Advisory Committee on
Fisheries Management

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REPORT OF THE

WORKING GROUP ON NORTH ATLANTIC SALMON

ICES Headquarters
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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 1997 Statutory Meeting, ICES resolved (C. Res. 1997/2:11:12) that the Working Group on North Atlantic Salmon (Chairman: Dr T.L. Marshall, Canada) will meet at ICES Headquarters from 14-23 April, 1998 to consider questions which include those 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 and catch and release, and worldwide production of farmed and ranched salmon in 1997;	2.1 & 2.2
ii. report on significant developments which might assist NASCO with the management of salmon stocks;	2.3
iii. provide any new information on the causes of changes in abundance of salmon,	2.4
iv. comment and advise on the Report of the NASCO Working Group on the Precautionary Approach, as it relates to the work of ICES;	2.5
v. provide a compilation of microtag, finclip and external tag releases by ICES Member Countries in 1997;	2.6
vi. compile all available information on the possible occurrence of the M74 syndrome or similar conditions in salmon stocks outside the Baltic Sea.	2.7
b) With respect to Atlantic salmon in the North-East Atlantic Commission area	
i. describe the events of the 1997 fisheries and the status of the stocks;	3.1–3.4
ii. update the evaluation of the effects on stocks and homewater fisheries of the suspension of commercial fishing activity at Faroes since 1991;	3.5
iii. estimate the expected abundance of salmon in the North-East Atlantic for 1998/1999;	3.7
iv. provide catch options with an assessment of risks relative to the objective of exceeding stock conservation limits;	3.6 & 3.8
v. evaluate any new information on the potential by-catch of post-smolts in pelagic fisheries;	3.9
vi. identify relevant data deficiencies and research requirements.	3.10
c) With respect to Atlantic salmon in the North American Commission area:	
i. describe the events of the 1997 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;	4.3
iii. update age-specific stock conservation limits based on new information as available;	4.4
iv. provide catch options with an assessment of risks relative to the objective of exceeding stock conservation limits;	4.5
v. identify relevant data deficiencies and research requirements.	4.6
d) With respect to Atlantic salmon in the West Greenland Commission area:	
i. describe the events of the 1997 fisheries and the status of the stocks;	5.1 & 5.2
ii evaluate the Reserve Quota at West Greenland on salmon stocks in relation to the goal of exceeding stock conservation limits (spawning targets);	5.3
iii provide a detailed explanation 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	5.7
iv provide age specific stock conservation limits (spawning targets) for all stocks occurring in the Commission area based on the best available information;	5.4
v examine critically the model used to provide catch advice, looking at all the assumptions, and comment on the confidence limits on the output from the model	5.5
vi. provide catch options with an assessment of risks relative to the objective of exceeding stock conservation limits (spawning targets);	5.6
vii. identify relevant data deficiencies and research requirements.	5.8

The Working Group considered 29 Working Documents submitted by participants (Appendix 1); other references cited in the report are given in Appendix 2.

1.2 Participants

Baum, E.T.	USA
Caron, F.	Canada
Chaput, G.	Canada
Erkinaro, J.	Finland
Euzenat, G.	France
Friedland, K.	USA
Gudbergsson, G.	Iceland
Hansen, L.P.	Norway
Holm, M.	Norway
Insulander, C.	Sweden
Jacobsen, J.A.	Faroes
Kanneworff, P.	Greenland
Kimball, D.	USA
MacLean, J.	UK (Scotland)
Marshall, L. (Chairman)	Canada
Meerburg, D.J.	Canada
Ó Maoiléidigh, N.	Ireland
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Prusov, S	Russia
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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 1960–97 are given in Table 2.1.1.1, and nominal catches in homewater fisheries, divided into size or age categories where such data are available, are given in Table 2.1.1.2. 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 takes place and where the intent is to harvest all returns at the release site. While ranching does occur in other countries it is on a much smaller scale than in Iceland, some are experimental operations and at others harvesting does not occur solely at the release site. As such, the ranched component in these countries has been left in the nominal catches.

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 France, Ireland, UK(England and Wales), UK(N. Ireland) and UK(Scotland)); and 'North America' (including Canada, USA and St. Pierre et Miquelon); and 'Greenland and Faroes'.

The updated total nominal catch for 1996 of 3,128 t is 488 t less than the total for 1995 of 3,616 t. Catches in most countries remain below the averages of the previous 5-year and 10-year averages. Figures for 1997 (2,323 t) are provisional, but the final total is unlikely to exceed the 1996 value.

The lack of information on fishing effort presents major difficulties in interpreting catch data for any one year and also in comparing catches in different years. However, it is clear that management plans in most countries have decreased fishing effort and this accounts for some of the decline in catches in recent years.

Reported nominal catches for several countries by season and weight are summarised in Table 2.1.2.1. As in Tables 2.1.1.1 and 2.1.1.2, catches in some countries include both wild and reared salmon (excluding ranched fish from

Iceland) and fish farm escapees and the figures for 1997 are provisional. Different countries use different methods to partition their catches by sea-age class. These methods are described in the footnotes to Table 2.1.2.1. The composition of catches in different areas is discussed in more detail in Sections 3, 4 and 5.

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 large salmon in some areas of Canada and USA since 1984. Recent declines in salmon abundance in the North Atlantic has 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 2.1.3.1 presents catch-and-release information from 1991 for those countries which have records. There are large differences in the percentage of the total rod catch that is released among countries and this reflects the varying management practices among these countries.

2.1.3 Unreported catches

Unreported catches by year and Commission Area are presented in Table 2.1.4.1. While comparisons of the 1997 unreported catch can be compared to previous values, it must be remembered that these figures are at best guess-estimates, and 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 13 of the 1996 report (ICES 1996/Assess 11). A description of the methods used in Canada to evaluate the 1997 unreported catch is presented in Section 4.1.2.

The total unreported catch in NASCO areas in 1997 was estimated to be 827 t. The unreported catch estimated for the North-East Atlantic, the North American and the West Greenland Commission Areas in 1997 was 732 t, 90 t and 5 t respectively. Figure 2.1.4.1 shows that the unreported catch has remained an almost constant proportion (30 %) of the total catch since 1987. No data for the combined three Commission Areas is available prior to 1987.

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 1996/1997 season. A total of 11 surveillance flights was reported to have been undertaken by the Icelandic and Norwegian Coast guards between late autumn and early summer, and no salmon fishing was observed in the area. However, few of these flights were conducted over the winter period when fishing for salmon would be most likely to occur. Furthermore, these flights were associated primarily with the pelagic fisheries in the area rather than possible salmon fisheries.

2.2 Farming and Sea Ranching of Atlantic Salmon

2.2.1 Production of farmed Atlantic salmon

The production of farmed Atlantic salmon in the North Atlantic area in 1997 was 477,368 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 6 % increase over that of 1996 (451,581 t) and a 42 % increase over the 1992-96 average (335,586 t). The countries with the largest production were Norway and Scotland, which accounted for 65 % and 21 % of the total respectively. Proportional increases in production in the other seven countries were limited to between 0 % and 4 %. The production of farmed Atlantic salmon in the North Atlantic area in 1997 was over 200 times the nominal catch of Atlantic salmon in the North Atlantic.

Farmed Atlantic salmon production is not restricted to the North Atlantic and takes place in many other areas of the world. These figures have been collated and are presented in Table 2.2.1.2 and Figure 2.2.1.2. In 1997, 20 % of the world production of farmed Atlantic salmon was accounted for outside the North Atlantic region. As in the North Atlantic, production has increased throughout the time series. However, the current rate of increase in these countries is greater than that in the North Atlantic countries. Production in 1997 increased 21 % over that of 1996 (101,260 t) and 90 % over that of 1992–96 average (64,369 t). The areas with the largest production were Chile and the West Coast of Canada, which accounted for 72 % and 15 % of the total respectively. Proportional increases in production in the other seven countries were limited to between 1 % and 7 %.

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 1997 was 55 t, considerably lower than in 1996 (258 t) and the lowest value since 1987 (Table 2.2.2.1 and Figure 2.2.2.1). This reduction is almost solely due to the decreased production in Iceland where fewer ranching facilities operated. In 1997, 87 % of the ranched production was accounted for by Iceland. 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 Significant Developments towards Management of Salmon

2.3.1 Post-smolt growth and the nature of the marine juvenile habitat

The Working Group examined scale circuli spacing data from historical collections of post-smolts made in the Gulf of St. Lawrence, Canada (Figure 2.3.1.1), with the aim of understanding the role of estuarine and coastal habitats as juvenile habitat for Atlantic salmon. Circuli spacing patterns were extracted from the scales of 580 post-smolts collected in the Gulf during three seasons, 1982–84. Samples were sorted by date within years and compared. The analysis suggests that in some years post-smolts remain in the Gulf throughout the entire summer growth season whereas in other years only slower growing fish remain in these areas. Growth patterns for Gulf of St. Lawrence post-smolts were compared to patterns for returns from three salmon stocks from the southern end of the range in North America (Figure 2.3.1.2) which are assumed to grow in open ocean habitats. These data suggest that in some years post-smolt growth in the Gulf is as fast as that observed for both the one seawinter (1SW) and 2SW returns to southern rivers.

The analysis suggests that the role of the Gulf of St. Lawrence as salmon post-smolt nursery habitat varies annually. In some years it appears that the growth of post-smolts retained in the Gulf is as robust as observed for post-smolts assumed to use open ocean habitats. This correlation suggests that either post-smolts from other areas invade the Gulf and use it as a nursery area; or, the Gulf region is continuous with a larger area of similar growth conditions where the nursery is formed. In other years it appears only the smaller, and assumed slower growing, post-smolts remain in the Gulf area suggesting that the nursery habitat was elsewhere.

2.3.2 Spatial/temporal convergence of North Atlantic salmon at sea

The Working Group examined scale samples from historical collections of post-smolts made in the Labrador Sea with the aim of understanding the growth dynamics of stocks at the southern end of the range versus what is hypothesized to be the juvenile nursery for post-smolts from the entire stock complex (Figure 2.3.2.1). Circuli spacing patterns were recorded for the scales of 1,525 salmon collected from 1SW and 2SW returns to southern rivers and post-smolts collected in the Labrador Sea for three smolt years: 1988, 1989, and 1991. For two of the three years, growth patterns for fish from the southern stocks intersected the patterns for post-smolts from the Labrador Sea collections after 4-5 circuli pairs (Figures 2.3.2.2–2.3.2.4). Since circuli pairs are laid down at a rate of approximately one per week, the data suggest that distribution patterns for regional groups begin to overlap and stocks begin to experience similar environmental conditions by July of the post-smolt year or two months after their migration to sea. In some years, it would appear that regional groups do not mix until fall.

These data may be useful in understanding the regional and temporal contributions of salmon to the entire North American stock complex. Regional effects would be expected to dominate on an individual salmon stock for at least the first month at sea. Since post-smolt salmon are largely transported by prevailing currents during their first months at sea (Jonsson *et al.* 1993), a combination of swimming potential and current transport vectors will circumscribe an area relevant to a specific stock. After post-smolts attain sufficient size, it can be assumed that they begin to out-swim currents and distribute according to thermal and feeding preferences. These factors should be taken into account when considering models and analyses that attempt to explain survival mechanisms mediated by climate factors. In particular, the geographical distribution of any stock should match the geographical distribution of any proposed mortality factor.

2.3.3 Catch and release as a conservation measure

The acceptance of hook-and-release angling practises as a conservation measure for Atlantic salmon is a recent phenomenon. In 1984, in the Maritime provinces and on the island of Newfoundland, in Canada, it became mandatory that all salmon larger than 63 cm had to be released. In the 1990's, hook-and-release only angling of all size categories has routinely been required on rivers where salmon populations have been below established conservation levels. In Newfoundland, in 1997, hook-and-release angling was not permitted on some rivers where water temperatures exceeded 18 C. In 1997, it has been estimated that almost 50,000 salmon of all sizes were hooked-and-released (Table 2.1.3.1) in Canada.

As there have been divergent opinions among user groups on the effect of hook-and-release angling on salmon mortality and reproductive success, Canada hosted a workshop on the subject in February 1998 (Anon. 1998 a) to summarize information available on the subject (see Table 2.3.3.1)

Several studies have indicated that hook-and-release angling and associated handling at 20°C or above, can result in elevated mortality (immediate and delayed) in Atlantic salmon and that these critical temperatures can decrease if other stressful conditions are present, for example, soft water. Factors other than temperature can also be important. Fish which had recently entered fresh water from the sea and which were hooked-and-released had an elevated rate of mortality compared to no mortality for kelts in the spring in freshwater and for salmon in the autumn that had been in the river for some time.

While information is limited on the long term effects of hook-and-release angling, some studies using radio-tracking have documented that a large number of the fish survive for at least several months and spawning by some of these fish has been confirmed.

Although hook-and-release angling is a conservation measure relative to retention angling, due to the generally low levels of mortality, caution still must be exercised in its implementation. Mortality and resulting impact on resource conservation is potentially increased under certain river conditions and if anglers do not take care in releasing hooked fish.

2.4 Causes of Changes in Abundance of Salmon

2.4.1 Linkage between climate, growth, and survival

The Working Group re-evaluated the analysis of two long-term tagging studies with wild salmon stocks in the North Sea area (Friedland *et al.* 1998). The salmon stocks, the Figgjo in southern Norway and the North Esk in eastern Scotland, reside in relatively un-impacted rivers that continue to sustain healthy runs of salmon. The return rates for 1SW, the predominant age at maturity for both stocks, were highly correlated. An analysis of sea surface temperature distributions for periods of high versus low return rate showed that when low sea surface temperatures dominate the North Sea and southern coast of Norway during May, salmon survival has been poor. Conversely, when high sea surface temperatures extend northward along the Norwegian coast during May, survival has been good. Ocean conditions can be further related to the recruitment process through growth studies with the North Esk stock. Post-smolt growth increments for 1SW and 2SW fish (the back-calculated growth between the end of the freshwater zone and the end of the first winter band) returning to the North Esk were highly correlated and were patterned similarly to changes in survival and thermal habitat (Figure 2.4.1.1). This relationship can be seen in the relationship between growth and survival (Figure 2.4.1.2).

The results suggest there is a link between ocean climate conditions, post-smolt growth, and post-smolt survival for salmon stocks in the North Sea area. Aspects of these relationships have been described before. Working with a combined estimate of total stock abundance for all European stocks, Friedland *et al.* (1993) reported that spring temperature conditions might influence survival in some way. However, in that study both fish abundance and environmental data were smoothed in both time and space making any inference about the recruitment process impossible. The results presented to the Working Group are consistent with these earlier findings, but go significantly further to elucidate the mechanism at work. The analysis is discreet over time and space. Thus, it can be concluded that the ocean climate variation related to salmon survival occurs in spring when the post-smolts first enter the marine environment and occurs in the area of the North Sea and Norwegian coast.

2.4.2 Factors potentially influencing recent returns to North America

A workshop was convened in Canada in February 1998 to address the question of the lower than expected returns and sea survivals of Atlantic salmon to eastern Canada (Anon. 1998 b). An analysis of the relative sea survivals of 10 stocks (wild and hatchery smolts) and returns to 38 rivers of eastern Canada indicated that there was a very low probability that the observed broad-scale declines in 1997 relative to 1996 were a chance (independent) occurrence.

Factors that affect sea survival of salmon take place at various times prior to the onset of maturation and return to natal rivers. These factors could be associated with: 1) environmental conditions (temperature, salinity, etc.); 2) removals in legal and illegal fisheries; 3) predation (cod, seals, seabirds etc.); 4) diseases or parasites (bacterial, viral, sea lice, etc.); or 5) a suite of other factors including changes in biological characteristics of stocks (e.g., delayed sea-age at maturation), and effects of escaped aquacultured salmon. The task of tracking the events affecting survival of Atlantic salmon for each of these factors becomes more complex after postsmolts leave fresh water and enter the marine environment. To be implicated in the survivals of 1SW salmon returning in 1997, the event must have occurred sometime between the entry of the smolts into the sea during the spring-summer of 1996 up to their return in 1997. The following sections explore possible factors which may have contributed to the declines observed in 1997.

Life-stage effect

The time/location of increased levels of mortality of 1SW salmon in 1996–97 was inferred from an examination of the relative proportions of repeat-spawners compared to 1SW salmon spawning for the first time. The consecutive-year repeat spawners were at sea for only the spring and summer months of 1997. The repeat spawner survival rates were normal suggesting that mortality on the maiden spawners did not occur in the vicinity of homewaters in 1997.

Environmental conditions

Previous scientific studies have shown that oceanic variability influences both recruitment survival and growth of several salmon stocks as well as the timing and location of their migrations. Atlantic salmon typically are found near the surface. Sea surface temperatures (SST) observed from satellites have been combined with research vessel salmon catch rates to establish a thermal habitat index for salmon. This index has a strong association with the total North American Atlantic salmon abundance, and has been large when salmon abundance was high and low in recent years when abundance was low (see Section 5.6.1; Figure 5.6.1.1).

During most of the 1990s temperatures of the waters off Labrador and Newfoundland have been relatively cold. The average water column temperature at a monitoring site off St. John's has varied with an approximate 10-year period with minimum temperatures observed in the early 1970s, the mid–1980s and the early 1990s (Figure 2.4.2.1). In addition, there has been a gradual decline in temperature over this period, so that the lowest values in the 50-year record occurred during 1991–92. These cold conditions continued through 1995 before warming in 1996 to above normal values. In 1997, temperatures remained well above the early 1990s values, but were lower than those observed in 1996.

Further south, the long-term trends have differed. In the Gulf of St. Lawrence, southern Newfoundland and on the northeastern Scotian Shelf, average water temperatures have been cold since the mid–1980s and although a slight warming has occurred during recent years, temperatures remain below normal. On the rest of the Scotian Shelf and in the Gulf of Maine, average water column temperatures have generally been warmer than or near normal.

Associated with the ocean climate changes described above have been significant large-scale ecosystem changes. For example during the 1990s, Arctic cod (*Boreogadus saida*) increased in abundance on the Labrador Shelf and extended further southward onto the Grand Banks and into the Gulf of St. Lawrence. The distribution of Greenland halibut (*Reinhardtius hippoglossoides*) also extended further south at this time. During the late 1980s, capelin (*Mallotus villosus*) returned to Scotian Shelf, and have increased in abundance there steadily. Capelin also spread eastward from the Grand Banks to Flemish Cap. Cold waters in the 1990s delayed the inshore spawning time of capelin by approximately 1 month, and they have continued to spawn late in recent years. Large scale changes in the distribution and abundance of Atlantic herring (*Clupea harengus*) also occurred in the early 1990s. On the northeastern Scotian Shelf, snow crab, (*Chionoecetes opilio*) which prefer temperatures colder than 3°C, have increased their distribution since the late 1980s. Indirect evidence of ecosystem changes also comes from seabird diets. Since 1990, there has been a marked shift in the diet of Funk Island gannets (*Sula sula*) from warm-water species like mackerel (*Scomber scombrus*) to cold water species such as capelin as well as some Atlantic salmon (Figure 2.4.2.2). In addition, many important commercial species including cod (*Gadus morhua*) and redfish (*Sebastes* sp.) declined to very low numbers, although the respective roles of fishing and the environment in this decline remain unclear. While these significant and widespread ecosystem changes appear to be linked to cold water temperatures, the apparent lack of a rebound toward previous conditions during the last two years as waters have warmed is not understood.

Marine exploitation

Fisheries, both legal and illegal, reduce the number of salmon in the overall population, and where this happens prior to counting facilities, could have caused the lower returns in 1997. In order to explain the low returns in 1997, landings in these fisheries would have had to have increased dramatically from the previous year. Angling fisheries can be easily eliminated as a potential cause of the low returns because they occur after salmon have been enumerated.

Commercial fisheries affecting salmon from eastern Canada occurred at west Greenland, Labrador, Québec and St. Pierre et Miquelon (see Section 4.1). Additionally, there is a small recreational marine net fishery for salmon in St. Pierre et Miquelon. All of these to various degrees exploit salmon from a variety of stocks and age classes.

Landings in the Québec fishery have been declining steadily over the period of 1994-97. Landings in Labrador have also declined over the same period although they increased by 10 % in 1997 from 1996 by number (due to increases in smaller salmon). The increased harvest of small salmon in Labrador was insufficient to explain the low returns. Greenland harvests non-maturing 1SW, 2SW and repeat spawning salmon that would return home the following year. Landings of 1SW North American salmon at Greenland declined over time and declined further between 1995 and 1996 by 40 % which should have reduced the impact on returns of 2SW salmon in 1997. Landings from the fishery at St. Pierre et Miquelon of 1.5 tonnes in 1996 are thought to have remained the same in 1997.

Records of by-catches in offshore fisheries collected by observers placed aboard fishing vessels to examine catches on an individual set basis (1980 to present), reported by fisheries officer boardings for inspection of logbooks, catches and fishing gear (1987 to present), and kept by research vessels (1965 to present) indicate that in about one million observations of these catches at sea in the Newfoundland Region, a total of 49 salmon were reported taken.

The low overall catches of Atlantic salmon in commercial fisheries and lack of evidence of increasing by-catches in some inshore and offshore fisheries indicate that fisheries are unlikely to have been an important factor in the low returns of salmon in 1997.

Predation

Atlantic salmon are known to be prey for many species in the sea. For most of these species, there are no estimates of their abundance and consumption rates of salmon. Possible predators of Atlantic salmon in Canada were last provided in ICES 1996/Assess:11 but were revisited within Canada (Anon 1998 b) in an effort to understand possible factors for the rather dramatic decline of salmon returns to rivers in 1997.

<u>Birds:</u> In fresh water, the main bird predators are common mergansers (*Mergus merganser*)and belted kingfishers (*Megaceryle alcyon*). Consumption calculations suggest that these birds take a substantial fraction of juvenile salmon in some Maritime rivers. However, repeated experiments in bird control have failed to demonstrate that bird culls increase juvenile salmon populations. For this reason, and because merganser numbers in the Maritimes have been stable in the years up to 1996, it is unlikely that bird predation in fresh water could have contributed to low salmon returns in 1997.

Smolts leaving rivers with nearby double-crested cormorant (*Phalacrocorax auritus*) colonies pass through the foraging areas of these birds. In several Maritime rivers, cormorants could deplete smolt runs, even if salmon were only a small part of their diet. It is not known however if this occurs because data on cormorant diets from colonies near rivers with major wild smolt runs are lacking.

Gannets (*Sula sula*) are large seabirds which capture fish by plunge-diving from the air. Salmon were rare in gannet diets at Funk Island, Newfoundland, from 1977 to 1989, but increased during the 1990s to a sampled estimate of 3 % of the diet (in August) (Figure 2.4.2.2). At the same time the gannets' principal foods shifted from warm-water species (mackerel) to cold-water species (capelin and others including salmon), which reflected a significant change in the marine ecosystem. The gannets' exploitation of postsmolts is difficult to estimate because the duration of postsmolt predation by gannets has not been measured and because postsmolt populations and movements are poorly known.

Herring gulls (*Larus arsentatus*) and great black-backed gulls (*Larus fuscus*) in Newfoundland markedly changed their feeding behaviour following the closure of ground fisheries in the early 1990s. Fisheries discards and plant offal, formerly a mainstay of gull diet, became unavailable. Major delays in arrival times of inshore spawning capelin have also reduced gulls' food supplies in the 1990s. Based on information from people living near salmon rivers, it is speculated that these gulls, deprived of their traditional food sources, may have increased predation on parr and on out-migrating smolts. There is no evidence that this activity was greater in 1996 than in other years since 1992.

<u>Seals:</u> There are 6 species of seals found in eastern Canada. The harp seal (*Phoca groenlandica*), hooded seal (*Cystophora cristata),* harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) are the most common. Harp seals and hooded seals are both pelagic species which spend approximately half of the year in the Arctic and Greenland

waters, moving to Labrador, and Newfoundland and into the Gulf of St. Lawrence from about mid-November until mid June i.e., their spatial and temporal distribution coincides well with Atlantic salmon. Harbour seals and grey seals are primarily coastal species that can be found along the Atlantic coast and in the Gulf of St. Lawrence throughout the year. There were an estimated 4.9 million harp seals, 0.6 million hooded, 180,000 grey seals and 29,000 in Canadian waters in 1996 (Hammill and Stenson 1997). Harp seal populations decreased gradually from 2.6 million animals in 1955 to 1.78 million animals in 1971 (Shelton *et al.* 1996). As a result of quotas and reduced harvests, harp seals subsequently increased (approx. 5 % $year^{-1}$) to the current estimated high of 4.9 million animals (Shelton *et al.* op cit; Hammill and Stenson 1997) (Figure 2.4.2.3). The reported primary size range of cod consumed by harp seals is 10–20 cm (Lawson and Stenson 1995) although the incidence of cod >40 cm in seal stomachs was greater in harp seals sampled in the northern Gulf of St. Lawrence and NAFO Areas 2J3KL.

Fish consumption by seals has been estimated by combining information on seal abundance, distribution, energy requirements, and diet composition. Diet composition was determined by examining the contents of seal stomachs. Some salmon (number not reported) have been found in the stomachs of harp seals and most of these were from samples in the Gulf of St. Lawrence where <10 % of the adult population is normally found. Capelin (*Mallotus villosus*), Atlantic cod (*Gadus morhua,*) species of the Family Pleuronectidae, herring (*Clupea harengus*) and Window pane (*Scophthalmus aquosus*) comprised 84 % of the wet weight of diet samples collected 1982–95 (Hammill and Stenson 1997). Salmon comprised only 0.37 % of the wet weight of samples but were estimated to comprise 2-3 thousand tonnes of the annual consumption of fish by harp seals (Hammill and Stenson op cit). However, the uncertainty associated with the estimates is not reported. Cairns (*In prep.*) investigated the probability of observing a single salmon in the stomach of a harp seal in 1996 and concluded that over 7,000 stomachs would have to be examined to find one consumed post-smolt for every million post-smolts consumed.

Harbour and grey seals are known to establish themselves in or near salmon rivers through their range and at the local level also have the potential to prey upon salmon.

The negative association between pre-fishery abundance and harp seal population estimates in the northwest Atlantic suggests that predation may also be an important component determining sea survival of Atlantic salmon in the Northwest Atlantic (Figure 2.4.2.4). Backward stepping regression analyses of each of 1SW and MSW recruits to North America on logged indexes of North American smolt production, February or March indexes of marine winter habitat in the North Atlantic and estimated populations of harp seals, 1973–96 provided regressions (R^2_{adj} >0.86; $p < 0.001$) with seal variables (or product of seals and habitat) significant at $p \leq 0.04$. Data for recruits and indexes of marine habitat were extracted from ICES 1997/Assess:10; seal data were those of Shelton *et al.* (1996) and Hammill (pers. comm). The models assumed that annual smolt return rates for the Miramichi were synchronous for all rivers of North America and they yielded negative coefficients for the 'smolt production' stock variable. Negative association between smolt abundance and subsequent adult returns (depensation; Hilborn and Walters 1992) has not been described for Atlantic salmon but has been discussed by Peterman (1977 and 1980) for Pacific salmon. It was also noted that the Gulf stock variable 'lagged spawners' (Miramichi being 50 % of the Gulf) has to date been rejected by step-wise regression as a component of the stock variable in current pre-fishery abundance forecasts for non-maturing North American salmon. The seal variable was monotonically increasing over the period considered (1973–95). It has changed direction only once (1972) over a 43-year record (Figure 2.4.2.3).

Cod: In some localized areas in Norway, cod have been shown to consume about 20 % of smolts as they enter the sea. A recent shift inshore of cod distribution in Newfoundland and parts of the Gulf of St. Lawrence and possibly the eastern Scotian Shelf further suggested that cod predation on smolts in 1996 may have been a factor in the low returns in 1997. No salmon have been found in the several thousand cod stomachs examined to date; however, cod have not been extensively sampled in the mouths of rivers at the same time as salmon smolts have been moving to sea. Thus, the potential importance of cod predation cannot be eliminated.

In summary, the two decades of increasing seal populations, a decadal decline in many North American salmon stocks, and the low probability of observing salmon in harp seal stomachs even under extremely high predation rates suggest that the potentially significant impact by seals should not be discounted. It is difficult to assess the effects of predators and environment on salmon when neither variable can be controlled/varied independently of the other. The relative importance of predators can only be determined when contrasting conditions of habitat and predator abundance occur. The environmental signal is now increasing which will provide one of the combinations required for testing the biological mechanism (high environment: low predator abundance in the 1970's; high environment: high predator abundance in the late 1990s).

Forage

The available evidence on salmon diet indicates that salmon are opportunistic feeders on capelin, sand lance (*Ammodytes* sp.), squid, herring, mackerel, deepwater fishes such as blacksmelts and barracudina, and many different types of crustaceans. They exploit different prey species in different feeding areas and the diet in a particular area may vary both among and within years. The ability to exploit a wide range of prey species, even at the post-smolt stage, suggests that the abundance of any one forage species would not of itself greatly alter growth and therefore survival. However, forage abundance may affect growth rates of individual salmon. Furthermore, a year class composed of slow-growing individuals resulting from low prey abundance would, presumably, be more vulnerable to predators as it is thought that most natural mortality at sea takes place when salmon are small. Salmon would also be susceptible to any major climatic or oceanographic event that altered the abundance and/or distribution of entire assemblages of suitable prey.

There is no direct information on the availability of food for the 1996 smolt class in the marine environment. An indirect method of determining if there was a decrease in food resources was to examine returning adults in 1997 for a reduction in size and condition. Size and condition of maturing 1SW salmon in Newfoundland in 1997 was at or near the averages for the years corresponding to the commercial salmon fishery moratorium. Average size of this age class for Miramichi River, New Brunswick and Saint Jean River, Québec was the highest on record in 1997; LaHave River, Nova Scotia was average and de la Trinité River, Québec second highest. 2SW salmon returning to Miramichi River in 1997 were also among the largest of record and were the largest recorded for de la Trinité River and Saint Jean River.

Reduced growth in the sea has been associated with a delay in age at maturity and it has been suggested that salmon not returning as expected as 1SW fish in 1997 might come back as 2SW fish in 1998. The above data suggest that this will not occur.

Conclusion

A number of factors that could have contributed to the low returns of 1SW salmon and 2SW salmon to rivers of eastern Canada in 1997 were examined. No single factor was identified that explained the cause of the lower than expected returns in 1997. There are however indications that the ecosystem of the northwest Atlantic has changed since the late 1980s as evidenced by oceanographic conditions and reflected in biological data on a number of species. Evidence for this comes from the shift in diet of marine birds, later spawning times for capelin, and changes in distribution of fish species other than salmon. This change in the marine ecosystem may also be responsible for the low return rates of salmon. It is clear that the changes that occurred in the marine environment of Atlantic salmon, particularly in the Northwest Atlantic, could have influenced the susceptibility of salmon to predators and increased the magnitude of predation mortality. However, it is unlikely that any one species of predator accounts for the increase. The river-specific predictions of returns to rivers in North America in 1998 are uncertain. The factors which contributed to the low returns in 1997 remain undetermined and these may still be affecting salmon destined to return in 1998 (1SW salmon, 2SW salmon) and 1999 (2SW salmon).

2.5 NASCO Working Group on the Precautionary Approach

The Working Group was asked to comment and advise on the Report of the NASCO Working Group on the Precautionary Approach in North Atlantic Salmon Management (NASCO 1998), which met in Brussels in January 1998, as it relates to the work of ICES. The issues addressed by this group that were of principal interest to ICES were *'the application of a precautionary approach to the management of North Atlantic salmon fisheries'* and *'the formulation of management advice and associated scientific research'*.

The NASCO Working Group advised that the application of a precautionary approach (PA) to fisheries management requires that managers should make use of the best available scientific information when making management decisions; that they should be more cautious when information is uncertain, unreliable or inadequate; and that the absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.

With respect to the management of salmon fisheries, the recommendations of the NASCO Working Group were broadly consistent with the approach currently being taken by ICES. It was proposed, *inter alia*, that stocks be maintained above conservation limits by the use of management targets normally set at a higher level; that account should be taken of the risks of not achieving the fisheries management objectives by considering uncertainties in the current state of the stocks, in biological reference points and in fishery management capabilities; and that stock rebuilding programmes (including habitat improvement, stock enhancement and fishery management actions) be developed for stocks that are below their conservation limits.

The NASCO Working Group also made recommendations on the types of scientific advice that the Council might wish to request from ICES or other scientific advisors on a variety of topics. These would include: advice on risks of not achieving management objectives; provision of catch options; advice on stock rebuilding programmes (where stocks are well below target levels); identification of monitoring and data collection required; and advice on the impacts of existing and new fisheries for other species. It is implicit in the NASCO Working Group's recommendations that scientists should provide an estimate of conservation limits based upon best available information; the uncertainties in the data should be encompassed in the way that these figures are used in providing management advice, such as catch options. This is consistent with NASCO's request for advice from ICES which asks for age-specific stock conservation limits (spawning targets) for all stocks occurring in the Commission areas based on the best available information.

The ICES Working Group (WGNAS) supports the concept of a PA, but reiterates that the WGNAS mandate is to focus on scientific issues, leaving decisions on management objectives and socio-economic concerns to the managers. The Working Group believes that conservation limits are a biological imperative, and, for this reason they are concerned about the implication in the document that socio-economic factors may be used to justify fishing on stocks when they are below conservation limits. The Working Group supports NASCO's call for the development of river-specific biological reference points, however, in the absence of a major infusion of resources, progress in developing them will be slow in some areas.

The Working Group was concerned about the lack of a clear definition of the word "conservation" in NASCO's objectives and was uncertain whether it had the same meaning as in the term "conservation limit".

2.6 Compilation of Tag Releases and Finclip Data, Egg Collections, and Juvenile Releases for 1997

2.6.1 Compilation of tag releases and finclip data for 1997

Data on releases of tagged and finclipped salmon in 1997 were provided by the Working Group and are compiled as a separate report available from the Secretariat. A summary of national markings is given in Table 2.6.1.1. In 1997, slightly over 3 million salmon were marked, which are approximately 10 % less than 1996. Primary marks are summarized by four types; Microtag, External Tag, Adipose Clip, and Other Visible Marks. Secondary marks (primarily adipose clips on microtagged fish) are also recorded. The Adipose clip was the most used primary mark (1.73 million), with microtags (0.82 million) the next most use primary mark. Microtag use was down 5 % from 1996. Secondary marks were applied to 0.84 million fish. Most marks were applied to hatchery-origin juveniles (2.95 million), while 0.06 million wild juveniles and 0.02 million adults were marked.

Egg collections and juvenile releases for 1997

The Working Group initiated data summaries on eggs artificially spawned from sea-run adults that returned in 1997 and all eggs and juvenile life stages released in 1997. As this decision was the result of suggestions made during the 1997 meeting of the Working Group, the amount of data available for this first year's report is limited. The Working Group will expand the database with historical data back to 1990 inclusively at the 1999 meeting. The data on eggs spawned from sea-run adults provides some measure of the interception of ova for management purposes, that presumably would have been spawned naturally in home rivers. The release data will, over time, provide broad trend information on enhancement activities. The data for 1997 is presented in Table 2.6.2.1.

2.7 Possible Occurrence of M74 Syndrome Outside the Baltic

In the Baltic area, the M74 syndrome on salmon has caused severe mortality of alevins during the 1990s. The syndrome has occurred in hatcheries, is probably present in wild populations, and could be a reason for an unexplained decline in wild parr production. A broad research programme to assess the causes behind the syndrome was initiated in Sweden and Finland. Current evidence is that M74 is caused by a lack of thiamine. Treatment of females with thiamine in later stages of maturing or fry immediately after hatching has increased survival. The M74 syndrome, and utility of thiamine, appears to be related to the EMS problems (Early Mortality Syndrome) observed in the Great Lakes of USA and Canada.

The Swedish research programme also involved investigations on the Swedish West Coast and in Lake Vänern. Mortality caused by the M74-syndrome has not been observed in these areas to date, and none of the indices found to be linked to M74 in the Baltic area have been observed there. In the Baltic the first sign of M74 syndrome among broodstock during the spawning season is the presence of a few wiggling females. Another indication of M74 is eggs that are a very pale yellow. Analyses for thiamine and carotenoids (directly related to egg colour) in the eggs indicate differences between Baltic salmon and salmon from the River Lagan on the west coast. Data from Lake Vänern show a high content of thiamine and intermediate values of carotenoids (text table below).

Area	M74 - status	Thiamine in eggs (nmol/g)	Carotenoids in eggs (mg/kg)
Baltic	All		2.8±1.0
Baltic	OK	2.55	
Baltic	M74	0.59	
West coast	OK	3.56	8.5±2.1
Lake Vänern	OK	8.07	4.2±0.8

It has been observed that the highest value of thiamine found in eggs from a few females with partial M74 (not 100 % mortality) has been in the level of 0.9 nmol/g. This implies that any level below this value normally gives a 100 % mortality of alevins.

The M74 syndrome has not been observed in other countries in the North Atlantic area.

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

3.1 Fishing at Faroes in 1996/1997 and 1997/1998

In the period 1991–97 inclusive the Faroese salmon quota has been bought out. However, the Faroes Government continued sampling inside the 200 mile EZ during most of the period (ICES 1997/Assess:10). During the 1996/1997 fishing season, no sampling was undertaken due to various problems. The vessel chartered in previous seasons was sold and used in another fishery and no alternative was available until the winter of 1998. The buy-out is not in effect for 1998, and at present it is not clear whether the commercial fishery will start again this autumn.

In the 1997/1998 fishing season M/S "Polarlaks" went out in January 1998 and returned in early April; after 4 trips, 3 t (approximately 1,000 salmon) had been caught including discards (Table 3.1.1). The catch has not been analysed yet, therefore details on tag recoveries, length and age composition will be reported in 1999.

3.2 The Research Programme at Faroes

The joint Nordic research programme at Faroes initiated in 1992 was formally concluded in 1997. A report has been submitted to the Nordic Council of Ministers and the countries involved. Co-operation between Faroes and Norway has continued in 1998. Sampling will be undertaken as in previous years if the commercial fishery recommences in 1998.

During 1996 a further 2 tags were recovered from the tagging programme north of the Faroes, both from wild salmon. One tag was from Norway (mid Norway) and one was from Russia (Pechora river). In total 106 tags have been recovered (1.9 %) of the 1992–95 tagging, and of those 87 were recovered from wild salmon. An update of countries in which wild salmon have been recovered is given in Table 3.2.1. The additional two recoveries did not alter previous conclusions (ICES 1997/Assess:10) but emphasise the importance of the Faroe feeding area to Norwegian salmon during the winter months. Relatively large proportions of Scottish and Russian salmon are also found in the Faroes area.

3.3 Homewater Fisheries in the NEAC Area

3.3.1 National reports

This Section provides a general overview of the homewater fisheries in each country in the NEAC area in 1996. Further analysis of these data is included in Sections 3.3.2 to 3.3.9. At the encouragement of ACFM, the Working Group investigated a number of non-parametric techniques to better assess common features and trends in short time series. Multivariate techniques will be applied at subsequent meetings.

Finland

The reported salmon catch of the River Teno was 43 t and that of the River Näätämö 2 t. The Teno catch stayed at the same level as in 1996 and that of the Näätämö increased 30 %. No changes in gear were reported for 1997. Minor fishing regulation changes were introduced for recreational fishery of the River Teno. Decreases from 1996 of 20 % in tourist anglers and 10 % in angler days resulted in only 3 % decrease in catch. Thus, the CPUE increased. The catch of the local net fishery increased 5 %. No information about the effort or CPUE of the net fishery is available.

