Advisory Committee on Fisheries Management **ICES CM 2000/ACFM:13**

REPORT OF THE

WORKING GROUP ON NORTH ATLANTIC SALMON

ICES, Headquarters
3–13 April 2000

International Council for the Exploration of the Sea

Conseil International pour l’Exploration de la Mer

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1 INTRODUCTION

1.1 Main Tasks

At its 1999 Statutory Meeting, ICES resolved (C. Res. 1999/2ACFM07) that the Working Group on North Atlantic Salmon [WGNAS](Chair: Dr. N. Ó Maoiléidigh, Ireland) will meet at ICES Headquarters from 3-13 April, 2000 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
i. provide an overview of salmon catches, including unreported catches by country and catch and release, and worldwide production of farmed and ranched salmon in 1999;	2.1 & 2.2
ii. describe and evaluate methods currently used for estimating unreported catch by country and advise on improvements to these methods where appropriate;	2.3
iii. advise on the data requirements and methods for the scientific evaluation of bird and marine mammal predation on Atlantic salmon;	2.4
iv. report on significant developments which might assist NASCO with the management of salmon stocks;	2.5, 2.7, 3.9
v. provide a compilation of egg collections and juvenile releases and tag releases, by country, in 1999;	2.8, 2.9
vi. provide estimates of escapement from marine salmon farms by country and assess the reliability and comparability of estimates of salmon farm escapees in fisheries and stocks.	2.6
b) With respect to Atlantic salmon in the North-East Atlantic Commission area:	
i. describe the events of the 1999 fisheries and the status of the stocks;	3.1-3.4
ii. evaluate the effects on stocks and homewater fisheries of significant management measures introduced since 1991;	3.5
iii. further develop the age-specific stock conservation limits where possible based upon individual river-based stocks;	3.7
iv. further develop methods to estimate the expected abundance of salmon in the Commission area;	3.6
v. determine the most appropriate stock groupings for the provision of catch options or alternative management advice;	3.6
vi. provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;	3.8
vii. identify relevant data deficiencies, monitoring needs and research requirements.	3.10
c) With respect to Atlantic salmon in the North American Commission area:	Section
i. describe the events of the 1999 fisheries and the status of the stocks;	4.1 & 4.2
ii. update the evaluation of the effects on US and Canadian stocks and fisheries of management measures implemented after 1991 in the Canadian commercial salmon fisheries, with special emphasis on the Newfoundland stocks;	4.3
iii. update age-specific stock conservation limits based on new information as available;	4.4
iv provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;	4.5
v. identify relevant data deficiencies, monitoring needs and research requirements.	4.6

d) With respect to Atlantic salmon in the West Greenland Commission area:	Section
i. describe the events of the 1999 fisheries and the status of the stocks;	5.1 & 5.2
ii. critically evaluate, and provide sensitivity analyses of, the effects on European and North American stocks of the Greenlandic quota management measures and compensation arrangements since 1993;	5.3, 5.7
iii. provide estimates of uncertainty and evaluate apparent recent changes in the proportion of continent of origin detected in the West Greenland fishery catches;	5.3
iv. provide a detailed explanation and critical examination of any changes to the model used to provide catch advice and of the impacts of any changes to the model on the calculated quota;	5.4
v. provide age-specific stock conservation limits for all stocks occurring in the Commission area based on the best available information;	5.5
vi. provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;	5.6
vii. identify relevant data deficiencies, monitoring needs and research requirements;	5.8

The Working Group considered 32 Working Documents submitted by participants (Appendix 1); other references cited in the report are given in Appendix 2.

1.2 Participants

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A full address list for the participants is provided in Appendix 3.

2 ATLANTIC SALMON IN THE NORTH ATLANTIC AREA

2.1 Catches of North Atlantic Salmon

2.1.1 Nominal catches of salmon

Total nominal catches of salmon reported by country in all fisheries for 1960-99 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, ranched fish (see Section 3).

The Icelandic catches are presented under two separate categories; wild and ranched. Iceland is the only North Atlantic country where large scale ranching has previously been undertaken and where the intent was to harvest all returns at the release site. While ranching does occur in other countries it 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 within a single figure for the nominal catch.

Figure 2.1.1.1 shows the nominal catch data grouped by the following areas: ‘Scandinavia and Russia’ (including Denmark, Finland, Iceland, Norway, Russia and Sweden); ‘Southern Europe’ (including Spain, France, Ireland, UK (England and Wales), UK (Northern Ireland) and UK (Scotland)); and ‘North America’ (including Canada, USA and St Pierre et Miquelon); and ‘Greenland and Faroes’.

The provisional total nominal catch for 1999 is 2218 t , which is the lowest on record. This catch is 177 t less than the updated catch for 1998 of 2,395 t. Although 6 countries reported an increase in the 1999 catch compared to the final 1998 values, catches in 16 countries were less than both the previous 5-year and 10-year averages.

Several countries partition reported nominal catches by size or sea-age category and these data, where available, are given in Tables 2.1.1.2 and 2.1.1.3. The figures for 1999 are provisional and, as in Table 2.1.1.1, catches in some countries include both wild and reared salmon (excluding ranched fish from Iceland) and fish farm escapees. Different countries use different methods to partition their catches by sea-age class and these methods are described in the footnotes to Table 2.1.1.3. The composition of catches in different areas is discussed in more detail in Sections 3, 4 and 5.

Table 2.1.1.4 presents, where data is available, the nominal catch by country partitioned according to whether the catch was taken by coastal, estuarine or riverine fisheries. The proportions accounted for by each fishery varied considerably between countries. In total, however, coastal fisheries accounted for 51% of catches in North East Atlantic countries compared to 6% in North America, whereas in-river fisheries took 43% of catches in North East Atlantic countries compared to 68% in North America.

2.1.2 Catch and release

The practice of catch and release (often termed hook and release) in rod (recreational) fisheries has been used as a conservation measure for salmon in some areas of Canada and USA since 1984. Recent declines in salmon abundance in the North Atlantic have resulted in an increased use of this management option. The nominal catches presented in Section 2.1 are comprised of fish which have been caught and retained and do not include catch-and-release salmon. Table 2.1.2.1 presents catch-and-release information from 1991 for those countries which have records. Catch-and-release may be practised in other countries while not being formally recorded. There are large differences in the percentage of the total rod catch that is released among countries reflecting the varying management practices among these countries. Thus in 1999, release rates range from approximately 10% in Iceland to 100% in the USA. In most countries, however, rates in 1999 are among the highest in each 9-year series.

2.1.3 Unreported catches

Unreported catches by year and Commission Area are presented in Table 2.1.3.1. The 1999 unreported catch can be compared to previous values, it must be remembered that the methods used to arrive at these figures have varied both within and among countries. Consequently, these figures should be interpreted with caution. A discussion of the methods used to evaluate the unreported catches is provided in Section 2.3.

The total unreported catch in NASCO areas in 1999 was estimated to be 1027 t, a decrease of 15% from the 1998 estimate. Estimates were derived for the North American Commission Area (133 t), the West Greenland Commission Area (between 10 and 15 t, mid-point 12.5 t) and North East Atlantic Commission Area (881t). Figure 2.1.3.1 shows that the unreported catch has remained a relatively constant proportion (30%) of the total catch since 1987. No data for the combined three Commission Areas are available prior to 1987. Where available, data are presented by country for 1999 (Table 2.1.3.2). The unreported catch for France is included in the nominal catch. The individual inputs to the total North Atlantic catch range from 0% to 13.5 %. While this broadly indicates the level of unreporting by each country relative to the total catch in the North Atlantic, it should be noted that these estimates are not precise and are difficult to validate (see Section 2.3). The unreporting rates range from 2% to 71% of the total national catch in each country.

No data were available on fishing for salmon in international waters in the Norwegian Sea or on vessels landing catches from this area in the 1998/1999 season. Only one surveillence flight was reported to have been undertaken by the Icelandic and Norwegian Coastguards over the winter period 1999/2000 when fishing for salmon would be most likely to occur. No vessels were reported fishing for salmon.

2.2 Farming and Sea Ranching of Atlantic Salmon

2.2.1 Production of farmed Atlantic salmon

The worldwide production of farmed Atlantic salmon in 1999 was 825,915 t (Table 2.2.1.1 and Figure 2.2.1.1). This was the highest production in the history of the farming industry and represented a further 19% increase compared to 1998 (695,492 t) and a 50% increase on the 1994-98 average (550,406 t). The worldwide production of farmed Atlantic salmon in 1999 was over 370 times the reported nominal catch of Atlantic salmon in the North Atlantic.

The production of farmed Atlantic salmon in the North Atlantic area in 1999 was 620,415 t, which was a further 19% increase compared to 1998 (523,035 t) and a 40% increase on the 1994-98 average (442,779 t). The countries with the largest production were Norway and Scotland, which accounted for 67% and 18% of the North Atlantic total respectively. All countries except USA reported an increase in production between 1998 and 1999. All countries, except UK(N. Ireland), reported increases of between 16%, for Iceland, and 118%, for Faroes, over the 1994-1998 averages.

In areas other than the North Atlantic, the production of farmed Atlantic salmon in 1999 was 205,500 t, 25% of the world production of farmed Atlantic salmon. Production has increased throughout the time series, the 1999 figure showing an increase of 19% compared to 1998 (172,457 t) and a 91% increase on the 1994-98 average (107,628 t). The areas with the largest production were Chile and the West Coast of Canada which, as in 1998, accounted for 73% and 19% of the total respectively. Proportional changes in production between 1998 and 1999 ranged between 0%, for Australia and Turkey, to an increase of 67% for West Coast USA.

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 may include collecting fish for broodstock) (ICES 1994/Assess:16). The total production of ranched Atlantic salmon in countries bordering the North Atlantic in 1999 was 33 t, 13 t lower than in 1998 (46 t) and the lowest value since 1984 (Table 2.2.2.1 and Figure 2.2.2.1). Production in Iceland continued to decline, but still accounted for 79% of the total ranched production in 1999. Production at experimental facilities in Ireland, UK(N. Ireland) and Norway has remained low. Production in Ireland includes catches in net, trap and rod fisheries. Icelandic catches, on the other hand, are entirely from estuarine and freshwater traps at the ranching stations.

2.3 Evaluation of methods for estimating unreported catch with advice on improvements

The methods utilized in collecting information on unreported salmon catches in the North Atlantic, a brief evaluation, and advice on improvements in processes are summarized in Table 2.3. Unreported catches consist of harvests which are caught and retained. They do not include catch and release mortalities arising from nets or angling gear or fish retained by public or private agencies for broodstock purposes destined for enhancement. A summary of methods alone was last presented in 1996 (ICES 1996/Assess:11) wherein values were generally termed “guess-estimates”, indicating that they were not derived from annual surveys of fisheries or analyses of catch data. Guess-estimates were and are usually supported, in part at least, by observations of landings, knowledge of legal and illegal fishing activity, recoveries of illegal fishing gear, prosecutions, etc.

Unreported catch, is comprised of legal and illegal components (Table 2.3). In some countries, particularly where unreported catch is closely associated with licenced legal activities and where there is an element of structure in the estimate, such catches are included in the nominal “reported” catch statistics. This approach is, however, not consistent between countries, and in at least one case, is not consistent between jurisdictions within a country.

The current summary depicts a general trend by most countries to introduce some structuring (annual surveys of fishers via mail questionnaires or interviews, test fisheries, carcass tagging, better documentation of illegal catches etc.) to their methods of determining unreported catch. Thus, more national submissions of unreported catch than in 1996, have a structured approach to determination, and together with generally declining catches, are more frequently ascribed as "estimates" rather than "guess-estimates". Several countries have suggested possibilities of improving the estimate or guess-estimate of unreported catch by use of carcass tags and log books, test fishing, more systematic surveys and sampling, more detailed recording and increased coverage and repeat surveys.

2.4 Data requirements and methods for the evaluation of bird and marine mammal predation on Atlantic salmon

Predators are and have always been a mortality factor for Atlantic salmon. However, as wild salmon populations have diminished, concern has been expressed that present levels of predation may be having severe or disproportionate impacts upon the remaining fish.

Known predators of salmon in the ocean include seabirds (especially gannets), seals, cetaceans, gadoids and sharks. In fresh water, a variety of fish and avian predators feed on salmon and some invertebrates will consume salmon eggs and fry. Many of these predators are protected by national or international law, which restricts or prohibits control programs and experimental studies on them.

Compared to other fishes, salmon are rare in the ocean. Sampling of potential ocean predators suggests that they encounter salmon by chance and consume them incidentally. Because salmon are not a frequent diet component, measuring the predation levels on salmon by various ocean predators will be extremely difficult. Even with greatly expanded sampling effort, it is doubtful that measurable levels of salmon consumption by most bird and mammal predators will be detected. By contrast, in freshwater parr may be a diet staple of mergansers, goosanders and cormorants, and in these species measurable rates of predation on salmon may occur.

Approaches and data required to determine the impacts of salmon-predator interactions.

The standard approach to estimating the quantity of prey consumed by a predator consists of multiplying estimates of food consumption per predator (on a daily or other specified time period basis), times estimates of the number of predators, times the fraction of the food consumed that is composed of the prey of interest (*e.g*., Duffy and Schneider 1994).

To assess the amount and types of food that is consumed per unit time by an individual predator, typically the predator's stomach contents are determined either by killing the animal, by examining regurgitations that would have been fed to chicks in the case of some birds, or by visually observing predators and counting the captures of prey. Each prey item is then identified and sorted to the lowest possible taxa, and their numbers and/or weights determined.

To arrive at an estimate of the total number of prey killed by a predator population, the data from individual predators in the samples are tabulated, and measures of central tendencies and variances are calculated for each prey type. These are multiplied by the estimated predator population size, to scale up to the predator population's total consumption of the various prey types. The projected number of prey eaten can be compared to prey population sizes, to determine the impact on the population.

An alternative approach for estimating the total food intake uses bioenergetics modelling. Based on calculations of the calorie needs of individual predators for growth, body maintenance and reproduction, estimates can be obtained of the total number of calories that the predator must consume daily. Where predator population size is known, this can be scaled up to the total energy needs of a population. The energy contents of the samples of main prey species is determined, and a projection made of the number of these prey that a predator and/or the predator population would have eat in order to meet their needs over a specified time period. Bioenergetics approaches simply provide alternative estimates of the food requirements of the predators and it is still necessary to obtain information on the composition of the diet in order to estimate the impact of particular prey populations. Difficulties with obtaining this information are discussed below.

Sources of error and variability

There are major sources of error and variance associated with the determination of each of the parameters used in the calculations made with both approaches. Below, we discuss some of them with regards to the Atlantic salmon in the ocean.

Obtaining representative samples of stomach contents of salmon predators is difficult because predators are dispersed for much of the year, and following them to their hunting areas are costly. For example, because of the diffuse distribution of seabirds at other times of year there has been little sampling outside of the nesting period (Anon. 1998). Sampling needs to be extended over longer time periods and into areas where the bird distributions overlap with salmon distributions in order to document the true annual diet.

Wide confidence limits also result from the sorting and identification of prey in predator stomachs. This is a costly, time-consuming exercise that also may be imprecise and inefficient, because the rapid digestion that occurs in bird and mammal stomachs frequently makes the identification of prey types to species levels difficult or impossible. Frequently the identification of fish species in the diets of birds or seals is dependent on finding the otoliths of prey species. The rare salmon otoliths could be missed among the other items in the stomach In some instances the predators do not consume the heads of their prey, and no otoliths are present. Thus predation levels could be underestimated.

Large inter-individual differences in the numbers and types of prey consumed by individual predators are typical, and will generate large variances when central tendencies are calculated. These variances are magnified when they are combined with the wide confidence limits that frequently surround the population estimates of Atlantic salmon, and their predators.

Because of the rare occurrence of salmon in the stomachs of marine predators, and the problems described above with the estimation of parameters, the Working Group has concluded that it is unlikely that measurable rates of predation by at-sea predators upon Atlantic salmon can be calculated with the standard approaches that are available, even if sampling is scaled up greatly. By contrast, in freshwater, where predators like goosanders, mergansers and cormorants may frequently consume juvenile salmon, estimates of predation on a river-specific basis may be measurable at affordable costs, despite the sampling errors and variances the estimates will be subjected to.

Constricted areas: a special predation concern

In certain places, environmental conditions may heavily favor a predator, and result in predator concentrations. Frequently, these constrictions result from human habitat manipulations. Good examples are dams and their associated reservoirs, where natural salmon movements are blocked or delayed and the fish become concentrated. Natural constrictions are found in estuaries or narrow river channels.

In both the artificial and natural constrictions, the salmon have less opportunity to avoid detection or escape, and the predators that hunt them there are probably focussing particularly on salmon. Thus in the constrictions local predation impacts could be quite severe.

Sampling programs focussed upon predation in constricted areas could be informative and useful. There are much better chances of observing measurable predation rates, and linking them to salmon population sizes. At these sites, mitigation of identified predator problems may be more feasible.

New research

The Working Group noted the following new research that could provide indicators of the impacts of predators upon salmon, especially for ocean areas. Possibilities include:

- The development of predation indices based on the frequency of body scars on returning salmon.

The ultimate goal of scar investigations would be to estimate total salmon mortality due to marine mammal predation. However, the number of scars present on fish bodies needs to be related to the fraction of fish attacked and scarred, but which survived. This is technically difficult, and restrictions on experimentation with marine mammals have prevented some attempts to do this.

The first requirement of any study of scars resulting from marine mammal attacks is developing a method to reliably identify the marks. Preliminary data obtained in 1999 on paired wounds on the bodies of salmon returning to the St. John River (New Brunswick) and rivers in Québec, were consistent with attacks by seals, odontocetes or sharks. However, the possibility that the wounds resulted from getting wedged between rocks could not be excluded.

Time series of body scarring on returning adult salmon have been maintained at various counting facilities. With the development of reliable identification protocols for predator marks, these data could provide insights into historical trends in predation, providing ways can be found to link rates of predator-induced scarring with rates of predator-induced mortality. The development of reliable identification criteria would also encourage screening for predator marks at counting facilities that are not presently doing so.

Putative predator marks have been reported to be less frequent on grilse than large salmon. This may offer a method to evaluate minimum predation rates. If it is assumed that the migration routes, timing and behavior of small and large returnees is the same, and that marine mammals attack both groups at the same frequency, then the difference in recorded scarring is presumably due to the superior escape performance of large salmon. However, problems with this approach will arise if predators are size selective.

- Use of telemetry

One method to address salmon losses to predators while they move through constrictions is to fit fish above or below the constriction with radio or sonic tags, and record the number of fish which successfully negotiate their way past the predator concentration. A study of this type was carried out in 1999 in the Big Salmon River, New Brunswick. Published results are not yet available.

- Use of chemical means to trace salmon into predator diets.

Prey species may have species-specific chemical signatures that can be detected in tissue samples of prey by serological or other techniques like stable isotope ratios (Pierce *et al*. 1990, Doucet *et al*. 1996). However, the rarity of salmon in the diets of seabirds and seals means that chemical indicators of salmon may not be detectable for at-sea predators.

- Other Working Group initiatives

The impacts of predators on fish populations is an important focus of other ICES Working Groups, notably the Working Group on Seabird Ecology (WGSE) whose recent terms of reference have called for evaluating the significance of bird predation upon different size classes of fish and shellfish (Anon 1997,1998, 1999). The WGSE is developing a relational database (SEABDIET), to provide rapid access to what is known of seabird diets. This will become a powerful tool.

Additional questions

Predators are only one source of mortality for Atlantic salmon. Others include factors like disease, and starvation. These factors probably do not act independently of each other. Thus fish weak from starvation or disease may be particularly vulnerable to predators. However, it is possible that the fish that were eaten would have eventually died of the other stresses they were being subjected to. This has important implications for Atlantic salmon population dynamics. Even when reliable estimates of predation rates on Atlantic salmon are available for wherever we can obtain them, additional questions will need to be posed. These include:

- Is predator-induced mortality additive (the removal of individuals by predators does not affect future chances of survival for remaining individuals) or compensatory (the death of individuals increases the survival probability for the remaining members of the population, which “compensates” for the loss).
- Is predation a cause of population decrease?
- Will reduction of predation permit population recovery?

2.5 Significant Developments towards Management of Salmon

2.5.1 Infectious Salmon Anaemia (ISA) detected in escaped farmed salmon, and wild salmon.

The WGNAS membership does not include experts on fish diseases. However, because of the potential importance of this topic to wild salmon populations, it offers the following summary.

The Infectious Salmon Anaemia (ISA) virus was unknown prior to its outbreak at a Norwegian hatchery in 1984. This virus has not yet been completely described, or named. However, it is most probably a member of the Orthomyoxoviridae family (*i.e.*, one of the influenza group) and may be the first detected species in a new genus within this family (Krossøy *et al*. 1999).

ISA epidemics have now been reported from the Atlantic salmon farming industry in Norway (1984), Canada (1996), and Scotland (1999). The virus has spread rapidly among farms in each of these areas, and caused mortalities in sea cages averaging 12.2% in Canada (Hammell and Dohoo 1999). A severe case at one site in Norway reduced smolt survival from an average of 86%, to 18% (Håstein 1997). Extensive testing has not detected ISA from sea cage sites in Maine, despite the placement of Maine sea cages at distances of less than 10 km from infected Canadian sites. In March 2000, ISA was reported for the first time from Chile, where it was detected in farmed coho salmon (*Oncorhynchus kisutch*) at a single site. In April 2000, ISA became the first major disease of the Faroe Islands aquaculture industry.

Clinical and disease symptoms of ISA include the fish becoming lethargic or moribund, lifting of scales off of the body, a protuberance of the eyes, skin lesions, pale gills, swollen livers, petechiae, agglutination of the red blood cells, anaemia, necrosis and/or hemorrhages in the pyloric caecae, intestine, liver and the kidneys (Bouchard *et al*. 1999, Rodger 1998). There are no cures, and no therapeutants, for the disease.

Uninfected salmon held in tanks with infected fish in both fresh and salt water acquired ISA (Totland *et al*. 1996). This indicates the virus is water borne. ISA was not vertically transmitted from infected farmed Atlantic salmon to their offspring (Melville and Griffiths 1999).

Asymptomatic hosts of the ISA virus include rainbow trout (*O.mykiss)* and brown trout (*Salmo trutta*) (Rolland and Nylund 1998, Nylund *et al*. 1997). The European eel *(Anguilla anguilla*) has also recently been identified as a carrier.

The first ISA reports from escaped-farmed Atlantic salmon, and wild Atlantic salmon, came from the Bay of Fundy region of New Brunswick, Canada in 1999. Wild salmon populations in this region had declined to near extinction levels prior to the arrival of the virus (DFO 2000). Four of 58 escaped-farmed salmon sampled from the Magaguadavic River were confirmed as positive for ISA. ISA tests of escapees in this river in 1998 (N = 61) were all negative for the virus. In 1997, based on visual inspections, five escapees (N = 35) were diagnosed as suspect for the virus, but confirmation was not obtained.

Fifteen wild salmon were collected as broodstock from the Magaguadavic River in summer of 1999, and held in three separate broodstock tanks. Subsequently, three fish held in the same tank died of ISA. The remaining 12 fish had gill mucous smears and blood samples taken for an initial ISA screening, and tissue samples were tested after spawning. Only one fish was found to be virus-free in all tests. These fish were subsequently spawned and the eggs reared in quarantine. Resultant first-feeding fry were screened for ISA (17 January 2000, 60 fry), and all tested negative, providing evidence for the lack of vertical transmission of ISA in wild Atlantic salmon.

In 1999, ISA tests were also conducted on aquaculture escapees entering two additional rivers in the vicinity of the Magaguadavic River. For the St. Croix (N = 23) and Bocabec Rivers (N = 2), all tests were negative.

In November 1999, The Scottish Executive reported that the ISA virus had been found in wild salmon parr in the Rivers Conan, Easaidh and Tweed; in brown trout in the Conan and Easaidh; in sea run brown trout in Laxo Voe, Shetland, and River Snizort in Skye; at rainbow trout freshwater farms in Aberdeenshire and Kinnrossshire; and in European eel in Loch Uisg, Mull.

The Working Group is concerned about the implications of the spread of this disease to wild populations. Specific questions include:

1) What is the rate of spread of the disease among wild salmon in home water areas, and what wild salmon life stages (*e.g*., smolts, returning adults) are acquiring it?
2) What is the potential for spread of the disease among the mixed wild salmon populations from both sides of the Atlantic Ocean on the oceanic feeding grounds at Greenland and the Faroe islands?
3) What are the rates of mortality being caused by the disease in wild salmon, and at what life stages?

It would be prudent to initiate systematic monitoring for the disease in wild salmon in home waters, and the mixed population fisheries at Greenland and the Faroe Islands.

Given the potential importance of the ISA issue to wild salmon, it was felt that an expert review was needed. We recommend that the issue be refereed to the ICES Working Group on Fish Diseases for an evaluation of the threat that ISA poses to wild salmon populations, and for identification.

2.5.2 Migration of kelts in relation to sea water temperatures

Data storage tags recording temperatures were applied to 75 Atlantic salmon grilse kelts at the River Imsa, SW Norway. The tags were of the same type as those used by Reddin *et al.* (1999) in Newfoundland. The fish were tagged and released downstream the trap at the mouth of the River Imsa in December 1998 and January 1999. Immediately after release on 16 Dec 1998 one fish was observed to have lost the tag, and this tag continued to record temperature in the river until 1 September. Three fish returned to the trap between 27 September and 8 October, 264-296 days after release. In all four tags recovered, temperatures were recorded by hour.

The differences in the temperatures between the individual fish during their marine journey suggest that their geographical distribution were different, and the steep increase in temperature that occured from the beginning of July in all fish suggest the initiation of active homing migration (Figure 2.5.2.1). The frequency distributions of water temperatures on individual fish from sea entry to estimated time of active homeward migration (beginning of July) showed a range of temperatures from 2.5 to 9^{o}C (Figure 2.5.2.2) .

Further analyses of the data suggest that these tags may be a helpful tool to investigate the timing of sea entry of kelts, the movement patterns of previous spawners of salmon in the NE Atlantic, the timing of active homeward migration, as well as the timing of freshwater entry.

Because temperature is currently used in forecast models, The Working Group recommends that such studies are continued, and that tags that also record other environmental variables (e.g. pressure, salinity, light) are applied.

2.5.3 Retention of run-timing characteristics in salmon transferred between locations within a river catchment.

Data derived from a study designed to investigate success rates of different methods of stocking young salmon into streams (Struthers, 1984) was re-worked in order to examine run-timing differences among populations. The study site was the River Braan, a tributary of the River Tay in Scotland, which is inaccessible to adult salmon. Fish for stocking were obtained from two brood-stock sources in widely separated tributaries in the Tay catchment, the Rivers Almond and Tummel The progeny were transplanted into the Braan and the juveniles microtagged. In the current study, recaptures of returning adults in the coastal and estuarine net fisheries have been used as indicators of adult run-timing. Capture dates of native Almond and Tummel fish are compared with those of the transferred fish.

a. Run-timing of native fish

Comparisons of capture date were made between sea age classes and tributaries. For both Almond and Tummel fish,1SW salmon were captured significantly later in the year than 2SW salmon (Almond, P = 0.042; Tummel, P = 0.042). Between tributaries, the capture dates of Tummel fish were significantly earlier than the Almond fish for both 1SW and 2SW salmon (1SW, P=0.041; 2SW, P = 0.042) (Figure 2.5.3a).

b. Run-timing of transferred fish

Within both the sea age classes, the capture dates of transferred Almond and Tummel fish differed significantly (1SW, P = 0.007; 2SW, P = 0.005). As with the native fish, the median capture date of Tummel fish preceded the median capture date for Almond fish (Figure 2.5.3b).

c. Comparison of run-timing between native and transferred fish

In the case of Almond fish, capture date for both the 1SW and 2SW sea-age classes were not significantly different between native and transferred fish (1SW, P = 0.636; 2SW, P = 0.091). In the case of Tummel fish, although capture date differed significantly between native and transferred fish in both sea-age classes (1SW, P = 0.013; 2SW, P = 0.034), the range of weeks during which native and transferred Tummel fish were taken in the net fisheries were broadly similar. 1 SW native fish were taken between weeks 22 and 31 compared to a range between 23 and 31 for transferred fish. Similarly, 2SW native fish were captured between weeks 5 and 26 compared to a range between weeks 13 and 25 for transferred fish.

The study provides some indication that adult run-timing characteristics are retained when salmon are transferred between locations. These observations are consistent with the view that adult run-timing is attributable, at least in part, to a heritable population effect and that the run-timing behaviour exhibited by Almond and Tummel fish is to some extent genetically determined.

The results of the analysis extend the concept of inter-population differences in run-timing between rivers (Hansen and Jonsson, 1991) to a within-catchment scale. This extension to the finer scale is consistant with observations on the relationship between run-timing and spawning positions of fish returning to a number of Scottish rivers reported in Section 3.7.1. It is therefore likely that sub-catchment populations in many other Scottish rivers are distinguished in similar ways and that the relationship between sub-catchment populations and their adult run-timing will provide a link between variations in the performance of local populations and changes in the seasonal performance of the fisheries as explored in Section.

2.5.4 Causes of post-smolt mortality in the early marine phase

Following Scottish-Norwegian tests in 1997, a device for obtaining live fish in good condition from trawl catches, the "Fish Lift", was constructed and tested in Norway in 1998 and further improved in 1999 (Holst and McDonald 2000, Figure 2.5.4.1). Consequently the scale loss of post-smolts was reduced from 80-95% to the order of 0 -5 %, which allows for obtaining better quality scale samples, studying the natural ectoparasites on the fish, and obtaining viable fish for tagging and release from the marine environment.

Previously it has been very difficult to get reliable information on the sea lice infestations of free ranging post-smolts as the fish tended to lose most of their scales during capture and handling. The "Fish Lift" therefore represents a new approach to the problem. The device has, for the first time made it possible to establish more accurate estimates of the natural salmon lice infestations of wild post-smolts caught in the sea. In addition, in 1999 post-smolts were obtained in good enough post-capture condition for transport and use in laboratory experiments. Thereby it has, for the first time, been possible to assess the impact of such natural infestations on post-smolt survival.

The Fish Lift was used on two cruises in May 1999 in fjords in SW Norway resulting in good quality samples of 944 post-smolts. The sea lice infection rate on 22 examined fish captured in the mouth of the Sognefjord ranged from 8- 268 (mean 104, SD 68,7), while the infestation of post-smolts (n= 30)from the mouth of the Nordfjord (Figure 2.5.4.2.) ranged from 9 –94 (mean 31.4, SD 17.54). In both fjords the number of lice per fish decreased at stations with increasing distance inland from the coastline, evidently due to decreasing salinity in the upper water layers (Jakobsen *et al*. in prep.).

An experiment carried through at the Institute of Marine Research (IMR), Norway, and presented to the Working Group suggests that salmon lice, at least locally, may pose a greater problem for post-smolt survival than anticipated earlier. A trawl catch of 288 post-smolts was taken with the Fish Lift at a site in the outer Nordfjord (Figure 2.5.4.2.). 69 of the fish were randomly sacrificed for establishing initial status of sea lice infestation of the catch, and the rest were then transported to the laboratory of the IMR in Bergen. 30 post-smolts examined at capture all carried larval stages of sea lice ranging from 7 – 85 lice per fish. After quarantine in a large tank to overcome the possible post-capture and -transport mortality, 200 fish were weighed and measured, divided in 10 groups of 20 fish each, and distributed into 250 l aquariums (day 0 of experiment). At day 4 and day 7 after starting, 5 replicates (controls) were chosen at random and treated twice with a commercial delousing agent. The other 5 aquariums were left untreated (experimental groups). The aquariums were checked a minimum 3 times daily for dead or moribund fish, which were removed, and numbers and life stages of lice were recorded. After an observation period of 40 days, when only 1 fish of the experimental group had died during the last 6 days, all fish were killed and the sea lice counted.

At the termination of the experiment, a difference in mortality of 65% (95% conf. interval, 48.5% min.- 81.5% max.) was recorded between the untreated (11 surviving fish) and the treated group (76 survivors) which may be attributed to the lice infestation (Figure 2.5.4.3). There was also a considerable difference in the mean number and the stages of lice recorded on the fish that died, and on the 11 fish surviving the experiment period (Jakobsen *et al.,* in prep). Additionally, growth differences were observed between untreated and treated fish.

A direct extrapolation of these mortality rates to wild populations may not be appropriate due to insufficient knowledge of whether the impact of a sea lice infestation is as severe on a free ranging population as on fish confined to aquariums where they have no possibility of escaping or otherwise getting rid of the larvae. Other studies have indicated that higher numbers and older stages of lice are required to cause certain mortality of the fish. It should, however, be noted that such experiments have been made with hatchery fish which tend to be larger than the wild post-smolts. On the other hand it should also be taken into account that experiments performed in a predatorfree environment and where the food is abundant may underestimate the effects of the lice infestation. In contrast, wild fish in captivity may suffer from stress, which may make them more vulnerable to mortality from a lower sea lice infestation rate.

In spite of the possible interpretations of the data, the material presented to the Working Group raises concern about the fate of post-smolt cohorts passing through areas where aggregations of sea louse larvae is likely to occur.

The Working Group therefore recommends that:

a) Efforts to study the host/parasite relationship between free ranging post-smolts and sea lice should be continued and expanded.

b) The hydrographical carrier mechanisms of the sea lice infestations should be studied in order to gain information on how and where the infective stages of the lice aggregate and how they vary with changing hydrographical conditions in the fjords

This would provide a better understanding of the impact of sea lice in natural environments, allow for countermeasures to diminish local impact on wild smolts, and will also aid in obtaining data for assessment of natural mortality for input in stock management modelling.

2.5.5 Density and temperature effects on length-at-age of juvenile salmon

Returns of both small and large salmon to the Miramichi River (SFA 16 Canada) peaked during 1991 and 1992 at almost 200 thousand fish and subsequently declined during 1997 to 1999 to about 50 thousand fish, the lowest levels since 1971. The declines occurred despite increased escapements of salmon to the river and egg depositions which met or exceeded the conservation requirements. The increased egg depositions resulted in increased juvenile abundance in the river but the increased abundances did not result in improved or even sustained adult abundance. The divergence in juvenile trends and adult return trends suggests that an important bottleneck is occurring between the parr and adult stages. High water temperatures in the summer, in excess of 29ºC, have been recorded in the Miramichi River in recent years. These temperatures are substantially above the temperature of optimal growth (15.9ºC) and cessation of feeding (23ºC) (Elliott 1991; Elliott and Hurley 1997). The working group reviewed an analysis of the association between juvenile density and juvenile size-at-age moderated by water temperature.

Densities of juvenile salmon have increased in the Miramichi River during the period of study, 1971 to 1999 (Figure 2.5.5.1). Mean size-at-age, standardized to a common sampling date (August 31), shows important annual variations with size-at-age declining since 1995 to the lowest of the time series (Figure 2.5.5.2).

Two factors are suspected to affect juvenile salmon growth in the Miramichi: density of juveniles and water temperatures.

There is a negative relationship between size-at-age and density of juveniles in the Miramichi River (Figure 2.5.5.3). The relationship is strongest for age 1+ and age 2+ parr. The high densities occurred concurrently with high water temperatures in the summer. For age 1+ parr, the differences in size during the 1995-1999 time period relative to previous years is much greater in the warm water sites than in the cool water sites (Figure 2.5.5.4). There is a positive association between returns of adults at smolt age 2 or smolt age 3 and average size-at-age of age 1+ or age 2+ parr (Figure 2.5.5.5).

There are two possible mechanisms that would explain the association between parr size and abundance of adults. Parr to smolt survival may decrease with decreasing parr size at-age, possibly during the winter. Alternatively, parr-to-smolt survival may be independent of parr size and density but smaller parr may produce smaller smolts resulting in reduced sea survival. Both effects may also be occurring.

The negative association between juvenile size-at-age and density also corresponds to fewer adult salmon returning to the Miramichi for the 1990 to 1995 year-classes. Warm water temperatures during the growing season may have constrained further the growth and condition of juveniles which could have affected their survival in freshwater and/or survival at sea.

If temperatures are an important constraint on juvenile to adult survival and climatic conditions remain similar to those of the last five years, we should not expect to see any increased returns of adults to the Miramichi. If density-dependent effects are the major driving force to smaller size-at-age, then improved adult returns will not be expected until densities decline. The high juvenile abundances observed during the 1990s are the result of egg depositions which have been between 114% and 200% of the conservation requirements defined for the river. If these high escapement levels have such a dramatic effect on juvenile to adult survival, then it should be realized that there may be significant consequences to recruitment at high levels of escapement in the Miramichi.

The results from this study illustrate that there are limits to capacity which if surpassed can have consequences on the population dynamics of subsequent life stages. The apparent association between water temperature and growth and possible changes in the environment highlight the issue of non-stationarity in the stock and recruitment process. This factor should be examined with data from additional rivers and time periods.

Research recommendation: Analysis of similar data sets from other areas and countries should consider associations between temperature and density on juvenile growth and size-at-age.

2.5.6 Length-at-age of adult salmon reflect marine growth opportunities

The working group examined annual variations in length-at-age of 1SW and 2SW salmon returning to four rivers of eastern Canada. Since these age groups segregate at sea at some stage, an analysis of length can provide insights into the extent of variability in growth conditions and may lead to inferences on the assumption of common feeding areas or common conditions in different marine areas in the Northwest Atlantic.

Fish returning to the rivers in the fall months (Sept. to Nov.) tend to be longer at age than fish returning to the rivers in the summer (May to July) (Figure 2.5.6.1). After controlling for the seasonal effect, salmon from the outer Bay of Fundy rivers are longer at age than those of the Gulf rivers (Figure 2.5.6.2). The difference between the two areas is consistent with an earlier smolt migration and larger size at smoltification for the Bay of Fundy rivers as compared to the Gulf rivers.

There are important annual variations in size-at-age of returning salmon. In the Miramichi River, size at age of 1SW and 2SW salmon returning to the estuary increased after the closure of the commercial fisheries in 1985 (Figure2.5.6.3). The change in size-at-age was attributed to size-selective fishing mortality in the commercial fisheries. 1SW salmon returning to the Miramichi River in 1999 were the longest of the 29 year time series averaging 1.5 to 2 cm fork length longer than any mean lengths previously observed and 5 to 6 cm longer than the 1SW salmon returning to the river in the 1970s. Generally large 1SW salmon were also observed in the other Gulf river (Buctouche) as well as in the two Bay of Fundy rivers (Saint John River and Nashwaak River). 2SW salmon from the Miramichi River in 1999 were also the longest on record, averaging 1 to 3 cm longer than 2SW salmon in the runs of the 1990s and 3.5 to 6 cm longer than 2SW salmon from the 1970s (Figure 2.5.6.3). Growth conditions were particularly favourable for the 1SW salmon during 1998/1999 and for 2SW salmon during one or both years, 1997/1998 and 1998/1999.

A simple model of the response of size-at-age to growth conditions in the ocean assumes that positive or good conditions result in large size-at-age whereas poor growth conditions produce small sized fish. Previous studies have inferred that the age-at-maturity may be determined by the rate of growth or the attainment of a critical size threshold. If the critical size threshold determining age-at-maturity occurs early in the first year at sea, there is more opportunity for size at age variation. For 1SW salmon, growth conditions during one year would determine the size at return whereas for 2SW salmon, two years of growth conditions would determine size-at-age of return. Under this simple model of common marine areas or common growth conditions, large 2SW salmon or small 2SW salmon should be uncommon whereas greater annual variability in size-at-age of 1SW salmon is expected. Higher annual variation in fork length of 1SW was observed for the three rivers analyzed.

The length-at-age data were analyzed in the context of common growth conditions or common feeding areas for 1SW and 2SW salmon in the ocean and stock mixing. Sizes at age by season of return are strongly correlated, i.e. large summer run salmon generally result in large fall run fish. Since the closure of the homewater commercial fisheries in 1985, sizes of 1SW and 2SW salmon returning to the Miramichi show an observed size-at-age of return consistent with common marine areas or similar growth conditions in different areas for the two age groups (11 of 14 years). The larger size-at-age of early run 1SW salmon in 1999 observed in the Miramichi, Saint John and Nashwaak rivers point to equally favourable growth opportunities during 1998/1999 for these fish which enter the ocean and migrate in very different areas at least in the initial months at sea. In the last three years, larger 1SW and 2SW salmon have been observed in the Miramichi, consistent with a warming of marine conditons in the Northwest Atlantic.

Although length may be a weak surrogate measure of response to growth opportunity, it has been readily collected over a wide range of rivers and over a large number of years. The exceptional size of 1SW and 2SW salmon in the Miramichi River in 1999 points to exceptional growth conditions in the marine environment in the last two years. These large bodied survivors were however of low abundance. An alternative hypothesis for large size-at-age is size-dependent survival in the ocean although a shift in mean size observed in 1999 would have required a very strong size-dependent selection at sea. The general agreement between predicted growth responses and observed size-at-age of 1SW and 2SW salmon assuming similar feeding areas or growth conditions suggests broad-scale marine conditions which effect these age groups in similar ways. The exceptions to the general predictions of response to growth suggest that in some years, the marine environment may be more structured (less homogeneous, patchy). Although the reported indices of marine conditions have not been characterized in terms of the annual variability in structure, such an analysis (for example, variograms derived from geostatistics) may shed some insights into the degree of coherence of survival and growth measures of stocks in eastern North America.

Research recommendation: The Working Group would welcome analysis on a larger number of rivers and geographic areas in the context of using length or weight at age as indicators of marine conditions. The Working Group would also welcome presentations of marine environmental conditions in the context of the extent of structuring of the characteristics as it relates to salmon migration, growth and survival.

2.6 Estimates of escapement from marine salmon farms and impact on estimates of escapees in fisheries and stocks

Estimates of escapement from marine salmon farms

Escapes of salmon from farms are inevitable and are usually a result of storms, predator damage, equipment failures, accidental human error and vandalism. Overall, weather and predator attacks have been the most evident contributors to fish escapes. It is also likely that some fish are intentionally released, because some operators may be reluctant to dispose of small or unmarketable fish and surplus production in the belief that they are benefiting the resource or enhancing sport-fishing opportunities. While this is possible, there is no evidence that this practice occurs to any great degree or extent in the North Atlantic.

Escapes may occur as either large scale, one-time events, or as "leakage" of small quantities of salmon over extended periods of time. Additionally, escapes are reported to occur during harvest operations. While large scale escape events may occur at any time of the year, it has been shown in the eastern US that escapes are usually concentrated in the winter months (December-April), when threats to equipment integrity from storm damage and seal attacks are most common (Baum 1998).

Escapes of salmon and other species from aquaculture sites are required to be reported in some countries. For example, in Norway salmon farmers reported that about 500,000 salmon escaped in 1998 and 1999, while escapes from Irish fish farms have ranged from 1,500 to more than 70,000 since 1996 (Table 2.6.1). The numbers of salmon reported to have escaped in Norway and Ireland includes both smolts and adults. For most countries in the North Atlantic however, there is no information available pertaining to the number of salmon that escape annually from fish farms because there is no legal requirement to report such occurrences. Generally speaking, industry representatives tend to keep such information confidential for business and/or insurance reasons. Salmon farmers may be hesitant to publicly acknowledge accidental escapes for fear of additional regulatory actions being imposed by government agencies. Additionally, efforts to estimate the number of escapees within individual countries is compromised by the fact that escaped salmon are undoubtedly entering and spending significant time in waters outside of where they were reared.

The Working Group reviewed farmed salmon production figures and estimated catches of farmed salmon in fisheries in recent years. While the incidence of farmed salmon in catches is often high (e.g., in Norway), the total catch of farmed salmon in the wild represents a very small fraction of the aquaculture production in most countries. Furthermore, despite the rapid expansion of the salmon farming industry, escaped salmon in catches show a downward trend over time (Table 6.2.1). This is thought to be due to improved containment measures and technological improvements in equipment and monitoring throughout the industry in recent years.

Impact on estimates of escapees in Fisheries and stocks

Escapes of salmon from freshwater rearing facilities have been documented in many areas. Since there is no way to readily identify these fish as adults in the wild, the annual contribution of those fish to fisheries and stocks is largely unmeasured. Therefore, the reported number of escaped farm salmon from all sources (marine cage sites and freshwater rearing areas) is severely underestimated in fisheries and stocks in the North Atlantic. While there have been numerous published studies of the interactions between wild and farmed salmon (Hutchinson, 1997; Youngson *et al*. 1998) there is a general lack of knowledge about the migration, survival and behavior of escaped salmon in other areas of the North Atlantic (especially No. America). The Working Group noted that there is a particularly acute lack of information pertaining to the behavior of escapees at sea.

Due to the paucity of information pertaining to the magnitude of escapes from the salmon farming industry, the Working Group recommends that standardized reporting guidelines and improved monitoring procedures be developed for documenting escapes of salmon from marine salmon farms and freshwater rearing facilities. Furthermore, the Working Group recommends that additional research into the behavior, movements and survival of escaped salmon in the salmon farming industry in all areas of the North Atlantic be conducted. A universally applied marking system that would allow escapees to be readily identified when captured in fisheries and/or stock assessment programs would be beneficial, since the relatively few farmed salmon observed in scanned catches and at monitoring facilities in many areas makes inferences over large geographical areas impossible at this time.

2.7 Review of developments in setting conservation limits

The Working Group discussed the principles currently adopted by the ICES and NASCO in using reference points for the management of salmon stocks. It was noted that ideas and methods relating to the use of reference points are continuing to be developed by NASCO, ICES and other organisations, and that the Working Group should therefore review current knowledge and approaches on a regular basis. Where appropriate the Working Group should recommend changes in the assessment methods that are used.

NASCO and its Contracting Parties have agreed that the application of the Precautionary Approach to salmon fishery management requires, among other things, 'that conservation limits and management targets be set for each river and combined as appropriate for the management of different stock groupings defined by managers' (NASCO, 1998). The conservation limit is the point previously defined as the Minimum Biologically Acceptable Level (MBAL) and therefore demarcates undesirably low stock levels. The objective when managing stocks and regulating fisheries is therefore to ensure that there is a high probability that conservation limits are exceeded. However, it is not possible to guarantee that this occurs every year, and there will always be a chance that stocks will fall below this level, regardless of whether quotas or effort controls are used to regulate fisheries. The Working Group noted that the development and application of risk assessments in the management procedures would be an iterative process involving both scientists and managers. The Working Group has not previously received feedback from NASCO on how they consider that risk should be incorporated into the assessments but felt that this would be required in the future.

ICES and NASCO currently define the conservation limit for salmon stocks as the stock size that will give maximum sustainable yield (S_{MSY}). The Working Group noted that using S_{MSY} as the conservation limit for salmon had given the impression to some fisheries interests that the intention of managers was to maximise catches. This is, of course, incorrect because the point should be regarded as a threshold, and stocks should therefore be maintained above this level in most years. The Working Group therefore reiterated that this point had been proposed as the standard reference point for setting conservation limits because (a) it defined a point on the stock-recruitment curve where recruitment begins to fall rapidly with declining stock size and (b) it could be established objectively for any stock for which a stock-recruitment curve could be defined.

The Working Group noted that there may ultimately be a need for an absolute threshold below which no exploitation would be permitted. It was suggested that this might be set at a proportion of the conservation limit, although it might also need to reflect other considerations, such as protecting genetic diversity.

The Working Group agreed that the primary use of the conservation limits was to protect the productive capacity of the stock, and that the utilisation of any surplus production should be a secondary management consideration. It was recognised that alternative methods could be employed to define conservation limits, for example based upon the stock level at which recruitment is maximised (S_{MR}). One possibility might be to set the conservation limit at the stock size that gives a percentage (say 85%) of maximum recruitment. It was suggested that such a reference point might have advantages over S_{MSY} because it would not be affected by changes in marine survival, but evidence presented to the meeting further demonstrated that factors operating in freshwater (e.g. affecting smolt size) may have a significant effect on marine survival. It was also noted that any reference point can be affected by non-stationarity in either freshwater or marine survival and that conservation limits will therefore need to be reviewed on a regular basis.

The Working Group also emphasised that management of salmon stocks should not be based purely on compliance with conservation limits. A range of other factors would need to be taken into account, particularly the structure of the stock and any evidence concerning the status of particular stock components (e.g. tributary populations).

NASCO (1998) has proposed that 'stocks be maintained above conservation limits by means of management targets'. The purpose of using the target would be to satisfy the management objective of ensuring a high probability that the conservation limit will be exceeded. Targets are points to aim at, and a target reference point may therefore, for example, provide the basis for setting a quota. The Working Group acknowledged that it was the responsibility of managers to define the level of risk/uncertainty that they are prepared to accept of stocks falling below the conservation limit and thus the levels at which management targets should be set. However, they felt that the risk level employed should always be less than 50% (a risk level of 50% is currently used when setting the quota for West Greenland). It was also agreed that the appropriate risk level might be different for different fisheries; for example mixed stock fisheries pose a greater risk to the conservation of individual salmon populations than single river stock fisheries.

2.8 Compilation of Egg Collections and Juvenile Releases for 1999

2.8.1 Egg collections and juvenile releases for 1999

The Working Group compiled 1999 data summaries of artificially spawned eggs and egg and juvenile releases in Table 2.8.1.1. These data were provided to estimate the effects of egg collection on wild production and to characterize the overall scale of enhancement work by ICES member countries. Although all countries except Finland artificially spawn eggs to support enhancement activities, only six countries reported summaries of artificially spawned egg numbers for 1999. Where possible, the number of eggs collected from each of these sources is reported. Data on egg collections and juvenile releases by Norway are no longer available as of 1998.

For most countries, the database includes historical data from 1990 through 1998, which are summarized in Appendix 4.

2.8.2 Egg collections from wild stock in relation to egg deposition.

The Working Group examined the number of eggs collected from wild stocks for enhancement purposes and compared those numbers with the total estimated egg deposition at the national level in order to determine the relative amount of potential egg deposition required to meet hatchery needs. Only five to six countries of the 14 countries currently collecting eggs have reported juvenile releases during any year of the 1990-1999 period. The 1996 spawning year was used in order to include as many countries as possible in the analysis of the proportion of eggs taken from sea run salmon for enhancement purposes. Data for subsequent (1997-1999) releases of juvenile salmon produced from the 1996 egg cohort were used where actual spawned egg data was not available. The numbers of eggs spawned in 1996 were back calculated for five countries by applying estimated egg-to-life stage survival rates (see footnote (2), Table 2.8.2.1). The survival rate estimates used are based on general experience in US hatcheries for egg survival to the various life stages. These rate estimates were tested by comparing the calculated egg take for those countries that reported actual eggs taken in 1996 and the calculated number compared to the reported number. The calculated numbers averaged within 23% (range 14% to 39%) of the reported numbers.

The results of the comparison of 1996 eggs artificially spawned and estimated egg deposition for nine countries are shown in Table 2.8.2.1. A total of about 35.3 million eggs were taken from sea run salmon in 1996 for use in hatcheries. This number is equivalent to 0.5% of the estimated total egg deposition for those countries of 7,590 million in 1986. With the exception of the US, the relative proportion of eggs diverted for hatchery use was consistently low among the individual countries (range 0.1% - 1.3%). The US diverted a significant portion of eggs available from sea run fish, equivalent to 95% of estimated deposition from natural spawning. The numbers of artificially spawned eggs reported in 1996 are consistent with numbers reported in other years, indicating that relatively few eggs are being diverted from wild spawning to hatchery use with the exception of the US.

The Working Group concludes that, with the notable exception of the US, the number of eggs taken for hatchery needs have no significant impact on the amount of eggs spawned in the wild at the national level. The extent of impact on wild spawning by hatchery use of sea run eggs should be monitored locally on a river basis. The level of information contained in the current database and is value to the Working Group does not warrant its continued compilation at the international level. The Working Group recommends it discontinue the compilation of the database on egg collections and juvenile salmon releases.

2.9 Compilation of Tag Releases and Finclip Data by ICES Member Countries in 1999

2.9.1 Compilation of tag releases and finclip data for 1999

Data on releases of tagged, fin-clipped, and marked salmon in 1999 were provided by the Working Group and are compiled as a separate report (Annex to ICES CM 2000/ACFM:**13**). A summary of Atlantic salmon marked in 1999 is given in Table 2.9.1.1. About 4.43 million salmon were marked in 1999, a 71% increase from the 2.59 million fish marked in 1998. The increase was due largely to Canadian tagging. Primary marks are summarized in four classes: coded wire tag (i.e., microtag), external tag, adipose clip (without other external marks or fin clips), and other visible clip or mark. Secondary marks (primarily adipose clips on fish with coded wire tags) are also presented. The adipose clip was the most used primary mark (3.49 million), with coded wire tags (0.70 million) the next most used primary mark. Secondary marks (primarily adipose fin clips) were applied to 0.60 million fish. Most marks were applied to hatchery-origin juveniles (4.40 million), while 57,669 wild juveniles and 15,935adults were marked.

Table 2.1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1999. (1999 figures include provisional data)

Year	Canada (1)	Den.	Faroes (2)	Finland	France	East Grld.	West Grld. (3)	Iceland Wild	Iceland Ranch	Ireland (4,5)	Norway (6)	Russia (7)	Spain (8)	St. P. & M.	Sweden (West)	UK (E & W) (12)	UK N.Ireland (6,9)	UK (Scotland)	USA	Other (10)	Total Reported Catch	Unreported catches NASCO Areas	Unreported catches International waters (11)
1960	1636	-	-	-	-	-	60	100		743	1659	1100	33	-	40	283	139	1443	1	-	7237	-	-
1961	1583	-	-	-	-	-	127	127		707	1533	790	20	-	27	232	132	1185	1	-	6464	-	-
1962	1719	-	-	-	-	-	244	125		1459	1935	710	23	-	45	318	356	1738	1	-	8673	-	-
1963	1861	-	-	-	-	-	466	145		1458	1786	480	28	-	23	325	306	1725	1	-	8604	-	-
1964	2069	-	-	-	-	-	1539	135		1617	2147	590	34	-	36	307	377	1907	1	-	10759	-	-
1965	2116	-	-	-	-	-	861	133		1457	2000	590	42	-	40	320	281	1593	1	-	9434	-	-
1966	2369	-	-	-	-	-	1370	104	2	1238	1791	570	42	-	36	387	287	1595	1	-	9792	-	-
1967	2863	-	-	-	-	-	1601	144	2	1463	1980	883	43	-	25	420	449	2117	1	-	11991	-	-
1968	2111	-	5	-	-	-	1127	161	1	1413	1514	827	38	-	20	282	312	1578	1	403	9793	-	-
1969	2202	-	7	-	-	-	2210	131	2	1730	1383	360	54	-	22	377	267	1955	1	893	11594	-	-
1970	2323	-	12	-	-	-	2146	182	13	1787	1171	448	45	-	20	527	297	1392	1	922	11286	-	-
1971	1992	-	-	-	-	-	2689	196	8	1639	1207	417	16	-	18	426	234	1421	1	471	10735	-	-
1972	1759	-	9	32	34	-	2113	245	5	1804	1578	462	40	-	18	442	210	1727	1	486	10965	-	-
1973	2434	-	28	50	12	-	2341	148	8	1930	1726	772	24	-	23	450	182	2006	2.7	533	12670	-	-
1974	2539	-	20	76	13	-	1917	215	10	2128	1633	709	16	-	32	383	184	1628	0.9	373	11877	-	-
1975	2485	-	28	76	25	-	2030	145	21	2216	1537	811	27	-	26	447	164	1621	1.7	475	12136	-	-
1976	2506	-	40	66	9	<1	1175	216	9	1561	1530	542	21	2.5	20	208	113	1019	0.8	289	9327	-	-
1977	2545	-	40	59	19	6	1420	123	7	1372	1488	497	19	-	10	345	110	1160	2.4	192	9414	-	-
1978	1545	-	37	37	20	8	984	285	6	1230	1050	476	32	-	10	349	148	1323	4.1	138	7682	-	-
1979	1287	-	119	26	10	<0.5	1395	219	6	1097	1831	455	29	-	12	261	99	1076	2.5	193	8118	-	-
1980	2680	-	536	34	30	<0.5	1194	241	8	947	1830	664	47	-	17	360	122	1134	5.5	277	10127	-	-
1981	2437	-	1025	44	20	<0.5	1264	147	16	685	1656	463	25	-	26	493	101	1233	6	313	9954	-	-
1982	1798	-	606	54	20	<0.5	1077	130	17	993	1348	364	10	-	25	286	132	1092	6.4	437	8395	-	-
1983	1424	-	678	58	16	<0.5	310	166	32	1656	1550	507	23	3	28	429	187	1221	1.3	466	8755	-	-
1984	1112	-	628	46	25	<0.5	297	139	20	829	1623	593	18	3	40	345	78	1013	2.2	101	6912	-	-
1985	1133	-	566	49	22	7	864	162	55	1595	1561	659	13	3	45	361	98	913	2.1	-	8108	-	-
1986	1559	-	530	37	28	19	960	232	59	1730	1598	608	27	2.5	54	430	109	1271	1.9	-	9255	315	-
1987	1784	-	576	49	27	<0.5	966	181	40	1239	1385	564	18	2	47	302	56	922	1.2	-	8159	2788	-
1988	1310	-	243	36	32	4	893	217	180	1874	1076	420	18	2	40	395	114	882	0.9	-	7737	3248	-
1989	1139	-	364	52	14	-	337	140	136	1079	905	364	7	2	29	296	142	895	1.7	-	5903	2277	-
1990	911	13	315	60	15	-	274	146	280	567	930	313	7	1.9	33	338	94	624	2.4	-	4924	1890	180-350
1991	711	3.3	95	70	13	4	472	130	345	404	876	215	11	1.2	38	200	55	462	0.8	-	4106	1682	25-100
1992	522	10	23	77	20	5	237	175	460	630	867	167	11	2.3	49	186	91	600	0.7	-	4133	1962	25-100
1993	373	9	23	70	16	-	-	160	496	541	923	139	8	2.9	56	248	83	547	0.6	-	3696	1644	25-100
1994	355	6	6	49	18	-	-	140	308	804	996	141	10	3.4	44	249	91	649	-	-	3869	1276	25-100
1995	260	3.1	5	48	9	2	83	150	298	790	839	128	9	0.8	37	295	83	588	-	-	3628	1060	n/a
1996	292	1.7	-	44	14	<0.5	92	122	239	687	787	131	7	1.5	33	183	77	427	-	-	3138	1123	n/a
1997	229	1.3	-	45	8	1	58	106	50	570	630	111	3	1.5	19	146	93	296	-	-	2368	827	n/a
1998	157	1.3	6	48	9	-	11	130	34	624	740	131	4	2.3	15	125	78	279	-	-	2395	1210	n/a
1999	143	0.5	0	63	11	<0.5	19	119	26	515	811	102	6	2.3	13	152	53	182	-	-	2218	1027	n/a
Means																							
1994-1998	259	3	6	47	12	2	61	130	186	695	798	128	7	2	30	200	84	448	-	-	3080	1099	-
1989-1998	495	5	105	56	14	3	196	140	265	670	849	184	8	2	35	227	89	537	1	-	3816	1495	-

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Between 1991 & 1999, there was only a research fishery at Faroes. In 1997 no fishery took place.
3. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
4. From 1994, includes increased reporting of rod catches.
5. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
6. Before 1966, sea trout and sea charr included (5% of total).
7. Figures from 1991 onwards do not include catches taken in the recently developed recreational (rod) fishery.
8. Weights prior to 1990 are estimated from 1994 mean weight. Weights from 1990 based on mean wt. from R. Asturias.
9. Not including angling catch (mainly 1SW).
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. **Data for 1993-98 altered from previous reports to take account of catch & release**

Table 2.1.1.2 Nominal catch of SALMON in homewaters by country (in tonnes round fresh weight), 1960-1999. (1999 figures include provisional data).
S = Salmon (2SW or MSW fish). G = Grilse (1SW fish). Sm = small. Lg = large. T = S + G or Lg + Sm

Year	Canada (1)			Finland			France	Iceland Wild	Iceland Ranch	Ireland (2,3)			Norway (4)			Russia	Spain (5)	Sweden (West)	UK (7) (E&W)	UK(N.I.) (6)	UK(Scotland)			USA	Total
	Lg	Sm	T	S	G	T	T	T	T	S	G	T	S	G	T	T	T	T	T	T	Lg	Sm	T	T	T
1960	-	-	1636	-	-	-	-	100		-	-	743	-	-	1659	1100	33	40	283	139	971	472	1443	1	7177
1961	-	-	1583	-	-	-	-	127		-	-	707	-	-	1533	790	20	27	232	132	811	374	1185	1	6337
1962	-	-	1719	-	-	-	-	125		-	-	1459	-	-	1935	710	23	45	318	356	1014	724	1738	1	8429
1963	-	-	1861	-	-	-	-	145		-	-	1458	-	-	1786	480	28	23	325	306	1308	417	1725	1	8138
1964	-	-	2069	-	-	-	-	135		-	-	1617	-	-	2147	590	34	36	307	377	1210	697	1907	1	9220
1965	-	-	2116	-	-	-	-	133		-	-	1457	-	-	2000	590	42	40	320	281	1043	550	1593	1	8573
1966	-	-	2369	-	-	-	-	104	2	-	-	1238	-	-	1791	570	42	36	387	287	1049	546	1595	1	8422
1967	-	-	2863	-	-	-	-	144	2	-	-	1463	-	-	1980	883	43	25	420	449	1233	884	2117	1	10390
1968	-	-	2111	-	-	-	-	161	1	-	-	1413	-	-	1514	827	38	20	282	312	1021	557	1578	1	8258
1969	-	-	2202	-	-	-	-	131	2	-	-	1730	801	582	1383	360	54	22	377	267	997	958	1955	1	8484
1970	1562	761	2323	-	-	-	-	182	13	-	-	1787	815	356	1171	448	45	20	527	297	775	617	1392	1	8206
1971	1482	510	1992	-	-	-	-	196	8	-	-	1639	771	436	1207	417	16	18	426	234	719	702	1421	1	7575
1972	1201	558	1759	-	-	32	34	245	5	200	1604	1804	1064	514	1578	462	40	18	442	210	1013	714	1727	1	8357
1973	1651	783	2434	-	-	50	12	148	8	244	1686	1930	1220	506	1726	772	24	23	450	182	1158	848	2006	2.7	9768
1974	1589	950	2539	-	-	76	13	215	10	170	1958	2128	1149	484	1633	709	16	32	383	184	912	716	1628	0.9	9567
1975	1573	912	2485	-	-	76	25	145	21	274	1942	2216	1038	499	1537	811	27	26	447	164	1007	614	1621	1.7	9603
1976	1721	785	2506	-	-	66	9	216	9	109	1452	1561	1063	467	1530	542	21	20	208	113	522	497	1019	0.8	7821
1977	1883	662	2545	-	-	59	19	123	7	145	1227	1372	1018	470	1488	497	19	10	345	110	639	521	1160	2.4	7756
1978	1225	320	1545	-	-	37	20	285	6	147	1082	1229	668	382	1050	476	32	10	349	148	781	542	1323	4.1	6514
1979	705	582	1287	-	-	26	10	219	6	105	922	1027	1150	681	1831	455	29	12	261	99	598	478	1076	2.5	6341
1980	1763	917	2680	-	-	34	30	241	8	202	745	947	1352	478	1830	664	47	17	360	122	851	283	1134	5.5	8120
1981	1619	818	2437	-	-	44	20	147	16	164	521	685	1189	467	1656	463	25	26	493	101	834	389	1223	6	7342
1982	1082	716	1798	49	5	54	20	130	17	63	930	993	985	363	1348	364	10	25	286	132	596	496	1092	6.4	6275
1983	911	513	1424	51	7	58	16	166	32	150	1506	1656	957	593	1550	507	23	28	429	187	672	549	1221	1.3	7298
1984	645	467	1112	37	9	46	25	139	20	101	728	829	995	628	1623	593	18	40	345	78	504	509	1013	2.2	5883
1985	540	593	1133	38	11	49	22	162	55	100	1495	1595	923	638	1561	659	13	45	361	98	514	399	913	2.1	6668
1986	779	780	1559	25	12	37	28	232	59	136	1594	1730	1042	556	1598	608	27	54	430	109	745	526	1271	1.9	7744
1987	951	833	1784	34	15	49	27	181	40	127	1112	1239	894	491	1385	564	18	47	302	56	503	419	922	1.2	6615
1988	633	677	1310	27	9	36	32	217	180	141	1733	1874	656	420	1076	420	18	40	395	114	501	381	882	0.9	6595
1989	590	549	1139	33	19	52	14	140	136	132	947	1079	469	436	905	364	7	29	296	142	464	431	895	1.7	5200
1990	486	425	911	41	19	60	15	146	280	-	-	567	545	385	930	313	7	33	338	94	423	201	624	2.4	4320
1991	370	341	711	53	17	70	13	130	345	-	-	404	535	342	876	215	11	38	200	55	177	285	462	0.8	3531
1992	323	199	522	49	28	77	20	175	460	-	-	630	566	301	867	167	11	49	186	91	362	238	600	0.7	3856
1993	214	159	373	53	17	70	16	160	496	-	-	541	611	312	923	139	8	56	248	83	320	227	547	0.6	3661
1994	216	139	355	38	11	49	18	140	308	-	-	804	581	415	996	141	10	44	249	91	400	248	649	-	3854
1995	153	107	260	37	11	48	9	150	298	-	-	790	590	249	839	128	9	37	295	83	364	224	588	-	3534
1996	154	138	292	23	21	44	14	122	239	-	-	687	571	215	787	131	7	33	183	77	267	160	427	-	3043
1997	126	103	229	29	16	45	8	106	50	-	-	570	389	241	630	111	3	19	146	93	182	114	296	-	2306
1998	70	87	157	29	19	48	9	130	34	-	-	624	445	296	740	131	4	15	125	78	157	123	280	-	2375
1999	63	80	143	32	32	63	11	119	26	-	-	515	493	318	811	102	6	13	152	53	133	49	182	-	2196
Means																									
1994-98	144	115	259	31	16	47	12	130	186	-	-	695	515	283	798	128	7	30	200	84	274	174	448	-	3022
1989-98	270	225	495	39	18	56	14	140	265	-	-	670	530	319	849	184	8	35	227	89	312	225	537	1	3568

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
3. From 1994, includes increased reporting of rod catches.
4. Before 1966, sea trout and sea charr included (5% of total).
5. Weights prior to 1990 are estimated from 1994 mean weight.
   Weights from 1990 based on mean wt. from R. Asturias.
6. Not including angling catch (mainly 1SW).
7. Data for 1993-98 altered from previous reports to take account of catch & release

Table 2.1.1.3 Reported catch of SALMON in numbers and weight in tonnes (round fresh weight). Catches reported for 1999 may be provisional. Methods used for estimating age composition given in footnotes.

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
Canada	1982	358,000	716	-	-	-	-	-	-	-	-	240,000	1,082	-	-	598,000	1,798
	1983	265,000	513	-	-	-	-	-	-	-	-	201,000	911	-	-	466,000	1,424
	1984	234,000	467	-	-	-	-	-	-	-	-	143,000	645	-	-	377,000	1,112
	1985	333,084	593	-	-	-	-	-	-	-	-	122,621	540	-	-	455,705	1,133
	1986	417,269	780	-	-	-	-	-	-	-	-	162,305	779	-	-	579,574	1,559
	1987	435,799	833	-	-	-	-	-	-	-	-	203,731	951	-	-	639,530	1,784
	1988	372,178	677	-	-	-	-	-	-	-	-	137,637	633	-	-	509,815	1,310
	1989	304,620	549	-	-	-	-	-	-	-	-	135,484	590	-	-	440,104	1,139
	1990	233,690	425	-	-	-	-	-	-	-	-	106,379	486	-	-	340,069	911
	1991	189,324	341	-	-	-	-	-	-	-	-	82,532	370	-	-	271,856	711
	1992	108,901	199	-	-	-	-	-	-	-	-	66,357	323	-	-	175,258	522
	1993	91,239	159	-	-	-	-	-	-	-	-	45,416	214	-	-	136,655	373
	1994	76,973	139	-	-	-	-	-	-	-	-	42,946	216	-	-	119,919	355
	1995	61,940	107	-	-	-	-	-	-	-	-	34,263	153	-	-	96,203	260
	1996	82,490	138	-	-	-	-	-	-	-	-	31,590	154	-	-	114,080	292
	1997	58,988	103	-	-	-	-	-	-	-	-	26,270	126	-	-	85,258	229
	1998	51,251	87	-	-	-	-	-	-	-	-	13,274	70	-	-	64,525	157
	1999	45,732	80	-	-	-	-	-	-	-	-	11,290	63			57,022	143
Faroe Islands	1982/83	9,086	-	101,227	-	21,663	-	448	-	29	-	-	-	-	-	132,453	625
	1983/84	4,791	-	107,199	-	12,469	-	49	-	-	-	-	-	-	-	124,453	651
	1984/85	324	-	123,510	-	9,690	-	-	-	-	-	-	-	1,653	-	135,776	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	-	-	-	-	-	-	-	111,430	364
	1990/91	631	-	52,420	-	4,390	-	8	-	-	-	-	-	-	-	57,442	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	-	1560	-	205	-	-	-	-	-	-	-	-	-	1,990	8
Finland	1982	2,598	5	-	-	-	-	-	-	-	-	5,408	49	-	-	8,406	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	48
	1996	10,726	21	1,103	5	1,359	13	242	4	13	1	-	-	-	-	13,443	44
	1997	9,469	16	2,357	10	1,742	17	163	2	10	0	-	-	-	-	13,741	45
	1998	11,410	19	1,642	7	1,945	19	162	2	10	0	-	-	-	-	15,169	48
	1999	16,861	32	1,556	8	1,708	17	130	2	10	0	-	-	444	3	20,709	63

Table 2.1.1.3 (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
France	1985	1,074	-	-	-	-	-	-	-	-	-	3,278	-	-	-	4,352	22
	1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,801	28
	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	20
	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	-	-	-	-	-	-	-	-	4,005	14
	1997	1,060	3	964	5	37	0.3	-	-	-	-	-	-	-	-	2,061	8
	1998	2,065	5	824	4	22	0.2	-	-	-	-	-	-	-	-	2,911	9
	1999	690	2	1,799	9	32	0.2	-	-	-	-	-	-	-	-	2,521	
														-			
														-			
Iceland	1991	30,011	-	11,935	-	-	-	-	-	-	-	-	-	-	-	41,946	130
	1992	38,955	-	15,416	-	-	-	-	-	-	-	-	-	-	-	54,371	175
(Wild fish	1993	37,611	-	11,611	-	-	-	-	-	-	-	-	-	-	-	49,222	160
only, ranched	1994	25,480	62	14,408	78	-	-	-	-	-	-	-	-	-	-	39,888	140
fish not	1995	34,046	93	13,380	57	-	-	-	-	-	-	-	-	-	-	47,426	150
included)	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	23,723	63	10,961	56	-	-	-	-	-	-	-	-	-	-	34,684	119
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	-	-	526,450	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	630
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200,120	541
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	286,266	804
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	288,225	790
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	249,623	687
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	209,214	570
	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	237,663	624
	1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180,477	515

Table 2.1.1.3 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	-	-	449,442	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	-	-	286,466	930
	1991	171,041	342	-	-	-	-	-	-	-	-	92,214	535	-	-	263,255	876
	1992	151,291	301	-	-	-	-	-	-	-	-	92,717	566	-	-	244,008	867
	1993	153,407	312	62,403	284	35,147	327	-	-	-	-	-	-	-	-	251,957	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	787
	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	740
	1999	164,905	318	70,825	326	18,669	167	-	-	-	-	-	-	-	-	254,399	811
Russia	1987	97,242	-	27,135	-	9,539	-	556	-	18	-	-	-	2,521	-	139,011	564
	1988	53,158	-	33,395	-	10,256	-	294	-	25	-	-	-	2,937	-	100,066	420
	1989	78,023	-	23,123	-	4,118	-	26	-	-	-	-	-	2,187	-	107,477	364
	1990	70,595	-	20,633	-	2,919	-	101	-	-	-	-	-	2,010	-	96,258	313
	1991	40,603	-	12,458	-	3,060	-	650	-	-	-	-	-	1,375	-	58,146	215
	1992	34,021	-	8,880	-	3,547	-	180	-	-	-	-	-	824	-	47,452	167
	1993	28,100	-	11,780	-	4,280	-	377	-	-	-	-	-	1,470	-	46,007	139
	1994	30,877	-	10,879	-	2,183	-	51	-	-	-	-	-	555	-	44,545	141
	1995	27,775	62	9,642	50	1,803	15	6	0	-	-	-	-	385	2	39,611	128
	1996	33,878	79	7,395	42	1,084	9	40	0.5	-	-	-	-	41	0.5	42,586	131
	1997	31,857	72	5,837	28	672	6	38	0.5	-	-	-	-	559	3	39,003	111
	1998	34,870	92	6,815	33	181	2	28	0.3	-	-	-	-	638	3	42,532	131
	1999	24,016	66	5,317	25	499	5	-	-	-	-	-	-	1131	6	30,963	102
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	-	-	14,507	49
	1993	10,540	23	-	-	-	-	-	-	-	-	6,369	33	-	-	16,909	56
	1994	8,304	18	-	-	-	-	-	-	-	-	4,661	26	-	-	12,695	44
	1995	9,761	22	-	-	-	-	-	-	-	-	2,770	14	-	-	12,531	37
	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	2,928	6	-	-	-	-	-	-	-	-	1,190	6			4,118	13

Table 2.1.1.3 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	1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95,531	361
(England &	1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110,794	430
Wales)	1987	66,371	-	-	-	-	-	-	-	-	-	17,063	-	-	-	83,434	302
	1988	76,521	-	-	-	-	-	-	-	-	-	33,642	-	-	-	110,163	395
(2)	1989	65,450	-	-	-	-	-	-	-	-	-	19,550	-	-	-	85,000	296
	1990	53,143	-	-	-	-	-	-	-	-	-	33,533	-	-	-	86,676	338
	1991	34,596	-	-	-	-	-	-	-	-	-	17,053	-	-	-	51,649	200
	1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48,168	186
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69,562	249
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88,121	324
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80,476	295
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46,696	183
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41,374	146
	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,910	125
	1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40,997	152
UK	1982	208,061	416	-	-	-	-	-	-	-	-	128,242	596	-	-	336,3032	1,092
(Scotland)	1983	209,617	549	-	-	-	-	-	-	-	-	145,961	672	-	-	320,578	1,221
	1984	213,079	509	-	-	-	-	-	-	-	-	107,213	504	-	-	230,292	1,013
	1985	158,012	399	-	-	-	-	-	-	-	-	114,648	514	-	-	272,660	913
	1986	202,861	526	-	-	-	-	-	-	-	-	148,398	745	-	-	351,259	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	600
	1993	94,517	227	-	-	-	-	-	-	-	-	71,726	320	-	-	166,243	547
	1994	99,459	248	-	-	-	-	-	-	-	-	85,404	400	-	-	184,863	649
	1995	89,921	224	-	-	-	-	-	-	-	-	78,452	364	-	-	168,373	588
	1996	66,413	160	-	-	-	-	-	-	-	-	57,920	267	-	-	124,333	427
	1997	46,878	114	-	-	-	-	-	-	-	-	40,421	182	-	-	87,299	296
	1998	53,656	121	-	-	-	-	-	-	-	-	38,257	158	-	-	92,399	280
	1999	21,913	49	-	-	-	-	-	-	-	-	28,525	133				
USA	1982	33	-	1,206	-	5	-	-	-	-	-	-	-	21	-	1,265	6.4
	1983	26	-	314	1.2	2	-	-	-	-	-	-	-	6	-	348	1.3
	1984	50	-	545	2.1	2	-	-	-	-	-	-	-	12	-	609	2.2
	1985	23	-	528	2.0	2	-	-	-	-	-	-	-	13	-	557	2.1
	1986	76	-	482	1.8	2	-	-	-	-	-	-	-	3	-	541	1.9
	1987	33	-	229	1.0	10	-	-	-	-	-	-	-	10	-	282	1.2
	1988	49	-	203	0.8	3	-	-	-	-	-	-	-	4	-	259	0.9
	1989	157	0.3	325	1.3	2	-	-	-	-	-	-	-	3	-	487	1.7
	1990	52	0.1	562	2.2	12	-	-	-	-	-	-	-	16	-	642	2.4
	1991	48	0.1	185	0.7	1	-	-	-	-	-	-	-	4	-	238	0.8
	1992	54	0.1	138	0.6	1	-	-	-	-	-	-	-	-	-	193	0.7
	1993	17	-	133	0.5	-	-	-	-	-	-	-	-	2	-	152	0.6
	1994	12	-	0	-	-	-	-	-	-	-	-	-	-	-	12	0
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0

Table 2.1.1.3 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
West Greenland	1982	315,532	-	17,810	-	-	-	-	-	-	-	-	-	2,688	-	336,030	1,077
	1983	90,500	-	8,100	-	-	-	-	-	-	-	-	-	1,400	-	100,000	310
	1984	78,942	-	10,442	-	-	-	-	-	-	-	-	-	630	-	90,014	297
	1985	292,181	-	18,378	-	-	-	-	-	-	-	-	-	934	-	311,493	864
	1986	307,800	-	9,700	-	-	-	-	-	-	-	-	-	2,600	-	320,100	960
	1987	297,128	-	6,287	-	-	-	-	-	-	-	-	-	2,898	-	306,313	966
	1988	281,356	-	4,602	-	-	-	-	-	-	-	-	-	2,296	-	288,233	893
	1989	110,359	-	5,379	-	-	-	-	-	-	-	-	-	1,875	-	117,613	337
	1990	97,271	-	3,346	-	-	-	-	-	-	-	-	-	860	-	101,478	274
	1991	167,551	415	8,809	53	-	-	-	-	-	-	-	-	743	4	177,052	472
	1992	82,354	217	2,822	18	-	-	-	-	-	-	-	-	364	2	85,381	237
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1995	31,241	-	558	-	-	-	-	-	-	-	-	-	478	-	32,270	83
	1996	30,613	-	884	-	-	-	-	-	-	-	-	-	568	-	32,062	92
	1997	20,980	-	134	-	-	-	-	-	-	-	-	-	124	-	21,238	58
	1998	3,901	-	17	-	-	-	-	-	-	-	-	-	88	-	4,006	11
	1999	5,978	18	49	0.4	-	-	-	-	-	-	-	-	142	0.6	6,169	19

[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, UK (England and Wales), 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.

In Scotland, misclassification may be very high in some years.

In Norway, catches shown as 3SW refer to salmon of 3SW or greater.

2 . Data for 1993-98 altered from previous reports to take account of catch & release

Table 2.1.1.4 The weight (tonnes round fresh weight) and proportion (%) of the nominal catch by country taken in coastal, estuarine and riverine fisheries.

		Catch						
		Coast		Estuary		River		Total
Country	Year	Weight	%	Weight	%	Weight	%	Weight
Canada	1999	7	5	38	27	98	68	143
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	63	100	63
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
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	119	100	119
Ireland	1995	566	72	123	16	101	13	790
	1996	440	64	115	17	131	19	686
	1997	379	66	85	15	106	19	570
	1998	433	69	82	13	109	17	624
	1999	335	65	82	16	98	19	515
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
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
St Pierre et Miquelon	1995	1	100	0	0	0	0	1
	1996	2	100	0	0	0	0	2
	1997	2	100	0	0	0	0	2
	1998	2	100	0	0	0	0	2
	1999	2	100	0	0	0	0	2
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

Table 2.1.1.4: continued

Country	Year	Catch						Total
		Coast		Estuary		River		Total
		Weight	%	Weight	%	Weight	%	Weight
Sweden	1999	5	37	0	0	8	63	13
UK	1995	193	66	53	18	49	17	295
England &	1996	77	42	49	26	58	31	183
Wales	1997	76	54	31	22	35	24	142
	1998	62	50	23	19	38	31	123
	1999	97	64	28	19	26	17	151
UK (N. Ireland)	1999	44	83	9	17	0	0	53
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	22	28	10	191	68	279
	1999	34	18	16	9	133	73	182
Totals								
North East Atlantic [2]	1999	1045	52	141	7	839	41	2025
North America [3]	1999	10	7	38	26	98	67	145

[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

[2] data not available from Denmark

[3] includes Canada & St Pierre et Miquelon

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, 1991-1999.

Year	Canada [1]				Iceland		Russia		UK(E&W)		UK(Scot)				USA	
	Small	Large	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	Total	% of total rod catch	1SW	MSW	Total	% of total rod catch	Total	% of total rod catch
1991							3,211	51							239	50
1992	17,945	28,505	46,450	34			10,120	73							407	67
1993	30,970	22,879	53,849	41			11,246	82	1,448	10					507	77
1994	24,074	21,730	45,804	39			12,056	83	3,227	13	1,534	5,061	6,595	8	249	95
1995	18,601	12,610	31,211	36			11,904	84	3,189	20	3,290	8,843	12,133	14	370	100
1996	26,225	10,709	36,934	33	669	2	10,745	73	3,428	20	2,282	8,127	10,409	15	542	100
1997	26,798	21,589	48,387	49	1,558	5	14,823	87	3,132	24	2,790	8,116	10,906	18	333	100
1998	35,445	21,415	56,860	52	2,826	7	12,776	81	5,365	31	4,926	8,529	13,455	18	273	100
1999 [2]	23,210	20,574	43,784	49	3,051	10	11,450	77	5,293	44	3,556	10,591	14,147	29	211	100

1. Figures for 1992 to 1996 are minimal estimates as not all areas have reported catch and release.
2. Figures for 1999 are provisional.

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, 1986-1999.

Year	North-East Atlantic	North-American	West Greenland	Total
1986	-	315	-	315
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	1108	91	11	1,210
1999	881	133	12,5	1,027
Mean 1994-1998	977	108	-	1,099

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 America and West Greenland Commissions of NASCO, 1999, (NA = not available).

1999 Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Finland	10	0.3	14
NEAC	Iceland	2	0.1	2
NEAC	Ireland	122	3.8	19
NEAC	Norway	437	13.5	35
NEAC	Russia	246	7.6	71
NEAC	UK (E & W)	35	1.1	19
NEAC	UK (Scotland)	29	0.9	14
NAC	Canada	133	4.1	48
NAC	USA	0	0.0	0
WGC	West Greenland	12.5	0.4	40
	Total Unreported Catch	1027	31.6	
	Total Reported Catch of North Atlantic salmon	2218		

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), 1980-1999.

Year	North Atlantic Area										Outwith North Atlantic Area							Worldwide
	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	215,000	64,066	14,789	12,441	11,616	6,130	2,588	<100	0	326,630	34,077	5,000	16,100	5,000	1,000	800	61,977	388,607
1995	295,000	70,060	9,000	12,550	11,811	10,020	2,880	259	0	411,580	41,093	5,000	16,000	6,000	1,000	0	69,093	480,673
1996	305,000	83,121	18,600	17,715	14,025	10,010	2,772	338	0	451,581	69,960	5,200	17,000	7,500	1,000	600	101,260	552,841
1997	331,367	99,197	22,205	19,354	14,025	12,140	2,554	225	0	501,067	87,700	6,000	28,751	9,000	1,000	900	133,351	634,418
1998	344,645	110,784	20,362	16,418	14,860	13,166	2,686	114	0	523,035	125,000	3,000	33,057	10,000	1,000	400	172,457	695,492
1999	415,399	111,918	37,000	22,537	18,000	12,194	3,133	234	0	620,415	150,000	5,000	39,000	10,000	1,000	500	205,500	825,915
Mean 1994-1998	298,202	85,446	16,991	15,696	13,267	10,293	2,696	234	0	442,779	71,566	4,840	22,182	7,500	1,000	540	107,628	550,406

1999 data for some countries are provisional.

Source of production figures for non-Atlantic areas: misc. fishing publications & government reports.

West Coast USA = Washington State
West Coast Canada = British Columbia
Australia = Tasmania
Other includes South Korea

Table 2.2.2.1 Production of ranched salmon in the North Atlantic (tonnes round fresh weight) as harvested at ranching facilities, 1980-1999.

Year	Iceland commercial ranching	Ireland [1]	UK(N.Ireland) River Bush [1]	Norway various facilities [1]	Total production
1980	8				8
1981	16				16
1982	17				17
1983	32				32
1984	20				20
1985	55	17.5	17		90
1986	59	22.9	22		104
1987	40	6.4	7		53
1988	180	11.5	12	4	208
1989	136	16.3	17	3	172
1990	280	5.7	5	6	297
1991	345	3.6	4	5	358
1992	460	9.4	11	10	490
1993	496	9.7	8	11	525
1994	308	15.2	0.4	9.5	333
1995	298	16.8	1.2	2	318
1996	239	18.5	3	8	269
1997	50	4.1	2.8	2	59
1998	34	9.6	1	1	46
1999	26	4.3	1.4	1	33
Mean 1994-98	186	13	2	5	205

[1] Total yield in homewater fisheries and rivers.

Table. 2.3. Description and evaluation of national methods used for estimating legal and illegal unreported catches of Atlantic salmon.

Commission Area	Country	Method Legal / Illegal	Evaluation	Possibilities for Improvement
NAC	Canada	Legal: No legal unreported catches are submitted as unreported catches by Canada. All legal salmon fisheries are licenced & with one exception have a condition of requirement to report catch to respective federal or provincial licencing agencies.	Methods are structured & systematic.	
		The Province of New Brunswick (NB) issues recreational salmon licences without condition of reporting. Survey estimates of recreational catches by licence holders in NB are included in reported catches of Canada.	NB licences offer a structured and systematic method of estimating catches but must include a provision to report catches or must be followed up with a mail survey.	Make mandatory, the annual reporting of catches, or conduct annual mail surveys of licence holders.
		Illegal: (unlicenced) *Quebec* – based on previously undeclared proportions of angling, native & commercial fisheries determined by regional biologists in each fishing area.	Structured and somewhat systematic in Quebec.	
		Newfoundland &Labrador – largely based on annual Fishery Officer observations, unconfirmed occurrence reports, & anecdotal information relating to poaching & recreational & native fisheries.	Largely unstructured.	Provision of information and instructions to fishery Officers on systematic methods of annually raising observed illegal catches to a district/ area total estimate.
		New Brunswick (NB), Nova Scotia (NS) & Prince Edward Island (PEI) – based on guess-estimates by regional enforcement staff or a previously estimated proportion of the assessed run-size. (Design surveys and estimates of the unreported catch by licenced recreational fishers in NS & PEI (technically illegal) are like those of NB (legal), included in reported catches for Canada.)	Largely unstructured in NB, NS & PEI. NS & PEI rod catches estimates are structured and systematic.	
	USA	Legal: No legal catch is permitted. Native American Indians do not exercise their sustenance fishing rights. Discussions with fishery officers & anglers on Maine salmon rivers.	Not evaluated.	N/A
		Illegal: Discussions with fishery officers and anglers on Maine salmon rivers.	Not evaluated.	Unknown
NEAC	Faroes	Legal: *Sea fisheries* – Licenced. Assumed that all catches are reported. *River fishery* – Unlicenced, reporting not required and unreported.	No evaluation.	
		Illegal: *Sea fisheries* - Assumed to be none.	No evaluation	

Commission Area	Country	Method Legal / Illegal	Evaluation	Possibilities for Improvement
	Finland	Legal:- *Net & rod fisheries* – These are licenced but without requirement to report catch. Estimated by extrapolating the information from reported catch statistics. These estimated catches are submitted as reported catches.	Systematic.	Increase the coverage of catch inquiries (mailing). Cross check with other methods, e.g., a sample of telephone inquiries, personal interviews.
		Illegal:- Guess-estimated.	Not evaluated	Very difficult.
	France	Legal:- Data provided in ICES unreported catches are both legal & illegal. Illegal catches are generally assessed wherever they are thought to be significant. Unreported catches from legal fisheries are accorded to unreported catches		
		Illegal:- *Rod catches* – Guess-estimates made by fishery officers. except in Brittany and Normandy (75% of total rod catch), where two additional methods are used to improve the accuracy of the estimate 1) comparison by fishery officers of the declared catches and the catches they know, which allows them to estimate a report rate on a river-by-river basis; 2) a comparison between the declared catches and the number of carcass “tags” provided to anglers where anglers begin with a single tag and should get another as soon as they have caught one fish.	Largely structured and systematic.	
		Net catches – Surveys in nine estuaries of Brittany where salmon catches could have been significant in 1998 & 1999, involving a survey of netting activity and an evaluation of the catch per unit effort of the nets. Also, field surveys in the Adour estuary in order to assess the reporting rate.	Largely structured although less systematic than methods employed in rod catches.	An assessment should be made of unreported catches in the Garonne estuary as they are suspected of representing a significant part of a stock under restoration.
	Iceland	Legal:- All legally caught fish are supposed to be recorded in log books that are delivered to the authorities. If log books are not returned the fisheries associations or landowners are contacted. If information is not available, average catch for previous years is used as an estimate. The catch not reported is low & recorded in unreported catches.	Reasonably effective.	Unknown
		Illegal:- Guess-estimate. Very few incidences of illegal fishing is reported or observed by fishery officers. The number of illegally caught fish is thought to be low & included in the unreported catches.	Not evaluated.	Unknown

Commission Area	Country	Method Legal / Illegal	Evaluation	Possibilities for Improvement
	Ireland	Legal: *Commercial fishing* – Generally, licenced fisherman are obliged to sell fish only to a licenced salmon dealer and as such, sales should be recorded in a dealer register. However, fishermen can sell fish directly to the public. Therefore for the commercial fishery any fish not recorded in the dealers' register are accounted for in the estimates of illegal unreported catch.	Reasonably effective in some regions	
		Angling – The method of reporting rod catches was greatly improved in 1995 and consists of reports from angling clubs supplemented by reports from private and public fisheries and estimates of individual angling catches which are not included in either the reported or unreported catch statistics.	Reasonably effective.	
		Illegal: *Commercial fishing* - Estimated from local evaluations at ports and fish processors and by regional and district fisheries inspectors. Some use of reported illegal net and fish seizures may be used in the evaluation. Legislation of monofilament nets has led to a reported reduction in unreporting since 1996.	Not systematic & varies in quality by year and fishing district.	A salmon carcass tagging and logbook system is proposed for salmon fisheries in Ireland. Catches will be estimated directly from logbook returns and issue of carcass tags. This should facilitate the identification and enumeration of illegal catches & significantly reduce the level of unreported catch nationally.
		Angling – The method of reporting rod catches was greatly improved in 1995. Licenced anglers catch the vast majority of rod caught salmon. While the level of illegal rod catch is considered low relative to the national catch, the exact proportion is unknown. Unreported illegal angling is included in the reported catch if it is significant.	Not evaluated	
	Norway	Legal:- *By-catch in marine fisheries.* Test fishing with e.g., mackerel nets.	Occasional test fishing.	Test fishing screening fisheries.
		Marine troll & angling: No reporting system; occasional surveys & questionnaire.	Occasional test fishing.	More systematic surveys.
		Other marine – Logbooks & questionnaires.	Occasional evaluation.	
		Freshwater- Studies from several rivers, questionnaires & deposit on fishing licences.	Occasional evaluation.	
		Illegal:- *Marine fisheries* – Circulation of a questionnaire among the surveillance inspectors, fishermen & local managers.	Occasional reports from surveillance inspectors.	More systematic surveys.
		Angling – Based on occasional surveillance reports.	Occasional surveillance reports.	
	Sweden	Legal:- All legal fisheries are licensed & all catch is assumed		

Commission Area	Country	Method Legal / Illegal	Evaluation	Possibilities for Improvement
		to be reported. Illegal:- Guess-estimated proportion of legal catch based on the general abundance of salmon.	Has some structure.	
	Russia	Legal:- *Coastal fisheries* – Estimates based on local knowledge of fisheries, logbook data & catch statistics data. *In-river net fishery* – In Arhangelsk region the unreported catch is assessed by comparing catch survey results with reported catch. For Kola peninsula the estimates are made using log book data. *In-river rod fishery*. – the estimate is obtained by comparing catch statistics for local anglers with the more accurate catch statistics from foreign anglers. Illegal:- *Coastal fishery, inriver rod fishery and poaching* – guess-estimates based on local knowledge of fisheries.	Structured and systematic. Structured and systematic. Structured and systematic. No structure and not systematic.	More detailed recording. Further sampling. A reduction of fishing stations in Archangelsk region. Further sampling. A salmon carcass tagging system &/ or sampling of anonymous questionnaires.
	UK(E & W)	Legal:- *Nets*- Overall estimate of 8% applied based upon three sample studies. *Rods*:- Overall estimate of 10% calculated from study of catch returns from repeat reminders. Illegal:- Guess-estimates in each Region based upon enforcement activities combined to give overall estimate of the percentage of illegal catch	*Nets* - Semi rigorous; assessment based upon sampling, but not adjusted every year. *Rods* - Semi- rigorous; based upon national assessment but not adjusted every year. Not rigorous; based upon subjective evaluation in each Region.	Additional sampling of rod & net catches is being considered. More detailed recording and evaluation of enforcement activities would be possible but is not planned.
	UK (N.I.)	Legal:- *Net catches* - Estimates based on observation of catches by staff engaged in microtag recovery programmes. *Rod catches* - No data available. Illegal:-Guess-estimates based upon local knowledge of fisheries. *Rod catch*: - No data available.	Not systematic. but staff often observe catches being processed at points of capture. Not systematic, but based on experience of fishery officers.	Discussions have taken place between fishery authorities in NI and the Republic of Ireland. about the introduction of an all Ireland salmon tagging scheme. Agreement in principle has been reached & the regulatory framework & practical arrangements are being pursued. This should significantly improve reporting of rod catches, in particular.
	UK(Scotland)	Legal:- Estimates by local management groups in late 1980s; estimates include a fixed component and a component that varies with catch. Illegal:- Estimates by local management groups in late 1980s;	Subjective. Estimates not available for all areas. Subjective. Estimates not available for all	Repeat survey so that estimates reflect current situation. Expand survey. Repeat survey so that estimates

Commission Area	Country	Method Legal / Illegal	Evaluation	Possibilities for Improvement
		estimates include a fixed component and a component that varies with catch.	areas.	reflect current situation. Expand survey.

WGC	Greenland	Legal:- Guess-estimate of local consumption. Illegal:- Fishing not thought to occur outside of the salmon fishing seasons.	Fishery officer observations.	

Table 2.6.1 Farmed Atlantic salmon production and estimated catches of farmed salmon in the North Atlantic area. Note: - indicates no data available.

Country	Year	Farmed Production	Farmed in Catches	Total Farmed	Min % Escapees	Reported No. of Escapees
North East Atlantic Area						
Norway	1989	124,000	195	124,195	0.16%	-
	1990	165,000	214	165,214	0.13%	-
	1991	155,000	189	155,189	0.12%	-
	1992	140,000	203	140,203	0.14%	-
	1993	170,000	209	170,209	0.12%	-
	1994	215,000	205	215,205	0.10%	-
	1995	295,000	183	295,183	0.06%	-
	1996	305,000	222	305,222	0.07%	-
	1997	331,367	198	331,565	0.06%	-
	1998	344,645	209	344,854	0.06%	537,924
	1999	415,399	198	415,597	0.05%	500,000
UK-Scotland	1991	40,593	14	40,607	0.03%	-
	1992	36,101	31	36,132	0.09%	-
	1993	48,691	31	48,722	0.06%	-
	1994	64,066	5	64,071	0.01%	-
	1995	70,060	2	70,062	0.00%	-
	1996	83,121	<1	83,121	0.00%	-
	1997	99,197	<1	99,197	0.00%	-
	1998	115,483	<1	115,483	0.00%	-
	1999	111,918	<1	111,918	0.00%	
Faroes	1990	13,000	84.8	13,084.8	0.65%	-
	1991	15,000	10.6	15,010.6	0.07%	-
	1992	17,000	5.9	17,005.9	0.03%	-
	1993	16,000	1.2	16,001.2	0.01%	-
	1994	14,789	1.2	14,790.2	0.01%	-
	1995	9,000	0.2	9,000.2	0.00%	-
	1996	18,600	0.0	18,600.0	0.00%	-
	1997	22,205	0.0	22,205.0	0.00%	-
	1998	20,362	-	20,362.0	-	-
	1999	37,000	-	37,000.0	-	-
Ireland and UK-No. Ireland	1991	9,583	2.0	9,585.0	0.02%	-
	1992	9,431	3.4	9,434.4	0.04%	-
	1993	12,466	1.3	12,467.3	0.01%	-
	1994	11,716	3.1	11,719.1	0.03%	-
	1995	12,070	1.2	12,071.2	0.01%	-
	1996	14,363	1.8	14,364.8	0.01%	24,000
	1997	14,250	1.2	14,251.2	0.01%	40,000
	1998	14,974	2.1	14,976.1	0.01%	73,732
	1999	18,234	3.0	18,237.0	0.02%	1,500
Iceland	1991	2,680	3	2,683.0	0.11%	-
	1992	2,100	tr.	2,100.0	0.00%	-
	1993	2,348	-	2,348.0	-	-
	1994	2,588	-	2,588.0	-	-
	1995	2,880	-	2,880.0	-	-
	1996	2,772	-	2,772.0	-	-
	1997	2,554	-	2,554.0	-	-
	1998	2,686	-	2,686.0	-	-
	1999	3,133	-	3,133.0	-	-
Eastern North America Area						
Canada and USA[1]	1991	13,955	-	-	-	-
	1992	16,230	0.4	16,230.4	0.00%	-
	1993	17,870	0.4	17,870.4	0.00%	-
	1994	18,571	2.7	18,573.7	0.01%	-
	1995	22,570	1.7	22,571.7	0.01%	-
	1996	27,725	0.7	27,725.7	0.00%	-
	1997	31,494	0.3	31,494.3	0.00%	-
	1998	29,584	0.6	29,584.6	0.00%	-
	1999	34,731	0.6	34,731.6	0.00%	-

[1] Catches of live salmon in fish counting facilities at one NB, Canada river and four Maine, USA rivers.

Table 2.8.1.1 Eggs taken and juvenile Atlantic salmon and eggs stocked (excluding private commercial sea ranching) during 1999.

Country	Total Eggs Artificially Spawned (1)	Eggs Stocked (rounded to nearest 1,000)			No. Fry (rounded to nearest 1,000)			No. Parr (rounded to nearest 100)				No. Smolts (rounded to nearest 100)		
		Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
Total	44137000	1286000	1787000	3073000	21717000	1746000	23463000	5662300	465200	98600	6226100	3134200	1072400	4213600
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canada	7648000	1226000	215000	1441000	560000	452000	1012000	1364700	33100	0	1397800	791800	199300	991100
Denmark	-	0	0	0	0	0	0	1200	2000	0	3200	1100	100	1200
Finland	-	0	0	0	0	0	0	0	0	0	0	0	0	0
France	-	0	254000	254000	89000	159000	248000	1788200	151700	0	1939900	68000	5600	73600
Iceland	-	0	0	0	120000		120000	461000	0	0	461000	636000	8500	644500
Ireland	9000000	0	0	0	4228000	115000	4343000	256700	0	0	256700	610100	700	610800
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Russia	2072000	0	0	0	0	0	0	215000	12700	98600	326300	0	706100	706100
Spain	950000	0	0	0	0	0	0	639000	141000	0	780000	49000	0	49000
Sweden (2)	1140000	-	-	-	0	0	0	0	0	0	0	129500	70300	199800
UK - (England & Wales)	-	0	38000	38000	0	687000	687000	526400	118800	0	645200	123000	79800	202800
UK - (Northern Ireland)	-	60000	0	60000	1046000	0	1046000	0	0	0	0	37000	2000	39000
UK - (Scotland)	-	0	1280000	1280000	3092000	333000	3425000	0	0	0	0	0	0	7000
USA -1999 (3)	23327000	0	0	0	12582000	0	12582000	410100	5900	0	416000	688700	0	688700

(1) Includes eggs artificially spawned in fall of 1999 and winter of 1999/2000

(2) Includes 260000 collected for compensatory smolt production. Disposition of balance uncertain.

(3) USA eggs include 2502000 taken from reconditioned sea run kelts and 16988000 hatchery-reared broodstook

Table 2.8.2.1 Eggs of 1996 year class of sea run salmon redirected for hatchery production, expressed as a proportion of the 1996 egg deposition

Country (1)	Estimated Egg Deposition in 1996	Estimated Number of Eggs Artificially Spawned in 1996	Eggs of Sea Run Fish Redirected to Hatchery Use
	(millions)	(millions)	(as % of deposition)
Canada (2)	1336	9.7	0.7
France (2) (3)	53	0.8	1.4
Iceland (2)	104	1.4	1.3
Ireland	696	7.3	1.0
Russia	1705	2.1	0.1
UK - (England & Wales)	318	2.4	0.8
UK - (Northern Ireland) (2)	87	0.4	0.5
UK - (Scotland) (2) (4)	3287	7.4	0.2
USA (3) (5)	4	3.8	95.0
Mean (weighted)			0.5
Totals	7590	35.3	

(1) Insufficiient data for Belgium, Norway and Sweden; No stocking in Finland; no egg deposition estimate for Denmark and Spain.

(2) Actual data on number of eggs spawned in 1996 was not available; the total number was estimated for CY1996 based on subsequent fry/parr/smolt releases. Survival in hatchery from egg stage was assummed to be 90% to fry, 85% to 0+ parr, 80% to 1 parr or smolt, and 75 % to 2 parr or smolt.

(3) Total eggs spawned of 3.6 million reduced by 79% (France) and 30% (USA) to adjust for eggs from domestic sources.

(4) Number of eggs spawned is a minimal estimate

(5) Estimate based on spawning escapement of 500 2SW females and fecundity of 8000.

Table 2.9.1. Summary of the number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in the North Atlantic, 1999. 'Hatchery' and 'Wild' refer to smolts or parr; 'Adult' refers to wild and/or hatchery fish. Data from Belgium were not available. Fish were not tagged in Finland.

		Primary Tag or Mark				
Country	Origin	Coded wire tag	External tag	Adipose clip1	Other visible clip or mark	Secondary Mark2
Canada	Hatchery	12089	9175	2209362	0	17089
	Wild	0	11538	888	0	877
	Adult	0	7937	0	0	2
	Total	12089	28650	2210250	0	17968
Denmark	Hatchery	0	1300	0	0	0
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	0	1300	0	0	0
France	Hatchery	0	0	320037	0	21600
	Wild	0	0	0	945	566
	Adult	0	0	0	0	0
	Total	0	0	320037	945	22166
Iceland	Hatchery	123387	0	0	0	123387
	Wild	3816	0	0	0	0
	Adult	0	1665	0	0	52
	Total	127203	1665	0	0	123439
Ireland	Hatchery	306870	0	150000	0	297832
	Wild	4402	0	0	0	2975
	Adult	0	0	0	0	0
	Total	311272	0	150000	0	300807
Norway	Hatchery	0	91495	0	0	0
	Wild	0	11749	0	0	0
	Adult	0	230	0	0	0
	Total	0	103474	0	0	0
Russia	Hatchery	0	1000	514100	0	0
	Wild	0	0	207	0	0
	Adult	0	1436	0	0	0
	Total	0	2436	514307	0	0
Spain	Hatchery	52580	0	164159	0	0
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	52580	0	164159	0	0
Sweden	Hatchery	46673	0	0	0	0
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	46673	0	0	0	0
UK (England & Wales)	Hatchery	95344	0	84509	0	95344
	Wild	0	0	0	0	0
	Adult	0	1190	0	0	0
	Total	95344	1190	84509	0	95344
UK (N. Ireland)	Hatchery	20969	0	14249	0	20969
	Wild	1394	0	160	0	1394
	Adult	0	0	160	0	0
	Total	22363	0	14569	0	22363
UK (Scotland)	Hatchery	14145	0	7900	0	0
	Wild	16784	2558	38	2343	21489
	Adult	0	0	0	0	0
	Total	30929	2558	7938	2343	21489
USA	Hatchery	0	0	21287	91009	0
	Wild	0	0	695	152	0
	Adult	0	3289	0	28	0
	Total	0	3289	21982	91189	0
All Countries	Hatchery	672057	102970	3485603	91009	576221
	Wild	26396	25845	1988	3440	27301
	Adult	0	15747	160	28	54
	Total	698453	144562	3487751	94477	603576
	Grand total marked =	4425243				

[1] Fish without other external marks or coded wire tags.

[2] Typically adipose fin clip.

Figure 2.1.1.1 Nominal catches of salmon in four North Atlantic regions 1960-99.

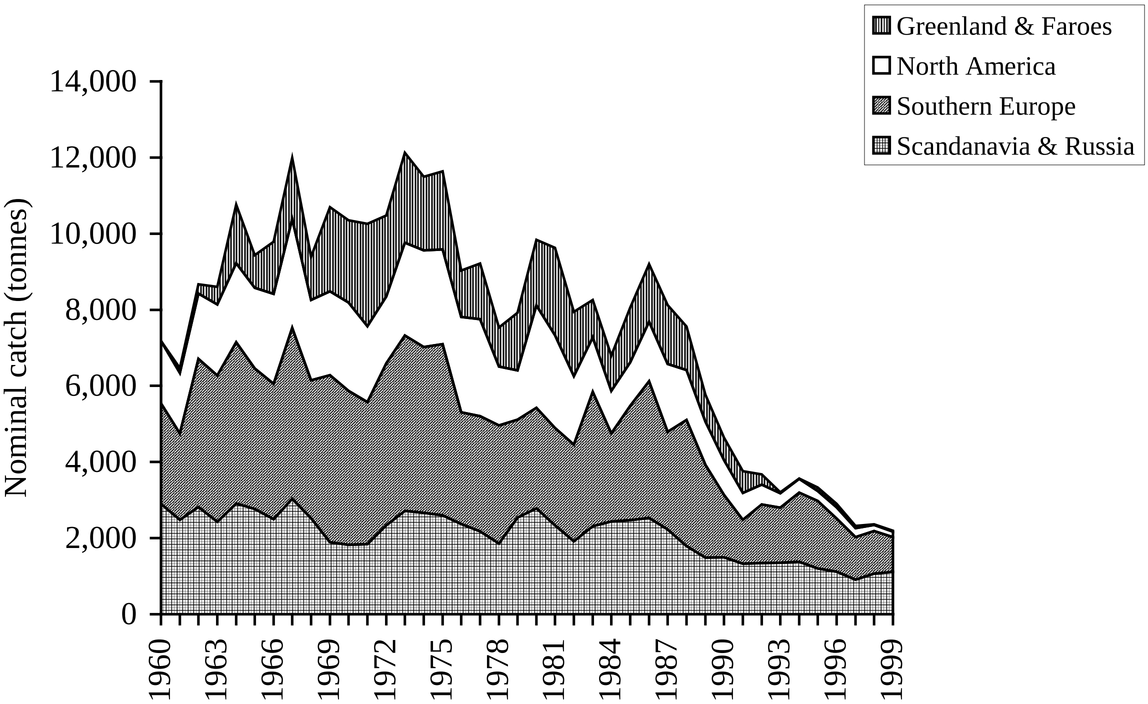


Figure 2.1.3.1. Total reported catch, unreported catch (in NASCO Areas) and % unreported catch of combined catch 1986-1999.

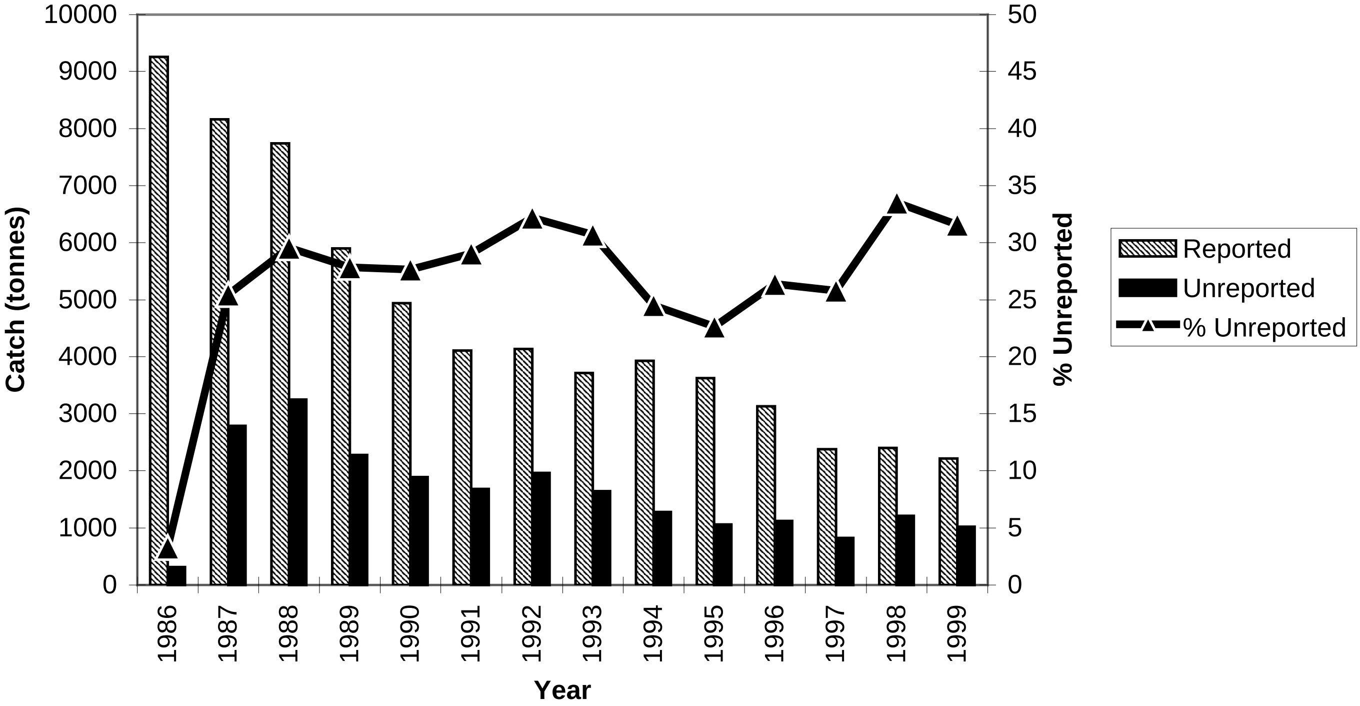


Figure 2.2.1.1. Worldwide farmed Atlantic salmon production, 1980-1999.

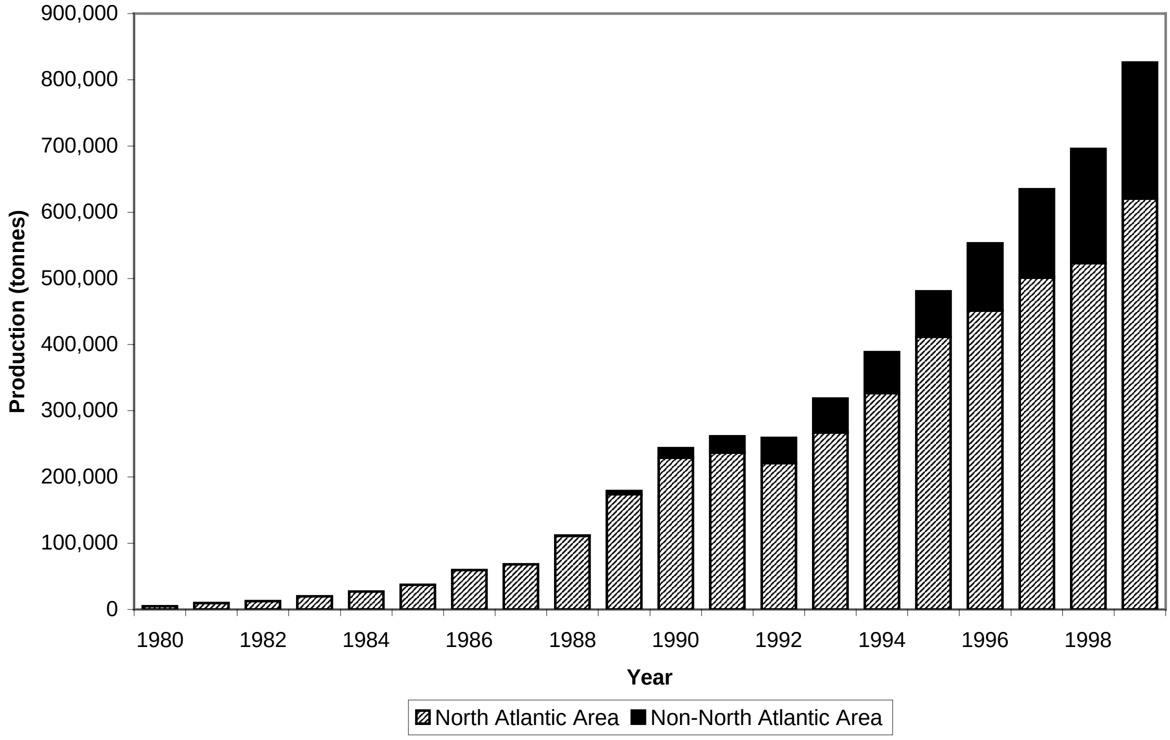


Figure 2.2.2.1. Production of ranched salmon (tonnes round fresh weight) as harvested at ranching facilities in the North Atlantic, 1980-1998 (legend stacked relative to 1998 tonnages).

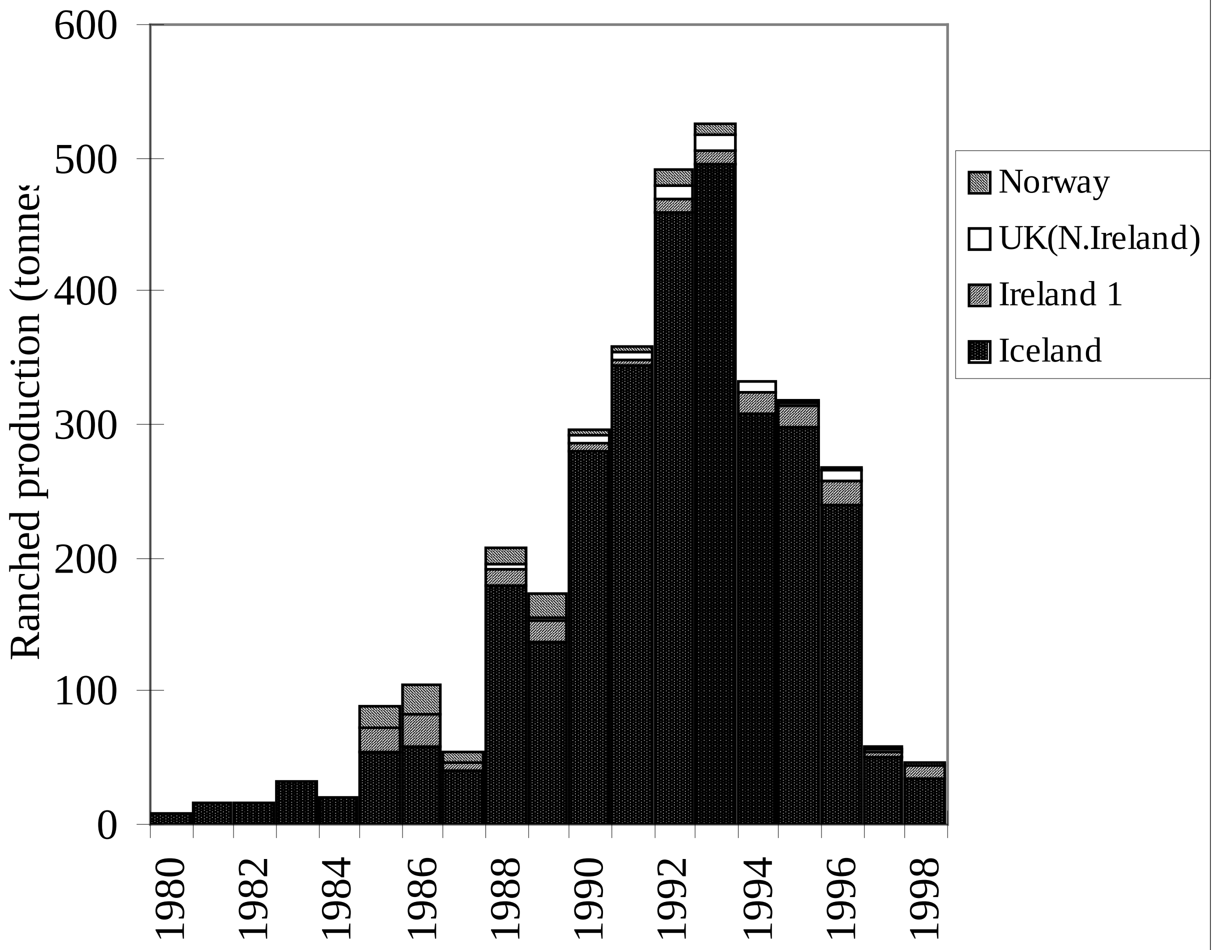


Figure 2.5.2.1. Weekly mean, maximum and minimum temperatures recorded by the three individual kelts.

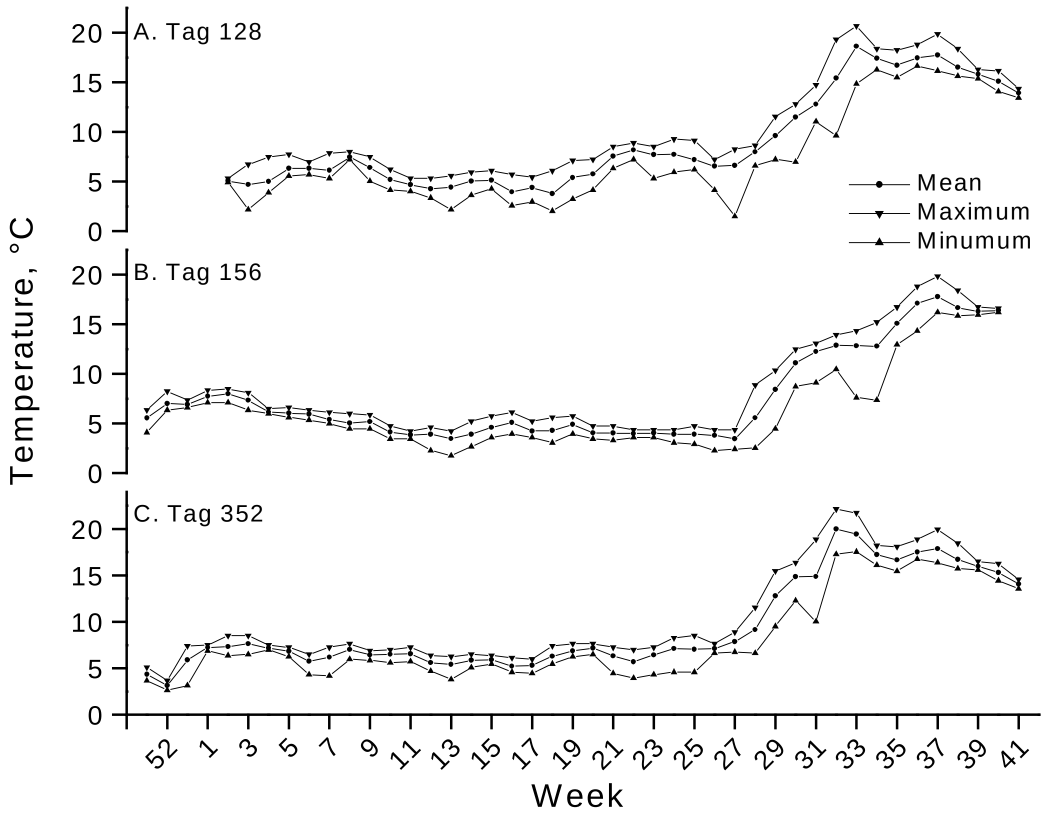
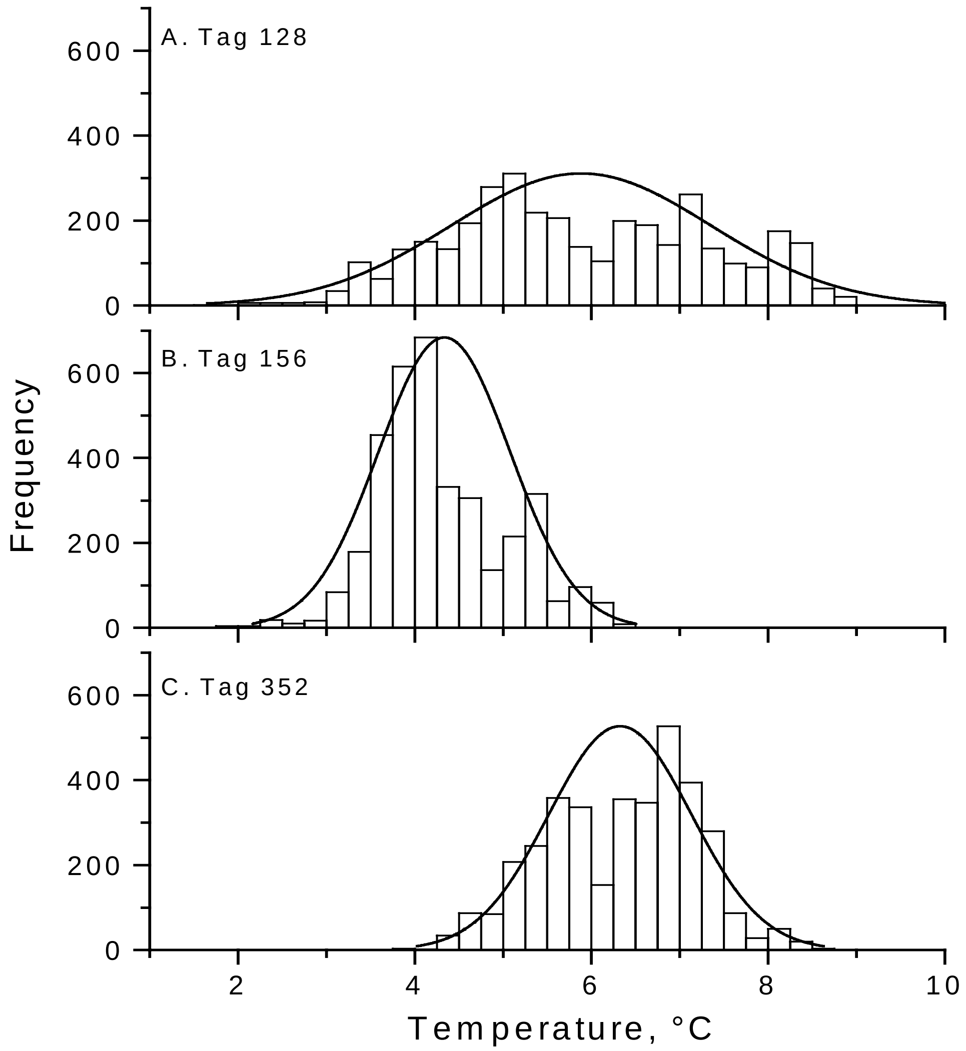
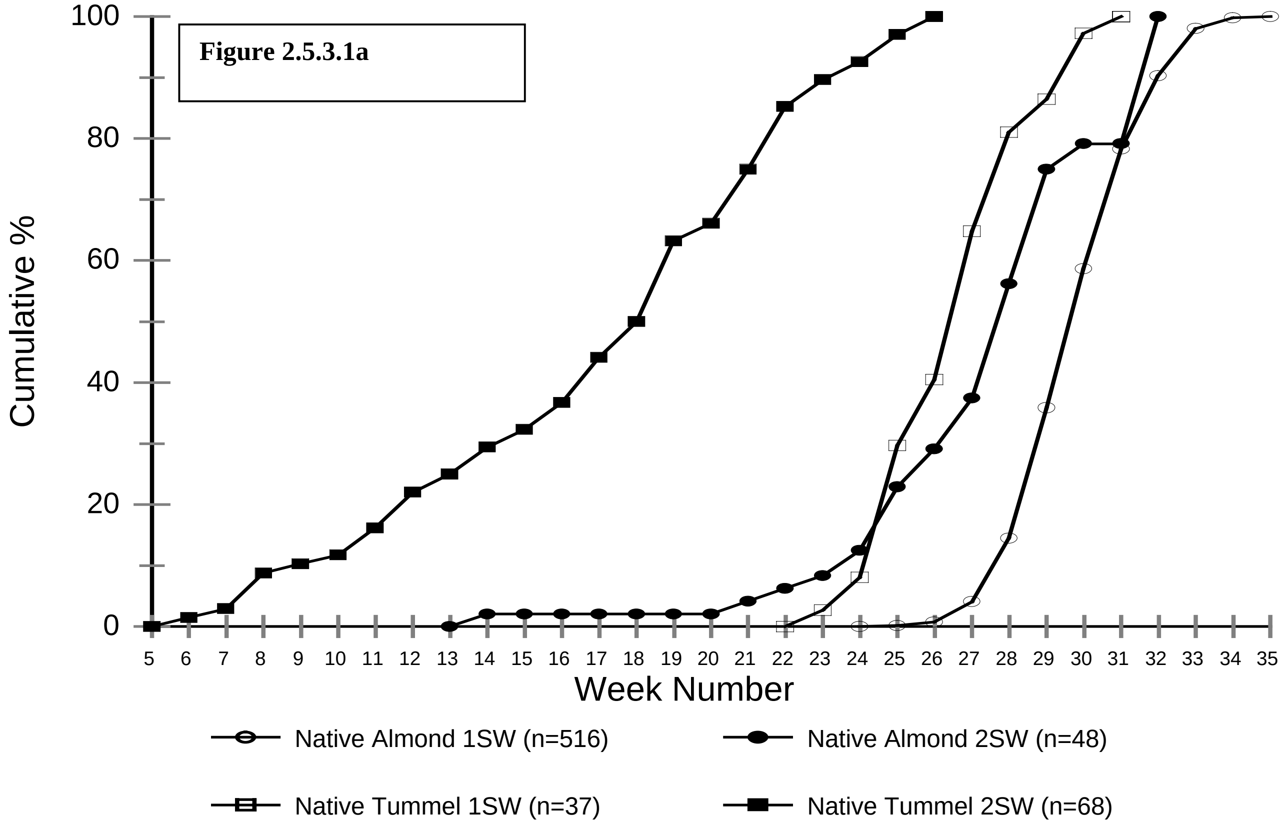


Figure 2.5.2.2 Frequency distributions of temperatures for the three individual fish from sea entry to the start of the active homing migration.





