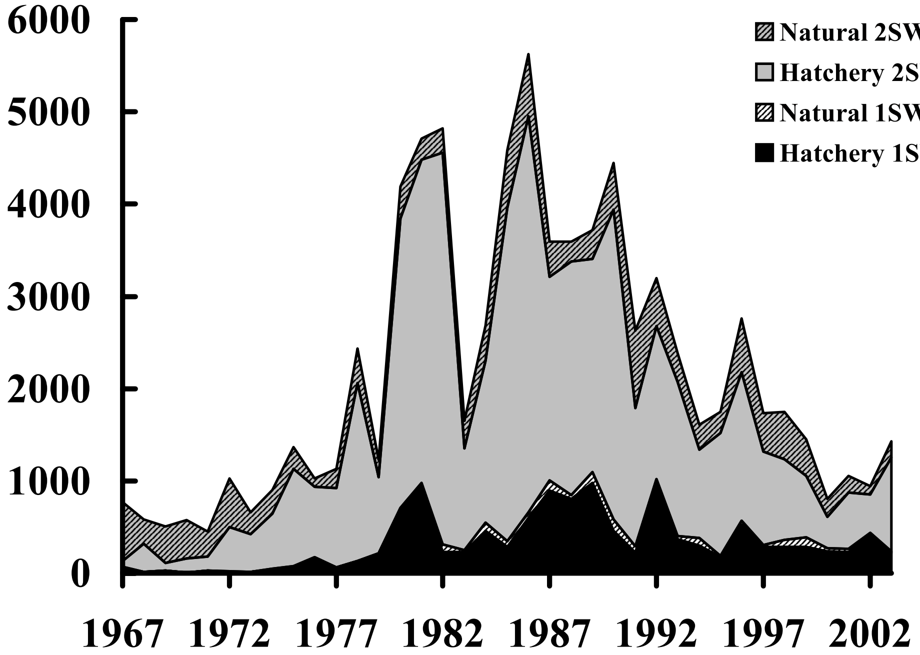


Figure 4.9.5.5 Comparison of estimated mid-points of 1SW returns to and 1SW spawners in rivers of six geographic areas in North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

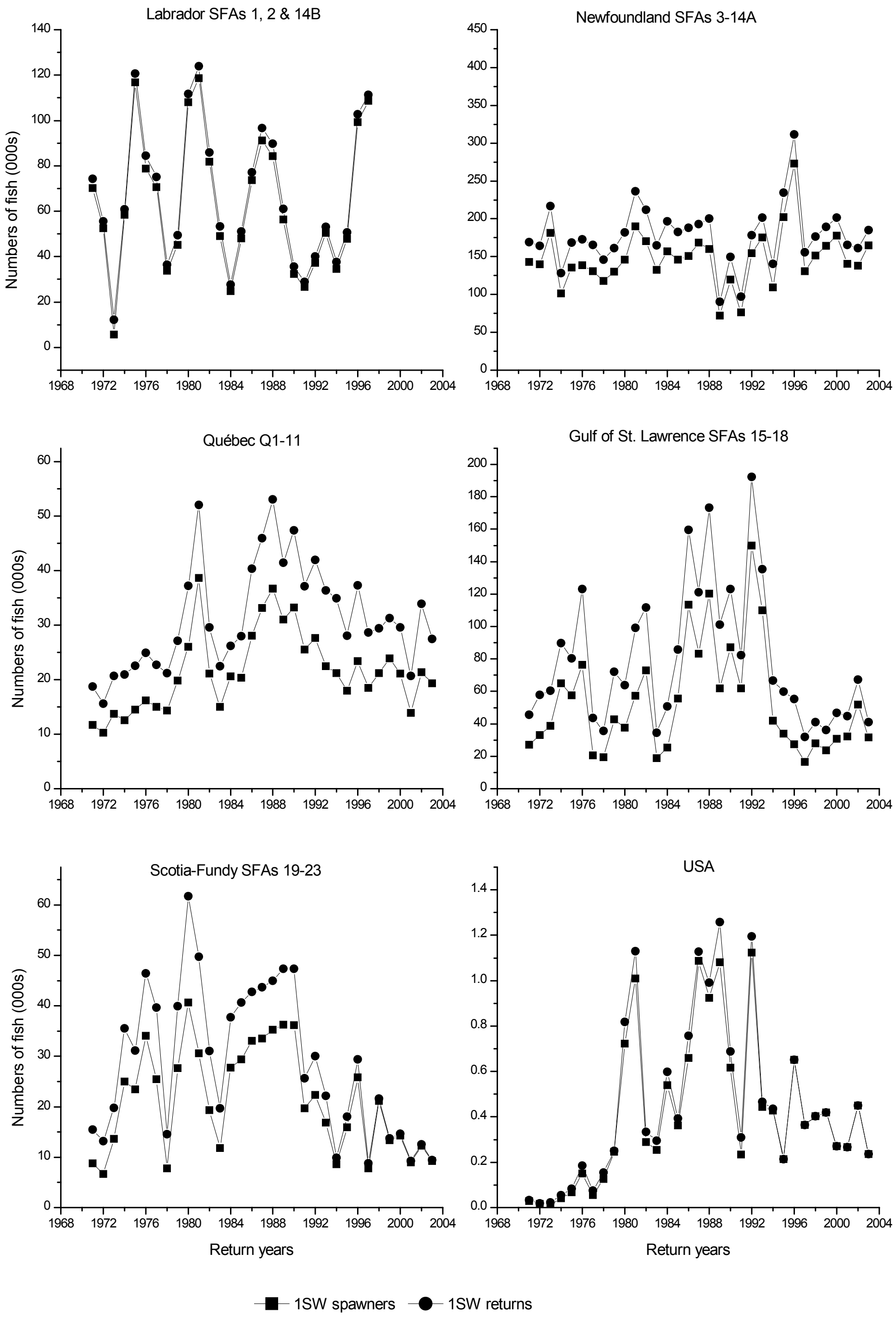


Figure 4.9.5.6 Comparison of estimated mid-points of 2SW returns, 2SW spawners, and 2SW conservation requirements for six geographic areas in North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

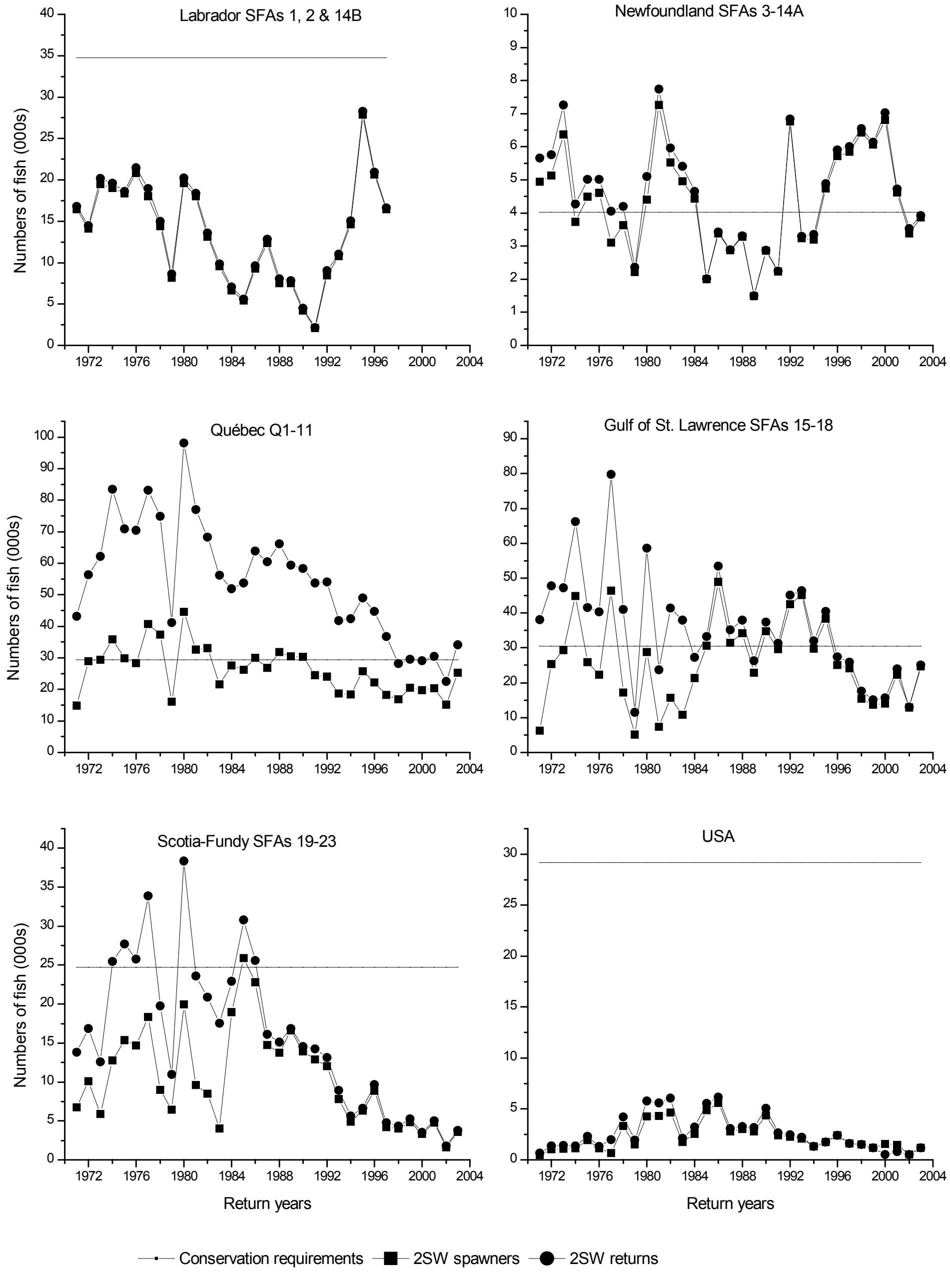


Fig. 4.9.7.1. Prefishery abundance estimate of maturing and non-maturing salmon in North America. Open symbols are for the years that returns to Labrador were assumed as a proportion of returns to other areas in North America.

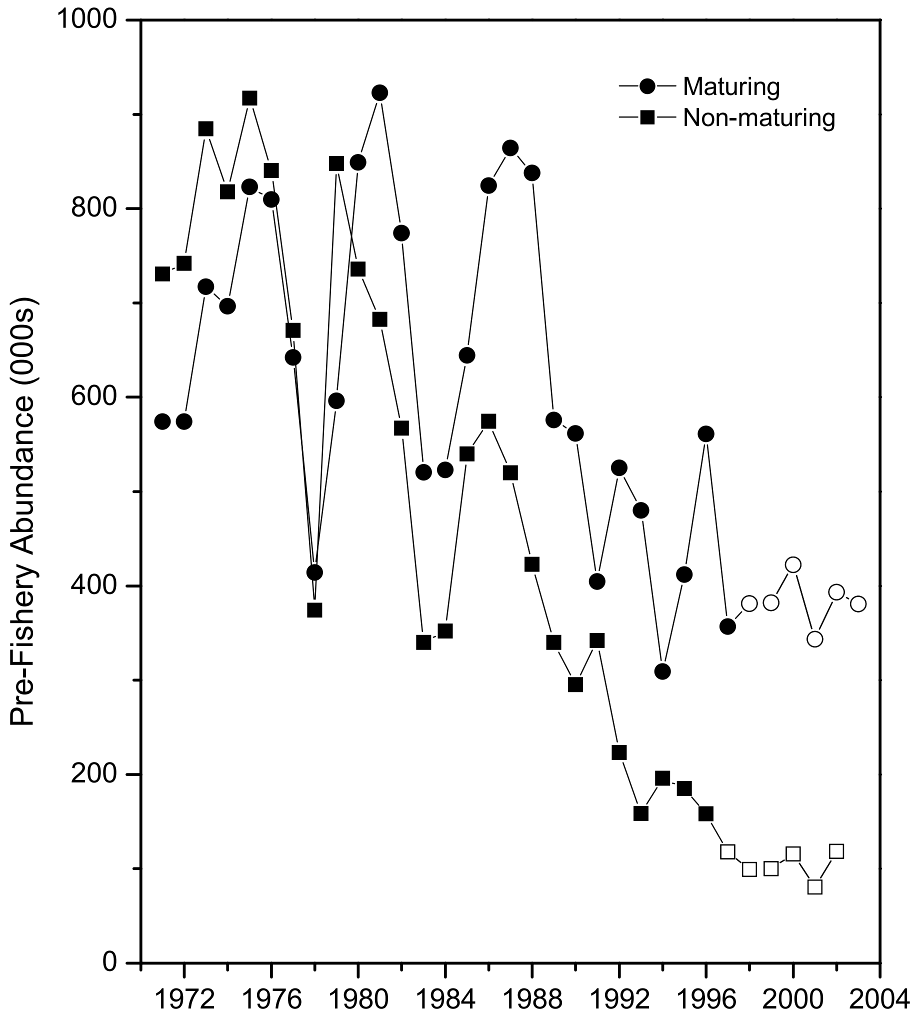


Fig. 4.9.7.2 Total 1SW recruits (non-maturing and maturing) originating in North America.

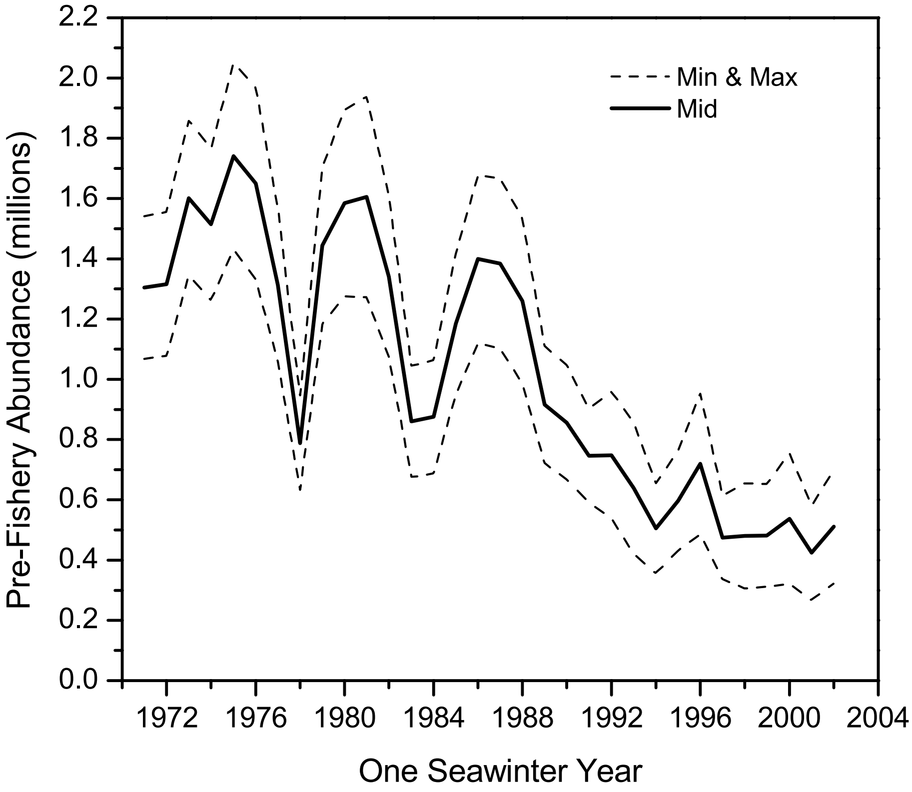


Figure 4.9.7.3 Top panel: comparison of estimated potential 2SW production prior to all fisheries, 2SW recruits available to North America, 1971-2002 and 2SW returns and spawners for 1971-97, as 1998-2003 data for Labrador are unavailable. The horizontal line indicates the 2SW conservation limits. Bottom panel: comparison of potential maturing 1SW recruits, 1971-2003 and returns and 1SW spawners for 1971-97 return years as Labrador data for 1998-2003 are unavailable.

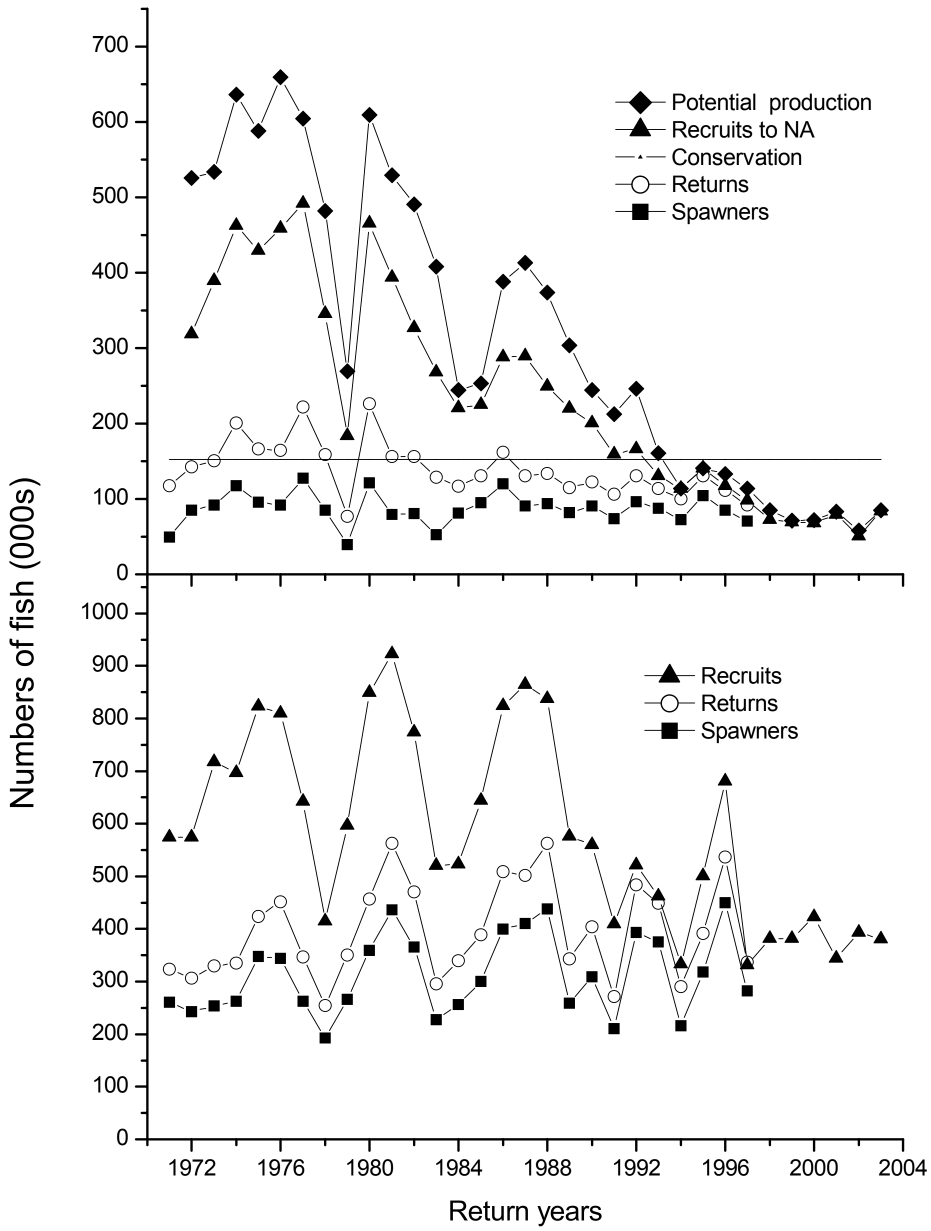


Fig. 4.9.7.4. Midpoints of lagged spawners (solid circles) and estimated annual spawners (open circles) as contribution to potential recruitment in the year of prefishery abundance (PFA) for six geographic areas of North America. The horizontal line represents the spawning requirement (in terms of 2SW fish) in each geographic area. Labrador spawner numbers not available after 2002 or for 1977.

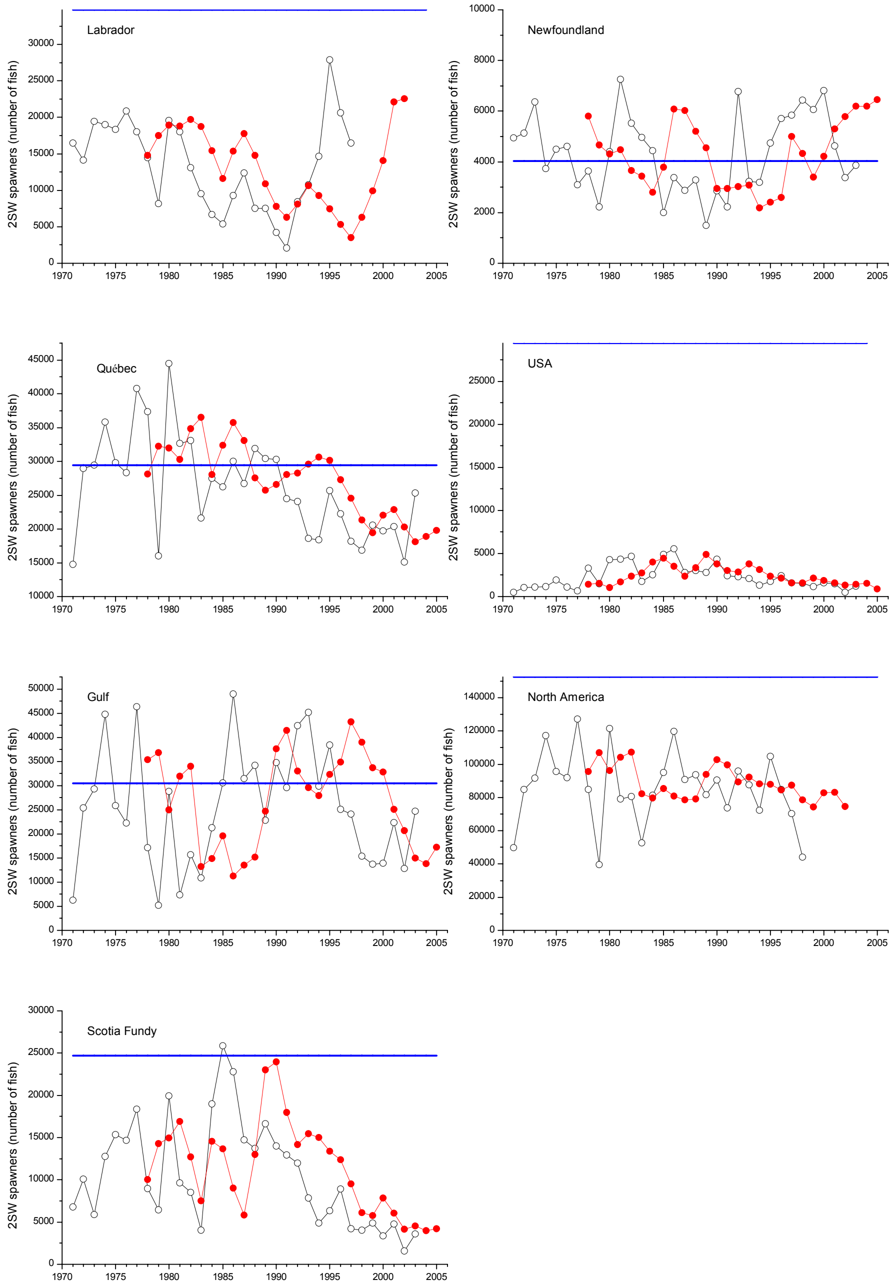


Fig. 4.9.7.5. Proportion of spawners (mid-points) lagged to year of PFA (solid circles) and as returns to rivers (open circles) in six geographic areas of North America relative to the total lagged spawner or annual spawning escapement to North America. The horizontal line represents the theoretical spawner proportions for each area based on the 2SW spawner requirement for North America.

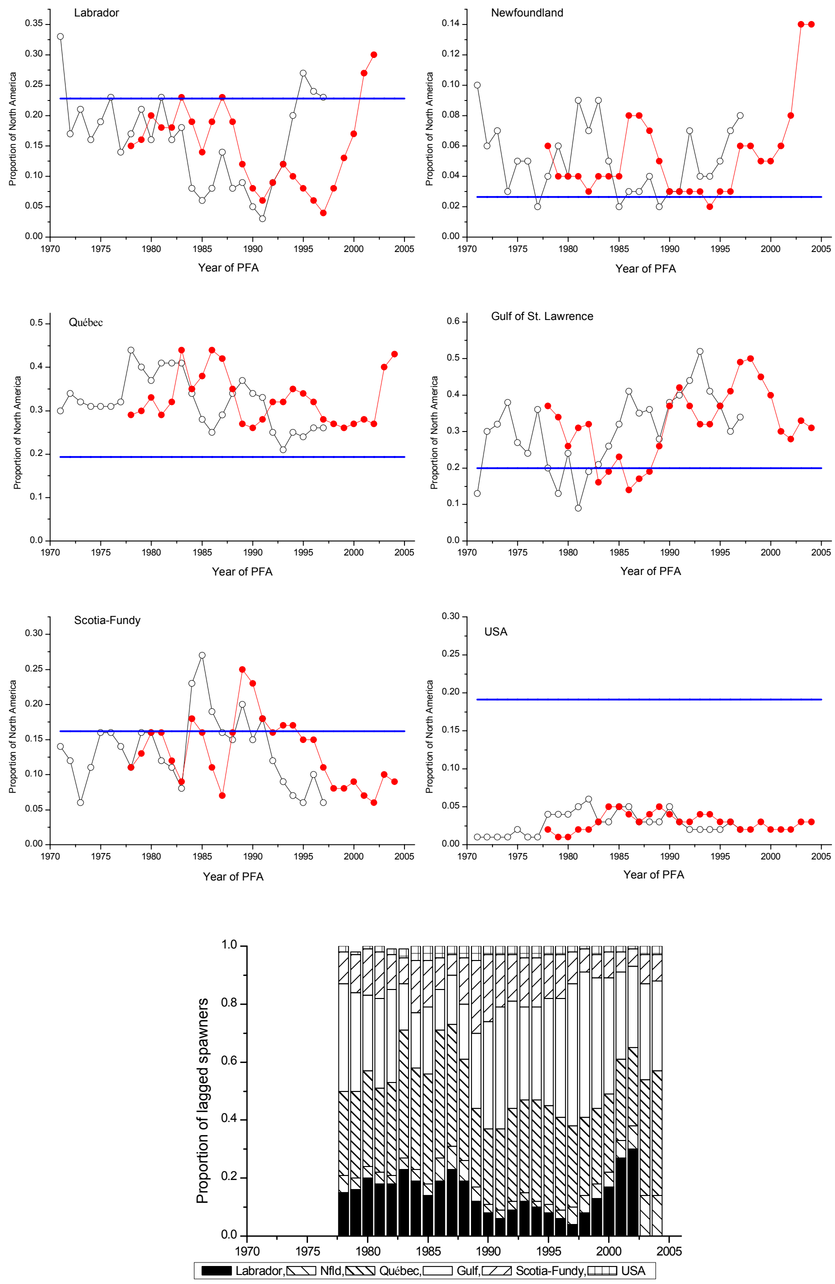


Figure 4.9.8.1. Egg depositions by all sea-ages combined relative to conservation limits in 83 rivers of North America in 2003. The black slice represents the proportion of the limit achieved. A solid black circle indicates the egg deposition limit was attained or exceeded.

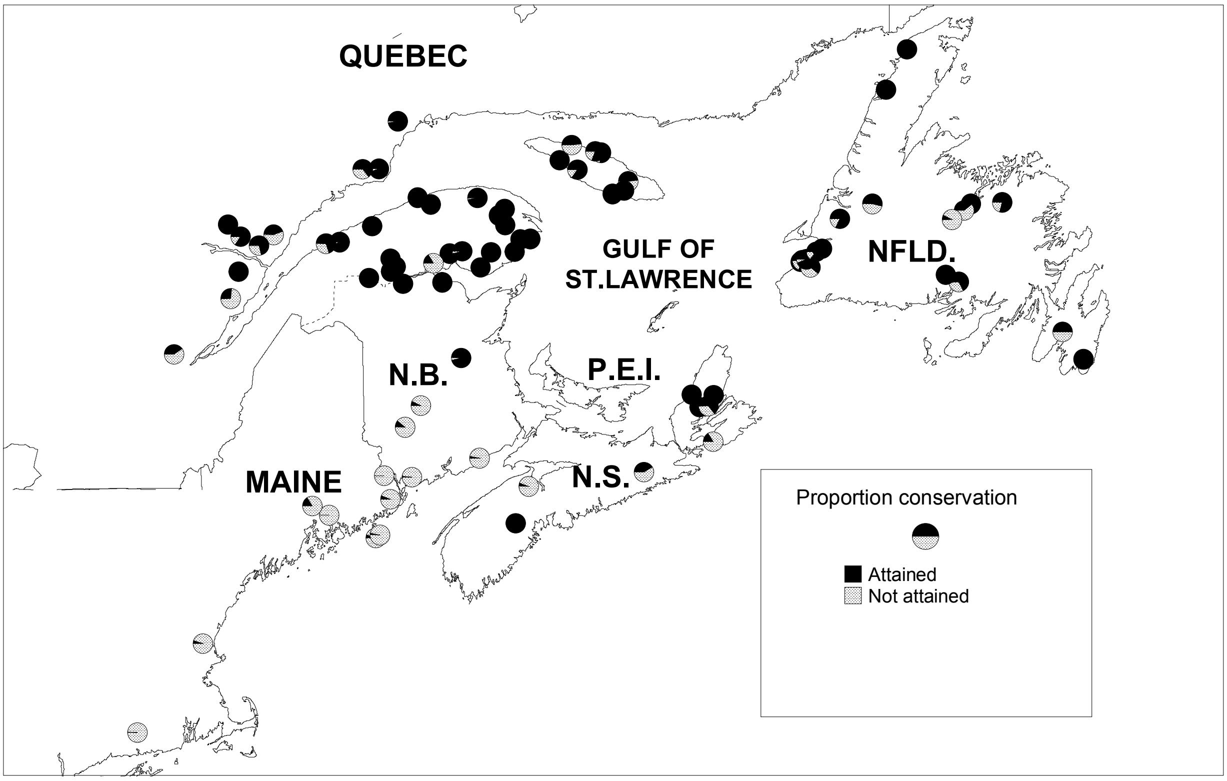


Figure 4.9.8.2. Proportion of the conservation limits met in monitored rivers in four geographic areas of eastern Canada, 1984 to 2003. The vertical line represents the minimum and maximum proportion achieved in individual rivers, the black square is the median proportion. The range of the number of rivers included in the annual summary was 7-8 for Newfoundland, 3-8 for the Gulf, 2 for Scotia-Fundy and 8-9 for Québec.

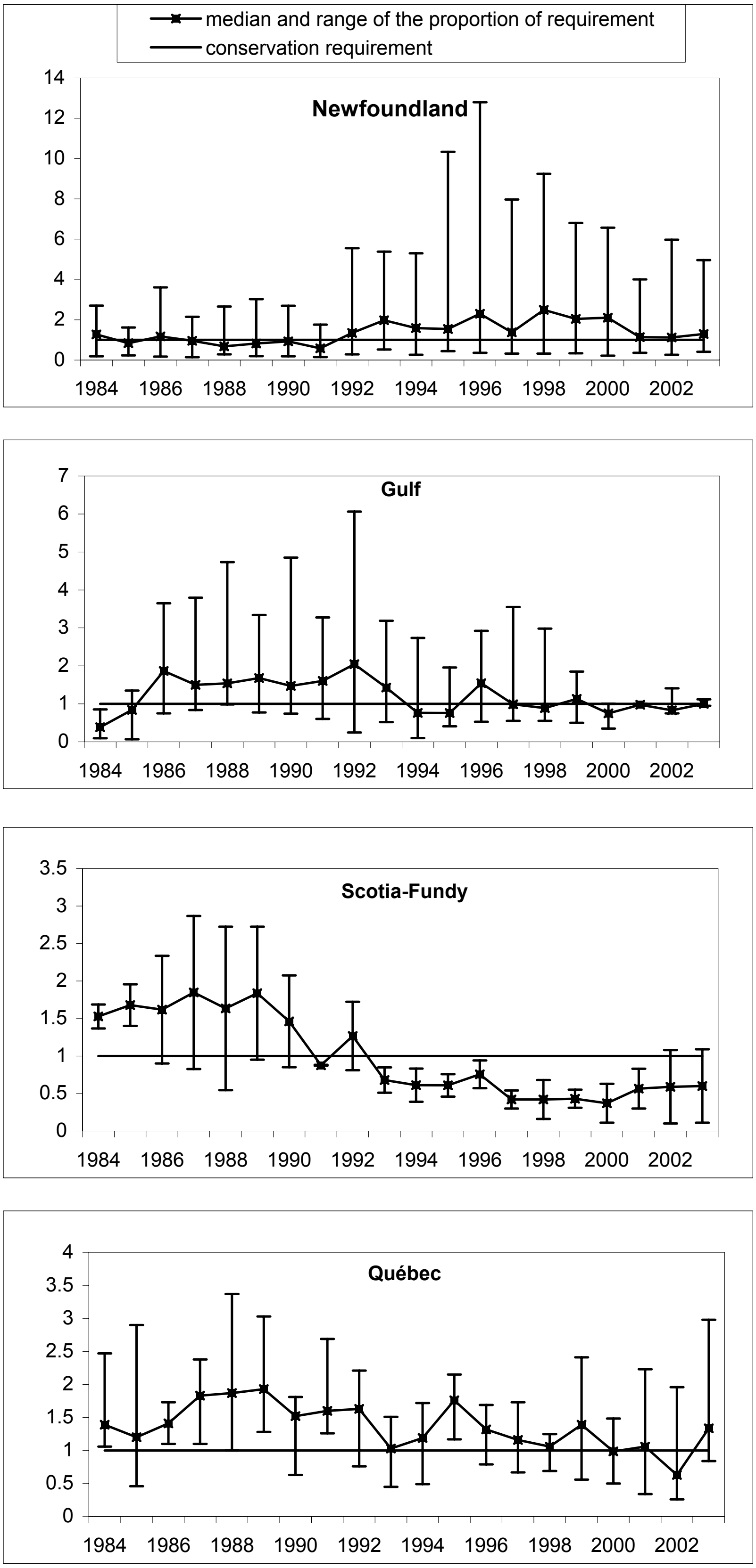
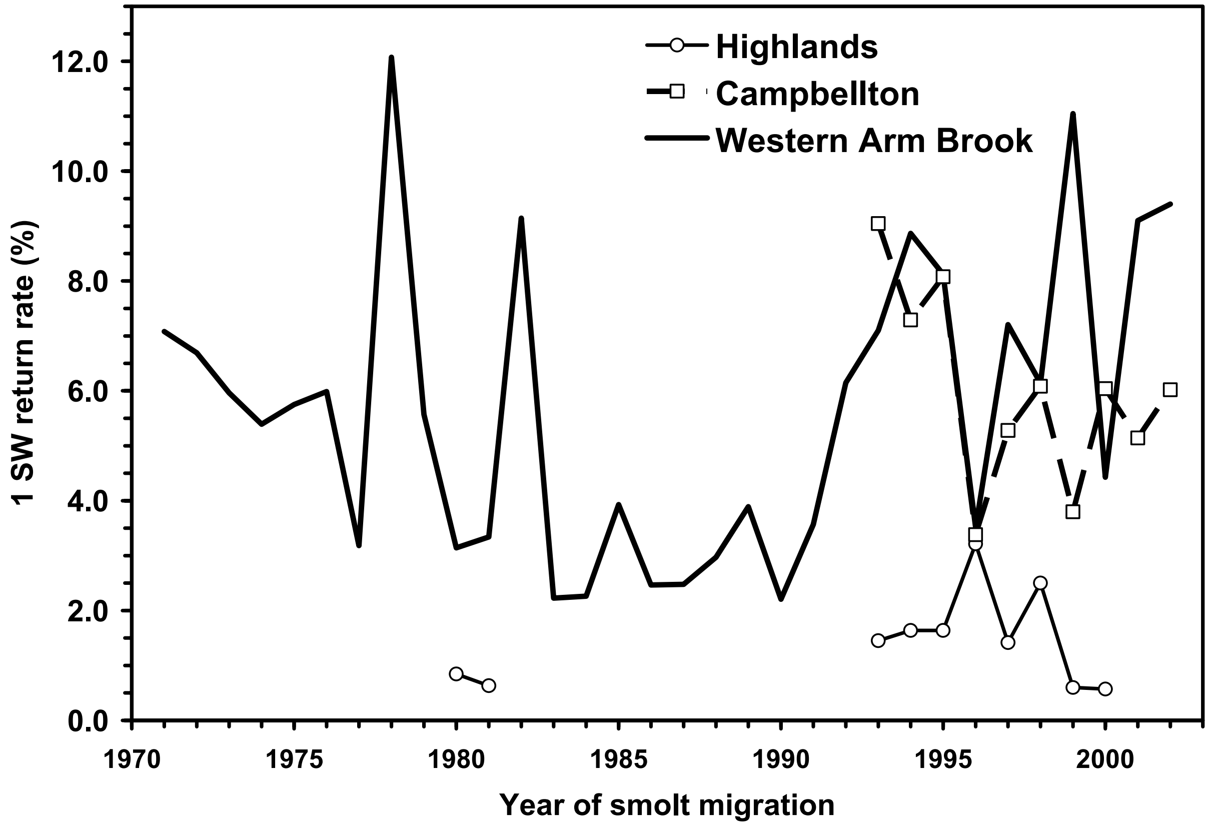


Figure 4.9.9.1. Return rates (%) of wild smolts to return as 1SW salmon from the rivers in west and north Newfoundland (Highlands, SFA 13, Western Arm Brook, SFA 14A and Campbellton, SFA 4) and south Newfoundland (NE Trepassey, SFA 9; Rocky, SFA 9; and Conne, SFA 11).