1SW salmon constituted 69 % of the catch of the River Teno in 1997 which is slightly more than the average for the past 20 years (62 %). However, the percentage of 1SW fish decreased from the previous year 1996 (80 %) and the percentage of 2SW salmon increased from 8 % to 17 %. The percentage of 3SW fish increased from 10 % to 13 %. The age distribution is based on scale samples gathered from the fishery of the River Teno main stem and represents a mixed sample of the entire river system. The percentage of repeat spawners in the sample was 3.2 % (n=95).

The River Teno catch included 0.1 % escapees (4 out of 3008 scale samples) from cages. An additional 20 salmon were sampled in September, after the end of the fishing season, but no escapees were detected. There were no escapees among 219 fish sampled in the River Näätämö salmon (n=219).

Some increase in the juvenile salmon abundance was detected in 1997 compared to 1996, especially in two major tributaries of the Teno (Inarijoki and Utsjoki). However, the densities were usually lower than the 5-year averages.

France

There was a significant change in the fishing gear used in 1997. Angling licences increased by 65 % compared to 1996 and ended a 10-year decline. Angling licences increased because of a 68 % reduction in the licence fee. The number of commercial licences in the river Adour, where the fishery was closed in July for the first time, decreased by 20 % compared with 1996. The sport and commercial fisheries in the river Loire-Allier which closed 4 years ago, have not been re-opened.

The total catch was 7.5 t in 1997, 56 % less than in 1996 and 42 % of the 10-year average catch. Anglers caught 4.5 t and net fishermen 3 t. Angling effort on grilse is still increasing in Brittany as a result of the later closure of the angling season on 8 rivers. The decreasing trend in the abundance of MSW fish is continuing: -45 % compared with the 5-year average. Catches per angler (experienced only) were similar to the 5-year average, 2.5 fish per season. Exploitation rates of 1SW fish decreased by half in the river Scorff and by a factor of 3 in the river Nivelle. Anglers took only 35 % of the TAC in Brittany because of adverse angling conditions: few fish, low flow and low effort.

Smolt runs were higher than the 5-year average on three indicator rivers (Nivelle, Oir and Bresle). On the river Bresle, the smolt count was the highest of the 11-year time series. On the same river, the egg-to-smolt survival was 4 % or 8 times the usual value. Higher than usual survival was probably due to good wintering conditions. Adult runs were low, less than half the 5-year average to the rivers Nivelle, Oir and Bresle. On the Bresle, declining trends in returns and later arrival of returns suggest that smolts are encountering adverse conditions at sea.

Investigations on the presence of *Gyrodactylus* and the resistance of salmonids to it will be conducted in 1998.

Iceland

Angling is the most valuable fishing method for salmon in Iceland generating much greater income per fish than netting. This has led to the buy-out and lease of netting rights both in rivers and on the coast, by in-river fisheries associations with governmental support. Thus, net fishing is now almost entirely confined to glacial rivers. These changes in fishing effort make it difficult to use net catch as a measure of abundance. Despite low effort in the net fishery, the rod catch in the 1997 fishing season was 13 % lower than in 1996, 30 % lower than the 5-year average and 32 % lower than the 10-year average. The low return rates of naturally produced salmon and low grilse-salmon ratio of the past few years are reflected in poor catches of salmon (Gudjonsson *et al.* 1995). Fishing effort in the rod fishery has been stable since 1970, and therefore the catch has been used as a measure of abundance and stock fluctuations. Because of the lower catches it has been suggested that the number of rods used should be reduced. Catch and release increased from 2.2 % of the rod catch in 1996 to 5.5 % of the rod catch in 1997

Ocean ranching has been declining due to low return rates, and some ocean ranching sites have been closed. This has led to lower numbers of strays in rivers and also fewer naturally produced salmon being caught in ocean ranching stations.

In 1995 furunculosis was detected in Iceland for the first time. This was in River Ellidaar and at Kollafjordur ranching station. However, no further incidents of furunculosis in adult salmon have been detected in Iceland since 1995.

A diatom algae (*Didymosphenia geminata*) has been detected in several rivers and its geographical distribution is increasing. Its effects on salmon juvenile nursing areas are uncertain.

Ireland

New management and conservation legislation was brought into force in 1997 which was aimed at reducing effort in the fishery or facilitating enforcement. This included a) a limit on commercial licences for draft nets and drift nets, b) area of fishing at sea reduced from 12 to 6 nautical miles, c) drift net season constrained to 1st June to 31st July, d) draft net fishery deferred to the 12th of May, e) restriction on night time fishing (0400 to 2100 hrs only), f) reduction to 4 days fishing per week, g) monofilament netting legalised for drift net fishing. The higher level of marine surveillance by the Navy and Regional Fisheries Boards in recent years has lead to a reduction in the use of illegal gears and illegal fishing. Low prices for wild salmon coupled with less people entering the fishery has also resulted in lower effort. The declared catch in 1997 (570 t) was lower than in 1996 (685 t) and 1995 (790t) reflecting decreases in most fisheries probably due to the new management measures. This may be balanced somewhat by a reduction in unreported catches due to the legalisation of monofilament nets. Drift net declared catches were 13 % lower than in 1996, draft net and trap catches by 24 % amounting to a decrease of 16 % in total. However, reported rods catches were also down in 1997 by 17 %. Exploitation by commercial nets on reared Burrishoole 1SW stock returning to Irish coastal waters in 1997 was estimated to be 68 % for 1SW salmon (1996 smolts) compared to 81 % in 1996 and 84 % in the 1995 fishing season. Exploitation by nets (trap exploitation not included) on the wild stock from the Corrib was also lower in 1997 (38 %) and was less than the average for the time series (43 %).

Preliminary spawning escapement requirements have been estimated for all Irish rivers. Survival of Corrib wild and Burrishoole hatchery smolts returning to the Irish coast has followed a similar pattern since 1980. Both of these were lower in 1997 with the Burrishoole estimate being among the lowest in the time series. Currently, survival for both stocks is less than 10 %, but survival of Corrib wild smolts appears to be very low compared with the pre–1988 period. In contrast, survival of wild salmon smolts to freshwater has remained stable or is decreasing slightly. Survival of wild Burrishoole smolts reflects the high survival period identified in coastal returns for both Corrib wild and Burrishoole hatchery smolts from 1984 to 1988. Presently, return rates to the river vary from 1.6 % to 9.2 % for 1SW fish.

Only one escape of farmed fish was reported in 1997. This occurred off the south west coast and comprised approximately 40,000 fish of 140 g weight. Fish farm production of salmon in 1995 was 11,811 t and increased to 14,000 t in 1996. Production will not be less than 14,000 t in 1997.

Norway

Some significant new regulations were introduced to the Norwegian salmon fishery before the start of the 1997 fishing season. The most important was the ban on the use of bend nets along the Norwegian coast from Rogaland county to Troms county. There the number of bend nets registered decreased from 2,860 in 1996 to 1,075 in 1997. The number of bagnets in use declined from 2,280 in 1996 to 2,002 in 1997. There were also a number of local adjustments on bagnets and angling. This was done by delaying the start of the fishing season by 2 weeks. The purpose was to reduce exploitation on MSW salmon. It should also be noted that since 1990 small adjusments in reduction of the salmon fishing season in different areas of the country have gradually reduced the overall fishing effort.

Total catches both in weight and numbers declined from 1995 (839 t) to 1996 (787 t) and to 1997 (630 t). The catch in 1997 is the lowest recorded. In 1997, the decline was most pronounced in the marine fishery, which could at least partly be explained by the reduction in the number of bend nets in use. There was a slight increase in the catch of grilse in 1997 compared with 1996, but a decline in the catch of MSW salmon. This helps explain the reduction of mean weight of salmon both in freshwater and marine catches. It should also be noted that most of the salmon fishing season in the mid and southern part of Norway was heavily affected by a warm and dry summer which delayed upstream migration of salmon in the smaller rivers. The sea temperature was also unusually high.

Farmed salmon were estimated to comprise 47 % and 42 % in coastal and fjord nets. Farmed salmon comprised an estimated 9 % of rod catches and 27 % of the spawning populations.

Marine exploitation rates on wild 1SW and 2SW fish from the River Imsa were estimated at 61 and 80 % respectively, and for 1SW hatchery fish the marine exploitation rate was 74 %. No data was available for 2SW fish of hatchery origin.

Marine exploitation rates for 1SW and 2SW hatchery fish from the River Drammen were low, 14 and 18 % respectively. The rod exploitation rate in the River Drammen was estimated at 45 %.

Russia

There were no significant changes in the effort and gear in 1997 compared to last year. However, some modifications in the in-river fishery regimes on the Kola Peninsula should be noted. The regime was modified on the Kola river, where after a 37-year long period of 100 % retention of salmon at the trap (counting fence 30 km upstream of the confluent with the Barents Sea), 50 % of spawners were allowed to escape for spawning. On the Tuloma river an additional number of salmon were released from the trap to spawn with the aim to achieve a conservation limit for the river.

Total commercial catch was 111 t, which was 15 % less than that of 1996. The decline was largely due to re-allocation of quotas between commercial and recreational fisheries on the Kola Peninsula. The catch from the coastal fishery in the White Sea remained about the same as in 1996 (64.1 t) - 62.6 t. There was a 25 % increase of catch in recreational fishing from a 5-year average of 1.86 fish per rod-day to 2.40 fish per rod-day.

Age composition of total catch taken in Russian homewaters in 1997 was the same as in 1996. Grilse continue to dominate the catch - 82 %, that is approximately 10 % more than in previous years.

Gyrodactylus salaris was found in the Keret river (Karelia) recently. There is a real threat of the spread of this parasite to other salmon rivers in the region.

The bulk of the catch was composed of wild salmon. Hatchery fish constituted 39 % (1040 salmon) and 64 % (116 salmon) of the catch in the Kola and Keret rivers, respectively.

Sweden

In 1997, the salmon catches on the Swedish west coast were less than half the 5-year and 10-year means both in weight and numbers. The catches have been declining for a number of years and this is a matter of great concern to local people. For 1997, it is possible that the decline could partly be explained by a decline in exploitation rates.

On the Swedish west coast, concern has previously been expressed about the presence of salmon which are bigger and have paler flesh than normal west coast salmon. These are characteristics of Baltic salmon. Evidence from recaptures of tagged salmon indicate the these salmon emanate from Danish experiments with delayed release at Møn in the Danish Islands and at the Island of Bornholm. The proportion of the catch of Baltic origin appears to be increasing. In 1997, 15 % of the catch by numbers in Halland county were estimated to be of Baltic origin. Danish tagging data suggest that almost 9 % of the fish released at Møn were recaptured outside the Baltic area. The value for releases at Bornholm was almost 3 %.

UK (England & Wales)

Rod and net catches of salmon were very low in most Regions of England and Wales in 1997, with the exception of the North East Region rod fishery. The total nominal catch (i.e., excluding released fish) is provisionally estimated at 151.3 t (78 % of that in 1996), comprising 103.8 t by nets and fixed engines and 47.5 t by rods (Anon. 1998 c). The total catch was 42 % below the 5-year average, and was the lowest recorded over this period. Rod catches of both grilse and MSW salmon have fallen in 1997. In general, 1997 was a fairly wet year throughout England and Wales; this may have reduced the availability of fish to some net fisheries, but angling conditions were considered to be not unfavourable for much of the season. Thus the declines reflect both reduced fishing effort and low numbers of returning fish.

There have been further reductions in the netting and angling effort for salmon in 1997 as a result of fishing regulations, economic factors and the perceived low abundance of fish. The number of licences issued for nets and fixed engines has continued to decline; 5 coastal mixed stock fisheries are now being phased out; and netsmen on 5 rivers in south-west England are being compensated not to fish at the start of the season as an alternative to mitigation stocking schemes. Controls on various rod fisheries are aimed primarily at reducing levels of exploitation of earlier-running MSW salmon. Exploitation rates in 9 monitored fisheries in England and Wales in 1997 were all well below the 5-year averages, and in many instances were the lowest values recorded. This may reflect, in part, reduced fishing effort and the increased use of catch and release, which accounted for 24 % of the rod catch in 1997.

The Environment Agency has set spawning targets for all rivers in England and Wales, although the majority of these are still provisional. Compliance with these targets is assessed over a series of years and so a single year's data must be viewed with caution. However, the data suggest that the spawning escapement was above the targets levels in 13 rivers (20 %) in 1997; between 50 % and 100 % of the targets in 22 rivers (34 %) and less than 50 % of the target in 30 rivers (46 %). Data from counters and traps in England and Wales show no common trends in the runs for the rivers in the north and west but a significant downward trend for rivers in the south over the past 5 and 10 years. It is therefore apparent that many salmon stocks in England and Wales are in a seriously depleted state.

UK (Northern Ireland)

The number of commercial fishing licences issued in 1997 (190) was slightly lower than in 1996 (195). There were no changes in fishing season bylaws or gear regulations. The provisional declared catch (93 t) was higher than for the 1996 season (77 t) and higher than the 5- and 10-year averages. Angling catches are only available for the Foyle system, and were lower in 1997 (921) compared to 1996 (1,444), though some returns are still expected. Anglers reported a reasonably good season, despite low water conditions at times. Rod CPUE estimates are only available for the lower R. Bush, where CPUE was higher in 1997 (0.338 fish per rod day) compared to 1996 (0.267). CPUE on this river has been generally higher during the 1990s than in the 1980s.

Ranched fish, released from the R. Bush for experimental purposes, comprised a small component of the commercial catch in 1997 (2.2 t). The incidence of escaped farmed salmon in the net catch in 1997 was very low (0.14 % by number), and below the range for the period 1991–1995 (0.26–4.03 %). Only 4 fish (0.24 %) entering the R. Bush adult trap in 1997 were identified as farm escapees. The exploitation rate of 1SW wild fish in the coastal net fishery was lower in 1997 (60 %) than in 1995 (67 %, no 1996 data available), but was slightly higher than in the previous 5-year average (57 %). Exploitation of hatchery origin 1SW fish in 1997 (79 % for age 1^+ smolts and 75 % for age 2^+ smolts) was higher than the 5-year average. No estimates are available for exploitation of 2SW fish of hatchery or wild origin.

The only operational spawning target at present in UK (N. Ireland) is that for the R. Bush. In 1997, only 60 % of the target was achieved, though the target has been reached or exceeded in this river in 8 out of the last 13 years. In the R. Bush, the wild smolt count in 1997 (18,250) was higher than the 1996 figure (12,449) as well as the 5-year average, while an index of juvenile (age 0^+) salmon abundance was lower in 1997 (6.9) than in 1996 (9.9) despite a slightly improved ova deposition. Ova-to-smolt survival on this river continues to be lower than average for the time series, and may reflect habitat degradation as well as predation. The wild adult salmon run to the R. Bush in 1997 (1,667) was higher than in 1996 (1,097), though lower than the 5-year average (2,082).

Survival of wild 1SW R. Bush fish to homewaters in 1997 (31.0 %) was higher than the 5-year average and was the highest since 1990 (34.7 %), while survival of hatchery origin 1SW adults to homewaters (2.0 % for 1+ and 2.3 % for 2+ smolt releases) was considerably lower than the average for the time series. Returns of 1SW R. Bush wild adults to freshwater were very good in 1997 (12.1 %), higher than the average for the previous 10-year period (11.0 %). Returns to freshwater of wild 2SW fish from the same river in 1997 (2.4 %) were the highest in the time series to date. In contrast, returns of R. Bush hatchery origin 1SW fish to freshwater were low in 1997 (age 1^+ smolts, 0.41 %; age 2^+ smolts, 0.57 %), continuing a trend of reduction in survival of hatchery fish.

UK (Scotland)

Effort indices for the net and coble and fixed engine fisheries in 1997 showed a 27 % and a 28 % decrease respectively, compared to 1996. The final reported catch for 1996 was 426.7 t, 53 % less than the previous 5-year average (1991–95) and 60 % less than the previous 10-year average (1986–95). The provisional 1997 figure (caught and retained) is 267.3 t, the lowest on record. In 1997, the fixed engine CPUE decreased by 47 % and the net and coble CPUE decreased by 39 % compared to 1996. In 1997, 54 % of the catch was recorded as grilse. However, scale analyses of samples from major fisheries in each of the main statistical regions have indicated that the proportion of grilse is always greater than the reported figure as a result of 1SW fish being misreported as MSW fish. The errors in classification are neither consistent among regions, nor between years. Of the 267.3 t caught and retained in 1997, 266.5 t was reported as wild salmon and 0.8 t was reported as escapees. The only fishery in Scotland for which there is a time series of exploitation rates is the North Esk net and coble fishery. In 1997, the exploitation rates for 1SW and MSW fish were both 12 %. In general, exploitation rates have declined, particularly since 1991 when there was a major reduction in effort.

3.3.2 Gear

In Ireland, monofilament netting was authorized for drift net fishing in 1997. Other countries did not report changes or restrictions on fishing gear.

3.3.3 Effort

For the NEAC area, the effort (gear units) has generally declined over the years to the low values of 1996–97 (Table 3.3.3.1.). The number of gear units was generally well below the 5- and 10-year means.

In Iceland, only one coastal gillnet operated (August only), as compared to five nets in the early 1990's. The other four nets have now been bought out permanently. In Norway, the coastal bend nets were banned in a large area along the Norwegian coast and some new regulations were introduced to bagnet and rod fisheries. The effort in the Irish fisheries was reported to have decreased somewhat, although the gear units have stayed at the same level since 1995 and in 1997 the number of net licences was capped at the 1995 level. The net fishery in France was closed in July for the first time. It was estimated that approximately 50 % of the potential catch was saved as most of the grilse enter the rivers in early July. There was an increase in the French rod fisheries which showed a 54 % increase in number of licences compared to the 5-year average. Licence fees were reduced in 1997, which may have contributed to the increased sales.

3.3.4 Catches

NEAC catch data are presented in Table 3.3.4.1. Figure 3.3.4.1 shows the percentage change of the 1997 NEAC homewater catch data relative to the previous 5-year (1992–96) and 10-year means (1987–96). With the exception of UK(N. Ireland), the 1997 catch was below both the 1992–96 and 1987–96 means. Clearly, current catch levels are markedly lower than in the recent past. This is believed to reflect both reductions in fishing effort (Section 3.3.3) and reductions in stocks (Section 3.7).

3.3.5 Catch per unit effort (CPUE)

CPUE data for the NEAC area are presented in Tables 3.3.5.1., 3.3.5.2, and 3.3.5.3. Route regression analysis was used to examine trends in the data and the results are shown in Table 3.3.5.4. CPUE in rod fisheries in Finland, France and on the River Bush, UK (N. Ireland) show no trend for catch per angler day for the last 10 years. However, there is a marginally significant positive trend in CPUE for the whole season for rod fisheries in Finland and France over the same period of time ($p=0.09$). No trends were detected in the CPUE of the fixed engine fisheries of England and Wales ($p=0.27$). For Scotland there is a clear, significant downward trend in CPUE in the net fishery ($p<0.0001$). Additional information of changes in CPUE for different countries are given in the National Reports (Section 3.3.1).

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 exists. The proportion of 1SW fish in the 1997 catches is presented as a percentage of the 1992–96 mean, and, where possible, the 1987–96 mean. In Norway, Russia and Finland, the proportion of 1SW fish in the catch has increased compared to both long term indices. In UK (Scotland), the proportion has remained similar to the 1992–96 mean but decreased relative to the longer term mean. In France, the proportion remained similar to the longer term mean while decreasing relative to the 1992–96 mean. Compared to the 1992–96 mean, the proportion in the 1997 UK (England & Wales) catch remained the same while that of Sweden has decreased.

3.3.7 Farmed and ranched salmon in catches

The contribution of wild, farm-origin and ranched salmon to national catches in the North-East Atlantic 1991–97, is shown in Table 3.3.7.1. In 1997, farmed salmon are still accounting for a relatively large proportion of the national catch in Norway (31 %). Although no fishing was carried out at Faroes in the 1996/97 fishing season, data from previous years suggest that there is a relatively high proportion of farmed salmon in this area as well. In 1997, ranched salmon accounted for 65 % of the national Swedish catch (fish released for mitigation purposes and not expected to contribute to natural spawning) and for 31 % of the national catch in Iceland.

In Norway, the incidence of farmed salmon in coastal fisheries in 1997 was estimated at 47 %, and in fjord fisheries the corresponding value was 42 % (Table 3.3.7.2). In anglers catches the proportion of farmed salmon was 9 % whereas in brood stock samples the incidence was estimated at 27 % (Table 3.3.7.3). There was great variation between individual localities.

Farmed salmon accounted for a small part of the reported catches in Ireland, N. Ireland and Scotland in 1997 (< 1 % of the national catch). On the River Bush, 0.24 % of the total salmon run was estimated to be farm escapees (Table 3.3.7.4).

A catch sampling programme in 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 3.3.7.5).

Inshore coastal catches of salmon in both UK (N. Ireland) and Ireland are examined for escaped farmed salmon (Table 3.3.7.6). 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 1997 figures remain at this level.

3.3.8 National origin of catches

In 1994, the Working Group provided an estimate of the catch of non-national origin salmon in national catches in the North-East Atlantic. The estimate was made for catches in 1992 and were based on tag recoveries for that year or historic tag data. The Working Group did not consider that there were sufficient new tagging data to warrant updating this model for 1997.

Summaries of tag recoveries from fish of non-national origin were provided by Ireland, Sweden and Norway. Of 6,747 CWT tags recovered in Ireland in 1997, 151 (2.2 %) were reported to be of UK (N. Ireland) origin, 30 (0.4 %) of UK (Eng & Wales) origin and 2 (0.03 %) of Spanish origin.

In 1997, it was estimated that 15 % of the catch in the county of Halland, Sweden comprised recaptures of tagged salmon which originated from Danish experiments at Møn in the Danish Islands and from the Island of Bornholm. Salmon from Danish releases have been recorded in the past, but accounted for only a small percentage of the catch.

A summary of recaptures of salmon tagged as smolts with Carlin tags in Norway from 1990–96 is shown below. The great majority of the smolts released are of hatchery origin, and consist of smolts released for enhancement, ranching, or compensation for hydropower development. The majority of the adults were recaptured in Norway (98.7 % of the number of salmon recaptured). Tags were also recovered from fisheries operating in Sweden, Denmark and Ireland. Small numbers of tags were recovered in other NEAC fisheries as shown below.

Number of salmon recaptured in Norway and other countries of 804,802 smolts tagged and released in Norway 1990–96

Country	No of recaptures	Percent distribution
Norway	14,330	98.77
Sweden	86	0.59
Denmark	44	0.30
Ireland	30	0.21
United Kingdom	13	0.09
Finland	2	0.01
Iceland	1	0.01
Germany	1	0.01
France	1	0.01
Total	14,508	100

3.3.9 Exploitation rates in homewater fisheries

Exploitation rates for 14 wild stocks, 5 hatchery and 3 mixed stocks are shown in Table 3.3.9.1. Exploitation rates decreased in 1997 from those of 1996 for 23 of 30 datasets. Although reported exploitation rates in some fisheries have changed, route regression analyses indicate that there has been no overall trend in exploitation rates in Irish, UK, Icelandic or Scandinavian stocks over 10-year or 5-year periods (Table 3.3.5.4). However, significant downward trends in exploitation were shown for Russian rivers over these periods.

3.3.10 Summary of homewater fisheries in the NEAC area

There has been a continuation in the trend to reduce commercial fishing in the North-East Atlantic area in recent years, mainly reflecting conservation measures in the respective countries and the reduced value of commercially caught salmon.

Provisional figures show that all nominal catches in North-East Atlantic countries in 1997, with the exception of Finland and Ireland, were below the 1996 values and, all countries, with the exception of UK (N. Ireland) were below the previous 5-year and 10-year means. Commercial fishing effort in 1997, in terms of licenses issued and gears used, continued to show a decrease throughout the area while effort in recreational fisheries remained broadly the same. CPUE for commercial fisheries decreased in UK (Scotland) and increased in rod fisheries in Finland. No other significant trends in CPUE were noted. The proportions of 1SW fish in national catches varied from 51 % to 82 %. The lowest proportions of 1SW fish in catches were reported in France, Sweden and UK (Scotland) and the highest in Finland, Russia and Iceland.

Farmed salmon continue to represent a large proportion of the catch in Norway (31 %). The incidence is <1 % for catches taken in UK (N. Ireland), UK (Scotland) and Ireland. Ranched fish comprise 65 % of the Swedish catch (returns of hatchery origin exploited in acidified rivers where spawning may be unsuccessful) and 31 % of the Icelandic catch (commercial ranching) but comprise only a small proportion (<3 %) in the catches of Norway, Ireland and UK (N. Ireland).

However, the only significant trend over the previous 5-year and 10-year averages was for Russia where exploitation has decreased.

3.4 Status of Stocks in the NEAC Area

3.4.1 Attainment of stock conservation limits

Spawner requirement levels and time series of compliance data have been provided for 12 rivers in the NEAC area (Table 3.4.1.1). This includes new data from 6 rivers in the UK (England and Wales). Most of these are monitored rivers where stock-recruitment data have been collected over a number of years. Where possible, threshold levels have been set at MBAL for the stocks (max. gain in the appropriate stock-recruitment relationship) according to the guidelines presented in Section 8.1.1 of the 1995 Working Group Report (ICES 1995/Assess:14). These can be regarded as conservation limits. For the Tuloma River (Russia), the reference point is the target for the number of female spawners required to give optimal recruitment.

Spawning thresholds have only been exceeded in 5 of the 12 rivers where data are available in 1997. There was no significant trend noted in spawner attainment over the last 10-year period for all stocks combined, but a significant trend towards lower egg deposition was noted over the most recent 5-year period ($p = 0.05$, Table 3.4.1.2). Again, these data represent only a small number of fisheries in the NEAC area and may not be indicative of the status of stocks in all rivers.

Conservation limits have been set for 66 rivers in UK (England and Wales), although many of these are still provisional. Some of these rivers, and particularly some of the smaller catchments on the west coast of Wales, support relatively small salmon stocks and are principally regarded as sea trout rivers. Targets for such rivers may therefore need to be refined in the future. However, in 1997, spawning escapement is estimated to have exceeded the conservation levels in 13 rivers (20 %); been between 50 % and 100 % of the targets in 22 rivers (34 %) and less than 50 % of the target in 30 rivers (46 %). A number of rivers, such as the rivers Wear and Tees in the North East, and some catchments in South Wales are being restored from previous polluted conditions and may require interim rebuilding targets to be set.

3.4.2 Measures of juvenile abundance

Smolt counts or estimates of juvenile abundance are available for 21 rivers (Table 3.4.2.1). Values for 1997 are higher than in the previous year in most areas. The values in 1997 were lower than the 5-year mean in the R. Esk but higher in all other rivers. Route regression analyses show no significant trend in juvenile production in these rivers over the last 10- and 5-year periods.

3.4.3 Measure of spawning escapement

Adult counts are available for 33 rivers in the NEAC area for the previous four or more years (Table 3.4.3.1). The counts in 1997 were generally lower than the 5-year mean. Higher estimates were obtained for some Russian and UK (N. Ireland and Scotland) rivers.

Route regression analyses were carried out separately for adult counts in Russian rivers and other rivers in the NEAC area (Table 3.4.1.2). An increasing trend is shown for Russian adult counts over the last 30- and 20-year periods while no trend was observed for the last 10- and 5-years periods.

For other rivers in the NEAC area there has been a significant downward trend for the last 5 years but no trend for the last 10 years (Table 3.4.1.2).

3.4.4 Survival indices

Estimates of marine survival for wild smolts from nine stocks returning to homewaters (i.e., before homewater exploitation) and for eight stocks returning to freshwater in 1997 are presented in Tables 3.4.4.1 and 3.4.4.2, respectively. 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 the juveniles emigrate after only one year in freshwater. In most areas the marine survival was lower than the previous 5-year mean. However, route regression analysis showed no significant trends in marine survival for the last 5- and 10-year periods (Table 3.4.1.2).

Marine survival rates for six hatchery stocks are given in Table 3.4.4.3 and Table 3.4.4.4. Returns to homewaters are likely to present a clearer picture of marine survival than returns to freshwater because of variation in exploitation in coastal fisheries. Route regression analysis showed a significant downward trend for survival to homewaters for 1SW and 2SW fish. The differences in survival rates between wild and hatchery fish are intriguing, but unexplained at this time.

3.4.5 Summary of status of stocks in the NEAC area

Examination of the general trends in the previous sections suggests that there has been no significant change in the wild smolt output or in the survival of wild smolts to homewater or freshwater over the past 5- or 10-year period. However, adult runs in Western European rivers showed a downward trend over the previous 5-year period and there was also a decrease in the egg deposition rates for 11 rivers in the NEAC area.

There appears to be a general decline in escapement in many of the NEAC rivers. Although the analysis of wild smolt returns to homewaters and freshwater did not indicate a decline in survival, marine and freshwater survival of hatchery fish declined significantly over the previous 10- and 5-year periods.

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

Since 1991 the Faroese fishermen have 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. The maximum catch that would have been taken is the quota (Table 3.1.1) which in turn represents the total potential benefit of a quota purchase. However, in the three years prior to the suspension of fishing (1988–90) the quota was not taken in full. On average the catch was 307 t (87,484 fish) or 56 % of the quota (Table 3.1.1) and Table 3.5.1 in ICES 1997/Assess:10. Calculations based on the average savings were performed in last year's report (ICES 1997/Assess:10) and suggested a yield of 3 to 9 % gain in the number of returns to homewaters. These values would change very little each additional year of calculation, because the input number of fish estimated to be caught would be constant (the number equivalent of 307 t). Thus, no new information would be generated continuing the procedure from last year (see Table 3.5.1 in ICES 1997/Assess:10).

The Working Group re-assessed the above position and concluded that the full quota could have been taken had the quota purchase not been in effect. Therefore the Working Group performed the assessment using the allowable quotas (Table 3.1.1).

Data on the expected discard rate, the proportion of farm escapees in catches, the expected age composition of the catch, and the expected time to return were obtained from research vessel catches in the 1991/92 to 1994/95 seasons and previous published data (ICES 1997/Assess:10). No new values of these parameters were available for the 1995/96 and 1996/97 seasons so means for the previous four seasons were used. The assessment is shown in Table 3.5.1. This suggests that if the full quota was not taken, between 3,000 and 20,000 additional 1SW salmon and between 70,000 and 140,000 additional MSW salmon would have returned to homewaters each year from 1992 to 1997.

In addition, between 20,000-50,000 escaped farm fish would have been spared from the Faroes fishery in each season. However, results from the tagging experiments north of the Faroes suggests that practically all of the escaped farmed fish in Faroese area that return to homewaters might be expected to return to Norway (Hansen & Jacobsen 1997).

Estimates (means of 1000 simulations) of the total numbers of 1SW and MSW salmon returning to homewaters in the NEAC area and to countries in Northern and Southern Europe are provided in Tables 3.6.1 and 3.6.2. The additional returns represent 6 % to 12 % of MSW fish and 0 to 1 % of 1SW fish returning to homewaters between 1992 and 1997 (Table 3.5.1). However, analyses of smolt tagging data (e.g., ICES 1993/Assess:10) and results from the adult tagging studies (Hansen & Jacobsen 1997) show that the majority of the MSW salmon caught in the Faroes fishery would return to Scandinavian countries, Finland and Russia. The estimates from the adult tagging studies (Table 3.2.1) suggest that about 65 % of the spared wild MSW fish might have returned to these countries; if this were the case they might have represented 9 % to 20 % of MSW returns and 0 to 1 % of 1SW returns between 1992 and 1997 (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 significant change following the suspension of fishing at Faroes in 1991. Reductions in catches were significant for 1SW salmon in Northern Europe (Finland, Sweden and Norway) (Rcrit, $p = 0.006$) and southern Europe (Ireland, UK(Scotland) and France) (Rcrit, $p = 0.05$). 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 after 1991 for Southern Europe (UK(Scotland) and France) (Rcrit, $p = 0.002$). 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 exploitation rates in homewaters.

3.6 Expected Abundance of Salmon in the North-East Atlantic for 1998/1999

In 1995, the Working Group presented a model to estimate the pre-fishery abundance (PFA) of salmon from countries in the NEAC area. The method employed a basic run-reconstruction approach similar to that described by Potter and Dunkley (1993) and Rago *et al.* (1993 a). The model estimated the PFA from the catch in numbers of 1SW and MSW salmon in each country, which were then raised to take account of minimum and maximum estimates (or guess-estimates) of non-reported catches and exploitation rates on the two age groups. Finally these values were raised to take account of maximum and minimum estimates of the natural mortality between the first sea winter and the mid-point of the national fisheries.

In 1997, the Working Group presented a Monte Carlo simulation ('@Risk' in Excel) to generate distributions around the estimated PFA values. The same minimum and maximum parameter values were used as previously (except where these were updated or corrected); these were considered likely to encompass the full range of true values. Each parameter was entered as a uniform distribution in the simulation. The model was run separately to estimate the total numbers of maturing and non-maturing 1SW recruits in the NEAC area and in southern and northern European countries (ICES 1996/Assess:11); each run was based on 500 simulations.

The Working Group has further refined and updated this approach. The Monte Carlo simulation has been reformulated using the software package 'Crystal Ball' (Decisioneering, 1996) in Excel and has been run separately for each country (1000 simulations), to calculate, for 1971-97:

- the total catch of 1SW and MSW salmon (including un-reported catch);
- the total returns of 1SW and MSW salmon;
- the number of maturing and non-maturing 1SW recruits; and
- the 1SW and MSW spawning escapement.

[Separate estimates of these parameters are required for the estimation of conservation limits (see Section 3.7.2).]

Thus, the model uses the following equations:

Number of fish killed of age 'i' in year 'n' = $K_{ni} = C_{ni} / (1 - R_{ni}*)$

Number of returns of fish of age 'i' in year 'n' = $H_{ni} = K_{ni} / U_{ni}*$

Number of maturing 1SW recruits (PFA_1) (in year 'n') = $P_{n1} = H_{n1} / e^{-M1*t1*}$

Number of non-maturing 1SW recruits (PFA_2) (in year 'n') = $P_{nm} = H_{(n+1)m} / e^{-Mm*t_m*}$

Total 1SW recruits in year 'n' = $P_{n1} + P_{nm}$

Where:

C_i = catch in numbers of salmon (1SW or MSW);

$R_{i(min)}$ and $R_{i(max)}$ = minimum and maximum guess-estimates of the proportion of the catches that are unreported;

$U_{i(min)}$ and $U_{i(max)}$ = minimum and maximum estimates of the average level of exploitation salmon in the stock;

$M_{(min)}$ and $M_{(max)}$ = minimum (0.005) and maximum (0.015) estimates of the natural mortality on salmon greater than 1SW in the sea;

$t_{i(min)}$ and $t_{i(max)}$ = maximum and minimum times between homewater fisheries and the time of recruitment. (NB: for MSW fish 12 months is added to the values of 't' given in the data sets)

[NB Recruitment is estimated at 1st January in the first sea winter.]

The input data for the model for ten salmon producing countries in the NEAC area and the Faroes and West Greenland fisheries (as updated for the 1998 assessment) are shown in Appendix 7. Parameters marked with '*' were entered as uniform distributions in the Monte Carlo simulation with ranges given by the min and max values provided.

In the case of the Faroes fishery, the unreported catch comprises only the discards; these are nearly all 1SW fish but have previously been estimated as a percentage of the total catch in numbers (e.g., ICES 1997/Assess:10). Thus, in the case of this fishery, the number of 1SW fish killed is estimated to be:

$$K_1 = C_1 + (0.8 \times ((C_1 + C_m) / (1 - R_{tot}* / 100) - (C_1 + C_m)))$$

where: R_{tot} is the estimated discard rate (a uniform distribution was used based on minimum and maximum values observed in previous years (ICES 1997/Assess:10), and the value of 0.8 in the equation represents the estimated proportion of discarded fish which are dead when they are removed from the line or which die subsequently (ICES 1996/Assess:11).

The output from the simulation, giving the mean estimates of the numbers of fish killed (1SW and MSW), returns (1SW and MSW), recruits (maturing and non maturing 1SW)(plus variances), spawners (1SW and MSW) and total 1SW recruits are shown for each of the ten NEAC countries in Appendix 8. Tables 3.6.1 to 3.6.8 summarise these data and also show combined results for Northern and Southern European countries (see text table below) and the whole NEAC area. The PFA of maturing and non-maturing 1SW salmon (with confidence limits) and the numbers of 1SW and MSW spawners for these areas are shown in Figures 3.6.1 to 3.6.3.

Split used for Northern European and Southern European stock complexes:

Southern European countries:	Northern European countries:
Ireland	Finland
France	Norway
UK(England & Wales)	Russia
UK(Northern Ireland)	Sweden
UK(Scotland)	70 % Faroes catches
Greenland catches	
30 % Faroes catches	

Icelandic stocks are omitted from both groups because their distribution is thought to differ markedly from other stocks; they are included in the NEAC totals.

It appears that the maturing 1SW component of the northern European stocks has remained at a relatively constant level despite showing marked variation in some years. The non-maturing 1SW component on the other hand appears to have been declining since the 1980s, with the most marked change occurring around 1986–87. However, it must be noted that these estimates include large numbers of farm escapees in the more recent years. The Southern European stocks appear to have been more volatile, with large fluctuations occurring in the first half of the time series. The maturing 1SW component of these stocks appears to have fallen markedly in the 1990s to a new, relatively stable but low level, while the non-maturing 1SW component has been in steady decline since the mid 1980s.

Spawning escapement has remained rather more stable (although it should be noted that the smaller scale of these plots masks quite large proportional variations). The plots suggest that the large declines in recruitment of some components have been balanced by major reductions in effort and thus exploitation rates.

Coherence in recruitment patterns in pre-fishery abundance of European salmon

The Working Group was uncertain whether the split of NEAC countries into the Northern and Southern groups given above was the most appropriate for providing catch advice. The split is based upon very limited data on the behaviour and distribution of these stocks in the sea, obtained from tagging studies. These suggest that a much greater proportion of fish tagged in Scandinavian countries are recaptured in the Norwegian Sea, and a greater proportion of fish from southern European countries have been caught at West Greenland. However, recent tagging data from some countries are sparse. In addition, the correlation between smolt-to-adult survival for fish from the River Figgio (southern Norway) and North Esk (Scottish east coast) suggests that these rivers should be grouped together. The Working Group therefore considered how alternative groupings could be established.

Time series of pre-fishery abundance for national stocks in Europe, disaggregated by age-at-maturity, were analysed to attempt to define stock complex borders relevant to the mixed-stock fisheries at Faroes and West Greenland. Two clustering approaches were applied to abundance data normalised by the mean of each time series. K-means clustering seeks to form k groups which are as distinct as possible from other clusters. First, k random clusters are formed and then objects within clusters are moved to minimise variability within clusters and maximise variability between clusters. Many stocks had distinct patterns, thus, in both analyses the Working Group found a number of single member clusters. The K-means clustering did not clearly show the inter-relationship between stocks. Tree clustering methods use the dissimilarities or distances between objects when forming clusters. These distances can be based on a single dimension or multiple dimensions. The most straightforward way of computing distances between objects in a multi-dimensional space is to compute Euclidean distances:

$$\text{distance}(x,y)=\{\Sigma_i (x_i - y_i)^2\}^{1/2}$$

Tree clustering of the maturing component of national stocks was restricted to those stocks predominately producing wild fish and revealed two main groupings (Figure 3.6.4). A large cluster of Ireland, N. Ireland, Scotland, Norway, and England/Wales was formed which appears distinct from Russia. This cluster suggests survival and abundance of 1SW salmon is tracking similarly for most stocks in Europe. This is consistent with emerging models and observations on post-smolt survival and distribution (Friedland *et al.* 1998 and section 3.9.1). Normalised abundance for Ireland, Norway, and Scotland show all three stocks have declined over the past two decades and that the pattern of decline for each stock has been weakly correlated (Figure 3.6.5).