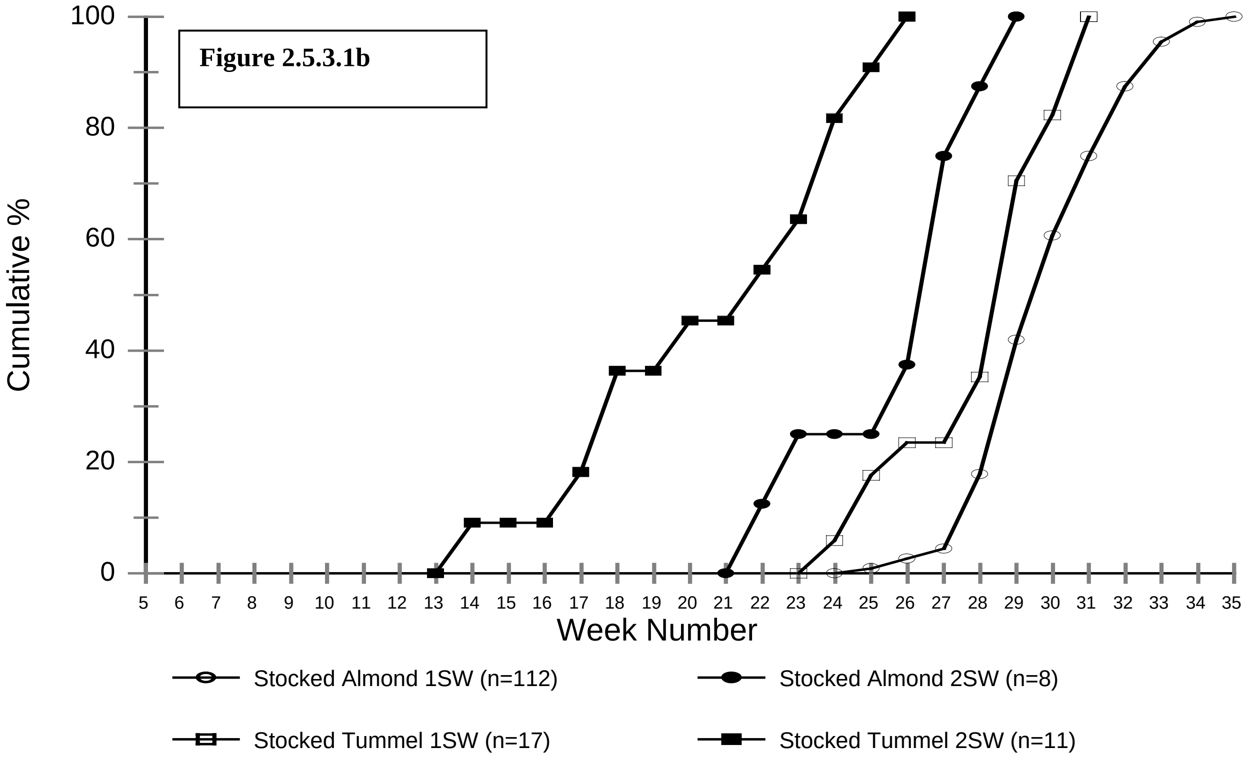


Figure 2.5.3.1. The cumulative frequency of the captures of microtagged fish in coastal & estuarine net fisheries. Data for 1SW and 2SW adults of Almond and Tummel origin are shown seperately.

a. native fishfish transferred to the River Braan.

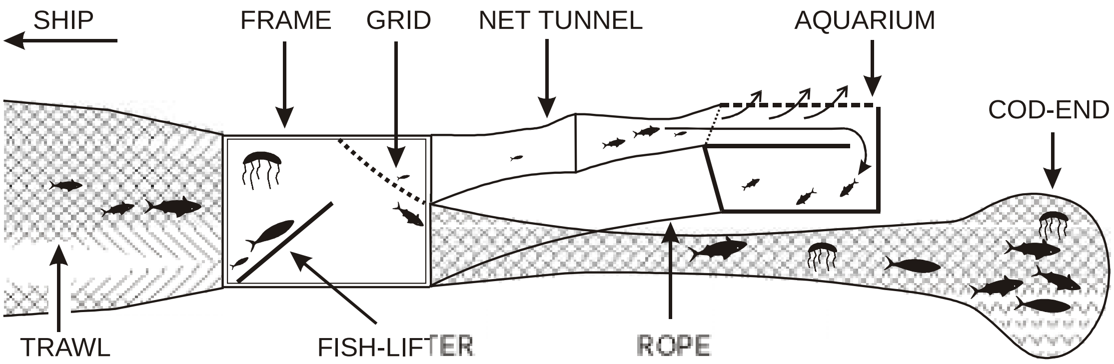


Figure 2.5.4.1. The "FISH-LIFT" Mark II (live fish trawl sampler). Device for obtaining viable fish from trawling. The captured fish are guided with a lifter towards a sorting grid prior to entering into the cod-end. The captured small fish enter through the grid and pass through a net funnel into a boat shaped metal "aquarium" where they stay protected in a non-turbulent environment during trawling (Holst and McDonald 1999)

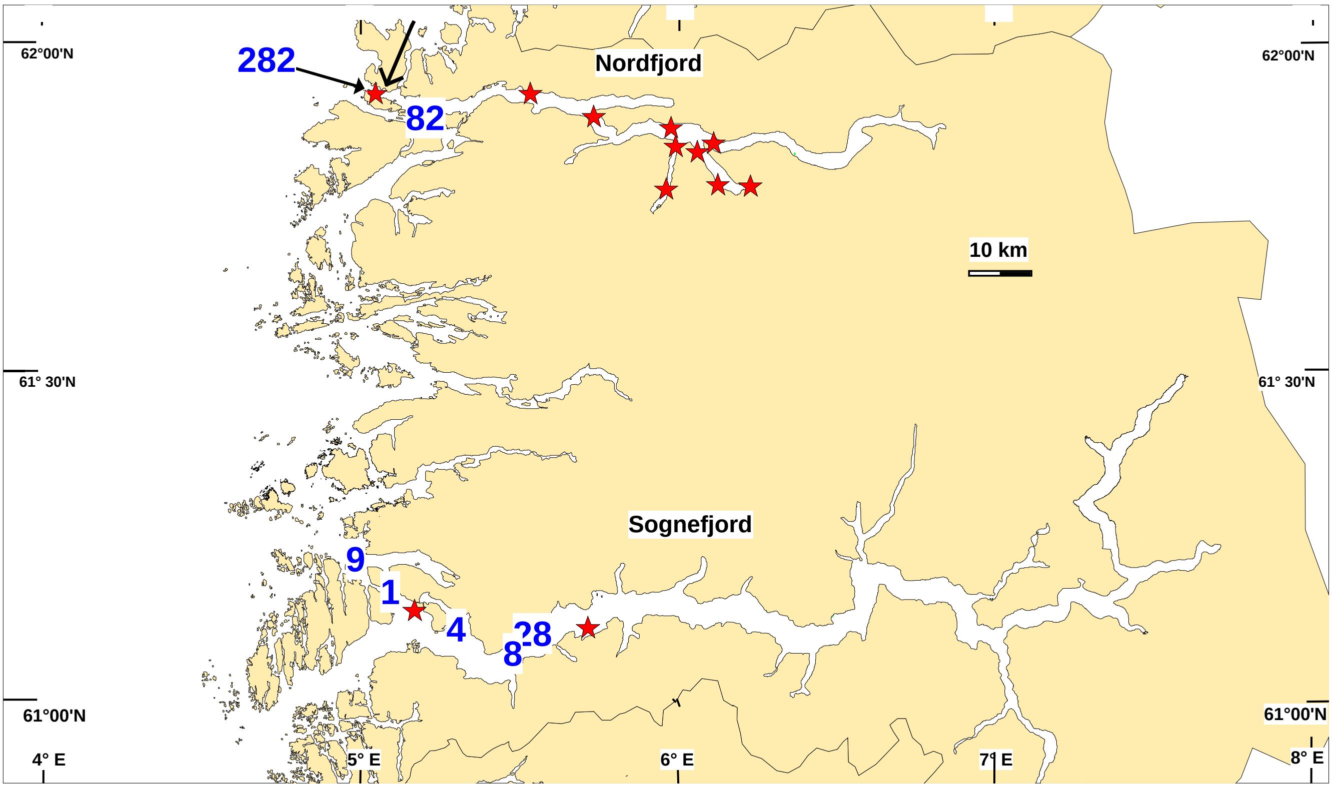


Figure 2.5.4.2 Capture sites and number of post-smolts captured in surface trawl hauls with the Fish Lift, Mark II device 24 – 30 June 1999. Stars indicate hauls without salmon capture. The site of fish used in experiment with investigation of mortality from natural sea lice infestation is indicated with an arrow in the figure.

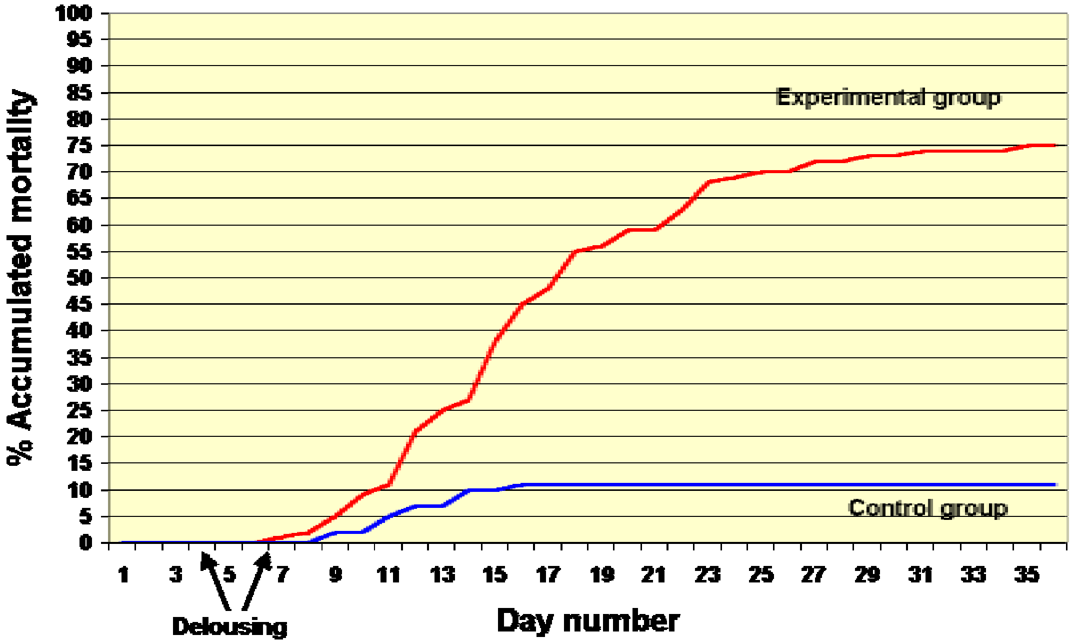
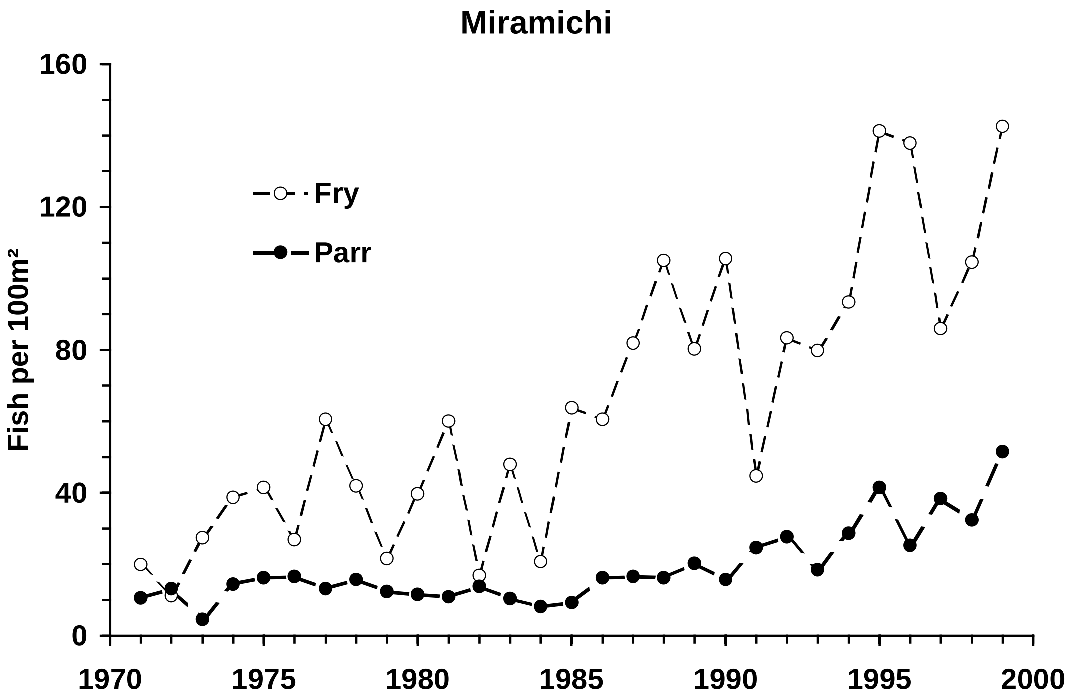


Figure 2.5.4.3 Cumulative mortality rate for experimental and control group of wild caught post-smolts with natural ectoparasites. The experimental setup consists of 5 aquariums with 20 each of deloused (control) fish (n= 100) and 5 aquariums with 20 each of experimental fish (untreated) with natural sea-lice infestation. The control fish were deloused at day 4 and 7 after start of experiment. All fish were caught at a site in the entrance of the Nordfjord (62°N; 5°E, Figure2.5.4.2) and transported to the laboratory in a tank.

Figure 2.5.5.1. Juvenile densities (fish per 100 m^2) (upper panel) and Percent Habitat Saturation Index (PHS) (lower panel) in the Miramichi River, 1971 to 1999.



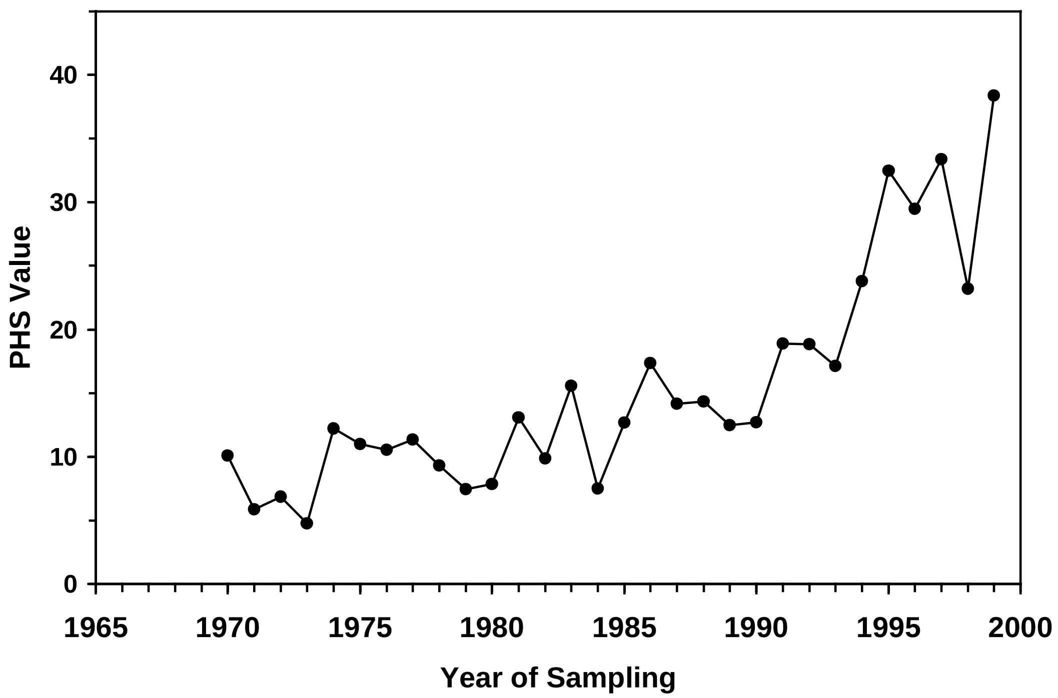


Figure 2.5.5.2. Annual variation in mean fork length (cm) at age of juvenile salmon from the Miramichi River, New Brunswick, Canada.

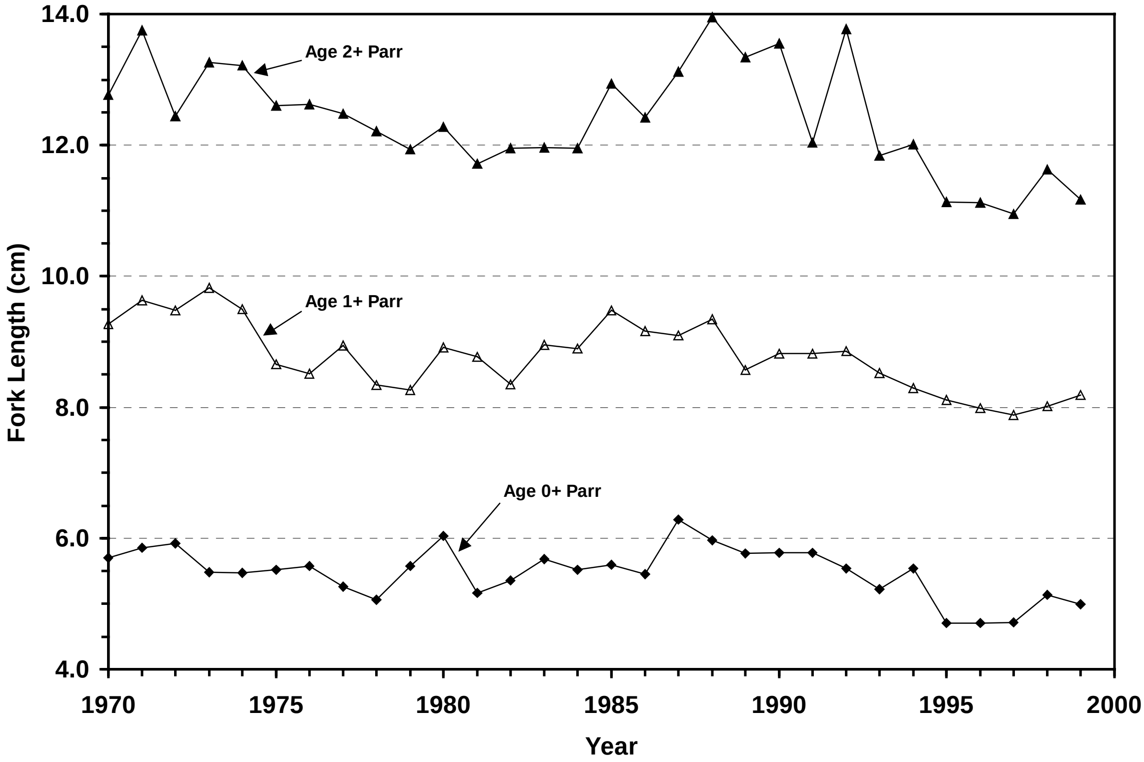
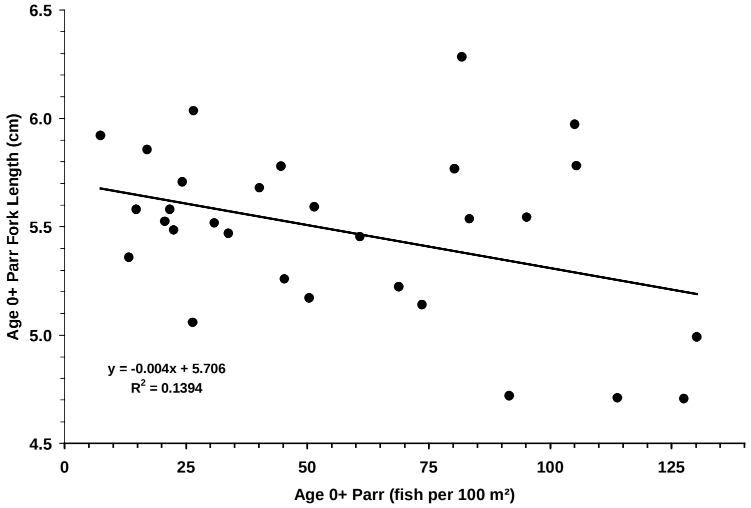
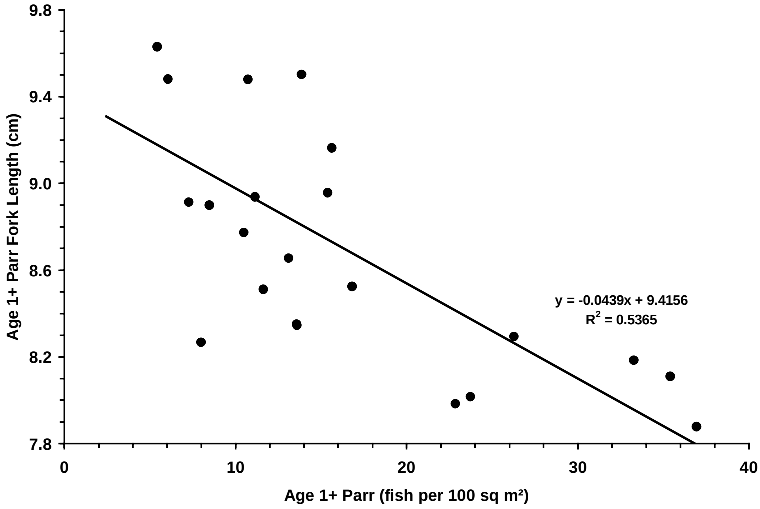


Figure 2.5.5.3. Size-at-age relative to density for age 0+ (upper), 1+ (middle) and 2+ (lower) parr in the Miramichi River, 1971 to 1999.





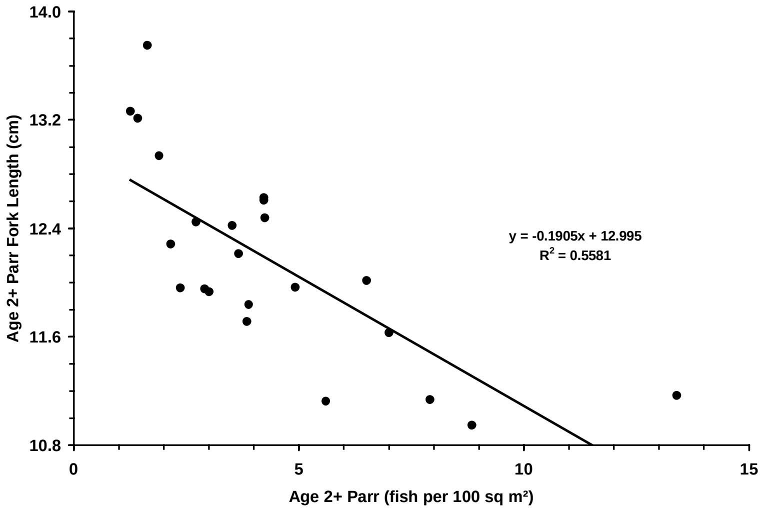


Figure 2.5.5.4. Size-at-age of 1+ parr relative to sampling date in cool water sites (upper) and warm water sites (lower) in the Miramichi River, 1971 to 1999. Open circles represent samples for the years 1995 to 1999.

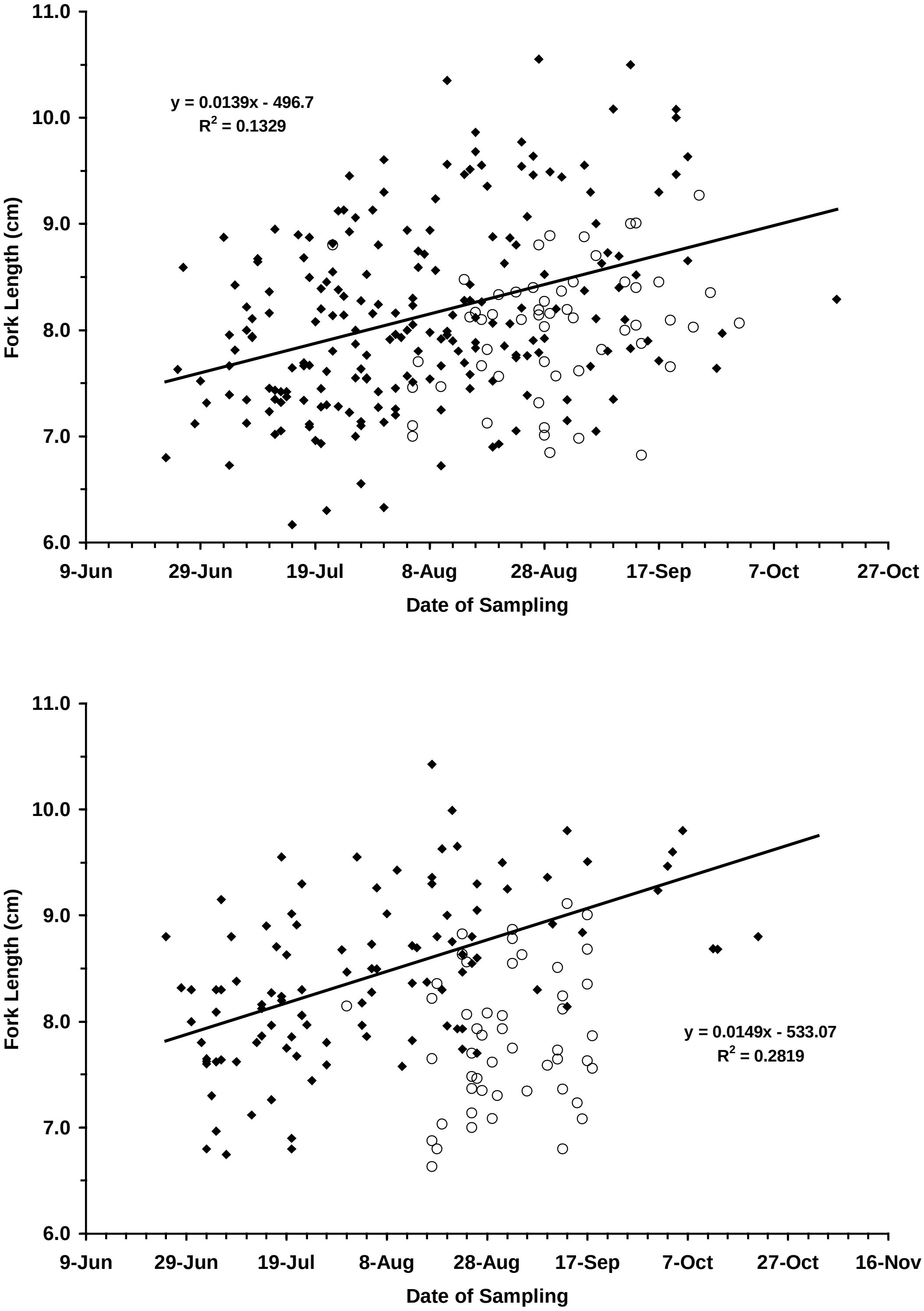


Figure 2.5.5.5. Relationship between abundance of 1SW and 2SW salmon returning at smolt age 2 (upper) and at smolt age 3 (lower) relative to mean size-at-age of 1+ parr (upper) and 2+ parr (lower).

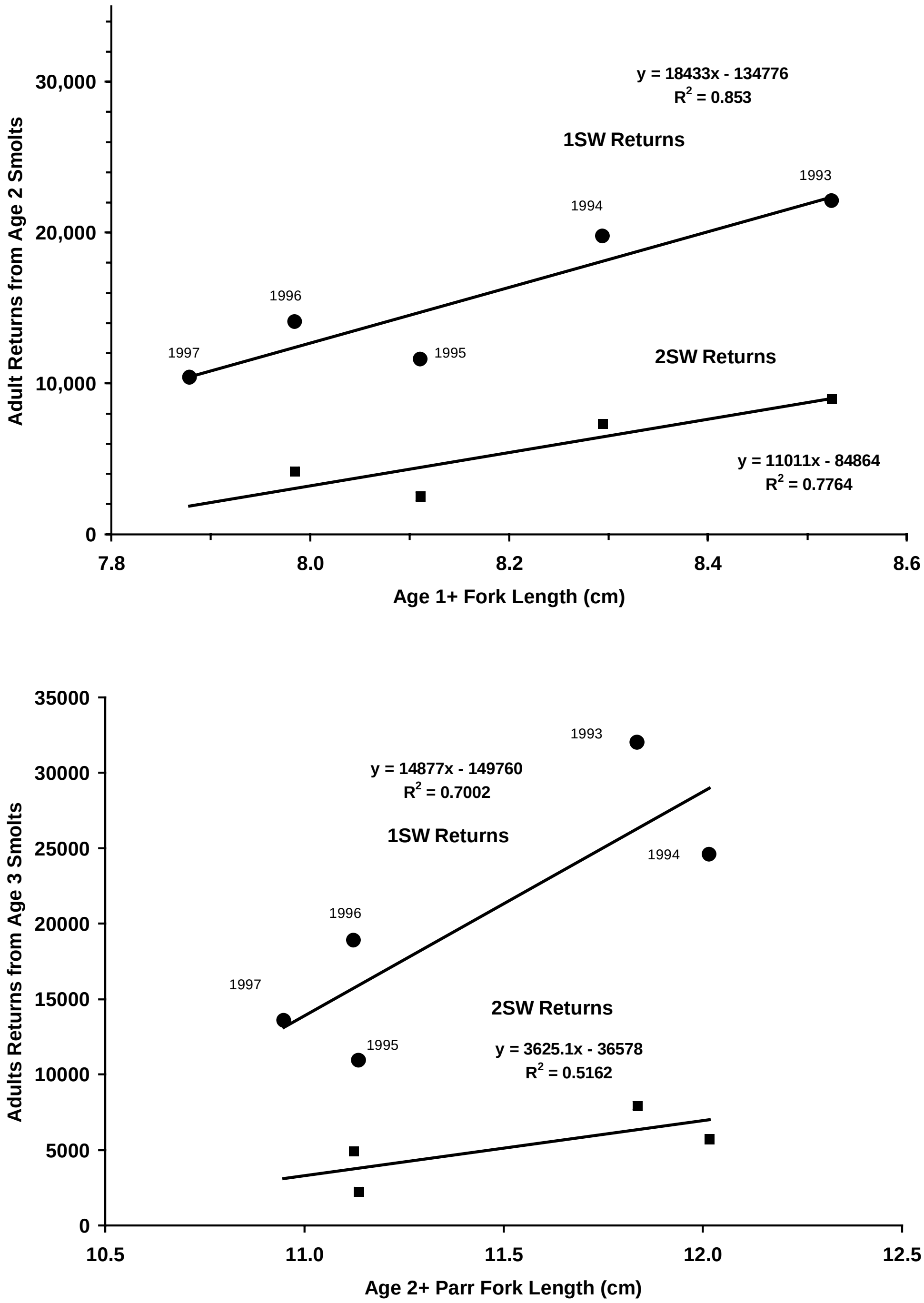
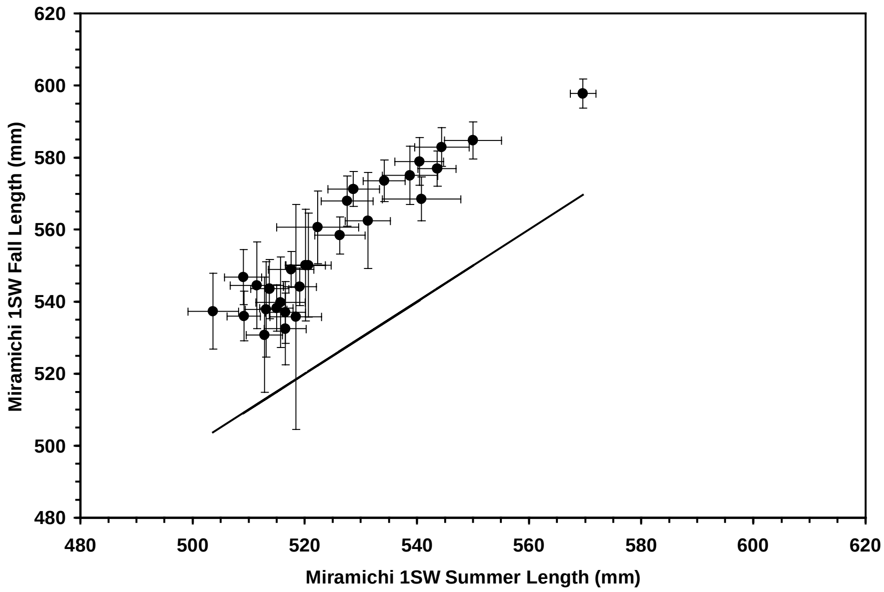


Figure 2.5.6.1. Mean fork length (mm) of salmon returning to the Miramichi River in the summer (May to July) versus fall (Sept. to Nov.) periods during 1971 to 1999 for 1SW (upper) and 2SW (lower) salmon. The dots are the corresponding mean lengths for the year of return and the error bars represents +/- 2 standard errors of the mean. The point in the upper right is the 1999 return year.



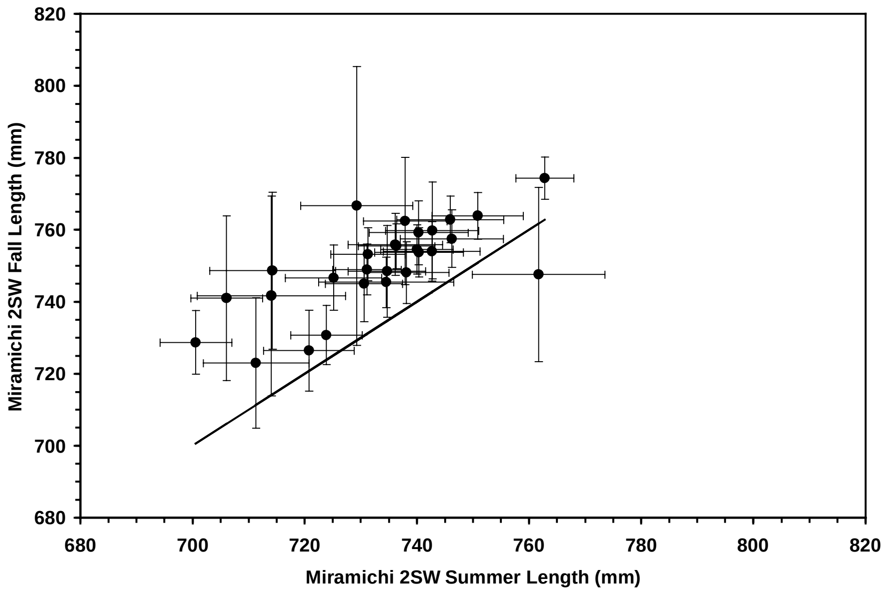
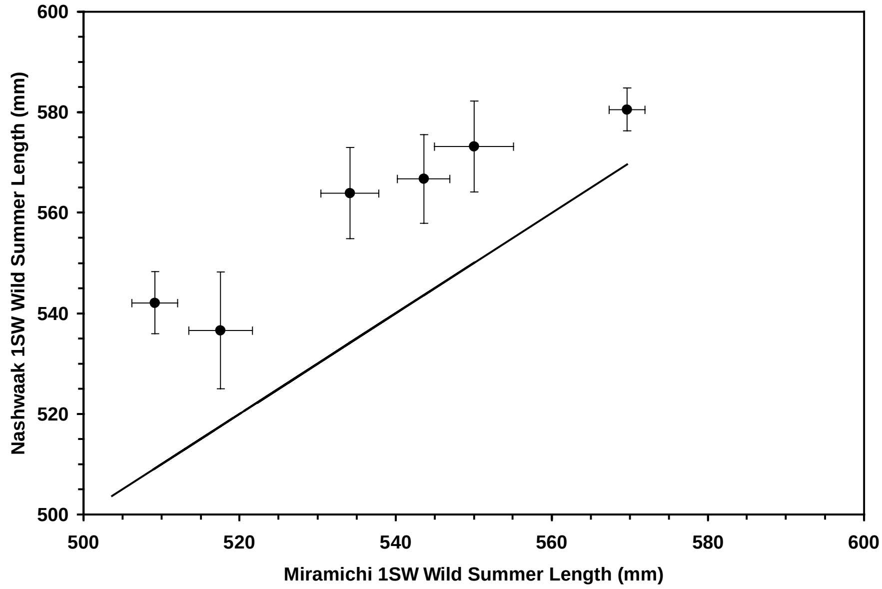


Figure 2.5.6.2. Size of 1SW wild salmon from the summer run from the Miramichi compared to those from the Saint John at Mactaquac (upper) and the Nashwaak River (lower). Solid points are the mean lengths for the same year of return.



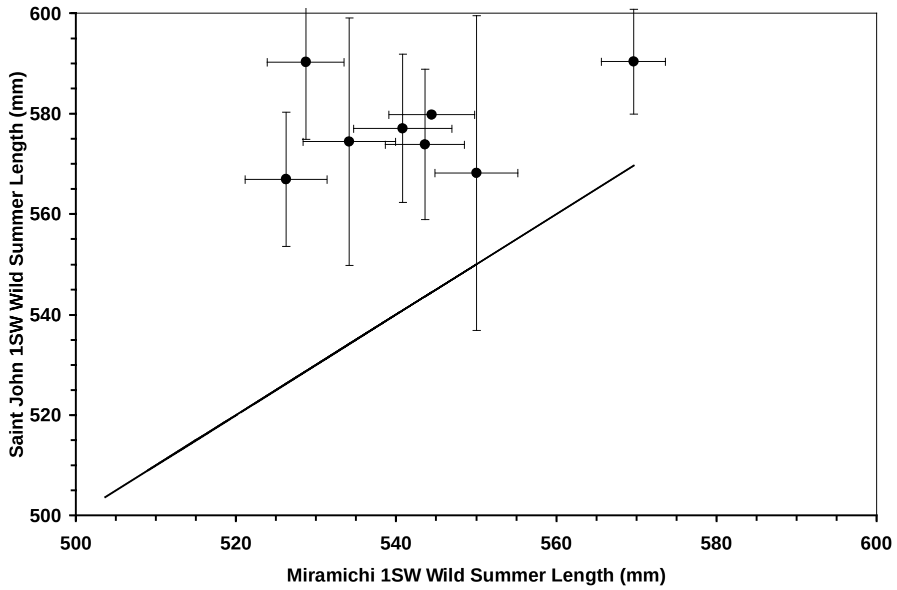
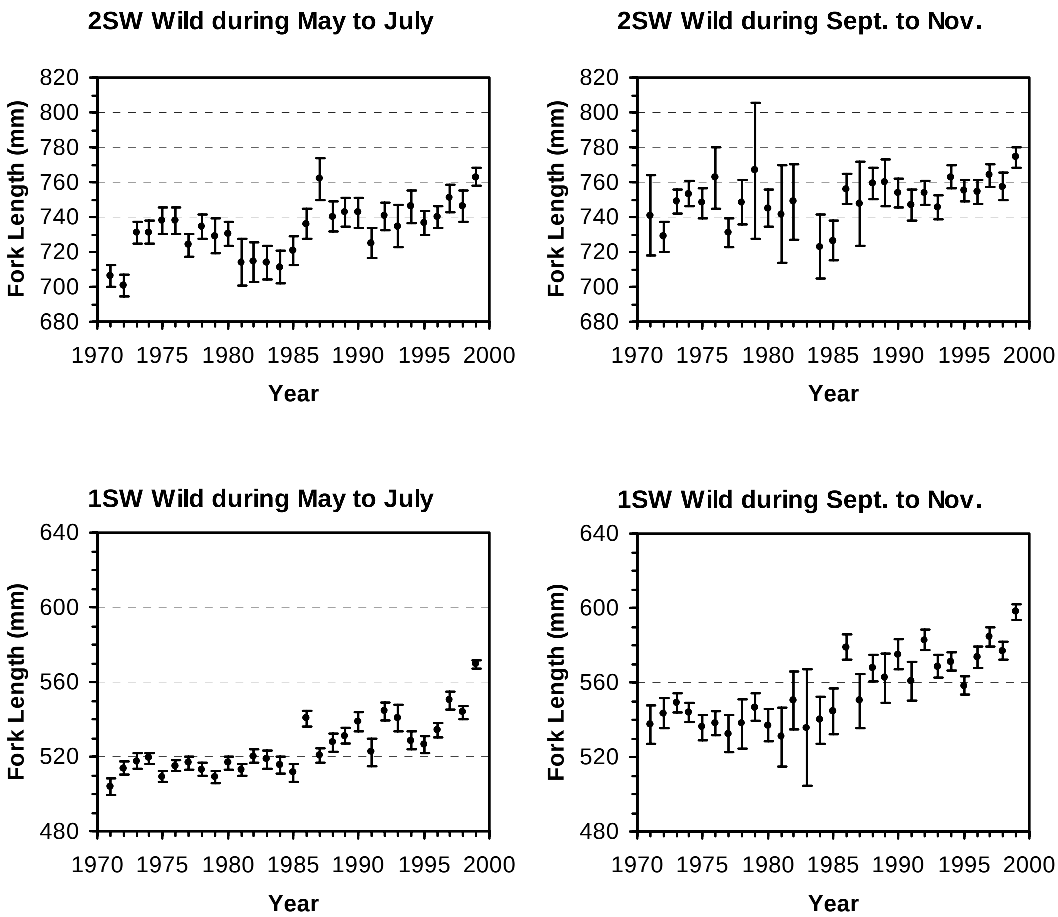


Figure 2.5.6.3. Annual variations in mean length at age (+/- 2 std. Errors) of 2SW (upper panels) and 1SW (lower panels) returning to the Miramichi River (SFA 16) Canada during the summer (May to July) and fall (Sept. to Nov.).



3 FISHERIES AND STOCKS IN THE NORTH-EAST ATLANTIC COMMISSION AREA

3.1 Fishing at Faroes in 1998/1999 and 1999/2000

In the period 1991-98 inclusive the Faroese salmon quota was bought out. However, the Faroese Government continued sampling inside the 200 mile EEZ during most years (ICES 1999/ACFM:14). No buyout was arranged for 1999 and 2000. No fishing took place in 1999 and the commercial fishery resumed in 2000.

3.2 Description of the 1999/2000 commercial fishery

3.2.1 Gear, effort and catch

The vessel M/S "Túgvusteinur" undertook 2 commercial fishing trips between late January and early April 2000. A total of 35 sets, 7.6 t (1990 salmon) had been caught including discards (Table 3.2.1.1). The average catch rate (CPUE) in 2000 was 34.3 salmon per 1000 hooks employed. It should noted that the fishery was severely hampered by bad weather with several storms during the fishing period. Furthermore, this was a novel trip for this vessel, which has not fished for salmon since 1991. The CPUE is below the range of 36 to 84 fish per 1,000 hooks for the fishery 1981 through 1995 (ICES 1996/Assess:11), but is the same as "Polarlaks" obtained in winter 1998 (ICES 1999/ACFM:14).

3.2.2 Composition of the catch

The weight distribution of salmon in the Faroese area in the winter of 2000 is shown in Table 3.2.2.1.

The sea age distribution (Table 3.2.2.2) is similar to the previous fishing seasons with the 2SW salmon dominating (78.4%) and with 1SW (11.3%) and 3+SW (10.3%) caught in lower proportions. The sea age was determined by using length-splits previously applied (ICES 1996/Assess:11) to the average lengths (last column in Table 3.2.2.1).

The proportion of discards in the catch (i.e., salmon <60 cm) was approximately 14% which is close to the maximum range of 1.8 to 15.6 (ICES 1996/Assess:11). However, the fishery only took place during the latter part of the season (January to April) at which time there is usually a lower proportion of discards compared to the earlier part of the season.

3.2.3 Origin of the catch

Three Norwegian tags were recovered from the fishery in January-March 2000 with "Túgvusteinur". No coded wire tags were found. Despite the small sample size, the recovery of Norwegian tags is consistent with previously estimated proportions of tagged fish from other countries (ICES 1996/Assess:11).

Tagging studies have shown that approximately 65% of the salmon in the Faroese fishery were estimated to originate from countries belonging to the northern European region and approximately 28% were estimated to originate from the southern European region (Hansen & Jacobsen, 2000). These figures add up to 93%, which is the proportion originating from the Northeast Atlantic, the remaining 7% were estimated to originate from Canada (right column in Table 3.2.3.1). Farmed salmon (20%) were excluded from the analysis (Hansen *et al.*, 1999).

From recoveries of external tags and microtags in the same fishery the approximate sea age distribution for the northern group was 12% 1SW and 88% MSW salmon, respectively, and for the southern group 70% 1SW and 30% 2+SW salmon, respectively (Jacobsen et al., 2000). In the Northwest Atlantic only 2SW were recovered.

Thus, the Faroese fishery exploits mainly the MSW northern stock complex (65% of 88% = 57%) and the 1SW southern stock complex (28% of 70% = 20%), followed by the MSW southern stock complex (28% of 30% = 8%) and 1SW northern stock complex (65% of 12% = 8%) in equal proportions. The remaining 7% were estimated to originate from Canada (Table 3.2.3.1).

3.3 Homewater Fisheries in the NEAC Area

3.3.1 Significant events in NEAC home-waters

A Swedish working group on the evaluation and further development of the status of the wild salmon populations on the West Coast, established in 1998, produced a final report in 1999. Amongst the recommendations was a proposal to adipose fin clip all artificially reared smolts so that selective exploitation could take place in the fishery to the advantage of wild salmon. Other proposals aimed to increase the freshwater capacity through improving access for adults and/or increasing the quality of nursery areas..

In April 1999, new national measures were introduced in the UK (England and Wales) to protect early running MSW ("spring") salmon. Most nets will be closed until 31 May each year and anglers will be required to release all salmon caught before June 16. The measures will be reviewed after 5 years.

Treatments with rotenone in River Lærdalselv and R. Steinkjerelv in Norway to eradicate the parasitic fluke *Gyrodactylus salaris*, has not been successful as the parasite has again been observed on salmon parr in the two rivers.

3.3.2 Gear

There were no reports of significant changes in fishing gear from the other NEAC countries in 1999.

3.3.3 Effort

The numbers of gear units licenced or authorised in several of the NEAC Area countries are shown in Table 3.3.3.1. This provides a partial measure of effort but does not take into account other restrictions, for example, close season. In addition, there is no indication from these data of the actual number of licences utilised or the amount of time each licencee fished.

In net fisheries, the number of gear units licenced or authorised in 1999 declined in all but one of the countries where this information was available. In UK (England and Wales), UK (Scotland), UK (Northern Ireland), Norway and France the number of gear units licenced or authorised in 1999 was lower than 1998. Longer term trends were also consistant among these countries. In all cases, the number of gear units licenced or authorised were lower than both the previous 5- and 10-year averages. The only exception to this general decline was reported in Ireland. Although the number of both draft net and drift net licences issued decreased compared to 1998, both showed small increases compared to the previous 5- and 10-year averages.

In contrast to the general decline in the number of gear units authorised in the net fisheries, the number of rod licences issued showed no consistant trends among countries. In Ireland, the number of salmon licences issued in 1999 showed an increase on 1998 and on the previous 5- and 10-year averages. In Finland, rod effort on both the rivers Teno and Näätämö in 1999 was up on 1998. All indicators of rod effort were also greater than the previous 5- and 10-year averages except for the numbers of fishermen on the River Teno, which decreased compared to the 10-year average. In France, however, rod effort in 1999 declined compared to 1998 and, although showing an increase compared to the previous 5-year average was also down on the previous 10-year mean. The total declared number of rod days fished in UK (England & Wales) has been collated since 1994. These data indicate that the rod fishing effort in 1999 declined by 21% compared to 1998 and by 27% compared to the 1994 to 1998 average.

3.3.4 Catches

NEAC area catches are presented in Table 3.3.4.1. The total catch in the NEAC area was 2054 tonnes, down 8% on the 1998 catch, and representing 93% of the total north Atlantic nominal catch in 1999. Both homewater and total reported catches in NEAC area showed declines compared to 1998 and both the previous 5- and 10-year averages. Figure 3.3.4.1 shows the percentage change in the 1999 NEAC homewater catches relative to the previous 5-year (1994-98) and 10-year (1989-98) means. All countries except Finland showed decreases in their 1999 catches compared to the previous 10-year means. Declines in nominal salmon catches ranged between a 5% reduction in Norway to a 63% reduction in Sweden (excluding ranched catches in Ireland). Similarly, all countries except Finland and Norway showed decreases in their 1999 catches compared to the previous 5-year means. Declines in nominal catches ranged between a 5% reduction in France to a 56% reduction in Sweden. These declines are believed to reflect a combination of reductions in fishing effort (Section 3.3.3) and reductions in stock (Section 3.4).

3.3.5 Catch per unit effort (CPUE)

CPUE data for NEAC area are presented in Tables 3.3.5.1, 3.3.5.2 and 3.3.5.3. The data for rod fisheries has 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. Grouping of data for the trend analysis was based on units of CPUE (rod fisheries) or on national/regional distribution (rod and net fisheries).

There were no general trends in CPUE for rod fisheries. In France and in Finland (River Teno), CPUE for rod fisheries increased in 1999 compared to 1998, whereas that of the rivers Bush (UK, N.Ireland) and Näätämö (Finland) were lower than in 1998 but at the level of the previous 5-year means. No trends in CPUE of these rod fisheries were detected for the last 10 years (Table 3.3.5.4). CPUE for rod fisheries of the Russian rivers in the White Sea basin showed an increasing trend, whereas a highly significant decreasing trend was detected for the Barents Sea basin rivers (Table 3.3.5.4).

In the UK (England and Wales), CPUE for net fisheries increased in 1999 compared to 1998, whereas that of UK (Scotland) decreased, stayed well below the previous 5-year means, and showed a significant decreasing trend for the last 10 years (Tables 3.3.5.2, 3.3.5.3 and 3.3.5.4).

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. However, both may also be affected by many measures taken to reduce fishing effort, for example, changes in regulations affecting gear. No common pattern is evident in measures of net CPUE.

3.3.6 Age composition of catches

The percentage of 1SW salmon in catches are presented in Table 3.3.6.1 and Figure 3.3.6.1 for those countries where a time series of data exist. The proportion of 1SW fish in the 1999 catches is presented as a percentage of the 1994-98 and 1989-1998 averages. Clear differences between countries in Northern and Southern Europe are apparent. The proportion of 1SW fish in the 1999 catch was lower than both long term indices in each of the southern European countries where data is available (France, UK (Scotland) and UK (England and Wales)). France and UK (Scotland) also report nominal catches partitioned according to sea-age category (Table 2.1.1.3.). These data suggest that, for France and UK (Scotland) at least, the changes in the proportion of 1SW fish in the 1999 catch was driven by a reduction in 1SW catches rather than increases in the number of MSW fish taken.

In contrast, the proportion of 1SW fish in the 1999 catches of northern European countries (Finland, Sweden, Russia and Norway) was greater than both the 1994-98 and 1989-1998 averages.

3.3.7 Farmed and ranched salmon in catches

The contribution of wild, farm-origin and ranched salmon to national catches in the NEAC Area 1991-1998, is shown in Table 3.3.7.1. In 1999, farmed salmon continued to account for a relatively large proportion (24%) of the nominal catch in Norway, but less than 2% in all other NEAC countries.

Table 3.3.7.2 gives estimates of the incidence of farmed salmon in Norwegian coastal and fjord fisheries. In 1999, farmed fish accounted for 35% of the catch of coastal fisheries, a decline compared to the previous 4 years estimates. The estimated 41% of farmed salmon in fjord fisheries in 1999 was similar to that found in the previous 3 years. In 1999, the proportion of farmed salmon in Norwegian rod catches was 6% whereas in broodstock samples the incidence was estimated to be 15% (Table 3.3.7.3). Both estimates showed a decline compared to 1998 figures.

In the River Teno (Finland and Norway), the incidence of farmed salmon during the fishing season in June-August has been low, varying between 0.04% and 0.4% over the period 1987 to 1999. However, occasional sampling after the fishing season in September-October has resulted in much higher proportions of farmed fish, reaching 30 to 50% in the years 1990 and 1991 (Table 3.3.7.4) indicating that the proportion of farmed fish in the spawning stock may be higher than shown in the in-season samples. These trends are similar to the findings presented from Norway (Table 3.3.7.3).

Catches of salmon in coastal fisheries in both UK (Northern Ireland) and Ireland are examined for escaped farmed salmon (Table 3.3.7.5). Data for both countries are presented together as they constitute a continuous part of the species' geographic range. Escaped farmed fish have been detected every year; the frequency being less than 1% in most years. The 1999 figures remain at this level.

In UK (Northern Ireland), only 0.5% of the total salmon run trapped in the River Bush comprised farmed salmon, continuing the trend for a low incidence of farmed fish being detected in freshwater (Table 3.3.7.6).

A catch sampling programme in UK (Scotland) from 1981 to the present indicates that the incidence of farmed salmon in catches of fisheries around the country continues to decrease from their highest recorded levels around 1993 (Table 3.3.7.7).

There were no significant catches of farmed salmon reported from the other NEAC countries

While the incidence of farmed salmon in catches might have been expected to increase in areas where farmed salmon production has increased, the Working Group noted that it has no evidence of such trends.

3.3.8 National origin of catches

Some new information on tag recoveries was made available to the Working Group. However, this does not change the previous conclusions of the Working Group (e.g. ICES 1994/Assess: 16, ICES 1997/Assess: 10) on the interception of salmon of other countries in homewater fisheries of their neighbouring countries. Such coastal fisheries occur especially in West coast of Ireland, parts of UK (N. Ireland), North East coast of UK (England and Wales) and Norway.

Of the Swedish salmon catch in 1999, less than 10% was estimated to have originated from the Danish experimental smolt releases in the Baltic Sea.

3.3.9 Exploitation rates in homewater fisheries

Exploitation rates for 19 wild stocks and 3 mixed (wild and hatchery) stocks are shown in Table 3.3.9.1. In comparison to 1998 exploitation rates increased for five of the 1SW stock components from the rivers reported, decreased for seven and were at the same level as the previous year for one. For the 2SW stock components reported exploitation rate increased for one river, decreased for three and were at the same level for one. In rivers were exploitation were reported for 1SW and 2SW combined, increase were detected for five stocks, decreased for seven and were at the same level as in 1998 for two stocks. Route regression analysis shows that there was a significant downward trend in exploitation for the past 10-year periods for rivers flowing to the Barents Sea and The White Sea (Table 3.3.5.4).

Route regression analysis shows a significant upward trend in exploitation for the past 10-year period for 1SW stocks in Ireland, UK (Scotland), UK (N Ireland), Norway, Iceland and Sweden. Significant upward trend in exploitation was also detected for the 2SW stock components in those rivers where data existed for the 10-year period. No significant trend was observed for the 1SW and 2SW fish for the past 5-year period. The analysis is based on few stocks and may not be representative for other rivers.

Exploitation rate trends are not uniform over all fisheries and while catch and effort has gone down generally (Section 3.3.4 and 3.3.3), exploitation has increased in some areas.

Exploitation rate can be influenced by many factors, for example, management measures in number and type of gear used, the length of the fishing or by local conditions such as weather and water discharge.

3.3.10 Summary of homewater fisheries in the NEAC area

In the NEAC area there has been a general reduction in catches that has been ongoing since the 1980s. In some areas this may reflect reduction in fishing effort because of conservation needs and size of the stocks as well as lower value of commercially caught salmon.

Clear differences in the sea age composition between countries in Northern and Southern Europe are apparent. The proportion of 1SW fish in the 1999 catch was lower than both long term indices in each of the southern European countries and, where data was available, it appeared that the changes in the proportion of 1SW fish in the 1999 catch was driven by a reduction in 1SW catches rather than increases in the number of MSW fish taken. In contrast, the proportion of 1SW fish in the 1999 catches of northern European countries (Finland, Sweden, Russia and Norway) was greater than both the 1994-98 and 1989-1998 averages.

There was a general decline in number of gear units licensed but in homewater fisheries, there are no consistent trends among effort indices in the rod-fishery.

CPUE data analysis for the net and rod fisheries shows differences between countries and areas. For the net fishery in UK (Scotland) there was a downward trend while no trend was detected for UK (England and Wales). In the rod fishery significant increase in CPUE was observed for rivers in the White Sea but a decreasing trend for the Barents Sea Rivers in Russia.

CPUE can be affected by different factors like weather and water discharges and the type of gear used. Reduction in the number of fisheries operated can also benefit those fisheries still in operation and therefore no immediate change in exploitation can be expected. Exploitation rate can also be affected by management measures in number of gear used and length of the fishing season. The Working Group noted that while gear and effort has gone down, as well as catches, exploitation rate increased in some areas. The lack of consistency in CPUE trends may be partly attributable to the imprecise nature of the effort indices.

In general, the incidence of farmed salmon in homewater countries remained low and at levels than those in 1998 despite the continuing increase in the aquaculture industry. However, in Norway farmed salmon still comprise approximately 25% of the nominal catches. Furthermore, farmed salmon are recorded at higher levels in spawning stocks than in fishery catches.

3.4 Status of Stocks in the NEAC Area

3.4.1 Attainment of conservation limits

In 1999, in order to provide a composite view for the NEAC area over the previous 10 years (1989-98), escapement levels had been examined for rivers where egg deposition can annually be equated to a conservation limit (CL). Data was available for 18 rivers in the NEAC area. Egg depositions were assessed on the basis of pooled 1SW and MSW spawners but future efforts should attempt to account for stock composition. Sixteen rivers, five from Russia, five from UK (England and Wales), three from France and one each from Ireland, UK (Northern Ireland), and UK (Scotland) had sufficient data to be included in the 10-year analysis (Table 3.4.1.1). (The River Dee UK [England & Wales] was included even though there were only seven years of data). For each river, escapement was divided by its' CL so that escapement status could be readily compared across rivers independent of various river CLs.

By ranking the rivers according to the mean rate of CL attainment, four categories were distinguished :

- Type A : five rivers in which egg deposition was mostly below CL (means of the river CL attainment rates of 0.44 to 0.78) ;
- Type B : five rivers in which egg deposition fluctuated around CL (means of the CL attainment rates of: 0.94 to 1.17) ;
- Type C : four rivers in which egg deposition was mostly in excess their CL (means of the CL attainment rates of 1.44 to 1.89) ;
- Type D : two rivers in which deposition was well above CL (means of the CL attainment rates of 2.48 and 2.88). These rivers never fell below CL during the last 10 years.

On the basis of change in CL values over the previous 10 years, the 16 rivers examined could be classified into two groups :

- nine rivers showing a decreasing trend ($p < 0.01$, route regression) ;
- seven rivers with no clear trend around their mean ($p = 0.12$, route regression).

No rivers had an increasing trend.

In combination the two categories indicated that:

- rivers having the lowest and the highest egg depositions are stable (4/7) or decreasing (3/7);
- rivers with escapement levels intermediate to the two extremes (fluctuating around the CL or mostly above CL) are mainly decreasing (6/9).

The result for 1999 is given in Table 3.4.1.1, including the two rivers with a short time series (Coquet, England ; Scorff, France). Eight of the eighteen rivers have an egg deposition above their CL in 1999, which is less than the previous year (11 out of 16 exceeding their CL).

However, the mean value of the CLs attainment percentages is slightly increasing, from 1.25 to 1.41. The analysis shows that the improvements in egg deposition are on average limited to the last two categories above, that is those rivers having the best CL attainment. In contrast, the rivers with egg deposition near or under the CL show on average a slight decrease (Figures 3.4.1.1 & 3.4.1.2).

In summary , the 1999 data are generally consistent with the previous analysis and the ranking of rivers based on the 10 previous years data. The recovery of 1998 (11 rivers out of 18 exceeding the CL), after the 1994-1997 period with poor egg depositions (4 to 6 rivers out of 16 exceeding the CL) is not confirmed by the 1999 data. The general pattern seems to show an increase in the difference in egg deposition target attainment between rivers having a good status and rivers with low egg deposition. This is consistent with the previous observation that rivers with low escapement values show no sign of recovery.

3.4.2 Measures of juvenile abundance

Smolt counts or estimates of juvenile abundance are available for 17 rivers (Table 3.4.2.1). About half of the smolt counts in 1999 were higher than those of the previous year and the 5-year mean. In the rivers Oir and Bresle (France), the Vesturdalsa (Iceland) and in the Halselva (Norway), the present values were less than a half of those in the previous year. Route regression analysis revealed a significant decreasing trend ($p>0.9$) during the last 10 years for the smolt counts of southern (France, UK, Ireland) and northern rivers (Sweden, Norway), and also for the combined group supplemented by two Icelandic rivers. In contrast, no trends were detected for the past 5-year period for the same groups of rivers (Table 3.4.2.2).

In Finland, estimates of juvenile salmon (parr & fry) abundance in the River Teno system were higher than those in 1998 and the 5-year means. The fry abundance estimate of the River Bush (UK N.Ireland) was substantially higher than in 1998 and the 5-year mean, being the highest for the last 10 years.

3.4.3 Measures of adult returns back to the rivers

The Working Group previously undertook an analysis using adult counts provided in Table 3.4.3.1 in order to depict common trends over time in the adult returns into the rivers of the NEAC area. These data, pooling MSW and 1SW, are intermediate between recruitment back to the coast and spawning escapement, because in most cases the counting facilities are located below riverine fisheries. In order to provide the widest possible geographical view, the 1999 analysis used only the data of the ten previous years (1989-98). Each series was divided by its mean and a cluster analysis (Ascending Hierarchical Classification based on an inertia criteria with a chi-square distance) was used to help define groups of rivers showing common features in their trend over time.

Two broad categories could be distinguished at first :

Type 1: nineteen rivers (58%) which had decreasing salmon returns over time ;

Type 2: thirteen rivers (39%) showing no trend ;

The Type 1 (decreasing rivers) could be split into four subgroups:

1A: 5 rivers which showed a strong decrease at the beginning of the period analysed (1989-91) with no recovery thereafter ;

1B: 5 rivers which showed a drop from 1992 to 1994 ;

1C: 4 rivers which were affected by an abrupt change between 1994 and 1995;

1D: 5 rivers which reflected a continuous trend over the study period.

Within the Type 2 (rivers showing no trend over time), two subgroups could be identified :

2A: 9 rivers which reflected inconsistent variations between rivers ;

2B: 4 rivers characterised by a notable improvement in 1998 over 1997.

There was a differnce between Northern and Southern countries. In the Northern region (Scandinavian countries and Russia), most rivers showed a decline (10/14, 71%) whereas in the Southern region (UK, Ireland and France) the split between rivers decreasing or with no trend was about balanced (9 declining against 10 stable or showing some improvement).

The update of raw data tables for 1999 has resulted in some significant changes involving corrections of several series and leading to the possible misclassification of at least four rivers. These rivers have been reallocated to groups by minimising the squared distance to the mean of each group (Figure 3.4.3.1). Furthermore, the former sub-group 2b (rivers showing no trend with a notable improvement in 1998 over 1997) has been replaced by a new subgroup 2b gathering together the rivers showing large fluctuations over time with a marked peak during the ten years of observation (Figure 3.4.3.2). This somewhat heterogeneous subgroup showed almost no trend over the first nine years of observation but all rivers converge to a level well below average in 1999 (approximately 50% of the ten years mean). Variance around the average within this subgroup tends also to be higher in the second half of the last decade, with lowest annual levels tending to be below those observed in the first half.

The results of 1999 remain consistent with the previous analysis: 18 rivers with a decreasing trend, 14 rivers with a stable or fluctuating status and no rivers with an increasing trend.

The overall 1998-1999 change is balanced, with the adult returns decreasing in 13 rivers, increasing in 14 and stable on one river. This change does not reveal any geographical pattern as the two above regions show a similar trend;

- Northern region : adult returns decreasing in 6 rivers and increasing in 7 rivers,
- Southern region : adult returns decreasing in 7 rivers and increasing in 7 rivers.

However, the two main groups of rivers react differently to this 1998-1999 change:

- The first group (decreasing trend) shows an improvement with 10 rivers out of 15 (67%) having a higher adult run than the previous year,
- The second group (stable trend or fluctuating) shows a decline in adult returns, with 9 rivers out of 13 (69%) having a lower adult run than in 1998.

The pooling of MSW and 1SW fish in the data sets available remains a major limitation to the interpretation of the analyses. As sea-age represents alternative life history strategies which potentially maximise stock survival and allows the stocks to cope with changes of the environment, there is little reason for sea-age components to have the same pattern of return over time. More insight into the trends in adult returns over time could be provided if the data were available for MSW and 1SW salmon separately. This is of special importance for 1998/1999 changes because MSW and 1SW tend to show very contrasting trends (see Sec. 3.6.3).

Nevertheless, the data set gives a rather pessimistic overall picture, with most of the rivers showing a decreasing trend, no river with a increasing trend, and a decline in 1999 adult returns over the previous year for most of the rivers with a stable trend.

3.4.4 Survival indices

Estimates of marine survival for wild smolts from 10 stocks returning to homewaters (i.e. before homwater exploitation) and for 11 stocks returning to freshwater in 1999 are presented in Tables 3.4.4.1 and 3.4.4.2, respectively. Returns to homewater are likely to present a clearer picture of marine survival than returns to freshwater because of variation in exploitation in coastal fishery. In Table 3.4.4.2 indices of survival are also provided for autumn age-0^+ parr for the Nivelle River (France). This provides an approximation of marine survival as more than 80% of juveniles migrate after only on year in freshwater. In most areas marine survival was under the 5 and the 10-year mean for 1SW and 2SW fish. Route regression analysis showed significant downward trend in marine survival for 1SW fish for both the past 5 and 10-year periods (Table 3.4.2.2). In addition, marine survival in southern Europe showed a decrease in 1SW stocks in 1999.

Marine survival for six hatchery stocks are given in Table 3.4.4.3 and Table 3.4.4.4. For the past 10-year period, route regression analysis showed a downward trend for survival to homewaters for 1SW and 2SW fish and for the past 5-year period for 2SW fish (Table 3.4.2.2). However, return rates of hatchery released fish may not always be a reliable indicator survival of wild fish due to difference in release on conditions.

3.4.5 Status of early-running(or spring) salmon

Early running MSW salmon occur in the rivers of the central and southern European coasts. Recent declines in the catch of these fish have been observed over most of their range. In UK (Scotland), an assessment approach that relies, initially, on rod catch data is being developed to assess subcatchment groups of salmon (Working doc: 18). To date, the approach has been restricted to early running MSW salmon. Spatial and temporal variations in monthly rod catches of 2SW salmon from February through to June were examined using the all Scotland rod catch (Figure 3.4.5.1). Catch levels are currently lower than the long-term average and the most likely explanation is that natural mortality at sea has increased. Declines have been observed in all months but that the rate of decline in the most recent part of the time series increases through the months February to June. Radiotracking studies (Laughton and Smith, 1992) have demonstrated an association between time of river entry and spawning distribution and this suggests that the observed pattern of catch decline indicates that populations in different subcatchments show differential rates of mortality.

Subcatchment trends in early-running salmon can be examined further with reference to Girnock and Baddoch Burns, which are tributaries in the upper portion of the river Dee catchment. Adult and juvenile traps operate on both burns and both tributaries support predominately MSW salmon. Adult recaptures of tagged smolts indicate that these fish, in the main, return to the river Dee in April. In recent years, the number of spawning females in both burns has been lower than the minimum of 40 that is considered necessary to seed the burns fully. Indeed, in 1999, only 22 females returned to each of these burns. An index of marine survival has been derived (Figure 3.4.5.2) and the latest estimates for both burns suggest that these subcatchment populations have entered a new phase of sustained low marine survival.

3.4.6 Summary of the status of stocks in the NEAC area

Analysis of attainment of conservation limits (CLs) indicated that the recovery of salmon stocks observed in 1998, from a period of low attainment (1994-1997), did not continue in 1999. The proportion of rivers with an egg deposition above their CL was smaller in 1999 than in 1998. The general pattern indicates that the difference in CL attainment values between those rivers previously showing a high level of attainment compared to those showing lower rates of attainment has increased in 1999.

Measures of smolt production indicated that while about half of the rivers showed higher smolt output in 1999, other rivers showed large decreases in comparison to 1998. Route regression analysis revealed a significant downward trend over the last 10 years both for southern and northern rivers, but no trend was detected for the last 5 years. In contrast, juvenile abundance data on parr and/or fry stages showed an increase in 1999 compared the previous year and the 5-year means which was consistent over the countries where data were available.

Measures of adult returns back to the rivers showed that of the rivers examined in 1999, approximately half showed increased counts and half decreased counts. A classification analysis, based on the last 10 years count information, identified two groups of rivers; one showing declining counts over the period and the other revealing no trend. The majority of the Northern rivers were classified in the declining group whereas the Southern rivers were split equally between the two groups.

For most rivers where information is available, marine survival indices were below both the previous 5 and 10 year means for 1SW and 2SW fish. A route regression analysis revealed a significant decline in marine survival to homewaters over both the last 5 and 10 years for 1SW throughout the NEAC area. A similar analysis showed a downward trend in marine survival for 1SW and 2SW hatchery fish over the last 10 years and a decline over the past 5 year period for 2SW hatchery fish.

3.5 Evaluation of the effects on stocks and homewater fisheries of significant management measures introduced since 1991.

3.5.1 Evaluation of the Effects of the Suspension of Commercial Fishing Activity at Faroes

Between 1991 and 1998 the Faroese fishermen agreed to suspend commercial fishing for the salmon quota set by NASCO, in exchange for compensation payments. The number of fish spared as a result of this suspension is the catch that would have been taken if the fishery had operated, minus the catch in the research fishery. As for last year (ICES 1999/ ACFM:14), analysis was based on the assumption that full quota would have been taken, had commercial fishing taken place. Thus, the maximum catch that would have been taken in 1998/99 would have been 330 t (Table 3.2.1.1).

Data on the discard rates that might have applied if a fishery had operated in 1998/99, together with the age composition of the catch were taken from the previous year’s research fishery. No new values were available for the proportion of farm escapees in catches, or to expected time to return to homewaters, so the same values used for the previous four years were applied. The assessment is shown in Table 3.5.1. This suggests that if the full quota had been bought out, between 3,000 and 21,000 additional 1SW salmon and between 70,000 and 138,000 additional MSW salmon would have returned to homewaters each year from 1992 to 1999. For the 1998/99 season, the numbers of fish believed saved were 17,000 1SW and 99,000 MSW, respectively. In addition, between 27,000-55,000 escaped farmed fish each season would have avoided capture in the Faroese fishery. However, data from tagging experiments suggest they return to

Norway (Hansen and Jacobsen 1997), provided they behaved in a similar manner to wild fish. The analysis carried out suggests that, for the 1998/99 season, an estimated 27,000 escaped-farmed fish may have been saved.

Estimates (means of 1000 simulations) of the total numbers of 1SW and MSW salmon returning to homewaters (i.e., Pre Fishery Abundance estimates) in the NEAC area and to countries of northern and southern Europe are provided in Tables 3.6.2.1 and 3.6.2.2. The calculated additional returns represent between 6% and 14% of MSW fish and up to 1% of 1SW fish returning to homewaters between 1992 and 1999 (Table 3.5.1). However, data from adult tagging studies (), indicate that the majority (about 65%) of MSW salmon caught in the Faroes fishery would return to Scandinavian countries, Finland and Russia. If this were the case, they might have represented from 8% to 19% of MSW returns and up to 2% of 1SW returns to northern European homewaters in these years (Table 3.5.1). If stocks and fisheries had remained stable, total catches would have been expected to increase by approximately the same proportions in respective areas.

Catches in homewater fisheries in four areas of Europe (Table 3.5.2) were examined for any significant change following the suspension of fishing at Faroes in 1991. There have been significant reductions in catches for 1SW salmon in Northern Europe (Finland, Sweden and Norway) (Rcrit, p =0.008) and southern Europe (Ireland, UK (England & Wales), UK (Scotland) and France) (Rcrit, p =0.003). No detectable change was noted for MSW catches in northern Europe (Finland, Sweden and Norway) or for adult counts to Russian rivers in the same period. (It should be noted that catches of MSW salmon in Europe in 1994 and 1995 should also have been affected by the suspension of salmon fishing in Greenland). MSW catches were significantly lower in the period following the cessation of commercial fishing at Faroes from 1992 to 1999, compared to the period 1987 to 1991 for southern Europe (UK (Scotland) and France) (Rcrit, p =0.012). Although the additional returns would have been expected to have contributed to catches and spawning stocks, it appears that any expected increase has been masked by other factors such as changes in marine survival or management measures in homewaters, such as those outlined in Section 3.5.2, below.

3.5.2 Evaluation of the effects of management measures introduced in homewaters since 1991.

The Working Group noted significant reductions in net licences issued in most countries in the NEAC area (Table 3.5.3). Additional measures have been taken is some countries. For example, in Ireland new regulations were brought into force in 1997 to reduce the effort in the fishery. These included a reduction in the fishing week from 5 to 4 days, restrictions in season length and a ban on night-time fishing. Although an increase in drift net licences was evident, the result of all these measures together has been to effectively reduce the number of days available for fishing during the season by 38% since 1991 compared to the period prior to 1997. In UK (England & Wales) the total number of licences issued has been reduced by 38%, but the introduction of additional controls (eg. Increased close periods) has reduced the total allowable fishing effort by 48%. Although licence numbers may not reflect effort exactly (as effort varies in response to many additional factors, such as fishing conditions and perceptions about stock abundance), it is likely that the overall reductions in gear units observed represent a significant cumulative reduction in fishing pressure in homewaters on NEAC stocks.

The Working Group felt that these changes would be excepted to lead to detectable reductions in homewater catches, and in this context noted the results of the analysis carried out in Section 3.5.1 (Table 3.5.2) which indicated significant reductions in catches for 1SW salmon in both Northern and Southern Europe, during the period 1992-1999 (compared to a baseline 1987-1991). Although no detectable change was noted for MSW catches in Northern Europe over the same time period, MSW catches were significantly lower for Southern Europe. However, as indicated in that section, it is not possible to attribute the decline in catches specifically to management measures taken in homewaters or distant water fisheries, or to declines in stock abundance. Given continuing poor marine survival affecting many stocks and the variation across countries in management measures taken, the precise impact of these measures on spawning stocks will be difficult to judge, especially in the short term.

3.6 Expected abundance of Salmon in the North East Atlantic

3.6.1 Development of a 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. A Monte Carlo simulation (1000 runs) (using 'Crystal Ball' in Excel; Decisioneering, 1996) is used to estimate confidence limits on the

PFA values. The changes in the population estimates derived from this model compared with 1999 (ICES CM 1999/ACFM:14) mainly reflect the significant changes to the input parameters provided by some countries as described above.

Potter et al (1998) provides full details of the model and a sensitivity analysis. The model is particularly sensitive to errors in the exploitation rate estimates when these rates are thought to be low. This may therefore be an increasing matter of concern because levels of exploitation have been reduced to quite low levels in many fisheries in the North East Atlantic in recent years. There is therefore a need for detailed validation of the model outputs, using independent data sets. As yet there has been limited opportunity to undertake this at the Working Group meetings. The Working Group therefore reiterated that the model should only be used to provide an overall indication of trends in stocks and that great care needs to be taken in interpreting particular annual or national figures. Any interpretation must take account of information derived from monitored stocks.

No changes were made to the model used in 1999. National representatives reviewed the data inputs for each country and made the following amendments:

1. catch data and other parameter values were added for 1999;

2. parameter values for earlier years were modified where new data or new estimation procedures were available; the following significant changes were incorporated:

   - Ireland - it was considered more appropriate to include separate estimates of non-reporting rates rather than including these in the exploitation rate estimates;
   - Finland, France and Russia - exploitation rates for the full time series were reviewed and corrected to reflect changes in the management of fisheries.

The input data for the model for ten salmon producing countries in the NEAC area and for the Faroes and West Greenland fisheries (as updated for the 2000 assessment) are shown in Appendix 8a-8l. The maximum and minimum values denote the limits of the uniform distributions used in the Monte Carlo Simulations.

Full results for each NEAC country are shown in Appendix 9a-9l. Tables 3.6.1.1 to 3.6.1.6 summarise the outputs from the simulation, giving the mean estimates of the numbers (plus variances/standard deviations) of:

- returns (1SW and MSW),
- recruits (maturing and non-maturing 1SW and total 1SW),
- spawners (1SW and MSW) and

The tables suggest that Ireland, Norway and UK(Scotland) account for over three-quarters of the production of maturing 1SW recruits in the North East Atlantic. Norway, Russia and UK(Scotland) account for a similar proportion of the non-maturing 1SW recruits (i.e. potential MSW salmon).

3.6.2 Grouping of national stocks

NASCO has asked ICES to consider the most appropriate stock groupings for the provision of catch options or alternative management advice. The Working Group noted that stock groupings may be proposed for two purposes: first, to provide advice on the status of all the stocks in the NEAC area in a way that can conveniently be used by NASCO managers; and second to provide catch advice for the stocks contributing to specific fisheries. These approaches may require different stock groupings. For example, for the first type of grouping, all stocks will be included in one of the groups and no stocks will be included in more than one group. The second type of grouping need not include all stocks (if they do not contribute significantly to any fishery) and might include some stocks in more than one group (if they contribute significantly to more than one fishery).

Ultimately, the second type of grouping may be required for providing quantitative catch advice for the West Greenland and Faroes fisheries, but the Working Group does not consider that the current assessments are sufficiently robust to provide more than qualitative advice. Thus in 1999, the first type of grouping was employed; all the national PFA estimates for the NEAC Area were divided into two groups, Southern Europe (comprising UK, Ireland and France) and Northern Europe (comprising the Nordic countries and Russia). No new information was presented to the Working Group to suggest that any alternative grouping of the total national stocks would be more appropriate.

The Working Group has previously considered evidence that alternative groupings might be appropriate if some national stocks could be split. In 1999, the Group noted similarities between the marine survival trends for the River Figgio (Norway) and North Esk (Scotland) which are quite close to each other, but on either side of, the current divide between the Northern and Southern areas. However, the Working Group noted that there were always likely to be similarities between stocks adjacent to any chosen dividing line. The Working Group had also observed that catches of 1SW salmon from the south and mid areas of Norway were correlated with each other but not with catches in the north. This had been proposed as a reason for establishing alternative stock groupings, possibly separating out a third area comprising southern and mid Norway and Eastern Scotland. The Working Group felt that this deserved closer attention but considered that further refinement of the PFA modelling would be required before such changes to the analysis could be regarded as appropriate.

The Working Group has therefore continued to use the following groups of countries to present the PFA data:

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

Tables 3.6.1.1 to 3.6.1.6 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 3.6.2.1 to 3.6.2.3.

At present, the Southern group includes the main European countries that have contributed fish to the West Greenland fishery; evidence from tagging studies suggests that the Nordic countries contribute relatively few fish to this fishery. It is therefore appropriate that the European input to the advice on the West Greenland fishery should be based principally on the status of non-maturing 1SW from the Southern area.

Provision of catch advice for the Faroes fishery is more complex. Recent tagging studies at Faroes (1991/92 – 1994/95), suggest that the main countries contributing to the MSW salmon to the fishery is Norway, with significant contributions also from Scotland and Russia (Table 3.2.3.1). The 1SW salmon caught in the fishery come mainly from the Southern European countries. This therefore means that the catch advice for both Northern and Southern European stocks must be taken into account when considering management actions for the Faroes fishery.

3.6.3 Trends in the PFA for NEAC stocks

The 95% confidence limits (dotted lines for PFA and vertical bars for the spawning escapement) shown in Figures 3.6.2.1 to 3.6.2.3 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 must largely reflect errors in our best estimates of these parameters. Nevertheless 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 treated with caution.

Figure 3.6.2.1 shows no strong trend in the recruitment of maturing 1SW salmon (potential grilse) in the Northern Europe, although the numbers have fluctuated quite widely and fell to their lowest levels during the mid 1990s. The increase in the spawning escapement in the latter part of the time series is likely to reflect mainly the decrease in exploitation of these stocks in homewater fisheries, particularly in Norway and Russia.

Numbers of non-maturing 1SW recruits (potential MSW returns) for Northern Europe are estimated to have fluctuated around 900,000 between 1970 and 1985, but subsequently fell to about 500,000 in the late 1990s. The numbers of MSW spawners, however, show no significant trend over the time series. It therefore appears that the decline in recruitment has been balanced by the reductions in exploitation both in homewater fisheries and at Faroes.

This trends in recruitment for the Northern European stocks are broadly consistent with the limited data available on the marine survival of monitored stocks in Norway and Iceland.

In the Southern European stock complex (Figure 3.6.2.2), the numbers of maturing 1SW recruits are estimated to have fallen substantially since the 1970s. Recruitment was at its lowest during the 1990s, although there is no evidence of a trend in this period. However, there has been a sharp drop in the estimated recruitment in 1999, resulting from a similar proportional reduction in all the Southern European countries. 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 on the four monitored rivers in the Southern European area for which data were available (Corrib and Burrishoole (Ireland), Bush (UK(Northern Ireland)), Nivelle (France)) (See section 3.4.4). This suggests that the marked reduction in 1SW returns in 1999 is likely to have been due in large part to a widespread decline in marine survival. However, it was noted that reductions have also been observed in freshwater production and that marine survival could be affected by factors operating in freshwater.

The PFA estimates suggest that the number of non-maturing 1SW recruits in the Southern Europe has declined fairly steadily over the full time series. This is broadly consistent with the general pattern of decline in marine survival of 2SW returns in most monitored stocks in the area. In more recent years, reductions in exploitation do not appear to have kept pace with the stock declines and the spawning escapement has thus also fallen over the period.

3.6.4 Forecasting the PFA for NEAC stocks

NASCO has asked ICES to further develop methods to estimate the expected PFA of salmon in the NEAC area. In order to provide numerical catch advice, PFA values must be forecast one or two years in advance. For example, the PFA of non-maturing 1SW recruits must be predicted for 2000 if we are to provide catch advice for the West Greenland fishery in 2000, for the Faroes fishery (MSW stock) in 2000/01 and for homewater MSW fisheries in 2001. Because the latest estimate of non-maturing 1SW recruits is for 1998, the PFA must be forecast two years ahead, as is currently practised for the North American assessment. For maturing 1SW stocks, a single year's projection is sufficient.

The model used to forecast PFA for North American stocks is based upon both environmental (thermal habitat in the north-west Atlantic) and biological (lagged spawners) parameters. A similar approach has been considered for the NEAC area however, there is as yet insufficient information to develop such a model. Although information was presented to the Working Group on further pelagic trawl surveys for post-smolts in the NEAC area, we still have a very limited understanding of the factors affecting the distribution and survival of salmon during the marine phase of the life-cycle. The Working Group considered that inclusion of environmental parameters in a model must be based upon justifiable hypotheses concerning the impacts on freshwater and/or marine survival. In addition, because of the preliminary and uncertain nature of the PFA analysis, these estimates may not provide a sound basis for predictive assessments.

Co-ordination of further work on the PFA assessments and predictive models for NEAC stocks is a central part of a current EU Concerted Action programme.

3.7 Development of conservation limits

3.7.1 Progress with setting river-specific conservation limits

The Working Group reviewed the progress that was being made with the development of river specific stock conservation limits, and alternative management approaches, in different countries in the NEAC area:

Finland and Iceland: No progress was reported.

France: In Brittany salmon rivers where the majority of rod and line catches take place, an individual quota of one large salmon per angler and year has been set up in 1999 in order to protect MSW. As this measure did not give the expected results, it will be replaced with a specific TAC for large salmon in year 2000, the measure will be running for a period of at least 5 years.

Ireland: Potential spawning requirements have been estimated for all rivers by applying reference egg deposition rates from the River Bush stock-recruitment relationship to the wetted area or catchment areas of each river to circulate spawning targets. While this provides a very approximate estimate, it is believed that the order of magnitude is broadly indicative of the spawning requirements for these rivers. This preliminary analysis is gradually superseded by river specific analyses and GIS analyses.

Norway: Work are in progress to estimate the area of freshwater habitat available for smolt production in a number of Norwegian salmon rivers. Work have been initiated to examine the use of estimates of parr density in the development of conservation limits.

Russia: Provisional conservation limits have been set for all salmon rivers on the Kola peninsula. Conservation limits have been defined for 5 rivers as S_{MSY} points on "stock-recruitment" curves. For those rivers where habitat data are available conservation limits have been established by transporting reference points – 2.73 eggs/m^2 for the Barents Sea rivers and 3.85 eggs/m^2 for the White Sea rivers. The approach using total catchment area has been applied for other rivers. Mapping of nursery areas and spawning grounds has been carried out on a number of Kola rivers.

Sweden: A Working Group to assess the potential and status of wild salmon populations established in 1998 was completed in 1999. Provisional estimates of present smolt production levels, as well as present potential smolt production are now available for all salmon rivers in western Sweden.

UK (England and Wales): Provisional conservation limits (referred to as 'spawning targets') have been developed for all principal salmon rivers. These are being reviewed and finalised as Salmon Action Plans are developed for each river; a Ministerial Direction issued to the Environment Agency in September 1998 requires that the SalmonAction Plans be completed for 68 salmon rivers by the year 2002; 32 have been prepared to date. The 'spawning targets' are set using a nationally agreed methodology (Environment Agency 1998). This adjusts a stock-recruitment relationship for the River Bush, UK (Northern Ireland) according to the quality and quantity of juvenile habitat in each river, derived from a simple habitat model (Wyatt and Barnard 1997).

UK (Northern Ireland) The most extensively developed conservation limit for N Ireland is that for the R. Bush, derived from a whole river stock/recruitment relationship, based on long time series estimates of ova deposition and smolt counts. Provisional CLs have been set for all rivers in the Fisheries Conservancy Board area of N. Ireland. by transporting the Bush figure on the basis of catchment area (See Anon., 1998 [ICES WG on Setting Conservation Limits in the Northeast Atlantic]). These CLs are indicative only and not currently being used for management. Further work to refine these CLs by using river-specific habitat data is in progress and will be reported in due course. A programme of installation of fish counters is underway, to enable compliance to be assessed in 5-10 key indicator rivers.

A spawning arget based management system has been operating in the Foyle fishery area (Foyle, Carlingford and Irish Lights Commission) for many years, based on a scientific study of stock/recruitment relationships in the system (Elson & Tuomi, 1975). Associated management targets are operated on the basis that, if, at particular dates during the season, certain target numbers of fish have not been counted upstream at Sion Mills Weir (R. Mourne), and at two other rivers (R. Faughan & R. Roe) then specified closures of the angling and/or commercial fisheries take place. Conversely, if the seasonal management targets have been met by the normal end of the commercial netting season, then a 96h netting extension is granted. This system has been refined and formalised for 2000 and beyond by the introduction of the Foyle Area (Control of Fishing) Regulations 1999

UK (Scotland): Consideration of the structure of salmon populations has influenced the approach adopted with respect to conservation limits. Radiotracking studies have demonstrated a link between time of river entry and spatial distribution at time of spawning while genetic differences have been detected among subcatchments within rivers. Furthermore, areas in which salmon have become depleted are not utilised by other run types. This suggests that all groups of salmon within a river need an adequate number of spawners and this needs to be taken into account when considering conservation limits. An approach, based on rod catch analysis and juvenile surveys, for assessing optimal spawning levels is currently being developed. In essence, a two stage process is envisaged. Firstly, trend analysis of catch data will be used to determine those subcatchments where spawning numbers have become depleted. Secondly, having targeted the appropriate subcatchments, juvenile surveys will be used to identify the severity of reduced spawner abundance. Management polices to protect specific subcatchment groups can then be developed. Initial investigation into the usefulness of the rod catch data suggest this approach will prove fruitful.

3.7.2 National conservation limits

The Working Group has previously developed a method for estimating preliminary national conservation limits based upon the output of the PFA analysis described in Section 3.6. There have been no changes to the model in 2000. A full description of the model along with a sensitivity analysis is provided in Potter *et al* (1998).

In brief, the model provides a means for relating the estimates of numbers of spawners and recruits derived from the PFA model. This is addressed 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, and these proportions are therefore used to estimate the 'lagged egg deposition' contributing to the recruitment of maturing and non-maturing 1SW fish in year 'n+8'. The plots of lagged eggs (stock) against the 1SW adults in the sea (recruits) have been presented as 'pseudo-stock-recruitment' relationships. Three non-parametric methods have been used to estimate conservation limit 'options' from these relationships and these options have been evaluated to provide the most appropriate choice for each country. To be compared with any forecast of PFA, the egg deposition conservation limit levels must be converted back to fish numbers. This number is then converted to numbers of 1SW and MSW salmon based upon the average age composition of the spawning stock over the past 10 years.

These results of this analysis are shown in Appendix 10a – 10j. The three conservation limit 'options' derived for each country are summarised in Table 3.7.2.1. Where river specific conservation limits have been derived, these are provide as a fourth option.

The Working Group has previously noted that some of the national conservation limit estimates are broadly consistent with independently derived river specific conservation limits (e.g. UK(England and Wales) and UK(Northern Ireland)), but in other cases no independent means of validation is available (e.g. UK(Scotland)). The Working Group felt that they had no basis for modifying the data inputs for the model without further information and concluded that the combined conservation limits provide a useful preliminary reference point to assist in assessing the state of current levels of recruitment and providing qualitative the catch advice.

The approach is based on a very simple model of national salmon stocks and depends upon a number of assumptions. One feature of the three Options for setting the conservation limits is that they tend to provide estimates close to the minimum level of recruitment previously seen (as estimated by the PFA model). In some cases this will be a conservative estimate of the true conservation limit (i.e. S_{MSY}). 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.

As in 1999, the Working Group selected the most appropriate conservation limit option for each country based upon the nature of the 'pseudo-stock-recruitment relationships' (Appendices 10a-10j) and local knowledge. This evaluation is summarised below:

Country	Option	Reason
Finland	3	Recruitment reduced at Option 1 and 2 egg deposition levels.
France	4	Based upon river specific estimates.
Iceland	1	Options 1 & 2 equal; no increase in recruitment at Option 3.
Ireland	1	Option 2 lower; no increase in recruitment at Option 3.
Norway	1	Option 2 lower; no increase in recruitment at Option 3.
Russia	1	Option 2 lower; no increase in recruitment at Option 3.
Sweden	4	Option 1-3 not consistent with current wild/reared proportion
UK(Eng. & Wales)	4	Based upon river specific estimates.
UK(N. Ireland)	3	Option closest to preliminary river specific limits..
UK(Scotland)	3	Recruitment reduced at Option 1 and 2 egg deposition levels.

The selected options have been summed in the appropriate stock groups. These are then increased to take account of the natural mortality between recruitment and the time of return in order to provide spawner escapement reserves (SERs) for maturing and non-maturing 1SW salmon from the Northern and Southern Europe. Changes in the SER estimates from last year mainly reflect the changes in the PFA estimates described above. The SERs are shown as horizontal lines in Figures 3.6.2.1 and 3.6.2.2. The SERs are not shown on the total NEAC data (Figure 3.6.2.3) because evaluation of stocks against conservation limits is thought to be inappropriate at that level. The Working Group noted that the SER levels may be less appropriate for evaluating the historic status of stocks.

3.8 Catch options or alternative management advice

The Working Group has been asked to provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits in the NEAC area. The Working Group expressed concerns about harvesting salmon in mixed stock fisheries, particularly when many individual river stocks and sub-river populations are known to be at unsatisfactorily low levels. Annual adjustments in quotas or effort regulations based on changes in the mean status of the stocks is unlikely to provide adequate protection to the individual river stocks that are most heavily exploited by the fishery or are in the weakest condition.

The Working Group also emphasized that the 'national conservation limits' discussed above are not appropriate for the management of homewater fisheries, particularly where these exploit separate river stocks. This is both 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 catch advice for these fisheries.

In view of the uncertainties expressed above about the most appropriate stock groupings and the preliminary nature of the conservation limit estimates, the Working group considered that it would be inappropriate to provide quantitative catch options at this stage. However, the Working Group felt that the following qualitative catch advice was appropriate based upon the PFA data and estimated SERs shown in Figures 3.6.2.1 and 3.6.2.2:

Northern European 1SW stocks: The Working Group considers the spawning escapement of 1SW salmon from the Northern European stock complex to have been within but close to safe biological limits in recent years. Although there is evidence of a small upturn in stocks in the past three years, the increase is not significant. The Working Group considers that overall exploitation of the stock complex at the current rate is acceptable but, it is recognised that the status of individual stocks varies considerably. Since very few 1SW 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: These are the main stocks that have contributed to the fisheries in the Norwegian Sea in past years. The PFA of non-maturing 1SW salmon from Northern Europe has been declining since the mid 1980s and the exploitable surplus has fallen from over 800,000 recruits in the 1970s to around 250,000 recruits in recent years. The Working Group considers the Northern European MSW stock complex to be within but close to safe biological limits, although it is recognised that the status of individual stocks will vary considerably. The Working Group therefore considers that great caution should be exercised in the management of these stocks particularly in mixed stock fisheries and exploitation should not be permitted to increase. The Working Group considers that management of single stock fisheries should be based upon local assessments of the status of stocks.

Southern European 1SW stocks: The Working Group considers that recruitment of maturing 1SW salmon in the Southern European stock complex has been very close to safe biological limits for much of the past 10 years, and the spawning escapement for the whole stock complex has fallen below the conservation limit is some years. There is also evidence of a serious reduction in recruitment in 1999, taking recruitment for the stock complex outside safe biological limits for the first time. Since nearly all exploitation of 1SW salmon takes place in homewater fisheries, management of these stocks should be based on local assessments of the status of river or sub-river stocks. The Working Group considers that great caution should be exercised in the management of mixed stock fisheries in this area and that reductions in exploitation rates are likely to be required for some stocks.

Southern European MSW stocks: This stock complex includes the main European stocks contributing to the West Greenland fishery. The PFA of non-maturing 1SW salmon from Southern Europe has been declining steadily since the 1970s. The Working Group's latest analysis suggests that the spawning escapement for the whole stock complex has been close to or outside safe biological limits for the past 30 years and has been significantly below the preliminary conservation limit for the past three years. In 1998, the recruitment (i.e. before exploitation) fell to a level which was significantly below the conservation limit. Qualitative projection of these estimates suggests that the PFA is likely to remain below the conservation limit in 2000. The Working Group therefore considers that extreme caution should be exercised in the management of these stocks in mixed stock fisheries and that reductions in levels of exploitation should be pursued. Management of single stock fisheries should be based upon local assessments of the status of river and sub-river stocks.

3.9 Catches of post-smolts in the North East Atlantic

3.9.1 Post-smolt surveys in 1990-1999

Figure 3.9.1.1. summarises the distribution of salmon captures in 1990 – 98. New data are provided from 9 Norwegian research cruises in 1999, two of which were specifically aimed at salmon investigations along the SW- and mid-Norwegian coast and SW Norwegian fjords. 406 surface trawl hauls yielded 984 post-smolts and 24 salmon, most of which were captured in the fjords or at the coast during the special salmon cruises (Table 3.9.1.1). The distribution of the trawl sites and number of salmon captured are presented in Figure 3.9.1.2. For the first time since the sampling programme began, a few post-smolts and salmon were captured in the Barents Sea and adjacent fjords.

In 1999 fewer post-smolts than in previous years were captured on the feeding grounds in the Norwegian Sea. As there were differences in the sampling times, and the cruises were aimed mainly at sampling herring and mackerel, it is not possible to estimate whether the low catches are a result of low number of post-smolts present or sub-optimal timing of the sampling.

Preliminary analysis of the scale samples, show a similar smolt age distribution to previous years. The lower smolt ages (1-2 years) predominate in the catches in the Norwegian Sea while the higher ages are found along the Norwegian coast and in the fjords. The age difference observed indicates a separation in time or in space of stocks from southern areas (south- and mid-Europe including south Norway) and the more northerly Norwegian and the Russian stocks (Holm et al. 1998 and 2000). Furthermore, it is documented from the Faroese research fishery (Jacobsen *et al*. 1997) that both the southern and the northern stocks are present in the sea north of the Faroes from November - April. Consequently, there is still insufficient information on the distribution of these stock groups to fully describe either the timing of migration or the migration routes of these stocks.

An improved device for capturing live fish from trawl hauls was succesfully used at the near shore cruises (Holst and McDonald 2000). The method provided material for salmon lice investigations the results of which are further described in section 2.5.4.

No investigations of salmon in the sea have been undertaken by other NEAC countries in 1999.

It is recommended that the sampling programme for post-smolt should be maintained and further extended with surveys in July along the northern most coast of Norway and Russia and also into the Barents Sea.

3.9.2 By catch of post-smolts in pelagic fisheries

Salmon post-smolt and herring seem to overlap spatially only in July to early August in the areas north of 68°N (Holst *et al.*. 1998; Belikov *et al.* 1998). Information provided by the WGMHSA in 1999 show that older year classes of mackerel have very similar summer migrations and distribution patterns as post-smolts (Figure 3.9.2.1). A purse seine fishery for herring takes place in the Norwegian Sea (north of the Faroes up to the Jan Mayen Island), but this fishery operates too early and is unlikely to intercept with young salmon.

In response to a request in 1999, the Working Group on Northern pelagic and Blue Whiting Fisheries (WGNPBW) and the Working Group on the Assessment of Mackerel, Horse Mackerel Sardine and Anchovy (WGMHSA) have collated information that might assist in assessing the potential impact of post-smolt by-catches in the commercial pelagic fisheries. No by-catch data were provided byWGNPBW in 1999, however, temporal (by quarter) and spatial distribution maps of the fishery for herring, capelin and blue whiting were provided.

The WGHMSA reported landings of 3 kg–2000 kg of salmon from trawl and artisanal fisheries outside the river Minho in Portugal in 1986 - 98. It is unclear whether these catches all are made in the sea or if they come from the Minho estuary. In the other WGHMSA member countries there were no surveillance programme and in the only country (Faroe Islands) where dedicated sampling was implemented no by-catches of salmon were found.

The Fishery Laboratory of the Faroes and the Russian Polar Institute (PINRO) have initiated a bilateral collaboration on the by-catch of salmon post-smolts north of the Faroes in the fishery for herring and mackerel. So far no joint report have been prepared from the two parties. However, limited Faroese efforts to collect data on by-catch of salmon and to screen herring catches for post-smolts in 1998 and 1999 did not record any by-catches in the herring fishery in June (Table 3.9.2.1).

During two consecutive days in early June 1999, in the northern North Sea, a Norwegian research vessel carried out small scale sampling for pelagic fishes in a restricted area around the Frigg Field oil installations with two different trawl methods. Post-smolts were captured in 5 out of the 9 hauls where the upper panel had flotation and stayed in an on-surface position. No post-smolts were captured in the 6 hauls that were towed stepwise from 60 m to the surface. In spite of the very limited number of observations, this provides further support for the assumption put forward by ICES (ICES 1999/ACFM:14), that a simple precautionary measure against post-smolt catches in commercial fisheries might be to negotiate that the fleet should operate their trawl with the float line at minimum 10 m from the surface.

3.10 Data Deficiences and Research Needs in the NEAC Area

3.10.1 Progress on items cited in the 1999 report of NASWG

1. *More research into the biology of salmon in the early marine phase is required and extension of recent research on the biology of post-smolts is recommended. Competitive interactions with other marine species should be explored. Additionally, by-catches of post-smolts in marine fisheries for other species should be monitored and estimates of mortality from this source should be derived. There is a continuing requirement to monitor trends in marine mortality for a wider range of stocks than at present, and to identify causes for current low levels of marine*

survival. In the latter context, it is noteworthy that an ICES Workshop on the Usefulness of Scale Growth Analyses and Other Measures of Condition in Salmon will be held in Amherst, USA in July, 1999.

- A new approach to study effects of sea lice on postsmolts was presented (section 2.5.4).

- Results from research cruises in the Norwegian Sea were reported (section 3.9.1).

- Area of potential overlap of the distribution of salmon postsmolts and mackerel was reported (section 3.9.2).

- Three purse seine catches of herring and mackerel were examined at Faroes, no postsmolt was observed (section 3.9.2).

- Report from the ICES Workshop is available.

2. *It is recommended that a research fishery at Faroes should be continued and that material gained during previous study should continue to be worked-up.*

   - No research fishery has been initiated.

   - The material gained during the previous study is continued to be worked-up.

3. *The quality of data used to set conservation limits should continue to be improved and the PFA model should continue development. More and better input data should be obtained from a greater range of sources. Data collection should be targeted at finer scales. New ways of handling data, including GIS applications, and particularly new methods for grouping sub-divisions (eg., populations, or alternative divisions based on biological characteristics such as sea-age or run-timing) should continue to be explored, developed and validated. In particular, sensitivity analyses are essential to assess the confidence with which data derived from the theoretical models can be used in an applied management context.*

   - The NEAC members have initiated an EU funded Concerted Action.

4. *Assessment methods for juvenile salmon and for freshwater habitat parameters should continue to be developed. Attempts should be made to couple these parameters with adult return parameters, via life-history models of appropriate scale. Habitat and life-history variables should be used together to examine the extent to which stock-recruitment relationships from a limited range of index rivers are transferable to other rivers.*

The NEAC members have initiated an EU funded Concerted Action.

5. *The status of southern and central European rivers with respect to* Gyrodactylus *species, and particularly* G. salaris, *should be established without delay. Monitoring of the spread and occurrence of* G. salaris *should be encouraged in salmon-producing countries, and in other countries that are possible sources for transfer of the parasite.*

   - The initial identification of *Gyrodactylus salaris* in France was incorrect, and further investigations have shown that it is a new species *G. teuchis.*

   - A public information campaign was initiated in Ireland to inform anglers and the aquaculture industry on methods to prevent the spread of *G. salaris*.

3.10.2 Continuing requirements for data, research and monitoring

1) More research into the biology of salmon in the marine phase is required. This includes the need to monitor trends in marine mortality for a wider range of stocks than at present, and identify causes for mortality. The use of data storage tags will significantly improve the information on the marine life history of salmon.

2) Research on postsmolts in the early marine phase should be continued and expanded. This should include studies of competitive interactions with other marine species, interaction with parasites and diseases and by-catches of post-smolts in marine fisheries for other species. To improve the understanding of the impact of sea lice on postsmolts, ongoing studies on wild fish in the natural environment should be continued and expanded.

3) Efforts to catch postsmolts should be continued and expanded to areas not previously sampled.

4) It is recommended that a research fishery at Faroes should be resumed and that material gained during the previous studies should continue to be worked-up. DNA analyses of fish sampled at Faroes should be performed to assess continent of origin.

5) The quality of data used to set conservation limits should continue to be improved and the PFA model should continue to be developed. Efforts should be made to provide data on 1SW/MSW composition in catches and spawning stocks, to facilitate more comprehensive stock assessements.

6) Assessment methods for juvenile salmon and for freshwater habitat parameters should continue to be developed and the interaction between freshwater and marine life histories should be investigated further.

Table 3.2.1.1. Nominal landings of Atlantic salmon by Faroes vessels in years 1982-1998 and the 1981/1982 to 1999/2000 fishing seasons.

Year	**Catch (t)**	**Quota (t)** a	**Season**	**Catch (t)**
1982	606		1981/1982	796
1983	678		1982/1983	625
1984	628		1983/1984	651
1985	566	625	1984/1985	598
1986	530	625	1985/1986	545
1987	576	597 b	1986/1987	539
1988	243	597 b	1987/1988	208
1989	364	597 b	1988/1989	309
1990	315	550 c	1989/1990	364
1991	95	550 c	1990/1991	202
		Research fishery		
1992	23	550	1991/1992	31
1993	23	550	1992/1993	22
1994	6	550	1993/1994	7
1995	5	550	1994/1995	6
1996	-	470	1995/1996	1
1997	-	425	1996/1997	-
1998	6	380	1997/1998	6
1999	-	330	1998/1999	-
		Commercial fishery		
2000	8	300	1999/2000	8

a Quotas set by NASCO from 1987

b Three year quota of 1790 t

c Two year quota of 1100 t

Table 3.2.2.1. Percentage distribution by weight category (kg) of salmon landed at Faroes in the 1999/2000 fishing season. Wild and farmed fish combined.

Weight category	Weight (kg)	Number	Mean weight (kg)	Estimated mean length (cm)
<1	120.05	122	0.98	50.0
1-2	274.05	206	1.33	54.7
2-3	1224.5	425	2.88	68.8
3-4	2463	646	3.81	74.8
4-5	1250	265	4.72	79.7
5-6	696	121	5.75	84.5
6-7	529	79	6.70	88.4
7-8	508.5	66	7.70	92.2
8-9	292.5	35	8.36	94.4
9+	266	25	10.64	101.4
Total	7623.6	1990	3.83	73.0

[a] The salmon in the 1-2 kg category are equally divided into 1 and 2 SW salmon.

Table 3.2.2.2. Sea age distribution of Atlantic salmon caught in Faroese waters in the 1999/2000 fishing season. Not discriminated between wild and farmed fish.

Sea age	1SW	2SW	3+SW	Total
Number	225	1560	205	1990
%	11.3	78.4	10.3	100

Table 3.2.3.1. Approximate proportions (%) of various stock components and age groups exploited in the Faroese salmon fishery, as inferred from tag recaptures in the North Atlantic (1991/1992-1994/1995).

	Sea age		
Group	1SW	2+SW	All ages
Northern stocks	8	57	65
Southern stocks	20	8	28
Canadian stocks	0	7	7
Total	28	72	100

Table 3.3.3.1 Numbers of gear units licensed or authorised by country and gear type.

Year	UK (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)
1966	-	-	-	-	-	3,513	861	-	-	-	7,101	-	55	-
1967	-	-	-	-	-	2,982	836	-	-	-	7,106	2,827	48	11,498
1968	-	-	-	-	-	3,495	970	-	-	-	6,588	2,613	36	9,149
1969	-	-	-	-	-	3,239	849	139	311	17	6,012	2,756	32	8,956
1970	-	-	-	-	-	2,861	775	138	306	17	5,476	2,548	32	7,932
1971	-	-	-	-	-	3,069	802	142	305	18	4,608	2,421	26	8,976
1972	-	-	-	-	-	3,437	810	130	307	18	4,215	2,367	24	13,448
1973	-	-	-	-	-	3,241	884	130	303	20	4,047	2,996	32	18,616
1974	-	-	-	-	-	3,182	777	129	307	18	3,382	3,342	29	14,078
1975	-	-	-	-	-	2,978	768	127	314	20	3,150	3,549	25	15,968
1976	-	-	-	-	-	2,854	756	126	287	18	2,569	3,890	22	17,794
1977	-	-	-	-	-	2,742	677	126	293	19	2,680	4,047	26	30,201
1978	-	-	-	-	-	2,572	691	126	284	18	1,980	3,976	12	23,301
1979	-	-	-	-	-	2,698	747	126	274	20	1,835	5,001	17	23,989
1980	-	-	-	-	-	2,892	670	125	258	20	2,118	4,922	20	25,652
1981	-	-	-	-	-	2,704	647	123	239	19	2,060	5,546	19	24,081
1982	-	-	-	-	-	2,377	641	123	221	18	1,843	5,217	27	22,520
1983	232	209	333	74	-	2,514	659	120	207	17	1,735	5,428	21	21,813
1984	226	223	354	74	-	2,438	630	121	192	19	1,697	5,386	35	21,210
1985	223	230	375	69	-	1,999	524	122	168	19	1,726	5,848	34	20,329
1986	220	221	368	64	-	1,976	583	121	148	18	1,630	5,979	14	17,945
1987	213	206	352	68	-	1,693	571	120	119	18	1,422	6,060	13	17,234
1988	210	212	284	70	-	1,536	390	115	113	18	1,322	5,702	11	15,532
1989	201	199	282	75	-	1,224	347	117	108	19	1,880	4,100	16	0
1990	200	204	292	69	-	1,276	334	114	106	17	2,375	3,890	7	0
1991	199	187	264	66	-	1,144	306	118	102	18	2,343	3,628	8	0
1992	203	158	267	65	-	857	296	121	91	19	2,268	3,342	5	0
1993	187	151	259	55	-	909	266	120	73	18	2,869	2,783	-	0
1994	177	158	257	53	293,759	753	245	119	68	18	2,630	2,825	-	0
1995	163	156	249	47	243,288	737	226	122	68	16	2,542	2,715	-	0
1996	151	132	232	42	231,744	614	203	117	66	12	2,280	2,860	-	0
1997	139	131	231	35	269,705	671	196	116	63	12	2,002	1,075	-	0
1998	130	129	196	35	233,401	537	151	117	70	12	1,865	1,027	-	0
1999	120	109	178	30	185,502	355	109	113	52	11	1,649	989	-	0
Mean 1994-98	152	141	233	42	254,379	662	204	118	67	14	2,264	2,100	-	0
% change [4]	-21.1	-22.8	-23.6	-29.2	-27.1	-46.4	-46.6	-4.4	-22.4	-21.4	-27.2	-52.9	-	-
Mean 1989-98	175	161	253	54	-	872	257	118	82	16	2,305	2,825	-	-
% change [4]	-31.4	-32.1	-29.6	-44.6	-	-59.3	-57.6	-4.3	-36.2	-31.7	-28.5	-65.0	-	-

[1] Total declared number of rod days fished, data for 1999 is provisional

[2] Number of gear units expressed as trap months.

[3] Number of gear units expressed as crew months.

[4] (98/mean - 1) * 100

Table 3.3.3.1 continued Number of gear units licensed or authorised by country and gear type.

Year	Ireland: Driftnets No.	Ireland: Draftnets	Ireland: Other nets	Ireland: Rod	Finland, The Teno River, Recreational fishery, Tourist anglers: Fishing days	Finland, The Teno River, Recreational fishery, Tourist anglers: Fishermen	Finland, R. Näätämö, Local rod and net fishery: Fishermen	Finland, R. Näätämö, Recreational fishery: Fishermen	France: Rod and line licences	France: Com. nets in freshwater[3]	France: Com. nets in estuary[3,4]
1966	510	742	214	11,621	-	-	-	-	-	-	-
1967	531	732	223	10,457	-	-	-	-	-	-	-
1968	505	681	219	9,615	-	-	-	-	-	-	-
1969	669	665	220	10,450	-	-	-	-	-	-	-
1970	817	667	241	11,181	-	-	-	-	-	-	-
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	200	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	5804 [2]	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
1992	691	535	183	20,263	26,748	9,058	749	875	2,160	57	71
1993	673	457	161	23,875	29,461	10,198	755	705	2,111	53	55
1994	732	494	176	24,988	26,517	8,985	751	671	1,680	17	59
1995	768	468	176	25,124	24,951	8,141	687	716	1,881	17	59
1996	778	497	176	28,261	17,625	5,743	672	814	1,806	21	69
1997	852	492	141	29,881	16,255	5,036	616	588	2,974	10	59
1998	871	494	141	29,848	18,700	5,759	621	673	2,358	16	63
1999	874	502	159	30,000	22,935	6,857	616	850	2,232	15	61
Mean 1994-98	800	489	162	27,620	20,810	6,733	669	692	2,140	16	62
% change [5]	9.2	2.7	-1.9	8.6	10.2	1.8	-8.0	22.8	4.3	-7.4	-1.3
Mean 1989-98	763	496	169	22,930	22,689	7,756	706	707	2,453	42	66
% change [5]	14.6	1.2	-6.2	30.8	1.1	-11.6	-12.7	20.2	-9.0	-64.5	-7.6

[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] The number of licences 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.
[4] Adour estuary only southwest of France.
[5] (98/mean - 1) * 100

Table 3.3.3.1 Numbers of gear units licensed or authorised by country and gear type.

	England & Wales				
Year	Gillnet	Sweepnet	Hand-held net	Fixed engine	
1975	269	244	341	69	
1976	275	248	355	70	
1977	273	251	365	71	
1978	249	242	376	70	
1979	241	225	322	68	
1980	233	237	339	69	
1981	232	219	336	72	
1982	232	221	319	72	
1983	232	209	333	74	
1984	226	223	354	74	
1985	223	230	375	69	
1986	220	221	368	64	
1987	213	206	352	68	
1988	210	212	284	70	
1989	201	199	282	75	
1990	200	204	292	69	
1991	199	187	264	66	
1992	203	158	267	65	
1993	187	151	259	55	
1994	177	158	257	55	
1995	162	156	249	47	
1996	147	125	232	42	
1997	139	131	231	35	-
1998	130	129	196	35	-
1999	120	109	178	30	-

Table 3.3.4.1 Nominal catch of SALMON in NEAC Area (in tonnes round fresh weight), 1960-1999.
(1999 figures are provisional)

Year	Homewater countries	Faroes (1)	Other catches in international waters	Total Reported Catch	Unreported catches NEAC Area	Unreported catches International waters (2)
1960	5540	-	-	5540	-	-
1961	4753	-	-	4753	-	-
1962	6709	-	-	6709	-	-
1963	6276	-	-	6276	-	-
1964	7150	-	-	7150	-	-
1965	6456	-	-	6456	-	-
1966	6052	-	-	6052	-	-
1967	7526	-	-	7526	-	-
1968	6146	5	403	6554	-	-
1969	6281	7	893	7181	-	-
1970	5882	12	922	6816	-	-
1971	5582	-	471	6053	-	-
1972	6597	9	486	7092	-	-
1973	7331	28	533	7892	-	-
1974	7027	20	373	7420	-	-
1975	7116	28	475	7619	-	-
1976	5314	40	289	5643	-	-
1977	5209	40	192	5441	-	-
1978	4966	37	138	5141	-	-
1979	5121	119	193	5433	-	-
1980	5434	536	277	6247	-	-
1981	4909	1025	313	6247	-	-
1982	4471	606	437	5514	-	-
1983	5873	678	466	7017	-	-
1984	4769	628	101	5498	-	-
1985	5533	566	-	6099	-	-
1986	6183	530	-	6713	-	-
1987	4830	576	-	5406	2554	-
1988	5284	243	-	5527	3087	-
1989	4059	364	-	4423	2103	-
1990	3420	315	-	3735	1779	180-350
1991	2822	95	-	2917	1555	25-100
1992	3343	23	-	3366	1825	25-100
1993	3311	23	-	3334	1471	25-100
1994	3563	6	-	3569	1157	25-100
1995	3277	5	-	3282	942	n/a
1996	2750	-	-	2750	947	n/a
1997	2074	-	-	2074	827	n/a
1998	2218	6	-	2224	1108	n/a
1999	2054	-	-	2054	877	n/a
Means						
1994-1998	2776	6	-	2780	996	-
1989-1998	3084	105	-	3167	1371	-

1. Since 1991, there has only been a research fishery at Faroes.
2. Estimates refer to season ending in given year.

Table 3.3.5.1 CPUE for salmon rod fisheries in Finland (Teno, Naatamo), France,the River Bush (UK(N.Ireland)) and Russia.

	Finland (Teno River)				Finland (Naatamo River)				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	5 yr mean	kg	5 yr mean	kg	5 yr mean	kg	5 yr mean	Number	5 yr mean	Number	5 yr mean
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	**3.3**	1.2	**1.1**							0.248	
1984	2.2		0.8		0.5		0.2				0.083	
1985	2.7		0.9								0.283	
1986	2.1		0.7								0.274	
1987	2.3		0.8						0.39		0.194	
1988	1.9	**2.2**	0.7	**0.8**	0.5		0.2		0.73		0.165	**0.2**
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	**3.4**	1.3	**1.2**	0.4	**1.0**	0.2	**0.3**	0.88	**0.7**	0.341	**0.3**
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		0.338	
1998	3.0	**2.9**	0.9	**0.9**	1.3	**0.8**	0.3	**0.2**	0.67	**1.2**	0.569	**0.3**
1999	3.7		1.1		0.8		0.2		0.76		0.344	

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

	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
Mean 1994-98	0.821	0.747	0.865	0.944	3.834	2.042	2.080	1.200

Table 3.3.5.2 CPUE data for net and fixed engine salmon fisheries by Region in UK (England & Wales), 1988-1999. (Data expressed as catch per licence-day.)

Year	Region			
	North East	Southern [1]	Welsh	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	6.43	-	0.68	0.63
1994	7.53	-	1.02	0.71
1995	7.84	-	1.00	0.79
1996	3.74	-	0.73	0.59
1997	5.30	-	0.77	0.35
1998	5.12	-	0.69	0.32
1999	7.28	-	0.83	0.37
Mean 1994-98	5.91	-	0.84	0.55

[1] Fishery has not operated since 1993.

Table 3.3.5.3 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	62.26	181.89
1983	56.20	206.83
1984	58.98	160.98
1985	54.48	156.55
1986	75.93	204.87
1987	64.34	147.14
1988	51.91	204.53
1989	71.68	268.78
1990	33.31	148.37
1991	35.62	100.44
1992	59.10	151.85
1993	52.29	124.06
1994	93.23	123.40
1995	75.03	139.72
1996	60.51	110.93
1997	33.95	56.27
1998	36.75	65.54
1999	23.70	46.78
Mean 1994-98	59.89	99.17

1 - Excludes catch and effort for Solway Region

Table 3.3.5.4 Fisheries in the North East Atlantic, summary of trend analyses based on non-parametric method (1000 iterations) (p <0.1 means significance upward trend, p>0.9 means significant downward trend).

Section/Data type	Fisheries	Life stage	Period (years)	'p' value	Trend
Section 3.3.5					
CPUE	UK (Scotland) net fisheries. Catch/trap month		10	0.99	**Dn**
	UK (England & Wales) net and fixed engines. Catch per licence-day		10	0.18	Nt
	Finland (Teno, Näätämö) and France. Rod catch/season,		10	0.21	Nt
	Finland (Teno, Näätämö) and UK (N Ireland) (Bush). Rod catch/day		10	0.18	Nt
	Russia (Barents Sea basin: Rynda, Kharlovka, Varzina, Iokanga). Rod catch/day		8	0.99	**Dn**
	Russia (White Sea basin: Ponoy, Varzuga, Kitsa, Umba). Rod catch/day		9	0.05	**Up**
Section 3.3.9					
Exploitation rates	Burrishoole + Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Dee (UK (E&W))	1 SW	10	0.01	**Up**
	Burrishoole + Corrib (Irl), North Esk (UK Scot), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Dee (UK (E&W))	1 SW	5	0.14	Nt
	Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Dee (UK (E&W))	2 SW	10	1	**Dn**
	North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Dee (UK (E&W))	2 SW	5	0.75	Nt
	B.Z.Litsa, Ura, Tuloma, Kola (Russia, Barents Sea basin)	All ages	10	1	**Dn**
			5	0.89	Nt
	Ponoy, Kitsa,Varzuga, Umba (Russia, White Sea basin)	All ages	10	1	**Dn**
			5	0.94	Nt

Table 3.3.6.1 The percent of 1SW salmon in catches from countries in the North East Atlantic Commission, 1987-1999.

Year	Finland	France	Norway	Russia	Sweden	UK (Scot)	UK (E&W) (1)
1987	66	77	61	71		61	
1988	63	29	64	53		57	
1989	66	33	73	73	41	63	
1990	64	45	68	73	70	48	
1991	59	39	65	70	71	53	
1992	70	48	62	72	68	55	77
1993	58	74	61	61	62	57	78
1994	55	55	-	69	65	54	77
1995	59	60	58	70	78	53	72
1996	80	51	53	80	63	54	65
1997	70	51	64	82	54	54	73
1998	75	71	66	82	59	58	83
1999	81	27	65	78	71	43	70
Means							
1994-98	68	58	60	77	64	54	74
1989-98	66	53	63	73	63	55	75

1. Refers to rod and line catches only.

Table 3.3.7.1 Estimated catches (in tonnes round fresh weight) of wild, farmed and ranched salmon in national catches in the North East Atlantic (figures for 1999 include provisional values).

Country	Catches of Salmon						
	Year/Season	Wild	FW Farmed	SEA Farmed	Total Farmed	Ranched	Total
Norway	1989	707	29	166	195	3	905
	1990	709.8	29	185	214	6.2	930
	1991	682.5	20	169	189	5.5	877
	1992	653.7	27	176	203	10.3	867
	1993	707	18	191	209	7	923
	1994	781	18	187	205	10	996
	1995	654	13	170	183	2	839
	1996	557	19	203	222	8	787
	1997	430	21	177	198	2	630
	1998	530	29	180	209	1	740
	1999	612	20	178	198	1	811
Faroes	1990/1991	117.2			84.8	0	202
	1991/1992	20.4			10.6	0	31
	1992/1993	16.1			5.9	0	22
	1993/1994	5.8			1.2	0	7
	1994/1995	4.8			1.2	0	6
	1995/1996	0.8			0.2	0	1
	1996/1997	0			0	0	0
	1997/1998 [5]	-			-	-	6
	1998/1999	0			0	0	0
	1999/2000 [5]	-			-	-	8
Finland	1991	68			<1	0	69
	1992	77			<1	0	78
	1993	70			<1	0	70
	1994	49			<1	0	49
	1995	48			<1	0	48
	1996	44			<1	0	44
	1997	45			<1	0	45
	1998	48			<1	0	48
	1999	63			<1	0	63
France	1991	13			0	0	13
	1992	20			0	0	20
	1993	16			0	0	16
	1994	18			0	0	18
	1995	9			0	0	9
	1996	14			0	0	14
	1997	8			0	0	8
	1998	9			0	0	9
	1999	11			0	0	11
Iceland[1]	1991	130			3	345	478
	1992	175			+	460	635
	1993	160			-	496	656
	1994	140			-	308	448
	1995	150			-	298	448
	1996	122			-	239	361
	1997	106			-	50	156
	1998	130			-	34	164
	1999	119			-	26	145
Ireland[2]	1991	400			1.7	2.3	404
	1992	619			3.8	6.7	630
	1993	531			2.0	8.1	541
	1994	789			2.6	12.5	804
	1995	774			0.7	14.8	790
	1996	669			1.7	15.9	687
	1997	566			1.1	2.9	570
	1998	614			2.1	7.9	624
	1999	509			2.3	3.6	515

Table 3.3.7.1 (continued). Estimated catches (in tonnes round fresh weight) of wild, farmed and ranched salmon in national catches in the North East Atlantic (figures for 1999 include provisional values).

Country	Catches of Salmon						
	Year/Season	Wild	FW Farmed	SEA Farmed	Total Farmed	Ranched	Total
Russia	1991	215			0	0	215
	1992	167			0	0	167
	1993	139			0	0	139
	1994	141			0	0	141
	1995	128			0	0	128
	1996	131			0	0	131
	1997	111			0	0	111
	1998	131			0	0	131
	1999	102			0	0	102
Sweden	1991	23			1	14[3]	38
	1992	24			1	24[3]	49
	1993	35			1	20[3]	56
	1994	15			1	29[3]	44
	1995	12			1	24[3]	37
	1996	10			1	22[3]	33
	1997	9			0	10[3]	19
	1998	9			0	6[3]	15
	1999	8			0	5[3]	13
UK (E&W)	1991	200			0	0	200
	1992	186			0	0	186
	1993	263			0	0	263
	1994	307			0	0	307
	1995	295			0	0	295
	1996	180			0	0	180
	1997	142			0	0	142
	1998	125			0	0	125
	1999	152			0	0	152
UK (N.Ire)	1991	54			<1	-	55
	1992	85.3			1.1	2.6	89
	1993	80.5			0.2	2.3	83
	1994	90.1			0.5	0.4	91
	1995	80.6			1.5	0.9	83
	1996	74.7			n/a	2.3	77
	1997	90.7			0.07	2.2	93
	1998	76.6			0.03	1.0	78
	1999	50.9			0.67	1.4	53
UK (Scot)[4]	1991	448			14	0	462
	1992	569			31	0	600
	1993	516			31	0	547
	1994	644			5	0	649
	1995	586			2	0	588
	1996	427			<1	0	427
	1997	296			<1	0	296
	1998	280			<1	0	280
	1999	181			1	0	182

1 "+" indicates a small but unquantified catch.
2 Smolts released for enhancement of stocks or rod fisheries are categorised as wild
3 Fish released for mitigation purposes and not expected to contribute to natural spawning.
4 Data from 1994 onwards is the figure reported in national catch statistics, previous years' data have been calculated from a sampling programme
5 Breakdown of the 1997/1998 & 199/2000 catches not available

Table 3.3.7.2 Proportion of farmed Atlantic salmon (unweighted means) in marine fisheries in Norway 1989-1999. n=number of salmon examined.