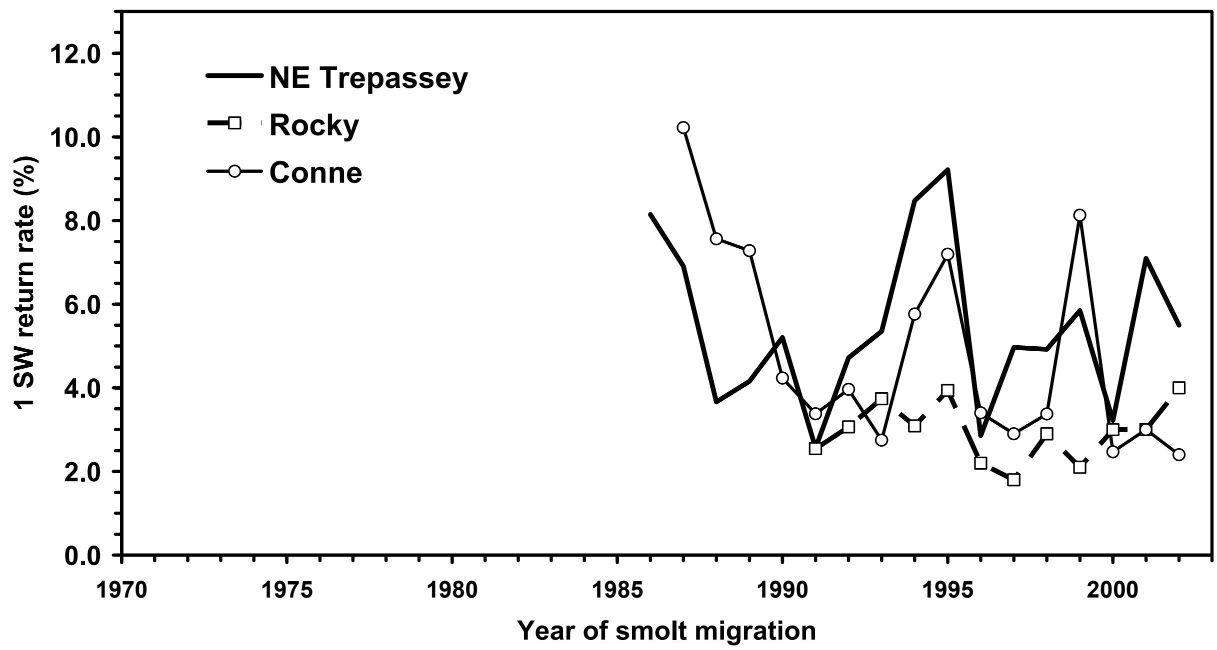
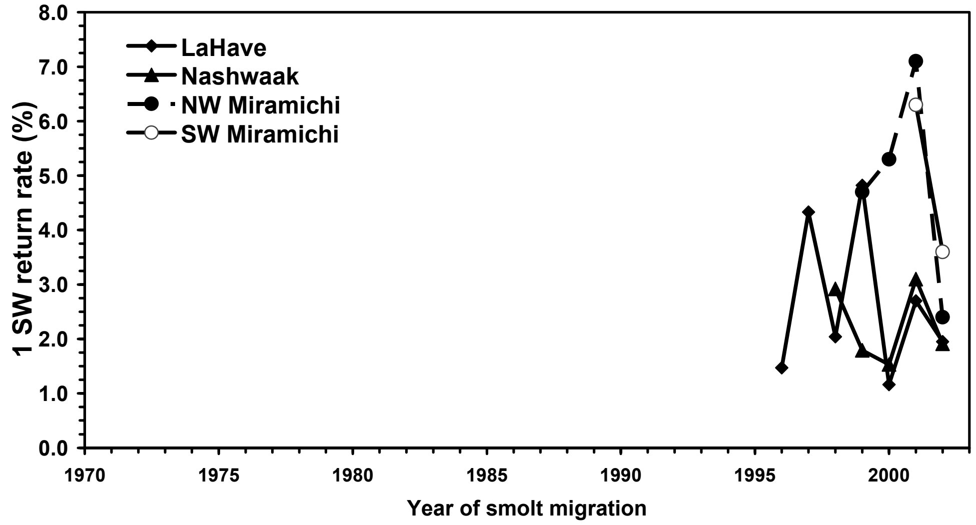


Figure 4.9.9.2. Return rates (%) of wild smolts to return as 1SW (upper two panels) and 2SW (bottom panel) salmon from the rivers in the Maritime provinces (top: Northwest Miramichi SFA 16, LaHave SFA 21, Nashwaak SFA 23) and Quebec (Bec-Scie Q10, de la Trinité, Q7 and Saint-Jean, Q2).



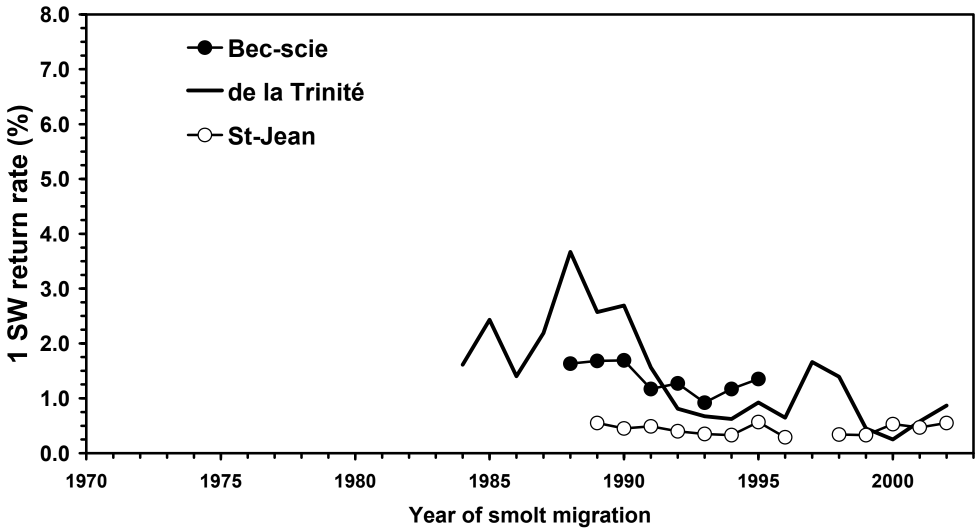
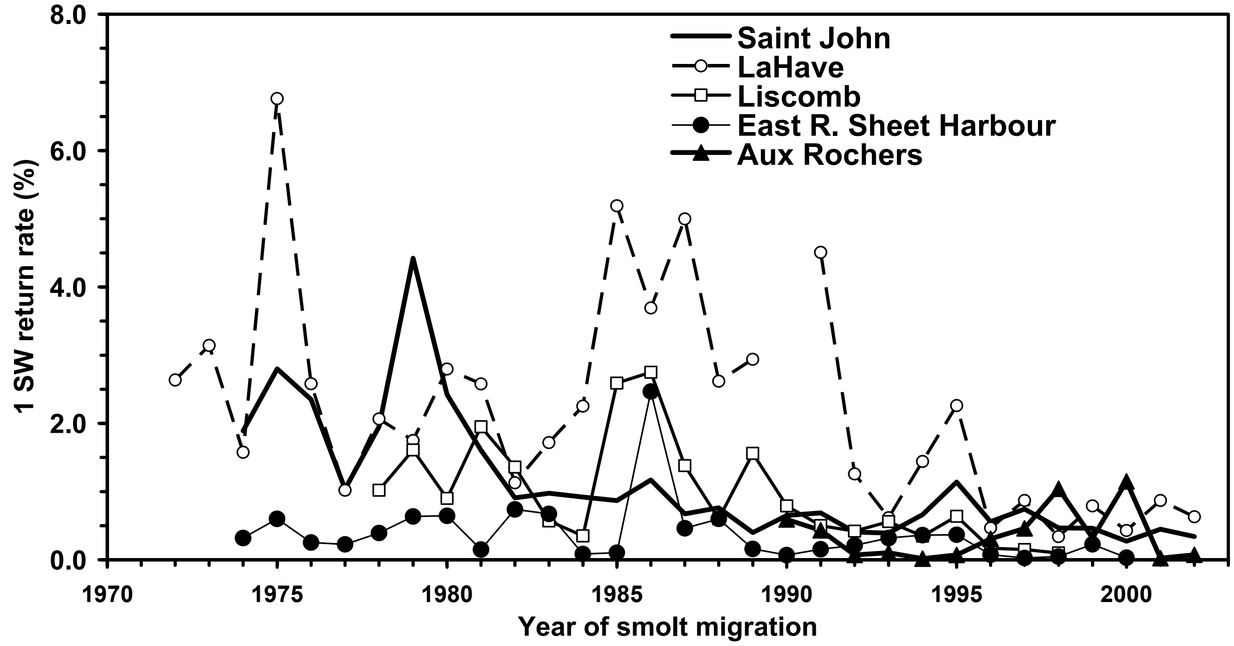


Figure 4.9.9.3. Return rates (%) to the river of hatchery released smolts from the Saint John River (SFA 23), LaHave River (SFA 21), Liscomb and East Rivers (SFA 20), and Aux Rochers River (Q7) as 1SW (upper panel) and 2SW (lower panel) salmon.



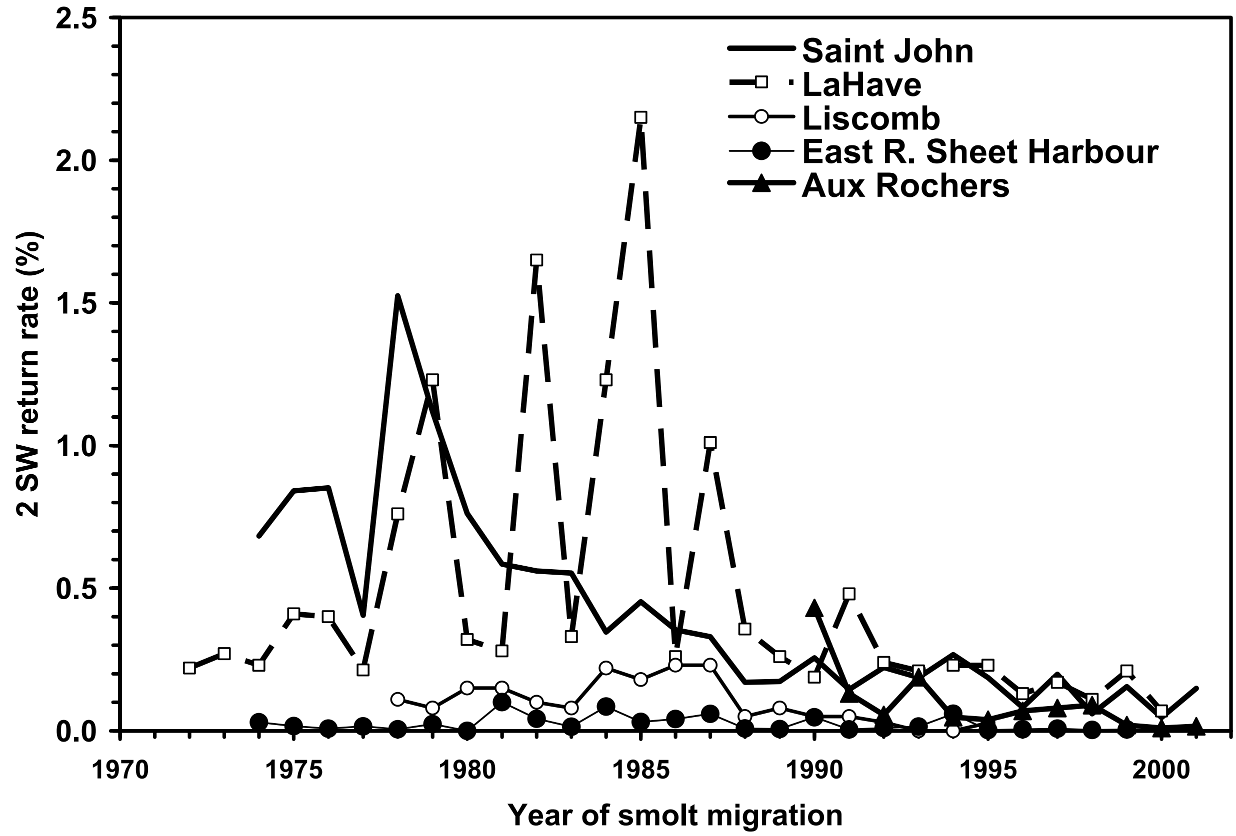


Figure 4.9.9.4. River return rates (%) of hatchery released smolts from the Penobscot River (Maine, USA) as 1SW and 2SW salmon.

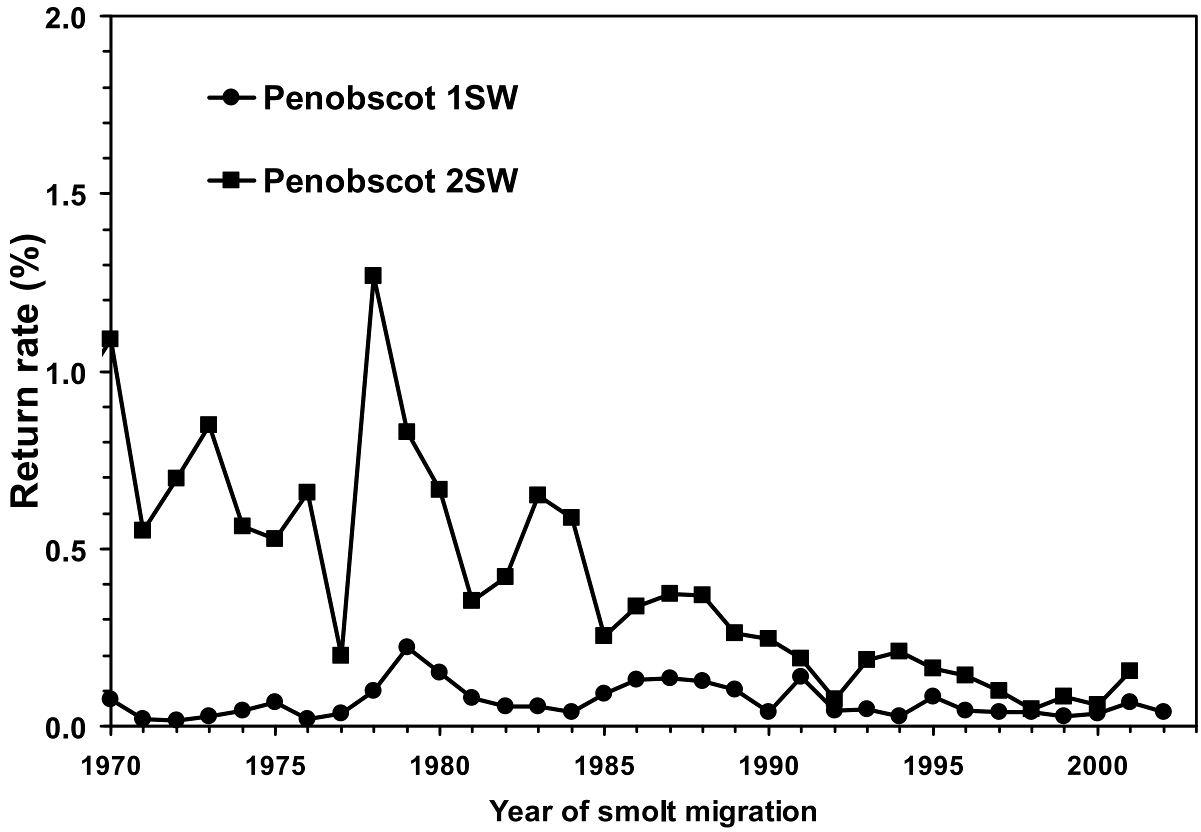


Figure 4.9.9.5. Return rates (%) of wild smolts to return as 2SW salmon from the rivers (Miramichi SFA 16, LaHave SFA 21, Nashwaak SFA 23) in the Maritime provinces (upper panel) and from the Narraguagus River, Maine, USA (bottom panel).

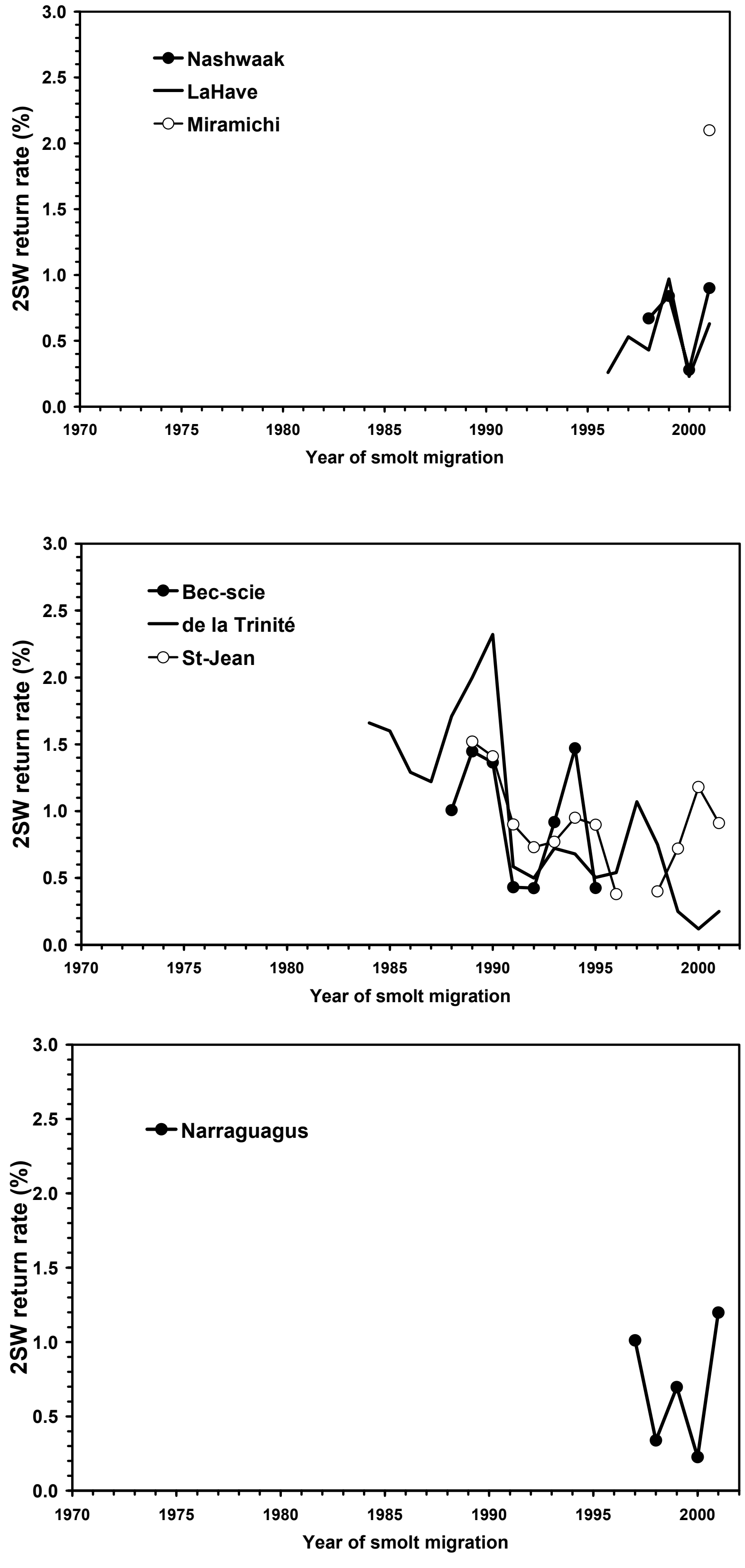


Figure 4.12.1.1. Locations of salmon catches reported by the DFO (Canada) observer program.

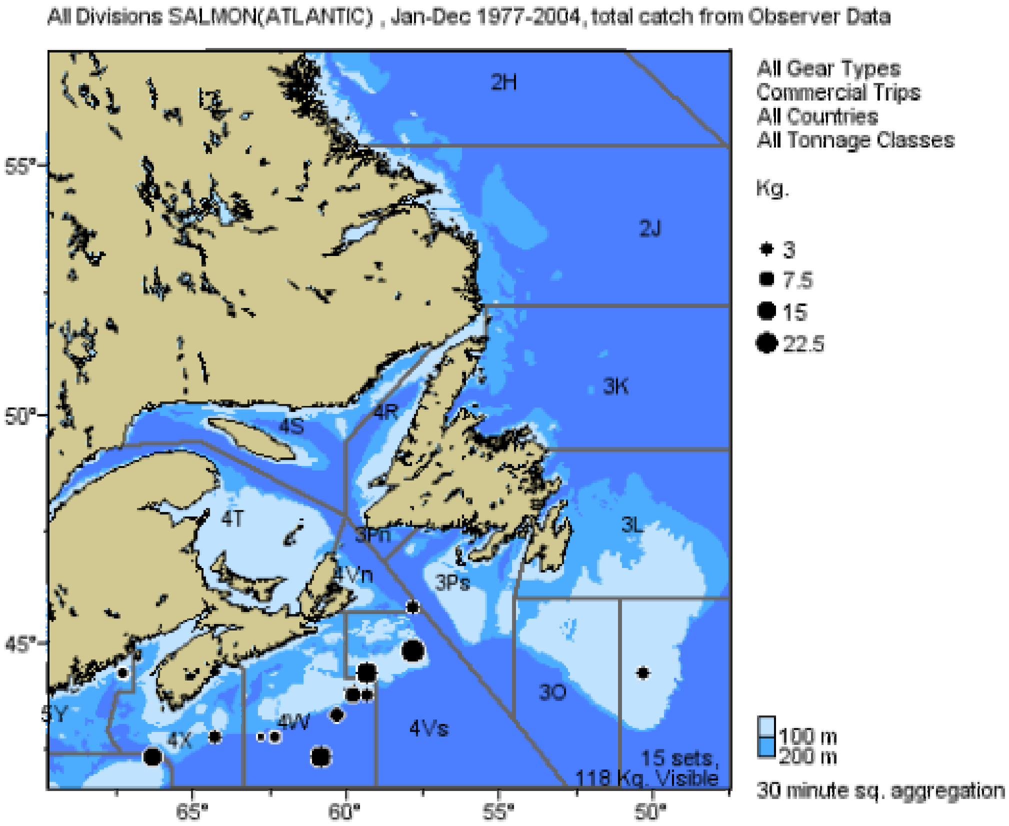


Figure 4.12.1.2 USA reporting areas used for recording commercial catch.

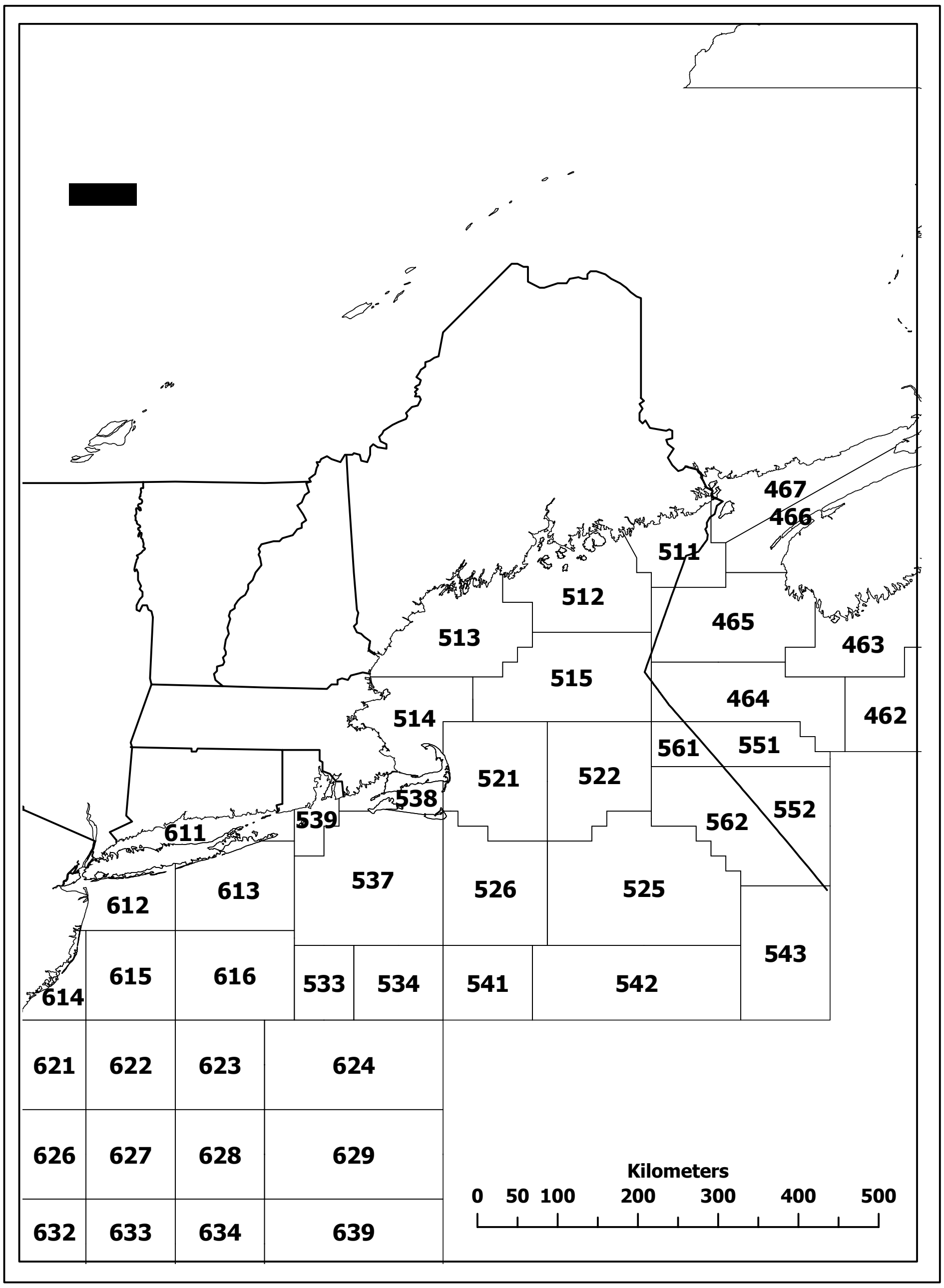


Figure 4.12.1.3. Location and total catch of all species by purse seine operations during the months of April to October, 2003, based on USA trip vessel reports.

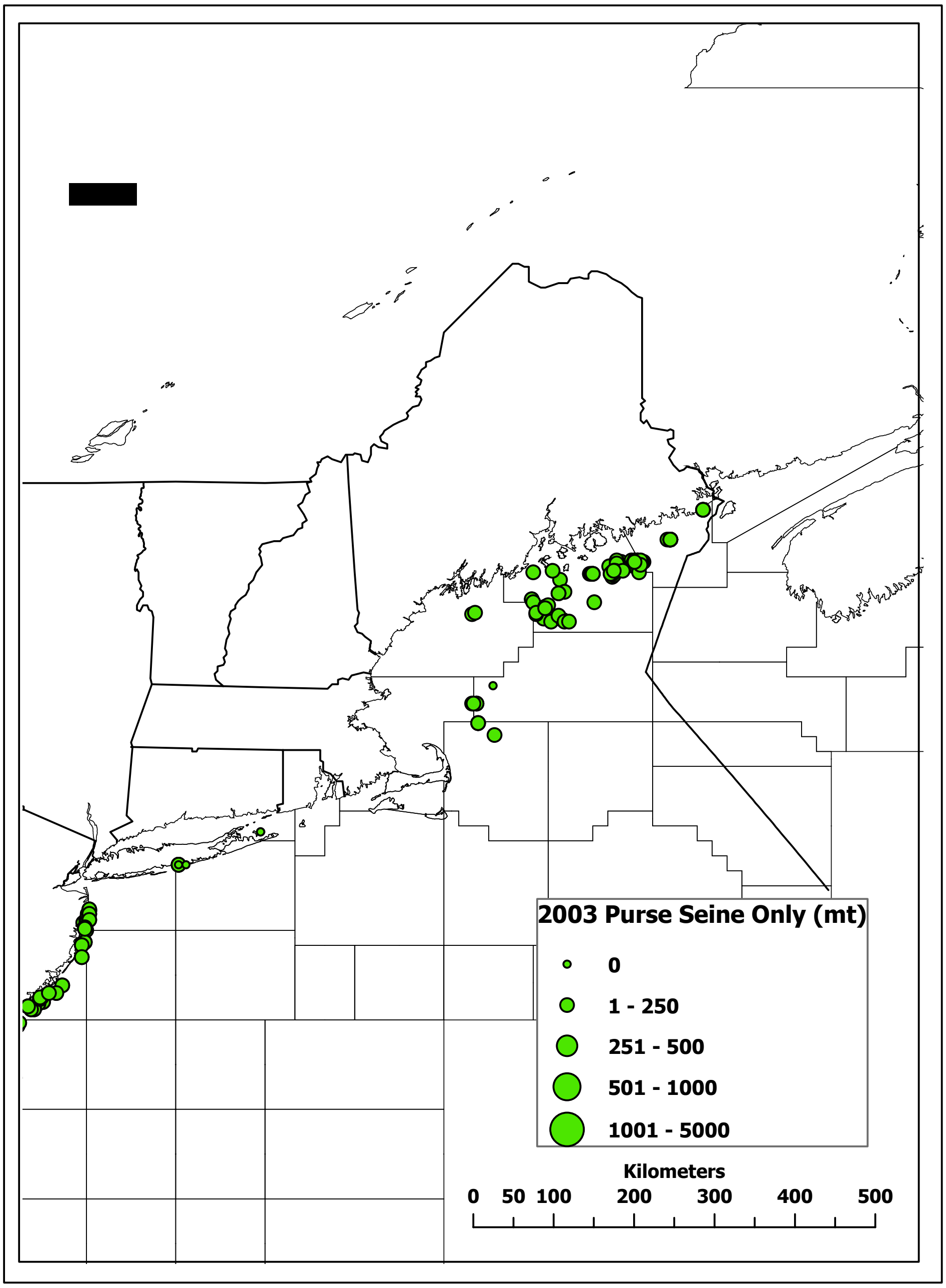


Figure 4.12.1.4. Location and total catch of all species by midwater trawl operations during the months of April to October, 2003, based on USA trip vessel reports.

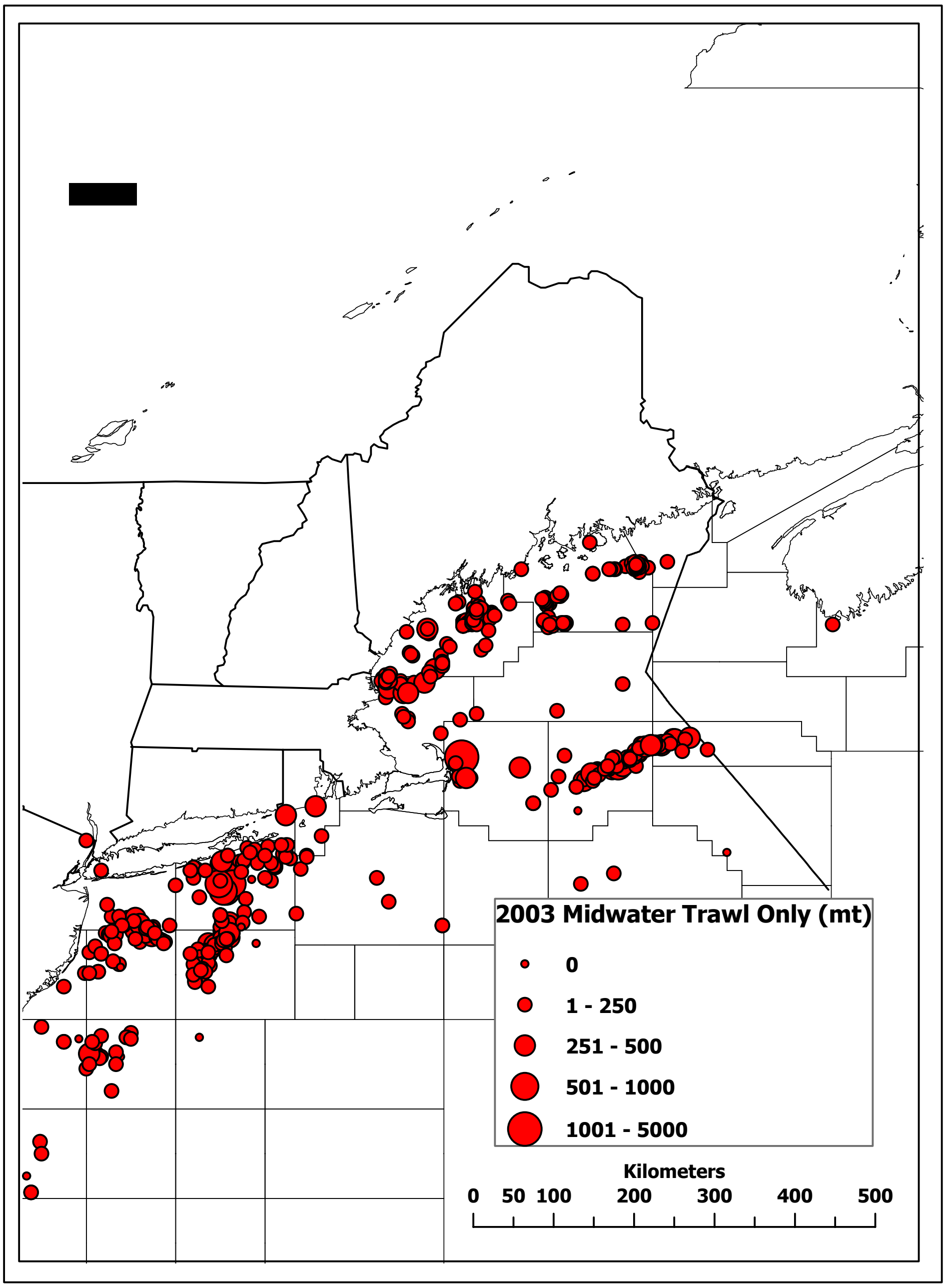


Figure 4.12.1.5. Catch of herring for southern New Brunswick (NB), Georges Bank (GB), and Gulf of Maine (GOM).

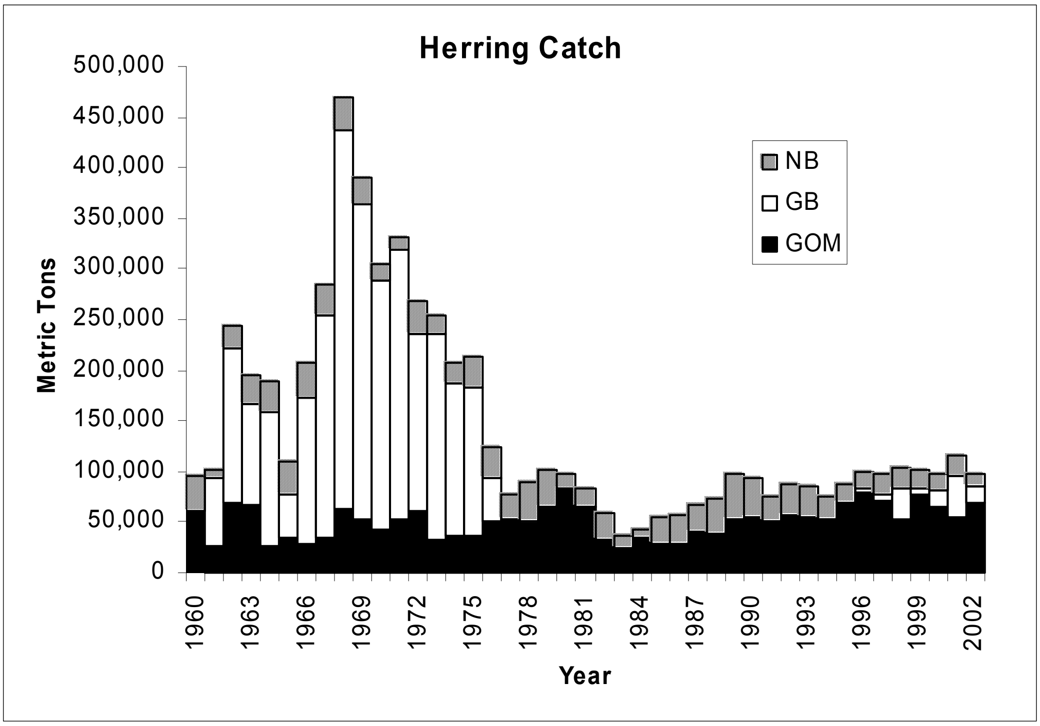
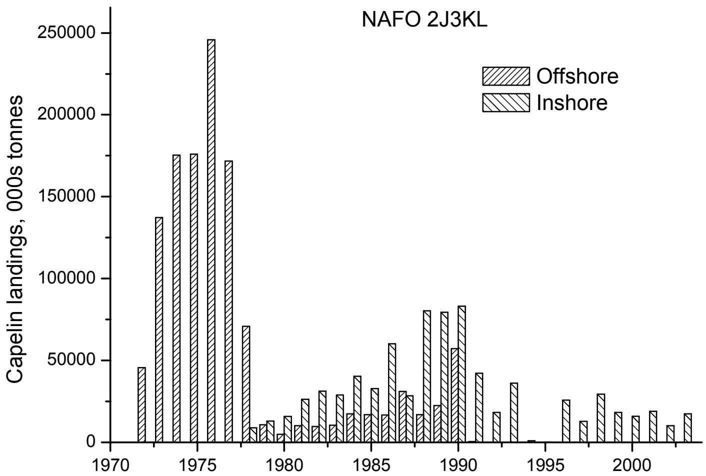


Figure 4.12.2.1. Capelin landings from NAFO Area 2J3KL from 1972 to 2003.



5 ATLANTIC SALMON IN THE WEST GREENLAND COMMISSION

5.1 Status of stocks/exploitaton

The Working Group considers the stock complex at West Greenland to be outside safe biological limits.

The salmon caught in the West Greenland fishery are mostly (>90%) non-maturing 1SW salmon, most of which are destined to return to homewaters in Europe or North America as MSW fish if they survived. There are also 2SW salmon and repeat spawners, including salmon that had originally spawned for the first time after 1-sea-winter. The most abundant European stocks in West Greenland are thought to originate from the UK and Ireland, although low numbers may originate from northern European rivers. Most MSW stocks in North America are thought to contribute to the fishery at West Greenland.

The Working Group notes that the North American stock complex of non-maturing salmon has declined to record levels and is in tenuous condition. Despite the closure of Newfoundland commercial fisheries in 1992 and subsequently in Labrador in 1998 and Québec in 2000, sea survival of adults returning to rivers has not improved and in some areas has declined further. The abundance of maturing 1SW salmon has also declined in many areas of eastern North America. Smolt production in 2002 and 2003 in monitored rivers of eastern Canada was less than or similar to the average of the last five years. Unless sea survival improves, the abundance of non-maturing 1SW salmon in the Northwest Atlantic is not expected to increase above the levels of the last five years.

The Working Group also noted that the non-maturing 1SW salmon from Southern Europe have been declining steadily since the 1970s (Figure 3.9.14.5), and the preliminary quantitative prediction of pre-fishery abundance for this stock complex will remain low for 2004 (489,000 fish) (Figure 3.6.1.1).