Clustering of the non-maturing component of national stocks, restricted to those stocks predominately producing wild fish, suggests a pattern of stock boundaries distinct form the pattern observed for maturing fish (Figure 3.6.6). Two extreme clusters were formed consisting of Norway and Scotland, and Ireland and Northern Ireland. Normalised abundances for Ireland, Norway, and Scotland support the results of the cluster analysis showing similar patterns for Norway and Scotland versus Ireland (Figure 3.6.7). This suggests stock boundaries significantly different from the boundaries used in previous assessments. Instead of a North Sea boundary between Norway and Scotland, this new analysis suggests the boundary should be to the west of Scotland. In addition, Russia is sufficiently different from Norway to suggest a third group of northern stocks may be appropriate.

The Working Group considered this to be a valuable preliminary analysis but was concerned that production boundaries for stocks may not match patterns of utilisation in mixed-stock fisheries. It may for example be possible to define various groups of stocks and weight their contribution to the catch option assessments based upon their relative contribution to the fisheries. It was recommended that other biological stock characters be examined and tagging databases be reviewed to determine whether functional stock boundaries can be defined.

Forecasting pre-fishing abundance

In order to use these PFA estimates to provide catch advice, a forecast is required of the PFA of recruits in the year preceding the fisheries. Thus, for example, the PFA of non-maturing 1SW recruits must be predicted for 1998 if we are to provide advice for: the West Greenland fishery in 1998; the Faroes fishery (MSW stock) in 1998/99; and homewater fisheries in 1999. Because the latest estimate of non-maturing 1SW recruits is for 1996, 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.

Because of the preliminary nature of these assessments and, in particular, of the conservation limits (Section 3.7.2), and uncertainties about appropriate stock groups, the Working Group considered that this year's advice should be based on only qualitative forecasts from these data. These are discussed in Section 3.8.

3.7 Development of Age-Specific Conservation Limits

3.7.1 Workshop on Setting Conservation Limits for Salmon in the NE Atlantic (WKCLS)

A resolution to hold a Workshop on Setting Conservation Limits for Atlantic Salmon in the North East Atlantic was agreed by delegates of the International Council for the Exploration of the Sea at their Annual Science Meeting in Baltimore, USA in 1997. The following terms of reference were proposed:

A ***establish the criteria to be used in setting national age-specific stock conservation limits.***

B ***where possible, provide age-specific stock conservation limits.***

The Workshop met in the Marine Institute, Dublin from the 10th of March to the 12th of March 1998 and was expected to report to the Working Group on North Atlantic Salmon before their meeting in April, 1998.

The Workshop (ICES 1998/ACFM:13) recognised that the terminology referred to in ICES 1997/Assess:10 described MBAL as MSY and that this was equivalent to a conservation limit. The Workshop therefore accepted this as a starting point for fulfilling the Terms of Reference.

Evidence from Scotland for the existence of genetically distinct groups of salmon within single rivers suggested that, ideally, conservation limits should be set at the population level. The use of limits set on a larger scale than that of the population level could, in theory, damage some populations. A precautionary approach therefore suggests that salmon genetic diversity should be conserved. It may not be possible at present to actually monitor compliance with or manage targets set at this level, and this implies some genetic risk to some populations. Therefore, each individual country's representative would need to decided on the scale at which they felt it was appropriate to set conservation limits. In most cases it was thought that a river by river basis was the lowest scale which would be practical at present.

There was some concern expressed about the possible confusion that could result at a management level as a result of defining the minimum threshold value as the point of MSY. The difference between the minimum threshold level and the higher target level was emphasised. In the case of the first, there should be a high probability that spawning biomass would not fall below this level while, in the case of the second, all fish estimated to exceed this number would be are available for harvest.

The Workshop noted that the use of biological reference levels had also been considered by the NASCO Working Group on the Precautionary Approach in North Atlantic Salmon Management (NASCO 1998) which met in Brussels in January 1998. A review of this report is given in Section 2.5.

Methods for establishing conservation limits

The concept of setting conservation limits has been widely accepted internationally as a viable approach to managing salmon fisheries. Ideally, these limits should be based on reference points derived from fitted stock-recruitment curves. Unfortunately, less than 10 rivers in the NEAC have sufficient data to give these curves and even fewer have been fully developed. Other methods of establishing reference points were addressed within the Workshop, in particular those which are based on habitat/spawning stock indices, transporting targets and correcting for topographical and biological information on river and stock. Particular emphasis was placed on examining methods which could be applied in the virtual absence of specific river data. Table 3.7.1.1 outlines a hierarchy of approaches which have been used with existing data to derive targets/conservation limits for many rivers in the North East Atlantic Area. The basic methodology of each approach and the data required to provide a target estimate or a potential target estimate are outlined. The number of rivers in each country for which each approach has been taken is also shown as well as the total number of rivers, to indicate the progress being made with establishing conservation limits in the NEAC area. It is implicit that the lower the rank the less precise the estimate is likely to be.

Stock and recruitment methods

a) <u>Stock-recruitment models:</u> Ideally, conservation limits should be set for individual rivers based on long time-series of stock and recruitment data. The best S/R relationship would be derived from data collected over a long time period using multiple traps or counters (Approach 1, Table 3.7.1.1) and which can describe S/R relationships for all biological populations (tributary populations etc.). There are three rivers in Europe where such data have been obtained. As the stocks for the Burrishoole (Ireland) and the Bush (N. Ireland) are predominantly comprised of summer grilse they may be regarded as single populations.

S/R relationships can also be described for combined biological populations where long time series of trap/counter data are available but S/R relationships have not been differentiated on the basis of run timing, sea age or specific tributary populations (Approach 2). There are 11 index rivers in Russia where S/R relationships are being developed.

b) <u>Transporting reference points to non-index rivers:</u> Several methods for transporting target data from 'donor' rivers where conservation limits have been established were described. These rely on estimating suitable habitat types by various methods and applying target egg deposition rates derived from known S/R relationships (Approach 3 to 6, Table 3.7.1.1). These approaches have been used for 2 rivers in the UK (N. Ireland, Table 3.7.1.2), 77 rivers in the UK (England and Wales, Table 3.7.1.3), 10 rivers in Russia (Table 3.7.1.4), 37 rivers in France (Table 3.7.1.5). There are also 54 rivers in Russia where reference points from index rivers could be used to establish conservation limits based on habitat estimates derived from field surveys and map data. A similar approach could be taken for 18 Swedish rivers where habitat data are available (Table 3.7.1.6) if a suitable transport target were developed for a Swedish index river or rivers.

As these methods are being developed for most of the NEAC countries, the best estimate of conservation limits for the whole area should be based on data derived from stock and recruitment parameters derived for suitable index rivers and transported individual rivers where habitat areas have been differentiated and measured. Adopting approaches which are further down the rank in Table 3.7.1.1 are likely to be less precise.

Less precise approaches using total wetted area or catchment area (Approach 7 to 9) were also included in Table 3.7.1.1. Again, donor index rivers with known targets expressed in units of wetted area or catchment would be used to derive the targets for these recipient rivers. These approaches have been used for 174 rivers in Ireland.

(Table 3.7.1.7) and 38 rivers in the UK (N. Ireland, Table 3.7.1.2). The data for UK N. Ireland are very provisional and are provided for illustrative purposes only. A similar approach (Approach 10) could be used by transporting reference points to regions or rivers grouped by areas.

c) Conservation limits based on direct stock abundance estimates: There are a number of rivers in Ireland and Norway where there are short time series of full trap or counter data which could be used to establish pragmatic conservation limits based on recent stock information (Approach 11, Table 3.7.1.1). In the absence of habitat derived targets, these counts would at least show the present stock level which should be maintained or conserved and the effects of management measures designed to improve returns or escapement to spawn.

d) Conservation limits based on indirect stock abundance estimates: These estimates are based on indexes of abundance which must be corrected to derive total stock data. Juvenile productivity studies (Approach 12) can be used to indicate the potential stock required to produce these juveniles. Similar approaches could be adopted for 2 Norwegian rivers.

Catch data (commercial nets/traps and rod catch data) can be corrected for known or estimated exploitation rates to derive the current stock levels in specific rivers (Approach 13 and 14).

In 1997 the Working Group continued developments of the methods to estimate the pre-fishery abundance of maturing and non-maturing salmon in the NEAC area (lagged spawner model - Approach 13). The model developed in 1995 estimated pre-fishery abundance from the catch in numbers of 1SW and MSW salmon in each country. This model was further developed at the Workshop to examine the relationship between estimated spawners and subsequent recruitment and is presented in Section 3.7.3. While acknowledging that this method is ranked low in Table 3.7.1.1, the approach could be used to provide a conservation limit for all rivers combined for countries or regions in the NEAC area.

Where there was a paucity of suitable data it was felt that if necessary conservation limits should be derived from partial trap/counter data or from historical catch data for previous years to provide some measure of possible abundance of stock (Approach 15 and 16).

General approach to setting age-specific conservation limits

Clearly, the problem of setting age specific conservation limits is the lack of information on the proportion of each age class in the national stocks. It is not possible at present to provide age specific conservation limits on a river by river basis. It has been shown (ICES 1997/Assess:10) that returns of MSW fish have been declining in the last decade. It is more difficult therefore to decide where to set a conservation limit for this component of the stock. The Workshop was undecided as to whether conservation limits should be aimed at (a) conserving a historical age composition or (b) preserving the current age composition or (c) adopting some other approaches.

(a) Conserving a historical age composition: Egg deposition rates must be converted to numbers of grilse and MSW spawners required. Where there has been a change in the age composition of the stocks (e.g., a decline in MSW salmon) the required age composition of the spawning stock may be based on historic data. Although this would provide management with a possible approach to improve MSW stocks there may be difficulties with this in practise. The problem of including these theoretical fish is similar to the situation in rivers with specific problems (dams, chronic pollution etc.) where the potential production is far greater than the current achievable escapement levels.

(b) Preserving the current age composition: The conversion of egg deposition rates to grilse and MSW salmon could be set at the existing ratio of age groups if known.

(c) Alternatively: the age distribution over and intermediate period (e.g. 3 to 5 years) could be used to set conservation limits on the understanding that this would more achievable in the short term. An additional margin could be built into this approach to allow for more gradual inclusion of extra MSW fish over a period of time. This would provide a reasonable target for management while acknowledging the fact that MSW stocks have been higher in the past.

Setting conservation limits for combined stocks initially was considered. There may be severe management difficulties if all tributaries are to be considered individually on the understanding that each tributary represents a single population. While the caveats expressed in earlier in this section must be acknowledged, management on the basis of combined stock components for individual rivers even when these individual river stocks are low is probably the most that will achievable over the next few years.

3.7.2 Development of national conservation limits

As conservation limits have so far been defined for a relatively small proportion (<10 %) of salmon stocks in the NEAC area, the Working Group considered an alternative approach to estimating these on a national scale. The method uses the outputs of the PFA analysis described in Section 3.6.

Lagged spawner analysis

In order to develop conservation limits, information is required on the relationship between spawning stocks and recruitment. The PFA model provides estimates of the numbers of spawners and the numbers of 1SW recruits. However, these value cannot be used to derive stock-recruitment relationships directly because the spawners in year 'n' contribute to the recruitment over several years depending upon the relative proportions of 1 to 6 year old smolts that they produce. 1SW and MSW salmon also contribute to the recruitment in different proportions, principally because of the greater egg deposition from the MSW fish resulting from their greater size and the higher proportion of females. Since most stocks have seen significant changes in the relative proportions of 1SW and MSW salmon in the last 25 years, this difference needs to be taken into account to avoid biases caused by changes in the age composition of the spawning stock. This can be addressed by converting the numbers of 1SW and MSW spawners into numbers of eggs deposited. Thus, in each country and for each year:

$$\text{Total egg deposition} = E_{tot} = (W_1 \times F_i \times G_1) + (W_m \times F_m \times G_{m})$$

where:

the numbers of spawners = $W_{ni} = H_{ni} - K_{ni}$ (derived from the simulation model)

the % female in age group 'i' = F_i, and

the average number of eggs produced by a female of age 'i' = G_i

This approach assumes that there have been no significant changes in the egg production or in the proportion of females for 1SW and MSW salmon over the time period. Males are therefore ignored in the foregoing analysis, the assumption being that their numbers have not limited production during the period 1971-present.

The egg deposition in year 'n' may be estimated 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. (e.g., spawners in year 'n' will produce parr in year 'n+1' and 1yr smolts in year 'n+2', and these will generate 1SW recruits in year 'n+3'). Thus the number of 'lagged eggs' (L) related to the number of 1SW recruits in year 'n+8' is estimated as:

$$L_{n+8} = (E_n \times p_6) + (E_{n+1} \times p_5) + (E_{n+2} \times p_4) + (E_{n+3} \times p_3) + (E_{n+4} \times p_2) + (E_{n+5} \times p_1)$$

where:

E_n = the estimated number of eggs deposited in year 'n', and

p_i = the proportion of smolts of age 'i'

The estimates of lagged eggs provides a measure of the relative spawning level which may be related to the recruitment figures derived from the PFA analysis.

The lagged egg deposition estimates are given in Appendix 9 for the 10 salmon-producing countries in the NEAC area along with the estimated numbers of 1SW recruits, which have been carried over from the PFA analyses. The lagged egg deposition for all countries and Southern and European stock complexes are also summarised in Table 3.7.2.1. Plots of lagged eggs ('stock') and 1SW recruits are also shown in Appendix 9 for each country.

The plots of lagged eggs (stock) against the 1SW adults in the sea (recruits) may be considered as pseudo-stock-recruitment relationships. While it might be possible to estimate a replacement line for these plots, this would require further approximations, and the Working Group did not consider this to be appropriate at this stage. In addition, in view of the preliminary status of the assessment and the 'shot-gun' pattern of the plots, fitting of classic stock recruitment curves (e.g., Ricker or Beverton and Holt) is not considered appropriate. However, a range of other, non-parametric methods have been proposed for estimating the MBAL (e.g., see ICES 1993/Assess:12), a level which is now considered as synonymous with conservation limits for salmon. These methods therefore provide approaches for estimating provisional conservation limits from these plots.

The following options for setting MBAL or conservation limit estimates are therefore considered on each stock-recruitment graph:

Option 1: the minimum observed spawning stock level (defined by ICES as the minimum requirement for MBAL where there is great uncertainty about the stock-recruit relationship). [i.e. CL_{opt1} = min L]

Option 2: the stock size where the 90th percentile of survival intersects the 90th percentile of recruitment (Serebryakov 1991); [i.e. $CL_{opt2} = (R / L)_{90\%ile} \times R_{90\%ile}$]

Option 3: the stock size where the 90th percentile of survival intersects the median recruitment level. [i.e. $CL_{opt3} = (R / L)_{90\%ile} \times R_{med}$]

An example of how these calculations work is shown in Figure 3.7.2.1. The Working Group noted that these Options, in particular Option 1, despite being based upon recognised ICES methodologies (ICES, 1993/Assess:12), might provide more risky conservation limits than the MSY point currently adopted for river stocks for which true stock-recruit relationships can be estimated. These 'conservation limit' estimates are shown as numbers of eggs (Options 1-3) in Appendix 9 and are indicated by triangles on the X-axes of the in-table plots of recruits against lagged eggs. The Working Group felt that further analyses of these stock-recruit relationships should be explored to provide additional conservation limit options for consideration.

Conversion of egg conservation limits to age specific conservation limits

To be compared with any forecast of PFA, the conservation limit levels expressed as egg depositions must be converted back to fish numbers. NASCO has also asked that age-specific conservation limits be provided, which is clearly a necessity where decisions have to be made about the management of fisheries exploiting predominantly (or exclusively as in the case of West Greenland) one age group of fish.

There have been substantial changes in the age composition of many national salmon stocks in the NEAC area, in most cases reflecting the relatively greater decline of MSW compared to 1SW salmon numbers. As a result the age composition used to set the conservation limit will depend upon which time period is used to provide the base line age-composition. While many may wish to see a return to the days when MSW salmon were very much more abundant, this may not be realistic in the near future if the changes have been driven, at least in part, by changing environmental factors. Thus it may be more realistic to use the age composition in the more recent past as the short to medium term goal (maintaining a longer term objective of restoring historic stock compositions as and when this become as possible).

It may also be considered that the age composition of the conservation limit should reflect the ratio of maturing to non-maturing recruits rather than the ratio of 1SW to MSW spawners, which is affected by exploitation. While this may reflect a desirable medium to long term goal of balancing levels of exploitation on all age groups, in the short term it is likely to be impractical to achieve such a major change.

Thus, in this analysis, the age composition of the estimated conservation limit options are based upon the ratio of the averages of the estimated numbers 1SW and MSW spawners for the last 10 years for each country from the simulation analysis. The Working Group emphasised that this is a fairly arbitrary decision, and noted that managers may wish to advise on their attitudes towards restoring stocks to their historic compositions.

Thus: $CL = (av.W_1 + av.W_m)/((av.W_1 \times F_1 \times G_1) + (av.W_m \times F_m \times G_m)) \times av.W_1 / av.W_m$

where: $av.W_i$ is the 10-year average (1988-97) of the estimated number of spawners of age 'i'

Thus the various egg conservation limits have been converted to numbers of 1SW and MSW spawners as shown in Appendix 9 and summarised in Table 3.7.2.2.

Conservation limits for Northern and Southern European stock complexes

Similar 'pseudo' stock-recruit relationships may be examined for the Northern and Southern stock complexes using the same approach as described above with the combined data from the countries listed in the text table.

A modification to the method has been required to split the conservation limit based on lagged eggs into age-specific numbers. To achieve this, the proportion of females (F_i) and the egg production per female (G_i) for each country were weighted according to the 10-year mean estimated numbers of spawners (av.W_i) of each age group ('$_i$') in each country. The results of these analyses are shown in Tables 3.7.2.3 to 3.7.2.5.

Caveats on the lagged egg deposition assessments of conservation limits

The Working Group considered that, because of the very preliminary nature of this assessment, only the conservation limits for the stock complexes should be used in the provision of advice this year. They also agreed that all three options should be treated as acceptable estimates of the conservation limit in order to reflect the uncertainty in the assessments. However, it must be noted that the analysis does not encompass all of the uncertainties in the parameter estimates.

This methodology is both new and very approximate. While it will be possible to improve the model by refining the input data and, where possible, breaking the national stocks down into smaller units, it remains desirable to adopt more precise methods to develop conservation limits for all rivers in the NEAC area. However, it is likely to be at least 5 years before such estimates are available for all stocks (ICES 1997/Assess:11). The Working Group therefore considered that the conservation limits provided by this analysis are the best available estimates for the whole NEAC area and could be used to provide catch advice in the short term if due account was taken of the uncertainties involved.

The results of the analyses are broadly consistent with generally perceived views about the state of stocks in the NEAC area and the Working Group's previous advice. However, it should be noted that because of the form of the analyses and the nature of the ICES advice on methods for setting MBAL, it is inevitable that the spawning escapement estimates will be close to the conservation limit options at some stage in the time series. Nevertheless the Working Group has previously endorsed the advice that conservation limits should not be set at stock levels below those previously observed. The output from the model is consistent with this approach. Since the abundance of many stocks appears to be at the lowest levels recorded, it is inevitable that any advice on catch options must be for extreme caution to be taken in the management of fisheries, particularly those exploiting mixed stocks.

The age specific conservation limits have been based upon the average age composition of spawning stocks in the past 10 years. This is a relatively conservative approach, and it would probably be desirable to progressively change the composition towards one thought to be more ideal in the long term. If the age composition had been based upon the state of stocks further in the past, the conservation limits for MSW salmon would probably have been higher and the conservation limits for 1SW fish lower. As a result MSW stocks in Southern Europe would probably have been below the conservation limit for much of the past 25 years, while 1SW stocks might still be above the level.

The great diversity of European salmon stocks increases the risks associated with combining conservation limits for many stocks. These risks must therefore be taken into account in providing the catch advice and in taking management actions.

3.8 Catch Options and Assessment of Risk Relative to the Objective of Exceeding Stock Conservation Limits

In order to compare the conservation limits with the PFA, conservation limits must be raised to take account of natural mortality between 1st January in the first sea winter and the time of return to home waters to provide the *spawning escapement reserve* (SER). Thus:

$$SER = CL / e^{-Mt}$$

Estimates of the SER for each conservation limit are provided in Table 3.7.2.2 based on values of M = 0.01 and 't' of 7 months for 1SW and 17 month for MSW salmon. The SER values for all three conservation limit options from the stock complex analysis are plotted on Figures 3.8.1 to 3.8.3 to show the relationship with the historic PFA estimates.

Catch advice:

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 catch advice was appropriate:

Northern European 1SW stocks: Although the confidence limits on the PFA estimates for maturing 1SW salmon from Northern Europe are large, the estimates are greater than the conservation limit options and appear to be relatively stable. The Working Group therefore considers that continuation of exploitation of these stocks at current levels is acceptable.

Northern European MSW stocks: The PFA of non-maturing 1SW salmon from Northern Europe has been declining since the late 1980s and is now approaching the conservation limit estimates. The Working group therefore suggests that great caution should be exercised in the management of these stocks particularly in mixed river-stock fisheries.

Southern European 1SW stocks: The PFA of maturing 1SW salmon from southern Europe appears to have been very close to the conservation limit estimates for about the past eight years. The declines in stocks in 1997 are therefore of great concern and the Working Group considers that extreme caution should be exercised in the management of these stocks, particularly in mixed river-stock fisheries.

Southern European MSW stocks: The PFA of non-maturing 1SW salmon on southern Europe has been declining steadily for about 10 years and the Working Groups preliminary analysis suggests that it fell below the conservation limits in 1996. Simple projection of these data by eye suggests that the PFA is also likely to fall below the conservation limits in 1998. The Working Group considers that extreme caution should be exercised in the management of these stocks, particularly in mixed river-stock fisheries, and that reductions in levels of exploitation should be pursued.

3.9 Catches of Post-Smolts in the Norwegian Sea and Adjacent Areas

3.9.1 Post-smolt surveys 1991–1997

The 1996 Working Group (ICES 1996/Assess:11) reported on the by-catch of 34 post-smolts and 2 1SW salmon in a pair trawling experiment for herring in the northern Norwegian Sea in July/August conducted by the Institute of Marine Research (IMR), Norway (Holst *et al.* 1993). This coincided with the development at the IMR of a new pelagic research trawl designed to sample also the 0–25 m surface layer (Valdemarsen and Misund 1995).A regular sampling programme was initiated in 1995 in the Norwegian Sea and adjacent areas within the frame work of a large scale ecology study the «Mare Cognitum Programme» (MCP) (Holm *et al.* 1996 a). The surface trawl technique for capturing post-smolts was tested with a similar but smaller trawl by the FRS in Scotland, with equal success (Shelton *et al.* 1997) in the area between NW Scotland, the Shetlands and the Faroes in June 1996. Further gear development by IMR using floating long-lines, driftnets and a specially developed otter board trolling device has allowed large salmon to be caught.

From 1991–97, 799 surface trawl hauls have been made covering an area from southwest of Ireland (50°N) up to 75°N-east of Bear Island. A total of 851 post-smolts and 25 1SW fish have been caught (Table 3.9.1.1). Captures from the Norwegian surveys in 1997 are plotted in (Figure 3.9.1.1).

The latest information supplied to the Working Group indicate that more than 50 post-smolts were again recorded in some of the 1997 hauls west of the Hebrides and along the Wyville- Thomson Ridge (WTR) in early June. These locations were all within the strong north-east running slope current along the northwest European continental shelf edge where earlier post-smolt sampling had been successful (Holm *et al.* 1996 a). Interestingly the 1997 IMR cruise in mid June yielded 142 post-smolts during a single 30 minute haul approximately half way between Shetland and the Norwegian coast in the northern North Sea, an area outside the main current pathways. This suggests that although post-smolts may be concentrated by major currents, other factors such as counter currents and wind driven gyres also dictate their distribution.

Data from Shelton *et al.* (1997) on a large number of post-smolts of similar size and age caught in some hauls taken in proximity to each other, and patterns of tag recovery tend to support the hypothesis that post-smolt salmon may remain in shoals, the composition of which may reflect the region of origin.

In the 1995 IMR post-smolt catches, the proportion of river-age-1 smolts was significantly higher in the northern than in southern areas indicating that a relatively large proportion probably originated from more southerly areas. This observation was supported by the retrieval in 1995 and 1996 of microtagged fish tagged the same year in south England and Ireland respectively. Both these fish were captured north of 70°N together with other untagged post-smolts (Holst *et al.* 1996). In 1997, most post-smolts were river-age-1 and -2 suggesting a southern European origin. The trawl sampling programme covers only a small part of the vast northern areas likely inhabited by post-smolts. It is notable that few fish of older smolt ages have been caught in any of the cruises.

Although the areas in the southerly and easterly limits of the Faroes EEZ have been surveyed regularly by IMR since 1995, post-smolts were recorded for the first time in June 1997.

While post-smolts were abundant in the southerly areas of the Norwegian Sea (cruises 1997b and c, Table 3.9.1.1) in June 1997, only three post-smolts and one 1SW salmon were captured in a total of 191 surface trawl hauls during the three IMR cruises north of latitude 63°N during late June -August. Possible explanations include the cruises having taken place after the post-smolts had moved out of this area and high post-smolt mortality due to disease, parasite infestation, lack of food and predation.

Some of the post-smolt captures have been plotted in relation to salinity and water temperature. During a cruise in the eastern and northern Norwegian Sea (Table 3.9.1.1, cruise 1995 b) all post-smolts except two were captured in areas where the salinity exceeded 35 ppm (Holm *et al.* 1996 b). A similar observation is reported by Shelton *et al.* (1997) where all smolts were caught in the warmest and most saline waters during cruise 1996a along the Wyville-Thomson Ridge (WTR). The Working Group was submitted material showing that during cruise 1997c the hydrographical pattern was more complex. Fish caught at the WTR were located in the shelf edge current of warm saline water, while at the western Norwegian Trench the two capture sites were characterised by low salinity warm Norwegian coastal water.

To further investigate some of the causes of marine mortality it is recommended that efforts should be made to study (a) the infestation rate and prevalence of salmon lice on wild ranging salmon (b) the link between marine productivity and salmon growth and (c) the relationship between marine mammals and salmon in the sea.

3.9.2 By-catch of post-smolts in pelagic fisheries

There is little new information about the by-catch of post-smolts in pelagic fisheries. The fishery for mackerel and Norwegian spring spawning herring are the two major fisheries for pelagic species occurring in the Norwegian Sea during summer. The mackerel fishery uses mainly pelagic trawls similar, but larger, to that used to sample post-smolts. The herring fishery, on the other hand, employs predominantly purse seines. The catches of mackerel off the Faroes (Division Vb) and in the Norwegian Sea (Division IIa) have varied from about 50,000–165,000 metric tonnes in the period 1983–95 (ICES 1997/Assess:3). The catch in 1996, in Div IIa and Vb was 99,300 tonnes. Unregulated catches of mackerel in international waters were in 1996 estimated at 45,000 tonnes (ICES 1998/Assess:6). As a rule, the fishery starts in the Faroese zone in early July and moves northward in the international zone following the northward migration of the western mackerel stocks. The fishery for Norwegian spring spawning herring in the Norwegian Sea commenced in 1994 and has increased rapidly. Only a small tonnage has been taken with pelagic trawls. In 1996, the catches of herring in the Norwegian Sea in spring and summer were around 360,000 tonnes (ICES 1997/Assess:14) in the northern Norwegian Sea. The purse seine fishery operates in the Norwegian Sea mainly operates from late May to July. The pelagic fishery for capelin is anticipated to restart in the Barents Sea in 1999.

Both the fishery for mackerel and herring in the Norwegian Sea overlap geographically with the anticipated migration routes of European post-smolts. To some extent the fishery has been observed to intercept with the post-smolt migration paths as a large fleet was observed trawling in international waters just outside the Norwegian EEZ at around 66°N during cruise 1995 b (Table 3.9.1.1) in July in areas where smolts were captured during the research survey (Holm *et al.* 1996 a). In addition, a Norwegian Carlin tag from a smolt released in the Trondheimfjord in May 1996 was retrieved by a Fisheries Control Officer during a screening of the mackerel catch on a pelagic trawler in international waters in the Norwegian Sea in the summer 1996. No data on the possible by-catch of post-smolts in purse-seine catches are available.

Provided the methods used in the trawl-surveys were comparable with those used by the commercial fishery, i.e., the gear is operated in the surface mode from 0 m downwards, the catch rates from the scientific trawl fishery could be used to estimate the number of smolts taken in commercial catches. However, the information about the trawl methods used in the international mackerel fishery is of an anecdotal nature only, i.e., there are no data on the actual fishing depth, towing time and speed etc. Also the spatial and temporal dispersion of this fishery is unknown.

The pelagic fishery in the area concerned is presently at a high level. An effort to investigate the interception between these fisheries and post-smolt migrations is therefore necessary to allow a proper evaluation of their possible impact on salmon in the sea. As a first step the Working Group recommends that the Working Group on Northern Pelagic and Blue Whiting Fisheries, the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, and the Herring Assessment Working Groups should be asked for the following:

1. The timing of pelagic fisheries in the ICES Areas I, IIa and b, IVa and b, Va, Vb1 and b2, VIa and b and VIIa and b.

2. Specifications of the gear used.

3. Catch per ICES statistical rectangles in the relevant Areas.

4. Catch per month in the relevant Areas.

5. Information on possible by-catches of salmon in the pelagic catches.

It is recommended that the sampling programme for post-smolts should be extended to more closely define their temporal and spatial distribution in relation to pelagic fisheries in the north east North Atlantic.

3.10 Data Deficiencies and Research Needs in the NEAC Area

1. Estimates of marine mortality of salmon should be re-examined in the North-East Atlantic, and causes for this mortality should be identified and quantified.

2. The Working Group strongly endorses the continuation of the post-smolt surveys in the North-East Atlantic, and recommends this to be extended to presently uncovered areas.

3. Efforts should be made to provide estimates of by-catch of salmon in marine waters.

4. The Working Group recommends that the Working Group on Northern Pelagic and Blue Whiting Fisheries, the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, and the Herring Assessment Working Group are asked for:

    - Timing of pelagic fisheries in ICES Areas I; IIa,b; IVa,b; Va; Vb1,2; VIa,b; VIIa,b.

    - Gear used.

    - Catch per ICES statistical rectangle per month in the relevant Areas.

    - Information on by-catches of salmon in the pelagic catches.

5. The Working Group recommends a continuation of the research fishery at Faroes.

6. Alternative ways to group salmon stocks, or stock complexes should be examined to improve the catch advice for salmon in the North-East Atlantic.

7. The quality of data used to set conservation limits in the North-East Atlantic should be improved and provided for smaller stock complexes. Furthermore, a sensitivity analysis of the input parameters to the pre-fishery abundance model should be carried out.

8. More information is required on a river by river basis relating to catches, exploitation rates and habitat assessment and this should be referenced to the appropriate scale (e.g., tributary populations etc.). Specific information on required age class composition of the stocks should be established on a river by river basis (historical and current).

9. Life history models are required for as many index rivers as possible.

10. Transportability of existing targets derived from known S/R relationships must be evaluated in comparison with other indices of abundance.

11. Further refinement is required to the model to estimate PFA and Conservation Limit particularly with regard to the examination of the input data from each country to explain differences between the model output and current estimates of abundance from other analyses.

12. Further research and development is required, particularly with regard to establishing stock size (counters) and relating productivity to suitable habitat area (catchment surveys, juvenile production studies and application of GIS and other techniques).

13. The implications of combining required adult escapement levels over districts, regions and countries must be examined and the scale to which this is appropriate identified.

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 directly are called Salmon Fishing Areas (SFAs); for Québec, the management is delegated to the Ministère de l'Environnement et de la Faune 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 categorised 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 1997: Native peoples, commercial fishers, and recreational fishers. The following management measures were in effect in 1997.

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 and 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 1997. The signed agreements 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 5-year moratorium which was placed on the commercial fishery in insular Newfoundland in 1992 continued in 1997. In addition, the commercial fishery in southern Labrador (SFA 14B) was closed in 1997. In the remainder of Labrador, commercial fishing quotas assigned by SFA were reduced further from 1996 and the number of fishers declined minimally (Table 4.1.1.1). The opening of the Labrador commercial fishery was June 20, similar to 1996. The season was to close on October 15 or sooner if the quota was caught. Commercial fisheries in Québec in 1997 occurred in zone Q9 (July 1 to August 23) and in Ungava Bay (zone Q11 by Native peoples). The quota for Q9 in 1997, established in terms of number of fish, was similar to 1996.

Recreational fisheries: Recreational fisheries management in 1997 varied by area (Figure 4.1.1.2). Except in Québec and Labrador, only small salmon could be killed and retained in the recreational fisheries. The seasonal bag limits in the recreational fishery remained at eight small salmon in New Brunswick (SFA 15, 16) and in SFA 18 of Nova Scotia. In Nova Scotia SFA 21, the season and daily limits were set at eight and one small salmon retained, respectively. In SFA 17 (PEI), the season and daily bag limits were 7 and 1 respectively. Catch-and-release fishing for all sizes of Atlantic salmon was in effect in SFAs 19 and 20 of Nova Scotia and SFA 23 of New Brunswick. SFA 22 was again closed to salmon angling. For insular Newfoundland (SFA 2 to 14A), the seasonal bag limit was similar to the 1994–96 period: six fish of which three small salmon could be retained prior to July 31 and three small salmon after that date. After the bag limit of three was reached in each time period, catch-and-release fishing only was permitted. For southern

Labrador (SFA 14B), the management plan similar to insular Newfoundland was in effect: no retention of large salmon was allowed. In the northern SFAs of Labrador (SFA 1, 2), there was no seasonal division of the bag limit but the season limit for large salmon was set at one as in 1995 and 1996 with a daily limit of two fish. In Québec, season and bag limits varied by zone: for Q1 to Q8 and Q10, the season limit was 7 fish of any size. For rivers in zone Q9 and Q11, the season limit was 10 fish with daily limits of two fish in Q8, three fish in Q9 and four fish in Q11. In most rivers of zones Q1 to Q7 and Q10, fishing for the day would end if the first fish kept was a large salmon. If the first fish kept was a small salmon, then fishing could continue until a second fish was caught, regardless of the size of the second fish.

Throughout eastern Canada in 1997, non-retention of salmon regardless of size and in some cases, complete closure, was imposed following river-specific inseason reviews of returns (Figure 4.1.1.2). In all insular Newfoundland, retention angling seasons were shortened as a result of low returns and/or low water conditions and warm water temperatures.

USA

Angling for sea-run Atlantic salmon in the USA is permitted only in the State of Maine, and in 1997 the sport fishery continued to be restricted to catch and release. Effort, as measured by license sales, remained the same as in 1996.

France (Islands of Saint-Pierre and Miquelon)

For the Saint-Pierre and Miquelon fisheries in 1997, there was no information presented to the Working Group on gear and effort used. For 1996, there were 10 professional fishermen using an estimated 10,400 m of surface gillnet, similar to values last reported in 1994. There were 42 licensed recreational gillnet fishermen using an estimated 7,560 m of surface gillnet. In 1994, there were reported to have been 26 recreational fishermen using 13,860 m of net.

4.1.2 Catch and catch per unit effort (CPUE)

Canada

The provisional harvest of salmon in 1997 by all users was 225 t, a decrease of 22 % by weight from the 1996 harvest of 290 t (Table 2.1.1.1; Figure 4.1.2.1).

The 1997 harvest was 57,143 small salmon and 26,530 large salmon, a decrease from the 1996 harvests of 30 % and 16 % for small salmon and large salmon, respectively. The dramatic decline in harvested tonnage since 1988 is in large part the result of the large reductions in commercial fisheries effort and, since 1992, the closure of the insular Newfoundland commercial fishery (Figure 4.1.2.1). These reductions were introduced as a result of declining abundance of salmon.

The 1997 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 provinces, accounting for 71 % of the total small salmon harvests in eastern Canada. Commercial fishers took the largest share of large salmon (51 % by number). Native peoples harvested 4 % (by number) of the total small salmon and 24 % of the total large salmon in eastern Canada.

Native peoples' fisheries: In many cases, Native peoples' food fisheries harvests in 1997 were less than the allocations. Harvests in 1997 (by weight) were down 14 % from 1996 but 3 % above the previous 5-year average harvest. The proportion of the harvest composed of large salmon increased to 90 % by weight and 71 % by number in 1997.

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	41.0	90	71

Recreational fisheries: Harvest in recreational fisheries in 1997 totalled 47,419 small and large salmon, 33 % below the previous five-year average and 36 % below the 1996 harvest level (Figure 4.1.2.2). The small salmon harvest of 40,673 fish was a decrease of 32 % from the previous five-year mean. The large salmon harvest of 6,746 fish was a 37 % decline from the previous five-year mean. Small salmon harvests were down 38 % and large salmon harvests were down 21 % from 1996. The small salmon size group has contributed 86 % 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) fisheries in 1984 (Figure 4.1.2.2).

Recreational catches (including retained and released fish) of small salmon in 1997 were similar or above the 1984 to 1991 mean in most fishing areas of Québec, and the west coast and northern peninsula of Newfoundland (Figure 4.1.2.3). Small salmon catches were among the lowest observed in the majority of the Maritimes (with the exception to PEI) and in the northeast and south coasts of Newfoundland. Large salmon catches were well below the average throughout mainland Canada (with the exception of the Gulf shore rivers of Nova Scotia) but were among the highest in the west coast of Newfoundland, (SFA 12, 13, 14A), Labrador (SFA 14B, 2), and the Gulf shore of Nova Scotia (SFA 18). Catches in PEI (SFA 17) were above average but more than 90 % of the returns originate from smolt stocking programs.

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 1997 were closed to all retention of salmon, regardless of size (Figure 4.1.1.2).

In 1997, the first year for which estimates are complete for Canada, almost 50,000 salmon (22,000 large and 28,000 small) were caught and released (Table 4.1.2.2). Most of the fish released were in New Brunswick (46 %), followed by Newfoundland (41 %), Nova Scotia (9 %), Québec (4 %) 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 (75 %), followed by New Brunswick (62 %), Newfoundland (51 %), Prince Edward Island (47 %) and Québec (13 %).

Commercial fisheries: The commercial harvest in 1997 declined to 78.5 t from a peak of more than 2,400 t in 1980 (Figure 4.1.2.4). Commercial harvest in Labrador was the lowest ever (47 t) with large salmon representing less than 38 % by number of the harvests (Table 4.1.1.1). The commercial fishery in SFA 2 closed in mid-July after the SFA specific quota of 35.5 t was caught. The quota in SFA 1 was not caught in 1997. For Québec, the harvest of large salmon in the commercial fishery continued to decline in 1997, in part as a result of license retirements and reduced quotas.

Unreported Catches: Canada has been providing estimates of unreported catches of Atlantic salmon since 1986. These numbers have previously been confidential and summed in the Working Group reports either as part of a total for the North Atlantic or as a subset expressed as a total for the North American Commission area. However, as the other countries (USA, and France for Saint-Pierre and Miquelon) providing input into the North American Commission area unreported catch estimates have very small catches relative to Canada, it has been obvious that most of the unreported catch estimated for the North American Commission area has been Canada's.

Canada's unreported catch estimate for 1997 is about 89 tonnes with estimates included for all provinces and arises mainly from illegal retention (Table 4.1.2.3). The breakdown by SFA was not available however for any of the SFAs in Newfoundland and Labrador, where the totals estimated were 24.5 and 2.5 t respectively, nor for SFA 21 where no response was received from enforcement staff.

For the Province of Québec, all estimates were developed by regional biologists for each fishing area using proportions of the angling, native and commercial fisheries which were assumed to be undeclared. Such proportions were based on previous studies.