	Coast				Fjords			
Year	n	No.localities	%	Range	n	No.localities	%	Range
1989	1217	7	45	7 - 66	803	4	14	8 – 29
1990	2481	9	48	16 - 64	940	5	15	6 – 36
1991*	1245	6	49	29 - 63	336	3	10	6 – 16
1992	1162	7	44	4 - 72	307	1	21	–
1993	1477	7	47	1 - 60	520	4	20	7 – 47
1994	1087	7	34	2 - 62	615	4	19	2 – 42
1995	976	7	42	2 - 57	745	4	17	2 – 47
1996*	1183	6	54	35 - 68	678	4	16	3 – 22
1997	2046	8	47	7 - 68	793	5	42	15 – 85
1998	1194	8	45	6 - 61	1152	5	43	9 – 91
1999	1351	8	35	20 - 59	872	5	41	2 – 85

* In 1991 and 1996 the coastal results do not include the locality in Finnmark.

Table 3.3.7.3 Proportion of farmed Atlantic salmon (unweighted means) in rod catches (1 June–18 August) and brood stock catches (18 August–30 November) in Norway in 1989–1999. (n=number of salmon examined; R= number of rivers sampled).

	1 June–18 August				**18 August–30 November**			
Year	**n**	**R**	**%**	**Range**	**n**	**R**	**%**	**Range**
1989	5970	39	7	0 – 26	1892	19	35	2 - 77
1990	5380	39	7	0 – 55	2144	24	34	2 - 82
1991	4563	31	5	0 – 23	1799	26	24	0 - 82
1992	4259	32	5	0 – 24	1489	22	26	0 - 71
1993	4070	29	5	0 – 22	1213	21	22	0 – 75
1994	3243	18	4	0 – 19	1699	19	22	0 – 75
1995*	3480	26	5	0 – 20	1279	19	29	0 – 71
1996*	3020	29	7	0 – 54	1443	23	31	0 – 82
1997*	2747	30	9	0 – 34	1892	36	29	0 – 83
1998*	4161	33	9	0 – 46	1546	26	22	0 – 97
1999*	5003	34	6	0 – 29	1755	23	15	0 – 53

* From 1995 to 1999 the results are presented for the two periods separated at 31 August.

Table 3.3.7.4 Proportions of escaped farmed Atlantic salmon in the River Teno (Finland, Norway) during the fishing season (June-August) and after the season (September-October).

Year	Fishing season (June-August) samples (n)	farmed fish (n)	farmed fish (%)	After season (September-October) samples (n)	farmed fish (n)	farmed fish (%)
1987	1430	1	0.07			
1988	1026	1	0.10			
1989	2096	5	0.24			
1990	2467	11	0.45	19	10	47.3
1991	3146	11	0.35	7	4	37.5
1992	3748	2	0.05			
1993	2413	1	0.04			
1994	1529	6	0.39			
1995	1604	5	0.31			
1996	2173	3	0.14	8	1	12.5
1997	3881	7	0.18	28	0	0.0
1998	3722	10	0.27			
1999	6243	10	0.16			

Table 3.3.7.5 Geographical distribution by frequency (%) of escaped farmed fish located among commercial catch samples for UK (Northern Ireland) and Ireland inshore catches (1991–1999).

	Frequency (%)								
Location	1991	1992	1993	1994	1995	1996	1997	1998	1999
Northern Ireland (UK)	-	3.72	0.26	1.18	4.03	-	0.14	0.2	1.9
Donegal	0.00	0.02	0.09	0.14	0.02	0.34	0.03	0.01	0.04
Mayo	1.16	1.69	0.27	0.10	0.14	0.25	0.27	0.17	0.79
Galway	0.39	0.10	0.06	0.08	0.03	0.00	0.06	0.10	0.51
S. West	0.00	0.01	1.05	1.08	0.19	0.42	0.47	1.10	0.69
S. and East	-	-	-	-	-	0.00	-	-	-

Table 3.3.7.6 Salmon farm escapees in R. Bush (UK, N.Ireland) based on trapping of the total run throughout the year. (Note: 1994 data includes 14 escapees entering in January 1995).

	Year								
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Total run (excl. ranched)	2344	2570	3253	2064	1527	1099	1681	2961	959
No. escapees	3	24	18	54	6	2	4	6	5
% in sample	0.13	0.93	0.55	2.62	0.39	0.18	0.24	0.20	0.5

Table 3.3.7.7 Frequency of occurrence of escaped farmed salmon among Scottish fisheries for wild salmon (1981–1999).

Year	Net												Rod
	East Riggs %	Redpoint %	Achiltibuie %	Culkein Clachtol %	Laxford %	Strathy %	Bonar B. %	Spey %	Dee %	N. Esk %	Tay %	Tweed %	N. Esk %
1981	[a]0					[a]0	[a]0	[a,b]0		[a,b]0			
1982	[a]0					[a]0.3	[a]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	
1983	[a]0					[a]0	[a]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	
1984	[a]0					[a]0	[a]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	
1985	[a]0			[a]0		[a]0	[a]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0
1986				[a]0.6		[a]0	[a]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0	[a,b]0
1987	[a]0			[a]1.3		[a]0	[a]0	[a,b]0		[a,b]0	[a,b]0	[a,b]0	[a,b]0
1988				[a]1.5		[a]0.6	[a]0	[a,b]0		[a,b]0	[a,b]0	[a,b]0	[a,b]0
1989				[a]6.6		[a]6.1	[a]0.7	[a,b]0.08		[a,b]0	[a,b]0	[a,b]0	[a,b]0
1990		[a,b,c]22		[a]4.7		[a]3.8	[a]0	[a,b]0		[a,b]0	[a,b]0	[a,b]0.13	[a,b]0
1991		[a,b,c]19.8		[a]8.6		[a]7.3	[a]0.4	[a,b]0.14		[a,b]0.13	[a,b]0	[a,b]0	[a,b]0
1992		[a,b,c]18.5		[a]3.5		[a]2.3	[a]0.5	[a,b]0		[a,b]0	[a,b]0.13	[a]0	[a,b]0.16
1993		[a,b,c]37.5		[a,b]14.4		[a,b]15.2	[a,b]0.7			[a,b]0	[a,b]0	[a,b]0	[a,b]0.15
1994				[a,b]7.7		[a,b]7.1	[a,b]0.6			[a,b]0	[a,b]0.18	[a,b]0.4	[a,b]0.3
1995		[a,b]14.5	[a,b]4.2			[a,b]4.1				[a,b]0	[a,b]0	[a,b]0	[a,b]0
1996		[a,b]4.84	[a,b]6.9			[a,b]3.4				[a,b]0	[a,b]0	[a,b]0	[a,b]0
1997		[a,b]0	[a,b]0		[a,b]0.2	[a,b]2.1				[a,b]0			[a,b]0
1998			[a,b]3.45	[a,b]2.8	[a,b] 0.0	[a,b]0.5				[a,b]0.05		[a,b]0	[a,b]0.35
1999					[a,b] 0.0	[a,b]2.76				[a,b]0.14		[a,b] 0	[a,b] 0

Detected by [a]morphological characters, [b]scales growth patterns or [c]carotenoid pigment analysis.

Table 3.3.9.1 Estimated exploitation rates (in %) of salmon in homewater fisheries in the North East Atlantic area (Ireland and UK)

	Ireland[1]			UK (England and Wales)									UK (Northern Ireland) [1]				UK (Scotland)[2]	
	Burrishoole	Corrib		Test	Itchen	Frome	Dee	Dee	Dee	Leven	Lune	Lune	River Bush				North Esk	
	net	net	net	rod	rod	rod	rod	rod	nets	rod	rod	net	net	net	net	net	In-river netting	
Year	HR	W	W	W	W	W	W	W	W	W	W	W	W	W/HR	HR1+	HR2+	W	W
	1SW	1SW	2SW	(all ages)	(all ages)	(all ages)	1SW	MSW	(all ages)	(all ages)	(all ages)	(all ages)	1SW	2SW	1SW	1SW	1SW	2SW
1985	86	69	22	-	-	-	-	-	-	-	-	-	-	-	93	-	23	35
1986	86	57	34	-	-	-	-	-	-	-	-	-	-	-	82	75	40	29
1987	78	-	48	-	-	-	-	-	-	-	-	-	69	46	94	77	29	37
1988	75	32	-	39	33	9	-	-	-	-	-	-	65	36	72	57	35	37
1989	82	22	35	29	47	7	-	-	-	-	22	44	89	60	92	83	25	26
1990	52	31	54	36	47	10	-	-	-	-	30	36	61	38	63	70	36	34
1991	65	14	7	26	43	8	6	10		-	27	30	65	43	57	46	10	15
1992	71	23	8	25	29	9	14	18	15	-	33	30	56	33	74	75	28	27
1993	71	31	58	33	39	11	11	15	11	27	21	30	41	12	67	71	25	18
1994	73	50	0	32	39	13	15	21	22	28	35	35	-	40	71	64	19	18
1995	84	47	9	28	25	9	7	11	18	37	24	27	67	42	69	-	14	12
1996	81	48	47	23	36	13	9	11	17	45	23	24	-	-	81	77	19	10
1997	68	36	100	14	14	7	8	9	17	26	25	29	60	-	79	75	12	12
1998	82	49	58	13	9	9	10	10	15	n/a	24	14	26	-	-	32	23	12
1999 [3]	82	57	27	9	13	n/a	11	9	21	n/a	21	14	63	-	68	51	18	14
Mean																		
1989-98	73	35	38	26	33	10	10	13	16	33	26	30	58	38	73	66	21	18
1994-98	78	46	43	22	25	10	10	12	18	34	26	26	51	41	75	62	17	13

[1] Estimate based on microtag recoveries raised to total catch and including estimate of non-catch fishing mortality.
[2] Estimate based on counter and catch figures.
[3] Provisional figures.
HR = Hatchery reared.
W = Wild.
'-' = no data

Continued...........

Table 3.3.9.1 (cont'd) Estimated exploitation rates (in %) of salmon in homewater fisheries in the North East Atlantic area (Iceland, Norway and Sweden)

	Iceland[1]	Norway[2]							Sweden[3]	
	Ellidaar	Drammen			Imsa				Lagan	
	rod	rod	net		net		net		net	
Year	W	W/HR	HR[4]		W		HR[4]		HR [4]	
	1SW		1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW
1985	40	33	57	-	73	94	81	100	81	-
1986	34	50	81	50	79	82	78	90	93	82
1987	54	44	64	52	56	95	83	95	78	55
1988	45	53	70	47	51	80	78	91	73	91
1989	41	35	40	59	65	74	44	65	76	86
1990	41	33	23	40	42	42	47	68	80	82
1991	37	28	54	59	37	72	50	66	91	92
1992	48	46	-	51	61	76	74	91	73	98
1993	41	45	20	-	53	80	85	89	89	82
1994	49	42	42	34	58	80	70	94	70	100
1995	43	53	29	40	-	86	56	88	58	70
1996	56	47	7	23	66	-	80	89	64	78
1997	50	45	15	23	58	80	67	-	55	58
1998	55	47	27	33	12	33	10	66	83	66
1999	57	42	12	33	0	0	16	-	81	-
Mean										
1989-98	46	42	29	40	50	69	58	80	74	81
1994- 98	51	47	24	31	49	70	57	84	66	74

[1]Estimate based on counter and catch figures.
[2]Estimates based on counter catch figures.
[3]Estimate based on external tag recoveries and before 1994 on assumed 50% exploitation in the river brood stock fishery and in 1994-96 on mark-recovery estimates.
[4]HR in R. Drammen, R. Imsa and R. Lagan are pooled groups of 1+ and 2+ smolts.
[5]Provisional figures.
[6]Net only.
W = Wild
HR = Hatchery reared.
'-' = no data

Reporting rates for external tags:

Norway	0.50
Sweden	0.65
Elsewhere	0.50

Continued..........

Table 3.3.9.1 (cont'd) Estimated exploitation rates (in %) of salmon in homewater fisheries in the North East Atlantic area (Russia)

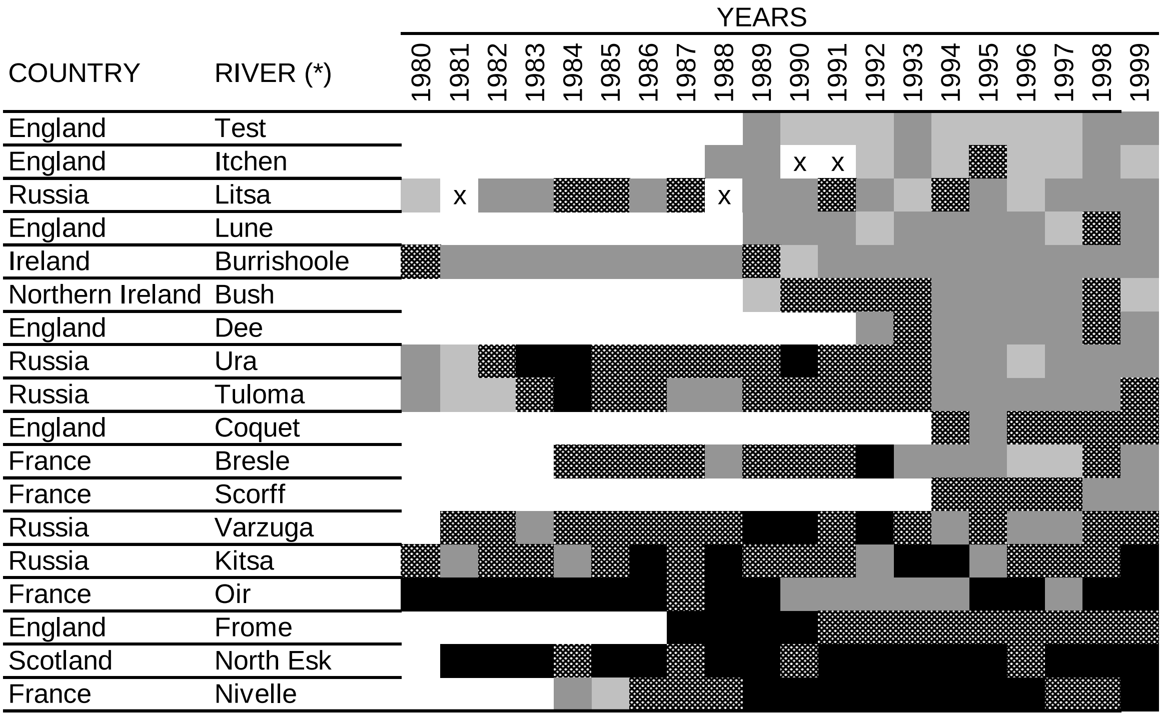
	Russia[1,6] Barents sea basin				Russia[1,6] White sea basin			
	B.Z.Litsa net	Ura net	Tuloma net	Kola net	Ponoi net and rods	Kitsa net	Varzuga net	Umba net
Year	W	W	W	W+HR	W	W	W	W
	all sea ages							
1985	48	49	47	90	47	46	39	50
1986	49	50	50	77	50	44	49	50
1987	49	49	49	91	48	35	37	35
1988	49	48	51	87	77	35	36	34
1989	49	48	50	84	78	35	37	31
1990	49	47	50	80	50	35	35	3
1991	51	48	48	58	20	32	31	13
1992	42	49	45	77	11	30	29	5
1993	48	64	39	79	10	23	27	9
1994	38	48	42	73	14	15	30	15
1995	44	45	49	77	14 [7]	22	27	8
1996	42	49	43	66	10 [7]	20	14	8
1997	30	32	16	43	19	21	12	9
1998	24	24	0	31	14	20	32	0
1999	38	39	3	0	12	18	17	0
Mean								
1989-98	42	45	38	67	27	25	27	10
1994- 98	36	40	30	58	16	20	23	8

[1]Estimate based on counter and catch figures.

[6]Net only.

[7] Commercial fisheries on the Ponoi were closed in 1993 and catch-and-release rod fishing was introduced.

Table 3.4.1.1 Conservation limits achievement (egg deposition /conservation limit) in rivers in the NEAC area



(*) Rivers ranked by mean % Conservation Limit achieved over the last 10 years

Fraction of conservation limit attained :
(egg deposition / conservation limit)

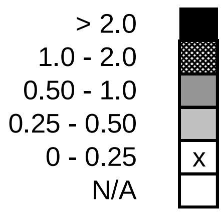


Table 3.4.2.1 Wild smolt counts and estimates, and juvenile survey data on various index streams in the North East Atlantic (Finland, Norway and Sweden).

Year	Finland			Norway			Sweden
	River Teno	River[1] Inarijoki	River[1] Utsjoki	River Halselva	River Imsa	River Orkla	River Hogvadsån
	Juvenile Survey[3]	Juvenile Survey[3]	Juvenile Survey[2]	Smolt Total count	Smolt Total count	Smolt Estimate	Smolt Partial Count[3]
1964							9,771
1965							2,610
1966							367
1967							627
1968							1,564
1969							4,742
1970							242
1971							-
1972							-
1973							1,184
1974							184
1975							363
1976							247
1977							-
1978							38
1979	19.9	18.0	93.2				103
1980	26.4	37.2	46.2				1,064
1981	13.4[5]	17.9	52.3		3,214		500
1982	36.6	19.7	70.5		736		1,566
1983	53.4	51.8	86.5		1,287	121,000	2,982
1984	39.1	40.6	70.7		936	183,000	4,961
1985	60.8	40.8	84.2		892	173,000	4,989
1986	52.0	40.5	41.5		477	227,000	2,076
1987	45.1	45.5	70.8		480	238,000	3,173
1988	33.4	46.2	49.0		1,700	152,000	2,571
1989	36.1	37.9	81.3	788	1,194	-	882
1990	35.3	51.1	101.5	812	1,822	323,000	1,042
1991	40.7	53.2	32.3	1,377	1,995	243,000	1,235
1992	25.8[4]	48.2	51.2	865	1,500	262,534	1,247
1993	34.0	41.5	66.7	613	398	297,264	1,305
1994	50.8	60.9	96.9	494	34	165,875	993
1995	45.7	40.5	63.5	497	369	174,677	1,525
1996	32.3	27.1	48.7	558	773	162,522	795
1997	27.2	38.3	56.7	1,013	1,180	225,471	703
1998	24.1	38.4	57.0	1,106	305	124,545	1,180
1999	38.9	49.1	-	333	532	159,728	979
Mean 94–97	36.0	41.0	64.6	734	734	170,618	1,039

[1] Major tributary of River Teno; [2] Juvenile survey represents mean fry and parr abundance (number 100 m^2 caught by electrofishing) at 35, 10 and 12 sites respectively.

[3] Smolt trap catch represents part of the run.; [4] Incomplete data. Minimum numbers due to high water levels.

Table 3.4.2.1 (Cont'd) Wild smolt counts and estimates, and juvenile survey data on various index streams in the North East Atlantic (Iceland, France, Ireland, UK(N.Ireland), and UK(Scotland).

Year	Iceland		France			Ireland	UK (N Ireland)		UK (Scotland)		
	River Ellidaar	River Vesturdalsa	River Nivelle	River Oir	River Bresle	River Burrishoole	River Bush		River North Esk	Girnock Burn	Baddock Burn
	Smolt Estimate	Smolt Estimate	Juvenile Survey[5]	Smolt est.	Smolt est.	Smolt Total trap	Smolt Total Trap	Juvenile Survey[6]	Smolt est.	Smolt Total trap	Smolt Total trap
1964									275,000		
1965									183,000		
1966									172,000		
1967									98,000	2,057	
1968									227,000	1,440	
1969									-	2,610	
1970									-	2,412	
1971									167,000	2,461	
1972									260,000	2,830	
1973									165,000	1,812	
1974							43,958		106,000	2,842	
1975							33,365		173,000	2,444	
1976							21,021		93,000	2,762	
1977							19,693		-	3,679	
1978							27,104		-	3,149	
1979							24,733		-	2,724	
1980						11,208	20,139		132,000	3,074	
1981						9,434	14,509		195,000	1,640	
1982					3,120	10,381	10,694		160,000	1,626	
1983					3,155	9,383	26,804	32.6	-	1,747	
1984					2,095	7,270	30,009[7]	19.5	225,000	3,247	
1985	29,000		882	529	4,130	6,268	30,518[7]	7.6	130,000	2,716	
1986	-		6,881[8]	1,312	1,940	5,376	18,442	11.3	-	2,091	
1987	-		11,039[8]	363	1,080	3,817	21,994	10.3	199,000	1,132	
1988	23,000		9,946[8]	419	2,400	6,554	22,783	8.9	-	2,595	
1989	22,500	14,642	6,658[8]	830	-	6,563	17,644	16.2	141,000	1,360	
1990	24,000	11,115	2,505[8]	808	-	5,968	17,133	5.6	175,000	2,042	1,907
1991	22,000	9,300	5,287[8]	202	-	3,804	18,218	12.5	236,000	1,503	2,582
1992	27,700	19,100	3,452	672	1,160	6,926	10,021	13.0	-	2,572	2,029
1993	18,000	-[10]	2,640	226	1,700	5,429	11,583[9]	7.8	-	2,147	-
1994	14,500	-[10]	8,092[8]	539	2,400	5,971	14,145	11.5	148,000	1,223	1,280
1995	18,000	6,750	2,841	733	-	5,998	5,718	8.5	138,000	2,056	1,789
1996	23,200	11,500	5,068	1,003	1,320	5,854	12,449	9.9	162,000	1,636	1,627
1997	16,500	14,741	5,888	724	6,300	6,331	10,783	6.9	143,000	2,788	2,913
1998	17,064	3,735	5,392	1,034	1,650	9,588	14,819	3.5	-	1,652	1,417
1999	-	-	8,797	316	410	7,188	11,921	15.1	-	2,386	1,363
Mean 94–98	17,853	9,182	5,456	807	2,918	6,748	11,583	8.0	147,750	1,871	1,816

[5] Estimate of 0+ parr population size in autumn.
[6] Juvenile surveys represent index of fry (0+) abundance (number per 5 minutes electrofishing) at 137 sites, based on natural spawning in the previous year.
[7] These smolt counts show effects of enhancement.
[8] Influenced by enhancement (fry releases).
[9] Minimum estimate due to severe flooding.
[10] Smolt counts too small for estimate.

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Table 3.4.2.2 Status of stocks in the North East Atlantic. Summary of trend analyses on smolt counts and survival based on a non-parametric method (1000 iterations). (p <0.1 means significance upward, trend, p>0.9 means significant downward trend).

Type of data	**Rivers (Countries)**	**Life stage**	**Period (years)**	**'p' value**	**Trend**
Section 3.4.2 Smolt counts	Southern rivers: Oir (Fra), Burrishoole (Irl), Bush (UK NI), North Esk, Girnock, Baddoch (UK Scot)	Smolts	5	0.31	Nt
			10	0.96	**Dn**
	Northern rivers: Orkla, Halselva (Nor), Högvadsån (Swe)	Smolts	5	0.73	Nt
			10	0.98	**Dn**
	Southern + Northern rivers + Ellidaar, Vesturdalsa (Ice).	Smolts	5	0.51	Nt
			10	0.99	**Dn**
Section 3.4.4 Wild smolt	Corrib (Irl), Bush (UK NI), Imsa (Nor), North Esk (UK Scot), Ellidaar + Midfjardara(Ice)	1SW return to homewaters	10	0.93	**Dn**
survival	Corrib (Irl)+Bush, Imsa (Nor), North Esk (UK Scot), Ellidaar+Midfjardara (Ice)	1SW return to homewaters	5	0.96	**Dn**
	Corrib (Irl), Imsa (Nor), North Esk (UK Scot), Midfjardara (Ice)	2SW return to homewaters	10	0.71	Nt
	Corrib (Irl), Imsa (Nor), North Esk (UK Scot), Midfjardara (Ice)	2SW return to homewaters	5	0.10	Nt
Section 3.4.4 Hatchery smolt	Midfjardara (Ice), Burrishoole (Irl), Bush (UK NI), Imsa and Drammen (Nor), Lagan (Swe)	1SW return to homewaters	10	0.99	**Dn**
survival	Midfjardara (Ice), Burrishoole (Irl), Bush (UK NI), Imsa and Drammen (Nor), Lagan (Swe)	1SW return to homewaters	5	0.48	Nt
	Midfjardara (Ice), Imsa + Drammen (Nor), Lagan (Swe)	2SW return to homewaters	10	1	**Dn**
	Midfjardara (Ice), Imsa + Drammen (Nor), Lagan (Swe)	2SW return to homewaters	5	0.98	**Dn**

Trends: Up = significant increase
Dn = significant decrease
Nt = no trend

Table 3.4.3.1 Wild adult counts to various rivers in the North East Atlantic area (Iceland, Sweden and Russia).

Year	Iceland	Sweden	Russia	Russia	Russia	Russia	Russia	Russia	Russia	Russia	Russia
	River Ellidaar	River Högvadsån	River Ura	River Kitsa	River Tuloma	River Varzuga	River Keret	River Ponoy[1]	River Kola	River Yokanga	R. Zap. Litca
	Estimate	Total trap	Total trap	Total Trap	Total trap	Total trap	Total trap	Total trap	Total trap	Total trap	Total trap
1952	3792				4800						
1953	2526				2950						
1954	2794	364			4010						
1955	4118	210			4600				4855		
1956	2911	144			4800				2176		
1957	2965	126			4300				2949		
1958	3057	632	983		6228				1771		1051
1959	4773	197	997		6125				2790		1642
1960	4815	209	3293		10360				5030		2915
1961	3779	229	2178		11050	55480			5121		2091
1962	3126	385	1184		10920	69388			5776	3655	2196
1963	4031	217	811		7880	64210			3656	3253	1983
1964	4526	390	787		4400	21424		23666	3268	2642	1664
1965	3249	442	1334		5600	63812		12998	3676	4482	1506
1966	4274	375	925		3648	21086		10333	3218	2488	787
1967	4839	90	2679		9011	20534		11527	7170	4993	1486
1968	3024	172	1996		6277	47258		18352	5008	3357	1971
1969	3580	321	967		4538	53048		9267	6525	1437	2341
1970	2187	610	1792		6175	55556		9822	5416	1117	2048
1971	2590	173	1172		3284	71400		8523	4784	2300	1502
1972	4627	281	1693		6554	48858		10975	8695	1620	1316
1973	6014	100	2502	4472	9726	45750		20553	9780	869	1319
1974	6925	270	1968	3564	12784	39360		24652	15419	280	2605
1975	7184	138	3249	13950	11074	89836		41666	12793	736	2456
1976	3331	65	2110	6996	8060	57246		44283	9360	2767	1325
1977	3756	49	2784	7976	2878	35354		37159	7180	2488	1595
1978	4372	23	1358	4410	3742	18483		24045	5525	1715	766
1979	4948	15	888	5998	2887	40992		17920	6281	598	700
1980	2632	260	957	2310	4087	43664		15069	7265	1052	548
1981	2656	512	438	5013	3467	32158		11670	7131	472	477
1982	4275	572	1205	4158	4252	26824		9585	5898	1200	889
1983	3257	447	2108	3778	9102	59784		15594	10643	1769	1254
1984	1659	629	4458	7498	10971	39636		26330	10970	2498	1859
1985	2896	768	2634	11134	8067	48566		38787	6163	1774	1563
1986	2651	1632	2474	7290	7275	71562	3230	32266	6508	3212	1815
1987	2191	1475	1788	9911	5470	137419	3427	21212	6300	3468	1498
1988	4435	1283	1252	10488	8069	72528	3294	20620	5203	2270	575
1989	4329	480	2434	3697	8413	65524	3531	19214	10929	2850	2613
1990	3383	879	1558	6548	11594	56000	2520	37712	13383	3376	1194
1991	3020	534	1328	3041	7253	63000	690	21000	8500	1704	2081
1992	2917	345	3391	8587	5377	61300	536	26600	14670	5208	2755
1993	3363	603	1972	2956	4516	68300	687	26800	11400	2600	2267
1994	2298	640	1738	3222	3316	77800	753	28600	9730	2500	2100
1995	2509	156	1461	3207	4737	42290	1066	33100	6051	1153	1916
1996	2170	249	1171	4740	4424	67900	391	32600	7700	2700	2330
1997	1132	189	2028	5222	4405	73430	180	37600	6180	2700	1350
1998	875	160	1100	5560	3338	83050	607	34400	4848	-	1510
1999	628	450	2180	4300	6040	71000	333	31700	7950	-	1720
Mean 94–98	1797	279	1500	4390	4044	68894	599	33260	6902	2263	1841

[1]Mark recapture estimate from 1994.

Continued....

Table 3.4.3.1 Cont'd Wild adult counts to various rivers in the NE Atlantic area. (Russia and UK).

	Russia	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (E&W)	UK (NI)	UK (NI)	UK (NI)	UK (NI)
Year	Umba	Frome	Test	Itchen	Kent	Leven	Tamar	Dee	Lune	Caldew	Roe	Bush	Faughan	Mourne
	Total trap	Counter	Counter + catch	Counter + catch	Counter	Counter	Counter	Counter + catch	Counter	Trap	Counter	Total trap	Counter	Counter
1966													6792	15112
1967													1723	7087
1968													1657	2147
1969	2030												1195	1569
1970	1316												3214	5050
1971	288												1758	4401
1972	548												1020	1453
1973	2536											2614	1885	2959
1974	2692											3483	2709	3630
1975	5432											3366	1617	1742
1976	1926											3124	2040	2259
1977	3692											1775	2625	2419
1978	3308											1621	2587	5057
1979	3772											1820	3262	2226
1980	5924											2863	3288	3146
1981	6252											1539	3772	2399
1982	8690											1571	2909	4755
1983	7850											1030	2410	1271
1984	6326											672[1]	2116	1877
1985	12190											2443	9077	8149
1986	8568											2930	4915	6295
1987	10040											2530	907	2322
1988	8455	4093	1507	1336								2832	3228	7572
1989	12029	3186	1730	791	1137				8785			1029	8287	9497
1990	9040	1880	790	367	2216				8261			1850	6458	11541
1991	6400	805	538	152	1736	667			7591			2341	4301	7987
1992	8400	900	614	357	1816	394		4643	5567			2546	7375	7420
1993	8500	1182	1249	852	1526	469		9757	10852			3235	8655	17855
1994	6800	1078	775	374	2072	562	6343	5285	9236	1590		2010	7439	19908
1995	7340	1016	647	880	2762	329	5623	5703	6111	1417		1521	5838	7547
1996	6450	1353	623	437	3246	387	3975	4931	6080	1289		1097	13297	5475
1997	6200	1157	361	246	1476	233	2813	5496	4371	889		1677	n/a	6979
1998	6440	1210	898	453	801	n/a	3132	6661	7457	1106	2600	2995	n/a	6077
1999	6850	n/a	957	213	1022	n/a	2619	3794	5739	1022	n/a	959	n/a	8500
Mean 94–98	6646	1163	661	478	2071	378	4377	5615	6651	1258	-	1860		9197

[1]Minimum count.

In the UK(Scotl.)Girnock, the trap is located in the Girnock Burn, a tributary in the upper reaches of the River Dee (Aberdeenshire). In the UK(Scotl.) N. Esk, counts are recorded upstream of the in-river commercial fishery and most important angling fishery. Thus, the counts do not necssarily reflect the numbers of fish entering the river.

Table 3.4.3.1 Cont'd Wild adult counts to various rivers in the NE Atlantic area (UK , France, Norway and Ireland).

	UK (Scotl.)	UK (Scotl.)	UK (Scotl.)	UK (Scotl.)	France	France	France	France	Norway	Norway	Ireland
Year	N. Esk	West Water	Girnock	Baddoch	Nivelle	Oir	Scorff	Bresle	Halselva	Imsa	Burrishoole
	Counter	Counter	Total trap Females	Total trap Females	Trap est.	Trap est.	Trap est.	Trap est.	Total trap	Total trap	Total trap
1966			156								
1967			115								
1968			111								
1969			31								
1970			34								
1971			61								
1972			79								
1973			127								
1974			105								
1975			65								
1976			90								
1977			49								
1978			16								
1979			49								
1980			121								832
1981	9025		41								348
1982	8121		43							66	510
1983	8972		26							14	602
1984	7007		58		33	307		110		32	319
1985	9912		30		61	296		135		31	567
1986	6987		75		204	216		210		22	495
1987	7014		110		138	180		200	52	9	468
1988	11243		112	47	130	235		105	77	44	458
1989	11026		43	67	263	235		220	64	83	662
1990	4762		29	52	291	84		125	68	67	231
1991	9127	2962	57	46	184	47		215	89	43	547
1992	10795	2809	35	32	234	60		225	35	70	360
1993	10887	2699	21	27	472	176		75	18	39	528
1994	11341	2976	37	40	317	155	694[1]	105	29	30	516
1995	9864	2391	71	16	195	128	982	80	9	1	561
1996	7993	2656	41	26	214	196	756	40	25	2	405
1997	11315	2926	9	9	126	67	542	45	77	9	538
1998	10474	2422	11	10	160	189	551	270	38	20	516
1999	11789	2312	22	22	160	257	353	62	14	36	508
Mean 94–98	10197	2674	34	20	202	147	705	108	36	12	507

[1] Grilse only

Table 3.4.4.1 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		UK (N.Ireland)[8]	Norway[2]		UK (Scotland)[2]			France	
migration	Ellidaar	R.Vesturdalsa[4]		R.Midfjardara[4]		River Corrib	River Corrib	R. Bush	R. Imsa		North Esk			Nivelle[6]	Bresle
year	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW[3]	1SW	2SW	1SW	2SW	3SW	All ages	All ages
1975	20.8														
1980						14.3	1.6								
1981						10.0	3.0		17.3	4.0	13.7	6.9	0.3		
1982						16.7	2.6		5.3	1.2	12.6	5.4	0.2		
1983		2.0				8.0	1.0		13.5	1.3	-	-	-		
1984						20.0	1.6		12.1	1.8	10.0	4.1	0.1		
1985	9.4					15.1	2.5		10.2	2.1	26.1	6.4	0.2		
1986						-	-	31.3	3.8	4.2	-	-	-	15.1	
1987				2.4	1.4	13.2	1.0	35.1	17.3	5.6	13.9	3.4	0.1	2.6	
1988	12.7			0.6	0.9	7.5	0.6	36.2	13.3	1.1	-	-	-	2.4	
1989	8.1	1.1	2.0	0.2	0.7	5.3	2.1	25.0	8.7	2.2	7.8	4.9	0.1	3.5	
1990	5.4	1.0	1.0	1.2	1.3	4.1	1.4	34.7	3.0	1.3	7.3	3.1	0.2	1.8	
1991	8.8	4.2	0.6	1.1	0.5	5.6	1.1	27.8	8.7	1.2	11.2	4.5	-	9.2	
1992	9.6	2.4	0.8	1.4	0.5	5.9	-	29.0	6.7	0.9	-	-	-	8.9	6.9[7]
1993	9.8	-	-	1.0	1.1	9.0	1.6	-	15.6		-	-	-	8.3[7]	10.3[7]
1994	9.0	-	-	1.4	0.6	8.4	1.1	27.1	-	-	17.2	2.3	0.1	7.2[7]	7.5[7]
1995	9.4	1.6	1.2	0.3	0.9	7.4	0.1	n/a	1.8	1.5	11.5	5.1	0.1	2.3	n/a
1996	4.6	1.4	0.3	1.2	0.7	4.9	0.9	31.0	3.5	0.9	10.7	3.5	0.2	4.4	n/a
1997	5.3	0.7	0.5	2.4	0.5	9.7	0.3	19.8	1.5	0.2	10.3	6.3	n/a	3.3	4.8
1998	4.4	1.9		1.3		2.9		13.4	7.2		n/a	n/a		2.0	-
Mean															
(5-year)	7.6	1.2	0.8	1.3	0.8	7.9	0.9	26.0	5.6	1.1	12.4	4.3	0.1	3.3	4.8
(10-year)	8.3	1.8	1.0	1.1	0.9	6.8	1.1	28.8	7.0	1.8	10.9	3.8	0.1	4.5	4.8

[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.

umes 30% exploitation in trap fishery.

Table 3.4.4.2 Estimated survival of wild smolts (%) into freshwater for various monitored rivers in the NE Alantic area.

Smolt year	Iceland[1]					Ireland		Ireland	UK(N.Ireland)		Norway[2]		UK (Scotland)[1]			France		
	River Ellidaar	River Vesturdalsa[5]		River Midfjardara[5]		River Corrib[8]		River Burrishoole	River Bush		River Imsa		North Esk[4]			Oir [3]	Nivelle [6]	Bresle
	1SW	1SW	2SW	1SW	2SW	1SW	2SW	1SW	1SW	2SW	1SW	2SW	1SW	2SW	3SW	All ages	All ages	All ages
1975	20.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	7.3	-	-	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	2.6	0.8	3.1	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	3.3	1.3	5.4	9.5	0.9	2.1	0.3	4.2	2.0	0.2	-	-	-
1982	-	-	-	-	-	5.7	1.6	5.8	7.8	0.8	0.7	0.1	4.9	2.2	0.2	-	-	-
1983	-	2.0	-	-	-	3.2	0.3	3.4	1.9 [3]	1.7	2.4	0.1	-	-	-	3.2	-	-
1984	-	-	-	-	-	4.5	0.7	7.8	6.4	1.4	3.2	0.3	3.9	2.1	0.1	7.7	-	-
1985	9.4	-	-	-	-	4.0	0.8	7.9	7.9	1.9	2.1	0.1	5.9	2.9	0.2	7.5	-	-
1986	-	-	-	-	-	-	-	8.7	9.7	1.9	1.7	0.8	-	-	-	3.6	15.1	-
1987	-	-	-	2.4	1.4	6.0	0.4	12.0	12.0	0.4	8.3	1.5	6.7	2.1	0.1	7.3	2.6	-
1988	12.7	-	-	0.6	0.9	3.7	0.2	10.1	3.9	0.8	4.5	0.6	-	-	-	2.0	2.4	-
1989	8.1	1.1	2.0	0.2	0.7	2.5	1.6	3.5	9.3	1.4	4.9	0.6	3.5	2.7	0.1	1.6	3.5	-
1990	5.4	1.0	1.0	1.2	1.3	2.3	1.2	9.2	11.8	1.7	1.7	0.3	4.2	2.1	0.2	3.5	1.8	-
1991	8.8	4.2	0.6	1.1	0.5	2.5	0.4	9.5	12.0	2.2	3.4	0.2	5.2	2.3	0.2	11.3	9.2	-
1992	9.6	2.4	0.8	1.4	0.5	2.7	-	7.6	16.8	2.0	3.1	0.2	-	-	-	5.4	8.9	5.8
1993	9.8	-	-	1.0	1.1	1.9	1.0	9.5	15.1	2.0	7.0	-	-	-	-	17.0	8.3	6.3
1994	9.0	-	-	1.4	0.6	2.4	0.5	9.4	8.9	0.7	-	-	4.9	2.0	0.1	3.0	7.2	4.3 [7]
1995	9.4	1.6	1.2	0.3	0.9	2.5	0.0	6.8	n/a	2.4	0.6	0.3	5.2	3.2	0.1	4.0	2.3	n/a
1996	4.6	1.4	0.3	1.2	0.7	2.3	0.4	9.2	12.1	2.1	1.5	0.6	5.5	2.8	0.2	4.0	4.4	2.7
1997	5.3	0.7	0.5	2.4	0.5	3.6	0.2	8.2	14.5	2.1	1.3	0.2	5.4	3.6	n/a		3.3	4.4
1998	4.4	1.9		1.3		1.1		5.3	4.9	0.7	7.2		n/a	n/a			2.0	4.6
Mean																		
(5-year)	7.6	1.2	0.8	1.3	0.8	1.9	0.5	8.6	12.7	1.9	2.6	0.4	5.3	2.9	0.1	7.0	5.1	4.5
(10-year)	8.3	1.8	1.0	1.1	0.9	2.6	0.6	8.3	11.6	1.7	3.1	0.5	4.8	2.7	0.2	5.8	5.1	4.8

[1] Microtags.
[2] Carlin tags, not correctd for tagging mortality.
[3] Minimum estimate.
[4] Before in-river netting.
[5] Assumes 50% exploitotation in rod fishery.
[6] Survival of 0+parr to adults.
[7] Incomplete returns.
[8] Assumes 30% exploitation in trap fishery.

Table 3.4.4.3 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. Midfjardara[3]		Ireland[1] R. Burris-hoole[3]	N. Ireland[1] R. Bush (1SW)		Norway[2] R. Imsa		Norway[2] R. Drammen		Sweden[2] R. Lagan	
	1SW	2SW	1SW	1+ smolts	2+ smolts	1SW	2SW	1SW	2SW	1SW	2SW
1981			10.5	-	-	10.1	1.3	-	-	-	-
1982			9.7	-	-	4.2	0.6	-	-	-	-
1983	0.0	0.2	3.6	1.9	8.1	1.6	0.1	-	-	-	-
1984	0.5	0.2	25.1	13.3	-	3.8	0.4	3.5	3.0	11.8	1.1
1985	0.4	0.1	28.9	15.4	17.5	5.8	1.3	3.4	1.9	11.8	0.9
1986	0.4	0.7	9.4	2.0	9.7	4.7	0.8	6.1	2.2	7.9	2.5
1987	2.7	0.7	13.6	6.5	19.4	9.8	1.0	1.7	0.7	8.4	2.4
1988	0.7	0.2	17.9	4.9	6.0	9.5	0.7	0.5	0.3	4.3	0.6
1989	0.7	0.4	5.1	8.1	23.2	3.0	0.9	1.9	1.3	5.0	1.3
1990	1.9	0.5	10.5	5.6	5.6	2.8	1.5	0.3	0.4	5.2	3.1
1991	1.8	0.2	8.4	5.4	8.8	3.2	0.7	0.1	0.1	3.6	1.1
1992	1.3	0.2	7.5	6.0	7.8	3.8	0.7	0.4	0.6	1.5	0.4
1993	0.5	0.2	12.3	1.1	5.8	6.5	0.5	3.0	1.0	2.6	0.9
1994	1.0	0.2	11.5	1.6	-	6.2	0.6	1.2	0.9	4.0	1.2
1995	0.8	0.1	16.8	3.1	2.4	0.4	0.0	0.7	0.3	3.9	0.6
1996	0.1	0.0	5.6	2.0	2.3	2.1	0.2	0.3	0.2	3.5	0.5
1997	0.9	0.0	9.0	no release	4.1	1.0	0.0	0.6	0.2	0.6	0.0
1998	no release		4.9	2.3	4.5	2.3		1.7		0.7	
Mean											
(5-year)	0.7	0.1	9.6	2.3	3.7	2.4	0.3	0.9	0.5	2.5	0.6
(10-year)	1.0	0.2	9.2	3.9	7.3	3.9	0.6	1.0	0.5	3.1	1.0

[1]Microtagged.

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

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

Table 3.4.4.4 Estimated survival of hatchery smolts (%) to adult return to freshwater, for various monitored rivers and experimental facilities in the NE Atlantic area.

Smolt year	Iceland[1] R. Midfjardara[3]		Ireland[1] R.Burri-shoole[3]	N. Ireland[1] R. Bush (1SW)		Norway[2] R. Imsa		Norway[2] R. Drammen		Sweden[4] R. Lagan	
	1SW	2SW	1SW	1+ smolts	2+ smolts	1SW	2SW	1SW	2SW	1SW	2SW
1981			1.3	-	-	2.0	0.1	-	-	-	-
1982			1.7	-	-	0.2	0.0	-	-	-	-
1983	0.0	0.2	0.5	0.1	0.4	0.1	0.0	-	-	-	-
1984	0.5	0.2	3.4	0.9	-	0.6	0.0	2.5	1.2	-	-
1985	0.4	0.1	4.0	2.8	4.3	1.3	0.1	0.6	0.9	-	-
1986	0.4	0.7	0.1	2.1	1.1	0.1	2.2	1.1	-	-	-
1987	2.7	0.7	3.4	1.8	8.2	2.1	0.3	0.5	0.3	-	-
1988	0.7	0.2	3.3	0.4	1.0	4.8	0.2	0.3	0.2	-	-
1989	0.7	0.4	2.5	2.9	6.8	1.5	0.3	1.4	0.6	-	-
1990	1.9	0.5	3.7	2.4	3.0	1.3	0.1	0.1	0.2	-	-
1991	1.8	0.2	2.5	1.4	2.2	0.8	0.1	-	-	-	-
1992	1.3	0.2	2.2	2.0	2.3	0.6	0.1	0.3	0.4	-	0.1
1993	0.5	0.2	3.3	0.3	2.0	2.2	0.0	1.7	0.6	1.1	0.6
1994	1.0	0.2	1.8	0.5	-	2.6	0.1	0.8	0.6	3.0	0.6
1995	0.8	0.1	3.1	0.6	0.6	0.1	0.0	0.7	0.3	1.4	0.3
1996	0.1	0.0	1.8	0.4	0.6	0.7	0.1	0.3	0.1	1.6	0.5
1997	0.9	0.0	1.6	no release	2.8	0.9	0.0	0.4	0.1	0.1	0.0
1998	no release		0.9	0.7	2.2	1.9		1.5		0.2	
Mean											
(5-year)	0.7	0.1	2.3	0.4	1.5	1.3	0.1	0.8	0.4	1.4	0.4
(10-year)	1.0	0.3	2.6	1.2	2.4	1.6	0.1	0.7	0.4	1.4	0.4

[1]Microtagged.

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

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

[4]Carlin tagged, not corrected for tagging mortality. Return rate to broodstock and rod fishery. Estimated exploitation in broodstock fishery in 1994 and 1995 : 49% and 27%.

Table 3.5.1 Assessment of the effects of the suspension of commercial fishing at Faroes on the numbers of salmon returning to home waters.

		Fishing season							
		1991/92	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**	**1997/98**	**1998/99**
NASCO quota (t) for the calender year if fishery operated [a]		550	550	550	550	470	425	380	330
Expected No. fish **landed** if quota had been taken [b]		147,048	162,850	182,027	172,931	142,037	128,438	140,927	122,384
Discard rate		8.8%	9.4%	14.4%	15.1%	11.9% [c]	11.9% [c]	16.9%	16.9% [g]
Discard mortality		80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80%	80%
Expected No. fish killed if fishery operated		158,399	176,367	206,524	197,536	157,422	142,350	163,855	142,295
No. fish **killed** in research fishery		9,350	9,099	3,035	4,187	282	0	1465	0
Total number of fish saved per year		149,049	167,268	203,489	193,349	157,140	142,350	162,390	142,295
Proportion of farmed fish in catch		37.0%	27.0%	17.0%	19.0%	19.0%	19.0%	19.0%	19.0% [f]
Number farm escapees spared		55,148	45,162	34,593	36,736	29,857	27,046	30,854	27,036
Number of wild fish spared		93,901	122,106	168,896	156,613	127,283	115,303	131,536	115,259
Sea age composition of wild fish:	1SW	4.0%	12.0%	16.0%	10.6%	10.7% [d]	10.7% [d]	19.2%	19.2%
	2SW	83.0%	61.0%	64.0%	80.8%	72.2% [d]	72.2% [d]	74.6%	74.6%
	2SW+	13.0%	27.0%	20.0%	8.6%	17.2% [d]	17.2% [d]	6.2%	6.2%
		1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Additional salmon	**1SW**	**2,842**	**11,429**	**21,078**	**12,949**	**10,573**	**9,578**	**19,699**	**17,261**
expected to have returned:	**MSW**	**70,809**	**106,307**	**134,159**	**138,533**	**122,196**	**105,368**	**103,169**	**99,130**
Estimated **1SW** returns to all European homewaters: [e]		2,288,367	2,120,034	2,403,850	2,065,777	2,031,660	1,987,470	2304352	1323038
% 1SW returns derived from suspension of commerial fishing at Faroes:		0%	1%	1%	1%	1%	0%	1%	1%
Estimated **MSW** returns to all European homewaters: [e]		1,161,890	1,095,400	1,210,235	1,104,759	1,010,548	780,398	773018	778804
% MSW returns derived from suspension of commerial fishing at Faroes:		6%	10%	11%	13%	12%	14%	13%	13%
Estimated **1SW** returns to Northern European homewaters: [e]		1,049,894	914,669	985,292	909,448	906,526	940,116	1091123	742108
% 1SW returns derived from suspension of commerial fishing at Faroes: (Assuming 65% from N. Europe)		0%	1%	1%	1%	1%	1%	1%	2%
Estimated **MSW** returns to Northern European homewaters: [e]		552,741	546,852	541,139	482,513	468,991	378,683	402698	475014
% MSW returns derived from suspension of commerial fishing at Faroes: (Assuming 65% from N. Europe)		8%	13%	16%	19%	17%	18%	17%	14%

a. NASCO quota agreed for the calender year in the latter part of the fishing season.

b. Expected no. landed in year *y* calculated from quota: Sum(p_i /w_i)*$Quota_y$, p_i is proportion of age group *i*, *i* = 1; 2 and 2+SW, and w_i is mean weight of sea age *i*.

c. No data, estimated from mean discard rate 1992-95.

d. No data, mean values from 1992-95 data.

e. Includes farmed escapees.

f. Data not yet available, mean value from 1994-1996 data

g. Taken from 1997/98 research fishery

Table 3.5.2 Results of non-parametric ratio analysis to examine changes in homewater catches or returns after the cessation of commercial fishing at Faroes in 1991

Type of data	Area considered	Periods compared	p value	Effect
1SW catches in Northern Europe	Finland, Sweden, Norway	1987-91 vs 1992-99	0.008	**Lower catch**
	Norway only	1987-91 vs 1992-99	< 0.001	**Lower catch**
1SW catches in Southern Europe	Ireland (total catch), UK(Scot), UK (E&W) total catch, France	1987-91 vs 1992-99	0.003	**Lower catch**
MSW catches in Northern Europe	Finland, Sweden, Norway	1987-91 vs 1992-99	0.109	Not significant
	Norway only	1987-91 vs 1992-99	0.101	Not significant
MSW catches in Southern Europe	UK (Scot), France	1987-91 vs 1992-99	0.012	**Lower catch**
Russian adult counts All ages	R. Tuloma, Varzuga, Keret, Ponoy, Kola, Yokanga and Zap Litka	1988-91 vs 1991-99	0.18	Not significant

Table 3.5.3. Percent reduction in gear units over the period 1991-1999 for countries where such information is available.

Country	Type of gear units	% Change in gear units over 1991 to 1999
UK (England & Wales)	Gillnet Sweepnet Hand-held net Fixed engine	-40 -42 -33 -55
UK (Scotland)	Fixed engine Net and coble	-69 -64
UK (N. Ireland)	Driftnet Draftnet Bagnets and boxes	-4 -49 -39
Norway	Bagnet Bendnet	-30 -73
Ireland	Driftnet Draftnet Other nets	23 0 -13
France	Commercial nets in freshwater Commercial nets in estuary	-81 -14

Table 3.6.1.1 Estimated number of RETURNING 1SW salmon by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	Est.	SD	Est.	SD
1971	7,816	54,100	44,584	1,309,418	542,551	123,214	12,028	154,565	131,797	1,357,014	**3,006,894**	312,528	**730,193**	77,203	**3,737,086**	321,922
1972	12,180	107,332	40,699	1,441,366	710,647	136,168	9,569	190,057	118,434	1,294,669	**3,151,858**	307,943	**909,262**	101,346	**4,061,120**	324,192
1973	18,435	65,011	41,500	1,544,840	780,023	227,949	11,921	188,100	102,884	1,505,107	**3,405,942**	344,546	**1,079,828**	111,786	**4,485,769**	362,226
1974	16,886	30,114	29,313	1,700,643	733,824	209,024	17,131	194,433	103,569	1,471,339	**3,500,097**	352,756	**1,006,177**	105,966	**4,506,274**	368,328
1975	16,726	60,209	41,969	1,775,250	692,879	222,776	18,336	230,129	92,524	1,140,874	**3,298,986**	290,411	**992,685**	99,905	**4,291,671**	307,115
1976	14,558	56,044	36,001	1,254,844	691,676	168,049	10,359	136,727	63,897	956,009	**2,467,522**	237,416	**920,644**	98,709	**3,388,166**	257,118
1977	12,965	42,226	40,050	1,100,744	670,528	141,542	4,881	153,208	62,039	995,849	**2,354,065**	229,070	**869,966**	93,709	**3,224,032**	247,496
1978	9,595	44,033	50,030	985,838	477,459	153,669	5,620	170,816	84,055	1,060,942	**2,345,683**	236,822	**696,372**	67,045	**3,042,056**	246,129
1979	9,868	49,904	48,956	882,635	823,531	174,805	5,873	117,100	55,746	955,839	**2,061,223**	224,684	**1,063,033**	119,662	**3,124,256**	254,562
1980	9,769	104,697	15,833	689,544	825,289	115,761	7,470	138,245	68,865	694,674	**1,696,025**	180,063	**974,122**	114,918	**2,670,147**	213,609
1981	9,046	83,598	32,234	417,330	565,819	82,283	13,559	178,914	57,106	875,058	**1,612,004**	221,126	**702,940**	78,411	**2,314,945**	234,617
1982	6,517	51,835	24,661	937,922	418,226	126,398	11,883	109,092	74,840	1,185,006	**2,358,695**	358,820	**587,686**	62,400	**2,946,381**	364,206
1983	9,792	55,451	33,267	1,386,500	707,661	186,000	15,801	139,128	105,452	1,204,164	**2,890,695**	323,631	**952,521**	103,772	**3,843,216**	339,861
1984	12,227	90,733	20,687	631,107	750,866	174,741	22,232	121,862	44,054	1,208,238	**2,095,993**	311,495	**980,753**	107,629	**3,076,746**	329,565
1985	15,493	33,671	41,570	1,180,864	765,132	234,130	26,420	120,988	55,485	904,308	**2,295,317**	253,781	**1,082,745**	110,948	**3,378,061**	276,974
1986	15,396	62,161	63,976	1,222,296	679,673	202,039	27,997	160,557	61,849	1,163,268	**2,670,130**	319,394	**989,081**	100,688	**3,659,212**	334,889
1987	21,733	108,178	42,281	836,633	601,595	328,552	22,719	140,232	31,641	929,329	**2,046,013**	261,464	**1,016,879**	96,336	**3,062,892**	278,647
1988	14,737	37,877	77,661	1,580,247	551,948	180,076	18,960	188,315	68,594	845,225	**2,720,258**	274,394	**843,383**	80,290	**3,563,640**	285,900
1989	21,817	20,068	42,244	724,494	753,036	264,793	6,058	142,820	64,066	1,165,692	**2,117,140**	381,970	**1,087,947**	122,025	**3,205,087**	400,988
1990	21,151	34,350	39,301	558,518	657,825	236,561	14,328	131,951	53,254	556,662	**1,334,735**	178,006	**969,166**	105,720	**2,303,900**	207,033
1991	19,204	24,474	47,160	448,958	603,500	229,243	17,176	75,072	29,891	484,593	**1,062,987**	152,788	**916,284**	94,897	**1,979,271**	179,860
1992	31,531	45,923	63,763	653,802	512,085	191,591	18,728	72,339	59,186	677,960	**1,509,210**	225,276	**817,698**	82,955	**2,326,908**	240,064
1993	23,424	65,390	60,970	519,844	428,543	157,715	20,117	127,317	71,121	640,598	**1,424,270**	209,581	**690,768**	63,972	**2,115,038**	219,127
1994	15,674	49,805	36,306	682,129	434,963	174,041	17,448	179,462	48,957	667,835	**1,628,188**	215,790	**678,432**	63,557	**2,306,619**	224,955
1995	16,480	15,878	53,364	554,898	384,153	156,256	24,831	87,302	46,873	626,072	**1,331,023**	194,285	**635,084**	56,419	**1,966,107**	202,311
1996	26,593	18,932	44,667	622,641	309,108	189,883	15,166	75,517	48,575	530,520	**1,296,184**	174,127	**585,417**	46,580	**1,881,601**	180,250
1997	23,469	9,681	44,281	619,346	353,279	178,569	7,030	67,461	54,774	375,866	**1,127,129**	143,774	**606,628**	52,635	**1,733,757**	153,106
1998	28,677	19,639	73,779	747,022	465,014	195,752	4,007	81,225	120,412	500,916	**1,469,214**	155,892	**767,229**	72,548	**2,236,443**	171,946
1999	35,243	6,388	49,268	361,190	517,202	135,586	4,809	67,994	33,297	212,107	**680,977**	69,057	**742,108**	79,550	**1,423,085**	105,343
10yr Av.	23,933	28,230	50,464	590,259	492,610	191,817	13,609	100,769	57,310	585,347	**1,361,914**	678,218	**772,433**	264,198	**2,134,347**	727,860

Table 3.6.1.2 Estimated number of RETURNING MSW salmon by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	Est.	SD	**Est.**	SD
1971	7,354	11,324	22,527	167,368	346,155	204,419	863	101,726	26,350	614,659	**921,427**	106,739	**581,319**	54,482	**1,502,746**	119,839
1972	11,514	22,708	36,428	184,581	452,166	171,191	608	122,457	23,635	821,173	**1,174,554**	142,403	**671,907**	66,337	**1,846,461**	157,096
1973	17,396	13,790	30,968	196,784	495,754	285,805	2,107	118,332	20,512	896,505	**1,245,923**	155,118	**832,030**	78,681	**2,077,954**	173,932
1974	16,885	6,435	24,662	217,382	469,011	262,515	1,366	120,613	20,744	711,631	**1,076,805**	120,535	**774,439**	71,304	**1,851,244**	140,046
1975	16,678	12,834	30,988	226,776	441,701	328,524	334	139,246	18,489	783,844	**1,181,189**	141,038	**818,226**	75,395	**1,999,415**	159,925
1976	14,294	9,318	23,760	159,428	438,221	279,260	994	79,503	12,704	488,315	**749,268**	95,111	**756,529**	70,468	**1,505,798**	118,372
1977	12,839	7,160	29,814	140,921	424,472	211,185	748	87,454	12,331	599,610	**847,476**	112,435	**679,059**	64,658	**1,526,535**	129,701
1978	8,124	7,436	39,420	125,442	302,434	146,328	576	95,584	16,718	710,147	**955,328**	135,613	**496,882**	46,261	**1,452,210**	143,287
1979	6,461	8,434	27,380	112,109	520,857	161,559	1,679	63,699	11,077	569,350	**764,668**	107,453	**717,937**	74,913	**1,482,605**	130,989
1980	8,622	17,463	34,405	125,650	518,657	244,655	2,900	72,453	13,610	661,623	**890,799**	118,680	**809,239**	77,147	**1,700,038**	141,550
1981	13,748	12,420	16,320	102,241	544,954	133,565	855	92,283	11,328	800,645	**1,018,916**	165,650	**709,442**	78,314	**1,728,358**	183,230
1982	15,078	7,566	16,181	51,781	444,024	135,547	3,055	54,423	14,808	582,484	**711,062**	117,461	**613,886**	63,388	**1,324,947**	133,473
1983	16,993	8,189	19,667	94,771	435,063	217,291	2,069	68,241	20,926	671,053	**863,180**	135,496	**691,083**	67,442	**1,554,263**	151,352
1984	13,492	13,704	20,556	86,664	450,849	229,538	2,951	58,829	8,764	499,764	**667,726**	102,981	**717,386**	71,556	**1,385,112**	125,401
1985	13,727	10,021	11,763	80,396	414,233	256,631	1,228	56,384	11,000	524,585	**682,386**	104,873	**697,582**	68,911	**1,379,968**	125,488
1986	9,266	10,496	21,583	85,460	489,148	286,869	1,186	73,247	12,258	837,658	**1,019,118**	208,755	**808,052**	79,915	**1,827,170**	223,529
1987	12,555	5,400	21,993	108,648	387,230	133,649	3,533	61,514	6,232	568,569	**750,364**	142,345	**558,961**	56,701	**1,309,325**	153,223
1988	9,850	15,188	18,014	92,514	307,552	149,625	3,421	82,471	16,377	625,750	**832,298**	159,213	**488,463**	48,154	**1,320,761**	166,336
1989	12,362	7,036	16,143	73,906	276,707	180,681	9,548	60,566	12,599	529,627	**683,734**	132,033	**495,441**	56,728	**1,179,175**	143,704
1990	13,022	7,063	17,767	35,083	313,051	176,719	6,589	54,621	11,525	453,646	**561,939**	111,167	**527,148**	54,847	**1,089,087**	123,961
1991	14,336	6,277	14,671	29,686	311,867	150,478	7,476	29,883	5,917	417,081	**488,844**	133,416	**498,828**	53,041	**987,672**	143,573
1992	14,604	8,296	20,013	55,397	333,513	137,032	9,744	28,480	13,313	544,530	**650,015**	175,150	**514,908**	54,167	**1,164,923**	183,335
1993	18,971	3,978	16,596	27,467	263,450	203,415	13,138	36,344	32,152	476,131	**576,072**	156,077	**515,569**	49,159	**1,091,641**	163,635
1994	14,396	7,966	17,980	61,493	280,981	176,107	9,735	64,464	11,319	563,232	**708,473**	182,620	**499,199**	48,682	**1,207,672**	188,997
1995	12,409	3,803	14,933	54,068	280,522	128,854	6,107	40,754	9,862	522,910	**631,397**	166,893	**442,826**	43,650	**1,074,222**	172,507
1996	7,724	6,764	13,440	38,591	273,394	200,210	7,829	49,864	11,077	465,240	**571,537**	157,144	**502,597**	58,064	**1,074,135**	167,528
1997	11,982	3,448	12,268	41,685	196,921	167,890	5,123	30,336	13,042	319,504	**408,015**	103,450	**394,185**	47,374	**802,200**	113,781
1998	10,585	2,928	13,430	46,976	234,626	165,830	2,828	20,063	18,052	347,752	**435,770**	92,403	**427,298**	51,133	**863,069**	105,608
1999	9,628	6,390	18,834	35,736	281,702	162,866	1,985	36,208	8,730	265,319	**352,384**	72,535	**475,014**	57,363	**827,398**	92,476
10yr Av.	12,729	5,814	16,007	45,463	276,976	168,189	7,282	41,053	13,417	445,907	**551,653**	461,549	**481,183**	173,742	**1,032,836**	493,167

Table 3.6.1.3 Estimated pre-fishery abundance of MATURING 1SW salmon (potential 1SW returns) by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	Est.	SD	Est.	SD
1971	8,532	58,869	47,904	1,415,594	577,799	133,724	13,016	168,074	143,211	1,466,207	**3,251,955**	340,515	**780,976**	83,274	**4,032,931**	350,550
1972	13,229	116,674	43,729	1,558,425	756,563	147,750	10,391	206,612	128,705	1,398,938	**3,409,354**	336,989	**971,661**	108,943	**4,381,015**	354,161
1973	19,971	70,743	44,589	1,670,373	830,476	247,158	12,935	204,528	111,849	1,626,312	**3,683,805**	376,896	**1,155,128**	120,038	**4,838,933**	395,550
1974	18,256	32,799	31,493	1,838,711	781,081	226,598	18,462	211,292	112,545	1,589,390	**3,784,737**	384,221	**1,075,890**	114,135	**4,860,627**	400,815
1975	18,116	65,511	45,093	1,919,466	737,692	241,535	19,787	250,114	100,583	1,232,776	**3,568,451**	319,110	**1,062,224**	107,485	**4,630,675**	336,726
1976	15,735	60,928	38,679	1,356,779	736,002	182,161	11,191	148,580	69,447	1,032,696	**2,668,431**	259,076	**983,768**	105,254	**3,652,199**	279,640
1977	13,996	45,900	43,028	1,190,070	713,351	153,417	5,294	166,409	67,403	1,075,566	**2,545,348**	249,000	**929,086**	99,888	**3,474,434**	268,289
1978	10,359	47,837	53,747	1,065,801	508,031	166,542	6,071	185,509	91,292	1,145,822	**2,536,261**	257,432	**744,750**	72,122	**3,281,012**	267,344
1979	10,693	54,259	52,597	954,356	876,247	189,504	6,381	127,287	60,601	1,032,596	**2,229,099**	244,906	**1,135,422**	128,225	**3,364,521**	276,442
1980	10,736	113,907	17,013	745,821	879,102	125,839	8,238	150,564	74,997	751,287	**1,836,577**	196,212	**1,040,928**	123,842	**2,877,505**	232,026
1981	10,098	91,140	34,634	451,872	604,012	89,857	14,904	194,995	62,372	946,665	**1,747,044**	240,536	**753,504**	84,566	**2,500,548**	254,969
1982	7,354	56,620	26,496	1,014,320	446,831	137,574	13,082	119,115	81,587	1,281,117	**2,552,760**	388,361	**631,336**	66,922	**3,184,097**	394,084
1983	10,919	60,604	35,744	1,499,645	754,956	202,247	17,322	151,840	114,875	1,302,361	**3,129,325**	353,966	**1,021,188**	111,780	**4,150,514**	371,196
1984	13,332	98,666	22,224	682,640	799,587	189,662	24,008	132,658	48,015	1,305,431	**2,267,409**	337,046	**1,048,813**	115,234	**3,316,222**	356,201
1985	16,796	36,703	44,665	1,276,618	814,526	253,882	28,452	131,630	60,378	977,198	**2,482,527**	275,388	**1,158,321**	119,129	**3,640,847**	300,051
1986	16,738	67,705	68,742	1,321,937	723,961	219,192	30,181	174,691	67,335	1,257,318	**2,888,985**	349,618	**1,058,815**	108,450	**3,947,799**	366,052
1987	23,508	117,554	45,425	904,710	640,712	356,089	24,495	152,547	34,507	1,004,217	**2,213,535**	283,881	**1,090,228**	103,887	**3,303,763**	302,293
1988	16,006	41,265	83,433	1,708,615	587,982	195,403	20,485	204,755	74,633	913,340	**2,942,607**	298,857	**903,309**	86,333	**3,845,917**	311,077
1989	23,561	21,917	45,392	783,424	801,507	287,008	6,607	155,278	69,662	1,259,838	**2,290,119**	415,571	**1,164,074**	131,163	**3,454,193**	435,779
1990	22,816	37,394	42,230	604,011	700,164	256,378	15,436	143,438	57,900	601,712	**1,444,456**	194,133	**1,037,024**	114,208	**2,481,480**	225,235
1991	20,683	26,613	50,666	485,446	642,044	248,399	18,452	81,589	32,498	523,481	**1,149,627**	165,745	**980,243**	101,887	**2,129,871**	194,557
1992	33,900	49,878	68,508	706,823	544,646	207,538	20,087	78,563	64,268	732,296	**1,631,828**	244,473	**874,679**	88,804	**2,506,507**	260,103
1993	25,185	70,986	65,500	561,990	455,818	170,839	21,571	138,237	77,221	691,784	**1,540,218**	227,069	**738,913**	68,631	**2,279,131**	237,214
1994	16,865	54,111	39,010	737,462	462,724	188,525	18,710	194,896	53,170	721,514	**1,761,154**	235,263	**725,833**	68,715	**2,486,986**	245,093
1995	17,732	17,257	57,329	599,956	408,654	169,280	26,634	94,812	50,907	676,096	**1,439,027**	210,426	**679,630**	60,622	**2,118,657**	218,985
1996	28,592	20,573	47,989	673,146	328,832	205,643	16,268	82,016	52,749	573,029	**1,401,513**	189,376	**627,324**	50,089	**2,028,837**	195,889
1997	25,218	10,513	47,573	669,534	375,697	193,381	7,535	73,234	59,461	405,886	**1,218,628**	156,185	**649,405**	56,570	**1,868,033**	166,114
1998	30,816	21,325	79,271	807,525	494,525	212,001	4,297	88,184	130,716	541,033	**1,588,784**	169,885	**820,910**	77,987	**2,409,695**	186,930
1999	37,860	6,932	52,941	390,483	549,911	146,833	5,152	73,789	36,142	229,017	**736,362**	75,318	**792,697**	84,735	**1,529,059**	113,370
10yr Av	25,748	30,682	54,219	638,164	524,047	207,802	14,613	109,458	62,245	632,335	**1,472,883**	737,295	**826,430**	283,888	**2,299,314**	790,061

Table 3.6.1.4 Estimated pre-fishery abundance of NON-MATURING 1SW salmon (potential MSW returns) by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	**Est.**	SD	Est.	SD
1971	14,275	34,137	44,862	265,435	596,979	225,393	4,349	190,032	28,154	1,179,189	**1,696,948**	178,217	**885,858**	83,404	**2,582,806**	196,768
1972	21,368	22,009	38,317	272,337	653,938	364,213	6,344	176,866	24,438	1,235,342	**1,730,993**	193,180	**1,084,179**	99,728	**2,815,172**	217,403
1973	20,781	13,907	30,535	298,119	608,182	330,001	4,674	182,253	24,722	1,021,934	**1,540,934**	154,063	**994,173**	92,757	**2,535,107**	179,831
1974	20,471	20,026	38,225	302,499	582,488	412,104	3,760	197,053	22,032	1,077,432	**1,619,042**	177,289	**1,057,049**	96,244	**2,676,091**	201,728
1975	17,614	16,881	29,340	225,956	564,548	346,718	3,806	129,908	15,140	740,757	**1,128,641**	120,402	**962,027**	90,503	**2,090,668**	150,624
1976	15,737	11,748	36,369	188,469	535,278	261,358	2,636	124,657	14,693	807,453	**1,147,019**	139,785	**851,378**	82,609	**1,998,397**	162,370
1977	10,036	12,948	47,881	174,014	383,997	181,723	2,182	138,909	19,918	957,810	**1,303,599**	169,081	**625,819**	58,968	**1,929,418**	179,069
1978	7,940	12,288	33,488	149,900	655,634	205,281	4,000	91,052	13,197	750,832	**1,017,268**	132,268	**906,342**	95,177	**1,923,611**	162,952
1979	10,647	24,737	42,734	182,064	701,428	325,310	8,361	113,922	16,222	925,886	**1,262,831**	151,452	**1,088,480**	100,659	**2,351,311**	181,852
1980	16,829	17,571	21,685	155,301	782,988	217,340	8,750	134,239	13,497	1,088,782	**1,409,390**	204,525	**1,047,592**	100,169	**2,456,982**	227,738
1981	18,468	12,293	21,418	96,814	654,750	216,104	11,006	90,817	17,644	835,106	**1,052,673**	145,660	**921,746**	80,855	**1,974,419**	166,596
1982	20,742	11,506	25,180	135,971	617,578	301,618	8,194	97,598	24,937	892,670	**1,162,681**	168,030	**973,313**	86,983	**2,135,994**	189,209
1983	16,452	17,430	25,782	118,862	606,599	302,599	7,503	81,191	10,441	658,615	**886,539**	126,468	**958,934**	90,501	**1,845,474**	155,514
1984	16,729	12,557	15,196	108,721	563,432	335,079	5,420	75,504	13,109	676,844	**886,735**	130,991	**935,856**	88,209	**1,822,591**	157,922
1985	11,373	15,100	27,162	126,203	659,902	372,969	5,857	107,036	14,611	1,101,508	**1,364,457**	256,252	**1,077,264**	102,916	**2,441,721**	276,146
1986	15,357	8,269	27,611	149,244	535,384	190,649	8,511	88,425	7,428	759,797	**1,013,162**	177,342	**777,511**	73,517	**1,790,674**	191,977
1987	12,042	19,703	22,335	124,693	408,572	195,297	6,563	110,906	19,509	808,656	**1,083,467**	193,840	**644,809**	60,607	**1,728,276**	203,094
1988	15,153	11,498	20,308	112,170	384,572	237,471	14,781	93,264	15,013	733,928	**965,872**	161,300	**672,285**	70,990	**1,638,157**	176,231
1989	15,873	9,135	22,169	52,923	425,237	232,523	10,913	72,859	13,734	585,591	**734,242**	136,576	**706,715**	69,848	**1,440,958**	153,400
1990	17,433	7,612	17,980	39,238	394,447	188,122	10,255	38,158	7,049	513,313	**605,369**	159,299	**628,236**	65,925	**1,233,605**	172,401
1991	17,798	10,587	24,265	71,198	409,446	166,818	12,384	38,980	15,864	674,754	**811,383**	212,748	**630,710**	68,983	**1,442,093**	223,652
1992	23,095	5,296	20,124	36,957	324,201	245,084	16,391	47,434	38,308	587,858	**715,854**	187,937	**628,894**	62,229	**1,344,748**	197,972
1993	17,513	9,460	21,788	74,478	345,889	213,161	12,296	78,247	13,486	679,602	**855,272**	223,038	**610,647**	61,362	**1,465,918**	231,325
1994	15,091	4,525	18,138	65,836	346,553	157,743	7,995	49,770	11,749	631,572	**763,452**	201,126	**545,520**	54,638	**1,308,973**	208,416
1995	9,402	8,131	16,336	47,868	337,507	241,890	10,035	61,238	13,200	564,795	**695,232**	191,095	**615,170**	72,118	**1,310,402**	204,251
1996	14,566	4,176	14,785	50,154	236,839	199,621	6,255	37,059	15,530	384,919	**491,838**	123,890	**472,066**	57,864	**963,904**	136,737
1997	12,877	3,493	16,180	55,996	281,631	196,985	3,451	24,315	21,509	417,310	**522,623**	112,766	**511,125**	63,504	**1,033,748**	129,418
1998	11,716	7,583	22,681	42,483	337,584	193,314	2,406	43,656	10,405	318,117	**422,244**	88,984	**567,701**	71,698	**989,945**	114,275
10yr Av.	15,501	7,409	19,523	59,027	347,628	206,612	9,742	53,180	15,986	553,796	**689,398**	559,756	**599,006**	217,643	**1,288,405**	600,579

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Table 3.6.1.5 Estimated number of 1SW SPAWNERS by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	Est.	SD	**Est.**	SD
eggs/F	5,000	3,450	5,800	3,400	3,500	4,500	3,000	4,800	3,400	5,000	3996		4323		4296	
% Fem	12%	77%	47%	60%	40%	45%	50%	50%	60%	40%	42%		50%		48%	
1971	3,669	52,360	22,752	547,717	112,626	62,730	2,163	101,580	41,484	981,864	1,725,004	306,081	181,188	57,859	1,928,944	311,501
1972	5,692	103,852	20,714	601,458	146,913	69,067	1,743	124,702	37,200	934,028	1,801,239	300,520	223,416	77,175	2,045,369	310,271
1973	8,554	62,881	21,036	644,721	159,516	115,843	2,157	122,968	32,162	1,082,916	1,945,648	336,942	286,071	84,334	2,252,754	347,336
1974	7,806	29,124	14,819	709,537	148,983	106,034	3,097	126,894	32,264	1,055,539	1,953,357	344,262	265,921	80,920	2,234,097	353,644
1975	7,733	58,229	21,224	741,177	140,646	112,533	3,298	150,154	28,827	820,736	1,799,122	279,611	264,210	75,202	2,084,556	289,547
1976	6,788	54,224	18,297	524,802	142,175	84,843	1,828	88,275	20,020	684,686	1,372,007	230,632	235,635	74,121	1,625,938	242,250
1977	5,965	40,826	20,195	459,120	135,298	71,986	889	96,824	19,276	715,893	1,331,940	223,471	214,137	69,768	1,566,272	234,109
1978	4,465	42,598	25,407	413,013	97,830	77,698	1,021	106,882	26,306	765,212	1,354,010	231,994	181,014	49,990	1,560,430	237,319
1979	4,552	48,259	24,712	369,983	166,499	87,979	1,058	71,871	17,333	686,516	1,193,961	220,594	260,088	89,732	1,478,761	238,146
1980	4,535	101,267	8,028	288,534	168,954	58,587	1,340	79,144	21,538	537,504	1,027,987	177,425	233,416	85,465	1,269,430	196,936
1981	4,214	80,878	16,372	137,924	116,223	41,401	2,484	100,901	17,885	679,827	1,017,415	219,808	164,322	59,166	1,198,108	227,631
1982	3,044	50,155	12,544	340,332	86,288	76,726	2,148	60,593	23,485	915,223	1,389,788	336,392	168,206	48,568	1,570,539	339,880
1983	4,568	53,651	16,911	578,287	145,662	113,600	2,819	75,899	33,057	933,245	1,674,139	318,291	266,649	79,801	1,957,698	328,142
1984	5,684	87,773	10,495	224,430	153,652	105,813	3,974	64,180	13,775	932,338	1,322,497	308,507	269,123	81,534	1,602,114	319,099
1985	7,203	32,571	21,092	339,590	156,911	143,022	4,794	62,026	17,365	699,428	1,150,981	240,735	311,930	86,334	1,484,003	255,748
1986	7,198	58,761	32,572	387,783	140,563	122,144	5,134	82,355	19,431	900,188	1,448,518	308,448	275,039	78,155	1,756,130	318,196
1987	10,123	102,178	21,473	294,852	123,824	206,652	4,134	72,098	9,917	716,079	1,195,123	254,329	344,732	77,419	1,561,328	265,851
1988	6,834	35,777	39,340	798,924	112,627	113,492	3,438	97,473	24,494	652,607	1,609,275	262,377	236,391	61,998	1,885,006	269,603
1989	7,935	18,968	21,461	253,315	306,414	167,079	1,087	69,232	7,314	959,623	1,308,451	381,167	482,514	109,754	1,812,427	396,654
1990	7,685	32,450	19,958	281,118	267,588	148,201	2,656	62,536	20,374	461,146	857,624	177,359	426,131	95,297	1,303,713	201,339
1991	6,891	23,074	23,812	254,950	243,687	161,234	3,158	36,430	10,644	397,830	722,928	152,446	414,970	84,937	1,161,710	174,511
1992	11,527	43,423	32,471	318,904	209,036	134,642	3,374	37,238	26,256	558,456	984,278	224,696	358,579	74,851	1,375,328	236,836
1993	8,544	61,790	31,015	261,044	174,767	110,821	3,606	72,988	42,113	529,395	967,330	208,762	297,738	58,764	1,296,083	216,875
1994	5,660	47,005	18,383	335,067	176,291	122,351	5,002	106,098	14,792	550,602	1,053,564	215,306	309,304	58,180	1,381,250	223,028
1995	6,074	14,209	27,286	248,024	157,606	109,923	9,539	53,111	15,736	520,074	851,154	194,160	283,142	51,803	1,161,582	200,952
1996	12,308	16,869	22,610	304,281	125,136	133,323	5,723	49,685	21,145	452,479	844,458	173,985	276,490	42,889	1,143,559	179,193
1997	10,829	8,621	22,367	390,493	160,555	125,391	2,726	45,689	22,128	321,083	788,013	143,558	299,502	49,710	1,109,883	151,921
1998	13,444	17,574	37,517	487,999	213,605	137,579	1,147	58,066	90,900	437,732	1,092,270	155,619	365,776	68,769	1,495,563	170,137
1999	12,756	5,698	25,060	164,622	262,187	95,457	1,358	50,902	12,365	186,324	419,911	68,719	371,758	76,175	816,730	102,591
10yr.av.	8,885	29,069	26,929	357,647	195,210	133,094	3,769	62,595	26,900	531,002	1,007,213		340,958		1,375,100	
	5,331	77,222	73,409	729,600	273,294	269,516	5,653	150,228	54,875	1,062,005	553,794		2,073,930		2,701,133	

Table 3.6.1.6 Estimated number of MSW SPAWNERS by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern Europe		Northern Europe		Total	
											Est.	SD	Est.	SD	**Est.**	SD
eggs/F	13,000	6,900	10,800	7,000	9,000	10,500	6,000	7,900	7,000	10,000						
% Fem	77%	77%	72%	85%	80%	80%	70%	70%	85%	60%						
1971	3,136	7,264	9,175	82,574	71,306	103,379	208	72,921	14,300	381,817	558,876	106,525	178,029	43,689	746,081	115,136
1972	4,926	14,588	14,861	90,909	93,366	86,851	146	87,855	12,833	507,369	713,554	142,193	185,289	50,958	913,704	151,048
1973	7,369	8,820	12,574	96,788	101,622	144,702	508	84,674	11,121	553,018	754,422	154,913	254,201	63,355	1,021,196	167,368
1974	7,185	4,125	10,040	106,929	96,455	132,953	332	86,384	11,255	439,844	648,537	120,219	236,926	56,714	895,503	132,925
1975	7,076	8,214	12,583	111,782	90,496	166,060	82	99,682	10,023	483,461	713,162	140,727	263,714	62,516	989,459	153,988
1976	5,998	5,938	9,599	78,342	88,786	140,445	239	56,074	6,873	322,890	470,118	94,902	235,470	56,463	715,186	110,429
1977	5,379	4,560	12,038	69,437	85,909	107,133	186	60,947	6,670	399,470	541,084	112,280	198,607	50,634	751,730	123,169
1978	3,466	4,771	16,061	61,654	62,321	74,170	144	66,216	9,074	474,662	616,377	135,492	140,101	36,328	772,538	140,277
1979	3,395	5,379	11,074	55,225	105,870	81,686	415	43,429	5,996	379,045	489,074	107,355	191,366	57,338	691,514	121,707
1980	4,495	11,093	13,837	61,925	104,001	123,575	703	46,575	7,349	438,495	565,438	118,562	232,774	59,849	812,049	132,812
1981	7,239	8,340	6,609	50,423	110,961	67,889	212	58,859	6,134	574,441	698,197	165,563	186,301	58,963	891,107	175,749
1982	7,844	5,046	6,507	27,441	89,039	82,432	762	34,104	7,997	416,083	490,670	117,334	180,078	48,129	677,254	126,821
1983	8,918	5,489	7,950	47,466	88,199	131,702	503	42,376	11,323	482,250	588,904	135,422	229,322	54,024	826,176	145,800
1984	7,185	9,264	8,384	53,253	93,095	139,182	732	35,887	4,759	361,086	464,249	102,897	240,193	57,818	712,827	118,029
1985	7,158	6,691	4,739	47,298	83,440	156,294	309	33,422	5,945	375,856	469,211	104,789	247,200	56,763	721,150	119,175
1986	4,935	7,096	8,806	37,800	101,048	174,974	285	43,718	6,656	645,624	740,894	208,673	281,242	65,475	1,030,941	218,704
1987	6,529	3,600	8,834	67,428	77,547	81,363	860	36,438	3,365	434,273	545,104	142,248	166,300	44,030	720,238	148,906
1988	5,175	10,188	7,280	49,863	62,336	91,028	836	49,419	10,496	480,223	600,187	159,107	159,374	38,710	766,842	163,748
1989	5,236	4,736	6,551	35,536	112,328	141,377	2,345	34,662	5,067	407,180	487,181	131,987	261,287	53,299	755,019	142,342
1990	5,540	4,763	7,227	12,451	127,386	142,419	1,621	30,823	7,168	350,029	405,234	111,129	276,965	50,481	689,427	122,057
1991	5,926	4,177	5,880	13,990	124,995	121,180	1,819	17,040	3,369	340,293	378,868	133,406	253,920	48,465	638,669	141,936
1992	6,211	5,596	8,142	28,141	135,587	110,136	2,445	17,001	8,936	446,932	506,605	175,141	254,379	49,142	769,126	181,905
1993	8,030	2,678	6,731	6,370	106,818	163,452	3,143	23,450	28,302	391,531	452,332	156,057	281,443	46,601	740,506	162,867
1994	6,084	5,666	7,287	33,223	113,908	141,964	2,438	42,714	6,805	462,712	551,120	182,585	264,394	45,833	822,801	188,250
1995	5,261	2,708	6,064	29,107	113,866	103,661	1,780	27,448	5,734	430,367	495,364	166,892	224,569	40,605	725,997	171,760
1996	4,100	4,822	5,470	12,659	111,252	170,840	2,271	35,935	7,438	397,089	457,943	157,142	288,463	55,804	751,875	166,756
1997	6,281	2,447	4,959	23,009	89,568	143,979	1,499	22,284	8,717	272,040	328,498	103,448	241,326	46,264	574,783	113,322
1998	5,579	2,082	5,479	25,937	106,932	142,206	816	15,319	14,140	302,690	360,169	92,400	255,533	49,771	621,181	104,952
1999	4,497	4,559	7,649	19,752	143,392	139,391	582	28,885	5,957	231,767	290,921	72,532	287,862	55,929	586,432	91,591
10yr.av.	5,704	4,021	6,560	24,170	112,364	134,303	1,800	28,748	9,344	376,071	442,869		254,126		703,555	

Table 3.6.2.1 Estimated number of RETURNING 1SW salmon by NEAC country and year

Year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	Southern E	Northern E	Total
											Est.	Est.	Est.
1979	0.29	0.66	0.68	0.56	1.75	0.37	2.87	0.51	1.08	0.47	**0.65**	**1.19**	**9.23**
1980	0.36	1.42	0.29	0.58	1.92	0.22	4.55	0.49	0.94	0.48	**0.78**	**1.47**	**11.25**
1981	0.39	1.13	0.40	0.41	1.50	0.22	10.59	0.40	1.07	0.54	**0.71**	**2.62**	**16.65**
1982	0.44	0.66	0.35	0.96	1.36	0.41	8.97	0.53	1.67	0.50	**0.86**	**2.30**	**15.84**
1983	0.51	0.39	0.37	1.51	1.87	0.60	7.26	0.42	0.72	0.52	**0.71**	**2.12**	**14.17**
1984	0.75	0.62	0.23	0.88	1.59	0.60	6.44	0.51	0.96	0.49	**0.69**	**1.92**	**13.08**
1985	0.71	0.45	0.54	2.08	1.55	0.60	6.80	0.69	0.73	0.45	**0.88**	**2.04**	**14.59**
1986	0.60	0.68	0.90	1.55	1.35	0.53	6.40	0.68	0.46	0.40	**0.75**	**1.96**	**13.54**
1987	0.49	0.78	0.72	0.81	1.24	0.64	4.50	0.86	1.47	0.38	**0.86**	**1.52**	**11.91**
1988	0.38	0.51	1.08	2.06	1.17	0.35	4.20	0.61	1.16	0.45	**0.96**	**1.44**	**11.98**
1989	0.46	0.25	0.68	0.87	1.44	0.37	2.02	0.44	0.91	0.24	**0.54**	**0.99**	**7.69**
1990	0.52	0.26	0.56	0.64	1.28	0.28	2.85	0.28	0.87	0.26	**0.46**	**1.10**	**7.81**
1991	0.55	0.31	0.59	0.47	1.23	0.25	3.28	0.29	1.05	0.31	**0.48**	**1.18**	**8.33**
1992	0.92	0.86	0.60	0.47	1.12	0.37	3.86	0.62	1.67	0.33	**0.79**	**1.38**	**10.83**
1993	0.66	1.09	0.63	0.77	1.06	0.36	3.14	0.92	0.87	0.38	**0.80**	**1.17**	**9.86**
1994	0.55	0.95	0.43	1.24	0.79	0.24	2.37	0.82	1.15	0.40	**0.91**	**0.88**	**8.97**
1995	0.47	0.27	0.67	1.00	0.61	0.28	2.90	0.51	0.51	0.29	**0.52**	**0.99**	**7.50**
1996	0.71	0.23	0.53	0.97	0.45	0.30	1.46	0.26	0.38	0.23	**0.41**	**0.69**	**5.52**
1997	0.59	0.13	0.48	1.10	0.54	0.31	0.62	0.33	1.92	0.23	**0.75**	**0.51**	**6.26**
10yr Av.	1	0	1	1	1	0	3	0	1	0	**1**	**1**	**8**

Table 3.7.2.1 Conservation limit options for NEAC stock groups from lagged egg deposition analysis (options 1-3) and river specific assessments (option 4)

Option	Individual countries										European stock groupings	
	Finland	France	Iceland	Ireland	Norway	Russia	Swed'n	UK(EW)	UK(NI)	UK(Sc)		
Choice	3	4	1	1	1	1	4	4	3	3	Southern	Northern
1SW												
Opt. 1	6,028	19,972	20,139	265,111	129,168	69,831	674	38,482	13,171	445,193	781,929	205,700
Opt. 2	6,756	23,985	20,153	226,224	106,578	62,291	1,018	59,331	12,065	524,111	845,715	176,643
Opt. 3	9,018	43,902	27,792	407,315	149,574	79,029	1,436	72,718	15,812	592,471	1,132,218	239,057
Opt. 4	0	17,400	0	0	0	0	2,720	53,000	0	0		
Chosen	**9,018**	**17,400**	**20,139**	**265,111**	**129,168**	**69,831**	**2,720**	**53,000**	**15,812**	**592,471**	**943,794**	**210,736**
MSW												
Opt. 1	3,622	2,914	5,017	17,808	76,166	75,307	324	17,529	4,601	365,568	408,420	155,419
Opt. 2	4,059	3,500	5,020	15,196	62,845	67,177	490	27,027	4,214	430,371	480,307	134,571
Opt. 3	5,418	6,406	6,923	27,360	88,199	85,227	690	33,125	5,523	486,505	558,918	179,534
Opt. 4	0	5,100	0	0	0	0	830	17,500	0	0		
Chosen	**5,418**	**5,100**	**5,017**	**17,808**	**76,166**	**75,307**	**830**	**17,500**	**5,523**	**486,505**	**532,436**	**157,721**

Spawner escapement reserve:

	Southern	Northern
1SW	**1,017,300**	**228,287**
MSW	**631,099**	**186,947**

Table 3.9.1.1. Summary of cruises with surface trawling for salmon and salmon and post-smolt captures in 1999.

Year Cruise ID[1]	**Ship**	**Gear used** Surface trawls	**Dates**	**Area**	**Total number of hauls**	**Surface hauls with smolt %**	**Number of poststs-smolts captured**	**Number of salmon captured**
1999-1	R/V G.O. Sars	Åkra trawl 16 x 16	27.04- 20.05.	Norwegian Sea	30	3.3	0	1
1999-2	R/V Michael Sars	Firkløver trawl 10 x 10; Fish lift	19.05- 04.06.	Norwegian coastal current, fjords SW – mid Norway. Special salmon investigation	79	27.8	354	4
1999- 3	R/V G.M. Dannevig	Harstad trawl 8 x 8 ; Fish lift	19.05- 31.05.	Selected SW- Norwegian fjords. Special salmon investigations	40	37.5	588	2
1999- 4	R/V Michael Sars	Åkra trawl	05.06- 05.07	Barents Sea E; Tana + Alta fjd	46	6.5	5	2
1999- 5	R/V J. Hjort	Åkra trawl	01.06-13.06	Northern North Sea (Frigg field)	9	56	6	1
1999-6	R/V J. Hjort	Åkra trawl	15.06- 09.07	Greenland Sea, northern Norwegian Sea, Barents Sea (W)	33	21	21	11
1999-7	R/V G.O.Sars	Åkra trawl	20.07- 19.08.	Norwegian Sea	64	9.7	10	1
1999- 8	R/V G.O.Sars	Harstad 15 x 15 float- trawl	21.08- 07.09.	Barents Sea	5	3.5	0	0
1999-9	R/V Michael Sars	Firkløver trawl 10 x 10	1.11.- 10.12	Fjords SW – N- Norway (Young sprat & herring cruise)	100	2	0	2
Total					406		984	24

Table 3.9.1.2 Preliminary results on smolt ages recorded from scales and/or otholits of post-smolts and salmon captured in the North Sea/ Norwegian Sea in 1999 (includes ≈ 30% of the material collected in 1999). The material also includes fish captured in south west- and mid-Norwegian fjords.

Area	Fjords, SW- Norway		Mid-norwegian coast		Norwegian Sea		1999 Total	
Smolt ages	Number	%	number	%	Number	%	Number	%
1	0	0.0	0	0.0	4	22.2	4	1.4
2	37	18.8	5	6.3	11	61.1	53	18.0
3	135	68.5	48	60.8	3	16.7	186	63.3
4	20	10.2	20	25.3	0	0.0	40	13.6
5	5	2.5	6	7.6	0	0.0	11	3.7
TOTAL NUMBER	**197**	**100.0**	**79**	**100.0**	**18**	**100.0**	**294**	**100.0**
Hatchery fish	17	8.6	0	0.0	4	22.2	21	7.1
Precociuos males	9	4.6	8	10.1	0	0.0	17	5.8

Table 3.9.2.1. Sampling details of commercial catches of herring and mackerel at "Havsbrún" fish meal plant, Faroes in 1998 and 1999. So far no salmon have been found.

		Position		Catch (tonnes)		Sample (kg)		% of catch		No. measured	
Date	Vessel	Lat.	Lon.	Herring	Mackerel	Herring	Mackerel	Herring	Mackerel	Herring	Mackerel
13-06-98	Saksaberg	6942	0812	800	0	5430.9	-	0.68	-	103	-
14-06-98	Norðborg	6333	0630	0	40	-	956	-	2.39	-	105
24-06-99	Krúnborg	7100	0412	600	0	16900	-	2.82	-	0	-

Figure 3.3.4.1. Nominal catches of salmon in the NEAC area relative to previous indices

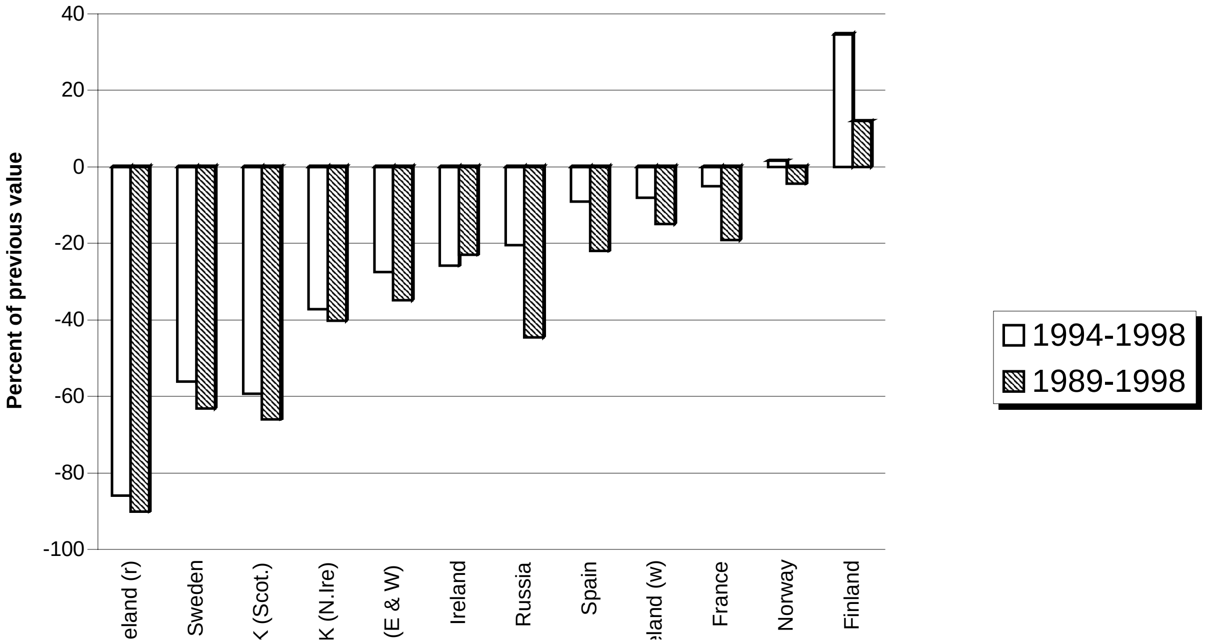
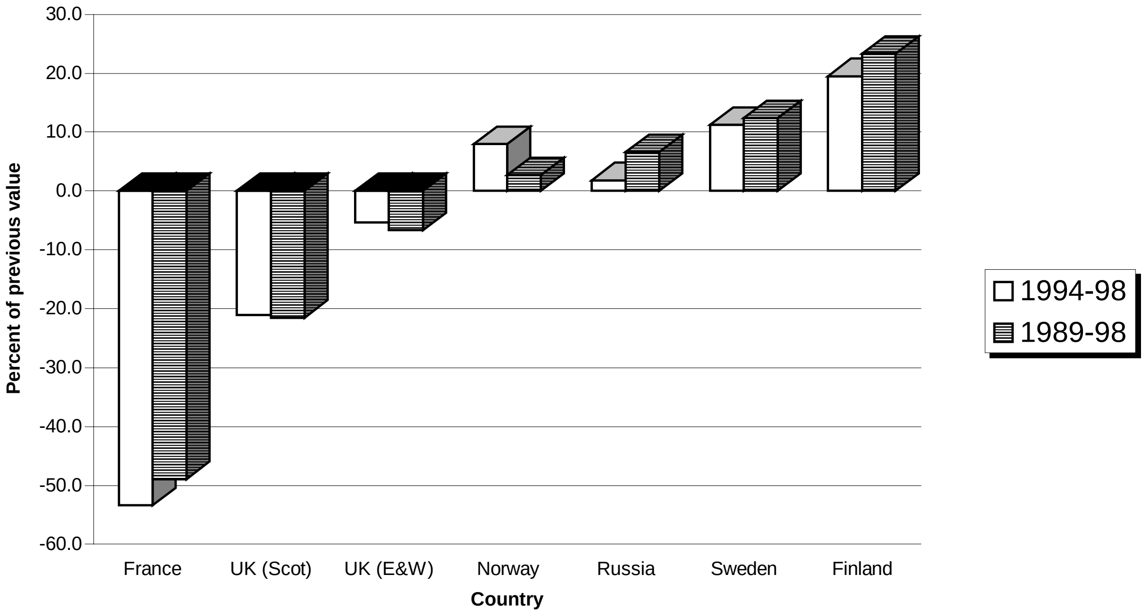


Figure 3.3.6.1. The proportions of 1SW salmon in the NEAC catches in 1999 relative to previous indices



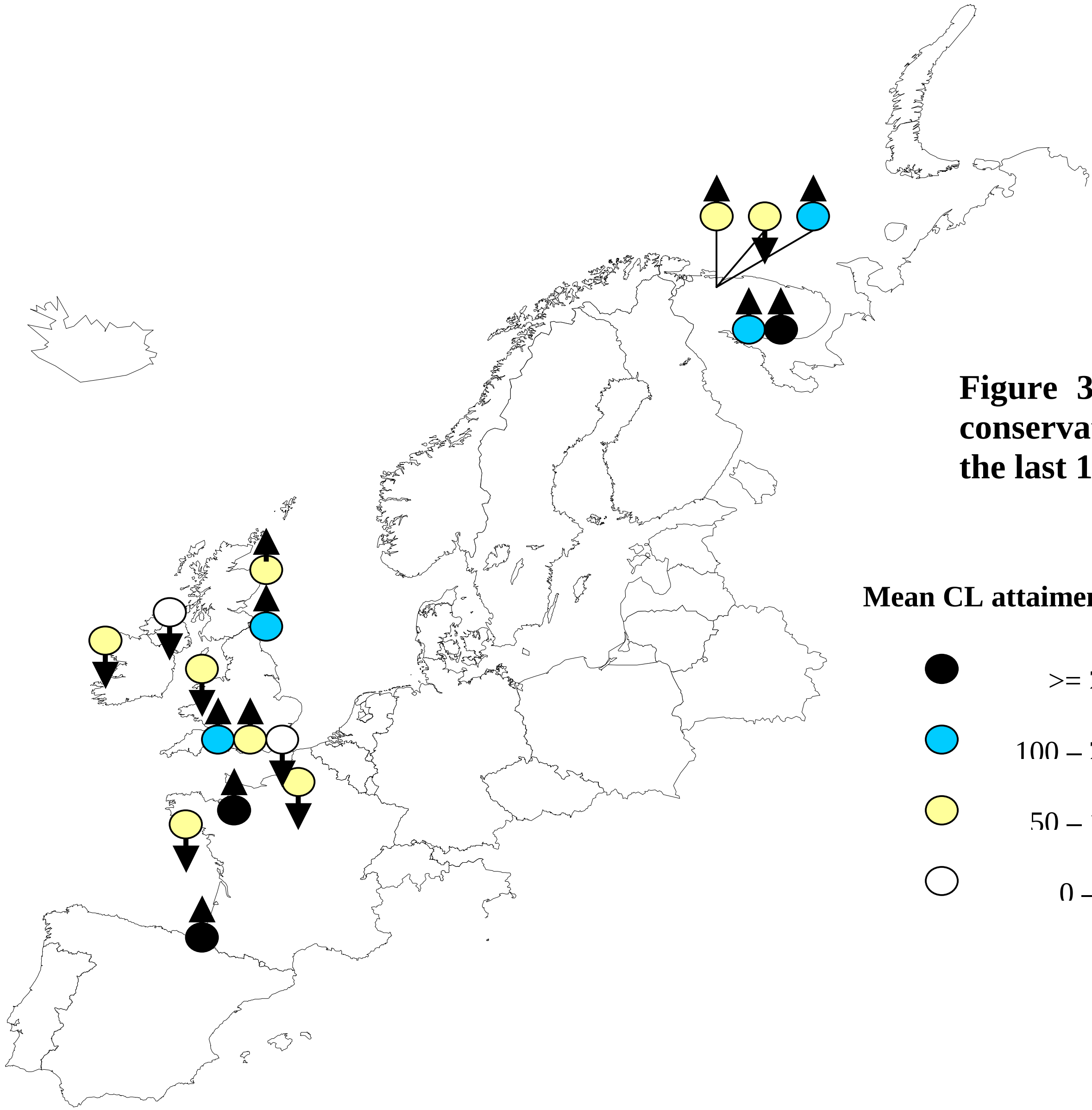


Figure 3.4.1.1 Rate of attainment of conservation limits : mean value over the last 10 years and 1998-1999 change

Mean CL attaiment

>= 200 %

100 – 200 %

50 – 100 %

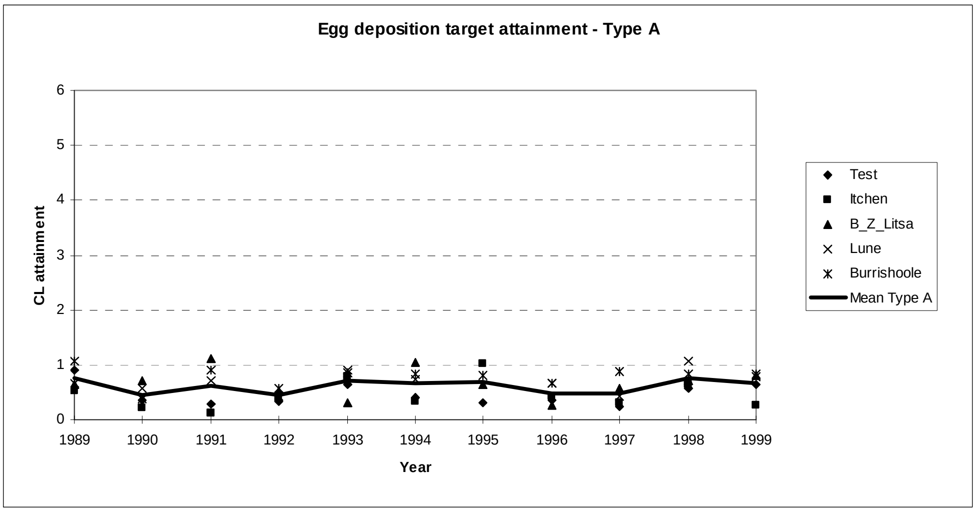
0 – 50 %

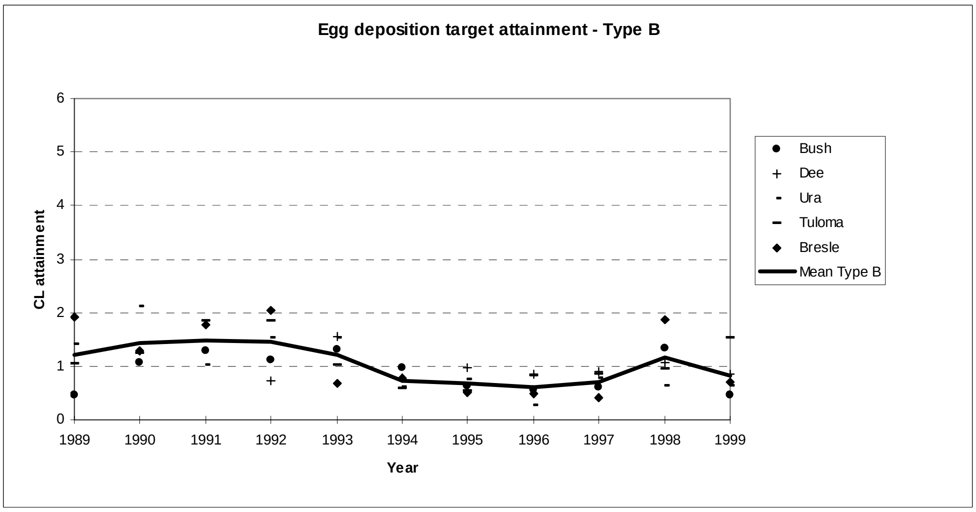
1998-1999 change

Increas

Decrease

Fig. 3.4.1.2. Conservation limit attainment (egg deposition / conservation limit) for index rivers having a mean egg deposition below (type A), around (type B) or above (type C & D) the conservation limit over the 10 previous years.





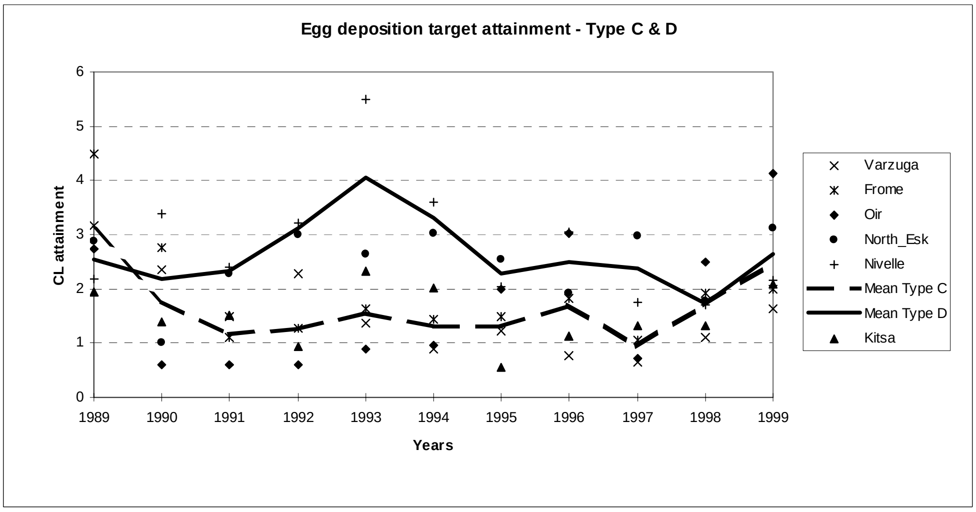
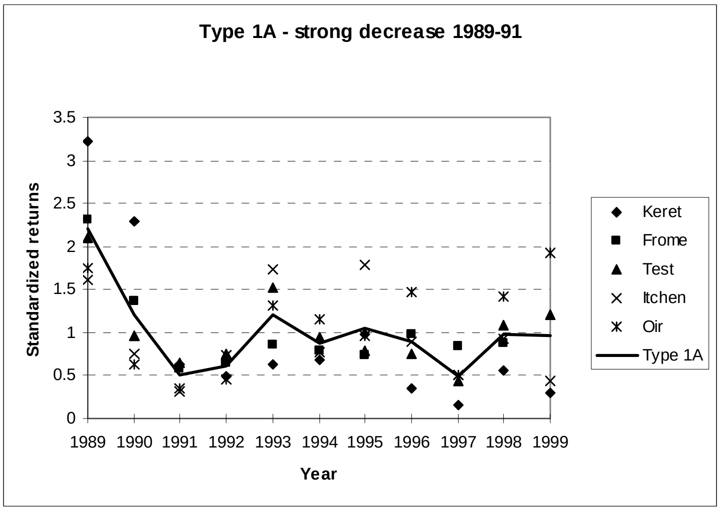


Fig. 3.4.3.1 Standardized returns (Number of fish / mean number of the previous ten years) for Index Rivers showing a decreasing trend.



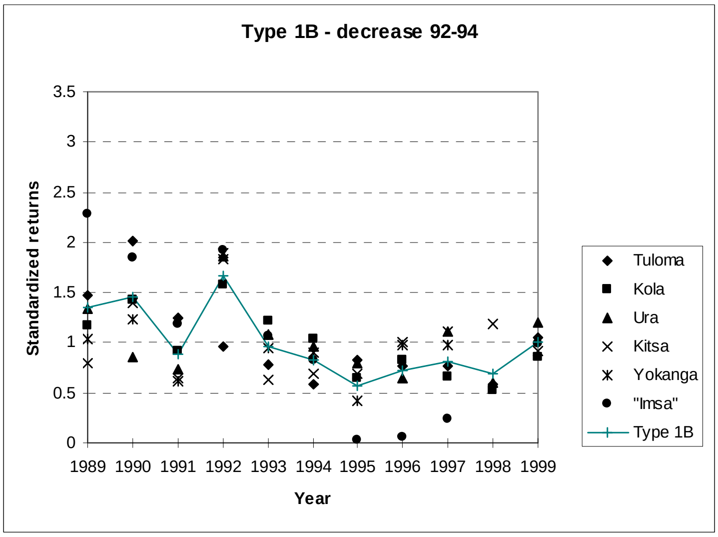


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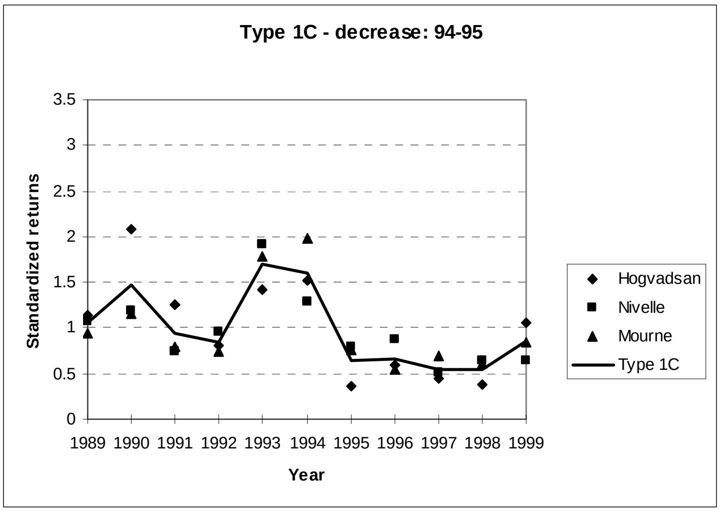
Fig. 3.4.3.1 Continued



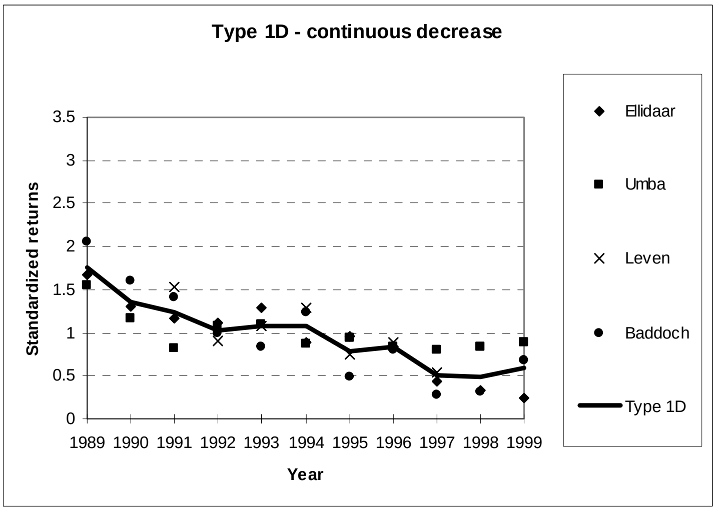
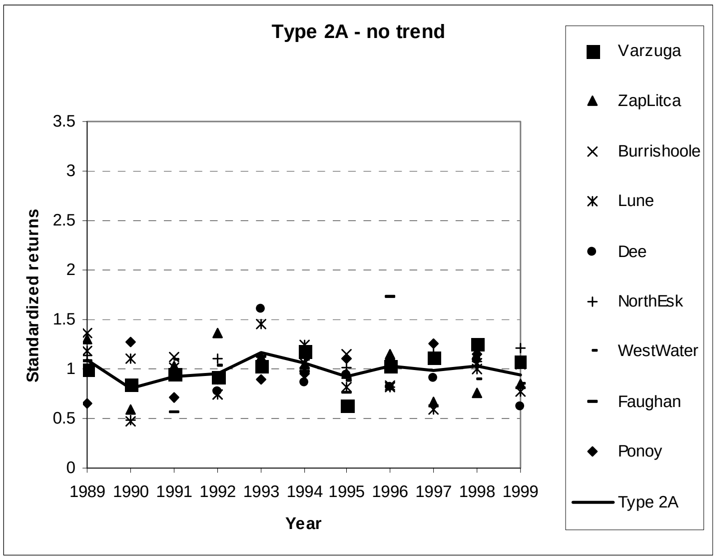


Fig. 3.4.3.2 Standardized returns (Number of fish / mean number of the previous ten years) for Index Rivers showing a stable or fluctuating trend.



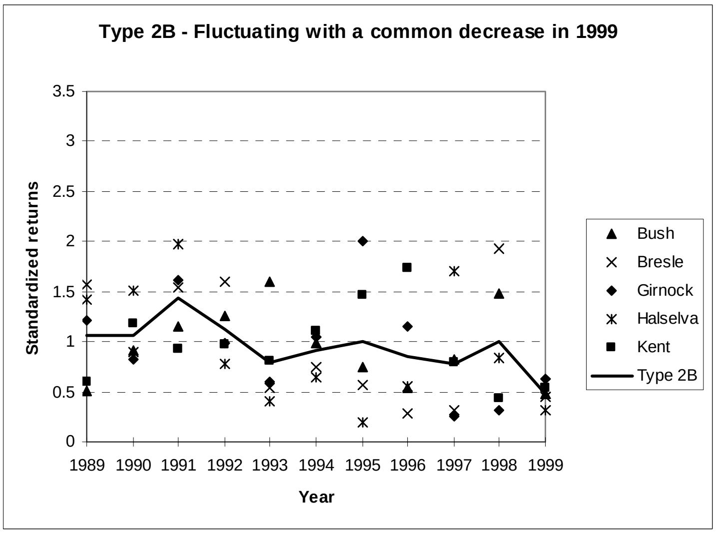


Figure 3.4.5.1. Description of Scottish rod catch trends over the period 1952-1997 for the months February to June. Trend lines (solid) and the 95% confidence limits (dashed) have been fitted.

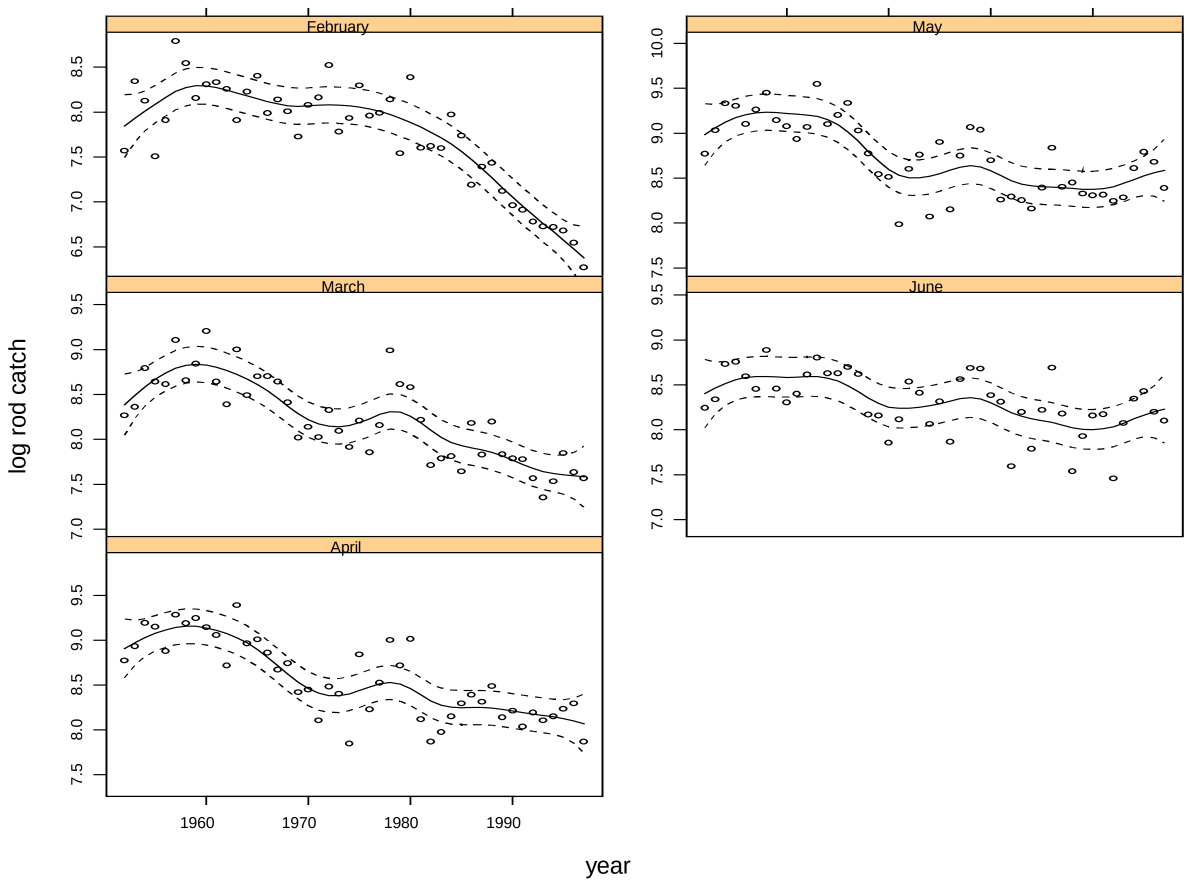


Figure 3.4.5.2. Index of juvenile to spawner survival for Girnock (x) and Baddoch (o) Burns (smolt years 1967-1997).

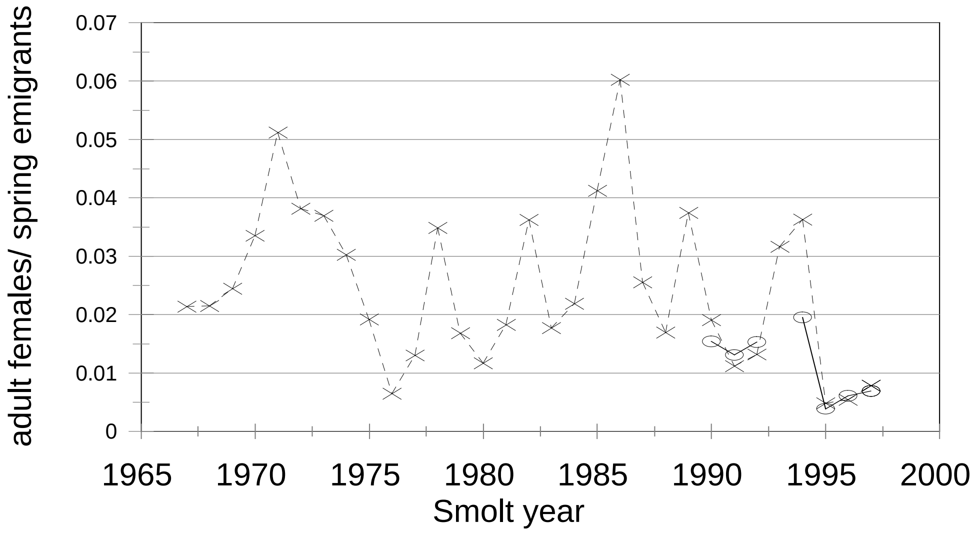
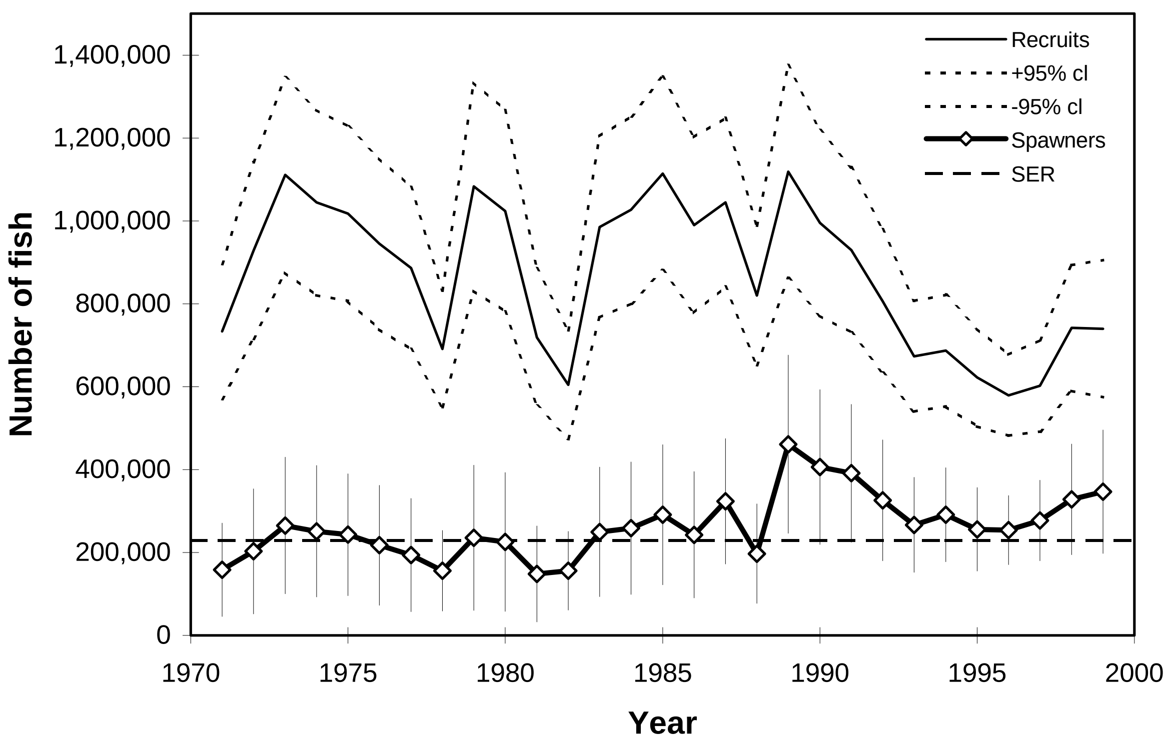


Figure 3.6.2.1 Estimated PFA, spawning escapement and SER for maturing and non-maturing 1SW components of Northern European stocks, 1971-99.