In European and North American areas, the overall status of stocks contributing to the West Greenland fishery is at the lowest level recorded, and as a result, the status of stocks within the West Greenland area is thought to be extremely low compared to historical levels. Status of stocks in the NEAC and NAC areas are presented in the relevant commission sections of this report.

The Working Group noted that tentative exploitation rates for non-maturing 1SW fish at West Greenland can be calculated by dividing the recorded harvest of 1SW salmon of North American origin at West Greenland by the PFA estimate for the corresponding year. This indicates that exploitation rates in last five years have averaged around 5% compared to values prior to 1993 averaging 26%, and suggests that recent management measures in this fishery have reduced exploitation in this stock complex.

5.2 Management objectives

The Conservation limits (CLs) have been defined by ICES as the level of stock that will achieve long term average maximum sustainable yield (MSY), as derived from the adult to adult stock and recruitment relationship. NASCO has adopted this definition of CLs (NASCO, 1998). The CL is a limit reference point (S_{lim}). However, management targets have not yet been defined for North Atlantic salmon stocks. ICES has interpreted stocks to be within safe biological limits only if the lower bound of the confidence interval of the most recent spawner estimate is above the CL.

The spawning requirement used for North America is for the continent as a whole. However, based on past performance, there is no reason to expect the abundance of salmon in the North Atlantic to be proportional to the regional 2SW spawner requirements. Specifically, the 2SW returns to Scotia-Fundy, and USA have been below their corresponding conservation limits since 1985 (Figure 4.9.5.6). For the 1998 to 2002 PFA_{NA} years, the most recent years when estimates of lagged spawners are available for all regions of North America, the Quebec and Gulf regions have accounted for a disproportionate number of lagged spawners relative to their 2SW requirements (Figure 5.2.1). Assuming that the abundance of Atlantic salmon in 2004 will be proportional to the abundance of lagged spawners in the last five years when lagged spawner estimates across regions were available, it is possible to calculate the number of salmon required to return to North America to achieve region-specific conservation requirements. For example, to achieve the Newfoundland 2SW requirement of 4,022 2SW salmon, a total of 92,722 fish would be required to leave West Greenland at the PFA_{NA} stage (Table 5.2.1). In the regions with lower stock performance, total PFA_{NA} abundance of about 454,000 fish would be required for the Scotia-Fundy region, and PFA_{NA} abundance of almost 1.8 million fish would be required for achieving the USA conservation requirements (See Section 4).

NASCO has therefore considered an Alternative Management Objectives of meeting the conservation limits simultaneously in the four northern regions of North America: Labrador, Newfoundland, Quebec, and Gulf. For the two southern regions, Scotia-Fundy and USA, where there is a zero chance of meeting conservation limits, an alternate objective would be to achieve increases in returns relative to previous years with the hope that this will lead to the rebuilding of stocks. Improvement from previous years could be as low as 10% for those stocks that are approaching a stock status objective. More aggressive rebuilding rates might be to seek a 25% improvement over returns of a previous time period. These improvements refer to current stock size and not to percent of conservation limits.

The Working Group had previously used a moving average as the baseline value for these increases. However, if a moving average were used, and these stocks continued to decline, so would the baseline value. The Working Group therefore decided to establish 1992 to 1996 as the range of years to define the baseline for the Scotia-Fundy and USA regions to assess PFA_{NA} abundance and fishery options. These years correspond to about one generation time for 2SW salmon following the closure of the Newfoundland commercial fishery and reductions in the Labrador commercial fishery prior to the complete moratorium in 1998. Improvements of greater than 10% and greater than 25% relative to returns during this base period were evaluated. This will provide NASCO with consistent criteria to assess performance of the fisheries management being considered. In Section 2, it was shown that stocks with low productivity, such as these, are particularly susceptible to over fishing in a mixed stock fishery, thus preventing or delaying rebuilding to conservation limits. To assess the potential to rebuild these stocks, the Working Group calculated the probability of returns to the weaker stocks in USA and Scotia-Fundy being equal or less than the previous five-year average.

5.3 Reference points

As precautionary reference points have not been developed for these stocks, management advice is therefore referenced to the S_{lim} conservation limit. Thus, these limits should be avoided with high probability (i.e. at least 75%).

Sampling of the fishery at West Greenland since 1985 has shown that harvested European and North American stocks harvested are primarily (greater than 90%) 1SW non-maturing salmon destined to mature as either 2 or 3SW salmon. Usually less than 3% of the harvest is composed of salmon that have previously spawned and a few percent are 2SW salmon that would mature as 3SW or older salmon. Therefore, conservation limits defined for North American stocks have been limited to the 2SW salmon. These numbers have been documented previously by the Working Group and are in Section 4.3. The 2SW spawner limits of salmon stocks from North America total 152,548 fish, with 123,349 and 29,199 required in Canadian and USA rivers, respectively.

Conservation limits for the NEAC area have been split into 1SW and MSW components on the basis of the average age composition of catches in the past ten years. The stocks have also been partitioned into northern and southern stock complexes, and tagging information and biological sampling indicates that the majority of the European salmon caught at West Greenland originate from the southern stock complex. The current conservation limit estimate for southern European MSW stocks is approximately 268,000 fish. There is still considerable uncertainty in the conservation limits for European stocks and estimates may change from year to year as the input of new data affects the pseudo-stock-recruitment relationship.

5.4 Advice on management

The Working Group has provided management advice for the West Greenland fishery, based on the NAC stocks, and for the combined NAC and NEAC stock complexes.

Catch advice for the NAC area

For 2004, the PFA_{NA} forecast remains among the lowest of the time series with a median value of 100,000 fish and a 75% probability that the abundance will be less than 218,000 fish (i.e. highly unlikely to meet the 2SW spawner reserve of 212,000 salmon to North America) (Figure 5.4.1). In the absence of any marine-induced fishing mortality, there is a very low probability (5% probability) that the returns of 2SW salmon to North America in 2005 will be sufficient to meet the conservation requirements of the four northern regions (Labrador, Newfoundland, Quebec, and Gulf) (Table 5.4.1). There is essentially no chance (<1%) that the returns in the southern regions (Scotia-Fundy and USA) will be greater than the returns observed in the 1992 to 1996 base period. Furthermore, in the absence of a fishery there is a 73% probability that returns in these regions will be less than the average of the period 1999 to 2003 (Table 5.4.2).

Even in the absence of fisheries on the non-maturing 1SW salmon at West Greenland in 2004 and subsequently on the returning 2SW salmon to North America in 2005, there is a very small chance (5%) that the abundance of salmon will be sufficient to achieve the conservation requirements for 2SW salmon in the four northern regions. The probability of realizing increases in returns to the southern North American stocks is close to zero. None of the stated management objectives would allow a fishery to take place.

Catch advice for the NAC/NEAC combined

The Working Group followed the process developed last year for providing catch advice for West Greenland using the PFA and CLs of the NAC and NEAC areas. The PFA for NAC and NEAC are applied in parallel to the Greenland fishery and then combined at the end of the process into a single catch advice table (Section 5.10.2). In the absence of any fishery at West Greenland, there is a less than 75% probability that the MSW conservation limit for southern Europe will be met (Table 5.4.1).

Using the 75% probability level, none of the stated management objectives in NAC or NEAC would allow a fishery to take place.

5.5 Relevant factors to be considered in management

For all fisheries, ICES considers that management of single stock fisheries should be based upon assessments of the status of individual stocks. Conservation would be best achieved if fisheries can be targeted at stocks that have been shown to be above safe biologically limits. Fisheries on mixed stocks, either in coastal waters or on the high seas, do not target only those stocks exceeding biologically based escapement levels. Fisheries in estuaries and rivers are more likely to fulfill this requirement.

5.6 Catch forecast for 2004

The abundance of non-maturing 1SW in the Northwest Atlantic is not expected to improve. Sea survival of adults returning to rivers has not improved and in some areas of North America has declined further. The abundance of maturing 1SW salmon has also declined in many areas of eastern North America. Associations between 1SW returns in year i and 2SW returns in year i+1 observed in several rivers in eastern Canada suggest that abundance of 2SW salmon in 2004 in eastern Canada will be less than that of 2003 (Section 4.9.5). Further, smolt production in 2002 and 2003 in monitored rivers in eastern Canada and USA were less than or similar to the average for the previous five years (Section 4.9.5).

The Working Group has described two temporal phases of salmon production in the Northwest Atlantic. A phase shift in recruitment per spawner in the northwest Atlantic became apparent during the last two decades. The lower recruitment rate, which may not be sufficient to achieve population replacement, is evident throughout eastern Canada and U.S., especially in the southern regions. The reduced rate of recruitment may be the result of an integration of factors across all aquatic habitats of Atlantic salmon. Given the present condition of salmon stocks, there is no evidence in the stock status from any of the regions in North America that there will be a turnaround in abundance in 2004.

The Working Group also concluded that the southern European stock complex of non-maturing salmon has declined to record levels. The spawning escapement to southern Europe has not greatly exceeded conservation limit for the last eight years (Figure 3.9.14.6b).

5.7 Medium to long-term projections

North American stocks

Catch options which could be derived from the pre-fishery abundance forecast for 2004 (100,000) would apply principally to North American fisheries in 2005 and hence the level of fisheries in 2004 needs to be accounted for before providing these catch options. Accounting for mortality and the conservation limit and considering an allocation of 60% of the surplus to North America, the only risk averse catch option for 2SW salmon in 2005 is zero catch. This zero catch option refers to the composite North American fisheries. As the biological objective is to have all rivers reaching or exceeding their conservation limits, river-by-river management will be necessary. On individual rivers, where conservation limits are being achieved, there are no biological reasons to restrict the harvest.

NEAC stocks

The quantitative prediction for the southern NEAC MSW stock component gives a projected PFA (at 1st January 2004) of 489,000 in 2004. No projections are available beyond that for this stock complex. The stock group is outside safe biological limits, and the Working Group considers that precautionary reductions in exploitation rates are required for as many stocks as possible, in order to ensure that conservation requirements are met for each river stock with high probability. On individual rivers, where conservation limits are being achieved, there are no biological reasons to restrict the harvest.

5.8 Comparison with previous assessment and advice

The current modelling approach was applied to the PFA_{NA} series that now includes the 2002 PFA to update the 2003 forecast. The median value of the updated analysis has decreased to 90,000 fish from 110,000 based on the previous year's model and data. More importantly, the upper bound on the distribution is substantially lower, 196,000 in the updated analysis versus 305,000 in the previous year's analysis (Figure 5.8.1).

5.9 NASCO has requested ICES to Describe the events of the 2003 fishery and status of the stocks

At its annual meeting in June 2003 NASCO agreed to restrict the fishery at West Greenland *to that amount used for internal subsistence consumption in Greenland, which in the past has been estimated at 20 tons*. Consequently, the Greenlandic authorities set the commercial quota to nil, i.e. landings to fish plants, purchase of salmon by shops for resale, and any export of salmon from Greenland were forbidden. Licensed fishermen 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 were to be reported to the License Office on a daily basis. In agreement with the Organisation for Fishermen and Hunters in Greenland the fishery for salmon was allowed from 11 August. The Greenland authorities set a closing date of 31 October.

5.9.1 Catch and effort in 2003

By the end of the season a total of 8.7 t of landed salmon were reported (Table 5.9.1.1). In total, 77 reports were received. The geographical distribution of the reported catches was similar to that in 2000 and 2001, with more than 50 % of the landings reported from NAFO Div. 1F (Table 5.9.1.2). Provided that the information on the landing reports is representative of the temporal distribution of the catches for the total fishery was not similar to previous years, with the majority of the catches taken in the first 7 weeks of the season.

The number of active participants in the salmon fishery has decreased sharply since 1987, when a catch of more than 900 tons was allowed and more than 500 licenses were active in the fishery. During 2000, 2001 and 2003, there were about 40 active fishermen, the lowest numbers recorded in the time series.

Because the fishery includes provisions for personal consumption or subsistence fishing, unreported catch is likely. There is presently no quantitative approach for estimating the magnitude of unreported catch; however, it is likely to have been at the same level proposed in recent years (around 10 t).

5.9.2 Biological characteristics of the catches

An international sampling program instituted by NASCO in 2001 to sample landings at West Greenland has continued. The sampling program in 2003 included sampling teams from Canada, Greenland, Ireland, United Kingdom and United States. Teams were in place at the start of the fishery and continued to mid September. Further, one sample was obtained late in the season (20-21 October). In total, 2,198 specimens, representing a high proportion of the landings, were sampled for presence of tags or fork length, weight, scales, and tissue samples for DNA analysis. The limitation of the fishery to subsistence fishery caused practical problems for the sampling teams, however, the sampling program was fairly successful in adequately sampling the Greenland catch temporally and spatially. In fact, the sampling teams at some sites sampled larger amounts of salmon than reported for sale in the official statistics. Where that occurred, the Working Group adjusted the total landings by replacing the purchased catch with the weight of fish sampled to use in assessment calculations.

Tissue and biological samples were collected from the mixed population at West Greenland caught for local consumption in 2003. Samples were obtained from three landing sites: Qaqortoq, Nuuk (NAFO Div. 1D), and Maniitsoq (NAFO Div. 1C) (Figure 5.9.1). The sampled salmon were measured, scales were removed for ageing, and gutted weight recorded. Data from this program were used to fulfill the requests for information from NASCO related to Atlantic salmon in the West Greenland Commission area.

Biological characteristics (length, weight, and age) were recorded from 1,824 fish in catches from NAFO Div. 1C, 1D and 1F in 2003 (Tables 5.9.2.1 to 5.9.2.3). The smallest fish sampled was 51 cm fork length and weighed 1.46 kg gutted weight while the largest was 100 cm and weighed 10.74 kg. The average weight of fish in the 2003 catch was 3.04 kg, with North American 1SW fish averaging 63 cm and European 1SW fish averaging 64.4 cm in length (Table 5.9.2.1). There was a significant decline in weight (unadjusted for sampling date) of both European and North American 1SW from 1969 to 1992, followed by a significant increase in weights over time (1995-2003). The mean lengths and mean weights for 2003 were among the highest in the last decade.

The river ages of European salmon ranged from 1 to 5 (Table 5.9.2.2). Over half (58%) of the European fish in the catch were river-age 2 and 22% were river age 3. Although the proportion of the European origin river age 1 salmon in the catch has been variable in the last 15 years, it has been between 10% and 16% since 2001 (Table 5.9.2.2). A low proportion of this group suggests low representation of Southern European stocks in the catch. North American Salmon up to river age 6 were caught at West Greenland in 2003 (Table 5.9.2.2), with over half distributed among river ages 2 (29%) and 3 (39%).

In 2003, 1SW salmon were 98.9% of the European catch (Table 5.9.2.3). No previous spawners of European origin were observed and 1.1% of the European samples collected from the West Greenland fishery were 2SW salmon. One SW salmon dominated (96.7%) the North American component, with repeat spawners 2.3% of the catch (Table 5.9.2.3).

Between 17 August and 4 September the sampling team stationed in Nuuk obtained 55 whole fish to remove tissue for disease testing. These samples were tested for the presence of ISAv by RTPCR assay only and all test results were negative. The sex of 59 individuals, the 55 collected in Nuuk and 4 in Maniitsoq, was determined by examining gonads; of these 6 (10%) were males and 53 (90%) females. The Working Group recommends that sex be determined on as many whole fish as practicable, and methods be considered for determining sex on gutted individuals.

5.9.3 Continent of Origin of catches at West Greenland

A total of 1,779 tissue samples were removed and preserved for DNA analysis. All genetically sampled salmon were genotyped at 4 microsatellite loci (Ssa202, Ssa289, SSOSL438, and SSOSL311). A database of 4,802 Atlantic salmon genotypes of known origin was used as a baseline to assign the 1,779 salmon to continent of origin. In total, 1,212 (68.1 %) of the salmon sampled from the 2003 fishery were of North American origin and 567 (31.9%) fish were determined to be of European origin (Table 5.9.3.1). For the first time, continent of origin was determined solely based on genetics.

The Working Group noted that the variability in the composition of the catch among the divisions (see table below) (Chi Square p <0.001) necessitates a broad geographic sampling program.

NAFO division	North America		Europe	
	Number	%	Number	%
Div. 1C	234	79.9	59	20.1
Div. 1D	611	81.9	135	18.1
Div. 1F	367	49.6	373	50.4

Applying the continental percentages to the adjusted total catch (12.3 t) resulted in estimates of 7.9 t of North American origin and 4.3 t of European origin fish (2,600 and 1,400 rounded to the nearest 100 fish, respectively) landed in West Greenland in 2003 (Table 5.9.3.2 and Fig. 5.9.3.1). The Working Group also adjusted the 2002 landings, raising the total catch from 9.0 t to 9.8 t to the weighted catch result in estimates of 6.8 t of North American origin and 3.0 t of European origin fish (2,300 and 1,000 fish rounded to the nearest 100 fish respectively). Quota reductions have resulted in an overall reduction in the numbers of both North American and European salmon landed at West Greenland.

5.9.4 NASCO has requested ICES to Provide information on the origin of Atlantic salmon caught at West Greenland at a finer resolution than continent of origin (river stocks, country or stock complexes)

Within a mixed stock fishery, the identification of the origin and composition of the catch is essential for responsible management. This is especially true for stocks that are protected under various nation-specific Endangered species legislations. In addition, the NASCO Decision Structure requires that the stock composition of mixed stock fisheries be considered while developing management plans. As an example, the West Greenland Atlantic salmon fishery falls within this category. In 2003, the International Sampling Team determined the origin of 16 fish with either external or internal tags. These included seven fish from Ireland, two from UK England and Wales, one from UK Scotland, three from Canada, and three from USA.

A major genetic dichotomy exists between populations from either side of the North Atlantic Ocean and between European populations in Baltic and Atlantic drainages (Ståhl 1987). One microsatellite locus has shown almost perfect separation of North American and European Atlantic salmon (Taggart et al. 1995; Koljonen et al. 2002). Such hypervariable nuclear DNA marker types can in theory be used to distinguish any distinct population group from one another, provided that there is a demonstrated positive correlation between genetic and geographic distance and that a sufficient number of unlinked loci are studied. However, it remains to be seen how well these markers estimate finer scale composition within a mixed stock fishery where a large number of populations are contributing.

A model was presented at the 2003 Working Group meeting that classified the West Greenland catch not only to continent of origin, but country and sub-country of origin as well. The Probabilistic-based Genetic Assignment model (PGA) uses Monte Carlo sampling to partition the reported and unreported catch estimates to continent, country and within country levels for all North American origin fish. Known misclassification accuracies at the sub-continent level within North America are incorporated and both point and variance estimates are generated for each assignment level.

The PGA model was applied to the 2002 West Greenland fishery by inputting the genetic assignment data obtained from the fishery for both continent and country of origin. The 2002 genetic assignment data came from samples genotyped at the 11 loci traditionally used for continent of origin assignment (King et al. 2001). The suit of 11 loci provides the maximum genetic distance dataset between North American (Canada vs. USA) origin fish currently available to researchers. This allows for suitable classification accuracy within the North America country of origin level. The 2002 West Greenland catch was partitioned into European and North American origin and then Canadian and USA origin. The USA estimate was then partitioned to river of origin, in particular, the federally protected Distinct Population Segment (a group of 8 federally protected rivers).

A progress report on the PGA development was presented to the Working Group. The PGA continues to be tuned and error checked. An inventory of West Greenland genetic sample data at 11 loci was conducted and the years available as inputs to the PGA model were 1997 and 2000-2002. The 2003 samples are expected to be available in the near future. Once the model is finalized, all available data will be inputted and estimated catch at West Greenland at a finer scale than continent of origin for the North American origin samples will be made available.

Classifying Southern and Northern European stock complexes in the West Greenland catch has direct applicability to the forecast of PFA. An example of the potential for management based on finer scale stock classification was described for the Foyle area of Northeast Ireland (Section 2.4.2), where genetics techniques are being used to identify stocks contributing to the coastal fishery. Knowledge of temporal and spatial variation in fishery composition may allow managers to achieve conservation in stocks and to identify where specific actions are required to protect or rebuild stocks.

The PGA model demonstrates that identifying country or region of origin for the management of mixed stock fisheries is possible and practical. The Working Group endorsed the PGA model and was encouraged by the preliminary results presented. They supported this approach that accounts for the inaccuracy of assigning samples to country of origin and the estimation of both point estimates and variance around these estimates. The Working Group noted last year that reference baseline datasets for the European and Canadian stock complexes lacked adequate spatial and temporal coverage for finer scale assignments with acceptable accuracy. Some progress has been made to bolster reference datasets within the lab currently processing the samples from the West Greenland fishery; however, deficiencies remain, particularly for Southern NEAC stocks. An ad hoc approach will not assure significant progress toward assigning origin of Atlantic salmon caught at West Greenland at a finer resolution than continent of origin (river stocks, country or stock complexes). Therefore, the Working Group recommends an integrated approach that builds on work at the laboratories in NAC and NEAC currently studying Atlantic salmon genetics.

5.9.5 Elaboration on Status of the stocks in the West Greenland Commission area

The most abundant European stocks in West Greenland are thought to originate from the UK and Ireland, although low numbers may originate from northern European rivers. Most MSW stocks in North America are thought to contribute to the fishery at West Greenland. The percentage of North American salmon in the West Greenland catch was less than 70 % for all but one year until 1992, then increased from 60% to 90% from 1995 to 1999, and has averaged approximately 68% from 2000 to 2003 (Table 5.9.3.2).

North American Stock

Estimates of pre-fishery abundance suggest a continuing decline of North American adult salmon over the last 10 years. The total population of 1SW and 2SW Atlantic salmon in the northwest Atlantic has oscillated around a generally declining trend since the 1970s, and the abundance recorded in 1993–2002 was the lowest in the time-series (Figure

4.9.7.2). During 1993 to 2000, the total population of 1SW and 2SW Atlantic salmon was about 600,000 fish, about half of the average abundance during 1972 to 1990. A 21% increase however has occurred between 2001 and 2002, the most recent year for which it is possible to estimate the total population. The decline from earlier higher levels of abundance has been more severe for the 2SW salmon component than for the small salmon (maturing as 1SW salmon) age group.

In most regions, the returns in 2003 of 2SW fish increased substantially from 2002 however they are still close to the lower end of the 33-year time-series (1971-2003). In Newfoundland, the 2SW salmon are a minor age group component of the stocks in this area and even here, decreases of about 30% have occurred from peak levels of a few years ago. Returns of 1SW salmon generally decreased from 2002 in all areas except Newfoundland. In 2003, the overall conservation limit (S_{lim}) for 2SW salmon was not met in any area. Specifically:

Newfoundland:

- 2SW and 3SW salmon are a relatively small component of this stock complex
- 2SW returns ranked 19 for the last 33 years
- 2SW spawners in 2003 were approximately 96% of the 2SW stock conservation limits (S_{lim})

Labrador:

- 2SW salmon are historically an important part of this stock complex
- 2SW returns peaked in 1995, and decreased again in 1996 and 1997
- no estimate is given after 1997 from this area when the commercial fishery, the basis for the return and spawner model for Labrador, ended

Québec:

- 2SW and 3SW salmon are an important part of this stock complex
- 2SW returns ranked 19 in a 33-year time-series
- 2SW spawners in 2003 were at 86% of 2SW conservation limit (S_{lim})

Gulf of St. Lawrence:

- 2SW salmon are an important part of this stock complex
- 2SW returns ranked 18 in a 33-year time-series
- 2SW spawners in 2003 were at 81% of 2SW conservation limit (S_{lim})

Scotia-Fundy:

- 2SW salmon are historically an important part of this stock complex
- 2SW returns were the third lowest in a 33-year time-series
- 2SW spawners in 2003 were at 15% of 2SW conservation limit (S_{lim})
- inner Bay of Fundy stocks are listed as Endangered by the Committee on the Status of Endangered Wildlife in Canada

United States:

- 2SW salmon are historically an important part of this stock complex
- 2SW returns ranked 25 in a 33-year time-series
- 2SW returns in 2003 are at 4% of 2SW conservation limit (S_{lim})
- stocks in 8 rivers are listed as Endangered under the Endangered Species Act

Southern European Stock

The main contributor to the abundance of the European component of the West Greenland stock complex is non-maturing 1SW salmon from southern Europe. The percentage of European fish in catches at West Greenland was around 30% in the early 1990's and the 2000's, but was below 20% from 1996 to 1999. The contributions of countries within NEAC to this PFA, based on tagging data are: France, 2.7%; Ireland, 14.7%; UK (England &Wales), 14.9%; UK (Northern Ireland), <0.01%; UK (Scotland), 64.5%; and northern NEAC countries, 3.2%. Southern European MSW salmon stocks in the NEAC area consistently decline over the past 10-15 years, and the estimated overall spawning escapement has been below conservation limits (S_{lim}) in recent years. Information from individual countries is summarized below:

France:

- MSW returns are third lowest in the time series
- MSW spawners are below CL in 2003.

Ireland:

- MSW returns are below the median value for the time series
- MSW spawners are below the median value for the time series
- MSW numbers are subject to considerable uncertainty as the sea age composition of the catch is not known accurately
- MSW spawners are above CL in 2003.

UK (England & Wales):

- MSW returns are below the median value for the time series
- MSW spawners are close to the median value for the time series
- MSW spawners are at or above CL in 2003

UK (Northern Ireland):

- Historical trends are unclear as the sea age composition of the catch is unknown for most of the time series.
- MSW spawners are at or above CL in 2003

UK (Scotland):

- MSW fish are estimated to contribute between 40% & 70% of the spawning stock

- MSW returns are for the last nine years lowest in the time series

- MSW spawners are below CL in 2003

5.10 NASCO has requested ICES to provide a detailed explanation and critical examination of any changes to the models used to provide catch advice

The forecast model used to estimate pre-fishery abundance of 2SW salmon in 2004 was modified from the model used in 2003. The change to the model was made to better account for uncertainty in the data and in model selection. The overall approach of modeling the natural log transformed PFA_{NA} and LS_{NA} using linear regression did not change from 2003, and the Monte Carlo method used to derive the probability density for the PFA_{NA} forecast was also retained from 2003. The change to the model in 2004 was the addition of several alternative models, one of which was selected during each Monte Carlo simulation and used to predict a value used to generate the PFA_{NA} probability density. The specific changes to the model to incorporate this feature are:

- In 2003, a single model was used to estimate the mean PFA in each of two productivity phases. The break year between phases alternated between 1989 and 1990 in each Monte Carlo random draw when generating the probability density for the 2003 PFA_{NA}.

- In 2004, 42 models were fit to each dataset produced in each Monte Carlo simulation. These models included two models without phase shifts, plus five models with phase shifts with eight possible break years (1986 to 1993) for each model. In each simulation the most parsimonious model was selected using Akaike's Information Criterion and this model was used to generate a value for the probability density for the 2004 PFA_{NA}.

5.10.1 Forecast models for pre-fishery abundance of 2SW salmon

The advice for any given year has been dependent on obtaining a reliable predictor of the abundance of non-maturing 1SW North American stocks prior to the start of the fishery in Greenland. A two-phase regression between North American pre-fishery abundance (PFA_{NA}) and lagged spawners (LS_{NA}) was used (Figure 5.10.1.1). Seven models (Table 5.10.1.1) and eight break years (1986 to 1993) were run for ten thousand random datasets of PFA_{NA} and LS_{NA} created based on the estimated ranges for each year and PFA. One PFA_{NA} prediction was carried forward for the parsimonious model for each randomly selected dataset. For phase shift models, the probability of being in either phase was based on changes in PFA_{NA} from year t to year t+2. Although it was possible that up to 42 combinations of model and break year (8 years * 5 regressions + 2 regressions without break years) might be represented in estimating the distribution of PFA_{NA}, those selected most often were model numbers 2, 5, and 6 and break years 1989 through 1992. The selection of model 2 indicated that the lagged spawner index was not informative and the break years selected was 1991 or 1992. When the lagged spawner index was included in the model (models 5 and 6) the break years were 1989 and 1990 (Table 5.10.1.2).

North American run-reconstruction model

The Working Group has used the North American run-reconstruction model to estimate pre-fishery abundance of 1SW non-maturing and maturing 2SW fish adjusted by natural mortality to the time prior to the West Greenland fishery (Section 4.9.7). Region-specific estimates of 2SW returns are listed in Table 4.9.5.2. Estimates of 2SW returns prior to 1998 in Labrador are derived from estimated 2SW catches in the fishery using a range of assumptions regarding exploitation rates and origin of the catch. With the closure of the Labrador fishery, 1998 to 2003 returns were estimated as a proportion of the total for other areas based on historical data (Section 4.9.7).

The Working Group examined 1SW and 2SW returns and spawner estimates for insular Newfoundland salmon stocks for the years 1971-2003. The catch statistics used to derive returns and spawner estimates were updated for 1994-2002 from those used in Anon. (2003) and new estimates were presented for 2003. The updated catch statistics are the result of information collected during telephone surveys of anglers who did not respond (non-respondents) to the prompts to return their angling logs with records of their angling activities. Non-respondent surveys were carried out in years 1998-2003. Year-specific information for non-respondents has been incorporated into catch and effort estimates for 1998-2002 and average values of catch and effort per angler (1998-2000) for years 1994-1998. Average non-respondents information for all years is used for the preliminary estimates for 2003. Also, the conversion of large salmon to 2SW salmon requires a sea age distribution. From recent samples collected on various rivers a range of 0.06 to 0.14 was used for SFAs 3-12 and for SFAs 13-14A, a range of 0.24 to 0.46 is used for the period of 1994 to 2003. These two revisions of the data resulted in PFA_{NA} changing from 1% to 8% in any year.

Update of Lagged Spawners

The lagged spawner variable used in the model is an index of the 2SW parental stock of the PFA. It provides a means of examining the value in managing for spawning escapement and predicting recruitment in the extant sea fisheries. The calculation procedure is described in Section 4.9.7. The lagged spawner index was the sum of the lagged spawner estimates for five regions of North America, excluding Labrador. Ideally, the lagged spawner variable would be the sum of the lagged spawners in six regions. The difficulty arises after 1998 when the spawner estimate for Labrador could not be derived because of the closure of the commercial fishery (ICES 2003/ACFM:19). In terms of assessing population dynamics or relative recruits per spawner, a relative (time) index of spawners is sufficient. The lagged spawner index without Labrador was highly correlated with the sum of lagged spawners for all of North America ($r = 0.86$) in the years when these data were available.

Spawner estimates are available for these regions and are anticipated to continue into the future. The Working Group recognized however that this is not an ideal situation as this spawner index may not be an unbiased measure of the overall lagged spawner abundance from North America, particularly as the impression into the late 1990s was that spawning escapement in Labrador was estimated to have been rising rapidly. However the exclusion of Labrador did allow the lagged spawner series to be extended back in time one more year to the 1977 year of PFA (Section 4.9.7).

North American Forecast Model

In 2003, a plot of the midpoint estimates PFA_{NA} versus the LS_{NA} index suggested two periods of productivity, a high productivity period during 1977 to 1988 and a low productivity period during 1990 to 2001 with intermediate productivity in 1978 and 1989. This pattern was reinforced with the addition of the 2002 PFA_{NA} estimate (Figure 5.10.1.1). A two-phase regression between North American pre-fishery abundance (PFA_{NA}) and lagged spawners (LS_{NA}), assuming a break between the phases occurred during 1989 or 1990, was developed in 2003.

The relative recruit (PFA_{NA}) per spawner (LS_{NA}) has declined from an average of 7.6 during 1977-1989 to an average of 2.3 during the period 1990 to 2002 (Figure 5.10.1.1).

In 2004, a more generalized nested model structure was considered which examined the form of the lagged spawner index and PFA relationship as well as the break years when a phase shift occurred (Table 5.10.1.1). The PFA_{NA} and LS_{NA} variables were natural log transformed before analysis. The linearized form of the model was:

$$Ln(PFA_{NA}) \quad = \quad \alpha + \beta{*}Ph + (\gamma + \delta{*}Ph){*}Ln(LS_{NA}) + \xi$$

Akaike's Information Criterion (AICc) with the adjustment for small sample size (Burnham and Anderson 1998) was used to determine the parsimonious model, i.e. the model that best explains the data while using the fewest parameters. The model and break year combination with the lowest AICc value was retained for forecasting. The AICc is calculated as:

$$AIC_c = -2\log(L(\hat{\theta})) + 2K\left(\frac{n}{n-K-1}\right)$$

where $L(\hat{\theta})$ = likelihood of the parameters given the model and the data

K = number of parameters in the model (including intercept and σ^2)

n = number of observations (26 for 1997 to 2002), and

$\left(\frac{n}{n-K-1}\right)$ = small sample size correction.

The effect of uncertainty in PFA_{NA} and LS_{NA} on the selection of the most parsimonious model and the detection of a phase shift was examined by Monte Carlo simulation. The minimum and maximum values of the PFA_{NA} and lagged spawner variables were calculated from the input data (Figure 5.10.1.2). PFA_{NA} was estimated by random draws from a uniform distribution within the minimum and maximum range of the source data (from Section 4.9.7). The uncertainty in LS_{NA} was characterized by random draws from a uniform distribution within the minimum and maximum range of the regional estimates prior to summation. A total of 10,000 data sets of annual values (1977–2002) of PFA_{NA} and LS_{NA} were generated.

The model and phase shift period combination resulting in the minimum AIC_c was saved for each of the simulated data sets. Over the 10,000 datasets, three models for predicting PFA were retained (Table 5.10.1.2). The lagged spawner index variable was informative for PFA_{NA} in 67% of the simulated data sets. In such cases, the break years describing the phase shift were 1988 and 1989. The simple proportional model with the intercept through the origin was favored more often (43% of all models). In 33% of the data sets, the lagged spawner index was uninformative and the model with two means describing phases in PFA was selected. The corresponding break years were 1991 and 1992 (Table 5.10.1.2).

Determining the probability of the forecast year of interest being in one of the phases

When sequential observations are autocorrelated, previous states may provide a reasonable forecast of the immediate future. In the case of the phases described by the lagged spawner and PFA_{NA} model, it seems reasonable to expect that 2004 will be in the lower phase, as observed over the last ten years. However, to provide a PFA_{NA} for 2004, and a revised value for 2003, a quantification of the probability of being in either phase is required. The approach taken to estimate this probability was to examine the historical changes in Ln(PFA_{NA}) from year t to year t+2. The two-year lag is used because current year PFA (i.e 2003) is not available due to its dependence upon 2SW returns in the next year. These historical observations are used to estimate the possible values of Ln(PFA_{NA}) in the predicted year from the observed Ln(PFA_{NA}) two years earlier under the assumption that the rate of change in PFA_{NA} is stationary over time (Figure 5.10.1.3). Application of these observed rates of change to last year's PFA_{NA} results in a distribution of potential PFA_{NA} values for the forecast year. These values are not used for catch advice, but rather to determine the probability of being in each phase of the two-phase regression. Using the mean square error from the fit model, the probability of any PFA value given a lagged spawner value can be calculated for each regression. Summing and standardizing these probabilities over all the potential PFA_{NA} values for each regression and standardizing produces the probability of being in either phase.

For the 2004 forecast of PFA_{NA}, the probability (runs/10,000) of being in the high phase was negligible (0.5%) and the probability of being in the lower productivity phase was over 99.5% (Table 5.10.1.2). The predicted PFA_{NA} is then a modeled average distribution with random draws of a binomial distribution determining which intercept shift is applied to the lagged spawner variable in the year of interest. This distribution is as a weighted combination of the two possible predicted PFA distributions, with weights determined by the probability of being in each phase.

Stochastic Analyses for North American PFA

Although the exact error bounds for the estimates of pre-fishery abundance (NN1(i)) are unknown, minimum and maximum values of component catch and return estimates have been estimated. Simulation methods, in the software package SAS (SAS Institute, 1996), were used to generate the probability density function of NN1(i) (PFA_{NA}) (Appendix 6). This was done in a six-step procedure as follows:

Step 1: Annual values (1977–2002) of pre-fishery abundance (NN1) were generated assuming a uniform distribution of the minimum to maximum values of input parameters NC1, NC2, and NR2.

Step 2: Annual values (1977-2002) of the new lagged spawner index (LS_{NA}) were generated assuming a uniform distribution of the minimum to maximum values of LS_{NA}.

Step 3: The nested models and break year combinations are fit to the data and the model/break year combination that gave the minimum AICc value was retained.

Step 4: A single pre-fishery forecast value for 2003 or 2004 was obtained by drawing at random from a normal distribution defined by the mean forecast value and the mean square error of the estimate (for a single prediction) from the regression statistics. The year 2003 or 2004 was assigned to one of the phases based on the likelihood of observing a change from PFA levels sufficient to move the stock to an alternate state (see following section). The normal distribution was used because the error structure of the regression (after log transformation) is assumed to be normal.

Step 5: Steps 1-4 are repeated 10,000 times to generate a vector of forecast values from variable model fits and predicted values. This resampling incorporates the uncertainty of the input parameters (steps 1 to 3) and the unexplained variance in pre-fishery abundance from the regression (steps 4 and 5).

Step 6: The probability profile of these stochastic realizations of the pre-fishery abundance forecast was generated from the vector of pre-fishery abundance forecast values obtained in step 5.

These estimates were then used to develop the risk analysis and catch advice presented in Section 5.4. Managers may use this information to determine the relative risks borne by the stock (i.e., not meeting spawning limits S_{lim}) versus the fishery (e.g., reduced catches).

5.10.2 Development and risk assessment of catch options for 2004

The provision of catch advice in a risk framework involves incorporating the uncertainty in all the factors used to develop the catch options. The ranges in the uncertainties of all the factors will result in assessments of differing levels of precision.

The analysis of risk involves four steps: 1) identifying the sources of uncertainty; 2) describing the precision or imprecision of the assessment; 3) defining a management strategy; and 4) evaluating the probability of an event (either desirable or undesirable) resulting from the fishery action. Atlantic salmon are managed with the objective of achieving spawning conservation limits. The undesirable event to be assessed is that the spawning escapement after fisheries will be below the conservation limit.

A composite spawning limit (S_{lim}) for the North American 2SW stock complex was developed by summing the spawning limits of Salmon Fishing Areas in Canada and river basins within the USA. Details on the methodology to estimate and update the spawner limits are provided in (ICES 1996/Assess:11) and in Section 4.4 of this report.