For Newfoundland and Labrador, there was no information provided on a fishing area basis, the only divisions being insular Newfoundland and Labrador. As well, size information, numbers of fish and location (freshwater or marine) were not provided. All information provided came from enforcement staff and was largely based on Fishery Officer observations, unconfirmed occurrence reports and anecdotal information.

For Nova Scotia and New Brunswick (SFA 23) and Prince Edward Island (SFA 17), either regional enforcement staff or biologists provided estimates. For SFAs 15 and 16 in New Brunswick, the unreported catch estimates are the average of those reported for these areas in 1990-94.

Canada's estimate of unreported catch in 1997 is incomplete and the methods used to develop such information is not rigorous. More effort was expended this year on this subject and although the estimates are very approximate, it is likely that the unreported catch for 1997 was less than that for 1996. Returns were generally lower to most rivers and many areas were completely closed to fishing due to low stocks and/or low water levels. Such conditions should generally lead to reduced levels of unreported catch.

USA

There was no harvest of sea-run Atlantic salmon in the USA in 1997. The estimated number of salmon caught and released was 333 fish, which was 39 % lower than in 1996 and 32 % and 46 % below the 5-year and 10-year averages, respectively. Most of the reduction in catch occurred in the Penobscot River as a result of a decline in salmon abundance and a reduction (by 60 days) in the length of the angling season.

France (Islands of Saint-Pierre and Miquelon)

No information was presented to the Working Group on the harvest in 1997. A value of 1.5 t, similar to 1996, was assumed. The harvest of salmon by commercial nets in 1996 was estimated to have been 950 kg and 560 kg were harvested recreational fishermen using gillnets. The commercial catch in 1996 was approximately two times that reported for 1995. There was no estimate provided for the recreational catch in 1995.

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. No external tags of USA origin were reported from this fishery in 1997 although there were releases from the USA in 1996 which could have been in Labrador waters in 1997. There was no scanning for coded wire tags in 1997 in Labrador as there have been no coded wire tags released from USA in recent years.

Canada

Origin of returns in 1997: 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. 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 sampled from the returns to two rivers of the Bay of Fundy (St. Croix, Magaguadavic)

(Table 4.1.3.1). No aquaculture escapees were identified in the returns to Mactaquac on the Saint John River or the Nashwaak tributary in 1997.

Aquaculture production of Atlantic salmon in eastern Canada has increased annually, exceeding 10,000 t in 1992 and rising to just over 22,000 t in 1997 (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. Escapes for 1995 to 1997 are believed to be low.

The number of aquaculture escapees have increased in the Magaguadavic River (SFA 23) which is in close proximity to the centre of the aquaculture production area (Table 4.1.3.1). 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 54 % of the total run of salmon to the St. Croix River during 1994 to 1997 (Table 4.1.3.1).

USA

Some salmon that were caught in the sport fishery in 1997 were assumed escapees from aquaculture operations in Maine and New Brunswick (Canada). In addition, a few of those caught and released originated from captive broodstock that were released into three rivers in June. The incidence of aquaculture escapes was low in monitored rivers before 1994. Since 1994, the incidence of aquaculture escapes had increased in the Narraguagus River but none were observed in 1997. Aquaculture escaped fish were not observed in one river in 1997 but remained high in another river in eastern Maine (Table 4.1.3.1).

4.1.4 Exploitation rates in Canadian and USA fisheries

Canada

Exploitation rates can be estimated by dividing the harvests (57,143 small and 26,530 large salmon) by the sum of the estimated recruitment of small (220,773 – 397,674) and large (106,863 - 173,510) salmon to eastern Canada. Recruitment was estimated by summing returns of small and large salmon in the sub-areas (Appendix 5) with the harvest of small and large salmon in the Newfoundland and Labrador commercial fishery (Table 4.1.1.1). Calculated in this manner, the exploitation rate on the total recruitment to Canada of small salmon was between 0.14 and 0.26 and for large salmon, between 0.15 and 0.25. The rates on both small and large salmon are about the same as 1996 levels.

Native peoples' fisheries: The harvest of salmon in eastern Canada by Native peoples in 1997 totalled 2,532 small salmon and 6,293 large salmon. The exploitation rate by Native peoples on small salmon in eastern Canada was about 0.01 and for large salmon between 0.04 - 0.06 of total recruitment to Canada. These rates are similar to those estimated for 1996 for small salmon but slightly higher for large salmon.

Recreational fisheries: The recreational harvest of salmon in eastern Canada in 1997 totalled 40,673 small salmon and 6,746 large salmon. The exploitation rate on small salmon was between 0.10 - 0.18 and for large salmon between 0.04 and 0.06. These rates have decreased from 1996 for both small and large salmon.

Commercial fisheries: The commercial harvest of salmon in eastern Canada during 1997 totalled 13,938 small salmon and 13,491 large salmon. The exploitation rate on small salmon was between 0.04 - 0.06 and for large salmon was between 0.08 and 0.13. Both rates increased slightly from the 1996 levels.

USA

There was no exploitation of USA salmon in home waters and no salmon of USA origin were detected in Canadian catches in 1997.

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. Assessments are prepared for a limited number of specific rivers, mostly on the basis of the size of the Atlantic salmon resource within the river, the demands by user groups, and 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 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 108 rivers were assessed in eastern Canada in 1997. Estimates of total returns of small and large salmon were obtained using various techniques: 48 were derived from counts at fishways and counting fences; 7 were obtained using mark and recapture experiments; 39 using visual counts by snorkelling or from shore; 1 from an acoustic system; and 13 from angling catches or catch rate indices.

Of the 108 stocks for which returns of salmon were determined in 1997, comparable data were available for 81 of these in 1996. 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 1997 were less than 50 % of the 1996 returns in 19 of the 81 rivers assessed (23 %), between 50 % and 90 % of 1996 returns in 49 % of the rivers and were 90 % or greater than 1996 returns in 28 % of the rivers.

Large salmon returns in 1997 decreased from 1996 in rivers throughout the Maritime provinces and Québec but were similar or improved in Newfoundland (Figure 4.2.1.1). In most of the rivers of Newfoundland, except for rivers of the southwest coast (SFA 13), large salmon are mostly repeat spawning 1SW fish. Small salmon returns in 1997 relative to 1996 were lower throughout eastern Canada (Figure 4.2.1.1). In 30 % of the rivers, the returns of small salmon in 1997 were less than 50 % of the 1996 returns. Returns were similar to or improved in only 26 % of the assessed rivers. The southwest coast of Newfoundland rivers (SFA 13) showed the most consistent improvement in returns.

Annual returns of salmon by size group are available for 24 rivers in eastern Canada since 1985. These returns do not account for commercial fisheries removals in Newfoundland, Labrador 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 (1992–97) for all areas except Newfoundland are lower than returns in 1986–88 when there were commercial fisheries in Newfoundland, Labrador and Greenland harvesting mainland Canada origin salmon. The total returns to six insular Newfoundland rivers doubled during 1993–96 from the low levels observed during 1989–91 (Figure 4.2.1.2). The returns in 1997 were collectively as low as the 1992 returns and just above the returns in the 1980s.

Returns of small salmon to seven Gulf rivers (NB, NS) have fluctuated annually but declined between 1994 and 1997 to the lowest levels since 1985. The returns in 1997 were the lowest of the time series. Returns of large salmon have not fluctuated as greatly as the small salmon returns and have levelled off at about 45,000 fish.

Returns to the rivers of the Atlantic coast of Nova Scotia and Bay of Fundy declined to new lows for both large salmon and small salmon. Returns to nine rivers of Québec in 1997 were the second lowest since 1985 with large salmon returns declining from the peak returns of 1988.

Trends in abundance of small salmon and large salmon within the geographic areas show a general synchronicity among the rivers. Returns of both small salmon and large salmon were the lowest observed since 1987 in most of the areas (Table 4.2.1.1). The returns in 1997 of small salmon were among the lowest in the last 11 years in all regions of eastern Canada. For the rivers of Newfoundland (there are no rivers from Labrador in the time series), large salmon returns were among the highest in the last 11 years (as indicated by the high rank of the abundance level for the majority of rivers in 1997 within the 1987 to 1997 time period). Large salmon returns in the Gulf of St. Lawrence and Québec were among the lowest.

Densities of juveniles have been monitored annually since 1971 in the Miramichi (SFA 16) and Restigouche (SFA 15) rivers. In these rivers, juvenile 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 4.2.1.3). Densities of parr remained high in 1997 in the Miramichi but fry densities declined. In the Restigouche River, both fry and parr densities increased from the previous year to 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) which have declined since 1984, as a result of reduced spawning escapement. Fry densities in the Stewiacke River in 1997, an index of spawning escapement in 1996, were improved from 1996 but remained well below values observed in the 1980s (Figure 4.2.1.3). For this river, parr densities declined to the lowest in the time series. Except for the rivers along the eastern and southern shores of Nova Scotia (SFA 20 and 21) which have been impacted by acid precipitation and rivers of the inner Bay of Fundy (SFA 22 and part of 23), the freshwater production of the monitored rivers in Atlantic Canada has increased or remained constant at high levels since 1985. Rivers along the south and eastern shores of Nova Scotia remain vulnerable to acid precipitation. Populations of Atlantic salmon in these areas are considered extinct in 14 rivers and remnant populations survive in 19 other rivers.

Although the returns of small salmon and large salmon in 1997 were low throughout eastern Canada, there is a greater concern for the trends in returns of small salmon and large salmon in the last decade. Analysis of the trends in returns to 37 rivers of eastern Canada revealed a clear geographic segregation in stock status. Returns act as an indicator of potential spawning stock, but do not reflect true population size, particularly prior to the commercial salmon fishery closure in 1992.

There was a strong declining trend in returns to eight rivers, mostly from the Bay of Fundy and Atlantic coast of Nova Scotia. These rivers are now at less than one-third of the average for the time series (1987–97) (Figure 4.2.1.4). A second group of 16 rivers was characterized by stable returns up to 1993 followed by a declining trend. These rivers were clustered around the southern Gulf and Gaspé region of Québec and the southeast coast of Newfoundland (Figure 4.2.1.4). The third major group of 13 rivers was described by an increasing trend since 1992. Rivers characterized by this pattern were mostly from insular Newfoundland and these benefited most from the closure of the Newfoundland commercial salmon fisheries in 1992 (Figure 4.2.1.4). These trends characterize returns to rivers, which are most closely associated to spawning escapement, and do not represent trends in total stock size. Where estimates of total stock size are available, the abundance has remained lower or was similar to the abundance levels during the 1980s.

Trends in large salmon returns over the same time series were characterized by three patterns:, two with a decreasing trend and one with an increasing trend. There was a strong decreasing trend in seven rivers, four of which were on the Atlantic coast of Nova Scotia. Large salmon abundance in these rivers since 1994 has leveled off at less than 50 % of the average for the 1987 to 1997 period (Figure 4.2.1.5). A slowly declining trend in returns to 17 rivers characterized the majority of rivers from Québec and the southern Gulf of St. Lawrence (Figure 4.2.1.5). The large salmon in these mainland rivers are comprised of maiden 2SW and 3SW salmon with varying proportions of repeat spawners of all age groups. In a large number of Newfoundland rivers, returns of large salmon have increased since the closure of the commercial salmon fisheries in 1992 (Figure 4.2.1.5). Increased returns have also been noted in some of the southern Gulf rivers which are primarily fall-run.

The analysis of the combined trends for small salmon and large salmon returns to rivers illustrates a clear geographic segregation (Figure 4.2.1.6). The Bay of Fundy and Atlantic coast of Nova Scotia are characterized by strong declines with returns since 1994 being considerably less than half the recent 10-year average. Rivers of Québec cover the entire range of slight declines through stable trend. The southern Gulf of St. Lawrence rivers ranged from slightly declining to some that are stable and others that are increasing. The majority of Newfoundland rivers have been characterized by increasing returns of both small and large salmon since the closure of the commercial salmon fisheries in 1992. The only exception was Conne River on the south coast of Newfoundland which exhibited a declining trend most similar to the southern Bay of Fundy and Atlantic coast of Nova Scotia group.

USA

Documented adult salmon returns to rivers in New England in 1997 amounted to 1,746 salmon (Figure 4.2.1.7), a 36 % decrease from 1996. Returns of 1SW salmon declined by 46 % (570 to 310), while MSW returns declined by 34 % (2,192 to 1,436) from the previous year. The documented adult returns are minimal estimates, since many rivers in Maine do not contain counting facilities and throughout New England not all counting facilities are 100 % effective at capturing adult salmon.

Most of the USA salmon returns were recorded in the rivers of Maine, with the Penobscot River accounting for about 77 % of the total. Returns to the Penobscot River (1,355 fish) were 34 % lower than the previous year and 21 % lower than the previous 5-year average. Total returns to the Penobscot River were 39 % lower than the previous 10-year average.

Adult salmon returns to all other Maine rivers with fish counting facilities were also significantly lower (42–97 %) than those observed in 1996.

About 11 % of the USA returns (199 salmon) were recorded in the Connecticut River, a 24 % decrease from the previous year. Returns to the Connecticut River in 1997 were 32 % and 20 % below the previous 5-year and 10-year averages, respectively.

Salmon returns to the Merrimack River numbered 71 fish. While this represented a 7 % decrease from the previous year, the 1997 salmon run was 9 % and 34 % below the previous 5-year and 10-year averages, respectively.

4.2.2 Estimates of total abundance by geographic area

For assessment purposes, the following regions were considered: Labrador (SFA 1, 2, & 14B), Newfoundland (SFA 3–14A), Québec (Q1-Q11), Gulf of St. Lawrence (SFA 15–18), Scotia-Fundy (SFA 19-23) and USA. Returns of 1SW and 2SW salmon to each region (Tables 4.2.2.1 and 4.2.2.2; Figures 4.2.2.1 and 4.2.2.2; and Appendix 5) were estimated by updating the methods and variables used by Rago *et al* (1993 b) 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 5). MSW returns were proportioned to 2SW returns on the basis of sea-age composition of one or more indicator stocks.

In the context used here "returns" means 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 catches of Newfoundland and Labrador origin salmon in homewater commercial fisheries have been added to Newfoundland and Labrador returns to show the total "recruits" produced by these regions. Similar procedures to estimate recruits produced by Québec, Gulf of St. Lawrence, Scotia Fundy and USA regions were not followed as it was not possible to annually estimate the region of origin of intercepted salmon in the Newfoundland-Labrador commercial fisheries.

Labrador

The basis for estimates of 2SW and 1SW salmon returns and spawners for Labrador (SFAs 1, 2 & 14B) 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. Commercial catch data were collected by DFO enforcement staff from fish plant landing slips and processed by DFO Statistics and Informatics 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.

Parameter values for proportion of salmon of Labrador origin came from the sampling program in the commercial fishery, 1974-91. All river-age-4 and older salmon in the commercial catches were assumed to be of Labrador origin. In 1997, commercial sampling resumed with samples being collected throughout the fishing season at Makkovik and Rigolet in SFA 1 and Cartwright and St. Lewis/Fox Harbour in SFA 2. In 1997, in SFA 1, the percentage of the commercial catch that was Labrador origin was for large salmon 68 % (95 % C.I. 64.3–72.5 %); whereas for small salmon it was 39 % (95 % C.I. 35.6 %–41.6 %). In 1997, in SFA 2, the percentage of the commercial catch that was Labrador origin was for large salmon 92 % (95 % C.I. 88.4–95.2 %); whereas for small salmon it was 80 % (95 % C.I. 74.8 %–85.0 %).

In 1997, the opening date remained at June 20 but the quota levels resulted in early closures in SFA 2 of 2A - July 12, 2B - July 15, and 2C - July 13 while SFA 1 closed on October 15 as the quota was not caught. The effect of these early closures was to reduce the catch to 47 % and 64 % of small salmon and large salmon potential catch, respectively, that would have occurred had the fishery remained open. These reduced catches resulted in lower estimated exploitation rates.

Modifications were made to the estimation procedure for returns to Labrador in 1997. Firstly, exploitation rates were calculated separately for SFA 1, 2 and 14B using the active effort (licenses actually fished) individually for each SFA. For SFA 1, the active number of licences declined from 141 in 1991 to 39 in 1997. For SFA 2, the active number of licences declined from 320 in 1991 to 99 in 1997. For SFA 14B, active licences declined from 52 in 1991 to 0 in 1997 when the fishery was closed. Exploitation rates are: SFA 1 – small was 0.07 to 0.14 and - large was 0.22 to 0.40; and SFA 2 – small was 0.04 to 0.07 and - large was 0.16 to 0.28. As the commercial fishery in SFA 14B was closed in 1997, the estimated numbers of small and large salmon returns and spawners were based on the results of assessments on Forteau Brook and Pinware River which were expanded to the total watersheds in SFA 14B. Returns to SFA 14B were 663 to 1545 small salmon and 146 to 327 large salmon.

The mid-point of the 1SW salmon returns to Labrador rivers in 1997 was about 111,400, which is the fourth highest in the time series, 1971–97 and about 10 % higher than that of 1996 (Figure 4.2.2.1, Appendix 5i). The abundance (recruits) of 1SW salmon 1971-88, has been quite variable with low numbers returning in 1973, 1978, and 1984. The mid-point of the estimated number of recruits declined from about 150,000 1SW salmon in 1987 to about 45,000 in 1991 and remained between 40,000 and 51,000 from 1992 to 1995.

The mid-point of the 2SW returns to Labrador rivers in 1997 is about 16,600, a 21 % decline from 1996 yet the third highest since 1981 (Figure 4.2.2.2, Appendix 5ii). There was a decline in recruits of 2SW salmon from 1980 to 1991, and recruits (mid-points) have remained between 9,000 and 28,000 fish from 1992 to 1997. The low returns and recruits of 1SW and 2SW salmon in 1991 may be underestimates of the population size since severe ice conditions in that year affected the commercial catch which is used to estimate population size.

Newfoundland

In 1997, there have been several minor changes to the data input for estimating the numbers of returns and spawners, although the general method remains the same as in other years. These changes only influence the 1997 returns and spawners and all other years remain the same.

The estimates of 1SW and 2SW returns and spawners for insular Newfoundland (SFAs 3–12 & 14A) 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 at Exploits, Campbellton, Middle Brook, Salmon Brook, Gander River, Terra Nova River, Northeast River (Placentia), Biscay Bay River, Grand Bank Brook, and Humber River. In 1997, for SFAs 3–12 and 14A, angling catch data was derived from the licence stub return system (O'Connell *et al.* 1998) while in previous years angling catch data was collected by DFO Fishery Officers and Guardian staff. Exploitation rates for small salmon at these counting facilities ranged from 0.1 to 0.2 with a mean of 0.15. In 1997, total returns to all rivers were derived using a range in exploitation of 0.1 – 0.2. Also, in 1997, for SFA 13, estimates of 1SW, large and 2SW returns and spawners were based on the results of spawner surveys in Crabbes, Fischells, Robinsons, Middle Barachois, and Flat Bay Brook plus the returns to a counting fence on Highlands River, combination of spawner surveys and counting fence in Harrys River, and mark-recapture estimates for Humber River. This includes about 80 % of the watershed in SFA 13. The results from the 8 rivers with estimates were then expanded to the entire watershed of SFA 13. Similar to previous years, returns and spawners were summed over all SFAs to provide estimates of returns and spawners for insular Newfoundland.

The mid-point of the estimated returns (115,267) of 1SW salmon to Newfoundland rivers in 1997 is 46 % lower than 1996 and 32 % lower than the average 1SW returns (170,300) for the period 1992–94 (Figure 4.2.2.1, Appendix 5iii). 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 115,000 in 1997.

The mid-point (4,900) of the estimated 2SW returns to Newfoundland rivers in 1997 is slightly (16 %) lower than in 1996 and about the same as 1995 (Figure 4.2.2.2, Appendix 5iii). The 2SW recruits in 1992-97 are the lowest observed in the time series (1969-97).

Québec

The procedure to estimate returns was revised by using individual river information for 117 rivers for each year between 1984 and 1997 (Fontaine and Caron, *In press*). Previously, a simplistic approach was taken where the total angling catch for the province was used to estimate returns by assuming that angling exploitation rates were between 25 and 50 % to establish minimum and maximum values. New estimates calculated back to 1984 indicate that average returns are 17 % and 6 % over the previous maxima for small and large salmon, respectively and 35 % and 14 % over the previous maxima spawner estimates for small and large salmon, respectively. Revised estimates were provided for the years

1971–83 using upper limits of the previous maximum estimates adjusted with correction factors based on 1984–96 calculations.

The mid-point (28,722) of the estimated returns of 1SW to Québec in 1997 is a 23 % decrease from the returns observed in 1996 and a 20 % decrease from the 1992–96 average (Figure 4.2.2.1).

The mid-point (36,970) of the estimated returns of 2SW salmon in Québec in 1997 is a 17 % decrease from the returns observed for 1996 and and a 20 % decrease from the average of the years 1992–96 (Figure 4.2.2.2). Within the 1971–97 time series, the 1997 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 (40,900) of the estimated returns in 1997 of 1SW salmon returning to the Gulf of St. Lawrence was a 45 % decrease from 1996 and is the third lowest in the time series 1971-97; the two lowest years were 1978 and 1983. The low value noted in 1997 continues a downward trend from the high value of about 188,000 in 1992 (Figure 4.2.2.1, Appendices 5 iv, va, vb, vi, viia,viib).

The mid-point (27,800) of the estimate of 2SW returns in 1997 is 12 % lower than the estimate for 1996 and 36 % lower than the value for 1995 (Figure 4.2.2.1, Appendices 5iv,va,vb,vi,viia,viib). Only four other years have been lower in the time series, 1971-97. The average return of 2SW salmon for 1992–97 is slightly (10 %) higher than the average for 1987–91 and may reflect the reductions in fishing mortality due to the closure of the Newfoundland commercial fishery.

Scotia-Fundy, SFAs 19-23

The mid-point (7,800) of the estimate of the 1SW returns in 1997 to the Scotia-Fundy Region is the lowest of the time series 1971-97, is 67 % lower than the 1996 estimate, and continues the general decrease since 1990 (Figure 4.2.2.1, Appendix 5viii).

The mid-point (4,900) of the 2SW returns in 1997 is 50 % lower than the returns in 1996 and the lowest value in the time series, 1971–97 (Figure 4.2.2.2, Appendix 5viii,ixa,ixb). A declining trend in returns has been observed from 1985 to 1997.

USA

Total salmon returns and spawners for USA rivers in 1997 were calculated as described in ICES 1996/Assess:11. Minor adjustments were made to the historical estimates of total 1SW and 2SW returns and spawners to USA rivers. Previous errors were corrected and minor additions to the historical database were made, resulting in less than a 1 % change for most years. Since the harvest of salmon is not permitted in Maine and many rivers do not contain fish counting facilities, run sizes for several small rivers in Maine continue to be underestimated. Since there is no retention of salmon in USA the number of spawners is considered to be the same as the number of returns.

The estimated 1SW returns and spawners to USA rivers in 1997 were 365 salmon. This was 44 % below the estimated returns in 1996, and 38 % and 50 % below the previous 5-year and 10-year averages, respectively (Table 4.2.2.1, Figure 4.2.2.1).

The estimated 2SW returns and spawners to USA rivers in 1997 was 1,611 salmon. This was 33 % below the 1996 estimate, and was 21 % and 43 % below the previous 5-year and 10-year averages, respectively.

North America (combined Canada and USA)

The mid-point estimate of the total number of 1SW salmon returning to North America in 1997 (304,400) is 33 % lower than the estimate for 1996. It is the fourth lowest observed in the 27-year time series, 1971–97 (Table 4.2.2.1) and the lowest since 1991. The estimates of returns are quite variable over the time series with no trends indicated.

The mid-point of the estimated 2SW returns (92,700) is 19 % lower than the total returns for 1996 and 23 % lower than the average (120,500) for the past 10 years. It is the second lowest in the time series, 1971–97 (Table 4.2.2.2). It has declined from a peak of about 226,000 in the late 1980s.

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 the fishery exploitation rates for West Greenland. The data required to estimate exploitation rates are also used 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 1997/Assess:10 (Table 4.2.3.1).

Non-maturing 1SW Salmon

The non-maturing component of 1SW fish, destined to be 2SW returns rather than older fish, 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 Canada [NC2(i+1)], and catches in year i from fisheries on non-maturing 1SW salmon in Canada [NC1(i)] and Greenland [NG1(i)]. 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. 4.2.3.1 $$NN1(i) = ((NR2(i+1) / S1 + NC2(i+1))/S2 + NC1(i) + NG1(i)$$

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.* (1993 a).

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. Thus, catches used in the run-reconstruction model for the West Greenland fishery (1993 and 1994) and Newfoundland fishery (1992–97) were set to zero in order to remain consistent with catches used in other years in both of these areas (see Section 4.1.1) There were no fisheries in these areas for the years indicated.

As the pre-fishery abundance estimates for potential 2SW salmon requires estimates of returns to rivers, the most recent year for which an estimate is available is 1996. The minimum and maximum values of the catches and returns for the 2SW cohort are summarised in Table 4.2.3.3. The 1996 abundance estimates ranged between 98,000 and 156,500 salmon. The mid-point of this range (127,300) is 19 % lower than the 1995 value (157,200) and is the lowest in the 26-year time series but only slightly lower than 1993 (Figure 4.2.3.1). The results suggest a continuation of the decline from 731,000 in 1978. The Working Group expressed concern about the continued decline in the pre-fishery abundance and its impact on spawner levels.

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.

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.* 1993 a; ICES 1993/Assess:10). Salmon catches in SFAs 8–14A are mainly maturing salmon (Idler *et al.* 1981).

The maturing component of 1SW fish destined to be grilse returns 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. 4.2.3.2. $MN1(i) = MR1(i) / S1 + MC1(i)$

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

Eq. 4.2.3.3 $MC1(i) = [(1\text{-}f\_imm)(H\_s(i)_{[1-7,14b]} + q*H\_l(i)_{[1-7,14b]})] + H\_s(i)_{[8\_14a]}$

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 fishery were set to zero for 1992–97 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 mid-point of the range of pre-fishery abundance estimates for 1997 (317,000) is 32 % lower than 1996 (465,000) and is the lowest of the time series. 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 1996 and Figure 4.2.3.2 shows these data combined to give the total 1SW recruits. The steady decline in recruits over the last 10 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. 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 almost 80 % in the last year. Environmental variation could have resulted in earlier maturation of the salmon or the historically higher exploitation rates on the non-maturing component could have reduced the recruitment of this component. 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

Egg depositions in 1997 exceeded or equalled the river specific conservation requirements in 26 of the 89 assessed rivers (29 %) and were less than 50 % of conservation in 30 other rivers (34 %) (Figure 4.2.4.1). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 14 of the 19 rivers assessed (74 %) had egg depositions which were less than 50 % of conservation requirements. In Newfoundland and Labrador, 50 % of the rivers assessed met or exceeded the conservation egg requirements. Conne River in Newfoundland (SFA 11) exceeded its conservation requirement but fell short of the management target for the river.

Nineteen rivers in Newfoundland and Québec are under colonization or rehabilitation programs, i.e. salmon have been given access to previously inaccessible habitat or are being assisted in the re-establishment of wild production (Figure 4.2.4.1; not including stocking for mitigation or supplementation). Two of these rivers met or exceeded the conservation requirements in 1997. Egg depositions in 74 % of these rivers were less than 50 % of requirements. Only 33 % of these rivers had improved egg depositions relative to 1996.

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 and the proportion of the conservation requirements achieved in 1997 were the lowest of record. For the Québec rivers, spawning escapements have declined continually from a peak median value in 1988 with a slight recovery in 1995. Escapements relative to conservation were among the lowest in the series with a few rivers showing improvements in 1997. The eight rivers of the southern Gulf have been the most consistent in equalling or exceeding the conservation requirements. However, the median escapements in the last four years were below conservation requirements and 1997 was the lowest value since 1984. 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 remained above the pre-1992 levels.

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, 1971–97 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: The mid-point of the estimated numbers of 2SW spawners (16,400) in Labrador in 1997 is 20 % and 41 % below the respective 1996 and 1995 estimates. The 1995 value (27,900) was the highest estimated spawning escapement during the period 1971-97. The 1997 value is slightly less than 50 % of the total 2SW spawner requirements for all rivers in Labrador (Figure 4.2.2.2). The 2SW spawning escapement declined during the period 1980 to record low levels in 1991. Subsequent to 1991 the spawning escapement appears to have increased each year to 1995, which is consistent with increasing restrictive management measures in the commercial fisheries.

The mid-point of the estimated spawning escapement of 1SW salmon (108,600) in 1997 is the third highest value in the time series, 1971–96 and is 10 % higher than the mid-point estimated in 1996. Spawning escapements of 1SW salmon have been quite variable over the time series but have generally increased since 1991, consistent with increasing restrictive management measures in the commercial fisheries (Figure 4.2.2.1).

Newfoundland: The mid-point of the estimated numbers of 2SW spawners (4,800) in Newfoundland in 1997 is 16 % lower than that estimated in 1996 and is 120 % of the total 2SW spawner requirements for all rivers. This year is the fourth time that the 2SW spawner requirement has been met or exceeded since 1984 (Figure 4.2.2.2).

The 1SW spawners in Newfoundland rivers in 1997 decreased by 44 % from 176,000 in 1996 to 97,800 in 1997. The 1992–96 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 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 (18,520) in Québec in 1997 is lower (17 %) than that estimated in 1996 and is about 30 % of the total 2SW spawner requirements for all rivers (Figure 4.2.2.2). The spawning escapement in 1997 is the third lowest estimated since the mid–1980s. Estimates of the numbers of spawners in Québec have consistently been about one-third to three-quarters of the spawner requirement over the time series (1971–97). Estimates however have increased for each year as a result of refined estimation procedures described in section 4.2.1.

The mid-point of the estimated 1SW spawners in 1997 (18,500) was a 21 % decrease from 1996 (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 (25,600) in Gulf of St. Lawrence in 1997 is 11 % lower than that estimated in 1996 and is about 84 % of the total 2SW spawner requirements for all rivers in this region (Figure 4.2.2.2). This is the second time in seven years that these rivers have not exceeded their 2SW spawner requirements.

The mid-point of the estimated spawning escapement of 1SW salmon (24,600) decreased by 47 % from 1996 and is the fourth lowest in the time series, 1971–97; 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, however, been higher since the mid-1980s than it was before this period.

Scotia-Fundy: The mid-point of the estimated numbers of 2SW spawners (4,600) in Scotia Fundy area in 1997 is a 51 % decrease from 1996 and is less than 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 parts of SFA 23) as these rivers do not contribute to distant water fisheries. Inner Fundy rivers are, however, in as poor, if not poorer status when spawning escapements are considered. The 2SW spawning escapement in the rest of the area has been generally declining since 1985.

The mid-point of the estimated 1SW spawners (6,800) in 1997 is a 66 % decrease from 1996 and is the second lowest in the time series, 1971-97, continuing a general downward trend since 1990 (Figure 4.2.2.1).

Canada: The mid-point of the estimated 2SW spawners in 1997 in Canada was 70,000 and is 45 % of the 154,653 total 2SW spawner requirement. This is a decrease from the 56 % attained in 1996.

The overall 2SW spawner requirement for Canada could have been met or exceeded in only 3 (1974, 1977, 1980) of the past 26 years (considering the mid-points of the estimates), by adjustments to the terminal fisheries alone. In the remaining years, spawning requirements could not have been met even if all in-river harvests had been eliminated.

USA

The estimated 1,611 2SW returns to USA rivers in 1997 represents about 5 % of the spawner requirements for all rivers. Estimated spawning escapements in the Penobscot, Connecticut and Merrimack rivers remained at very low levels (about 19 % for the Penobscot River spawning requirement, and about 2 % of requirements established for the Connecticut and Merrimack rivers).

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 1993 to 1997. 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 1990. 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 1997 2SW spawners to North America are known, the spawning stock contributing to the pre-fishery abundance up to 2001 is known for North America and up to 2002 for the stock areas in Canada (Figure 4.2.4.4, Table 4.2.4.4).

Spawning escapement to several stocks complexes has been well below the spawner requirement (Labrador, Québec, Scotia-Fundy, USA) and decreasing (Labrador, Québec and USA) since the late 1980s (Figure 4.2.4.4). The relative contributions of the stocks from different geographic areas to the total spawning escapement of 2SW salmon has varied over time (Figure 4.2.4.5). The reduced potential contribution of Labrador and Scotia-Fundy stocks and the increased importance of the spawning stock from the Gulf of St. Lawrence rivers to future recruitment is most evident. Thus abundance of non-maturing 1SW salmon would not be expected to increase dramatically in most areas of North America even if the sea survival improves. Only the Gulf and Newfoundland stock complexes have received spawning escapements which have been close to requirements, all other complexes are below requirement and some declined further in the recent year.

4.2.5 Survival indices

Canada

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.

The number of wild smolts leaving the rivers depends upon the number of eggs deposited adjusted by variable survival rates throughout the juvenile stages. The production among river systems is also not necessarily synchronised and it is not possible to calculate how many smolts in total leave the rivers of Atlantic Canada for any given year. In the Québec rivers where smolt production has been monitored, the 1996 smolt production was similar to the average production during 1990 to 1995 but the 1997 smolt production in the one monitored river was the lowest of record (Figure 4.2.5.1). In Newfoundland, smolt production increased from 1996 to record levels in all the rivers of Newfoundland with the exception of the southwest coast river (Highlands) where production was less than half the recent years' values. The production of smolts from Western Arm Brook (WAB) was the highest of record (1971 to 1997).

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 13 rivers in Atlantic Canada with smolt counts and corresponding adult counts are available; four are hatchery stocks and nine are wild populations. Geographically, populations for which data were available for the 1997 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 Quebec North Shore, and several populations from southern (SFAs 9 and 11), eastern and northern Newfoundland (SFA 4, 14).

In general, survival of hatchery stocks is lower and more variable than that of wild stocks (Figure 4.2.5.2 to 4.2.5.4). 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 with the exception of the Highlands River population in southwest Newfoundland (SFA 13). The survival of hatchery smolts to 1SW returns in the LaHave and Liscomb rivers was the lowest of record whereas the Saint John hatchery smolt return rate was the fourth lowest in the 23-year time series. The single hatchery stock from Québec (aux Rochers) had improved survival rates from the previous four years but remained below the 1990–91 return rates.

In 1997, survivals to 1SW salmon were 69 % and 39 % of the means for the Saint Jean and de la Trinité rivers in Quebec (Figure 4.2.5.3). The survivals of smolts to 2SW salmon were 91 % and 41 % of the mean. The survival rates declined from the previous year's rates.

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 (Figure 4.2.5.4). 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. Despite major changes to fisheries and corresponding reductions in marine exploitation, marine survival rates are still less than 10 % and sea survival of the salmon populations from eastern Canada has not increased in the manner expected.

USA

The survival of hatchery-reared smolts released in the Penobscot River in 1995 was about the same as that observed for the 1994 smolt class (Figure 4.2.5.5). Marine survival for hatchery smolts released into the Penobscot River has remained at about 0.24 % for the past three years.

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 1971–97. The estimate of pre-fishery abundance of 127,521 for 1996 of **non-maturing 1SW salmon** was the lowest on record, and 19 % below the previous year and 8 % below the previous low estimate for 1993. Conversely, for **maturing 1SW salmon** there was a 38 % increase over 1995 in the 1996 estimate (464,962) of pre-fishery abundance. An estimate of 316,949 fish in 1997 is 32 % less than that of 1996 and the lowest in the 27-year time series. The results suggest a continuing decline of North American salmon production. 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 80 % in the last four years.

The estimate of the total number of 1SW salmon returning to Labrador and Newfoundland rivers and coastal waters of other areas of North America in 1997 is 33 % lower than the estimate for 1996. It is the fourth lowest observed in the 27-year time series, 1971–1997 (Table 4.2.2.1). The estimates of returns are quite variable over the time series with a declining trend since the mid 1980s indicated.

The estimated 2SW returns are 19 % lower than the total returns for 1996 and the second lowest in the time series (Table 4.2.2.2). They have declined from a peak of about 226,000 in the late 1970s.

The rank of the estimated returns in 1997 in the 1971–97 time series for six regions in North America is shown below:

Region	Rank of 1997 returns in 1971–97 time series (1=highest)		Mid-point estimate of 2SW spawners as proportion of escapement requirement
	1SW	2SW	(%)
Labrador	4	11	47
Newfoundland	25	13	120
Québec	14	27	30
Gulf	25	23	84
Scotia-Fundy	27	23	19
USA	14	21	6

In most regions the returns of 2SW fish are near the lower end of the 27-year time series except Labrador and Newfoundland where they are about in the middle. Returns of 1SW salmon were at the lower end of the time series in Newfoundland, Gulf and Scotia-Fundy, about at the mid-point in Quebec and USA and near the highest in the series for Labrador.

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, and in the Gulf of St. Lawrence approached, in 1997. The overall 2SW spawning escapement requirement for Canada could have been met or exceeded in only 3 (1974, 1977 and 1980) of the past 27 years (considering the mid-points of the estimates) by reduction of in-river fisheries. In the remaining years, spawning requirements could not have been met even if all in-river harvests had been eliminated.

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 1993–97 was the lowest in the time series (Figure 4.2.3.2). During 1993 to 1996, 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.

Substantive increases in spawning escapements in recent years in northeast coast Newfoundland rivers, high smolt and juvenile production in many rivers, and improved sea survivals in recent years in conjunction with suitable ocean climate indices were all suggestive of improved adult salmon returns for 1997. 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 1996 would have favoured marine survival and subsequent adult salmon production. Returns to Gulf of St. Lawrence rivers and generally throughout Newfoundland were expected to equal or exceed the conservation requirements. Most rivers which recently have been below conservation requirements were expected to have returns again below conservation requirements in 1997. In particular, returns to the Bay of Fundy and Atlantic coast of Nova Scotia were expected to be low, relative to conservation requirements, in 1997.

Trends in abundance of small salmon and large salmon within the geographic areas show a general synchronicity among the rivers. Returns of both small salmon and large salmon were generally the lowest observed since 1987. The returns in 1997 of small salmon were among the lowest in the last 11 years in all regions of eastern Canada. For the rivers of Newfoundland, large salmon returns were among the highest in the last 11 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 absence of any clear factor(s) to explain the lower returns in 1997 make any predictions of river-specific abundance of small and large salmon in eastern Canada in 1998 very uncertain. 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, and the south coast of Newfoundland. Despite major changes in fisheries management, returns have continued to decline in these areas and many populations are currently threatened with extirpation.

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

4.3 Effects on US and Canadian Stocks and Fisheries of Quota Management and Closure after 1991 in Canadian Commercial Salmon Fisheries

There were no new analyses available to the Working Group in 1998 to evaluate the results of the reductions and closures in these commercial fisheries. Last year, the Working Group considered a detailed assessment of the impact of the Newfoundland-Labrador changes on Newfoundland stocks (ICES 1997/Assess:10). At that time, estimates were made of commercial exploitation rates on small salmon during premoratorium years (1984-91) which ranged from 29 % to 66 %, averaging 49 % for all areas combined. On large salmon they ranged from 64 % to 98 % and averaged 76 %.

4.4 Update of Age-Specific Stock Conservation Limits

In previous years, the word target was used to describe the spawning requirements for rivers in North America. Following the discussion in Section 2.7 of the 1997 Working Group report (ICES 1997/Assess:10), the spawning requirement is considered as a threshold reference point. In Canada, this threshold reference point has been synonymously defined as the conservation requirement. The conservation requirements for North America have been expressed in terms of the number of 2SW fish required for all production areas of North America. Stock-recruitment curves which form the basis of conservation requirements in North America can be found in Prévost and Chaput (In press), Chaput (In press) and ICES 1994/M:6.