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)

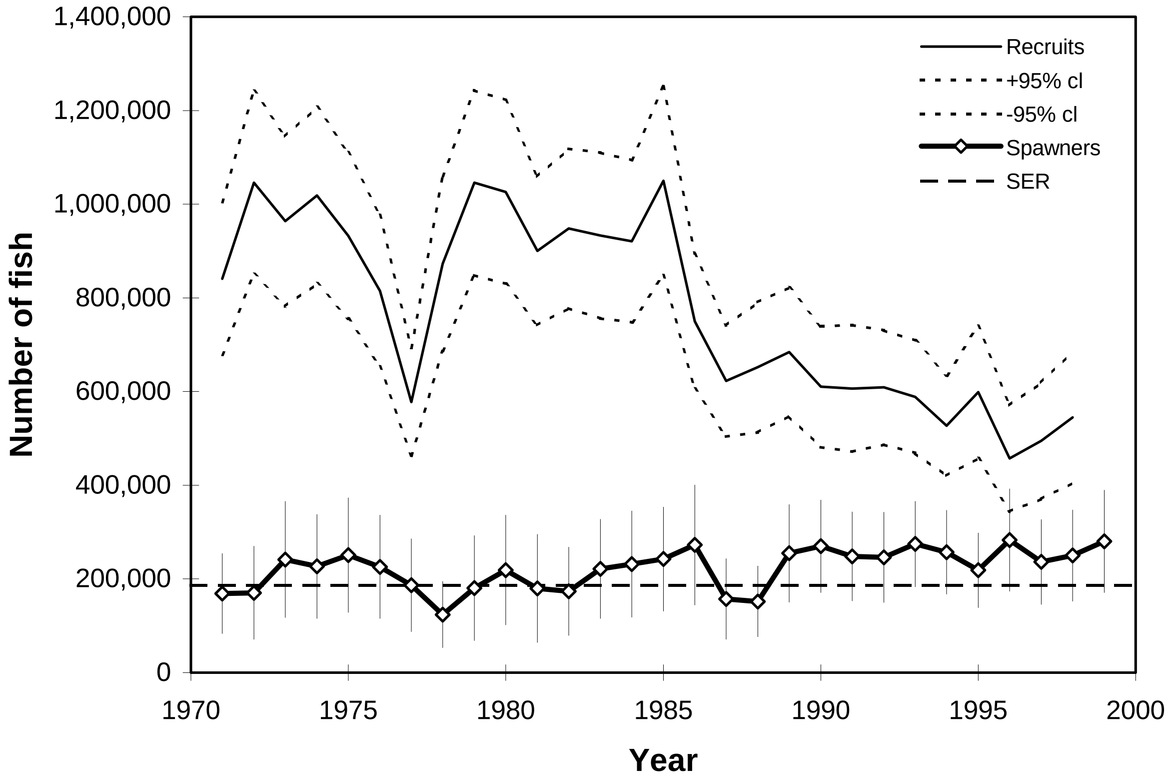
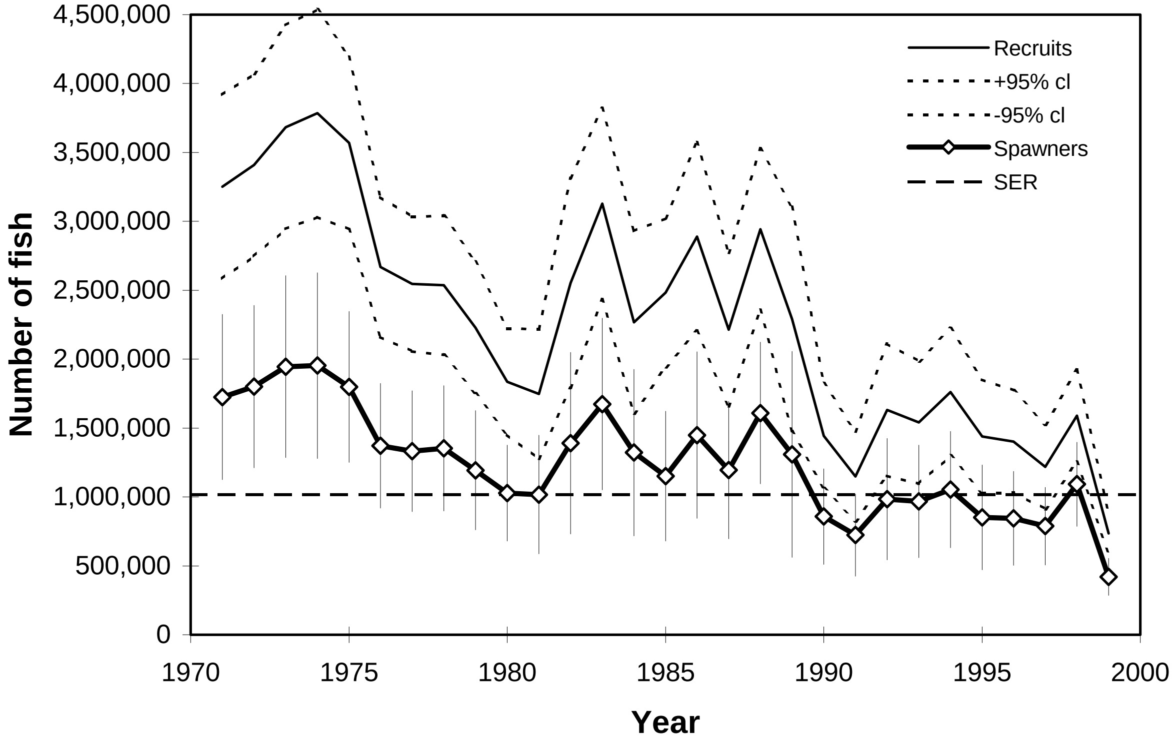


Figure 3.6.2.2 Estimated PFA, spawning escapement and SER for maturing and non-maturing 1SW component of Southern European stock groups, 1971-99

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)

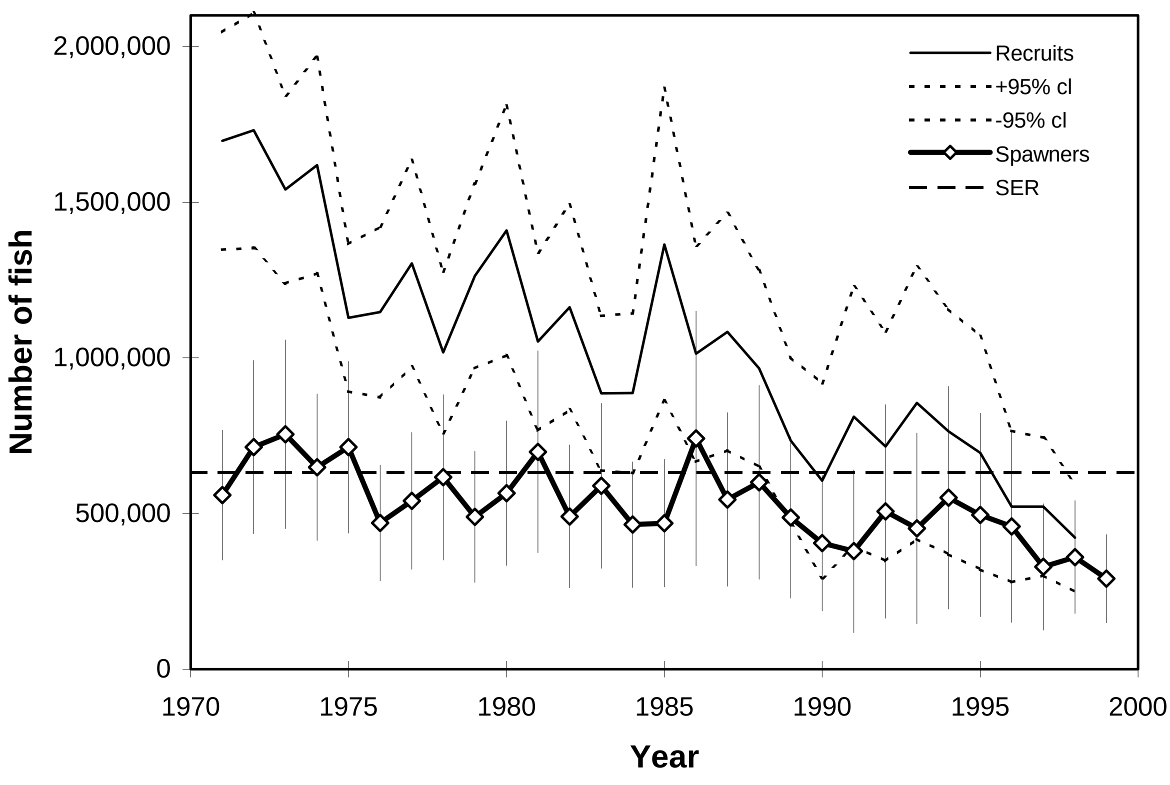
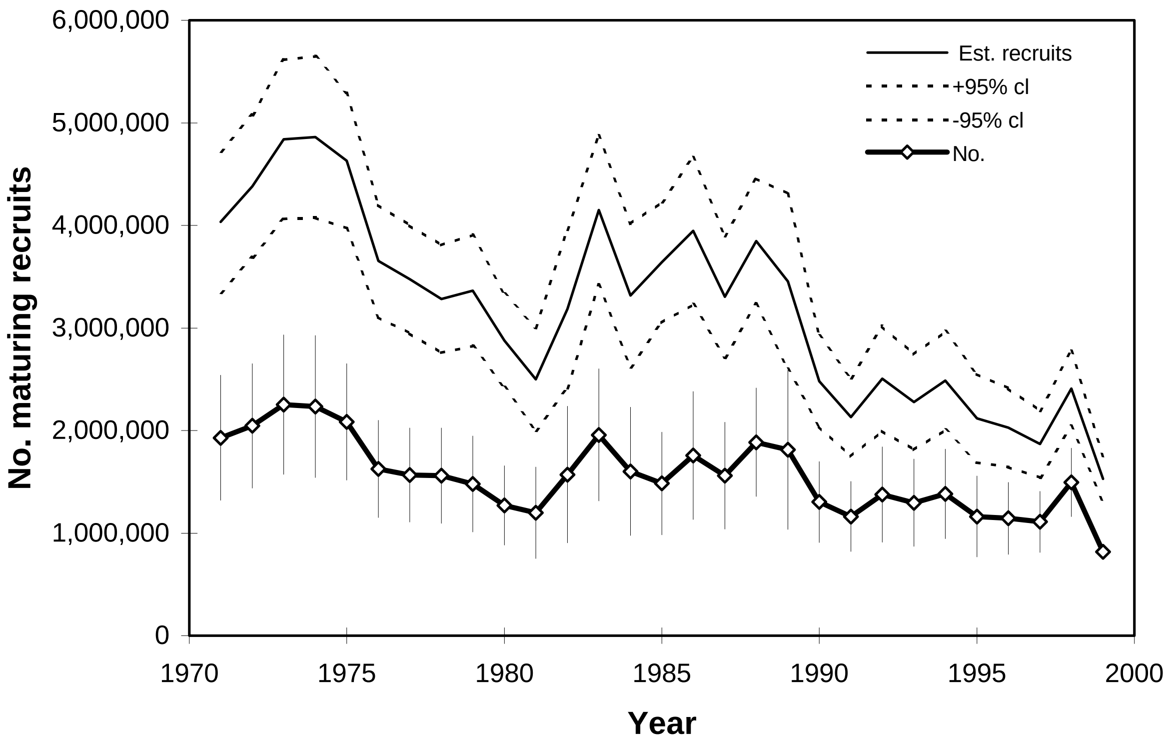


Figure 3.6.2.3 Estimated prefishery abundance of salmon stocks and spawning escapement in the NEAC Area, 1971-99

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)

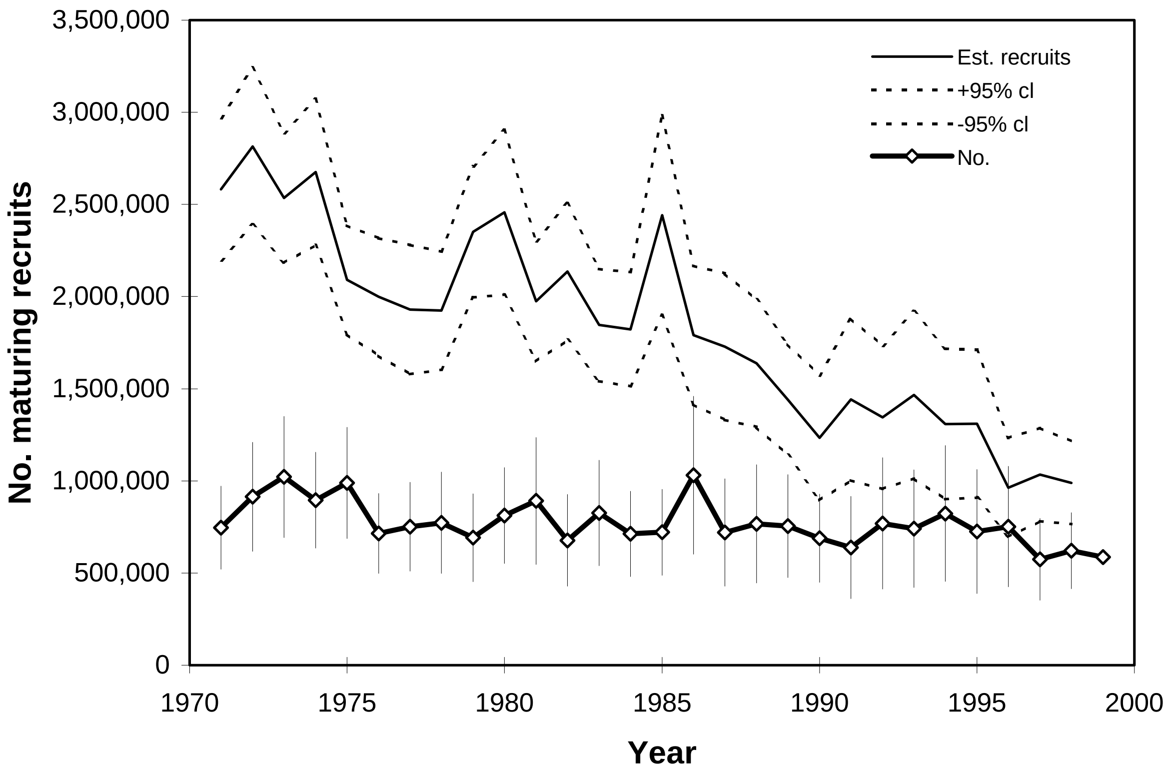
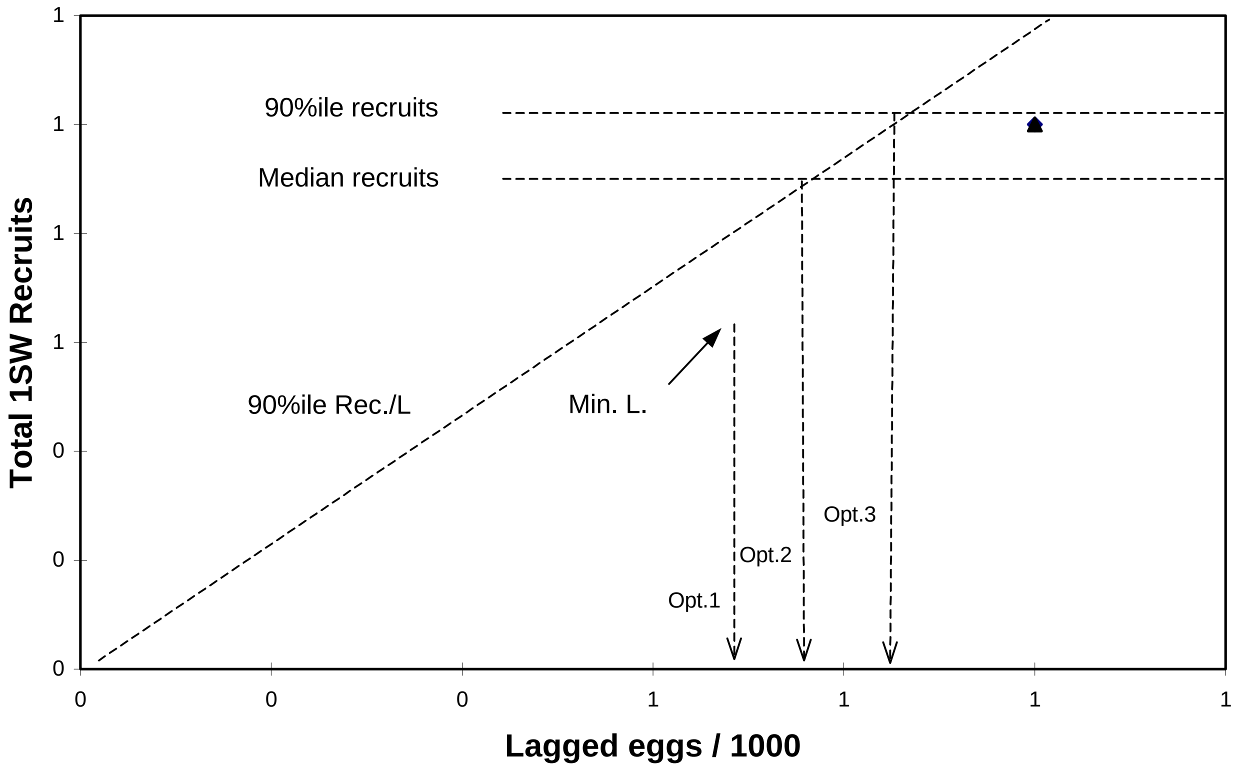


Figure 3.7.2.1 Example to show how Conservation Options Limit Options for NEAC area have been estimated.



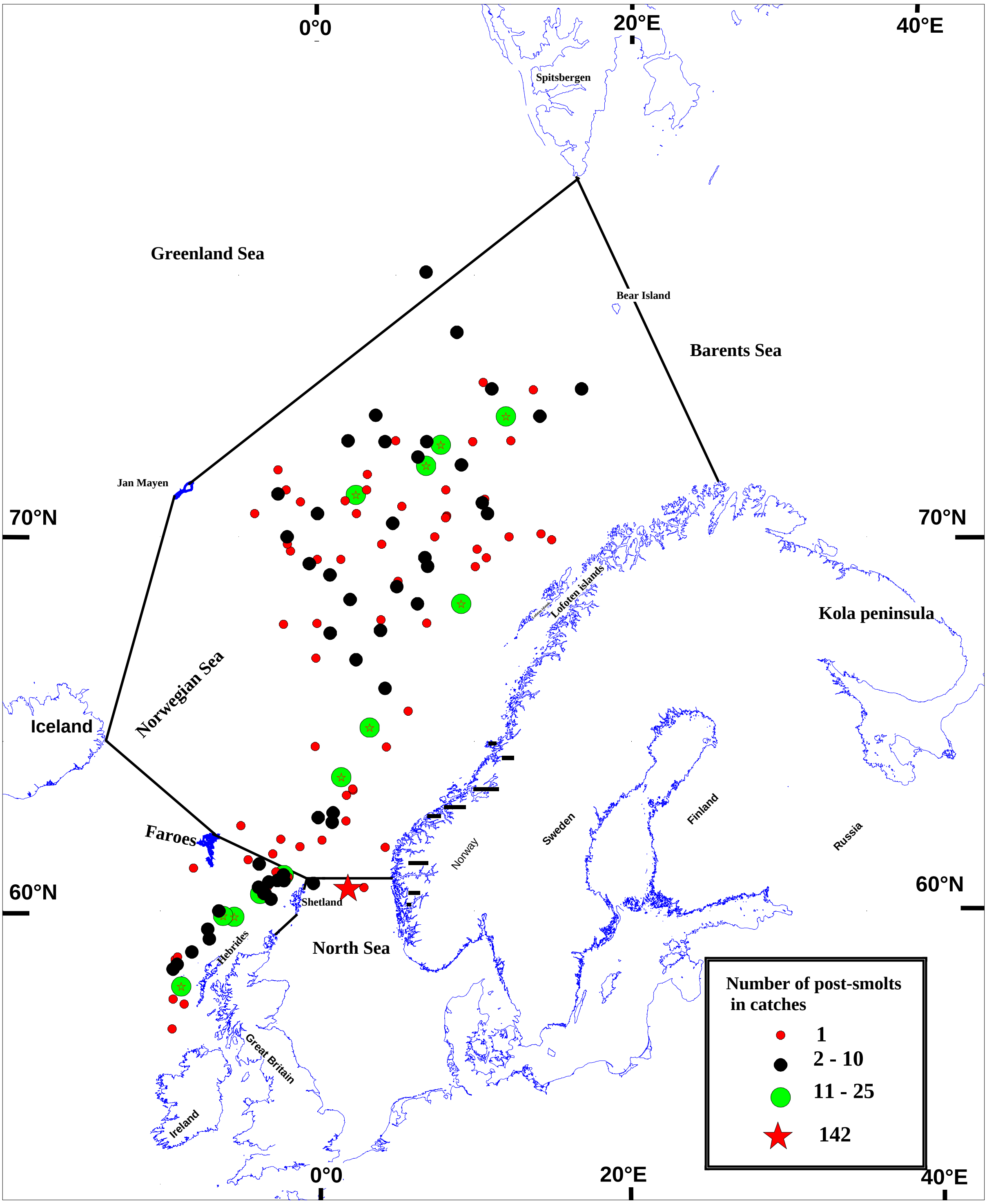


Figure 3.9.1.1 Distribution of post-smolt captures in surface trawl hauls in the Norwegian Sea and adjacent areas 1990 – 1998. (Holm *et al*. 2000)

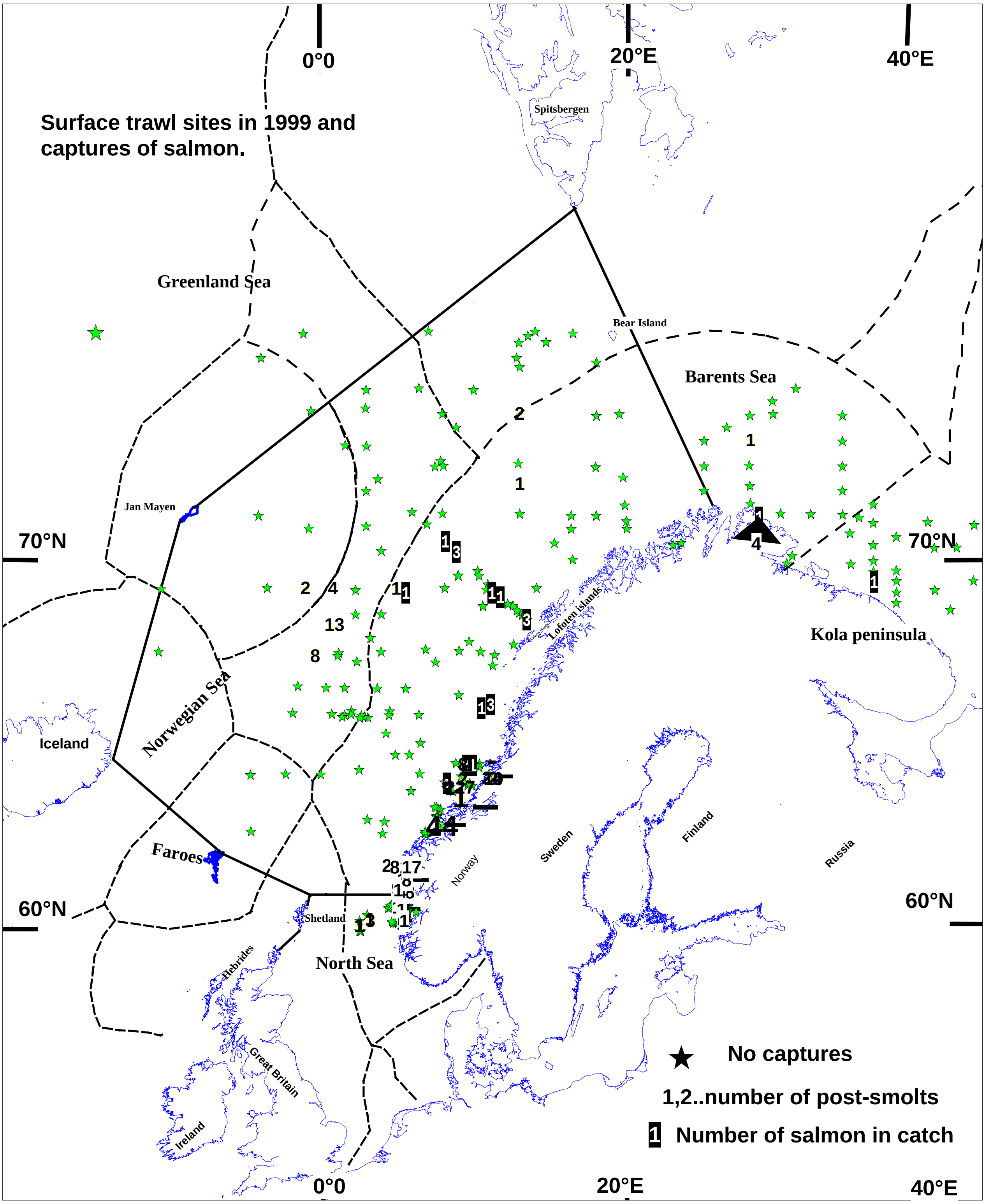


Figure. 3.9.1.2. Trawl sites in 1999. Result from 9 cruises in May – September. Two cruises along the Norwegian coast in May were specifically aimed at trawling for salmon. Dashed lines indicate national EEZs while unbroken lines indicate the limits of the sea areas according to Anon (1953)

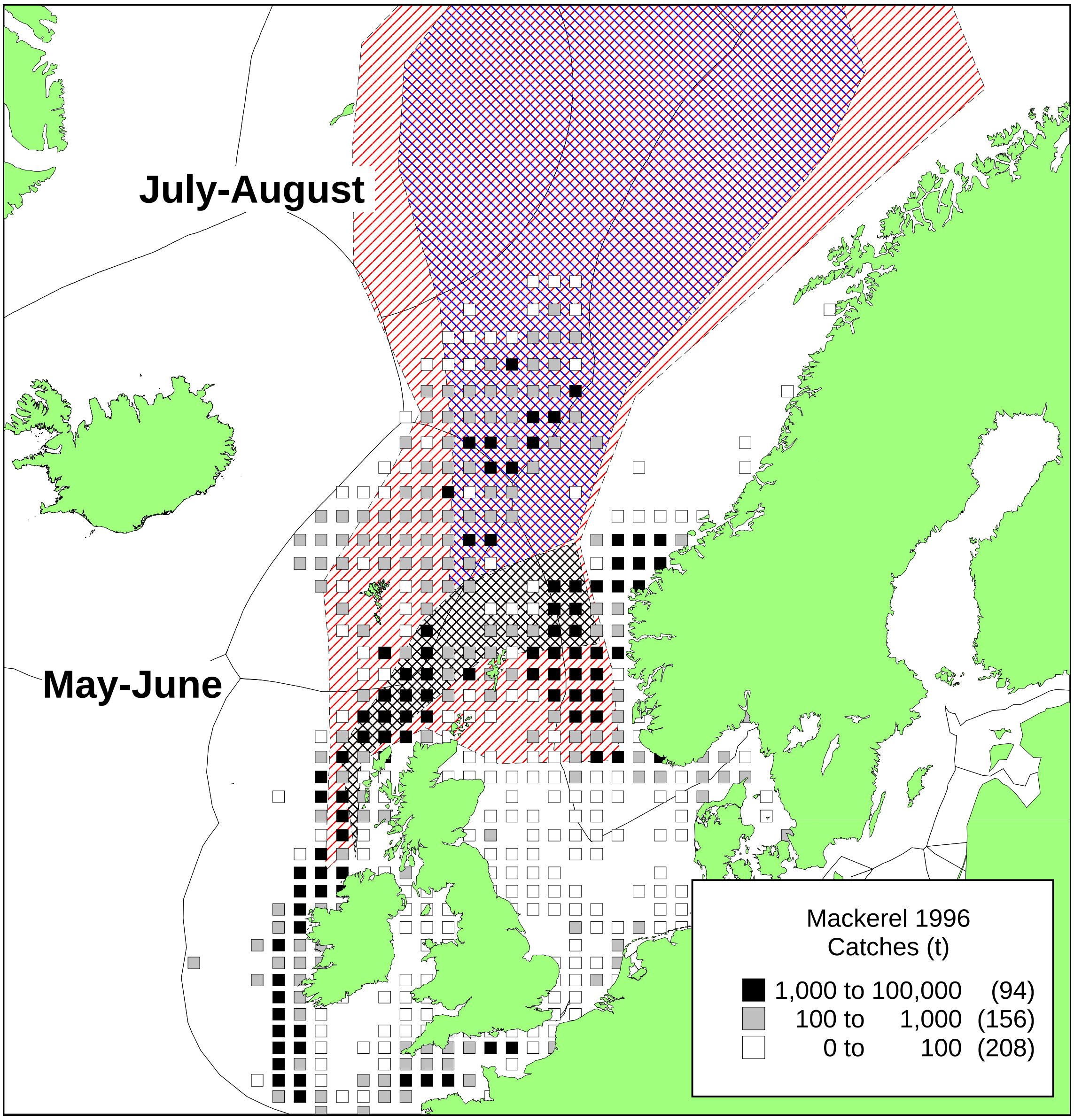


Figure 3.9.2.1. Distribution of commercial mackerel catches (squares) during May-August 1996. The shading of the squares indicate the catch rates (ICES 1998/ACFM:6). Superimposed on the mackerel catches are approximate areas where salmon post-smolts have been caught in pelagic trawls towed at the surface in May-June and July-August 1991-1999. The densely hatched areas indicate highest catch rates of post-smolts (Shelton *et al*. 1997; Holm *et al*. 2000; Holst *et al*. 2000).

4 FISHERIES AND STOCKS IN THE NORTH AMERICAN COMMISSION AREA

4.1 Description of Fisheries

4.1.1 Gear and effort

Canada

The 23 areas for which the Department and 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 4.1.1.1). Harvest (fish which are killed and retained) and catches (including harvests and fish caught-and-released in recreational fisheries) are categorized in two size groups: small and large. Small salmon in the recreational fisheries refer to salmon less than 63 cm fork length, whereas in commercial fisheries, it refers to salmon less than approximately 2.7 kg whole weight. Large salmon 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 about 2.7 kg whole weight.

Three user groups exploited salmon in Canada in 1999: Native peoples, commercial fishers, and recreational fishers. The following management measures were in effect in 1999:

Native peoples' fisheries: In Québec, Native peoples' food fisheries took place subject to agreements or through permits issued to the bands. There are nine bands with food fisheries in addition to the fishing activities of the Inuit in Ungava. The permits generally stipulate gear, fishing effort and catch limits. In the Maritimes and Newfoundland (SFAs 1 to 23), food fishery harvest agreements were signed with several Native peoples' groups (mostly First Nations) in 1999. The signed agreements often included allocations of small and large salmon. Harvests which occurred both within and outside agreements were obtained directly from the Native peoples. Harvest by Native peoples with recreational or commercial licenses are reported under the recreational and commercial harvest categories.

Commercial fisheries: The moratorium, which was placed on the commercial fishery in insular Newfoundland in 1992, continued in 1999. In addition, the commercial fishery in Labrador remained closed in 1999, as in 1998 (Table 4.1.1.1). Commercial fisheries in Québec in 1999 occurred only in zone Q9 (July 1 to August 23) as the commercial quota normally fished by Native peoples' in Ungava Bay (zone Q11) was closed. The quota for Q9 in 1999, established in terms of number of fish, was reduced from 1998, as a voluntary buyback of licenses, which started in 1997 for this fishery, continued.

Recreational fisheries: Recreational fisheries management in 1999 varied by area (Figure 4.1.1.2). Except in Québec and Labrador (SFA 1 and 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 SFAs 15 (Nepisiquit River) and 16 of New Brunswick, the small salmon daily retention limit remained at one fish; other areas of new Brunswick had daily retention limits of two small salmon. The maximum daily catch limit was four fish daily. In SFA 17 (PEI), the season and daily bag limits were 7 and 1 respectively. Catch-and-release fishing only for all sizes of Atlantic salmon was in effect in SFA 19 of Nova Scotia and on ten rivers in Newfoundland. SFAs 20-23 of Nova Scotia and New Brunswick were closed to all salmon angling, except for four acid-impacted rivers on the Atlantic coast of Nova Scotia, where retention of returning small hatchery salmon was allowed and four additional rivers of SFA 21 where there was a three week small salmon retention season. For insular Newfoundland (SFAs 3 to 14A) and the Strait of Belle Isle shore of Labrador (SFA 14B), a new three year management plan was introduced for the recreational fishery which allowed differing seasonal retention limits based on the status of the salmon stocks in the rivers. Retention limits ranged from a seasonal limit of 6 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. The river classification scheme rated individual rivers as Class I (highest) to Class IV (lowest) according to their ability to sustain angling activities as follows:

Class I – large rivers with a seasonal bag limit of 6 fish,

Class II – smaller rivers with a season bag limit of 4 fish,

Class III – rivers with a season bag limit of 2 fish,

Class IV – rivers with catch and release only.

Special class – with various management plans.

In the northern and southern SFAs of Labrador (SFA 1 and 2), there was a seasonal limit of four fish, only one of which could be a large salmon. In Québec, the season limit was seven fish of any size. The daily limit was three fish in zone Q9, two in Q8 and in all other zones, fishing for the day would end if the first fish caught was a large salmon. If the first fish was a small salmon, then fishing would continue on most rivers until the second fish was caught. Eight rivers were restricted to retention of small salmon only at the start of the season. Unlike last year, no additional rivers were restricted to retention of small salmon only after mid-season reviews as sufficient numbers of spawners were detected by this time in the rivers. (Figure 4.1.1.2).

USA

Angling for sea-run Atlantic salmon in the USA is permitted only in the State of Maine, and in 1999 the sport fishery continued to be restricted to catch and release. Effort, as measured by license sales, declined by 18% in 1999 and was 34% and 56% below the 5-year and 10-year averages, respectively.

France (Islands of Saint-Pierre and Miquelon)

For the Saint-Pierre and Miquelon fisheries in 1999, there were 7 professional and 40 recreational gillnet licenses issued. The number of professional fishermen has decreased since 1995 and the number of recreational licenses has remained about the same.

Year	Number of Professional Fishermen	Number of Recreational Licenses
1995	12	42
1996	12	42
1997	6	36
1998	9	42
1999	7	40

4.1.2 Catch and catch per unit effort (CPUE)

Canada

The provisional harvest of salmon in 1999 by all users was 143 t, a decrease of 9% by weight from the 1998 harvest of 157 t (Table 2.1.1.1; Figure 4.1.2.1).

The 1999 harvest was 45,732 small salmon and 11,290 large salmon, an 11% and 15% decrease from the 1998 harvests for small salmon and large salmon, respectively (Table 4.1.2.1). 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 and the closure of the Labrador commercial fishery in 1998 (Figure 4.1.2.1). These reductions were introduced as a result of declining abundance of salmon.

The 1999 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 4.1.2.1). 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 84% of the total small salmon harvests in eastern Canada. Unlike previous years when commercial fisheries took the largest share of large salmon, Aboriginal fisheries accounted for the largest share in 1999 (53% by number). Commercial fisheries harvested 2% (by number) of the total small salmon and 4% of the total large salmon taken in eastern Canada.

Native peoples' fisheries: In many cases, Native peoples' food fisheries harvests in 1999 were less than the allocations. Harvests in 1999 (by weight) were down 5 % from 1998 and 8 % above the previous 5-year average harvest.

Native peoples' 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	45.4	73	49

Recreational fisheries: Harvest in recreational fisheries in 1999 totaled 43,357 small and large salmon, 28% below the previous 5-year average and 14% below the 1998 harvest level (Figure 4.1.2.2). The small salmon harvest of 38,546 fish was a decrease of 26% from the previous 5-year mean. The large salmon harvest of 4,811 fish was a 41% decline from the previous five-year mean. Small salmon harvests were down 16% and large salmon harvests were up 2% from 1998. 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 4.1.2.2).

Recreational catches (including retained and released fish) of small salmon in 1999 were similar or above the 1984 to 1991 mean in some fishing areas of Québec (Q1,Q2,Q3,Q5), and the north-east coast and northern peninsula of Newfoundland and throughout Labrador (Figure 4.1.2.3). Small salmon catches were among the lowest observed in the majority of the Maritimes (with the exception of PEI, and SFAs 15 and 16) and in the west (SFA 13) and south coasts of Newfoundland. Large salmon catches were among the lowest observed throughout mainland Canada (with the exception of the Gulf shore rivers of Nova Scotia and New Brunswick) but were among the highest in the west coast of Newfoundland, (SFA 13, 14A) and Labrador (SFAs 1,2, and 14B).

In 1984, anglers were required to release all large salmon in the Maritime provinces and insular Newfoundland. Changes in the management of the recreational fisheries since 1984 have compromised the use of angling catches as indices of abundance. Therefore, the interpretation of trends in abundance relies mostly on rivers where returns have been estimated or completely enumerated. Caught-and-released fish are not considered equivalent to retained fish and their inclusion in catch statistics further compromises the reliability of interpretation of trends. 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 1999 were closed to retention of all sizes of salmon (Figure 4.1.1.2).

In 1999, about 44,000 salmon (about 21,000 large and 23,000 small) were caught and released (Table 4.1.2.2), representing about 50% of the total number caught, including retained fish. This was a 23% decrease from the number released in 1998. Most of the fish released were in New Brunswick (47%), followed by Newfoundland (39%), Québec (7%), Nova Scotia (6%) and Prince Edward Island (<1%). Expressed as a proportion of the fish caught, that is, the sum of the retained and released fish, Nova Scotia released the highest percentage (84%), followed by Prince Edward Island (65%), New Brunswick (56%), Newfoundland (50%), and Québec (25%).

Commercial fisheries: The commercial harvest in 1999 declined to about 4 t from a peak of more than 2,400 t in 1980 (Figure 4.1.2.4) with only area Q9 of Québec reporting a commercial harvest. In Québec, the harvest of large and small salmon in the commercial fishery continued to decline in 1999, as a result of license retirements.

Unreported catches: Canada's unreported catch estimate for 1999 is about 133 t, up about 46% from 1998. Estimates were included for all provinces (but not for all areas within the provinces) and were provided mainly by enforcement staff. In some cases where enforcement staff did not respond to requests for estimates, values previously provided were assumed for 1999. 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 1999 were:

Stock Area	Unreported Catch (t)
Labrador	6.3
Newfoundland	65.5
Gulf	41.1
Scotia-Fundy	1.2
Québec	18.9
Total	133.0

USA

There was no harvest of sea-run Atlantic salmon in the USA in 1999. The estimated number of salmon caught and released was 211 fish, which represented decreases of 23% from the previous year (273 fish) and 41% and 65% from the previous 5-year and 10-year averages, respectively. Most of the catch in 1999 occurred in the Penobscot River and was the reduction from previous years was attributed to a decline in salmon abundance, a reduction in angler effort (as evidenced by reduced license sales), and by poor angling conditions (low flows and warm water temperatures). As in 1998, unreported catches in the USA were estimated to be 0.

On December 28, 1999 the State of Maine instituted a regulation closing all Maine rivers to Atlantic salmon angling. This closure will remain in effect until further notice. All fisheries (commercial and recreational) for sea-run Atlantic salmon are now closed, including rivers previously open to catch-and-release fishing.

France (Islands of Saint-Pierre and Miquelon)

The harvest in 1999 was reported to be 2.3 t, the same as in 1998, the largest value since 1994. Professional fishermen harvested 1.2 t and recreational fishermen, 1.1 t in 1999. There was no estimate made of unreported catch for 1999.

4.1.3 Origin and composition of catches

In the past, salmon from both Canada and USA have been taken in the commercial fisheries of Labrador. These fisheries were closed in 1999. The remaining Aboriginal food fisheries that exist in this area may intercept some salmon from other areas of North America although there are no reports of tagged fish being captured there in 1999.

Canada

Origin of returns in 1999: Fish designated as being of wild origin are defined as the progeny of fish where mate selection occurred naturally (eggs not stripped and fertilised 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 regardless of life stage, were identified on the basis of the presence of 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. Aquaculture escapees were identified from hatchery fish on the basis of fin erosion (especially of the tail) and from scale characteristics.

The returns 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 4.1.3.1). Hatchery origin salmon made up varying proportions of the total returns and were most abundant in the rivers of the Bay of Fundy and the Atlantic coast of Nova Scotia. Aquaculture escapees were present in the returns to three rivers of the Bay of Fundy (St. Croix, Magaguadavic and Saint John) in 1999.

Aquaculture production of Atlantic salmon in eastern Canada has increased annually, exceeding 10,000 t in 1992 and rising to almost 23,000 t in 1999 (Table 2.2.1.1). Escapes of Atlantic salmon have occurred annually. In 1994, escapes of Atlantic salmon in the Bay of Fundy area were estimated at 20,000 to 40,000 salmon, an amount greater than the total returns of wild and hatchery origin salmon (both small and large) (13,000 to 21,000 fish) to the entire Bay of Fundy and Atlantic coast of Nova Scotia area (SFA 19 to 23) in the same year. The level of escapes in 1993 was similar to that of 1994. Levels of escapes for 1995 to 1999 are unknown.

The proportion of the run that are aquaculture escapees has increased in the Magaguadavic River (SFA 23; Table 4.1.3.1) which is in close proximity to the centre of the aquaculture production area (Figure 4.1.3.2 upper panel; lower panel is historical occurences). Escaped fish were not observed between 1983 and 1988. Since 1992, escaped fish have comprised between 33% and 90% of the total counts at the fishway. Aquaculture escapees comprised between 13% and 64% of the total run of salmon to the St. Croix River during 1994 to 1999 (Table 4.1.3.1).

USA

Most of the salmon caught and released in Maine in 1999 originated from hatchery-origin salmon released in the Penobscot River drainage as part of an ongoing restoration program. However, it is possible that some of the salmon that were caught in eastern Maine (11 fish reported) may have been escapees from aquaculture operations in Maine or New Brunswick.

Production of Atlantic salmon in the Maine aquaculture industry has increased rapidly since 1987 (Table 2.2.1.1), with production exceeding 10,000 t annually since 1995. Production for 1999 was 12,194 t, which was 7% (972 t) below the 1998 production. Aquaculture escapees were again documented in some Maine rivers (Table 4.1.3.1). There were three aquaculture escapees captured in the Narraguagus River in 1999, representing about 8% of the salmon returns to that river. In the Union River, there were 63 aquaculture escapees, representing about 91% of the trap catch in 1999. Since many Maine rivers in the vicinity of pen-rearing operations do not contain provisions for capturing adult salmon, the number of escapees reported above is considered to be incomplete.

4.1.4 Exploitation rates in Canadian and USA fisheries

Canada

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 and 1999, 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 and 1999. Harvests in 1999 of 45,732 small and 11,290 large salmon were less than those of 1997, substantially in the case of large salmon. Exploitation rates in 1997 were estimated to be between 0.14 and 0.26 for small and 0.15 and 0.25 for large salmon.

USA

There was no exploitation of USA salmon in home waters and no salmon of USA origin were detected in Canadian fisheries in 1999.

4.2 Status of Stocks in the North American Commission Area

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.

4.2.1 Measures of abundance in monitored rivers

Canada

The returns represent the size of the population before any in-river and estuarine removals. Spawning escapement is determined by subtracting all the known removals, including food fisheries, recreational harvests, broodstock collections, and scientific samples from the total returns.

A total of 84 rivers were assessed in eastern Canada in 1999. Estimates of total returns of small and large salmon were obtained using various techniques: 43 were derived from counts at fishways and counting fences; 6 were obtained using mark and recapture experiments; 22 using visual counts by snorkeling or from shore; and 13 from angling catches, and redd counts.

1999 compared to 1998 adult returns: Of the 84 stocks for which returns of salmon were determined in 1999, comparable data were available for 71 of these in 1998. For 54 of these rivers, returns were estimated by small salmon and large salmon size groups separately in both years (Table 4.2.1.1). For both size groups combined, returns in 1999 were less than 50% of the 1998 returns in six of the rivers assessed (9%), between 50% and 90% of 1998 returns in twenty of the rivers and were 90% or greater than 1998 returns in forty-five of the rivers.

Large salmon returns in 1999 increased from 1998 in rivers throughout the Maritime provinces and Québec but were equally down or improved in Newfoundland (Table 4.2.1.1; Figure 4.2.1.1). In most of the rivers of Newfoundland, except for rivers of the south-west coast (SFA 13), large salmon are mostly repeat-spawning 1SW fish. Small salmon returns in 1999 relative to 1998 were generally reduced throughout eastern Canada (Figure 4.2.1.1). Returns were similar to or improved (>90% in 1999 relative to 1998) in about half (48%) of the assessed rivers. The north-west and north-east coast Newfoundland rivers showed the most consistent improvement in returns.

1985-99 patterns of adult returns: Annual returns of salmon by size group are available for 25 rivers in eastern Canada since 1985. These returns do not account for commercial fisheries removals in Newfoundland, Labrador, Québec and Greenland and in some rivers include returns from hatchery stocking. Peak return years differed for regions within eastern Canada (Figure 4.2.1.2). The returns during the Newfoundland commercial fishery moratorium years (1992 to 1998) for all areas except Newfoundland are lower than returns in 1986 to 1988 when there were commercial fisheries in Newfoundland, Labrador, Québec and Greenland harvesting mainland Canada origin salmon. The total returns to six Newfoundland rivers doubled during 1993 to 1996 from the low levels observed during 1989 to 1991 (Figure 4.2.1.2). The returns in-river of small salmon in 1999 were collectively the third highest observed in the time series and the large salmon are the seecond highest recorded.

The returns of large salmon in all areas except Newfoundland were among the lowest observed during 1985 to 1999 (Figure 4.2.1.2). Returns of small salmon to six Gulf rivers (NB, NS) in 1999 decreased from 1998 and were less than one-half of the average returns during 1985 to 1991, prior to the Newfoundland commercial fishery moratorium. The returns of large salmon in 1999 were the second lowest of the time series. Returns to the rivers of the Atlantic coast of Nova Scotia and Bay of Fundy improved slightly from the record lows for large salmon but decreased for small salmon to the second lowest of the time series. Returns to ten rivers of Québec in 1999 were the third lowest since 1985 with large salmon returns improving somewhat but still the fourth lowest since 1985. The low abundance of large salmon was most evident in the Scotia-Fundy and Gulf rivers. Low abundance of 2SW salmon in 1999 had been anticipated from the low abundance of 1SW salmon in 1998.

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 in magnitude by a factor of two. Wild smolt production has been estimated in 11 rivers of eastern Canada, although only nine rivers have several years of data (Figure 4.2.1.3). In other rivers, juvenile abundance surveys have been conducted.

Two salmon rivers have been monitored for smolt production in Québec; in Q7, smolt production in 1997 and 1998 was less than half of the 1990-95 average (Figure 4.2.1.4) however smolt production in 1999 was about average in the two rivers. The low smolt production in the Québec Zone Q7 in 1997 and 1998 was attributed to the July 1996 flood which physically reconfigured a large number of rivers in that zone and resulted in a near complete loss of the juveniles in 1996. In Newfoundland, smolt production in 1999 remained above or at the 1990 to 1995 average in the indexed rivers (Figure 4.2.1.4).

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 4.2.1.5). 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 4.2.1.6). Densities of parr in 1999 increased to record values in the Miramichi. In the Restigouche River, both fry and parr densities remain high and near record levels. High densities of juveniles have also been reported from Nova Scotia rivers along the Gulf of St. Lawrence (SFA 18) and in several Cape Breton Island streams (SFA 19). This is in contrast to juvenile densities from an inner Bay of Fundy river (Stewiacke River; SFA 22) and Saint John River (SFA 23)and its tributary, the Nashwaak River, which have declined since 1984, as a result of reduced spawning escapement. Densities of juveniles in the Stewiacke River in 1999 were at record low level (Figure 4.2.1.5). In the St. Mary's River, along the Atlantic coast of Nova Scotia, age 1^+ and 2^+ parr densities remain low while fry densities are higher since 1993.

It is not possible to estimate how many smolts in total leave the rivers of Atlantic Canada for any given year. However, juvenile abundance indices were considered as surrogates of smolt production from eastern Canada. To allow for the combined analysis of smolt counts and juvenile abundance surveys from all the rivers, the individual river surveys were divided by the average within river abundance for the period 1995 to 1998.

$$Ind_{ij} = Abund_{ij} / Average_{i'j}$$

where Ind_{ij} = Adjusted index of juvenile or smolt abundance for year *i* and river *j*

$Abund_{ij}$ = Measured abundance of juvenile or smolts for year *i* and river *j*

$Average_{i'j}$ = Average abundance for years *i'* (1995 to 1998) in river *j*

This adjustment places all the rivers on a common scale and provides a measure of the temporal variability in the smolt and juvenile measures. Juvenile measures were age 1 and older parr and were lagged forward one year to correspond to the smolt migration year.

The index of smolts from North America was obtained by weighting the annual river indices by the relative proportion of the conservation egg requirements (O'Connell et al. 1997) of the SFA or Zone to the total conservation egg requirements of the zones under consideration (Table 4.2.1.2). An alternative weighting incorporated the relative contribution to the 2SW spawner requirements of the six main areas within North America. This allows indices of smolt production from all areas of North America to be used but attributes weights to the area indices according to the expected contribution to 2SW abundance.

The longest time series are from Western Arm Brook (SFA 14A) in Newfoundland and the Miramichi and Restigouche rivers in the Gulf (SFAs 15 and 16). The number of rivers with available data has increased from two in 1971 to 25 or more rivers since 1995 (Table 4.2.1.3). The proportion of the indexed areas represented by the index rivers has increased from 11% in 1971 to more than 25% since 1995 (Table 4.2.1.3).

The relative index weighted by the area-index proportions suggests relative smolt production at three levels since 1971: at about one-third the 1995 to 1998 average between 1971 and 1979, at about 60% of the average during 1980 to 1985 and at about average since 1991 (Figure 4.2.1.6). The relative index for 2SW recruitment (calculated by excluding the Newfoundland areas which do not produce 2SW salmon, SFA 3-12, 14A or by weighting all areas according to the 2SW spawner requirements by area) suggests an overall similar trend.

Estimates of the relative smolt index in the four geographic areas correspond to the previously documented status of rivers (Figure 4.2.1.7). Smolt production from Newfoundland rivers has approximately doubled over the 1971 to 1998 time period (Figure 4.2.1.7). The Gulf smolt index is at its highest level in the 1990s. The Quebec smolt index has declined between 1984 and 1999, driven by de la Trinité time series which for Quebec has a large area-index weight (Table 4.2.1.2). The relative index for Scotia-Fundy has essentially remained unchanged.

USA

Documented Atlantic salmon returns to rivers in New England amounted to 1,452 salmon, which was about 17% lower than the previous year. Returns of 1SW salmon increased by 7% from 1998 to 1999 (356 to 380), while MSW returns decreased by 23% from the previous year (1,393 to 1,072). Total salmon returns to the rivers of New England continued the downward trend that began in the mid-1980s, and were 25% and 44% lower than the previous 5-year and 10-year averages, respectively. Documented Atlantic salmon returns to USA rivers since 1967 are shown in Figure 4.2.1.8. 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.

Most of the USA Atlantic salmon returns were recorded in the rivers of Maine, with the Penobscot River accounting for about 67% of the total. Returns of 1SW salmon to the Penobscot in 1999 were 1% lower than 1998, while MSW returns declined by 25%. Total salmon returns to the Penobscot River (968) were 20% lower than the previous year (1,210,) and 31% and 50% lower than the previous 5-year and 10-year averages, respectively

Atlantic salmon returns to other Maine rivers with fish counting facilities were variable in 1999, compared to those observed in 1998. For example, the salmon count on the Saco River increased by 136% (from 28 to 66), while salmon returns in the St. Croix River declined by 68% (from 41 to 13). Atlantic salmon returns to the Union and Androscoggin rivers were similar to the previous year. The trap catch of Atlantic salmon (32) on the Narraguagus River increased by 45% from the previous year, although the 1999 salmon run was the second lowest number of salmon counted since the first fish trapping facility was installed in 1960. The 1998 salmon run was the lowest in the time series. Salmon counts on this river were 30% and 43% below the 5-year and recent historical (1991-1998) averages, respectively.

Documented salmon returns to the Merrimack River numbered 185 fish, about 13% of the Atlantic salmon returns to New England rivers. The 1999 returns to the Merrimack represented a 50% increase (62 fish) from the previous year, and 185% and 48% increases from the previous 5-year and 10-year averages, respectively. Increased salmon returns to the Merrimack River in 1998 and 1999 were attributed to the annual release of 50,000 smolts (reared in the State of Maine) beginning in 1996, which are supplemental to ongoing stocking of fry.

About 11% of the documented New England salmon returns (154 salmon) were recorded in the Connecticut River. The 1999 returns to the Connecticut represented a 49% decrease from the previous year, and 40% and a 39% decreases from the previous 5-year and 10-year averages, respectively.

4.2.2 Estimates of total abundance by geographic area

For assessment purposes, the 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 4.2.2.1 and 4.2.2.2; Figures 4.2.2.1 and 4.2.2.2; and Appendix 6) 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 using a variety of methods using 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 6). 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 Newfoundland and Labrador regions where returns do not include commercial fisheries. The addition of catches of Newfoundland and Labrador origin salmon in commercial fisheries in Newfoundland and Labrador to "returns" to Newfoundland and Labrador are referred to as total "recruits". Estimation of "recruits" to Québec, Gulf of St. Lawrence, Scotia Fundy and USA regions are not possible because the origin of intercepted salmon in the Newfoundland-Labrador commercial fisheries are not specifically known. In part 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 create the PFA of North American salmon.

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. Catch and effort data from the angling fishery were collected by DFO enforcement staff in conjunction with angling reports submitted by fish camp operators and processed by DFO Science Branch personnel. In 1997 for SFA 14B, the angling catch statistics were derived from a licence stub system similar to insular Newfoundland while in SFAs 1 & 2 the camp statistics data were used. Commercial catch data were collected by DFO enforcement staff from fish plant landing slips and processed by DFO Statistics and Informatics Branch personnel.

In 1998 and 1999, there was no commercial fishery in Labrador and although counting projects started on three Labrador river in 1999, it is not yet possible to extrapolate from these rivers to unsurveyed ones. Hence, it was not possible to estimate the returns or spawners to Labrador for this year.

Newfoundland

The estimates of 1SW and 2SW returns and spawners for insular Newfoundland (SFAs 3–12 & 14A) are updated for 1999. Prior to 1999, they are derived from exploitation rates estimated from rivers with counting facilities which are 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 are 2SW. Exploitation rates for small salmon (retained only) were calculated by dividing the total count and the catch (retained) from rivers with enumeration facilities. In 1998, for SFAs 3–12 and 14A, angling catch data was derived from the licence stub return system (O'Connell *et al.* 1997) while in previous years angling catch data was collected by DFO Fishery Officers and Guardian staff. For SFA 13, returns and spawners come from four assessment facilities expanded to the entire drainage area based on their proportionate contribution.

For 1999, the method used in previous years was modified to take into consideration the changes implemented in the 1999-2001 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. Since the intent of the Management Plan was to alter exploitation for rivers in the various classes, it was necessary to model the estimation procedure for returns and spawners individually for each of them. Also, rivers that were completely closed to angling or that were not included in the river classification scheme were individually dealt with if there was assessment information. Class I rivers included Humber and Gander and for these rivers returns and spawners were derived from their assessments. Since catch statistics were not available separated by river class, classes II and III were combined and returns and spawners estimated based on exploitation rates from five assessed Class II/III rivers to avoid double counting. Most of the Class IV rivers are in Bay St. George area of SFA 13 and the entire area returns and spawners were estimated based on assessments for 7 rivers expanded to the total drainage based on their proportionate contribution. Landings for these rivers were subtracted from those of the other Class II/III rivers. Four rivers in a class with individual management plans were included from their assessment information and four other rivers were not included at all due to a lack of information. These four rivers are very small and represent only a small portion of the overall drainage area of Newfoundland. There were two rivers not listed in the River Classification System which were included based on their assessed information.

The mid-point of the estimated returns (223,000) of 1SW salmon to Newfoundland rivers in 1999 is 20% higher than 1998 and 31% higher than the average 1SW returns (170,300) for the period 1992–95 (Figure 4.2.2.1, Appendix 6). The 1992–95 1SW returns are higher than the returns in 1989-91, but similar to the returns to the rivers between 1971 and 1988. The 1SW recruits to Newfoundland, before commercial fisheries, have declined significantly from about 500,000 in 1988 to 223,000 in 1999. The mid-point (7,900) of the estimated 2SW returns to Newfoundland rivers in 1999 is 15% lower than in 1998 (Figure 4.2.2.2, Appendix 6).

Québec

The mid-point (31,600) of the estimated returns of 1SW salmon to Québec in 1999 is a 10% increase from the returns observed in 1998 about the same as the 1994-98 average of 31,549 (Figure 4.2.2.1).

The mid-point (27,300) of the estimated returns of 2SW salmon in Québec in 1999 is a 2% decrease from the returns observed for 1998 and a 32% decrease from the average of the years 1994-98 of 40,156 (Figure 4.2.2.2). Within the 1971-99 time series, the 1999 value is the lowest estimated and continues a downward trend from the high of 98,000 2SW salmon in 1980.

Gulf of St. Lawrence, SFAs 15–18

The mid-point (37,500) of the estimated returns in 1999 of 1SW salmon returning to the Gulf of St. Lawrence was a 30% decrease from 1998 and it is the lowest value since 1984. The low values noted in 1997,1998 and 1999 continue a downward trend from the high value of about 189,000 in 1992 (Figure 4.2.2.1, Appendix 6).

The mid-point (16,800) of the estimate of 2SW returns in 1999 is 25% higher than the estimate for 1998 and the third lowest of the time series (Figure 4.2.2.1, Appendix 6), the lowest being 1979 at 11,500. Returns of 2SW salmon have declined since 1995 with only slight improvement shown in 1999.

Scotia-Fundy, SFAs 19-23

The mid-point (13,700) of the estimate of the 1SW returns in 1999 to the Scotia-Fundy Region was a 37% decrease from the 1998 estimate, and the third lowest value in the time series, 1971-1999. Returns have generally been low since 1990 (Figure 4.2.2.1, Appendix 6).

The mid-point (5,300) of the 2SW returns in 1999 is 21% higher than the returns in 1998 and the third lowest value in the time series, 1971–99 (Figure 4.2.2.2, Appendix 6). A declining trend in returns has been observed from 1985 to 1999.

USA

Total salmon returns and spawners for USA rivers in 1999 were calculated as described in Anon. 1996/Assess: 11. Since the harvest of salmon is not permitted in Maine and many rivers do not contain fish counting facilities, total run sizes for several small rivers in Maine continue to be underestimated. In recent years, the number of USA spawners is considered to be the same as the number of estimated returns because it is not possible to determine the age and origin of salmon caught in the sport fishery, nor mortality associated with catch-and-release angling in Maine.

The estimated 1SW returns and spawners to USA rivers in 1999 were 419 fish. This was 4% above the estimated 1SW returns in 1998 and 2% and 25% below the previous 5-year and 10-year averages, respectively.

The estimated 2SW returns and spawners to USA rivers in 1999 were 1,168 fish. This was 23% below the 1998 estimate and 32% and 48% below the 5-year and 10-year averages, respectively.

North America (combined Canada and USA)

It is not possible to calculate the total numbers of returns in 1998 and 1999 of either 1SW or 2SW salmon to North America as no estimates exist for Labrador for reasons previously described.

4.2.3 Pre-fishery abundance estimates of non-maturing and maturing 1SW North American salmon

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 1999/ACFM:14 (Table 4.2.3.1). 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 4.2.3.2. It is constructed by summing 2SW returns in year i+1 [NR2(i+1)], 2SW salmon catches in commercial and Aboriginal 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)].

The method of calculating pre-fishery abundance of non-maturing 1SW salmon remains the same as for the 1997 value. In Labrador, Aboriginal food harvests of small (AH_s) and large salmon (AH_l) were included in the reported catches for 1999. Because Aboriginal harvests occurred in both Lake Melville and coastal areas of northern Labrador, the fraction of these catches that are immature was labelled 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 do occur in coastal marine areas in the remainder of northern Labrador. Consequently, af_imm for the fraction of Aboriginal harvests that were 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. 4.2.3.1 $NC1(i) = [(H\_s(i)_{\{1\text{-}7,14b\}} + H\_l(i)_{\{1\text{-}7,14b\}} * q) * f\_imm]$

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

Eq. 4.2.3.2 $NC2(i+1) = [H\_l(i+1)_{\{1\text{-}7,14b\}} * (1-q)] + [AH\_l(i+1) * (1-q)]$

Similar to 1998, the commercial fishery in Labrador remained closed in 1999. 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 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. 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 1971-96. The raising factor (RFL2) to estimate returns to Labrador for 1998-99 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 0.01 per month is used to adjust the back-calculated 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. 4.2.3.3 $NN1(i) = [RFL2*((NR2(i+1) / S1 + NC2(i+1))/S2 + NC1(i)] + NG1(i)$

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 (1992–99) and Labrador fishery (1998-99) as these fisheries were closed.

As the pre-fishery abundance estimates for potential 2SW salmon require estimates of returns to rivers, the most recent year for which an estimate is available is 1998. This is because pre-fishery abundance estimates for 1999 require 2SW returns to rivers in North America in the year 2000 which of course are as of yet unavailable. The minimum and maximum values of the catches and returns for the 2SW cohort are summarized in Table 4.2.3.3. The 1998 abundance estimates ranged between 56,511 and 107,212 salmon. The mid-point of this range (81,861) is 15% lower than the 1997 value (96,319) and is the lowest in the 27-year time series (Figure 4.2.3.1). The most recent two years are shown with hollow symbols as no Labrador values were estimated for these years and the raising factor described previously was used. The results indicate a continuation of the general decline from 807,000 in 1975. The Working Group expressed concern about the continued decline in the pre-fishery abundance and its impact on spawner levels. While maturing 1SW salmon in both 1998 and 1999 have increased over low values in 1997, the non-maturing portion of these cohorts have continued to decline. This continued decline is considered to be very serious.

Maturing 1SW salmon (grilse)

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. Grilse (or maturing 1SW salmon) are in some areas a major component of salmon stocks and measuring their abundance is thought to be 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 1–7,14B 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 and 1999 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 component of 1SW fish destined to mature as grilse 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 Atlantic Canada and catches in year i from fisheries on maturing 1SW salmon in Newfoundland and Labrador [MC1(i)]. An assumed natural mortality rate [M] of 0.01 per month is used to adjust the back-calculated numbers between the fishery on 1SW salmon and returns to the rivers (1 month) as shown below:

Eq. 4.2.3.4 $$MN1(i) = [MR1(i) / S1 + MC1(i)] * RFL1$$

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

Eq. 4.2.3.5 $$MC1(i) = [(1\text{-}f\_imm)(H\_s(i)_{\{1\text{-}7,14b\}} + q*H\_l(i)_{\{1\text{-}7,14b\}})] + H\_s(i)_{\{8\text{–}14a\}} + [(1\text{-}af\_imm)(AH\_s(i) + q*AH\_l(i))]$$

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 1992–99 to remain consistent with catches used in other years in this area (see Section 4.1.1).

The minimum and maximum values of the catches and returns for the 1SW cohort are summarised in Table 4.2.3.4 and the mid-point values are shown in Figure 4.2.3.1. The most recent two 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 1999 (435,500) is 3% higher than 1998 (422,500) which had increased considerably from the 1997 value of 319,300 which was the lowest estimated in the time series 1971-99. Estimates for 1995 and 1994 decreased over those of the previous two years. The reduced values observed in 1978 and 1983–84 were followed by large increases in pre-fishery abundance.

Total 1SW recruits (maturing and non-maturing)

Figure 4.2.3.1 shows the pre-fishery abundance of 1SW maturing and 1SW non-maturing salmon from North America for the period 1971 to 1998 and Figure 4.2.3.2 shows these data combined to give the total 1SW recruits. The steady decline in recruits over the last ten years is alarming. Although the declining trend appears common to both maturing and non-maturing portions of the cohort, non-maturing 1SW salmon have declined at a steeper rate. Also, in the last two years maturing 1SW salmon have increased while non-maturing salmon have continued to decline. Causes for the differences in rate of decline are uncertain. Figure 4.2.3.1 shows that grilse are becoming an increasingly larger proportion of the total North American stock complex. This proportion has risen from about 45% at the beginning of the 1970s to about 84% in the last year. The Working Group expressed concerns about these stock trends and recommended further investigation into their causes.

4.2.4 Spawning escapement and egg deposition

Canada

On rivers not under colonization or rehabilitation, egg depositions in 1999 exceeded or equalled the river specific conservation requirements in 37 of the 67 assessed rivers (55%) and were less than 50% of conservation in 15 other rivers (22%) (Figure 4.2.4.1). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where nine of the 12 rivers assessed (75%) had egg depositions which were less than 50% of conservation requirements. Proportionally fewer rivers in Gulf (7%) and Quebec (0%) had egg depositions less than 50% of conservation. Only 66% of the Gulf rivers and 72% of the Quebec rivers had egg depositions which equalled or exceeded conservation (Figure 4.2.4.1). In Newfoundland, 64% of the rivers assessed met or exceeded the conservation egg requirements and almost all the others (23%) had egg depositions which were less than 50% of requirement. The deficits occurred in the southwest rivers of Newfoundland (SFA 13) and in Labrador.

Seventeen rivers in Newfoundland and Québec are under rehabilitation or colonization programs where in recent years salmon have gained access to previously inaccessible habitat or to re-establish the wild production (Figure 4.2.4.1). Four of these rivers met or exceeded the conservation requirements in 1999. Egg depositions in 53% of these rivers were less than 50% of requirements

Escapements over time relative to conservation requirements have improved in some areas of eastern Canada but have declined in others (Figure 4.2.4.2). The status of three Bay of Fundy/Atlantic coast of Nova Scotia rivers has severely declined, especially since 1991. The proportion of the conservation requirements achieved in 1999 was slightly higher than 1998, the lowest year in all three rivers. For the Québec rivers, spawning escapements declined continually from a peak median value in 1988 with a slight recovery in 1995 and a similar increase in 1999. In almost all years in Quebec, the median proportion of conservation requirements achieved has exceeded the requirements. The eight rivers of the Gulf of St. Lawrence have also been quite consistent in equalling or exceeding the conservation requirements but the median escapements were below conservation requirements in three of the last five years. Newfoundland rivers have shown the greatest improvement in the proportion of the spawning requirement achieved as a direct result of the commercial salmon and groundfish moratoria initiated in 1992. There was a decline in 1997 relative to 1996 but escapements increased again in 1998 (and decreased only slightly in 1999) to their highest median values since the 1992 closure of the commercial salmon fishery.

Run-reconstruction estimates of spawning escapement

Updated estimates for 2SW spawners were derived for the six geographic regions referenced in Section 4.2.2 (Table 4.2.4.1). Estimates of 1SW spawners, 1971-99 are provided in Table 4.2.4.2. 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 spawning requirements for 1SW and 2SW salmon are shown in Figures 4.2.2.1 and 4.2.2.2 respectively (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 or 1999 due to lack of assessment information.

Newfoundland: The mid-point of the estimated numbers of 2SW spawners (7,800) in 1999 is 15% lower than that estimated in 1998 and is 194% of the total 2SW spawner requirements for all rivers. This year is the sixth time that the 2SW spawner requirement has been met or exceeded since 1984 (Figure 4.2.2.2). The 1SW spawners in 1999 increased by 26% from 164,200 in 1998 to 206,900 in 1999, the highest estimate in the time series, 1971-1999. The 1992–96 and 1998-99 1SW spawners are higher than the spawners in 1989–91 and similar to levels in the late 1970s and 1980s (Figure 4.2.2.1). The spawning level in 1997 however was the third lowest in the data series, with 1989 and 1991 being lower. There had been a general increase in both 2SW and 1SW spawners during the period 1992–96 and 1998-99 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 (19,900) in 1999 is higher (19%) than that estimated in 1998 and is about 68 % of the total 2SW spawner requirements for all rivers (Figure 4.2.2.2). The spawning escapement in 1999 is the seventh lowest in the time series (1971-99) and the highest since 1996. Estimates of the numbers of spawners approximated the spawner requirement from 1971 to 1990 however they have been below requirements since 1990. The mid-point of the estimated 1SW spawners in 1999 (22,200) was an 8% increase from 1998 (Figure 4.2.2.1). Spawning escapement of 1SW fish has generally been higher since the early 1980s than it was before this period.

Gulf of St. Lawrence: The mid-point of the estimated numbers of 2SW spawners (15,100) in 1999 is 36% higher than that estimated in 1998 and is about 50% of the total 2SW spawner requirements for all rivers in this region (Figure 4.2.2.2). This is the fourth time in ten years that these rivers have not exceeded their 2SW spawner requirements. The mid-point of the estimated spawning escapement of 1SW salmon (26,700) decreased by 10% from 1998 and is the sixth lowest in the time series, 1971–99; the trend has been downwards since the peak of about 153,000 reached in 1992 (Figure 4.2.2.1). 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 (4,800) in 1999 is a 20% increase from 1998 and is about 20 % of the total 2SW spawner requirements for rivers in this region (Figure 4.2.2.2). Neither the spawner estimates nor the spawner requirements 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 (13,300) in 1999 is a 37% decrease from 1998 and is the seventh lowest in the time series, 1971-99. There has been a general downward trend in 1SW spawners since 1990 (Figure 4.2.2.1).

Canada: It is not possible to calculate the total numbers of spawners in 1998 or 1999 of either 1SW or 2SW salmon to North America as no estimates exist for Labrador for reasons previously described.

USA

The estimated 2SW returns and spawners in 1999 (1,168 salmon) represented about 4% of the spawner requirements for all USA rivers. Estimated spawning escapements (% of conservation requirement) in the Penobscot (10%), Connecticut (<2%) and Merrimack (5%) rivers remained at very low levels.

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 1% per month. These values, termed potential 2SW recruits, along with total North American 2SW returns, spawners and requirements are shown in Figure 4.2.4.3 and indicate that the overall North American spawner requirement could have been met, in the absence of all fisheries, in all years except 1994 and 1997-1999. 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 4.2.4.3. 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. The 2SW recruits to North America indicate that, even if there had not been a West Greenland commercial fishery, spawner requirements 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.

In 1994, the Working Group (ICES 1994/Assess:16) undertook a preliminary analysis of the effects of escapement on potential fishery yield. It was noted that the stock-recruitment relationship ultimately defines the sustainable level of harvesting and its expected variability over time, although spawning stock size is often not a significant variable in models relating recruitment to stock and environmental variables. The establishment of strong correlations between recruits and an environmental variable is sometimes used to support the notion that spawning stock size is unimportant. However, it was concluded that if environmental variability regulates survival in a density-independent fashion, then the importance of stock size is enhanced.

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 4.2.4.3). 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 4.2.4.3)). Since the 1999 2SW spawners to North America (except for Labrador) are known, the spawning stock contributing to the pre-fishery abundance up to 2002 is known for North America and up to 2003 except for Labrador (Figure 4.2.4.4, Table 4.2.4.4).

Spawning escapement of 2SW salmon to several stock complexes has been below the spawner requirement (Labrador, Québec, Scotia-Fundy, USA) since at least the 1980s (Figure 4.2.4.4). In the last four years, lagged spawner abundance has been increasing in Labrador and Newfoundland but decreasing in all other areas. The relative contributions of the stocks from geographic area to the total spawning escapement of 2SW salmon has varied over time (Figure 4.2.4.5). The reduced potential contribution of Scotia-Fundy stocks and the increased proportion of the spawning stock from the Gulf of St. Lawrence and recently Labrador rivers to future recruitment is most evident. Thus production of non-maturing 1SW salmon would not be expected to increase dramatically from most areas of North America even if the sea survival improves. Only the Newfoundland stock complex has received spawning escapements which have exceeded the area requirements, all other complexes were below requirement and some declined further in 1999.

4.2.5 Survival indices

Canada

Counts of smolts and adult salmon returns enable estimates of marine survival to be derived. Examination of trends over time provide insight into the impact of changes in management measures or other factors that can influence the production of salmon. Information from 15 rivers in Atlantic Canada with smolt counts and corresponding adult counts are available; four are hatchery stocks and eleven are wild populations. Geographically, populations for which data were available for the 1999 adult returns ranged from the Saint John River (SFA 23 Bay of Fundy) in the south, LaHave River (SFA 21) and Liscomb River (SFA 20) along the Atlantic coast of Nova Scotia, Saint-Jean (Q2) in the Gaspé region, de la Trinité and aux Rochers (Q7) on the Québec North Shore, and several populations from southern (SFAs 9 and 11), and eastern and northern Newfoundland (SFA 4, 14). In general, survival of hatchery stocks is lower and more variable than that of wild.

There was a large decline in the return rates of both hatchery and wild smolts as 1SW salmon in 1997. The decline was generally observed throughout eastern Canada. Survival rates to the river as 1SW salmon improved for most rivers of eastern Canada in 1998 and 1999 relative to survival rates observed in 1997 (Figure 4.2.5.1 to 4.2.5.3). Survival rates to 1SW salmon of hatchery smolts in 1998 and 1999 were less than 1% while survival rates to 2SW salmon have been less than 0.3% in the recent five years (Figure 4.2.5.1).

In 1999, the survival rate to 1SW salmon declined slightly from 1998 but was greatly improved from 1997 in de la Trinité River (Figure 4.2.5.2); survival rates since the early 1990s have declined from values seen prior to the early 1990s. The LaHave River smolt survivals to 1SW salmon improved in 1998 relative to 1997 but reduced again to 1997 levels in 1999. The survivals to 2SW salmon in the Quebec rivers declined in 1998 to the lowest levels of the time series (Figure 4.2.5.2)but rebounded to high levels in 1999 for the one river surveyed (de la Trinité).

Following a brief period of increasing survival of smolts in recent years, return rates to most rivers of Newfoundland exhibited a substantive decline in 1997 but generally recovered in 1998 and 1999 although survivals generally remain low (Figure 4.2.5.3). Considering that the historical survival rates (prior to 1992) represent survival to the river after commercial fisheries, the recent survival rates and in particular the low rates in 1997 are dismal. The survival rates increased slightly in the south (SFA 9, 10) and southwest coast (SFA 13) rivers of Newfoundland but remained at near record low levels. Despite major changes to fisheries and corresponding reductions in marine exploitation, marine survival rates are still low and sea survival of the salmon populations from eastern Canada has not increased as expected.

The Working Group noted that induced freshwater habitat constraints were substantial in some areas and productive capacity has been reduced. Causes include physical, chemical and biological induced constraints. Documented losses include hydropower development, acidification, and siltation. Suspected losses include interactions caused by the introduction of competitive or predator species, chemicals that disrupt endocrine development and localized effects associated with aquaculture. Mitigation of these losses has, for the most part, been insufficient. Fish passage is not generally complete, hatchery production has not generally replaced the loss of natural production, the reduction in atmospheric pollutants has not declined and numbers of suspected negative factors and sites has continued to increase.

Fish passage efficiency, both upstream and downstream, limit populations at hydropower facilities such as on the Saint John River, St. Croix River, and several US rivers. The distribution of endocrine disrupting chemicals has been reduced in some forest spraying programs but these chemicals may also be associated with industrial and municipal wastes and agricultural practises. Aquaculture has continued to increase and documented negative interaction with wild salmon stocks has occurred. Salmon populations of the Southern Upland of Nova Scotia have fallen to critically low levels in acid-impacted areas.

Collectively these factors have reduced the productive capacity of North American salmon populations but cannot account for the decline in adult returns in recent years.

USA

The survival of hatchery-reared smolts released in the Penobscot River drainage in 1997 was 0.14%. This was the second lowest survival observed in the time series (Figure 4.2.5.4). Marine survival for Penobscot River hatchery-reared smolts continued the downward trend that began in the mid-1980s, with the greatest decline occurring in the 1990s.

4.2.6 Summary of status of stocks in the North American Commission Area

The North American run-reconstruction model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon from 1971–99. The estimate of pre-fishery abundance of 81,861 for 1998 of **non-maturing** 1SW salmon was the lowest on record, and 15% below the previous year. For **maturing** 1SW salmon**,** there was a 32% increase from 1997 in the 1998 estimate (422,517) of pre-fishery abundance. An estimate of 435,502 maturing 1SW fish in 1999 is 3% greater than that of 1998 and the seventh lowest in the 29-year time series. The results suggest a continuing decline of North American adult salmon abundance. In addition to the steady decline in total recruits over the last 10 years, grilse have become an increasingly larger proportion of the total North American stock complex. This proportion has risen from about 45% at the beginning of the 1970s to between 65 and 84% in the last five 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 1993–99 was the lowest in the time series (Figure 4.2.3.2). During 1993 to 1998, the total population of 1SW and 2SW Atlantic salmon was about one-half million fish, 45% of the average abundance during 1972 to 1990. The decline 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 of 2SW fish are at or near the lower end of the 29-year time series (1971-99) except Newfoundland where they are at the second highest level but are a minor age group component of the stocks in this area. Returns of 1SW salmon were at the lower end of the time series in Gulf and Scotia-Fundy, and about at the mid-point in Quebec and USA and second highest in Newfoundland.

The rank of the estimated returns in 1999 in the 1971–99 time series for six regions in North America is shown below:

Region	Rank of 1999 returns in 1971-99 time series (1=highest)		Mid-point estimate of 2SW spawners as proportion of escapement requirement
	1SW	2SW	(%)
Labrador	Unknown	Unknown	unknown
Newfoundland	2	2	194
Québec	13	29	68
Gulf	27	27	50
Scotia-Fundy	26	27	20
USA	13	28	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 were slightly improved or about the same as 1998 and among the lowest observed since 1987 while grilse returns improved marginally for stocks in many areas. For the rivers of Newfoundland, large salmon returns were among the highest in the last 12 years but large salmon returns in the Gulf of St. Lawrence and Québec were among the lowest. The differences in the relative abundance of large salmon in Newfoundland as compared with the other areas of eastern Canada are consistent with the age structure. 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.

The text table above also shows the estimated total spawning escapement of 2SW salmon in each region expressed as a percentage of the spawning escapement requirement. Only in Newfoundland were requirements exceeded in 1999. The overall 2SW spawning escapement requirement for Canada could have been met or exceeded in only nine (1974-78, 1980-82 and 1986) of the past 28 years (considering the mid-points of the estimates) by reduction of terminal fisheries (Figures 4.2.2.2 and 4.2.4.3). In the remaining years, spawning requirements could not have been met even if all terminal harvests had been eliminated. It is only within the last few years that Quebec and the Gulf areas have failed to achieve their overall 2SW salmon spawning requirements.

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 and 1999. 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. It was expected that increased marine water temperatures in 1994 to 1998 would have favoured marine survival and subsequent adult salmon production. Low returns of 2SW salmon in 1998 were consistent with the low grilse return of 1997. Improved grilse returns in 1998 did resulted in improved 2SW salmon returns in 1999 in several areas.

The lower 1SW returns in 1997 and the low 2SW returns in 1998 remain unexplained. Based on grilse returns in 1999, no significant improvements in most areas, and further declines in some areas, are expected for large salmon in 2000. An additional concern is the low abundance levels which currently describe many salmon stocks in rivers in eastern Canada, particularly in the Bay of Fundy and Atlantic coast of Nova Scotia. Despite major changes in fisheries management, returns have continued to decline in these areas and many populations are currently threatened with extirpation.

Although no direct evidence yet exists that can conclusively indicate that predators are the cause of salmon declines, increasing numbers of some predators, particularly seals and seabirds, are increasing in number. At the same time, marine survival of salmon is declining. This suggests that there is a strong possibility that predators and salmon populations are linked (ICES 1999/ACFM:14).

USA salmon stocks exhibit the same downward trend that has been shown for many Canadian salmon stocks, especially those located in the Bay of Fundy and along the Atlantic coast of Nova Scotia. Most salmon rivers in the USA are hatchery-dependent and remain at low levels compared to conservation requirements.

The Working Group noted that induced freshwater habitat constraints were substantial in some areas and productive capacity has been reduced. Causes include physical, chemical and biological induced constraints. Documented losses include hydropower development, acidification, and siltation. Suspected losses include interactions caused by the introduction of competitive or predator species, chemicals that disrupt endocrine development and localized effects associated with aquaculture.

4.3 Effects on US and Canadian Stocks and Fisheries of Quota Management and Closure after 1991 in Canadian Commercial Salmon Fisheries, with special emphasis on the Newfoundland stocks

The Working Group previously considered the impact of the closure of the Newfoundland commercial fishery in 1992 on the Newfoundland stocks (ICES 1997/Assess:10).

Dempson et al. (1997) developed an index of salmon returns to illustrate the impact of the commercial salmon fishery moratorium on Newfoundland stocks. It is based on the difference between the returns prior to the moratorium (1984-91) when there was a commercial fishery to those in the years since the commercial fishery closed (1992-97). By averaging among rivers with counting facilities this provides an estimate of commercial fishing mortality which can then be used to estimate what returns would have been if the commercial fishery had not closed. The method assumes that natural mortality during the commercial fishery years remained at the same levels on average after the commercial fishery was closed. Average commercial fishing exploitation rate was 44% on small salmon and 75% on large. These exploitation rates should be regarded as a minimum values because it is evident that the natural component of marine survival has declined in recent years.

For 2SW salmon, if the commercial fishery had remained open during this period then, on average, from 1,942 to 6,821 fish less would have spawned. For 1SW salmon, had the commercial remained open then, on average, from 37,672 to 96,655 salmon less would have spawned. For 2SW salmon, in the years since the moratorium, spawner requirements have never been achieved if one uses the minimum estimates or have always been achieved using the maximum estimate. If the commercial fishery had not closed, then 2SW spawners would never have achieved spawning requirements even at maximum estimates.

Within Newfoundland, the commercial fishery closure has resulted in increased escapements of both small and large salmon to rivers, higher catches of large salmon (which were subsequently released) in the recreational fishery, and increased spawning escapements of both size groups. These increased spawning escapements have not however always resulted in increased smolt production. Some areas of Newfoundland, particularly the south coast, did not see increases in escapement as was expected from the closure of the commercial fishery.

4.4 Update of Age-Specific Stock Conservation Limits

As indicated by the Working Group last year in ICES 1999/ACFM:14, the conservation requirements for Quebec were adjusted this year. Previously, the number of spawners required for Québec was calculated using Elson's (1975a) work in New Brunswick rivers, which are south of the distribution of salmon in Québec. It was never clear if these previous calculations were equivalent to conservation thresholds or management targets. Québec has adopted a new approach which reflects present day management principles: the setting of conservation thresholds and a precautionary approach in management.

The new conservation threshold was determined following stock-recruitment analysis for six Québec rivers. The conservation limit threshold was defined as the Sopt value (equivalent to the spawner abundance which would provide for MSY) at the 75% cumulative probability level calculated by Bayesian analysis. A relationship between conservation thresholds and habitat production units was applied to all rivers after calculating production units for each river by means of aerial photography and a Québec specific habitat suitability index (HSI). Only self-sustaining rivers, or parts of rivers which had been fully restored or were under restoration, were included. An egg conservation threshold was calculated then transformed for each river into numbers of 1SW, 2SW and other fish (this last category containing 3SW and older fish and repeat spawners). Salmon population characteristics (age, sex ratio) were also updated based on new information.

Overall, the conservation threshold is 61% (expressed in terms of eggs) of that previously used for Québec salmon rivers. The drop was most noticeable for northern rivers and very large rivers. This is due to the new HSI's, that downgraded the production potential in river sections that exceeded 18 m in width and in rivers where the growing season was shorter.

The new conservation threshold for 2SW spawners is 48% of that used previously for Quebec salmon rivers (to 29,446 from 60,750). This reduction is proportionally larger than the reduction in egg requirement mainly due to the updating of stock characteristics.

The application off these new conservation thresholds in Québec will lead to reduced retention of large salmon on rivers where it is forecast that conservation thresholds will not be met. As a consequence of these new thresholds, it is anticipated that large salmon retention will be prohibited on forty Québec rivers in year 2000 and quotas for large salmon will be imposed on twenty other rivers. The number of rivers affected in this way could vary in the future dependent upon changes to the forecasted returns.

Spawner requirements for 2SW salmon for Canada now total 123,349 and for the USA, 29,199 for a combined total of 152,548 (Table 4.4.1). The Working Group again recommends that these requirements be refined as additional information on sea-age composition of spawners becomes available and as further understanding of life history strategies is gained.

4.5 Catch Options or Alternative Management Advice and Assessment of Risks Relative to the Objective of Exceeding Stock Conservation Limits

Overview

Catch options are provided only for the non-maturing 1SW and maturing 2SW components which migrate between two Commission areas and the waters of two, three or four nations. The maturing 1SW component (grilse) is of a lesser migrational tendency, and in the absence of significant marine interceptory fisheries, managed in homewaters by the producing nations.

Catch histories of salmon exposed to the Greenland fishery, 1972-98, are provided in Tables 4.5.1 and 4.5.2. and expressed as 2SW salmon equivalents. The Newfoundland-Labrador commercial fisheries historically 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 1% per month for 11 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 food fishery occurred in 1998 and 1999 which may have harvested, to some degree, mixed stocks and catches for this fishery have been included in Tables 4.5.1 and 4.5.2. 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 4.5.1). Mortalities within North America peaked at about 382,000 in 1976 and are now about 11,100 2SW salmon equivalents. In the most recent three years estimated, those taken as non-maturing fish in Labrador comprise about 5% of the total in North America.

Of the North American fisheries on the cohort destined to be 2SW salmon, 90% of the catch comes from terminal fisheries in the most recent year. This value has ranged from as low as 19% in 1973, 1976 and 1987 to values of 76-90% in 1996-99 fisheries (Table 4.5.1). The percentage increased significantly with the reduction and closures of the Newfoundland and Labrador commercial fisheries, particularly since 1992.

Table 4.5.2 shows the mortalities expressed as 2SW equivalents in Canada, USA and Greenland for 1972–99. 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 has been taken in North American waters has ranged from 43-100%, with the most recent year estimated at 80%. The two years when 100 % of the mortality occurred in North America were the years when the Greenland commercial fishery did not operate.

It is possible to provide catch advice for the North American Commission area for two years. The revised forecast for 1999 for 2SW maturing fish is based on a new forecast of the 1998 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 1998 as 1SW non-maturing fish. The second is a new estimate for 2000 based on the pre-fishery abundance forecast for 1999 from Section 5.6. 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.

4.5.1 Catch advice for 2000 fisheries on 2SW maturing salmon

A revised forecast of the pre-fishery abundance for 1999 is provided in Table 5.6.1.1. This value of 66,663 is lower than the value forecast last year at this time of 79,450 (See Section 5.2 for more detailed derivation of the models used, etc.). A pre-fishery abundance of 66,663 in 1999 can be expressed as 2SW equivalents by considering natural mortality of 1% per month for 10 months (a factor of 0.904837), resulting in 60,319 2SW salmon equivalents. There have already been harvests of this cohort as 1SW non-maturing salmon in 1999 for both the Labrador (203) and Greenland (5374) fisheries (Tables 4.5.1 and 4.5.2) for a total of 5,046 2SW salmon equivalents already harvested, when the mortality factor of 0.904837 is considered.

Table 4.5.1.1 uses the probability density projections for the revised pre-fishery abundance estimate of 66,663 (at 50% probability) and subtracts the spawning reserve (170,286) and the harvests in Greenland and Labrador of 1SW non-maturing fish in 1999,and converts the remainder to 2SW salmon equivalents. The calculation is as follows:

[PFA_i - spawning reserve - harvest in Greenland and Labrador in 1999 of 1SW non-maturing fish] x exp - (0.01 *10 months)]

where PFA_i = values from 25–95%

spawning reserve = 170,286

From Table 4.5.1.1, it is clear that there are no harvest possibilities at forecasted levels which would be considered risk-neutral or risk-averse, that is, at probability levels of 50% and below. It should be clear from the above that the numbers provided for catch options refer to the composite North American fisheries. As the biological objective is to have all rivers reaching their conservation requirements, it is obvious that 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 2000, taking into consideration the contribution of all sea ages of salmon to the spawning population. By area, these are:

Labrador: salmon returns in the year 2000 will be from a higher number of spawners than in recent years, although the lack of long-term monitoring facilities in Labrador makes it difficult to define forecasts or the current status of these stocks.

Newfoundland: the number of spawners has been relatively high in recent years, however, smolt output from all monitored rivers (with the exception of Highlands River in SFA 13) declined in each of the past two years. In the absence of any improvement in marine survival rates, returns of small salmon in 2000 could be lower.

Quebec: Returns of large salmon are expected to be insufficient for attainment of conservation requirements on the following rivers in 2000 and large salmon fisheries are not expected to occur in these rivers (Betsiamites, Cap-Chat,du Grand Pabos, du Petit Pabos, Godbout, Malbaie (Q7), Mingan, Nouvelle, Petite Cascapedia, and Rimouski). In addition, twenty-nine additional small rivers will be either closed to all exploitation or restricted to small salmon retention only .

Gulf: In SFA 15, returns in 2000 should be similar to the last 5 years, approximately at conservation requirements and current levels of harvest have not been limiting stock conservation. In SFA 16, a lower return of large salmon is expected with little to no chance of meeting the conservation requirement in the Southwest Miramichi, the Miramichi River overall and the Buctouche River while there is a modest chance of reaching conservation on the Northwest Miramichi and an expectation of exceeding requirements on the Tabusintac River. In SFA 18, Northumberland Strait and Cape Breton rivers, including the Margaree, are expected to exceed conservation requirements in 2000.

Scotia-Fundy: In SFAs 19-23, salmon returns (both large and small) in 2000 are not expected, with few exceptions, to be sufficient to meet conservation requirements, including those receiving hatchery stocking.

USA: Salmon returns (both large and small) in 2000 are not expected to be sufficient to meet conservation requirements in any river, including those receiving hatchery stocking.

4.5.2 Catch advice for 2001 fisheries on 2SW maturing salmon

Table 4.5.2.1, as an example, assumes a 40% Greenland/60% North America division of the surplus for harvest (after reserving the spawner requirement of 170,286) and expresses catch options as 2SW salmon equivalents for 2001 (by considering 10 months of mortality at 1% per month, a factor of 0.904837). As is noted in Section 5.2, the forecast is very uncertain. Precautionary approaches would use probabilities much lower than 50%. The calculation is as follows:

$[[PFA_i - \text{spawning reserve}] \times \exp - (0.01 \times 10 \text{ months}) \times 0.60]$

Table 4.5.2.1 provides catch options for 2001 which can be refined next year when information becomes available from harvests of the cohort as non-maturing fish in Greenland and Canada in 2000.

From Table 4.5.2.1, it is clear that there are no harvest possibilities at forecasted levels that would be considered risk-averse, that is, below probability levels of 50%. At the 50% level, a catch option of 5,218 2SW salmon equivalents is forecast. This is less than half of the most recent estimate of the fishing mortality of 11,057 fish harvested as 2SW equivalents in 1999. It should be clear from the above that the numbers provided for catch options refer to the composite North American fisheries. As the biological objective is to have all rivers reaching their conservation requirements, it is obvious that river-by-river management is necessary. On individual rivers, where spawning requirements are being achieved, there are no biological reasons to restrict the harvest.

4.6 Data Deficiencies and Research Needs in the North American Commission Area

While some progress was made on research needs identified last year, particularly in the areas of refinement of spawner requirements and the initiation of some wild smolt sampling programs (Miramichi) and adult enumeration programs in Labrador, the Working Group felt that further work is required, and accordingly reiterates last year's recommendations and suggests some further ones.

1) There is a critical need to maintain and augment monitoring of salmon returns and develop habitat-based spawner requirements in Labrador, and to monitor salmon returns in the Ungava regions of Québec.
2) There is a need to investigate changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and the harvest in aboriginal fisheries in Labrador. These data and new information on measures of habitat and stock recruitment are necessary to reevaluate existing estimates of spawner requirements in Canada and USA and for use in the run reconstruction model.
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.
4) 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.
5) Return estimates for the few rivers (Annapolis, Cornwallis and Gaspareau) in SFA 22 that do contribute to distant fisheries should be developed and, when these are available, the SFA 22 spawning requirements for these rivers (476 fish) be included in the total.
6) A consistent approach to estimating returns is needed, to incorporate broodstock, if offspring from such broodstock are stocked back into the management area from which their parents originated.
7) Update the smolt age distributions of 2SW salmon in the six stock areas of north America and assess the effects of annual changes of smolt age distribution in the calculation of lagged spawners, and other measures of spawning stock variables, used in PFA forecast modeling.

Table 4.1.1.1. Licensed effort, quota, harvests and percent of total harvest comprised of large salmon in the Labrador and Québec commercial fisheries, 1992 to 1999. The commercial fishery of Labrador was partly closed in 1997 (SFA 14B) and completely closed in 1998 and 1999. The commercial fishery in Québec Zone Q7 was closed in 1993 and in Zone Q8 in 1994. A voluntary commercial buyback was in effect in Québec Zone Q9 in 1998 and 1999.

	1992	1993	1994	1995	1996	1997	1998	1999
Labrador (SFA 1, 2 and 14B)								
Licensed effort	495	288	218	218	218	205	0	0
Quota (t)	273	178	92	73.5	55	50	0	0
Harvest (t)	204	112	93	55	48	47	0	0
Harvest (number)	56,590	34,170	24,017	19,156	15,116	16,696	0	0
% Large (by number)	57%	50%	64%	59%	48%	38%		
Québec (Q7 to Q9)								
Licensed effort	147	94	90	90	87	87	31	11
Quota (number)	23,400	15,325	15,175	15,175	12,068	12,068	3,036	2,240
Harvest (number)	19,363	14,657	13,800	13,653	11,718	10,437	2,106	1,285
Harvest (t)	63	46	43	42	32	30	5	4
% Large (by number)	80%	75%	72%	71%	61%	66%	49%	37%
Québec (Q11)								
Licensed effort	5	5	5	5	5	5	5	5
Quota (number)	3,125	3,125	3,125	3,125	3,125	3,125	0	0
Harvest (number)	337	212	485	300	268	296	0	0
Harvest (t)	2	1	3	2	1	2	0	0

Table 4.1.2.1. Percentages by user group and province of small and large salmon harvested (by number) in the Atlantic salmon fisheries of eastern Canada during 1999.

	% of Provincial Harvest			**% of**	
	Aboriginal fisheries	**Recreational fisheries**	**Commercial fisheries**	**eastern Canada**	**Number of fish**
Small salmon					
Newfoundland / Labrador	13.7	86.3	0.0	43.6	19,941
Québec	14.1	72.5	13.4	13.3	6,091
New Brunswick	14.5	85.5	0.0	41.5	18,979
P.E.I.	0.0	100.0	0.0	0.4	189
Nova Scotia	5.1	94.9	0.0	1.2	532
Large salmon					
Newfoundland / Labrador	76.2	23.8	0.0	12.6	1,422
Québec	44.0	50.6	5.3	78.2	8,833
New Brunswick	100.0	0.0	0.0	9.2	1,035
P.E.I.	-	-	-	0.0	0
Nova Scotia	-	-	-	0.0	0
Eastern Canada		**% by User Group**			
Small salmon	13.9	84.3	1.8		45,732
Large salmon	53.2	42.6	4.2		11,290

Table 4.1.2.2: Hook-and-Released Atlantic salmon caught by recreational fishermen in Canada, 1984-99

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	11,105	2,343	13,448	796	2,894	3,690	4,153	7,443	4,790	11,556	27,942	577	147	724				**24,074**	**21,730**	**45,804**
1995	12,383	2,588	14,971	979	2,861	3,840	770	4,260	880	5,220	11,130	209	139	348		922	922	**18,601**	**12,610**	**31,211**
1996	22,227	3,092	25,319	3,526	5,661	9,187						472	238	710		1,718	1,718	**26,225**	**10,709**	**36,934**
1997	17,362	3,810	21,172	717	3,358	4,075	3,457	4,870	3,786	8,874	20,987	210	118	328	182	1,643	1,825	**26,798**	**21,589**	**48,387**
1998	25,314	4,351	29,665	687	2,520	3,207	3,154	5,760	3,452	8,298	20,664	233	114	347	297	2,680	2,977	**35,445**	**21,415**	**56,860**
1999	13,393	3,816	17,209	541	2,171	2,712	3,155	5,631	3,456	8,281	20,523	192	157	349	298	2,693	2,991	**23,210**	**20,574**	**43,784**

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

Table 4.1.3.1. Counts of salmon and percentage of the counts which were identified as aquaculture escapes (% Aqua') at the counting facilities of the Magaguadavic River (SFA 23, Canada) and in rivers of easterm Maine, USA.

Magaguadavic River (SFA 23, Canada)						
Year	1SW	% Aqua'	MSW	% Aqua'	Total	% Aqua'
1983	303	-	637	-	940	-
1984	249	-	534	-	783	-
1985	169	-	466	-	635	-
1988	291	-	398	-	689	-
1992	238	35	201	31	439	33
1993	208	46	177	29	385	38
1994	1064	94	228	73	1292	90
1995	540	90	198	85	738	89
1996	195	89	68	29	263	74
1997	94	63	47	49	141	58
1998	247	89	6	50	253	88
1999	74	74	29	83	103	77

	Rivers of eastern Maine							
	Union		St. Croix		Dennys		Narraguagus	
Year	Total Run	% Aqua'	Total run	% Aqua'	Total run	% Aqua'	Total run	% Aqua'
1994	-	-	181	54	47	89	52	2
1995[1]	-	-	60	22	9	44	56	0
1996	-	-	152	13	31	68	64	22
1997	-	-	70	39	2[2]	100	37	0
1998	-	-	65	37	1[2]	100	22	0
1999	72	91	36	64	-	Unk	35	8

[1] High flows in 1995 may have affected accuracy of counts in all three rivers, especially the Dennys River

[2] Incomplete count of total run

Table 4.2.1.1. Comparison of returns of small salmon, large salmon, and size groups combined to assessed rivers of eastern Canada in 1999 relative to returns in 1998 and to returns in 1989 to 1999.

	Number of rivers in each category			
		Returns in 1999 relative to returns in 1998		
Size group	Total	<50%	50% to 90%	>= 90%
Bay of Fundy and Atlantic Coast of Nova Scotia (SFA 19 to 23)				
Small	11	4	6	1
Large	11	3	2	6
Small & Large	11	5	5	1
Southern Gulf of St. Lawrence (SFA 15 to 18)				
Small	10	1	1	8
Large	10	0	2	8
Small & Large	10	0	4	6
Quebec (Zones Q1 to Q11)				
Small	13	0	8	5
Large	13	1	0	12
Small & Large	30	0	3	27
Newfoundland and Labrador (SFA 1 to 14)				
Small	20	1	7	12
Large	20	2	9	9
Small & Large	20	1	8	11

		Rank of 1999 within the 1989 to 1999 period		
Size group	Number of rivers	Best	Median	Worst
Bay of Fundy and Atlantic coast of Nova Scotia (SFA 19 to 23)				
Small	4	3	9	11
Large	5	5	9	10
Small & Large	6	7	10	11
Southern Gulf of St. Lawrence (SFA 15 to 18)				
Small	6	2	6	10
Large	6	3	8	11
Small & Large	6	2	6.5	11
Quebec (Zones Q1 to Q11)				
Small	11	2	9	11
Large	11	7	9	11
Small & Large	26	1	7	11
Newfoundland and Labrador (SFA 1 to 14)				
Small	10	3	4.5	11
Large	10	1	4.5	10
Small & Large	10	2	4	10

Table 4.2.1.2. Index rivers in eastern North America with available juvenile abundance or smolt abundance estimates for 1971 to 1999. The index area refers to the SFAs or Zones which are assumed to be represented by the index rivers surveyed in those zones. River locations are shown in Figure 4.2.1.3.

				Egg requirement (millions)				
Geographic Area	SFA, Zone	Index river	Abundance Type	SFA, Zone	Index river	Index river / all index rivers	River relative to SFA, Zone	River as % of Total
Labrador	1							
	2							
	14B							
Newfoundland	3							
	4	Campbellton	Smolts	158.6	2.9	0.9%	1.8%	0.3%
	5			37.9				
	6							
	7							
	8							
	9	NE Trepassey	Smolts	16.2	0.1	0.0%	0.6%	0.0%
		Rocky	Smolts		3.4	1.0%	14.2%	0.3%
	10			7.8				
	11	Conne	Smolts	41.1	7.8	2.4%	19.0%	0.7%
		Little	Smolts		0.3	0.1%	0.8%	0.0%
	12							
	13	Highlands	Smolts	75.4	1.5	0.5%	2.0%	0.1%
	14A	WAB	Smolts	19.1	0.9	0.3%	4.8%	0.1%
Gulf	15	Restigouche	Juveniles	71.9	53.6	16.2%	74.5%	5.1%
	16	Miramichi	Juveniles	143.5	131.0	39.7%	91.3%	12.4%
		Buctouche	Juveniles		1.6	0.5%	1.1%	0.2%
	17	Morell	Juveniles	1.9	0.6	0.2%	29.7%	0.1%
	18	Margaree	Juveniles	23.1	6.7	2.0%	29.0%	0.6%
		R. Philip	Juveniles		2.3	0.7%	10.0%	0.2%
		Wallace	Juveniles		1.5	0.5%	6.4%	0.1%
		East Pict	Juveniles		1.8	0.5%	7.6%	0.2%
		West	Juveniles		0.8	0.2%	3.5%	0.1%
Scotia-Fundy	19	Middle	Juveniles	21.2	2.1	0.6%	9.8%	0.2%
		Baddeck	Juveniles		2.0	0.6%	9.4%	0.2%
		North	Juveniles		0.9	0.3%	4.0%	0.1%
		Grand	Juveniles		1.1	0.3%	5.2%	0.1%
		Inhabitants	Juveniles		1.4	0.4%	6.6%	0.1%
	20	St. Marys	Juveniles	55.2	9.6	2.9%	17.3%	0.9%
	21	LaHave	Juveniles	77.6	12.2	3.7%	15.7%	1.2%
	22			21.2				
	23	Saint John	Juveniles	90.6	32.3	9.8%	35.7%	3.1%
		Nashwaak	Juveniles		13.7	4.1%	15.1%	1.3%
		Kennebecasis	Juveniles		5.0	1.5%	5.5%	0.5%
		Hammond	Juveniles		4.0	1.2%	4.4%	0.4%
Quebec	Q1			24.8				
	Q2	Saint-Jean	Smolts	11.1	1.9	0.6%	16.9%	0.2%
	Q3			11.3				
	Q4							
	Q5			6.1				
	Q6			5.6				
	Q7	de la Trinité	Smolts	14.1	1.6	0.5%	11.2%	0.1%
		Moisie	Smolts		20.4	6.2%	145.1%	1.9%
	Q8			80.8				
	Q9			25.9				0.0%
	Q10	Bec-scie	Smolts	7.5	0.1	0.0%	1.9%	0.0%
U.S.	Maine		Juveniles	5.5	5.5	1.7%		0.5%
North America	Subtotal			1054.9	330.5	100.0%		31.3%

Table 4.2.1.3. Number of rivers and percent of total indexed area represented by the indexed rivers in 1971 to 1999.

Year	Rivers Monitored	River Area as % of Total Indexed Area
1971	2	11.5%
1972	3	16.2%
1973	3	16.2%
1974	3	16.2%
1975	4	16.8%
1976	4	16.8%
1977	5	16.9%
1978	8	17.3%
1979	6	18.0%
1980	6	17.6%
1981	9	20.0%
1982	10	20.1%
1983	8	19.8%
1984	10	20.1%
1985	10	19.9%
1986	11	19.9%
1987	12	20.8%
1988	11	20.2%
1989	11	19.5%
1990	14	21.9%
1991	16	22.5%
1992	17	22.7%
1993	21	26.0%
1994	22	26.1%
1995	26	28.5%
1996	24	27.3%
1997	27	28.5%
1998	28	28.5%
1999	25	26.4%

Table 4.2.2.1 Estimated numbers of 1SW returns in North America by geographic regions, 1971-99.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy			North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	USA	Min	Max	Mid-points
1971	32966	115382	112266	224994	14969	22453	33118	57966	11515	19525	32	204866	440352	322609
1972	24675	86362	108509	217092	12470	18704	42202	73695	9522	16915	18	197395	412787	305091
1973	5399	18897	143729	287832	16585	24877	43681	77041	14766	24823	23	224183	433493	328838
1974	27034	94619	84667	169103	16791	25186	65673	114060	26723	44336	55	220943	447359	334151
1975	53660	187809	111847	223890	18071	27106	58613	101873	25940	36316	84	268214	577079	422647
1976	37540	131391	114787	229853	19959	29938	90308	155657	36931	55937	186	299711	602962	451336
1977	33409	116931	109649	219106	18190	27285	31322	56062	30860	48387	75	223506	467847	345677
1978	16155	56542	97070	194133	16971	25456	26008	45404	12457	16587	155	168816	338277	253547
1979	21943	76800	106791	213327	21683	32524	50872	93119	30875	49052	250	232414	465072	348743
1980	49670	173845	120355	240449	29791	44686	45716	81675	49925	73560	818	296274	615033	455654
1981	55046	192662	156541	312697	41667	62501	70238	128324	37371	62083	1130	361994	759398	560696
1982	38136	133474	139951	279115	23699	35549	79874	143287	23839	38208	334	305833	629968	467900
1983	23732	83061	109378	218548	17987	26981	25337	43897	15553	23775	295	192282	396557	294420
1984	12283	42991	129235	257256	21566	30894	37696	63889	27954	47493	598	229331	443120	336226
1985	22732	79563	120816	240985	22771	33262	61255	110487	29410	51983	392	257376	516672	387024
1986	34270	119945	124547	248688	33758	46937	114718	204342	30935	54678	758	338986	675348	507167
1987	42938	150283	125116	249856	37816	54034	86564	155937	31746	55564	1128	325307	666801	496054
1988	39892	139623	132059	263363	43943	62193	123578	223136	32992	56935	992	373457	746243	559850
1989	27113	94896	59793	119261	34568	48407	72944	129437	34957	59662	1258	230634	452922	341778
1990	15853	55485	98830	197276	39962	54792	83670	159051	33939	60828	687	272941	528120	400530
1991	12849	44970	64016	127698	31488	42755	59721	113412	19759	31555	310	188143	360699	274421
1992	17993	62094	116116	231954	35257	48742	146539	231099	22832	37340	1194	339931	612423	476177
1993	25186	80938	131045	261721	30645	42156	89934	146670	16714	27539	466	293990	559491	426740
1994	18159	56888	95487	190655	29667	40170	55639	117461	8216	11583	436	207603	417193	312398
1995	25022	76453	111889	223758	23851	32368	26019	96786	14239	21822	213	201233	451399	326316
1996	51867	153553	140217	285387	32008	42558	50311	99377	22795	36047	651	297849	617573	457711
1997	66812	155963	86230	146833	24300	33018	27514	54389	7173	10467	365	212395	401035	306715
1998	-	-	89680	282369	24029	33524	38029	68886	16770	26481	403	-	-	-
1999	-	-	143029	302412	29572	33653	27453	47542	10517	16850	419	-	-	-

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

Table 4.2.2.2 Estimated numbers of 2SW returns in North America by geographic regions, 1971-99.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy			North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	USA	Min	Max	Mid-points
1971	4312	29279	2385	9104	34568	51852	29483	46834	11187	16410	653	81935	153479	117707
1972	3706	25168	2494	9129	45094	67642	35640	59940	14028	19731	1383	102347	182993	142670
1973	5183	35196	2995	11808	49765	74647	34911	59553	10359	14793	1427	104640	197425	151032
1974	5003	34148	1968	6702	66762	100143	49081	83405	21902	29071	1394	146110	254863	200486
1975	4772	32392	2382	8002	56695	85042	31175	51866	23944	31496	2331	121298	211129	166214
1976	5519	37401	2327	7663	56365	84547	29266	51429	21768	29837	1317	116562	212194	164378
1977	4867	33051	1880	6309	66442	99663	58822	100770	28606	39215	1998	162615	281007	221811
1978	3864	26147	2005	6419	59826	89739	30465	51485	16946	22561	4208	117314	200558	158936
1979	2231	15058	1103	3691	32994	49491	8671	14327	8962	12968	1942	55903	97476	76690
1980	5190	35259	2447	7794	78447	117670	43407	73845	31897	44823	5796	167184	285186	226185
1981	4734	32051	2317	7475	61633	92449	17743	29598	19030	28169	5601	111058	195342	153200
1982	3491	23662	2975	9228	54655	81982	31652	51133	17516	24182	6056	116344	196242	156293
1983	2538	17181	2511	7915	44886	67329	29038	46878	14310	20753	2155	95438	162210	128824
1984	1806	12252	2273	7117	44661	59160	20478	34134	17938	27899	3222	90379	143783	117081
1985	1448	9779	961	3319	45916	61460	23106	43545	22841	38784	5529	99802	162415	131109
1986	2470	16720	1592	5402	55159	72560	36214	70953	18102	33101	6176	119714	204912	162313
1987	3289	22341	1338	4629	52699	68365	22668	47955	11529	20679	3081	94604	167051	130827
1988	2068	14037	1553	5346	56870	75387	26140	49970	10370	19830	3286	100287	167855	134071
1989	2018	13653	704	2452	51656	67066	17311	35358	11939	21818	3197	86825	143543	115184
1990	1148	7790	1341	4562	50261	66352	24616	53154	10248	18871	5051	92665	155780	124223
1991	548	3740	1057	3577	46841	60724	20983	44478	10613	17884	2647	82690	133050	107870
1992	2515	15548	3024	10354	46917	61285	29101	61174	9777	16456	2459	93793	167276	130535
1993	3858	18234	1487	5217	37023	46484	25753	51827	6764	11087	2231	77117	135081	106099
1994	5653	24396	1889	6255	37703	47180	22097	57079	4379	6908	1346	73067	143163	108115
1995	12368	44205	2296	7462	43755	54186	24276	62971	4985	8317	1748	89428	178889	134159
1996	9113	32759	2569	8887	39413	49846	20379	42986	7227	12054	2407	81108	148939	115023
1997	9384	23833	2841	7226	32443	41017	17563	37834	3645	5922	1611	67487	117443	92465
1998	-	-	3792	14757	24295	31726	8053	18801	2728	6003	1526	-	-	-
1999	-	-	3601	12188	25153	29492	11339	22204	3482	7107	1168	-	-	-

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

Table 4.2.3.1 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 4.2.3.2).

	{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	0	1084	0	0	0	0	0

Table 4.2.3.2 Definitions of key variables used in continental run-reconstruction models for North American salmon.

Variable	Definition
i	Year of the fishery on 1SW salmon in Greenland and Canada
M	Natural mortality rate (0.01 per month)
t1	Time between the mid-point of the Canadian fishery and return to river = 2 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 harvest of small salmon in northern Labrador
AH_l	Aboriginal 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 fisheries in N Labrador
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 4.2.3.3 Run reconstruction data inputs used to estimate pre-fishery abundance of non-maturing (NN1) 1SW salmon of North American origin (terms defined in Table 4.2.3.2).

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	102347	182993	578955	726765	652860
1972	200784	15768	37316	203072	248628	104640	197425	557789	733257	645523
1973	241493	21150	51412	223422	262767	146110	254863	672662	867805	770234
1974	220584	21187	50243	223332	266337	121298	211129	623993	800853	712423
1975	278839	32385	73371	243315	285486	116562	212194	710244	904589	807417
1976	155896	24285	57005	225424	271703	162615	281007	610837	826861	718849
1977	189709	24323	57902	146535	177644	117314	200558	506934	667818	587376
1978	118853	11796	29813	86644	103079	55903	97476	288809	371396	330103
1979	200061	19478	42242	202634	245013	167184	285186	630107	831432	730770
1980	187999	31132	70739	186367	228568	111058	195342	549070	729402	639236
1981	227727	31000	70441	125578	151442	116344	196242	527385	684598	605992
1982	194715	23583	52338	104116	125802	95438	162210	439899	567157	503528
1983	33240	17688	39712	76554	94103	90379	143783	236421	337454	286938
1984	38916	13255	30019	74062	88256	99802	162415	245428	347774	296601
1985	139233	18582	40002	97329	118841	119714	204912	399013	539313	469163
1986	171745	23343	50988	121610	150859	94604	167051	435092	575933	505512
1987	173687	29639	65127	74996	92205	100287	167855	398157	528089	463123
1988	116767	20709	44860	75300	92364	86825	143543	317617	423939	370778
1989	60693	18139	39691	53173	65040	92665	155780	241038	346158	293598
1990	73109	11072	24518	37739	45590	82690	133050	218194	296533	257364
1991	110680	9302	20175	22639	29107	93793	167276	249702	349750	299726
1992	41855	2748	6790	11967	15386	77117	135081	143913	216437	180175
1993	0	1878	4441	10764	13839	73067	143163	95337	179546	137441
1994	0	1018	2651	7823	10058	89428	178889	109491	213457	161474
1995	21341	910	2267	5090	6545	81108	148939	118415	197098	157757
1996	21944	858	2006	4860	6249	67487	117443	103507	161955	132731
1997	16814	1045	2367	1588	2269	40394	72813	67047	125591	96319
1998	3026	161	367	759	1084	44743	72159	56511	107212	81861
1999	5374	142	306	0	0	0	0	5516	5680	5598

Table 4.2.3.4 Run reconstruction data inputs and estimated pre-fishery abundance for maturing (MN1) 1SW salmon (grilse) of North American origin (terms defined in Table 4.2.3.2).

1SW Year (i)	MC1 min (i)	max (i)	MR1 min (i)	max (i)	MN1 min (i)	max (i)	mid-point (i)
1971	213987	267720	204866	440352	420912	712498	566704.96
1972	237286	279064	197395	412787	436665	695999	566332
1973	346109	408260	224183	433493	572545	846109	709327
1974	322772	379370	220943	447359	545936	831225	688580
1975	351015	422105	268214	577079	621925	1004984	813455
1976	313060	375300	299711	602962	615783	984322	800053
1977	252058	318032	223506	467847	477810	790581	634196
1978	132546	172340	168816	338277	303059	514017	408538
1979	218442	252711	232414	465072	453192	722457	587825
1980	343344	412617	296274	615033	642596	1033831	838214
1981	308670	377651	361994	759398	674302	1144681	909492
1982	265678	312538	305833	629968	574585	948837	761711
1983	197184	234389	192282	396557	391398	634932	513165
1984	158852	187900	229331	443120	390487	635474	512981
1985	227928	259284	257376	516672	487890	781148	634519
1986	278654	321357	338986	675348	621046	1003493	812270
1987	319510	375472	325307	666801	648087	1048974	848531
1988	240291	276488	373457	746243	617501	1030231	823866
1989	205998	239495	230634	452922	438950	696969	567959
1990	134630	156382	272941	528120	410314	689810	550062
1991	117141	133509	188143	360699	307174	497834	402504
1992	21986	30556	339931	612423	365334	649134	507234
1993	15027	19983	293990	559491	311972	585096	448534
1994	8142	11928	207603	417193	217832	433313	325573
1995	7278	10200	201233	451399	210533	466136	338334
1996	6861	9028	297849	617573	307703	632807	470255
1997	8358	10652	212395	401035	222888	415718	319303
1998	3054	3302	168912	411663	180610	664424	422517
1999	2705	2758	210990	400876	224448	646557	435502

Table 4.2.4.1 Estimated numbers of 2SW spawners in North America by geographic regions, 1971-99.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy			North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	USA	Min	Max	Mid-points
1971	4012	28882	1810	8230	11822	17733	4303	8239	4496	9032	490	26933	72606	49769
1972	3435	24812	1985	8358	23160	34741	17803	32999	7459	12699	1038	54880	114646	84763
1973	4565	34376	2275	10720	23564	35346	20505	38129	3949	7844	1100	55957	127514	91736
1974	4490	33475	1534	6043	28657	42985	31702	57926	9526	15979	1147	77056	157555	117305
1975	4564	32119	1959	7355	23818	35726	18477	33212	11861	18830	1942	62620	129185	95902
1976	4984	36701	2003	7160	22653	33980	14821	29697	11045	18337	1126	56633	127001	91817
1977	4042	31969	1134	5131	32602	48902	32535	60191	13578	23119	643	84533	169956	127244
1978	3361	25490	1564	5728	29889	44834	11511	22834	6517	11428	3314	56157	113628	84893
1979	1823	14528	992	3506	12807	19210	3575	6826	4683	8234	1509	25389	53813	39601
1980	4633	34525	1894	6928	35594	53390	19947	37649	14270	25628	4263	80602	162384	121493
1981	4403	31615	1935	6874	26132	39199	4657	10033	5870	13353	4334	47331	105408	76370
1982	3080	23127	2635	8691	26492	39738	11036	20336	5656	11335	4643	53542	107870	80706
1983	2267	16824	2167	7364	17308	25963	7436	14293	1505	6529	1769	32452	72741	52596
1984	1478	11822	2082	6829	22345	32659	15332	27198	14245	23650	2547	58030	104705	81367
1985	1258	9530	949	3300	20668	31742	21168	39994	18185	33580	4884	67111	123029	95070
1986	2177	16334	1560	5354	24088	35939	32991	65010	15435	30120	5570	81821	158328	120074
1987	2895	21821	1322	4605	21723	31727	19877	43155	10235	19233	2781	58833	123321	91077
1988	1625	13452	1529	5310	25390	38343	23392	44871	9074	18381	3038	64048	123395	93722
1989	1727	13270	697	2441	25016	35905	14758	30886	11689	21539	2800	56686	106840	81763
1990	923	7493	1321	4532	24422	36219	22554	49521	9688	18245	4356	63262	120365	91814
1991	491	3665	1044	3557	19959	29052	19590	41987	9356	16479	2416	52856	97156	75006
1992	2012	14889	2968	10270	19337	28833	27448	54219	8725	15280	2292	62783	125783	94283
1993	3624	17922	1437	5139	15774	21428	25218	46342	5710	9921	2065	53828	102816	78322
1994	5339	23981	1825	6156	15631	21147	20315	54125	3682	6093	1344	48137	112846	80491
1995	12006	43726	2223	7350	22575	28703	22634	60532	4672	7971	1748	65857	150030	107944
1996	8838	32395	2482	8755	19010	25421	18416	39778	6507	11242	2407	57661	119997	88829
1997	9221	23646	2731	7058	15531	20780	15832	35173	3095	5311	1611	48021	93579	70800
1998	-	-	3688	14595	14176	19333	6207	15975	2424	5663	1526	-	-	-
1999	-	-	3535	12082	16824	23002	9973	20186	3041	6648	1168	-	-	-

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

Table 4.2.4.2 Estimated numbers of 1SW spawners in North America by geographic regions, 1971-99.

	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy			North America		
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	USA	Min	Max	Mid-points
1971	29032	111448	85600	198328	9338	14007	19874	35527	4800	12810	29	148673	372150	260411
1972	21728	83415	84107	192690	8213	12320	24319	43306	2992	10385	17	141376	342133	241754
1973	0	11405	108247	252350	10987	16480	28105	51208	8658	18715	13	156009	350171	253090
1974	24533	92118	58182	142618	10067	15100	48343	84668	16209	33822	40	157374	368366	262870
1975	49688	183837	78457	190500	11606	17409	42668	74909	18232	28608	67	200718	495330	348024
1976	31814	125665	80324	195390	12979	19469	56021	99782	24589	43595	151	205878	484052	344965
1977	28815	112337	75297	184754	12004	18006	14045	27565	16704	34231	54	146920	376949	261934
1978	13464	53851	68451	165514	11447	17170	13768	25467	5678	9808	127	112935	271937	192436
1979	17825	72682	75622	182158	15863	23795	29764	57208	18577	36754	247	157897	372843	265370
1980	45870	170045	84506	204600	20817	31226	26450	50249	28878	52513	722	207243	509354	358299
1981	49855	187471	109871	266027	30952	46428	39421	77240	18236	42948	1009	249345	621124	435234
1982	34032	129370	98080	237244	16877	25316	52020	96870	12179	26548	290	213478	515638	364558
1983	19360	78689	76958	186128	12030	18045	13611	24663	7747	15969	255	129961	323749	226855
1984	9348	40056	89904	217925	16316	24957	17990	33622	17964	37503	540	152062	354604	253333
1985	19631	76462	84264	204433	15608	25140	39514	73854	18158	40731	363	177539	420983	299261
1986	30806	116481	87051	211192	22230	33855	82122	149536	21204	44947	660	244072	556671	400372
1987	37572	144917	100634	225374	25789	40481	59330	110264	21589	45407	1087	246000	567529	406764
1988	34369	134100	92218	223522	28582	44815	85644	159754	23288	47231	923	265025	610345	437685
1989	22429	90212	41331	100799	24710	37319	44715	81686	23873	48578	1080	158138	359675	258907
1990	12544	52176	68863	167309	26594	39826	56161	113089	22753	49642	617	187531	422660	305096
1991	10526	42647	43487	107169	20582	30433	44350	87626	13814	25610	235	132994	293720	213357
1992	15229	59331	92434	208272	21754	33583	118723	189112	15125	29633	1124	264389	521055	392722
1993	22499	78251	104712	235387	17493	27444	70969	117858	11539	22252	444	227656	481636	354646
1994	15228	53958	65691	160859	16758	25642	32651	90276	6918	10218	427	137673	341380	239526
1995	22144	73575	81877	193746	14409	21548	15408	61181	12114	19697	213	146164	369960	258062
1996	48362	150048	101773	246943	18923	27805	24410	70049	19253	32472	651	213373	527969	370671
1997	64049	153200	67297	127900	14724	22210	12699	36646	6143	9428	365	165277	349750	257513
1998	-	-	67860	260550	16277	24954	15958	43545	16342	26028	403	-	-	-
1999	-	-	127178	286561	17813	26637	18920	34447	10138	16465	419	-	-	-

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

Table 4.2.4.3. 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	0.377	0.520	0.103	0.0	0.0	0.0

Table 4.2.4.4 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)	
	Total 2SW	Lagged 2SW	abundance	2SW lagged												
Year	spawners	spawners	recruits	spawner	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged	Total	Lagged
71	49769		652860		16447		5020		14777		6271		6764		490	
72	84763		645523		14124		5171		28951		25401		10079		1038	
73	91736		770234		19470		6497		29455		29317		5896		1100	
74	117385		712423		18982		3788		35821		44814		12752		1147	
75	95982		807417		18341		4657		29772		25845		15345		1942	
76	91817		718849		20842		4582		28316		22239		14691		1126	
77	127244		587376		18086		3132		40752		46363		18348		643	
78	84893	95524	330103	3.46	14425	14759	3646	5901	37362	28016	17173	35372	8973	10034	3314	1442
79	39601	107113	730770	6.82	8175	17486	2249	4752	16008	32232	5280	36820	6459	14270	1589	1553
80	121483	96222	639236	6.64	19579	18903	4611	4440	44492	31940	20798	24973	19949	14937	4263	1029
81	76370	104122	605992	5.82	18089	18795	4404	4517	32666	30266	7345	31956	9612	16888	4334	1699
82	80706	107304	503528	4.69	13184	19695	5663	3679	33115	34821	15686	34051	8496	12699	4643	2358
83	52596	82201	286938	3.49	9546	18710	4765	3457	21636	36526	10864	13260	4817	7514	1769	2733
84	81367	79823	296601	3.72	6630	13422	4406	2822	27302	28063	21263	14939	18947	14369	2347	4006
85	95070	85307	469163	5.50	5394	11576	2124	3682	36205	32359	30581	19578	25882	13668	4884	4443
86	120074	79281	505512	6.38	9255	15361	3457	4377	30013	35728	49001	11289	22777	8998	5570	3528
87	91077	77760	463123	5.96	12338	17772	2963	5171	26723	33119	31516	13526	14734	5813	2781	2359
88	93722	78823	370778	4.70	7538	14762	3420	5029	31866	27538	34132	15144	13728	13002	3038	3347
89	81763	93741	293598	3.13	7488	10875	1569	4506	30461	25762	22822	24671	16614	23026	2880	4901
90	91814	103479	257364	2.49	4288	7799	2936	3032	30320	26380	36037	37642	13966	23978	4336	4449
91	75086	100042	299726	3.00	2078	6283	2380	3043	24506	28072	30788	41312	12817	17963	2406	3166
92	94283	89572	180175	2.01	8451	8072	6619	3110	24085	28227	40834	33069	12802	14173	2292	2922
93	78322	91896	137441	1.50	10773	10649	3288	3197	18601	29616	35780	29539	7816	15464	2065	3410
94	80491	89032	161474	1.81	14660	9247	3990	2273	18389	30646	37220	28412	4888	15007	1344	3464
95	107944	89539	157757	1.76	27866	7453	4786	2480	25639	30138	41583	33568	6322	13358	1748	2570
96	88829	84773	132731	1.57	20617	5299	5619	2652	22216	27289	29097	34941	8875	12373	2487	2219
97	70880	82852	96319	1.16	16434	3511	4894	4946	18155	24850	25582	38534	4203	9493	1611	1817
98	-	76109	81861	1.08	-	6285	9141	4358	16754	21312	11091	36583	4844	6088	1526	1371
99	-	79919	-	-	-	9930	7889	3894	19913	19459	15079	38918	4845	5764	1168	1954
00		87035				14098		4506		22855		36492		7845		2039
01		86023				22118		5258		22890		28033		6036		1661
02		73512				22527		5298		20281		19875		4133		1400

Spawners lagged by:

Labrador = 0.0768 x i-5 spawners + 0.542 x i-6 + 0.348 x i-7 + 0.0401 x i-8
Newfoundland = 0.0408 x i-4 spawners + 0.3979 x i-5 + 0.3237 x i-6 + 0.0373 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.

Table 4.4.1. 2SW spawning requirements for North America by country, management zone and overall. Management zones are shown in Figure 4.1.1.1.

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 4.5.1 Fishing mortalities of 2SW salmon equivalents by North American fisheries, 1972-99.
Only mid-points of the estimated values have been used.

Year	CANADA										USA	Total	
	MIXED STOCK				TERMINAL FISHERIES IN YEAR i								
	NF-LAB Comm 1SW (Yr i-1) b	% 1SW of total 2SW equivalents	NF-LAB Comm 2SW (Yr i) b	NF-Lab comm total	Labrador rivers (a)	Nfld rivers (a)	Quebec Region	Gulf Region	Scotia - Fundy Region	Canadian total	Yr i		Terminal Fisheries as a % of Total
1972	27874	11	156881	184755	314	640	27417	22389	6801	242317	346	242662	24
1973	24016	8	223603	247619	719	904	32751	17915	6680	306588	327	306916	19
1974	32828	9	240676	273504	593	547	47631	21429	12734	356438	247	356685	23
1975	32316	9	242398	274715	241	535	41097	15675	12375	344637	389	345026	20
1976	47846	13	261770	309616	618	414	42139	18088	11111	381986	191	382177	19
1977	36777	10	246090	282867	954	962	42301	33433	15562	376079	1355	377434	25
1978	37200	14	160477	197677	580	566	37421	23802	10781	270827	894	271721	27
1979	18825	13	93918	112742	469	148	25234	6298	4506	149398	433	149831	25
1980	27923	8	221596	249520	646	709	53567	29828	18411	352679	1533	354212	30
1981	46088	14	205403	251492	384	491	44375	16326	13988	327055	1267	328322	23
1982	45894	18	137132	183026	473	438	35204	25707	12353	257200	1413	258613	29
1983	34348	15	113815	148163	313	448	34472	27094	13515	224005	386	224391	34
1984	25969	18	84479	110448	379	239	24408	6041	3971	145487	675	146162	24
1985	19578	14	80351	99929	219	16	27483	2745	4930	135323	645	135968	27
1986	26504	15	107010	133514	340	40	33846	4583	2824	175147	606	175752	24
1987	33629	16	134879	168508	457	21	33807	3796	1370	207957	300	208258	19
1988	42874	26	82769	125643	514	30	34262	3923	1373	165744	248	165992	24
1989	29665	20	82998	112663	337	9	28901	3513	265	145687	397	146084	23
1990	26163	22	58518	84682	261	25	27986	2847	593	116395	696	117091	28
1991	16102	18	41250	57352	66	17	29277	1942	1331	89985	231	90216	36
1992	13336	18	25616	38952	581	70	30016	4303	1114	75036	167	75204	48
1993	4315	9	13540	17856	273	64	23153	3010	1110	45466	166	45632	61
1994	2859	7	12179	15038	365	82	24052	2368	756	42661	1	42662	65
1995	1660	5	8852	10511	420	93	23331	2041	330	36727	0	36727	71
1996	1437	4	5760	7197	320	109	22413	2586	766	33391	0	33391	78
1997	1296	5	5499	6795	175	139	18574	2196	581	28460	0	28460	76
1998	1544	9	1909	3453	268	133	11256	2336	322	17768	0	17768	81
1999	239	2	912	1151	268	86	7410	1692	450	11057	0	11057	90
2000	203	-	-	-	-	-	-	-		-	-	-	-

NF-Lab comm as 1SW = NC1(mid-pt) * 0.904837
NF-Lab comm as 2SW = NC2 (mid-pt) * 0.99005
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 1998-99

Table 4.5.1.1: Catch options for 2000 North American Fisheries

Catch Options for 2000 North American Fisheries (Probability levels refer to probability density function estimates of pre-fishery abundance)		
Probability Level	**Pre-fishery Abundance Forecast**	**Catch Options in 2SW Salmon Equivalents (no.)**
25	0	0
30	14,130	0
35	28,146	0
40	41,334	0
45	54,100	0
50	66,663	0
55	79,170	0
60	91,971	0
65	105,146	0
70	119,103	0
75	134,154	0
80	150,956	0
85	170,585	0
90	195,448	17,721
95	232,526	51,271

Table 4.5.2 History of fishing-related mortalities of North American salmon as 2SW equivalents, 1972-98.