Fisheries are managed for harvests of fish, not for escapes of fish. As such the development of catch advice in a risk analysis framework considers the consequences to the objective of meeting conservation limits in the rivers of North America of catching different quantities of fish. The risk consists of not having sufficient numbers of fish returning after the harvesting has taken place and the evaluation of the risk of not meeting the conservation limits depends upon the degree of uncertainty associated with the predicted number of salmon returning to the rivers to spawn.

The risk analysis of catch options for Atlantic salmon from North America incorporates the following input parameter uncertainties:

1) the uncertainty in attaining the conservation requirements simultaneously in different regions,
2) the uncertainty of the pre-fishery abundance forecast, and
3) the uncertainty in the biological parameters used to translate catches (weight) into numbers of North American origin salmon.

The risk analysis proceeds as illustrated in the Flowchart of Figure 5.10.2.1. The three primary inputs are the PFA_{NA} forecast for the year of the fishery, the harvest level being considered (t of salmon), and the management objectives for the regions of North America. The uncertainty in the PFA_{NA} is accounted for in the re-sampling approach described in Section 5.10.1. The number of fish of North American and European origin in a given catch (t) is conditioned by the continent of origin of the fish ($prop_{NA}$, $prop_E$), by the average weight of the fish in the fishery ($Wt1SW_{NA}$, $Wt1SW_E$) and a correction factor by weight for the other age groups in the fishery (ACF). These parameters define how many fish originating from the NAC and southern NEAC areas will be in the fishery. Since these parameters are not known, they must be borrowed from previous year values. For the 2003 fishery, it was assumed that the parameters for $Wt1SW_{NA}$, $Wt1SW_E$, $prop_{NA}$, and $prop_E$, and the ACF could vary uniformly within the values observed in the past five years (Table 5.10.2.1).

Harvest

For a level of fishery under consideration, the weight of the catch is converted to fish of each continent's origin and subtracted from one of the simulated forecast values of PFA_{NA}. The fish that escape the Greenland fishery are immediately discounted by the fixed sharing fraction (Fna) historically used in the negotiations of the West Greenland fishery. The sharing fraction chosen is the 4:6 West Greenland:North America split. Any sharing fraction can be considered and incorporated at this stage of the risk assessment. After the fishery, fish returning to home waters are discounted for natural mortality from the time they leave West Greenland to the time they return to rivers, a total of 11 months at a rate of M = 0.03 (equates to 28.1% mortality). The fish that survive to homewaters are then distributed among the regions and the total fish escaping to each region is compared to the region's 2SW spawning requirements.

The final step in the risk analysis of the catch options involves combining the conservation requirement with the probability distribution of the returns to North America for different catch options. The returns to North America are partitioned into regional returns based on the regional proportions of lagged spawners for the 1998 to 2002 period. Estimated returns to each region are compared to the conservation objectives of Labrador, Newfoundland, Quebec, and Gulf. Estimated returns for Scotia-Fundy and US are compared to the objective of achieving an improvement of 10% and 25% increase relative to average returns of the base period, 1992 to 1996. The management objectives are shown in Table 5.10.2.1.

Incorporating southern NEAC PFA into catch advice

The Working Group considered a process for the provision of catch advice for West Greenland based on the combined PFA and CLs of the NAC and southern NEAC areas. A procedure for doing this is outlined in Figure 5.10.2.1 in which the PFA for NAC and southern NEAC are applied in parallel to the Greenland fishery and then combined at the end of the process into a single summary plot or catch advice table.

For the southern NEAC evaluation, the following parameter inputs were used.

- The southern NEAC PFA prediction model for MSW salmon from southern Europe and the prediction of PFA_{NEAC} for 2004 are presented in Section 3.6. For 2004, the forecast for the southern Europe MSW salmon on January 1 of the first sea-winter year is 489,477 fish (95% C.I. 304,832 to 785,968).

- Fish returning to home waters are discounted for natural mortality from the time they leave West Greenland to the time they return to rivers, a total of 8 months at a rate of M = 0.03 (equates to 21% mortality).

- The sharing arrangement for the West Greenland fishery used in this example corresponds to the sharing arrangement used for the provision of catch advice for the southern NAC area. Historically, the West Greenland share of the total southern NEAC MSW harvest was on average 40% from 1970 to 1993.

- The biological characteristics of the fish at West Greenland are simultaneously derived for fish from both continents

- The conservation limit for the southern NEAC MSW salmon is 267,898 fish (Table 3.3.3.1)

Critical evaluation

Critical evaluations of updates to the model were documented during the process of developing catch advice. These include:

- Application of the updated model to estimate the 2003 PFA produced a lower estimate (median 99,400) than the estimate provided last year (median 325,000).

- The lagged spawner variable used in the model declines in 2004 to its lowest value and is used to predict PFA using relative spawner abundances that are outside the range of previously observed values. The uncertainty of associations increases as the predictor variable gets farther from the mean, which is the case for the 2004 projection.

- A residual analysis of the model and break year performance indicated that all model formulations overpredicted the estimated PFA in the most recent five years (Figure 5.10.2.2). The phase shifted slope and intercept models had the least bias but these models were picked less frequently.

5.11 NASCO has requested ICES to With respect to stock rebuilding consider and evaluate various alternative baseline measures for use in the risk analysis.

The Working Group had previously used a moving average as baseline value for these increases. However, if a moving average were used, and these stocks continued to decline, so would the baseline value. The Working Group decided to establish 1992 to 1996 as the range of years to define the baseline for the Scotia-Fundy and USA regions to assess PFA_{NA} abundance and fishery options. These years correspond to about one generation time for 2SW salmon, follow the closure of the Newfoundland commercial fishery, reductions in the Labrador commercial fishery, and are prior to the complete moratorium in 1998. This provides NASCO with a consistent criterion to assess performance of the fisheries management being considered.

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

There have been the following significant changes in the management regime at West Greenland since 1993:

- First, NASCO adopted a new management model (Anon 1993) based upon ICES' assessment of the PFA of non-maturing 1SW North American salmon and the spawner escapement requirements for these stocks. This resulted in a substantial reduction in the TAC agreed to by NASCO from 840 t in 1991 to 258 t in 1992, and further reductions in subsequent years.

- The next change in management was the suspension of fishing in 1993 and 1994 following the agreement of compensation payments by the North Atlantic Salmon Fund. Due to the closure of the fishery in the two years no sampling could be carried out in Greenland, and no biological data were collected.

- In 1998, NASCO agreed on a subsistence fishery of 20 t, which in the past has been estimated for internal consumption at Greenland. In 1999, a multi-year management was agreed restricting the annual catch to that amount used for internal consumption.

- An *ad hoc* management arrangement for 2001 was agreed by NASCO, implementing an adaptive quota calculation, based upon three harvest periods. The resulting total quota for all harvest periods was 114 t.

- A revised *ad hoc* management arrangement for 2002 was agreed to by NASCO. In addition, an agreement was negotiated between the North Atlantic Salmon Fund and its partners, and the Greenland Association of Hunters and Fishers (KNAPK), to suspend the commercial part of the salmon fishery. The agreement is for a total of five years, and is automatically renewed annually unless one of the parties gives notice in advance of the fishing season of their intention to withdraw.

- In 2003, NASCO agreed on a subsistence fishery of 20 t, which in the past has been estimated for internal consumption at Greenland. No landing to factories or shops, and no export from Greenland were permitted.

The table produced contains the number of salmon returning to home waters provided no fishing of the given magnitude took place in Greenland. The mean number for 1994-2003 of potentially returning fish per ton caught at Greenland (Table 5.12.1) is calculated to 172 and 83 salmon for North America and Europe, respectively. The biological parameters given in the table represent the annual sampling data.

In the current analysis the effects of the management measures taken at West Greenland have been examined in terms of numbers of fish only. Thus it has been difficult to show direct benefits to home-water stocks from these measures.

Table 5.2.1. A - Lagged spawners achieved, 2SW conservation limits and the PFA number of fish required to meet region specific conservation limits if the returns to the regions are in proportion to the average lagged spawner distributions of 1998 to 2002. **B** - 2SW returns to the regions of North America for two time perioids, 1992-1996, 1999-2003. **C** – Management objectives for the NAC area used to develop the risk analysis of catch options for the 2004 fishery.

A - Achieved lagged spawners

Year of PFA	Labrador	NF	Quebec	Gulf	Scotia-Fundy	US	North America	LS Index
1998	6285	4337	21312	39005	6080	1613	78632	72347
1999	9930	3404	19459	33680	5764	2152	74389	64459
2000	14098	4219	22055	32847	7845	1893	82958	68860
2001	22118	5307	22898	25088	6056	1575	83042	60924
2002	22527	5786	20286	20664	4133	1303	74697	52171
2003	.	6202	18121	14960	4525	1439	.	45246
2004	.	6202	18894	13829	3952	1518	.	44394
% of North America (1998-2002)								
	19.0	5.9	26.9	38.4	7.6	2.2		
% of Lagged Spawner Index (1998-2004)								
	.	8.7	35.0	44.1	9.4	2.8		
2SW Conservation Limit								
Number of fish	34,746	4,022	29,446	30,430	24,705	29,199	152,548	
% of NA	22.8	2.6	19.3	19.9	16.2	19.1		
Spawner Reserve corrected for 11 months of M at 0.03 per month							212,189	
PFA required to meet regional 2SW conservation limit based on average lagged spawner contributions 1998-2002								
	253,860	92,722	147,623	106,902	439,452	1,817,776		

B - 2SW Returns to Regions

	Labrador	NF	Quebec	Gulf	Scotia-Fundy	US	North America
1992-1996	18380	4689	42905	34450	7129	1868	117679
1999-2003	.	5067	29158	18559	3884	838	.

C - Management objectives for the NAC area

	Northern regions				Southern regions		
	Labrador	NF	Quebec	Gulf	Scotia-Fundy	US	
	2SW Conservation Limit				Average returns during base period 1992-1996		
Number of fish	34,746	4,022	29,446	30,430	7129	1868	
	2SW Conservation Limit				Increase relative to base period		
Total	98644				7,842	2,055	+10%
					8,911	2,336	+25%

Table 5.4.1. Probability of meeting the 2SW conservation limits simultaneously in the four northern areas of North America (Labrador, Newfoundland, Quebec, Gulf); of achieving increases in returns from the 1992 to 1996 base year average in the two southern areas (Scotia-Fundy and USA) of NAC area, of meeting the MSW conservation limit of the southern European stock complex relative to quota options for West Greenland. A sharing arrangement of 40:60 (Fna) of the salmon from North America and southern European MSW stocks was assumed.

West Greenland Harvest (t)	Simultaneous Conservation (Lab, NF, Queb, Gulf)	Improvement (SF, USA) of Returns in 2004 > 10%	Improvement (SF, USA) of Returns in 2004 > 25%	Conservation MSW Salmon Southern NEAC
0	0.05	0.01	0.01	0.73
5	0.05	0.01	0.01	0.73
10	0.05	0.01	0.01	0.73
15	0.04	0.01	0.01	0.72
20	0.04	0.01	0.01	0.72
25	0.04	0.01	0.01	0.71
30	0.04	0.01	0.01	0.71
35	0.04	0.01	0.01	0.71
40	0.03	0.01	0.00	0.70
45	0.03	0.01	0.00	0.70
50	0.03	0.01	0.00	0.69
100	0.02	0.01	0.00	0.66

Table 5.4.2. Probability of 2SW returns in 2005 being less than the previous five-year average (1999 to 2003) returns to regions of North America, relative to catch options at West Greenland.

West Greenland Harvest Tons	Probability
0	0.73
5	0.75
10	0.77
15	0.78
20	0.80
25	0.81
30	0.83
35	0.84
40	0.85
45	0.86
50	0.87
100	0.93

Table 5.9.1.1. Nominal catches of salmon, West Greenland 1977-2003 (metric tons round fresh weight).

Year	Total	Quota
1977	1,420	1,191
1978	984	1,191
1979	1,395	1,191
1980	1,194	1,191
1981	1,264	1,265[2]
1982	1,077	1,253[2]
1983	310	1,191
1984	297	870
1985	864	852
1986	960	909
1987	966	935
1988	893	-[3]
1989	337	-[3]
1990	274	-[3]
1991	472	840
1992	237	258[4]
1993	0[1]	89[5]
1994	0[1]	137[5]
1995	83	77
1996	92	174[4]
1997	58	57
1998	11	20[6]
1999	19	20[6]
2000	21	20[6]
2001	43	114[7]
2002	9[10]	55[5,8,9,10]
2003	9[10]	20[6,8,10]

[1] The fishery was suspended.
[2] Quota corresponds to specific opening dates of the fishery.
[3] Quota for 1988-90 was 2,520 t with an opening date of 1 August and annual catches not to exceed the annual average (840 t) by more than 10%. Quota adjusted to 900 t in 1989 and 924 t in 1990 for later opening dates.
[4] Set by Greenland authorities.
[5] Quotas were bought out.
[6] Fishery restricted to catches used for internal consumption in Greenland.
[7] Calculated final quota in *ad hoc* management system.
[8] No factory landing allowed.
[9] Maximum allowable catch
[10] For the assessments the Working Group used higher catch figures for 2002 and 2003, based on information from the sampling programme.

Table 5.9.1.2. Distribution of nominal catches (metric tons) by Greenland vessels (1977-2003).

Year	NAFO Division							Tot West	East	Total
	1A	1B	1C	1D	1E	1F	NK	Greenland	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

[1]) The fishery was suspended
+) Small catches <0.5 t
-) No catch

Table 5.9.2.1. Annual mean fork lengths (cm) and whole weights (kg) of Atlantic salmon caught at West Greenland, 1969-1992 and 1995-2003. NA = North America; E = Europe.

	Whole weight (kg)									Fork length (cm)			
	Sea age & origin									Sea age & origin			
	1SW		2SW		PS		All sea ages		TOTAL	1SW		2SW	
Year	NA	E	NA	E	NA	E	NA	EU		NA	E	NA	E
1969	3.12	3.76	5.48	5.80	-	5.13	3.25	3.86	3.58	65.0	68.7	77.0	80.3
1970	2.85	3.46	5.65	5.50	4.85	3.80	3.06	3.53	3.28	64.7	68.6	81.5	82.0
1971	2.65	3.38	4.30	-	-	-	2.68	3.38	3.14	62.8	67.7	72.0	-
1972	2.96	3.46	5.85	6.13	2.65	4.00	3.25	3.55	3.44	64.2	67.9	80.7	82.4
1973	3.28	4.54	9.47	10.00	-	-	3.83	4.66	4.18	64.5	70.4	88.0	96.0
1974	3.12	3.81	7.06	8.06	3.42	-	3.22	3.86	3.58	64.1	68.1	82.8	87.4
1975	2.58	3.42	6.12	6.23	2.60	4.80	2.65	3.48	3.12	61.7	67.5	80.6	82.2
1976	2.55	3.21	6.16	7.20	3.55	3.57	2.75	3.24	3.04	61.3	65.9	80.7	87.5
1977	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	2.96	3.50	7.00	7.90	2.45	6.60	3.04	3.53	3.35	63.7	67.3	83.6	-
1979	2.98	3.50	7.06	7.60	3.92	6.33	3.12	3.56	3.34	63.4	66.7	81.6	85.3
1980	2.98	3.33	6.82	6.73	3.55	3.90	3.07	3.38	3.22	64.0	66.3	82.9	83.0
1981	2.77	3.48	6.93	7.42	4.12	3.65	2.89	3.58	3.17	62.3	66.7	82.8	84.5
1982	2.79	3.21	5.59	5.59	3.96	5.66	2.92	3.43	3.11	62.7	66.2	78.4	77.8
1983	2.54	3.01	5.79	5.86	3.37	3.55	3.02	3.14	3.10	61.5	65.4	81.1	81.5
1984	2.64	2.84	5.84	5.77	3.62	5.78	3.20	3.03	3.11	62.3	63.9	80.7	80.0
1985	2.50	2.89	5.42	5.45	5.20	4.97	2.72	3.01	2.87	61.2	64.3	78.9	78.6
1986	2.75	3.13	6.44	6.08	3.32	4.37	2.89	3.19	3.03	62.8	65.1	80.7	79.8
1987	3.00	3.20	6.36	5.96	4.69	4.70	3.10	3.26	3.16	64.2	65.6	81.2	79.6
1988	2.83	3.36	6.77	6.78	4.75	4.64	2.93	3.41	3.18	63.0	66.6	82.1	82.4
1989	2.56	2.86	5.87	5.77	4.23	5.83	2.77	2.99	2.87	62.3	64.5	80.8	81.0
1990	2.53	2.61	6.47	5.78	3.90	5.09	2.67	2.72	2.69	62.3	62.7	83.4	81.1
1991	2.42	2.54	5.82	6.23	5.15	5.09	2.57	2.79	2.65	61.6	62.7	80.6	82.2
1992	2.54	2.66	6.49	6.01	4.09	5.28	2.86	2.74	2.81	62.3	63.2	83.4	81.1
1993	-	-	-	-	-	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-	-	-	-	-	-
1995	2.37	2.67	6.09	5.88	3.71	4.98	2.45	2.75	2.56	61.0	63.2	81.3	81.0
1996	2.63	2.86	6.50	6.30	4.98	5.44	2.83	2.90	2.88	62.8	64.0	81.4	81.1
1997	2.57	2.82	7.95	6.11	4.82	6.90	2.63	2.84	2.71	62.3	63.6	85.7	84.0
1998	2.72	2.83	6.44	-	3.28	4.77	2.76	2.84	2.78	62.0	62.7	84.0	-
1999	3.02	3.03	7.59	-	4.20	-	3.09	3.03	3.08	63.8	63.5	86.6	-
2000	2.47	2.81	-	-	2.58	-	2.47	2.81	2.57	60.7	63.2	-	-
2001	2.89	3.03	6.76	5.96	4.41	4.06	2.95	3.09	3.00	63.1	63.7	81.7	79.1
2002	2.84	2.92	7.12	-	5.00	-	2.89	2.92	2.90	62.6	62.1	83.0	-
2003	2.94	3.08	8.82	5.58	4.04	-	3.02	3.10	3.04	63.0	64.4	86.1	78.3

Table 5.9.2.2. River age distribution (%) and mean river age for all North American origin salmon caught at West Greenland, 1968-1992 and 1995-2003.

Year	River age 1	2	3	4	5	6	7	8	Mean age
North American origin									
1968	0.3	19.6	40.4	21.3	16.2	2.2	0.0	0.0	3.4
1969	0.0	27.1	45.8	19.6	6.5	0.9	0.0	0.0	3.1
1970	0.0	58.1	25.6	11.6	2.3	2.3	0.0	0.0	2.6
1971	1.2	32.9	36.5	16.5	9.4	3.5	0.0	0.0	3.1
1972	0.8	31.9	51.4	10.6	3.9	1.2	0.4	0.0	2.9
1973	2.0	40.8	34.7	18.4	2.0	2.0	0.0	0.0	2.8
1974	0.9	36.0	36.6	12.0	11.7	2.6	0.3	0.0	3.1
1975	0.4	17.3	47.6	24.4	6.2	4.0	0.0	0.0	3.3
1976	0.7	42.6	30.6	14.6	10.9	0.4	0.4	0.0	3.0
1977	-	-	-	-	-	-	-	-	-
1978	2.7	31.9	43.0	13.6	6.0	2.0	0.9	0.0	3.0
1979	4.2	39.9	40.6	11.3	2.8	1.1	0.1	0.0	2.7
1980	5.9	36.3	32.9	16.3	7.9	0.7	0.1	0.0	2.9
1981	3.5	31.6	37.5	19.0	6.6	1.6	0.2	0.0	3.0
1982	1.4	37.7	38.3	15.9	5.8	0.7	0.0	0.2	2.9
1983	3.1	47.0	32.6	12.7	3.7	0.8	0.1	0.0	2.7
1984	4.8	51.7	28.9	9.0	4.6	0.9	0.2	0.0	2.6
1985	5.1	41.0	35.7	12.1	4.9	1.1	0.1	0.0	2.7
1986	2.0	39.9	33.4	20.0	4.0	0.7	0.0	0.0	2.9
1987	3.9	41.4	31.8	16.7	5.8	0.4	0.0	0.0	2.8
1988	5.2	31.3	30.8	20.9	10.7	1.0	0.1	0.0	3.0
1989	7.9	39.0	30.1	15.9	5.9	1.3	0.0	0.0	2.8
1990	8.8	45.3	30.7	12.1	2.4	0.5	0.1	0.0	2.6
1991	5.2	33.6	43.5	12.8	3.9	0.8	0.3	0.0	2.8
1992	6.7	36.7	34.1	19.1	3.2	0.3	0.0	0.0	2.8
1993	-	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-	-
1995	2.4	19.0	45.4	22.6	8.8	1.8	0.1	0.0	3.2
1996	1.7	18.7	46.0	23.8	8.8	0.8	0.1	0.0	3.2
1997	1.3	16.4	48.4	17.6	15.1	1.3	0.0	0.0	3.3
1998	4.0	35.1	37.0	16.5	6.1	1.1	0.1	0.0	2.9
1999	2.7	23.5	50.6	20.3	2.9	0.0	0.0	0.0	3.0
2000	3.2	26.6	38.6	23.4	7.6	0.6	0.0	0.0	3.1
2001	1.9	15.2	39.4	32.0	10.8	0.7	0.0	0.0	3.4
2002	0.6	26.7	44.8	16.9	10.1	0.9	0.0	0.0	3.1
2003	2.6	28.9	39.0	21.0	7.6	1.1	0.0	0.0	3.1
Mean	2.9	33.4	38.3	17.3	6.8	1.3	0.1	0.0	3.0

cont.

Table 5.9.2.2. cont. River age distribution (%) and mean river age for all European origin salmon caught at West Greenland, 1968-1992 and 1995-2003.

	River age								Mean
Year	1	2	3	4	5	6	7	8	age
European origin									
1968	21.6	60.3	15.2	2.7	0.3	0.0	0.0	0.0	2.0
1969	0.0	83.8	16.2	0.0	0.0	0.0	0.0	0.0	2.2
1970	0.0	90.4	9.6	0.0	0.0	0.0	0.0	0.0	2.1
1971	9.3	66.5	19.9	3.1	1.2	0.0	0.0	0.0	2.2
1972	11.0	71.2	16.7	1.0	0.1	0.0	0.0	0.0	2.1
1973	26.0	58.0	14.0	2.0	0.0	0.0	0.0	0.0	1.9
1974	22.9	68.2	8.5	0.4	0.0	0.0	0.0	0.0	1.9
1975	26.0	53.4	18.2	2.5	0.0	0.0	0.0	0.0	2.0
1976	23.5	67.2	8.4	0.6	0.3	0.0	0.0	0.0	1.9
1977	-	-	-	-	-	-	-	-	-
1978	26.2	65.4	8.2	0.2	0.0	0.0	0.0	0.0	1.8
1979	23.6	64.8	11.0	0.6	0.0	0.0	0.0	0.0	1.9
1980	25.8	56.9	14.7	2.5	0.2	0.0	0.0	0.0	1.9
1981	15.4	67.3	15.7	1.6	0.0	0.0	0.0	0.0	2.0
1982	15.6	56.1	23.5	4.2	0.7	0.0	0.0	0.0	2.2
1983	34.7	50.2	12.3	2.4	0.3	0.1	0.1	0.0	1.8
1984	22.7	56.9	15.2	4.2	0.9	0.2	0.0	0.0	2.0
1985	20.2	61.6	14.9	2.7	0.6	0.0	0.0	0.0	2.0
1986	19.5	62.5	15.1	2.7	0.2	0.0	0.0	0.0	2.0
1987	19.2	62.5	14.8	3.3	0.3	0.0	0.0	0.0	2.0
1988	18.4	61.6	17.3	2.3	0.5	0.0	0.0	0.0	2.1
1989	18.0	61.7	17.4	2.7	0.3	0.0	0.0	0.0	2.1
1990	15.9	56.3	23.0	4.4	0.2	0.2	0.0	0.0	2.2
1991	20.9	47.4	26.3	4.2	1.2	0.0	0.0	0.0	2.2
1992	11.8	38.2	42.8	6.5	0.6	0.0	0.0	0.0	2.5
1993	-	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-	-
1995	14.8	67.3	17.2	0.6	0.0	0.0	0.0	0.0	2.0
1996	15.8	71.1	12.2	0.9	0.0	0.0	0.0	0.0	2.0
1997	4.1	58.1	37.8	0.0	0.0	0.0	0.0	0.0	2.3
1998	28.6	60.0	7.6	2.9	0.0	1.0	0.0	0.0	1.9
1999	27.7	65.1	7.2	0.0	0.0	0.0	0.0	0.0	1.8
2000	36.5	46.7	13.1	2.9	0.7	0.0	0.0	0.0	1.8
2001	16.0	51.2	27.3	4.9	0.7	0.0	0.0	0.0	2.2
2002	10.1	65.2	18.4	6.3	0.0	0.0	0.0	0.0	2.2
2003	16.2	58.1	22.1	3.0	0.7	0.0	0.0	0.0	2.1
Mean	18.7	61.6	17.0	2.4	0.3	0.0	0.0	0.0	2.0

Table 5.9.2.3. Sea-age composition (%) of samples from commercial catches at West Greenland, 1985-2003.

Year	North American			European		
	1SW	2SW	Previous Spawners	1SW	2SW	Previous spawners
1985	92.5	7.2	0.3	95.0	4.7	0.4
1986	95.1	3.9	1.0	97.5	1.9	0.6
1987	96.3	2.3	1.4	98.0	1.7	0.3
1988	96.7	2.0	1.2	98.1	1.3	0.5
1989	92.3	5.2	2.4	95.5	3.8	0.6
1990	95.7	3.4	0.9	96.3	3.0	0.7
1991	95.6	4.1	0.4	93.4	6.5	0.2
1992	91.9	8.0	0.1	97.5	2.1	0.4
1993	-	-	-	-	-	-
1994	-	-	-	-	-	-
1995	96.8	1.5	1.7	97.3	2.2	0.5
1996	94.1	3.8	2.1	96.1	2.7	1.2
1997	98.2	0.6	1.2	99.3	0.4	0.4
1998[1]	96.8	0.5	2.7	99.4	0.0	0.6
1999[1]	96.8	1.2	2.0	100.0	0.0	0.0
2000[1]	97.4	0.0	2.6	100.0	0.0	0.0
2001	98.2	1.3	0.5	97.8	2.0	0.3
2002[1]	97.3	0.9	1.8	100.0	0.0	0.0
2003[1]	96.7	1.0	2.3	98.9	1.1	0.0

[1] Catches for local consumption only.

Table 5.9.3.1. Size of biological samples and percentage (by number) of North American and European salmon in research vessel catches at West Greenland (1969-82), from commercial samples (1978-92, 1995-97 and 2001), and from local consumption samples (1998-2000 and 2002-03).

		Sample size		Continent of origin (%)			
Source	Year	Length	Scales	NA	(95%CI)[1]	E	(95%CI)[1]
Research	1969	212	212	51	(57,44)	49	(56,43)
	1970	127	127	35	(43,26)	65	(75,57)
	1971	247	247	34	(40,28)	66	(72,50)
	1972	3,488	3,488	36	(37,34)	64	(66,63)
	1973	102	102	49	(59,39)	51	(61,41)
	1974	834	834	43	(46,39)	57	(61,54)
	1975	528	528	44	(48,40)	56	(60,52)
	1976	420	420	43	(48,38)	57	(62,52)
	1977	-	-	45	-	55	-
	1978[2]	606	606	38	(41,34)	62	(66,59)
	1978[3]	49	49	55	(69,41)	45	(59,31)
	1979	328	328	47	(52,41)	53	(59,48)
	1980	617	617	58	(62,54)	42	(46,38)
	1982	443	443	47	(52,43)	53	(58,48)
Commercial	1978	392	392	52	(57,47)	48	(53,43)
	1979	1,653	1,653	50	(52,48)	50	(52,48)
	1980	978	978	48	(51,45)	52	(55,49)
	1981	4,570	1,930	59	(61,58)	41	(42,39)
	1982	1,949	414	62	(64,60)	38	(40,36)
	1983	4,896	1,815	40	(41,38)	60	(62,59)
	1984	7,282	2,720	50	(53,47)	50	(53,47)
	1985	13,272	2,917	50	(53,46)	50	(54,47)
	1986	20,394	3,509	57	(66,48)	43	(52,34)
	1987	13,425	2,960	59	(63,54)	41	(46,37)
	1988	11,047	2,562	43	(49,38)	57	(62,51)
	1989	9,366	2,227	56	(60,52)	44	(48,40)
	1990	4,897	1,208	75	(79,70)	25	(30,21)
	1991	5,005	1,347	65	(69,61)	35	(39,31)
	1992	6,348	1,648	54	(57,50)	46	(50,43)
	1995	2,045	2,045	68	(72,65)	32	(35,28)
	1996	3,341	1,297	73	(76,71)	27	(29,24)
	1997	794	282	80	(84,75)	20	(25,16)
Local cons.	1998	540	406	79	(84,73)	21	(27,16)
	1999	532	532	90	(97,84)	10	(16,3)
	2000	491	491	70	[4]	30	[4]
Commercial	2001	2,896	1,718	69	(72,67)	31	(33,29)
Local cons.	2002	1,326	501	68	[4]	33	[4]
	2003	1,823	1,823	68	[5]	32	[5]

[1] CI – confidence interval calculated by method of Pella and Robertson (1979) for 1984 -86 and by binomial for the others, except 1997 when percentages extrapolated.

[2] During Fishery.

[3] Research samples after fishery closed.

[4] Determined by genetic analysis to be 100% correct

[5] Determined by genetic analysis only

Table 5.9.3.2. The weighted percentages and numbers of North American and European Atlantic salmon caught at West Greenland 1982-1992 and 1995-2003. Numbers are rounded to the nearest hundred fish.

	Percentages weighted by catch in numbers		Numbers of salmon caught	
Year	NA	E	NA	E
1982	57	43	192,200	143,800
1983	40	60	39,500	60,500
1984	54	46	48,800	41,200
1985	47	53	143,500	161,500
1986	59	41	188,300	131,900
1987	59	41	171,900	126,400
1988	43	57	125,500	168,800
1989	55	45	65,000	52,700
1990	74	26	62,400	21,700
1991	63	37	111,700	65,400
1992	55	45	46,900	38,500
1993	-	-	-	-
1994	-	-	-	-
1995	67	33	21,400	10,700
1996	70	30	22,400	9,700
1997	85	15	18,000	3,300
1998	79	21	3,100	900
1999	91	9	5,700	600
2000	65	35	5,100	2,700
2001	67	33	9,400	4,700
2002	69	31	2,300	1,000
2003	64	36	2,600	1,400

Table 5.10.1.1. Reference number, formula, and brief description of the nested models included in the approach to modelling lagged spawner index and PFA_{NA} encompassing a possible phase shift relative recruitment per spawner.

Number	*Function* $Ln(PFA_{NA})$ =	*Model description*
0	$\mu + \xi$	*A single mean PFA_{NA}; No phases or lagged spawner index variable*
1	$\alpha + \gamma * Ln(LS_{NA}) + \xi$	*A single regression of PFA_{NA} on lagged spawner index*
2	$\beta * Ph + \xi$	*Two means of PFA_{NA} for the two phases; no lagged spawner index variable*
3,4,5	$\alpha + \beta * Ph + (\gamma + \delta * Ph) * Ln(LS_{NA}) + \xi$	*Two regressions of PFA_{NA} on lagged spawner index with possible variations in slopes and intercepts*
6	$\alpha + \beta * Ph + Ln(LS) + \xi$	*Two regressions of PFA_{NA} on lagged spawner index with intercept trough the origin*

PFA_{NA} = PFA for North America (1977 to 2002)
LS_{NA} = Lagged spawner index excluding Labrador (1977 to 2002)
Ph = Phase (indicator variable representing two time periods)
α, β, γ, δ = coefficients of the slope and intercept variables
ξ = residual error, normal
phase shift periods: ranging from 1977-1985 and 1986-2002 to 1977-1993 and 1994-2002

Table 5.10.1.2. Summary of model and break year selections for PFA prediction for 2004, based on 10,000 simulations. Break year refers to last year in high phase.

	Models								
Break	Mean by phase		Intercept at origin – slope by phase		Intercept and slope by phase		By phase		By
Year	High	Low	High	Low	High	Low	High	Low	Year
1988				898	28	1123	28	2021	2049
1989				2304	20	930	20	3234	3254
1990				115		27		142	142
1991		2102		810		228		3140	3140
1992		1168		210		37		1415	1415
Total	0	3270	0	4337	48	2345			10000
By model	3270		4337		2393				
By phase							48	9952	

Table 5.10.2.1. Input parameters and management objectives for the risk analysis of catch advice for the West Greenland salmon fishery for 2004.

Biological characteristics in the fishery			
Time period	1999 to 2003		
		Minimum	Maximum
Proportion NA		0.65	0.91
Proprtion European		0.09	0.35
Mean weight 1SW NA		2.47	3.02
Mean weight 1SW NEAC		2.81	3.08
Age Correction Factor		1.017	1.050
Conservation spawning objectives (2SW fish)			
Labrador	34746		
Newfoundland	4022		
Quebec	29446		
Gulf	30430		
Scotia-Fundy	24705		
USA	29199		
Alternative management objectives – return of 2SW salmon			
	Mean	Minimum	Maximum
Base period	1992 to 1996		
Scotia-Fundy	7127	5579	8549
USA	1868	1346	2407
Recent five-year period	1998 to 2002		
Labrador[1]	*37748*	*12260*	*67139*
Newfoundland	5054	2357	7901
Quebec	29152	25405	32849
Gulf	18582	12665	23961
Scotia-Fundy	3886	2744	5008
USA	838	511	1192

[1] Labrador returns are derived from a ratio of Labrador to all of North America during 1971 to 1998

Table 5.12.1. Number of salmon returning to home waters provided no fishery took place at Greenland 1994-2003. The average number of potentially returning salmon per ton caught in Greenland is also given.

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Nominal catch at Greenland (tons) [1]:	137.0	82.7	92.1	58.2	11.1	19.0	20.5	42.5	9.8	12.3
Proportion of NA fish in catch (PropNA):	0.540	0.670	0.732	0.850	0.785	0.910	0.650	0.670	0.690	0.640
Proportion of EU fish in catch (PropEU):	0.460	0.330	0.268	0.150	0.215	0.090	0.350	0.330	0.310	0.360
Mean weight, NA fish, all sea ages (kg):	2.655	2.450	2.830	2.630	2.760	3.090	2.470	2.950	2.890	3.020
Mean weight, EU fish, all sea ages (kg):	2.745	2.750	2.900	2.840	2.840	3.030	2.810	3.090	2.920	3.100
Mean weight of all sea ages (NA+EU fish):	2.696	2.549	2.849	2.662	2.777	3.085	2.589	2.996	2.899	3.049
Proportion of 1SW NA-fish in catch:	0.919	0.968	0.941	0.982	0.968	0.968	0.974	0.982	0.973	0.967
Catch of 1SW NA fish:	25607	21892	22417	18471	3056	5416	5254	9479	2269	2523
Catch of 1SW EU fish:	21098	9606	8009	3019	813	546	2487	4457	1009	1383
Natural mortality during migration to NA:	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Natural mortality during migration to EU:	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Additional fish if no fishery at Greenland:										
2SW fish returning to NA (numbers):	**18410**	**15739**	**16116**	**13279**	**2197**	**3894**	**3778**	**6815**	**1632**	**1814**
Percent of conservation limit [2]:	**12.1**	**10.3**	**10.6**	**8.7**	**1.4**	**2.6**	**2.5**	**4.5**	**1.1**	**1.2**
2SW fish returning to EU (numbers):	**16597**	**7557**	**6300**	**2375**	**640**	**430**	**1956**	**3506**	**794**	**1088**
Percent of conservation limit [3]:	**6.2**	**2.8**	**2.4**	**0.9**	**0.2**	**0.2**	**0.7**	**1.3**	**0.3**	**0.4**

[1] Figure for 1994 correspond to calculated quotas. Figures for 2002 and 2003 were adjusted by the WG

[2] Conservation limit for NA: 152,548

[3] Conservation limit for Southern Europe: 267,894

Average number of salmon potentially returning to home waters per ton caught in Greenland:	
2SW fish returning to NA (numbers per ton, 10 year average):	**172**
2SW fish returning to EU (numbers per ton, 10 year average):	**85**

Figure 5.2.1. Average lagged spawners in the six regions of North America for the PFA years 1998 to 2002 and the 2SW spawner requirement in each region expressed as a proportion of the total for North America.