The requirements for USA rivers were reviewed in 1995 (ICES 1995/Assess:14). A review of the spawner requirements for Canada was conducted in 1996 (ICES 1996/Assess:11) and since then, Canada has further refined these estimates (O'Connell *et al.* 1997). These changes have been incorporated into the 2SW spawner requirements (Table 4.4.1) There were no changes from the previous year for the island of Newfoundland or the province of Québec. Within Labrador, the total increased by 46 fish and in SFA 18 of the Gulf area there was a 46 fish decrease. Changes were more substantial in the Scotia-Fundy region where the 2SW spawner requirements increased by 3,357 fish; changes were increases of 8, 1,015, 1,025 and 1,520 in SFAs 19, 20, 21 and 23 respectively, and a decrease of 211 fish in SFA 22. Increases resulted from improved estimates of rearing habitat and biological characteristics of spawners, such as sex ratios and fecundity. SFA 22 requirements decreased to 0 as no SFA 22 salmon returns have been included in the calculations leading to estimates of pre-fishery abundance as most rivers in this area do not contribute to distant water fisheries.

The Working Group recommends that return estimates for the few rivers (Annapolis, Cornwallis and Gaspareau) in SFA 22 that do contribute to distant fisheries be developed and, when these are available, the SFA 22 spawning requirements for these rivers (476 fish) be included in the total. Spawner requirements for 2SW salmon for Canada now total 154,653 and for the USA, 29,199 for a combined total of 183,852. 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 and Assessment of Risk for the North American Commission Area

This is the second year that the Working Group has been asked to provide catch options for the North American Commission Area. Last year, the Working Group suggested that catch options for the North American Commission Area be considered commencing with the forecast for 1997 of pre-fishery abundance for 1SW non-maturing salmon. This would mean that, principally, the 1998 fisheries for 2SW salmon in North America would be considered. Only a small proportion of the cohort would be expected to be harvested as 1SW non-maturing salmon in 1997 in the Labrador commercial fishery, if exploitation and stock composition patterns continue as in recent years.

Catch histories for the years 1972–97 are provided in Tables 4.5.1 and 4.5.2 with fishing mortalities of the cohorts exposed to the Greenland fishery all expressed as 2SW salmon equivalents. Maturing 1SW salmon (grilse) are not considered. The Newfoundland-Labrador commercial fisheries have 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 has not been 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 1 month to express all harvests as 2SW equivalents in the year and time they would reach rivers of origin. 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 28,000 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.

The percentage of the cohort destined to be 2SW salmon which were taken in terminal fisheries during 1972–96 in Canada and the USA has ranged from as low as 19 % in 1973, 1976 and 1987 to values of 78 % and 76 % respectively in the 1996 and 1997 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 1972–97. 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 US, 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 66 %. 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 now possible to provide catch advice for the North American Commission area for two years. The first is a revised estimate for 1998 for 2SW maturing fish based on improved estimates of the 1997 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 1997. The second is an estimate for 1999 based on the pre-fishery abundance forecast for 1998 from Section 5.6. A consequence of these annual revisions is that the catch options for 2SW equivalents in North America may either increase or decrease compared to the options developed the year before.

Catch Advice for 1998 fisheries on 2SW Maturing Salmon

A revised estimate of the pre-fishery abundance for 1997 is provided in Table 5.6.1.1. This value of 93,326 is lower than the value forecast last year at this time of 196,858 (See Section 5.2 for more detailed derivation of the models used, etc.). A pre-fishery abundance of 93,326 in 1997 can be expressed as 2SW equivalents by considering natural mortality of 1 % per month for 10 months (a factor of 0.904837), resulting in 84,445 2SW salmon equivalents. There have already been harvests of this cohort as 1SW non-maturing salmon in 1997 for both the Labrador (1,544) and Greenland (14,641) fisheries (Tables 4.5.1 and 4.5.2) for a total of 16,185 2SW salmon equivalents already harvested. The text table below uses the probability density projections for the revised pre-fishery abundance estimate of 93,326 and subtracts the spawning reserve (205,230), converts it to 2SW salmon equivalents and then subtracts the 16,185 2SW equivalents already harvested (Tables 4.5.1 and 4.5.2). The calculation is as follows:

[[PFA_i - spawning reserve] x exp - (0.01 x 10 months)] - harvest in Greenland and Labrador in 1997 of 1SW non-maturing fish

where PFA_i = values from 25–90 %

spawning reserve = 205,230

harvests WG = 1SW non-maturing in 2SW equivalents

Catch Options for 1998 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	11,899	0
30	29,956	0
35	46,761	0
40	62,706	0
45	78,187	0
50	93,326	0
55	108,533	0
60	123,903	0
65	140,013	0
70	156,801	0
75	174,862	0
80	195,172	0
85	218,847	0
90	248,799	23,238
95	293,386	63,582

Catch Advice for 1999 fisheries on 2SW Maturing Salmon

The text table below, as an example, assumes a 40 % Greenland/ 60 % North America division of the surplus for harvest (after reserving the spawner requirement of 205,230) and expresses catch options as 2SW salmon equivalents for 1999 (by considering 10 months of mortality at 1 % per month, a factor of 0.904837). As is noted in Section 5.2, there is a wide variability in the forecast and caution is warranted in the use of the 50 % level. Precautionary approaches would utilise probabilities much lower than 50 %. The calculation is as follows:

[PFA_i - spawning reserve] x exp - (0.01 x 10 months) x 0.60] - harvest in Greenland and Labrador in 1998 of 1SW non-maturing fish

Catch Options for 1999 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	14,235	0
30	36,326	0
35	56,943	0
40	76,459	0
45	95,362	0
50	113,899	0
55	132,851	0
60	151,512	0
65	171,000	0
70	191,607	0
75	213,945	4,731
80	238,851	18,253
85	268,003	34,080
90	304,873	54,096
95	360,140	84,101

The above table provides catch options for 1999, currently about 15 months in the future, and can be refined for 1999 next year as further information becomes available on any harvests of the cohort as non-maturing fish in Greenland and Canada.

It should be clear from the above that the numbers provided for catch options refer to the composite North American fisheries. On individual rivers, where spawning requirements are being achieved, there are no biological reasons to restrict the harvest. Managers may however consider doing so for socio-economic reasons.

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

1. There is a need for improved habitat surveys for rivers in Labrador and Ungava so that spawner requirements can be developed based on habitat characteristics.

2. Review possible changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and total recruits prior to fisheries. As new information becomes available, refine estimates of spawning requirements in USA and Canada by incorporating new information such as on biological characteristics for individual stocks, habitat measurements and stock and recruitment analysis.

3. Annual estimates of wild smolt-to-adult salmon survival rates need to be obtained for rivers in Labrador, New Brunswick and Nova Scotia. As well, sea survival rates of hatchery and wild salmon should be examined to determine if changes in survival of hatchery releases can be used as an index of sea survival of wild salmon.

5 ATLANTIC SALMON IN THE WEST GREENLAND COMMISSION AREA

5.1 Description of Fishery at West Greenland

5.1.1 Catch and effort in 1997

At its annual meeting in 1997 the West Greenland Commission of NASCO agreed on a 'reserve quota' to Greenland of 6 % of the forecast PFA using the biological parameters provided by ICES in 1996. The quota was calculated to be 57 t, an amount which the Greenland authorities subsequently set as a TAC for 1997.

The fishery opened on August 18 and closed on September 23 when the quota was complete. The total nominal catches amounted to 58 t (Table 5.1.1.1), the majority of the catch being taken during the first three weeks.

The geographical distribution of the nominal catches by Greenland vessels is given in Table 5.1.1.2 for the years 1977–97. In recent years only minor catches have been taken in Div. 1A and 1B, while Div. 1C and 1E have been the most important areas. In 1997 also Div. 1F had relatively large catches.

According to the regulations in force, all landings, including salmon taken to local markets and purchased privately, are to be reported on a daily basis to the Greenland Fishery Licence Office. Compared to earlier years a large part of the private sales are now recorded, reducing considerably the amount of unreported catch. Information about landings taken to local markets is still only sparse. The total amount of unreported catch in 1997 is estimated to be less than 5 t.

No information on fishing effort in terms of e.g., number of set nets per day, is available from the fishery. However, to roughly quantify the fishing effort, the number of (actually used) licences, or persons landing salmon, per season may be used as an estimate. The total number of licences declined over the period 1987–95, and since then has been around 150 persons.

5.1.2 Origin of catches at West Greenland

The Working Group examined the 1997 composition and origin of Atlantic salmon caught at West Greenland based on discriminant analysis of scale characteristics from 128 samples from NAFO Div. 1C (August 29 to September 7) and 666 samples from Div. 1D (August 22 to August 26). A randomised sampling design was used to obtain samples from salmon landed by commercial vessels fishing in these areas. No samples were collected in NAFO Div. 1E and 1F.

Since 1969, discriminant analysis of scale characteristics from salmon caught in the commercial fishery has been used to determine the proportions of the two continental stock groups 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 one based on nuclear and mitochondrial DNA.

In 1996, the combined genotypic/phenotypic approach was again attempted using tissue and scales collected in Greenland. Out of the 200 samples of muscle tissue from salmon landed at the fish plant in Nuuk there were 19 (9.5%) samples with DNA of poor quality for which a continent of origin could not be determined. The DNA from the 181 samples of suitable quality was used to determine continent of origin using a series of 12 microsatellite markers. Previous analyses had shown that three of the 12 PCR amplified loci Ssa202, SSOSL311, and SSOSL438 were found to possess the highest degree of discrimination between North American and European salmon in 1300 samples collected in Europe and North America. Mitochondrial DNA was also used to ensure correct classifications in ambiguous tests using the microsatellites. Scales from these same samples were also classified using the same discriminant analysis technique as used to determine continent of origin in the 1996 fishery (ICES 1997/Assess:10).

The results of comparing the scale determined continent of origin versus DNA determined continent of origin for 1996 material indicated misclassification rates of 37% and error rates of ± 23.3% in the scale discriminations. This was deemed to be an unacceptable level of error and it was suggested that the scale discriminant analysis should be redone using the within year samples, i.e., 1996 DNA samples used to form a discriminant database. As a temporary measure, the proportion North American, was chosen as 55% (95% C.I. ± 12.0%), i.e., the mid-point (± range) between a value of 67% derived by the method of Pella and Robertson (1979) to correct for misclassifications and the 42% value determined from discriminant function of scale characters in 1996 (ICES 1997/Assess:10).

Classification of salmon caught at West Greenland in 1997 by the discriminant function indicated that 60 % (95% C.I. = 66%, 55%) were of North American origin (propNA). The proportions of North American fish in catches in Divisions 1C and 1D were 59.2 and 56.5%, respectively. Data for 1978 to 1996 (no data for 1993-94) are summarised in Table 5.1.2.1.

Applying the results of the above analysis to the reported catch indicated that 37.6 t (12,957 salmon) of North American origin and 23.0 t (8,281 salmon) of European origin were landed in West Greenland in 1997. This indicates that the numbers of North American salmon landed at West Greenland is reduced by 3800 (23 %) from 1996, while the numbers of European salmon caught is reduced by 6900 (56.7 %). The data for 1982 to 1997 (no data for 1993-94) are summarised in Table 5.1.2.2, Fig. 5.1.2.1.

During the 1997 sampling of commercial catches in Greenland, 658 salmon were examined for external and internal tags; none were found. Four tags of Canadian origin were captured at West Greenland in 1997 and returned to Canada. Two of the tagged fish were from a release in the Saint John River, 1996, and they were reported recaptured in Div 1C, August 1997, the other two were from kelts tagged at the West Coast of Newfoundland. Eight tags of Penobscot River, US origin were also reported from West Greenland in 1997. Three of these tags (reported from Div. 1F) were from releases in 1984, while five were from tag releases in 1996. All of these tags were reported from Div. 1C.

5.1.3 Biological characteristics of the catches

Biological characteristics (length, weight, and age) were recorded for 794 samples of commercial catches from NAFO Div. 1C and 1D in 1997. Characteristics of the North American and European components were derived on the basis of the discriminant analysis. The data for 1997 and previous years appear in Tables 5.1.3.1 to 5.1.3.3.

Mean lengths of both European and North American 1SW salmon in the 1996 and 1997 samples appear to have ended the downward trend observed since 1969. Values for 1997 were, however, similar to the means of the last 5 years. 2SW and older North American fish were considerable longer than their counterparts in previous years (Table 5.1.3.1). Weight data reflected the observations in length data (Table 5.1.3.1).

The proportion of the European origin salmon that were river-age-3 (37.8%) in 1997 (and in most of the 1990s), continued to be approximately twice the 1968–96 mean (Table 5.1.3.2). This appears to indicate a continued change in the stock composition in the area. Proportions of river-age-2 salmon of North American-origin salmon (18.7%) have declined appreciably from the 1968–96 mean of 36.5%; conversely, the proportion river-age-3 fish were above the long-term mean.

The sea-age composition of the samples collected from the West Greenland commercial fishery indicated a higher proportion of 1SW fish in 1997 (98.0%) in the North American component than in any previous year (Table 5.1.3.3). The proportion of 1SW salmon in the European component in 1997 was similar (99.7%) to the North American component and also the highest of the data series. Conversely, 2SW and older fish comprised the lowest proportion of the commercial catch data series.

The proportionate distribution by weight categories (1.1–3.3 kg, 3.3–5.6 kg, and >5.6 kg) of the landings at fish plants in West Greenland in 1997 was similar to that of 1996 and the period 1987-96, exclusive of 1991 and 1995 (Table 5.1.3.4). In 1991, 1995 and somewhat in 1989, the catch consisted of proportionately more smaller fish.

5.2 Status of the Stocks in the West Greenland Commission 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 one winter at sea. 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 North-East Atlantic Commission Area, a run-reconstruction model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon (Tables 3.6.1 to 3.6.8). The non-maturing component of pre-fishery abundance for the northern European stocks appears to have been declining since the 1980s, with the most marked change occurring around 1986-87 (Section 3.6). Southern European stocks appear to have been more volatile, with large fluctuations occurring in the first half of the time series. Over the past 12 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 11 rivers in the NEAC area. This includes new data from 6 rivers in the UK. Conservation limits have only been exceeded in 5 of the 11 rivers where data are available in 1997. There were no significant trends noted in the spawner attainment over the last ten years for all stocks combined, but a significant trend towards lower egg deposition was noted over the most recent 5-year period (Section 3.4).

In most parts of the NEAC area, marine survival was lower than the previous 5-year mean. However, analysis showed no significant trends in marine survival for the last 5- and 10-year periods. Marine survival rates for 6 hatchery stocks showed a significant downward trend in survival to homewaters for 1SW and 2SW salmon.

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 five years but no trend for the last 10 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 1971–96. The 1996 estimate of pre-fishery abundance of non-maturing 1SW salmon was the lowest on record; although only slightly lower than the 1993 estimate. Pre-fishery abundance in 1996 has declined by 19 % from the 1995 value (Section 4.2.2, 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 1996.

The estimate of the total number of 2SW salmon returning to Labrador and Newfoundland rivers and coastal waters of other areas of North America in 1997 is 19 % lower than the estimate for 1996 and lower than the average of the previous years (1971–96) by 34 %. It is the lowest observed in the past 10 years and second lowest in the 27 year time series, 1971–97 (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.

In most regions, the returns of 2SW fish are near the lower end of the 27-year time series. However, returns of 2SW salmon to Labrador in 1995 and 1996 were the best in the time series. Returns of 1SW salmon declined in most areas in 1997 relative to 1996; except in Labrador.

The majority of the USA returns were recorded in the rivers of Maine. The estimated 2SW returns and spawners to USA rivers in 1997 was 33 % below the 1996 estimate and was 21 % and 43 % 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 26 of the 89 rivers (29 %) that were assessed in Canada and were less than 50 % of requirements in 30 other rivers (34 %). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 14 of the 19 rivers assessed had egg depositions that were less than 50 % of 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. In addition, returns in 1997 of maturing 1SW salmon (grilse) to North American rivers were very low; the fourth lowest in the 27-year time series. This being the case, improvement in 2SW salmon returns and spawners is unlikely in 1998. Only insular Newfoundland achieved its spawning requirements for 2 SW salmon in 1997, where 2SW salmon comprise only a small proportion of salmon production. The next highest was the Gulf of St. Lawrence at 84 %, where 2SW salmon are a high proportion of production and very important in terms of their contribution to both North American and Greenland fisheries. The other areas ranged from 6 % in USA to 47 % in Labrador (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 'Reserve Quota' in Relation to the Goal of Exceeding Stock Conservation Limits

The 'Reserve Quota' was an arrangement that provided for a fishery at Greenland when the forecasted Pre-fishery Abundance (PFA) was between 0 and 300,000 North American 1SW non-maturing salmon (NA1SW). Below 100,000 PFA, only a subsistence fishery was allowed. Between 100,000 and 300,000 PFA, a quota was calculated based on an allocation to Greenland of 6 % of the PFA (at the 50 % probability level) which was translated into quota weight using the biological parameters forecasted by ICES for the 1996 PFA. These biological characteristics were:

- proportion North American origin 0.59224

- weight (kg) of 1SW North American origin salmon 2.42
- weight (kg) of 1SW European origin salmon 2.62
- age correction factor 1.133

Under this approach, quotas ranged from 29 to 86 t when the possible PFAs ranged from 100,000 to 300,000 fish.

PFA	Reserve Quota (tonnes)
<100,000	Subsistence fishery
100,000	29
110,000	32
120,000	35
130,000	37
140,000	40
150,000	43
160,000	46
170,000	49
180,000	52
190,000	55
200,000	58
210,000	61
220,000	63
230,000	66
240,000	69
250,000	72
260,000	75
270,000	78
280,000	81
290,000	84
300,000	86

At intermediate levels of PFA, the 'Reserve Quota' was interpolated.

The quota allocated to Greenland was agreed to be the higher of the 'Reserve Quota' or the 'calculated quota'. The 'calculated quota' was the quota calculated according to the 1993 NASCO agreement using the PFA forecast at the 50 % probability level. This agreement allocated 40 % of the available surplus (after subtracting the spawner reserve for North America from the PFA) to the Greenland fishery.

In 1997 (ICES 1997/Assess:10), the PFA forecast was 196,858 fish at the 50 % probability level. As this PFA was below the spawning reserve that year, the 'calculated quota' was 0 t. Using the 'Reserve Quota' arrangement, the quota was calculated to be 57 t.

The Working Group was asked to evaluate the impact of the 'Reserve Quota' at West Greenland in relation to the goal of exceeding the conservation limits.

The use of this 'Reserve Quota' arrangement when the calculated quota is 0 will result in an increased risk (greater than 50 %) of failing to achieve the conservation limit objectives. From Table 5.2.3.1 and Figure 5.2.4.5 of ICES 1997/Assess:10, the level of risk was 56 % for a 57 t quota if none of the surviving fish were subsequently harvested in North America.

The Working Group has previously cautioned against the use of probability levels greater than 50 % and has regularly advised that a precautionary approach would consider much lower levels of risk as more appropriate.

Biological characteristics change from year to year and the Working Group forecasts these values based on most recent sampling at West Greenland. In recent years, the predicted characteristics have been:

	Using biological characteristics forecasted for		
	1996	1997	1998
Proportion NA	0.59224	0.5568	0.5844
Weight of 1SW NA	2.42	2.647	2.623
Weight of 1SW European	2.62	2.75	2.74
Age correction factor	1.133	1.133	1.118
'Reserve Quota' based on 1997 PFA of 196,858 fish	57 t	65 t	60 t
'Reserve Quota' based on 1998 PFA of 113,899 fish	33 t	37 t	35 t

The 'Reserve Quota' for 1997 would have varied between 57 and 65 t dependent on the biological characteristic values used. The same 'Reserve Quota' arrangement applied to the 1998 PFA would produce the quota variations of 33 t to 37 t.

The Working Group noted that the 'Reserve Quota' arrangement would have come into effect based on the revised/updated forecast for 1997 (93,326 fish) tabled at this meeting. This would have resulted in a subsistence fishery at Greenland in 1997 and no fishery harvest on MSW salmon in North America in 1998 except:

> "in subsistence fisheries and in individual North American river fisheries for MSW salmon where the target (*conservation is the preferred WG term*) spawning escapement of MSW fish is exceeded in that river" (Article 23 of the 'Reserve Quota' agreement of NASCO).

5.4 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 3 SW or older salmon, if surviving to spawn. In 1997, 98.0 and 99.7 % of the sampled catch was 1SW salmon of North American and European origins respectively. For this reason, conservation limits defined previously for North American stocks have been limited to 2SW salmon 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 183,852 fish, with 154,653 and 29,199 required in Canadian and USA rivers, respectively.

A preliminary estimate of the spawner requirements for MSW salmon has been developed for European stocks. The approaches used are described in Section 3.7 Table 3.7.2.2 provides a range of estimates for the total European stock complex (722,000–894,000) and these values have been further partitioned into Northern and Southern components. From tagging information and biological sampling at Greenland, it is clear that this area is used primarily by Southern European stocks. The range of spawner requirements for these southern stocks is between 463,000 and 630,000. Spawner composition in rivers in the past ten years was used to establish the appropriate 1SW/MSW ratios for determination of requirements.

5.5 'Model' Used to Provide Catch Advice

5.5.1 Development of the procedure

In 1991, the Working Group developed and first applied a continental run-reconstruction model (ICES 1992/M:8). Its objective was to look backward in time, after the completion of a years fishery and the termination of the spawning runs of the survivors, and estimate the number of fish that had been present in Greenland (the pre-fishery abundance) prior to the fishery's start. This model was an extrapolation of run-reconstruction models that had previously been developed for specific rivers.

The first step involved in running the continental run reconstruction is the estimation of the number of 2SW salmon returning to North America. Regional assessments are generated for the Labrador, Newfoundland, Quebec, Gulf of St.

Lawrence, Scotia-Fundy, and USA. These regional assessments are estimated by various methods using data from individual rivers and management areas. These methods include salmon counts at fences or fish ladders, mark-recapture population estimates, extrapolations of angling and commercial statistics, angling exploitation rates, and measurements of juvenile salmon fresh water rearing habitats. These returns are coupled with catch evaluations, and projections of natural mortality, to generate the pre-fishery abundance estimates.

The continental run-reconstruction model's pre-fishery abundance estimate permitted evaluation of the impacts of the various fisheries upon the combined spawning stock for all of North America. The model was used to estimate exploitation rates at West Greenland for the period 1983–1990 (ICES 1991/Assess:12) and was improved in 1992 (ICES 1992/Assess:15) by incorporating information which permitted better estimates of stock abundances and their availability to the Greenland fisheries. However, the continental model could not predict future abundances, hence it could not provide catch advice in advance of the fisheries.

During the 1990s, drops in commercial catch rates, adult returns to index rivers, and the continental run reconstruction model output indicated continued declines in the numbers of fish destined to mature as MSW salmon, despite measures which had been taken to reduce fishing mortality. The need for forecasts of pre-fishery abundances in advance of a given year's fishery became increasingly important.

In 1993, a significant relation was identified between the pre-fishery abundance of fish destined to mature as MSW salmon, and winter sea surface temperatures (SSTs) (ICES 1993/Assess:10). Cold temperatures can impact directly and indirectly on the biology of salmon. They can limit food availability, by slowing the production of prey organisms. They reduce the salmon's metabolic rates, slowing growth, decreasing survival, and altering muscle efficiency and hence swimming capacity. Atlantic salmon prefer a 4-8°C temperature range (Saunders 1986). In addition recent investigations have explored the influence of winter conditions on maturation rates and the combined effects of survival and maturation on stock abundance (Friedland *et al.* In press).

It was anticipated that the temperature relationship could be used to predict stock abundance. A model was built relating the estimates that had been made of the pre-fishery abundances, to winter (March) sea surface temperatures in the putative ocean overwintering areas. In this "thermal habitat" model (ICES 1993/Assess:10), temperature data for each year came from satellite records, and from direct measurements by ships of opportunity. Catch rates from experimental fishing in areas of different temperatures were determined in the Northwest Atlantic. Higher catch rates were observed in warmer areas, and presumably indicated that more fish were present. It was then assumed that the abundances of salmon at a given temperature in the experimental fishing would be the same in all parts of the salmon's ocean distribution with the similar temperatures. The ocean area where salmon were thought to be was divided into smaller "squares". Within each square, the temperatures were assigned from the ship and satellite data, and the total areas encompassed by squares with similar temperatures were summed. These areas were then weighted such that the areas with the temperatures that were believed to "salmon rich" were correspondingly more important in the calculations. This model had a biological underpinning, and could predict pre-fishery abundances whenever March sea surface temperatures became available.

In 1995, the model was slightly altered and used thermal habitat available in the January to March period. This was due to a strong recommendation from ACFM that a longer winter period be employed, and because it provided a slightly better fit for the model (ICES 1995/Assess:14, p. 38).

In 1996, the Working Group noted that the thermal habitat model's predictions frequently exceeded the corresponding estimates of pre-fishery abundance generated by the run-reconstruction model (ICES 1996/Assess:11). That is, its projections were too high. Improvements in thermal conditions can only improve fish numbers if there are recruits for whom survival can be improved. There was no term in the model that factored in recruit trends. Because there was no direct estimate available for recruits (smolt production), a term incorporating the number of spawners ("lagged spawner component") that would have generated the corresponding smolts was added to the model as a surrogate. This significantly improved the correspondence between the predictions of the continental run model and the thermal habitat model. The thermal habitat component was also retained, but used only the February SST values which provided the best fit.

In 1997, the Working Group used the same procedure as in 1996 to provide catch advice. However, the input data to the run-reconstruction model, and the abundance estimates from each region in North America were updated and improved (Section 4.2.2).

5.5.2 Catch advice

Atlantic salmon are managed to ensure adequate numbers of spawners return to individual rivers. For Greenland fishery management purposes, a single spawning requirement for the North American Salmon complex (sum of the conservation requirements of North American areas that contribute fish to the Greenland area) is used. Salmon conservation requirements in North America are calculated based on numbers of grilse and MSW fish returning. By contrast, fishery quotas in Greenland are set in tonnes of fish. To standardise the units for setting the quota, a modelling exercise is required to convert the numbers of fish, to weights. Because growth rates change from year to year, this model has to be updated regularly with information of the sizes of the fish in the catches. The Greenland fishery also takes fish of both North American and European origin, and this too varies from year to year. This must also be estimated annually and incorporated in the model. Finally, European and North American fish may also grow at different rates, which requires further adjustments.

Using estimates that incorporate the degree of certainty of the pre-fishery abundance estimates, and information on the sizes of fish and the North American component in the fishery, the surplus available for harvest is simulated and a range of possible catch quotas projected. This exercise generates a matrix, which permits estimation of quotas assuming different percentages of the surplus are harvested at Greenland. Quotas are also projected as a function of the certainty of the pre-fishery abundance estimate. In this, a probability level of 50 indicates that at this quota level there will be a 50 % chance that the abundance is lower than that estimated. Similarly, a probability level of 25 indicates there will be a 25 % chance that abundance is lower than estimated.

5.5.3 Description of the procedure used to provide catch advice

In an attempt to outline the whole procedure used to provide catch advice at West Greenland and to provide references to the various steps in the procedure in the present Working Group report, a flow chart was prepared (Figure 5.5.3.1) that show the 5 main steps in the development of the catch advice. The various main steps (processes) typically include several estimation procedures. A short description of various steps followed in the overall procedure is given in Table 5.5.3.1. The methods used, input data and the output produced is given in the table. Associated sections, figures and tables in the present report are provided as a guide to find more detailed explanation of the various assumptions and methods employed.

5.5.4 Evaluation of the 'model'

In its reports, the Working Group has regularly listed the strengths and weaknesses of the various models used to make its predictions. These are updated as required by the addition of new information, or as changes to the structure of the models used in its procedure are effected. Steady improvements have been made in the thermal/lagged spawner model's predictions of pre-fishery abundances, by working to insure that data inputs are the best available, and by incorporating new, biologically relevant variables that are shown to be appropriate predictors. Further improvements could be realised by improving the quality of the inputs to the various models (e.g., estimates of the number of salmon returning to individual rivers or to regions, confirmatory sampling campaigns off Greenland to verify the predicted pre-fishery abundances, better sampling of fish caught at Greenland to determine biological parameters and continent of origin). However, the Working Group remains concerned about the following vulnerabilities in the procedure:

1) Catch data is a critical input to the run -reconstruction model. As fisheries have been reduced in recent years, a smaller proportion of the salmon stocks have been sampled, and less data are available. The reliability of the models is therefore reduced.

2) The models used assume a constant natural mortality for the salmon at sea. By contrast, it is quite likely that mortality is variable, possibly highly so. This will introduce uncertainty to the predictions.

3) We do not understand exactly how marine environment is linked to salmon production. Because of this, the present formulation of the model is likely to fail.

4) The resolution of the present model is too imprecise for the present management needs. Based on the risk analysis, we can assess the impacts of quotas upon North American spawning requirements to the order of hundreds of tons. Managers are presently considering quotas of the order of tens of tons.

A sensitivity analysis could provide useful insights. However, considerable time needs to be devoted to collecting and reviewing the necessary information. Following this, an extensive series of computer simulations would be required.

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 detriments 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 equivalent to the sum of 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.

The advice for any given year is 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. Commercial 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 is also harvested on their return as 2SW salmon in commercial fisheries in Labrador and Québec, 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 harvests a mix from the non-maturing component as well as maturing 1SW and MSW salmon. The commercial fishery in Québec harvests maturing 1SW and MSW salmon.

The Working Group has advocated models based on thermal habitat in the northwest Atlantic to forecast pre-fishery abundance in order to 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. The models of previous years included using the following predictor variables: 1993 - thermal habitat in March; 1994 - thermal habitat in March; 1995 - thermal habitat in January, February, and March, and 1996–97 - thermal habitat in February and lagged spawners from the Labrador, Newfoundland, Québec, and Scotia-Fundy regions of Canada.

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 in Labrador are derived from estimated 2SW catches in the fishery using a range of assumptions regarding exploitation rates and origin of the catch. The 1997 spawner and return estimates were adjusted to account for reductions in licensed fishing effort and season in Labrador in 1997 as well as the closure of the commercial fishery in SFA 14B. Also, the methods of calculation of returns and spawners in Québec were further refined revising the entire time series of data and hence the input values for model parameters have also changed (See Sections 4.2.2 and 4.2.4).

Update of thermal habitat

The Working Group has been using the relationship between marine habitat, 2SW spawners and pre-fishery abundance to forecast pre-fishery abundance (ICES 1993/Assess:10; 1994/Assess:16; 1995/Assess:14; 1996/Assess:11 and 1997/Assess:10). 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 1998 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 has increased considerably in 1998 over 1997 from 1594 to 1849; an increase of 16 %. The 1998 February value is the highest value in the last seventeen years and is a return to the high values experienced in the 1970s.

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

The 1996 model used by the Working Group was also used in 1997 to forecast pre-fishery abundance and was based on regression analysis to predict the pre-fishery abundance of non-maturing 1SW fish prior to the start of the Greenland fishery using thermal habitat for February (term H2) and lagged spawners (sum of lagged spawners from Labrador, Newfoundland, Scotia-Fundy and Quebec, term SLNQ) as predictor variables (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 (Scarnecchia 1989; Reddin and Shearer 1987; Friedland *et al.* 1993). Consequently, the model used in 1997 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 and then the 1998 pre-fishery abundance was forecasted.

The linear fit to the 1998 model of pre-fishery abundance versus February thermal habitat and lagged spawners (SNLQ) produced a significant relationship between observed and predicted values at less than the 5 % level ($F_{2,16} = 31.0$) (Table 5.6.2.1). The results show that with the 1996 data point and revision of the Québec time series of lagged spawners and returns there is an improvement in fit over that of last year (R^2=0.79 in 1998 versus 0.71 in 1997 and 0.68 in 1996). The Working Group observed that an improvement in the methods was reflected in an improvement in the model fit. The model parameters are all significant. Individually, the two predictor variables used 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 77 % of the total sum of squares by itself but with SLNQ spawners included the contribution of February habitat was only 13 % 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 1978–98 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=+0.836) can be seen in Figure 5.6.2.3A. The residual pattern for the model shows a positive relationship with observed values (r=+0.447) and there are low positive residuals at the end of the time series (Figure 5.6.2.3B). Also, the Working Group was encouraged by the low residual value shown in 1996, the last observed value in the time series. The residual pattern for the model shows no autocorrelation. The forecasted estimate by simulation of pre-fishery abundance for 1998 using the February thermal habitat and lagged spawner model is about 113,899 at the 50 % probability level (Table 5.6.1.1). Application of the 1998 forecast model to forecast the 1997 value results in a forecast of 93,326 which is considerably lower than the previously reported value of 196,858. It should be noted that deterministic and simulated forecast values will show slight differences due to the method of calculation.

The main difference between this year and last years model is that the influence of the spawning stock level in the predictive relationship for pre-fishery abundance has become more important than the habitat variable (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 value for 1998, as thermal habitat has increased considerably, the predicted pre-fishery abundance in 1998 is low due to the large decline in spawners producing them (Figure 5.6.1.1). As 2SW spawners contributing to returns will not improve until the year 2000 this is likely to be the case for next year as well.

Stochastic Analyses

Although the exact error bounds for the estimates of 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 6-step procedure as follows:

1. Annual values (1978–96) of pre-fishery abundance (NN1) were generated assuming a uniform distribution of the minimum to maximum values of input parameters NC1, NC2, and NR2.

2. The parameter values of the regression model of pre-fishery abundance on the February thermal habitat (H2) variable and the lagged spawners (SNLQ) variable were estimated from the data set generated in step 1.

3. A single pre-fishery forecast value for 1988 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.

4. Step 3 was repeated 1,000 times to generate a vector of forecast values from an individual regression fit.

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).

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 can be used to quantify the probability that the actual stock is above the relative probabilities of attaining spawning requirements for the stock under different allocation schemes. Managers may also 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).

5.6.3 Development of catch options for 1998

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 and is shown in Appendix 6. Previously, NASCO considered all salmon above the conservation requirement as being available for harvest.

Catch Advice for 1998

The fishery allocation for West Greenland is for 1SW fisheries in 1998, whereas the allocation for North America can be harvested in 1SW fisheries in 1998 and/or in 2SW fisheries in 1999. 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 years report, a spawning requirement of 180,495 fish was reported for all North American rivers (ICES 1996/Assess:11). In this years model this was updated as per the explanation in Section 4.4 to 183,852. Thus, 205,230 pre-fishery abundance fish must be reserved (183,852/exp(-.01*11)) to ensure achievement of the requirement after natural mortality.

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 1998 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]. Exponential smoothing model forecasts utilising data collected during the 1997 fishery and using interpolated values for 1993 and 1994, with approximate 50 % confidence limits, are summarised below.

Parameter	Forecast	Minus 1SE	Plus 1SE
PropNA	0.584	0.503	0.667
WT1SWNA	2.622	2.468	2.778
WT1SWE	2.740	2.557	2.923
ACF	1.118	1.018	1.218

The Working Group recommends that as these parameters have changed in the past, they should be updated with new data from sampling programs to ensure the greatest possible accuracy in the quota calculation.

Greenland quota levels for H2-SNLQ forecast of pre-fishery abundance were computed. The quota values based on this forecast between interquartile limits of the probability density function are presented in Table 5.6.3.1. For the point estimate level and the stochastic regression estimate using NN1, the quota options ranged from 0 to 45 t, depending on the proportion allocated to West Greenland (FNA) and was bounded by the 25 % to 75 % probability levels. For the FNA level used in recent management measures for the West Greenland Commission (at the 0.4 allocation rate), the quota is 0 t at the 50 % risk level.

The 50 % risk level is intended to produce spawning escapements in North America that will meet the requirement level for all rivers combined 50 % of the time. Even if this overall requirement is achieved, it is likely that some stocks will therefore fail to meet their individual requirement 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. In the latter case, adoption of a 50 % risk approach may result in some stocks failing to meet requirement levels over an extended period if the full TAC is harvested. This could result in the long-term decline in those stocks.

The Working Group concludes that it is evident from both the indicators of stock status that the North American stock complex is in tenuous condition. If the forecast is accurate then pre-fishery abundance in 1998 will be lower than any other pre-fishery abundance value previously estimated despite nearly complete closures of mixed and single stock fisheries, a continuing trend of below requirement spawning escapements for 2SW salmon, and the low marine survival rates for some monitored stocks. The increasing advantage associated with each additional spawner in under-seeded river systems make 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 level 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 tons but the uncertain assessment would provide for a catch of 800 tons (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 tons but for the imprecise assessment, no catch is advised. Under precautionary management principles (Section 2.7), 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 conservation requirement risk plot, and

2. the uncertainty of the pre-fishery abundance forecast,

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 1998 fishery in West Greenland.

Spawner requirement risk analysis

The derivation of the spawning requirement risk plot 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 female in each stock area was described in terms of a uniform distribution corresponding to values for each stock area. A total of 1000 simulations were run for each spawning escapement level. The sex ratio varied independently in each stock for each simulation. The risk plots 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 200,000 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 (183,852 2SW salmon, Table 4.4.1) because it includes the annual variation in proportion female.

Pre-fishery forecast abundance uncertainty

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 5.6.4.2).

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. The predicted stock characteristics for 1998 and their associated errors are presented in Section 5.6.3. In the risk analysis, the biological characteristics in 1998 were modelled assuming a normal distribution with a mean and standard error generated from the exponential smoothing function (Section 5.6.3). The only exception was for the age correction factor (ACF) for which the lower bound was trimmed to unity. The resultant distributions from 1000 iterations appropriately represented the initial input parameters with the exception of the ACF distribution (Figure 5.6.4.3). An alternative to the normal error distribution for the ACF parameter was not explored at this meeting.

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. An example of the distribution of harvest (numbers) of North American origin salmon for a quota of 100 t at West Greenland which incorporated the uncertainty in the biological characteristics is shown in the middle panel of Figure 5.6.4.2. The distribution of returns to North America after harvest at Greenland which incorporates the uncertainty in the pre-fishery abundance forecast and the uncertainty in harvest numbers is shown in the bottom panel of Figure 5.6.4.2.

Catch options and risk summary for 1998

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 risk 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 underescapement (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 1998 is expected to be low (Figure 5.6.4.2). There is a high risk (74 % probability) that the returns of 2SW salmon to North America in 1999 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 1998 and North America in 1999 (Figure 5.6.4.2). There is a high probability (45 % chance) that at least one of the six stocks will be severely underescaped (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 impact of the combined Greenland and North American fisheries must also be considered. The fisheries exploitation rates in North America in 1997 were estimated to be between 0.15 and 0.25 (Section 4.1.4). Assuming that fisheries management in North America in 1999 would be similar to that of 1997, then it would be expected that 15 % to 25 % of the 2SW returns to North America would be removed prior to spawning. The impact of such a fishing scenario in North America on the salmon returning to homewaters in 1999, in the absence of any fishery at Greenland in 1998, results in a high risk (83 %) of not meeting the conservation requirements in at least one of the six stock areas (Figure 5.6.4.4 lower panel). This assumes that salmon will return to each geographic area in proportion to the relative conservation requirements in each area and that the exploitation rates in each of the six stock areas are similar. Although this is not true (see Section 4.1.4, 4.2.2), it was the only scenario considered by the Working Group at this meeting.

The cumulative consequences of fisheries at Greenland (1998) and in North America (1999) on the potential spawning escapements to North American stock areas increases the risk of severe underescapement (50 % of conservation requirements) in North America. There is a 48 % risk of severe underescapement with no fisheries and the risk rises to greater than 50 % at a Greenland catch option of 50 t and exploitation rates between 0.15 and 0.25 in North America (Figure 5.6.4.4). Considering the uncertainty in the assessment of the abundance of North American salmon in West Greenland in 1998, precautionary approach principles in managing the both the Greenland and North American salmon fisheries are advised.