Year	Canadian total	USA total	North America Grand Total	% USA of Total North American	Greenland total	NW Atlantic Total	Harvest in homewaters as %of total NW Atlantic
1972	242317	346	242662	0.14	260296	502958	48
1973	306588	327	306916	0.11	181677	488592	63
1974	356438	247	356685	0.07	218512	575197	62
1975	344637	389	345026	0.11	199593	544619	63
1976	381986	191	382177	0.05	252304	634481	60
1977	376079	1355	377434	0.36	141060	518495	73
1978	270827	894	271721	0.33	171656	443376	61
1979	149398	433	149831	0.29	107543	257374	58
1980	352679	1533	354212	0.43	181023	535234	66
1981	327055	1267	328322	0.39	170108	498431	66
1982	257200	1413	258613	0.55	206056	464668	56
1983	224005	386	224391	0.17	176185	400576	56
1984	145487	675	146162	0.46	30077	176239	83
1985	135323	645	135968	0.47	35213	171180	79
1986	175147	606	175752	0.34	125983	301736	58
1987	207957	300	208258	0.14	155401	363659	57
1988	165744	248	165992	0.15	157158	323150	51
1989	145687	397	146084	0.27	105655	251739	58
1990	116395	696	117091	0.59	54917	172008	68
1991	89985	231	90216	0.26	66152	156367	58
1992	75036	167	75204	0.22	100147	175351	43
1993	45466	166	45632	0.36	37872	83504	55
1994	42661	1	42662	0.00	0	42662	100
1995	36727	0	36727	0.00	0	36727	100
1996	33391	0	33391	0.00	19310	52701	63
1997	28460	0	28460	0.00	19856	48316	59
1998	17768	0	17768	0.00	15214	32982	54
1999	11057	0	11057	0.00	2738	13795	80

Greenland harvest of 2SW equivalents = NG1 * 0.904837

Table 4.5.2.1: Catch options for 2001 North American fisheries

Catch Options for 2001 North American fisheries (probability levels refer to probability density function estimates of pre-fishery abundance)		
Probability Level	**Pre-fishery Abundance Forecast**	**Catch Options in 2SW Salmon Equivalents (no.)**
25	118,888	0
30	132,507	0
35	145,043	0
40	157,014	0
45	168,478	0
50	179,897	5,218
55	191,176	11,341
60	202,661	17,576
65	214,497	24,002
70	227,141	30,866
75	240,703	38,229
80	255,978	46,522
85	273,746	56,169
90	296,133	68,323
95	329,550	86,465

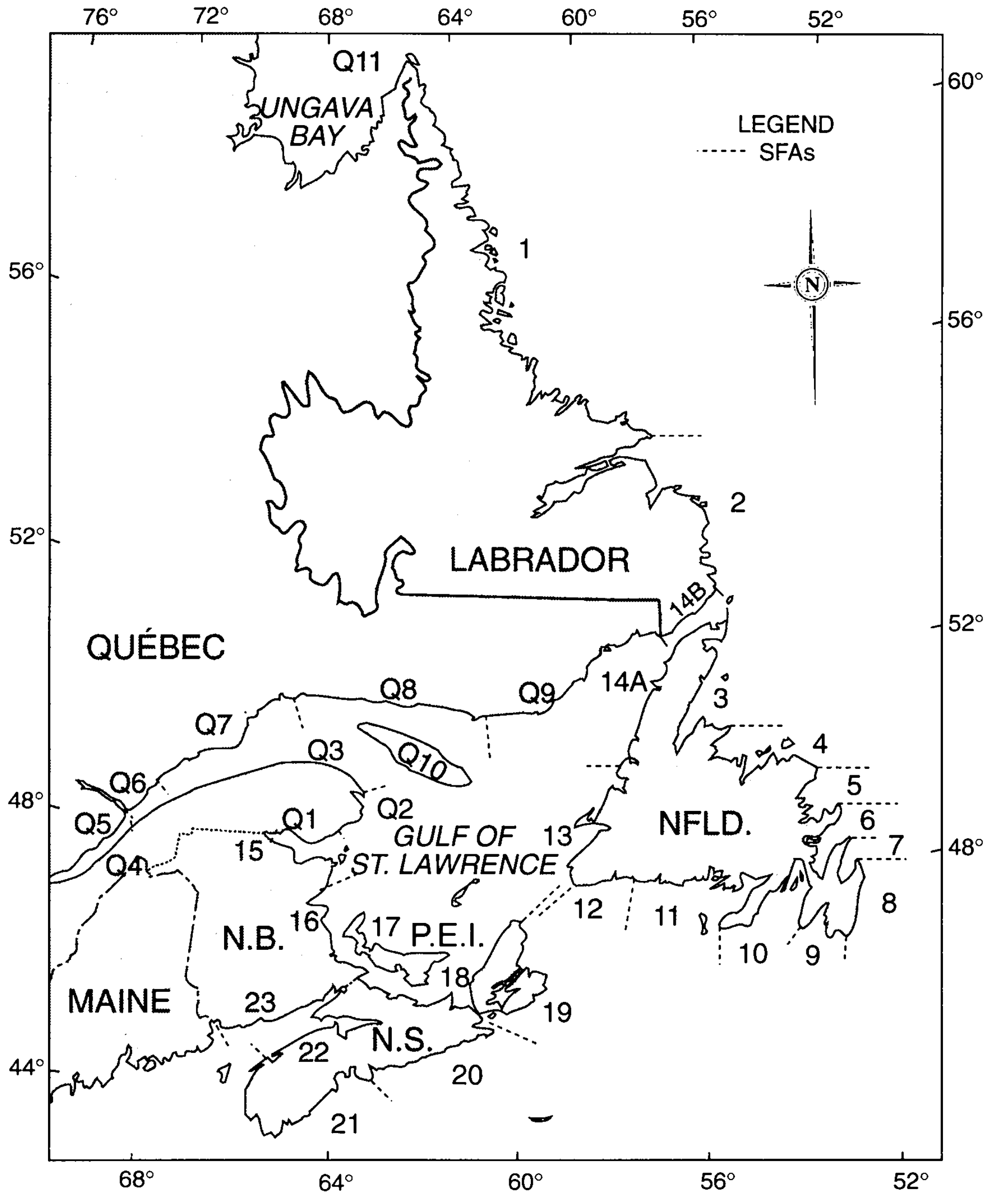
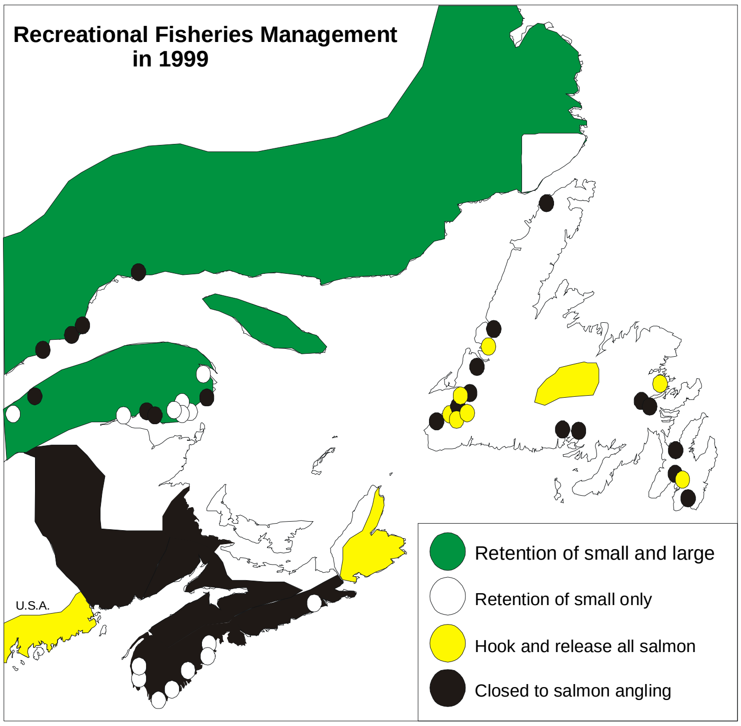


Figure 4.1.1.1. Map of Salmon Fishing Areas (SFAs) and Quebec Management Zones (Qs) in Canada.



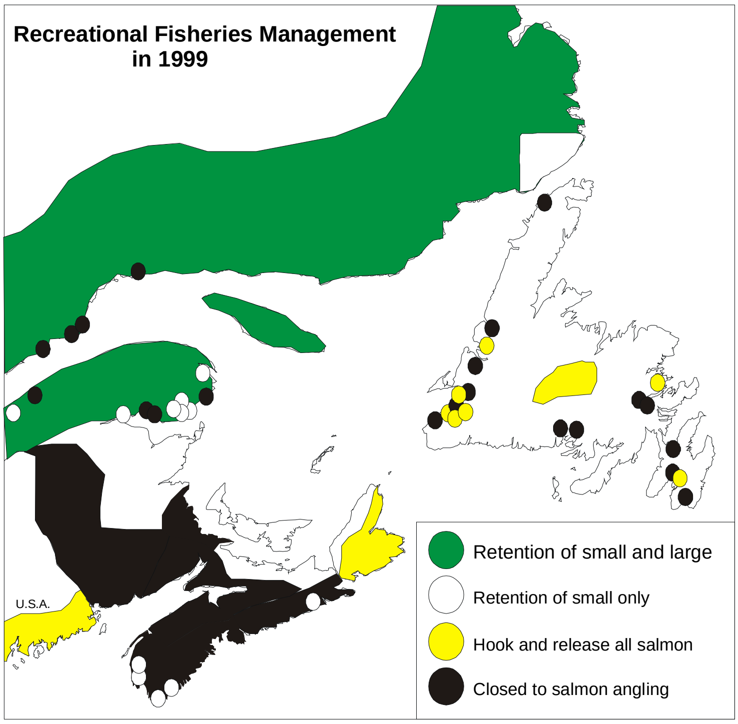


Figure 4.1.1.2. Summary of recreational fisheries management in eastern Canada and Maine, USA at the start of the angling season (upper map) and after adjustments stemming from river/area specific inseason assessments during 1999.

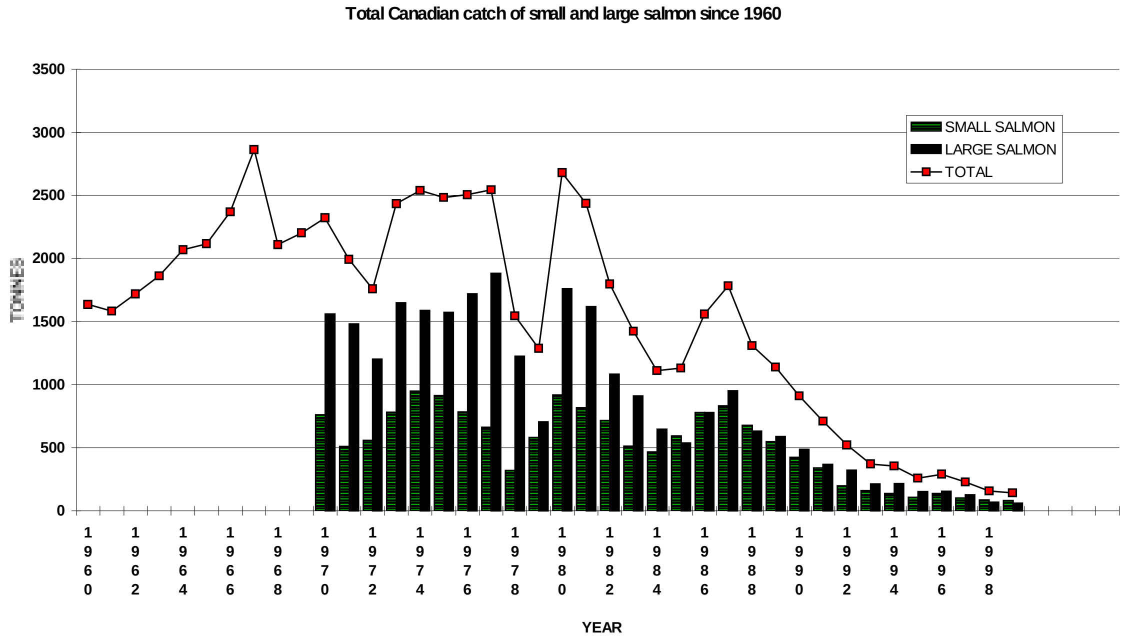


Figure 4.1.2.1. Harvest (t) of small salmon, large salmon, and combined in Canada , 1960-1999

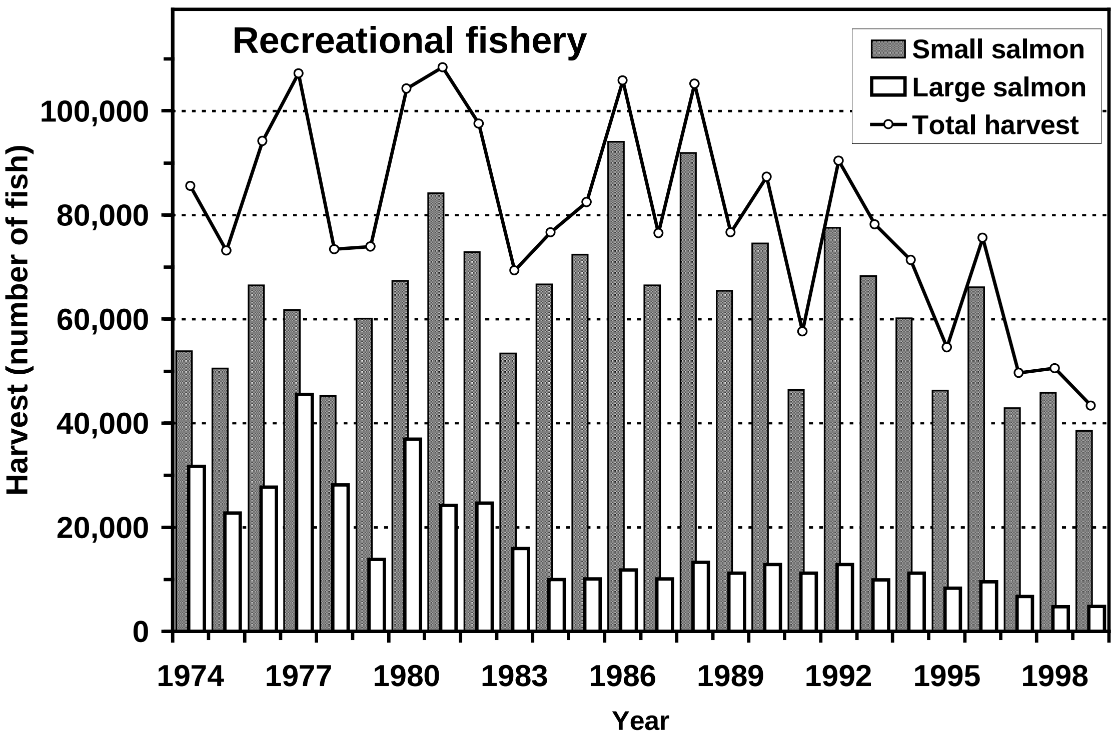


Figure 4.1.2.2. Harvest (number) of small and large salmon and both sizes combined in the recreational fisheries of Canada, 1974 to 1999.

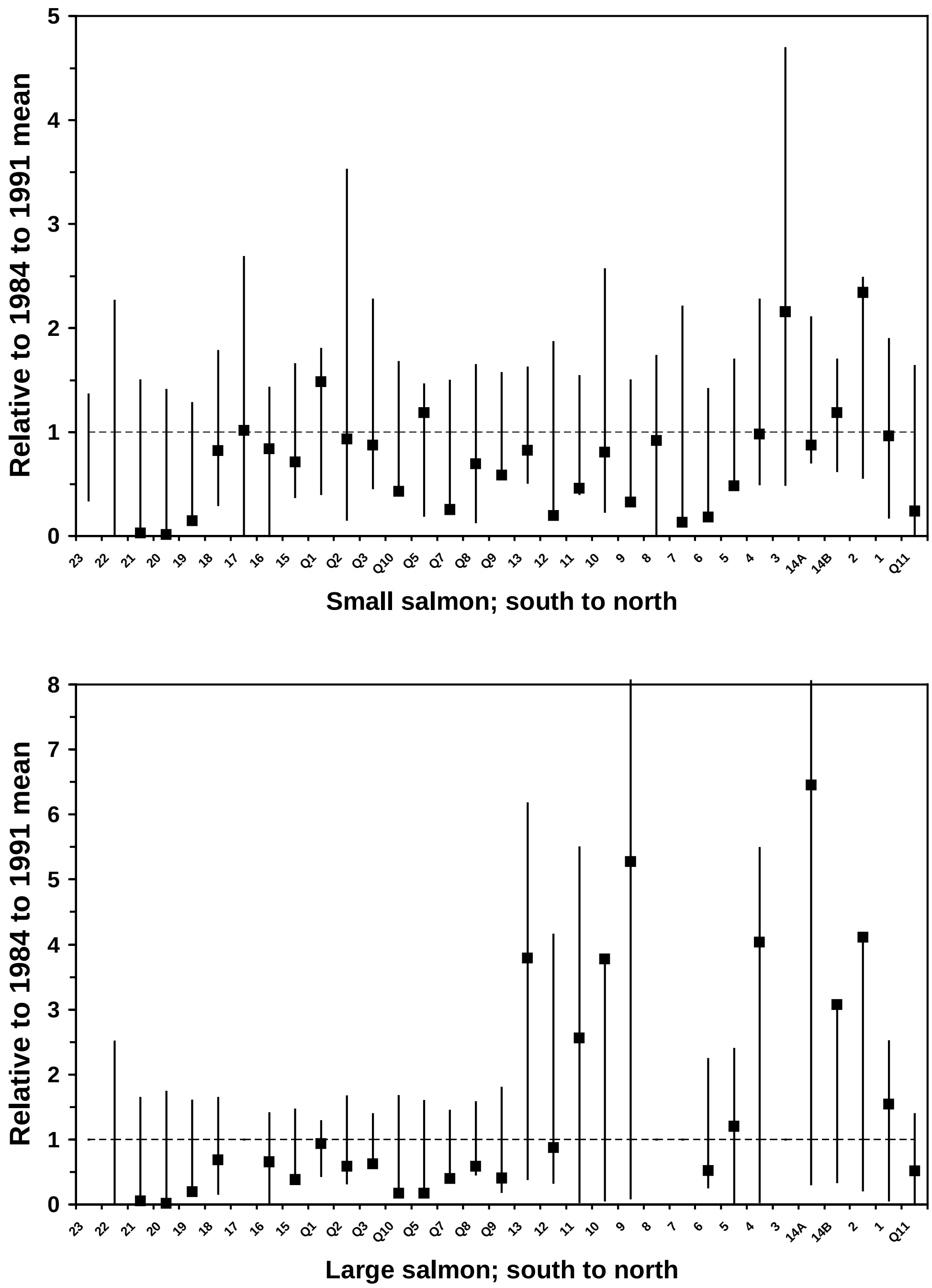


Figure 4.1.2.3. Angling catches (including kept and released fish) of small and large salmon by management area in 1999 (black square) expressed as a percentage of the average catches for the period 1984 to 1991. The vertical lines represent the minimum to maximum range. The 1984 to 1991 standard period was selected to represent the period of no commercial fisheries in SFAs 15 to 23 and Zones Q1 to Q6 and before the commercial salmon moratorium in Newfoundland SFAs 3 to 14A introduced in 1992. There were no estimates available for releaseed salmon in Newfoundland SFAs 3 to 11 for the years 1984 to 1991.

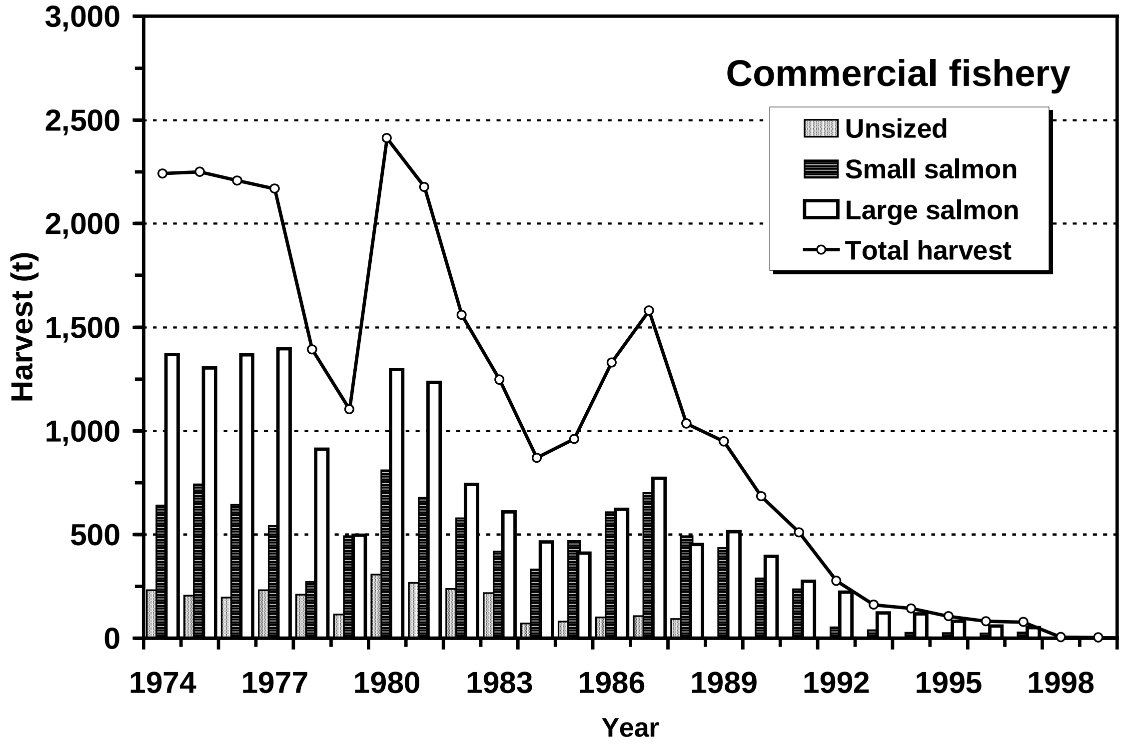


Figure 4.1.2.4. Harvest (t) of small salmon and large salmon and both size groups combined in the commercial fisheries of Canada, 1974 to 1999.

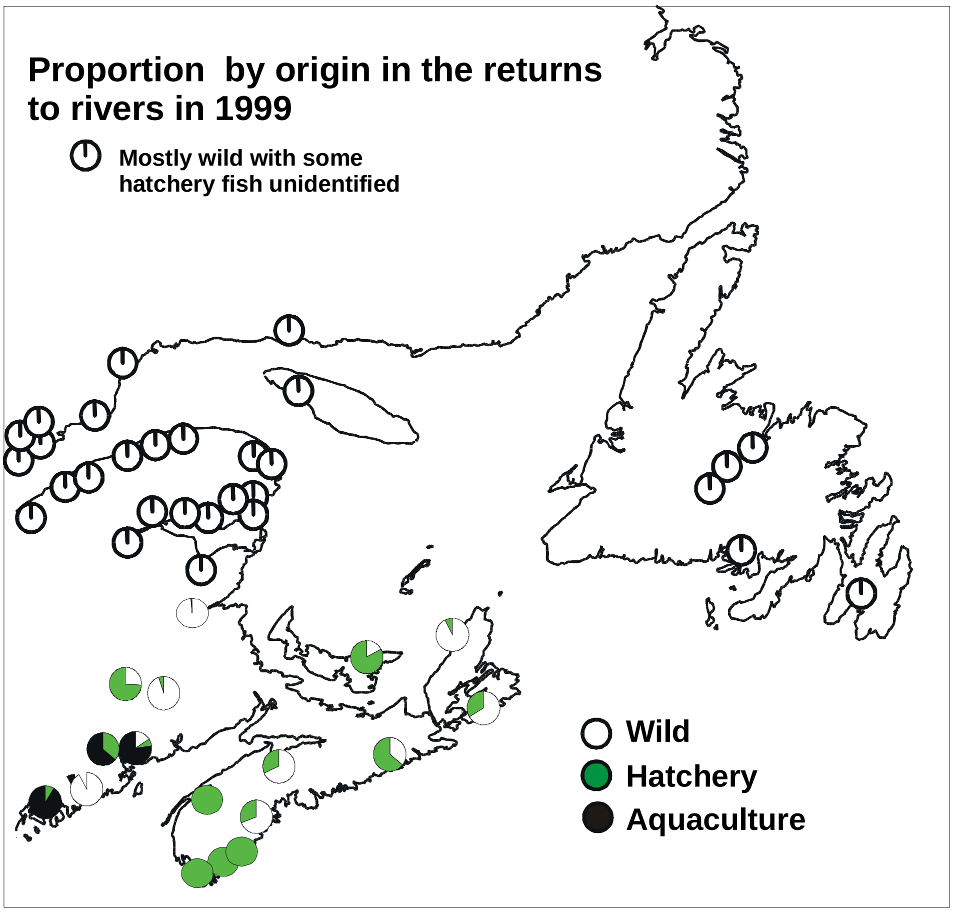
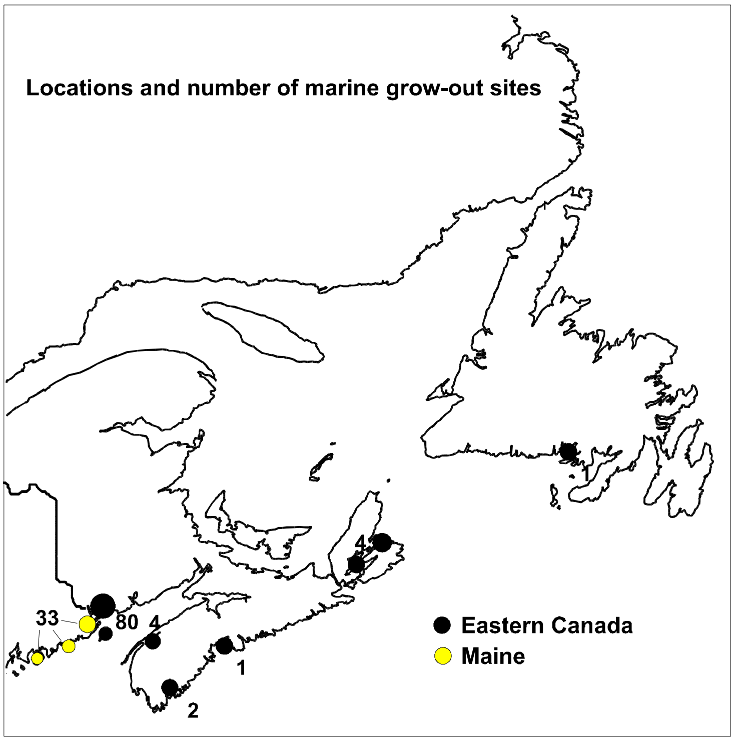


Figure 4.1.3.1. Origin (wild, hatchery, aquaculture) of Atlantic salmon returning to monitored rivers of eastern Canada in 1999. Only rivers in which more than one origin type was observed are indicated.



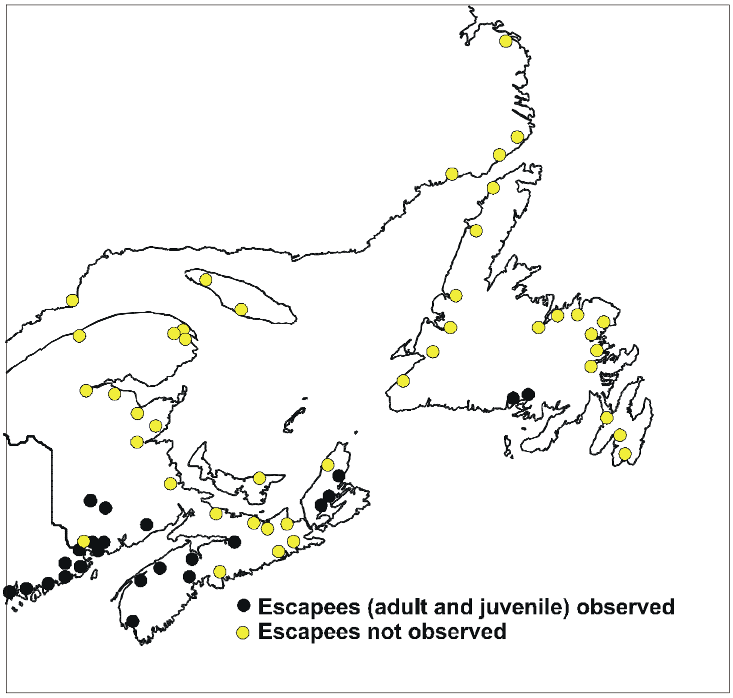
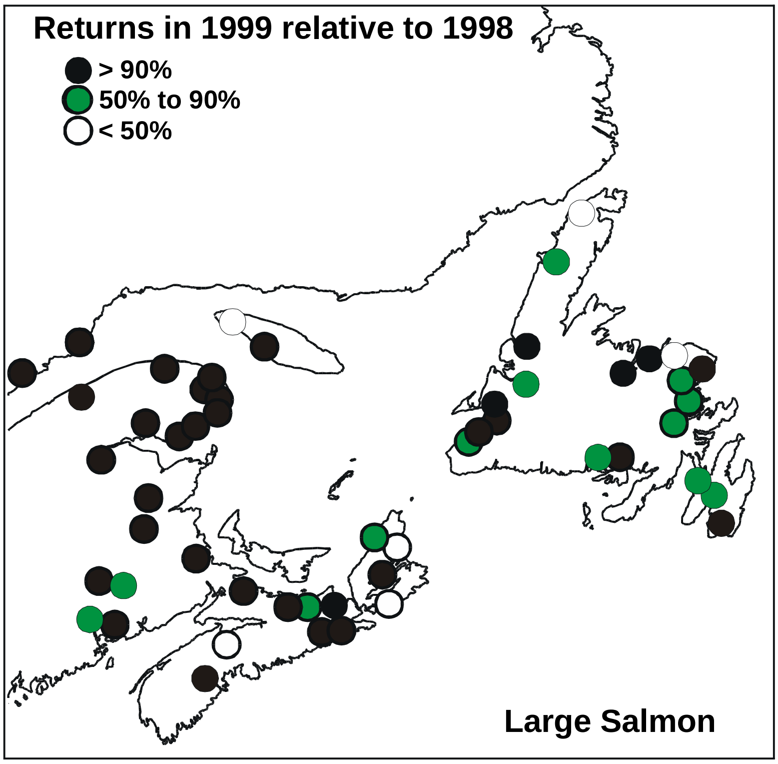


Figure 4.1.3.2. Location of Atlantic salmon marine grow-out sites in eastern North America (upper panel) and distribution of rivers with observed juvenile or adult aquaculture escaped Atlantic salmon (lower panel).



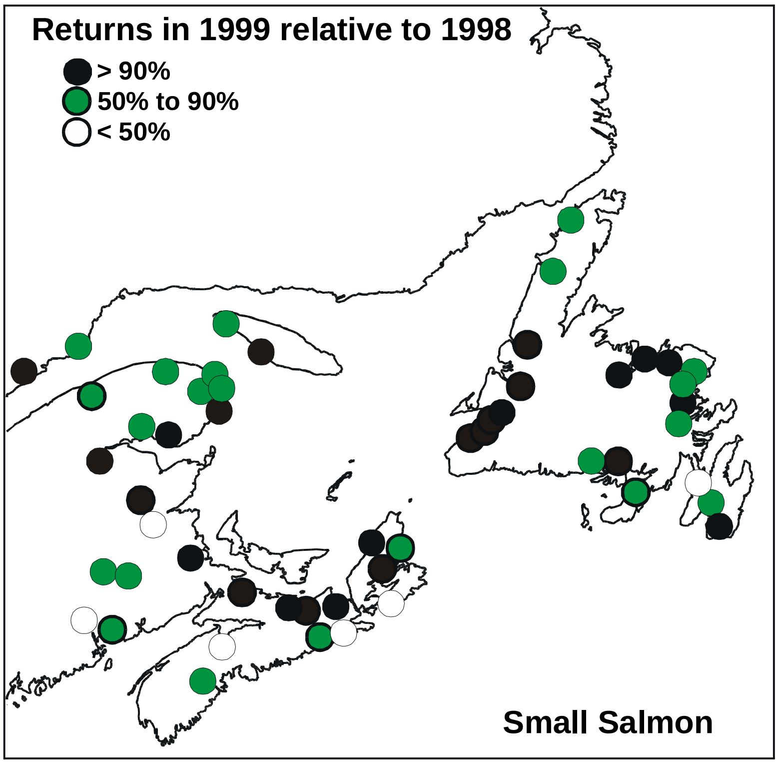


Figure 4.2.1.1. In-river returns of small salmon and large salmon for 54 monitored rivers of eastern Canada in 1999 relative to 1998.

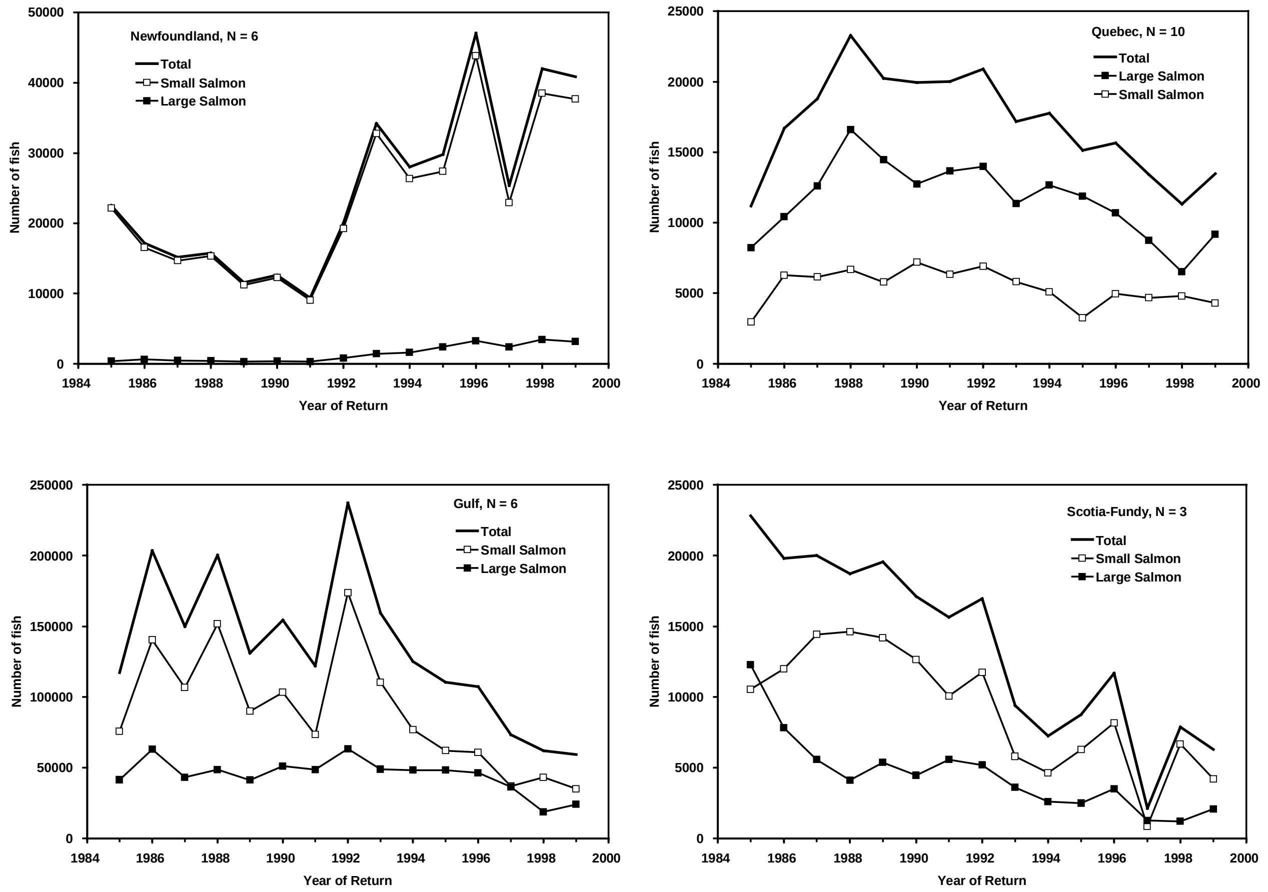


Figure 4.2.1.2. In-river returns of small salmon and large salmon for 25 monitored rivers in four geographic areas of eastern Canada from 1985 to 1999. The in-river returns do not account for removals in marine fisheries. Rivers by area are: Newfoundland (Exploits, Middle Brook, Terra Nova, Northeast Brook, Torrent, Western Arm Brook), Québec (Bonaventure, Cascapédia, Port-Daniel Nord, Grande Rivière, St-Jean, York, Darmouth, Madeleine, Matane, de la Trinité), Gulf (Restigouche, Miramichi, Philip, East Pictou, West Antigonish, Margaree), and Scotia-Fundy (Liscomb, LaHave, Saint John at Mactaquac).

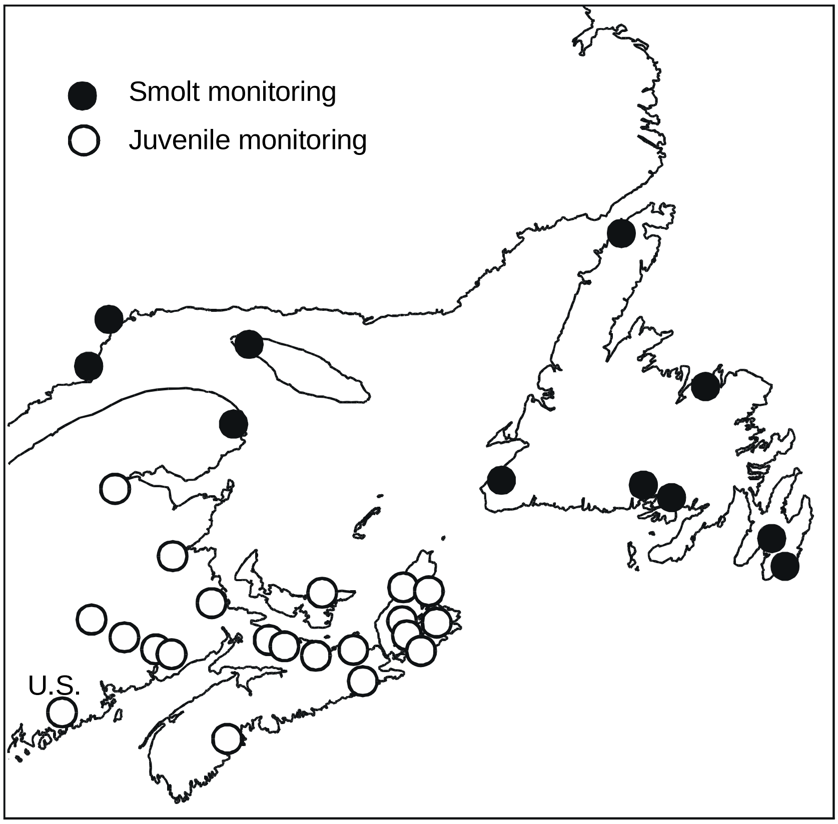


Figure 4.2.1.3. Rivers with smolt and juvenile monitoring programs in eastern Canada and U.S. used in the analysis for estimating a relative juvenile abundance index.

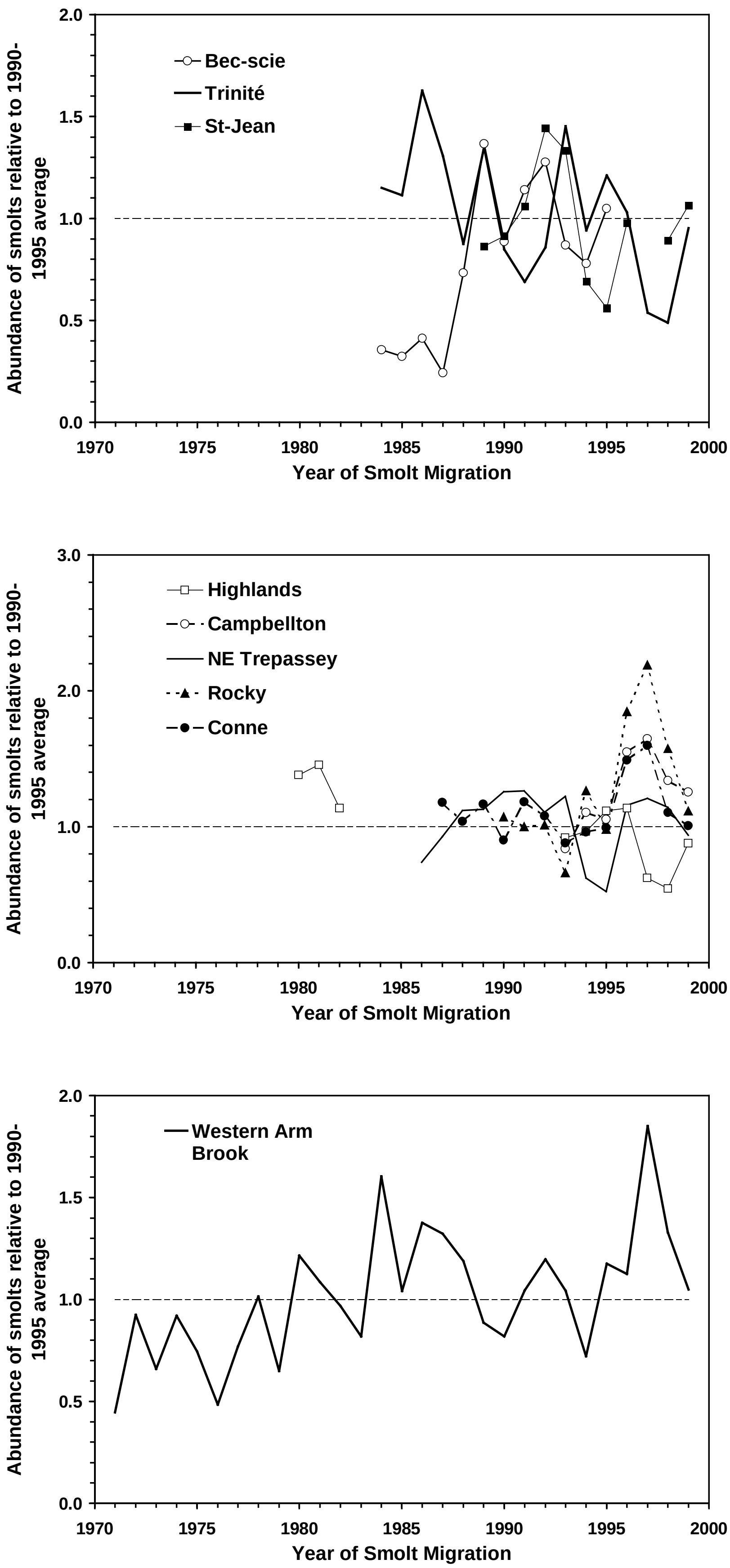
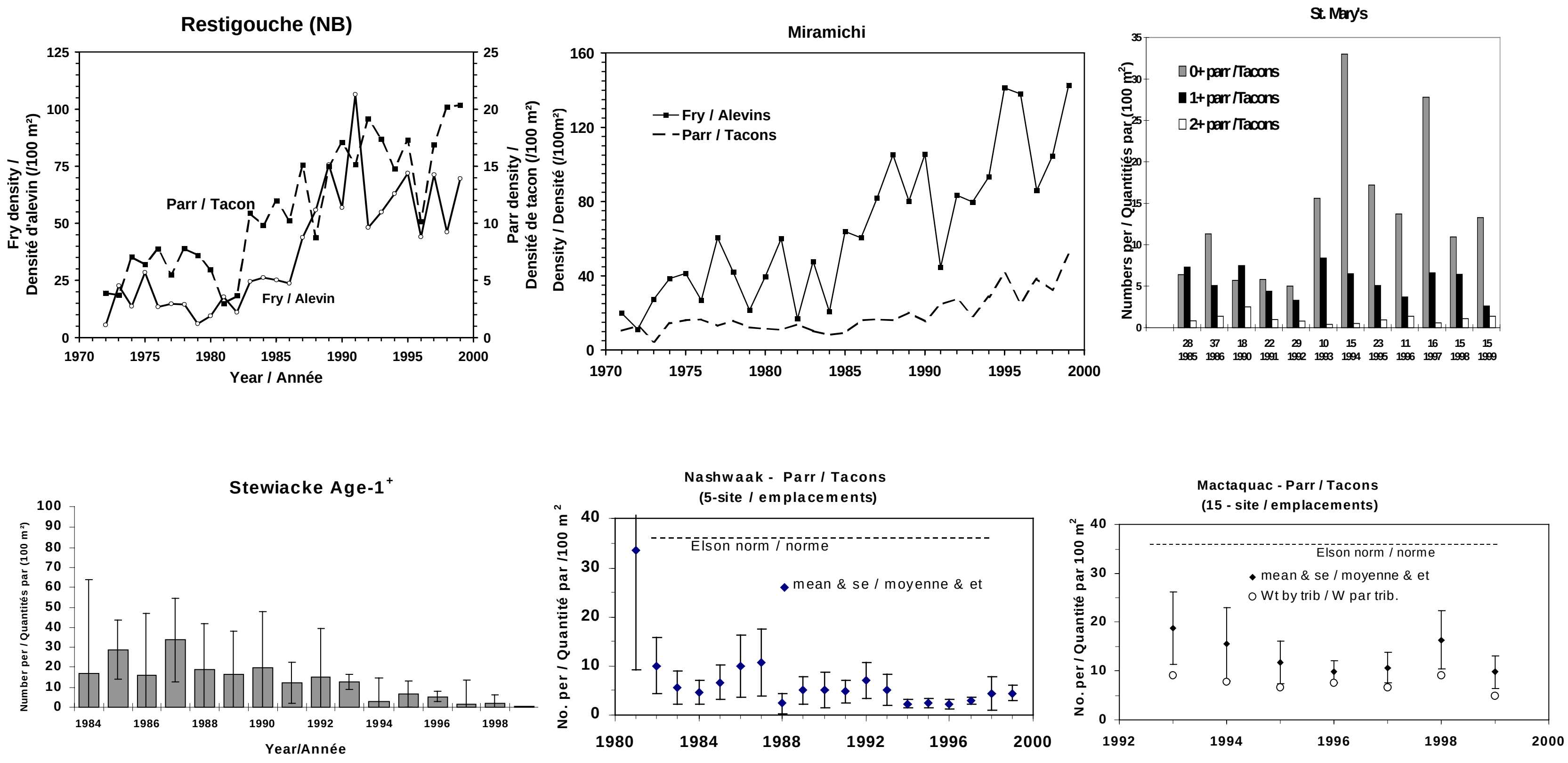


Figure 4.2.1.4. Variability in the wild smolt output from nine rivers of eastern Canada in 1971 to 1999 relative to the average smolt output (by individual river) for the 1990 to 1995 period.

Figure 4.2.1.5. Atlantic salmon juvenile densities in six rivers of the Maritime provinces (Restigouche SFA 15; Miramichi SFA 16; St. Mary's SFA 20, Stewiacke SFA 22, Nashwaak and Saint John above Mactaquac SFA 23).



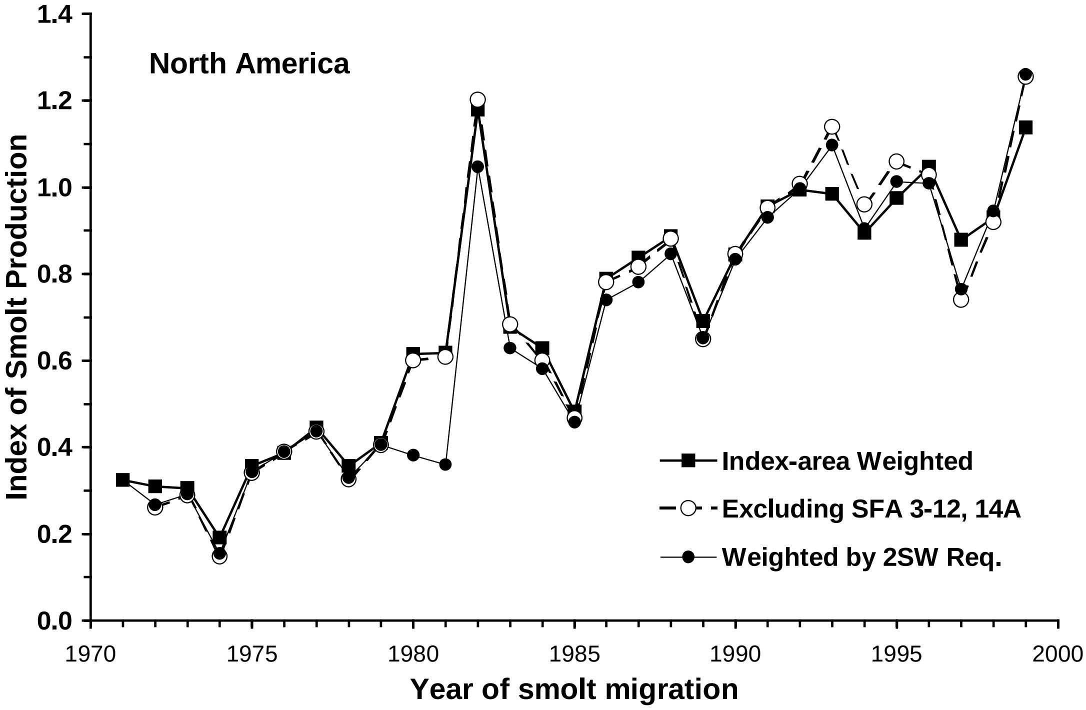


Figure 4.2.1.6. Relative index of smolt production in eastern North America. Index-area weighted refers to weights to index rivers corresponding to the size of the zone or Salmon Fishing Area. The middle index excludes the Newfoundland areas which do not contribute to 2SW production (Salmon Fishing Areas 3 to 12, 14A). The 2SW weighted index uses all the indices but weights them additionally by the relative contribution to 2SW spawner requirements.

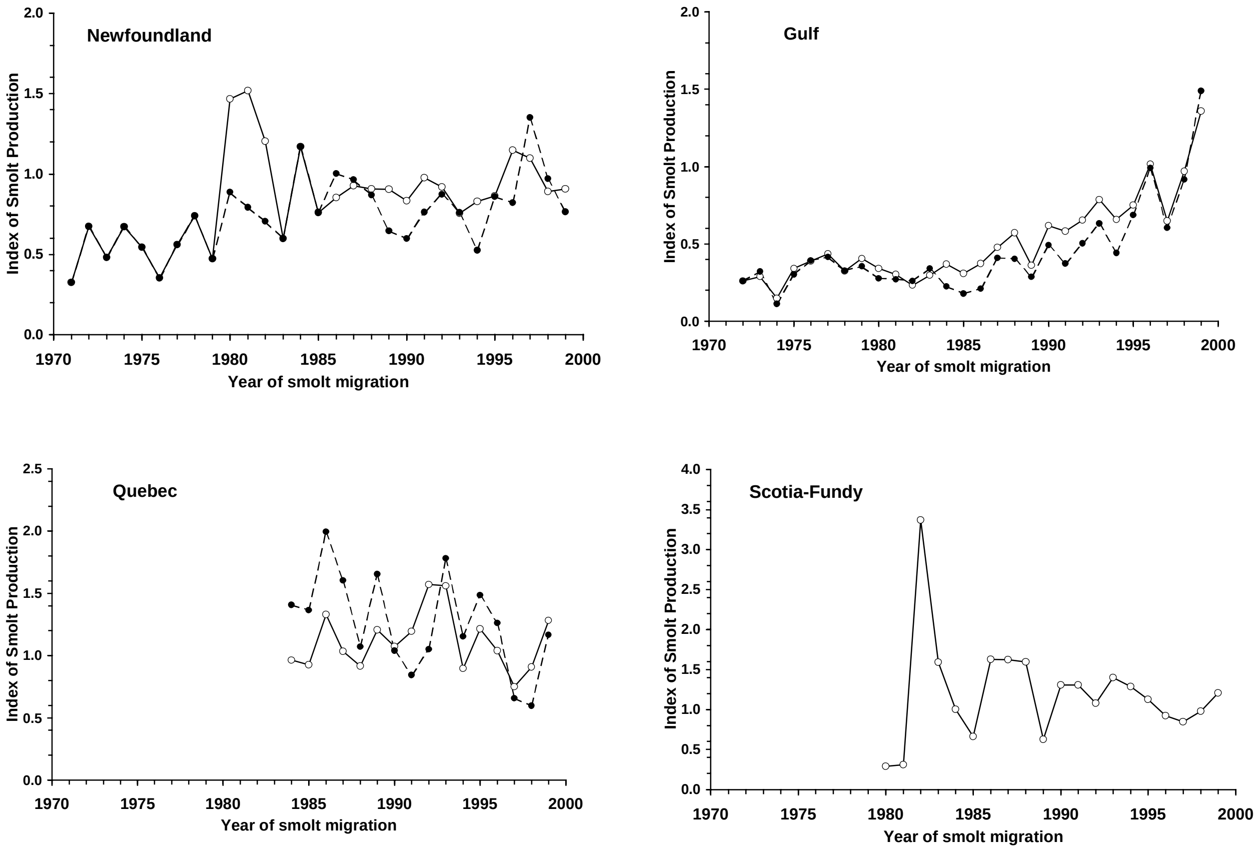


Figure 4.2.1.7. Relative index (squares and line) of smolt production in four areas of Canada. Relative indices are derived by weighting index river series by corresponding Salmon Fishing Area or Zone size (defined by conservation egg requirements). The dashed line (solid circles) describes the trend in an index river: for Newfoundland (Western Arm Brook SFA 14A), Gulf (Miramichi River SFA 16), and Quebec (Rivière de la Trinité).

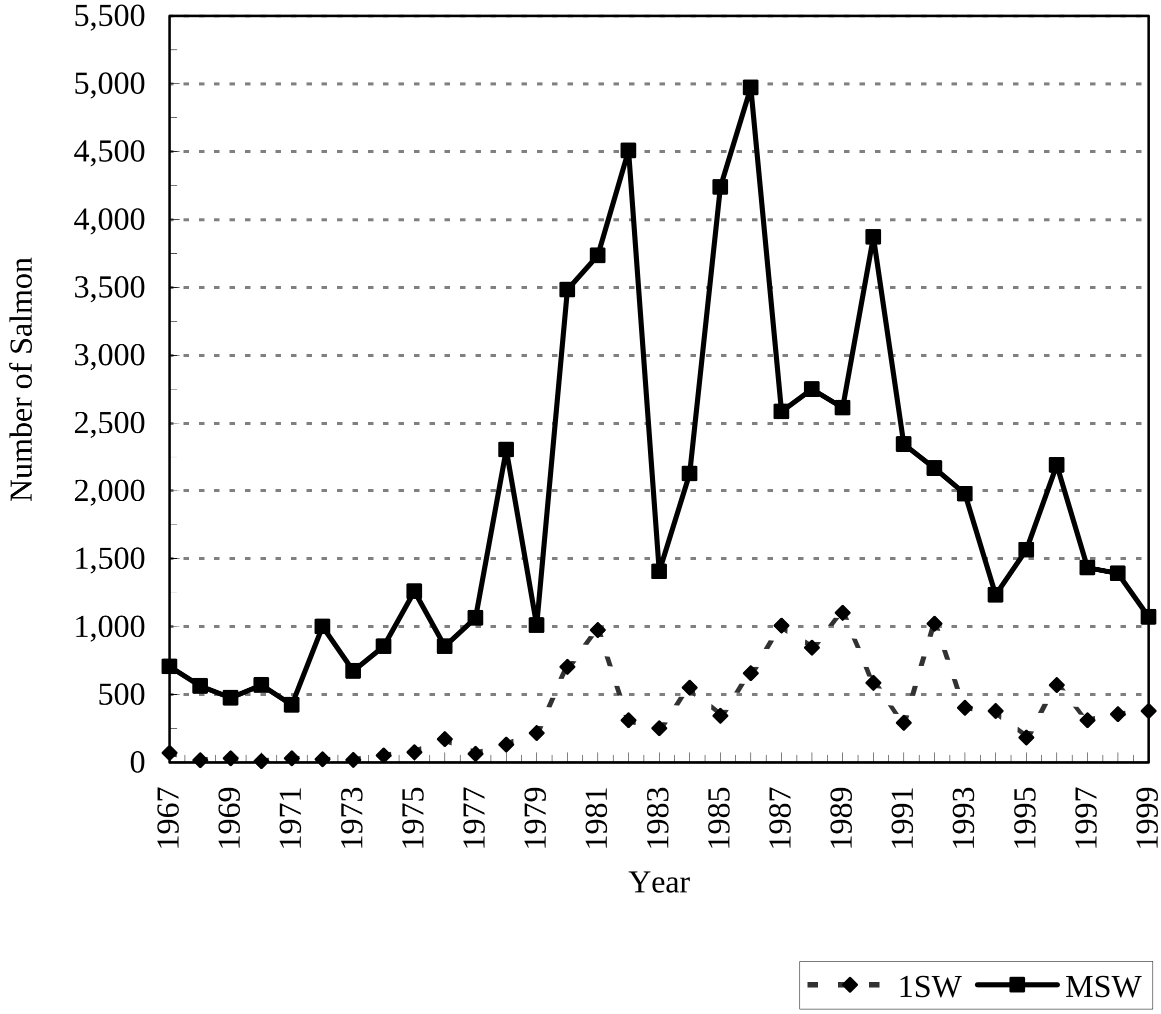


Figure 4.2.1.8 Documented Atlantic salmon returns to USA rivers, 1967-1999.

Figure 4.2.2.1 Estimated mid-points of 1SW returns (circles) to rivers of Nfld & Labrador and to SFAs of the other geographic areas, 1SW recruits of Nfld & Labrador origin before commercial fisheries in Nfld & Labrador (dashed lines), 1SW spawners (squares), 1971-99. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Labrador data for 1998-99 is unavailable.

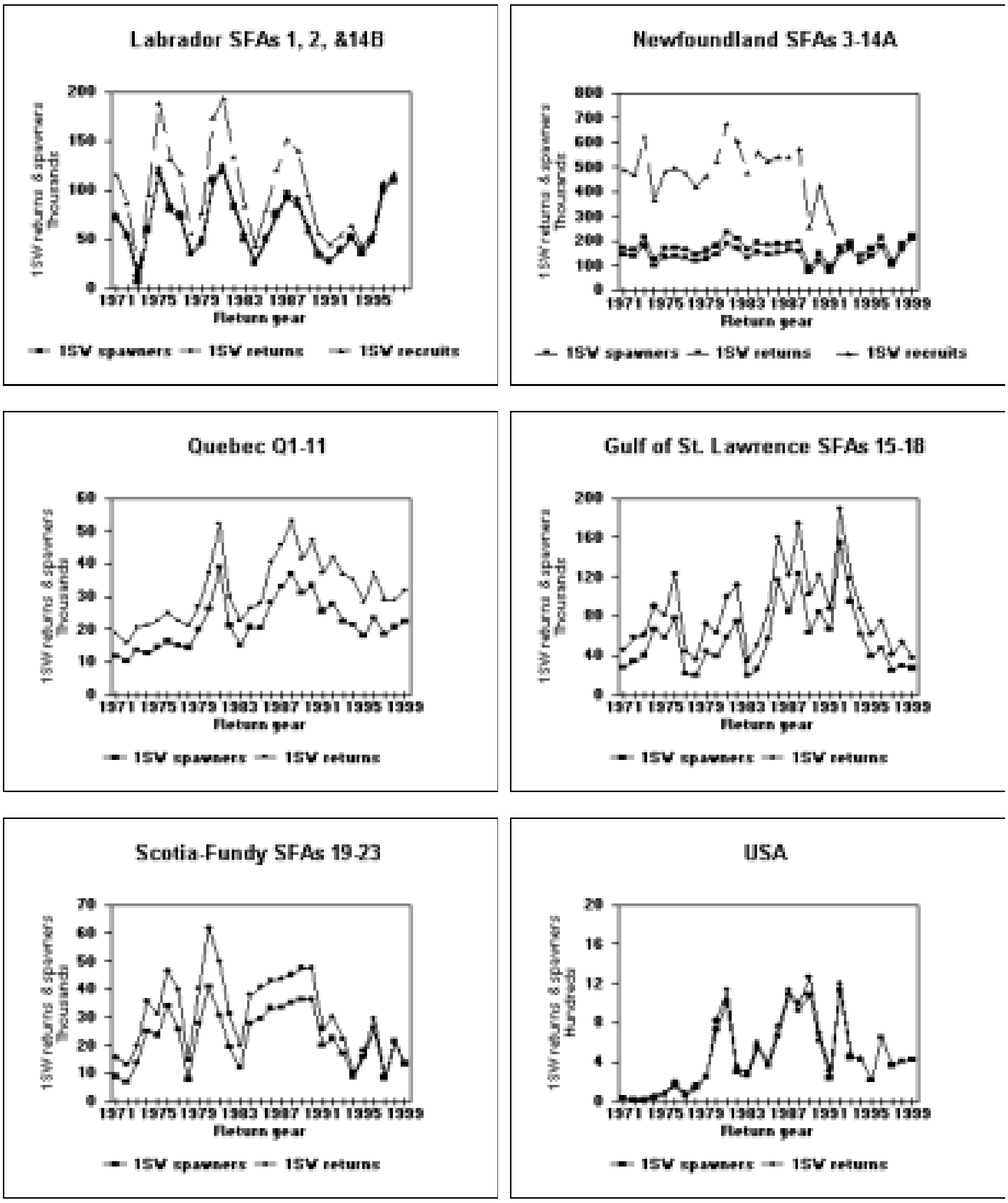
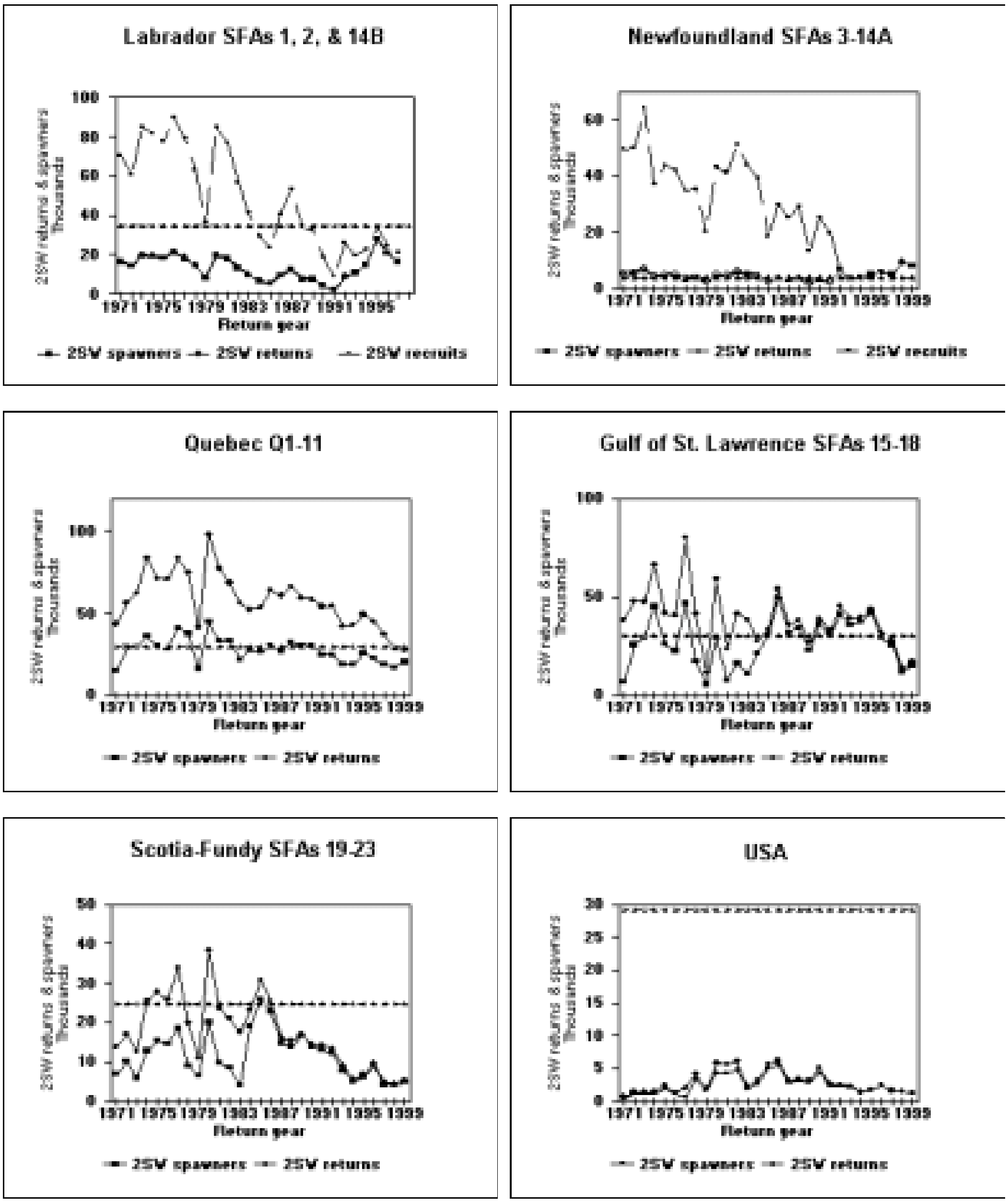


Figure 4.2.2.2 Comparison of estimated mid-points of 2SW returns (circles) to rivers of Nfld & Labrador and to SFAs of the other geographic areas, 2SW recruits of Nfld & Labrador origin before commercial fisheries in Nfld & Labrador (dashed lines), 2SW spawners (squares) and 2SW conservation requirements (triangles) for 1971-99 return years. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Estimates for 1998-99 for Labrador are unavailable.



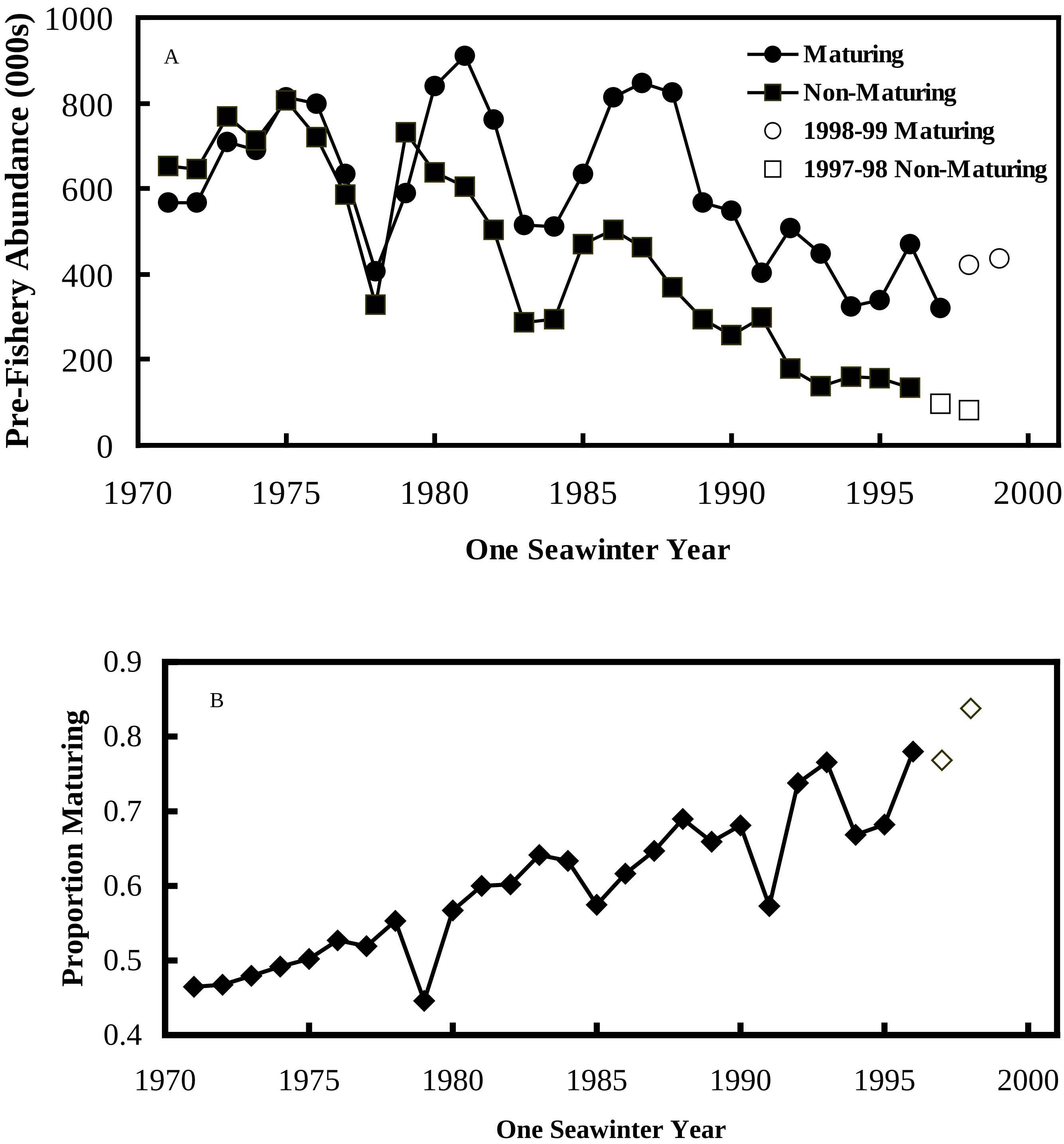


Figure 4.2.3.1. Pre-fishery abundance estimate of maturing and non-maturing salmon in North America (upper panel), and proportion of smolt class maturing after 1SW (lower panel).

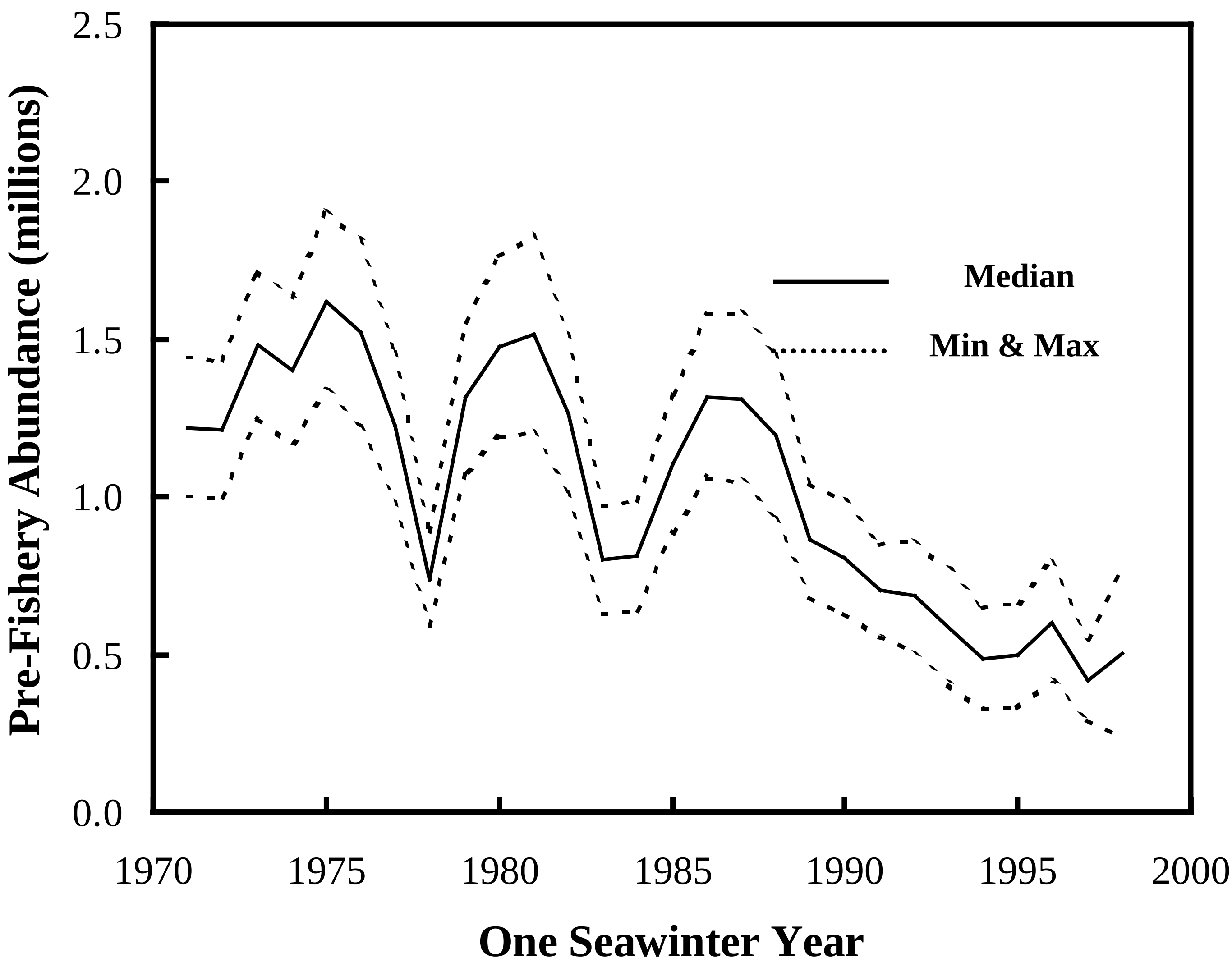
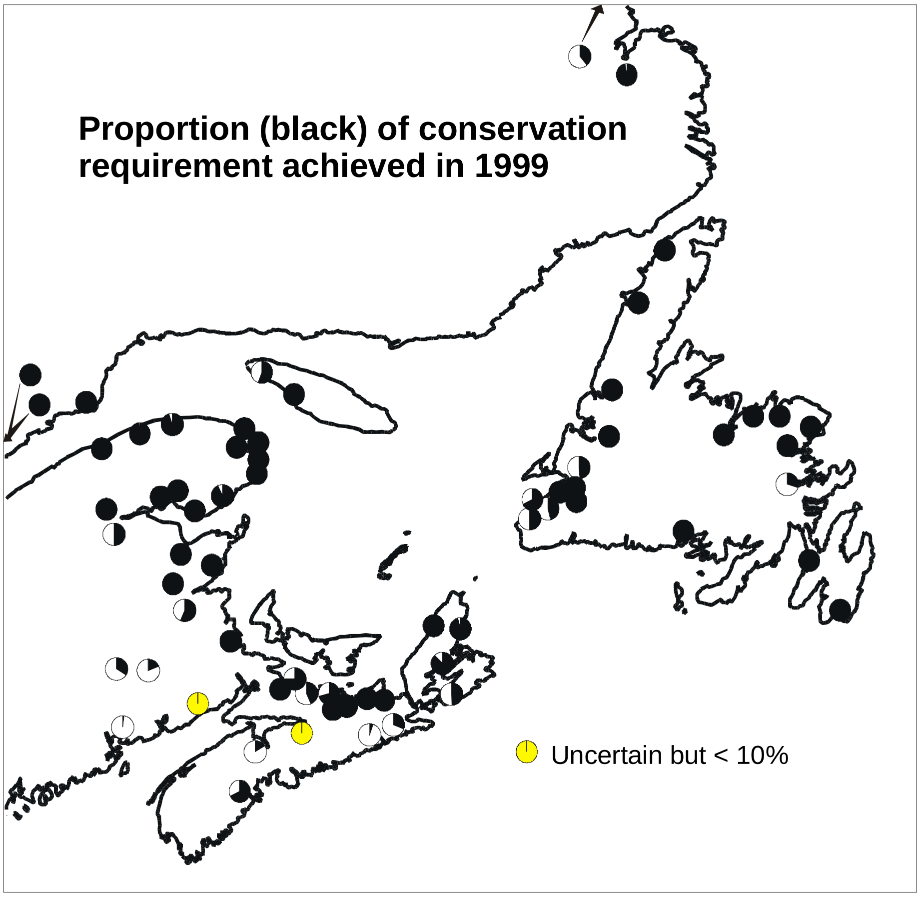


Figure 4.2.3.2 Total 1SW recruits (non-maturing and maturing) originating in North America.



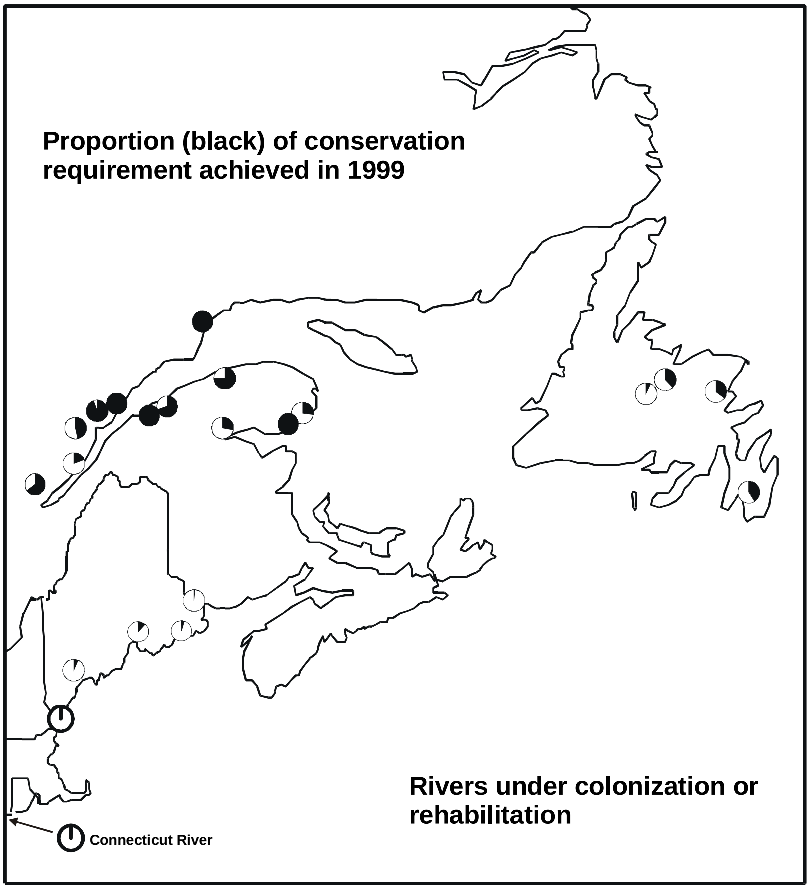


Figure 4.2.4.1. Egg depositions in 1999 relative to conservation requirements in 67 rivers (left panel) and for 17 rivers of eastern Canada and five rivers of U.S. under colonization or rehabilitation (right panel). The black slice represents the proportion of the conservation requirement achieved in 1999. A solid black circle indicates the egg deposition requirement was attained or exceeded.

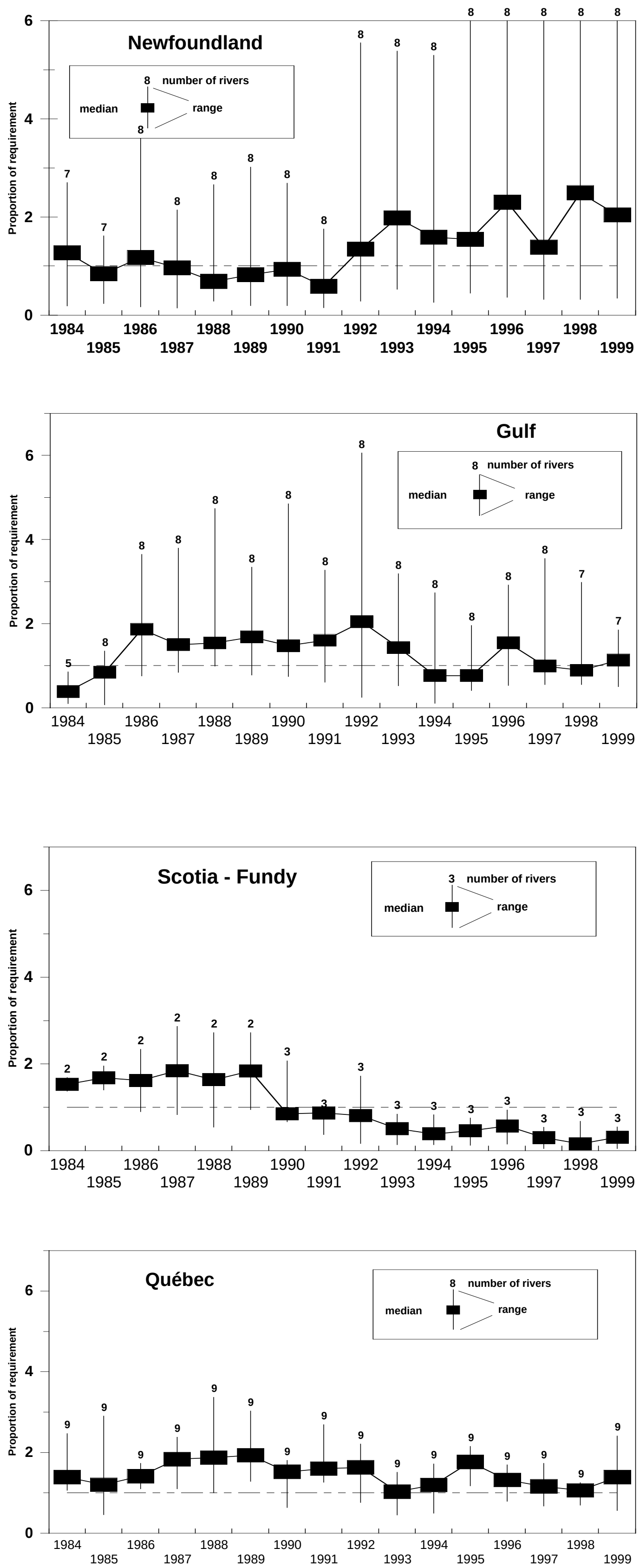
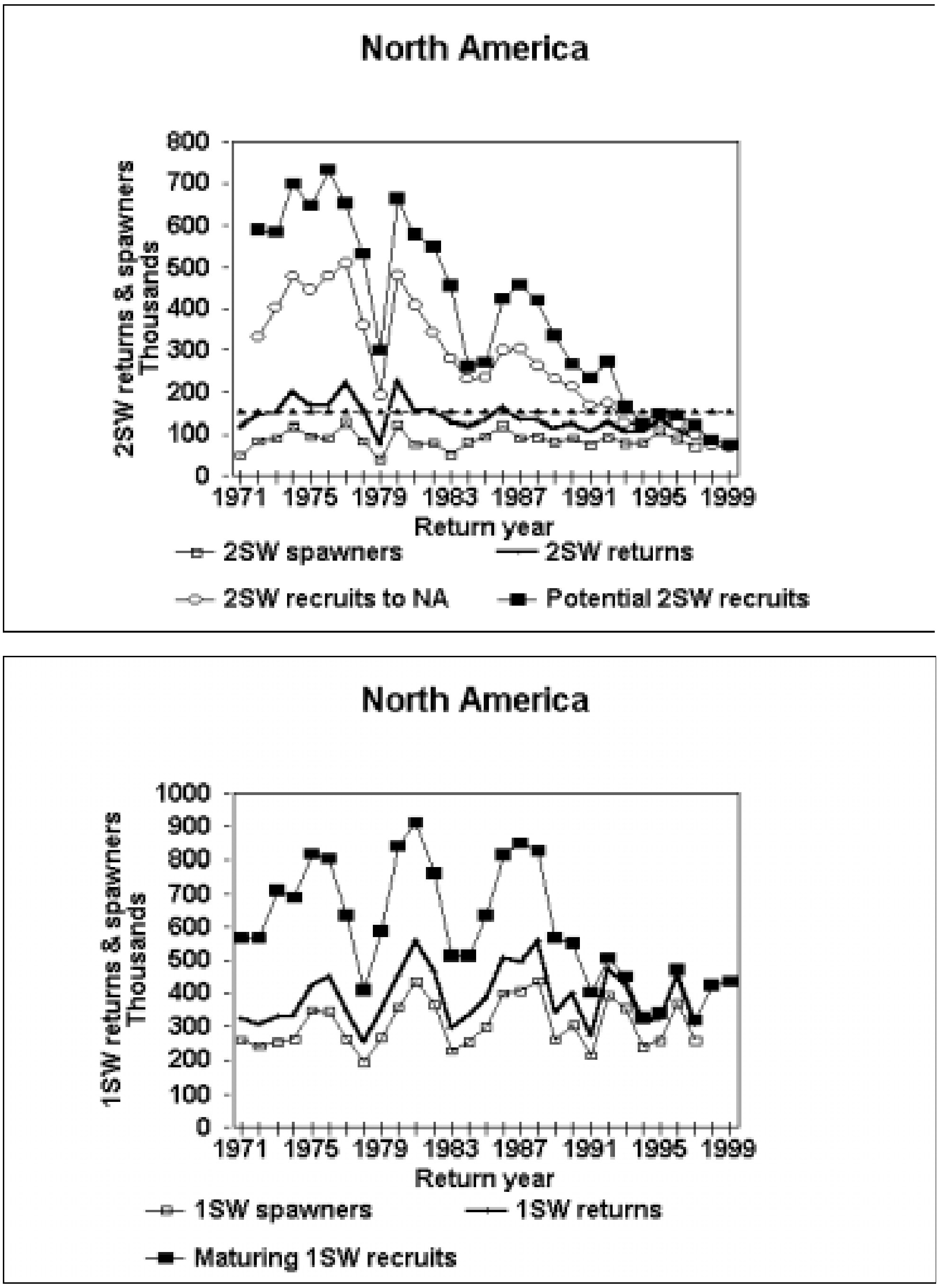


Figure 4.2.4.2. Proportion of the conservation requirements met in monitored rivers in four geographic area of eastern Canada, 1984 to 1999. The vertical line represents the minimum and maximum proportion achieved in individual rivers, the black square is the median proportion and the number above the vertical line is the number of rivers included in the annual summary. The horizontal line defines 100% of conservation requirement.

Figure 4.2.4.3 Top panel: comparison of estimated of potential 2SW production prior to all fisheries, 2SW recruits available to North America, 1971-99 and 2SW returns and spawners for 1971-97, as 1998-99 data for Labrador are unavailable. Triangles indicate the 2SW spawner threshold. Bottom panel: comparison of potential maturing 1SW recruits, 1971-99 and returns and 1SW spawners for 1971-97 return years as Labrador data for 1998-99 are unavailable.



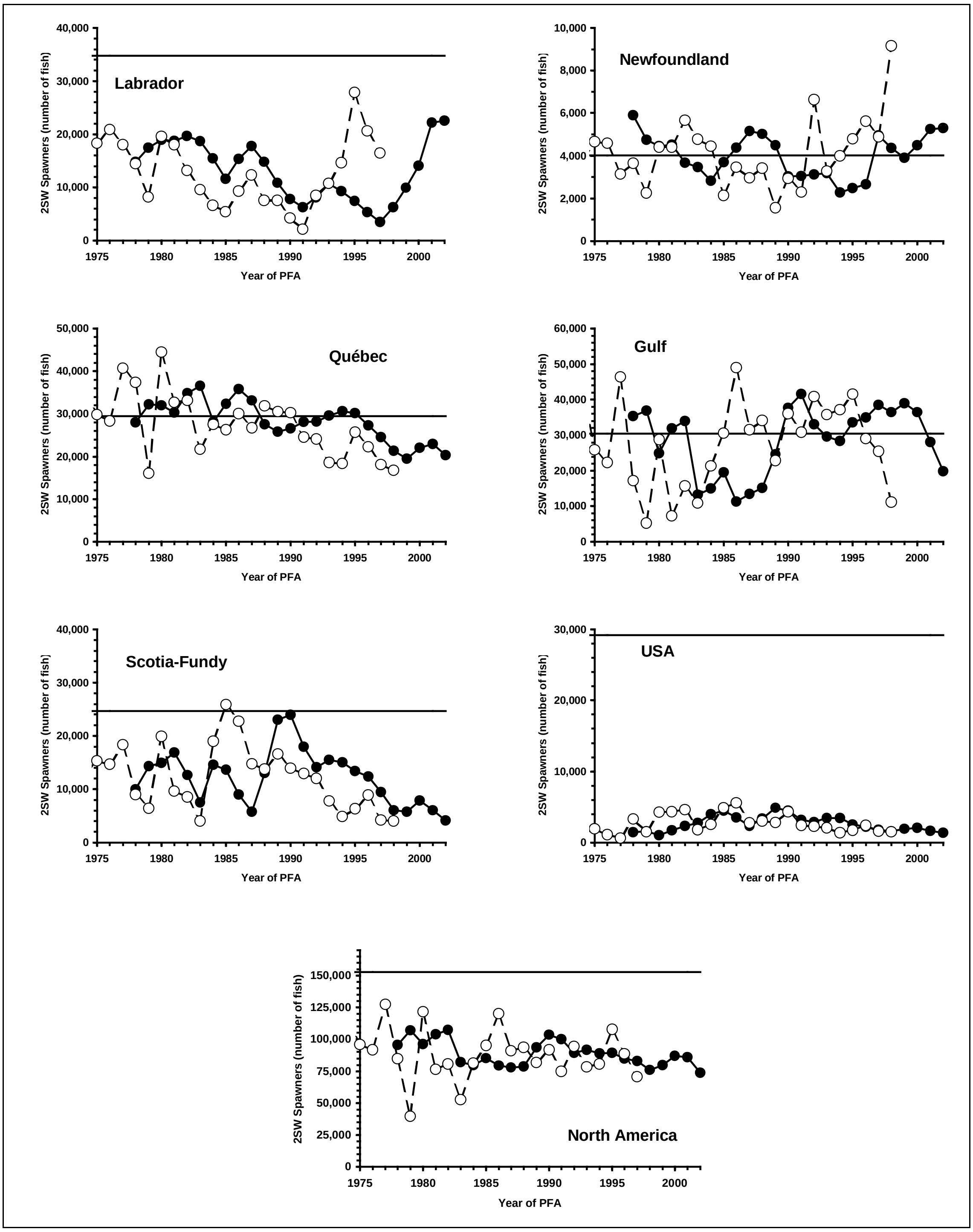


Figure 4.2.4.4. Midpoints of lagged spawners (solid circles) and estimated annual spawners (open circles) as contribution to potential recruitment in the year of prefishery abundance (PFA) for six geographic areas of North America. The horizontal line represents the spawning requirement (in terms of 2SW fish) in each geographic area.

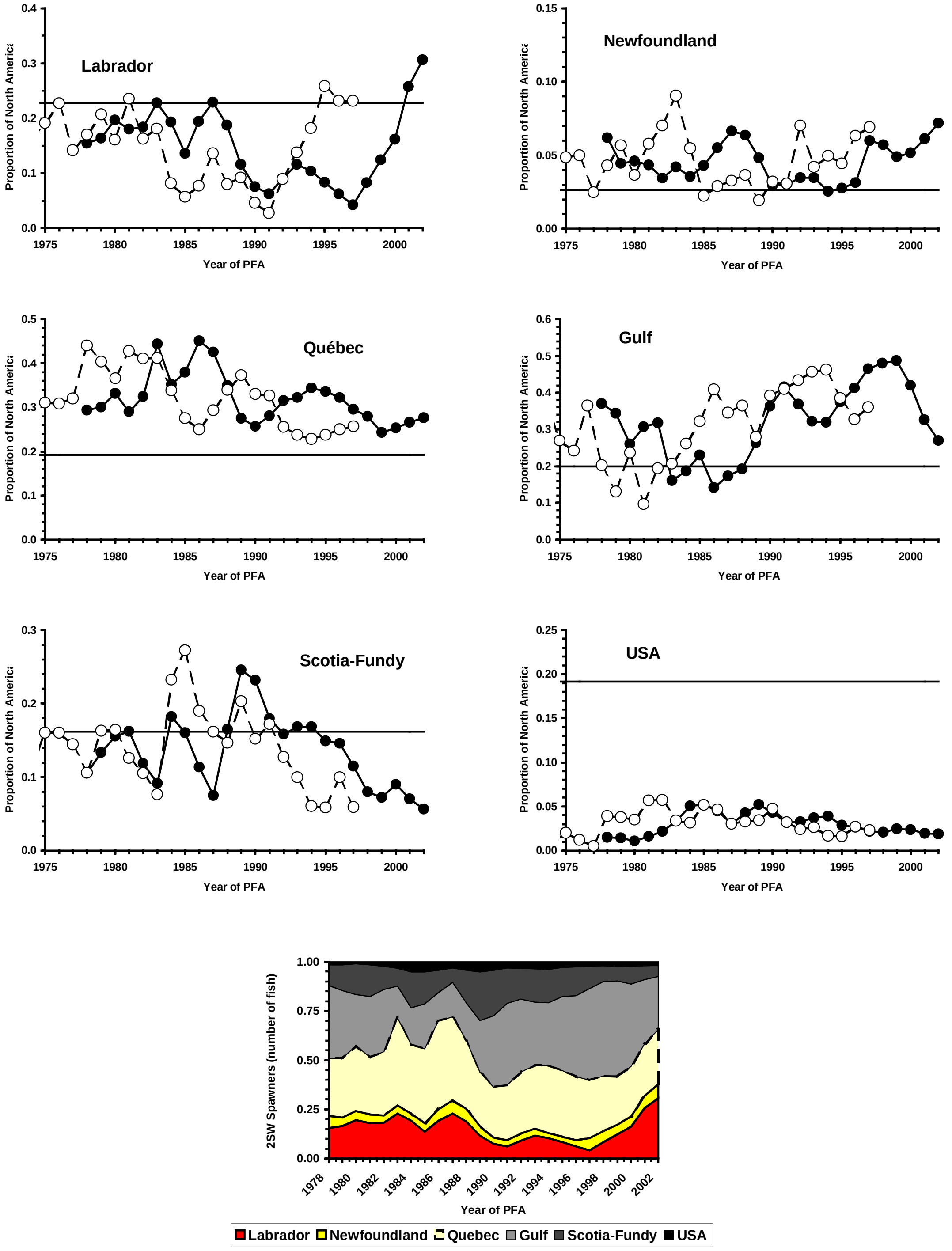


Figure 4.2.4.5. Proportion of spawners (mid-points) lagged to year of PFA (solid circles) and as returns to rivers (open circles) in the six geographic areas of North America relative to the total lagged spawner or annual spawning escapement to North America. The horizontal line represents the theoretical spawner proportions for each area based on the 2SW spawner requirement for North America.

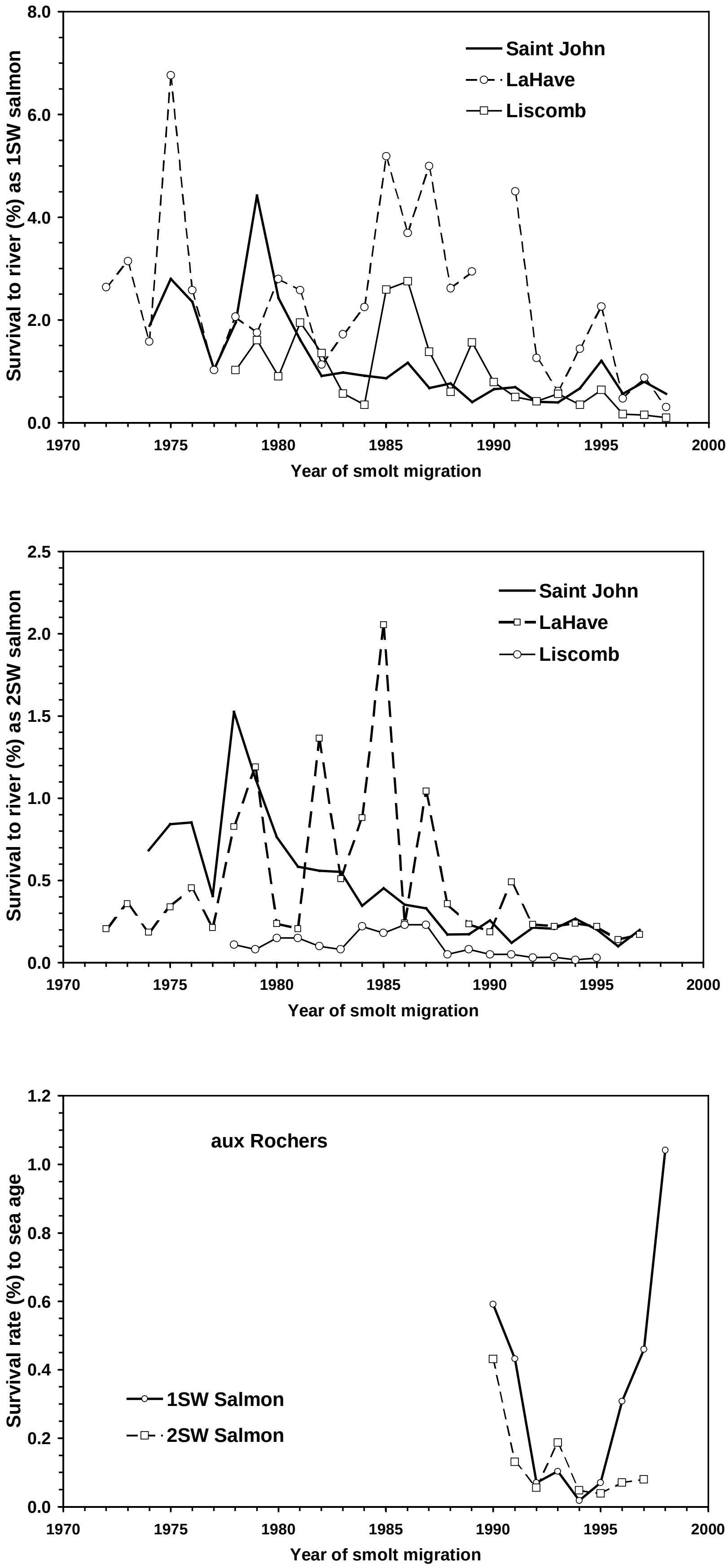
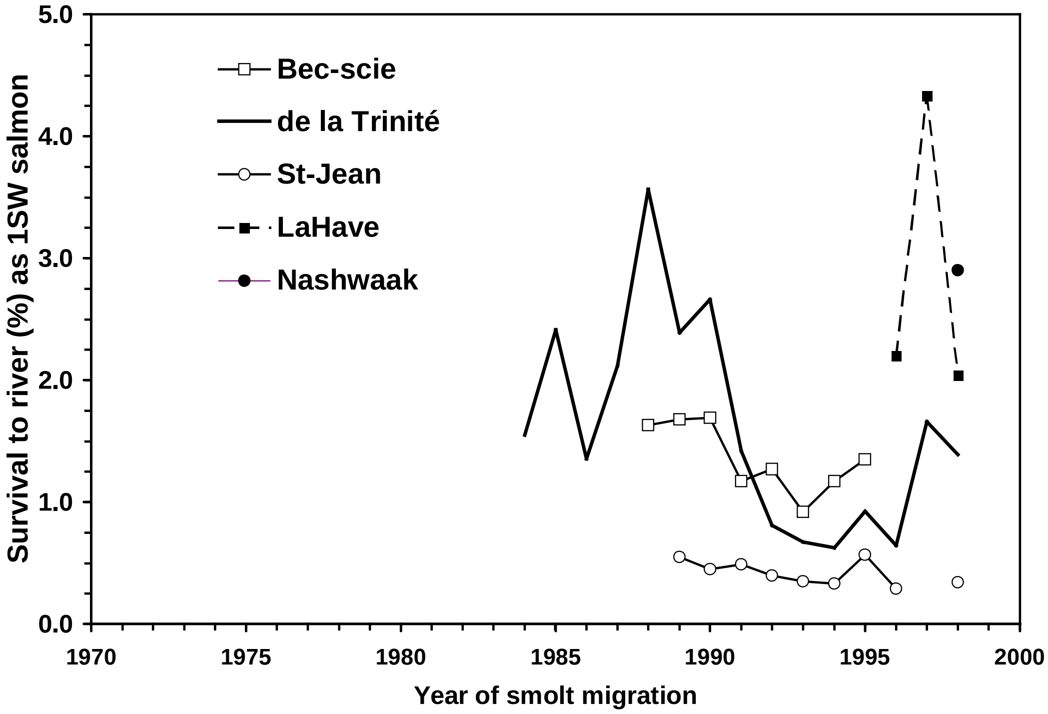


Figure 4.2.5.1. Trends in survival rates (%) of hatchery released smolts from the Saint John River (SFA 23), LaHave River (SFA 21), Liscomb River (SFA 20), and aux Rocher River (Q7) as 1SW, 2SW returns to the river.



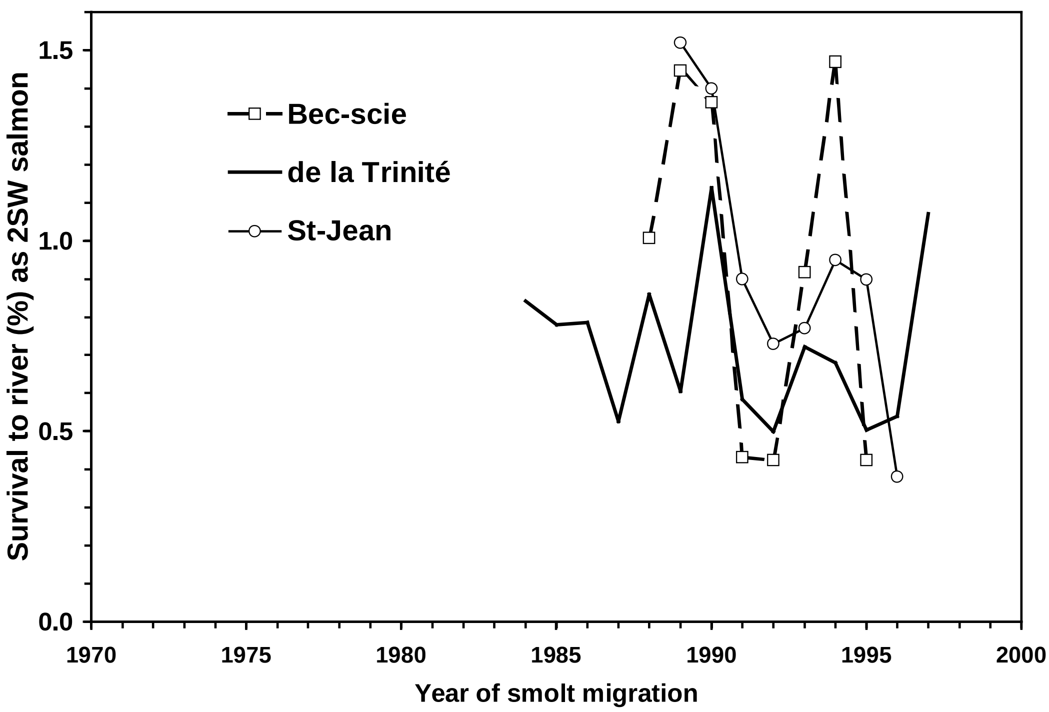
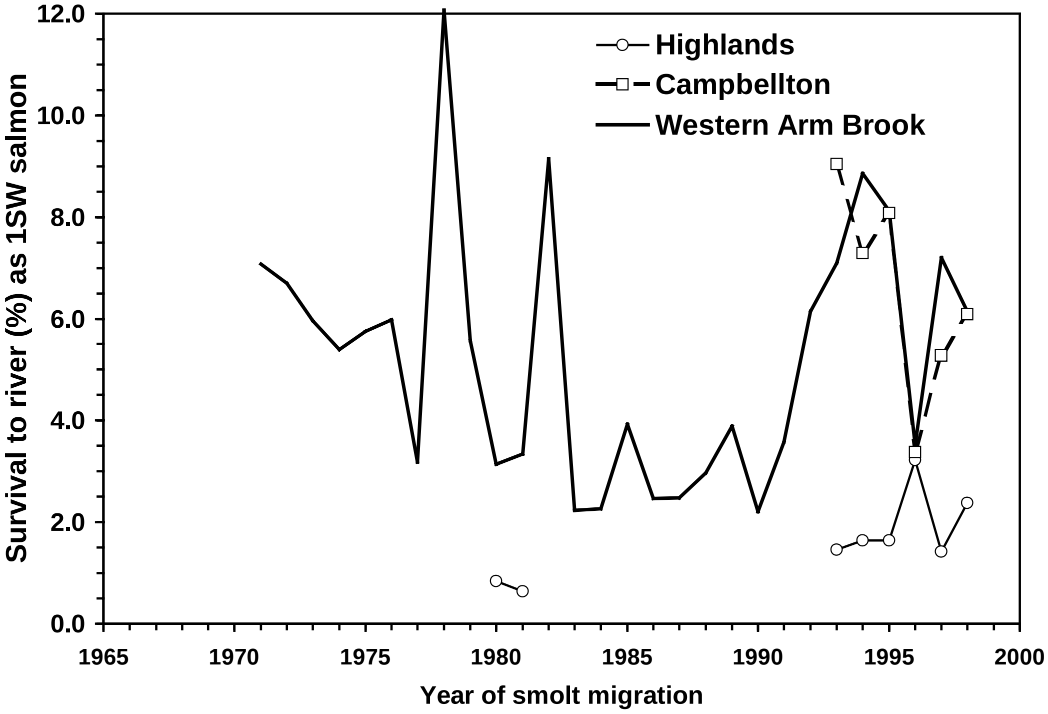


Figure 4.2.5.2. Trends in survival rates (%) of wild smolts as 1SW and 2SW salmon from the rivers in Nova Scotia and New Brunswick (LaHave, SFA 21; Nashwaak, SFA 23) and Quebec (Saint-Jean, Q2; de la Trinité, Q7; Bec-scie, Q10).



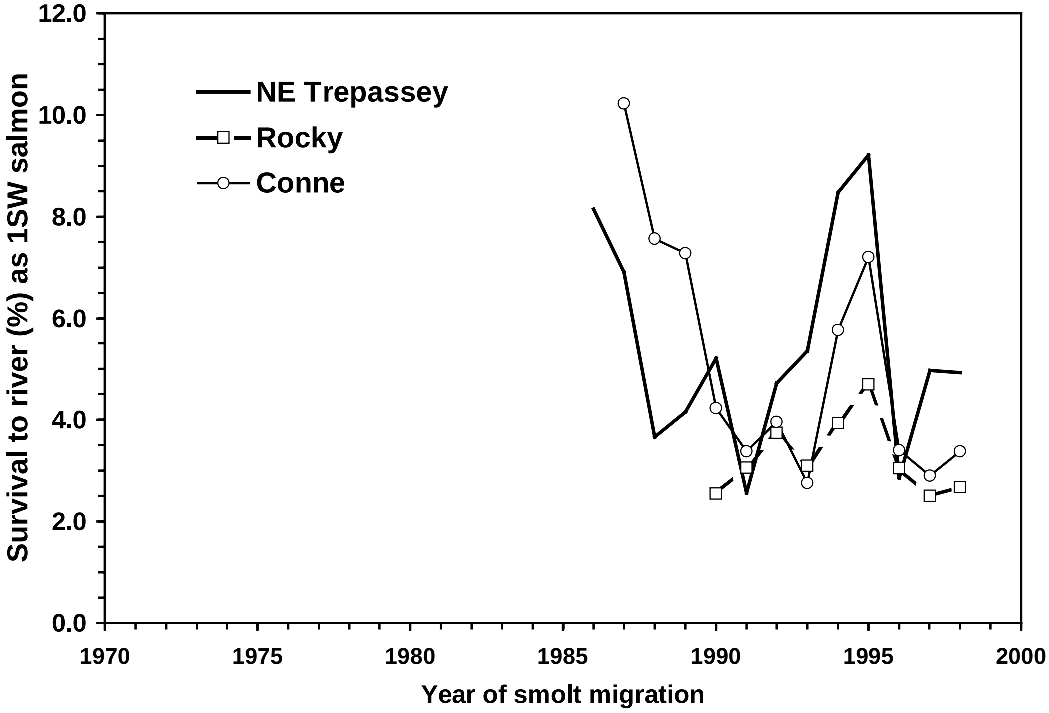


Figure 4.2.5.3. Trends in survival rates (%) of wild smolts as 1SW salmon from the rivers in Newfoundland (Campbellton, SFA 4; NE Trepassey, SFA 9; Rocky, SFA 9; Conne, SFA 10; Highlands, SFA 13, and Western Arm Brook, SFA 14A).

5 ATLANTIC SALMON IN THE WEST GREENLAND COMMISSION AREA

5.1 Description of fishery at West Greenland

5.1.1 Catch and effort in 1999

At its annual meeting in 1999 the West Greenland Commission of NASCO agreed on a multi-year approach for conservation of the salmon stocks occurring in Greenland, and therefore for 1999 and 2000 the catch at West Greenland in each of the years should be restricted to that amount used for internal consumption in Greenland, which in the past has been estimated at 20 tonnes. The Greenland authorities subsequently set this amount as total allowable catch.

The fishery was opened on August 18 and was closed by the authorities October 14 as the reported catch had passed 18 tonnes. The total nominal catches amounted to 19 tonnes (Table 5.1.1.1). The geographical distribution of the nominal catches by Greenland vessels is given in Table 5.1.1.2 for the years 1977-99.

According to the regulations in force all catches, including landings to local markets, privately purchased salmon, and salmon caught by food fishermen, are reported on a daily basis to the Fishery Licence Office. Since 1998, no landing to fish plants were permitted. Licences for the salmon fishery have been issued to fishermen fishing for the local markets, hotels, hospitals etc., while fishing for personal use was permitted without licence for residents of Greenland. In total, 412 licences were issued, however only 98 of the licensed fishermen reported landings to local markets or private sales. In total, 103 persons have reported catches in 1999. Landings to local markets accounted for the largest part of the reported amount. Due to the new reporting system, the fishermen being personally responsible for reporting their catches, and due to the extremely scattered fishery a relatively large part of the total catches is considered to remain unreported. The unreported catches are estimated to be approximately 10-15 tonnes in 1999.

5.1.2 Origin of catches at West Greenland

The Working Group examined the composition and origin of Atlantic salmon caught at West Greenland in 1999 based on discriminant analysis of characteristics from 116 salmon in NAFO Div. 1B (August 23 to September 3), 129 salmon in Div. 1C (August 27 to September 25), 232 salmon in Div. 1D (August 24 to September 3), and 55 salmon in Div. 1F (August 26 to September 10). No sampling was carried out in Div. 1A or in 1E. However, landings in 1A are a very small percentage of the total. Within the spatial and temporal scope of catch sampling, a randomised sampling design was used to obtain samples from salmon landed for local consumption. The Working Group noted that the period of sampling was limited to the first half of the fishing season only, corresponding to approximately 54 % of the reported landings. Apart from landing sites in Div. 1E a better geographical sampling coverage was obtained than in the year before. There was considerable improvement in the sampling success over the years before was obtained in 1999.

Since 1969, discriminant analysis of scale characters from salmon caught in the commercial fishery has been used to determine the proportions of the two continental stock groups in this fishery. The technique has proven to be a reliable method for discriminating and identifying salmon caught in this fishery (Lear and Sandeman 1980; Reddin 1986; Reddin et al. 1988; Reddin et al. 1990). Beginning in 1986, a combined genotypic/phenotypic approach was used whereby a subset of the samples obtained from the Greenland fishery was also sampled for liver and muscle tissue, from which continent of origin was determined using genetic protein polymorphisms (Reddin et al. 1990). The scale characters from this subset were used as a database for discriminant analysis to determine the proportions of North American and European salmon in all of the samples from this fishery. In 1995, the genetic technique was changed from protein polymorphisms to nuclear and mitochondrial DNA, which have been shown to provide a more reliable identification to continent of origin. This combined genotypic/phenotypic approach was used again in 1999 to develop a database to determine the proportions of North American and European salmon at Greenland.

Samples of muscle tissue were taken during the 1999-sampling programme at Greenland. The database was developed from 348 North American and 59 European scale samples. Because of the low number of European samples the discriminant analysis was done by the bootstrap method. Samples of 45 North American and 45 European were randomly selected from the overall database and were used to classify the 532 samples of unknown origin from the fishery samples. This procedure was repeated 1,000 times outputting the probabilities of group membership, which were then averaged to provide the final classifications to North American or European groups. The results of a cross-validation procedure indicated misclassification rates of 20.4 % and error rates of ± 2.3 %. This is an acceptable level of error. The method of Pella and Robertson (1979) was used to correct for misclassifications and gave an overall percent North American origin of 90.1 % and European origin of 9.9 % (Table 5.1.2.1, Fig. 5.1.2.1). The proportion of North American origin salmon has changed significantly over the period of observation, 1969-1999, from below 40 % to 90 % (Fig. 5.1.2.1). Randomisations of the proportion of North American origin including a growth factor for mean weight of the fish for each NAFO Division and week were done to explore variations in number of fish and North American proportion in catches. The results showed a similar North American proportion as in the samples, but a considerably lower number of fish in the catch (about 15 %).

Continent of origin was also determined in the samples collected for DNA analysis. In these samples, the overall percent North American salmon was 85.5 %. It should be noted that the proportions derived from scale and DNA material are not directly comparable because some samples had DNA but no scales while others had scales but no DNA.

The Working Group noted that the significant increase in proportion of North American origin salmon at West Greenland in recent years concordant with the reductions in absolute number caught (Table 5.1.2.2) is possibly related to the declining number of non-maturing salmon especially in the Southern European countries.

Applying the results of the above analysis to the reported catch indicated that 17.8 t (5,700 salmon) of North American origin and 1.8 t (600 salmon) of European origin were landed in West Greenland in 1999. This indicates that the numbers of North American salmon landed at West Greenland is greatly reduced from 1996 and 1998 mainly due to the lowering of the quota. The data for 1982 to 1999 (no data for 1993-94) are summarised in Table 5.1.2.2, Fig. 5.1.2.2.

Comparison of the two techniques for 366 samples in common indicated a North American proportion of 86.6 % for DNA samples and 87.5 % for scale samples.

5.1.3 Biological characteristics of the catches

Biological characteristics (length, weight, and age) were recorded from 532 fish of catches from NAFO Div. 1B, 1C, 1D and 1F in 1999 using the results of discriminant analysis to divide samples into North American and European components. The data for 1999 are compared with those for previous years in Tables 5.1.3.1 to 5.1.3.3.

The downward trend in mean length of both European and North American 1SW salmon since 1969 changed in 1996, as mean lengths increased. From 1996 to 1998 the mean lengths decreased only slightly, whereas a significant increase in mean lengths for all components is indicated in 1999 (Table 5.1.3.1).

Distribution of the catch by river age in 1968-99 as determined from scale samples is shown in Table 5.1.3.2. The proportion of the European origin salmon that were river age 1 fish has been quite variable through the later years with relatively high values in 1998 and 1999 (28.6 and 24.6 %, respectively). A high proportion of this group is reflecting a high contribution from the more Southern European stocks. In the same two years low proportions on 7.6 and 6.5 %, respectively, of river age 3 were observed, the lowest on record. The proportion of river age 2 salmon of North American origin declined from 1998, which was close to the overall mean value of 34.8 %, to 15.5 % in 1999.

The sea-age composition of the samples collected from the West Greenland fishery showed no significant changes in the proportions in the North American component of fish from 1998 to 1999 (Table 5.1.3.3), the 1SW proportion being among the highest in the time series. The proportion of 1SW salmon in the European component has been very high since 1997 (99.7 %), and was in 1999 estimated at 100 %, however based on only 162 individuals.

5.2 Status of the stocks in the West Greenland area

The salmon caught in the West Greenland fishery are non-maturing 1SW salmon or older, nearly all of which would return to homewaters in Europe or North America as MSW fish if they survived. While non-maturing 1SW salmon make up more than 90% of the catch 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. For North American MSW salmon, the most abundant stocks in West Greenland are thought to originate in the southern area of the range.

For the Northeast Commission Area, a Run-reconstruction Model was used to update the estimates of pre-fishery abundance of non-maturing 1SW salmon (Table 3.6.2.4). The main contributor to the abundance of the European component of the West Greenland stock complex is non-maturing 1SW salmon from the southern areas of Europe. These stocks appear to have been more volatile, with large fluctuations occurring in the first half of the time series. Over the past 13 years, however, there has been a steady decline in non-maturing 1SW salmon from Southern European stocks.

Conservation limits and the time series of spawners have been provided for 16 rivers in the NEAC area. Only 6 of the 16 rivers had egg depositions above their conservation limits in the later years. Improvements in egg deposition are indicated for the rivers that were above their conservation limits, while other rivers, which remain near or under their conservation limits on average show a slight decrease (Section 3.4). In general, there seemed to be no tendency to recover at low escapement levels.

In most areas marine survival was lower than the previous 5-year and 10-year mean for 1SW and 2SW fish. Marine survival rates for 6 hatchery stocks showed a downward trend in survival to homewaters for 1SW and 2SW salmon for the past 10-year period.

In general, there has been no significant change in smolt production in the Northeast Atlantic. Returns of salmon to most European rivers showed a significant downward trend for the last ten years period both for southern and northern rivers, but no trend was detected for the last five years.

For the North American Commission Area, the North American Run-Reconstruction Model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon from 1971-1999. The 1998 estimate of pre-fishery abundance of non-maturing 1SW salmon was the lowest on record and continues a decline that began in 1996. Some increase is indicated for the period 1997-1999 for maturing 1SW salmon (Section 4.2.3, Figure 4.2.3.1). In addition to the steady decline in total recruits (both maturing and non-maturing 1SW salmon) over the last ten years, maturing 1SW salmon (grilse) have become an increasingly large percentage of the North American stock complex. This percentage has risen from about 45 % at the beginning of the 1970s, to around 70 % in 1992-95 to almost 80 % in 1997-99.

The estimate of the total number of 2SW salmon returning to Newfoundland rivers and coastal waters of other areas of North America increased slightly from 1998 to 1999, but was about 23 % lower than the estimate for 1997 and lower than the average of the previous years (1971-96). The estimates for 1998 and 1999 are the lowest observed in the past 10 years and second and third lowest in the 28 year time series, 1971-1999 (Table 4.2.2.2). The estimates of returns are quite variable over the time series with no trends indicated. Returns have declined from a peak of 226,000 in 1980 to 98,000 in 1999.

In most regions apart from Newfoundland, the returns of 2SW fish in 1999 are near the lower end of the twenty-seven year time series. However, returns of 2SW salmon to Labrador in 1995 and 1996 were the best in the time series. The estimated returns decreased again in 1997. No estimate is given for 1998 and 1999 from this area, there being no commercial fishery, which was the basis for the return and spawner model for Labrador.

The majority of the USA returns were recorded in the rivers of Maine. The estimated 2SW returns and spawners to USA rivers have declined since 1996, and were in 1999 32 % and 52 % below the previous 5-year and 10-year averages, respectively. Returns to most USA rivers are hatchery-dependent. Spawning escapements remained at low levels (5 %) compared to conservation requirements.

Egg depositions exceeded or equalled the specific conservation requirements in 37 of the 67 rivers (55 %) that were assessed in Canada and were less than 50 % of requirements in 15 other rivers (22 %). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 9 of the 12 rivers assessed (75 %) had egg depositions that were less than 50 % of conservation requirements (Figure 4.2.4.1).

North American salmon stocks remain at low levels relative to the 1970s. The 1SW non-maturing component continues to be depressed with river returns and total production amongst the lowest recorded. The estimate of pre-fishery abundance of non-maturing 1SW salmon for 1998 was the lowest on record, and 15 % below the previous year. In addition, returns in 1999 of maturing 1SW salmon (grilse) to North American rivers were the seventh lowest in the 29-year time series, however 3 % over the 1998 estimate. This being the case, improvement in 2SW salmon returns and spawners is unlikely in 2000. Only Newfoundland achieved its spawning requirements for 2SW salmon in 1999, where they are at the second highest level. However, 2SW salmon comprise only a small proportion of salmon production in this region. The second and third highest were Québec and the Gulf of St. Lawrence, where 2SW salmon are a high proportion of production and very important in terms of their contribution to both North American and Greenland fisheries (Section 4.2.6).

Despite some improvements in the annual returns to some rivers, both in European and North American areas, the overall status of stocks contributing to the West Greenland fishery remains poor, and as a result, the status of stocks within the West Greenland area is thought to be low compared to earlier (historical) levels.

5.3 Evaluation of the effects on European and North American stocks of the West Greenland management measures since 1993.

There have been two 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 second 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 information on the biological characteristics was thus obtained. To calculate a possible TAC for those years according to the agreed quota allocation model (Anon., 1993) biological parameters from sampling in 1992 were used (Table 5.3.1). The variables given in the Table (proportion of origin, mean weights, and proportion of 1SW fish) are those used in the analyses, see Section 5.3.1.

The numbers of fish spared by the closure are shown in the Table. The potential catches in the years 1993 and 1994 of 89 and 137 tons, respectively correspond to the TACs calculated in accordance with the quota allocation computation model that was agreed by NASCO at its annual meeting in 1993. For the successive years nominal catch figures are used. The table shows the number of salmon returning to home waters provided no fishing of the given magnitude took place in Greenland. The biological parameters given in the table represent the annual sampling data.

The mean number for 1993-99 of potentially returning fish per ton caught at Greenland is calculated to 204 and 105 salmon for North America and Europe, respectively.

In the years 1972-92 exploitation rates in Greenland of the North American component of the salmon stock fluctuated between 10 and 45 % around an average of 34 % (Figure 5.3.1). The management measures in force since 1993 resulted in an average exploitation rate of this component of 13 %, about one third of its previous level, for the period 1995-97, after reopening of the fishery in 1995.

In the current analyses the effects of the management measures taken at West Greenland have been examined in terms of numbers of fish only. Thus it has been dificult to show direct benefits to homewater stocks from these measures. The Working Group recommends that other indices of change, i.e. changes in age composition, size at age and sea survival, should also be included in this evaluation.

5.4 Changes to the ‘Model’ Used to Provide Catch Advice and Impacts of Changes on the Calculated Quota

5.4.1 Changes from the 1999 assessment

The models used to predict pre-fishery abundance of the North American non-maturing stock complex and subsequent quota levels for West Greenland were unchanged from the 1999 assessment. The same independent variables used previously were found to provide an improved fit over last year’s model. However, some of the input data streams were modified to reflect new information available to the Working Group. These included: a modification of the method used to calculate returns and spawners to Newfoundland due to a new River Classification System (see Section 4.2.2); and another year of data was added to all data series and catches were updated for recent years. Changes from ICES 1999/ACFM:14 in the data used to estimate pre-fisheries abundance resulted in only a very small change in the pre-fishery abundance estimates for most years or no change at all. In addition to the changes discussed above, we also note that the 1999 catch advice of 0 t would not have been different if the 1999 assessment had been done with the revised input data from this year. Although not completely appropriate, an assessment of what the forecast value would have been is 66,663 (Table 5.6.1.1).

Following on the information presented in last year’s working group report regarding the effects of errors in the lagged spawner variable, the posterior predictive probabilities of the PFA for year 2000 were also derived with these errors included. The results are carried forward into the risk analysis of catch options for 2000 (Section 5.6.4).

5.4.2 Impact of changes on the catch advice

Modifications and improvement to the data streams used to predict pre-fishery abundance would impact the quota in various ways. Modifications to the data that increase the estimated pre-fishery abundance will tend to increase the quota by potentially providing more fish to the surplus portion of the populations. The opposite is also true. Since the updates made in the database resulted in a fit that was only slightly different than in the 1998 assessment, we can conclude minimal change would have occurred to the 1999 forecast.

5.5 Age-Specific Stock Conservation Limits for All Stocks in the West Greenland Commission Area

Sampling of the fishery at West Greenland (Table 5.1.3.3) since 1985 has shown that both European and North American stocks harvested there are primarily (greater than 90%) 1SW non-maturing salmon that would mature as either 2 or 3 SW salmon, if surviving to spawn. Usually less than 1% of the harvest are salmon which have previously spawned and a few percent are 2 SW salmon which would mature as 3SW or older salmon, if surviving to spawn. In 1998, 96.8 of the sampled catch of North American origin and 99.4% of the sampled catch of European origin were 1SW salmon. For this reason, conservation limits defined previously for North American stocks have been limited to this cohort (2SW salmon on their return to homewaters) that may have been at Greenland as 1SW non-maturing fish. These numbers have been documented previously by the Working Group and are revised this year in Section 4.4. From Table 4.4.1, the 2SW spawning requirements of salmon stocks from North America which may be present in the West Greenland Commission Area total 152,548 fish, with 123,349 and 29,199 required in Canadian and USA rivers, respectively. The lower spawning requirement for salmon stocks from North America in the West Greenland Commission Area is due to revisions of the values for Quebec (see Section 4.4).