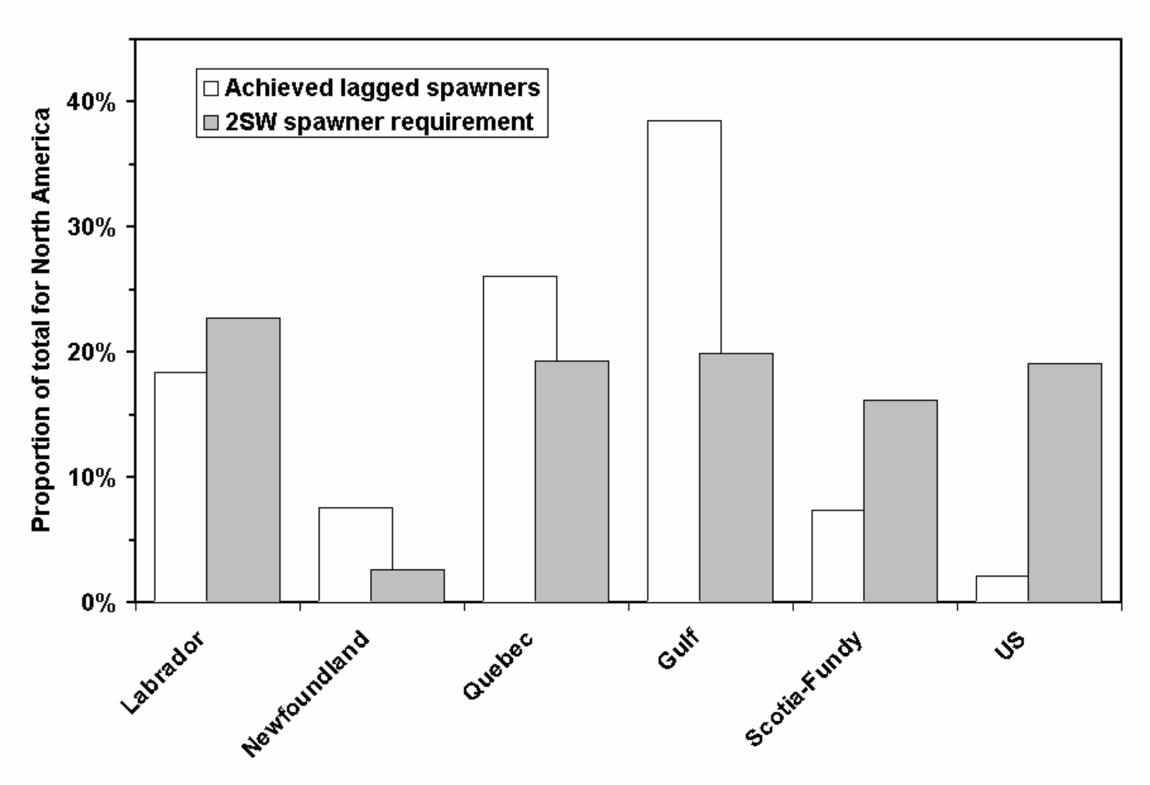
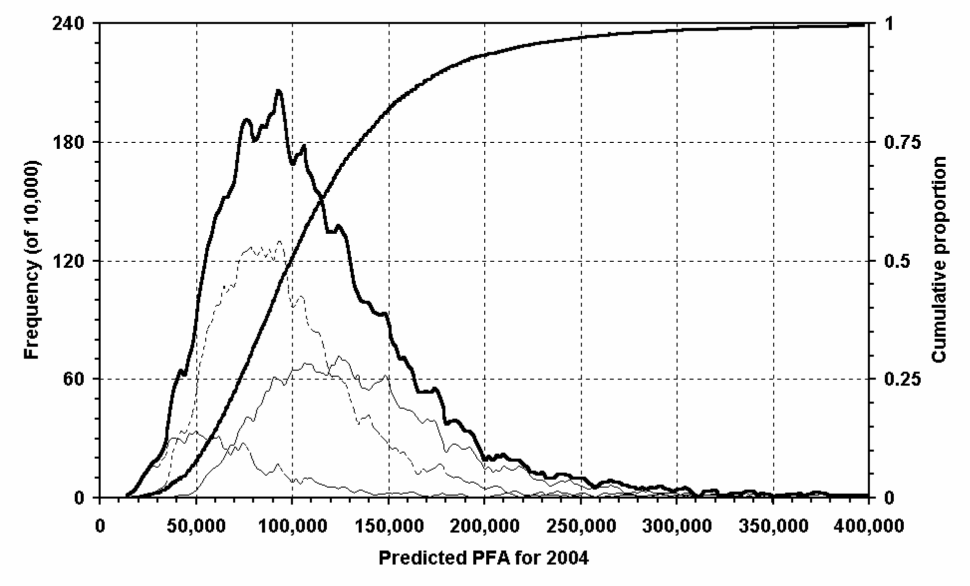
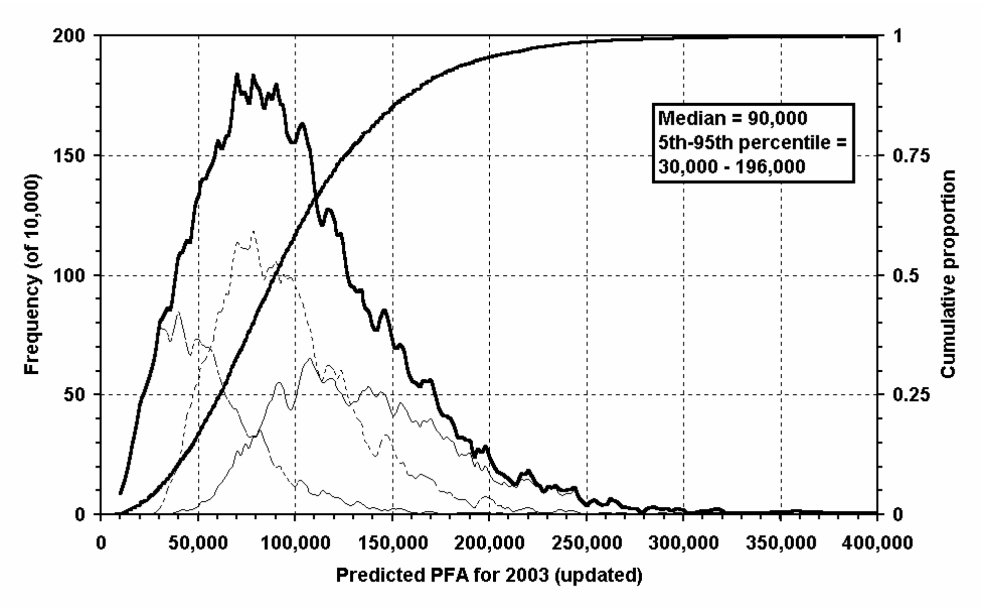


Figure 5.4.1. PFA_{NA} forecast estimate distribution for the year 2004 non-maturing 1SW salmon.



Percentile	Estimate
5	45,148
10	54,857
15	61,901
20	68,289
25	73,642
30	79,073
35	84,538
40	89,519
45	94,471
50	100,357
55	106,096
60	112,263
65	119,408
70	126,784
75	136,006

Figure 5.8.1. Revised PFA_{NA} estimated distribution for the 2003 PFA year using the updated data and nested model selection approach of 2004 (upper panel) and PFA forecast distribution using the previous year's formulation (lower panel).



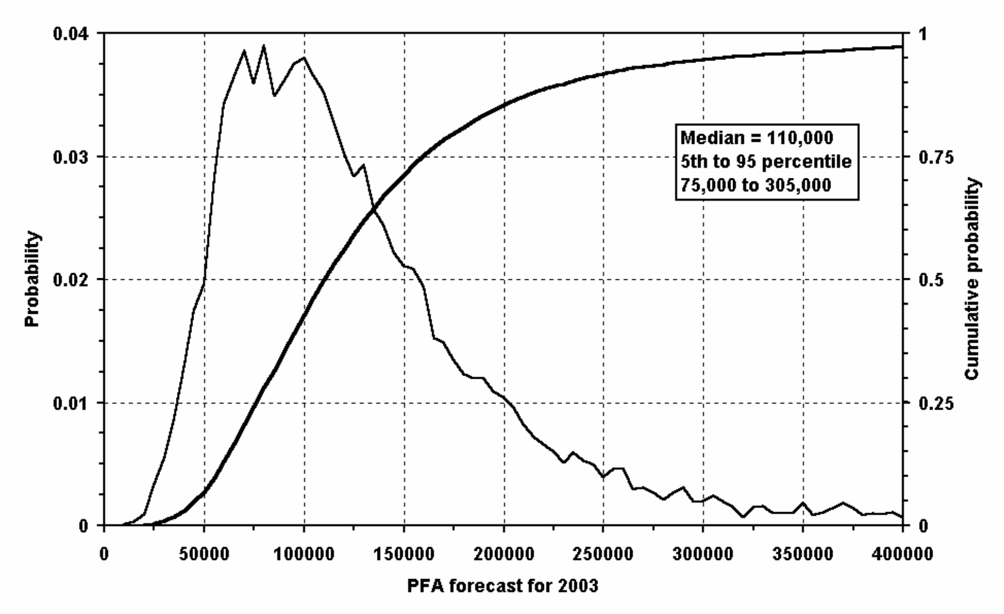


Figure 5.9.1. West Greenland NAFO divisions.

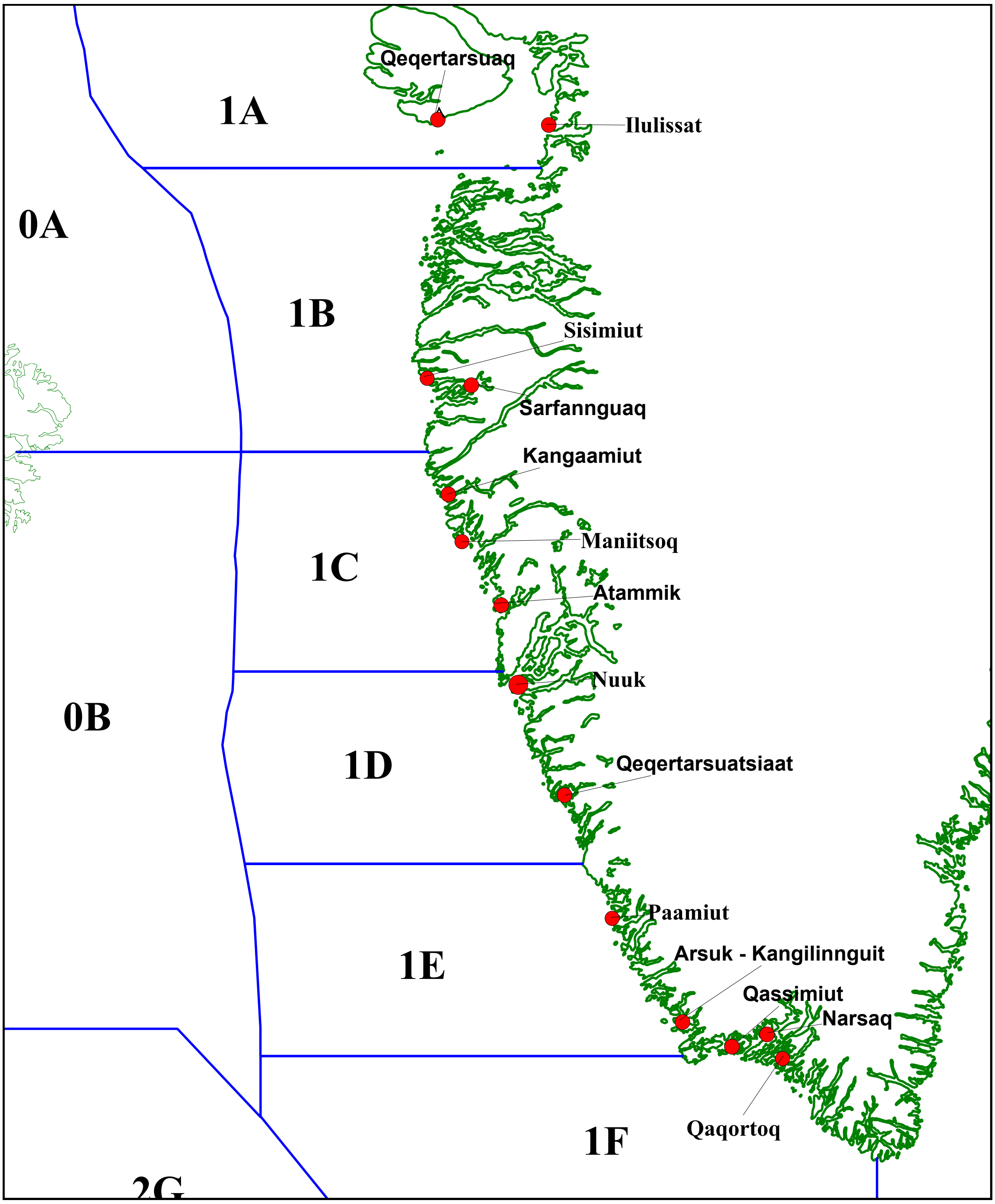


Figure 5.9.3.1. Number of North American and European salmon caught at West Greenland 1982-1992 and 1995-2003.

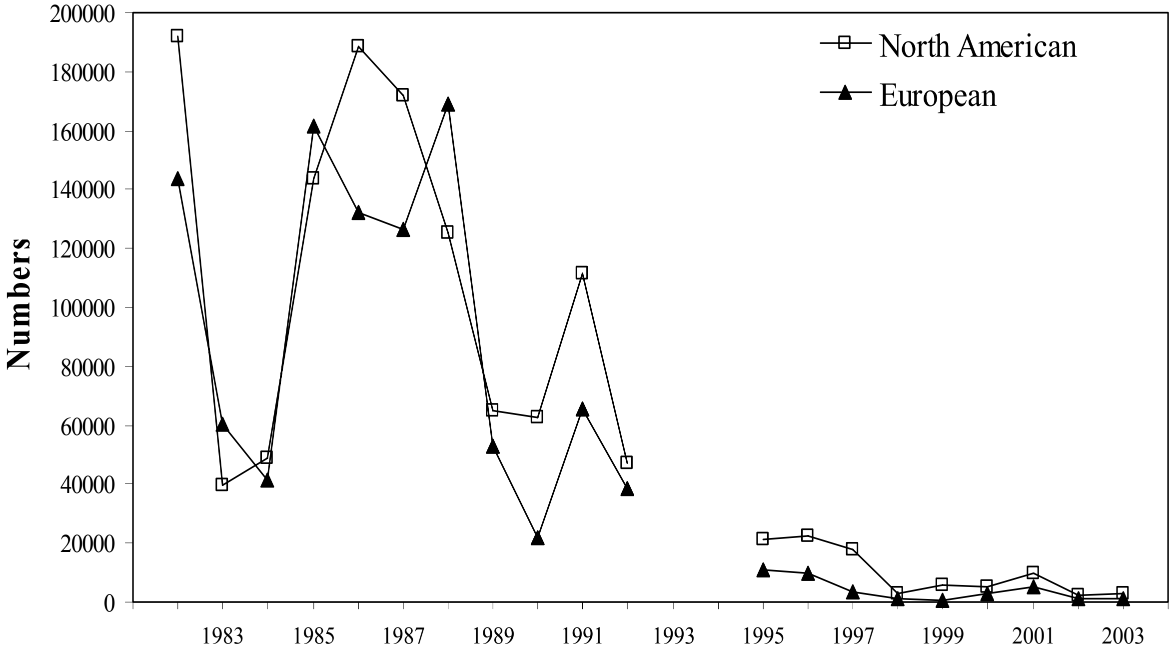
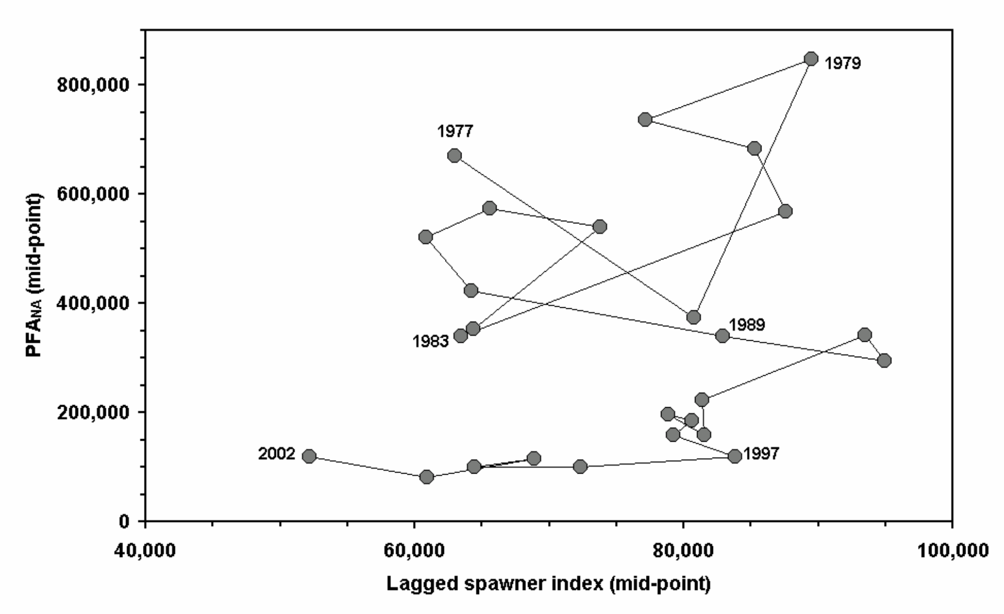


Figure 5.10.1.1. PFA (mid-point) and lagged spawner (mid-point) association for the NAC area showing the sequence from 1977 to 2002 (upper panel) and the relative change of the Ln(PFA) (recruit) to Ln(LS) (lagged spawner index) over the time series (lower panel).



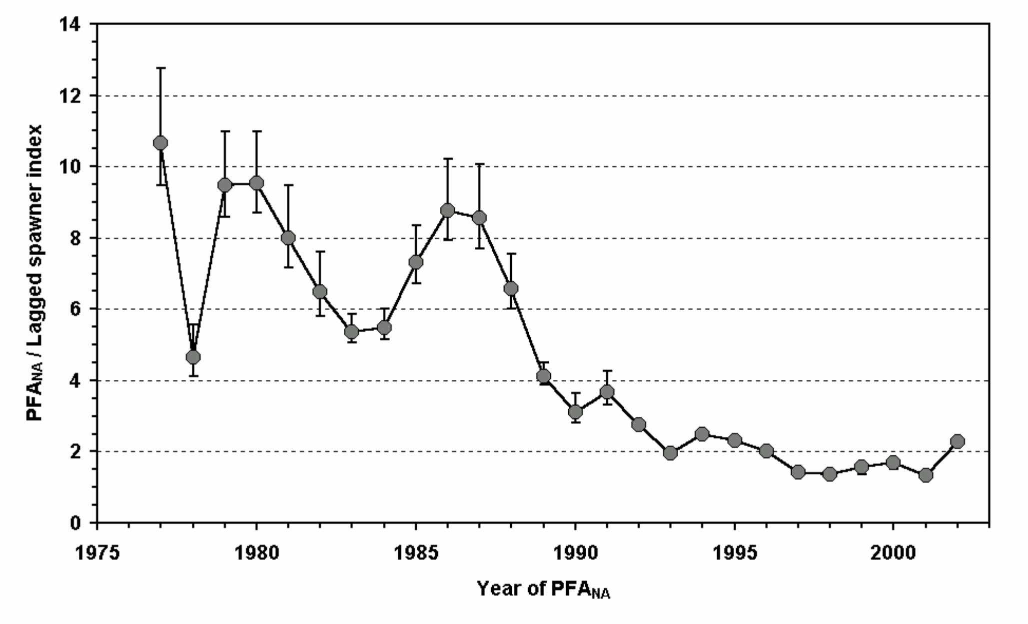
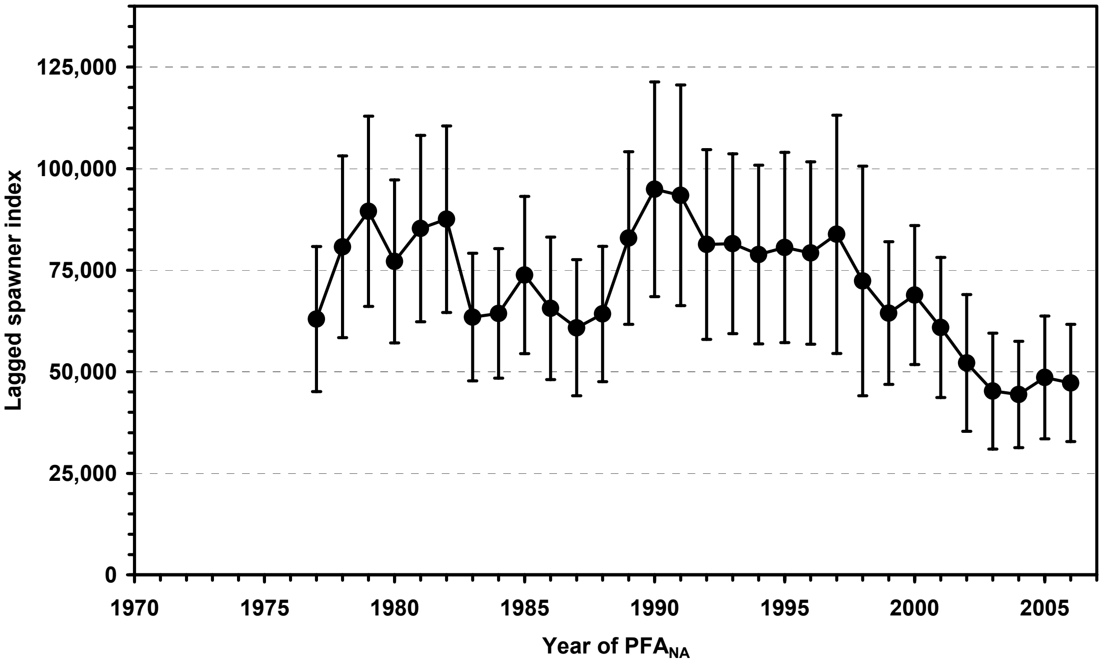


Figure 5.10.1.2. Midpoints and error bars (minimum to maximum range) of lagged spawner index (upper) and PFA (lower) used in the forecasting of PFA abundance for the NAC area.



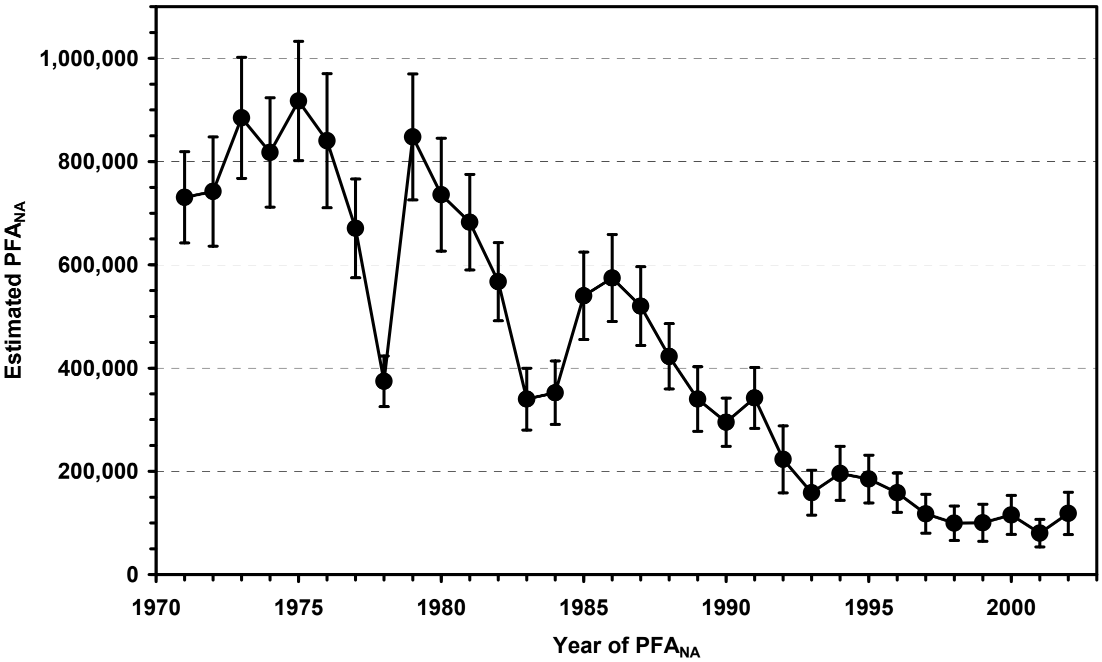


Figure 5.10.1.3. Relative change in Ln(PFA) in year relative to Ln(PFA) in year-2 (upper panel).

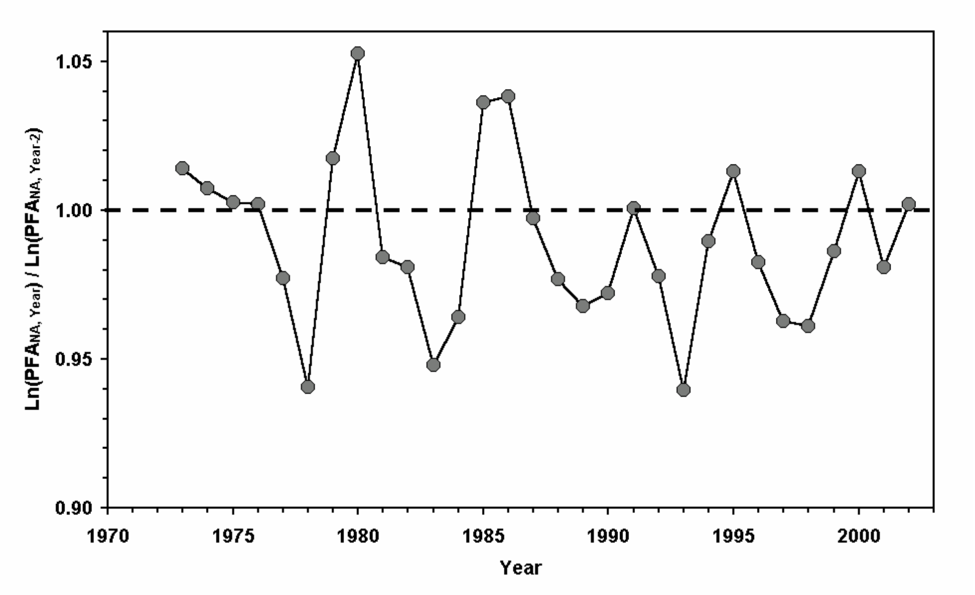


Figure 5.10.2.2. Mean residuals from the best model fits to 1,000 data sets for each of the model groups retained. Mean by phase refers to model predicting PFA based on average abundance in two phases. Slopes-intercept through origin refers to a model with lagged spawners proportional to PFA with the intercept set through the origin. Slopes and intercepts refer to models that allow the slope, intercept or both to vary with phase.

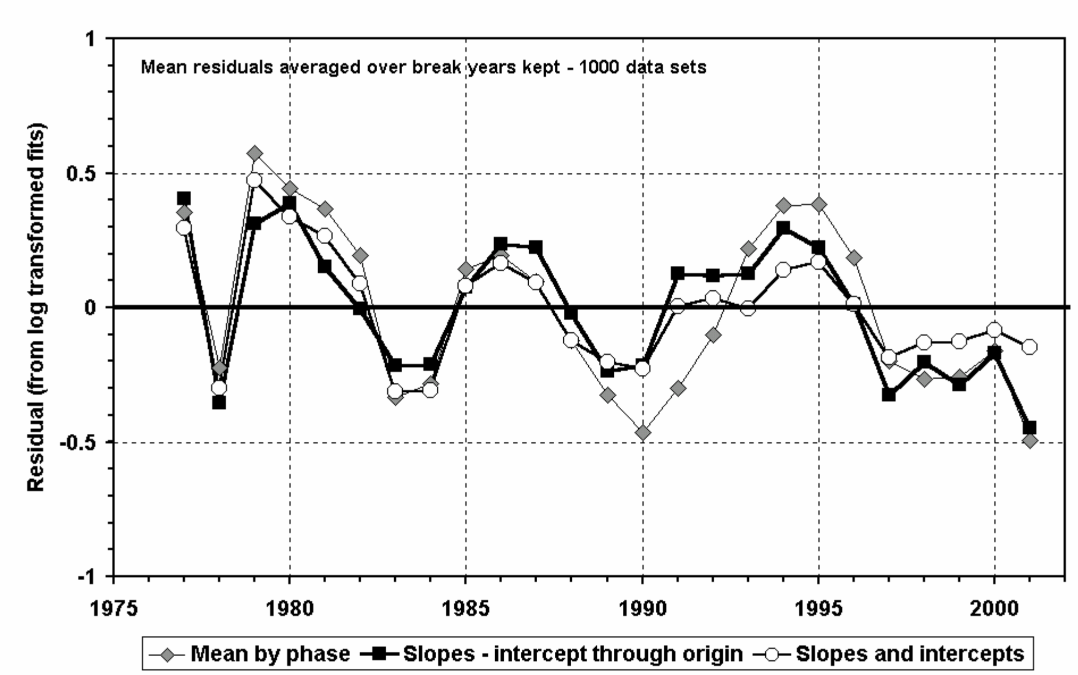
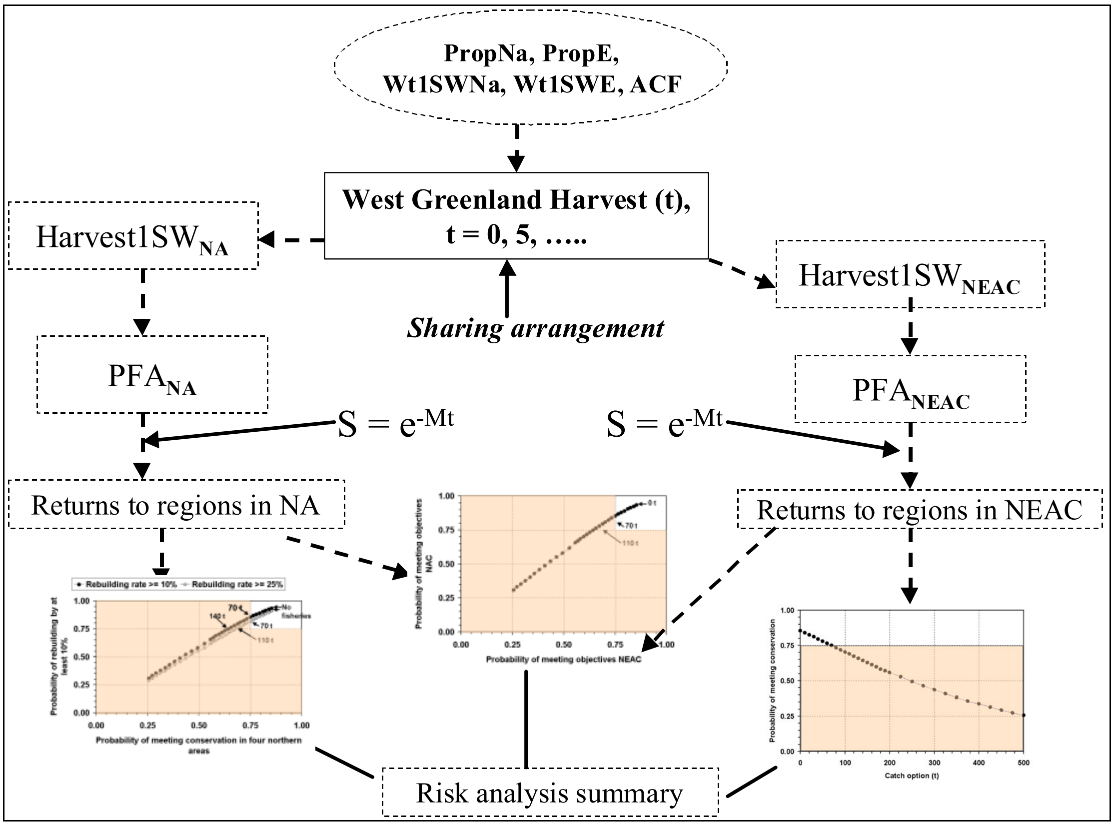


Figure 5.10.2.1. Flowchart, risk analysis for catch options at West Greenland using the PFA_{NA} and the PFA_{NEAC} predictions for the year of the fishery. Inputs with solid borders are considered known without error. Inputs with dashed borders are estimated, contain observation error that is incorporated in the analysis. Solid arrows are functions that introduce or transfer without error whereas dashed arrows transfer errors through the components.



6 NASCO HAS REQUESTED ICES TO IDENTIFY RELEVENT DATA DEFICIENTCIES, 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

The Working Group recommends that it should meet in 2005 to address questions posed by ACFM, including those posed by NASCO. The Working Group intends to convene in Nuuk, Greenland, from the 4th April to 14th April 2005. <u>It is strongly recommended by the Working Group that this period is adhered in order to provide sufficient time to adequately review and complete the report.</u>

6.1 Data deficiencies and research needs.

<u>Recommendations from Section 2- Atlantic salmon in the North Atlantic Area:</u>

1. Given the importance of M in the provision of catch advice and in the understanding of the dynamics of Atlantic salmon in the ocean, and in order to refine the assessment of M with the maturity schedule method, hatchery stocking programs should attempt to confirm the sex ratio of the released smolts (Section 2.3.1).

2. The Working Group recommends that life history characteristics of salmon stocks including age structure, length at age, relative and absolute abundance of repeat spawners, run-timing and other such features be examined for Atlantic salmon stocks to ensure that conservation of salmon goes beyond abundance (Section 2.4.3).

3. The Working Group recommends that in regions where fishery closures have not resulted in stock rebuilding, that urgent research work be undertaken to forecast population viability, to determine the cause or causes of declines, and that activities be implemented to reverse declining population trends (Section 2.5).

4. A coordinated tagging study should be designed and carried on to give information on migration, distribution, survival and growth of escaped farmed salmon from the NEAC countries (Sections 2.6.1 & 2.6.3).

5. Further basic research is needed on the spatial and temporal distribution of salmon and their predators at sea to assist in explaining variability in survival rates (Sections 2.6).

<u>Recommendations from Section 3 - Fisheries and Stocks from the North East Atlantic Commission Area:</u>

1. Further progress should be made in establishing a PFA predictive model using the PFA of maturing 1SW salmon, in addition to the spawner term, as a predictor variable for the PFA of non-maturing 1SW in the northern NEAC area (Section 3.6.2).

   The Working Group endorses the recommendations given by the SGBYSAL and makes the following additional recommendations (Section 3.11):

2. Existing long-term data sets on the pelagic trawl surveys by IMR, Norway, and PINRO, Russia, from relevant areas should be made available for further analysis to SGBYSAL and WGNAS. Special attention should be paid to hauls close to or at the surface.

3. Experimental trawling surveys should be conducted using commercial trawl in addition to the experimental trawl for better comparison of results between the two gear types and efforts should be made to inter-calibrate the CPUE for different trawling methods, in particular research gears against commercial trawls, to provide a better basis for assessing levels of by-catch.

4. Surveys should be extended to provide better temporal and spatial information on the distribution of post-smolts in relation to pelagic fisheries.

5. Experimental trawling surveys should be conducted to evaluate the vertical distribution of post-smolts and older salmon in the sea, if possible in combination with tagging of post-smolt and salmon with depth and temperature recording tags (DSTs).

6. Studies on post-smolts and older salmon should be extended to elucidate behaviour patterns at sea and to investigate their behaviour in relation to different commercial gear types (e.g. pelagic trawls, purse seines).

7. The Planning Group on Surveys on Pelagic Fish in the Norwegian Sea (PGSPFN) should consider intensive screenings of pelagic research hauls for the presence of post-smolts (small salmon in their 1st year at sea, generally < 45cm) and older salmon.

8. The Working Group requests that ICES should make available data on the commercial catches of mackerel and herring in the Norwegian Sea (ICES Divisions IIa and Vb), Northern North Sea (Division IVa), and the west of Ireland and Scotland (Divisions VI a & b; VII b,c,j & k) by ICES Division and standard week. Further information on the number of vessels fishing, gear types, fishing techniques and fishing effort is also requested.

Recommendations from Section 4- Fisheries and Stocks from the North American Commission Area:

1. Estimates of total returns to Labrador no longer exist. There is a critical need to develop alternate methods to derive estimates of salmon returns and develop habitat-based spawner requirements in Labrador, and to monitor salmon returns in the Ungava region of Québec (Sections 4.9.5 & 4.9.7).

2. There is a need to investigate changes in the biological characteristics (mean weight, sex ratio, sea-age and river-age composition) of returns to rivers, of smolt output, of spawning stocks of Canadian and US rivers, and the harvest in food fisheries in Labrador. These data and new information on measures of habitat and stock recruitment are necessary to re-evaluate existing estimates of spawner requirements in Canada and USA and for use in the run reconstruction model (Sections 4.9.7).

3. There is a requirement for additional smolt-to-adult survival rates for wild salmon. As well, sea survival rates of wild salmon from rivers stocked with hatchery smolts should be examined to determine if hatchery return rates can be used as an index of sea survival of wild salmon elsewhere (Section 4.9.7).

4. A consistent approach to estimating returns is needed for instances in which offspring from broodstock are stocked back into the management area from which their parents originated (Section 4.1.3).

5. After consideration of the changes in North American Atlantic salmon dynamics, the Working Group recommends that the Canadian smolt age distribution be updated in 2005 and smolt age distributions for the six North American areas be re-evaluated on a five year schedule, starting in 2009 (Section 4.9.7).

Recommendations from Section 5 - Atlantic Salmon in the West Greenland Commission Area:

1. Continued efforts should be made to improve the estimates of the annual catches of salmon taken for private sales and local consumption in Greenland (Section 5.9.1).

2. The mean weights, sea and freshwater ages and continent of origin are essential parameters to provide catch advice for the West Greenland fishery. In addition, sampling to determine sex on as many whole fish as practicable and testing for ISAv and other diseases in Atlantic salmon caught in West Greenland methods should be included in the program. Methods for determining sex on gutted individuals should be considered. The Working Group recommends that the sampling program be continued and closely coordinated with fishery harvest plan to be executed annually in West Greenland. (Section 5.9).

3. To assure significant progress toward assigning origin of Atlantic salmon caught at West Greenland at a finer resolution than continent of origin (river stocks, country or stock complexes). The Working Group recommends an integrated approach that builds on work at the laboratories in NAC and NEAC currently studying Atlantic salmon genetics. (Section 5.9.4).

4. Scale analysis of salmon captured at West Greenland indicated an infrequent appearance of escaped-farm salmon. To investigate this observation, farmed salmon need to be genetically characterized and included as baseline populations in continent of origin analyses of samples collected at West Greenland (Section 5.9.3.1).

5. The Working Group recommends that stage-specific mortality rates be determined, in particular the PFA estimate be verified through at sea research programs, similar to 1972, when an estimate of the non-maturing Atlantic salmon population at Greenland and the extant population in the western North Atlantic was developed (Section 5.10).

6. Further basic research is needed on the spatial/temporal distribution and migration patterns of salmon and their predators at sea to assist in explaining variability in survival rates. Other indices of change, i.e. changes in age composition, size at age and sea survival, should also be included in this analysis (Section 5.12).