5.7 Changes to the 'Model' Used to Provide Catch Advice and Impacts of Changes on the Calculated Quota

5.7.1 Changes from the 1997 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 1997 assessment. The same independent variables used previously were found to provide an improved fit over last year's model; for instance. However, some of the input data streams were modified to reflect new information available to the Working Group. These included: modified conservation requirements for the North American non-maturing stock component (see Section 4.4); improved estimates of returns to the province of Québec (see Section 4.2.2); improvement of the catch reporting system in the Province of Newfoundland; corrections to the discriminant model used to estimate continent of origin in Greenland (see section 5.1.2); and, another year of data was added to all data series. Changes from ICES 1997/Assess:10 in the data used to estimate pre-fisheries abundance resulted in an approximately 5 % change in the pre-fishery abundance estimates for most years (Figure 5.7.1.1).

In addition to the changes discussed above, we also note that the 1997 quota of 57 tonnes would have been different if the 1997 assessment had been done with the revised input data from this year. Although not completely accurate, an assessment of what the forecast value would have been is 93,077 (Table 5.6.1.1). Because this number is less than the threshold that still allows a reserve quota it would provide no surplus for harvest in any fisheries. This new information is available to be taken into account for 1998 fisheries affected by the 1997 agreement.

5.7.2 Impact of changes on the calculated quota

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. Since the changes made in the database resulting in a fit that was approximately 5 % larger than in the 1997 assessment, we can conclude a concomitant increase in fish availability for the 1998 forecast are due to these changes. The change in spawning requirements for the North America stock complex was a slight increase from last year. These changes will tend to reduce the number of fish potentially available for harvest by the difference between the survival between the fisheries and homewaters (i.e., applying the correction for natural mortality).

5.8 Data Deficiencies and Research Needs in the West Greenland Commission Area

1. The mean weights, sea ages and proportion of fish originating from North America and Europe 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 1995-97, be continued and improved to 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 at West Greenland.

3. The catch options for the West Greenland fishery are based almost entirely upon data derived from North American stocks. 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.

6 RECOMMENDATIONS

6.1 Fisheries

1a. Northern European 1SW stocks: Although the confidence limits on the PFA estimates for maturing 1SW salmon from Northern Europe are large, the estimates are greater than the conservation limit options and appear to be relatively stable. The Working Group therefore considers that continuation of exploitation of these stocks at current levels is acceptable.

1b. Northern European MSW stocks: The PFA of non-maturing 1SW salmon from Northern Europe has been declining since the late 1980s and is now approaching the conservation limit estimates. The Working group therefore suggests that great caution should be exercised in the management of these stocks particularly in mixed river-stock fisheries.

1c. Southern European 1SW stocks: The PFA of maturing 1SW salmon from southern Europe appears to have been very close to the conservation limit estimates for about the past eight years. The declines in stocks in 1997 are therefore of great concern and the Working Group considers that extreme caution should be exercised in the management of these stocks, particularly in mixed river-stock fisheries.

1d. Southern European MSW stocks: The PFA of non-maturing 1SW salmon on southern Europe has been declining steadily for about 10 years and the Working Groups preliminary analysis suggests that it fell below the conservation limits in 1996. Simple projection of these data by eye suggests that the PFA is also likely to fall below the conservation limits in 1998. The Working Group considers that extreme caution should be exercised in the management of these stocks, particularly in mixed river-stock fisheries, and that reductions in levels of exploitation should be pursued.

2. The Working Group reiterates the advice given in 1997, that it is evident from both the indicators of stock status and the extremely low pre-fishery abundance forecasts for Greenland, that the North American stock complex is in tenuous condition. Stock abundance is low despite nearly complete closures of mixed and single stock fisheries. Two sea winter salmon are experiencing low marine survival rates and in many monitored stocks are below spawning requirements. The increasing advantage associated with each additional spawner in under-seeded river systems make a strong case for a conservative management strategy.

3. Although the analytical tools are not currently available to distinguish between native and wild salmon beyond the parental generation, the Working Group recommends that native salmon populations be given special management consideration.

6.2 Meetings

The Working Group recommends that it should meet in 1999 to address questions posed by ACFM, including those posed by NASCO to ICES. To provide catch advice for West Greenland, the Working Group relies upon sea-surface temperature data which are complete by April 6. Therefore the Working Group should convene on April 11.

6.3 Data Deficiencies and Research Requirements

1. More information is required on a river by river basis relating to catches, exploitation rates and habitat assessment and this should be referenced to the appropriate scale (e.g., tributary populations etc.).

2. Life history models are required for as many index rivers as possible.

3. Transportability of existing targets derived from known S/R relationships must be evaluated in comparison with other indices of abundance.

4. Further refinement on lagged spawner model is required particularly with regard to the examination of the input data from each country to explain differences between the model output and current estimates of abundance from other analyses.

5. Further research and development is required, particularly with regard to establishing stock size (counters) and relating productivity to suitable habitat area (catchment surveys, juvenile production studies and application of GIS and other techniques).

6. Specific information on required age class composition of the stocks should be established on a river by river basis (historical and current).

7. Estimates of marine mortality of salmon should be re-examined in the North East Atlantic, and causes for this mortality should be identified and quantified.

8. The Working Group strongly endorses the continuation of the post-smolt surveys in the North East Atlantic, and recommends this to be extended to presently uncovered areas.

9. Efforts should be made to provide estimates of by-catches of salmon in marine waters.

10. The Working Group recommends that the Working Group on Northern Pelagic and Blue Whiting Fisheries, the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, and the Herring Assessment Working Group are asked for:

    - Timing of pelagic fisheries in ICES areas I; IIa,b; IVa,b; Va; Vb1,2; VIa,b; VIIa,b.

    - Gear used.

    - Catch per ICES statistical rectangle per month in the relevant areas.

    - Information on by-catches of salmon in the pelagic catches.

11. The Working Group recommends a continuation of the research fishery at Faroes.

12. Alternative ways to group salmon stocks, or stock complexes should be examined to improve the catch advice for salmon in the North East Atlantic.

13. The quality of data used to set conservation limits in the North East Atlantic should be improved and provided for smaller stock complexes. Furthermore, a sensitivity analysis of the input parameters to the pre-fishery abundance model should be carried out.

14. More information is required on a river by river basis relating to catches, exploitation rates and habitat assessment and this should be referenced to the appropriate scale (e.g., tributary populations etc.). Specific information on required age class composition of the stocks should be established on a river by river basis (historical and current).

15. Life history models are required for as many index rivers as possible.

16. Transportability of existing targets derived from known S/R relationships must be evaluated in comparison with other indices of abundance.

17. Further refinement is required to the model to estimate PFA and Conservation Limit particularly with regard to the examination of the input data from each country to explain differences between the model output and current estimates of abundance from other analyses.

18. Further research and development is required, particularly with regard to establishing stock size (counters) and relating productivity to suitable habitat area (catchment surveys, juvenile production studies and application of GIS and other techniques).

19. The implications of combining required adult escapement levels over districts, regions and countries must be examined and the scale to which this is appropriate identified.

20. The implications of combining required adult escapement levels over districts, regions and countries must be examined and the scale to which this is appropriate identified.

21. There is a need for improved habitat surveys for rivers in Labrador and Ungava so that spawner requirements can be developed based on habitat characteristics.

22. Review possible changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and total recruits prior to fisheries. As new information becomes available, refine estimates of spawning requirements in USA and Canada by incorporating new information such as on biological characteristics for individual stocks, habitat measurements and stock and recruitment analysis.

23. Annual estimates of wild smolt-to-adult salmon survival rates need to be obtained for rivers in Labrador, New Brunswick and Nova Scotia. As well, sea survival rates of hatchery and wild salmon should be examined to determine if changes in survival of hatchery releases could be used as an index of sea survival of wild salmon.

24. The mean weights, sea ages and proportion of fish originating from North America and Europe 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 1995-97, be continued and improved to cover as much of the landings as possible.

25. Efforts should be made to improve the estimates of the annual catches of salmon taken for local consumption at West Greenland.

26. The catch options for the West Greenland fishery are based almost entirely upon data derived from North American stocks. 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.

Table 2.1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1997. (1997 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)	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	772	21	2.5	20	208	113	1019	0.8	289	9557	-	-
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	-	865	54	20	<0.5	1077	130	17	993	1348	364	10	-	25	286	132	1092	6.4	437	8654	-	-
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	65	1730	1598	608	27	2.5	54	430	109	1271	1.9	-	9261	315	-
1987	1784	-	576	49	27	<0.5	966	181	38	1239	1385	564	18	2	47	302	56	922	1.2	-	8157	2788	-
1988	1311	-	243	36	32	4	893	217	179	1874	1076	419	18	2	40	395	114	882	0.9	-	7736	3248	-
1989	1139	-	364	52	14	-	337	140	136	1079	905	359	7	2	29	296	142	895	1.7	-	5898	2277	-
1990	911	13	315	60	15	-	274	146	280	586	930	315	7	2	33	338	94	624	2.4	-	4945	1890	180-350
1991	711	3.3	95	70	13	4	472	130	375	404	876	215	11	1	38	200	55	462	0.8	-	4136	1682	25-100
1992	522	10	23	77	20	5	237	175	461	630	867	166	11	1.3	49	186	91	600	0.7	-	4132	1962	25-100
1993	373	9	21	70	16	-	-	160	496	541	923	140	8	1.8	56	263	83	547	0.6	-	3708	1644	25-100
1994	355	6	6	49	18	-	-	140	308	804	996	138	10	2.7	44	307	91	649	-	-	3924	1276	25-100
1995	260	-	5	48	9	2	83	150	289	790	839	129	9	0.4	37	295	83	588	-	-	3616	1060	n/a
1996	290	-	1	44	14	<0.5	92	122	236	685	787	131	7	1.5	33	180	77	427	-	-	3128	1123	n/a
1997	225	-	-	45	8	1	58	106	48	570	630	111	-	1.5	17	142	93	267	-	-	2323	827	n/a
Means																							
1992-1996	360	5	11	58	15	2	82	149	358	690	882	141	9	2	44	246	85	562	<0.5	-	3702	1413	-
1987-1996	766	-	165	56	18	2	335	156	280	863	958	258	11	2	41	276	89	660	1	-	4938	1895	-

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Since 1991, there has only been 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. These will be included in next year's report.
8. Weights prior to 1990 are estimated from 1994 mean weight. Weights from 1990 based on mean wt. from R. Asturias. Data for 1997 not yet available.
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.

Table 2.1.1.2 Nominal catch of SALMON in homewaters by country (in tonnes round fresh weight), 1960-1997. (1997 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 (E&W)	UK(N.I.) (3,6)	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	772	21	20	208	113	522	497	1019	0.8	8051
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	65	136	1594	1730	1042	556	1598	608	27	54	430	109	745	526	1271	1.9	7750
1987	951	833	1784	34	15	49	27	181	38	127	1112	1239	894	491	1385	564	18	47	302	56	503	419	922	1.2	6613
1988	633	677	1311	27	9	36	32	217	179	141	1733	1874	656	420	1076	419	18	40	395	114	501	381	882	0.9	6594
1989	590	549	1139	33	19	52	14	140	136	132	947	1079	469	436	905	359	7	29	296	142	464	431	895	1.7	5195
1990	486	425	911	41	19	60	15	146	280	-	-	586	545	385	930	315	7	33	338	94	423	201	624	2.4	4341
1991	370	341	711	53	17	70	13	130	375	-	-	404	535	342	876	215	11	38	200	55	177	285	462	0.8	3561
1992	323	199	522	49	28	77	20	175	461	-	-	630	566	301	867	166	11	49	186	91	362	238	600	0.7	3856
1993	214	159	373	53	17	70	16	160	496	-	-	541	611	312	923	140	8	56	263	83	320	227	547	0.6	3677
1994	216	139	355	38	11	49	18	140	308	-	-	804	581	415	996	138	10	44	307	91	400	248	649	-	3909
1995	153	107	260	37	11	48	9	150	289	-	-	790	590	249	839	129	9	37	295	83	364	224	588	-	3526
1996	154	136	290	23	21	44	14	122	236	-	-	685	571	215	787	131	7	33	180	77	267	160	427	-	3033
1997	126	99	225	29	16	45	8	106	48	-	-	570	389	241	630	111	-	17	142	93	164	104	267	-	2262
Means																									
1992-96	212	148	360	40	18	58	15	149		-	-	690	584	298	882	141	9	44	246	85	343	219	562	<0.5	3600
1987-96	409	357	766	39	17	56	18	156		-	-	863	602	357	958	258	11	41	276	89	378	281	660	1	4430

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).

Table 2.1.2.1 Reported catch of SALMON in numbers and weight in tonnes (round fresh weight). Catches reported for 1997 may be provisional or incomplete. 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	1,311
	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	81,534	136	-	-	-	-	-	-	-	-	31,590	154	-	-	113,124	290
	1997	57,143	99	-	-	-	-	-	-	-	-	26,530	126	-	-	83,673	225
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
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

Table 2.1.2.1 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	-	-	-	-	-	-	-	-	2061	8
Iceland	1991	30,011	-	11,935	-	-	-	-	-	-	-	-	-	-	-	41,946	130
	1992	38,955	-	15,416	-	-	-	-	-	-	-	-	-	-	-	54,371	175
(Wild fish only,	1993	37,611	-	11,611	-	-	-	-	-	-	-	-	-	-	-	49,222	160
ranched fish not	1994	25,480	62	14,408	78	-	-	-	-	-	-	-	-	-	-	39,888	140
included)	1995	34,046	93	13,380	57	-	-	-	-	-	-	-	-	-	-	47,426	150
	1996	28,039	69	9,971	53	-	-	-	-	-	-	-	-	-	-	38,010	122
	1997	23,945	62	8,872	44	-	-	-	-	-	-	-	-	-	-	32,817	106
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	194,785	586
	1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	135,600	404
	1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235,153	630
	1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200,120	541
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	286,266	804
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	288,225	790
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	248,901	685
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	209,214	570

Table 2.1.2.1 continued

Country	Year	1SW		2SW		3SW		4SW		5SW	
		No.	Wt	No.	Wt	No.	Wt	No.	Wt	No.	Wt
Norway	1981	221,566	467	-	-	-	-	-	-	-	-
	1982	163,120	363	-	-	-	-	-	-	-	-
	1983	278,061	593	-	-	-	-	-	-	-	-
	1984	294,365	628	-	-	-	-	-	-	-	-
	1985	299,037	638	-	-	-	-	-	-	-	-
	1986	264,849	556	-	-	-	-	-	-	-	-
	1987	235,703	491	-	-	-	-	-	-	-	-
	1988	217,617	420	-	-	-	-	-	-	-	-
	1989	220,170	436	-	-	-	-	-	-	-	-
	1990	192,500	385	-	-	-	-	-	-	-	-
	1991	171,041	342	-	-	-	-	-	-	-	-
	1992	151,291	301	-	-	-	-	-	-	-	-
	1993	153,407	312	62,403	284	35,147	327	-	-	-	-
	1994	-	415	-	319	-	262	-	-	-	-
	1995	134,341	249	71,552	341	27,104	249	-	-	-	-
	1996	110,085	215	69,389	322	27,627	249	-	-	-	-
	1997	124,387	241	52,842	238	16,448	151	-	-	-	-
Russia	1987	97,242	-	27,135	-	9,539	-	556	-	18	-
	1988	53,158	-	33,395	-	10,256	-	294	-	25	-
	1989	78,023	-	23,123	-	4,118	-	26	-	-	-
	1990	70,595	-	20,633	-	2,919	-	101	-	-	-
	1991	40,603	-	12,458	-	3,060	-	650	-	-	-
	1992	34,021	-	8,880	-	3,547	-	180	-	-	-
	1993	28,100	-	11,780	-	4,280	-	377	-	-	-
	1994	30,877	-	10,879	-	2,183	-	51	-	-	-
	1995	27,775	62	9,642	50	1,803	15	6	0	-	-
	1996	33,878	79	7,395	42	1,084	9	40	0.5	-	-
	1997	31,857	72	5,837	28	672	6	38	0.5	-	-
Sweden	1989	3,181	7	-	-	-	-	-	-	-	-
	1990	7,428	18	-	-	-	-	-	-	-	-
	1991	8,987	20	-	-	-	-	-	-	-	-
	1992	9,850	23	-	-	-	-	-	-	-	-
	1993	10,540	23	-	-	-	-	-	-	-	-
	1994	8,304	18	-	-	-	-	-	-	-	-
	1995	9,761	22	-	-	-	-	-	-	-	-
	1996	6,008	14								
	1997	2,566	6								

Country	Year	MSW[1]		PS		Total	
		No.	Wt	No.	Wt	No.	Wt
Norway	1981	213,943	1,189	-	-	435,509	1,656
	1982	174,229	985	-	-	337,349	1,348
	1983	171,361	957	-	-	449,442	1,550
	1984	176,716	995	-	-	471,081	1,623
	1985	162,403	923	-	-	461,440	1,561
	1986	191,524	1,042	-	-	456,373	1,598
	1987	153,554	894	-	-	389,257	1,385
	1988	120,367	656	-	-	337,984	1,076
	1989	80,880	469	-	-	301,050	905
	1990	91,437	545	-	-	286,466	930
	1991	92,214	535	-	-	263,255	876
	1992	92,717	566	-	-	244,008	867
	1993	-	-	-	-	251,957	923
	1994	-	-	-	-	-	996
	1995	-	-	-	-	232,977	839
	1996	-	-	-	-	207,101	787
	1997	-	-	-	-	193,677	630
Russia	1987	-	-	2,521	-	139,011	564
	1988	-	-	2,937	-	100,066	419
	1989	-	-	2,187	-	107,477	359
	1990	-	-	2,010	-	96,258	315
	1991	-	-	1,375	-	58,146	215
	1992	-	-	824	-	47,452	166
	1993	-	-	1,470	-	46,007	140
	1994	-	-	555	-	44,545	138
	1995	-	-	385	2	39,611	129
	1996	-	-	41	0.5	42,586	131
	1997	-	-	559	3	39,003	111
Sweden	1989	4,610	22	-	-	7,791	29
	1990	3,133	15	-	-	10,561	33
	1991	3,620	18	-	-	12,607	38
	1992	4,656	26	-	-	14,507	49
	1993	6,369	33	-	-	16,909	56
	1994	4,661	26	-	-	12,695	44
	1995	2,770	14	-	-	12,531	37
	1996	3,542	19			9,550	33
	1997	2,153	11			4,719	17

Table 2.1.2.1 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 (England & Wales)	1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95,531	361
	1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110,794	430
	1987	66,371	-	-	-	-	-	-	-	-	-	17,063	-	-	-	83,434	302
	1988	76,521	-	-	-	-	-	-	-	-	-	33,642	-	-	-	110,163	395
	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69,773	263
	1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88,121	307
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80,478	295
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46,696	180
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42,070	142
UK (Scotland)	1982	208,061	416	-	-	-	-	-	-	-	-	128,242	596	-	-	336,303	1,092
	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	42,405	104	-	-	-	-	-	-	-	-	36,140	164	-	-	78,545	267
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	-
	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
	1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0

Table 2.1.2.1 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	1982	315,532	-	17,810	-	-	-	-	-	-	-	-	-	2,688	-	336,030	1,077
Greenland	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

[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), 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, misclassificationmay be very high in some years. In Norway, catches shown as 3SW refer to salmon of 3SW or greater.

Table 2.1.3.1 Numbers of fish caught and released in rod fisheries along with the % of the total rod catch (released + retained) for various countries in the North Atlantic.

Year	Canada (1)				Iceland		Russia		UK(E&W) (2)		UK(Scot) (2)				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	5,535	30					507	77
1994	24,074	21,730	45,804	39			12,056	83	3,227	13	1,535	5,067	6,602	8	249	95
1995	18,601	12,610	31,211	36			11,904	84	3,187	20	3,292	8,846	12,138	14	370	100
1996	23,171	9,941	33,112	31	669	2	10,745	73	3,428	20	2,282	8,127	10,409	15	542	100
1997	27,787	22,049	49,836	51	1,558	5	14,823	87	3,120	23	2,395	7,037	9,432	18	333	100

1. Figures for 1992 to 1996 are minimal estimates as not all areas have reported catch and release. The 1997 figure is provisional.
2. Figures for 1997 are provisional.

Table 2.1.4.1 Guess-estimates of unreported catches in tonnes within national EEZs in the North-East Atlantic, North America and West Greenland Commissions of NASCO, 1986-1997.

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
Mean 1992-1996	1,268	132	-	1,413

Table 2.2.1.1 Production of farmed salmon in the North Atlantic area (in tonnes round fresh weight), 1980-1997.

Year	Norway	UK (Scot.)	Faroes	Canada	Ireland	USA	Iceland	UK (N.Ire.)	Russia	Total
1980	4,153	598	-	11	21	-	-	-	-	4,783
1981	8,422	1,133	-	21	35	-	-	-	-	9,611
1982	10,266	2,152	70	38	100	-	-	-	-	12,626
1983	17,000	2,536	110	69	257	-	-	-	-	19,972
1984	22,300	3,912	120	227	385	-	-	-	-	26,944
1985	28,655	6,921	470	359	700	-	91	-	-	37,196
1986	45,675	10,337	1,370	672	1,215	-	123	-	-	59,392
1987	47,417	12,721	3,530	1,334	2,232	365	490	-	-	68,089
1988	80,371	17,951	3,300	3,542	4,700	455	1,053	-	-	111,372
1989	124,000	28,553	8,000	5,865	5,063	905	1,480	-	-	173,866
1990	165,000	32,351	13,000	7,810	5,983	2,086	2,800	<100	5	229,035
1991	155,000	40,593	15,000	9,395	9,483	4,560	2,680	100	-	236,811
1992	140,000	36,101	17,000	10,380	9,231	5,850	2,100	200	-	220,862
1993	170,000	48,691	16,000	11,115	12,366	6,755	2,348	<100	-	267,275
1994	215,000	64,066	14,789	12,441	11,616	6,130	2,588	<100	-	326,630
1995	295,000	70,060	9,000	12,550	11,811	10,020	2,880	259	-	411,580
1996	305,000	83,121	18,600	17,715	14,025	10,010	2,772	338	-	451,581
1997	310,100	100,110	20,000	20,198	14,025	12,140	2,700	225	-	479,498
Mean 1992-1996	225,000	60,408	15,078	12,840	11,810	7,753	2,538	199	-	335,586

1997 data for Scotland, Canada, Ireland and USA are provisional.

Table 2.2.1.2 Production of farmed Atlantic salmon in areas other than the North Atlantic (in tonnes round fresh weight), 1985-1997.

Year	Chile	West Coast USA	West Coast Canada	Australia	Turkey	Other	Total
1985	0	0	0	0	0	0	0
1986	0	0	0	20	0	0	0
1987	3	0	0	50	0	0	53
1988	174	0	0	250	0	0	424
1989	1,864	1,100	1,000	400	0	700	5,064
1990	9,500	700	1,700	1,700	0	800	14,400
1991	14,991	2,000	3,500	2,700	0	1,400	24,591
1992	23,769	4,900	6,600	2,500	0	400	38,169
1993	29,248	4,200	12,000	4,500	1,000	400	51,348
1994	34,077	5,000	16,100	5,000	1,000	800	61,977
1995	41,093	5,000	16,000	6,000	1,000	0	69,093
1996	69,960	5,200	17,000	7,500	1,000	600	101,260
1997	87,700	6,000	18,000	9,000	1,000	900	122,600
Mean 1992-1996	39,629	4,860	13,540	5,100	800	440	64,369

Data for 1997 provisional
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, 1980-1997.

Year	Iceland commercial ranching	Ireland River[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	65	22.9	22		110
1987	38	6.4	7		51
1988	179	11.5	12	4	203
1989	136	16.3	17	3	169
1990	280	5.7	5	6	291
1991	375	3.6	4	5	383
1992	461	9.4	11	10	481
1993	496	9.7	8	11	514
1994	308	15.2	0.4	9.5	324
1995	289	16.8	1.2	2	307
1996	236	18.5	3	8	258
1997	48	4.1	2.8	2	55
Mean 1992-96	358	14	5	8	377

[1] Total yield in homewater fisheries and rivers. 1997 figure for Ireland is provisional.

Table 2.3.3.1 Survival of Atlantic salmon after exhaustive exercise or angling under various conditions.

Study/Conditions	N-number	% Survival	Comments
Late Fall @ 6 C	20 MSW salmon	100%	Wild salmon experimentally angled to exhaustion in their natural environment. Recovery (24h) in holding boxes in the river.
Mid-Summer @ 22 C	10 grilse	60%	Wild grilse experimentally angled to exhaustion in their natural environment. Recovery (24h) in holding boxes in the river.
Temperature @ 12 C	10 grilse	100%	Hatchery-reared grilse exercised to exhaustion and recovered in a holding tank for 3 days.
18 C	10 grilse	100%	
23 C	10 grilse	70%	
Mid-to-late summer - fish below subjected to surgery prior to experiments.			
8 C	6 grilse	100%	Hatchery-reared fish exercised to exhaustion.
16.5 C	5 grilse	100%	Wild fish exercised to exhaustion
20 C	5 grilse	20%	Wild fish exercised to exhaustion.
Different migratory stages			
Kelts @ 4 C	12 grilse	100%	Wild grilse experimentally angled to exhaustion. Recovery (4-12h) in holding boxes.
Bright fish @ 16 C	12 grilse	75%	
Water Chemistry @ 15 C			
hard neutral pH water[1]	16 grilse	100%	Hatchery-reared grilse. Some grilse (roughly half) in each group underwent surgery 24h prior to experiments. All groups exercised to exhaustion and recovery (24h) in holding tank.
soft neutral pH water[2]	25 grilse	68%	
soft acidic water[3]	34 grilse	68%	
Air exposure @ 15 C	14 grilse	100%	Wild grilse. Exercised to exhaustion and then air exposed for 1 min. Recovered in holding tanks for 24 hours.
Normal Angling			
Upsalquitch R. @ 20 C	25 grilse	92%	All groups are wild fish, angled normally by the general public with recovery (24 hr.) in fenced pool in river
LaHave R.[4]	9 grilse	89%	Recovery (24h) in holding tank/boxes/cage
Ponoy R.	62 various sea-age	98%	Ponoy River wild fish are 8 large salmon kelts, 6 grilse kelts, 17 spring grilse, 15 autumn run MSW salmon, 15 autumn run grilse, and 1 uncategorized kelt.

N-number refers to the number of Atlantic salmon used in each survival experiment. [1] $CaCO_3$ = 90-100 mg L^{-1}, pH = 6.7-7.2. [2] $CaCO_3$ = 30-50 mg L^{-1}, pH = 7.1-7.5. [3] $CaCO_3$= 30-50 mg L^{-1}, pH = 5.3-5.9. [4] Angling at various temperatures.

Table 2.6.1.1 Number of microtags, external tags, marks and finclips applied to Atlantic salmon by countries for 1997.
('Hatchery' and 'wild' refer to smolts or parr; adults are 'wild' and/or 'hatchery')

Country	Origin	Primary Marking Method				Auxillary Marks Applied
		Microtags	External Tags	Adipose Clip Only	Other Visible Clips/Marks	
Belgium	Hatchery	15672				3000
	Wild					
	Adult					
	Total	15672				3000
Canada	Hatchery		12448	556830		4450
	Wild					
	Adult		8439			
	Total		20887	556830		4450
Denmark	Hatchery	18167				18167
	Wild					
	Adult					
	Total	18167				18167
Finland	Hatchery					
	Wild					
	Adult					
	Total					
France	Hatchery	9000		307025	181800	5000
	Wild			500	350	350
	Adult					
	Total	9000		307525	182150	5350
Iceland	Hatchery	153218				153218
	Wild	6684				6684
	Adult		1417			
	Total	159902	1417			159902
Ireland	Hatchery	356324			100000	356324
	Wild	5302				5302
	Adult					
	Total	361626			100000	361626
Norway	Hatchery		100692			9100
	Wild		3313			
	Adult		400			400
	Total		104405			9500
Russia	Hatchery		3500	474400		
	Wild		900	1240		
	Adult		2038			
	Total		6438	475640		
Spain	Hatchery	26100		114600	19800	45900
	Wild					
	Adult					
	Total	26100		114600	19800	45900
Sweden	Hatchery		4436		1690	
	Wild		280			
	Adult					
	Total		4716		1690	
UK (England & Wales)	Hatchery	174006		219927		174006
	Wild	5285				5285
	Adult		1753			
	Total	179291	1753	219927		179291
UK (Northern Ireland)	Hatchery	9615		230		9615
	Wild	2428				2428
	Adult			261		
	Total	12043		491		12043
UK (Scotland)	Hatchery	5157		32600	2638	7795
	Wild	28772	4473			33245
	Adult		69			
	Total	33929	4542	32600	2638	41040
USA	Hatchery			18286	26982	29
	Wild				1474	100
	Adult		3288		147	
	Total		3288	18286	28603	129
TOTALS	Hatchery	767259	121076	1723898	332910	786604
	Wild	48471	8966	1740	1824	53394
	Adult	0	17404	261	147	400
	Total by Type	815730	147446	1725899	334881	840398
tal Salmon Marked =		3023956				

Table 2.6.2.1 Eggs taken and Juvenile Atlantic salmon and eggs stocked in 1997 (excluding private commercial sea ranching). Blank fields indicate data not available.

Country	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														
Canada	6996000	870000	550000	1420000	1572000	1535000	3107000	1578600	343300	25500	1947400	1061000	183900	1244900
Denmark														106400
France		0	53000	53000	420000	0	420000	2437000	48000	0	2485000	164000	0	164000
Finland		0	0	0	0	0	0	0	0	0	0	0	0	0
Iceland														
Ireland		0	0	0	3588000	644000	4232000	331600	0	0	331600	500400	100	500500
Norway														
Russia		0	0	0	0	0	0	50800	20000	209000	279800	0	594600	594600
Spain														
Sweden		0	0	0	0	0	0	0	0	0	0	563000	72700	635700
UK (England and Wales)		0	0	0	0	236000	236000	1123000	169000	0	1292000			168000
UK (Northern Ireland)														
UK Scotland)		296000	263000	559000	3854000	1781000	5635000	0	59000	0	59000	0	24000	24000
USA	3288000	0	0	0	10583000	3283000	13866000	510600	30200	0	540800	666500	5400	671900
Grand Totals	10284000	1166000	866000	2032000	20017000	7479000	27496000	6031600	669500	234500	6935600	2954900	880700	4110000

* Estimated number (nearest 1,000) of eggs spawned by artificial methods from 1997 sea-run adults in autumn/winter period of 1997-1998.

Table 3.1.1 Nominal landings of Atlantic salmon by Faroes vessels in years 1982–1994 and the 1981/1982 to 1997/1998 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	3	380	1997/1998	3

a Quotas set by NASCO from 1987
b Three year quota of 1790 t
c Two year quota of 1100 t

Table 3.2.1 Results of Monte Carlo simulation to estimate proportion (%) of wild Atlantic salmon tagged at Faroes returning to different countries. Confidence limits (95%) were applied based on 1000 simulations (@Risk). Recoveries were adjusted for homewater exploitation rates and tag reporting rates as provided by the North Atlantic Salmon Working Group members, 1997.

Country	No.	Tag reporting rate		Exploitation rate		Estimated	Simulation		
	recapt.	min	max	min	max	recapt.	'-5%	Mean(%)	'+95%
Norway	47	0.40	0.60	0.50	0.80	145	27.2	39.6	51.7
Scotland	13	0.80	1.00	0.10	0.30	67	8.8	19.2	32.5
Russia	5	0.60	0.80	0.10	0.15	69	7.6	18.3	30.5
Canada[1]	4	0.65	0.85	0.15	0.28	25	1.6	6.9	13.6
Ireland	9	0.60	0.80	0.50	0.75	21	2.5	5.7	9.4
Denmark	2	0.40	0.60	0.14	0.34	17	0	4.7	11.8
England	1	0.40	0.60	0.15	0.35	8	0.6	2.3	4.7
Sweden	4	0.55	0.75	0.55	0.90	8	0	2.3	7.1
Spain	1	0.60	0.80	0.55	0.85	2	0	0.6	1.8
Iceland	1	0.80	1.00	0.40	0.60	2	0	0.6	1.7
Total	87					363		100.2	

1. Canada provided updated exploitation rates at the 1998 Working Group Meeting.

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

Year	England & Wales				UK (Scotland)		UK (N. Ireland)			Norway			
	Gillnet licences	Sweepnet	Hand-held net	Fixed engine	Fixed engine[1]	Net and coble	Driftnet	Draftnet	Bagnets and boxes	Bagnet	Bendnet	Liftnet	Driftnet (No. nets)
1966	-	-	-	-	11,750	859	-	-	-	7,101	-	55	-
1967	-	-	-	-	12,697	833	-	-	-	7,106	2,827	48	11,498
1968	-	-	-	-	12,561	966	-	-	-	6,588	2,613	36	9,149
1969	-	-	-	-	12,306	847	139	311	17	6,012	2,756	32	8,956
1970	-	-	-	-	11,097	772	138	306	17	5,476	2,548	32	7,932
1971	-	-	-	-	10,105	800	142	305	18	4,608	2,421	26	8,976
1972	-	-	-	-	10,995	806	130	307	18	4,215	2,367	24	13,448
1973	-	-	-	-	9,646	882	130	303	20	4,047	2,996	32	18,616
1974	-	-	-	-	14,332	773	129	307	18	3,382	3,342	29	14,078
1975	-	-	-	-	13,520	764	127	314	20	3,150	3,549	25	15,968
1976	-	-	-	-	10,814	746	126	287	18	2,569	3,890	22	17,794
1977	-	-	-	-	14,502	971	126	293	19	2,680	4,047	26	30,201
1978	-	-	-	-	11,358	686	126	284	18	1,980	3,976	12	23,301
1979	-	-	-	-	12,862	742	126	274	20	1,835	5,001	17	23,989
1980	-	-	-	-	12,074	666	125	258	20	2,118	4,922	20	25,652
1981	-	-	-	-	11,750	652	123	239	19	2,060	5,546	19	24,081
1982	-	-	-	-	8,385	644	123	221	18	1,843	5,217	27	22,520
1983	232	209	333	74	10,605	664	120	207	17	1,735	5,428	21	21,813
1984	226	223	354	74	7,711	634	121	192	19	1,697	5,386	35	21,210
1985	223	230	375	69	5,775	529	122	168	19	1,726	5,848	34	20,329
1986	220	221	368	64	4,788	590	121	148	18	1,630	5,979	14	17,945
1987	213	206	352	68	6,243	574	120	119	18	1,422	6,060	13	17,234
1988	210	212	284	70	2,115	393	115	113	18	1,322	5,702	11	15,532
1989	201	199	282	75	1,837	353	117	108	19	1,888	4,100	16	0
1990	200	204	292	69	2,232	338	114	106	17	2,375	3,890	7	0
1991	199	187	264	66	1,836	295	118	102	18	2,343	3,628	8	0
1992	203	158	267	65	1,799	292	121	91	19	2,268	3,342	5	0
1993	187	151	259	55	1,847	264	120	73	18	2,869	2,783	≤2	0
1994	177	158	257	55	1,621	245	119	68	18	2,630	2,825	≤2	0
1995	163	156	249	47	1,444	223	122	68	16	2,542	2,715	≤2	0
1996	151	132	232	42	1,458	201	117	66	12	2,280	2,860	≤2	0
1997	139	131	231	35	1,046	147	116	63	12	2,002	1,075	≤2	0
Mean 1992-96	176.2	151	252.8	52.8	1633.8	245	119.8	73.2	16.6	2517.8	2905		
% change[2]	-21.1	-13.2	-8.6	-33.7	-36.0	-40.0	-3.2	-13.9	-27.7	-20.5	-63.0		
Mean 1987-96	190.4	176.3	273.8	61.2	2243.2	317.8	118.3	91.4	17.3	2193.9	3790.5		
% change[2]	-27.0	-25.7	-15.6	-42.8	-53.4	-53.7	-1.9	-31.1	-30.6	-8.7	-71.6		

[1] Number of gear units expressed as trap or crew months.
[2] (97/mean - 1) * 100

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

	Ireland [5]				Finland				France		
					The Teno River			R. Näätämö			
	Driftnets No.	Draftnets	Other nets	Rod	Recreational fishery		Commercial fishery	Recreational fishery	Rod and line licences	Com. nets in freshwater[3]	Licences in estuary[3,4]
Year					Fishing days	Fishermen	Fishermen	Fishermen			
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	192	15,697	19,690	7,002	693	484	4,145	55	82
1983	801	526	190	16,737	20,363	7,053	740	587	3,856	49	82
1984	819	515	194	14,878	21,149	7,665	737	677	3,911	42	82
1985	827	526	190	15,929	21,742	7,575	740	866	4,443	40	82
1986	768	507	183	17,977	21,482	7,404	702	691	5,919	58 [1]	86
1987	-	-	-	-	22,487	7,759	754	689	5,804 [1]	87 [2]	80
1988	836	-	-	11,539	21,708	7,755	741	538	4,413	101	76
1989	801	-	-	16,484	24,118	8,681	742	696	3,826	83	78
1990	756	525	189	15,395	19,596	7,677	728	614	2,977	71	76
1991	707	504	182	15,178	22,922	8,286	734	718	2,760	78	71
1992	691	535	183	20,263	26,748	9,058	749	875	2,160	57	71
1993	673	497	161	23,875	29,461	10,198	755	705	2,111	53	55
1994	732	519	176	24,488	26,517	8,985	751	671	1,680	17	59
1995	773	446	176	25,000	24,951	8,141	687	716	1,881	17	59
1996	773	446	176	25,000	17,625	5,743	672	814	1,806	21	69
1997	773	446	176	25,000	16,255	5,036	616	588	2,974	10	59
Mean 1992-96	728.4	488.6	174.4	23725.2	25060.4	8425	722.8	756.2	1927.6	33	62.6
% change [6]	6.1	-8.7	0.9	5.4	-35.1	-40.2	-14.8	-22.2	54.3	-69.7	-5.8
Mean 1987-96	749.1	496.0	177.6	19691.3	23613.3	8228.3	731.3	703.6	2941.8	58.5	69.4
% change [6]	3.2	-10.1	-0.9	27.0	-31.2	-38.8	-15.8	-16.4	1.1	-82.9	-15.0

[1] Common licence for salmon and seatrout.
[2] Introduction of quotas/fisherman, obligation to declare the 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] Since 1995 data for Ireland are provisional.
[6] (97/mean - 1) * 100

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Table 3.3.4.1 Nominal catch of SALMON in NEAC Area (in tonnes round fresh weight), 1960-1997. (1997 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	5544	40	289	5873	-	-
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	865	437	5773	-	-
1983	5873	678	466	7017	-	-
1984	4769	628	101	5498	-	-
1985	5533	566	-	6099	-	-
1986	6189	530	-	6719	-	-
1987	4828	576	-	5404	2554	-
1988	5282	243	-	5525	3087	-
1989	4054	364	-	4418	2103	-
1990	3441	315	-	3756	1779	180-350
1991	2852	95	-	2947	1555	25-100
1992	3343	23	-	3366	1825	25-100
1993	3312	21	-	3333	1471	25-100
1994	3560	6	-	3566	1157	25-100
1995	3266	5	-	3271	942	n/a
1996	2743	1	-	2744	947	n/a
1997	2037	-	-	2037	827	n/a
Means						
1992-1996	3245	11	-	3256	1268	-
1987-1996	3668	165	-	3833	1742	-

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 1974-97 and Naatamo 1988-97), France (1987-97) and on the River Bush (UK(N.Ireland))

	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	**3.5**	1.2	**0.9**							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	**2.5**	0.7	**0.9**	0.5		0.2		0.73	**1.0**	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	**3.3**	1.3	**1.1**	0.4	**0.7**	0.2	**0.2**	0.88	**1.1**	0.341	**0.3**
1994	2.4		0.8		0.6		0.2		1.12		0.205	
1995	2.7		0.9		0.5		0.1		1.15		0.206	
1996	3.0		1.0		0.7		0.2		1.57		0.267	
1997	3.4		1.0		1.1		0.2		0.43 [1]		0.338	

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

Table 3.3.5.2 CPUE data for net and fixed engine salmon fisheries by Region in UK (England & Wales), 1988-1997. (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
Mean 1992-96	5.87	5.00	0.82	0.62

[1] Fishery has not operated since 1993.