The Working Group revised their estimates of provisional conservation limits for MSW salmon in Europe based on the methods developed in 1999 (ICES 1999/ACFM:14 and outlined in Section 3.7.2 (Table 3.7.2.1). The conservation limits were 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 groups, and tagging information and biological sampling indicates that the majority of the European salmon caught at West Greenland originate from the southern group. The provisional conservation limit for southern European MSW stocks is approximately 530,000 fish (Table 3.7.2.1). There is still considerable uncertainty in the conservation limits for European stocks. The above value has been increased from 430,000 in the 1999 report to 530,000 fish. To date, the conservation limits for MSW salmon in Europe have not been incorporated into the modelling of catch options for West Greenland..

5.6 Catch Options with Assessment of Risks Relative to the Objective of Achieving Conservation Limits

5.6.1 Overview of provision of catch advice

The Working Group was asked to advise on catch levels based upon maintaining adequate spawning escapements sufficient to achieve conservation limits. Although advances have been made in our understanding of the population dynamics of Atlantic salmon and the exploitation occurring in the fisheries, the concerns about the implications of applying TACs to mixed-stock fisheries are still relevant. In principle, adjustments in catches in mixed-stock fisheries provided by means of an annually adjusted TAC would reduce mean mortality on the contributing populations. However, benefits that might result for particular stocks would be difficult to demonstrate, in the same way that damage to individual stocks are difficult to identify.

In 1993, the Working Group considered how the predictive measures of abundance could be used to give annual catch advice (ICES 1993/Assess:10; Sections 5.3 and 5.4). The aim of management would be to limit catches to a level that would facilitate achieving overall spawning escapement reflecting the spawning requirements in individual North American and European rivers (when the latter have been defined). In order to achieve the desired level of exploitation for a given level of predicted abundance, a TAC could be fixed or some form of effort adjustment introduced. Such an assessment would also depend on a forecast of prefishery abundance for both North American and European salmon stocks.

To date, 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. Gill net fisheries in Greenland and Labrador harvest one-sea-winter (1SW) salmon about one year before they mature and return to spawn in North American rivers. This component was also harvested on their return as 2SW salmon in commercial fisheries in eastern Canada, angling and native fisheries throughout eastern Canada and angling fisheries in the northeastern USA. The fishery in Greenland harvests salmon which would not mature until the following year while the fishery in Labrador (closed in 1998) harvested a mix from the non-maturing component as well as maturing 1SW and MSW salmon. The commercial fisheries in Québec and the Maritime provinces of Canada harvested maturing 1SW and MSW salmon.

The Working Group has advocated models based on thermal habitat in the northwest Atlantic and spawning stock indices to forecast pre-fishery abundance and provide catch advice for the West Greenland fishery. While the approach has been consistent since 1993, the models themselves have varied slightly over the years. The changes have been made to these models in attempts to improve the prediction and add more biological reality. In particular, the models since

1996 have used a spawning stock surrogate variable (lagged spawners) in an attempt to describe the variations in parental stock size of the non-maturing 1SW component (PFA). The models of previous years included the following predictor variables: 1993 - thermal habitat in March; 1994 - thermal habitat in March; 1995 -thermal habitat in January, February, and March; and 1996-98 - thermal habitat in February and lagged spawners from the Labrador, Newfoundland, Québec, and Scotia-Fundy regions of Canada.

The Working Group noted that because the method of estimating spawning escapement for Labrador was based on commercial catches and exploitation rates ended in 1997; lagged spawner values will have missing components in year 2001. An alternative model will be required for next year's assessment.

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 (See Section 4.2.3). Region-specific estimates of 2SW returns are listed in Table 4.2.2.2. 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, 1998-99 returns were estimated as a proportion of the total for other areas based on historical data (Section 4.2.3).

Update of thermal habitat

The Working Group has been using the relationship between marine habitat, 2SW lagged spawners and estimated pre-fishery abundance to forecast pre-fishery abundance in the year of interest (ICES 1993/Assess:10; 1994/Assess:16; 1995/Assess:14; 1996/Assess:11, 1997/Assess:10; 1998/ACFM:15, and 1999/ACFM:14). Marine habitat is measured as a relative index of the area suitable for salmon at sea, termed thermal habitat, and was derived from sea surface temperature (SST) data obtained from the National Meteorological Center of the National Ocean & Atmospheric Administration and previously published catch rates for salmon from research vessels fishing in the northwest Atlantic (Reddin *et al*. 1993 and ICES 1995/Assess:14). The SST data were determined by optimally interpolating SSTs from ships of opportunity, earth observation satellites (AVHRR), and sea ice cover data. The area used to determine available salmon habitat encompassed the northwest Atlantic north of 41°N latitude and west of 29°W longitude and includes the Davis Strait, Labrador Sea, Irminger Sea, and the Grand Bank of Newfoundland.

Thermal habitat has been updated to include 1999 and January and February 2000 year data. Two periods of decline in the available habitat are identified (1980 to 1984 and 1988 to 1995) in the February index (Table 5.6.1.1 and Figure 5.6.1.1). Available habitat for February was reduced in 2000 below the 1999 level from 1,741 to 1,634, a decline of approximately 6%. The 2000 February value is close to the long-term mean (1,733).

Update of Lagged Spawners

The lagged spawner variable used in the model is an estimate of the 2SW parental stock of the PFA. The calculation procedure is described in Section 4.2.4. Previous analyses indicated that the sum of lagged spawner components from Labrador, Newfoundland, Québec, and Scotia-Fundy and excluding Gulf and U.S. was the strongest explanatory variable for the model. Inclusion of the Gulf spawning component reduced the explanatory power of the variable.

The Working Group recognized the problems inherent in this variable. The exclusion of a major component of the spawning stock contributing to the PFA was less than satisfactory. As well, spawning escapement estimates for Labrador are not available for the years 1998 and 1999. The previously formulated lagged spawner variable will therefore not be available beyond 2001. Alternatives to the lagged spawner variable are explored in Section 5.7.3 and should be examined in greater detail at next year's assessment meeting.

5.6.2 Forecast model for pre-fishery abundance of North America 2SW salmon

The 2000 forecast of pre-fishery abundance was based on a linear regression analysis to predict the pre-fishery abundance of non-maturing 1SW fish prior to the start of the Greenland fishery. This makes the fifth consecutive year the same model has been used in the forecasting procedure. The basis for the model is two predictor variables: thermal habitat for February (term H2) and lagged spawners (sum of lagged spawners from Labrador, Newfoundland, Scotia-Fundy and Quebec, term SLNQ) (ICES 1996/Assess:11). This was justified on the basis of studies showing that salmon stocks over wide geographic areas tend to have synchronous survival rates and that the winter period may be the critical stage for post-smolt survival and maturation (Scarnecchia 1989; Reddin and Shearer 1987; Friedland *et al.* 1993;

Friedland *et al.* 1998). Consequently, the model used in 1999 was updated to reflect the inclusion of the additional value and the refinement of other parameters to the time series of pre-fishery abundance estimates.

There was a significant linear relationship between estimated and pedicted fit to the year 2000 model of pre-fishery abundance versus February thermal habitat and lagged spawners (SLNQ) ($F_{2,18}$ =44.2). All model parameters were significant at less than the 5% level (Table 5.6.2.1). Individually, the two predictor variables are also significantly related to pre-fishery abundance (Figure 5.6.2.1).

The contribution of the two variables to the model fit has changed compared to what was previously the case, where SLNQ spawners contributed much less than February habitat. In the current analysis, February habitat accounted for 47% of the total sum of squares by itself but with SLNQ spawners included, the contribution of February habitat was only 17% of the overall variability while the contribution of SLNQ spawners was 66% (Table 5.6.2.1). The jackknife and simulated predicted values for pre-fishery abundance for 1978-2000 are shown in Table 5.6.1.1 and Figure 5.6.2.2. The predicted values are shown to fit the observed data quite well except during the period of low abundance in 1978 and in the late 1980s and 90s when abundance was low. The high correlation between the observed and jackknife predictions (r=+0.911) can be seen in Figure 5.6.2.3. The residual pattern for the model shows a positive relationship with observed values (r=+0.411) and there are low positive residuals at the end of the time series (Figure 5.6.2.3). The forecasted estimate by simulation of pre-fishery abundance for 2000 using the February thermal habitat and lagged spawner model is about 179,900 at the 50% probability level (Table 5.6.1.1). Using the current model to estimate the 1999 pre-fishery abundance yields a value of 66,660, which is about 16% lower than the previously reported value of 79,450. The change is due to the addition of 1998 prefishery abundance which was not included last year as it was unavailable. This value is on the low end of the distribution of prefishery abundance and slightly outside of the former range of prefishery abundances. Also due to the time lag between forecasted and estimated prefishery abundance there is a delay of two years before comparison of estimated and forecasted values can be made. Consequently, any developing trend in high positive or negative residuals indicating a poor fit to recent data will be hard to detect until after the fishery. It should be noted that deterministic and simulated forecast values will show differences due to the method of calculation.

The model continues to be influenced primarily by the spawning stock level in the predictive relationship for pre-fishery abundance (Table 5.6.2.1). Thus, the prediction of pre-fishery abundance would be moderated during periods of high levels of habitat and low levels of spawning stock. The alternate case would be an increase in predicted pre-fishery abundance when spawning stocks were high and thermal habitat was low. The former has occurred with the predicted values for 1998 and 1999, as thermal habitat has increased considerably, the predicted pre-fishery abundance in recent years was low due to the large decline in spawners producing them (Figure 5.6.1.1). However, two-sea-winter spawners contributing to returns have improved in the year 2000 which is contributing substantially to the increase in forecasted prefishery abundance.

Stochastic Analyses

Although the exact error bounds for the estimates of prefishery abundance (NN1(i)) are unknown, minimum and maximum values of component catch and return estimates have been estimated. Simulation methods, implemented in the software package SAS (SAS Institute, 1996), were used to generate the probability density function of NN1(i). This was done as a six-step procedure as follows:

Step 1: Annual values (1978–98) 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: The parameter values of the regression model of pre-fishery abundance on the February thermal habitat (H2) variable and the lagged spawners (SLNQ) variable were estimated from the data set generated in step 1.

Step 3: A single pre-fishery forecast value for 2000 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 normal distribution was used because the error structure of the regression is assumed to be normal.

Step 4: Step 3 was repeated 1,000 times to generate a vector of forecast values from an individual regression fit.

Step 5: Steps 1 to 4 were repeated 1,000 times to generate 1,000,000 predictions (1,000 times 1,000) of pre-fishery abundance. This resampling incorporates the uncertainty of the input parameters (step 1) and the unexplained variance in pre-fishery abundance from the regression (step 4).

Step 6: The probability profile of these stochastic forecasts (in 5% intervals) of the pre-fishery abundance forecast was generated from the vector of pre-fishery abundance forecast values obtained in step 5 (Table 5.6.2.2).

These estimates will be used to develop risk analysis and catch advice presented in Section 5.6.3 and 5.6.4. Managers may use this information to determine the relative risks borne by the stock (i.e., not meeting spawning requirements) versus the fishery (e.g., reduced short-term catches).

The posterior predictive probability distributions for 2000 from the model incorporating the errors in both the PFA and the SLNQ are shown in Figure 5.6.2.4. The posterior distributions were obtained from 500,00 Monte Carlo simulations. A triangular distribution centered at the midpoint of the PFA and SLNQ variables and with the limits at the minimum and maximum were assumed. Data for both variables and all years were drawn independently. The predictions with this model show greater uncertainty in expected PFA with a median value of 270,000 fish (25^{th}-75^{th} percentile range 180,000 – 375,000) (Figure 5.6.2.4).

5.6.3 Development of catch options for 2000

Development of catch advice

Atlantic salmon are managed on the basis of ensuring adequate numbers of spawners in individual rivers. A composite spawning requirement for the North American 2SW stock complex was developed by summing the spawning requirements of Salmon Fishing Areas in Canada and river basins within the USA. Details on the methodology to estimate and update the spawning requirements are provided in (ICES 1996/Assess:11) and in Section 4.4 of this report. With these data, it is possible to compute an allowable harvest. This procedure is unchanged from the previous assessment. Previously, NASCO considered all salmon above the conservation requirement as being available for harvest.

Catch advice for 2000

The fishery allocation for West Greenland is for 1SW fisheries in 2000, whereas the allocation for North America can be harvested in fisheries on 1SW salmon in 2000 and/or in fisheries on 2SW salmon in 2001. To achieve spawning requirements, a pool of fish must be set aside prior to fishery allocation in order to meet spawning requirements and allow for natural mortality in the intervening months between the fishery and return to river. In last year's report, a spawning requirement of 183,852 fish was reported for all North American rivers (ICES 1998/ACFM:15). In 2000, the spawning requirement was lowered to 152,548 due to a change in the conservation reference level for rivers in Quebec, Canada. Thus, 170,286 pre-fishery abundance fish must be reserved (152,548/exp(-.01*11)) to ensure achievement of the requirement after natural mortality. This is a decrease of 17% from the previous value.

By using the probability density function of the pre-fishery abundance, the probability of the expected stock abundance being greater or lower than the value selected can be estimated. This probability level also provides a measure of the probability of reaching conservation requirements assuming fishery allocations are taken without error. The mean estimate of the forecast represents a reference point at which there is a 50% chance that the true abundance is lower than required to achieve the conservation requirement. Likewise, the forecast value at the 25th percentile, or the value with a 25% chance that the abundance is lower and the forecast value at 75th percentile, or the value with a 75% chance that the abundance is lower, characterise a range of decision with lower and higher risks, respectively.

Quota computation for the 2000 fishery requires an estimate of pre-fishery abundance [NN1], stock composition by continent [PropNA], mean weights of North American and European 1SW salmon [WT1SWNA and WT1SWE, respectively], and a correction factor for the expected sea-age composition of the total landings [ACF]. Average values utilising data collected during the 1995-99 fisheries with standard errors, are summarised below.

Parameter	Mean	Minimum	Maximum
PropNA	0.779	0.68	0.90
WT1SWNA	2.666	2.37	3.04
WT1SWE	2.832	2.67	2.98
ACF	1.068	1.04	1.13

Greenland quota levels for H2-SLNQ forecast of pre-fishery abundance were computed. The quota values based on this forecast between interquartile limits of the probability density function from Table 5.6.2.2 are presented in Table 5.6.3.1. For the point estimate level and the stochastic regression estimate using NN1, the quota options are all 0 t, regardless of the proportion allocated to West Greenland (Fna) below the 50^{th} probability level. Above the 50th probability level and at the Fna of 0.4 there are harvests ranging from 14 to 104 tonnes.

The following risk assessment incorporates only uncertainties in the prefishery abundance estimates. As a result, at the 50^{th} percent risk level, spawning escapements in North America will not be expected to meet the requirement level for all rivers combined 50% of the time because of other uncertainties, such as in the conservation limit. Even if this overall requirement is achieved, it is likely that some stocks will therefore fail to meet their individual spawner requirements while others will exceed requirement levels. This may result from random variation between years or from systematic differences in the patterns of exploitation on fish from different rivers or regions. It is obvious from the uncertainty in the data inputs (Figure 5.7.2.3), the posterior distributions of the predicted values (Figure 5.6.2.4) and the performance of the predictions relative to estimated in previous years that our knowledge of abundance of salmon in the year 2000 is very uncertain. Given these uncertainties, a choice of risk level substantially below 50% is advocated by the Working Group.

The Working Group concludes that the North American stock complex of non-maturing salmon remains in tenuous condition. Increased spawning escapements to rivers of some areas of eastern North America have resulted in improved abundance of the juvenile life stages. Despite the closure of Canadian commercial fisheries in 1992 and subsequently in Labrador in 1998, 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. 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 2000 in eastern Canada will be similar to or less than recent years (Sections 4.2.6 and 4.5.1). Smolt production in 1999 in monitored rivers of eastern Canada were similar to the average of the last five years and unless sea survival improves, the abundance of non-maturing 1SW salmon in the Northwest Atlantic is not expected to improve above the levels of the last five years.

The prefishery abundance estimate has declined steadily for the last four years suggesting that a turnaround in a single year of the magnitude indicated by the 2000 year forecast of 179,900 is unlikely. The expected abundance in 2000 is only slightly above the spawner requirement of 170,286 2SW salmon to North America. The increasing advantage associated with each additional spawner in under-seeded river systems makes a strong case for a conservative management strategy.

5.6.4 Risk assessment of catch options

The provision of catch advice in a risk framework involves the incorporation of 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 precision of the assessment has a potential effect on the risk approach used by managers. One approach considers the catch options relative to a 50% chance of the undesirable event occurring and ignores the uncertainty in the stock assessment. The reliability of the assessment has very different and profound consequences on the catch options for risk-averse compared to risk-prone approaches (Figure 5.6.4.1). In a theoretical example, two assessments provide the same point estimate (50% probability value) but the precisions are very different. Under a risk-prone management approach, the allowed catch would be greater for the imprecise assessment: at a 70% risk level, the advised catch under the precise assessment would be 500 t but the uncertain assessment would provide for a catch of 800 t (Figure 5.6.4.1). The risk-averse management approach would advise for lower catch options for the imprecise assessment: at a 20% risk level, the precise assessment would provide a catch option of about 400 t but for the imprecise assessment, no catch is advised. Under precautionary management principles, a risk-averse approach would be favoured for imprecise assessments.

The analysis of risk involves three steps: 1) describing the precision or imprecision of the assessment; 2) the definition of a management strategy; and 3) the evaluation of the probability of an event (either desirable or undesirable) resulting from the fishery action. The management of Atlantic salmon in the North American and Greenland Commission areas involves managing for a fixed escapement of salmon to rivers in North America. The conservation requirements to North America are considered to be a threshold reference point. All potential recruits in excess of the conservation requirement are considered to be available for harvest. The undesirable event to be assessed is that the spawning escapement to North America will be below the conservation limit.

A risk analysis of catch options for Atlantic salmon from North America incorporates all the uncertainty in the estimates of the probable returns:

1. the uncertainty in the conservation requirement as shown in the risk plot,
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 plots are calculated for consideration of the 2000 fishery in West Greenland.

Spawner requirement risk analysis

The derivation of the spawning requirement risk profile for North America was similar to the method presented in ICES 1997/Assess:10. Briefly, North America is divided into six stock areas which correspond to the areas used to estimate returns and spawning escapements (Table 4.4.1). The annual variability in the proportion of female salmon in each stock area was described in terms of a uniform distribution corresponding to values for each stock area. A total of 1,000 simulations were run for each spawning escapement level. The sex ratio varied independently in each stock for each simulation. The risk profile were expressed as the probability of meeting or exceeding the spawning requirements concurrently in all six stock areas. In addition, plots of the probability of meeting or exceeding lower proportions of the spawning requirements were derived as an indication of the magnitude of under-escapement which would be expected for different levels of escapement to North American rivers.

Under the assumption of equal production from all stock areas (i.e., recruitment in direct proportion to the spawner requirement) just over 172,000 fish should escape to North America as spawners to achieve the spawner requirement in all six stock areas at a 50% probability level. This value is higher than the point estimate for the North American stock complex (152,548 2SW salmon, Table 4.4.1) because it includes the annual variation in proportion female.

Uncertainty in the pre-fishery forecast

Model fitting and the confidence intervals for the pre-fishery abundance of non-maturing North American origin salmon are described in Section 5.6.2. The required elements for the risk analysis are the distributions of pre-fishery abundance and their associated probabilities (Figure 5.6.2.4).

Uncertainty in the biological characteristics and predicted catches of North American origin salmon

The catch options table (Table 5.6.3.1) is calculated using the probability density function of the pre-fishery abundance forecasts and point estimates for the remaining parameters including: the spawner reserve for North America, proportion of the 1SW catch which would be of North American origin, weight of 1SW North American and European fish, and the age correction factor. In the risk analysis, the biological characteristics for 2000 were modelled assuming a uniform distribution between the minimum and maximum observed in the last five years.

Using the biological characteristics and the catch options, the total returns to North America after the Greenland fishery were calculated by subtracting the catch of North American 1SW origin salmon from the pre-fishery abundance forecast and discounting for the 11 months of natural mortality between the time of the Greenland fishery and return to homewaters.

Catch options and risk summary for 2000

The final step in the risk analysis of the catch options involves combining the cumulative risk plots from the conservation requirement calculation with the probability distribution of the returns to North America for different catch options. The sum of the products of the cumulative distribution of spawner requirements and the probability distribution of the corresponding returns to North America equals the probability of meeting the conservation requirements. The risk of not meeting the conservation requirement in at least one of the six stock areas is obtained by subtracting from unity the probability of meeting the requirements in all the areas. An analysis of the risk of the severity of the under-escapement (for example, the risk of not attaining 50% of the conservation requirement in at least one of the six stock areas) was derived in exactly the same way by substituting the cumulative distribution for a different conservation requirement proportion.

The pre-fishery abundance of salmon in 2000 is expected to be low (Figure 5.6.2.4). There is a high risk (almost 50% probability) that the returns of 2SW salmon to North America in 2001 will be below the conservation requirement in at least one of the six stock areas, even in the absence of any fisheries-induced mortality on this age group in Greenland in 2000 (Figure 5.6.4.2). There is a low (11% chance) but real probability that at least one of the six stock areas will be severely under-escaped (by 50%). The risk profile is shallow over the range of catch options illustrated (0 to 1000 t) which reflects the degree of uncertainty in the expected abundance relative to the catch options considered.

The model which incorporates the uncertainty in the PFA and SLNG (model additive with errors in PFA and SLNQ in Figure 5.6.4.2) provides a more realistic sense of the information available for predicting PFA in 2000. As stated in Section 5.6.3, a risk level substantially below 50% must be advised to account for the large uncertainty in the predicted abundance of salmon in 2000.

5.7 Critical Examination of the Confidence Limits on the Output of, and Assumptions in the 'Model' Used to Provide Catch Advice

5.7.1 Impact of measurement errors on the PFA forecast

Uncertainty in Regional Estimates of Returns

The pre-fishery abundance used to develop catch options for the fishery at West Greenland incorporates estimates of 2SW returns from six North American regions (Newfoundland, Labrador, Gulf of St. Lawrence, Quϑbec, Scotia Fundy, and the United States, as well as catch information from the West Greenland fishery. The methodology used to estimate returns varies considerably among regions, and the proportion of the estimate based on enumerated fish returns (weir counts, commercial and recreational landings, and experimentally validated assessment techniques) varies among regions and through time. Closure of Canadian commercial and recreational fisheries, and significant reductions in the quota and landings in the West Greenland fishery have significantly reduced enumeration of salmon from these sources. This has resulted in concerns that estimation of the 2SW returns has become increasingly reliant on estimation techniques, assumptions and raising factors (e.g, weir counts on a single or subset of rivers used to calibrate returns for an entire region).

To assess the reliability of 2SW return estimates, the Working Group initiated an effort to develop a relative precision index for 2SW return estimates. In general terms the purpose of this approach was to evaluate the loss of information due to increasing restrictions and closures of commercial and recreational fisheries that previously provided significant inputs to the estimation of 2SW returns. For each region and the fishery at West Greenland, the Working Group generated precision indices as ratios of the enumerated returns to the annual estimates of 2SW returns from 1971-1999. For Canadian regions, region specific precision indices were produced for both the minimum and maximum return estimates. For the United States and West Greenland fishery, the annual point estimate was used as both the minimum and maximum value to generate estimates for the precision index.

Regions where minimum and maximum estimates of returns were produced demonstrated the common feature that the precision index for the minimum estimate was usually larger than the precision index for the maximum estimate. For Newfoundland, the precision index remained at low levels (generally below 0.2) for both the minimum and maximum estimate between 1971 and the mid-1980s (Figure 5.7.2.1). In response to the development of river management plans and the initiation of adult monitoring programs on three large Newfoundland rivers, the precision index rose sharply to between 0.5 to 0.65 for the maximum estimate and between 0.8 and 1.2 for the minimum estimate. The production of precision index values in excess of 1.0 is problematic, indicating that in some years the enumerated returns exceeded the estimate of returns of 2SW salmon to Newfoundland. Additional work is recommended to ensure that procedures used to partition both enumerated and estimated MSW returns into 2SW returns is evaluated and if necessary, revised.

The precision index for the Gulf of St. Lawrence return estimates ranged between 0.2 and 0.4 for the maximum estimate and 0.4 and 0.6 for the minimum estimate in the 1970s, but increased to in excess of 0.8 by 1980 (Figure 5.7.2.1). Since 1980, precision indices for the Gulf of St. Lawrence have been variable, but generally exceeded 0.6. The precision index for Quebec was variable from 1972 to 1993, generally ranging between 0.3 and 0.5 for the minimum return estimate and 0.4 and 0.6 for the maximum estimate (Figure 5.7.2.1). The precision estimate dropped sharply between 1994 and 1995, and again between 1997 and 1998 due to successive commercial fishery closures.

The precision index for Scotia-Fundy ranged between 0.4 and 0.6 for the maximum estimate and 0.65 to 0.80 for the minimum estimate from 1971 to the early 1980s (Figure 5.7.2.1). Following closure of commercial fisheries in two major areas, the precision index dropped to 0.30 for the maximum estimate and 0.55 for the minimum estimate. The precision indices rose slightly during the 1990s, but declined precipitously in the late 1990s when a change in the estimation procedure for returns resulted in increased reliance on returning fish counts at weirs. The precision index for the United States ranged between 0.5 and 0.7 from 1971 to 1980, and rose steadily to approximately 0.9 by the late 1990s, as remaining recreational fisheries were closed (Figure 5.7.2.1). Currently, greater than 90 percent of U.S. returns are directly enumerated at counting weirs, resulting in a high degree of precision in the estimation of returning 2SW salmon.

To develop an overall precision index for the North American 2SW return estimate, precision indices from each region

$$PI_{NA,\,yr} = \sum_{j\ to\ reg} [PI_{j,\,yr} * (R_{j,\,yr} / \sum_{i\ to\ reg} R_{i,\,yr})]$$

were weighted by their relative contributions to the total 2SW return estimate as follows:

where

$PI_{NA,yr}$ = precision index for 2SW salmon in North America in year yr,

$PI_{region,\,yr}$ = precision index for 2SW salmon for region reg in year yr, and

$R_{reg,yr}$ = return estimate for region reg in year yr.

The overall precision index for the North American PFA estimate incorporates trends in the individual region indices, as well as changes in the magnitude of the mixed stock fishery in Greenland. The North American index remained relatively stable between 1971 and 1992 with the index for the maximum estimate generally remaining between 0.7 and 0.85 and the index for the minimum estimate ranging between 0.8 and 0.9 (Figure 5.7.2.1). The precision index exhibited a sharp decline between 1992 and 1993 in response to the 1993 buyout of the Greenland fishery, and continued to decline to approximately 0.5 in response to closure of Canadian fisheries and restricted catches in the West Greenland fishery.

Although additional work is required to standardize the inputs into the calculation of the precision index, the preliminary results demonstrate the relative impact of losses of information sources of non-maturing 1SW catches and enumerated returns of 2SW salmon to homewaters have on the estimation of returns and PFA estimates for North America.

Degree of Measurement Errors on PFA Estimates and Impact on Forecasts

In the previous year's report, the working group reported on some preliminary findings addressing the impact of measurement errors in the lagged spawners (LS) and prefishery abundance (PFA) estimates. Measurement errors can have disruptive effects on model fitting and on the uncertainty of the predictions. In particular, measurement errors in the predictor variable caused a shift in the distribution and reduced the precision of the predicted value (Figure 5.7.2.2). As the predictive variables become less informative about PFA, the most probable value of the PFA approaches the mean of the series. In the analysis presented last year, measurement errors were assumed to be independent between years and between variables and of similar levels of uncertainty in the time series. The structure of the errors was defined as triangular distributions with a mode located at the point estimates currently used and ranging between a minimum and maximum representing -/+ 10%, -/+ 25% and -/+ 50% of the midpoint.

Following on the recommendation from last year, the level of error in the PFA and SLNQ was estimated for the 1977 to 1998 time series. The level of error, expressed as half the range relative to the midpoint value, was generally less than 20% for the PFA between 1978 and 1992 but increased to between 25% and 30% afterwards (Figure 5.7.2.3). The SLNQ variable has a much higher relative error at about +/- 40% between 1978 and 1989 and decreasing to about 30% for the subsequent years. The 1999 PFA prediction was rerun using the tabled minimum and maximum values in the PFA and SLNQ variables and the resulting posterior predictive distribution is shown in Figure 5.7.2.4. The inclusion of the measurement error in the forecast model increased the uncertainty of the forecast. The description of uncertainty can be incorporated in a risk analysis framework. Under increased uncertainty, alternative risk levels to the 50% point should be considered, consistent with the precautionary approach.

5.7.2 Impact of measurement errors on the PFA forecast

The pre-fishery abundance used to develop catch options for the fishery at West Greenland incorporates estimates of 2SW returns from six North American regions (Newfoundland, Labrador, Gulf of St. Lawrence, Quϑbec, Scotia Fundy, and the United States, as well as catch information from the West Greenland fishery. The methodology used to estimate returns varies considerably among regions, and the proportion of the estimate based on enumerated fish returns (weir counts, commercial and recreational landings) varies among regions and through time. Closure of Canadian commercial and recreational fisheries, and significant reductions in the quota and landings in the West Greenland fishery have significantly reduced enumeration of salmon from these sources. This has resulted in concerns that estimation of the 2SW returns has become increasingly reliant on estimation techniques, assumptions and raising factors.

To assess the relative dependance of 2SW return estimates on both enumerated and estimated sources of returns, the Working Group initiated an effort to develop a relative precision index for 2SW return estimates. In general terms the purpose of this approach was to evaluate the loss of information due to increasing restrictions and closures of commercial and recreational fisheries that previously provided significant inputs to the estimation of 2SW returns. For each region and the fishery at West Greenland, the Working Group generated precision indices as ratios of the annual documented returns/catch to the annual estimates of 2SW returns from 1971-1999. For Canadian regions, region specific precision indices were produced for both the minimum and maximum return estimates. For the United States and West Greenland fishery, the annual point estimate was used as both the minimum and maximum value to generate estimates for the precision index.

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To develop an overall precision index for the North American 2SW return estimate, precision indices from each region were weighted by their relative contributions to the total 2SW return estimate as follows:

$$PI_{NA,\,yr} = \sum_{reg} [\,PI_{reg,\,yr} * (R_{reg,\,yr} / \sum_{reg} R_{reg,\,yr})]$$

where

$PI_{NA,yr}$ = precision index for 2SW salmon in North America in year yr,

$PI_{region,\,yr}$ = precision index for 2SW salmon for region reg in year yr, and

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The overall precision index for the North American PFA estimate incorporates trends in the individual region indices, as well as changes in the magnitude of the mixed stock fishery in Greenland. The North American index remained relatively stable between 1971 and 1992 with the index for the maximum estimate generally remaining between 0.7 and 0.85 and the index for the minimum estimate ranging between 0.8 and 0.9 (Figure 5.7.2.1). The precision index exhibited a sharp decline between 1992 and 1993 in response to the 1993 buyout of the Greenland fishery, and continued to decline to approximately 0.5 in response to closure of Canadian fisheries and restricted catches in the West Greenland fishery.

Although additional work is required to standardize the some inputs into the calculation of the precision index, the preliminary results demonstrate the relative impact of losses of information sources of non-maturing 1SW catches and enumerated returns of 2SW salmon to homewaters have on the estimation of returns and PFA estimates for North America.

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Following on the recommendation from last year, the level of error in the PFA and LS was estimated for the 1977 to 1998 time series. The level of error, expressed as the half the range relative to the midpoint value, was generally less than 20% for the PFA between 1978 and 1992 but increased to between 25% and 30% afterwards (Figure 5.7.2.3). The LS variable has a much higher relative error at about +/- 40% between 1978 and 1989 and decreasing to about 30% for the subsequent years. The 1999 PFA prediction was rerun using the tabled minimum and maximum values in the PFA and LS variables and the resulting posterior predictive distribution is shown in Figure 5.7.2.4. The inclusion of the measurement error in the forecast model increased the uncertainty of the forecast. The description of uncertainty can be incorporated in a risk analysis framework. Under increased uncertainty, alternative risk levels to the 50% point should be considered, consistent with the precautionary approach.

5.8 Data Deficiencies and Research Needs in the WGC area

5.8.1 Progress on data deficiencies and research needs in the WGC area

Some progress was made on the recommendations for resolving data deficiencies and research requirements made in the 1999 report. The catch reporting system was improved for records of local sales and catches by individual fishermen over previous years. In order to improve the recording of local sales and food catches, individual fishermen were required to directly and daily report their catches. However, in spite of these improvements, a relatively high proportion of the total catch is still thought to be unreported. The sampling programme in 1999 covered the landings better than the years before due to an increased sampling effort. However, the extremely scattered nature of this fishery needs much effort to further improve the sampling coverage both geographically and over the season.

5.8.2 Recommendations for 2000.

1) The mean weights, sea and freshwater ages and continent of origin are essential parameters to provide catch advice for the West Greenland fishery. As these parameters are known to vary over time, the Working Group recommends that the sampling programme, which occurred in 1995-99, be continued and improved to spatially and temporally cover as much of the landings as possible.

2) Efforts should be made to improve the estimates of the annual catches of salmon taken for local consumption in Greenland.

3) The Working Group recommends that other indices of change, i.e. changes in age composition, size at age and sea survival, should also be included in the evaluation of the effects on European and North American stocks of the West Greenlandic management measures since 1993.

4) The catch options for the West Greenland fishery are based almost entirely upon data taken from North American stocks (with the current exclusion of Labrador, see Section 4.6). In view of the evidence of a long-term decline in the European stock components contributing to this fishery (southern European non-maturing 1SW recruits) the Working Group emphasised the need for information from these stocks to be incorporated into the assessments as soon as possible.

5) The Working Group recommends that an evaluation be conducted on the present reliability of the PFA estimate. An initial approach is to determine what fraction of the PFA estimate is directly based on catches and assessed returns (hard data), and what fraction results from less certain information such as scaling factors for potential productive habitat.

6) It is recommended that the extent of the measurement error inherent in the run-reconstruction model should be estimated to describe the potential bias in the model and the description of uncertainty associated with the forecast.

7) The inclusion of measurement error in the forecast model increases the uncertainty of the forecast, and under increased uncertainty alternative risk levels to the 50 % point should be considered, consistent with the precautionary approach.

8) Other indices of adult salmon abundance should be examined and used as prior information to constrain the plausible range of abundance levels.

9) Alternative models should be explored (for example different predictive variables, model formulations, univariate time series, non-parametric change-of-state analyses) to provide some index of plausibility of the quantitative forecasts.

10) Further basic research is needed on the spatial and temporal distribution of salmon in relation to Sea Surface Temperature and their predators at sea to assist in explaining variability in survival rates.

Table 5.1.1.1. Nominal catches of salmon, West Greenland 1960-99 (metric tons round fresh weight).

Year	Norway	Faroes	Sweden	Denmark	Greenland[1]	Total	Quota[2]
1960	-	-	-	-	60	60	-
1961	-	-	-	-	127	127	-
1962	-	-	-	-	244	244	-
1963	-	-	-	-	466	466	-
1964	-	-	-	-	1539	1539	-
1965	-[3]	36	-	-	825	861	-
1966	32	87	-	-	1251	1370	-
1967	78	155	-	85	1283	1601	-
1968	138	134	4	272	579	1127	-
1969	250	215	30	355	1360	2210	-
1970	270	259	8	358	1244	2146[4]	-
1971	340	255	-	645	1449	2689	-
1972	158	144	-	401	1410	2113	1100
1973	200	171	-	385	1585	2341	1100
1974	140	110	-	505	1162	1917	1191
1975	217	260	-	382	1171	2030	1191
1976	-	-	-	-	1175	1175	1191
1977	-	-	-	-	1420	1420	1191
1978	-	-	-	-	984	984	1191
1979	-	-	-	-	1395	1395	1191
1980	-	-	-	-	1194	1194	1191
1981	-	-	-	-	1264	1264	1265[6]
1982	-	-	-	-	1077	1077	1253[6]
1983	-	-	-	-	310	310	1191
1984	-	-	-	-	297	297	870
1985	-	-	-	-	864	864	852
1986	-	-	-	-	960	960	909
1987	-	-	-	-	966	966	935
1988	-	-	-	-	893	893	-[7]
1989	-	-	-	-	337	337	-[7]
1990	-	-	-	-	274	274	-[7]
1991	-	-	-	-	472	472	840
1992	-	-	-	-	237	237	258[8]
1993	-	-	-	-	0[5]	0[5]	89[9]
1994	-	-	-	-	0[5]	0[5]	137[9]
1995	-	-	-	-	83	83	77
1996	-	-	-	-	92	92	174[8]
1997	-	-	-	-	58	58	57
1998	-	-	-	-	11	11	20[10]
1999	-	-	-	-	19	19	20[10]

[1] For Greenland vessels: all catches up to 1968 were taken with set gillnets only; after 1968, the catches were taken with set gillnets and drift nets. All non-Greenland catches 1969-75 were taken with drift nets.
[2] Quota figures apply to Greenland fishery only.
[3] Figures not available, but catch is known to be less than Faroese catch.
[4] Including 7 t caught on longline by one of two Greenland vessels in the Labrador Sea early in 1970.
[5] The fishery was suspended.
[6] Quota corresponding to specific opening dates of the fishery.
[7] 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.
[8] Set by Greenland authorities.
[9] Quotas were bought out.
[10] Fishery restricted to catches used for internal consumption in Greenland.

Table 5.1.1.2. Distribution of nominal catches (metric tons), Greenland vessels.

Year	NAFO Division 1A	1B	1C	1D	1E	1F	NK	Total Westgrl.	East Greenland	Total Greenland
1977	201	393	336	207	237	46	-	1420	6	1426
1978	81	349	245	186	113	10	-	984	8	992
1979	120	343	524	213	164	31	-	1395	+	1395
1980	52	275	404	231	158	74	-	1194	+	1194
1981	105	403	348	203	153	32	20	1264	+	1264
1982	111	330	239	136	167	76	18	1077	+	1077
1983	14	77	93	41	55	30	-	310	+	310
1984	33	116	64	4	43	32	5	297	+	297
1985	85	124	198	207	147	103	-	864	7	871
1986	46	73	128	203	233	277	-	960	19	979
1987	48	114	229	205	261	109	-	966	+	966
1988	24	100	213	191	198	167	-	893	4	897
1989	9	28	81	73	75	71	-	337	-	337
1990	4	20	132	54	16	48	-	274	-	274
1991	12	36	120	38	108	158	-	472	4	476
1992	-	4	23	5	75	130	-	237	5	242
1993[1]	-	-	-	-	-	-	-	-	-	-
1994[1]	-	-	-	-	-	-	-	-	-	-
1995	+	10	28	17	22	5	-	83	2	85
1996	+	+	50	8	23	10	-	92	+	92
1997	1	5	15	4	16	17	-	58	1	59
1998	1	2	2	4	1	2	-	11	-	11
1999	+	2	3	9	2	2	-	19	+	19

[1]) The fishery was suspended
+) Small catches <0.5 t
-) No commercial landings

Table 5.1.2.1. Size of biological samples and percentage (by number) of North American and European salmon in research vessel catches at West Greenland (1969-82), from commercial samples (1978-92 and 1995-97), and from local consumption samples (1998-99).

		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	3488	3488	36	(37,34)	64	(66,63)
	1973	102	102	49	(59,39)	51	(61,41)
	1974	834	834	43	(46,39)	57	(61,54)
	1975	528	528	44	(48,40)	56	(60,52)
	1976	420	420	43	(48,38)	57	(62,52)
	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	1653	1653	50	(52,48)	50	(52,48)
	1980	978	978	48	(51,45)	52	(55,49)
	1981	4570	1930	59	(61,58)	41	(42,39)
	1982	1949	414	62	(64,60)	38	(40,36)
	1983	4896	1815	40	(41,38)	60	(62,59)
	1984	7282	2720	50	(53,47)	50	(53,47)
	1985	13272	2917	50	(53,46)	50	(54,47)
	1986	20394	3509	57	(66,48)	43	(52,34)
	1987	13425	2960	59	(63,54)	41	(46,37)
	1988	11047	2562	43	(49,38)	57	(62,51)
	1989	9366	2227	56	(60,52)	44	(48,40)
	1990	4897	1208	75	(79,70)	25	(30,21)
	1991	5005	1347	65	(69,61)	35	(39,31)
	1992	6348	1648	54	(57,50)	46	(50,43)
	1995	2045	2045	68	(72,65)	32	(35,28)
	1996	3341	1297	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)

[1] CI – confidence interval calculated by method of Pella and Robertson (1979) for 1984 -86 and by binomial distribution for the others.

[2] During Fishery.

[3] Research samples after fishery closed.

Table 5.1.2.2. The weighted proportions and numbers of North American and European Atlantic salmon caught at West Greenland 1982-92 and 1995-99. Numbers are rounded to the nearest hundred fish.

	Proportion weighted by catch in number		Numbers of Salmon caught	
Year	NA	E	NA	E
1982	57	43	192200	143800
1983	40	60	39500	60500
1984	54	46	48800	41200
1985	47	53	143500	161500
1986	59	41	188300	131900
1987	59	41	171900	126400
1988	43	57	125500	168800
1989	55	45	65000	52700
1990	74	26	62400	21700
1991	63	37	111700	65400
1992	45	55	46900	38500
1993	-	-	-	-
1994	-	-	-	-
1995	67	33	21400	10700
1996	73	27	22400	9700
1997	85	15	18000	3300
1998	79	21	3100	900
1999	91	9	5700	600

Table 5.1.3.1. Annual mean fork lengths and whole weights of Atlantic salmon caught at West Greenland, 1969-92 and 1995-99. Fork length (cm); whole weight (kg). 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		PS	
Year	NA	E	NA	E	NA	E	NA	E		NA	E	NA	E	NA	E
1969	3.12	3.76	5.48	5.80	-	5.13	3.25	3.86	3.58	65.0	68.7	77.0	80.3	-	75.3
1970	2.85	3.46	5.65	5.50	4.85	3.80	3.06	3.53	3.28	64.7	68.6	81.5	82.0	78.0	75.0
1971	2.65	3.38	4.30	-	-	-	2.68	3.38	3.14	62.8	67.7	72.0	-	-	-
1972	2.96	3.46	5.85	6.13	2.65	4.00	3.25	3.55	3.44	64.2	67.9	80.7	82.4	61.5	69.0
1973	3.28	4.54	9.47	10.00	-	-	3.83	4.66	4.18	64.5	70.4	88.0	96.0	61.5	-
1974	3.12	3.81	7.06	8.06	3.42	-	3.22	3.86	3.58	64.1	68.1	82.8	87.4	66.0	-
1975	2.58	3.42	6.12	6.23	2.60	4.80	2.65	3.48	3.12	61.7	67.5	80.6	82.2	66.0	75.0
1976	2.55	3.21	6.16	7.20	3.55	3.57	2.75	3.24	3.04	61.3	65.9	80.7	87.5	72.0	70.7
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	-	60.8	85.0
1979	2.98	3.50	7.06	7.60	3.92	6.33	3.12	3.56	3.34	63.4	66.7	81.6	85.3	61.9	82.0
1980	2.98	3.33	6.82	6.73	3.55	3.90	3.07	3.38	3.22	64.0	66.3	82.9	83.0	67.0	70.9
1981	2.77	3.48	6.93	7.42	4.12	3.65	2.89	3.58	3.17	62.3	66.7	82.8	84.5	72.5	-
1982	2.79	3.21	5.59	5.59	3.96	5.66	2.92	3.43	3.11	62.7	66.2	78.4	77.8	71.4	80.9
1983	2.54	3.01	5.79	5.86	3.37	3.55	3.02	3.14	3.10	61.5	65.4	81.1	81.5	68.2	70.5
1984	2.64	2.84	5.84	5.77	3.62	5.78	3.20	3.03	3.11	62.3	63.9	80.7	80.0	69.8	79.5
1985	2.50	2.89	5.42	5.45	5.20	4.97	2.72	3.01	2.87	61.2	64.3	78.9	78.6	79.1	77.0
1986	2.75	3.13	6.44	6.08	3.32	4.37	2.89	3.19	3.03	62.8	65.1	80.7	79.8	66.5	73.4
1987	3.00	3.20	6.36	5.96	4.69	4.70	3.10	3.26	3.16	64.2	65.6	81.2	79.6	74.8	74.8
1988	2.83	3.36	6.77	6.78	4.75	4.64	2.93	3.41	3.18	63.0	66.6	82.1	82.4	74.7	73.8
1989	2.56	2.86	5.87	5.77	4.23	5.83	2.77	2.99	2.87	62.3	64.5	80.8	81.0	73.8	82.2
1990	2.53	2.61	6.47	5.78	3.90	5.09	2.67	2.72	2.69	62.3	62.7	83.4	81.1	72.6	78.6
1991	2.42	2.54	5.82	6.23	5.15	5.09	2.57	2.79	2.65	61.6	62.7	80.6	82.2	81.7	80.0
1992	2.54	2.66	6.49	6.01	4.09	5.28	2.86	2.74	2.81	62.3	63.2	83.4	81.1	77.4	82.7
1995	2.37	2.67	6.09	5.88	3.71	4.98	2.45	2.75	2.56	61.0	63.2	81.3	81.0	70.9	81.3
1996	2.63	2.86	6.50	6.30	4.98	5.44	2.83	2.90	2.88	62.8	64.0	81.4	81.1	77.1	79.4
1997	2.57	2.82	7.95	6.11	4.82	6.90	2.63	2.84	2.71	62.3	63.6	85.7	84.0	79.4	87.0
1998	2.72	2.83	6.44	-	3.28	4.77	2.76	2.84	2.78	62.0	62.7	84.0	-	66.3	76.0
1999	3.04	2.98	7.59	-	4.20	-	3.12	2.98	3.08	63.9	63.3	86.6	-	70.9	-

Table 5.1.3.2. River age distribution (%) for all North American and European origin salmon caught at West Greenland, 1968-92 and 1995-99.

	River age							
Year	1	2	3	4	5	6	7	8
North American								
1968	0.3	19.6	40.4	21.3	16.2	2.2	0.0	0.0
1969	0.0	27.1	45.8	19.6	6.5	0.9	0.0	0.0
1970	0.0	58.1	25.6	11.6	2.3	2.3	0.0	0.0
1971	1.2	32.9	36.5	16.5	9.4	3.5	0.0	0.0
1972	0.8	31.9	51.4	10.6	3.9	1.2	0.4	0.0
1973	2.0	40.8	34.7	18.4	2.0	2.0	0.0	0.0
1974	0.9	36.0	36.6	12.0	11.7	2.6	0.3	0.0
1975	0.4	17.3	47.6	24.4	6.2	4.0	0.0	0.0
1976	0.7	42.6	30.6	14.6	10.9	0.4	0.4	0.0
1977	-	-	-	-	-	-	-	-
1978	2.7	31.9	43.0	13.6	6.0	2.0	0.9	0.0
1979	4.2	39.9	40.6	11.3	2.8	1.1	0.1	0.0
1980	5.9	36.3	32.9	16.3	7.9	0.7	0.1	0.0
1981	3.5	31.6	37.5	19.0	6.6	1.6	0.2	0.0
1982	1.4	37.7	38.3	15.9	5.8	0.7	0.0	0.2
1983	3.1	47.0	32.6	12.7	3.7	0.8	0.1	0.0
1984	4.8	51.7	28.9	9.0	4.6	0.9	0.2	0.0
1985	5.1	41.0	35.7	12.1	4.9	1.1	0.1	0.0
1986	2.0	39.9	33.4	20.0	4.0	0.7	0.0	0.0
1987	3.9	41.4	31.8	16.7	5.8	0.4	0.0	0.0
1988	5.2	31.3	30.8	20.9	10.7	1.0	0.1	0.0
1989	7.9	39.0	30.1	15.9	5.9	1.3	0.0	0.0
1990	8.8	45.3	30.7	12.1	2.4	0.5	0.1	0.0
1991	5.2	33.6	43.5	12.8	3.9	0.8	0.3	0.0
1992	6.7	36.7	34.1	19.1	3.2	0.3	0.0	0.0
1995	2.4	19.0	45.4	22.6	8.8	1.8	0.1	0.0
1996	1.7	18.7	46.0	23.8	8.8	0.8	0.1	0.0
1997	1.3	16.4	48.4	17.6	15.1	1.3	0.0	0.0
1998	4.0	35.1	37.0	16.5	6.1	1.1	0.1	0.0
1999	0.0	15.5	57.6	23.5	3.4	0.0	0.0	0.0
Mean	3.9	34.8	37.4	16.7	6.1	1.1	0.1	0.0
European								
1968	21.6	60.3	15.2	2.7	0.3	0.0	0.0	0.0
1969	0.0	83.8	16.2	0.0	0.0	0.0	0.0	0.0
1970	0.0	90.4	9.6	0.0	0.0	0.0	0.0	0.0
1971	9.3	66.5	19.9	3.1	1.2	0.0	0.0	0.0
1972	11.0	71.2	16.7	1.0	0.1	0.0	0.0	0.0
1973	26.0	58.0	14.0	2.0	0.0	0.0	0.0	0.0
1974	22.9	68.2	8.5	0.4	0.0	0.0	0.0	0.0
1975	26.0	53.4	18.2	2.5	0.0	0.0	0.0	0.0
1976	23.5	67.2	8.4	0.6	0.3	0.0	0.0	0.0
1977	-	-	-	-	-	-	-	-
1978	26.2	65.4	8.2	0.2	0.0	0.0	0.0	0.0
1979	23.6	64.8	11.0	0.6	0.0	0.0	0.0	0.0
1980	25.8	56.9	14.7	2.5	0.2	0.0	0.0	0.0
1981	15.4	67.3	15.7	1.6	0.0	0.0	0.0	0.0
1982	15.6	56.1	23.5	4.2	0.7	0.0	0.0	0.0
1983	34.7	50.2	12.3	2.4	0.3	0.1	0.1	0.0
1984	22.7	56.9	15.2	4.2	0.9	0.2	0.0	0.0
1985	20.2	61.6	14.9	2.7	0.6	0.0	0.0	0.0
1986	19.5	62.5	15.1	2.7	0.2	0.0	0.0	0.0
1987	19.2	62.5	14.8	3.3	0.3	0.0	0.0	0.0
1988	18.4	61.6	17.3	2.3	0.5	0.0	0.0	0.0
1989	18.0	61.7	17.4	2.7	0.3	0.0	0.0	0.0
1990	15.9	56.3	23.0	4.4	0.2	0.2	0.0	0.0
1991	20.9	47.4	26.3	4.2	1.2	0.0	0.0	0.0
1992	11.8	38.2	42.8	6.5	0.6	0.0	0.0	0.0
1995	14.8	67.3	17.2	0.6	0.0	0.0	0.0	0.0
1996	15.8	71.1	12.2	0.9	0.0	0.0	0.0	0.0
1997	4.1	58.1	37.8	0.0	0.0	0.0	0.0	0.0
1998	28.6	60.0	7.6	2.9	0.0	1.0	0.0	0.0
1999	24.6	68.8	6.5	0.0	0.0	0.0	0.0	0.0
Mean	20.0	61.0	16.2	2.4	0.3	0.0	0.0	0.0

Table 5.1.3.3. Sea-age composition (%) of samples from commercial catches at West Greenland, 1985-99.

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

[1] Catches for local consumption only.

Table 5.3.1. Numbers of salmon returning to home waters provided no fishing took place at Greenland. The average number of potentially returning salmon per ton caught in Greenland is also given.

Year	1993	1994	1995	1996	1997	1998	1999
Nominal catch at Greenland (tons) [1]:	89	137	83	92	58	11	19
Proportion of NA fish in catch (PropNA):	0.540	0.540	0.670	0.730	0.850	0.790	0.910
Proportion of EU fish in catch (PropEU):	0.460	0.460	0.330	0.270	0.150	0.210	0.090
Mean weight, NA fish, all sea ages (kg):	2.860	2.860	2.450	2.830	2.630	2.760	3.120
Mean weight, EU fish, all sea ages (kg):	2.740	2.740	2.750	2.900	2.840	2.840	2.980
Mean weight of all sea ages (NA+EU fish):	2.805	2.805	2.549	2.849	2.662	2.777	3.107
Proportion of 1SW fish in catch:	0.919	0.919	0.968	0.941	0.982	0.968	0.968
Catch of 1SW NA fish:	15443	23772	21972	22331	18408	3048	5364
Catch of 1SW EU fish:	13731	21137	9641	8060	3008	787	555
Natural mortality during migration:	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Additional fish if no fishery at Greenland:							
2SW fish returning to NA (numbers):	**13973**	**21510**	**19881**	**20206**	**16656**	**2758**	**4854**
2SW fish returning to EU (numbers):	**12425**	**19126**	**8724**	**7293**	**2722**	**712**	**503**

Average number of salmon potentially returning to home waters per ton caught in Greenland:	
2SW fish returning to NA (numbers per ton, average of 1993-1999):	**204**
2SW fish returning to EU (numbers per ton, average of 1993-1999):	**105**

[1]) Figures for 1993 and 1994 correspond to calculated quotas.

Table 5.6.1.1. Pre-Fishery abundance estimates, thermal habitat index for February based on sea surface temperature, lagged spawner index for North America excluding Gulf and US spawners (SNLQ), results of a jackknife cross-validation of the forecast model, and simulated forecasts.

	Pre-Fishery Abundance			Thermal Habitat	Lagged Spawners			Jackknife Cross-Validation	
Year	Low	High	Mid	February	Low	High	Mid	Prediction	Residuals
1971	578,955	726,765	652,860	2,011					
1972	557,789	733,257	645,523	1,990					
1973	672,662	867,805	770,234	1,708					
1974	623,993	800,853	712,423	1,862					
1975	710,244	904,589	807,417	1,827					
1976	610,837	826,861	718,849	1,676					
1977	506,934	667,818	587,376	1,915					
1978	288,809	371,796	330,103	1,951	35,441	81,978	58,710	445,428	-115,325
1979	630,107	831,432	730,770	2,058	42,640	94,840	68,740	633,922	96,848
1980	549,070	729,402	639,236	1,823	43,222	97,219	70,221	578,884	60,352
1981	527,385	684,598	605,992	1,912	43,287	97,645	70,466	612,032	-6,040
1982	439,899	567,157	503,528	1,703	43,393	98,396	70,895	549,523	-45,995
1983	236,421	337,454	286,938	1,416	40,425	91,991	66,208	383,129	-96,191
1984	245,428	347,774	296,601	1,257	37,658	84,098	60,878	249,212	47,389
1985	399,013	539,313	469,163	1,410	39,305	83,265	61,285	305,981	163,182
1986	435,092	575,933	505,512	1,688	39,891	89,038	64,464	446,393	59,119
1987	398,157	528,089	463,123	1,627	36,298	87,453	61,875	386,708	76,415
1988	317,617	423,939	370,778	1,698	37,061	83,602	60,331	386,594	-15,816
1989	241,038	346,158	293,598	1,642	41,944	86,394	64,169	426,674	-133,076
1990	218,194	296,533	257,364	1,503	40,952	81,826	61,389	338,299	-80,935
1991	249,702	349,750	299,726	1,357	37,575	73,152	55,364	198,067	101,659
1992	143,913	216,437	180,175	1,381	35,591	71,572	53,582	178,789	1,386
1993	95,337	179,546	137,441	1,252	38,381	79,473	58,927	217,772	-80,331
1994	109,491	213,457	161,474	1,329	38,395	75,957	57,176	216,480	-55,006
1995	118,415	197,098	157,757	1,311	36,738	70,104	53,421	153,201	4,556
1996	103,507	161,955	132,731	1,470	33,488	61,737	47,612	117,062	15,669
1997	67,047	125,591	96,319	1,594	29,823	55,178	42,500	79,985	16,334
1998	56511	107212	81861	1,849	25,593	50,477	38,035	96,057	-14,196
1999				1,741	25,587	52,506	39,047	*66,663* [1]	
2000				1,634	32,077	64,932	48,505	*179,897* [1]	

1. Simulated forecast values.

Table 5.6.2.1 Results of analysis of prefishery abundance (NN1) on February thermal habitat (H2) and North American spawners (SLNQ), 1978-98.

General Linear Models Procedure

Dependent Variable: NN1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	594030885284	297015442642	44.19	0.0001
Error	18	120994384671	6721910259		
Corrected Total	20	715025269955			

	R-Square	C.V.	Root MSE	NN1 Mean
	0.830783	24.59551	81987.257	333342.38

Source	DF	Type I SS	Mean Square	F Value	Pr > F
H2	1	256959567507	256959567507	38.23	0.0001
SLNQ	1	337071317778	337071317778	50.15	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
H2	1	119215636012	119215636012	17.74	0.0005
SLNQ	1	337071317778	337071317778	50.15	0.0001

Regression statistics

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	-1095625.499	-7.05	0.0001	155393.4059
H2	330.428	4.21	0.0005	78.4614
SLNQ	15.268	7.08	0.0001	2.1561

Table 5.6.2.2 Estimate of pre-fishery abundance in 2000. forecasted by H2-SLNQ regression model of probability levels between 25 and 75%.

Cumulative Density Function %	Forecast
25	118,888
30	132,507
35	145,043
40	157,014
45	168,478
50	179,897
55	191,176
60	202,661
65	214,497
70	227,141
75	240,703

Table 5.6.3.1 Quota options (mt) for 2000 at West Greenland based on H2-SLNQ regression forecasts of fishery abundance. Proportion at West Greenland refers to the fraction of harvestable surplus allocated to the West Greenland fishery. The probability level refers to the pre-fishery abundance levels derived from the probability density function.

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
50	0	4	7	11	14	18	21	25	29	32	36
55	0	8	15	23	31	39	46	54	62	70	77
60	0	12	24	36	48	60	72	84	96	108	120
65	0	16	33	49	66	82	98	115	131	148	164
70	0	21	42	63	84	105	126	148	169	190	211
75	0	26	52	78	104	131	157	183	209	235	261

Sp. res =	170,286
Prop NA =	0.779
WT1SWNA =	2.666
WT1SWE =	2.832
ACF =	1.068

		95	96	97	98	99	SE
Prop NA	0.779	0.680	0.732	0.796	0.785	0.900	0.037
WT1SWNA	2.666	2.37	2.63	2.57	2.72	3.04	0.110
WT1SWE	2.832	2.67	2.86	2.82	2.83	2.98	0.050
ACF	1.068	1.0705	1.13	1.0508	1.0408	1.0454	0.016

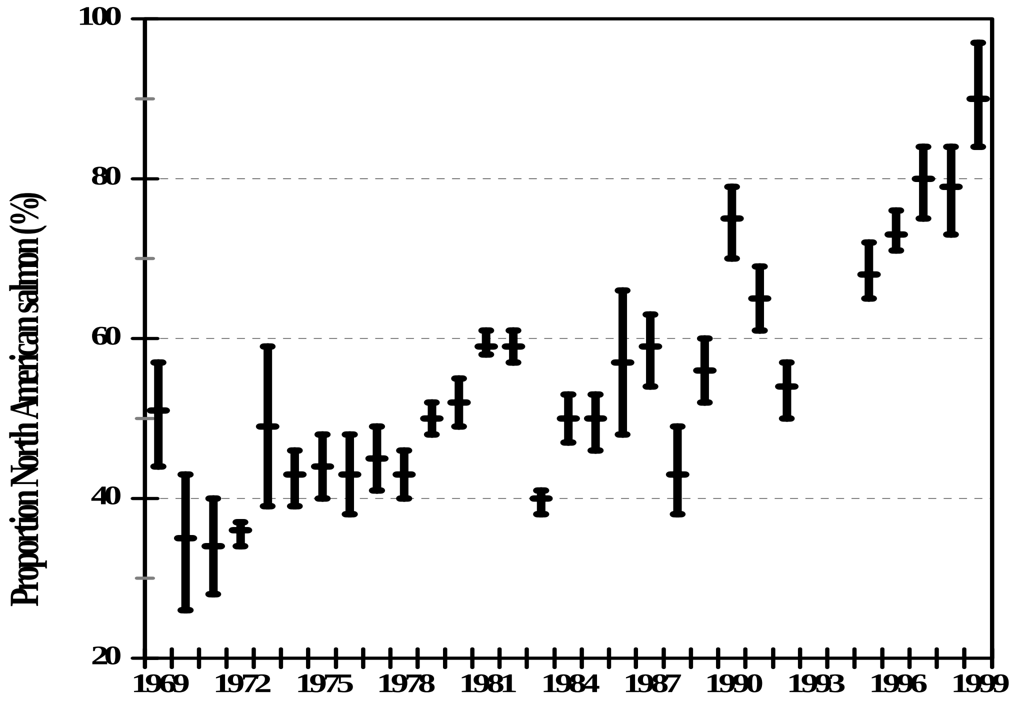


Figure 5.1.2.1. Proportion (in percent) of North American origin salmon at Greenland, 1969-99.

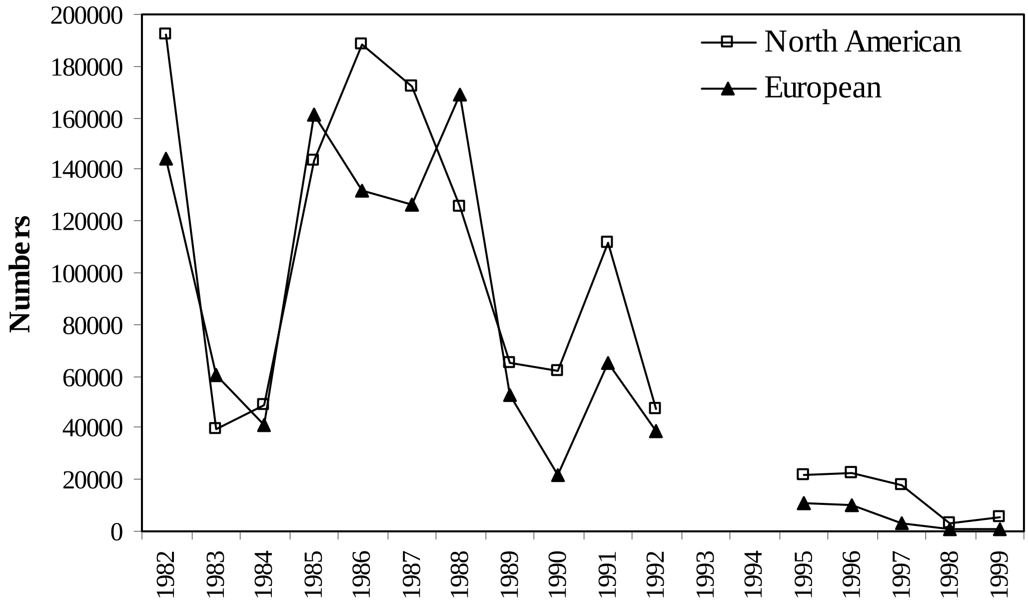


Figure 5.1.2.2. Numbers of North American and European Atlantic salmon caught at West Greenland 1982-92 and 1995-99.

Figure 5.3.1 Extant exploitation of the non-maturing component of North American salmon as 1SW salmon in North America (squares) and Greenland (circles) from the run reconstruction statistics.

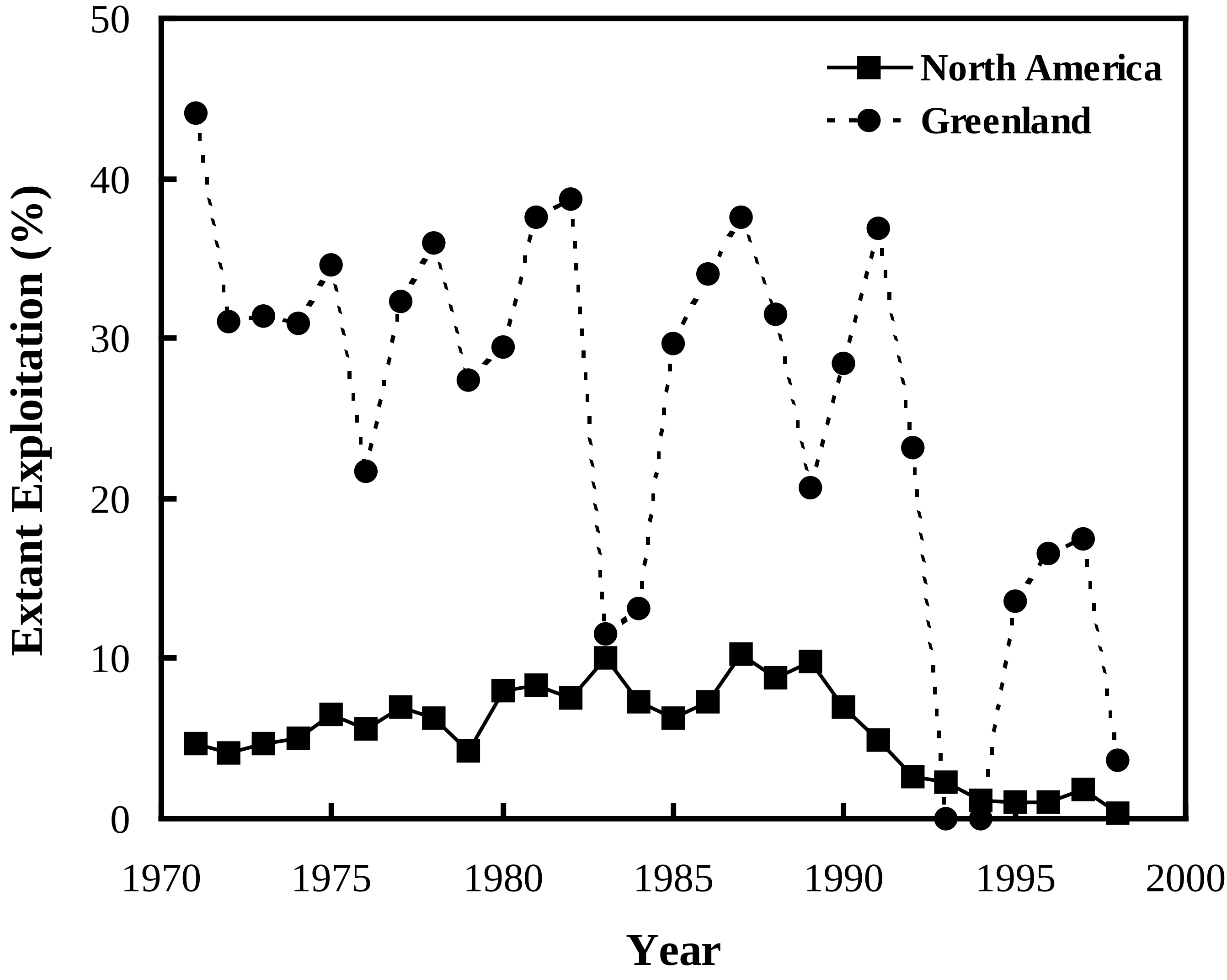


Figure 5.6.1.1 Thermal habitat index for February (H2) and lagged spawners (SLNQ).

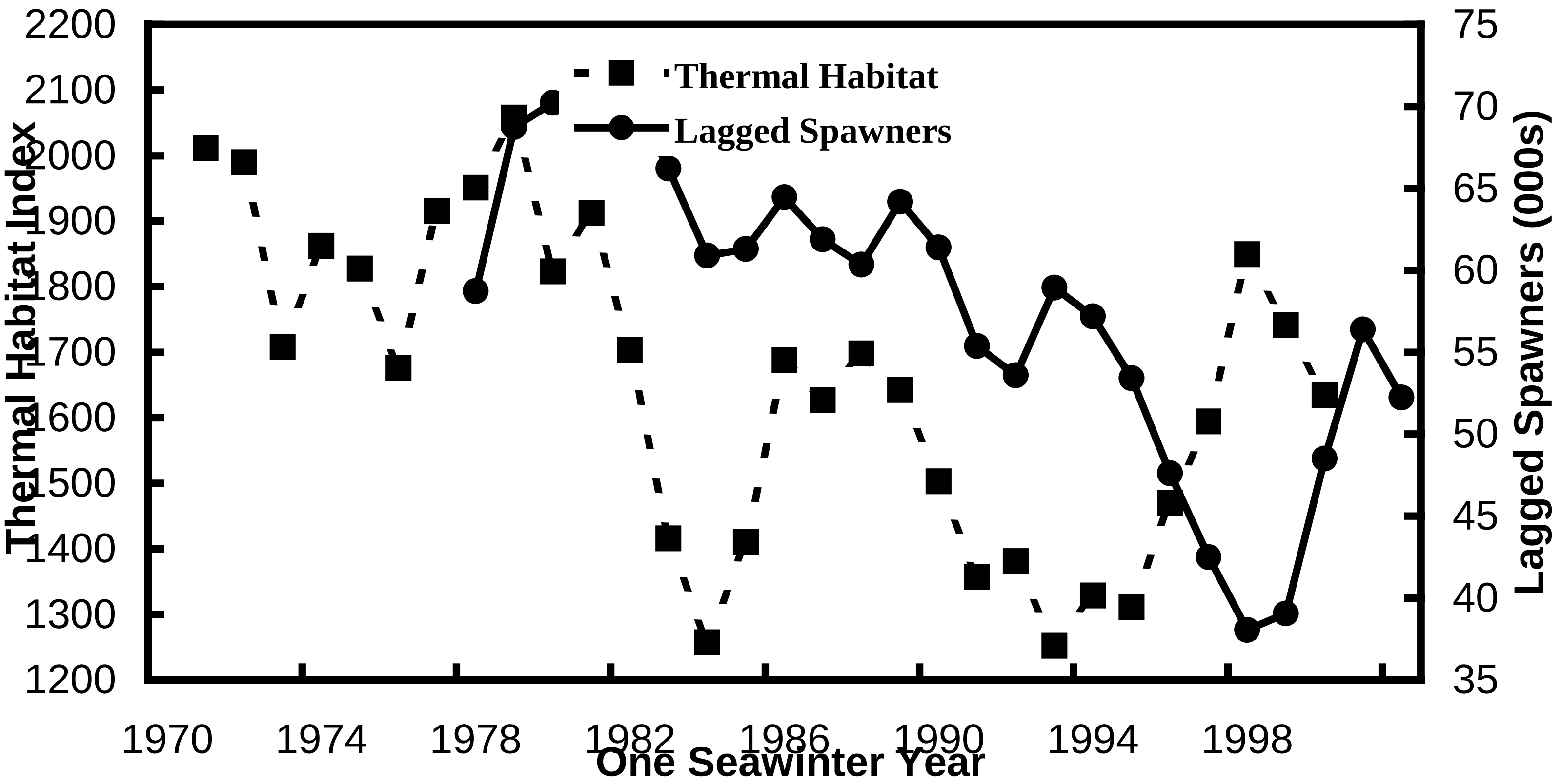


Figure 5.6.2.1 Bivariate relationships between independent variables including lagged spawners(upper panel) and thermal habitat (lower panel) used in the forecast model and pre-fishery abundance of non-maturing fish. The open symbol is the 1998 PFA estimate.

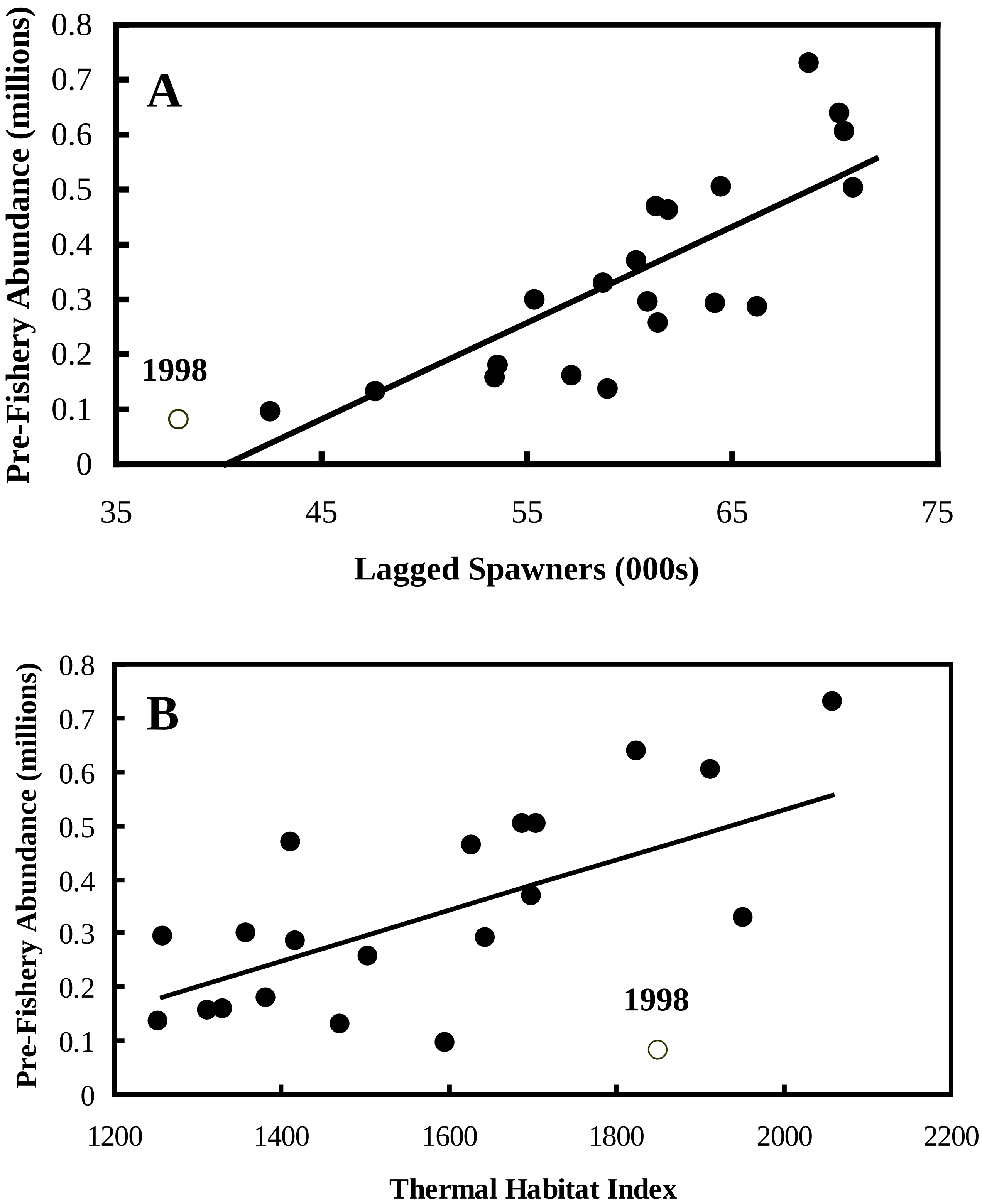


Figure 5.6.2.2 Observed estimates, jackknifed historical predictions, and deterministic forecasts (upper panel) of pre-fishery abundance. The residual pattern from the jackknifed predictions is shown in the lower panel.

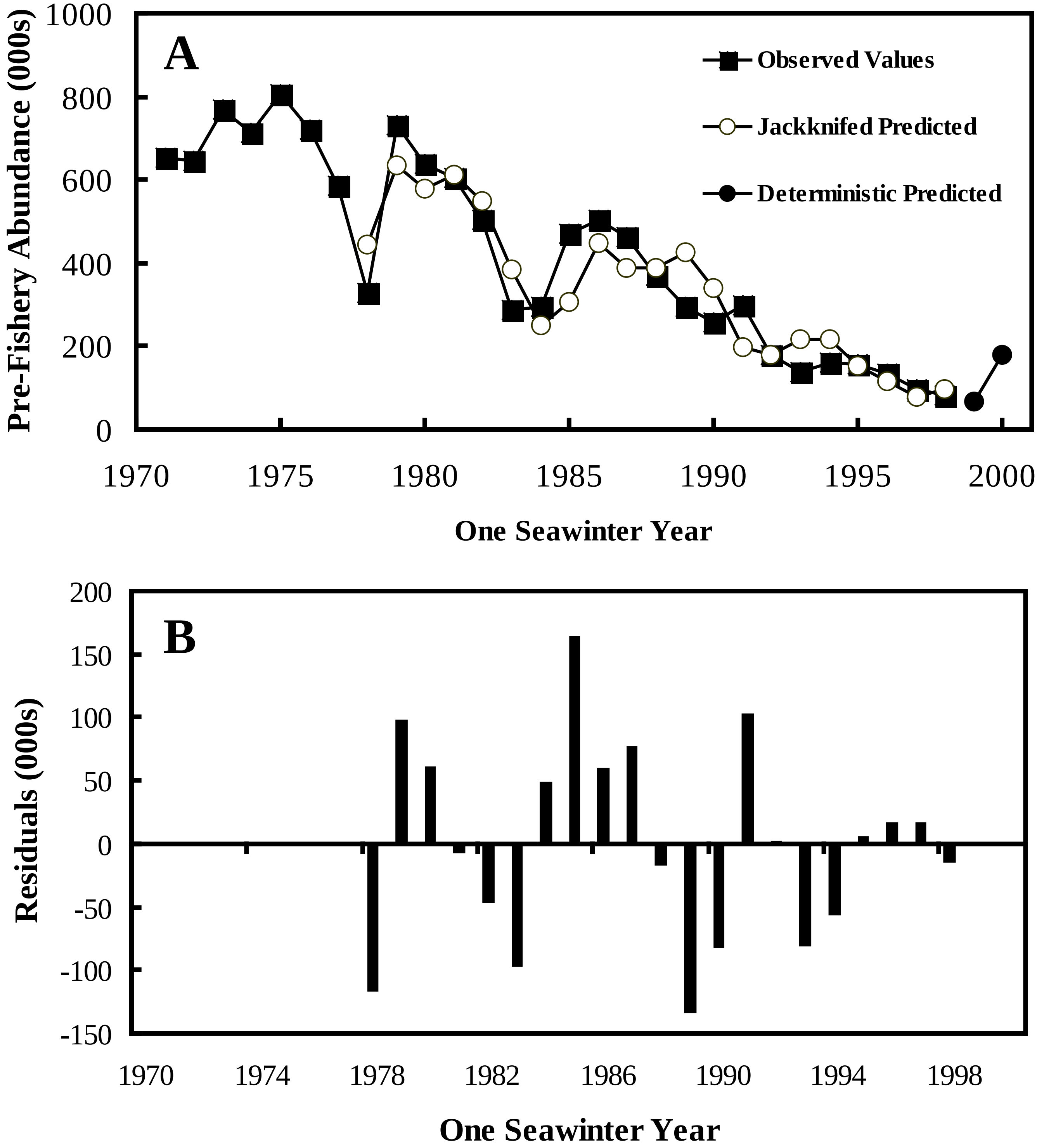
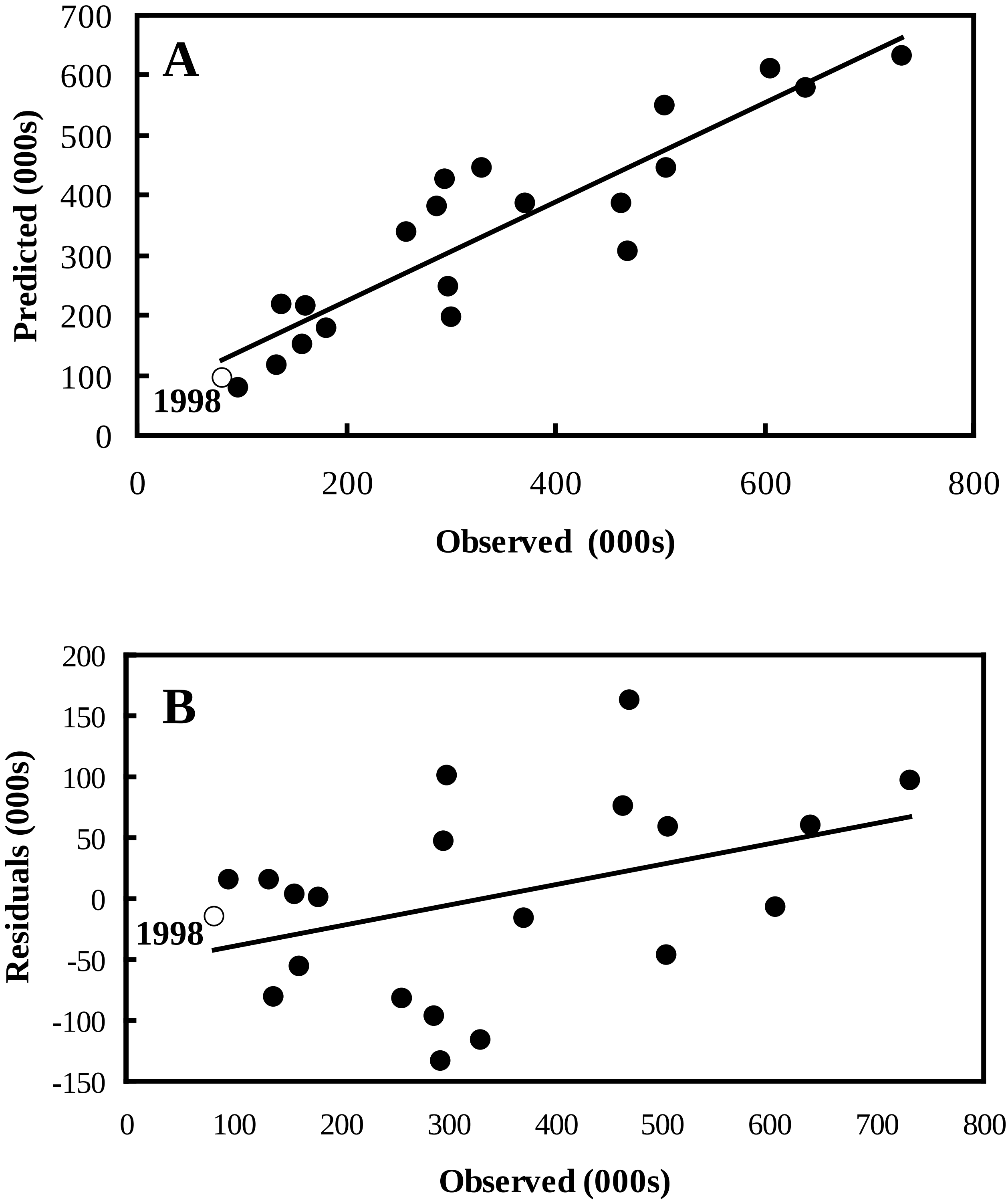


Figure 5.6.2.3 Jackknifed predictions versus observed (upper panel) and residuals versus observed (lower panel) pre-fishery abundance. 1998 values are indicated by open symbols.



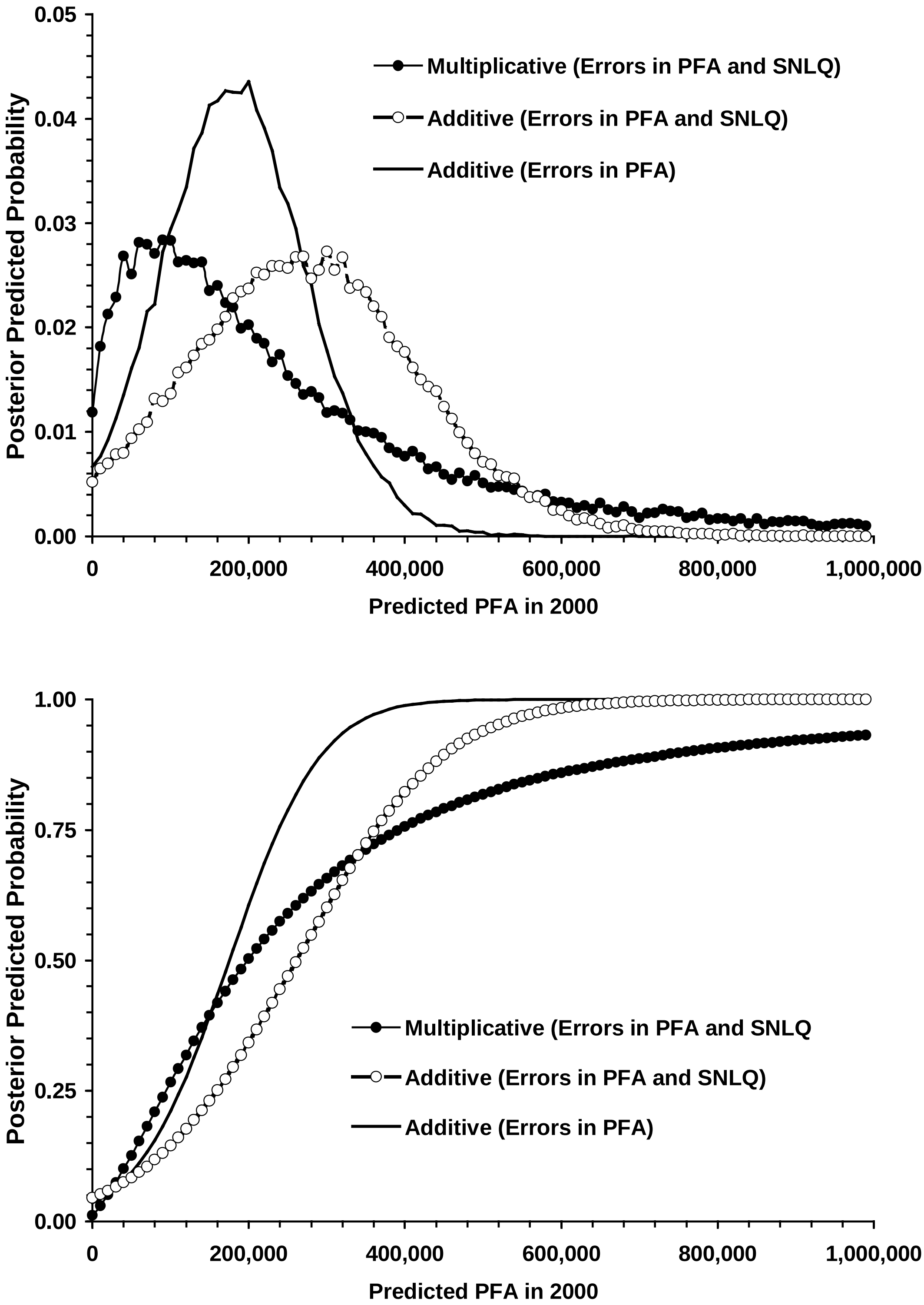


Figure 5.6.2.4. Exact (upper) and cumulative (lower) posterior predicted probability distributions of the PFA in year 2000 based on the previously employed model (Additive with errors in PFA), a similar model that incorporates errors in both PFA and lagged spawner (SNLQ) variables, and a multiplicative model of survival with errors in the PFA and SNLQ variables. The distributions were generated from 50,000 Monte Carlo simulations.

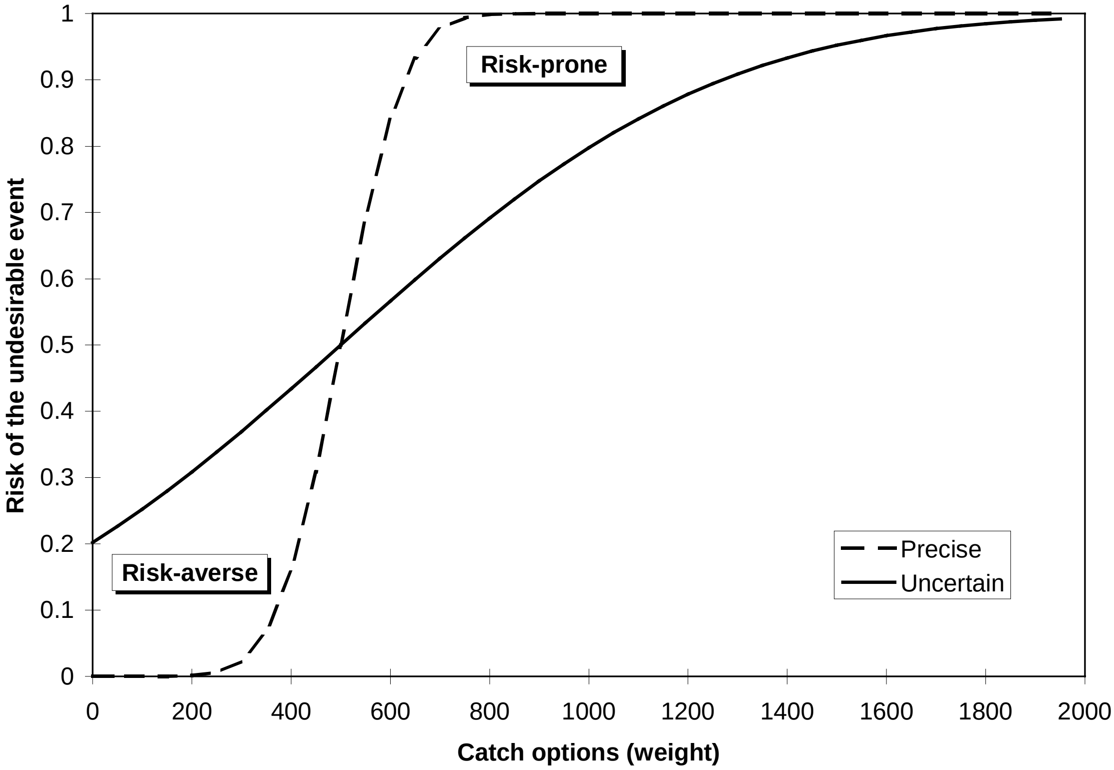
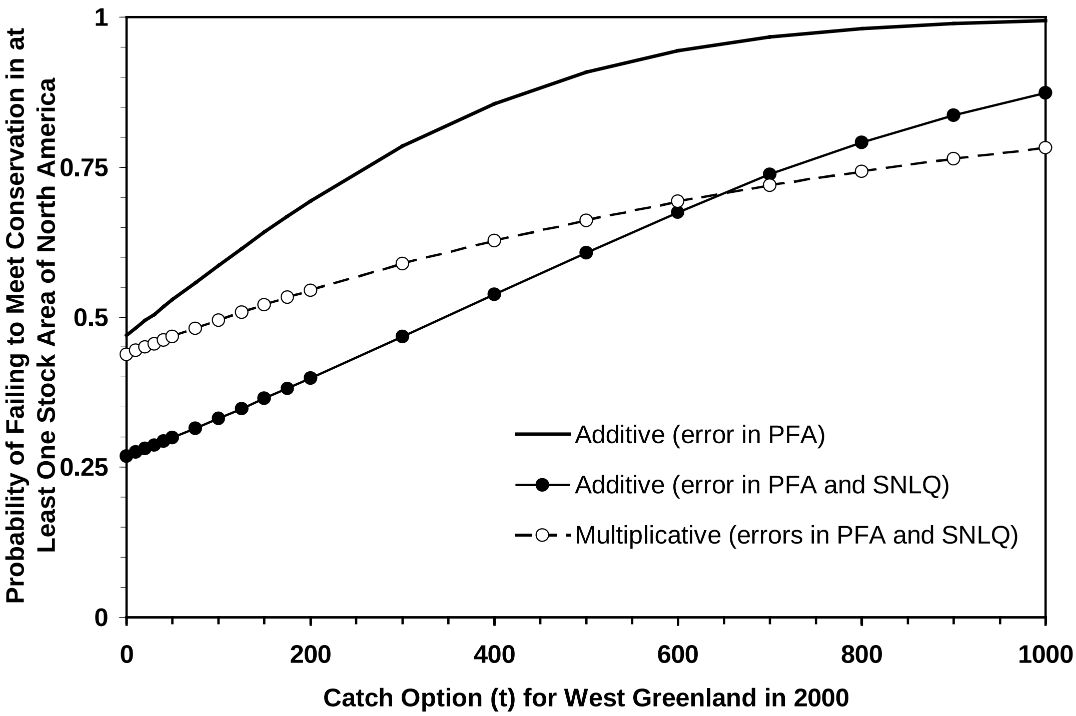


Figure 5.6.4.1. Theoretical risk analysis plots showing the risk-prone and risk-averse zones relative to the uncertainty of the stock assessment.

Figure 5.6.4.2. Risk analysis (probability of not meeting the conservation requirement in at least one of the six stock areas in North America) of catch options on the prefishery 1SW non-maturing salmon component in 2000. Risk is expressed relative to catch options at West Greenland relative to failing to meet 100% of the conservation requirement (upper panel) and the risk of severe underescapement (50% of conservation) (lower panel).



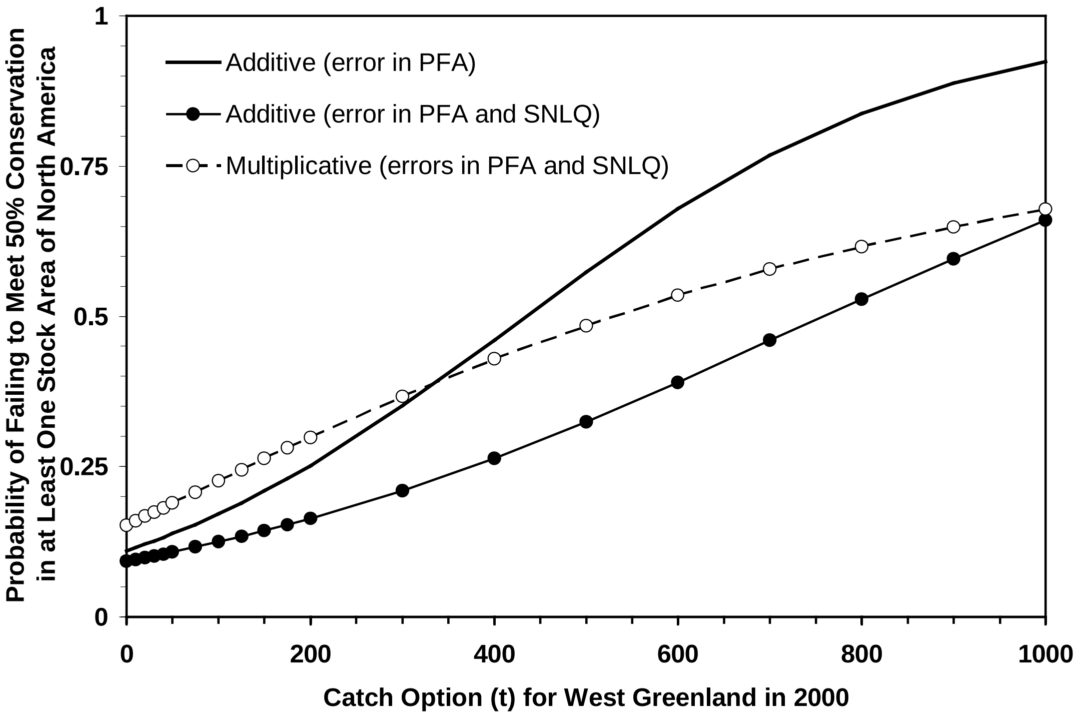
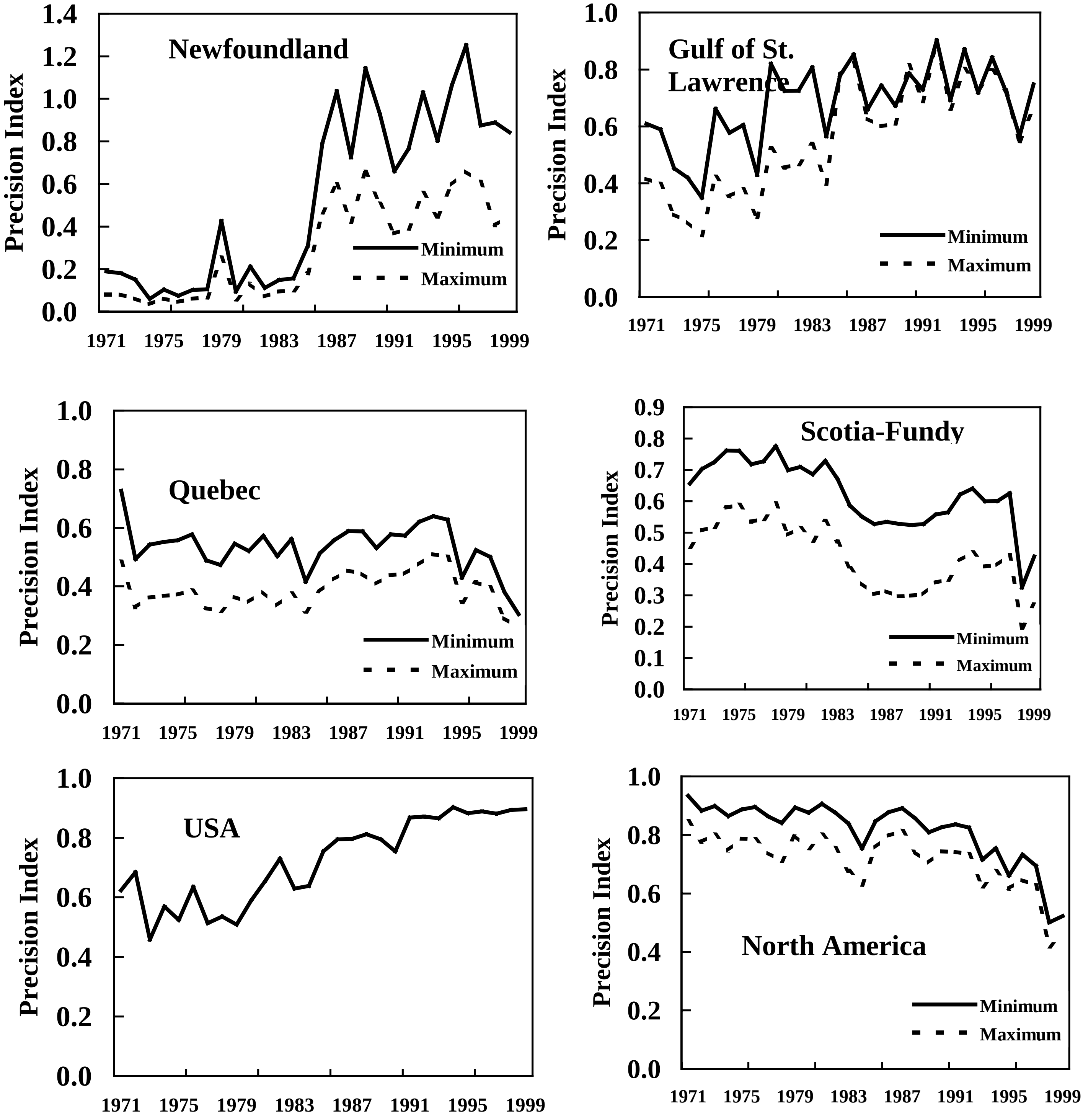


Figure 5.7.1.1 Precision indices of 2SW return estimates (documented returns or catch / total return estimate) for 5 North American regions and the weighted precision index for the North American estimate of 2SW returns.



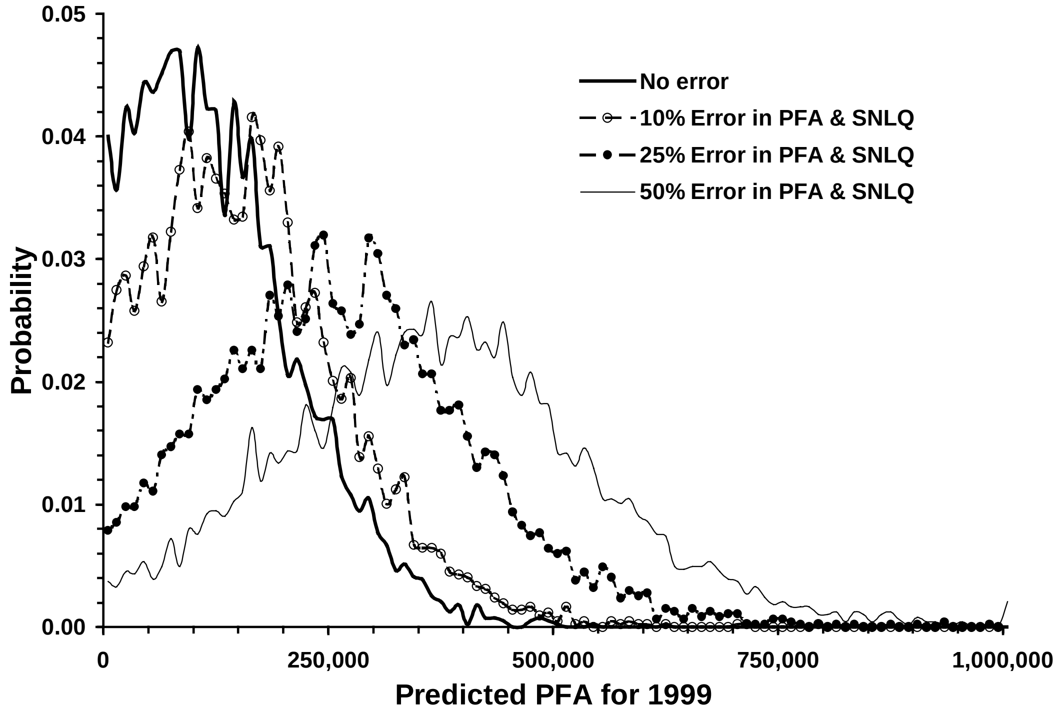


Figure 5.7.1.2. Posterior predictive distributions (5000 Monte Carlo simulations) of the 1999 PFA under varying levels of measurement errors in the PFA and lagged spawner (SNLQ) variables.

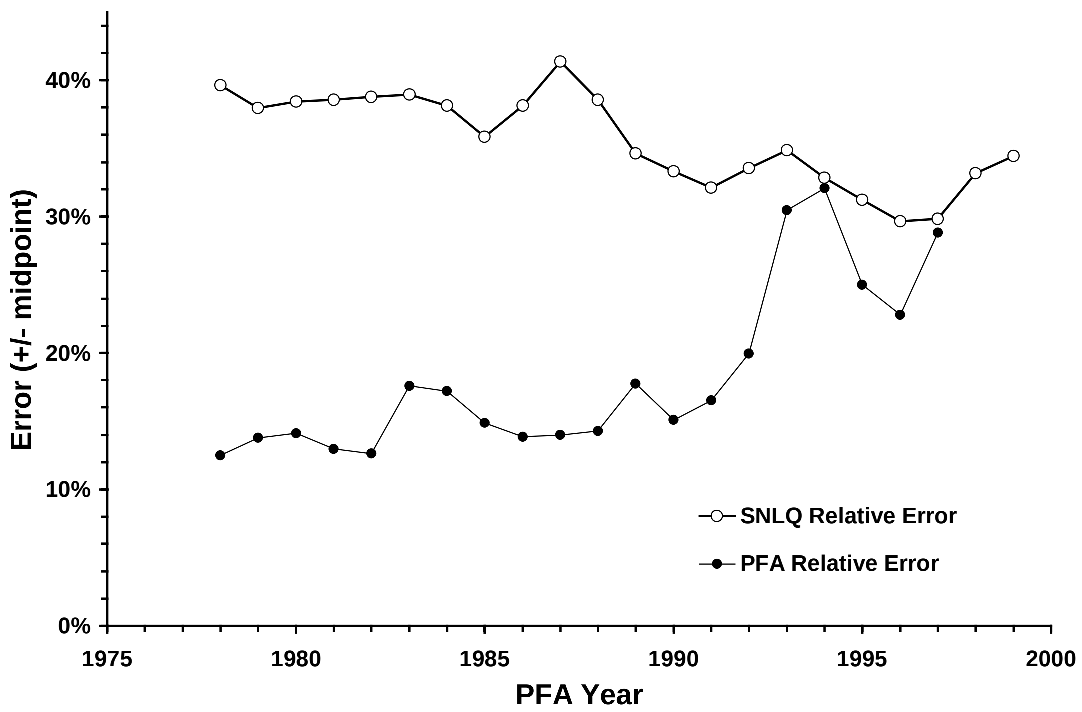


Figure 5.7.1.3. Error levels in the lagged spawner (SNLQ) and PFA data. Error levels are calculated as half the range (maximum – minimum divided by 2) relative to the midpoint.

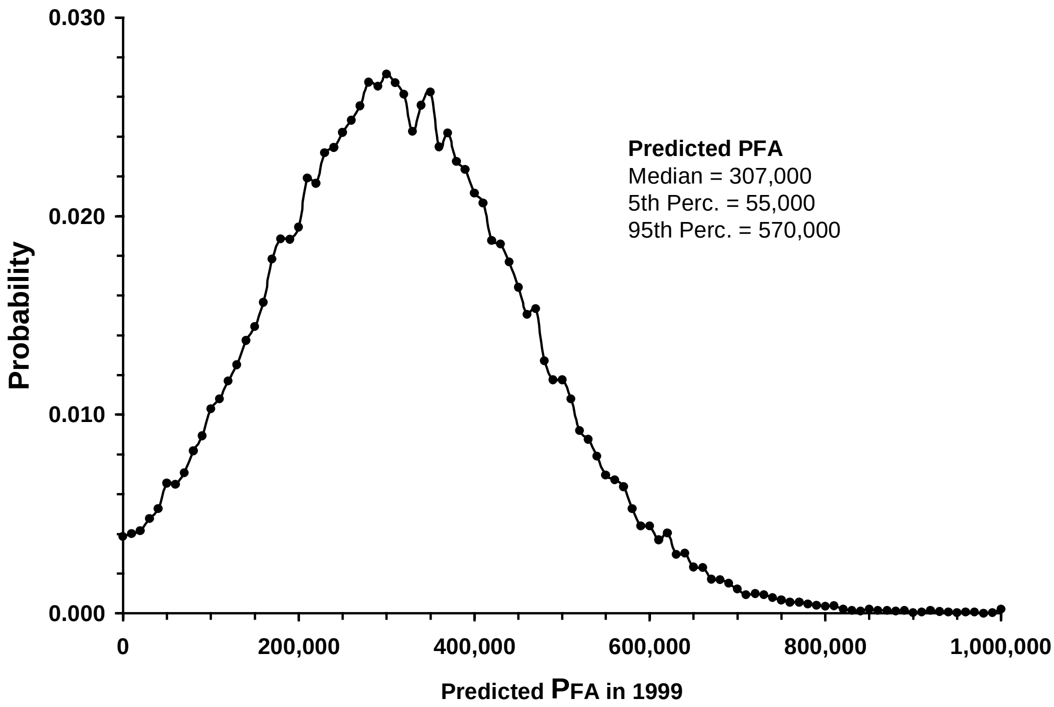


Figure 5.7.1.4. Approximate posterior predictive distribution (50000 Monte Carlo simulations) of the 1999 PFA using the annual error levels in the PFA and lagged spawner variables.

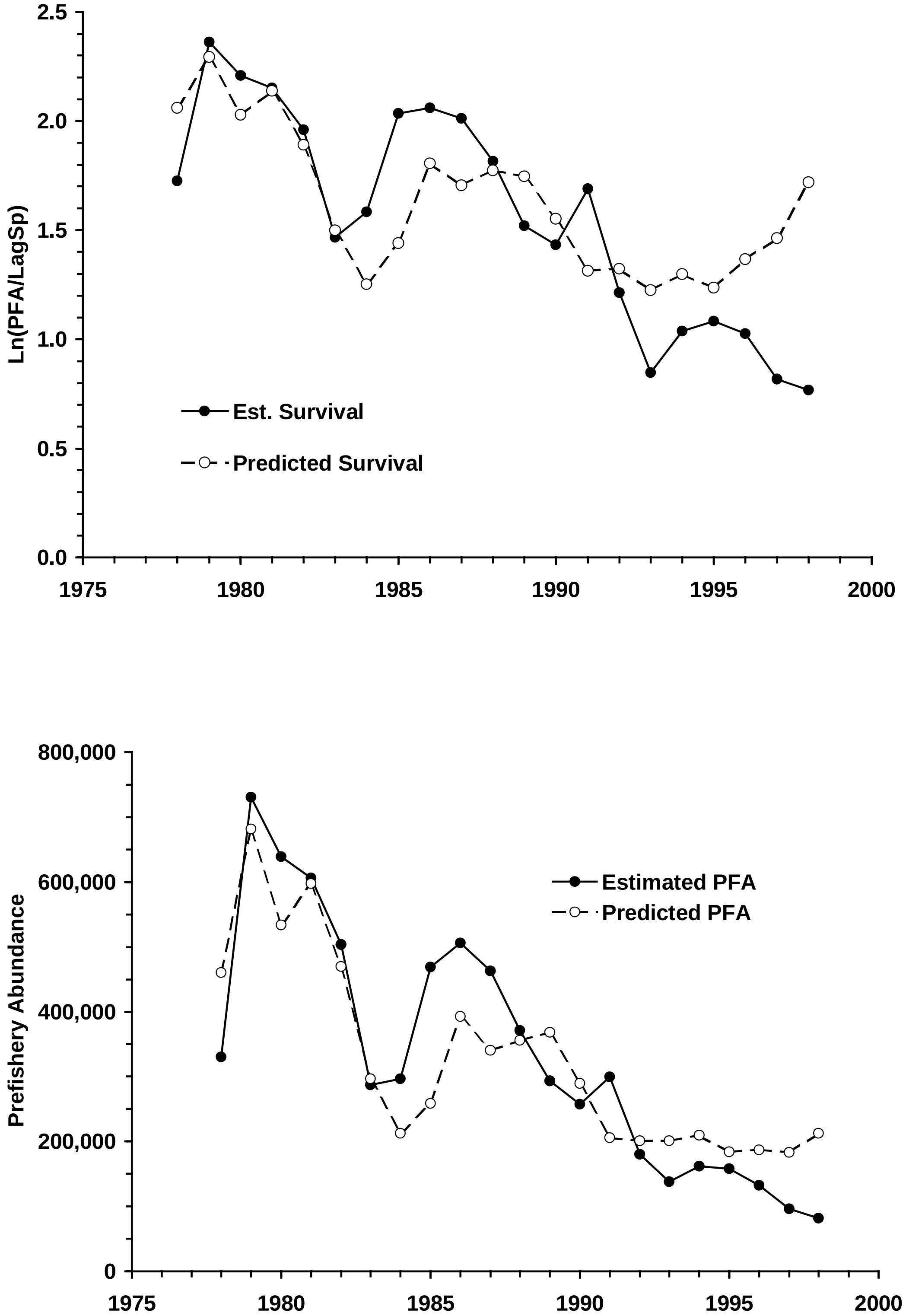
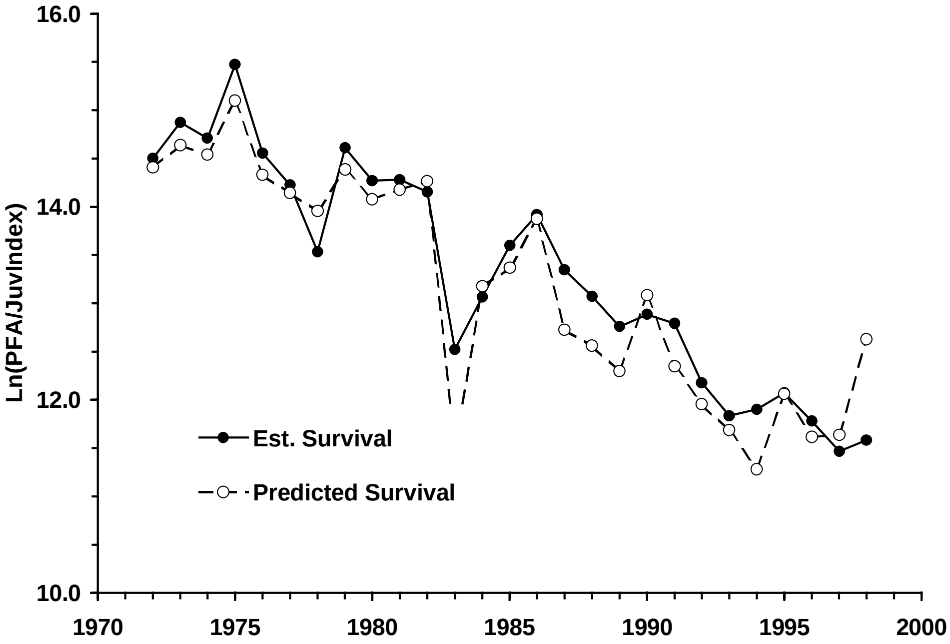


Figure 5.7.2.1. Estimated versus predicted survival (Ln(PFA/SNLQ)) (upper panel) and PFA for 1978 to 1998.



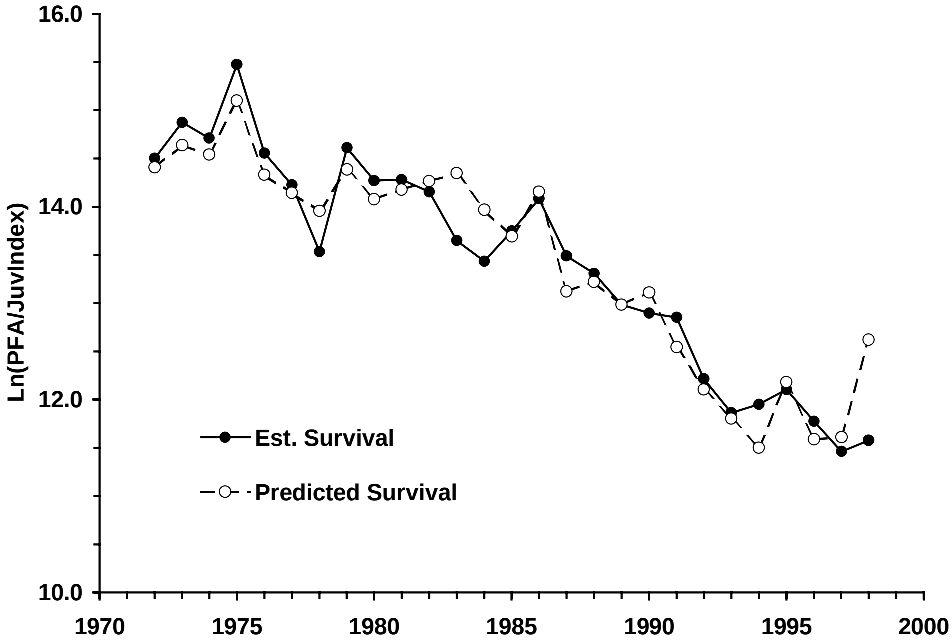
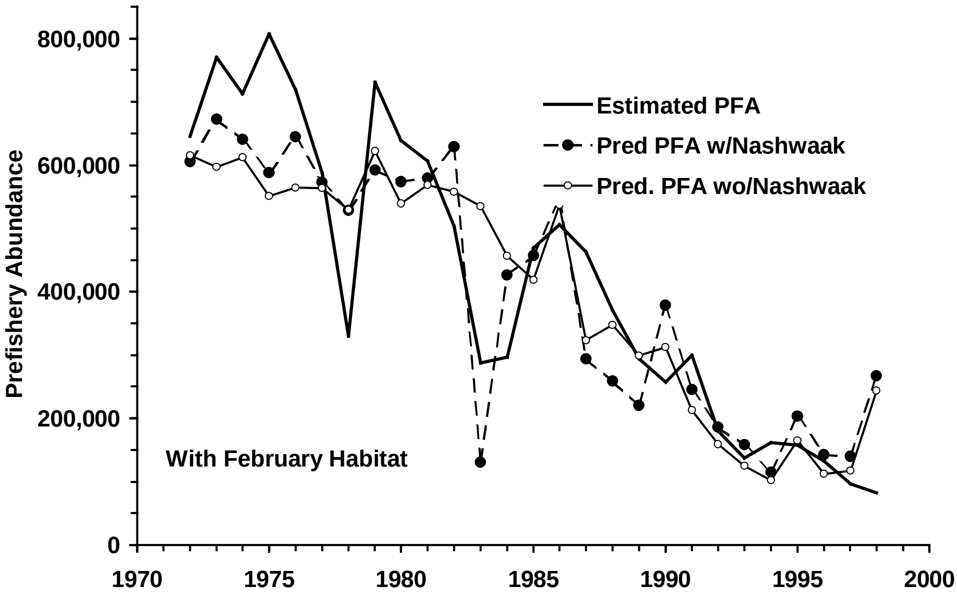


Figure 5.7.2.2. Estimated versus predicted relative Ln(PFA/JuvIndex) using a density dependent juvenile index model excluding habitat with all rivers included (upper panel) or excluding the Nashwaak River (lower panel).



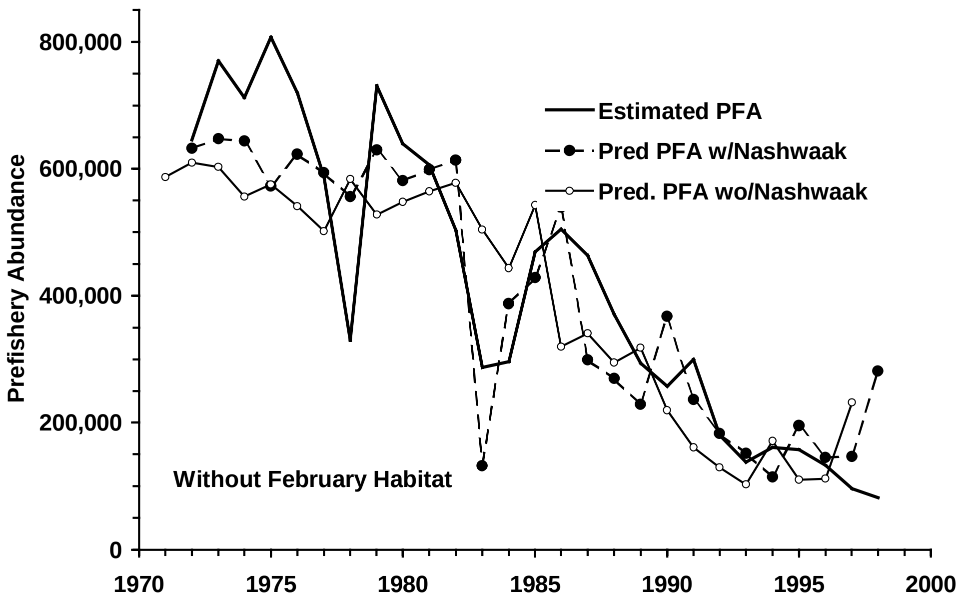


Figure 5.7.2.3. Estimated versus predicted PFA using density dependent juvenile index association with the February habitat variable included (upper panel) or excluded (lower panel).

6 RECOMMENDATIONS

6.1 General recommendations

- The Working Group recommends that it should meet in 2001 to address questions posed by ACFM, including those posed by NASCO. An informal invitation to host the meeting in Scotland in 2001 was extended to the Working Group and this should be considered. To provide catch advice for West Greenland the Working Group relies upon sea-surface temperature data, which are complete by April 4. Therefore, the Working Group should convene from the 2nd to the 12th of April 20001.
- Following examination of the relative value of the database on Egg Collections and Juvenile Releases (Section 2.8) and the time spent in updating and maintaining this database, it is recommended that consideration should be given by NASCO to reviewing the Terms of Reference of the Working Group, (Item a)v - Provide a compilation of egg collections and juvenile releases and tag releases, by country, in 1999).

6.2 Data deficiencies and research needs

<u>Recommendations from Section 2 – Atlantic salmon in the North Atlantic Area:</u>

1) Analysis of data sets from other areas and countries similar to those examined for the Mirimichi River (Canada) should consider associations between temperature and density on juvenile growth and size-at-age.
2) The Working Group would welcome analysis on a larger number of rivers and geographic areas in the context of using length or weight at age as indicators of marine conditions. The Working Group would also welcome presentations of marine environmental conditions in the context of the extent of structuring of the characteristics as it relates to salmon migration, growth and survival.
3) An expert review and evaluation by the ICES Working Group on Fish Diseases of the threat that Infectious Salmon Anaemia (ISA) poses to wild salmon populations is recommended.

<u>Recommendations from Section 3 – Fisheries and Stocks from the North East Atlantic Commission Area:</u>

1) More research into the biology of salmon in the marine phase is required. This includes the needs to monitor trends in marine mortality for a wider range of stocks than at present, and identify causes for mortality. The use of data storage tags will significantly improve the information on the marine life history of salmon.
2) Research on postsmolts in the early marine phase should be continued and expanded. This should include competitive interactions with other marine species, interaction with parasites and diseases, and by-catches of post-smolts in marine fisheries for other species. To improve the understanding of the impact of sea lice on postsmolts, ongoing studies on wild fish in the natural environment should be continued and expanded.
3) Efforts to catch postsmolts should be continued and expanded to areas not previously sampled.
4) It is recommended that a research fishery at Faroes should be resumed and that material gained during previous studies should continue to be worked-up. DNA analyses of fish sampled at Faroes should be performed to assess continent of origin.
5) The quality of data used to set conservation limits should continue to be improved, and the PFA model should continue to be developed. Efforts should be made to provide data on 1SW/MSW composition in catches and spawning stocks, to facilitate more comprehensive stock assessments.
6) Assessment methods for juvenile salmon and for freshwater habitat parameters should continue to be developed and the interaction between freshwater and marine life histories should be investigated further.

<u>Recommendations from Section 4 – Fisheries and Stocks from the North American Commission Area:</u>

1) There is a critical need to maintain and augment monitoring of salmon returns and develop habitat-based spawner requirements in Labrador, and to monitor salmon returns in the Ungava region of Québec.
2) There is a need to investigate changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and the harvest in aboriginal 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.
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.

4) Further basic research is needed on the spatial and temporal distribution of salmon in relation to Sea Surface Temperature and their predators at sea to assist in explaining variability in survival rates.

5) Return estimates for the few rivers (Annapolis, Cornwallis and Gaspareau) in SFA 22 that do contribute to distant fisheries should be developed and, when these are available, the SFA 22 spawning requirements for these rivers (476 fish) be included in the total.

6) A consistent approach to estimating returns is needed, to incorporate broodstock, if offspring from such broodstock are stocked back into the management area from which their parents originated.

7) Update the smolt age distributions of 2SW salmon in the six stock areas of north America and assess the effects of annual changes of smolt age distribution in the calculation of lagged spawners, and other measures of spawning stock variables, used in PFA forecast modelling.

Recommendations from Section 5 – Atlantic Salmon in the West Greenland Commission Area :

1) The mean weights, sea and freshwater ages and continent of origin are essential parameters to provide catch advice for the West Greenland fishery. As these parameters are known to vary over time, the Working Group recommends that the sampling programme, which occurred in 1995-99, be continued and improved to spatially and temporally cover as much of the landings as possible.

2) Efforts should be made to improve the estimates of the annual catches of salmon taken for local consumption in Greenland.

3) The Working Group recommends that other indices of change, i.e. changes in age composition, size at age and sea survival, should also be included in the evaluation of the effects on European and North American stocks of the West Greenlandic management measures since 1993.

4) The catch options for the West Greenland fishery are based almost entirely upon data taken from North American stocks (with the current exclusion of Labrador, see Section 4.6). In view of the evidence of a long-term decline in the European stock components contributing to this fishery (southern European non-maturing 1SW recruits) the Working Group emphasised the need for information from these stocks to be incorporated into the assessments as soon as possible.

5) The bootstrapping approach to improve confidence intervals for the pre-fishery abundance forecast error estimates shows promise, and should be explored further.

6) The Working Group recommends that an evaluation be conducted on the present reliability of the PFA estimate. An initial approach is to determine what fraction of the PFA estimate is directly based on catches and assessed returns (hard data), and what fraction results from less certain information such as scaling factors for potential productive habitat.

7) It is recommended that the extent of the measurement error inherent in the run-reconstruction model should be estimated to describe the potential bias in the model and the description of uncertainty associated with the forecast.

8) The inclusion of measurement error in the forecast model increases the uncertainty of the forecast, and under increased uncertainty alternative risk levels to the 50 % point should be considered, consistent with the precautionary approach.

9) Other indices of adult salmon abundance should be examined and used as prior information to constrain the plausible range of abundance levels.

10) Alternative models should be explored (for example different predictive variables, model formulations, univariate time series, non-parametric change-of-state analyses) to provide some index of plausibility of the quantitative forecasts.

11) There is a requirement to further investigate the cause of the observed change in proportion of maturing 1SW salmon over the later years and of the decline in recruits over the last ten years.

APPENDIX 1

Working Documents Submitted to the Working Group on North Atlantic Salmon, 2000

Doc. No. 1 Ó Maoiléidigh, N., A. Cullen, T. McDermott, N. Bond, D. McLaughlin, and G. Rogan. National report for the Republic of Ireland.

Doc. No. 2 Meerburg, D. Catch, catch-and-released and unreported catch estimates for Atlantic Salmon in Canada, 1999.

Doc. No.3 Cairns, D. Approaches and methods for the scientific evaluation of the marine bird and mammal predation on Atlantic salmon in the Northwest Atlantic.

Doc. No.4 Reddin, D.G., P.B. Short, R. Brown, T. King and P. Kanneworff. Identification and characteristics of North American and European Atlantic Salmon (Salmon salar L.) caught at west Greenland in 1999.

Doc. No. 5 Dempson, J.B., M.F. O'Connell, D.G. Reddin, T.R. Porter, C. Bourgeois and C.C. Mullins. Newfoundland & Labrador Atlantic Salmon stock status for 1999.