APPENDIX 1

WORKING DOCUMENTS SUBMITTED TO THE WORKING GROUP
ON NORTH ATLANTIC SALMON, 2004

1. Whoriskey F., Brooking P., Doucette G. and Tinker S. Preliminary results from sonic tracking of experimentally escaped farmed salmon in the Bay of Fundy region.
2. Whoriskey F., Brooking P., Doucette G. and Tinker S. Preliminary results from sonic tracking of smolts in the Miramichi River, New Brunswick.
3. McKeon J., Sweka J., Trial J., Kocik J., Legault C. and Sheehan T. National report for the United States, 2003.
4. Maoiléidigh N. Ó., Cullen A., McDermott T., Bond N., McLaughlin D., Rogan G. and Cotter D. National report for Ireland - The 2003 salmon season.
5. Maoiléidigh N. Ó., McGinnity P., Prévost E., Potter E. C. E., Gargan P., Crozier W., Mills P. and Roche W. Application of pre-fishery abundance modelling and bayesian hierarchical stock and recruitment analysis to the provision of precautionary catch advice for Irish salmon (*Salmo salar* L.) fisheries.
6. Caron F., Fontaine P.-M. and Lachance S. Status of Atlantic Salmon Stocks in Québec, 2003..
7. Caron F. and Lachance S. Smolt production, freshwater and sea survival,on two index rivers, the Trinité and Saint-Jean, in Québec.
8. Gibson A. J. F. and Black J. DFO VDC database query for records pertaining to Atlantic salmon bycatch.
9. Meerburg D. Catch, catch-and-released, and unreported catch estimates for Atlantic salmon in Canada, 2003.
10. Chaput G., Cameron P., Moore D., Cairns D. and Clement M. Stock status summary for Atlantic salmon from Gulf Region, SFA 15-18 for 2003.
11. Chaput G., Legault C., Reddin D., Caron F. and Amiro P. Provision of catch advice taking account of non-stationarity in productivity of Atlantic salmon in the northwest Atlantic.
12. Vauclin V. Changes in biological characteristics (length, age structure) of Atlantic salmon (*Salmo salar*) populations from Brittany (France) during 1972 to 2002.
13. Erkinaro J., Länsman M., Kylmäaho M., Kuusela J. and Niemelä E. National report for Finland: salmon fishing season in 2003.
14. Gudbergsson G., Antonsson Th. and Gudjonsson S. National report from Iceland. The 2003 salmon season.
15. Hansen L. P., Fiske P., Holm M., Jensen A. J., Sægrov H., Arnekleiv J. V., Holst J. C., Hvidsten N. A. and Jonsson N. Atlantic salmon; national report for Norway 2003.
16. Jacobsen, J. A. Status of the fisheries for Atlantic salmon and production of farmed salmon in 2003 for the Faroe Islands.
17. Jacobsen J. A. Survey report from the Faroese R/V Magnus Heinason, 22-29/10-2003 – Tagging of salmon with DSTs north of the Faroes.
18. Prusov S. V., Krylova S. S., Studenov I. I. and Mandrikov V. V. Atlantic salmon fisheries and status of stocks in Russia. National report for 2003.
19. Prusov S. V., Dolgov A. V., Prischepa B. F. and Krylova S. S. Russian studies of distribution and by-catch of Atlantic salmon post-smolts in the Norwegian Sea in 2003.
20. Sheehan T. F., Reddin D. G., Kanneworff P. and King T. L. The international sampling program, continent of origin and biological characteristics of Atlantic salmon collected at West Greenland in 2003.
21. Sheehan T. F., Legault C. M. and Spidle A. Probabilistic-based genetic assignment model (PGA): sub-continent of origin assignments of the West Greenland Atlantic salmon catch.
22. Legault C. M. and Sheehan T. F. Is Atlantic salmon bycatch at sea a big problem in the US?
23. Anon. Annual assessment of salmon stocks and fisheries in England and Wales, 2003.
24. MacLean J. C., Smith G. W. and McLaren I. S. National report for UK (Scotland) for the year 2003.
25. Karlsson L. Salmon fisheries and status of salmon stocks in Sweden: National report for 2003.
26. De la Hoz J. Spain-Asturias salmon report 2003 for ICES.

27. Reddin D.G. Return and spawner estimates for Atlantic salmon in Insular Newfoundland, 2003.
28. Anon. Newfoundland and Labrador Atlantic salmon 2003 Stock Status Update.
29. Reddin D.G. By catch of Atlantic salmon in pelagic fisheries in Newfoundland.
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APPENDIX 2

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APPENDIX 3

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APPENDIX 4

Appendix 4. continued

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
USA	1982	33	-	1,206	-	5	-	-	-	-	-	-	-	21	-	1,265	6
	1983	26	-	314	1	2	-	-	-	-	-	-	-	6	-	348	1
	1984	50	-	545	2	2	-	-	-	-	-	-	-	12	-	609	2
	1985	23	-	528	2	2	-	-	-	-	-	-	-	13	-	566	2
	1986	76	-	482	2	2	-	-	-	-	-	-	-	3	-	563	2
	1987	33	-	229	1	10	-	-	-	-	-	-	-	10	-	282	1
	1988	49	-	203	1	3	-	-	-	-	-	-	-	4	-	259	1
	1989	157	0	325	1	2	-	-	-	-	-	-	-	3	-	487	2
	1990	52	0	562	2	12	-	-	-	-	-	-	-	16	-	642	2
	1991	48	0	185	1	1	-	-	-	-	-	-	-	4	-	238	1
	1992	54	0	138	1	1	-	-	-	-	-	-	-	-	-	193	1
	1993	17	-	133	1	0	0	-	-	-	-	-	-	2	-	152	1
	1994	12	-	0	0	0	0	-	-	-	-	-	-	-	-	12	0
	1995	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1996	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1997	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1998	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	1999	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2000	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2001	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2002	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
	2003	0	0	0	0	0	0	-	-	-	-	-	-	-	-	0	0
Faroe Islands	1982/83	9,086	-	101,227	-	21,663	-	448	-	29	-	-	-	-	-	132,453	625
	1983/84	4,791	-	107,199	-	12,469	-	49	-	-	-	-	-	-	-	124,508	651
	1984/85	324	-	123,510	-	9,690	-	-	-	-	-	-	-	1,653	-	135,177	598
	1985/86	1,672	-	141,740	-	4,779	-	76	-	-	-	-	-	6,287	-	154,554	545
	1986/87	76	-	133,078	-	7,070	-	80	-	-	-	-	-	-	-	140,304	539
	1987/88	5,833	-	55,728	-	3,450	-	0	-	-	-	-	-	-	-	65,011	208
	1988/89	1,351	-	86,417	-	5,728	-	0	-	-	-	-	-	-	-	93,496	309
	1989/90	1,560	-	103,407	-	6,463	-	6	-	-	-	-	-	-	-	111,436	364
	1990/91	631	-	52,420	-	4,390	-	8	-	-	-	-	-	-	-	57,449	202
	1991/92	16	-	7,611	-	837	-	-	-	-	-	-	-	-	-	8,464	31
	1992/93	-	-	4,212	-	1,203	-	-	-	-	-	-	-	-	-	5,415	22
	1993/94	-	-	1,866	-	206	-	-	-	-	-	-	-	-	-	2,072	7
	1994/95	-	-	1,807	-	156	-	-	-	-	-	-	-	-	-	1,963	6
	1995/96	-	-	268	-	14	-	-	-	-	-	-	-	-	-	282	1
	1996/97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1997/98	339	-	1,315	-	109	-	-	-	-	-	-	-	-	-	1,763	6
	1998/99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1999/00	225	-	1,560	-	205	-	-	-	-	-	-	-	-	-	1,990	8
	2000/01	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2001/02	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2002/03	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2003/04	0	-	0	-	0	-	-	-	-	-	-	-	-	-	0	0
	2003	44,426	77	-	-	-	-	-	-	-	-	11,172	60	-	-	55,598	137

Appendix 4. continued

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Finland	1982	2,598	5	-	-	-	-	-	-	-	-	5,408	49	-	-	8,006	54
	1983	3,916	7	-	-	-	-	-	-	-	-	6,050	51	-	-	9,966	58
	1984	4,899	9	-	-	-	-	-	-	-	-	4,726	37	-	-	9,625	46
	1985	6,201	11	-	-	-	-	-	-	-	-	4,912	38	-	-	11,113	49
	1986	6,131	12	-	-	-	-	-	-	-	-	3,244	25	-	-	9,375	37
	1987	8,696	15	-	-	-	-	-	-	-	-	4,520	34	-	-	13,216	49
	1988	5,926	9	-	-	-	-	-	-	-	-	3,495	27	-	-	9,421	36
	1989	10,395	19	-	-	-	-	-	-	-	-	5,332	33	-	-	15,727	52
	1990	10,084	19	-	-	-	-	-	-	-	-	5,600	41	-	-	15,684	60
	1991	9,213	17	-	-	-	-	-	-	-	-	6,298	53	-	-	15,511	70
	1992	15,017	28	-	-	-	-	-	-	-	-	6,284	49	-	-	21,301	77
	1993	11,157	17	-	-	-	-	-	-	-	-	8,180	53	-	-	19,337	70
	1994	7,493	11	-	-	-	-	-	-	-	-	6,230	38	-	-	13,723	49
	1995	7,786	11	-	-	-	-	-	-	-	-	5,344	38	-	-	13,130	49
	1996	12,230	20	1,275	5	1,424	12	234	4	19	1	-	-	354	3	15,536	44
	1997	10,341	15	2,419	10	1,674	15	141	2	22	1	-	-	418	3	15,015	45
	1998	11,792	19	1,608	7	1,660	16	147	3	0	0	-	-	460	3	15,667	48
	1999	18,830	33	1,528	8	1,579	16	129	2	6	0	-	-	490	3	22,562	62
	2000	20,817	39	5,152	24	2,379	25	110	2	0	0	-	-	991	6	29,449	95
	2001	13,062	21	6,308	32	5,415	58	104	2	0	0	-	-	2,360	13	27,249	126
	2002	6,531	12	5,361	20	4,276	43	148	2	11	0	-	-	2,619	16	18,946	93
	2003	8,131	15	1,828	7	3,599	35	161	3	6	0	-	-	2,204	16	15,929	76
Iceland	1991	30,011	-	11,935	-	-	-	-	-	-	-	-	-	-	-	41,946	130
	1992	38,955	-	15,416	-	-	-	-	-	-	-	-	-	-	-	54,371	175
	1993	37,611	-	11,611	-	-	-	-	-	-	-	-	-	-	-	49,222	160
	1994	25,480	62	14,408	78	-	-	-	-	-	-	-	-	-	-	39,888	140
	1995	34,046	93	13,380	57	-	-	-	-	-	-	-	-	-	-	47,426	150
	1996	28,039	69	9,971	53	-	-	-	-	-	-	-	-	-	-	38,010	122
	1997	23,945	62	8,872	44	-	-	-	-	-	-	-	-	-	-	32,817	106
	1998	35,537	90	7,791	40	-	-	-	-	-	-	-	-	-	-	43,328	130
	1999	20,031	64	8,093	57	-	-	-	-	-	-	-	-	-	-	28,124	120
	2000	23,850	58	4,456	24	-	-	-	-	-	-	-	-	-	-	28,306	82
	2001	23,717	58	5,564	29	-	-	-	-	-	-	-	-	-	-	29,281	87
	2002	26,679	68	5,683	29	-	-	-	-	-	-	-	-	-	-	32,362	97
	2003	27,378	68	8,538	41	-	-	-	-	-	-	-	-	-	-	35,916	108
Sweden	1989	3,181	7	-	-	-	-	-	-	-	-	4,610	22	-	-	7,791	29
	1990	7,428	18	-	-	-	-	-	-	-	-	3,133	15	-	-	10,561	33
	1991	8,987	20	-	-	-	-	-	-	-	-	3,620	18	-	-	12,607	38
	1992	9,850	23	-	-	-	-	-	-	-	-	4,656	26	-	-	14,506	49
	1993	10,540	23	-	-	-	-	-	-	-	-	6,369	33	-	-	16,909	56
	1994	8,304	18	-	-	-	-	-	-	-	-	4,661	26	-	-	12,965	44
	1995	9,761	22	-	-	-	-	-	-	-	-	2,770	14	-	-	12,531	36
	1996	6,008	14	-	-	-	-	-	-	-	-	3,542	19	-	-	9,550	33
	1997	2,747	7	-	-	-	-	-	-	-	-	2,307	12	-	-	5,054	19
	1998	2,421	6	-	-	-	-	-	-	-	-	1,702	9	-	-	4,123	15
	1999	3,573	8	-	-	-	-	-	-	-	-	1,460	8	-	-	5,033	16
	2000	7,103	18	-	-	-	-	-	-	-	-	3,196	15	-	-	10,299	33
	2001	4,634	12	-	-	-	-	-	-	-	-	3,853	21	-	-	8,487	33
	2002	4,733	12	-	-	-	-	-	-	-	-	2,826	16	-	-	7,559	28
	2003	2,761	6	-	-	-	-	-	-	-	-	2,062	12	-	-	4,823	18

Appendix 4. continued

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Norway	1981	221,566	467	-	-	-	-	-	-	-	-	213,943	1,189	-	-	435,509	1,656
	1982	163,120	363	-	-	-	-	-	-	-	-	174,229	985	-	-	337,349	1,348
	1983	278,061	593	-	-	-	-	-	-	-	-	171,361	957	-	-	449,422	1,550
	1984	294,365	628	-	-	-	-	-	-	-	-	176,716	995	-	-	471,081	1,623
	1985	299,037	638	-	-	-	-	-	-	-	-	162,403	923	-	-	461,440	1,561
	1986	264,849	556	-	-	-	-	-	-	-	-	191,524	1,042	-	-	456,373	1,598
	1987	235,703	491	-	-	-	-	-	-	-	-	153,554	894	-	-	389,257	1,385
	1988	217,617	420	-	-	-	-	-	-	-	-	120,367	656	-	-	337,984	1,076
	1989	220,170	436	-	-	-	-	-	-	-	-	80,880	469	-	-	301,050	905
	1990	192,500	385	-	-	-	-	-	-	-	-	91,437	545	-	-	283,937	930
	1991	171,041	342	-	-	-	-	-	-	-	-	92,214	535	-	-	263,255	877
	1992	151,291	301	-	-	-	-	-	-	-	-	92,717	566	-	-	244,008	867
	1993	153,407	312	62,403	284	35,147	327	-	-	-	-	-	-	-	-	250,957	923
	1994	-	415	-	319	-	262	-	-	-	-	-	-	-	-	-	996
	1995	134,341	249	71,552	341	27,104	249	-	-	-	-	-	-	-	-	232,997	839
	1996	110,085	215	69,389	322	27,627	249	-	-	-	-	-	-	-	-	207,101	786
	1997	124,387	241	52,842	238	16,448	151	-	-	-	-	-	-	-	-	193,677	630
	1998	162,185	296	66,767	306	15,568	139	-	-	-	-	-	-	-	-	244,520	741
	1999	164,905	318	70,825	326	18,669	167	-	-	-	-	-	-	-	-	254,399	811
	2000	250,468	504	99,934	454	24,319	219	-	-	-	-	-	-	-	-	374,721	1,177
	2001	207,934	417	117,759	554	33,047	295	-	-	-	-	-	-	-	-	358,740	1,266
	2002	127,039	249	98,055	471	33,013	299	-	-	-	-	-	-	-	-	258,107	1,019
	2003	185,574	363	87,993	410	31,099	298	-	-	-	-	-	-	-	-	304,666	1,071
Russia	1987	97,242	-	27,135	-	9,539	-	556	-	18	-	-	-	2,521	-	137,011	564
	1988	53,158	-	33,395	-	10,256	-	294	-	25	-	-	-	2,937	-	100,065	420
	1989	78,023	-	23,123	-	4,118	-	26	-	0	-	-	-	2,187	-	107,477	364
	1990	70,595	-	20,633	-	2,919	-	101	-	0	-	-	-	2,010	-	96,258	313
	1991	40,603	-	12,458	-	3,060	-	650	-	0	-	-	-	1,375	-	58,146	215
	1992	34,021	-	8,880	-	3,547	-	180	-	0	-	-	-	824	-	47,452	167
	1993	28,100	-	11,780	-	4,280	-	377	-	0	-	-	-	1,470	-	46,007	139
	1994	30,877	-	10,879	-	2,183	-	51	-	0	-	-	-	555	-	44,545	141
	1995	27,775	62	9,642	50	1,803	15	6	0	0	0	-	-	385	2	39,611	129
	1996	33,878	79	7,395	42	1,084	9	40	0.5	0	0	-	-	41	1	42,438	131
	1997	31,857	72	5,837	28	672	6	38	0.5	0	0	-	-	559	3	38,963	110
	1998	34,870	92	6,815	33	181	2	28	0.3	0	0	-	-	638	3	42,532	130
	1999	24,016	66	5,317	25	499	5	0	0	0	0	-	-	1,131	6	30,963	102
	2000	27,702	75	7,027	34	500	5	3	0.1	0	0	-	-	1,853	9	37,085	123
	2001	26,472	61	7,505	39	1,036	10	30	0.4	0	0	-	-	922	5	35,965	115
	2002	24,588	60	8,720	43	1,284	12	3	0	0	0	-	-	480	3	35,075	118
	2003	22,014	50	8,905	42	1,206	12	20	0.3	0	0	-	-	634	4	32,779	107

Appendix 4. continued

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Ireland	1980	248,333	745	-	-	-	-	-	-	-	-	39,608	202	-	-	287,941	947
	1981	173,667	521	-	-	-	-	-	-	-	-	32,159	164	-	-	205,826	685
	1982	310,000	930	-	-	-	-	-	-	-	-	12,353	63	-	-	322,353	993
	1983	502,000	1,506	-	-	-	-	-	-	-	-	29,411	150	-	-	531,411	1,656
	1984	242,666	728	-	-	-	-	-	-	-	-	19,804	101	-	-	262,470	829
	1985	498,333	1,495	-	-	-	-	-	-	-	-	19,608	100	-	-	517,941	1,595
	1986	498,125	1,594	-	-	-	-	-	-	-	-	28,335	136	-	-	526,460	1,730
	1987	358,842	1,112	-	-	-	-	-	-	-	-	27,609	127	-	-	386,451	1,239
	1988	559,297	1,733	-	-	-	-	-	-	-	-	30,599	141	-	-	589,896	1,874
	1989	-	-	-	-	-	-	-	-	-	-	-	-	-	-	330,558	1,079
	1990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188,890	567
	1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	135,474	404
	1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235,435	631
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200,120	541
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	286,266	804
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	288,225	790
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	249,623	685
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	209,214	570
	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	237,663	624
	1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180,477	515
	2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	228,220	621
	2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270,963	730
	2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256,808	682
	2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	212,887	575
UK	1985	62,815	-	-	-	-	-	-	-	-	-	32,716	-	-	-	95,531	361
(England & Wales)	1986	68,759	-	-	-	-	-	-	-	-	-	42,035	-	-	-	110,794	430
	1987	56,739	-	-	-	-	-	-	-	-	-	26,700	-	-	-	83,439	302
	1988	76,012	-	-	-	-	-	-	-	-	-	34,151	-	-	-	110,163	395
	1989	54,384	-	-	-	-	-	-	-	-	-	29,284	-	-	-	83,668	296
	1990	45,072	-	-	-	-	-	-	-	-	-	41,604	-	-	-	86,676	338
	1991	36,671	-	-	-	-	-	-	-	-	-	14,978	-	-	-	51,649	200
	1992	34,331	-	-	-	-	-	-	-	-	-	10,255	-	-	-	44,586	171
	1993	56,033	-	-	-	-	-	-	-	-	-	13,144	-	-	-	69,177	248
	1994	67,853	-	-	-	-	-	-	-	-	-	20,268	-	-	-	88,121	324
	1995	57,944	-	-	-	-	-	-	-	-	-	22,534	-	-	-	80,478	295
	1996	30,352	-	-	-	-	-	-	-	-	-	16,344	-	-	-	46,696	183
	1997	30,203	-	-	-	-	-	-	-	-	-	11,171	-	-	-	41,374	142
	1998	30,641	-	-	-	-	-	-	-	-	-	6,276	-	-	-	36,917	123
	1999	28,766	-	-	-	-	-	-	-	-	-	12,328	-	-	-	41,094	150
	2000	48,153	-	-	-	-	-	-	-	-	-	12,800	-	-	-	60,953	219
	2001	38,480	-	-	-	-	-	-	-	-	-	12,827	-	-	-	51,307	184
	2002	34,252	-	-	-	-	-	-	-	-	-	11,417	-	-	-	45,669	161
	2003	14,510	-	-	-	-	-	-	-	-	-	7,475	-	-	-	21,985	88

Appendix 4. continued

Country	Year	1SW		2SW		3SW		4SW		5SW		MSW (1)		PS		Total	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
UK (Scotland)	1982	208,061	496	-	-	-	-	-	-	-	-	128,242	596	-	-	336,303	1,092
	1983	209,617	549	-	-	-	-	-	-	-	-	145,961	672	-	-	355,578	1,221
	1984	213,079	509	-	-	-	-	-	-	-	-	107,213	504	-	-	320,292	1,013
	1985	158,012	399	-	-	-	-	-	-	-	-	114,648	514	-	-	272,660	913
	1986	202,855	526	-	-	-	-	-	-	-	-	148,397	745	-	-	351,252	1,271
	1987	164,785	419	-	-	-	-	-	-	-	-	103,994	503	-	-	268,779	922
	1988	149,098	381	-	-	-	-	-	-	-	-	112,162	501	-	-	261,260	882
	1989	174,941	431	-	-	-	-	-	-	-	-	103,886	464	-	-	278,827	895
	1990	81,094	201	-	-	-	-	-	-	-	-	87,924	423	-	-	169,018	624
	1991	73,608	177	-	-	-	-	-	-	-	-	65,193	285	-	-	138,801	462
	1992	101,676	238	-	-	-	-	-	-	-	-	82,841	361	-	-	184,517	599
	1993	94,517	227	-	-	-	-	-	-	-	-	71,726	320	-	-	166,243	547
	1994	99,459	248	-	-	-	-	-	-	-	-	85,404	400	-	-	184,863	648
	1995	89,921	224	-	-	-	-	-	-	-	-	78,452	364	-	-	168,373	588
	1996	66,413	160	-	-	-	-	-	-	-	-	57,920	267	-	-	124,333	427
	1997	46,872	114	-	-	-	-	-	-	-	-	40,427	182	-	-	87,299	296
	1998	53,447	121	-	-	-	-	-	-	-	-	39,248	162	-	-	92,695	283
	1999	25,183	57	-	-	-	-	-	-	-	-	30,651	142	-	-	55,834	199
	2000	43,879	114	-	-	-	-	-	-	-	-	36,657	160	-	-	80,536	274
	2001	42,565	101	-	-	-	-	-	-	-	-	34,908	150	-	-	77,473	251
	2002	31,347	73	-	-	-	-	-	-	-	-	26,383	118	-	-	57,730	191
	2003	31,102	74	-	-	-	-	-	-	-	-	28,659	127	-	-	59,761	201
France	1987	6,013	18	-	-	-	-	-	-	-	-	1,806	9	-	-	7,819	27
	1988	2,063	7	-	-	-	-	-	-	-	-	4,964	25	-	-	7,027	32
	1989	1,124	3	1,971	9	311	2	-	-	-	-	-	-	-	-	3,406	14
	1990	1,886	5	2,186	9	146	1	-	-	-	-	-	-	-	-	4,218	15
	1991	1,362	3	1,935	9	190	1	-	-	-	-	-	-	-	-	3,487	13
	1992	2,490	7	2,450	12	221	2	-	-	-	-	-	-	-	-	5,161	21
	1993	3,581	10	987	4	267	2	-	-	-	-	-	-	-	-	4,835	16
	1994	2,810	7	2,250	10	40	1	-	-	-	-	-	-	-	-	5,100	18
	1995	1,669	4	1,073	5	22	0	-	-	-	-	-	-	-	-	2,764	9
	1996	2,063	5	1,891	9	52	0	-	-	-	-	-	-	-	-	4,006	14
	1997	1,060	3	964	5	37	0	-	-	-	-	-	-	-	-	2,061	8
	1998	2,065	5	824	4	22	0	-	-	-	-	-	-	-	-	2,911	9
	1999	690	2	1,799	9	32	0	-	-	-	-	-	-	-	-	2,521	11
	2000	1,792	4	1,253	6	24	0	-	-	-	-	-	-	-	-	3,069	11
	2001	1,544	4	1,464	7	25	0	-	-	-	-	-	-	-	-	3,033	11
	2002	2,424	6	1,023	5	41	0	-	-	-	-	-	-	-	-	3,488	12
	2003	1,531	4	1,834	10	-	-	-	-	-	-	-	-	-	-	3,365	14

Appendix 4. continued

Spain (2)	1993	1,589	-	827	-	75	-	-	-	-	-	-	-	-	-	2,491	8
	1994	1,658	-	1,042	-	14	-	-	-	-	-	-	-	-	-	2,714	10
	1995	389	-	1,373	-	30	-	-	-	-	-	-	-	-	-	1,792	9
	1996	351	-	1,219	-	9	-	-	-	-	-	-	-	-	-	1,579	7
	1997	172	-	604	-	21	-	-	-	-	-	-	-	-	-	797	3
	1998	486	-	486	-	8	-	-	-	-	-	-	-	-	-	980	4
	1999	160	-	1,047	-	42	-	-	-	-	-	-	-	-	-	1,249	6
	2000	1,223	-	705	-	10	-	-	-	-	-	-	-	-	-	1,938	7
	2001	1,138	-	1,913	-	111	-	-	-	-	-	-	-	-	-	3,162	13
	2002	655	-	1,266	-	39	-	-	-	-	-	-	-	-	-	1,960	9
	2003	199	-	1,127	-	-	-	-	-	-	-	-	-	-	-	1,326	6

1. MSW includes all sea ages >1, when this cannot be broken down.
   Different methods are used to separate 1SW and MSW salmon in different countries:
   - Scale reading: Faroe Islands, Finland (1996 onwards), France, Russia, USA and West Greenland.
   - Size (split weight/length): Canada (2.7 kg for nets; 63cm for rods), Finland up until 1995 (3 kg),
   Iceland (various splits used at different times and places), Norway (3 kg), UK Scotland (3 kg in some places and 3.7 kg in others),
   All countries except Scotland report no problems with using weight to catergorise catches into sea age classes; mis-classification may be very high in some years.
   In Norway, catches shown as 3SW refer to salmon of 3SW or greater.
2. Based on catches in Asturias (80-90% of total catch).

APPENDIX 5

Appendix 5(i). Estimated numbers of 1SW salmon recruits, returns and spawners for Labrador.

Year	Commercial catches of small salmon SFA 1	SFA 2	SFA 14B	Grilse Recruits SFA 1,2&14B+Nfld Min	Max	Grilse to rivers SFA 1,2&14B Min	Max	Labrador grilse spawners Angling catch subtracted SFA 1,2&14B Min	Max
*1969	10774	21627	6321	48912	122280	18587	65053	15476	61942
*1970	14666	29441	8605	66584	166459	25302	88556	21289	84543
*1971	19109	38359	11212	86754	216884	32966	115382	29032	111448
*1972	14303	28711	8392	64934	162335	24675	86362	21728	83415
*1973	3130	6282	1836	14208	35520	5399	18897	0	11405
1974	9848	37145	9328	71142	177856	27034	94619	24533	92118
1975	34937	57560	19294	141210	353024	53660	187809	49688	183837
1976	17589	47468	13152	98790	246976	37540	131391	31814	125665
1977	17796	40539	11267	87918	219796	33409	116931	28815	112337
1978	17095	12535	4026	42513	106282	16155	56542	13464	53851
1979	9712	28808	7194	57744	144360	21943	76800	17825	72682
1980	22501	72485	8493	130710	326776	49670	173845	45870	170045
1981	21596	86426	6658	144859	362147	55046	192662	49855	187471
1982	18478	53592	7379	100357	250892	38136	133474	34032	129370
1983	15964	30185	3292	62452	156129	23732	83061	19360	78689
1984	11474	11695	2421	32324	80811	12283	42991	9348	40056
1985	15400	24499	7460	59822	149555	22732	79563	19631	76462
1986	17779	45321	8296	90184	225461	34270	119945	30806	116481
1987	13714	64351	11389	112995	282486	42938	150283	37572	144917
1988	19641	56381	7087	104980	262449	39892	139623	34369	134100
1989	13233	34200	9053	71351	178377	27113	94896	22429	90212
1990	8736	20699	3592	41718	104296	15853	55485	12544	52176
1991	1410	20055	5303	33812	84531	12849	44970	10526	42647
1992	9588	13336	1325	29632	79554	17993	62094	15229	59331
1993	3893	12037	1144	33382	93231	25186	80938	22499	78251
1994	3303	4535	802	22306	63109	18159	56888	15228	53958
1995	3202	4561	217	28852	82199	25022	76453	22144	73575
1996	1676	5308	865	55634	159204	51867	153553	48362	150048
1997	1728	8025		72138	162610	66812	155963	64049	153200

Estimates are based on:

EST SMALL RETURNS - (COMM CATCH*PROP LAB ORIGIN)/EXP RATE, PROP SFAs1,2&14B=.6-.8, SFA 1:0.36-0.42&SFA 2:0.75-0.85(97)
EXP RATE-SFAs1,2&14B=.3-.5(69-91),.22-.39(92),.13-.25(93),
- .10-.19(94),.07-.13(95),.04-.07(96), SFA 1:0.07-0.14&SFA 2:0.04-0.07 (97)
EST GRILSE RETURNS CORRECTED FOR NON-MATURING 1SW - (SMALL RET*PROP GRILSE), PROP GRILSE SFAs1,2&14B=0.8-0.9
EST RET TO FRESHWATER - (EST GRILSE RET-GRILSE CATCHES)
EST GRILSE SPAWNERS = EST GRILSE RETURNS TO FRESHWATER - GRILSE ANGLING CATCHES
*Catches for 1969-73 are Labrador totals distributed into SFAs as the proportion of landings by SFA in 1974-78.
Furthermore small catches in 1973 were adjusted by ratio of large:small in 1972&74 (SFA 1-1.4591, SFA 2-2.2225, SFA 14B-1.5506).

Appendix 5(ii). Estimated numbers of 2SW salmon recruits, returns and spawners for Labrador salmon stocks including west Greenland.

	Commercial catches of large salmon			Labrador 2SW Recruits,NF & Greenland SFAs 1,2 &14B		Labrador at Greenland	Labrador salmon Total+NF+WG		Labrador 2SW to rivers SFAs 1,2 &14B		Labrador 2SW spawners SFAs 1,2 &14B Angling catch subtracted	
Year	SFA 1	SFA 2	SFA 14B	Min	Max		Min	Max	Min	Max	Min	Max
*1969	18929	48822	10300	32483	69198	34280	80636	133032	3248	20760	2890	20287
*1970	17633	45479	9595	30258	68490	56379	99561	154121	3026	20547	2676	20085
*1971	25127	64806	13673	43117	97596	24299	85831	163577	4312	29279	4012	28882
*1972	21599	55708	11753	37064	83895	59203	112096	178927	3706	25168	3435	24812
*1973	30204	77902	16436	51830	117319	22348	96314	189771	5183	35196	4565	34376
1974	13866	93036	15863	50030	113827	38035	109433	200476	5003	34148	4490	33475
1975	28601	71168	14752	47715	107974	40919	109012	195006	4772	32392	4564	32119
1976	38555	77796	15189	55186	124671	67730	146485	245646	5519	37401	4984	36701
1977	28158	70158	18664	48669	110171	28482	97937	185706	4867	33051	4042	31969
1978	30824	48934	11715	38644	87155	32668	87816	157045	3864	26147	3361	25490
1979	21291	27073	3874	22315	50194	18636	50481	90267	2231	15058	1823	14528
1980	28750	87067	9138	51899	117530	21426	95490	189152	5190	35259	4633	34525
1981	36147	68581	7606	47343	106836	32768	100331	185233	4734	32051	4403	31615
1982	24192	53085	5966	34910	78873	43678	93497	156236	3491	23662	3081	23127
1983	19403	33320	7489	25378	57268	30804	67021	112531	2538	17181	2267	16824
1984	11726	25258	6218	18063	40839	4026	29802	62306	1806	12252	1478	11822
1985	13252	16789	3954	14481	32596	3977	24644	50494	1448	9779	1258	9530
1986	19152	34071	5342	24703	55734	17738	52991	97275	2470	16720	2177	16334
1987	18257	49799	11114	32885	74471	29695	76625	135970	3289	22341	2895	21821
1988	12621	32386	4591	20681	46789	27842	57355	94614	2068	14037	1625	13452
1989	16261	26836	4646	20181	45509	26728	55528	91673	2018	13653	1727	13270
1990	7313	17316	2858	11482	25967	9771	26158	46828	1148	7790	923	7493
1991	1369	7679	4417	5477	12467	7779	15596	25571	548	3740	491	3665
1992	9981	19608	2752	14756	37045	13713	28469	50758	2515	15548	2012	14889
1993	3825	9651	3620	10242	29482	6592	16834	36074	3858	18234	3624	17922
1994	3464	11056	857	11396	34514	0	11396	34514	5653	24396	5339	23981
1995	2150	8714	312	16520	51530	0	16520	51530	12368	44205	12006	43726
1996	1375	5479	418	11814	37523	4312	16126	41835	9113	32759	8838	32395
1997	1393	5550		13167	28647	3806	16973	32453	9384	23833	9221	23646

Estimates are based on:

EST LARGE RETURNS - (COMM CATCH*PROP LAB ORIGIN)/EXP RATE, PROP SFAs1,2&14B=.6-.8,SFA 1: 0.64-0.72 & SFA 2 0.88-0.95 (97);
EXP RATE-SFAs1,2&14B=.7-.9(69-91),.58-.83(92),.38-.62(93),.29-.50(94), .15-.26(95), .13-.23(96),
- SFA 1: 0.22-0.40, SFA 2: 0.16-0.28 (97)
EST 2SW RETURNS - (EST LARGE RETURNS*PROP 2SW), PROP 2SW SFA 1=.7-.9,SFAs 2&14B=.6-.8
WG - are North American 1SW salmon of river age 4 and older of which 70% are Labrador origin
EST RET TO FRESHWATER - (EST 2SW RET-2SW CATCHES)
EST 2SW SPAWNERS = EST 2SW RETURNS TO FRESHWATER - 2SW ANGLING CATCHES
*Catches for 1969-73 are Labrador totals distributed into SFAs as the proportion of landings by SFA in 1974-78.

Appendix 5(iii). Atlantic salmon returns to freshwater, total recruits prior to the commercial fishery and spawners summed for Salmon Fishing Area 3-14A, insular Newfoundland, 1969-2003.
Ret. = retained fish; Rel. = released fish.

	Small catch	Small returns to river		Small recruits		Small spawners		Large returns to river		Large recruits		Large catch	Large spawners		2SW returns to river		2SW spawners		2SW recruits	
Year	Retained	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Min	Max	Min	Max	Min	Max	Min	Max
1969	34,944	109,580	219,669	219,160	732,230	74,636	184,725	10,634	25,631	35,446	256,307	2,310	8,324	23,321	2,193	8,995	1,383	7,760	7,311	89,953
1970	30,437	140,194	281,466	280,388	938,221	109,757	251,030	12,731	29,313	42,435	293,127	2,138	10,593	27,175	3,135	11,517	2,359	10,340	10,450	115,168
1971	26,666	112,644	226,129	225,288	753,763	85,978	199,463	9,999	23,221	33,330	232,208	1,602	8,397	21,619	2,388	8,923	1,817	8,055	7,959	89,230
1972	24,402	109,282	219,412	218,564	731,374	84,880	195,010	10,368	23,434	34,560	234,343	1,380	8,988	22,054	2,511	9,003	2,008	8,240	8,371	90,031
1973	35,482	144,267	289,447	288,534	964,822	108,785	253,965	13,489	31,645	44,964	316,451	1,923	11,566	29,722	2,995	11,527	2,283	10,449	9,985	115,268
1974	26,485	85,216	170,748	170,431	569,159	58,731	144,263	10,541	21,113	35,137	211,133	1,213	9,328	19,900	1,940	6,596	1,510	5,942	6,465	65,964
1975	33,390	112,272	225,165	224,544	750,550	78,882	191,775	11,605	23,260	38,682	232,596	1,241	10,364	22,019	2,305	7,725	1,888	7,086	7,684	77,247
1976	34,463	115,034	230,595	230,068	768,650	80,571	196,132	10,863	21,768	36,211	217,677	1,051	9,812	20,717	2,334	7,698	2,011	7,198	7,781	76,982
1977	34,352	110,114	220,501	220,229	735,004	75,762	186,149	9,795	19,624	32,650	196,237	2,755	7,040	16,869	1,845	6,247	1,114	5,088	6,151	62,470
1978	28,619	97,375	195,048	194,751	650,159	68,756	166,429	7,892	15,841	26,307	158,411	1,563	6,329	14,278	1,991	6,396	1,557	5,712	6,637	63,959
1979	31,169	107,402	215,160	214,803	717,199	76,233	183,991	5,469	10,962	18,230	109,619	561	4,908	10,401	1,088	3,644	980	3,463	3,625	36,437
1980	35,849	121,038	242,499	242,076	808,330	85,189	206,650	9,400	18,866	31,335	188,656	1,922	7,478	16,944	2,432	7,778	1,888	6,925	8,108	77,784
1981	46,670	157,425	315,347	314,850	1,051,158	110,755	268,677	21,022	42,096	70,074	420,961	1,369	19,653	40,727	3,451	12,035	3,074	11,442	11,502	120,353
1982	41,871	141,247	283,002	282,494	943,342	99,376	241,131	9,060	18,174	30,198	181,736	1,248	7,812	16,926	2,914	9,012	2,579	8,481	9,714	90,117
1983	32,420	109,934	220,216	219,868	734,053	77,514	187,796	9,717	19,490	32,391	194,903	1,382	8,335	18,108	2,586	8,225	2,244	7,677	8,620	82,253
1984	39,331	130,836	262,061	261,673	873,537	91,505	222,730	8,115	16,268	27,052	162,684	511	7,604	15,757	2,233	7,060	2,063	6,800	7,445	70,602
1985	36,552	121,731	243,727	243,461	812,424	85,179	207,175	3,672	7,370	12,240	73,702	0	3,641	7,339	958	3,059	946	3,042	3,193	30,593
1986	37,496	125,329	251,033	250,657	836,778	87,833	213,537	7,052	14,140	23,505	141,400	0	6,972	14,060	1,606	5,245	1,575	5,198	5,353	52,445
1987	24,482	128,578	257,473	257,157	858,244	104,096	232,991	6,394	12,817	21,313	128,170	0	6,353	12,776	1,336	4,433	1,320	4,409	4,453	44,329
1988	39,841	133,237	266,895	266,474	889,652	93,396	227,054	6,572	13,183	21,908	131,832	0	6,512	13,123	1,563	5,068	1,540	5,033	5,211	50,681
1989	18,462	60,260	120,661	120,520	402,203	41,798	102,199	3,234	6,482	10,780	64,815	0	3,216	6,463	697	2,299	690	2,289	2,325	22,992
1990	29,967	99,543	199,416	199,086	664,721	69,576	169,449	5,939	11,909	19,798	119,093	0	5,889	11,859	1,347	4,401	1,327	4,372	4,489	44,011
1991	20,529	64,552	129,308	129,105	431,027	44,023	108,779	4,534	9,090	15,112	90,896	0	4,500	9,056	1,054	3,429	1,041	3,410	3,514	34,291
1992	23,118	118,778	237,811	118,778	237,811	95,096	214,129	16,705	33,463	16,705	33,463	0	16,564	33,322	3,111	10,554	3,057	10,474	3,111	10,554
1993	24,693	134,150	268,550	134,150	268,550	107,816	242,217	8,121	16,267	8,121	16,267	0	7,957	16,103	1,499	5,094	1,449	5,017	1,499	5,094
1994	29,225	91,495	189,808	91,495	189,808	60,194	158,507	7,776	16,029	7,776	16,029	0	7,308	15,561	1,495	5,226	1,368	5,024	1,495	5,226
1995	30,512	167,485	301,743	167,485	301,743	134,676	268,934	13,391	24,268	13,391	24,268	0	12,926	23,802	2,243	7,535	2,125	7,343	2,243	7,535
1996	35,440	200,277	422,635	200,277	422,635	161,780	384,138	17,291	35,518	17,291	35,518	0	16,719	34,946	2,964	8,832	2,824	8,605	2,964	8,832
1997	22,819	118,973	192,852	118,973	192,852	93,841	167,720	18,213	29,000	18,213	29,000	0	17,798	28,584	3,469	8,538	3,348	8,346	3,469	8,538
1998	22,668	150,644	202,611	150,644	202,611	125,215	177,182	23,727	30,545	23,727	30,545	0	23,371	30,189	4,280	8,813	4,195	8,674	4,280	8,813
1999	22,870	163,417	215,042	163,417	215,042	138,692	190,317	22,018	37,509	22,018	37,509	0	21,697	37,189	2,599	9,661	2,551	9,565	2,599	9,661
2000	21,808	148,710	254,736	148,710	254,736	124,643	230,669	16,432	54,789	16,432	54,789	0	15,929	54,286	2,022	12,023	1,829	11,781	2,022	12,023
2001	20,977	136,949	194,299	136,949	194,299	111,756	169,106	14,601	37,188	14,601	37,188	0	14,201	36,788	1,614	7,832	1,534	7,709	1,614	7,832
2002	20,913	134,679	187,273	134,679	187,273	111,970	164,564	10,855	26,315	10,855	26,315	0	9,555	25,015	1,268	5,796	1,175	5,586	1,268	5,796
2003	19,141	143,456	227,146	143,456	227,146	122,742	206,433	10,678	29,771	10,678	29,771	0	10,373	29,466	1,266	6,586	1,229	6,510	1,266	6,586

SRR (Small returns to river) are the sum of Bay St. George small returns (Reddin & Mullins 1996) plus Humber R small returns (Mullins & Reddin 1996) plus small returns in SFAs 3-12 & 14A.
SSR (Small recruits) = SRR/(1-Exploitation rate commercial (ERC)) where ERC=0.5-0.7, 1969-91 & ERC=0, 1992-98.
SS (Small spawners) = SSR-(SC+(SR*0.1))
SC = small salmon catch retained
SR = small salmon catch released with assumed mortalities at 10%
RL (RATIO large:small) are from counting facilities in SFAs 3-11, 13 & 14A, angling catches in SFA 12.
LRR (Large returns to river) = SRR * RL
LR (Large recruits) = LRR*(1-Exploitation rate large (ERL)), where ERL=0.7-0.9, 1969-91; & ERL=0, 1992-98.
LS (Large spawners) = LRR-large catch retained (LC)-(0.1*large catch released)
2SW-RR (2SW returns to river)= LRR*proportion 2SW of 0.4-0.6 for SFAs 13-14A & 0.1-0.2 for SFAs 3-11, 1969-1993 & 0.24-0.46 for SFAs 13-14A & 0.06-0.12 for SFAs 3-12, 1994-2003.
2SW-S (2SW spawners) = LS * proportion 2SW of 0.4-0.6 for SFAs 13-14A & 0.1-0.2 for SFAs 3-12, 1969-1993 & 0.24-0.46 for SFAs 13-14A & 0.06-0.12 for SFAs 3-12, 1994-2003..
2SW-R (2SW recruits) = LR * proportion 2SW of 0.4-0.6 for SFAs 13-14A& 0.1-0.2 for SFAs 3-12, 1969-1993 & 0.24-0.46 for SFAs 13-14A & 0.06-0.12 for SFAs 3-12, 1994-2003..