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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	141.60
1996	58.16	112.03
1997	30.97	68.15

1 - Excludes catch and effort for Solway Region

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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 taken as significance level)

Section/Data type	Test No.	Fisheries	Life stage	Period (years)	'p' value	Trend
Section 3.3.5						
CPUE	**1.**	Scottish net fisheries. Catch/trap month		25	<0.001	**Dn**
	2.	UK (England & Wales) Net and fixed engines catches		10	0.27	Nt
	3.	Rod catch/season, Finland (Teno, Näätämö) and France		10	0.09	**Up**
	4.	Rod catch/day Finland (Teno, Näätämö) and UK (N Ireland) (Bush)		10	0.30	Nt
Section 3.3.9						
Exploitation rates	**5.**	Burrishoole + Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Frome + Leven + Lune (UK (E&W))	1 SW	10	>0.1	Nt
	6.	Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe), Frome + Leven + Lune (UK (E&W))	1 SW	5	>0.1	Nt
	7.	Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe)	2 SW	10	>0.1	Nt
	8.	Burrishoole + Corrib (Irl), North Esk (UK Scot), Bush (UK NI), Imsa + Drammen (Nor), Ellidaar (Ice), Lagan (Swe)	2 SW	5	>0.1	Nt
	9.	Ponoy rods, Tuloma + Kola rods and nets (Russia)	All ages	10 5	0.01 0.03	**Dn** **Dn**

Table 3.3.6.1 The percent of 1SW salmon in catches from countries in the North East Atlantic Commission Area, 1987-1997.

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	64	54	75
1995	59	60	58	70	78	53	70
1996	80	51	53	80	63	54	63
1997	70	51	74	82	54	54	73
1992-96 mean	64	58	58	70	67	54	73
1987-96 mean	64	51	63	69	-	55	-

1. Refers to rod and line catch 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.

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[2]	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
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	-			-	-	-
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
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
Iceland[4]	1991	127			3	375	505
	1992	175			+	461	636
	1993	160			-	496	656
	1994	140			-	308	448
	1995	150			-	289	439
	1996	122			-	236	358
	1997	106			-	48	154
Ireland[5]	1991	400			1.7	2.3	404
	1992	621			2.3	6.7	630
	1993	532			1.1	8.1	541
	1994	789			2.6	12.5	804
	1995	774			0.7	14.8	790
	1996	667			1.8	15.9	685
	1997	566			1.1	3.0	570
Russia	1991	215			0	0	215
	1992	166			0	0	166
	1993	140			0	0	140
	1994	138			0	0	138
	1995	129			0	0	129
	1996	131			0	0	131
	1997	111			0	0	111

Table 3.3.7.1 cont.

Country	Catches of Salmon					
	Year/ Season	Wild	Farmed	Total Farmed	Ranched	Total
Sweden	1991	23		1	14[1]	38
	1992	24		1	24[1]	49
	1993	35		1	20[1]	56
	1994	15		1	29[1]	45
	1995	12		1	24[1]	37
	1996	10		1	22[1]	33
	1997	6		0	11[1]	17
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[2]	142		0	0	142
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[2]	90.7		0.07	2.2	93
UK (Scot)[3]	1991	448		14	0	462
	1992	569		31	0	600
	1993	515		31	0	546
	1994	644		5	0	694
	1995	586		2	0	588
	1996	427		1	0	425
	1997[2]	267		1	0	267

[1] Fish released for mitigation purposes and not expected to contribute to natural spawning.
[2] Provisional figures.
[3] Data from 1994 onwards is figure reported in national catch statistics; previous years' data calculated from sampling programmes.
[4] "+" indicates a small but unquantified catch.
[5] Smolts released for enhancement of stocks or rod fisheries are included in wild.

Table 3.3.7.2 Proportion of farmed Atlantic salmon (unweighted means) in marine fisheries in Norway 1989-1997. 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

* 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 1989–1997. (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	2071	23	34	2 - 82
1991	4563	31	5	0 - 23	1738	25	24	0 - 82
1992	4259	32	5	0 - 24	1489	22	26	0 - 71
1993	3979	27	4	0 - 22	1207	19	20	0 - 64
1994	3243	18	4	0 - 19	1699	19	22	0 - 75
1995*	3554	27	4	0 - 20	1057	19	28	0 - 71
1996*	3020	29	7	0 - 54	1443	23	31	0 - 82
1997	2500	27	9	0 - 34	1809	34	27	0 - 83

* In 1995 and 1996 the results are presented for the two periods separated at 31 August.

Table 3.3.7.4 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
Total run (excl. ranched)	2344	2570	3253	2064	1527	1099	1681
No. escapees	3	24	18	54	6	2	4
% in sample	0.13	0.93	0.55	2.62	0.39	0.18	0.24

Table 3.3.7.5 Frequency of occurrence of escaped farmed salmon among Scottish fisheries for wild salmon (1981–1997).

Year	Net											Rod
	%											%
	East Riggs	Redpoint	Achiltibuie	Culkein Clachtol	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]2.1				[a,b]0			[a,b]0

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

Table 3.3.7.6 Geographical distribution by frequency (%) of escaped farmed fish located among commercial catch samples for UK (Northern Ireland) and Ireland inshore catches (1991–1997). All escapees were identified from morphological characters.

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

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

Year	Ireland[1] Burrishoole net HR 1SW	Corrib net W 1SW	Corrib net W 2SW	UK (England and Wales) Dee rod W 1SW	Dee rod W MSW	Itchen rod W (all ages)	Test rod W (all ages)	Frome rod W (all ages)	Leven rod W (all ages)	Lune rod W (all ages)	Lune net W (all ages)	UK (Northern Ireland)[1] River Bush net W 1SW	net W/HR 2SW	net HR1+ 1SW	net HR2+ 1SW	UK (Scotland)[2] North Esk In-river netting W 1SW	W 2SW
1985	86	66	11	-	-	-	-	-	-	-	-	-	-	93	-	23	35
1986	86	52	34	-	-	-	-	-	-	-	-	-	-	82	75	40	29
1987	78	-	5	-	-	-	-	-	-	-	-	69	46	94	77	29	37
1988	75	29	-	-	-	33	39	9	-	-	-	65	36	72	57	35	37
1989	82	43	35	-	-	47	29	7	-	28	42	89	60	92	83	25	26
1990	52	31	45	-	-	47	36	10	-	43	34	61	38	63	70	36	34
1991	65	19	19	6	10	43	26	8	-	27	29	65	43	57	46	10	15
1992	71	24	28	14	18	29	25	9	-	42	28	56	33	74	75	28	27
1993	71	31	82	11	15	39	33	11	27	36	28	41	12	67	71	25	18
1994	73	50	0	15	21	39	32	13	28	35	33	-	40	71	64	19	18
1995	84	50	18	7	11	25	28	9	37	24	26	67	42	69	-	14	12
1996	81	52	75	9	11	36	23	13	45	22	23	-	-	81	77	19	10
1997[3]	68	38	-	8	9	14	14	7	26	25	27	60	-	79	75	12	12
Mean																	
1987-96	73	37	34	10	14	38	30	10	34	32	30	64	39	74	69	24	23
1992-96	76	41	41	11	15	34	28	11	34	32	28	55	32	72	72	21	17

[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.
[4] Probably underestimated.
HR = Hatchery reared.
W = Wild.
'-' = no data

Continued..........

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

Year	Iceland[1]	Norway[2]							Sweden[3]		Russia[1,6]		
	Ellidaar	Drammen			Imsa				Lagan		Ponoy	Kola	Tuloma
	rod	rod	net		net		net		net		rods	rods and nets	
	W	W/HR	HR[4]		W		HR[4]		HR[4]		W	W+HR	W
	1SW		1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW	all sea ages		
1985	40	33	57	-	73	94	81	100	81	-	47	90	47
1986	34	50	81	50	79	82	78	90	93	82	50	77	50
1987	54	44	64	52	56	95	83	95	78	55	48	91	49
1988	45	53	70	47	51	80	78	91	73	91	77	87	51
1989	41	35	40	59	65	74	44	65	76	86	78	84	50
1990	41	33	23	40	42	42	47	68	80	82	50	80	50
1991	37	28	54	59	37	72	50	66	91	92	20	58	48
1992	48	46	-	51	61	76	74	91	73	98	11	77	45
1993	41	45	20	-	53	80	85	89	89	82	10	79	39
1994	49	42	42	34	58	80	70	94	70	100	0[8]	73	42
1995	43	53	29	40	-	86	56	88	58	70	14[8]	77	49
1996[5]	56	47	7	23	66	-	80	89	80	78	10[8]	66	43
1997	50	45	14	18	61	80	74	-	65	64	19	43	16
Mean													
1987-96	46	43	39	45	54	76	67	84	77	83	42	77	47
1992-96	47	47	25	37	60	81	73	90	74	86	11	74	44

[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.
[8]Commercial fisheries on the Ponoy were closed in 1993 and catch-and-release rod fishing was introduced.
W = Wild
HR = Hatchery reared.
'-' = no data

Reporting rates for external tags:

Norway	0.50
Sweden	0.65
Elsewhere	0.50

Table 3.4.1.1 Conservation reference levels, estimated numbers of spawners and egg deposition and fraction of reference levels attained in rivers in the NEAC area

Year	Spawners 1SW	Spawners MSW	eggs (million)	Target attainment 1SW/target	Target attainment MSW/target	Target attainment eggs/target
FRANCE		**River Scorff**				
Egg deposition requirement:			**0.95**			
Observed:						
1994	587		1.61			1.69
1995	742	45	1.62			1.71
1996	501	81	1.38			1.45
1997	387	51	0.96			1.01
		River Nivelle				
Egg deposition requirement:			**0.22**			
Observed:						
1984	154	23	0.172			0.78
1985	72	43	0.090			0.41
1986	287	40	0.411			1.87
1987	169	46	0.266			1.21
1988	120	40	0.287			1.30
1989	207	55	0.482			2.19
1990	251	39	0.746			3.39
1991	142	39	0.528			2.40
1992	195	44	0.709			3.22
1993	430	35	1.208		-	5.49
1994	279	43	0.793			3.60
1995	182	42	0.446			2.03
1996	171	43	0.671			3.05
1997	72	10	0.387			1.76
IRELAND		**River Burrishoole**				
Spawner/egg deposition requirement:						
	616		**1.29**			
Observed:						
1980	832		1.75	1.35		1.36
1981	348		0.73	0.56		0.57
1982	510		1.07	0.83		0.83
1983	602		1.26	0.98		0.98
1984	319		0.67	0.52		0.52
1985	567		1.19	0.92		0.92
1986	495		1.04	0.80		0.81
1987	468		0.98	0.76		0.76
1988	458		0.96	0.74		0.74
1989	662		1.39	1.07		1.08
1990	231		0.49	0.38		0.38
1991	547		1.15	0.89		0.89
1992	360		0.76	0.58		0.59
1993	528		1.11	0.86		0.86
1994	516		1.08	0.84		0.84
1995	500		1.05	0.81		0.81
1996	405		0.85	0.66		0.66
1997	538		1.13	0.87		0.87

Table 3.4.1.1 cont'd Conservation reference levels, estimated numbers of spawners and egg deposition and fraction of reference levels attained in rivers in the NEAC area.

Year	Spawners		eggs	Target attainment		
	1SW	MSW	(million)	1SW/target	MSW/target	eggs/target
UK(ENG. & WALES)	**River Coquet**					
Egg deposition requirement:			**4.54**			
Observed:						
1994			4.88			1.08
1995			4.24			0.93
1996			4.96			1.09
1997			6.94			1.53
	River Test					
Egg deposition requirement:			**3.40**			
Observed:						
1989			3.04			0.89
1990			1.24			0.36
1991			1.00			0.29
1992			1.16			0.34
1993			2.13			0.63
1994			1.37			0.40
1995			1.08			0.32
1996			1.19			0.35
1997			0.77			0.23
	River Itchen					
Egg deposition requirement:			**1.63**			
Observed:						
1988			1.15			0.71
1989			0.86			0.53
1990			0.35			0.21
1991			0.20			0.12
1992			0.62			0.38
1993			1.29			0.79
1994			0.56			0.34
1995			1.64			0.01
1996			0.68			0.42
1997			0.50			0.31
	River Frome					
Egg deposition requirement:			**2.10**			
Observed:						
1987			10.88	5.61	5.27	5.18
1988			13.07	7.22	5.85	6.22
1989			9.45	5.24	4.21	4.50
1990			5.77	3.24	2.53	2.75
1991			2.34	1.06	1.28	1.11
1992			2.68	1.45	1.23	1.28
1993			3.42	1.94	1.48	1.63
1994			3.05	1.59	1.46	1.45
1995			3.10	1.59	1.51	1.48
1996			3.85	2.19	1.66	1.83
1997			2.20	1.50	0.70	1.05

Table 3.4.1.1 cont'd Conservation reference levels, estimated numbers of spawners and egg deposition and fraction of reference levels attained in rivers in the NEAC area.

Year	Spawners		eggs	Target attainment		
	1SW	MSW	(million)	1SW/target	MSW/target	eggs/target
UK(ENG. & WALES)	**River Dee**					
Egg deposition requirement:			**15.30**			
Observed:						
1992			11.24	5.86	5.38	0.73
1993			23.89	15.15	8.74	1.56
1994			11.80	7.08	4.72	0.77
1995			14.64	7.74	6.90	0.96
1996			12.97	7.06	5.91	0.85
1997			13.74	9.08	4.11	0.90
	River Lune					
Egg deposition requirement:			**13.80**			
Observed:						
1989			9.30			0.67
1990			7.80			0.57
1991			10.00			0.72
1992			5.90			0.43
1993			12.60			0.91
1994			10.10			0.73
1995			8.80			0.64
1996			9.20			0.67
1997			6.00			0.43
UK(N.IRELAND)	**River Bush**					
Egg deposition requirement:			**2.31**			
Observed						
1985			3.53			1.53
1986			4.79			2.07
1987			3.43			1.48
1988			4.60			1.99
1989			1.06			0.46
1990			2.44			1.06
1991			2.97			1.29
1992			2.57			1.11
1993			3.00			1.30
1994			2.25			0.97
1995			1.46			0.63
1996			1.32			0.57
1997			1.38			0.60

Table 3.4.1.1 cont'd Conservation reference levels, estimated numbers of spawners and egg deposition and fraction of reference levels attained in rivers in the NEAC area.

Year	Spawners		eggs	Target attainment		
	1SW	MSW	(million)	1SW/target	MSW/target	eggs/target
UK(SCOTLAND		**North Esk**				
Spawner/egg deposition requirement:						
	2334	**1658**	**12.78**			
Observed:						
1981	4975	3773	35.23	2.13	2.28	2.76
1982	5251	2495	26.96	2.25	1.50	2.11
1983	5800	2654	30.00	2.49	1.60	2.35
1984	4635	1962	21.69	1.99	1.18	1.70
1985	5548	3488	40.13	2.38	2.10	3.14
1986	3609	2717	26.45	1.55	1.64	2.07
1987	4409	1966	24.20	1.89	1.19	1.89
1988	7638	2575	31.56	3.27	1.55	2.47
1989	7234	2981	36.97	3.10	1.80	2.89
1990	2334	1658	12.78	1.00	1.00	1.00
1991	5785	2561	29.15	2.48	1.54	2.28
1992	7370	2334	38.32	3.16	1.41	3.00
1993	5426	4288	33.77	2.32	2.59	2.64
1994	7588	3688	38.76	3.25	2.22	3.03
1995	5784	3958	32.48	2.48	2.39	2.54
1996	5576	2364	24.64	2.39	1.43	1.93
1997	7532	3680	38.13	3.23	2.22	2.98

Year	Spawners		eggs	Target attainment		
	1SW	MSW	(million)	1SW/target	MSW/target	eggs/target
RUSSIA		**River Tuloma**				
Female spawner and egg deposition targets:						
	830	**3530**	**42.19**			
Observed:						
1982	320	535	5.41	0.39	0.15	0.13
1983	330	1956	20.89	0.40	0.55	0.50
1984	573	1996	26.10	0.69	0.57	0.62
1985	412	1665	17.90	0.50	0.47	0.42
1986	235	1010	13.40	0.28	0.29	0.32
1987	210	803	8.43	0.25	0.23	0.20
1988	168	669	6.41	0.20	0.19	0.15
1989	255	1251	12.21	0.31	0.35	0.29
1990	276	1691	14.47	0.33	0.48	0.34
1991	470	2265	21.50	0.57	0.64	0.51
1992	142	1222	21.40	0.17	0.35	0.51
1993	200	1207	12.04	0.24	0.34	0.29
1994	189	544	7.80	0.23	0.15	0.18
1995	305	674	10.00	0.37	0.19	0.24
1996	201	918	11.53	0.24	0.26	0.27
1997	298	1066	12.70	0.36	0.30	0.30

Table 3.4.1.2 Status of stocks in the North East Atlantic. Summary of trend analyses based on a non-parametric method (1000 iterations) (p>0.9 means significant downward trend, p<0.1 means significant upward trend).

Type of data	Test No.	Rivers (Countries)	Life stage	Period (years)	'p' value	Trend
Section 3.4.1 Egg deposition	6.	Bush (UK NI), North Esk (UK Scot), Nivelle (Fra), Burrishoole (Ire), Tuloma (Rus), Test, Itchen, Frome, Dee, Lune (UK (E&W)	Eggs	10	>0.1	Nt
	7.	Bush (UK NI), North Esk (UK Scot), Nivelle (Fra), Burrishoole (Ire), Tuloma (Rus), Test, Itchen, Frome, Dee, Lune (UK (E&W)	Eggs	5	0.05	**Dn**
Section 3.4.2 Smolt counts	8.	Oir (Fra), Imsa + Orkla + Halselva (Nor), Burrishoole (Irl), Bush (UK NI),North Esk + Girnock (UK Scot),	Smolts	10	0.83	Nt
	9.	Oir (Fra), Imsa + Orkla (Nor), Burrishoole (Irl), Bush (UK(NI)),North Esk, Girnock + Baddoch (UK Scot), Hogvadsan (Swe),Ellidaar (Ice).	Smolts	10	0.85	Nt
	9.		Smolts	5	0.45	Nt
Section 3.4.3 Adult counts	10.	Burrishoole (Irl), Usk + Test + Kent + Frome + Itchen (UK E&W), North Esk, Girnock + Baddoch (UK Scot), Bush, Mourne (UK NI), Imsa + Halselva (Nor),Ellidaar (Ice), Hogvadsan (Swe), Oir + Nivelle + Bresle (Fra)	Adults	10	0.878	Nt
	11.	Burrishoole (Irl), Usk + Test + Kent + Leven + Itchen (UK E&W), North Esk, Girnock + Baddoch + West Water (UK Scot), Bush, Mourne (UK NI), Imsa + Halselva (Nor),Ellidaar (Ice), Hogvadsan (Swe), Oir, Nivelle (Fra)	Adults	5	0.935	Dn
	12.	Tuloma + Ponoy + Kola + Zap Litca + Yokanga + Varsuga (Russia)	Adults	30	0.007	**Up**
	13.	Tuloma + Ponoy + Kola + Zap Litca + Yokanga + Varsuga (Russia)	Adults	20	0.001	**Up**
	14.	Tuloma + Ponoy + Kola + Zap Litca + Yokanga + Varsuga (Russia)	Adults	10	0.608	**Nt**
	15.	Tuloma + Ponoy + Kola + Zap Litca + Yokanga + Varsuga + Keret (Russia)	Adults	5	0.524	Nt
Section 3.4.4 Wild smolt survival	16.	Corrib (Irl), Bush (UK NI), Imsa (Nor), North Esk (UK Scot), Elidaar (Ice)	1SW return to homewaters	10	0.861	**Nt**
	17.	Corrib (Irl), Bush (UK NI), Imsa (Nor), North Esk (UK Scot), Elidaar (Ice)	1SW return to homewaters	5	0.5	Nt
	18.	Corrib (Irl), Imsa (Nor), North Esk (UK Scot)	2SW return to homewaters	10	0.814	**Nt**
	19.	Corrib (Irl), Imsa (Nor), North Esk (UK Scot)	2SW return to homewaters	5	0.496	Nt
Section 3.4.4 Hatchery smolt survival	20.	Kollafjordur (Ice), Burrishoole (Irl), Bush (UK NI), Imsa and Drammen (Nor), Lagan (Swe)	1SW return to homewaters	10	1.00	**Dn**
	21.	Kollafjordur (Ice), Burrishoole (Irl), Bush (UK NI), Imsa and Drammen (Nor), Lagan (Swe)	1SW return to homewaters	5	0.927	Dn
	22.	Kollafjordur (Ice), Imsa + Drammen (Nor), Lagan (Swe)	2SW return to homewaters	10	0.999	Dn
	23.	Kollafjordur (Ice), Imsa + Drammen (Nor), Lagan (Swe)	2SW return to homewaters	5	0.925	Dn

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

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[2] Ylapulmankijoki	River[2] Tsarsjoki	River[2] Karigasjoki	River[2] Kuoppilajoki	River Halselva	River Imsa	River Orkla	River Hogvadsån
	Juvenile Survey[3]	Juvenile Survey[3]	Juvenile Survey[3]	Smolt Total Trap	Smolt Total Trap	Smolt Total Trap	Smolt Total Trap	Smolt Total count	Smolt Total Count	Smolt Estimate	Smolt Partial Count[4]
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	2,500	2,495			788	1,194	-	882
1990	35.3	51.1	101.5	3,058	2,615	2,576		812	1,822	323,000	1,042
1991	40.7	53.2	32.3	2,447	1,828	1,349	739	1,377	1,995	243,000	1,235
1992	25.8[5]	48.2	51.2	3,538	4,219	435	257	865	1,500	262,534	1,247
1993	34.0	41.5	66.7	2,825	3,078	189[5]	70	613	398	297,264	1,305
1994	50.8	60.9	96.9	1,268	2,794	706	142	494	-	165,875	993
1995	45.7	40.5	63.5	-	-	-	-	497	338	174,677	1,525
1996	32.3	27.1	48.7	-	-	-	-	558	682	162,522	795
1997	27.2	38.3	56.7					1,013	1,180	225,471	703
Mean 92–96	37.72	43.64	65.4	-	-	-	-	1,210.8	729.5	212,574.4	1,173

[1] Major tributary of River Teno
[2] Tributary of River Teno. Smolt traps out of commission since 1995.
[3] Juvenile survey represents mean fry and parr abundance (number 100 m^2 caught by electrofishing) at 35, 10 and 12 sites respectively.
[4] Smolt trap catch represents part of the run.
[5] Incomplete data. Minimum numbers due to high water levels.

Continued.....

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), UK(E&W),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[6]	Smolt est.	Smolt est.	Smolt Total trap	Smolt Total Trap	Juvenile Survey[7]	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					1,860	10,381	10,694		160,000	1,626	
1983					1,880	9,383	26,804	32.6	-	1,747	
1984					1,250	7,270	30,009[8]	19.5	225,000	3,247	
1985	29,000		882	529	2,550	6,268	30,518[8]	7.6	130,000	2,716	
1986	-		6,881[9]	1,312	1,245	5,376	18,442	11.3	-	2,091	
1987	-		11,039[9]	363	-	3,817	21,994	10.3	199,000	1,132	
1988	23,000		9,946[9]	419	-	6,554	22,783	8.9	-	2,595	
1989	22,500	14,642	6,658[9]	830	-	6,563	17,644	16.2	141,000	1,360	
1990	24,000	11,115	2,505[9]	808	-	5,968	17,133	5.6	175,000	2,042	1,907
1991	22,000	9,300	5,287[9]	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	-[11]	2,640	226	1,700	5,429	11,583[10]	7.8	-	2,147	-
1994	14,500	-[11]	8,092[9]	539		5,971	14,145	11.5	148,000	1,223	1,280
1995	18,000	6,750	2,841	733	2,400	5,998	5,718	8.5	138,000	2,056	1,789
1996	23,200	11,500	5,068	1,003	1,300	5,854	12,449	9.9	162,000	1,636	1,627
1997			5,888	724	6,300	6,331	10,783	6.9	143,000	2,788	2,913
Mean 92–96	19,550	12,925	2,350	635	1,640	6,036	10,783	10.1	149,333	1,927	1,681

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

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

Year	Iceland	Norway	Norway	Sweden	Russia	Russia	Russia	Russia	Russia	Russia	Russia
	River Ellidaar	River Halselva	River Imsa	River Högvads ån	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	6228				1771		1051
1959	4773			197	6125				2790		1642
1960	4815			209	10360				5030		2915
1961	3779			229	11050	55480			5121		2091
1962	3126			385	10920	69388			5776	3655	2196
1963	4031			217	7880	64210			3656	3253	1983
1964	4526			390	4400	21424		23666	3268	2642	1664
1965	3249			442	5600	63812		12998	3676	4482	1506
1966	4274			375	3648	21086		10333	3218	2488	787
1967	4839			90	9011	20534		11527	7170	4993	1486
1968	3024			172	6277	47258		18352	5008	3357	1971
1969	3580			321	4538	53048		9267	6525	1437	2341
1970	2187			610	6175	55556		9822	5416	1117	2048
1971	2590			173	3284	71400		8523	4784	2300	1502
1972	4627			281	6554	48858		10975	8695	1620	1316
1973	6014			100	9726	45750		20553	9780	869	1319
1974	6925			270	12784	39360		24652	15419	280	2605
1975	7184			138	11074	89836		41666	12793	736	2456
1976	3331			65	8060	57246		44283	9360	2767	1325
1977	3756			49	2878	35354		37159	7180	2488	1595
1978	4372			23	3742	18483		24045	5525	1715	766
1979	4948			15	2887	40992		17920	6281	598	700
1980	2632			260	4087	43664		15069	7265	1052	548
1981	2656			512	3467	32158		11670	7131	472	477
1982	4275		66	572	4252	26824		9585	5898	1200	889
1983	3257		14	447	9102	59784		15594	10643	1769	1254
1984	1659		32	629	10971	39636		26330	10970	2498	1859
1985	2896		31	768	8067	48566		38787	6163	1774	1563
1986	2651		22	1632	7275	71562	3230	32266	6508	3212	1815
1987	2191	52	9	1475	5470	137419	3427	21212	6300	3468	1498
1988	4435	77	44	1283	8069	72528	3294	20620	5203	2270	575
1989	4329	64	83	480	8413	65524	3531	19214	10929	2850	2613
1990	3383	68	67	879	11594	56000	2520	37712	13383	3376	1194
1991	3020	89	43	534	7174	63000	690	21000	8500	1704	2081
1992	2917	35	70	345	5476	61300	536	26600	14670	5208	2755
1993	3363	18	39	603	4520	68300	687	26800	11400	2600	2267
1994	2298	29	-	640	3320	77800	753	28600	9730	2500	2100
1995	2509	9	-	156	4737	42290	1066	33100	6051	1153	1916
1996	2170	25	2	249	4430	67900	391	32600	7700	2700	2330
1997	1132	77	10	169	4395	73430	180	31700	6180	2700	1350
Mean 92–96	2651.4	23.2	37	399	4496.6	63518	686.6	29540	9910.2	2832.2	2273.6

[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. (Ireland, UK and France).

Year	Ireland	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 (E&W)	UK (NI)	UK (NI)	UK (NI)
	Burrishoole	Usk	Frome	Test	Itchen	Kent	Leven	Tamar	Dee	Taff	Lune	Bush	Faughan	Mourne
	Total trap	Counter	Counter	Counter + catch	Counter + catch	Counter	Counter	Counter	Counter + catch	Total trap	Counter	Total trap	Counter	Counter
1966													6792	15112
1967													1723	7087
1968													1657	2147
1969													1195	1569
1970													3214	5050
1971													1758	4401
1972													1020	1453
1973												2614	1885	2959
1974												3483	2709	3630
1975												3366	1617	1742
1976												3124	2040	2259
1977												1775	2625	2419
1978												1621	2587	5057
1979												1820	3262	2226
1980	832											2863	3288	3146
1981	348											1539	3772	2399
1982	510											1571	2909	4755
1983	602											1030	2410	1271
1984	319											672[1]	2116	1877
1985	567											2443	9077	8149
1986	495											2930	4915	6295
1987	468											2530	907	2322
1988	458	7446	4093	1507	1336							2832	3228	7572
1989	662	1719	3186	1730	791	1137					4985*	1029	8287	9497
1990	231	2532	1880	790	367	2216					5520	1850	6458	11541
1991	547	2746	805	538	152	1736	667				5322	2341	4301	7987
1992	360	3108	900	614	357	1816	394		4643	161	4489	2546	7375	7420
1993	528	5197	1182	1249	852	1526	469		9757	460	8294	3235	8655	17855
1994	516	9120	1078	775	374	2072	562	6343	5285	409	8525*	2010	7439	19908
1995	561	6189	1016	647	880	2762	329	5623	5703	319	4994	1521	5838	7547
1996	405	6926	1353	623	437	3246	387	3975	4931	128	6520	1097	13297	5475
1997	538	n/a	1157	361	246	1476	233	2813	5496	125	9137	1677		
Mean 92–96	474	6108	1105.8	781.6	580.2	2284.4	428.2	5314	6064	295	6564	2079.8	6127.2	11633

[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.

*Denotes incomplete record

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

	UK (Scotl.)	UK (Scotl.)	UK (Scotl.)	UK (Scotl.)	France	France	France
Year	N. Esk	West Water	Girnock	Baddoch	Nivelle	Oir	Bresle
	Counter	Counter	Total trap	Total trap	Trap est.	Trap est.	Trap est.
1966			269				
1967			214				
1968			196				
1969			49				
1970			90				
1971			125				
1972			137				
1973			225				
1974			184				
1975			121				
1976			164				
1977			115				
1978			38				
1979			82				
1980			203				
1981	9025		67				
1982	8121		73				
1983	8972		63				
1984	7007		106		33	295	98
1985	9912		67		61	301	148
1986	6987		156		204	204	211
1987	7014		293		138	128	188
1988	11243		187	150	130	235	89
1989	11026		108	191	263	235	214
1990	4762		58	144	291	121	126
1991	9127	2962	97	118	184	46	211
1992	10795	2809	73	88	234	45	243
1993	10887	2699	42	63	472	161	74
1994	11341	2976	81	149	317	-	77
1995	9864	2391	124	46	195	128	85
1996	7993	2656	68	85	214	165	40
1997	11315	2926	29	86	126	n/a	45
Mean 92–96	10176	2706.2	77.6	86.2	286.4	124.75	103.8

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]		River Corrib	River Corrib	R. Bush	R. Imsa		North Esk			Oir[5]	Nivelle[6]	Bresle
year	1SW	1SW	2SW	1SW	2SW	1SW[3]	1SW	2SW	1SW	2SW	3SW	All ages	All ages	All ages
1975	20													
1980				9.4	1.6									
1981				11.8	3.8		17.3	4	13.7	6.9	0.3			
1982				15.6	2.7		5.3	1.2	12.6	5.4	0.2			
1983		2		10.6	1.2		13.5	1.3	-	-	-	3.2		8.5
1984				19.8	1.7		12.1	1.8	10	4.1	0.1	7.7		16.3
1985	9.4			15.4	1.4		10.2	2.1	26.1	6.4	0.2	7.5		12.2
1986				-	-	31.3	3.8	4.2	-	-	-	3.9	15.8	19.4
1987				12.0	1.0	35.1	17.3	5.6	13.9	3.4	0.1	9.3	2.6	-
1988	12.7			12.4	0.5	36.2	13.3	1.1	-	-	-	2.3	2.4	-
1989	8.1	1.1	2	5.3	1.0	25.0	8.7	2.2	7.8	4.9	0.1	2.4	3.5	-
1990	5.4	1	1	4.4	0.6	34.7	3.0	1.3	7.3	3.1	0.2	6.1	1.8	-
1991	8.8	4.2	0.6	5.6	0.1	27.8	8.7	1.2	11.2	4.5	-	13.2	9.2	-
1992	9.6	2.4	0.8	5.9	-	29.0	6.7	0.9	-	-	-	4.4[7]	8.9	6.9[7]
1993	9.8	-	-	9.0	0.2	-	15.6		-	-	-	8.3[7]	8.3[7]	10.3[7]
1994	9.0	-	-	7.8	0.1	27.1	-	-	17.2	2.3	0.1	3.7	7.1[7]	7.5[7]
1995	9.4	1.6	1.2	6.7	-	n/a	1.8	1.5	11.5	5.1	-	n/a	1.8	
1996	4.6	1.4	-	4.1	-	31	3.4	-	10.7	-	-	-	-	-
Mean														
1992-1996	9.5	2.0	0.8	7.4	0.2	28.1	8.0	0.9	14.3	2.2	-	3.7	5.4	8.2

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

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

Smolt year	Iceland[1]			Ireland		Ireland	UK(N.Ireland)		Norway[2]		UK (Scotland)[1]			France		
	River Ellidaar	River Vesturdalsa[5]		River Corrib[8]		River Burrishoole	River Bush		River Imsa		North Esk[4]			Oir[3]	Nivelle[6]	Bresle
	1SW	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	1.8	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	0.7	3.4	1.9[3]	1.7	2.4	0.1	-	-	-	3.2	-	5.5
1984	-	-	-	4.5	0.7	7.8	6.4	1.4	3.2	0.3	3.9	2.1	0.1	7.7	-	11.7
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	-	9.6
1986	-	-	-	-	-	8.7	9.7	1.9	1.7	0.8	-	-	-	3.9	15.7	14.4
1987	-	-	-	6.0	0.4	12.0	12.0	0.4	8.3	1.5	6.7	2.1	0.1	9.3	2.7	-
1988	12.7	-	-	3.7	0.1	10.1	3.9	0.8	4.5	0.6	-	-	-	2.3	2.2	-
1989	8.1	1.1	2.0	2.5	0.4	3.5	9.3	1.4	4.9	0.6	3.5	2.7	0.1	2.4	3.5	-
1990	5.4	1.0	1.0	2.3	0.6	9.2	11.8	1.7	1.7	0.3	4.2	2.1	0.2	6.1	1.8	-
1991	8.8	4.2	0.6	2.5	0.1	9.5	12.0	2.2	3.4	0.2	5.2	2.3	0.2	13.2	9.2	-
1992	9.6	2.4	0.8	2.7	-	7.6	16.8	2.0	3.1	0.2	-	-	-	4.4	8.3	5.8
1993	9.8	-	-	1.9	0.2	9.5	15.1	2.0	7.0	-	-	-	-	8.3	7.2	6.3
1994	9.0	-	-	1.8	0.1	9.4	8.9	0.7	-	-	4.9	2.0	0.1	3.7	2.2	4.3[7]
1995	9.4	1.6	1.2	1.9	-	6.8	n/a	2.4	0.6	0.3	5.2	3.2	-	4.7	-	-
1996	4.6	-	-	1.6	-	9.2	12.1	-	1.3	-	5.5	-	-	(>4)+	-	-

[1] Microtags.
[2] Carlin tags, not corrected for tagging mortality.
[3] Minimum estimate.
[4] Before in-river netting.
[5] Assumes 50% exploitation 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 various monitored rivers and experimental facilities in the NE Atlantic area.

Smolt year	Iceland[1]		Ireland[1]	N. Ireland[1]		Norway[2]				Sweden[2]	
	Kollafjordur		R. Burris-hoole[3]	R. Bush (1SW)		R. Imsa		R. Drammen		R. Lagan	
	1SW	2SW	1SW	1+ smolts	2+ smolts	1SW	2SW	1SW	2SW	1SW	2SW
1981	5.6	3.1	10.5	-	-	10.1	1.3	-	-	-	-
1982	8.7	1.6	9.7	-	-	4.2	0.6	-	-	-	-
1983	1.2	0.9	3.64	1.9	8.1	1.6	0.1	-	-	-	-
1984	4.5	0.5	25.1	13.3	-	3.8	0.4	3.5	3.0	11.8	1.1
1985	7.3	0.7	28.9	15.4	17.5	5.8	1.3	3.4	1.9	11.8	0.9
1986	no release		9.4	2.0	9.7	4.7	0.8	6.1	2.2	7.9	2.5
1987	8.9	0.7	13.6	6.5	19.4	9.8	1.0	1.7	0.7	8.4	2.4
1988	1.0	0.7	17.9	4.9	6.0	9.5	0.7	0.5	0.3	4.3	0.6
1989	1.0	0.5	5.1	8.1	23.2	3.0	0.9	1.9	1.3	5.0	1.3
1990	2.7	0.4	10.5	5.6	5.6	2.8	1.5	0.3	0.4	5.2	3.1
1991	3.2	0.9	8.4	5.4	8.8	3.2	0.7	0.1	0.1	3.6	1.1
1992	5.1	0.7	7.5	6.0	7.8	3.8	0.7	0.4	0.6	1.5	0.4
1993	2.0	0.1	12.3	1.1	5.8	6.5	0.5	3.0	1.0	2.6	0.9
1994	3.34	0.1	11.5	1.6	-	6.2	0.6	1.2	0.9	4.0	1.2
1995	3.8		16.8	3.1	2.3	0.4	0.0	0.7	0.3	3.4	0.5
1996	no release		5.6	2.0		1.9		0.4		1.7	

[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] Kollafjordur 1SW	Iceland[1] Kollafjordur 2SW	Ireland[1] R.Burrishoole[3] 1SW	N. Ireland[1] R. Bush (1SW) 1+ smolts	N. Ireland[1] R. Bush (1SW) 2+ smolts	Norway[2] R. Imsa 1SW	Norway[2] R. Imsa 2SW	Norway[2] R. Drammen 1SW	Norway[2] R. Drammen 2SW	Sweden[4] R. Lagan 1SW	Sweden[4] R. Lagan 2SW
1981	5.6	3.1	1.3	-	-	2.0	0.1	-	-	-	-
1982	8.7	1.6	1.7	-	-	0.2	0.03	-	-	-	-
1983	1.2	0.9	0.5	0.1	0.4	0.1	0.0	-	-	-	-
1984	4.5	0.5	3.4	0.9	-	0.6	0.03	2.5	1.2	-	-
1985	7.3	0.7	4.0	2.8	4.3	1.3	0.13	0.6	0.9	-	-
1986	no release	2.1	0.1	2.1	1.1	0.07	2.2	1.1	-	-	-
1987	8.9	0.7	3.4	1.8	8.2	2.1	0.3	0.5	0.3	-	-
1988	1.0	0.7	3.3	0.4	1.0	4.8	0.2	0.3	0.2	-	-
1989	1.0	0.5	2.5	2.9	6.8	1.5	0.3	1.4	0.6	-	-
1990	2.7	0.4	3.7	2.4	3.0	1.3	0.1	0.1	0.2	-	-
1991	3.2	0.9	2.5	1.4	2.2	0.8	0.1	-	-	-	-
1992	5.1	0.7	2.2	2.0	2.3	0.6	0.1	0.3	0.4	-	0.1
1993	2.0	0.1	3.3	0.3	2.0	2.2	0	1.7	0.6	1.1	0.6
1994	3.34	0.1	1.8	0.5	-	2.6	0.1	0.8	0.6	3.0	0.6
1995	3.8	-	3.1	0.57	0.55	0.1	0.0	0.7	0.2	1.1	0.2
1996	no release		1.8	0.41	0.57	0.5		0.3		0.6	

[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 numers of salmon returning to home waters.