Doc. No.6 Reddin, D.G. Return and spawner estimates Atlantic Salmon for insular Newfoundland.

Doc. No.7 Marshall, T. L. Updated estimates of returns and spawners to Salmon Fishing Area (SFA) 18, Gulf of St. Lawrence and SFAs 19-21 and 23, Scotia-Fundy, Canada, 1970-1999.

Doc. No.8 Anon. Salmon stocks and fisheries in England and Wales, 1999. Report prepared by CEFAS and the EA, UK.

Doc. No.9 Kanneworff, P. The salmon fishery in Greenland 1999.

Doc. No.10 Hansen, L.P. , A.J. Jensen, P. Fiske and N.A. Hvidsten. Atlantic salmon; national report for Norway 1999.

Doc. No.11 Anon. Atlantic Salmon Maritime Provinces Overview for 1999. DFO, Canada.

Doc. No.12 Prusov, S.V., B.F. Prischepa, S.S. Krylova, V.P. Antonova and V.F. Bugaev. Atlantic Salmon fisheries and status of stocks in Russia – National report for 1999.

Doc. No.13 Gudbergsson, G. National Report for Iceland – The 1999 salmon season.

Doc. No.14 MacLean, J.C. and G.W. Smith. National report for UK (Scotland) – the 1999 salmon season.

Doc. No.15 Youngson, A.F., I.S. McLaren, D.W. Hay, G.W. Smith and J.C. MacLean. Recent step-wise declines in returns of early returning salmon to the Girnock and Baddoch Burns, monitored tributaries of the River Dee (UK:Scotland).

Doc. No.16 Stewart, D.C., G.W. Smith and A.F. Youngson. Retention of run-timing characteristics in salmon transferred between locations within a river catchment.

Doc. No.17 Smith. W.G., A.F. Youngson and J.C. MacLean. Run-timing, subcatchment structuring and conservation limits.

Doc. No.18 Youngson, A.F., J.C.MacLean and R.J. Fryer. Rod catch trends for early-running 2SW salmon in Scottish Rivers: recent divergence among stock components.

Doc. No.19 Baum, E.T. 1999 US Atlantic Salmon Stock and Restoration Program Report.

Doc. No.20 Caron, F. and S. Lachance. Determination of a new conservation threshold for Quebec salmon rivers and ensuing modifications of the number of reproductive adults required.

Doc. No. 21 Caron, F. 1999 Québec Atlantic Salmon Stock Status.

Doc. No.22 de la Hoz, J. Salmon fisheries and status of stocks in Spain (Asturias). National report for 1999.

Doc. No.23 Whoriskey, F.G., Jnr. Infectious Salmon Anemia (ISA) : Literature review and implications for wild salmon.

Doc. No.24 Holst, J.C., P.Jakobsen, F. Nilsen and M. Holme. Causes for post-smolt mortality in the early marine phase. The impact of salmon lice (*Lepheoptheirus salmonis*, Krøyer) on the southwest coast of Norway.

Doc. No.25 Holme, M., J.C. Holst and L.P. Hansen. Distribution of Atlantic salmon post-smolts in the NE Atlantic – 1999 surveys.

Doc. No.26 Baum, E.T. Documented aquaculture escapees in Maine Rivers.

Doc. No.27 Baum, E.T. Overview of seals as predators upon Atlantic Salmon and prevalence of seal bite marks on Penobscot River Atlantic salmon.

Doc. No.28 Crozier, W.W. Summary of salmon fisheries and status of stocks in UK (Northern Ireland) for 1999.

Doc. No.29 Porcher, J.P. Salmon fisheries and status of stocks in France: National report for 1999.

Doc. No.30 Erkinaro, J. M. Länsman, M. Julkunen and E. Niemelä. National report for Finland: salmon fishing season in 1999.

Doc. No. 31 Chaput, G. Size at age of salmon as an indicator of marine growth conditions.

Doc. No. 32 Chaput , G. Changes in juvenile salmon mean length-at-age: associations with density, temperature and implications for adult abundance.

Doc. No. 33 Jacobsen, J.A. Report of the Faroese salmon fisheries in 1999/2000

Doc. No. 34 Jacobsen, J.A. Potential by-catch of salmon post-smolts in the pelagic fisheries for mackerel and herring in the Northeast Atlantic.

Doc. No. 35 Jacobsen, J.A. Exploitation of various stock complexes in the Faroese high seas fishery.

APPENDIX 2

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APPENDIX 3

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APPENDIX 4

Eggs taken and juvenile Atlantic salmon and eggs stocked (excluding private commercial sea ranching).

Blank fields indicate data not available.

Estimated number (nearest 1,000) of eggs spawned by artificial methods from (Year) sea-run adults in autumn/winter period of Year / Year +1).

Example = eggs artificially spawned and recorded for 1997 were spawned during the fall/winter period of 1997/1998

Country / Year	Total Eggs Artificially Spawned	Eggs Stocked (rounded to nearest 1,000)			No. Fry Stocked (rounded to nearest 1,000)			No. Parr Stocked (rounded to nearest 100)				No. Smolts (rounded to nearest 100)		
		Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
Belgium														
Total	0	0	59000	59000				763400	0	0	763400	10400	0	10400
1990	0	0	15000	15000				51400	0	0	51400	500	0	500
1991	0	0	0	0				55900	0	0	55900	500	0	500
1992	0	0	25000	25000				71500	0	0	71500	700	0	700
1993	0	0	5000	5000				42000	0	0	42000	400	0	400
1994	0	0	14000	14000				57400	0	0	57400	1100	0	1100
1995	0	0	0	0				59400	0	0	59400	1800	0	1800
1996	0	0	0	0				111200	0	0	111200	900	0	900
1997	0	0	0	0				120700	0	0	120700	0	0	0
1998	0	0	0	0				193900	0	0	193900	4500	0	4500
1999														

Comments:

(1) All eggs and juveniles stocked are obtained from foreign eggs (french, irish, scottish) which are reared in hatchery in Belgium

(2) Parr stocked : parr 0+ from 50 to 100 mm, with a majority of 50 mm

Country / Year	Total Eggs Artificially Spawned	Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
Canada														
Total	37264000	2098000	925000	3023000	28673000	7948000	36621000	16152400	2125000	179100	18456500	8066500	1762300	9828700
1990	6742000	0	0	0	6752000	910000	7662000	2237500	62200	1400	2301100	803000	229600	1032600
1991	2734000	0	0	0	5687000	689000	6376000	1953400	55500	2600	2011500	802600	177900	980500
1992	2604000	0	0	0	3151000	948000	4099000	1743800	174200	2900	1920900	775600	211600	987200
1993	1088000	0	0	0	3578000	680000	4258000	1395900	157300	15700	1568900	804000	148500	952500
1994	1749000	0	0	0	2923000	930000	3853000	1269200	55900	14200	1339300	721200	156100	877300
1995	1279000	0	0	0	1183000	617000	1800000	1396700	152100	106000	1654800	796300	293000	1089300
1996	1190000	0	0	0	1963000	855000	2818000	1720200	45400	0	1765600	871500	44000	915500
1997	6996000	870000	550000	1420000	1573000	1535000	3108000	1578600	343300	25500	1947400	1061000	183900	1244900
1998	5234000	2000	160000	162000	1303000	332000	1635000	1492400	1046000	10800	2549200	639500	118400	757900
1999	7648000	1226000	215000	1441000	560000	452000	1012000	1364700	33100	0	1397800	791800	199300	991000

Comments:

(1) Total eggs artificially spawned includes some egg collections from captive sea run kelts.

(2) Eggs artificially spawned, 1990-1996, incomplete; eggs and unfed fry in 1997 are provisional.

Country / Year	Total Eggs Artificially Spawned	Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
Denmark														
Total						154600	154600	369200	2220300	0	2589500	865600	104200	969800
1990						50100	50100	10900	139900		150800	25900	0	25900
1991						7600	7600	8800	131800		140600	120300	0	120300
1992						7300	7300	9500	139700		149200	135700	0	135700
1993						5800	5800	36000	105700		141700	109300	30800	140100
1994						11800	11800	28900	178400		207300	70100	46600	116700
1995						0	0	10300	395000		405300	85200	6000	91200
1996						4000	4000	0	450700		450700	116100	0	116100
1997						0	0	0	464600		464600	106400	0	106400
1998						68000	68000	263600	212500		476100	95500	20700	116200
1999								1200	2000	0	3200	1100	100	1200

Country / Year	Total Eggs Artificially Spawned	Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
France														
Total		0	550000	550000	2041000	12233000	14274000	5674100	869100	0	6543200	1566400	134700	1701100
1990		0	0	0	334000	377000	711000	406400	100700	0	507100	44000	23500	67500
1991		0	0	0	58000	570000	628000	903400	1100	0	904500	103200	72500	175700
1992		0	0	0	113000	657000	770000	289100	111300	0	400400	114600	9400	124000
1993		0	94000	94000	352000	709000	1061000	320100	131600	0	451700	189200	13100	202300
1994		0	0	0	58000	568000	626000	342500	85900	0	428400	207200	6500	213700
1995		0	0	0	119000	2441000	2560000	468200	77700	0	545900	277100	800	277900
1996		0	0	0	310000	2416000	2726000	477900	120600	0	598500	248500	0	248500
1997		0	52000	52000	420000	2108000	2528000	264000	48000	0	312000	163700	0	163700
1998		0	150000	150000	188000	2228000	2416000	414300	40500	0	454800	150900	3300	154200

UK - (England & Wales)

Total	28059000	0	744000	744000	1701000	18198000	19899000	8044900	1944300	0	9989200	1565400	79800	1645200
1990	5025000	0	20000	20000	109000	1812000	1921000	331700	201400	0	533100	121200	0	121200
1991	5103000	0	12000	12000	373000	1561000	1934000	1186700	216600	0	1403300	126000	0	126000
1992	3587000	0	220000	220000	171000	1830000	2001000	1203300	391000	0	1594300	183000	0	183000
1993	5130000	0	0	0	172000	1248000	1420000	872000	173700	0	1045700	218700	0	218700
1994	3590000	0	48000	48000	688000	2024000	2712000	812300	199100	0	1011400	152500	0	152500
1995	3209000	0	379000	379000	139000	1386000	1525000	578900	143100	0	722000	203800	0	203800
1996	2415000	0	25000	25000	49000	7200000	7249000	1127800	143200	0	1271000	127300	0	127300
1997		0	0	0	0	277000	277000	1141000	199200	0	1340200	185400	0	185400
1998		0	2000	2000	0	173000	173000	264800	158200	0	423000	124500	0	124500
1999		0	38000	38000	0	687000	687000	526400	118800	0	645200	123000	79800	202800

Comments:

(1) Total eggs artificially spawned is estimated by backcalculating from egg and juvenile releases.

UK - (Northern Ireland)

Total	0	2655000	0	1890000	1760000	0	1760000	0	0	0	0	75000	14000	89000
1990														
1991														
1992														
1993														
1994														
1995														
1996														
1997		850000	0	85000	229000	0	229000	0	0	0	0	1000	10000	11000
1998		1745000	0	1745000	485000	0	485000	0	0	0	0	37000	2000	39000
1999		60000	0	60000	1046000	0	1046000	0	0	0	0	37000	2000	39000

UK - (Scotland)

Total		316000	2673000	2989000	10617000	4372000	14989000	0	182100	0	182100	0	31200	38200
1990														
1991														
1992														
1993														
1994														
1995														
1996														
1997		296000	263000	559000	3854000	1781000	5635000	0	59000	0	59000	0	24000	24000
1998		20000	1130000	1150000	3671000	2258000	5929000	0	123100	0	123100	0	7200	7200
1999		0	1280000	1280000	3092000	333000	3425000	0	0	0	0			7000

USA

Total	64843000	0	0	0	71965000	19918000	91883000	6279500	939800	0	7219300	9350300	137700	9488000
1990	4117000	0	0	0	1788000	1288000	3076000	799900	387300	0	1187200	1244500	33100	1277600
1991	4488000	0	0	0	2713000	1467000	4180000	948900	168900	0	1117800	1226100	88300	1314400
1992	5005000	0	0	0	2437000	2114000	4551000	918400	152400	0	1070800	1301400	8100	1309500
1993	3369000	0	0	0	5481000	1981000	7462000	825900	73200	0	899100	1099700	0	1099700
1994	3455000	0	0	0	8111000	2784000	10895000	347900	25400	0	373300	1113600	0	1113600
1995	5292000	0	0	0	9113000	2325000	11438000	493600	18300	0	511900	665000	0	665000
1996	5353000	0	0	0	7990000	3072000	11062000	562100	35400	0	597500	654300	2800	657100
1997	5662000	0	0	0	9849000	4040000	13889000	510600	30200	0	540800	666500	5400	671900
1998	4775000	0	0	0	11901000	847000	12748000	462100	42800	0	504900	690500	0	690500
1999	23327000	0	0	0	12582000	0	12582000	410100	5900	0	416000	688700	0	688700

Comments:

Summary

1990	21340000	0	35000	35000	9290000	5097100	14387100	4581800	891500	132100	5605400	2593200	1054200	3647400
1991	15857000	0	12000	12000	8940000	4981600	13921600	5593700	591900	145600	6331200	2734300	1273300	4007600
1992	13811000	0	245000	245000	6224000	6498300	12722300	5115600	986000	120500	6222100	3041000	1102300	4208900
1993	11407000	0	99000	99000	11910000	5693800	17603800	4569100	699600	340700	5609400	2897700	854000	4029100
1994	11315000	0	62000	62000	13816000	7625800	21441800	3819600	699200	165200	4684000	2639100	692000	3651300
1995	18914000	0	492000	534000	13592000	10727000	24319000	4874400	1152200	220400	6247000	2774100	655000	3762700
1996	18617000	0	211000	309000	16263000	15231000	31494000	5345700	980400	7800	6333900	3316500	985600	4647800
1997	23203000	2016000	1091000	2799000	20924000	11240000	32164000	4934200	1441200	29700	6405100	3411400	976100	4749900

Ireland

Total	41853000	0	1637000	1637000	15648000	4510000	20158000	1732900	0	0	1732900	2386200	800	2387000
1990														
1991														
1992														
1993														
1994														
1995	6751000		113000	113000	464000	3032000	3496000	488500			488500	295200		295200
1996	7322000		186000	186000	3209000	217000	3426000	307200			307200	520200		520200
1997	8189000	0	226000	226000	3588000	644000	4232000	331600	0	0	331600	500400	100	500500
1998	10591000		1112000	1112000	4159000	502000	4661000	348900			348900	460300		460300
1999	9000000	0	0	0	4228000	115000	4343000	256700	0	0	256700	610100	700	610800

Norway

Total				597000	10565000	3573000	14138000	5184800	623900	206100	6014800	0	0	1704900
1990														
1991														
1992					327000	254000	581000	745900	17100	59700	822700			65600
1993					2230000	523000	2753000	1043800	47200	75000	1166000			277400
1994					1788000	783000	2571000	909900	126400	0	1036300			320200
1995				42000	2287000	490000	2777000	975500	232000	59400	1266900			333600
1996				98000	2651000	1009000	3660000	776200	30300	7800	814300			345700
1997				457000	1282000	514000	1796000	733500	170900	4200	908600			362400
1998														
1999														

Comments

(1) 1992 data are incomplete

(2) 1990, 1991, and 1998 data are currently unavailable.

(3) In addition, 195300, 73733, 22000, and 150 Atlantic salmon of unspecified life stages were released from 1993 to 1996, respectively.

Russia

Total	25433000	0	0	0	0	0	0	482800	139700	886200	1508700	0	6450700	6450700
1990	5431000	0	0	0	0	0	0			130700	130700	0	621000	621000
1991	3492000	0	0	0	0	0	0			143000	143000	0	778800	778800
1992	2535000	0	0	0	0	0	0			57900	57900	0	773600	773600
1993	1780000	0	0	0	0	0	0			250000	250000	0	600900	600900
1994	2291000	0	0	0	0	0	0			151000	151000	0	360000	360000
1995	2183000	0	0	0	0	0	0	217000	34000	55000	306000	0	270800	270800
1996	2067000	0	0	0	0	0	0	0	40000	0	40000	0	836300	836300
1997	1676000	0	0	0	0	0	0	50800	20000	0	70800	0	669000	669000
1998	1906000	0	0	0	0	0	0	0	33000	0	33000	0	834200	834200
1999	2072000	0	0	0	0	0	0	215000	12700	98600	326300	0	706100	706100

Spain

Total	2515000							2195500	626300	0	2821800	334500	0	334500
1990	25000							539500	0	0	539500	17500	0	17500
1991	40000							426000	18000	0	444000	6100	0	6100
1992	80000							0	0	0	0	28900	0	28900
1993	40000							0	10900	0	10900	42200	0	42200
1994	230000							0	28100	0	28100	6000	0	6000
1995	200000							74000	100000	0	174000	27000	0	27000
1996	270000							0	114800	0	114800	71500	0	71500
1997	680000							85000	106000	0	191000	52800	0	52800
1998	950000							432000	107500	0	539500	33500	0	33500
1999	950000							639000	141000	0	780000	49000	0	49000

Sweden

Total		0	0	0	8000	0	8000	107500	300	0	107800	730900	945600	1676500
1990		0	0	0	0	0	0	107500	0	0	107500	77100	141600	218700
1991		0	0	0	0	0	0	0	0	0	0	17800	155800	173600
1992		0	0	0	0	0	0		300		300	73300	99600	172900
1993		0	0	0	0	0	0	0	0	0	0	71900	60700	132600
1994		0	0	0	8000		8000	0	0	0	0	63000	120800	183800
1995		0	0	0	0	0	0	0	0	0	0	88400	79400	167800
1996		0	0	0	0	0	0	0	0	0	0	61200	99000	160200

APPENDIX 5

Example of SAS program to calculate Atlantic salmon pre-fishery abundance with an estimate of precision based on empirically derived distributions of observed patterns of pre-fishery abundance.

```
FILENAME CATCH DDE 'EXCEL | Years78-99 ! R4C1:R25C14';
OPTIONS NOCENTER LINESIZE = 80;
*... DATA FOR CATCH ADVICE FOR 1999 FROM RISKVAR99.XLS ;
*<><><><><><><><><<  don't forget to update columns by one in FILENAME STATEMENT <><><>;
DATA CATCH;
   INFILE CATCH;
   INPUT YEAR NG1 NC1_L NC1_H NC2_L NC2_H NR2_L NR2_H NN1_L NN1_H NN1_M H2 GUS_L GUS_H ;
GUS_M=(GUS_L+GUS_H)/2;
PROC PRINT;
PROC REG;
  MODEL NN1_M = H2 GUS_M/P R;
DATA D2;  SET CATCH;
    SEED = 0;
DO SIM = 1 TO 1000;
 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));
 RAN_PFA = (((RAN_R2/.99005) + RAN_C2)/.90483) + RAN_C1 + NG1;
* RAN_SP  = GUS_L + ((GUS_H - GUS_L) * RANUNI(SEED));
OUTPUT;
END;
PROC SORT; BY SIM;
PROC REG NOPRINT;
 BY SIM;
 ID YEAR;
 MODEL RAN_PFA = H2 GUS_M/ P R;
 output out=predic p=pran_pfa stdi=stdi_pfa;
*<><><><><<  REMEMBER TO CHANGE THE YEAR   <><><><><><>;
data univ;
  set predic;
  if year=1999;
  do i=1 to 1000;
    new_pfa=pran_pfa+((stdi_pfa)*rannor(0));
    output;
  end;
run;

PROC UNIVARIATE  DATA = UNIV;
    VAR NEW_PFA;
    OUTPUT OUT=D4 PCTLNAME=
   MEAN=M STD=S
   PCTLPRE=PFA
       PCTLPTS=5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95;
proc print;
run;
```

APPENDIX 6

Appendix 6(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 6(ii). Estimated numbers of 2SW salmon recruits, returns and spawners for Labrador salmon stocks including west Greenland.

Year	Commercial catches of large salmon SFA 1	SFA 2	SFA 14B	Labrador 2SW Recruits,NF & Greenland SFAs 1,2 &14B Min	Max	Labrador at Greenland	Labrador salmon Total+NF+WG Min	Max	Labrador 2SW to rivers SFAs 1,2 &14B Min	Max	Labrador 2SW spawners SFAs 1,2 &14B Angling catch subtracted 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 6(iii). Atlantic salmon returns to freshwater, total recruits prior to the commercial fishery and spawners summed for Salmon Fishing Area 3-14A, insular Newfoundland, 1969-1999.
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	
Year	Retained	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Min	Max	Min	Max
1969	34944	108807	217349	217613	724497	73863	182405	10484	26767	34946	267666	2310	8174	24457	2245	9324
1970	30437	139570	279594	279139	931980	109133	249157	12627	30508	42091	305081	2138	10490	28371	3184	11851
1971	26666	112266	224994	224532	749980	85600	198328	9857	24146	32856	241462	1602	8255	22544	2385	9104
1972	24402	108509	217092	217018	723640	84107	192690	10046	23996	33485	239955	1380	8666	22616	2494	9129
1973	35482	143729	287832	287457	959438	108247	252350	13292	33061	44308	330613	1923	11369	31138	2995	11808
1974	26485	84667	169103	169335	563676	58182	142618	10821	21662	36069	216616	1213	9608	20449	1968	6702
1975	33390	111847	223890	223694	746300	78457	190500	12222	24478	40741	244782	1241	10981	23237	2382	8002
1976	34463	114787	229853	229573	766175	80324	195390	10756	21550	35855	215501	1051	9705	20499	2327	7663
1977	34352	109649	219106	219299	730354	75297	184754	9750	19493	32499	194933	2755	6995	16738	1880	6309
1978	28619	97070	194133	194141	647109	68451	165514	7873	15786	26243	157860	1563	6310	14223	2005	6419
1979	31169	106791	213327	213582	711091	75622	182158	5549	11113	18496	111128	561	4988	10552	1103	3691
1980	35849	120355	240449	240709	801497	84506	204600	9325	18691	31084	186909	1922	7403	16769	2447	7794
1981	46670	156541	312697	313083	1042325	109871	266027	9553	19144	31845	191442	1369	8184	17775	2317	7475
1982	41871	139951	279115	279902	930383	98080	237244	9528	19097	31758	190971	1248	8280	17849	2975	9228
1983	32420	109378	218548	218756	728495	76958	186128	8911	17871	29703	178711	1382	7529	16489	2511	7915
1984	39331	129235	257256	258469	857521	89904	217925	8007	15995	26691	159955	511	7496	15484	2273	7117
1985	36552	120816	240985	241633	803283	84264	204433	3612	7680	12041	76800	0	3581	7649	961	3319
1986	37496	124547	248688	249094	828961	87051	211192	6850	14103	22832	141030	0	6770	14023	1592	5402
1987	24482	125116	249856	250232	832852	100634	225374	6357	13068	21190	130684	0	6316	13027	1338	4629
1988	39841	132059	263363	264119	877877	92218	223522	6369	13330	21231	133299	0	6309	13270	1553	5346
1989	18462	59793	119261	119587	397537	41331	100799	3260	6752	10865	67518	0	3241	6733	704	2452
1990	29967	98830	197276	197659	657588	68863	167309	5751	11868	19170	118675	0	5701	11817	1341	4562
1991	20529	64016	127698	128032	425661	43487	107169	4449	9173	14831	91734	0	4416	9140	1057	3577
1992	23118	116116	231954	116116	231954	92434	208272	15797	31897	15797	31897	0	15656	31756	3024	10354
1993	24693	131045	261721	131045	261721	104712	235387	7955	16227	7955	16227	0	7791	16063	1487	5217
1994	28959	95487	190655	95487	190655	65691	160859	7915	16099	7915	16099	0	7709	15894	1889	6255
1995	29055	111889	223758	111889	223758	81877	193746	8972	18182	8972	18182	0	8753	17963	2296	7462
1996	36583	140217	285387	140217	285387	101773	246943	11752	24288	11752	24288	0	11488	24024	2569	8887
1997	17388	86230	146833	86230	146833	67297	127900	12105	20938	12105	20938	0	11771	20605	2841	7226
1998	19672	89680	282369	89680	282369	67860	260550	15112	41043	15112	41043	0	14752	40683	3792	14757
1999	14937	143029	302412	119151	339574	103300	323723	16310	46536	16310	46536	0	16027	46253	3470	13668

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 12-14A & 0.1-0.2 for SFAs 3-11.
2SW-S (2SW spawners) = LS * proportion 2SW of 0.4-0.6 for SFAs 12-14A & 0.1-0.2 for SFAs 3-11.
2SW-R (2SW recruits) = LR * proportion 2SW of 0.4-0.6 for SFAs 12-14A& 0.1-0.2 for SFAs 3-11.

Appendix 6(iv). Small, large and 2SW return and spawner estimates for SFA 15.

Year	Small salmon				Large salmon				Proportion of 2SW in large salmon	**2SW salmon**			
	Returns		Spawners		Returns		Spawners			Returns		Spawners	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		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

Return and spawner estimates for SFA 15 are based on Restigouche River data, scaled up for SFA 15 using angling data.
Restigouche stock assessment is based on angling catch with assumed exploitation rates between 50% (min.) and 30% (max).
The proportion of 2SW in large salmon numbers is based on aged scale samples from angling, trapnets, and broodstock.
No scale samples were available for 1970-71, 1995-96: the mean value of 0.65 is used here.
Salmon in the Quebec portions of the Restigouche River were subtracted from the total for the watershed.
The returns and spawners estimates thus derived for the SFA 15 portion of the Restigouche were then multiplied by the minumum (1.117) and maximum (1.465) ratios of angling catch in SFA15:SFA 15 portion of Restigouche catch to obtain estimates for SFA 15.

Appendix 6(v)a. Returns and escapements of large salmon to SFA 16

	Returns to the Miramichi River									
						Prop.			Returns of large	
	2SW returns to SFA 16		Large	0.8	1.33	2SW W	Returns to Miramichi		salmon to SFA 16	
Year	Min.	Max.	returns	Min.	Max.		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	15474	25725	28574	22859	38003	0.616	14081	23410	25120	41762
1991	15929	26482	29949	23959	39832	0.605	14495	24098	26329	43772
1992	19191	31905	37000	29600	49210	0.590	17464	29034	32527	54077
1993	21662	36012	35200	28160	46816	0.7	19712	32771	30945	51446
1994	14582	37515	27450	18278	47023	0.726	13270	34139	20086	51674
1995	18879	48135	32627	19747	50348	0.87	17180	43803	21700	55327
1996	13034	24328	24812	17443	32557	0.68	11861	22139	19168	35777
1997	10957	20049	18422	14183	25953	0.703	9971	18245	15586	28520
1998	4129	6882	9500	7500	12500	0.501	3758	6263	8242	13736
1999	7878	13179	13600	10700	17900	0.67	7169	11993	11758	19670

Returns to the Miramichi are from the assessment. Min. and max values are based on capture efficiencies of Millbank trapnet which gave a lower CI of -20% of estimate and upper CI of 33% of estimate.
For 1992 and 1993, lower and upper CI are based on estimate bounds of -18.5% to +18.5%.
For 1994 to 1999, min and max are 5th and 95th percentiles from the assessment.
Prop. 2SW are from scale ageing.

Miramichi makes up 91% of total rearing area of SFA 16.
Returns to SFA 16 are Miramichi returns / 0.91 or (Min., Max.) 2SW returns to Miramichi / 0.91

Appendix 6(v)b. Returns and escapements of large salmon to SFA 16
Same procedure for escapements as used to calculate returns.

			Escapements to the Miramichi River						Escapement of large salmon to SFA 16	
	Escapement of 2SW to SFA 16			0.8	1.33	Prop.	Escapement of 2SW			
Year	Min	Max	Large	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	0.95	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	0.87	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	14940	24838	27588	22070	36692	0.616	13595	22602	24253	40321
1991	15472	25721	29089	23271	38688	0.605	14079	23406	25573	42515
1992	18984	27603	35927	29281	42573	0.590	17275	25118	32176	46784
1993	21755	31632	34702	28282	41122	0.7	19797	28785	31079	45189
1994	14207	37140	27147	17808	46553	0.726	12929	33797	19569	51157
1995	18345	47600	32093	19188	49789	0.87	16694	43316	21086	54713
1996	12510	23804	23478	16741	31855	0.68	11384	21661	18397	35005
1997	10319	19411	17596	13357	25127	0.703	9390	17664	14678	27612
1998	3923	6725	9000	7000	12000	0.51	3570	6120	7692	13187
1999	7270	12571	12774	9874	17074	0.67	6616	11440	10851	18763

Appendix 6(v)c. Returns and escapements of small salmon to SFA 16.

			Returns to the Miramichi River			Prop. 1SW Returns to Miramichi		
	1SW returns to SFA 16			0.8	1.33	1SW	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	71160	121962	83448	66758	110986		64756	110986
1991	51906	88962	60869	48695	80956		47234	80956
1992	132610	198777	152647	124407	180887		120675	180887
1993	80271	120323	92400	75306	109494		73047	109494
1994	44288	92257	56929	41549	83954		40303	83954
1995	20998	85127	54145	19699	77466		19108	77466
1996	40133	73318	44377	37651	66719		36521	66719
1997	18980	33143	22565	17806	30160		17272	30160
1998	29313	45055	33000	27500	41000		26675	41000
1999	20999	30000	23000	19700	27300		19109	27300

Returns to the Miramichi are from the assessment. Min. and max values are based on capture efficiencies of Millbank trapnet which gave a lower CI of -20% of estimate and upper CI of 33% of estimate.
For 1992 and 1993, lower and upper CI are based on estimate bounds of -18.5% to +18.5%.
For 1994 to 1999, min and max are 5th and 95th percentiles from the assessment.
Prop. 1SW are from scale ageing. Proportions vary from 0.97 to 1.00. Ref. Moore et al. 1995.

Miramichi makes up 91% of total rearing area of SFA 16.
Returns to SFA 16 are Miramichi returns / 0.91 or (Min., Max.) 1SW returns to Miramichi / 0.91

Appendix 6(v)d. Returns and escapements of small salmon to SFA 16.
Same procedure for escapements as used to calculate returns.

			Escapements to the Miramichi River				Escapement of 1SW	
Escapement of 1SW to SFA 16				0.8	1.33	Prop.	Min	Max
Year	Min	Max	Small	Min.	Max.	1SW	0.97	1
1971	18714	32075	21946	17557	29188		17030	29188
1972	23139	39659	27135	21708	36090		21057	36090
1973	26169	44852	30688	24550	40815		23814	40815
1974	47060	80656	55186	44149	73397		42824	73397
1975	41332	70839	48469	38775	64464		37612	64464
1976	53194	91171	62380	49904	82965		48407	82965
1977	11296	19361	13247	10598	17619		10280	17619
1978	12239	20977	14353	11482	19089		11138	19089
1979	26306	45086	30848	24678	41028		23938	41028
1980	22934	39307	26894	21515	35769		20870	35769
1981	34049	58358	39929	31943	53106		30985	53106
1982	47754	81846	56000	44800	74480		43456	74480
1983	12662	21702	14849	11879	19749		11523	19749
1984	16142	27665	18929	15143	25176		14689	25176
1985	35658	61114	41815	33452	55614		32448	55614
1986	76234	130659	89398	71518	118899		69373	118899
1987	53533	91751	62777	50222	83493		48715	83493
1988	76984	131945	90278	72222	120070		70056	120070
1989	41260	70717	48385	38708	64352		37547	64352
1990	50759	86997	59524	47619	79167		46191	79167
1991	41161	70547	48269	38615	64198		37457	64198
1992	112317	168359	129288	105370	153206		102209	153206
1993	66385	99509	76416	62279	90553		60411	90553
1994	27829	75289	42479	26108	68513		25325	68513
1995	13079	53561	34084	12270	48740		11902	48740
1996	19278	51818	24812	18086	47154		17543	47154
1997	8762	22609	12979	8220	20574		7973	20574
1998	11725	26923	16500	11000	24500		10670	24500
1999	15507	21833	16858	14548	19868		14111	19868

Escapements to Miramichi for 1999 are based on preliminary estimates of 30% ER in recreational plus native harvests to estimate removals.
For 1999, native removals = 2526.

Appendix 6(vi). Estimated Atlantic salmon returning recruits and spawners to the Morell River, SFA 17, 1970-1999. PEI commercial landings are also given.

	Small recruits		Small spawners		Large recruits		Large spawners		2SW recruits		2SW spawners		PEI comm.
Year	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	catch (nos.)
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	29
1972	0	0	0	0	0	0	0	0	0	0	0	0	385
1973	5	9	3	7	0	0	0	0	0	0	0	0	206
1974	0	0	0	0	0	0	0	0	0	0	0	0	386
1975	0	0	0	0	0	0	0	0	0	0	0	0	345
1976	14	28	8	22	2	5	1	4	2	5	1	4	573
1977	0	0	0	0	0	0	0	0	0	0	0	0	606
1978	0	0	0	0	0	0	0	0	0	0	0	0	N/A
1979	2	5	1	4	5	9	3	7	5	9	3	7	454
1980	12	23	7	18	2	5	1	4	2	5	1	4	1697
1981	259	498	151	390	40	77	36	73	40	77	36	73	217
1982	175	336	102	263	16	31	8	23	16	31	8	23	416
1983	17	32	10	25	17	32	15	30	17	32	15	30	326
1984	17	32	10	25	13	26	13	26	13	26	13	26	46
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	209	383	117	291	168	309	165	306	168	309	165	306	
1995	1058	1915	585	1442	85	154	81	150	85	154	81	150	
1996	1159	2573	737	2151	158	351	154	347	158	351	154	347	
1997	484	931	282	729	31	59	30	58	31	59	30	58	
1998	635	1221	370	956	79	151	77	149	79	151	77	149	
1999	365	700	213	548	22	43	18	39	22	43	18	39	
70-89 X	213	410	124	321	21	40	20	40	21	40	20	40	
90-99 X	1048	2034	613	1600	113	220	111	218	113	220	111	218	

Notes

Number of small retained salmon in 1993 was not recorded. The number given is the mean for 1986-1992

For 1970-1980, percent small is calculated from numbers of small and large salmon in the retained catch in each year. For 1981-1997, percent small is calculated from numbers of small and large salmon taken at the Leard's Pond trap.

Small recruits are calculated as small retained salmon/exploitation rate. Angler exploitation was calculated as 0.34, 0.347, and 0.264 of estimated returns in 1994, 1995, and 1996, respectively. For other years the mean of these values is used. The min and max max numbers of small recruits are calculated using exploitation + or - 0.1; e.g. 0.34 + or - 0.1 gives 0.24 and 0.44.

Small spawners = number of small recruits - number of small retained

Large recruits = (number of small recruits/(0.01*percent small))-number of small recruits

Large spawners = number of large recruits - number of large retained

It is asssumed that large salmon and 2SW salmon are equivalent

Appendix 6(viia). Total 2SW returns and spawners to SFA 18, 1970-1999.

	LARGE RETURNS						Commercial catches			TOTAL 2SW		LARGE SPAWNERS				TOTAL 2SW	
	Margaree		SFA 18		2SW RETURNS			2SW ctch		RETURNS		Margaree		SFA 18		SPAWNERS	
	Large salmon		1.24	2.29	0.77	0.87	Zone 6	0.77	0.87	(inc. comm.)				1.24	2.29	0.77	0.87
Year	MIN	MAX	MIN	MAX	MIN	MAX	(kg)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1970	581	1,000	723	2,291	556	1,993	30,440	4,262	4,815	4,818	6,808	657	1,145	817	2,623	629	2,282
1971	254	437	316	1,002	243	871	12,001	1,680	1,898	1,923	2,770	256	446	318	1,022	245	889
1972	284	488	353	1,119	272	973	31,840	4,458	5,037	4,729	6,010	272	474	338	1,086	261	945
1973	316	544	393	1,247	303	1,085	27,694	3,877	4,381	4,180	5,465	287	499	356	1,144	274	995
1974	289	498	360	1,140	277	992	37,437	5,241	5,922	5,518	6,914	318	554	396	1,269	305	1,104
1975	173	298	215	683	166	594	23,631	3,308	3,738	3,474	4,332	214	372	266	853	205	742
1976	222	381	276	873	213	759	18,361	2,571	2,904	2,783	3,664	267	465	332	1,065	256	927
1977	378	651	470	1,492	362	1,298	26,221	3,671	4,148	4,033	5,445	393	683	488	1,565	376	1,362
1978	427	735	531	1,684	409	1,465	30,216	4,230	4,780	4,639	6,245	510	888	635	2,034	489	1,770
1979	219	377	272	864	210	751	7,917	1,108	1,252	1,318	2,004	265	461	330	1,056	254	919
1980	378	651	470	1,492	362	1,298	24,412	3,418	3,862	3,780	5,159	497	865	618	1,982	476	1,724
1981	375	647	466	1,482	359	1,290	15,562	2,179	2,462	2,538	3,751	451	785	561	1,798	432	1,564
1982	484	833	602	1,909	463	1,660	26,664	3,733	4,218	4,196	5,878	555	965	690	2,211	531	1,924
1983	402	693	500	1,588	385	1,381	24,280	3,399	3,841	3,784	5,222	480	834	596	1,912	459	1,663
1984	327	583	407	1,336	313	1,162	15,140	2,120	2,395	2,433	3,557	296	532	368	1,219	283	1,060
1985	1,109	2,217	1,379	5,079	1,062	4,419		0	0	1,062	4,419	1,025	2,133	1,275	4,887	981	4,252
1986	2,738	5,680	3,405	13,014	2,622	11,322		0	0	2,622	11,322	2,583	5,525	3,212	12,659	2,473	11,013
1987	2,976	6,540	3,701	14,984	2,850	13,036		0	0	2,850	13,036	2,860	6,424	3,557	14,718	2,739	12,805
1988	1,286	2,494	1,599	5,714	1,231	4,971		0	0	1,231	4,971	1,143	2,351	1,421	5,387	1,094	4,686
1989	1,708	3,693	2,124	8,461	1,635	7,361		0	0	1,635	7,361	1,583	3,568	1,969	8,175	1,516	7,112
1990	3,481	7,933	4,329	18,176	3,333	15,813		0	0	3,333	15,813	3,347	7,799	4,162	17,869	3,205	15,546
1991	1,853	5,785	2,304	13,254	1,774	11,531		0	0	1,774	11,531	1,692	5,624	2,104	12,885	1,620	11,210
1992	4,875	9,375	6,062	21,480	4,668	18,687		0	0	4,668	18,687	4,722	9,222	5,872	21,129	4,522	18,382
1993	2,408	6,158	2,995	14,109	2,306	12,275		0	0	2,306	12,275	2,274	6,024	2,828	13,802	2,177	12,008
1994	2,350	4,500	2,922	10,310	2,250	8,970		0	0	2,250	8,970	2,209	4,359	2,747	9,987	2,115	8,689
1995	1,750	3,815	2,176	8,741	1,676	7,604		0	0	1,676	7,604	1,693	3,758	2,105	8,610	1,621	7,491
1996	2,214	4,050	2,753	9,279	2,120	8,073		0	0	2,120	8,073	2,001	3,837	2,488	8,791	1,916	7,648
1997	3,268	5,435	4,064	12,452	3,129	10,834		0	0	3,129	10,834	3,006	5,173	3,738	11,852	2,878	10,311
1998	2,067	3,438	2,570	7,877	1,979	6,853		0	0	1,979	6,853	1,898	3,269	2,360	7,490	1,817	6,516
1999	1,268	2,109	1,577	4,832	1,214	4,204		0	0	1,214	4,204	1,099	1,940	1,367	4,445	1,052	3,867

Yr	SFA 18	Marg-aree	Ratio
84	449	305	1.47
85	1706	1215	1.40
86	4448	2636	1.69
87	3012	1857	1.62
88	3078	1932	1.59
89	3206	1570	2.04
90	2391	1507	1.59
91	3470	1757	1.97
92	3315	1938	1.71
93	2372	1102	2.15
94	2043	1479	1.38
95	1633	1060	1.54
96	3921	1864	2.10
97	2609	2098	1.24
98	2163	1327	1.63
99	1865	814	2.29
		Min	1.244
		Max	2.291

Margaree returns, 1970-84, equal catch /min (0.215) or max (0.37) exploitation rate.
Return of large salmon (MIN) and (MAX) to all SFA 18 equals Margaree returns * ratio Margaree catch to SFA 18 catch.
Margaree returns 1984-99 based on various Margaree CAFSAC, DFO Atl. Res and CSAS Res. Docs.
Margaree catch to SFA 18 catch; MIN_MAX 2SW based on the ratio 0.77-0.87 2SW fish among MSW fish.
Margaree escapements 1970-83 = returns minus removals; 1984-1999 from various Margaree CAFSAC, DFO Atl. Fish. and CSAS Res.
Docs e.g., Marshall et al. (MS 1997) where 2SW equal 0.77-0.87 of MSW fish; Margaree raised to SFA by respective ratios in recreational catch.

Appendix 6(viib). Total 1SW returns and spawners to SFA 18, 1970-1999.

	RETURNS				SPAWNERS			
	Margaree		SFA 18		Margaree		SFA 18	
	0.37	0.21	1.214	2.688			1.214	2.688
Year	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1970	230	395	279	1,063	145	310	176	834
1971	57	98	69	263	36	77	43	206
1972	114	195	138	525	72	153	87	412
1973	449	772	545	2,075	283	606	343	1,629
1974	162	279	197	750	102	219	124	589
1975	97	167	118	450	61	131	74	353
1976	259	447	315	1,200	163	351	198	942
1977	186	321	226	863	117	252	143	677
1978	68	116	82	313	43	91	52	245
1979	1,614	2,777	1,959	7,464	1,017	2,180	1,234	5,859
1980	451	777	548	2,088	284	610	345	1,639
1981	2,430	4,181	2,950	11,240	1,531	3,282	1,859	8,823
1982	1,868	3,214	2,267	8,639	1,177	2,523	1,429	6,782
1983	184	316	223	850	116	248	141	667
1984	400	688	486	1,849	158	446	192	1,199
1985	634	1,167	770	3,137	125	658	152	1,769
1986	838	1,420	1,017	3,817	56	638	68	1,715
1987	1,143	1,865	1,388	5,013	166	888	202	2,387
1988	1,674	2,911	2,032	7,825	795	2,032	965	5,462
1989	591	977	718	2,626	30	416	36	1,118
1990	940	5,077	1,141	13,647	291	4,428	353	11,903
1991	794	3,891	964	10,459	42	3,139	51	8,438
1992	1,258	2,419	1,527	6,503	701	1,862	851	5,005
1993	1,489	3,851	1,808	10,352	906	3,268	1,100	8,785
1994	573	1,101	696	2,960	259	787	314	2,116
1995	538	1,083	653	2,911	329	874	399	2,349
1996	1,277	2,960	1,550	7,957	935	2,618	1,135	7,037
1997	316	1,517	384	4,078	68	1,269	83	3,411
1998	349	1,573	424	4,228	126	1,350	153	3,629
1999	311	1,509	378	4,056	86	1,284	104	3,452

Recreational ctch:

Year	SFA 18	Marg-aree	Ratio
1984	298	242	1.23
1985	618	509	1.21
1986	1,180	782	1.51
1987	1,289	977	1.32
1988	1,349	879	1.53
1989	928	561	1.65
1990	1,206	649	1.86
1991	1,262	752	1.68
1992	1,242	678	1.83
1993	1,216	777	1.56
1994	659	429	1.54
1995	711	333	2.14
1996	2,022	918	2.20
1997	558	316	1.77
1998	829	349	2.38
1999	836	311	2.69
		Min	1.214
		Max	2.688

Margaree returns, 1970-1983, equal catch divided by MIN (0.37) and MAX (0.215) exploitation rate.
Return of small salmon to all SFA 18 equals Margaree returns * MIN and MAX ratio of
Margaree catch to SFA 18 catch. Margaree returns, 1984-1999, based on annual assessments
in CAFSAC and DFO Atl. Fish. and CSAS Res. Docs, eg., Marshall et al. (MS 1997).
Spawners for 1970-1983 equal returns minus removals; 1984-1999 from various Margaree CAFSAC,
Atl. Res. and CSAS Res Doc. series.

Appendix 6(viii). Total 1SW returns and spawners, SFAs 19, 20, 21 and 23, 1970-1999.

	RETURNS						TOTAL RETURNS		SPAWNERS						TOTAL SPAWNERS	
	River returns SFA 19-21		Comm-ercial	SFA 23			SFAs 19,20,21,23		angled	Spawners 19-21		SFA 23 H+W rtns		Harvest	19,20,21,23	
				Wild	Wild	Hatch										
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	12,610
1972	6,636	13,354	1,055	1,546	2,221	265	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	13,692		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	5,469	6,315		10,517	16,850	67	4,981	10,468	5,157	5,997		10,138	16,465

SFAs 19, 20, 21: Returns, 1970-1997, estimated as run size (1SW recreational catch / expl. rate [0.2 to 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 1998-1999, 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, 1993-1999, 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 1998-1999 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) & little (1999) angling in SFAs 20-21. In 1999, SFA 19-21 values for 1998 were corrected for inadvertent use of hatchery rather than wild (1SW only) counts at Morgans Falls.

Appendix 6(ixa). Total 2SW returns to SFAs 19, 20, 21 and 23, 1970-1999.

	SFA 19		SFA 20		SFA 21		Total	SFA 23				TOTAL RETURNS SFAs 19,20,21,23	
	MIN	MAX	MIN	MAX	MIN	MAX	Comm-ercial	Wild MIN	Wild MAX	Htch MIN	Htch MAX		
	2SW=0.7-0.9		2SW=0.6-0.9		2SW=0.5-0.9			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	4,088	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

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 1998-1999 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": Revision of method; SFA 23, 1993-1999, estimated MSW returns to Nashwaak fence raised by proportion of area below Mactaquac (0.21-0.30) * proportion 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 (previously) to estimate spawners.
SFAs 19-21, estimate of 2SW returns for 1998-99, 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 6(ixb). Total 2SW spawners in SFAs 19, 20, 21 and 23, 1970-1999.

	RETURNS						REMOVALS		SPAWNERS		SFA 23				TOTAL	
	SFA 19		SFA 20		SFA 21		angled (19-21)		SFAs (19-21)		RETURNS		REMOVALS		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

Spawners = returns minus removals where: "returns" are from previous Appendix as are outlines of revisions to methods for SFAs 19-21, 1998 and 1999, and SFA 23, 1993-1999. "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, 1993-1999, 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 6 (x). Global evaluation of the number of recruits and spawners for all the Quebec's river, 1969-1998.

	Recruits of small salmon			Recruits of large salmon			Spawners of small salmon			Spawners of large salmon		
Year	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1969	25 355	31 694	38 032	74 653	93 316	111 979	16 313	20 392	24 470	25 532	31 915	38 299
1970	18 904	23 630	28 356	82 680	103 350	124 020	11 045	13 806	16 568	31 292	39 115	46 937
1971	14 969	18 711	22 453	47 354	59 192	71 031	9 338	11 672	14 007	16 194	20 243	24 292
1972	12 470	15 587	18 704	61 773	77 217	92 660	8 213	10 267	12 320	31 727	39 658	47 590
1973	16 585	20 731	24 877	68 171	85 214	102 256	10 987	13 734	16 480	32 279	40 349	48 419
1974	16 791	20 988	25 186	91 455	114 319	137 182	10 067	12 583	15 100	39 256	49 070	58 884
1975	18 071	22 589	27 106	77 664	97 080	116 497	11 606	14 507	17 409	32 627	40 784	48 940
1976	19 959	24 948	29 938	77 212	96 515	115 818	12 979	16 224	19 469	31 032	38 790	46 548
1977	18 190	22 737	27 285	91 017	113 771	136 525	12 004	15 005	18 006	44 660	55 825	66 990
1978	16 971	21 214	25 456	81 953	102 441	122 930	11 447	14 309	17 170	40 944	51 180	61 416
1979	21 683	27 103	32 524	45 197	56 497	67 796	15 863	19 829	23 795	17 543	21 929	26 315
1980	29 791	37 239	44 686	107 461	134 327	161 192	20 817	26 021	31 226	48 758	60 948	73 137
1981	41 667	52 084	62 501	84 428	105 535	126 642	30 952	38 690	46 428	35 798	44 747	53 697
1982	23 699	29 624	35 549	74 870	93 587	112 305	16 877	21 096	25 316	36 290	45 363	54 435
1983	17 987	22 484	26 981	61 488	76 860	92 232	12 030	15 038	18 045	23 710	29 638	35 565
1984	21 566	26 230	30 894	61 180	71 110	81 041	16 316	20 636	24 957	30 610	37 674	44 739
1985	22 771	28 016	33 262	62 899	73 545	84 192	15 608	20 374	25 140	28 312	35 897	43 482
1986	33 758	40 347	46 937	75 561	87 479	99 397	22 230	28 042	33 855	32 997	41 114	49 232
1987	37 816	45 925	54 034	72 190	82 920	93 650	25 789	33 135	40 481	29 758	36 610	43 462
1988	43 943	53 068	62 193	77 904	90 587	103 269	28 582	36 699	44 815	34 781	43 653	52 524
1989	34 568	41 488	48 407	70 762	81 316	91 871	24 710	31 015	37 319	34 268	41 727	49 185
1990	39 962	47 377	54 792	68 851	79 872	90 893	26 594	33 210	39 826	33 454	41 535	49 615
1991	31 488	37 121	42 755	64 166	73 675	83 184	20 582	25 508	30 433	27 341	33 569	39 797
1992	35 257	42 000	48 742	64 271	74 112	83 953	21 754	27 668	33 583	26 489	32 993	39 497
1993	30 645	36 400	42 156	50 717	57 197	63 677	17 493	22 469	27 444	21 609	25 481	29 353
1994	29 667	34 918	40 170	51 649	58 139	64 630	16 758	21 200	25 642	21 413	25 191	28 968
1995	23 851	28 109	32 368	59 939	67 083	74 227	14 409	17 978	21 548	30 925	35 122	39 320
1996	32 008	37 283	42 558	53 990	61 136	68 282	18 923	23 364	27 805	26 042	30 433	34 824
1997	24 300	28 659	33 018	44 442	50 315	56 187	14 724	18 467	22 210	21 275	24 871	28 466
1998	24 029	28 777	33 524	33 280	38 370	43 460	16 277	20 615	24 954	19 419	22 951	26 483
1999	29 572	31 612	33 653	34 456	37 428	40 400	17 813	22 225	26 637	23 046	27 278	31 509

APPENDIX 7

Computation of Catch Advice for West Greenland

The North American Spawning Reserve (SpT) for 2SW salmon has been revised to 152,548 fish in 2000.

This number must be divided by the survival rate for the fish from the time of the West Greenland fishery to their return of the fish to home waters (11 months) to give the Spawning Target Reserve (SpR). Thus:

Eq. 1. $SpR = SpT * (exp(11*M)$ (where $M = 0.01$)

The Maximum Allowable Harvest (MAH) may be defined as the number of non-maturing 1SW fish that are available for harvest. This number is calculated by subtracting the Spawning Target Reserve from the pre-fishery abundance (PFA).

Eq. 2. $MAH = PFA - SpR$

To provide catch advice for West Greenland it is then necessary to decide on the proportion of the MAH to be allocated to Greenland (f_{NA}). The allowable harvest of North American non-maturing 1SW salmon at West Greenland NA1SW) may then be defined as

Eq. 3. $NA1SW = f_{NA} * MAH$

The estimated number of European salmon that will be caught at West Greenland (E1SW) will depend upon the harvest of North American fish and the proportion of the fish in the West Greenland fishery that originate from North America [PropNA] [1]. Thus:

Eq. 4. $E1SW = (NA1SW / PropNA) - NA1SW$

To convert the numbers of North American and European 1SW salmon into total catch at West Greenland in metric tonnes, it is necessary to incorporate the mean weights (kg) of salmon for North America [WT1SWNA][1] and Europe [WT1SWE][1] and age correction factor for multi-sea winter salmon at Greenland based on the total weight of salmon caught divided by the weight of 1SW salmon [ACF][1] . The quota (in tonnes) at Greenland is then estimated as

Eq. 5. $Quota = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF/1000$

[1] New sampling data from the 1995-99 fishery at West Greenland were used to update the forecast values of the proportion of North American salmon in the catch (PropNA), mean weights by continent [WT1SWNA, WT1SWE] and the age correction factor [ACF] in 1996.

APPENDIX 8

Appendix 8a Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - FINLAND

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	3,114	3,156	20	30	20	30	40	70	40	80
1972	4,865	4,932	20	30	20	30	40	70	40	80
1973	7,395	7,496	20	30	20	30	40	70	40	80
1974	6,803	7,253	20	30	20	30	40	70	40	80
1975	6,732	7,178	20	30	20	30	40	70	40	80
1976	5,817	6,202	20	30	20	30	40	70	40	80
1977	5,238	5,584	20	30	20	30	40	70	40	80
1978	3,832	3,481	20	30	20	30	40	70	40	80
1979	3,982	2,298	20	30	20	30	40	70	30	70
1980	3,920	3,093	20	30	20	30	40	70	30	70
1981	3,617	4,874	20	30	20	30	40	70	30	70
1982	2,598	5,408	20	30	20	30	40	70	30	70
1983	3,916	6,050	20	30	20	30	40	70	30	70
1984	4,899	4,726	20	30	20	30	40	70	30	70
1985	6,201	4,912	20	30	20	30	40	70	30	70
1986	6,131	3,244	20	30	20	30	40	70	30	70
1987	8,696	4,520	20	30	20	30	40	70	30	70
1988	5,926	3,495	20	30	20	30	40	70	30	70
1989	10,395	5,332	20	30	20	30	50	80	40	80
1990	10,084	5,600	20	30	20	30	50	80	40	80
1991	9,213	6,298	20	30	20	30	50	80	40	80
1992	15,017	6,284	20	30	20	30	50	80	40	80
1993	11,157	8,180	20	30	20	30	50	80	40	80
1994	7,493	6,230	20	30	20	30	50	80	40	80
1995	7,786	5,344	20	30	20	30	50	80	40	80
1996	10,726	2,717	20	30	20	30	40	70	30	70
1997	9,469	4,272	20	30	20	30	40	70	30	70
1998	11,410	3,749	20	30	20	30	40	70	30	70
1999	16,861	3,848	20	30	20	30	50	80	40	70
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)=	0.005	Return time (m)=	1SW(min)	6	MSW(min)	18
M(max)=	0.015		1SW(max)	8	MSW(max)	20

Appendix 8b 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								
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	1831	0	0	0	0	5	20	20	40
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 16

M(max)= 0.015 1SW(max) 9 MSW(max) 17

Appendix 8c Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - ICELAND

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	21,403	13,083	1	3	1	3	40	60	50	70
1972	19,588	21,134	1	3	1	3	40	60	50	70
1973	20,052	18,021	1	3	1	3	40	60	50	70
1974	14,204	14,325	1	3	1	3	40	60	50	70
1975	20,328	18,032	1	3	1	3	40	60	50	70
1976	17,349	13,874	1	3	1	3	40	60	50	70
1977	19,454	17,419	1	3	1	3	40	60	50	70
1978	24,120	22,884	1	3	1	3	40	60	50	70
1979	23,759	15,981	1	3	1	3	40	60	50	70
1980	7,649	20,158	1	3	1	3	40	60	50	70
1981	15,543	9,516	1	3	1	3	40	60	50	70
1982	11,872	9,478	1	3	1	3	40	60	50	70
1983	16,031	11,483	1	3	1	3	40	60	50	70
1984	9,988	11,929	1	3	1	3	40	60	50	70
1985	20,064	6,882	1	3	1	3	40	60	50	70
1986	30,769	12,521	1	3	1	3	40	60	50	70
1987	20,392	12,898	1	3	1	3	40	60	50	70
1988	37,561	10,516	1	3	1	3	40	60	50	70
1989	20,366	9,399	1	3	1	3	40	60	50	70
1990	18,956	10,327	1	3	1	3	40	60	50	70
1991	22,878	8,614	1	3	1	3	40	60	50	70
1992	30,676	11,633	1	3	1	3	40	60	50	70
1993	29,360	9,665	1	3	1	3	40	60	50	70
1994	17,562	10,480	1	3	1	3	40	60	50	70
1995	25,552	8,689	1	3	1	3	40	60	50	70
1996	21,624	7,812	1	3	1	3	40	60	50	70
1997	21,476	7,164	1	3	1	3	40	60	50	70
1998	35,537	7,791	1	3	1	3	40	60	50	70
1999	23,723	10,961	1	3	1	3	40	60	50	70
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005
M(max)= 0.015

Return time (m)= 1SW(min) 6 MSW(min) 17
1SW(max) 8 MSW(max) 19

Appendix 8d Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - IRELAND

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	475,839	52,871	30	45	30	45	54	63	47	55
1972	523,742	58,194	30	45	30	45	54	63	47	55
1973	560,323	62,258	30	45	30	45	54	63	47	55
1974	617,806	68,645	30	45	30	45	54	63	47	55
1975	643,355	71,484	30	45	30	45	54	63	47	55
1976	453,194	50,355	30	45	30	45	54	63	47	55
1977	398,323	44,258	30	45	30	45	54	63	47	55
1978	357,097	39,677	30	45	30	45	54	63	47	55
1979	318,484	35,387	30	45	30	45	54	63	47	55
1980	248,333	39,608	30	45	30	45	54	63	47	55
1981	173,667	32,159	30	45	30	45	62	72	47	55
1982	310,000	12,353	30	65	30	65	61	72	43	51
1983	502,000	29,411	30	45	30	45	54	63	46	54
1984	242,666	19,804	30	50	30	50	59	70	36	42
1985	498,333	19,608	30	50	30	50	66	77	38	45
1986	498,125	28,335	30	50	30	50	63	74	51	61
1987	358,842	27,609	20	45	20	45	60	70	35	41
1988	559,297	30,599	15	40	15	40	45	54	43	50
1989	305,667	24,891	30	40	30	40	60	70	48	56
1990	180,118	14,667	30	40	30	40	46	54	59	70
1991	125,389	10,211	30	40	30	40	40	47	49	57
1992	217,446	17,707	30	40	30	40	47	55	45	53
1993	186,901	15,220	20	35	20	35	46	54	71	83
1994	268,839	21,892	20	25	20	25	47	55	43	50
1995	237,773	19,362	20	25	20	25	51	60	43	50
1996	230,826	18,797	25	30	25	30	50	52	60	75
1997	194,187	15,813	10	20	10	20	30	45	40	50
1998	219,767	17,896	10	20	10	20	30	40	40	50
1999	166,887	13,590	10	20	10	20	45	65	40	50
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)=	0.005	Return time (m)=	1SW(min)	7	MSW(min)	17
M(max)=	0.015		1SW(max)	9	MSW(max)	18

Appendix 8e Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - NORWAY

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	213,595	135,247	40	60	40	60	70	90	70	90
1972	279,249	176,818	40	60	40	60	70	90	70	90
1973	305,439	193,402	40	60	40	60	70	90	70	90
1974	288,982	182,981	40	60	40	60	70	90	70	90
1975	271,993	172,224	40	60	40	60	70	90	70	90
1976	270,754	171,439	40	60	40	60	70	90	70	90
1977	263,322	166,733	40	60	40	60	70	90	70	90
1978	185,812	117,655	40	60	40	60	70	90	70	90
1979	324,020	205,167	40	60	40	60	70	90	70	90
1980	323,843	205,055	40	60	40	60	70	90	70	90
1981	221,566	213,943	40	60	40	60	70	90	70	90
1982	163,120	174,229	40	60	40	60	70	90	70	90
1983	278,061	171,361	40	60	40	60	70	90	70	90
1984	294,365	176,716	40	60	40	60	70	90	70	90
1985	299,037	162,403	40	60	40	60	70	90	70	90
1986	264,849	191,524	40	60	40	60	70	90	70	90
1987	235,703	153,534	40	60	40	60	70	90	70	90
1988	217,617	120,367	40	60	40	60	70	90	70	90
1989	220,170	80,880	40	60	40	60	50	70	50	70
1990	192,500	91,437	40	60	40	60	50	70	50	70
1991	177,041	92,214	40	60	40	60	50	70	50	70
1992	150,580	97,586	40	60	40	60	50	70	50	70
1993	151,291	92,717	30	50	30	50	50	70	50	70
1994	153,412	99,519	30	50	30	50	50	70	50	70
1995	134,341	98,656	30	50	30	50	50	70	50	70
1996	110,085	96,656	30	50	30	50	50	70	50	70
1997	124,387	69,290	25	45	25	45	45	65	45	65
1998	162,185	82,335	25	45	25	45	45	65	45	65
1999	164,905	89,494	25	45	25	45	40	60	40	60
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005 Return time (m)= 1SW(min) 5 MSW(min) 17
M(max)= 0.015 1SW(max) 7 MSW(max) 18

Appendix 8f Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - RUSSIA

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	48,312	80,841	15	25	15	25	40	60	40	60
1972	53,525	67,407	15	25	15	25	40	60	40	60
1973	89,440	112,636	15	25	15	25	40	60	40	60
1974	82,141	103,444	15	25	15	25	40	60	40	60
1975	87,944	129,896	15	25	15	25	40	60	40	60
1976	66,447	110,756	15	25	15	25	40	60	40	60
1977	55,463	83,195	15	25	15	25	40	60	40	60
1978	60,737	57,564	15	25	15	25	40	60	40	60
1979	69,423	63,844	15	25	15	25	40	60	40	60
1980	45,673	96,795	15	25	15	25	40	60	40	60
1981	32,611	52,528	15	25	15	25	40	60	40	60
1982	39,702	42,471	15	25	15	25	30	50	30	50
1983	57,870	68,396	15	25	15	25	30	50	30	50
1984	54,991	72,228	15	25	15	25	30	50	30	50
1985	72,803	80,292	15	25	15	25	30	50	30	50
1986	63,926	89,465	15	25	15	25	30	50	30	50
1987	97,242	41,769	15	25	15	25	30	45	30	50
1988	53,158	46,848	15	25	15	25	30	45	30	50
1989	78,023	29,454	15	25	20	30	30	45	15	30
1990	70,595	25,663	15	25	20	30	30	45	15	25
1991	40,603	17,543	33	47	33	47	25	35	15	25
1992	34,021	13,431	35	45	45	55	25	35	15	25
1993	28,100	17,907	35	45	50	60	25	35	15	25
1994	30,877	13,668	35	45	55	65	25	35	15	25
1995	27,775	10,023	35	45	55	65	25	35	15	25
1996	33,878	8,708	35	45	65	75	25	35	10	20
1997	31,857	7,107	35	45	65	75	25	35	10	20
1998	34,870	7,024	35	45	65	75	25	35	10	20
1999	24,016	6,998	35	45	65	75	25	35	10	20
2000	0	0	35	45	65	75	25	35	10	20

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 16
M(max)= 0.015 1SW(max) 9 MSW(max) 18

Appendix 8g 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 MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	min	max	min	max	min	max	min	max
1971	6,330	420	20	50	20	50	70	95	55	100
1972	5,005	295	20	50	20	50	70	95	55	100
1973	6,210	1,025	20	50	20	50	70	95	55	100
1974	8,935	660	20	50	20	50	70	95	55	100
1975	9,620	160	20	50	20	50	70	95	55	100
1976	5,420	480	20	50	20	50	70	95	55	100
1977	2,555	360	20	50	20	50	70	95	55	100
1978	2,917	275	20	50	20	50	70	95	55	100
1979	3,080	800	20	50	20	50	70	95	55	100
1980	3,920	1,400	20	50	20	50	70	95	55	100
1981	7,095	407	20	50	20	50	70	95	55	100
1982	6,230	1,460	20	50	20	50	70	95	55	100
1983	8,290	1,005	20	50	20	50	70	95	55	100
1984	11,680	1,410	20	50	20	50	70	95	55	100
1985	13,890	590	20	50	20	50	70	95	55	100
1986	14,635	570	20	50	20	50	70	95	55	100
1987	11,860	1,700	20	50	20	50	70	95	55	100
1988	9,930	1,650	20	50	20	50	70	95	55	100
1989	3,180	4,610	20	50	20	50	70	95	55	100
1990	7,430	3,135	20	50	20	50	70	95	55	100
1991	8,990	3,620	20	50	20	50	70	95	55	100
1992	9,850	4,655	20	50	20	50	70	95	55	100
1993	10,540	6,370	20	50	20	50	70	95	55	100
1994	8,035	4,660	20	50	20	50	60	85	55	100
1995	9,761	2,770	20	50	20	50	50	75	55	90
1996	6,008	3,542	20	50	20	50	50	75	55	90
1997	2,747	2,307	20	50	20	50	50	75	55	90
1998	2,421	1,702	5	25	5	25	60	85	55	90
1999	2,926	1,190	5	25	5	25	60	85	55	90
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005 Return time (m)= 1SW(min) 6 MSW(min) 18
M(max)= 0.015 1SW(max) 8 MSW(max) 20

Appendix 8h Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(ENGLAND & WALES)

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
	Exclude 80% NE coast									
1971	32,905	17,718	25	50	25	50	26	46	20	40
1972	40,468	21,315	25	50	25	50	26	46	20	40
1973	40,076	20,645	25	50	25	50	26	46	20	40
1974	41,715	21,014	25	50	25	50	26	46	20	40
1975	49,238	24,252	25	50	25	50	26	46	20	40
1976	29,842	14,369	25	50	25	50	27	47	20	40
1977	34,675	16,317	25	50	25	50	27	47	21	41
1978	39,117	17,988	25	50	25	50	28	48	22	42
1979	27,881	12,526	25	50	25	50	29	49	23	43
1980	36,451	15,997	25	50	25	50	34	54	26	46
1981	48,057	20,596	25	50	25	50	34	54	27	47
1982	29,791	12,466	25	50	25	50	35	55	28	48
1983	39,105	15,972	25	50	25	50	36	56	29	49
1984	35,539	14,166	25	50	25	50	38	58	30	50
1985	36,236	14,092	25	50	25	50	39	59	31	51
1986	48,023	18,215	25	50	25	50	40	60	31	51
1987	42,017	15,540	25	50	25	50	39	59	31	51
1988	56,248	20,280	25	50	25	50	39	59	31	51
1989	45,346	15,932	25	50	25	50	42	62	34	54
1990	42,802	14,651	25	50	25	50	43	63	34	54
1991	23,767	7,922	25	50	25	50	42	62	33	53
1992	21,801	7,075	25	50	25	50	39	59	31	51
1993	29,259	6,863	30	60	30	60	34	54	26	46
1994	39,176	11,702	30	60	30	60	32	52	25	45
1995	27,294	10,614	15	25	15	25	30	50	24	44
1996	20,690	11,141	15	25	15	25	25	45	19	39
1997	17,401	6,436	15	25	15	25	23	43	18	38
1998	18,507	3,791	15	25	15	25	20	40	15	35
1999	13,671	5,859	15	25	15	25	16	36	12	32
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)=	0.005	Return time (m)=	1SW(min)	7	MSW(min)	17
M(max)=	0.015		1SW(max)	9	MSW(max)	19

Appendix 8i Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(NORTHERN IRELAND)

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	70,760	9,375	10	33	10	33	62	76	41	51
1972	63,502	8,413	10	33	10	33	62	76	41	51
1973	55,035	7,291	10	33	10	33	62	76	41	51
1974	55,640	7,371	10	33	10	33	62	76	41	51
1975	49,592	6,570	10	33	10	33	62	76	41	51
1976	34,170	4,527	10	33	10	33	62	76	41	51
1977	33,263	4,407	10	33	10	33	62	76	41	51
1978	44,754	5,929	10	33	10	33	62	76	41	51
1979	29,937	3,966	10	33	10	33	62	76	41	51
1980	36,892	4,888	10	33	10	33	62	76	41	51
1981	30,542	4,046	10	33	10	33	62	76	41	51
1982	39,916	5,289	10	33	10	33	62	76	41	51
1983	56,548	7,492	10	33	10	33	62	76	41	51
1984	23,586	3,125	10	33	10	33	62	76	41	51
1985	29,634	3,926	10	33	10	33	62	76	41	51
1986	32,961	4,367	10	33	10	33	62	76	41	51
1987	16,934	2,243	10	33	10	33	62	76	41	51
1988	34,473	4,567	10	33	10	33	58	71	32	40
1989	42,940	5,689	10	37	10	37	80	98	54	66
1990	28,425	3,766	10	17	10	17	56	68	34	42
1991	16,631	2,203	10	17	10	17	58	71	39	47
1992	27,518	3,646	10	23	10	23	50	62	30	36
1993	25,098	3,325	10	17	10	17	37	45	11	13
1994	27,519	3,646	10	28	10	28	63	77	36	44
1995	26,904	3,565	10	17	10	17	60	74	38	46
1996	23,343	3,093	10	20	10	20	47	67	24	44
1997	29,360	3,890	5	15	5	15	50	70	24	44
1998	26,539	3,517	5	15	5	15	20	30	15	30
1999	18,838	2,496	5	15	5	15	58	68	25	40
2000	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 16
M(max)= 0.015 1SW(max) 9 MSW(max) 18

Appendix 8j Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(SCOTLAND)

Year	Catch (numbers)		Catch of Scottish fish in England	Unrep. as % of total 1SW		Unrep. as % of total MSW		Exp. rate 1SW (%)		Exp. rate MSW (%)	
	1SW	MSW	(% 1SW)	min	max	min	max	min	max	min	max
			70%								
1971	262,160	161,601	57,335	20	40	20	40	20	40	30	50
1972	251,465	218,023	49,097	20	40	20	40	20	40	30	50
1973	293,090	237,920	59,700	20	40	20	40	20	40	30	50
1974	289,416	188,357	50,118	20	40	20	40	20	40	30	50
1975	222,345	207,978	50,778	20	40	20	40	20	40	30	50
1976	188,492	114,582	14,759	20	40	20	40	20	40	25	45
1977	194,264	138,987	49,186	20	40	20	40	20	40	25	45
1978	204,470	162,954	47,500	20	40	20	40	20	40	25	45
1979	187,236	132,509	39,552	20	40	20	40	20	40	25	45
1980	121,441	172,588	41,202	15	30	15	30	15	35	25	45
1981	150,738	174,721	61,511	15	30	15	30	15	35	20	40
1982	208,061	128,242	44,147	15	30	15	30	15	35	20	40
1983	209,617	145,961	67,231	15	30	15	30	15	35	20	40
1984	213,079	107,213	50,994	15	30	15	30	15	35	20	40
1985	158,012	114,648	48,753	15	30	15	30	15	35	20	40
1986	202,855	148,397	53,277	15	30	15	30	15	35	15	35
1987	164,785	103,994	29,999	15	30	15	30	15	35	15	35
1988	149,098	112,162	41,696	15	30	15	30	15	35	15	35
1989	174,941	103,886	33,577	10	20	10	20	10	30	15	35
1990	81,094	87,924	41,224	10	20	10	20	10	30	15	35
1991	73,608	65,193	20,343	10	20	10	20	10	30	10	30
1992	101,676	82,841	16,115	10	20	10	20	10	30	10	30
1993	94,517	71,726	33,440	10	20	10	20	10	30	10	30
1994	99,459	85,404	37,243	10	20	10	20	10	30	10	30
1995	89,921	78,452	42,568	10	20	10	20	10	30	10	30
1996	66,413	57,920	14,865	10	20	10	20	8	25	8	25
1997	46,526	40,316	17,538	10	20	10	20	8	25	8	25
1998	53,656	38,257	14,612	10	20	10	20	8	20	8	20
1999	21,913	28,525	21,466	10	20	10	20	8	20	8	20
2000	0	0	0	-1	1	-1	1	-1	1	-1	1

M(min)= 0.005
M(max)= 0.015

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

Appendix 8k 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	339	1,424	10	20	0	0	100	100	100	100
1998	339	1,424	10	20	0	0	100	100	100	100
1999	0	0	5	15	0	0	100	100	100	100
2000	0	0	5	15	0	0	100	100	100	100

M(min)= 0.005 Return time (m)= 1SW(min) 0 MSW(min) 1
M(max)= 0.015 1SW(max) 1 MSW(max) 2

Appendix 8l 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	439,111	0	0	5	15	100	100	100	100
1972	0	345,051	0	0	5	15	100	100	100	100
1973	0	382,283	0	0	5	15	100	100	100	100
1974	0	292,402	0	0	5	15	100	100	100	100
1975	0	354,886	0	0	5	15	100	100	100	100
1976	0	198,413	0	0	5	15	100	100	100	100
1977	0	251,475	0	0	5	15	100	100	100	100
1978	0	145,265	0	0	5	15	100	100	100	100
1979	0	244,519	0	0	5	15	100	100	100	100
1980	0	166,716	0	0	5	15	100	100	100	100
1981	0	246,704	0	0	5	15	100	100	100	100
1982	0	143,800	0	0	5	15	100	100	100	100
1983	0	60,500	0	0	5	15	100	100	100	100
1984	0	41,200	0	0	5	15	100	100	100	100
1985	0	161,500	0	0	5	15	100	100	100	100
1986	0	131,900	0	0	5	15	100	100	100	100
1987	0	126,400	0	0	5	15	100	100	100	100
1988	0	168,800	0	0	5	15	100	100	100	100
1989	0	52,700	0	0	5	15	100	100	100	100
1990	0	21,700	0	0	5	15	100	100	100	100
1991	0	65,400	0	0	5	15	100	100	100	100
1992	0	38,500	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	10,700	0	0	5	15	100	100	100	100
1996	0	9,700	0	0	10	20	100	100	100	100
1997	0	3,300	0	0	9	19	100	100	100	100
1998	0	900	0	0	3	13	100	100	100	100
1999	0	600	0	0	40	60	100	100	100	100
2000	0	0	0	0	30	50	100	100	100	100

M(min)=	0.005	Return time (m)=	1SW(min)	7	MSW(min)	8
M(max)=	0.015		1SW(max)	8	MSW(max)	10

APPENDIX 9

Appendix 9a Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis FINLAND

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners	SD
1971	4,147	2.6E+04	4,218	8.4E-12	7,816	1.7E+06	7,354	2.3E+06	8,532	2.09E+06	14,275	9.32E+06	3,669	1,312	3,136	1,520
1972	6,487	6.1E+04	6,587	1.9E-11	12,180	4.2E+06	11,514	5.7E+06	13,229	4.98E+06	21,368	2.01E+07	5,692	2,031	4,926	2,386
1973	9,881	1.5E+05	10,027	1.3E-11	18,435	9.2E+06	17,396	1.3E+07	19,971	1.09E+07	20,781	1.91E+07	8,554	3,011	7,369	3,559
1974	9,079	1.2E+05	9,700	4.7E-13	16,886	8.3E+06	16,885	1.2E+07	18,256	9.65E+06	20,471	1.97E+07	7,806	2,852	7,185	3,402
1975	8,993	1.2E+05	9,603	1.5E-11	16,726	7.8E+06	16,678	1.2E+07	18,116	9.24E+06	17,614	1.41E+07	7,733	2,772	7,076	3,500
1976	7,770	9.2E+04	8,295	2.8E-12	14,558	6.1E+06	14,294	8.6E+06	15,735	7.12E+06	15,737	1.08E+07	6,788	2,452	5,998	2,930
1977	7,001	7.3E+04	7,460	5.1E-12	12,965	4.5E+06	12,839	6.8E+06	13,996	5.29E+06	10,036	4.59E+06	5,965	2,113	5,379	2,607
1978	5,130	3.9E+04	4,658	1.9E-12	9,595	2.5E+06	8,124	2.8E+06	10,359	2.89E+06	7,940	3.96E+06	4,465	1,561	3,466	1,677
1979	5,317	4.4E+04	3,066	9.3E-13	9,868	2.9E+06	6,461	2.6E+06	10,693	3.39E+06	10,647	7.72E+06	4,552	1,687	3,395	1,609
1980	5,234	4.1E+04	4,127	7.5E-12	9,769	2.6E+06	8,622	4.8E+06	10,736	3.13E+06	16,829	1.84E+07	4,535	1,589	4,495	2,181
1981	4,832	3.3E+04	6,509	2.8E-12	9,046	2.3E+06	13,748	1.2E+07	10,098	3.01E+06	18,468	2.15E+07	4,214	1,522	7,239	3,441
1982	3,473	1.8E+04	7,234	4.2E-12	6,517	1.2E+06	15,078	1.4E+07	7,354	1.66E+06	20,742	2.77E+07	3,044	1,107	7,844	3,701
1983	5,224	4.1E+04	8,075	2.3E-12	9,792	2.8E+06	16,993	1.8E+07	10,919	3.47E+06	16,452	1.77E+07	4,568	1,660	8,918	4,214
1984	6,543	6.4E+04	6,308	3.7E-12	12,227	4.3E+06	13,492	1.2E+07	13,332	5.02E+06	16,729	1.77E+07	5,684	2,054	7,185	3,396
1985	8,290	9.7E+04	6,569	6.5E-12	15,493	6.7E+06	13,727	1.1E+07	16,796	7.87E+06	11,373	8.39E+06	7,203	2,560	7,158	3,349
1986	8,198	9.9E+04	4,331	9.3E-12	15,396	6.7E+06	9,266	5.3E+06	16,738	7.96E+06	15,357	1.59E+07	7,198	2,560	4,935	2,313
1987	11,610	2.1E+05	6,026	7.0E-13	21,733	1.4E+07	12,555	9.8E+06	23,508	1.59E+07	12,042	9.69E+06	10,123	3,657	6,529	3,134
1988	7,903	9.0E+04	4,675	9.3E-12	14,737	6.2E+06	9,850	6.3E+06	16,006	7.22E+06	15,153	1.05E+07	6,834	2,470	5,175	2,506
1989	13,882	3.0E+05	7,126	2.8E-12	21,817	9.8E+06	12,362	6.6E+06	23,561	1.18E+07	15,873	1.16E+07	7,935	3,090	5,236	2,574
1990	13,465	2.7E+05	7,482	2.3E-12	21,151	9.1E+06	13,022	7.2E+06	22,816	1.09E+07	17,433	1.31E+07	7,685	2,967	5,540	2,689
1991	12,313	2.2E+05	8,410	1.4E-12	19,204	7.0E+06	14,336	8.6E+06	20,683	8.22E+06	17,798	1.43E+07	6,891	2,600	5,926	2,939
1992	20,004	5.9E+05	8,393	3.3E-12	31,531	2.1E+07	14,604	8.9E+06	33,900	2.44E+07	23,095	2.47E+07	11,527	4,487	6,211	2,982
1993	14,880	3.4E+05	10,940	0.0E+00	23,424	1.1E+07	18,971	1.6E+07	25,185	1.31E+07	17,513	1.44E+07	8,544	3,298	8,030	3,976
1994	10,014	1.5E+05	8,312	1.9E-12	15,674	4.9E+06	14,396	9.0E+06	16,865	5.82E+06	15,091	1.02E+07	5,660	2,173	6,084	2,997
1995	10,406	1.6E+05	7,148	3.5E-13	16,480	5.4E+06	12,409	6.5E+06	17,732	6.27E+06	9,402	5.92E+06	6,074	2,280	5,261	2,557
1996	14,285	3.0E+05	3,624	1.6E-12	26,593	1.9E+07	7,724	3.8E+06	28,592	2.19E+07	14,566	1.29E+07	12,308	4,292	4,100	1,942
1997	12,640	2.3E+05	5,702	5.8E-14	23,469	1.5E+07	11,982	8.6E+06	25,218	1.77E+07	12,877	1.08E+07	10,829	3,859	6,281	2,926
1998	15,232	3.6E+05	5,006	4.7E-13	28,677	2.5E+07	10,585	6.9E+06	30,816	2.94E+07	11,716	4.57E+06	13,444	4,973	5,579	2,631
1999	22,488	7.5E+05	5,130	1.2E-12	35,243	2.5E+07	9,628	2.7E+06	37,860	2.96E+07	0	4.57E+01	12,756	4,974	4,497	1,656
2000	0	0.0E+00	0	3.2E-11	0	0.0E+00	0	2.6E+01	0	0.00E+00	0	0.00E+00	0	0	0	5

Appendix 9b Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis
FRANCE

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners	SD
1971	1,740	4.66E-13	4,060	8.39E-12	54,100	2.18E+08	11,324	5.24E+06	58,869	2.60E+08	34,137	3.88E+07	52,360	14,748	7,264	2,289
1972	3,480	1.03E-11	8,120	1.86E-11	107,332	8.18E+08	22,708	2.14E+07	116,674	9.79E+08	22,009	1.51E+07	103,852	28,606	14,588	4,621
1973	2,130	4.66E-13	4,970	1.31E-11	65,011	2.95E+08	13,790	7.48E+06	70,743	3.52E+08	13,907	7.56E+06	62,881	17,170	8,820	2,736
1974	990	1.75E-13	2,310	4.66E-13	30,114	6.77E+07	6,435	1.64E+06	32,799	7.99E+07	20,026	1.34E+07	29,124	8,230	4,125	1,279
1975	1,980	9.32E-13	4,620	1.49E-11	60,209	2.63E+08	12,834	6.85E+06	65,511	3.15E+08	16,881	9.78E+06	58,229	16,232	8,214	2,618
1976	1,820	2.33E-13	3,380	2.80E-12	56,044	2.33E+08	9,318	3.50E+06	60,928	2.76E+08	11,748	4.44E+06	54,224	15,277	5,938	1,871
1977	1,400	9.32E-13	2,600	5.13E-12	42,226	1.24E+08	7,160	2.05E+06	45,900	1.47E+08	12,948	5.66E+06	40,826	11,146	4,560	1,431
1978	1,435	2.33E-13	2,665	1.86E-12	44,033	1.38E+08	7,436	2.26E+06	47,837	1.62E+08	12,288	4.83E+06	42,598	11,733	4,771	1,505
1979	1,645	1.63E-12	3,055	9.32E-13	49,904	1.90E+08	8,434	2.85E+06	54,259	2.26E+08	24,737	2.16E+07	48,259	13,783	5,379	1,687
1980	3,430	5.59E-12	6,370	7.46E-12	104,697	7.49E+08	17,463	1.27E+07	113,907	8.93E+08	17,571	1.68E+07	101,267	27,359	11,093	3,561
1981	2,720	1.12E-11	4,080	2.80E-12	83,598	5.16E+08	12,420	1.10E+07	91,140	6.16E+08	12,293	7.56E+06	80,878	22,708	8,340	3,311
1982	1,680	3.73E-12	2,520	4.20E-12	51,835	2.01E+08	7,566	3.99E+06	56,620	2.39E+08	11,506	7.49E+06	50,155	14,189	5,046	1,997
1983	1,800	2.33E-12	2,700	2.33E-12	55,451	2.28E+08	8,189	4.75E+06	60,604	2.73E+08	17,430	1.97E+07	53,651	15,097	5,489	2,179
1984	2,960	6.53E-12	4,440	3.73E-12	90,733	6.07E+08	13,704	1.36E+07	98,666	7.15E+08	12,557	1.01E+07	87,773	24,634	9,264	3,690
1985	1,100	6.99E-13	3,330	6.53E-12	33,671	8.04E+07	10,021	6.86E+06	36,703	9.58E+07	15,100	1.23E+07	32,571	8,968	6,691	2,619
1986	3,400	9.32E-13	3,400	9.32E-12	62,161	1.15E+09	10,496	7.82E+06	67,705	1.37E+09	8,269	3.67E+06	58,761	33,941	7,096	2,797
1987	6,000	2.61E-11	1,800	6.99E-13	108,178	3.38E+09	5,400	2.10E+06	117,554	3.98E+09	19,703	2.53E+07	102,178	58,156	3,600	1,448
1988	2,100	0.00E+00	5,000	9.32E-12	37,877	4.59E+08	15,188	1.72E+07	41,265	5.37E+08	11,498	6.38E+06	35,777	21,421	10,188	4,147
1989	1,100	5.83E-13	2,300	2.80E-12	20,068	1.25E+08	7,036	3.62E+06	21,917	1.48E+08	9,135	5.30E+06	18,968	11,165	4,736	1,903
1990	1,900	9.32E-13	2,300	2.33E-12	34,350	3.51E+08	7,063	3.58E+06	37,394	4.16E+08	7,612	3.98E+06	32,450	18,724	4,763	1,892
1991	1,400	3.50E-13	2,100	1.40E-12	24,474	1.72E+08	6,277	2.83E+06	26,613	2.04E+08	10,587	7.33E+06	23,074	13,130	4,177	1,681
1992	2,500	2.33E-12	2,700	3.26E-12	45,923	6.19E+08	8,296	4.97E+06	49,878	7.31E+08	5,296	1.76E+06	43,423	24,879	5,596	2,230
1993	3,600	3.73E-12	1,300	0.00E+00	65,390	1.24E+09	3,978	1.20E+06	70,986	1.46E+09	9,460	3.94E+06	61,790	35,148	2,678	1,096
1994	2,800	6.06E-12	2,300	1.86E-12	49,805	7.31E+08	7,966	2.64E+06	54,111	8.69E+08	4,525	8.80E+05	47,005	27,038	5,666	1,624
1995	1,669	1.40E-12	1,095	3.50E-13	15,878	4.17E+07	3,803	6.00E+05	17,257	4.90E+07	8,131	2.82E+06	14,209	6,455	2,708	774
1996	2,063	1.40E-12	1,942	1.63E-12	18,932	5.96E+07	6,764	1.89E+06	20,573	7.08E+07	4,176	6.60E+05	16,869	7,722	4,822	1,373
1997	1,060	5.83E-13	1,001	5.83E-14	9,681	1.60E+07	3,448	4.55E+05	10,513	1.89E+07	3,493	5.13E+05	8,621	3,997	2,447	675
1998	2,065	2.10E-12	846	4.66E-13	19,639	7.04E+07	2,928	3.45E+05	21,325	8.33E+07	7,583	2.58E+06	17,574	8,392	2,082	587
1999	690	5.83E-14	1,831	1.17E-12	6,388	7.00E+06	6,390	1.71E+06	6,932	8.25E+06	3	1.11E+02	5,698	2,646	4,559	1,306
2000	0	0.00E+00	0	3.17E-11	0	0.00E+00	0	2.61E+01	0	0.00E+00	0	0.00E+00	0	0	0	5

Appendix 9c Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis ICELAND

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners	SD
1971	21,832	17,016	13,352	6,262	44,584	2.8E+07	22,527	4.9E+06	47,904	3.41E+07	44,862	2.47E+07	22,752	5,327	9,175	2,206
1972	19,984	13,547	21,567	16,365	40,699	2.3E+07	36,428	1.3E+07	43,729	2.75E+07	38,317	1.67E+07	20,714	4,776	14,861	3,590
1973	20,464	14,624	18,394	11,787	41,500	2.3E+07	30,968	8.9E+06	44,589	2.75E+07	30,535	1.11E+07	21,036	4,781	12,574	2,982
1974	14,493	7,158	14,621	7,154	29,313	1.2E+07	24,662	5.6E+06	31,493	1.45E+07	38,225	1.78E+07	14,819	3,500	10,040	2,364
1975	20,745	15,214	18,406	12,028	41,969	2.4E+07	30,988	9.4E+06	45,093	2.94E+07	29,340	1.07E+07	21,224	4,944	12,583	3,061
1976	17,704	11,138	14,161	7,269	36,001	1.9E+07	23,760	5.4E+06	38,679	2.20E+07	36,369	1.53E+07	18,297	4,307	9,599	2,312
1977	19,854	13,668	17,776	11,003	40,050	2.1E+07	29,814	8.3E+06	43,028	2.54E+07	47,881	2.80E+07	20,195	4,626	12,038	2,872
1978	24,623	21,087	23,359	19,352	50,030	3.4E+07	39,420	1.5E+07	53,747	4.00E+07	33,488	1.27E+07	25,407	5,829	16,061	3,844
1979	24,244	21,393	16,306	9,109	48,956	3.5E+07	27,380	7.0E+06	52,597	4.15E+07	42,734	2.26E+07	24,712	5,915	11,074	2,650
1980	7,805	2,108	20,568	14,563	15,833	3.3E+06	34,405	1.1E+07	17,013	3.98E+06	21,685	4.88E+06	8,028	1,815	13,837	3,385
1981	15,862	8,276	9,711	3,333	32,234	1.5E+07	16,320	2.5E+06	34,634	1.77E+07	21,418	4.94E+06	16,372	3,837	6,609	1,585
1982	12,117	5,169	9,674	3,206	24,661	8.7E+06	16,181	2.4E+06	26,496	1.03E+07	25,180	7.12E+06	12,544	2,947	6,507	1,547
1983	16,356	9,330	11,717	4,651	33,267	1.6E+07	19,667	3.6E+06	35,744	1.91E+07	25,782	7.53E+06	16,911	3,983	7,950	1,896
1984	10,193	3,626	12,172	5,179	20,687	6.1E+06	20,556	4.0E+06	22,224	7.14E+06	15,196	2.46E+06	10,495	2,464	8,384	2,004
1985	20,478	13,869	7,024	1,722	41,570	2.3E+07	11,763	1.2E+06	44,665	2.81E+07	27,162	8.46E+06	21,092	4,842	4,739	1,112
1986	31,404	33,996	12,777	5,759	63,976	5.6E+07	21,583	4.4E+06	68,742	6.76E+07	27,611	9.24E+06	32,572	7,477	8,806	2,095
1987	20,808	15,634	13,159	5,782	42,281	2.5E+07	21,993	4.6E+06	45,425	2.92E+07	22,335	5.88E+06	21,473	4,964	8,834	2,140
1988	38,322	48,975	10,734	3,928	77,661	8.5E+07	18,014	3.1E+06	83,433	9.95E+07	20,308	4.71E+06	39,340	9,193	7,280	1,770
1989	20,783	15,486	9,592	3,217	42,244	2.5E+07	16,143	2.5E+06	45,392	3.07E+07	22,169	5.74E+06	21,461	5,033	6,551	1,590
1990	19,344	12,857	10,539	3,740	39,301	2.1E+07	17,767	3.0E+06	42,230	2.59E+07	17,980	3.63E+06	19,958	4,626	7,227	1,735
1991	23,349	18,729	8,790	2,545	47,160	2.9E+07	14,671	2.1E+06	50,666	3.46E+07	24,265	7.29E+06	23,812	5,400	5,880	1,432
1992	31,292	33,611	11,871	4,691	63,763	5.8E+07	20,013	3.8E+06	68,508	6.93E+07	20,124	4.97E+06	32,471	7,612	8,142	1,954
1993	29,954	32,070	9,865	3,448	60,970	5.1E+07	16,596	2.7E+06	65,500	6.01E+07	21,788	5.83E+06	31,015	7,138	6,731	1,646
1994	17,923	11,335	10,693	3,925	36,306	1.8E+07	17,980	3.1E+06	39,010	2.15E+07	18,138	3.93E+06	18,383	4,215	7,287	1,773
1995	26,078	23,906	8,869	2,644	53,364	3.8E+07	14,933	2.2E+06	57,329	4.52E+07	16,336	3.28E+06	27,286	6,195	6,064	1,467
1996	22,057	16,914	7,970	2,206	44,667	2.6E+07	13,440	1.7E+06	47,989	3.15E+07	14,785	2.43E+06	22,610	5,144	5,470	1,315
1997	21,914	16,416	7,310	1,965	44,281	2.7E+07	12,268	1.4E+06	47,573	3.17E+07	16,180	3.31E+06	22,367	5,172	4,959	1,162
1998	36,262	47,042	7,951	2,186	73,779	7.5E+07	13,430	1.7E+06	79,271	9.00E+07	22,681	6.49E+06	37,517	8,666	5,479	1,318
1999	24,208	20,434	11,185	4,393	49,268	3.4E+07	18,834	3.4E+06	52,941	4.19E+07	-26	4.20E+05	25,060	5,870	7,649	1,842
2000	0	0	0	0	0	0.0E+00	-21	2.6E+05	0	0.00E+00	0	0.00E+00	0	0	-21	511

Appendix 9d Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis
IRELAND

Year	Estimated total catch 1SW		Estimated total catch MSW		Estimated number 1SW returns		Estimated number MSW returns		Estimated maturing 1SW recruits		Est. non-mat. 1SW recruits		Est. 1SW spawners		Est MSW spawners
		Variance		Variance	mean	Variance	mean	Variance	Mean	Variance	mran	Variance		SD	
1971	761,701	2.89E+09	84,794	3.43E+07	1,309,418	1.19E+10	167,368	2.04E+08	1,415,594	1.45E+10	265,435	4.90E+08	547,717	95,087	82,574
1972	839,908	3.53E+09	93,673	4.30E+07	1,441,366	1.46E+10	184,581	2.41E+08	1,558,425	1.83E+10	272,337	5.24E+08	601,458	105,392	90,909
1973	900,119	3.84E+09	99,996	4.79E+07	1,544,840	1.61E+10	196,784	2.78E+08	1,670,373	2.04E+10	298,119	6.80E+08	644,721	110,806	96,788
1974	991,106	4.64E+09	110,453	6.06E+07	1,700,643	1.97E+10	217,382	3.33E+08	1,838,711	2.50E+10	302,499	7.22E+08	709,537	122,632	106,929
1975	1,034,073	5.31E+09	114,995	6.56E+07	1,775,250	2.34E+10	226,776	3.72E+08	1,919,466	2.96E+10	225,956	3.74E+08	741,177	134,330	111,782
1976	730,043	2.61E+09	81,086	3.17E+07	1,254,844	1.14E+10	159,428	1.77E+08	1,356,779	1.45E+10	188,469	2.50E+08	524,802	93,887	78,342
1977	641,624	1.94E+09	71,484	2.49E+07	1,100,744	8.50E+09	140,921	1.32E+08	1,190,070	1.07E+10	174,014	2.34E+08	459,120	81,003	69,437
1978	572,825	1.58E+09	63,789	2.08E+07	985,838	6.68E+09	125,442	1.18E+08	1,065,801	8.39E+09	149,900	1.73E+08	413,013	71,414	61,654
1979	512,651	1.25E+09	56,884	1.56E+07	882,635	5.70E+09	112,109	8.86E+07	954,356	7.19E+09	182,064	2.24E+08	369,983	66,673	55,225
1980	401,009	8.02E+08	63,725	1.87E+07	689,544	3.39E+09	125,650	1.10E+08	745,821	4.15E+09	155,301	1.58E+08	288,534	50,900	61,925
1981	279,406	3.77E+08	51,817	1.32E+07	417,330	1.30E+09	102,241	7.80E+07	451,872	1.61E+09	96,814	1.88E+08	137,924	30,432	50,423
1982	597,590	1.53E+10	24,341	2.44E+07	937,922	3.75E+10	51,781	1.18E+08	1,014,320	4.37E+10	135,971	1.30E+08	340,332	148,857	27,441
1983	808,213	3.10E+09	47,306	1.09E+07	1,386,500	1.37E+10	94,771	6.39E+07	1,499,645	1.72E+10	118,862	1.54E+08	578,287	102,818	47,466
1984	406,676	1.56E+09	33,411	1.00E+07	631,107	4.80E+09	86,664	8.58E+07	682,640	5.85E+09	108,721	1.31E+08	224,430	56,935	53,253
1985	841,274	6.27E+09	33,099	1.04E+07	1,180,864	1.51E+10	80,396	7.75E+07	1,276,618	1.80E+10	126,203	1.65E+08	339,590	94,174	47,298
1986	834,513	6.56E+09	47,660	2.23E+07	1,222,296	1.72E+10	85,460	9.31E+07	1,321,937	2.16E+10	149,244	2.95E+08	387,783	103,113	37,800
1987	541,781	3.46E+09	41,219	1.94E+07	836,633	9.45E+09	108,648	1.64E+08	904,710	1.14E+10	124,693	1.88E+08	294,852	77,360	67,428
1988	781,323	6.21E+09	42,651	1.90E+07	1,580,247	2.93E+10	92,514	1.10E+08	1,708,615	3.57E+10	112,170	5.95E+07	798,924	151,989	49,863
1989	471,179	4.50E+08	38,370	2.89E+06	724,494	2.17E+09	73,906	2.32E+07	783,424	2.84E+09	52,923	1.16E+07	253,315	41,455	35,536
1990	277,400	1.53E+08	22,632	1.00E+06	558,518	1.27E+09	35,083	4.97E+06	604,011	1.75E+09	39,238	9.14E+06	281,118	33,366	12,451
1991	194,008	7.52E+07	15,696	4.85E+05	448,958	8.67E+08	29,686	3.82E+06	485,446	1.15E+09	71,198	3.01E+07	254,950	28,141	13,990
1992	334,898	2.25E+08	27,257	1.52E+06	653,802	1.91E+09	55,397	1.36E+07	706,823	2.49E+09	36,957	9.21E+06	318,904	41,034	28,141
1993	258,800	2.47E+08	21,096	1.63E+06	519,844	1.69E+09	27,467	4.45E+06	561,990	2.13E+09	74,478	2.77E+07	261,044	37,968	6,370
1994	347,062	4.29E+07	28,270	2.81E+05	682,129	1.09E+09	61,493	9.55E+06	737,462	1.58E+09	65,836	1.95E+07	335,067	32,334	33,223
1995	306,875	3.33E+07	24,960	2.17E+05	554,898	7.70E+08	54,068	6.98E+06	599,956	1.14E+09	47,868	1.47E+07	248,024	27,140	29,107
1996	318,361	4.06E+07	25,933	2.62E+05	622,641	2.22E+08	38,591	6.45E+06	673,146	5.12E+08	50,154	1.92E+07	304,281	13,473	12,659
1997	228,853	5.72E+07	18,676	4.06E+05	619,346	5.51E+09	41,685	9.18E+06	669,534	6.66E+09	55,996	2.52E+07	390,493	73,818	23,009
1998	259,024	7.84E+07	21,038	5.31E+05	747,022	4.61E+09	46,976	1.23E+07	807,525	5.67E+09	42,483	1.31E+07	487,999	67,294	25,937
1999	196,569	4.49E+07	15,984	3.15E+05	361,190	1.61E+09	35,736	6.70E+06	390,483	1.98E+09	19	4.17E+02	164,622	39,547	19,752
2000	0	0.00E+00	0	3.37E-11	0	0.00E+00	0	2.31E+01	0	0.00E+00	0	0.00E+00	0	0	0

Appendix 9e Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis NORWAY

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns	Variance	Estimated number MSW returns	Variance	Estimated maturing 1SW recruits	Variance	Est. non-mat. 1SW recruits	Variance	Est. 1SW spawners	SD	Est MSW spawners	SD
1971	429,926	2.61E+09	274,849	1.05E+09	542,551	5.69E+09	346,155	2.34E+09	577,799	6.60E+09	596,979	6.23E+09	112,626	55,558	71,306	36,004
1972	563,733	4.31E+09	358,801	1.79E+09	710,647	9.96E+09	452,166	3.95E+09	756,563	1.15E+10	653,938	7.84E+09	146,913	75,185	93,366	46,453
1973	620,507	5.37E+09	394,132	2.15E+09	780,023	1.17E+10	495,754	4.90E+09	830,476	1.35E+10	608,182	6.76E+09	159,516	79,636	101,622	52,441
1974	584,841	4.66E+09	372,556	1.85E+09	733,824	1.05E+10	469,011	4.02E+09	781,081	1.21E+10	582,488	6.51E+09	148,983	76,455	96,455	46,617
1975	552,233	4.30E+09	351,205	1.74E+09	692,879	9.19E+09	441,701	4.00E+09	737,692	1.06E+10	564,548	6.32E+09	140,646	69,879	90,496	47,508
1976	549,501	4.24E+09	349,435	1.75E+09	691,676	9.30E+09	438,221	3.78E+09	736,002	1.05E+10	535,278	5.67E+09	142,175	71,137	88,786	45,057
1977	535,231	3.91E+09	338,563	1.60E+09	670,528	8.45E+09	424,472	3.46E+09	713,351	9.58E+09	383,997	2.91E+09	135,298	67,401	85,909	43,103
1978	379,629	1.99E+09	240,113	8.13E+08	477,459	4.10E+09	302,434	1.79E+09	508,031	4.72E+09	655,634	8.43E+09	97,830	45,979	62,321	31,315
1979	657,032	6.26E+09	414,988	2.32E+09	823,531	1.38E+10	520,857	5.22E+09	876,247	1.58E+10	701,428	8.58E+09	166,499	86,944	105,870	53,927
1980	656,336	5.90E+09	414,656	2.35E+09	825,289	1.30E+10	518,657	5.01E+09	879,102	1.51E+10	782,988	9.56E+09	168,954	84,257	104,001	51,565
1981	449,596	2.64E+09	433,994	2.65E+09	565,819	6.03E+09	544,954	5.85E+09	604,012	7.01E+09	654,750	5.83E+09	116,223	58,190	110,961	56,558
1982	331,938	1.53E+09	354,985	1.70E+09	418,226	3.52E+09	444,024	3.58E+09	446,831	4.03E+09	617,578	5.80E+09	86,288	44,591	89,039	43,334
1983	562,000	4.39E+09	346,864	1.62E+09	707,661	9.93E+09	435,063	3.48E+09	754,956	1.15E+10	606,599	6.24E+09	145,662	74,459	88,199	43,094
1984	597,214	4.92E+09	357,754	1.77E+09	750,866	1.09E+10	450,849	3.90E+09	799,587	1.24E+10	563,432	5.39E+09	153,652	77,246	93,095	46,162
1985	608,221	4.84E+09	330,793	1.51E+09	765,132	1.10E+10	414,233	3.19E+09	814,526	1.26E+10	659,902	7.80E+09	156,911	78,472	83,440	40,996
1986	539,110	4.01E+09	388,101	2.08E+09	679,673	9.11E+09	489,148	4.54E+09	723,961	1.05E+10	535,384	4.70E+09	140,563	71,420	101,048	49,603
1987	477,771	3.26E+09	309,683	1.27E+09	601,595	7.58E+09	387,230	2.76E+09	640,712	8.76E+09	408,572	2.85E+09	123,824	65,705	77,547	38,562
1988	439,321	2.59E+09	245,217	8.16E+08	551,948	5.84E+09	307,552	1.79E+09	587,982	6.71E+09	384,572	2.97E+09	112,627	56,999	62,336	31,188
1989	446,623	2.83E+09	164,379	3.74E+08	753,036	1.38E+10	276,707	1.86E+09	801,507	1.59E+10	425,237	3.73E+09	306,414	104,651	112,328	38,486
1990	390,236	2.08E+09	185,665	4.58E+08	657,825	1.03E+10	313,051	2.29E+09	700,164	1.20E+10	394,447	3.38E+09	267,588	90,646	127,386	42,861
1991	359,813	1.77E+09	186,872	4.60E+08	603,500	8.26E+09	311,867	2.18E+09	642,044	9.45E+09	409,446	3.96E+09	243,687	80,561	124,995	41,524
1992	303,049	1.27E+09	197,927	5.16E+08	512,085	6.35E+09	333,513	2.42E+09	544,646	7.24E+09	324,201	2.16E+09	209,036	71,310	135,587	43,692
1993	253,776	6.29E+08	156,632	2.37E+08	428,543	3.72E+09	263,450	1.33E+09	455,818	4.25E+09	345,889	2.51E+09	174,767	55,570	106,818	33,071
1994	258,672	6.46E+08	167,073	2.62E+08	434,963	3.66E+09	280,981	1.55E+09	462,724	4.25E+09	346,553	2.27E+09	176,291	54,870	113,908	35,856
1995	226,547	4.90E+08	166,656	2.53E+08	384,153	2.83E+09	280,522	1.44E+09	408,654	3.25E+09	337,507	2.36E+09	157,606	48,392	113,866	34,421
1996	183,972	3.20E+08	162,142	2.49E+08	309,108	1.70E+09	273,394	1.40E+09	328,832	1.95E+09	236,839	1.17E+09	125,136	37,076	111,252	34,000
1997	192,723	2.92E+08	107,353	9.81E+07	353,279	2.36E+09	196,921	7.70E+08	375,697	2.71E+09	281,631	1.73E+09	160,555	45,502	89,568	25,915
1998	251,408	5.26E+08	127,693	1.32E+08	465,014	4.70E+09	234,626	1.06E+09	494,525	5.40E+09	337,584	3.06E+09	213,605	64,601	106,932	30,507
1999	255,014	5.21E+08	138,309	1.57E+08	517,202	6.04E+09	281,702	1.90E+09	549,911	6.83E+09	3	1.12E+02	262,187	74,310	143,392	41,797
2000	0	0.00E+00	0	3.17E-11	0	0.00E+00	0	2.61E+01	0	0.00E+00	0	0.00E+00	0	0	0	5

Appendix 9f Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis RUSSIA

Year	Estimated total catch 1SW		Estimated total catch MSW		Estimated number 1SW returns		Estimated number MSW returns		Estimated maturing 1SW recruits		Est. non-mat. 1SW recruits		Est. 1SW spawners		Est MSW spawners	
		Variance		Variance	mean	Variance	mean	Variance	Mean	Variance	mran	Variance		SD		SD
1971	60,484	4.84E+06	101,041	1.33E+07	123,214	2.34E+08	204,419	6.19E+08	133,724	2.89E+08	225,393	6.92E+08	62,730	15,131	103,379	24,602
1972	67,100	5.90E+06	84,340	8.87E+06	136,168	2.81E+08	171,191	4.29E+08	147,750	3.42E+08	364,213	2.06E+09	69,067	16,587	86,851	20,502
1973	112,106	1.58E+07	141,104	2.66E+07	227,949	7.52E+08	285,805	1.27E+09	247,158	8.98E+08	330,001	1.81E+09	115,843	27,134	144,702	35,243
1974	102,989	1.42E+07	129,562	2.21E+07	209,024	6.92E+08	262,515	1.05E+09	226,598	8.44E+08	412,104	2.72E+09	106,034	26,044	132,953	32,033
1975	110,242	1.66E+07	162,464	3.58E+07	222,776	7.52E+08	328,524	1.67E+09	241,535	9.08E+08	346,718	1.85E+09	112,533	27,113	166,060	40,370
1976	83,206	9.10E+06	138,815	2.43E+07	168,049	4.17E+08	279,260	1.17E+09	182,161	4.98E+08	261,358	1.13E+09	84,843	20,186	140,445	33,822
1977	69,557	6.46E+06	104,052	1.41E+07	141,542	3.05E+08	211,185	7.05E+08	153,417	3.69E+08	181,723	5.38E+08	71,986	17,276	107,133	26,284
1978	75,971	7.42E+06	72,158	7.12E+06	153,669	3.55E+08	146,328	3.29E+08	166,542	4.38E+08	205,281	6.15E+08	77,698	18,657	74,170	17,930
1979	86,826	9.77E+06	79,873	7.95E+06	174,805	4.64E+08	161,559	3.78E+08	189,504	5.69E+08	325,310	1.52E+09	87,979	21,312	81,686	19,232
1980	57,173	4.35E+06	121,080	1.97E+07	115,761	2.03E+08	244,655	9.26E+08	125,839	2.46E+08	217,340	4.52E+08	58,587	14,089	123,575	30,107
1981	40,882	2.15E+06	65,676	5.76E+06	82,283	9.70E+07	133,565	2.69E+08	89,857	1.17E+08	216,104	6.84E+08	41,401	9,741	67,889	16,233
1982	49,672	3.15E+06	53,115	3.81E+06	126,398	3.62E+08	135,547	4.26E+08	137,574	4.31E+08	301,618	1.73E+09	76,726	18,937	82,432	20,545
1983	72,400	6.89E+06	85,589	9.83E+06	186,000	8.09E+08	217,291	1.05E+09	202,247	9.79E+08	302,599	1.92E+09	113,600	28,320	131,702	32,248
1984	68,927	6.24E+06	90,356	1.04E+07	174,741	6.70E+08	229,538	1.21E+09	189,662	8.17E+08	335,079	2.37E+09	105,813	25,765	139,182	34,585
1985	91,107	1.10E+07	100,337	1.29E+07	234,130	1.27E+09	256,631	1.54E+09	253,882	1.54E+09	372,969	2.77E+09	143,022	35,450	156,294	39,100
1986	79,895	8.02E+06	111,895	1.62E+07	202,039	9.42E+08	286,869	1.83E+09	219,192	1.13E+09	190,649	6.75E+08	122,144	30,563	174,974	42,623
1987	121,900	1.91E+07	52,286	3.54E+06	328,552	1.65E+09	133,649	4.40E+08	356,089	1.98E+09	195,297	8.07E+08	206,652	40,381	81,363	20,899
1988	66,584	5.83E+06	58,597	4.59E+06	180,076	5.05E+08	149,625	5.21E+08	195,403	6.29E+08	237,471	2.04E+09	113,492	22,340	91,028	22,714
1989	97,713	1.21E+07	39,304	2.33E+06	264,793	1.07E+09	180,681	1.35E+09	287,008	1.31E+09	232,523	1.13E+09	167,079	32,539	141,377	36,703
1990	88,360	9.70E+06	34,300	1.67E+06	236,561	8.41E+08	176,719	7.01E+08	256,378	1.03E+09	188,122	9.43E+08	148,201	28,841	142,419	26,445
1991	68,009	2.03E+07	29,298	4.08E+06	229,243	7.04E+08	150,478	6.16E+08	248,399	8.77E+08	166,818	7.73E+08	161,234	26,156	121,180	24,730
1992	56,948	7.70E+06	26,896	2.40E+06	191,591	4.42E+08	137,032	4.92E+08	207,538	5.46E+08	245,084	1.67E+09	134,642	20,840	110,136	22,119
1993	46,894	5.07E+06	39,963	6.41E+06	157,715	3.03E+08	203,415	1.06E+09	170,839	3.70E+08	213,161	1.23E+09	110,821	17,269	163,452	32,460
1994	51,691	6.00E+06	34,143	6.04E+06	174,041	3.52E+08	176,107	8.06E+08	188,525	4.33E+08	157,743	6.95E+08	122,351	18,610	141,964	28,275
1995	46,333	5.00E+06	25,193	3.22E+06	156,256	2.87E+08	128,854	4.57E+08	169,280	3.54E+08	241,890	2.83E+09	109,923	16,800	103,661	21,311
1996	56,560	7.89E+06	29,370	8.00E+06	189,883	4.22E+08	200,210	1.96E+09	205,643	5.01E+08	199,621	2.16E+09	133,323	20,355	170,840	44,168
1997	53,178	6.38E+06	23,911	5.57E+06	178,569	3.64E+08	167,890	1.46E+09	193,381	4.42E+08	196,985	2.29E+09	125,391	18,914	143,979	38,185
1998	58,173	7.97E+06	23,624	5.47E+06	195,752	4.64E+08	165,830	1.54E+09	212,001	5.67E+08	193,314	2.07E+09	137,579	21,348	142,206	39,213
1999	40,129	3.74E+06	23,475	5.20E+06	135,586	2.25E+08	162,866	1.38E+09	146,833	2.75E+08	0	4.05E-05	95,457	14,873	139,391	37,079
2000	0	0.00E+00	0	1.08E-07	0	0.00E+00	0	2.74E-05	0	0.00E+00	0	0.00E+00	0	0	0	0

Appendix 9g Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - SWEDEN

Year	Estimated total catch 1SW		Estimated total catch MSW		Estimated number 1SW returns		Estimated number MSW returns		Estimated maturing 1SW recruits		Est. non-mat. 1SW recruits		Est. 1SW spawners		Est MSW spawners	
		Variance		Variance	mean	Variance	mean	Variance	Mean	Variance	mran	Variance		SD		SD
1971	9,865	1.80E+06	655	8.21E+03	12,028	3.71E+06	863	3.63E+04	13,016	4.31E+06	4,349	9.41E+05	2,163	1,381	208	168
1972	7,826	1.08E+06	461	3.87E+03	9,569	2.31E+06	608	1.71E+04	10,391	2.70E+06	6,344	9.51E+05	1,743	1,107	146	115
1973	9,764	1.79E+06	1,599	4.62E+04	11,921	3.93E+06	2,107	2.13E+05	12,935	4.67E+06	4,674	9.21E+05	2,157	1,462	508	408
1974	14,035	3.67E+06	1,034	2.03E+04	17,131	7.63E+06	1,366	9.78E+04	18,462	8.83E+06	3,760	4.71E+05	3,097	1,990	332	279
1975	15,037	4.34E+06	252	1.19E+03	18,336	9.27E+06	334	5.62E+03	19,787	1.09E+07	3,806	7.23E+05	3,298	2,220	82	67
1976	8,531	1.31E+06	755	1.02E+04	10,359	2.75E+06	994	4.88E+04	11,191	3.19E+06	2,636	2.68E+05	1,828	1,200	239	196
1977	3,992	2.97E+05	561	5.76E+03	4,881	6.59E+05	748	2.71E+04	5,294	7.65E+05	2,182	3.14E+05	889	602	186	146
1978	4,599	4.07E+05	432	3.39E+03	5,620	8.83E+05	576	1.71E+04	6,071	1.03E+06	4,000	3.09E+05	1,021	690	144	117
1979	4,814	4.13E+05	1,264	3.05E+04	5,873	8.92E+05	1,679	1.39E+05	6,381	1.05E+06	8,361	1.05E+06	1,058	692	415	329
1980	6,130	7.17E+05	2,196	8.90E+04	7,470	1.53E+06	2,900	4.47E+05	8,238	1.85E+06	8,750	6.33E+05	1,340	899	703	598
1981	11,075	2.32E+06	642	7.45E+03	13,559	4.90E+06	855	3.58E+04	14,904	5.99E+06	11,006	2.05E+06	2,484	1,606	212	168
1982	9,735	1.80E+06	2,293	9.52E+04	11,883	3.74E+06	3,055	4.60E+05	13,082	4.59E+06	8,194	1.39E+06	2,148	1,390	762	604
1983	12,982	3.20E+06	1,566	4.53E+04	15,801	6.55E+06	2,069	2.22E+05	17,322	7.73E+06	7,503	1.31E+06	2,819	1,830	503	420
1984	18,258	6.07E+06	2,219	8.53E+04	22,232	1.28E+07	2,951	4.17E+05	24,008	1.48E+07	5,420	3.75E+05	3,974	2,594	732	576
1985	21,625	8.45E+06	919	1.56E+04	26,420	1.74E+07	1,228	7.23E+04	28,452	2.05E+07	5,857	4.97E+05	4,794	2,993	309	238
1986	22,863	9.63E+06	901	1.51E+04	27,997	2.05E+07	1,186	6.49E+04	30,181	2.38E+07	8,511	1.33E+06	5,134	3,300	285	223
1987	18,585	6.24E+06	2,673	1.33E+05	22,719	1.43E+07	3,533	5.78E+05	24,495	1.66E+07	6,563	1.28E+06	4,134	2,830	860	667
1988	15,522	4.56E+06	2,586	1.27E+05	18,960	9.67E+06	3,421	5.69E+05	20,485	1.13E+07	14,781	6.95E+06	3,438	2,262	836	664
1989	4,971	4.68E+05	7,203	9.67E+05	6,058	9.58E+05	9,548	4.27E+06	6,607	1.15E+06	10,913	3.61E+06	1,087	700	2,345	1,819
1990	11,671	2.41E+06	4,968	4.62E+05	14,328	5.07E+06	6,589	2.18E+06	15,436	5.96E+06	10,255	4.65E+06	2,656	1,633	1,621	1,311
1991	14,018	3.78E+06	5,657	6.04E+05	17,176	8.02E+06	7,476	2.95E+06	18,452	9.42E+06	12,384	7.94E+06	3,158	2,059	1,819	1,532
1992	15,354	4.30E+06	7,300	1.01E+06	18,728	9.47E+06	9,744	5.00E+06	20,087	1.12E+07	16,391	1.21E+07	3,374	2,274	2,445	1,999
1993	16,511	4.87E+06	9,995	1.91E+06	20,117	9.99E+06	13,138	7.76E+06	21,571	1.17E+07	12,296	6.96E+06	3,606	2,262	3,143	2,419
1994	12,446	2.83E+06	7,297	1.01E+06	17,448	8.16E+06	9,735	4.49E+06	18,710	9.43E+06	7,995	2.37E+06	5,002	2,309	2,438	1,866
1995	15,291	4.17E+06	4,327	3.52E+05	24,831	2.01E+07	6,107	1.49E+06	26,634	2.40E+07	10,035	3.56E+06	9,539	3,990	1,780	1,066
1996	9,443	1.61E+06	5,558	5.43E+05	15,166	7.19E+06	7,829	2.27E+06	16,268	8.38E+06	6,255	1.67E+06	5,723	2,361	2,271	1,316
1997	4,304	3.53E+05	3,624	2.45E+05	7,030	1.65E+06	5,123	1.06E+06	7,535	1.90E+06	3,451	3.26E+05	2,726	1,138	1,499	901
1998	2,860	3.94E+04	2,012	1.90E+04	4,007	2.66E+05	2,828	1.98E+05	4,297	3.11E+05	2,406	1.81E+05	1,147	476	816	423
1999	3,451	5.54E+04	1,403	9.37E+03	4,809	3.54E+05	1,985	1.07E+05	5,152	4.17E+05	0	5.26E+01	1,358	546	582	313
2000	0	0.00E+00	0	3.17E-11	0	0.00E+00	0	2.61E+01	0	0.00E+00	0	0.00E+00	0	0	0	5

Appendix 9h Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - UK(ENGLAND AND WALES)

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners
1971	52,986	3.96E+07	28,806	1.15E+07	154,565	1.02E+09	101,726	5.92E+08	168,074	1.22E+09	190,032	1.33E+09	101,580	31,276	72,921
1972	65,356	5.79E+07	34,602	1.67E+07	190,057	1.58E+09	122,457	8.52E+08	206,612	1.90E+09	176,866	1.23E+09	124,702	38,985	87,855
1973	65,132	5.91E+07	33,658	1.57E+07	188,100	1.48E+09	118,332	8.07E+08	204,528	1.77E+09	182,253	1.24E+09	122,968	37,732	84,674
1974	67,539	6.22E+07	34,229	1.56E+07	194,433	1.66E+09	120,613	7.76E+08	211,292	1.98E+09	197,053	1.80E+09	126,894	40,000	86,384
1975	79,975	9.03E+07	39,564	2.21E+07	230,129	2.23E+09	139,246	1.17E+09	250,114	2.67E+09	129,908	5.56E+08	150,154	46,253	99,682
1976	48,453	3.30E+07	23,429	7.88E+06	136,727	7.76E+08	79,503	3.41E+08	148,580	9.17E+08	124,657	5.98E+08	88,275	27,258	56,074
1977	56,384	4.34E+07	26,507	9.82E+06	153,208	9.00E+08	87,454	3.86E+08	166,409	1.06E+09	138,909	7.22E+08	96,824	29,261	60,947
1978	63,935	5.64E+07	29,368	1.22E+07	170,816	1.04E+09	95,584	4.62E+08	185,509	1.24E+09	91,052	2.98E+08	106,882	31,371	66,216
1979	45,229	2.96E+07	20,270	5.53E+06	117,100	5.40E+08	63,699	1.94E+08	127,287	6.44E+08	113,922	3.58E+08	71,871	22,583	43,429
1980	59,101	4.78E+07	25,878	9.15E+06	138,245	6.12E+08	72,453	2.14E+08	150,564	7.42E+08	134,239	5.47E+08	79,144	23,759	46,575
1981	78,012	7.96E+07	33,424	1.57E+07	178,914	1.02E+09	92,283	3.49E+08	194,995	1.23E+09	90,817	1.79E+08	100,901	30,629	58,859
1982	48,498	3.27E+07	20,319	5.56E+06	109,092	3.89E+08	54,423	1.08E+08	119,115	4.65E+08	97,598	2.70E+08	60,593	18,882	34,104
1983	63,229	5.56E+07	25,865	9.01E+06	139,128	6.11E+08	68,241	1.69E+08	151,840	7.40E+08	81,191	1.93E+08	75,899	23,565	42,376
1984	57,681	4.59E+07	22,942	7.27E+06	121,862	4.38E+08	58,829	1.25E+08	132,658	5.22E+08	75,504	1.70E+08	64,180	19,804	35,887
1985	58,962	4.55E+07	22,963	7.29E+06	120,988	4.07E+08	56,384	1.05E+08	131,630	4.87E+08	107,036	3.03E+08	62,026	19,022	33,422
1986	78,201	8.44E+07	29,529	1.21E+07	160,557	7.46E+08	73,247	1.84E+08	174,691	9.03E+08	88,425	2.11E+08	82,355	25,722	43,718
1987	68,135	6.63E+07	25,076	8.34E+06	140,232	6.05E+08	61,514	1.27E+08	152,547	7.30E+08	110,906	3.71E+08	72,098	23,204	36,438
1988	90,842	1.11E+08	33,052	1.48E+07	188,315	1.02E+09	82,471	2.39E+08	204,755	1.22E+09	93,264	2.01E+08	97,473	30,191	49,419
1989	73,588	7.69E+07	25,904	9.29E+06	142,820	5.62E+08	60,566	1.23E+08	155,278	6.80E+08	72,859	1.53E+08	69,232	22,026	34,662
1990	69,415	6.59E+07	23,799	7.52E+06	131,951	4.61E+08	54,621	9.52E+07	143,438	5.64E+08	38,158	4.30E+07	62,536	19,885	30,823
1991	38,642	2.04E+07	12,843	2.17E+06	75,072	1.45E+08	29,883	2.81E+07	81,589	1.74E+08	38,980	4.28E+07	36,430	11,167	17,040
1992	35,101	1.70E+07	11,479	1.73E+06	72,339	1.53E+08	28,480	2.65E+07	78,563	1.82E+08	47,434	1.09E+08	37,238	11,646	17,001
1993	54,329	8.03E+07	12,893	4.45E+06	127,317	7.85E+08	36,344	7.18E+07	138,237	9.34E+08	78,247	3.71E+08	72,988	26,551	23,450
1994	73,364	1.45E+08	21,750	1.24E+07	179,462	1.55E+09	64,464	2.44E+08	194,896	1.87E+09	49,770	8.45E+07	106,098	37,453	42,714
1995	34,191	1.54E+06	13,306	2.23E+05	87,302	1.70E+08	40,754	5.49E+07	94,812	2.04E+08	61,238	1.73E+08	53,111	12,995	27,448
1996	25,832	8.73E+05	13,929	2.53E+05	75,517	1.64E+08	49,864	1.11E+08	82,016	1.97E+08	37,059	6.50E+07	49,685	12,781	35,935
1997	21,772	6.08E+05	8,051	8.97E+04	67,461	1.53E+08	30,336	4.40E+07	73,234	1.82E+08	24,315	3.76E+07	45,689	12,344	22,284
1998	23,159	7.23E+05	4,745	2.96E+04	81,225	3.02E+08	20,063	2.48E+07	88,184	3.61E+08	43,656	1.74E+08	58,066	17,355	15,319
1999	17,092	3.80E+05	7,323	7.14E+04	67,994	2.60E+08	36,208	1.15E+08	73,789	3.06E+08	20	3.89E+02	50,902	16,104	28,885
2000	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0	0

Appendix 9i Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - UK(NORTHERN IRELAND)