Appendix 5(iv). Small, large, and 2SW return and spawner estimates for SFA 15.

Year	Small salmon				Large salmon				Proportion 2SW	2SW salmon			
	Returns		Spawners		Returns		Spawners		in large	**Returns**		**Spawners**	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	salmon	**Min.**	**Max.**	**Min.**	**Max.**
1970	3513	7505	1497	4418	24955	36452	1917	5548	0.65	16221	23694	1246	3606
1971	2629	5566	1116	3246	12096	17412	846	2335	0.65	7863	11318	550	1518
1972	2603	5537	1092	3235	10621	21963	4323	12085	0.59	6266	12958	2550	7130
1973	5146	9852	1589	4720	10588	21653	4184	11686	0.74	7835	16023	3096	8648
1974	2869	6007	1159	3422	13102	27353	5345	15221	0.73	9564	19968	3902	11112
1975	3150	6567	1262	3717	7229	13894	2413	6660	0.79	5711	10976	1906	5261
1976	11884	20582	2619	7647	12318	25396	5005	14313	0.76	9362	19301	3804	10878
1977	7438	14652	2606	7527	14011	28399	5728	15988	0.83	11629	23571	4754	13270
1978	5215	9595	1477	4244	9716	19224	3768	9917	0.75	7287	14418	2826	7437
1979	5451	11163	2223	6260	3655	6267	1114	2602	0.51	1864	3196	568	1327
1980	9692	18781	3164	9285	11473	22537	4577	11997	0.81	9294	18255	3708	9717
1981	11367	21188	3362	9669	12078	21265	3163	8305	0.47	5677	9995	1487	3903
1982	8889	16834	2736	7978	9431	15011	1810	4599	0.59	5565	8856	1068	2713
1983	3621	6207	799	2268	9281	14864	1654	4489	0.59	5476	8770	976	2648
1984	11861	18589	1646	4732	6924	12237	3603	7403	0.79	5470	9667	2847	5848
1985	8525	18272	3639	10801	9802	20224	7600	16096	0.63	6175	12741	4788	10140
1986	12895	27635	5490	16311	13324	27128	10333	21470	0.76	10126	20617	7853	16317
1987	11708	24768	4930	14408	9627	19058	6932	14401	0.64	6161	12197	4437	9217
1988	16037	34159	6796	20027	12796	26222	9932	20804	0.72	9213	18880	7151	14979
1989	7673	16088	3185	9249	9905	19797	7319	15185	0.57	5646	11284	4172	8655
1990	9527	19902	3975	11418	8125	16280	6066	12636	0.68	5525	11070	4125	8592
1991	5276	10962	2219	6270	6185	12207	4621	9388	0.50	3092	6104	2311	4694
1992	10529	22220	4462	12930	9530	19257	7125	14911	0.54	5146	10399	3848	8052
1993	6578	13541	2739	7643	4407	8742	3156	6647	0.40	1763	3497	1262	2659
1994	10446	21861	4390	12580	8493	17143	6379	13317	0.60	5096	10286	3828	7990
1995	3310	6832	1344	3830	5590	10880	3977	8132	0.65	3636	7077	2587	5290
1996	7468	15529	3259	9043	7796	15745	5902	12275	0.65	5067	10234	3836	7979
1997	7666	16238	3572	9898	5302	10602	4008	8295	0.65	3446	6891	2605	5392
1998	7657	18381	3710	12036	2871	7562	600	3976	0.65	1866	4916	390	2584
1999	5712	12785	3096	8614	3423	7350	2511	5706	0.65	2225	4778	1632	3709
2000	7659	12983	4581	9160	4782	7193	2805	4838	0.65	3108	4676	1823	3145
2001	7232	15183	3644	9750	4835	9691	3165	7018	0.65	3142	6299	2057	4562
2002	10011	21882	7650	18786	3078	6729	2986	6608	0.65	2001	4374	1941	4295
2003	3228	7056	2471	6063	6208	13571	6022	13327	0.65	4035	8821	3914	8662

Appendix 5(v) a. Returns of large salmon and 2SW salmon to SFA 16.

	2SW returns to SFA 16		Large Salmon Returns to the Miramichi River						Returns of large salmon to SFA 16	
			Point			Prop.	2SW Returns			
Year	Min.	Max.	Estimate	Min.	Max.	2SW	Min	Max	Min	Max
1971	19697	32746	24407	19526	32461	0.918	17924	29799	21457	35672
1972	24645	40972	29049	23239	38635	0.965	22427	37284	25538	42456
1973	22896	38065	27192	21754	36165	0.958	20835	34639	23905	39742
1974	33999	56523	42592	34074	56647	0.908	30939	51436	37444	62250
1975	21990	36558	28817	23054	38327	0.868	20011	33267	25334	42117
1976	17118	28459	22801	18241	30325	0.854	15578	25898	20045	33325
1977	43160	71753	51842	41474	68950	0.947	39275	65296	45575	75769
1978	18539	30822	24493	19594	32576	0.861	16871	28048	21532	35797
1979	5484	9117	9054	7243	12042	0.689	4991	8297	7960	13233
1980	30332	50426	36318	29054	48303	0.95	27602	45888	31928	53080
1981	9489	15775	16182	12946	21522	0.667	8635	14355	14226	23651
1982	21875	36368	30758	24606	40908	0.809	19907	33095	27040	44954
1983	19762	32854	27924	22339	37139	0.805	17983	29897	24549	40812
1984	12562	20884	15137	12110	20132	0.944	11431	19005	13307	22123
1985	15861	26369	20738	16590	27582	0.87	14434	23996	18231	30309
1986	23460	39003	31285	25028	41609	0.853	21349	35493	27503	45724
1987	13590	22594	19421	15537	25830	0.796	12367	20561	17073	28385
1988	15599	25933	21745	17396	28921	0.816	14195	23599	19116	31781
1989	9880	16426	17211	13769	22891	0.653	8991	14948	15131	25155
1990	14452	24087	28574	21350	35583	0.616	13152	21919	23462	39102
1991	14892	24820	29949	22400	37333	0.605	13552	22586	24615	41025
1992	21106	30340	37000	31056	44643	0.618	19206	27609	34127	49058
1993	14946	58092	35000	19732	76695	0.689	13601	52863	21684	84280
1994	13155	24008	20946	15870	28962	0.754	11971	21847	17440	31827
1995	24711	35937	32015	26643	38747	0.844	22487	32703	29278	42579
1996	10711	18429	18433	14294	24594	0.682	9747	16771	15708	27026
1997	8254	13759	16399	12931	21554	0.581	7511	12520	14210	23686
1998	4565	11229	14753	10039	24695	0.414	4154	10218	11032	27138
1999	6059	9627	14078	11329	18002	0.487	5513	8761	12449	19782
2000	6280	10757	15492	12058	20653	0.474	5715	9789	13250	22696
2001	12615	17780	21027	17780	25060	0.646	11479	16180	19538	27539
2002	4074	9322	10453	7382	16892	0.502	3707	8483	8112	18563
2003	9549	16916	19361	14849	26305	0.585	8689	15393	16317	28907

Appendix 5(v) b. Large salmon and 2SW salmon spawners to SFA 16. Same procedure as for returns (Appendix 5(v) a.

	2SW spawners to SFA 16		Large Salmon Spawners to the Miramichi River						Large salmon spawners to SFA 16	
			Point			Prop.	2SW Spawners			
Year	Min.	Max.	Estimate	Min.	Max.	2SW	Min	Max	Min	Max
1971	3508	5832	4347	3478	5782	0.918	3192	5307	3822	6353
1972	14992	24924	17671	14137	23502	0.965	13643	22681	15535	25827
1973	17134	28486	20349	16279	27064	0.958	15592	25922	17889	29741
1974	27495	45711	34445	27556	45812	0.908	25021	41597	30281	50343
1975	16366	27209	21448	17158	28526	0.868	14893	24760	18855	31347
1976	10760	17889	14332	11466	19062	0.854	9792	16279	12600	20947
1977	27404	45560	32917	26334	43780	0.947	24938	41459	28938	48109
1978	8197	13627	10829	8663	14403	0.861	7459	12401	9520	15827
1979	2751	4573	4541	3633	6040	0.689	2503	4161	3992	6637
1980	15762	26204	18873	15098	25101	0.950	14343	23846	16592	27584
1981	2702	4492	4608	3686	6129	0.667	2459	4088	4051	6735
1982	9429	15676	13258	10606	17633	0.809	8581	14265	11655	19377
1983	5986	9951	8458	6766	11249	0.805	5447	9056	7436	12362
1984	12189	20264	14687	11750	19534	0.944	11092	18440	12912	21466
1985	15390	25586	20122	16098	26762	0.870	14005	23283	17690	29409
1986	22659	37670	30216	24173	40187	0.853	20619	34280	26564	44162
1987	12635	21006	18056	14445	24014	0.796	11498	19116	15873	26390
1988	15050	25021	20980	16784	27903	0.816	13696	22769	18444	30663
1989	8921	14831	15540	12432	20668	0.653	8118	13496	13662	22712
1990	13785	23420	27588	20364	34597	0.616	12544	21312	22378	38019
1991	14321	24249	29089	21540	36473	0.605	13032	22066	23670	40080
1992	20377	29610	35927	29983	43570	0.618	18543	26945	32948	47879
1993	14483	57629	34389	19121	76084	0.689	13179	52442	21012	83609
1994	12826	23679	20549	15473	28565	0.754	11672	21548	17003	31390
1995	24192	35419	31456	26084	38188	0.844	22015	32231	28664	41965
1996	10185	17903	17731	13592	23892	0.682	9268	16292	14936	26255
1997	7727	13231	15573	12105	20728	0.581	7032	12041	13302	22778
1998	4361	11026	14306	9592	24248	0.414	3969	10033	10540	26646
1999	5505	9073	13042	10293	16966	0.487	5009	8257	11311	18644
2000	5978	10455	14911	11477	20073	0.474	5440	9514	12613	22058
2001	12466	17631	20816	17570	24850	0.646	11344	16044	19307	27308
2002	4017	9265	10350	7278	16788	0.502	3655	8431	7998	18449
2003	9425	16792	19168	14656	26112	0.585	8576	15280	16105	28695

Appendix 5(v) c. Returns of small salmon and 1SW salmon to SFA 16.

			Small returns to Miramichi			1SW Returns to Miramichi	
	1SW returns to SFA 16					0.97	1.00
Year	Min.	Max.	Small	Min.	Max.	Min	Max
1971	30420	52137	35673	28538	47445	27682	47445
1972	39461	67633	46275	37020	61546	35909	61546
1973	37986	65104	44545	35636	59245	34567	59245
1974	62607	107303	73418	58734	97646	56972	97646
1975	55345	94857	64902	51922	86320	50364	86320
1976	78095	133848	91580	73264	121801	71066	121801
1977	23658	40547	27743	22194	36898	21529	36898
1978	20711	35496	24287	19430	32302	18847	32302
1979	43460	74487	50965	40772	67783	39549	67783
1980	35464	60782	41588	33270	55312	32272	55312
1981	55661	95399	65273	52218	86813	50652	86813
1982	68543	117477	80379	64303	106904	62374	106904
1983	21476	36807	25184	20147	33495	19543	33495
1984	25333	43418	29707	23766	39510	23053	39510
1985	51847	88862	60800	48640	80864	47181	80864
1986	100240	171802	117549	94039	156340	91218	156340
1987	72327	123962	84816	67853	112805	65817	112805
1988	103966	178189	121919	97535	162152	94609	162152
1989	64153	109953	75231	60185	100057	58379	100057
1990	72484	124286	83500	68000	113100	65960	113100
1991	48713	83516	60900	45700	76000	44329	76000
1992	136440	202198	152600	128000	184000	124160	184000
1993	65555	169011	95000	61500	153800	59655	153800
1994	39087	57794	43571	36669	52592	35569	52592
1995	41524	61253	46458	38956	55741	37787	55741
1996	30041	44423	33610	28183	40425	27337	40425
1997	13470	23300	16139	*12637*	*21203*	12258	21203
1998	19962	31885	23143	18727	29015	18165	29015
1999	21073	29884	23121	19770	27194	19177	27194
2000	29411	40958	32031	27592	37272	26764	37272
2001	25606	37705	28664	24022	34312	23301	34312
2002	40139	59277	44864	37656	53942	36526	53942
2003	26045	41966	30264	24434	38189	23701	38189

Appendix 5(v) d. Small salmon and 1SW salmon spawners to SFA 16. Same procedure as for Appendix 5(v)c.

	1SW Spawners to SFA 16		Small Spawners to Miramichi			1SW Spawners to Miramichi	
Year	Min	Max	Small	Min.	Max.	Min	Max
1971	17557	32075	21946	17557	29188	15977	29188
1972	21708	39659	27135	21708	36090	19754	36090
1973	24550	44852	30688	24550	40815	22341	40815
1974	44149	80656	55186	44149	73397	40175	73397
1975	38775	70839	48469	38775	64464	35285	64464
1976	49904	91171	62380	49904	82965	45413	82965
1977	10598	19361	13247	10598	17619	9644	17619
1978	11482	20977	14353	11482	19089	10449	19089
1979	24678	45086	30848	24678	41028	22457	41028
1980	21515	39307	26894	21515	35769	19579	35769
1981	31943	58358	39929	31943	53106	29068	53106
1982	44800	81846	56000	44800	74480	40768	74480
1983	11879	21702	14849	11879	19749	10810	19749
1984	15143	27665	18929	15143	25176	13780	25176
1985	33452	61114	41815	33452	55614	30441	55614
1986	71518	130659	89398	71518	118899	65082	118899
1987	50222	91751	62777	50222	83493	45702	83493
1988	72222	131945	90278	72222	120070	65722	120070
1989	38708	70717	48385	38708	64352	35224	64352
1990	44376	98325	59876	44376	89476	40382	89476
1991	33289	69878	48489	33289	63589	30293	63589
1992	100557	172041	125157	100557	156557	91507	156557
1993	45516	151446	79016	45516	137816	41420	137816
1994	22232	41929	29134	22232	38155	20232	38155
1995	18895	39208	26397	18895	35680	17194	35680
1996	8618	22923	14045	8618	20860	7842	20860
1997	3051	12766	6553	3051	11617	2776	11617
1998	11719	24183	16135	11719	22007	10664	22007
1999	11490	20784	14841	11490	18914	10456	18914
2000	16508	28778	20947	16508	26188	15022	26188
2001	16871	29847	21513	16871	27161	15352	27161
2002	26457	46971	33665	26457	42743	24076	42743
2003	16901	33688	22731	16901	30657	15380	30657

Appendix 5(vi). Estimated Atlantic salmon returning recruits and spawners to the Morell River, SFA 17, 1970-2003.

	Small recruits		Small spawners		Large recruits		Large spawners		2SW recruits		2SW spawners	
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	5	9	3	7	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	14	28	8	22	2	5	1	4	2	5	1	4
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	2	5	1	4	5	9	3	7	5	9	3	7
1980	12	23	7	18	2	5	1	4	2	5	1	4
1981	259	498	151	390	40	77	36	73	40	77	36	73
1982	175	336	102	263	16	31	8	23	16	31	8	23
1983	17	32	10	25	17	32	15	30	17	32	15	30
1984	17	32	10	25	13	26	13	26	13	26	13	26
1985	113	217	66	170	8	15	8	15	8	15	8	15
1986	566	1088	330	852	5	11	5	11	5	11	5	11
1987	1141	2194	665	1718	66	128	66	128	66	128	66	128
1988	1542	2963	899	2320	96	185	96	185	96	185	96	185
1989	400	770	233	603	149	287	149	287	149	287	149	287
1990	1842	3539	1074	2771	284	545	284	545	284	545	284	545
1991	1576	3028	919	2371	188	361	188	361	188	361	188	361
1992	1873	3599	1092	2818	95	183	95	183	95	183	95	183
1993	1277	2454	745	1922	22	43	22	43	22	43	22	43
1994	210	385	118	292	169	310	166	307	169	310	166	307
1995	1058	1914	585	1441	85	154	81	151	85	154	81	151
1996	1161	2576	738	2154	158	351	154	347	158	351	154	347
1997	485	932	283	730	31	59	30	58	31	59	30	58
1998	635	1221	370	956	79	151	76	149	79	151	76	149
1999	379	728	221	570	23	45	20	41	23	45	20	41
2000	304	584	177	457	56	108	55	107	56	108	55	107
2001	429	824	250	645	57	110	55	107	57	110	55	107
2002	307	591	179	463	46	88	45	87	46	88	45	87
2003	583	1120	340	877	76	146	73	143	76	146	73	143

Appendix 5(vii). Total returns and spawners of small salmon and large salmon, and 2SW salmon returns and spawners to SFA 18.

	Small salmon				Large Salmon				2SW Salmon			
	Returns		Spawners		Returns		Spawners		Returns		Spawners	
Year	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1970	264	1,073	167	842	6,161	7,858	709	2,660	4,744	6,836	546	2,314
1971	65	265	41	208	2,456	3,198	276	1,036	1,891	2,782	213	901
1972	131	530	82	416	6,095	6,924	293	1,101	4,693	6,024	226	958
1973	516	2,095	325	1,645	5,376	6,299	309	1,160	4,140	5,481	238	1,009
1974	187	757	118	595	7,119	7,963	343	1,286	5,481	6,928	264	1,119
1975	112	454	71	357	4,483	4,989	231	864	3,452	4,340	178	752
1976	299	1,212	188	951	3,578	4,223	288	1,080	2,755	3,674	222	939
1977	215	871	135	684	5,175	6,280	424	1,587	3,985	5,463	326	1,381
1978	78	316	49	248	5,954	7,201	550	2,062	4,585	6,265	424	1,794
1979	1,857	7,536	1,170	5,915	1,676	2,315	286	1,071	1,290	2,014	220	932
1980	520	2,108	327	1,655	4,846	5,951	536	2,009	3,732	5,177	413	1,748
1981	2,797	11,348	1,762	8,908	3,234	4,332	487	1,823	2,490	3,769	375	1,586
1982	2,150	8,722	1,354	6,847	5,370	6,783	598	2,242	4,135	5,901	461	1,951
1983	212	858	133	674	4,848	6,024	517	1,938	3,733	5,241	398	1,686
1984	460	1,867	182	1,210	3,105	4,107	336	1,319	2,391	3,573	259	1,148
1985	730	3,167	144	1,786	1,196	5,150	1,130	5,009	921	4,481	870	4,358
1986	965	3,854	64	1,731	2,953	13,195	2,811	12,888	2,274	11,479	2,164	11,213
1987	1,316	5,061	191	2,410	3,209	15,193	3,109	14,977	2,471	13,218	2,394	13,030
1988	1,927	7,900	915	5,514	1,387	5,794	1,296	5,598	1,068	5,040	998	4,870
1989	680	2,651	35	1,129	1,842	8,579	1,768	8,420	1,418	7,464	1,362	7,326
1990	1,082	13,778	335	12,017	3,754	18,429	3,683	18,276	2,891	16,033	2,836	15,900
1991	914	10,559	48	8,519	1,998	13,439	1,915	13,260	1,539	11,692	1,475	11,536
1992	1,448	6,565	807	5,053	5,257	21,778	5,166	21,581	4,048	18,947	3,978	18,776
1993	1,714	10,451	1,043	8,869	2,597	14,305	2,538	14,177	2,000	12,445	1,954	12,334
1994	660	2,988	298	2,136	2,534	10,454	2,465	10,304	1,951	9,095	1,898	8,964
1995	619	2,939	379	2,372	1,887	8,862	1,837	8,755	1,453	7,710	1,415	7,617
1996	1,470	8,033	1,076	7,105	2,388	9,408	2,300	9,220	1,839	8,185	1,771	8,021
1997	562	1,365	204	2,375	3,951	18,856	3,838	18,611	3,043	16,404	2,955	16,192
1998	636	1,545	278	2,799	2,517	12,012	2,445	11,856	1,938	10,450	1,883	10,315
1999	562	1,365	204	2,375	1,517	7,238	1,473	7,144	1,168	6,297	1,134	6,215
2000	473	1,150	115	1,868	1,306	6,234	1,269	6,154	1,006	5,424	977	5,354
2001	657	1,598	299	2,923	1,603	7,650	1,557	7,551	1,234	6,655	1,199	6,569
2002	692	1,681	334	3,120	1,235	5,894	1,200	5,818	951	5,128	924	5,061
2003	598	1,453	240	2,582	2,140	10,212	2,078	10,079	1,648	8,884	1,600	8,769

Appendix 5(viii). Total 1SW returns and spawners, SFAs 19, 20, 21 and 23, 1970-2003.

	RETURNS						TOTAL		SPAWNERS						TOTAL	
	River returns		Comm-	SFA 23			RETURNS			Spawners		SFA 23			SPAWNERS	
	SFA 19-21		ercial	Wild	Wild	Hatch	SFAs 19,20,21,23		angled	19-21		H+W rtns		Harvest	19,20,21,23	
Year	MIN	MAX	19-21	MIN	MAX		MIN	MAX	19-21	MIN	MAX	MIN	MAX		MIN	MAX
1970	8,236	16,868	3,189	5,206	7,421	100	16,731	27,578	3,609	4,627	13,259	5,306	7,521	1,420	8,513	19,360
1971	6,345	13,062	1,922	2,883	4,176	365	11,515	19,525	2,761	3,584	10,301	3,248	4,541	2,032	4,800	12,810
1972	6,636	13,354	1,055	1,546	2,221	285	9,522	16,915	2,917	3,719	10,437	1,831	2,506	2,558	2,992	10,385
1973	8,225	16,744	1,067	3,509	5,047	1,965	14,766	24,823	3,604	4,621	13,140	5,474	7,012	1,437	8,658	18,715
1974	14,478	29,385	2,050	6,204	8,910	3,991	26,723	44,336	6,340	8,138	23,045	10,195	12,901	2,124	16,209	33,822
1975	5,096	10,393	2,822	11,648	16,727	6,374	25,940	36,316	2,227	2,869	8,166	18,022	23,101	2,659	18,232	28,608
1976	12,421	25,398	1,675	13,761	19,790	9,074	36,931	55,937	5,404	7,017	19,994	22,835	28,864	5,263	24,589	43,595
1977	13,349	27,943	3,773	6,746	9,679	6,992	30,860	48,387	5,841	7,508	22,102	13,738	16,671	4,542	16,704	34,231
1978	2,535	5,241	3,651	3,227	4,651	3,044	12,457	16,587	1,113	1,422	4,128	6,271	7,695	2,015	5,678	9,808
1979	12,365	25,381	3,154	11,529	16,690	3,827	30,875	49,052	5,428	6,937	19,953	15,356	20,517	3,716	18,577	36,754
1980	16,534	33,825	8,252	14,346	20,690	10,793	49,925	73,560	7,253	9,281	26,572	25,139	31,483	5,542	28,878	52,513
1981	18,594	38,329	1,951	11,199	16,176	5,627	37,371	62,083	8,163	10,431	30,166	16,826	21,803	9,021	18,236	42,948
1982	10,008	20,552	2,020	8,773	12,598	3,038	23,839	38,208	4,361	5,647	16,191	11,811	15,636	5,279	12,179	26,548
1983	4,662	9,562	1,621	7,706	11,028	1,564	15,553	23,775	2,047	2,615	7,515	9,270	12,592	4,138	7,747	15,969
1984	12,398	25,815	0	14,105	20,227	1,451	27,954	47,493	4,724	7,674	21,091	15,556	21,678	5,266	17,964	37,503
1985	16,354	34,055	0	11,038	15,910	2,018	29,410	51,983	6,360	9,994	27,695	13,056	17,928	4,892	18,158	40,731
1986	16,661	34,495	0	13,412	19,321	862	30,935	54,678	6,182	10,479	28,313	14,274	20,183	3,549	21,204	44,947
1987	18,388	37,902	0	10,030	14,334	3,328	31,746	55,564	7,056	11,332	30,846	13,358	17,662	3,101	21,589	45,407
1988	16,611	33,851	0	15,131	21,834	1,250	32,992	56,935	6,384	10,227	27,467	16,381	23,084	3,320	23,288	47,231
1989	17,378	35,141	0	16,240	23,182	1,339	34,957	59,662	6,629	10,749	28,512	17,579	24,521	4,455	23,873	48,578
1990	20,119	41,652	0	12,287	17,643	1,533	33,939	60,828	7,391	12,728	34,261	13,820	19,176	3,795	22,753	49,642
1991	6,718	13,870	0	10,602	15,246	2,439	19,759	31,555	2,399	4,319	11,471	13,041	17,685	3,546	13,814	25,610
1992	9,269	18,936	0	11,340	16,181	2,223	22,832	37,340	3,629	5,640	15,307	13,563	18,404	4,078	15,125	29,633
1993	9,104	18,711	0	7,610	8,828	foot-	16,714	27,539	3,327	5,777	15,384	5,762	6,868	foot-	11,539	22,252
1994	2,446	4,973	0	5,770	6,610	note:"a"	8,216	11,583	493	1,953	4,480	4,965	5,738	note:"a"	6,918	10,218
1995	5,974	12,364	0	8,265	9,458		14,239	21,822	1,885	4,089	10,479	8,025	9,218		12,114	19,697
1996	9,888	20,791	0	12,907	15,256		22,795	36,047	2,211	7,677	18,580	11,576	13,892		19,253	32,472
1997	2,665	5,488	0	4,508	4,979		7,173	10,467	493	2,172	4,995	3,971	4,433		6,143	9,428
1998	7,567	15,680	0	9,203	10,801		16,770	26,481	0	7,567	15,680	8,775	10,348		16,342	26,028
1999	5,048	10,535	0	5,508	6,366		10,556	16,901	67	4,981	10,468	5,196	6,048		10,177	16,516
2000	6,201	12,890	0	4,796	5,453		10,997	18,343	0	6,201	12,890	4,455	5,087		10,656	17,977
2001	4,239	8,884	0	2,513	2,862		6,752	11,746	0	4,239	8,884	2,210	2,530		6,449	11,414
2002	5,706	11,879	0	3,501	3,991		9,207	15,870	0	5,705	11,878	3,232	3,689		8,937	15,567
2003	4,502	9,422	0	2,292	2,716		6,794	12,138	0	4,502	9,422	2,069	2,469		6,571	11,891

SFAs 19, 20, 21: Returns, 1970-1997, estimated as run size (1SW recreational catch / expl. rate [0.2 t0 0.45]; where MIN and MAX selected as 5th and 95th percentile values from 1,000 monte carlo estimates) + estimated 1SW fish in commercial landings 1970-1983 (Cutting MS 1984). For 1998-2000, see "a" below.

SFA 22: Inner Fundy stocks and inner-Fundy SFA 23 (primarily 1SW fish) do not go to the North Atlantic.

SFA 23: For 1970-'97, similar to SFAs 19-21 except that estimated wild 1SW returns destined for Mactaquac Dam, Saint John River, replaced values for recreational catch and estimated proportions that production above Mactaquac is of the total (0.4-0.6) river replaced exploitataion rates (commercial harvest, bi-catch etc., incl. in estimated returns); hatchery returns attributed to above Mactaquac only; 1SW production in rest of SFA (outer Fundy) omitted.

"a"- Revision of method, SFA 23, 1993-2001, estimated returns to Nashwaak fence raised by proportion of area below Mactaquac (0.21-0.30) and added to total estimated returns originating upriver of Mactaquac (Marshall et al. 1998); MIN and MAX removals below Mactaquac based on Nashwaak losses, Mactaquac losses are a single value and together summed and removed from returns to establish estimate of spawners. SFAs 19-21, estimate of returns 1998-2000 based on regression of LaHave wild counts on MIN and MAX estimates of total SFA 19-21 returns, 1984-1997, because there was no (1998 and 2000) & little (1999) angling in SFAs 20-21.

Appendix 5(ix)a. Total 2SW returns to SFAs 19, 20, 21 and 23, 1970-2003.

	SFA 19		*SFA 20*		*SFA 21*		Total	*SFA 23*				*TOTAL RETURNS*	
								Wild	Wild	Htch	Htch	*SFAs 19,20,21,23*	
	MIN	MAX	MIN	MAX	MIN	MAX	Comm-	MIN	MAX	MIN	MAX		
	2SW=0.7-0.9		2SW=0.6-0.9		2SW=0.5-0.9		ercial	2SW= 0.85-0.95		2SW= 0.85-0.95			
Year	Exp. rate=0.2-0.45		Exp. rate=0.2-0.45		Exp. rate=0.2-0.45		19-21	p. abv= 0.4-0.6				MIN	MAX
1970	1,170	2,537	658	1,535	597	1,525	2,644	8,540	12,674	0	0	13,609	20,915
1971	600	1,266	344	802	481	1,199	2,607	7,089	10,463	66	73	11,187	16,410
1972	735	1,614	421	1,002	454	1,198	4,549	7,362	10,809	507	559	14,028	19,731
1973	726	1,571	665	1,532	546	1,437	4,217	3,773	5,559	432	477	10,359	14,793
1974	1,035	2,225	691	1,588	548	1,397	8,873	8,766	12,790	1,989	2,198	21,902	29,071
1975	376	824	149	343	882	2,321	9,430	11,217	16,490	1,890	2,088	23,944	31,496
1976	791	1,672	346	822	441	1,146	5,916	12,304	18,106	1,970	2,175	21,768	29,837
1977	999	2,152	660	1,509	873	2,354	9,205	14,539	21,420	2,330	2,575	28,606	39,215
1978	810	1,739	429	995	655	1,706	6,827	6,059	8,903	2,166	2,391	16,946	22,561
1979	532	1,169	431	978	508	1,288	2,326	4,149	6,084	1,016	1,123	8,962	12,968
1980	1,408	3,051	746	1,714	1,483	3,989	9,204	16,500	24,041	2,556	2,824	31,897	44,823
1981	886	1,856	926	2,133	1,754	4,475	4,438	8,696	12,690	2,330	2,577	19,030	28,169
1982	917	1,990	316	746	682	1,756	5,819	8,266	12,198	1,516	1,673	17,516	24,182
1983	477	1,030	641	1,475	552	1,434	2,978	8,718	12,793	944	1,043	14,310	20,753
1984	828	1,768	638	1,500	766	2,004	0	14,753	21,573	953	1,054	17,938	27,899
1985	1,495	3,132	2,703	6,355	2,102	5,469	0	15,793	23,002	748	826	22,841	38,784
1986	3,500	7,541	2,561	5,987	2,150	5,312	0	9,210	13,507	681	754	18,102	33,101
1987	2,427	5,237	1,066	2,527	1,114	2,872	0	6,512	9,590	410	453	11,529	20,679
1988	2,635	5,724	1,914	4,464	1,105	2,945	0	3,936	5,836	780	861	10,370	19,830
1989	2,236	4,810	1,512	3,485	1,631	4,086	0	6,159	8,994	401	443	11,939	21,818
1990	2,406	5,178	1,085	2,515	1,271	3,260	0	4,994	7,375	492	543	10,248	18,871
1991	1,890	4,050	965	2,200	421	1,071	0	6,739	9,902	598	661	10,613	17,884
1992	1,788	3,923	631	1,488	480	1,236	0	6,213	9,074	665	735	9,777	16,456
1993	876	1,897	1,006	2,321	564	1,498	0	4,318	5,371	foot-		6,764	11,087
1994	833	1,845	242	561	305	773	0	2,999	3,729	note:"a"		4,379	6,908
1995	759	1,582	666	1,565	518	1,339	0	3,042	3,831			4,985	8,317
1996	1,231	2,692	604	1,404	894	2,293	0	4,498	5,665			7,227	12,054
1997	607	1,299	170	387	301	1,026	0	2,567	3,210			3,645	5,922
1998	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,103	3,888	0	1,625	2,115			2,728	6,003
1999	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,230	4,324	0	2,252	2,783			3,482	7,107
2000	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,086	3,816	0	952	1,263			2,038	5,079
2001	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,374	4,720	0	1,725	2,182			3,099	6,902
2002	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				876	1,483	0	523	658			1,399	2,141
2003	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,776	3,745	0	929	1,142			2,705	4,887

SFAs 19, 20, 21: Returns, 1970-'97 estimated as run size (MSW recreational catch * prop. 2SW [range of values]/ expl. rate [range of values]; where MIN and MAX selected as 5th and 95th percentile values from 1,000 monte carlo estimates) + estimated 2SW fish in commercial landings 1970-1983 (Cutting MS 1984). For 1998-2001 see "a" below.

SFA 22: Inner Fundy stocks do not go to north Atlantic.

SFA 23: For 1970-1997 Similar approach as for SFAs 19-21 except that estimated wild MSW returns destined for Mactaquac Dam, Saint John River, replaced values for recreational catch; and estimated proportions that production above Mactaquac is of the total river replaced exploitation rates (commercial harvest,bi-catch etc., incl. in estimated returns) + est. 0.85-0.95* MSW hatchery returns to Mactaquac; 2SW production in rest of SFA omitted.

"a": Revsion of method, SFA 23, 1993-2001, estimated MSW returns to Nashwaak fence raised by prop. of area below Mactaquac (0.21-0.30) * prop. 2SW (0.7 & 0.9) and added to estimated MSW hatchery and wild returns * (Marshall et al. MS 1998) (0.85-0.95; 2SW) originating upriver of Mactaquac. MIN & MAX removals below Mactaquac based on Nashwaak losses: Mactaquac losses were a single value and together summed and removed from MSW returns (prevously) to estimate spawners.
SFAs 19-21, estimate of 2SW returns for 1998-'02, based on regression of LaHave wild counts on MIN and MAX estimates of total SFA 19-21 MSW returns and 5th and 95th percentile values of MIN-MAX (0.5 & 0.9 2SW fish among MSW salmon).

Appendix 5(ix) b. Total 2SW spawners in SFAs 19, 20, 21 and 23, 1970-2003.