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners	SD
1971	90,313	6.09E+07	12,050	0.00E+00	131,797	1.90E+08	26,350	8.03E+06	143,211	2.38E+08	28,154	1.06E+07	41,484	11,350	14,300	2,834
1972	81,234	4.72E+07	10,802	0.00E+00	118,434	1.56E+08	23,635	6.38E+06	128,705	1.94E+08	24,438	8.38E+06	37,200	10,419	12,833	2,527
1973	70,721	3.68E+07	9,391	0.00E+00	102,884	1.14E+08	20,512	4.95E+06	111,849	1.42E+08	24,722	8.35E+06	32,162	8,801	11,121	2,225
1974	71,305	3.65E+07	9,489	0.00E+00	103,569	1.17E+08	20,744	4.63E+06	112,545	1.47E+08	22,032	7.13E+06	32,264	8,997	11,255	2,151
1975	63,697	3.02E+07	8,466	0.00E+00	92,524	9.19E+07	18,489	4.13E+06	100,583	1.15E+08	15,140	3.34E+06	28,827	7,853	10,023	2,032
1976	43,877	1.43E+07	5,831	0.00E+00	63,897	4.48E+07	12,704	1.87E+06	69,447	5.43E+07	14,693	2.98E+06	20,020	5,526	6,873	1,369
1977	42,763	1.32E+07	5,661	0.00E+00	62,039	4.07E+07	12,331	1.71E+06	67,403	4.93E+07	19,918	5.54E+06	19,276	5,244	6,670	1,309
1978	57,749	2.43E+07	7,644	0.00E+00	84,055	7.14E+07	16,718	3.23E+06	91,292	8.85E+07	13,197	2.38E+06	26,306	6,860	9,074	1,796
1979	38,413	1.13E+07	5,081	0.00E+00	55,746	3.56E+07	11,077	1.40E+06	60,601	4.38E+07	16,222	3.74E+06	17,333	4,933	5,996	1,183
1980	47,327	1.62E+07	6,260	0.00E+00	68,865	5.09E+07	13,610	2.03E+06	74,997	6.42E+07	13,497	2.57E+06	21,538	5,889	7,349	1,426
1981	39,220	1.06E+07	5,193	0.00E+00	57,106	3.47E+07	11,328	1.48E+06	62,372	4.39E+07	17,644	4.05E+06	17,885	4,910	6,134	1,218
1982	51,356	1.94E+07	6,811	0.00E+00	74,840	6.36E+07	14,808	2.34E+06	81,587	7.83E+07	24,937	8.42E+06	23,485	6,651	7,997	1,529
1983	72,395	3.84E+07	9,603	0.00E+00	105,452	1.24E+08	20,926	4.74E+06	114,875	1.56E+08	10,441	1.48E+06	33,057	9,268	11,323	2,178
1984	30,280	6.70E+06	4,006	0.00E+00	44,054	2.11E+07	8,764	8.72E+05	48,015	2.58E+07	13,109	2.38E+06	13,775	3,791	4,759	934
1985	38,119	1.00E+07	5,055	0.00E+00	55,485	3.27E+07	11,000	1.32E+06	60,378	4.03E+07	14,611	3.10E+06	17,365	4,757	5,945	1,150
1986	42,417	1.31E+07	5,601	0.00E+00	61,849	4.23E+07	12,258	1.69E+06	67,335	5.29E+07	7,428	7.74E+05	19,431	5,404	6,656	1,300
1987	21,724	3.57E+06	2,868	0.00E+00	31,641	1.18E+07	6,232	4.24E+05	34,507	1.48E+07	19,509	5.12E+06	9,917	2,872	3,365	651
1988	44,100	1.37E+07	5,881	0.00E+00	68,594	5.03E+07	16,377	3.04E+06	74,633	6.21E+07	15,013	3.87E+06	24,494	6,043	10,496	1,745
1989	56,752	3.53E+07	7,532	0.00E+00	64,066	6.02E+07	12,599	2.30E+06	69,662	7.38E+07	13,734	1.31E+06	7,314	4,984	5,067	1,515
1990	32,880	5.85E+05	4,358	0.00E+00	53,254	1.06E+07	11,525	5.74E+05	57,900	1.50E+07	7,049	2.74E+05	20,374	3,169	7,168	758
1991	19,247	2.00E+05	2,548	0.00E+00	29,891	3.36E+06	5,917	1.20E+05	32,498	4.51E+06	15,864	1.81E+06	10,644	1,778	3,369	347
1992	32,930	2.19E+06	4,377	0.00E+00	59,186	2.15E+07	13,313	8.06E+05	64,268	2.74E+07	38,308	7.82E+06	26,256	4,393	8,936	898
1993	29,009	4.74E+05	3,850	0.00E+00	71,121	1.95E+07	32,152	3.02E+06	77,221	2.58E+07	13,486	1.84E+06	42,113	4,356	28,302	1,737
1994	34,164	4.94E+06	4,514	0.00E+00	48,957	1.83E+07	11,319	9.90E+05	53,170	2.37E+07	11,749	8.00E+05	14,792	3,656	6,805	995
1995	31,137	5.36E+05	4,128	0.00E+00	46,873	9.17E+06	9,862	3.46E+05	50,907	1.21E+07	13,200	6.13E+06	15,736	2,938	5,734	588
1996	27,430	8.71E+05	3,639	0.00E+00	48,575	2.60E+07	11,077	3.96E+06	52,749	3.20E+07	15,530	7.66E+06	21,145	5,008	7,438	1,991
1997	32,647	1.08E+06	4,325	0.00E+00	54,774	3.10E+07	13,042	5.20E+06	59,461	3.82E+07	21,509	2.02E+07	22,128	5,469	8,717	2,280
1998	29,512	9.27E+05	3,912	0.00E+00	120,412	2.36E+08	18,052	1.34E+07	130,716	2.88E+08	10,405	2.57E+06	90,900	15,320	14,140	3,660
1999	20,932	4.50E+05	2,773	0.00E+00	33,297	3.57E+06	8,730	1.58E+06	36,142	4.76E+06	-3	4.09E+03	12,365	1,766	5,957	1,258
2000	0	0.00E+00	0	0.00E+00	0	0.00E+00	-2	2.61E+03	0	0.00E+00	0	0.00E+00	0	0	-2	51

Appendix 9j

UK(SCOTLAND)

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW returns mean	Variance	Estimated number MSW returns mean	Variance	Estimated maturing 1SW recruits Mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Est. 1SW spawners	SD	Est MSW spawners
1971	375,149	9.98E+08	232,842	0.00E+00	1,357,014	8.43E+10	614,659	1.06E+10	1,466,207	9.97E+10	1,179,189	2.99E+10	981,864	288,651	381,817
1972	360,641	8.83E+08	313,803	0.00E+00	1,294,669	7.76E+10	821,173	1.92E+10	1,398,938	9.22E+10	1,235,342	3.55E+10	934,028	277,052	507,369
1973	422,191	1.25E+09	343,487	0.00E+00	1,505,107	1.01E+11	896,505	2.30E+10	1,626,312	1.19E+11	1,021,934	2.18E+10	1,082,916	315,367	553,018
1974	415,800	1.18E+09	271,787	0.00E+00	1,471,339	1.03E+11	711,631	1.34E+10	1,589,390	1.20E+11	1,077,432	2.89E+10	1,055,539	318,950	439,844
1975	320,138	7.25E+08	300,383	0.00E+00	1,140,874	5.84E+10	783,844	1.83E+10	1,232,776	6.91E+10	740,757	1.36E+10	820,736	240,152	483,461
1976	271,322	5.20E+08	165,425	0.00E+00	956,009	4.39E+10	488,315	8.52E+09	1,032,696	5.13E+10	807,453	1.87E+10	684,686	208,254	322,890
1977	279,955	5.38E+08	200,140	0.00E+00	995,849	4.29E+10	599,610	1.21E+10	1,075,566	5.00E+10	957,810	2.76E+10	715,893	205,840	399,470
1978	295,730	6.06E+08	235,485	0.00E+00	1,060,942	4.82E+10	710,147	1.78E+10	1,145,822	5.64E+10	750,832	1.70E+10	765,212	218,065	474,662
1979	269,324	5.27E+08	190,304	0.00E+00	955,839	4.40E+10	569,350	1.13E+10	1,032,596	5.19E+10	925,886	2.23E+10	686,516	208,548	379,045
1980	157,171	7.73E+07	223,128	0.00E+00	694,674	2.76E+10	661,623	1.37E+10	751,287	3.26E+10	1,088,782	4.11E+10	537,504	165,955	438,495
1981	195,231	1.14E+08	226,204	0.00E+00	875,058	4.60E+10	800,645	2.70E+10	946,665	5.44E+10	835,106	2.08E+10	679,827	214,270	574,441
1982	269,784	2.32E+08	166,401	0.00E+00	1,185,006	9.06E+10	582,484	1.36E+10	1,281,117	1.06E+11	892,670	2.78E+10	915,223	300,664	416,083
1983	270,919	2.32E+08	188,803	0.00E+00	1,204,164	9.01E+10	671,053	1.81E+10	1,302,361	1.07E+11	658,615	1.56E+10	933,245	299,780	482,250
1984	275,899	2.40E+08	138,678	0.00E+00	1,208,238	9.12E+10	499,764	1.04E+10	1,305,431	1.06E+11	676,844	1.68E+10	932,338	301,532	361,086
1985	204,881	1.26E+08	148,729	0.00E+00	904,308	4.87E+10	524,585	1.08E+10	977,198	5.72E+10	1,101,508	6.52E+10	699,428	220,499	375,856
1986	263,080	2.17E+08	192,034	0.00E+00	1,163,268	8.29E+10	837,658	4.33E+10	1,257,318	9.83E+10	759,797	3.09E+10	900,188	287,515	645,624
1987	213,250	1.49E+08	134,296	0.00E+00	929,329	5.49E+10	568,569	2.00E+10	1,004,217	6.44E+10	808,656	3.70E+10	716,079	234,029	434,273
1988	192,618	1.13E+08	145,527	0.00E+00	845,225	4.44E+10	625,750	2.50E+10	913,340	5.18E+10	733,928	2.57E+10	652,607	210,557	480,223
1989	206,069	5.07E+07	122,447	0.00E+00	1,165,692	1.43E+11	529,627	1.73E+10	1,259,838	1.69E+11	585,591	1.85E+10	959,623	378,067	407,180
1990	95,516	1.05E+07	103,617	0.00E+00	556,662	2.96E+10	453,646	1.23E+10	601,712	3.49E+10	513,313	2.53E+10	461,146	172,008	350,029
1991	86,763	8.62E+06	76,788	0.00E+00	484,593	2.22E+10	417,081	1.78E+10	523,481	2.59E+10	674,754	4.52E+10	397,830	148,821	340,293
1992	119,504	1.64E+07	97,597	0.00E+00	677,960	4.80E+10	544,530	3.06E+10	732,296	5.63E+10	587,858	3.52E+10	558,456	219,159	446,932
1993	111,203	1.47E+07	84,600	0.00E+00	640,598	4.02E+10	476,131	2.43E+10	691,784	4.70E+10	679,602	4.93E+10	529,395	200,451	391,531
1994	117,233	1.62E+07	100,519	0.00E+00	667,835	4.32E+10	563,232	3.31E+10	721,514	5.10E+10	631,572	4.03E+10	550,602	207,759	462,712
1995	105,998	1.31E+07	92,543	0.00E+00	626,072	3.68E+10	522,910	2.78E+10	676,096	4.29E+10	564,795	3.63E+10	520,074	191,683	430,367
1996	78,041	7.05E+06	68,151	0.00E+00	530,520	2.98E+10	465,240	2.46E+10	573,029	3.51E+10	384,919	1.53E+10	452,479	172,746	397,089
1997	54,783	3.41E+06	47,463	0.00E+00	375,866	1.50E+10	319,504	1.06E+10	405,886	1.75E+10	417,310	1.26E+10	321,083	122,317	272,040
1998	63,184	4.76E+06	45,061	0.00E+00	500,916	1.91E+10	347,752	8.49E+09	541,033	2.25E+10	318,117	7.73E+09	437,732	138,140	302,690
1999	25,783	7.66E+05	33,553	0.00E+00	212,107	2.89E+09	265,319	5.14E+09	229,017	3.37E+09	83	5.83E+03	186,324	53,749	231,767
2000	0	0.00E+00	0	0.00E+00	0	0.00E+00	-2	2.61E+03	0	0.00E+00	0	0.00E+00	0	0	-2

Appendix 9k Estimated numbers of fish killed and recruits from Monto Carlo simulation analysis - FAROES

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Est. mat. 1SW recruits mean	Variance	Est. non-mat. 1SW recruits mran	Variance	Total 1SW recruits means	SD	Prop'n wild	Stock composition	1SW	MSW
1971	12,073	9.61E+06	105,796	9.45E-08	2,675	5.69E+05	122,310	6.61E+06	124,985	2,679	1.00	**France**	0.05	0
1972	12,778	1.06E+07	111,187	1.36E-07	2,837	6.67E+05	137,904	7.36E+06	140,741	2,834	1.00	**Finland**	0.05	0
1973	4,638	1.33E+06	126,012	8.40E-08	3,277	8.58E+05	101,156	8.81E+06	104,433	3,109	1.00	**Iceland**	0	0.006
1974	14,763	1.35E+07	88,276	7.88E-08	2,280	4.23E+05	122,714	4.64E+06	124,994	2,250	1.00	**Ireland**	0.1	0.057
1975	8,212	4.14E+06	112,984	5.06E-08	2,892	6.87E+05	85,184	6.58E+06	88,075	2,696	1.00	**Norway**	0.3	0.396
1976	10,266	6.65E+06	73,900	2.34E-08	1,911	2.78E+05	59,637	2.93E+06	61,548	1,790	1.00	**Russia**	0.1	0.183
1977	21,475	2.86E+07	52,112	6.21E-09	1,350	1.44E+05	44,663	1.57E+06	46,013	1,311	1.00	**Sweden**	0.05	0.023
1978	13,005	1.05E+07	39,309	1.07E-09	1,030	8.51E+04	74,763	9.95E+05	75,793	1,039	1.00	**UK(E&W)**	0.1	0.023
1979	6,086	2.39E+06	70,082	4.77E-10	1,823	2.59E+05	191,784	3.69E+06	193,606	1,987	1.00	**UK(NI)**	0.05	0
1980	34,823	7.76E+07	182,617	1.20E-07	4,770	1.84E+06	321,856	2.03E+07	326,627	4,710	1.00	**UK(Sc)**	0.2	0.192
1981	8,613	4.45E+06	300,542	5.58E-07	7,725	4.74E+06	308,375	5.12E+07	316,100	7,476	0.98			
1982	32,344	6.70E+07	276,957	6.49E-07	7,187	4.24E+06	243,893	4.35E+07	251,080	6,912	0.98	**Other**		0.122
1983	36,572	4.43E+07	215,350	2.41E-07	8,125	3.36E+06	168,924	2.86E+07	177,049	5,650	0.98			
1984	18,509	1.73E+07	138,227	8.97E-08	4,108	1.13E+06	174,965	1.16E+07	179,072	3,570	0.96	**Total**	1	1.002
1985	14,688	1.96E+07	158,103	2.33E-07	3,263	1.17E+06	195,143	1.35E+07	198,406	3,837	0.92			
1986	18,296	2.71E+07	180,934	2.16E-07	4,062	1.63E+06	183,058	1.77E+07	187,120	4,402	0.96			
1987	14,816	2.33E+07	166,244	1.97E-07	3,292	1.35E+06	100,539	1.48E+07	103,831	4,024	0.97			
1988	17,146	7.23E+06	87,629	4.92E-08	3,808	6.01E+05	137,214	5.13E+06	141,022	2,394	0.92			
1989	12,940	1.25E+07	121,965	7.73E-08	2,877	7.80E+05	152,280	8.41E+06	155,156	3,031	0.82			
1990	14,735	1.63E+07	140,054	1.05E-07	3,270	9.81E+05	97,745	1.04E+07	101,014	3,380	0.54			
1991	8,576	5.80E+06	84,935	4.68E-08	1,907	3.65E+05	42,945	3.58E+06	44,852	1,987	0.54			
1992	3,319	1.09E+06	35,700	7.04E-09	737	6.25E+04	33,072	7.11E+05	33,808	879	0.62			
1993	2,725	7.61E+05	30,023	2.45E-09	605	4.41E+04	34,280	4.86E+05	34,885	728	0.69			
1994	2,866	8.62E+05	31,672	5.85E-09	637	5.13E+04	37,423	5.57E+05	38,061	780	0.72			
1995	3,121	1.02E+06	34,662	1.04E-08	694	5.95E+04	31,248	6.52E+05	31,942	843	0.80			
1996	2,702	6.99E+05	28,381	6.03E-09	601	4.25E+04	3,560	4.31E+05	4,161	688	0.75			
1997	590	3.36E+03	1,424	1.68E-11	131	4.59E+02	1,908	2.45E+03	2,039	54	0.80			
1998	588	3.26E+03	1,424	1.75E-11	131	4.68E+02	461	2.25E+03	591	52	0.80			
1999	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0	0.80			
2000	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0	0.80			

Appendix 9l Estimated numbers of fish killed and recruits from Monto Carlo simulation analysis - WEST GREENLAND

Year	Estimated total catch 1SW	Variance	Estimated total catch MSW	Variance	Estimated number 1SW recruits mean	Variance	Est. non-mat. 1SW recruits mean	Variance	Prop'n EU	European stock composition	MSW
1971	0	0.00E+00	488,100	2.37E+08	0	0.00E+00	534,510	5.08E+08	**0.50**	**France**	0.027
1972	0	0.00E+00	383,321	1.54E+08	0	0.00E+00	419,744	3.03E+08	**0.50**	**Finland**	0.001
1973	0	0.00E+00	424,670	1.83E+08	0	0.00E+00	465,036	3.77E+08	**0.50**	**Iceland**	0.001
1974	0	0.00E+00	325,499	1.11E+08	0	0.00E+00	356,456	2.37E+08	**0.50**	**Ireland**	0.147
1975	0	0.00E+00	394,412	1.67E+08	0	0.00E+00	431,898	3.32E+08	**0.50**	**Norway**	0.027
1976	0	0.00E+00	220,716	5.20E+07	0	0.00E+00	241,699	1.06E+08	**0.50**	**Russia**	0.000
1977	0	0.00E+00	279,601	8.24E+07	0	0.00E+00	306,180	1.68E+08	**0.50**	**Sweden**	0.003
1978	0	0.00E+00	161,852	2.70E+07	0	0.00E+00	177,237	5.51E+07	0.48	**UK(E&W)**	0.149
1979	0	0.00E+00	272,297	7.69E+07	0	0.00E+00	298,186	1.60E+08	0.50	**UK(NI)**	0.000
1980	0	0.00E+00	185,423	3.66E+07	0	0.00E+00	203,040	7.06E+07	0.52	**UK(Sc)**	0.645
1981	0	0.00E+00	274,248	7.89E+07	0	0.00E+00	300,313	1.58E+08	0.41		
1982	0	0.00E+00	160,112	2.73E+07	0	0.00E+00	175,337	5.70E+07	0.38	**Other**	
1983	0	0.00E+00	67,183	4.65E+06	0	0.00E+00	73,568	9.35E+06	0.60		
1984	0	0.00E+00	45,769	2.20E+06	0	0.00E+00	50,120	4.55E+06	0.50	**Total**	1.000
1985	0	0.00E+00	179,818	3.47E+07	0	0.00E+00	196,913	7.10E+07	0.50		
1986	0	0.00E+00	146,480	2.25E+07	0	0.00E+00	160,405	4.64E+07	0.43		
1987	0	0.00E+00	140,577	2.10E+07	0	0.00E+00	153,943	4.37E+07	0.41		
1988	0	0.00E+00	187,520	3.68E+07	0	0.00E+00	205,346	7.56E+07	0.57		
1989	0	0.00E+00	58,600	3.61E+06	0	0.00E+00	64,170	7.25E+06	0.44		
1990	0	0.00E+00	24,173	6.18E+05	0	0.00E+00	26,473	1.34E+06	0.25		
1991	0	0.00E+00	72,689	5.17E+06	0	0.00E+00	79,598	1.06E+07	0.35		
1992	0	0.00E+00	42,821	1.87E+06	0	0.00E+00	46,891	3.79E+06	0.46		
1993	0	0.00E+00	2,046	9.32E+04	0	0.00E+00	2,240	1.13E+05	**0.3**		
1994	0	0.00E+00	2,044	8.94E+04	0	0.00E+00	2,238	1.10E+05	**0.3**		
1995	0	0.00E+00	11,887	1.45E+05	0	0.00E+00	13,017	2.95E+05	0.32		
1996	0	0.00E+00	11,461	1.53E+05	0	0.00E+00	12,551	2.94E+05	0.27		
1997	0	0.00E+00	3,832	1.64E+04	0	0.00E+00	4,197	3.24E+04	0.20		
1998	0	0.00E+00	980	9.23E+02	0	0.00E+00	1,073	1.80E+03	0.21		
1999	0	0.00E+00	1,206	2.07E+04	0	0.00E+00	1,321	2.61E+04	0.10		
2000	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00			

Appendix 10a Lagged egg deposition analysis and estimation of conservation limit options - FINLAND

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	5000	13000		**1 yr**	**2 yr**	**3 yr**	**4 yr**	**5 yr**	**6 yr**	S	R	R/S
Fem	12%	77%		0.00	0.00	0.26	0.59	0.14	0.01	egg x 10^{-3}		
1971	3,669	3,136	33,596							n/a	22,807	
1972	5,692	4,926	52,726							n/a	34,596	
1973	8,554	7,369	78,897							n/a	40,752	
1974	7,806	7,185	76,607	0						n/a	38,726	
1975	7,733	7,076	75,467	0	0					n/a	35,730	
1976	6,788	5,998	64,117	0	0	8,735				n/a	31,472	
1977	5,965	5,379	57,427	0	0	13,709	19,822			n/a	24,033	
1978	4,465	3,466	37,374	0	0	20,513	31,109	4,703		n/a	18,299	
1979	4,552	3,395	36,712	0	0	19,918	46,549	7,382	336	74,185	21,340	0.29
1980	4,535	4,495	47,717	0	0	19,621	45,198	11,046	527	76,392	27,565	0.36
1981	4,214	7,239	74,987	0	0	16,670	44,525	10,725	789	72,710	28,566	0.39
1982	3,044	7,844	80,348	0	0	14,931	37,829	10,565	766	64,091	28,096	0.44
1983	4,568	8,918	92,008	0	0	9,717	33,882	8,976	755	53,330	27,371	0.51
1984	5,684	7,185	75,328	0	0	9,545	22,051	8,040	641	40,277	30,061	0.75
1985	7,203	7,158	75,973	0	0	12,406	21,660	5,232	574	39,873	28,170	0.71
1986	7,198	4,935	53,715	0	0	19,497	28,153	5,140	374	53,163	32,095	0.60
1987	10,123	6,529	71,427	0	0	20,891	44,242	6,680	367	72,180	35,550	0.49
1988	6,834	5,175	55,902	0	0	23,922	47,405	10,498	477	82,303	31,159	0.38
1989	7,935	5,236	57,178	0	0	19,585	54,285	11,249	750	85,869	39,434	0.46
1990	7,685	5,540	60,063	0	0	19,753	44,444	12,881	803	77,881	40,249	0.52
1991	6,891	5,926	63,459	0	0	13,966	44,824	10,546	920	70,256	38,481	0.55
1992	11,527	6,211	69,088	0	0	18,571	31,692	10,636	753	61,652	56,995	0.92
1993	8,544	8,030	85,511	0	0	14,534	42,142	7,520	760	64,956	42,698	0.66
1994	5,660	6,084	64,296	0	0	14,866	32,982	10,000	537	58,385	31,956	0.55
1995	6,074	5,261	56,311	0	0	15,616	33,735	7,826	714	57,892	27,134	0.47
1996	12,308	4,100	48,423	0	0	16,499	35,437	8,005	559	60,501	43,158	0.71
1997	10,829	6,281	69,368	0	0	17,963	37,441	8,409	572	64,384	38,095	0.59
1998	13,444	5,579	63,908	0	0	22,233	40,762	8,884	601	72,480	42,532	0.59
1999	12,756	4,497	52,671	0	0	16,717	50,451	9,672	635	77,475	37,859	0.49
2000	0	0	-2	0	0	14,641	37,935	11,972	691	65,238	0	0.00

Median recruits	32,025
90%ile recruits	42,744
90%ile Rec./L	0.72

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	39,873	6,028	3,622
Option 2	(Med R./90%L)	44,688	6,756	4,059
Option 3	(90%Rec/90%L)	59,643	9,018	5,418

	1SW	**MSW**	**Tot.**
10yr av. #	9,572	5,751	15,323
10yr av.%	62%	38%	
eggsx10^{-3}	5,743	57,567	63,310

Appendix 10b Lagged egg deposition analysis and estimation of conservation limit options - FRANCE

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	3450	6900	egg x 10^{-3}	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	S	R	R/S
Fem	45%	80%		85%	15%	0%	0%	0%	0%	egg x 10^{-3}		
1971	52,360	7,264	121,388							n/a	93,007	
1972	103,852	14,588	241,756							n/a	138,683	
1973	62,881	8,820	146,310							n/a	84,650	
1974	29,124	4,125	67,984	103180						n/a	52,825	
1975	58,229	8,214	135,744	205493	18208					223,701	82,391	0.37
1976	54,224	5,938	116,961	124363	36263	0				160,627	72,676	0.45
1977	40,826	4,560	88,554	57787	21946	0	0			79,733	58,848	0.74
1978	42,598	4,771	92,471	115382	10198	0	0	0		125,580	60,125	0.48
1979	48,259	5,379	104,611	99417	20362	0	0	0	0	119,779	78,996	0.66
1980	101,267	11,093	218,453	75271	17544	0	0	0	0	92,815	131,478	1.42
1981	80,878	8,340	171,599	78600	13283	0	0	0	0	91,883	103,433	1.13
1982	50,155	5,046	105,717	88919	13871	0	0	0	0	102,790	68,127	0.66
1983	53,651	5,489	113,591	185685	15692	0	0	0	0	201,376	78,034	0.39
1984	87,773	9,264	187,407	145859	32768	0	0	0	0	178,627	111,222	0.62
1985	32,571	6,691	87,501	89860	25740	0	0	0	0	115,599	51,803	0.45
1986	58,761	7,096	130,394	96553	15858	0	0	0	0	112,410	75,974	0.68
1987	102,178	3,600	178,505	159296	17039	0	0	0	0	176,334	137,257	0.78
1988	35,777	10,188	111,780	74376	28111	0	0	0	0	102,487	52,762	0.51
1989	18,968	4,736	55,589	110835	13125	0	0	0	0	123,960	31,052	0.25
1990	32,450	4,763	76,672	151729	19559	0	0	0	0	171,288	45,006	0.26
1991	23,074	4,177	58,877	95013	26776	0	0	0	0	121,789	37,200	0.31
1992	43,423	5,596	98,301	47251	16767	0	0	0	0	64,018	55,175	0.86
1993	61,790	2,678	110,713	65171	8338	0	0	0	0	73,510	80,446	1.09
1994	47,005	5,666	104,250	50046	11501	0	0	0	0	61,547	58,636	0.95
1995	14,209	2,708	37,006	83556	8832	0	0	0	0	92,388	25,388	0.27
1996	16,869	4,822	52,809	94106	14745	0	0	0	0	108,851	24,749	0.23
1997	8,621	2,447	26,891	88613	16607	0	0	0	0	105,220	14,006	0.13
1998	17,574	2,082	38,778	31455	15638	0	0	0	0	47,093	28,909	0.61
1999	5,698	4,559	34,014	44887	5551	0	0	0	0	50,438	6,935	0.14
2000	0	0	-1	22857	7921	0	0	0	0	30,778	0	0.00

Median recruits	59,487
90%ile recruits	108,885
90%ile Rec./L	1.05

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	47,093	19,972	2,914
Option 2	(Med R./90%L)	56,554	23,985	3,500
Option 3	(90%Rec/90%L)	103,517	43,902	6,406

	1SW	**MSW**	**Tot.**
10yr av. #	27,071	3,950	31,021
10yr av.%	87%	13%	
eggsx10^{-3}	42,028	21,803	63,831

Appendix 10c Lagged egg deposition analysis and estimation of conservation limit options - ICELAND

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	5800	10800	egg x 10^{-3}	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	S	R	R/S
Fem	47%	72%		0%	20%	40%	40%	0%	0%	egg x 10^{-3}		
1971	22,752	9,175	133,369							n/a	92,767	
1972	20,714	14,861	172,025							n/a	82,047	
1973	21,036	12,574	155,117							n/a	75,124	
1974	14,819	10,040	118,471	0						n/a	69,718	
1975	21,224	12,583	155,699	0	26674					n/a	74,433	
1976	18,297	9,599	124,519	0	34405	53348				n/a	75,047	
1977	20,195	12,038	148,659	0	31023	68810	53348			153,181	90,908	0.59
1978	25,407	16,061	194,147	0	23694	62047	68810	0		154,551	87,235	0.56
1979	24,712	11,074	153,474	0	31140	47388	62047	0	0	140,575	95,331	0.68
1980	8,028	13,837	129,483	0	24904	62280	47388	0	0	134,572	38,697	0.29
1981	16,372	6,609	96,020	0	29732	49807	62280	0	0	141,819	56,053	0.40
1982	12,544	6,507	84,791	0	38829	59464	49807	0	0	148,100	51,676	0.35
1983	16,911	7,950	107,917	0	30695	77659	59464	0	0	167,817	61,526	0.37
1984	10,495	8,384	93,803	0	25897	61390	77659	0	0	164,945	37,420	0.23
1985	21,092	4,739	94,346	0	19204	51793	61390	0	0	132,387	71,827	0.54
1986	32,572	8,806	157,266	0	16958	38408	51793	0	0	107,159	96,353	0.90
1987	21,473	8,834	127,231	0	21583	33916	38408	0	0	93,908	67,759	0.72
1988	39,340	7,280	163,853	0	18761	43167	33916	0	0	95,844	103,740	1.08
1989	21,461	6,551	109,441	0	18869	37521	43167	0	0	99,557	67,561	0.68
1990	19,958	7,227	110,606	0	31453	37739	37521	0	0	106,713	60,210	0.56
1991	23,812	5,880	110,637	0	25446	62906	37739	0	0	126,091	74,930	0.59
1992	32,471	8,142	151,826	0	32771	50892	62906	0	0	146,570	88,631	0.60
1993	31,015	6,731	136,887	0	21888	65541	50892	0	0	138,322	87,288	0.63
1994	18,383	7,287	106,776	0	22121	43776	65541	0	0	131,439	57,149	0.43
1995	27,286	6,064	121,533	0	22127	44242	43776	0	0	110,146	73,665	0.67
1996	22,610	5,470	104,171	0	30365	44255	44242	0	0	118,862	62,774	0.53
1997	22,367	4,959	99,530	0	27377	60730	44255	0	0	132,362	63,753	0.48
1998	37,517	5,479	144,879	0	21355	54755	60730	0	0	136,840	101,952	0.75
1999	25,060	7,649	127,791	0	24307	42710	54755	0	0	121,772	52,916	0.43
2000	0	-21	-165	0	20834	48613	42710	0	0	112,158	0	0.00

Median recruits	69,793
90%ile recruits	96,251
90%ile Rec./L	0.74

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	93,908	20,139	5,017
Option 2	(Med R./90%L)	93,973	20,153	5,020
Option 3	(90%Rec/90%L)	129,597	27,792	6,923

	1SW	**MSW**	**Tot.**
10yr av. #	26,048	6,489	32,537
10yr av.%	80%	20%	
eggsx10^{-3}	71,007	50,457	121,463

Appendix 10d Lagged egg deposition analysis and estimation of conservation limit options - IRELAND

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	**Smolt age composition** **1 yr**	**2 yr**	**3 yr**	**4 yr**	**5 yr**	**6 yr**	Lagged egg dep. S egg x 10^{-3}	Total 1SW recruits R	R/S
Egg	3400	7000										
Fem	60%	85%		0	1	0	0	0	0			
1971	547,717	82,574	1,608,656							n/a	1,681,029	
1972	601,458	90,909	1,767,881							n/a	1,830,763	
1973	644,721	96,788	1,891,121							n/a	1,968,491	
1974	709,537	106,929	2,083,681	321,731						n/a	2,141,209	
1975	741,177	111,782	2,177,102	353,576	1,126,059					n/a	2,145,422	
1976	524,802	78,342	1,536,733	378,224	1,237,517	160,866				1,776,606	1,545,248	0.87
1977	459,120	69,437	1,349,756	416,736	1,323,784	176,788	0			1,917,309	1,364,083	0.71
1978	413,013	61,654	1,209,387	435,420	1,458,577	189,112	0	0		2,083,109	1,215,700	0.58
1979	369,983	55,225	1,083,355	307,347	1,523,971	208,368	0	0	0	2,039,686	1,136,420	0.56
1980	288,534	61,925	957,064	269,951	1,075,713	217,710	0	0	0	1,563,374	901,122	0.58
1981	137,924	50,423	581,385	241,877	944,829	153,673	0	0	0	1,340,380	548,686	0.41
1982	340,332	27,441	857,549	216,671	846,571	134,976	0	0	0	1,198,217	1,150,291	0.96
1983	578,287	47,466	1,462,125	191,413	758,348	120,939	0	0	0	1,070,700	1,618,507	1.51
1984	224,430	53,253	774,695	116,277	669,945	108,335	0	0	0	894,557	791,360	0.88
1985	339,590	47,298	974,184	171,510	406,969	95,706	0	0	0	674,186	1,402,821	2.08
1986	387,783	37,800	1,015,988	292,425	600,284	58,138	0	0	0	950,848	1,471,181	1.55
1987	294,852	67,428	1,002,697	154,939	1,023,487	85,755	0	0	0	1,264,181	1,029,404	0.81
1988	798,924	49,863	1,926,487	194,837	542,286	146,212	0	0	0	883,336	1,820,785	2.06
1989	253,315	35,536	728,203	203,198	681,929	77,469	0	0	0	962,596	836,348	0.87
1990	281,118	12,451	647,566	200,539	711,192	97,418	0	0	0	1,009,149	643,249	0.64
1991	254,950	13,990	603,339	385,297	701,888	101,599	0	0	0	1,188,784	556,644	0.47
1992	318,904	28,141	818,001	145,641	1,348,541	100,270	0	0	0	1,594,451	743,780	0.47
1993	261,044	6,370	570,434	129,513	509,742	192,649	0	0	0	831,904	636,468	0.77
1994	335,067	33,223	881,213	120,668	453,296	72,820	0	0	0	646,784	803,299	1.24
1995	248,024	29,107	679,157	163,600	422,337	64,757	0	0	0	650,694	647,824	1.00
1996	304,281	12,659	696,051	114,087	572,601	60,334	0	0	0	747,022	723,300	0.97
1997	390,493	23,009	933,511	176,243	399,304	81,800	0	0	0	657,347	725,530	1.10
1998	487,999	25,937	1,149,845	135,831	616,849	57,043	0	0	0	809,724	850,009	1.05
1999	164,622	19,752	453,353	139,210	475,410	88,121	0	0	0	702,742	390,502	0.56
2000	0	0	0	186,702	487,236	67,916	0	0	0	741,854	0	0.00

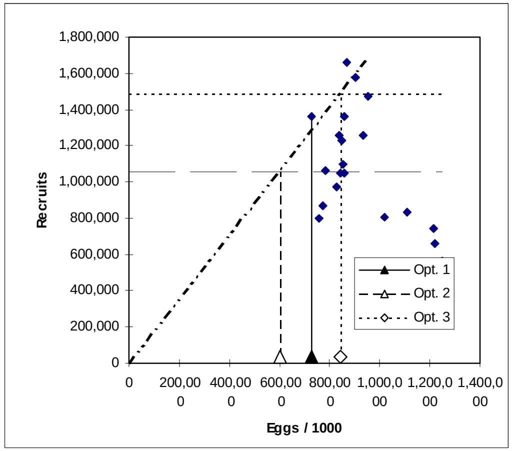
Median recruits	850,009
90%ile recruits	1,530,434
90%ile Rec./L	1.54

Conservation limits		**Eggs**	**1SW**
Option 1	(Min Lag. eggs)	646,784	265,111
Option 2	(Med R./90%L)	551,914	226,224
Option 3	(90%Rec/90%L)	993,717	407,315

	1SW	**MSW**	**Tot.**
10yr av. #	304,650	20,464	325,114
10yr av.%	94%	6%	
eggsx10^{-3}	621,486	121,761	743,247

Appendix 10e Lagged egg deposition analysis and estimation of conservation limit options - NORWAY

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^3	Smolt age composition						Lagged egg dep. S egg x 10^3	Total 1SW recruits R	R/S
Egg	3500	9000		1 yr	2 yr	3 yr	4 yr	5 yr	6 yr			
Fem	40%	80%		0.00	0.15	0.48	0.29	0.07	1%			
1971	112,626	71,306	671,081							n/a	1,174,779	
1972	146,913	93,366	877,910							n/a	1,410,500	
1973	159,516	101,622	955,002							n/a	1,438,658	
1974	148,983	96,455	903,054	0						n/a	1,363,569	
1975	140,646	90,496	848,478	0	102004					n/a	1,302,240	
1976	142,175	88,786	838,308	0	133442	320777				n/a	1,271,280	
1977	135,298	85,909	807,962	0	145160	419641	196627			n/a	1,097,348	
1978	97,830	62,321	585,672	0	137264	456491	257228	45634		n/a	1,163,665	
1979	166,499	105,870	995,362	0	128969	431660	279816	59698	3355	903,497	1,577,676	1.75
1980	168,954	104,001	985,343	0	127423	405573	264595	64940	4390	866,920	1,662,090	1.92
1981	116,223	110,961	961,628	0	122810	400711	248604	61408	4775	838,308	1,258,761	1.50
1982	86,288	89,039	761,886	0	89022	386206	245624	57697	4515	783,064	1,064,409	1.36
1983	145,662	88,199	838,962	0	151295	279951	236733	57005	4242	729,226	1,361,555	1.87
1984	153,652	93,095	885,395	0	149772	475783	171602	54941	4192	856,290	1,363,018	1.59
1985	156,911	83,440	820,444	0	146167	470994	291641	39826	4040	952,668	1,474,428	1.55
1986	140,563	101,048	924,333	0	115807	459658	288706	67685	2928	934,784	1,259,344	1.35
1987	123,824	77,547	731,694	0	127522	364182	281757	67003	4977	845,441	1,049,283	1.24
1988	112,627	62,336	606,495	0	134580	401024	223233	65391	4927	829,154	972,555	1.17
1989	306,414	112,328	1,237,740	0	124707	423219	245816	51808	4808	850,359	1,226,744	1.44
1990	267,588	127,386	1,291,804	0	140499	392172	259421	57049	3809	852,950	1,094,610	1.28
1991	243,687	124,995	1,241,125	0	111217	441831	240390	60207	4195	857,840	1,051,490	1.23
1992	209,036	135,587	1,268,874	0	92187	349750	270830	55790	4427	772,984	868,848	1.12
1993	174,767	106,818	1,013,761	0	188136	289904	214386	62855	4102	759,384	801,707	1.06
1994	176,291	113,908	1,066,946	0	196354	591640	177703	49755	4622	1,020,074	809,276	0.79
1995	157,606	113,866	1,040,481	0	188651	617482	362658	41242	3658	1,213,691	746,161	0.61
1996	125,136	111,252	976,205	0	192869	593258	378499	84166	3032	1,251,824	565,671	0.45
1997	160,555	89,568	869,667	0	154092	606522	363650	87843	6189	1,218,294	657,328	0.54
1998	213,605	106,932	1,068,959	0	162176	484578	371780	84396	6459	1,109,389	832,110	0.75
1999	262,187	143,392	1,399,487	0	158153	510000	297032	86283	6206	1,057,674	549,915	0.52
2000	0	0	-2	0	148383	497350	312615	68936	6344	1,033,628	0	0.00



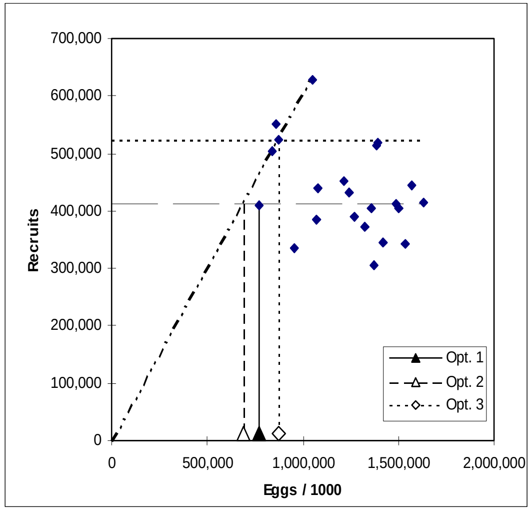
Median recruits	1,057,950
90%ile recruits	1,484,753
90%ile Rec./L	1.76

Conservation limits		Eggs	1SW
Option 1	(Min Lag. eggs)	729,226	129,168
Option 2	(Med R./90%L)	601,696	106,578
Option 3	(90%Rec/90%L)	844,435	149,574

	1SW	MSW	Tot.
10yr av. #	199,046	117,370	316,416
10yr av.%	63%	37%	
eggsx10^{-3}	278,664	845,066	1,123,731

Appendix 10f Lagged egg deposition analysis and estimation of conservation limit options - RUSSIA

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	4500	10500		1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	S	R	R/S
Fem	45%	80%		0.00	0.10	0.70	0.20	0.00	0.00	egg x 10^{-3}		
1971	62,730	103,379	995,408							n/a	359,117	
1972	69,067	86,851	869,411							n/a	511,962	
1973	115,843	144,702	1,450,076							n/a	577,159	
1974	106,034	132,953	1,331,528	0						n/a	638,703	
1975	112,533	166,060	1,622,786	0	99,541					n/a	588,253	
1976	84,843	140,445	1,351,550	0	86,941	696,786				n/a	443,519	
1977	71,986	107,133	1,045,686	0	145,008	608,588	199,082			952,677	335,140	0.35
1978	77,698	74,170	780,363	0	133,153	1,015,053	173,882	0		1,322,088	371,823	0.28
1979	87,979	81,686	864,323	0	162,279	932,070	290,015	0	0	1,384,364	514,813	0.37
1980	58,587	123,575	1,156,667	0	135,155	1,135,950	266,306	0	0	1,537,411	343,179	0.22
1981	41,401	67,889	654,107	0	104,569	946,085	324,557	0	0	1,375,211	305,960	0.22
1982	76,726	82,432	847,799	0	78,036	731,980	270,310	0	0	1,080,326	439,192	0.41
1983	113,600	131,702	1,336,336	0	86,432	546,254	209,137	0	0	841,823	504,846	0.60
1984	105,813	139,182	1,383,401	0	115,667	605,026	156,073	0	0	876,765	524,742	0.60
1985	143,022	156,294	1,602,487	0	65,411	809,667	172,865	0	0	1,047,942	626,851	0.60
1986	122,144	174,974	1,717,123	0	84,780	457,875	231,333	0	0	773,988	409,842	0.53
1987	206,652	81,363	1,101,922	0	133,634	593,460	130,821	0	0	857,915	551,387	0.64
1988	113,492	91,028	994,456	0	138,340	935,435	169,560	0	0	1,243,335	432,875	0.35
1989	167,079	141,377	1,525,905	0	160,249	968,381	267,267	0	0	1,395,897	519,531	0.37
1990	148,201	142,419	1,496,425	0	171,712	1,121,741	276,680	0	0	1,570,134	444,500	0.28
1991	161,234	121,180	1,344,410	0	110,192	1,201,986	320,497	0	0	1,632,676	415,216	0.25
1992	134,642	110,136	1,197,797	0	99,446	771,345	343,425	0	0	1,214,216	452,622	0.37
1993	110,821	163,452	1,597,413	0	152,591	696,120	220,384	0	0	1,069,094	384,001	0.36
1994	122,351	141,964	1,440,255	0	149,642	1,068,134	198,891	0	0	1,416,668	346,268	0.24
1995	109,923	103,661	1,093,350	0	134,441	1,047,497	305,181	0	0	1,487,119	411,170	0.28
1996	133,323	170,840	1,705,037	0	119,780	941,087	299,285	0	0	1,360,151	405,264	0.30
1997	125,391	143,979	1,463,338	0	159,741	838,458	268,882	0	0	1,267,081	390,366	0.31
1998	137,579	142,206	1,473,131	0	144,026	1,118,189	239,559	0	0	1,501,774	405,315	0.27
1999	95,457	139,391	1,364,183	0	109,335	1,008,179	319,483	0	0	1,436,996	146,833	0.10
2000	0	0	0	0	170,504	765,345	288,051	0	0	1,223,900	0	0.00



Median recruits	413,193
90%ile recruits	524,221
90%ile Rec./L	0.60

Conservation limits		**Eggs**	**1SW**
Option 1	(Min Lag. eggs)	773,988	69,831
Option 2	(Med R./90%L)	690,422	62,291
Option 3	(90%Rec/90%L)	875,942	79,029

	1SW	**MSW**	**Tot.**
10yr av. #	127,892	137,923	265,815
10yr av.%	48%	52%	
eggsx10^{-3}	258,982	1,158,552	1,417,534

Appendix 10g Lagged egg deposition analysis and estimation of conservation limit options - SWEDEN

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition						Lagged egg dep. S egg x 10^{-3}	Total 1SW recruits R	R/S
				1 yr	2 yr	3 yr	4 yr	5 yr	6 yr			
Egg	3000	6000										
Fem	50%	70%		0	1	0	0	0	0			
1971	2,163	208	4,119							n/a	17,364	
1972	1,743	146	3,229							n/a	16,734	
1973	2,157	508	5,369							n/a	17,608	
1974	3,097	332	6,042	824						n/a	22,222	
1975	3,298	82	5,292	646	2,471					n/a	23,594	
1976	1,828	239	3,747	1,074	1,937	824				3,835	13,827	3.61
1977	889	186	2,115	1,208	3,222	646	0			5,076	7,476	1.47
1978	1,021	144	2,138	1,058	3,625	1,074	0	0		5,757	10,070	1.75
1979	1,058	415	3,329	749	3,175	1,208	0	0	0	5,133	14,742	2.87
1980	1,340	703	4,963	423	2,248	1,058	0	0	0	3,730	16,988	4.55
1981	2,484	212	4,618	428	1,269	749	0	0	0	2,446	25,909	10.59
1982	2,148	762	6,422	666	1,283	423	0	0	0	2,372	21,276	8.97
1983	2,819	503	6,340	993	1,997	428	0	0	0	3,418	24,825	7.26
1984	3,974	732	9,035	924	2,978	666	0	0	0	4,567	29,427	6.44
1985	4,794	309	8,488	1,284	2,771	993	0	0	0	5,048	34,310	6.80
1986	5,134	285	8,899	1,268	3,853	924	0	0	0	6,045	38,692	6.40
1987	4,134	860	9,814	1,807	3,804	1,284	0	0	0	6,896	31,058	4.50
1988	3,438	836	8,667	1,698	5,421	1,268	0	0	0	8,387	35,266	4.20
1989	1,087	2,345	11,479	1,780	5,093	1,807	0	0	0	8,680	17,520	2.02
1990	2,656	1,621	10,792	1,963	5,339	1,698	0	0	0	9,000	25,691	2.85
1991	3,158	1,819	12,377	1,733	5,888	1,780	0	0	0	9,402	30,835	3.28
1992	3,374	2,445	15,329	2,296	5,200	1,963	0	0	0	9,459	36,479	3.86
1993	3,606	3,143	18,609	2,158	6,887	1,733	0	0	0	10,779	33,868	3.14
1994	5,002	2,438	17,743	2,475	6,475	2,296	0	0	0	11,247	26,704	2.37
1995	9,539	1,780	21,786	3,066	7,426	2,158	0	0	0	12,651	36,669	2.90
1996	5,723	2,271	18,122	3,722	9,198	2,475	0	0	0	15,395	22,523	1.46
1997	2,726	1,499	10,385	3,549	11,166	3,066	0	0	0	17,780	10,986	0.62
1998	1,147	816	5,149	4,357	10,646	3,722	0	0	0	18,725	6,703	0.36
1999	1,358	582	4,482	3,624	13,071	3,549	0	0	0	20,245	5,152	0.25
2000	0	0	-1	2,077	10,873	4,357	0	0	0	17,308	0	0.00

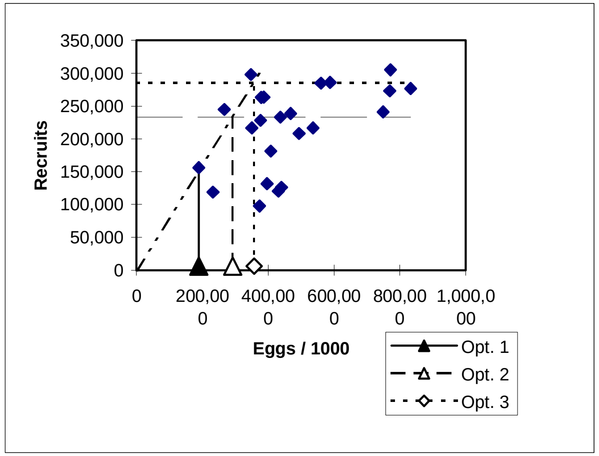
Median recruits	25,691
90%ile recruits	36,236
90%ile Rec./L	7.17

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	2,372	674	324
Option 2	(Med R./90%L)	3,583	1,018	490
Option 3	(90%Rec/90%L)	5,054	1,436	690

	1SW	**MSW**	**Tot.**
10yr av. #	3,829	1,841	5,670
10yr av.%	68%	32%	
eggsx10^{-3}	5,744	7,734	13,477

Appendix 10h Lagged egg deposition analysis and estimation of conservation limit options - UK(ENGLAND & WALES)

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition						Lagged egg dep. S egg x 10^{-3}	Total 1SW recruits R	R/S
Egg	4800	7900		1 yr	2 yr	3 yr	4 yr	5 yr	6 yr			
Fem	50%	70%		0.40	0.55	0.05	0.00	0.00	0.00			
1971	101,580	72,921	647,042							n/a	358,106	
1972	124,702	87,855	785,122							n/a	383,478	
1973	122,968	84,674	763,370							n/a	386,780	
1974	126,894	86,384	782,248	258,817						n/a	408,344	
1975	150,154	99,682	911,609	314,049	355,873					n/a	380,023	
1976	88,275	56,074	521,949	305,348	431,817	32,352				769,517	273,237	0.36
1977	96,824	60,947	569,414	312,899	419,853	39,256	0			772,009	305,318	0.40
1978	106,882	66,216	622,690	364,644	430,237	38,168	0	0		833,049	276,562	0.33
1979	71,871	43,429	412,652	208,780	501,385	39,112	0	0	0	749,277	241,208	0.32
1980	79,144	46,575	447,503	227,766	287,072	45,580	0	0	0	560,418	284,803	0.51
1981	100,901	58,859	567,653	249,076	313,178	26,097	0	0	0	588,351	285,812	0.49
1982	60,593	34,104	334,017	165,061	342,479	28,471	0	0	0	536,011	216,713	0.40
1983	75,899	42,376	416,498	179,001	226,959	31,134	0	0	0	437,094	233,031	0.53
1984	64,180	35,887	352,488	227,061	246,126	20,633	0	0	0	493,820	208,162	0.42
1985	62,026	33,422	333,685	133,607	312,209	22,375	0	0	0	468,191	238,666	0.51
1986	82,355	43,718	439,411	166,599	183,710	28,383	0	0	0	378,692	263,116	0.69
1987	72,098	36,438	374,534	140,995	229,074	16,701	0	0	0	386,770	263,452	0.68
1988	97,473	49,419	507,220	133,474	193,868	20,825	0	0	0	348,167	298,018	0.86
1989	69,232	34,662	357,837	175,765	183,527	17,624	0	0	0	376,916	228,137	0.61
1990	62,536	30,823	320,534	149,814	241,676	16,684	0	0	0	408,174	181,596	0.44
1991	36,430	17,040	181,662	202,888	205,994	21,971	0	0	0	430,852	120,570	0.28
1992	37,238	17,001	183,385	143,135	278,971	18,727	0	0	0	440,833	125,997	0.29
1993	72,988	23,450	304,851	128,214	196,810	25,361	0	0	0	350,385	216,484	0.62
1994	106,098	42,714	490,845	72,665	176,294	17,892	0	0	0	266,850	244,666	0.92
1995	53,111	27,448	279,252	73,354	99,914	16,027	0	0	0	189,295	156,050	0.82
1996	49,685	35,935	317,963	121,940	100,862	9,083	0	0	0	231,885	119,075	0.51
1997	45,689	22,284	232,887	196,338	167,668	9,169	0	0	0	373,175	97,549	0.26
1998	58,066	15,319	224,071	111,701	269,965	15,243	0	0	0	396,908	131,840	0.33
1999	50,902	28,885	281,897	127,185	153,589	24,542	0	0	0	305,316	73,809	0.24
2000	0	0	0	93,155	174,880	13,963	0	0	0	281,997	0	0.00



Median recruits	233,031
90%ile recruits	285,610
90%ile Rec./L	0.80

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	189,295	38,482	17,529
Option 2	(Med R./90%L)	291,851	59,331	27,027
Option 3	(90%Rec/90%L)	357,701	72,718	33,125

	1SW	**MSW**	**Tot.**
10yr av. #	57,274	26,090	83,364
10yr av.%	69%	31%	
eggsx10^{-3}	137,458	144,276	281,735

Appendix 10i Lagged egg deposition analysis and estimation of conservation limit options - UK(N IRELAND)

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	3400	7000	egg x 10^{-3}	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	S	R	R/S
Fem	60%	85%		20%	78%	2%	0%	0%	0%	egg x 10^{-3}		
1971	41,484	14,300	169,712							n/a	171,365	
1972	37,200	12,833	152,243							n/a	153,143	
1973	32,162	11,121	131,783							n/a	136,571	
1974	32,264	11,255	132,786	33,942						n/a	134,578	
1975	28,827	10,023	118,445	30,449	132,376					n/a	115,724	
1976	20,020	6,873	81,737	26,357	118,750	3,394				148,501	84,140	0.57
1977	19,276	6,670	79,011	26,557	102,791	3,045	0			132,393	87,321	0.66
1978	26,306	9,074	107,652	23,689	103,573	2,636	0	0		129,898	104,489	0.80
1979	17,333	5,996	71,036	16,347	92,387	2,656	0	0	0	111,390	76,823	0.69
1980	21,538	7,349	87,666	15,802	63,755	2,369	0	0	0	81,926	88,495	1.08
1981	17,885	6,134	72,984	21,530	61,628	1,635	0	0	0	84,794	80,015	0.94
1982	23,485	7,997	95,491	14,207	83,968	1,580	0	0	0	99,756	106,524	1.07
1983	33,057	11,323	134,812	17,533	55,408	2,153	0	0	0	75,095	125,316	1.67
1984	13,775	4,759	56,415	14,597	68,380	1,421	0	0	0	84,397	61,124	0.72
1985	17,365	5,945	70,798	19,098	56,928	1,753	0	0	0	77,779	74,989	0.96
1986	19,431	6,656	79,244	26,962	74,483	1,460	0	0	0	102,905	74,763	0.73
1987	9,917	3,365	40,250	11,283	105,153	1,910	0	0	0	118,346	54,016	0.46
1988	24,494	10,496	112,416	14,160	44,004	2,696	0	0	0	60,860	89,646	1.47
1989	7,314	5,067	45,068	15,849	55,223	1,128	0	0	0	72,200	83,396	1.16
1990	20,374	7,168	84,211	8,050	61,810	1,416	0	0	0	71,276	64,949	0.91
1991	10,644	3,369	41,759	22,483	31,395	1,585	0	0	0	55,463	48,362	0.87
1992	26,256	8,936	106,733	9,014	87,684	805	0	0	0	97,503	102,576	1.05
1993	42,113	28,302	254,307	16,842	35,153	2,248	0	0	0	54,243	90,706	1.67
1994	14,792	6,805	70,666	8,352	65,684	901	0	0	0	74,937	64,920	0.87
1995	15,736	5,734	66,219	21,347	32,572	1,684	0	0	0	55,603	64,106	1.15
1996	21,145	7,438	87,389	50,861	83,252	835	0	0	0	134,948	68,279	0.51
1997	22,128	8,717	97,009	14,133	198,360	2,135	0	0	0	214,628	80,970	0.38
1998	90,900	14,140	269,567	13,244	55,120	5,086	0	0	0	73,450	141,121	1.92
1999	12,365	5,957	60,672	17,478	51,651	1,413	0	0	0	70,542	36,139	0.51
2000	0	-2	-13	19,402	68,163	1,324	0	0	0	88,890	0	0.00

Median recruits	80,970
90%ile recruits	106,117
90%ile Rec./L	1.63

Conservation limits		**Eggs**	**1SW**	**MSW**
Option 1	(Min Lag. eggs)	54,243	13,171	4,601
Option 2	(Med R./90%L)	49,686	12,065	4,214
Option 3	(90%Rec/90%L)	65,118	15,812	5,523

	1SW	**MSW**	**Tot.**
10yr av. #	27,645	9,657	37,302
10yr av.%	74%	26%	
eggsx10^{-3}	56,396	57,457	113,853

Appendix 10j Lagged egg deposition analysis and estimation of conservation limit options - UK(SCOTLAND)

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition 1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	Lagged egg dep. L egg x 10^{-3}	Total 1SW recruits R	R/L
Egg	5000	10000										
Fem	40%	60%		10%	45%	40%	5%	0%	0%			
1971	981,864	381,817	4,254,633							n/a	2,645,396	
1972	934,028	507,369	4,912,273							n/a	2,634,280	
1973	1,082,916	553,018	5,483,941							n/a	2,648,246	
1974	1,055,539	439,844	4,750,143	425,463						n/a	2,666,822	
1975	820,736	483,461	4,542,236	491,227	1,914,585					n/a	1,973,532	
1976	684,686	322,890	3,306,711	548,394	2,210,523	1,701,853				n/a	1,840,149	
1977	715,893	399,470	3,828,607	475,014	2,467,773	1,964,909	212,732			5,120,428	2,033,376	0.40
1978	765,212	474,662	4,378,396	454,224	2,137,564	2,193,576	245,614	0		5,030,978	1,896,654	0.38
1979	686,516	379,045	3,647,304	330,671	2,044,006	1,900,057	274,197	0	0	4,548,931	1,958,483	0.43
1980	537,504	438,495	3,705,978	382,861	1,488,020	1,816,894	237,507	0	0	3,925,282	1,840,069	0.47
1981	679,827	574,441	4,806,299	437,840	1,722,873	1,322,684	227,112	0	0	3,710,509	1,781,771	0.48
1982	915,223	416,083	4,326,942	364,730	1,970,278	1,531,443	165,336	0	0	4,031,787	2,173,787	0.54
1983	933,245	482,250	4,759,992	370,598	1,641,287	1,751,358	191,430	0	0	3,954,673	1,960,976	0.50
1984	932,338	361,086	4,031,192	480,630	1,667,690	1,458,922	218,920	0	0	3,826,161	1,982,276	0.52
1985	699,428	375,856	3,653,989	432,694	2,162,835	1,482,391	182,365	0	0	4,260,285	2,078,706	0.49
1986	900,188	645,624	5,674,120	475,999	1,947,124	1,922,520	185,299	0	0	4,530,942	2,017,114	0.45
1987	716,079	434,273	4,037,797	403,119	2,141,996	1,730,777	240,315	0	0	4,516,207	1,812,873	0.40
1988	652,607	480,223	4,186,550	365,399	1,814,036	1,903,997	216,347	0	0	4,299,779	1,647,268	0.38
1989	959,623	407,180	4,362,328	567,412	1,644,295	1,612,477	238,000	0	0	4,062,184	1,845,429	0.45
1990	461,146	350,029	3,022,466	403,780	2,553,354	1,461,596	201,560	0	0	4,620,289	1,115,025	0.24
1991	397,830	340,293	2,837,418	418,655	1,817,008	2,269,648	182,699	0	0	4,688,011	1,198,235	0.26
1992	558,456	446,932	3,798,507	436,233	1,883,948	1,615,119	283,706	0	0	4,219,005	1,320,154	0.31
1993	529,395	391,531	3,407,974	302,247	1,963,048	1,674,620	201,890	0	0	4,141,804	1,371,386	0.33
1994	550,602	462,712	3,877,478	283,742	1,360,110	1,744,931	209,328	0	0	3,598,111	1,353,086	0.38
1995	520,074	430,367	3,622,351	379,851	1,276,838	1,208,987	218,116	0	0	3,083,792	1,240,891	0.40
1996	452,479	397,089	3,287,493	340,797	1,709,328	1,134,967	151,123	0	0	3,336,216	957,948	0.29
1997	321,083	272,040	2,274,408	387,748	1,533,588	1,519,403	141,871	0	0	3,582,610	823,196	0.23
1998	437,732	302,690	2,691,606	362,235	1,744,865	1,363,190	189,925	0	0	3,660,215	859,150	0.23
1999	186,324	231,767	1,763,250	328,749	1,630,058	1,550,991	170,399	0	0	3,680,197	229,099	0.06
2000	0	-2	-13	227,441	1,479,372	1,448,940	193,874	0	0	3,349,627	0	0.00

Median recruits	1,797,322
90%ile recruits	2,031,750
90%ile Rec./L	0.50

Conservation limits		**Eggs**
Option 1	(Min Lag. eggs)	3,083,792
Option 2	(Med R./90%L)	3,630,446
Option 3	(90%Rec/90%L)	4,103,971

	1SW	**MSW**
10yr av. #	441,512	362,545
10yr av.%	55%	45%
eggsx10^{-3}	883,024	2,175,271

Annex to ICES CM 2000/ACFM:13

Report of the

ICES COMPILATION OF MICROTAGS, FINCLIP AND EXTERNAL TAG RELEASES 1999

by

THE WORKING GROUP ON NORTH ATLANTIC SALMON

International Council for the Exploration of the Sea
Conseil International pour L'exploration de la Mer

Palaegade 2-4 DK- 1261 Copenhagen K Denmark

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1 TERMS OF REFERENCE

The terms of reference for the 2000 Working Group on North Atlantic Salmon (C.Res. 1999/2ACFM07) stated that the Group should

"With respect to the Atlantic salmon in the NASCO area, provide a compilation of microtag, finclip and external tag releases by ICES Member Countries in 1999"

Data were provided by Working Group members for national tagging programme, as far as possible including all agencies and organisations. These compilations for 1999 are presented by country together with a summary of the tags and finclips by all countries (Table 1). Data were supplied in the standard format agreed by the Working Group in 1997. A list of national tag clearing houses is also given (Appendix 1).

Table 2. Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Canada, 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild[2]	Stock Origin	Primary Tag or Mark[3]	Number Marked	Code or Serial	Secondary Mark[3]	Release Date	Release Location	Comment
DFO-M		adult	H,W	St. John	Carlin-yellow	46	3898, 4349, 4100-4130, 4141-4152, 4265	none	Oct-Nov	St. John R	Broodstock
DFO-M		adult	H,W	St. John	Carlin-white	57	18531-18535 18500-18558	none	Oct-Nov	St. John R	Broodstock
DFO-M		adult	H,W	St. John	Carlin-red	146	4006-4007 1021-1096 1200-1299	none	Oct-Nov	St. John R	Broodstock
DFO-M		adult	H,W	St. John	Carlin-blue	70	1200-1270	none	Oct-Nov	St. John R	Broodstock
DFO-M		adult	H	St. John	Carlin-blue	3	1225, 1279	none	Jun-Jul	St. John R	
DFO-M		adult	H	St. John	Carlin-red	2	1019, 1020	none	Sep	St. John R	
DFO-M		adult	W	St. John	Carlin-white	100	19500-19599	none	Jun-Jul	St. John R	
DFO-M		adult	W	St. John	Carlin-orange	100	2600-2699	none	Jun-Jul	St. John R	
DFO-M		adult	W	St. John	Carlin-yellow	358	3396-3398, 3845-3899, 4000-4099, 4131-4140 4153-4399	none	Jun-Jul	St. John R	
DFO-M							1394-1399				
DFO-M	1+	smolt	H	St. John	Carlin-blue	5000	GG31000-GG35999	ADC	Apr-May	St. John R	
DFO-M	1+	smolt	H	St. John	ADC	308901		none	Apr-May	St. John R	
DFO-M	1+	smolt	H	St. John	ADC	15021		none	May	Petitcodiac R	
DFO-M	0+	parr	H	St. John	ADC	354639		none	Sep-Nov	St. John R	
DFO-M	0+	parr	H	St. John	ADC,PVC-L	1996		none	Oct	St. John R	
DFO-M	2+	smolt	H	Musquodoboit	ADC	8992		none	May	Musquodoboit R	
DFO-M	1+	smolt	H	Indian Bk	ADC	9384		none	May	Indian Bk	
DFO-M	2+	smolt	H	East R Sh Hbr	ADC	8212		none	May	East R Sh Hbr	
DFO-M	2+	smolt	H	East R Sh Hbr	CWT	4039	agency 62 4/2	ADC	May	East R Sh Hbr	
DFO-M	1+	smolt	H	East R Sh Hbr	CWT	8050	agency 62 4/1, 2/26,	ADC	May	East R Sh Hbr	
DFO-M	2+	smolt	H	Liscomb	ADC	17875		none	May	Liscomb R	
DFO-M	0+	parr	H	Medway	ADC	24853		none	Nov	Medway R	
DFO-M	1+	smolt	H	Lahave	ADC	9715		none	May	Lahave R	
DFO-M	1+	smolt	H	Sackville	ADC	4548		none	May	Sackville R	
DFO-M	1+	smolt	H	Musquodoboit	ADC	9960		none	May	Musquodoboit R	
DFO-M	1+	smolt	H	East R Sh Hbr	ADC	8768		none	May	East R Sh Hbr	
DFO-M	0+	parr	H	Lahave	ADC	12936		none	Oct	Petite Riviere	
DFO-M	0+	parr	H	Lahave	ADC	12936		none	Oct	Mushamush R	
DFO-M	1+	smolt	H	Lahave	ADC	9544		none	May	Mushamush R	
DFO-M	1+	smolt	H	Lahave	ADC	10804		none	May	Petite Riviere	
DFO-M	1+	smolt	H	Lahave	ADC	9960		none	May	Mersey R	
DFO-M	1+	smolt	H	Lahave	ADC	4980		none	May	Jordan R	
DFO-M	0+	parr	H	Lahave	ADC	23637		none	Oct	Lahave R	
DFO-M	1+	smolt	H	Tusket	ADC	15504		none	May	Bear R	
DFO-M	1+	smolt	H	Tusket	ADC	41465		none	Apr-May	Tusket R	
DFO-M	0+	parr	H	East R Sh Hbr	ADC	4364		none	Oct	East R Sh Hbr	
DFO-M	0+	parr	H	Liscomb	ADC	4833		none	Oct	Liscomb R	
DFO-M	0+	parr	H	Tusket	ADC	2826		none	Nov	Tusket R	
DFO-M	1+	parr	H	Lahave	ADC	19510		none	May	Lahave R	

DFO-M	0+	parr	H	Lahave	ADC	21000		none	Nov	Lahave R	
DFO-M	1+	smolt	H	Liscomb	ADC	38190		none	May	Liscomb R	
DFO-M	1+	smolt	H	Sackville	ADC	15968		none	May	Sackville R	
DFO-M	0+	parr	H	Musquodoboit	ADC	28000		none	Oct	Musquodoboit R	
DFO-M	0+	parr	H	Lahave	ADC	28384		none	Oct	Lahave R	
DFO-M	1+	smolt	H	Tusket	Carlin	3992	GG27000-GG30999	ADC	Apr-May	Tusket R	
DFO-M	1+	smolt	H	Salmon, Digby	ADC	7032		none	Apr	Salmon R Digby	
DFO-M	1+	smolt	H	Medway	ADC	41640		none	Apr	Medway R	
DFO-M	0+	parr	H	Salmon, Digby	ADC	14292		none	Oct	Salmon R Digby	
DFO-M	0+	parr	H	Lahave	ADC	12180		none	Oct	Lahave R	
DFO-M	0+	parr	H	Sackville	ADC	26598		none	Oct	Sackville R	
DFO-M	0+	parr	H	Gaspereau	ADC	22312		none	Sep	Gaspereau R	
DFO-M	1+	smolt	H	Lahave	ADC	11552		none	Apr	Clyde R	
DFO-M	1+	smolt	H	Gold	ADC	16432		none	Apr	Gold R	
DFO-M	1+	smolt	H	Gaspereau	ADC	17139		none	Apr	Gaspereau R	
DFO-M	0+	parr	H	Liscomb	ADC	18364		none	Oct	Liscomb R	
DFO-M	0+	parr	H	Tusket	ADC	25434		none	Oct	Tusket R	
DFO-M	0+	parr	H	Tusket	ADC	14130		none	Oct	Metegan R	
DFO-M	2+	smolt	H	Annapolis	ADC	4776		none	May	Annapolis R	
DFO-M	2+	smolt	H	Gaspereau	ADC	8337		none	May	Gaspereau R	
DFO-M	2-4	smolt	W	Tay	STR-green	877	9000-9884	ADC	Apr-May	Tay R	
DFO-M	2-4	smolt	W	Tay	ADC	888		none	Apr-May	Tay R	
DFO-M	0+ to 3+	parr	W	Tobique	STR-green	590	101-250,451-700, 1501-1762	none	Sep-Nov	Tobique R. - Nictau	
DFO-M	0+ to 3+	parr	H	Tobique	STR-green	63	101-250,451-700, 1501-1762				
DFO-M	0+ to 3+	parr	W	Tobique	STR-green	458	701-1100,1901-2065	none	Sep-Nov	Tobique R. - Gulquac	
DFO-M	0+ to 3+	parr	H	Tobique	STR-green	100	701-1100,1901-2065	none	Sep-Nov	Tobique R. - Gulquac	
DFO-M	0+ to 3+	parr	W	Tobique	STR-green	189	1101-1310	none	Sep-Nov	Tobique R. - Odell	
DFO-M	0+ to 3+	parr	H	Tobique	STR-green	20	1101-1310	none	Sep-Nov	Tobique R. - Odell	
DFO-M	1SW	adult	W/H	Tobique	Carlin-blue	52	8800-8852	none	Aug-Sep	Saint John R	Perth Andover
DFO-M	1SW,MSW	adult	W/H	Hammond	Carlin-orange	23	4102-4125	none	Aug-Sep	Hammond R	Estuary
DFO-M	1SW,MSW	adult	W/H	Hammond	Carlin-orange	2	4177,4188	none	Aug-Sep	Hammond R	Estuary
DFO-M	0+	parr	H	St. Croix	ADC	22450		none	Aug-Sep	St. Croix R	
DFO-M	0+	parr	H	St. John	ADC	182616		none	Sep	St. John R	
DFO-M	0+	parr	H	St. John	ADC	168425		none	Oct	St. John R	
DFO-M	0+	parr	H	St. John	ADC	8676		none	Nov	St. John R	
DFO-M	2+	smolt	H	NW Miramichi	ADC	4723		none	May	NW Miramichi R.	
DFO-M	1+	parr	H	Little River	ADC	7330		none	May	NW Miramichi R.	
DFO-M	0+	parr	H	Black Brook	ADC	10462		none	Nov	SW Miramichi R.	
DFO-M	0+	parr	H	Cains	ADC	16667		none	Oct	SW Miramichi R.	
DFO-M	0+	parr	H	Clearwater	ADC	56700		none	Nov	SW Miramichi R.	
DFO-M	0+	parr	H	Juniper	ADC	6600		none	Nov	SW Miramichi R.	
DFO-M	0+	parr	H	NW Miramichi	ADC	13577		none	Oct	NW Miramichi R.	
DFO-M	0+	parr	H	Rocky Brook	ADC	20689		none	Oct	SW Miramichi R.	
DFO-M	0+	parr	H	Sevogle	ADC	9123		none	Oct	NW Miramichi R.	
DFO-M	0+	parr	H	SW Miramichi	ADC	20262		none	Oct	SW Miramichi R.	
DFO-M	1+	parr	H	Little River	ADC	7330		none	May	NW Miramichi R.	
DFO-M	2+	smolt	H	Morell	ADC	21000		none	Apr-May	Trout R	
DFO-M	2+	smolt	H	Morell	ADC	45224		none	Apr-May	Morell R	

DFO-M	2+	smolt	H	Morell	ADC	3200		none	Apr-May	Valleyfield R	
DFO-M	1+	parr	H	Morell	ADC	3500		none	Oct	Valleyfield R	
DFO-M	0+	parr	H	Kedgwick	ADC	21150		none	Oct	Kedgwick	satellite rearing site
DFO-M	0+	parr	H	L Main Restig.	ADC	45940		none	Oct	L. Main Restigouche	satellite rearing site
DFO-M	0+	parr	H	L Main Restig.	ADC	35100		none	Oct	Restigouche	satellite rearing site
DFO-M	2+,3+,4+	smolt	W	NW Miramichi	STR-green	5423	NW0001-5649	none	May	NW Miramichi	smolt trap
DFO-M	2+,3+,4+	smolt	W	LSW Miramichi	STR-green	1822	NW7000-8999	none	May	LSW Miramichi	smolt wheel
DFO-M	1SW,MSW	adult	W	Tabusintac	Carlin-blue	47	zz86053-86099	none	Sep-Oct	Tabusintac R.	traps in estuary
DFO-M	1SW,MSW	adult	W	Tabusintac	Carlin-blue	100	zz54600-54699	none	Sep-Oct	Tabusintac R.	traps in estuary
DFO-M	1SW,MSW	adult	W	Tabusintac	Carlin-blue	100	zz63500-63599	none	Sep-Oct	Tabusintac R.	traps in estuary
DFO-M	1SW,MSW	adult	W	Tabusintac	Carlin-blue	50	zz86200-86249	none	Sep-Oct	Tabusintac R.	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	4	zz56004-56014	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	594	zz62300-62979	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	99	zz65600-65699	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	135	zz66000-66135	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	999	zz67000-67999	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	38	zz74899-74936	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	320	zz80082-80649	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	344	zz82176-82791	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	253	zz84360-84999	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	472	zz85079-85747	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	181	zz86100-86549	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Miramichi	Carlin-blue	564	zz87276-87999	none	May-Oct	Miramichi	traps in estuary
DFO-M	1SW,MSW	adult	W	Restigouche	Carlin-blue	85	zz3700-3784	none	Jun-Jul	Restigouche	traps in estuary
DFO-M	1SW,MSW	adult	W	Restigouche	Carlin-blue	67	zz65100-65166	none	Jul-Sep	Restigouche	traps in estuary
DFO-M	1SW,MSW	adult	W	Restigouche	STR-green	61	NB09251-09350	none	Sep	Restigouche R.	broodstock seining
DFO-M	1SW,MSW	adult	W	LSW Miramichi	Carlin-blue	19	zz50920-50997	none	Sep-Nov	LSW Miramichi	Catamaran Bk
DFO-M	1SW,MSW	adult	W	LSW Miramichi	Carlin-blue	49	zz52911-52961	none	Sep-Nov	LSW Miramichi	Catamaran Bk
DFO-M	1SW,MSW	adult	W	Buctouche R.	Carlin-blue	69	zz63426-63494	none	Sep-Oct	Buctouche R.	traps in estuary
Québec	1+	smolt	H	riv. À Mars	ADC	65000		none	May	riv. À Mars	
Québec	2+	smolt	H	riv. À Mars	ADC	6700		none	May	riv. À Mars	
Québec		adult	W	St.-Jean Q8	T-bar	27	03068B, 03146B 03115B - 03123B 03151B - 03154B 03162B - 03166B 03172B, 03173B 03186B, 03196B 03197B	none	Jun-Jul	St. Jean Q8	
Québec		adult	W	Escoumins	T-bar	1	03697	none	Jun	Escoumins	
ASF	1	adult	W	Magaguadavic	T-bar-blue	1	4711	none	Jul	Magaguadavic R	
ASF	1	adult	W	Magaguadavic	T-bar-blue	1	4717	none	Jul	Magaguadavic R	
ASF	1	adult	W	Magaguadavic	T-bar-green	1	5448	none	Jul	Magaguadavic R	
ASF	1	adult	W	Magaguadavic	T-bar-green	1	5404	none	Jul	Magaguadavic R	
ASF	2	adult	A	Magaguadavic	T-bar-blue	1	4727	none	Jul	At Sea	
ASF	2,1	adult	A	Magaguadavic	T-bar-white	2	2702, 2703	none	Jul	At Sea	
ASF	1,1	adult	A	Magaguadavic	T-bar-white	2	2705, 2706	none	Aug	At Sea	
ASF	2,2,1	adult	A	Magaguadavic	T-bar-white	3	2707, 2708, 2709	none	Aug	At Sea	
ASF	2,1	adult	A	Magaguadavic	T-bar-white	2	2729, 2730	none	Aug	At Sea	
ASF	1,1,1	adult	A	Magaguadavic	T-bar-white	3	2732, 2733, 2734	none	Aug	At Sea	
ASF	2,1	adult	A	Magaguadavic	T-bar-white	2	2735, 2736	none	Aug	At Sea	

ASF	2,2,1	adult	A	Magaguadavic	T-bar-white	3	2738, 2739, 2740	none	Aug	At Sea	
ASF	1,2,2	adult	A	Magaguadavic	T-bar-white	3	2745, 2746, 2747	none	Aug	At Sea	
ASF	2	adult	A	Magaguadavic	T-bar-white	1	2748	none	Aug	At Sea	
ASF	1	adult	A	Magaguadavic	T-bar-white	1	2752	none	Aug	At Sea	
ASF	1,1,2	adult	A	Magaguadavic	T-bar-white	3	2785, 2786, 2787	none	Aug	At Sea	
ASF	1,2	adult	A	Magaguadavic	T-bar-white	2	2793, 2795	none	Aug	At Sea	
ASF	1,1	adult	A	Magaguadavic	T-bar-white	2	2798, 2799	none	Aug	At Sea	
ASF	1	adult	A	Magaguadavic	T-bar-green	1	5445	none	Jul	At Sea	
ASF		adult	L	Landlocked	T-bar-blue	1	4725	PVC-R	Oct	Magaguadavic R	
ASF		adult	L	Landlocked	T-bar-white	1	2728	PVC-L	Oct	Magaguadavic R	
ADAM	0+	parr	H	Margaree	ADC	78995		none	Oct	Margaree R	
DFO-N		kelt	W	Highlands	DST-green	29	N2363, N2365 N2367, N2370 N2377, N2381 N2382- N2385 N2390 N2393- N2399 N2403- N2408 N2412 N2414 - N2418	none none	May-Jun	Highlands	
DFO-N		kelt	W	Highlands	Carlin-green	36	P36832 - P36867	none	May-Jun	Highlands	
DFO-N		kelt	W	Highlands	Carlin-green	1	P36880	none	May-Jun	Highlands	
DFO-N		smolt	W	Conne	STR-green	1616	17884 - 19500	none	May-Jun	Conne River	
DFO-N		smolt	W	Conne	STR-green	563	1 - 564	none	May-Jun	Conne River	
DFO-N		adult	W	Gander	Carlin-yellow	38	Y7961-Y7998	none	Jun-Aug	Gander River	
DFO-N		adult	W	Gander	Carlin-yellow	37	Y7901-Y7937	none	Jun-Aug	Gander River	
DFO-N		adult	W	Gander	Carlin-yellow	1	Y7848	none	Jun-Aug	Gander River	
DFO-N		adult	W	Gander	Carlin-yellow	9	Y7940-Y7948	none	Jun-Aug	Gander River	
DFO-N		adult	W	Gander	Carlin-yellow	151	Y7250-Y7400	none	Jun-Aug	Gander River	
DFO-N		adult	W	Gander	Carlin-yellow	96	Y7402-Y7495	none	Jun-Aug	Gander River	
DFO-N		kelt	W	Campbellton	T-bar-orange	572	J41112-J41174 J41175-J41537 J41539-J41524 J41551-J41559 J41561J41670 J41672J41724 J41726J41793 J41795-J41976 J41978-J41860 J41862-J41992	none	May-Jun	Campbellton River	
DFO-N		kelt	W	Campbellton	DST	51	36, 52, 92, 127, 134, 138, 169,189,198 204, 218, 244, 255, 259, 271, 274, 299, 323, 364, 423, 426, 441, 444, 446, 448, 469, 535, 537,538,539,	none	May-Jun	Campbellton River	kiwi & atkins tags

						540, 542, 543, 544, 546, 552, 554, 557, 559, 560, 563, 564, 565, 567, 569, 570, 574, 576, 578, 580, 599			
DFO-N	adult	W	Paradise	T-bar-green	191	S3001-S3246	none	Jun-Aug	Parasie River
DFO-N	adult	W	Humber River	Carlin-green	14	P37700-P37713	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	104	P37716-P37819	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	36	P37821-P37856	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	95	P37858-P37952	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	58	P37954-P38011	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	287	P38013-P38299	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	375	P38400-P38774	none	June-July	Humber River
DFO-N	adult	W	Humber River	Carlin-green	5	P38776-P38780	none	June-July	Humber River
DFO-N	kelt	W	Western Arm Bk	Carlin-blue	1	47810	none	May-Jun	Western Arm Bk
DFO-N	kelt	W	Western Arm Bk	Carlin-green	20	N 0480 - N 0499	none	May-Jun	Western Arm Bk
DFO-N	kelt	W	Western Arm Bk	Carlin	29	N 5570 - N 5598	none	May-Jun	Western Arm Bk
DFO-N	kelt	W	Western Arm Bk	Carlin	27	N 5600 - N 5626	none	May-Jun	Western Arm Bk

[1] ADAM=Aquatic Development Association of Margaree; ASF=Atlantic Salmn Federation; DFO=Department of Fisheries and Oceans (-M, Maritimes region; -N, Newfoundland region)

[2] A=aquaculture escapees; L=landlocked salmon

[3] ADC=adipose fin clip; DST=data storage tag (i.e., archival); PVC-L=left pelvic fin clip; PVC-R=right pelvic fin clip; STR=streamer tag

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Denmark, 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark	Number Marked	Code or Serial	Secondary Mark	Release Date	Release Location	Comment
DIFRES	1	smolt	H	mixed origin	Carlin	1000	143000-143999	none	19-Apr	Storaa River	
DIFRES	2	smolt	H	Skjernaa river	Carlin	300	144000-144299	none	29-Mar	Skjernaa River	

[1] DIFRES=Danish Institute of Fisheries Research

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in France, 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
CSP	0+	parr	H	Brittany	ADC	8180		none	Aug	Trieux	
CSP	1+	smolt	H	Brittany	ADC	21351		none	Mar-Apr	Trieux	
CSP	0+	parr	H	Brittany	ADC	12747		none	Nov	Aulne	
CSP	1+	parr	H	Brittany	ADC	66753		none	Apr-May	Aulne	
CSP	1+	smolt	H	Brittany	ADC	26500		none	May	Aulne	
CSP	0+	parr	H	Adour	ADC	37182		none	Oct	Ariège (Garonne)	
CSP	1+	parr	H	Adour	ADC	24		none	Oct	Ariège (Garonne)	
CSP	0+	parr	H	Dordogne	ADC	60500		none	June	Dordogne	
CSP	0+	parr	H	Adour	ADC	61400		none	July	Gave Mauléon	
CSP	1+	parr	H	Adour	ADC	21600		FBM	Sep	Gave Oloron	
CSP	1+	smolt	H	Adour	ADC	3800		none	Mar	Gave Pau	
INRA	1,2	smolt	W	Scorff	VIE	379	see below	none	Mar-May	Scorff	mark/recap study
INRA	0+	parr	W	Oir	PCC	566		PIT	Oct	De la Roche B.(Oir trib)	

[1] CSP=National Council of Fishing; INRA=National Institute for Agricultural Research

[2] ADC=adipose fin clip; FBM=fluorescent bone marking; PCC=pectoral fin clip; PIT=passive integrated transponder; VIE=visible implant tag near

Codes for visual implant tags: KE2-KF5, KF8-KF9, KH1-KH3, KH5-KH9, KJ0-KJ4, KJ6-KL0, KL2-KM0, KM2, KM5-KM8, KN0-KN4, KN8-KP5, KP7-KP8, KR0-KS3, KS5-KT2, KT4-KW7, KW9-KY5, KY7-L01, L03-L16, L18-L20, L22-L30, L33, L35-L46, L49-L65, L67-L72, L75-L96, L98-LC2, LC4-LD5, LD7-LF9, LH0-LH9, LJ0-LK4, LK6-LK8, LL2-LM1, LM4

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Iceland, 1999.

Marking Agency[1]	Age	Life stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
IFF	0+	smolt	H	Norðurá	CWT	10045	063263ser	ADC	June-July	Norðurá	
IFF	1+	smolt	H	Kollafjörður	CWT	940	063963ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Fljótaá	CWT	4219	064063ser	ADC	June-July	Fljótaá	
IFF	0+	smolt	H	Elliðaár	CWT	9999	064163ser	ADC	June-July	Elliðaár	
IFF	1+	smolt	H	Kollafjörður	CWT	770	064163ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Kollafjörður	CWT	990	064163ser	ADC	June-July	Ytri Rangá	
IFF	0+	smolt	H	Þjórsá	CWT	9733	064263ser	ADC	June-July	Þjórsá	
IFF	1+	smolt	H	Elliðaár	CWT	5001	064363ser	ADC	June-July	Elliðaár	
IFF	1+	smolt	H	Elliðaár	CWT	2507	064363ser	ADC	June-July	Elliðaár	
IFF	0+	smolt	H	Sogið	CWT	3004	064363ser	ADC	June-July	Sogið	
IFF	1+	smolt	H	Kollafjörður	CWT	242	064463ser	ADC	June-July	Eystri Rangá	
IFF	0+	smolt	H	Fnjóská	CWT	10056	064463ser	ADC	June-July	Fnjóská	
IFF	1+	smolt	H	Kollafjörður	CWT	526	064463ser	ADC	June-July	Þverá	
IFF	1+	smolt	H	Laxá+Selá	CWT	2003	064563ser	ADC	June-July	Breiðdalsá	
IFF	1+	smolt	H	Laxá+Selá	CWT	999	064563ser	ADC	June-July	Breiðdalsá	
IFF	1+	smolt	H	Hölkná	CWT	1998	064563ser	ADC	June-July	Hölkná	
IFF	1+	smolt	H	Laxá í Aðaldal	CWT	6031	064563ser	ADC	June-July	Laxá í Aðaldal	
IFF	1+	smolt	H	Elliðaár	CWT	9680	064663ser	ADC	June-July	Elliðaár	
IFF	1+	smolt	H	Laxá í Leirársveit	CWT	7514	064763ser	ADC	June-July	Laxá í Leirársveit	
IFF	1+	smolt	H	Lárós	CWT	1025	064763ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Straumfjarðará	CWT	1004	064763ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Kollafjörður	CWT	1005	064863ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Lárós	CWT	1012	064863ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Reykjadalsá	CWT	1004	064863ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Straumfjarðará	CWT	1002	064863ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Gljúfurá	CWT	1970	064863ser	ADC	June-July	Gljúfurá	
IFF	2+	smolt	H	Langá	CWT	1008	064863ser	ADC	June-July	Langá	
IFF	1+	smolt	H	Norðurá	CWT	3002	064863ser	ADC	June-July	Norðurá	
IFF	1+	smolt	H	Kollafjörður	CWT	1000	064863ser	ADC	June-July	Ytri Rangá	
IFF		smolt	W	Austurá	CWT	467	064963ser	ADC	June-July	Austurá	

IFF		smolt	W	Elliðaár	CWT	1427	064963ser	ADC	June-July	Elliðaár	
IFF		smolt	W	Núpsá	CWT	573	064963ser	ADC	June-July	Núpsá	
IFF		smolt	W	Vesturdalsá	CWT	5	064963ser	ADC	June-July	Vesturdalsá	
IFF	1+	smolt	H	Rangár	CWT	2014	065063ser	ADC	June-July	Eystri Rangá	
IFF	1+	smolt	H	Rangár	CWT	6022	065063ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Sogið	CWT	1903	065163ser	ADC	June-July	Sogið	
IFF	1+	smolt	H	Kollafjörður	CWT	3013	065163ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Rangár	CWT	6003	065163ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Rangár	CWT	2011	065163ser	ADC	June-July	Ytri Rangá	
IFF	1+	smolt	H	Hafralónsá	CWT	204	065263ser	ADC	June-July	Hafralónsá	
IFF	1+	smolt	H	Laxá í Aðaldal	CWT	824	065263ser	ADC	June-July	Laxá í Aðaldal	
IFF	1+	smolt	H	Sogið	CWT	2104	065263ser	ADC	June-July	Sogið	
IFF		smolt	W	Austurá	CWT	19	065363ser	ADC	June-July	Austurá	
IFF		smolt	W	Núpsá	CWT	17	065363ser	ADC	June-July	Núpsá	
IFF		smolt	W	Vesturdalsá	CWT	1308	065363ser	ADC	June-July	Vesturdalsá	
IFF		adult	W		T-bar-green	26	IS64300-IS64333	DST	May	OlfusaRiver system	
IFF		adult	W		T-bar-green	1	IS47147	DST	May	OlfusaRiver system	
IFF		adult	W		T-bar-green	1	IS47147	DST	May	OlfusaRiver system	
IFF		adult	W		T-bar-green	1	IS47184	DST	May	OlfusaRiver system	
IFF		adult	W		T-bar-white	11	IS01501-IS01511	DST	May	River Botnsa	
IFF		adult	W		T-bar-green	6	IS61186-IS61191	DST	July	63° 00' 05" N 26° 28' 260" W	
IFF		adult	W		T-bar-white	2	IS01528-IS01529	DST	July	64° 47' 80" N 24° 15' 62" W	
IFF		adult	W		T-bar-blue	4	IS48395-IS48398	DST	July	Hraunsfjord	
IFF		adult	H		T-bar-green	1195	IS68001-IS69249	none	July-Aug	Nodlingaflot	Ocean ranch./put&take
IFF		adult	H		T-bar-green	50	IS66950-IS66999	none	July-Aug	Nodlingaflot	Ocean ranch./put&take
IFF		adult	H		T-bar-blue	96	IS47025-IS47171	none	July-Aug	Nodlingaflot	Ocean ranch./put&take
IFF		adult	W		T-bar-green	100	IS69500-IS69599	none	July-Aug	Laxa Adaldal	Catch and release
IFF		adult	W		T-bar-green	9	IS67825-IS67835	none	July	Hafjardara	Catch and release
IFF		adult	W		T-bar-green	10	IS67825-IS67836	none	July	Hafjardara	Catch and release
IFF		adult	W		T-bar-blue	25	Grímsá 2001-2025	none	July-Aug	Grimsa	Catch and release
IFF		adult	W		T-bar-blue	24	Grímsá 2051-2074	none	July-Aug	Grimsa	Catch and release
IFF		adult	W		T-bar-blue	38	Grímsá 2101-2138	none	July-Aug	Grimsa	Catch and release
IFF		adult	W		T-bar-blue	55	Grímsá 2201-2255	none	July-Aug	Grimsa	Catch and release
IFF		adult	W		T-bar-blue	11	Grímsá 2601-2611	none	July-Aug	Grimsa	Catch and release

[1] IFF=Institute of Freshwater Fisheries

[2] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag); DST=data storage tag

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Ireland, 1999.

Marking Agency[1]	Age	Life stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
Marine Inst.	1+	parr	H	Shannon	CWT	8341	47/19/23A	ADC	24/04/99	Liffey	transfer - 23/02/'99
Marine Inst.	1+	parr	H	Shannon	CWT	4959	47/02/13	ADC	27/04/99	Shannon	MSW 97cm-m
Marine Inst.	1+	parr	H	Shannon	CWT	10329	47/02/12	ADC	27/04/99	Shannon	MSW 97cm-m
Marine Inst.	1+	parr	H	Shannon	CWT	8881	47/18/33A	ADC	27/04/99	Shannon	MSW 90cm-m
Marine Inst.	1+	parr	H	Shannon	CWT	9508	47/02/11	ADC	27/04/99	Shannon	MSW - all female
Marine Inst.	1+	parr	H	Shannon	CWT	6193	47/18/56A	ADC	27/04/99	Shannon	MSW - all female
Marine Inst.	1+	parr	H	Shannon	CWT	6278	47/18/57A	ADC	27/04/99	Shannon	MSW - all female
Marine Inst.	1+	parr	H	Corrib	CWT	1618	47/18/60A	ADC	29/03/99	Cong	MSW - upstream
Marine Inst.	1+	parr	H	Corrib	CWT	8565	47/18/46A	ADC	29/03/99	Cong	MSW - upstream
Marine Inst.	1+	parr	H	Corrib	CWT	3326	47/18/59A	ADC	15/04/99	Corrib	MSW - downstream
Marine Inst.	1+	parr	H	Corrib	CWT	6579	47/18/47A	ADC	15/04/99	Corrib	MSW - downstream
Marine Inst.	1+	parr	H	Erriff	CWT	648	47/18/51A	ADC	12/04/99	Erriff	transfer
Marine Inst.	1+	parr	H	Erriff	CWT	7438	47/18/36A	ADC	12/04/99	Erriff	transfer
Marine Inst.	1+	parr	H	Erriff	CWT	1487	47/17/50B	ADC	22/04/99	Erriff	transfer - direct
Marine Inst.	1+	parr	H	Bunowen	CWT	4741	47/03/03	ADC	08/04/99	Bunowen	transfer
Marine Inst.	1+	parr	H	Bunowen	CWT	10968	47/03/02	ADC	08/04/99	Bunowen	transfer
Marine Inst.	1+	parr	H	Burrishoole	CWT	10949	47/03/01	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Burrishoole	CWT	1133	47/18/61A	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	11079	47/02/09	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	8898	47/02/10	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	11186	47/02/14	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	11080	47/02/15	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	10985	47/02/16	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Delphi	CWT	10938	47/02/17	ADC	28/04/99	Bundorragha	
Marine Inst.	1+	parr	H	Hybrid	CWT	5661	47/18/48A	ADC	29/04/99	Burrishoole	freeze brand - H
Marine Inst.	1+	parr	H	Fanad	CWT	9131	47/19/24A	ADC	29/04/99	Burrishoole	freeze brand - T
Marine Inst.	1+	parr	H	Hybrid	CWT	7297	47/19/22A	ADC	29/04/99	Burrishoole	freeze brand - ^
Marine Inst.	1+	parr	H	Burrishoole	CWT	2544	47/19/09A	ADC	29/04/99	Burrishoole	freeze brand - X wild
Marine Inst.	1+	parr	H	Owenmore	CWT	3894	47/17/49B	ADC	29/04/99	Burrishoole	freeze brand - O wild
Marine Inst.	1+	parr	H	Burrishoole	CWT	2913	47/18/50A	ADC	29/04/99	Burrishoole	freeze brand - S
Marine Inst.	1+	parr	H	Burrishoole	CWT	5640	47/18/27A	ADC	23/03/99	Burrishoole	vaccinated

Marine Inst.	1+	parr	H	Burrishoole	CWT	4353	47/19/15A	ADC	30/04/99	Burrishoole	vaccinated
Marine Inst.	1+	parr	H	Burrishoole	CWT	5616	47/01/01B	ADC	30/04/99	Burrishoole	
Marine Inst.	1+	parr	H	Burrishoole	CWT	7108	47/18/38A	ADC	30/04/99	Burrishoole	
Marine Inst.	1+	parr	H	Erne	CWT	9137	47/02/03	ADC	30/04/99	Erne	Assaroe Lake
Marine Inst.	1+	parr	H	Erne	CWT	10069	47/03/04	ADC	05/05/99	Erne	Tailrace
Marine Inst.	1+	parr	H	Erne	CWT	7838	47/03/05	ADC	29/04/99	Erne	Belleek
Marine Inst.	1+	parr	H	Erne	CWT	9060	47/03/06	ADC	04/05/99	Erne	Upstream
Marine Inst.	1+	parr	H	Erne	CWT	9502	47/03/07	ADC	19/04/99	Erne	Swanlinbar
Marine Inst.	1+	parr	H	Erne	CWT	10432	47/02/05	ADC	05/05/99	Erne	Tailrace
Marine Inst.	1+	parr	H	Erne	CWT	9038	47/03/08	none	30/03/99	Erne	Upstream
Marine Inst.	1+	parr	H	Screebe	CWT	11530	47/02/07	ADC	14/04/99	Screebe	Hatchery pool
Marine Inst.	1+ to 3+	smolt	W	Corrib	CWT	1427	47/03/09	ADC	26/04/99	Galway	Trap
Marine Inst.	1+ to 3+	smolt	W	Corrib	CWT	1352	47/03/10	ADC	29/04/99	Galway	Trap
Marine Inst.	1+ to 3+	smolt	W	Corrib	CWT	1623	47/03/11	ADC	13/05/99	Galway	Trap
Marine Inst.		smolt	H		ADC	150000		none			

[1] Marine Inst.=Marine Institute of Ireland

[2] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag); CWT-S=sequential CWT rather than batch tags

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Norway, 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
NINA	2+	smolt	H	Imsa	Carlin	2948	NF-20000-22999	none	04 May	Imsa	
NINA	1+	smolt	H	Imsa	Carlin	2991	NF-27000-29999	none	04 May	Imsa	
NINA	1+	smolt	H	Lone	Carlin	1000	NF-32000-32999	none	04 May	Imsa	
NINA	2+	smolt	H	Lone	Carlin	1983	NF-33000-34999	none	04 May	Imsa	
NINA	1+	smolt	H	Figgjo	Carlin	1489	NF-35000-36499	none	04 May	Imsa	
NINA	1+	smolt	H	Suldal	Carlin	1118	NF-36500-37699	none	04 May	Imsa	
NINA		smolt	W	Imsa	Carlin	381	NC-11535-11919	none		Imsa/fella	
NINA	2+	smolt	H	Figgjo	Carlin	1835	NF-30000-31849	none	06 May	Figgjo	
NINA	1+	smolt	H	Imsa	Carlin	1989	NF-23000-24999	none	10 May	Dirdal	
NINA	1+	smolt	H	Imsa	Carlin	1991	NF-25000-26999	none	10 May	Frafjord	
NINA	2+	smolt	H	Imsa	Carlin	2948	NF-20000-22999	none	04 May	Imsa	
NINA	1+	smolt	H	Imsa	Carlin	1073	NF-37700-38899	none	04 May	Imsa	
NINA	1+	smolt	H	Suldal	Carlin	1115	NF-38900-40099	none	04 May	Imsa	
NINA	1+	smolt	H	Imsa	Carlin	1092	NF-40100-41299	none	04 May	Imsa	
NINA	1	smolt	H	Suldal	Carlin	2392	NE-73100-75499	none	06 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	2485	NE-75500-77999	none	06 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	2497	NE-84000-86499	none	06 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	2486	NE-86500-88999	none	06 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	2006	NE-89000-91499	none	06 May	Sandsfjord	
NINA	1	smolt	H	Suldal	Carlin	2448	NE-91500-93999	none	06 May	Sandsfjord	
NINA	1	smolt	H	Suldal	Carlin	2497	NE-94000-96499	none	03 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	2496	NE-96500-98999	none	03 May	Suldal	
NINA	1	smolt	H	Suldal	Carlin	99	NZ37800-37899	none	06 May	Suldal	
NINA	1	smolt	H	Vikja	Carlin	3000	NE-33000-35999	none	10 May	Vikja,Sogn	
NINA	2	smolt	H	Eira	Carlin	2993	NE-36000-38999	none	07 May	Eira	
NINA	2	smolt	H	Eira	Carlin	2989	NE-39000-41999	none	07 May	Eira	
NINA	1	smolt	H	Dale	Carlin	2940	NE-78000-80957	none	20 May	Dale/Vaksdal	
NINA	1	smolt	H	Dale	Carlin	2959	NE-81000-83999	none	20 May	Dale/Vaksdal	
NINA		smolt	W	Vosso	Carlin	126	ND-48000-48125	none	23 Apr	Vosso	
NINA		smolt	W	Vosso	Carlin	991	ND-49000-49999	none	23 Apr	Vosso	
NINA		smolt	W	Ekso	Carlin	89	ND-48200-48288	none	30 Apr	Ekso	

NINA		smolt	W	Ekso	Carlin	13	ND-48700-48712	none	30 Apr	Ekso
NINA	1	smolt	H	Mandal	Carlin	1996	NE-69000-70999	none	19 May	Mandal
NINA	1	smolt	H	Mandal	Carlin	997	NE-71000-71999	none	19 May	Mandal
NINA	1	smolt	H	Mandal	Carlin	1095	NE-72000-73099	none	19 May	Mandal
NINA	1	smolt	H	Drammen	Carlin	998	NE-65000-65999	none	19 May	Drammen
NINA	1	smolt	H	Drammen	Carlin	1000	NE-66000-66999	none	19 May	Drammen
NINA	1	smolt	H	Drammen	Carlin	982	NE-67000-67999	none	19 May	Drammen
NINA	1	smolt	H	Drammen	Carlin	997	NE-68000-68999	none	19 May	Drammen
NINA		smolt	W	Bjerkreim	Carlin	511	NE-4000-4519	none	24 Apr	Bjrekreim
NINA	1	smolt	H	Audna	Carlin	400	NE-3000-3399	none	11 May	Audna
NINA	1	smolt	H	Audna	Carlin	2596	NE-58400-60999	none	11 May	Audna
NINA		smolt	W	Audna	Carlin	81	NE-57000-57099	none	20 Mar	Audna
NINA		smolt	W	Audna	Carlin	300	NE-57200-57499	none	20 Mar	Audna
NINA		smolt	W	Audna	Carlin	300	NE-57600-57899	none	20 Mar	Audna
NINA		smolt	W	Audna	Carlin	200	NE-58000-58199	none	20 Mar	Audna
NINA		smolt	W	Audna	Carlin	30	NE-58300-58329	none	20 Mar	Audna
NINA	1	smolt	H	Alta	Carlin	1274	ND-60726-61999	none	08 July	Alta
NINA	1	smolt	H	Alta	Carlin	1736	NE-42000-43735	none	08 July	Alta
NINA	1	smolt	H	Alta	Carlin	3016	NE-43736-46751	none	08 July	Alta
NINA	1	smolt	H	Alta	Carlin	3009	NE-48958-51966	none	30 Jun	Alta
NINA	2	smolt	H	Alta	Carlin	3083	NE-51967-55049	none	01 Jul	Alta
NINA	1	smolt	H	Alta	Carlin	1342	ND-57001-58349	none	June	Halselva
NINA	2	smolt	H	Alta	Carlin	1307	ND-58350-59711	none	June	Halselva
NINA	1	smolt	H	Alta	Carlin	204	ND-59713-59916	none	05 Jul	Halselva
NINA	2	smolt	H	Alta	Carlin	202	ND-59917-60118	none	05 Jul	Halselva
NINA	1	smolt	H	Alta	Carlin	304	ND-60119-60422	none	05 Jul	Halselva
NINA	2	smolt	H	Alta	Carlin	302	ND-60423-60725	none	05 Jul	Halselva
NINA	1	smolt	H	Alta	Carlin	1406	ND-46752-48157	none	02-Jul	Halselva
NINA	1	smolt	H	Alta	Carlin	398	ND-48159-48557	none	22-Jun	Halselva
NINA	2	smolt	H	Alta	Carlin	394	NE-48558-48957	none	22-Jun	Halselva
NINA	1	smolt	H	Alta	Carlin	1603	NE-55050-56652	none	25-Jun	Halselva
NINA		smolt	W	Hals	Carlin	unknown		none		Halselva/fella
NINA		adult		Bjerkreim	Lea	74	X85301-85400	none	15-Nov	Bjerkreim

NINA		adult			Lea	21	X84108-84200	none	Jun	Agdenes
NINA		adult			Lea	135	X84401-84535	none	Jun-July	Agdenes
Rådg.biol.		smolt	W	Gloppen	Carlin	812	NE-61000-61811	none	22-Apr	Gloppenelv
Rådg.biol.		smolt	W	Ommedal	Carlin	814	NE-61812-62625	none	07-May	Ommedals-/Åelv
Rådg.biol.		smolt	W	Oselva	Carlin	1230	NE-63000-64229	none	30-Apr	Oselva, Os
Rådg.biol.		smolt	W	Jølstra	Carlin	1001	NE-99000-99999	none	30-Apr	Jølstra
Rådg.biol.		smolt	W	Jølstra	Carlin	3000	NF-50000-52999	none	30-Apr	Jølstra
TOFA	2	smolt	H	Nidelv	Carlin	998	ND-45000-45999	none	20 May	Nidelva
TOFA	2	smolt	H	Nidelv	Carlin	999	NE-32000-32999	none	20 May	Nidelva
TOFA	2	smolt	H	Nidelv	Carlin	998	NF-49000-49999	none	20 May	Nidelva
Vitensk.museum		smolt	W	Stjørdal	Carlin	1000	NC-56000-56999	none	Mar-Apr	Stjørdalselva
Vitensk.museum		smolt	W	Stjørdal	Carlin	370	NC-58130-58499	none	May-Jun	Stjørdalselva
Vitensk.museum		smolt	W	Stjørdal	Carlin	500	NC-63500-63999	none	Mar-Apr	Stjørdalselva

[1] NINA=Norwegian Institute of Nature Research; Rådg.biol.=Rådgivende Biologer; TOFA=Trondheim Fisheries Administration; Vitensk.museum=University of Trondheim

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Russia, 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
Murmanrybvod	2+	smolt	H	Umba R.	ADC	145600		none	June	Umba River	
Murmanrybvod	2+	smolt	H	Kola R.	ADC	141200		none	June	Kola River	
Murmanrybvod	1SW,2SW	adult	W	Kola R.	Carlin	127	57073-57999	none	Oct	Kola River	
PINRO	2+	smolt	H	Umba R.	Carlin	1000	59000-59999	none	June	Umba River	
PINRO	1SW,2SW	adult	W	Iokanga R.	Carlin	91	273031-298267	none	July	Iokanga River	
PINRO & ASF	1SW,2SW	adult	W	Ponoi R.	T-bar	1218	11001-12489	none	Jun-Sep	Ponoi River	
PINRO & ASF	3+,4+	smolt	W	Ponoi R.	ADC	207		none	July	Ponoi River	
Karelrybvod	2+	parr	H	Keret R.	ADC	123400		none	May	Keret River	
Karelrybvod	2+	parr	H	Keret R.	ADC	31100		none	May	Wyg River	
Karelrybvod	2+	smolt	H	Keret R.	ADC	43800		none	May	Keret River	
Karelrybvod	2+	smolt	H	Keret R.	ADC	12100		none	May	Wyg River	
Karelrybvod	3+	smolt	H	Kem R.	ADC	16900		none	May	Kem River	

[1] ASF=Atlantic Salmon Federation; PINRO=Polar Research Institute of Marine Fisheries and Oceanography

[2] ADC=adipose fin clip

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in Spain, 1999.

Marking Agency	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[1]	Number Marked	Code or Serial	Secondary Mark[1]	Release Date	Release Location	Comment
Sección de Pesca	1	smolt	H	Sella	ADC	6000		SI	Feb	Sella	
Sección de Pesca	1	smolt	H	Narcea	ADC	26000		SI	Feb	Narcea	
Sección de Pesca	1	smolt	H	Eo	CWT	17000		SI	Feb	Eo	
Sección de Pesca	1	parr	H	Sella	ADC	10000		SI	Nov	Sella	
Sección de Pesca	1	parr	H	Sella	ADC	15000		SI	Oct	Sella-Piloña	
Sección de Pesca	1	parr	H	Esva	ADC	5000		SI	Nov	Esva	
Sección de Pesca	1	parr	H	Esva	ADC	9000		SI	Nov	Esva	
Sección de Pesca	1	parr	H	Narcea	ADC	36000		SI	Dec	Narcea	
Sección de Pesca	1	parr	H	Narcea	ADC	36000		SI	Nov	Narcea	
Sección de Pesca	1	parr	H	Eo	CWT	30000		SI	Nov	Eo	
Gobierno de Navarra	1+	smolt	H	Bidasoa-98	CWT	5580	23/50/02	ADC	Mar	R. Bidasoa	
Gobierno de Navarra	0+	parr	H	Bidasoa-99	ADC	21159		none	Jun	R. Bidasoa	

[1] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag)

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in UK (England & Wales), 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
EA North East	1+	parr	H	Tyne	CWT	7166	20/42/18	ADC	01-Mar	Kielder Burn	R.Tyne
EA North East	1+	parr	H	Tyne	CWT	7299	20/42/19	ADC	01-Apr	Main Rede	R.Tyne
EA North East	1+	parr	H	Tyne	CWT	7126	20/42/17	ADC	01-Apr	Main S. Tyne	R.Tyne
EA Thames	1+	smolt	H	Delphi	ADC	5000		none	19-Mar	Kennet	R.Thames
EA Thames	1+	smolt	H	Delphi	ADC	3721		none	22-Mar	Kennet	R.Thames
EA Thames	1+	smolt	H	Shannon	CWT	10300	20/42/04	ADC	22-Mar	Kennet	R.Thames
EA Thames	1+	smolt	H	Shannon	CWT	10150	22/42/63	ADC	22-Mar	Kennet	R.Thames
EA Thames	1+	smolt	H	Shannon	CWT	10100	19/42/12	ADC	25-Mar	Kennet	R.Thames
EA Thames	1+	smolt	H	Shannon	CWT	10250	23/42/10	ADC	25-Mar	Kennet	R.Thames
EA Thames	2+	smolt	H	Thames	ADC	2846		none	01-Apr	Kennet	R.Thames
EA Thames	1+	smolt	H	Delphi	ADC	4923		none	23-Apr	Kennet	R.Thames
EA Thames	1+	smolt	H	Delphi	ADC	296		none	07-May	Kennet	R.Thames
EA Thames		adult	W	Thames	T-bar	34	4625 - 4657	Radio	Jun -Nov	Thames	
EA Southern		adult	W	Test	T-bar-green	10	C000091-C0000100	Radio		Test	
EA Southern		adult	W	Test	T-bar-white	4	B01151 - B01153	Radio		Test	
EA Southern	0+	parr	H	Test	CWT	9850	01/42/28	ADC	21-Dec	Test	
EA Southern	0+	parr	H	Test	ADC	45473		none		Test	
EA Wales		adult	W	Taff	T-bar	305		none	Apr-Dec	Taff	
EA Wales		adult	W	Taff	T-bar	11		none	May-Oct	Severn Est	
EA Wales		adult	W	Dee	T-bar-blue	706	1138 - 1845	none	Feb-Oct	Dee	
EA Wales	1+	smolt	H	Dee	CWT	4267	22/42/57	ADC	01-Feb	Tryweryn	R.Dee
EA Wales	1+	smolt	H	Dee	CWT	4433	22/42/56	ADC	03-Feb	Alwen	R.Dee
EA Wales	1+	smolt	H	Dee	CWT	6586	22/42/61	ADC	04-Feb	Alwen	R.Dee
EA Wales	2+	smolt	H	Taff	CWT	5000	23/42/11	ADC	19-Apr	Taff	
EA Wales	2+	smolt	H	Taff	CWT	1500	23/42/11	ADC	20-Apr	Taff	
EA Wales		smolt	W	Dee	CWT	165	01/42/22	ADC	Apr-May	R.Dee	R.Dee
CEFAS		smolt	W	R.Lyd	CWT	436	01/42/03	ADC	Apr-May	R.Lyd	R.Tamar
CEFAS		smolt	W	R.Inny	CWT	716	01/42/02	ADC	Apr-May	R.Inny	R.Tamar
EA South West	1+	smolt	H	Axe	ADC	5000		none	01-May	Axe	
EA South West	2+	smolt	H	Axe	ADC	5000		none	May	Axe	
EA South West	1+	parr	H	Avon/Stour	ADC	12250		none	Mar-Nov	Avon (Hants.)	
EA South West		adult	W	Avon/Stour	T-bar	14		none	Jun -Jul	Avon/Stour	
EA North West		adult	W	Eden	T-bar	106	0030 - 0498	Radio	Mar-Nov	Eden	

[1] EA=Environment Agency ; CEFAS=Center for Environment, Fisheries, and Aquaculture Science

[2] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag); Radio=radio transmitter

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in UK (N. Ireland), 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
DARD	2+	smolt	H	R. Bush	CWT	1395	43/16/30	ADC	08-Apr	R. Lagan	
DARD	2+	smolt	H	R. Bush	CWT	1736	43/16/31	ADC	29-Mar	R. Bush	
DARD	2+	smolt	H	R. Bush	CWT	498	43/16/21	ADC	25-Feb	R. Bush	
DARD	1+	smolt	H	R. Bush	CWT	5857	43/16/42	ADC	10-May	R. Bush	
DARD	1+	smolt	H	R. Bush	CWT	9303	43/16/41	ADC	07-Apr	R. Bush	
DARD	1+	smolt	H	R. Bush	CWT	2180	43/16/33	ADC	08-Apr	R. Lagan	
DARD	1+	smolt	H	R. Bush	ADC	12838		none	29-Mar	R. Bush	
DARD	2+	smolt	H	R. Bush	ADC	1411		none	29-Mar	R. Bush	
DARD		kelt	W,H	R. Bush	ADC	320		none	03-Feb	R. Bush	panjetted ventral surface
DARD	1+,2+	smolt	W	R. Bush	CWT-S	1394	43/01/01	ADC	23-Apr	R. Bush	

[1] DARD=Department of Agriculture and Rural Development

[2] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag)

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in UK (Scotland), 1999.

Marking Agency[1]	Age	Life Stage	Hatchery or Wild	Stock Origin	Primary Tag or Mark[2]	Number Marked	Code or Serial	Secondary Mark[2]	Release Date	Release Location	Comment
FRS	2-3-4	smolt	W	Girnock	CWT-S	2385	62/50/26	ADC	Feb-May	Girnock	Trib of Aberdeen. Dee
FRS	1-2-3	parr	W	Girnock	CWT-S	479	62/50/26	ADC	Sep-Dec	Girnock	
FRS	1-2-3	parr	W	Girnock	ADC	38		PIT	Oct-Dec	Girnock	
FRS	2-3-4	smolt	W	Baddoch	CWT-S	1363	62/50/26	ADC	Feb-May	Baddoch	Trib of Aberdeen.Dee
FRS	1-2-3	parr	W	Baddoch	CWT-S	233	62/50/26	ADC	Sep-Dec	Baddoch	
FRS	1	smolt	H	Conon	CWT	7285	62/16/46	ADC	Spring	R. Conon	
FRS	1	smolt	H	Conon	CWT	6860	62/16/47	ADC	Spring	R. Conon	
FRS		smolt	W	Conon	CWT	1244	62/16/48	ADC	Spring	R. Conon	
FRS		smolt	W	Conon	CWT	550	62/19/09	ADC	Spring	R. Conon	
FRS	0	fry-fed	H	Tay	ADC	7900		none	Summer	Cochill Burn	River Braan
FRS		parr	W	Conon	PIT	1262		none	Spring	R. Conon	
FRS		smolt	W	Conon	PIT	1248		none	Spring	R. Conon	
FRS	1-4	smolt	W	North Esk	Carlin-green & CWT-S	2524	C44200-C46741, 62/20/12	ADC	Apr-Jun	R. North Esk	
FRS	1-4	smolt	W	North Esk	CWT-S	641	62/20/12	ADC	Apr-Jun	R. North Esk	
FRS	1-3	parr	W	North Esk	CWT-S	2357	62/20/12	ADC	Aug-Sep	R. North Esk	
SRT		parr	W	Spey	CWT-S	1896	62/20/11	ADC	Oct	Fiddich	
SRT		smolt	W	Spey	CWT-S	3588	62/20/11	ADC	Apr-May	Fiddich	
SRT		smolt	W	Spey	CWT-S	1148	62/10/2	ADC	Apr-May	Fiddich	
SRT		adult	W	Spey	T-bar-yellow	34	13109-13124	none	Nov	Fiddich	Tagged as kelts
							16571-16599, 15493	none			
TF		parr	W	Tweed basin	CWT	900	A62-030/01	ADC		Tweed basin	
WGFT		smolt	W	Bladnoch	Elastomer dye	2143		ADC	Apr-May	R. Bladnoch	Eye & Jaw
WSFT		smolt	W	Manse Loch	Elastomer dye	200		none	Apr-May	Manse Loch	behind left eye

[1] FRS=Fisheries Research Services, SRT=Spey Research Trust, TF=Tweed Foundation, WGFT=West Galloway Fisheries Trust, WSFT=West Sutherland Fisheries Trust

[2] ADC=adipose fin clip; CWT=coded wire tag (i.e. microtag), CWT-S=sequential CWT rather than batch tags; PIT=passive integrated transponder

Number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in USA, 1999.

Agency[1]	Age	Life Stage	Hatchery or Wild[2]	Stock Origin	Primary Tag or Mark[3]	Number Marked	Code or Serial	Secondary Mark[3]	Release Date	Release Location	Comment
	1	smolt	H	Connecticut R.	ADC	74		PIT	May	Connecticut R.	Smith Bk. Study VT
	1	smolt	H	Connecticut R.	ADC	77		PIT	May	Connecticut R.	CTR mainstem MA
	4	adult	W	Connecticut R.	T-bar	10		PIT	Jan	Connecticut R.	CTR mainstem MA
	1	smolt	H	Connecticut R.	ADC	21136		none	April	Connecticut R.	Farmington R. CT
	4	adult	W	Connecticut R.	T-bar	2		PIT	Dec	Connecticut R.	CTR mainstem MA
	5	adult	W	Connecticut R.	T-bar	1		PIT	Dec	Connecticut R.	CTR mainstem MA
	4	adult	W	Connecticut R.	Radio	16		PIT	May	Connecticut R.	Deerfield R. - MA
	5	adult	W	Connecticut R.	Radio	4		PIT	May	Connecticut R.	Deerfield R. - MA
	3	adult	W	Connecticut R.	T-bar	1		PIT	Dec	Connecticut R.	Salmon R. CT
	1	smolt	H	Connecticut R.	Radio	150		none	May	Connecticut R.	Deerfield R. - MA
	1	smolt	H	Connecticut R.	Radio	100		none	May	Connecticut R.	Deerfield R. - MA
	2	smolt	W	Connecticut R.	Ping	50		none	May	Connecticut R.	Holyoke-Windsor
	1	parr	W	Connecticut R.	PIT	400		none	Oct	Connecticut R.	Smith Bk. Study VT
RU	1+, 2+	parr	W	Connecticut R.	PIT	260		none	July	Connecticut R.	UVM B Willms W.
	1-2	parr	W	Connecticut R.	PIT	1023		none	Mar-Dec	Connecticut R.	W. Br. Study, MA
	1-2	parr	W	Connecticut R.	PIT	141		none	Mar-Dec	Connecticut R.	Sawmill R-MA
	3+, 4+	adult	H	Merrimack R.	T-bar-yellow	700		none	Apr-May	Merrimack R.	
	3+, 4+	adult	H	Merrimack R.	T-bar-green	797		none	Apr-May	Merrimack R.	
	3+	adult	H	Merrimack R.	T-bar-white	309		none	April	Merrimack R.	
	3+	adult	H	Merrimack R.	T-bar-blue	365		none	April	Merrimack R.	
	3+, 4+	adult	H	Merrimack R.	T-bar-red	703		none	Apr-May	Merrimack R.	
	3+	adult	H	Merrimack R.	T-bar-gray	190		none	Nov	Merrimack R.	
	3+	adult	H	Merrimack R.	T-bar-purple	211		none	Nov	Merrimack R.	
	1	smolt	H	Merrimack R.	PVC-R	3144		none	April	Merrimack R.	
	1+	parr	H	Merrimack R.	PVC-L	2130		none	June	Merrimack R.	
	1+	parr	H	Merrimack R.	PVC-R	2220		none	April	Merrimack R.	
	3+	adult	W	Merrimack R.	Radio	7		none	Oct	Merrimack R.	Baker R. Study
	3+	adult	H	Merrimack R.	Radio	1		none	Oct	Merrimack R.	Baker R. Study
	1	smolt	H	Merrimack R.	PVC-L	754		none	June	Merrimack R.	Strp Bass study
	1	smolt	H	Penobscot R.	Radio	87	40.6-40.69 mHz	none	April	Penobscot R.	
MASC	5	adult	C	Dennys R.	PIT	15		none	Nov	Dennys R.	
MASC	4	adult	C	Dennys R.	PIT	56		none	Nov	Dennys R.	surplus broodstock
	0+	parr	H	Penobscot R.	PVC-L	82100		none	Sep	Union R.	
MFS	2	smolt	W	Narraguagus R.	Radio	102	65.5-76.8 kHz	none	April	Narraguagus R.	smolt study
MFS	1	smolt	H	Narraguagus R.	Radio	24	65.5-76.8 kHz	none	April	Narraguagus R.	smolt study
	1	smolt	H	Penobscot R.	Radio	300	149.32 mHz	none	May	Saco R.	15 day transmitter
MFS	0+	parr	W	Pleasant R.	PIT	134		none	Aug	Pleasant R.	parr to smolt est.
MFS	1+	parr	W	Pleasant R.	ADC	695		PIT	Aug	Pleasant R.	parr to smolt est.

=Connecticutt Department of Environmental Protection; FPL=Florida Power & Light ; GNP=Great Northern Paper Company ; MASC=Maine Atlantic Salmon Commission; lew Hampshire Fish & Game; NUSCO=Northeast Utilities Service Company ; PGE=Philadelphia Gas & Electric ; USFWS=U.S. Fish & Wildlife Service; USGS=U.S. al Survey; VTCFWRU=Vermont Cooperative Fish & Wildlife Research Unit

fish that were collected as juveniles and held in captivity until maturity

dipose fin clip; Ping=sonic transmitter; PIT=passive integrated transponder; PVC-L=left pelvic fin clip; PVC-R=right pelvic fin clip; Radio=radio transmitter; STR=streamer

Table 1. Summary of the number of coded wire tags, fin clips, and external tags applied to Atlantic salmon in the North Atlantic, 1999. 'Hatchery' and 'Wild' refer to smolts or parr; 'Adult' refers to wild and/or hatchery fish. Data from Belgium were not available. Fish were not tagged in Finland.

		Primary Tag or Mark				
Country	Origin	Coded wire tag	External tag	Adipose clip[1]	Other visible clip or mark	Secondary Mark[2]
Canada	Hatchery	12089	9175	2209362	0	17089
	Wild	0	11538	888	0	877
	Adult	0	7937	0	0	2
	Total	12089	28650	2210250	0	17968
Denmark	Hatchery	0	1300	0	0	0
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	0	1300	0	0	0
France	Hatchery	0	0	320037	0	21600
	Wild	0	0	0	945	566
	Adult	0	0	0	0	0
	Total	0	0	320037	945	22166
Iceland	Hatchery	123387	0	0	0	123387
	Wild	3816	0	0	0	0
	Adult	0	1665	0	0	52
	Total	127203	1665	0	0	123439
Ireland	Hatchery	306870	0	150000	0	297832
	Wild	4402	0	0	0	2975
	Adult	0	0	0	0	0
	Total	311272	0	150000	0	300807
Norway	Hatchery	0	91495	0	0	0
	Wild	0	11749	0	0	0
	Adult	0	230	0	0	0
	Total	0	103474	0	0	0
Russia	Hatchery	0	1000	514100	0	0
	Wild	0	0	207	0	0
	Adult	0	1436	0	0	0
	Total	0	2436	514307	0	0
Spain	Hatchery	52580	0	164159	0	0
	Wild	0	0	0	0	0
	Adult	0	0	0	0	0
	Total	52580	0	164159	0	0
Sweden	Hatchery					
	Wild		data being entered			
	Adult					
	Total	0	0	0	0	0
UK (England & Wales)	Hatchery	95344	0	84509	0	95344
	Wild	0	0	0	0	0
	Adult	0	1190	0	0	0
	Total	95344	1190	84509	0	95344

UK (N. Ireland)	Hatchery	20969	0	14249	0	20969
	Wild	1394	0	160	0	1394
	Adult	0	0	160	0	0
	Total	22363	0	14569	0	22363
UK (Scotland)	Hatchery	14145	0	7900	0	0
	Wild	16784	2558	38	2343	21489
	Adult	0	0	0	0	0
	Total	30929	2558	7938	2343	21489
USA	Hatchery	0	0	21287	91009	0
	Wild	0	0	695	152	0
	Adult	0	3289	0	28	0
	Total	0	3289	21982	91189	0
All Countries	Hatchery	625384	102970	3485603	91009	576221
	Wild	26396	25845	1988	3440	27301
	Adult	0	15747	160	28	54
	Total	651780	144562	3487751	94477	603576
	Grand total marked =	4378570				

[1] Fish without other external marks or coded wire tags.

[2] Typically adipose fin clip.

APPENDIX 1

NATIONAL TAG CLEARING HOUSES TO WHICH ATLANTIC SALMON TAGS SHOULD BE RETURNED FOR VERIFICATION

Country	Institution	Address
BELGIUM	Unite de Recherches en Biologie des Organismes	Rue de Bruxelles, 61 B-5000 NAMUR (Belgique) Claire.Prignon@fundp.ac.be
CANADA	Atlantic Salmon Tag Clearing House Department of Fisheries & Oceans (Att. K. Rutherford)	P.O.Box 1006 Darmouth Nova Scotia, B3K2A4 RutherfordK@mar.dfo-mpo.gc.ca
DENMARK	Danmarks Fiskeri og Havundersogelser	Charlottenlund Slot DK-2920 Charlottenlund ffi@dfu.min.dk
FAROES	Fiskirannsoknarstovan	Noatun, P.O. Box 3051 FR 110 Torshavn
FINLAND	Finnish Game & Fisheries Research Institute	P.O. Box 202 SF-00151 Helsinki maija.lansman@rktl.fi
FRANCE	Conseil Superieur de la Peche	Delegation Regionale 84 Rue de Rennes F-35510 Cesson-Sevigne jean-pierre.porcher@ csp-rennes.environnement.gouv.fr
ICELAND	Institute of Freshwater Fisheries	Vagnhofdi 7 112 Reykjavik Gudni.Gudbergsson@veidimal.is
IRELAND	Marine Institute Fisheries Research Center (Att. A. Cullen)	Abbotstown, Castleknock Dublin 15 anne.cullen@marine.ie

NORWAY	Norwegian Institute for Nature Research (NINA)	Tungasletta 2 N-7005 Trondheim l.p.hansen@ninaosl.ninaniku.no
PORTUGAL	Institute Superior Agronomia Dept. de Engenharia Florestal	Tapada da Ajuda 1399 Lisbon Portugal
RUSSIA	PINRO (Att. S. Prusov)	6 Knipovitch Street 183763 Murmansk inter@pinro.murmansk.ru
SPAIN (Navarra)	Gobierno de Navarra Servicio de Medio Ambiente	c/o Alhondiga, 1 E 31002 Pamplona
SPAIN (Asturias)	Principado De Asturias Consejeria De Agricultura (Att. Mr. Jeronimo de la Hoz)	Seccion de Pesca fluvial c/ Coronel Coronel Arvada s/n 33005 OVIEDO.ASTURIAS. (Spain)
SWEDEN	Laxforskningsinstitutet Swedish Salmon Research Institute	Forskarstigen S-814 94 Alvkarleby Curt.Insulander@imr.no
UK (England & Wales)	MAFF, Fisheries Laboratory (Att. I. Russell)	Pakefield Road, Lowestoft Suffolk NR33 OHT russell@cefas.co.uk
UK (Scotland)	Fisheries Research Services (Att. J. Higgins)	Freshwater Fisheries Lab. Field Station, 16 River Street, Montrose DD108DL j.higgins@marlab.ac.uk
UK (N Ireland)	Department of Agriculture for N. Ireland, Fishery Research Laboratory (Att. J. Moffett)	38, Castle Road Coleraine C.Londonderry BT51 3RL
USA	Northwest Fisheries Centre NMFS/NOAA (Att. R. Brown)	166 Water Street Woods Hole, MA 02543 Russell.Brown@noaa.gov