	RETURNS						REMOVALS		SPAWNERS		SFA 23					
	SFA 19		SFA 20		SFA 21		angled (19-21)		SFAs (19-21)		RETURNS		REMOVALS		TOTAL SPAWNERS	
Year	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1970	1,170	2,537	658	1,535	597	1,525	941	1,375	1,485	4,222	8,540	12,674	7,004	7,828	3,021	9,068
1971	600	1,266	344	802	481	1,199	541	812	884	2,455	7,155	10,536	3,543	3,960	4,496	9,032
1972	735	1,614	421	1,002	454	1,198	623	922	987	2,892	7,869	11,368	1,397	1,562	7,459	12,699
1973	726	1,571	665	1,532	546	1,437	740	1,108	1,197	3,432	4,205	6,036	1,454	1,625	3,949	7,844
1974	1,035	2,225	691	1,588	548	1,397	871	1,277	1,404	3,933	10,755	14,988	2,632	2,942	9,526	15,979
1975	376	824	149	343	882	2,321	534	867	874	2,621	13,107	18,578	2,120	2,369	11,861	18,830
1976	791	1,672	346	822	441	1,146	603	887	975	2,754	14,274	20,281	4,203	4,698	11,045	18,337
1977	999	2,152	660	1,509	873	2,354	967	1,463	1,565	4,552	16,869	23,995	4,856	5,427	13,578	23,119
1978	810	1,739	429	995	655	1,706	723	1,088	1,171	3,352	8,225	11,294	2,879	3,218	6,517	11,428
1979	532	1,169	431	978	508	1,288	560	851	911	2,585	5,165	7,207	1,393	1,557	4,683	8,234
1980	1,408	3,051	746	1,714	1,483	3,989	1,390	2,131	2,247	6,623	19,056	26,865	7,033	7,860	14,270	25,628
1981	886	1,856	926	2,133	1,754	4,475	1,338	2,125	2,228	6,339	11,026	15,267	7,384	8,253	5,870	13,353
1982	917	1,990	316	746	682	1,756	734	1,096	1,181	3,396	9,782	13,871	5,307	5,932	5,656	11,335
1983	477	1,030	641	1,475	552	1,434	633	971	1,037	2,968	9,662	13,836	9,194	10,275	1,505	6,529
1984	828	1,768	638	1,500	766	2,004	267	419	1,965	4,853	15,706	22,627	3,426	3,829	14,245	23,650
1985	1,495	3,132	2,703	6,355	2,102	5,469			6,300	14,956	16,541	23,828	4,656	5,204	18,185	33,580
1986	3,500	7,541	2,561	5,987	2,150	5,312			8,211	18,840	9,891	14,261	2,667	2,981	15,435	30,120
1987	2,427	5,237	1,066	2,527	1,114	2,872			4,607	10,636	6,922	10,043	1,294	1,446	10,235	19,233
1988	2,635	5,724	1,914	4,464	1,105	2,945			5,654	13,133	4,716	6,697	1,296	1,449	9,074	18,381
1989	2,236	4,810	1,512	3,485	1,631	4,086			5,379	12,381	6,560	9,437	250	279	11,689	21,539
1990	2,406	5,178	1,085	2,515	1,271	3,260			4,762	10,953	5,486	7,918	560	626	9,688	18,245
1991	1,890	4,050	965	2,200	421	1,071			3,276	7,321	7,337	10,563	1,257	1,405	9,356	16,479
1992	1,788	3,923	631	1,488	480	1,236			2,899	6,647	6,878	9,809	1,052	1,176	8,725	15,280
1993	876	1,897	1,006	2,321	564	1,498			2,446	5,716	4,318	5,371	1,054	1,166	5,710	9,921
1994	833	1,845	242	561	305	773			1,380	3,179	2,999	3,729	697	815	3,682	6,093
1995	759	1,582	666	1,565	518	1,339			1,943	4,486	3,042	3,831	313	346	4,672	7,971
1996	1,231	2,692	604	1,404	894	2,293			2,729	6,389	4,498	5,665	720	812	6,507	11,242
1997	607	1,299	170	387	301	1,026			1,078	2,712	2,567	3,210	550	611	3,095	5,311
1998	>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,103	3,888			1,103	3,888	1,625	2,115	304	340	2,424	5,663
1999	>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,230	4,324			1,230	4,324	2,252	2,783	441	459	3,041	6,648
2000	>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,086	3,816			1,086	3,816	952	1,263	183	202	1,855	4,877
2001	>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,374	4,720			1,374	4,720	1,725	2,182	239	271	2,860	6,631
2002	>>>>>>>>>>>>>>>>>>>>>>>>>>>				876	1,483			876	1,483	523	658	166	192	1,233	1,949
2003	>>>>>>>>>>>>>>>>>>>>>>>>>>>				1,776	3,745			1,776	3,745	929	1,142	178	200	2,527	4,687

Spawners = returns minus removals where: "returns" are from previous Appendix as are outlines of revisions to methods for SFAs 19-21, 1998-2000, and SFA 23, 1993-2000. "Removals" of 2SW fish in SFAs 19-21 have been few, largely illegal and unascribed since the catch-and-release angling regulations in 1985; removals in SFA 23, 1985-1997, had been in total, the assessed losses to stocks originating above Mactaquac. The revised method, 1993-2000, incorporates 5th and 95th percentile values for losses noted on the Nashwaak raised to the total production area downstream of Mactaquac as well as the previously assessed and used values for stocks upstream of Mactaquac.

Appendix 5(x). Estimated numbers of salmon returns and spawners for Québec 1969-2003.

	Recruit of small salmon			Recruit of large salmon			Spawner of small salmon			Spawner of large salmon		
Year	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1969	25355	31694	38032	74653	93316	111979	16313	20392	24470	25532	31915	38299
1970	18904	23630	28356	82680	103350	124020	11045	13806	16568	31292	39115	46937
1971	14969	18711	22453	47354	59192	71031	9338	11672	14007	16194	20243	24292
1972	12470	15587	18704	61773	77217	92660	8213	10267	12320	31727	39658	47590
1973	16585	20731	24877	68171	85214	102256	10987	13734	16480	32279	40349	48419
1974	16791	20988	25186	91455	114319	137182	10067	12583	15100	39256	49070	58884
1975	18071	22589	27106	77664	97080	116497	11606	14507	17409	32627	40784	48940
1976	19959	24948	29938	77212	96515	115818	12979	16224	19469	31032	38790	46548
1977	18190	22737	27285	91017	113771	136525	12004	15005	18006	44660	55825	66990
1978	16971	21214	25456	81953	102441	122930	11447	14309	17170	40944	51180	61416
1979	21683	27103	32524	45197	56497	67796	15863	19829	23795	17543	21929	26315
1980	29791	37239	44686	107461	134327	161192	20817	26021	31226	48758	60948	73137
1981	41667	52084	62501	84428	105535	126642	30952	38690	46428	35798	44747	53697
1982	23699	29624	35549	74870	93587	112305	16877	21096	25316	36290	45363	54435
1983	17987	22484	26981	61488	76860	92232	12030	15038	18045	23710	29638	35565
1984	21566	26230	30894	61180	71110	81041	16316	20636	24957	30610	37674	44739
1985	22771	28016	33262	62899	73545	84192	15608	20374	25140	28312	35897	43482
1986	33758	40347	46937	75561	87479	99397	22230	28042	33855	32997	41114	49232
1987	37816	45925	54034	72190	82920	93650	25789	33135	40481	29758	36610	43462
1988	43943	53068	62193	77904	90587	103269	28582	36699	44815	34781	43653	52524
1989	34568	41488	48407	70762	81316	91871	24710	31015	37319	34268	41727	49185
1990	39962	47377	54792	68851	79872	90893	26594	33210	39826	33454	41535	49615
1991	31488	37121	42755	64166	73675	83184	20582	25508	30433	27341	33569	39797
1992	35257	42000	48742	64271	74112	83953	21754	27668	33583	26489	32993	39497
1993	30645	36400	42156	50717	57197	63677	17493	22469	27444	21609	25481	29353
1994	29667	34918	40170	51649	58139	64630	16758	21200	25642	21413	25191	28968
1995	23851	28109	32368	59939	67083	74227	14409	17978	21548	30925	35122	39320
1996	32008	37283	42558	53990	61136	68282	18923	23364	27805	26042	30433	34824
1997	24300	28659	33018	44442	50315	56187	14724	18467	22210	21275	24871	28466
1998	24495	29398	34301	33368	38487	43605	16743	21237	25730	19506	23068	26629
1999	25880	31279	36679	34815	40496	46178	18969	23889	28808	23631	28124	32618
2000	24129	29599	35070	33312	39938	46565	16444	21154	25865	22094	27027	31960
2001	16931	20684	24437	35016	41753	48490	10829	13902	16974	22871	27913	32954
2002	28609	33942	39275	25635	30718	35801	17070	21347	25625	17079	20722	24366
2003	23103	27515	31928	40013	46810	53606	15406	19314	23222	28987	34658	40330
Mean 84-03	29237	35360	41160	54772	63152	71531	19186	24279	29372	26550	32249	37947

APPENDIX 6

SAS program code to:
(1) - model and forecast PFA for North America based on phase shift
(2) provide catch advice for the West Greenland fishery in 2004 based on catch options and management objectives of NAC and NEAC areas.

```
***FILE CALLED pfa-model-PREDICTION-2004.sas
Code written by Gerald Chaput, DFO Gulf Region, Canada;

OPTIONS NOCENTRE;
/**** ASCII file containing regional lagged spawner estimates, by minimum and
maximum generated from Excel table of lagged spawners, edited and updated by
Dave Reddin **/
Filename in1 "I:\WGNAS-04\personal\Chaput\catch-advice\regional-lagged-spawners-
2004.prn";
data spawners;
infile in1 missover;
input year LBLS_L LBLS_H NFLS_L NFLS_H QCLS_L QCLS_H GFLS_L GFLS_H SFLS_L SFLS_H
       USALS;
RUN;

/**** ASCII file containing input data to calculate PFA as well as estimates of
2SW returns by region, as minimum and maximum  generated from Excel table of
input data and regional returns edited and updated by Dave Reddin**********/
Filename in2 "I:\Wgnas-04\personal\Chaput\catch-advice\catch-returns-2004.prn";
data catchreturns;
  infile in2 missover;
  INPUT YEAR NG1 NC1_L NC1_H NC2_L NC2_H NR2_L NR2_H RFL2_L RFL2_H
  LBR2_L LBR2_H NFR2_L NFR2_H QCR2_L QCR2_H GFR2_L GFR2_H SFR2_L SFR2_H USAR2;
  RUN;
PROC SORT DATA = catchreturns; BY YEAR; RUN;
PROC SORT DATA = spawners; BY YEAR; RUN;
DATA INPUTS; MERGE spawners catchreturns;
    BY YEAR;
    RUN;

/* this seciton creates various sub-files used in generating PFA estimates,
model fits, PFA predictions and for subsequent risk analysis   */
data  fishdata (keep = sim break year phase pfa lnspawn lnpfa lnpfaspawn dumb)
   /** this is the base file for modelling  */
      pfa (keep = sim year lnpfa)
/** this is the base file for estimating relative change in pfa relative to
year-2 **/
     lnpfa2002 (keep = sim lnpfa2002)
     lnpfa2001 (keep = sim lnpfa2001)
/* these files are later combined with "pfa" file to generate predictions of PFA
for the years of interest, the earlier year is for an update, later year is for
prediction in year of interest  ****/
returnsall (keep = sim year USAR2 R2SF R2GF R2QC R2NF R2LB R2NA)
returnssouthnow (keep = sim year R2SF USAR2)
RETURNSSOUTH (keep = sim year R2SF USAR2)
/*** these files are used to accumulate returns by region for apportioning PFA
to regions and for developing indices of returns for risk analysis      ****/
yearofinterest (keep = sim break year phase lnspawn dumb);
/**** this file accumulates years for which forecasts will be generated, it is
required to automatically generate forecasts under two phase states     *****/
   set inputs;

maxsim = 1000;   *** maximum number of simulations;

do sim = 1 to maxsim;
   seed = 0;
```

```
/*  incorporating uncertainty in PFA estimated  */
  RAN_C1  = NC1_L + (NC1_H - NC1_L)* RANUNI(SEED);
  RAN_C2  = NC2_L + (NC2_H - NC2_L)* RANUNI(SEED);
  RAN_R2  = NR2_L + (NR2_H - NR2_L)* RANUNI(SEED);
  if rfl2_l = 1.00 then RAN_RFL2 = 1;
  else RAN_RFL2 = RFL2_L + (RFL2_H - RFL2_L)* RANUNI(SEED);
          *ratio correction for Labrador;
  nareturns = RAN_RFL2*(((RAN_R2*exp(0.03*1) + RAN_C2)*exp(0.03*10))+ RAN_C1);
  pfa = nareturns + NG1;
        /* PFA based on equation 4.2.3.3 in WG report*/
  lnpfa = log(pfa);

  /* calculates uncertainty of lagged spawner index and the lagged spawner
proportions by region   */
  LSLB = LBLS_L + (LBLS_H - LBLS_L)* RANUNI(SEED);
  LSNF = NFLS_L + (NFLS_H - NFLS_L)* RANUNI(SEED);
  LSQC = QCLS_L + (QCLS_H - QCLS_L)* RANUNI(SEED);
  LSGF = GFLS_L + (GFLS_H - GFLS_L)* RANUNI(SEED);
  LSSF = SFLS_L + (SFLS_H - SFLS_L)* RANUNI(SEED);
  LSIndex = sum(LSNF, LSQC, LSGF, LSSF, USALS); ** all lagged spawnes minus
Labrador;
  LSNA = sum(LSLB, LSNF, LSQC, LSGF, LSSF, USALS); ** all lagged spawners;
  lnspawn = log(LSIndex);
  if year = 2001 then do;  /** for updated forecasts, adjust year as needed **/
     lnpfa2001 = lnpfa;
     output lnpfa2001;
     end;
  if year = 2002 then do;
/** for forecast of year of interest, adjust year as needed ***/
     lnpfa2002 = lnpfa;
     output lnpfa2002;
     end;

*** file to prepare data for selecting phase ********;
  if lnpfa ne . then do;
     output pfa;
     end;

     R2SF = SFR2_L + (SFR2_H - SFR2_L)* RANUNI(SEED);
     R2LB = LBR2_L + (LBR2_H - LBR2_L)* RANUNI(SEED);
     R2NF = NFR2_L + (NFR2_H - NFR2_L)* RANUNI(SEED);
     R2QC = QCR2_L + (QCR2_H - QCR2_L)* RANUNI(SEED);
     R2GF = GFR2_L + (GFR2_H - GFR2_L)* RANUNI(SEED);
     if year ge 1997 then R2LB = nareturns - sum(USAR2, R2SF, R2GF, R2QC, R2NF);
     R2NA = sum(R2LB, R2NF, R2QC, R2GF, R2SF, USAR2);

if 1992 le year le 1996 then OUTPUT RETURNSSOUTH;
/*** <<--5 year base period for Scotia-Fundy and USA returns improvement--*/

if 1998 le year le 2002 then do;
    OUTPUT RETURNSALL;
    output returnssouthnow;
    end;
/*** <<--5 year moving period for proportioning PFA to regions
        slide 5-year period as more recent PFA value is obtained**/

  lnpfaspawn = lnpfa - lnspawn;
  dumb = 1;  * need this to calculate likelihood of null model;

do break = 1985 to 1993;
        * stepping through possible break years;
    if year le break then phase = 1;
    if break lt year le 2002 then phase = 2;
/** change to 2003 once 2003 PFA is known;
```

```
  if lnspawn ne . and lnpfa ne . then output fishdata;
    if 2003 le year le 2004 then do;
    do i = 1 to 2;
     phase = i;
     output yearofinterest;
     end;
    end;
  end;
end;   * finish generating the data sets;

run;

proc means data = returnssouth noprint nway mean;
 class sim;
 var R2SF USAR2;
 output out = meanretsouth  mean = R2SF USAR2;
 run;
data _nul_; set meanretsouth;
  file "I:\Wgnas-04\personal\Chaput\catch-advice\meanretsouth.dat";
  /* file of average returns by simulation to southern areas, 1992 to 1996 ***/
  put sim 8. R2SF 10.  USAR2 10.;
run;
proc means data = returnssouthnow noprint nway mean;
 class sim;
 var R2SF USAR2;
 output out = meanretsouthnow  mean = R2SF USAR2;
 run;
data _nul_; set meanretsouthnow;
  file "I:\Wgnas-04\personal\Chaput\catch-advice\meanretsouth-now.dat";
  /* file of average returns by simulation to southern areas, most recent five
years ***/
  put sim 8. R2SF 10.  USAR2 10.;
run;

proc means data = returnsall noprint nway mean;
 class sim;
 var USAR2 R2SF R2GF R2QC R2NF R2LB R2NA;
 output out = meanretall  mean = USAR2 R2SF R2GF R2QC R2NF R2LB R2NA;
 run;
data _nul_; set meanretall;
  file "I:\Wgnas-04\personal\Chaput\catch-advice\meanretall.dat";
/* file of average returns by simulation to all areas, most recent five years*/
  put sim 8. USAR2 10. R2SF 10. R2GF 10. R2QC 10. R2NF 10. R2LB 10. R2NA 10.;
run;

/*** prepares the predictions files for year of interest based on
history of ratio of pfa in year to pfa in year-2  */
data pfa2 (keep = sim year lnpfa2); set pfa;
  year = year+2;
  lnpfa2 = lnpfa;
  run;

proc sort data = pfa; by sim year; run;
proc sort data = pfa2; by sim year; run;
data pfaratio; merge pfa2 pfa;
  by sim year;
  pfaratio = lnpfa/lnpfa2;
  if pfaratio ne . then output pfaratio;
  run;
data expectations (keep = sim expected2003 expected2004);
/** variable names correspond to years of interest during this analysis, i.e.
update 2003, forecast 2004. Change for clarity as new data become available */
  merge pfaratio lnpfa2001 lnpfa2002;
  by sim;
```

```
  expected2003 = pfaratio*lnpfa2001;
  expected2004 = pfaratio*lnpfa2002;
run;


/*   Model fitting, seven nested models considered    */
/** file to analyze the models for different break years ***/
data analyze; set fishdata yearofinterest;
run;
proc sort data = analyze; by sim break;
run;

/*model 0, just intercept  */

proc glm data = analyze noprint outstat = results;
  by sim break;
  class dumb;
  model lnpfa = dumb / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;
data model0 (keep = sim break model parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 2;
          model = 0;
          output;
  end;
run;
data pred0 (keep = sim break model year phase predpfa prederror meanerror);
 set pred;
  model = 0;
  if 2003 le year le 2004; /* adjust to 2003 once 2002 PFA is known */
  run;


/*model 1, fixed intercept, just slope  */

proc glm data = analyze noprint outstat = results;
  by sim break;
  model lnpfa = lnspawn / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;
data model1 (keep = sim break model parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 3;
          model = 1;
          output;
  end;
run;
data pred1 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 1;
  if 2003 le year le 2004;  ** adjust to 2003 once 2002 PFA is known;
  run;

  /*  model 2 - no slope, just intercept   */
proc glm data = analyze noprint outstat = results;
  by sim break;
  class phase;
  model lnpfa = phase / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;

data model2 (keep = sim break model  parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
```

```
      parameters = 3;
          model = 2;
          output;
  end;
run;
data pred2 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 2;
  if 2003 le year le 2004; ** adjust to 2003 once 2002 PFA is known;
  run;

  /* model 3  different intercept, common slope  */
proc glm data = analyze noprint outstat = results;
  by sim break;
  class phase;
  model lnpfa = phase lnspawn / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;
data model3 (keep = sim break model  parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 4;
          model = 3;
          output;
  end;
run;
data pred3 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 3;
  if 2003 le year le 2004;  ** adjust to 2003 once 2002 PFA is known;
  run;

  /*   model 4 - common intercept, different slope  */
proc glm data = analyze noprint outstat = results;
  by sim break;
  class phase;
  model lnpfa = phase*lnspawn / solution;
  output out = pred  p = predpfa  stdi = prederror  stdp = meanerror;
run;
data model4 (keep = sim break model parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 4;
          model = 4;
          output;
  end;
run;
data pred4 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 4;
  if 2003 le year le 2004;  ** adjust to 2003 once 2002 PFA is known;
  run;

  /*  model 5 - different slope, different intercept  */
proc glm data = analyze noprint outstat = results;
  by sim break;
  class phase;
  model lnpfa = phase lnspawn phase*lnspawn / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;
data model5 (keep = sim break model parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 5;
          model = 5;
          output;
  end;
```

```
run;
data pred5 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 5;
  if 2003 le year le 2004;  ** adjust to 2003 once 2002 PFA is known;
  run;

  /*  model 6 - different slope, intercept through the origin  */
proc glm data = analyze noprint outstat = results;
  by sim break;
  class phase;
  model lnpfaspawn = phase / solution;
  output out = pred  p = predpfa  stdi = prederror stdp = meanerror;
run;
data model6 (keep = sim break model parameters SS DF); set results;
  if _SOURCE_ = "ERROR" then do;
      parameters = 3;
          model = 6;
          output;
  end;
run;
data pred6 (keep = sim break model year phase predpfa prederror meanerror); set
pred;
  model = 6;
  predpfa = predpfa + lnspawn;
  if 2003 le year le 2004;  ** adjust to 2003 once 2002 PFA is known;
  run;

/* calculates negative log likelihood and Akaike information criterion for each
simulation and model and break year */

data models; set model0 model1 model2 model3 model4 model5 model6;
N = 26; * number of observations in model fitting, once PFA2002 is known, N=26-;
      MSE = SS / DF;
          LH = (N/2 *log(2*(3.141593)) + (N/2 * log(MSE)) + (1/(2*MSE))*SS);
          AICc = 2*LH + 2*parameters *(N / (N-parameters-1));
  run;


/* summarizes parsimonious model based on break year, and uncertainty in data */
proc sort data = models; by sim;
run;

proc means data = models noprint min;
/* finds the minimum Akaike value among break year and models for each sim */
  by sim;
  var AICc;
  output out = minac min = minaicc;
  run;

data modelkeep (keep = sim break model aicdiff);
   merge models minac;
/*  calculates AIC differences as per Burnham and Anderson 1998 for each sim  */
  by sim;
  aicdiff = aicc - minaicc;
  run;

  /* output predicted PFA for years of interest in phase 1 and phase 2
       for each model and break year */
  /* <<--year of interest for forecast for 2004 WGNAS meeting, interested in
updated 2003 forecast and 2004 PFA forecast-----*/
data predyear;
   set pred0 pred1 pred2 pred3 pred4 pred5 pred6;
run;
```

```
proc sort data = modelkeep; by sim break model;
proc sort data = predyear; by sim break model;
data predict2003 predict2004 predict2003high predict2003low predict2004high
predict2004low;
  merge modelkeep predyear;
  by sim break model;
  if aicdiff = 0;
  if year = 2003 and phase = 1 then output predict2003high;
  if year = 2003 and phase = 2 then output predict2003low;
  if year = 2004 and phase = 1 then output predict2004high;
  if year = 2004 and phase = 2 then output predict2004low;
  if year = 2003 then output predict2003;
  if year = 2004 then output predict2004;
  run;

/* calculates the relative probability of the year of interest being in either
phase 1 or phase 2. Calculate the density based on the normal distirbution of
observing in 2003 the value of PFA in 2001 times pfaratio within the 2003
predicted value distribution. Then sums the exact densities for 2003 in phase 1,
2003 in phase 2 and calculates relative probabilities of phase 1 and phase 2. */

proc sort data = predict2003high; by sim; run;
proc sort data = predict2003low; by sim; run;

proc sort data = predict2004high; by sim; run;
proc sort data = predict2004low; by sim; run;
proc sort data = expectations; by sim; run;

/**** REVISED PREDICTIONS FOR UPCOMING 2SW YEAR IN NORTH AMERICA ****/
data density2003low;  merge predict2003low expectations;
  by sim;
  density = (1 / (sqrt(2*3.14159)*prederror))* exp(-0.5 * (((expected2003-
predpfa)/meanerror)**2));
/** from Neter, Kutner Nachtsheim and Wasserman 1996  Applied Linear Regression
Models  p. 34-35  **/
  run;
data density2003high;  merge predict2003high expectations;
  by sim;
  density = (1 / (sqrt(2*3.14159)*prederror))* exp(-0.5 * (((expected2003-
predpfa)/meanerror)**2));
  ** from Neter, Kutner Nachtsheim and Wasserman 1996  Applied Linear Regression
Models p. 34-35  ;
  run;

proc means data = density2003low noprint nway sum;
  class sim;  * sum of densities by sim in low phase;
  var density;
  output out = sum2003low sum = dens2003low;
  run;
proc means data = density2003high noprint nway sum;
  class sim;  * sum of densities by sim in high phase;
  var density;
  output out = sum2003high sum = dens2003high;
  run;
data phaseweight2003; merge sum2003low sum2003high;
  by sim;
  density2003 = dens2003low + dens2003high;
  weightlow = dens2003low/density2003;
  if ranuni(0) le weightlow then phasekeep = 2; *** low phase;
  else phasekeep = 1; *** high phase;
  run;

data predictions2003 (keep = sim model break phase predpfa prederror pfa);
  merge phaseweight2003 predict2003;
```

```
  by sim;
  if phase = phasekeep;
  pfa = exp(predpfa + prederror*(rannor(0)));
  run;

data _nul_; set predictions2003;
  file "I:\Wgnas-04\personal\Chaput\catch-advice\predicted2003.dat";
/*** ASCII file containing the predicted values, models kept for each simulation
for the updated year of interest ***/
put sim 8. break 8. model 6. phase 6. pfa 12. predpfa 12.6 prederror 12.6;
run;

/****** PREDICTIONS FOR 2004 PFA  ************/
data density2004low;  merge predict2004low expectations;
  by sim;
  density = (1 / (sqrt(2*3.14159)*prederror))* exp(-0.5 * (((expected2004-
predpfa)/meanerror)**2));
  ** from Neter, Kutner Nachtsheim and Wasserman 1996  Applied Linear Regression
Models p. 34-35  ;
  run;
data density2004high;  merge predict2004high expectations;
  by sim;
  density = (1 / (sqrt(2*3.14159)*prederror))* exp(-0.5 * (((expected2004-
predpfa)/meanerror)**2));
  ** from Neter, Kutner Nachtsheim and Wasserman 1996  Applied Linear Regression
Models p. 34-35  ;
  run;

proc means data = density2004low noprint nway sum;
  class sim;  * sum of densities by sim in low phase;
  var density;
  output out = sum2004low sum = dens2004low;
  run;
proc means data = density2004high noprint nway sum;
  class sim;  * sum of densities by sim in high phase;
  var density;
  output out = sum2004high sum = dens2004high;
  run;
data phaseweight2004; merge sum2004low sum2004high;
  by sim;
  density2004 = dens2004low + dens2004high;
  weightlow = dens2004low/density2004;
  if ranuni(0) le weightlow then phasekeep = 2; *** low phase;
  else phasekeep = 1; *** high phase;
  run;

data predictions2004 (keep = sim model break phase predpfa prederror pfa);
  merge phaseweight2004 predict2004;
  by sim;
  if phase = phasekeep;
  pfa = exp(predpfa + prederror*(rannor(0)));
  run;

data _nul_; set predictions2004;
  file "I:\Wgnas-04\personal\Chaput\catch-advice\predicted2004.dat";
/*** ASCII file containing the predicted values, models kept for each simulation
for the
     year of interest, in this case 2004 ***/
  put sim 8. break 8. model 6. phase 6. pfa 12. predpfa 12.6 prederror 12.6;
run;


(2) ***FILE CALLED risk-analysis-2004.sas;
```

```
OPTIONS NOCENTRE;


/* this is the risk analysis portion of the Greenland advice
   PFA forecast, returns variability, etc. are generated using previous program
   called PFA-model-prediciton-2004.sas
   written by Gerald Chaput, DFO Gulf Region    */

data harvestperton (keep = sim NA1SW NEAC1SW);
/*** this generates number of fish of NA and NEAC origin per ton of catch at
West Greenland ***/
  maxsim = 10000;
/*** maximum number of simulations, should match number of simulations from PFA
estimation run ************/

do sim = 1 to maxsim;
   seed = 0;
/* calculating harvest of NA and European fish per ton of fishery input
parameters for biological characteristics variations for 2004
        PropNA:  0.65 to 0.91
        PropE:  1 - propNA
        Wt1SWNA:  2.47 to 3.02 kg
        Wt1SWE:  2.81 to 3.08 kg
        ACF:    1.017 to 1.050
        HarvestNA: harvest of NA 1SW salmon based on bio characteristics.
             Harvest per ton = (1000 / ACF / (propNA*Wt1SWNA +
propE*Wt1SWE))*propNA
        HarvestNEAC: harvest of NEAC 1SW salmon based on bio characteristics.
             Harvest (per ton) = (1000 / ACF / (propNA*Wt1SWNA +
propE*Wt1SWE))*propE  */
   propNA = 0.65 + ((0.91 - 0.65)*ranuni(seed));  /* change min and max as
required-*/
   propE =  1 - propNA;
   Wt1SWNA = 2.47 + ((3.02 - 2.47)*ranuni(seed)); *** <<-change min and max as
required----;
   Wt1SWE = 2.81 + ((3.08 - 2.81)*ranuni(seed));  *** <<-change min and max as
required----;
   ACF = 1.017 + ((1.050 - 1.017)*ranuni(seed));  *** <<-change min and max as
required----;
   NA1SW = (1000 / ACF / (propNA * Wt1SWNA + propE * Wt1SWE))* propNA;
   NEAC1SW =  (1000 / ACF / (propNA * Wt1SWNA + propE * Wt1SWE))* propE;

  output harvestperton;  /*** number of fish by continent per ton of catch----*/
  end;
run;

filename a1 "I:\Wgnas-04\personal\Chaput\catch-advice\meanretsouth.dat";
/*generated previously, mean returns to southern areas for period 1992 to 1996*/
data southobj (keep = sim R2SFthen USAR2then); infile a1 missover;
  input sim R2SF USAR2;
  R2SFthen = R2SF;
  USAR2then = USAR2;
  * mean returns to southern areas for 1992 to 1996;
  run;

filename a2 "I:\Wgnas-04\personal\Chaput\catch-advice\meanretall.dat";
/*** mean returns to each region for most recent five years, 1998 to 2002  ****/
data returnna;
  infile a2 missover;
  input sim USAR2 R2SF R2GF R2QC R2NF R2LB R2NA;
  propUSA = USAR2/R2NA;
  propSF = R2SF/R2NA;
  propGF = R2GF/R2NA;
  propQC = R2QC/R2NA;
```

```
  propNF = R2NF/R2NA;
  propLB = R2LB/R2NA;
  run;

filename a4 "I:\Wgnas-04\personal\Chaput\catch-advice\predicted2004.dat";
data pfayearnac (keep = sim pfanac); infile a4 missover;
  input sim break model phase pfanac predpfa prederror;
  /* predicted PFA over all models and break years*/
run;
filename a5 "I:\Wgnas-04\personal\Chaput\catch-advice\neac-mswsouth-pfaforecast-
2004.prn";
data pfayearneac (keep = sim pfaneac); infile a5 missover;
  input sim pfaneac;
/* 10000 values of PFA NEAC were derived using CrystallBall and lognormal
distibution parametrized by 95% CI of 304832 to 785968  */
  run;
  /* predicted PFA for southern MSW European stock */

/**** doing the Greenland risk analysis ********/

data risk; merge southobj harvestperton returnna pfayearnac pfayearneac;
   by sim;
    ShFr = 0.4; /*sharing fraction 40:60 Greenland:NA, used to bump up Greenland
quota to pre-agreed sharing arrangement for NA   ********/
    do t = 0 to 100 by 5;
       na1swt = na1sw * t;
       neac1swt = neac1sw*t;
       returnna = (pfanac - (na1swt/ShFr))*exp(-0.03*11);
       returnneac = (pfaneac*exp(-0.03*7) - (neac1swt/ShFr))*exp(-0.03*8);
       /** NEAC PFA is for Jan. 1 of first year at sea therfore fish are
discounted for 7 months (Jan 1 to Aug 1) to get to the Greenland fishery and
after harvests are taken, fish are discounted for 8 months on their return to
homewaters  (Aug. 1 to April 1 of next year)  */
       consLB = ((returnna*propLB)>=34746);
       consNF = ((returnna*propNF)>=4022);
       consQC = ((returnna*propQC)>=29446);
       consGF = ((returnna*propGF)>=30430);
       consNorth = consLB*consNF*consQC*consGF;
       consneac = (returnneac>=267894);  /* NEAC CL for MSW southern Europe -
2004 report**/

       objSFless0 = ((returnna*propSF) lt R2SF);
       objUSless0 = ((returnna*propUSA) lt USAR2);
       objSouthless0 = objSFless0*objUSless0;

     objSF10then = ((returnna*propSF) ge (R2SFthen*1.1));
     objUS10then = ((returnna*propUSA) ge (USAR2then*1.1));
       objSF25then = ((returnna*propSF) ge (R2SFthen*1.25));
       objUS25then = ((returnna*propUSA) ge (USAR2then*1.25));
     objSouth10then = objSF10then*objUS10then;
       objSouth25then = objSF25then*objUS25then;

       output risk;
       end;
       run;

proc means data = risk noprint sum nway;
        class t;
       var consLB consNF consQC consGF consNorth
            objSF10then  objUS10then objSouth10then
            objSF25then objUS25then objSouth25then
            objSFless0 objUSless0 objsouthless0 consneac;
       output out = byton
              sum = consLB consNF consQC consGF consNorth
```

```
            objSF10then  objUS10then objSouth10then
            objSF25then objUS25then objSouth25then
            objSFless0 objUSless0 objsouthless0 consneac;
       run;

data probtable; set byton;
 file "I:\Wgnas-04\personal\Chaput\catch-advice\risk-analysis-results-2004.dat";
          put t 6. consLB 10. consNF 10. consQC  10. consGF  10. consNorth 10.
            objSF10then  10.  objUS10then  10. objSouth10then 10.
            objSF25then  10. objUS25then  10. objSouth25then 10.
            objSFless0 10.  objUSless0 10.  objsouthless0 10. consneac 10. ;
       run;

proc print data = probtable;
var t consLB consNF consQC consGF consNorth
      objSF10then  objUS10then objSouth10then
      objSF25then objUS25then objSouth25then
      objSFless0 objUSless0 objsouthless0 consneac;
    run;
```

International Council for the Exploration of the Sea
Advisory Committee on Fishery Management

INTERNAL DOCUMENT

TECHNICAL MINUTES OF ACFM SUB-GROUP MEETING

ICES 21-23 April 2004

1 INTRODUCTION

The meeting was attended by the WGNAS Chair Walter Crozier, the ACFM Chair Poul Degnbol, the Reviewer Jake Rice, the Chair of ICES Diadromous Fish Committee Niall Ó Maoiléidigh, and ICES Fisheries Assessment Scientist Henrik Sparholt.

Minutes of the ACFM meeting are compiled as two separate papers following the decision made at the May 1996 ACFM meeting. The first paper is called "Minutes of ACFM Meeting" and is made available to a broad audience as an "A:" paper at the Annual Science Conference. The other paper is called "Technical Minutes of ACFM Meeting" and is for use internally in ACFM and in its Assessment Working Groups.

The "Minutes of the ACFM Meeting" records general topics discussed and especially decisions taken on such general issues. The "Minutes" furthermore records revised assessments if such were done during the ACFM plenary.

The "Technical Minutes of ACFM Meeting" (the present one) records the technical considerations related to specific assessment Working Groups, i.e. Advisory Committee on Fishery Management's review of the Working Group reports. The "Technical Minutes" includes new VPA and projection runs, etc. where such new runs were presented to ACFM. The "Technical Minutes" paper is mainly the outcome of the ACFM Sub-group meetings.

At the present meeting the report of the Working Group of North Atlantic Salmon (WGNAS) was dealt with.

2 GENERAL POINTS

No points**.**

3 WORKING GROUP ON THE NORTH ATLANTIC SALMON

The report was presented by the WG Chair Walter Crozier.

The Working Group was commended for the report.

Given the decision in 2003 to restructure the ACFM advice format, to align it with current ICES formats for advice on other species, the Working Group report was similarly restructured in 2004. The Review Group noted that this would simplify the process of reviewing the report and preparing the advice.

The Review Group noted that the term "safe biological limits" was used in the WGNAS report when referring to formal assessment of stock status. It was pointed out that ICES is moving towards globally adopting the terms "within precautionary limits/outside precautionary limits". However, as these terms have not yet been formally ratified by ICES, there was no need to change this in the report or ACFM extract. However, ACFM requested the WGNAS chair to point out the incoming terms at the presentation to NASCO.

Generally, the technical parts of the report were accepted and no significant modifications were required. Specific comments on the report sections are summarised below:

Section 2.3 (Extract Section 2.2.1).The review Group noted further analyses of data sets intended to improve estimates of natural mortality "m", as used in the run-reconstruction models. The Review Group recommended that, where possible, further datasets should be examined for temporal changes in M.

Section 2.4.1, (Extract Section 2.3.2) The Review Group welcomed the progress being made with developing river-specific conservation limits in Ireland, with Bayesian hierarchical approaches being applied to determine conservation requirements at district and national levels, replacing the previously used pseudo-s/r method. The Review Group noted that when comparing results from existing and developing methods, uniform measures of central tendency should be used.

Section 2.5 (Extract Section 2.3.4).The Review Group commended the way in which the Working Group is continuing to approach answering the terms of reference relating to long-term projections for stock rebuilding, especially in modelling trajectories for achieving conservation limits in stocks of differing productivity under mixed stock fishery scenarios. In order for these approaches to be incorporated into catch advice, the theoretical models must include increased complexity and specific applications that will require adequate data on stocks and well defined management objectives. However, the Review Group considers that these theoretical models are sufficiently well developed to demonstrate the sensitivity of low and medium productivity stocks to over-exploitation in mixed stock fisheries.The

Working Group was also commended for extending analyses of stock rebuilding to encompass population viability analysis (PVA). Noting that these PVA simulations were preliminary, the Review Group suggested that further development should be carried out to explore PVA in Atlantic salmon stocks and stock complexes, as this will highlight to managers the risks of extinction facing some stocks. In particular, it was noted that, in many cases, restricting catches alone may be insufficient to achieve stock rebuilding unless additional rebuilding measures are taken.

Section 3. 11 (Extract Section 3.10). The Review Group noted the information provided by the Working Group on salmon by-catches in pelagic fisheries in the NEAC area and strongly endorsed the Working Group's recommendations for the vital necessity for disaggregated pelagic catch data for certain fisheries, before reliable estimates of salmon by-catch could be provided. The Review Group strongly endorsed the view of the Working Group that screening of commercial catches was likely to provide the most viable method of deriving by-catch estimates, and although research surveys were very useful in understanding distribution in time and space of salmon in relation to pelagic fisheries, extrapolations from these surveys was not likely to be viable (particularly from research surveys targeted specifically on salmon post-smolts).

Section 5.10 (Extract Section 5.10). The Review Group noted the further development of the model used to provide forecasts of PFA of North American stocks at West Greenland, commending the new approaches on model selection and on further accounting for uncertainty in the data used in developing catch advice.