		Fishing season					
		1991/92	1992/93	1993/94	1994/95	1995/96	1996/97
NASCO quota (t) for the calender year if fishery operated [a]		550	550	550	550	470	425
Expected No. fish **landed** if quota had been taken [b]		147,048	162,850	182,027	172,931	142,037	128,438
Discard rate		8.8%	9.4%	14.4%	15.1%	11.9% [c]	11.9% [c]
Discard mortality		80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
Expected No. fish killed if fishery operated		158,399	176,367	206,524	197,536	157,422	142,350
No. fish **killed** in research fishery		9,350	9,099	3,035	4,187	282	0
Total number of fish saved per year		149,049	167,268	203,489	193,349	157,140	142,350
Proportion of farmed fish in catch		37.0%	27.0%	17.0%	19.0%	19.0%	19.0%
Number farm escapees spared		55,148	45,162	34,593	36,736	29,857	27,046
Number of wild fish spared		93,901	122,106	168,896	156,613	127,283	115,303
Sea age composition of wild fish:	1SW	4.0%	12.0%	16.0%	10.6%	10.7% [d]	10.7% [d]
	2SW	83.0%	61.0%	64.0%	80.8%	72.2% [d]	72.2% [d]
	2SW+	13.0%	27.0%	20.0%	8.6%	17.2% [d]	17.2% [d]
		1992	**1993**	**1994**	**1995**	**1996**	**1997**
Additional salmon expected to have returned:	**1SW**	**2,842**	**11,429**	**21,078**	**12,949**	**10,573**	**9,578**
	MSW	**70,809**	**106,307**	**134,159**	**138,533**	**122,196**	**105,368**
Estimated **1SW** returns to all European homewaters: [e]		2,519,103	2,270,026	2,522,055	2,234,742	2,468,915	2,157,700
% 1SW returns derived from suspension of commerial fishing at Faroes:		0%	1%	1%	1%	0%	0%
Estimated **MSW** returns to all European homewaters: [e]		1,211,473	1,150,143	1,234,045	1,115,005	1,073,386	845,749
% MSW returns derived from suspension of commerial fishing at Faroes:		6%	9%	11%	12%	11%	12%
Estimated **1SW** returns to Northern European homewaters: [e]		981,328	861,468	949,357	856,645	907,625	1,012,710
% 1SW returns derived from suspension of commerial fishing at Faroes: (Assuming 65% from N. Europe)		0%	1%	1%	1%	1%	1%
Estimated **MSW** returns to Northern European homewaters: [e]		524,188	542,850	515,435	454,093	494,564	434,197
% MSW returns derived from suspension of commerial fishing at Faroes: (Assuming 65% from N. Europe)		9%	13%	17%	20%	16%	16%

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.

Table 3.5.2 Results of Non-parametric Ratio analysis to examine changes in homewater catches between 1987-91 and 1992-97.

Type of data	Area considered	Periods compared	p value	Effect
1SW catches in Northern Europe	Finland, Sweden, Norway	1987-91 vs 1992-96	0.006	**Lower catch**
	Norway only	1987-91 vs 1992-96	<0.001	**Lower catch**
1SW catches in Southern Europe	Ireland (total catch), UK(Scot), France	1987-91 vs 1992-96	0.05	**Lower catch**
MSW catches in Northern Europe	Finland, Sweden, Norway	1987-91 vs 1992-96	0.162	Not sig.
	Norway only	1987-91 vs 1992-96	0.14	Not sig.
MSW catches in Southern Europe	UK (Scot), France	1987-91 vs 1992-96	0.002	**Lower catch**
Russian adult counts All ages	R. Varzuga, Ponoy, Kola, Yokanga, Zap Litca, Tuloma	1968-91 vs 1992-96	0.132	Not sig.

Table 3.6.1 Estimated number of RETURNING 1SW salmon by country and year.

year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	South	North	Total
											Mean	Mean	Mean
1971	8,657	23,776	43,012	1,312,140	541,737	171,477	12,046	105,512	131,577	1,288,430	2,861,435	733,918	3,638,365
1972	13,695	48,026	39,601	1,449,691	712,988	191,801	9,604	119,551	118,657	1,250,750	2,986,675	928,088	3,954,363
1973	20,680	29,242	40,450	1,545,820	775,507	318,853	11,837	111,182	102,413	1,447,391	3,236,049	1,126,878	4,403,377
1974	19,493	13,841	28,949	1,715,317	741,229	297,927	17,240	111,593	104,365	1,460,551	3,405,667	1,075,889	4,510,505
1975	18,912	27,232	41,100	1,770,056	687,148	313,891	18,230	126,090	91,972	1,098,300	3,113,650	1,038,180	4,192,930
1976	16,418	25,154	35,121	1,253,255	689,793	238,379	10,371	79,512	63,769	938,157	2,359,845	954,963	3,349,929
1977	14,753	19,313	39,406	1,097,928	667,388	198,568	4,861	89,325	61,834	963,352	2,231,752	885,570	3,156,729
1978	10,762	19,768	48,724	987,077	473,379	217,268	5,583	90,454	83,487	1,014,829	2,195,616	706,992	2,951,331
1979	11,292	22,833	48,232	882,352	828,157	250,110	5,917	71,561	56,000	936,830	1,969,576	1,095,476	3,113,284
1980	11,266	48,054	15,629	688,785	829,086	165,949	7,548	99,118	69,113	676,641	1,581,711	1,013,848	2,611,189
1981	10,159	37,441	31,410	558,268	562,225	137,316	13,516	117,739	56,815	820,570	1,590,832	723,216	2,345,458
1982	7,325	23,216	23,994	755,274	417,552	167,911	11,987	71,784	74,738	1,138,496	2,063,508	604,776	2,692,278
1983	11,060	24,879	32,521	1,442,144	705,022	244,735	15,778	98,366	105,161	1,146,686	2,817,236	976,595	3,826,352
1984	13,878	41,018	20,267	634,778	750,111	233,246	22,359	86,056	44,026	1,169,975	1,975,853	1,019,594	3,015,714
1985	17,356	15,102	40,506	1,171,374	757,289	305,640	26,398	102,077	55,040	856,838	2,200,430	1,106,683	3,347,619
1986	17,367	47,088	62,381	1,225,067	674,373	271,022	27,987	137,564	61,493	1,113,839	2,585,051	990,748	3,638,180
1987	24,988	72,764	41,642	834,202	602,637	417,176	22,800	129,870	31,693	917,854	1,986,382	1,067,601	3,095,625
1988	16,782	25,209	76,177	1,580,369	555,440	225,521	19,048	164,716	68,904	818,861	2,658,059	816,791	3,551,028
1989	26,947	13,102	41,132	723,539	746,604	328,056	6,049	119,073	63,696	1,118,800	2,038,210	1,107,656	3,186,998
1990	26,027	22,576	38,194	558,145	654,554	296,123	14,189	107,598	53,059	515,968	1,257,347	990,893	2,286,433
1991	24,186	20,171	46,477	447,028	601,607	415,559	17,122	75,647	29,930	477,476	1,050,253	1,058,475	2,155,205
1992	38,930	35,765	61,948	653,828	510,841	412,804	18,754	76,833	59,010	650,391	1,475,827	981,328	2,519,103
1993	29,355	43,278	59,672	518,537	427,709	384,284	20,121	101,375	71,059	614,638	1,348,886	861,468	2,270,026
1994	19,722	33,680	35,663	684,216	435,557	476,466	17,611	123,172	48,990	646,977	1,537,036	949,357	2,522,055
1995	20,574	20,123	51,976	554,922	381,329	429,854	24,889	116,886	46,696	587,494	1,326,122	856,645	2,234,742
1996	30,242	24,681	43,807	824,407	344,336	517,835	15,213	97,741	48,677	521,977	1,517,483	907,625	2,468,915
1997	26,922	12,762	43,592	617,682	486,749	492,474	6,565	78,830	55,076	337,049	1,101,398	1,012,710	2,157,700
10yr Av.	25,969	25,135	49,864	716,267	514,472	397,898	15,956	106,187	54,510	628,963	1,531,062	954,295	2,535,221

Table 3.6.2 Estimated number of RETURNING MSW salmon by country and year.

year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	South	North	Total
											Mean	Mean	Mean
1971	8,952	21,734	26,549	167,735	345,540	219,081	878	57,803	26,309	595,312	868,894	574,451	1,469,895
1972	13,998	43,502	42,924	184,623	451,580	242,908	616	64,764	23,610	803,520	1,120,019	709,103	1,872,046
1973	21,439	26,744	36,698	197,901	495,408	407,979	2,155	61,048	20,513	881,121	1,187,327	926,980	2,151,005
1974	20,589	12,359	29,100	217,212	465,247	372,257	1,372	59,446	20,620	692,112	1,001,749	859,465	1,890,313
1975	20,128	26,394	36,415	225,543	436,105	463,433	330	67,902	18,312	758,474	1,096,625	919,996	2,053,035
1976	17,579	19,488	28,154	160,008	439,112	399,002	1,005	43,034	12,729	486,257	721,516	856,698	1,606,367
1977	15,632	14,859	35,144	140,015	424,023	296,941	745	47,972	12,321	583,917	799,084	737,341	1,571,569
1978	9,803	15,290	46,300	125,675	299,850	206,303	572	48,795	16,605	687,503	893,868	516,528	1,456,696
1979	6,431	17,451	32,248	111,862	520,895	227,739	1,651	38,058	11,077	556,008	734,455	756,716	1,523,419
1980	8,798	36,745	40,976	125,331	521,584	348,871	2,919	52,865	13,676	658,548	887,165	882,172	1,810,313
1981	13,685	23,337	19,245	127,667	541,452	221,082	839	63,318	11,275	778,384	1,003,982	777,057	1,800,284
1982	15,394	14,554	19,265	42,260	444,960	180,891	3,055	38,873	14,843	578,361	688,890	644,300	1,352,455
1983	16,904	15,384	23,168	98,339	432,239	286,568	2,060	52,458	20,822	647,254	834,257	737,771	1,595,197
1984	13,356	25,532	24,185	86,347	450,147	305,908	2,935	46,286	8,751	480,792	647,708	772,346	1,444,239
1985	13,830	19,103	13,920	80,033	414,038	339,057	1,227	55,315	10,999	512,659	678,110	768,152	1,460,182
1986	9,244	19,654	25,484	85,485	488,934	381,397	1,192	74,493	12,253	819,762	1,011,646	880,767	1,917,897
1987	12,824	8,981	26,211	104,395	389,640	177,278	3,529	69,114	6,265	571,559	760,314	583,272	1,369,796
1988	9,751	24,681	21,186	82,741	304,927	196,228	3,397	87,490	16,269	606,529	817,710	514,302	1,353,198
1989	13,811	11,376	18,986	76,612	273,210	123,661	9,468	63,959	12,474	513,388	677,809	420,150	1,116,945
1990	14,884	11,547	21,081	35,126	312,070	109,758	6,551	58,967	11,536	444,314	561,490	443,264	1,025,835
1991	16,409	10,444	17,423	31,054	315,576	178,817	7,554	40,711	5,943	418,900	507,052	518,356	1,042,831
1992	16,495	13,461	23,592	57,786	333,057	164,939	9,698	41,769	13,300	537,377	663,693	524,188	1,211,473
1993	21,542	6,496	19,642	27,451	262,744	245,275	13,289	54,687	32,153	466,862	587,650	542,850	1,150,143
1994	16,192	11,405	21,165	61,156	281,243	208,336	9,664	65,699	11,329	547,856	697,445	515,435	1,234,045
1995	13,987	5,456	17,597	54,175	280,012	153,966	6,128	66,855	9,853	506,977	643,315	454,093	1,115,005
1996	7,612	9,625	15,777	36,009	302,008	177,160	7,784	56,085	10,977	450,349	563,045	494,564	1,073,386
1997	12,122	4,989	14,525	45,385	270,410	146,901	4,764	46,642	13,133	286,878	397,027	434,197	845,749
10yr Av.	14,280	10,948	19,097	50,750	293,526	170,504	7,830	58,286	13,697	477,943	611,624	486,140	1,116,861

Table 3.6.3 Estimated number of 1SW SPAWNERS by country and year.

	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	North Europe	South Europe	Total NEAC
eggs/F	5,000	3,950	5,800	3,400	3,500	4,500	3,000	4,800	3,400	5,000	4191	4344	4329
% Fem	12%	77%	47%	60%	40%	45%	50%	50%	60%	40%	43%	50%	48%
1971	4,497	21,092	21,609	546,234	107,962	112,367	2,110	59,133	40,661	910,836	226,936	1,577,955	1,826,500
1972	7,191	42,654	20,012	605,723	144,491	126,265	1,723	67,547	36,941	888,030	279,670	1,640,895	1,940,578
1973	10,808	25,959	20,398	645,118	156,309	209,532	2,107	62,615	31,807	1,025,873	378,756	1,791,372	2,190,526
1974	10,399	12,313	14,744	720,078	153,416	197,370	3,188	63,768	32,799	1,043,269	364,373	1,872,227	2,251,344
1975	9,940	24,187	20,772	739,349	139,022	206,649	3,263	71,250	28,615	779,824	358,873	1,643,225	2,022,870
1976	8,647	22,346	17,771	523,954	140,139	157,092	1,867	45,008	19,876	666,738	307,745	1,277,922	1,603,438
1977	7,770	17,159	19,952	459,366	136,058	130,905	879	50,592	19,302	684,871	275,613	1,231,290	1,526,855
1978	5,642	17,555	24,603	412,439	96,019	142,974	1,003	51,085	25,996	720,388	245,639	1,227,463	1,497,705
1979	5,971	20,295	24,473	369,669	169,876	165,166	1,080	40,655	17,529	667,105	342,094	1,115,253	1,481,820
1980	6,032	42,767	7,980	289,548	172,533	110,117	1,406	56,784	21,778	519,459	290,088	930,337	1,228,404
1981	5,333	33,251	15,867	184,724	113,888	97,485	2,424	66,509	17,683	625,651	219,129	927,818	1,162,814
1982	3,848	20,619	12,122	254,803	84,610	119,231	2,151	40,568	23,263	868,280	209,840	1,207,533	1,429,495
1983	5,839	22,110	16,490	601,082	144,069	174,142	2,863	55,798	32,868	876,024	326,914	1,587,882	1,931,285
1984	7,336	36,455	10,279	226,496	153,288	166,017	4,058	48,840	13,760	894,156	330,700	1,219,708	1,560,686
1985	9,085	13,409	20,442	335,124	152,794	216,770	4,706	61,877	17,103	652,646	383,355	1,080,159	1,483,956
1986	9,178	41,846	31,612	386,923	137,416	192,858	5,061	87,961	19,193	851,214	344,513	1,387,137	1,763,261
1987	13,380	64,754	21,250	296,737	125,127	298,339	4,234	83,624	9,976	704,642	441,079	1,159,733	1,622,062
1988	8,866	22,404	38,616	800,335	113,719	160,505	3,469	105,373	24,632	625,766	286,559	1,578,510	1,903,684
1989	13,074	11,634	20,766	252,687	301,355	232,751	1,082	75,829	7,090	912,857	548,263	1,260,097	1,829,125
1990	12,555	20,038	19,238	280,315	263,469	209,759	2,518	68,371	20,169	420,408	488,301	809,301	1,316,839
1991	11,904	18,305	23,599	254,097	244,560	347,774	3,124	48,444	10,711	390,900	607,362	722,457	1,353,418
1992	18,895	32,430	31,272	318,972	206,146	344,619	3,352	48,930	26,021	530,730	573,013	957,083	1,561,368
1993	14,477	38,478	30,311	260,354	174,016	321,720	3,681	64,969	42,052	503,446	513,894	909,299	1,453,504
1994	9,711	29,939	18,100	337,113	176,994	398,770	4,987	78,871	14,838	529,770	590,462	990,531	1,599,094
1995	10,175	17,894	26,423	247,991	155,240	360,033	9,590	81,097	15,574	481,569	535,038	844,125	1,405,586
1996	15,928	21,928	22,183	402,773	159,435	432,799	5,822	67,528	21,199	443,799	613,984	957,227	1,593,394
1997	14,254	11,344	22,116	389,434	276,544	412,136	2,521	54,598	22,368	287,022	705,455	764,765	1,492,335
10yr.av.	12,984	22,439	25,262	354,407	207,148	322,087	4,015	69,401	20,465	512,627	546,233	979,339	1,550,835
	7,790	68,249	68,866	722,990	290,007	652,225	6,022	166,562	41,749	1,025,253	956,045	2,024,804	3,049,715

Table 3.6.4 Estimated number of MSW SPAWNERS by country and year.

	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	North Europe	South Europe	Total NEAC
eggs/F	13,000	7,400	10,800	7,000	9,000	10,500	6,000	7,900	7,000	10,000	9906	9517	9702
% Fem	77%	77%	72%	85%	90%	80%	70%	70%	85%	60%	84%	63%	72%
1971	4,735	21,092	13,466	82,617	70,684	144,634	218	32,823	14,260	362,480	220,271	513,271	747,008
1972	7,409	42,654	21,790	90,980	92,638	160,450	154	36,807	12,804	489,594	260,651	672,839	955,280
1973	11,418	25,959	18,677	97,624	102,304	270,094	545	34,841	11,138	538,184	384,359	707,745	1,110,782
1974	10,912	12,313	14,775	107,014	95,278	245,929	341	33,793	11,180	421,670	352,460	585,970	953,204
1975	10,555	24,187	18,383	110,866	88,193	304,887	80	38,328	9,904	460,088	403,715	643,373	1,065,470
1976	9,283	22,346	14,280	78,800	89,684	263,312	248	24,410	6,898	320,828	362,527	453,282	830,089
1977	8,173	17,159	17,725	68,809	85,628	195,184	180	27,033	6,662	383,833	289,165	503,496	810,386
1978	5,153	17,555	23,416	61,831	60,953	135,893	140	27,598	8,989	452,869	202,139	568,843	794,398
1979	3,362	20,295	16,267	54,968	105,074	149,686	399	21,440	5,988	365,415	258,521	468,106	742,894
1980	4,673	42,767	20,817	61,792	107,479	230,723	735	30,125	7,422	435,548	343,611	577,654	942,083
1981	7,187	33,251	9,729	62,791	109,850	156,998	205	35,785	6,102	552,751	274,239	690,680	974,647
1982	8,170	20,619	9,787	22,388	91,433	128,947	765	22,130	8,051	412,284	229,316	485,472	724,575
1983	8,843	22,110	11,685	49,136	87,178	203,193	498	29,563	11,256	458,936	299,712	571,000	882,397
1984	7,047	36,455	12,256	53,044	92,073	217,627	727	26,254	4,743	342,050	317,474	462,546	792,276
1985	7,266	13,409	7,038	46,981	84,017	240,804	300	33,589	5,953	364,095	332,387	464,026	803,452
1986	4,912	41,846	12,963	37,827	100,786	272,037	300	47,793	6,651	627,702	378,035	761,819	1,152,817
1987	6,799	64,754	13,313	64,834	80,057	126,334	883	44,289	3,399	437,302	214,072	614,578	841,962
1988	5,086	22,404	10,670	44,464	61,368	139,001	817	55,600	10,417	461,478	206,273	594,363	811,307
1989	6,706	11,634	9,587	36,742	110,284	87,747	2,299	40,738	5,000	391,245	207,036	485,359	701,981
1990	7,418	20,038	10,754	12,558	127,581	78,449	1,667	37,938	7,184	340,899	215,115	418,617	644,486
1991	7,985	18,305	8,809	14,589	127,683	149,360	1,849	25,966	3,393	342,003	286,877	404,255	699,942
1992	8,102	32,430	11,959	29,306	135,102	137,978	2,401	26,715	8,923	439,784	283,582	537,159	832,700
1993	10,622	38,478	9,977	6,392	106,890	205,336	3,323	35,044	28,308	382,401	326,172	490,622	826,771
1994	7,866	29,939	10,685	32,886	113,442	173,929	2,341	41,835	6,803	447,187	297,578	558,651	866,913
1995	6,840	17,894	8,908	29,164	113,430	128,706	1,768	47,531	5,725	414,447	250,744	514,760	774,412
1996	3,981	21,928	7,965	11,809	139,131	147,812	2,223	39,773	7,331	382,083	293,148	462,924	764,037
1997	6,413	11,344	7,361	25,043	153,601	122,939	1,382	33,208	8,804	244,285	284,335	322,683	614,379
10yr.av.	7,102	22,439	9,668	24,295	118,851	137,126	2,007	38,435	9,189	384,581	265,086	478,939	753,693
	71,091	127,859	75,175	144,557	962,695	1,151,856	8,429	212,545	54,673	2,307,487	2,194,071	2,847,121	5,116,367

Table 3.6.5 Estimated number of MATURING 1SW salmon recruits by country and year.

year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)		Faroes	Grn'd
											p(S)	0.30	0
											p(N)	0.70	0.00
1971	9,386	25,781	46,173	1,423,192	575,704	185,941	12,932	114,404	142,709	1,389,988		2,702	0
1972	14,857	52,098	42,522	1,572,496	757,760	208,061	10,311	129,686	128,707	1,349,916		2,856	0
1973	22,431	31,718	43,431	1,676,727	824,173	345,850	12,708	120,592	111,085	1,561,986		3,275	0
1974	21,140	15,011	31,081	1,860,443	787,683	323,113	18,507	121,019	113,192	1,575,875		2,280	0
1975	20,513	29,539	44,128	1,920,071	730,332	340,481	19,574	136,772	99,767	1,185,322		2,906	0
1976	17,814	27,291	37,714	1,359,602	733,235	258,633	11,138	86,272	69,181	1,012,725		1,898	0
1977	16,001	20,947	42,309	1,190,973	709,325	215,377	5,219	96,886	67,074	1,039,597		1,333	0
1978	11,674	21,444	52,317	1,070,734	503,123	235,687	5,995	98,123	90,563	1,095,305		1,014	0
1979	12,250	24,769	51,788	957,220	880,293	271,321	6,354	77,631	60,753	1,011,154		1,772	0
1980	12,218	52,118	16,780	747,104	881,101	179,986	8,103	107,499	74,964	730,140		4,705	0
1981	11,022	40,618	33,727	605,607	597,576	148,969	14,513	127,730	61,633	885,731		7,666	0
1982	7,947	25,187	25,764	819,351	443,838	182,168	12,873	77,881	81,080	1,228,925		7,124	0
1983	11,998	26,989	34,919	1,564,427	749,355	265,490	16,942	106,709	114,078	1,237,640		8,167	0
1984	15,058	44,502	21,763	688,594	797,275	253,063	24,009	93,367	47,759	1,263,044		4,062	0
1985	18,828	16,382	43,494	1,270,542	804,808	331,558	28,342	110,726	59,700	924,842		3,217	0
1986	18,838	51,079	66,978	1,328,997	716,801	293,993	30,053	149,228	66,709	1,202,161		4,123	0
1987	27,104	78,926	44,711	904,870	640,490	452,503	24,480	140,866	34,377	990,528		3,315	0
1988	18,200	27,342	81,786	1,714,548	590,412	244,603	20,456	178,662	74,751	883,597		3,810	0
1989	29,226	14,211	44,161	784,871	793,558	355,827	6,495	129,157	69,100	1,207,343		2,825	0
1990	28,227	24,486	41,006	605,442	695,671	321,173	15,235	116,702	57,554	556,752		3,298	0
1991	26,222	21,875	49,896	484,868	639,305	450,554	18,381	82,028	32,463	515,047		1,880	0
1992	42,217	38,791	66,510	709,216	542,910	447,669	20,135	83,328	64,008	701,729		714	0
1993	31,845	46,949	64,071	562,538	454,641	416,897	21,608	109,980	77,084	663,373		609	0
1994	21,391	36,532	38,289	742,203	462,956	516,808	18,912	133,608	53,146	698,129		630	0
1995	22,318	21,829	55,810	601,960	405,289	466,294	26,724	126,795	50,654	634,069		683	0
1996	32,799	26,770	47,035	894,261	365,932	561,610	16,332	106,005	52,798	563,246		588	0
1997	29,206	13,844	46,807	670,080	517,407	534,285	7,051	85,524	59,748	363,789		0	
10yr Av.	28,165	27,263	53,537	776,999	546,808	431,572	17,133	115,179	59,131	678,708		1,504	0

Table 3.6.6 **Estimated number of MATURING 1SW salmon recruits from Northern and Southern European stocks.**

year	Southern European stocks				Northern European stocks				Total for European stocks			
	sum vars $x10^{-6}$	-95% cl	Mean recruits	+95% cl	sum vars $x10^{-6}$	-95% cl	Mean recruits	+95% cl	sum vars $x10^{-6}$	-95% cl	Mean recruits	+95% cl
1971	104,500	2,471,483	3,105,081	3,738,679	6,926	624,703	787,824	950,945	111,426	3,274,653	3,928,912	4,583,171
1972	108,267	2,597,503	3,242,422	3,887,341	12,849	772,893	995,069	1,217,245	121,117	3,587,154	4,269,270	4,951,386
1973	135,761	2,790,849	3,513,025	4,235,201	16,937	954,763	1,209,841	1,464,918	152,697	3,988,076	4,753,976	5,519,876
1974	151,382	2,930,544	3,693,139	4,455,734	15,805	907,295	1,153,700	1,400,104	167,187	4,067,928	4,869,343	5,670,758
1975	95,845	2,774,365	3,381,157	3,987,950	13,711	885,544	1,115,052	1,344,560	109,556	3,880,660	4,529,405	5,178,151
1976	63,681	2,066,790	2,561,398	3,056,006	12,275	806,376	1,023,532	1,240,688	75,956	3,075,325	3,615,504	4,155,684
1977	62,632	1,929,403	2,419,921	2,910,439	11,393	738,619	947,827	1,157,034	74,025	2,871,772	3,405,041	3,938,310
1978	70,662	1,858,533	2,379,548	2,900,562	7,142	592,290	757,928	923,566	77,804	2,639,268	3,185,978	3,732,689
1979	56,582	1,671,209	2,137,434	2,603,659	17,815	911,143	1,172,750	1,434,356	74,397	2,820,701	3,355,307	3,889,913
1980	39,008	1,340,398	1,727,508	2,114,618	16,294	837,943	1,088,130	1,338,317	55,302	2,353,798	2,814,718	3,275,639
1981	63,251	1,253,936	1,746,872	2,239,807	8,129	606,314	783,031	959,747	71,380	2,011,137	2,534,791	3,058,446
1982	107,167	1,614,541	2,256,172	2,897,803	5,328	513,941	657,005	800,068	112,494	2,254,753	2,912,140	3,569,527
1983	126,231	2,380,698	3,077,066	3,773,434	13,741	825,700	1,055,451	1,285,203	139,971	3,403,423	4,136,713	4,870,003
1984	109,032	1,503,616	2,150,808	2,798,001	14,743	857,224	1,095,207	1,333,190	123,775	2,562,935	3,252,496	3,942,057
1985	75,120	1,855,718	2,392,915	2,930,113	17,405	929,555	1,188,132	1,446,708	92,525	3,016,250	3,612,440	4,208,630
1986	119,973	2,133,029	2,811,916	3,490,804	13,404	838,653	1,065,575	1,292,496	133,377	3,213,151	3,928,959	4,644,767
1987	78,458	1,611,615	2,160,619	2,709,622	17,271	891,728	1,149,313	1,406,898	95,730	2,735,743	3,342,171	3,948,599
1988	93,119	2,293,501	2,891,601	3,489,702	9,881	684,283	879,114	1,073,945	103,000	3,209,134	3,838,168	4,467,202
1989	157,359	1,436,596	2,214,097	2,991,599	19,678	914,197	1,189,142	1,464,086	177,036	2,612,090	3,436,773	4,261,457
1990	35,098	1,004,731	1,371,928	1,739,124	16,178	815,716	1,065,017	1,314,317	51,276	2,021,717	2,465,546	2,909,374
1991	28,439	812,016	1,142,548	1,473,080	24,195	832,274	1,137,149	1,442,024	52,634	1,872,853	2,322,519	2,772,185
1992	55,011	1,139,745	1,599,450	2,059,155	22,544	759,665	1,053,950	1,348,236	77,554	2,171,394	2,717,226	3,263,058
1993	48,873	1,028,651	1,461,954	1,895,257	17,517	666,452	925,861	1,185,271	66,390	1,944,575	2,449,595	2,954,614
1994	55,454	1,204,161	1,665,717	2,127,272	25,701	706,751	1,020,966	1,335,182	81,155	2,164,245	2,722,604	3,280,963
1995	44,656	1,023,397	1,437,584	1,851,772	20,140	643,449	921,600	1,199,751	64,796	1,913,507	2,412,425	2,911,343
1996	37,163	1,267,199	1,645,040	2,022,881	28,472	646,791	977,514	1,308,237	65,635	2,165,239	2,667,376	3,169,513
1997	23,177	894,593	1,192,986	1,491,378	36,339	714,316	1,087,949	1,461,582	59,517	1,849,578	2,327,742	2,805,905
10yr Av.	57,835	1,210,459	1,662,291	2,114,122	22,064	738,389	1,025,826	1,313,263	79,899	2,192,433	2,735,997	3,279,561

Table 3.6.7 Estimated number of NON-MATURING 1SW salmon recruits by country and year.

year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)		Faroes	Grnlnd
											p(S)	0.30	1.00
											p(N)	0.70	0.00
1971	16,689	51,339	51,176	220,124	532,959	286,671	652	67,789	24,839	849,676		138,142	535,538
1972	25,564	31,565	43,757	235,967	584,723	481,535	2,279	63,908	21,582	931,849		155,744	420,765
1973	24,544	14,584	34,692	258,964	549,043	439,285	1,451	62,215	21,692	731,780		114,205	466,403
1974	23,993	31,148	43,413	268,905	514,676	546,889	349	71,068	19,264	801,976		138,518	356,163
1975	20,954	22,997	33,564	190,766	518,212	470,841	1,062	45,039	13,390	514,119		96,293	432,119
1976	18,638	17,537	41,901	166,939	500,438	350,447	788	50,214	12,963	617,469		67,298	242,175
1977	11,689	18,046	55,205	149,844	353,895	243,488	605	51,078	17,470	727,045		50,368	306,627
1978	7,668	20,597	38,450	133,378	614,805	268,799	1,747	39,841	11,654	588,023		84,304	177,123
1979	10,488	43,362	48,851	149,424	615,540	411,698	3,086	55,330	14,388	696,307		216,215	298,066
1980	16,312	27,539	22,942	152,217	639,009	260,878	887	66,268	11,861	822,946		363,017	203,004
1981	18,353	17,176	22,969	50,383	525,095	213,480	3,230	40,687	15,614	611,563		347,866	300,317
1982	20,155	18,157	27,624	117,249	510,136	338,227	2,179	54,913	21,906	684,491		275,133	175,321
1983	15,925	30,132	28,835	102,956	531,293	361,034	3,104	48,451	9,207	508,423		191,056	73,606
1984	16,489	22,546	16,596	95,430	488,690	400,159	1,297	57,903	11,572	542,121		197,332	50,213
1985	11,021	23,195	30,383	101,925	577,053	450,117	1,261	77,974	12,891	866,840		220,061	196,987
1986	15,288	10,599	31,250	124,464	459,837	209,212	3,732	72,340	6,591	604,346		206,853	160,765
1987	11,626	29,129	25,260	98,653	359,896	231,595	3,592	91,583	17,117	641,411		113,663	153,833
1988	16,467	13,426	22,637	91,342	322,436	145,944	10,012	66,948	13,122	542,891		154,926	205,650
1989	17,749	13,628	25,136	41,881	368,304	129,544	6,928	61,727	12,136	469,899		171,714	64,127
1990	19,566	12,327	20,774	37,027	372,461	211,056	7,988	42,617	6,253	443,017		110,458	26,414
1991	19,665	15,886	28,128	68,897	393,069	194,649	10,255	43,719	13,992	568,203		48,433	79,824
1992	25,681	7,666	23,418	32,729	310,088	289,446	14,053	57,240	33,826	493,619		37,242	48,155
1993	19,307	13,461	25,235	72,916	331,934	245,891	10,220	68,773	11,919	579,380		38,710	0
1994	16,679	6,439	20,981	64,593	330,497	181,728	6,482	69,986	10,365	536,166		42,217	0
1995	9,075	11,360	18,811	42,934	356,434	209,080	8,232	58,707	11,548	476,189		35,240	13,670
1996	14,452	5,888	17,317	54,111	319,143	173,374	5,038	48,823	13,816	303,351		2,364	18,539
1997													
10yr Av.	17,027	12,921	22,770	60,508	346,426	201,231	8,280	61,012	14,409	505,413		75,497	61,021

Table 3.6.8 Estimated number of NON-MATURING 1SW salmon recruits from Northern and Southern European stocks.

year	Southern European stocks				Northern European stocks				Total for European stocks			
	sum vars $x10^{-6}$	-95% cl	ean recruits	+95% cl	sum vars $x10^{-6}$	-95% cl	ean recruits	+95% cl	sum vars $x10^{-6}$	-95% cl	ean recruits	+95% cl
1971	21,121	1,924,930	2,209,779	2,494,627	6,198	880,015	1,034,317	1,188,618	27,319	2,451,638	2,775,594	3,099,551
1972	26,346	1,906,644	2,224,781	2,542,918	10,991	1,111,108	1,316,592	1,522,076	37,337	2,620,509	2,999,237	3,377,965
1973	15,439	1,692,786	1,936,321	2,179,856	9,010	991,426	1,177,473	1,363,520	24,449	2,412,389	2,718,858	3,025,326
1974	19,707	1,735,103	2,010,251	2,285,399	11,693	1,071,848	1,283,790	1,495,733	31,400	2,469,049	2,816,362	3,163,675
1975	9,180	1,351,618	1,539,409	1,727,200	9,068	961,991	1,148,631	1,335,272	18,248	2,094,593	2,359,357	2,624,121
1976	14,053	1,099,275	1,331,623	1,563,972	6,835	804,416	966,452	1,128,487	20,887	1,803,538	2,086,807	2,370,076
1977	19,487	1,164,397	1,438,005	1,711,614	3,435	566,761	681,631	796,501	22,922	1,688,617	1,985,361	2,282,104
1978	12,256	1,034,647	1,251,629	1,468,612	7,164	847,553	1,013,453	1,179,353	19,420	1,713,251	1,986,389	2,259,526
1979	17,081	1,721,432	1,977,592	2,233,753	10,582	1,148,071	1,349,691	1,551,311	27,663	2,236,766	2,562,755	2,888,744
1980	29,431	2,157,645	2,493,894	2,830,143	8,265	1,257,499	1,435,682	1,613,866	37,696	2,206,338	2,586,881	2,967,424
1981	16,861	1,940,789	2,195,294	2,449,799	5,733	1,108,707	1,257,110	1,405,513	22,594	1,872,122	2,166,734	2,461,345
1982	21,070	1,704,641	1,989,148	2,273,655	7,882	1,089,731	1,263,745	1,437,759	28,953	1,911,987	2,245,491	2,578,996
1983	11,570	1,198,806	1,409,628	1,620,449	8,853	999,871	1,184,292	1,368,713	20,423	1,623,919	1,904,020	2,184,121
1984	12,933	1,214,660	1,437,558	1,660,456	8,981	1,002,789	1,188,538	1,374,288	21,914	1,610,200	1,900,349	2,190,498
1985	48,402	1,582,138	2,013,347	2,444,555	11,799	1,140,920	1,353,825	1,566,729	60,201	2,088,803	2,569,708	3,050,612
1986	23,920	1,365,477	1,668,614	1,971,751	4,739	848,652	983,572	1,118,493	28,659	1,573,469	1,905,276	2,237,083
1987	27,336	1,086,542	1,410,601	1,734,660	3,855	647,384	769,084	890,784	31,191	1,431,200	1,777,358	2,123,515
1988	18,605	1,182,456	1,449,802	1,717,148	2,589	616,449	716,182	815,914	21,194	1,320,459	1,605,802	1,891,145
1989	13,906	1,004,651	1,235,778	1,466,905	3,043	659,706	767,831	875,955	16,949	1,127,605	1,382,773	1,637,941
1990	20,139	657,699	935,848	1,213,997	5,252	626,820	768,869	910,917	25,392	997,635	1,309,957	1,622,278
1991	35,339	583,508	951,964	1,320,421	5,131	546,426	686,827	827,228	40,471	1,090,419	1,484,719	1,879,019
1992	25,970	481,520	797,376	1,113,232	6,532	534,056	692,470	850,885	32,502	1,019,808	1,373,163	1,726,519
1993	36,689	500,057	875,483	1,250,909	5,329	519,574	662,653	805,732	42,018	1,015,980	1,417,747	1,819,513
1994	31,053	482,885	828,274	1,173,664	3,689	476,654	595,696	714,737	34,742	920,805	1,286,134	1,651,462
1995	23,732	429,932	731,874	1,033,817	5,888	482,767	633,164	783,560	29,620	913,953	1,251,278	1,588,603
1996	11,392	243,218	452,410	661,603	6,574	356,467	515,385	674,304	17,966	713,508	976,218	1,238,928
10yr Av.	24,416	665,247	966,941	1,268,636	4,788	546,630	680,816	815,002	29,204	1,055,137	1,386,515	1,717,892

Table 3.7.1.1 Hierarchy of methods to establish conservation limits

METHOD	RANK	APPROACH	DATA REQUIRED	NUMBER OF RIVERS WHERE THESE DATA ARE AVAILABLE AND APPROACH CAN BE TAKEN							
				Irl	Norway	Russia	Sweden	UK (E/W)	UK(Scot)	UK (NI)	TOTAL
S/R relationship											
Index river	1	For all biological populations	Long time series of full census data.) (multiple traps/counters)	1	1					1	3
	2	For entire river stocks	Long time series of counter/trap data)			11					11
Transporting ref. point to non-index rivers	3	Grade A nursery habitat used	Habitat area and utilisation with reference to index river data					77		2	79
	4	Grade A nursery habitat	Habitat area with reference to index river data			54					54
	5	Habitat classification matrix	Stream order and altitude with reference to index river data								
	6	All available nursery habitat	Available nursery area of all grades with reference to index river data				18				18
	7	Wetted area	Wetted area with reference to index river data								
	8	Catchment area topographically corrected	Catchment area elevation relief ratios with reference to index river data								
	9	Catchment Area	Catchment area with reference to idex river data	174						38	212
Transporting ref. point Regional or grouped by area	10	Combined catchment areas	Catchment area with reference to idex river data								
Alternative to S/R relationships											
Direct abundance estimate	11	Short time series census data (smolts and /or adults)	Full counter/trap data for recent period		1						
Indirect abundance estimates	12	Smolt productivity studies	Smolt production estimates referenced to habitat area/type and abundance estimate		2						
	13	Lagged spawners based on exploitation rate data	Long time series of catch and exploition data, smolt/adult age composition		665				382		1047
	14	Catches corrected by exploitation rates	Catch and exploitation rate								
	15	Partial count/trap data									
	16	Catch or historical estimate of abundance				35					35
TOTAL				175	669	Approx 100	18	77	382	41	1559

Table 3.7.1.2 Provisional development of conservation limits for UK (N. Ireland) salmon rivers

Fishery District	Primary river basin	Catchment area Ha	Conservation limit eggs	Conservation limit females	Conservation limit fish
Foyle	Foyle/Deele	40842	2799311	823	1372
	Burndennet	14820	1015763	299	498
	Finn	41981	2877378	846	1410
	Mourne	8205	562371	165	276
	Derg	43704	2995472	881	1468
	Owenkillew	45439	3114389	916	1527
	Strule	9474	649348	191	318
	Fairy Water	18000	1233720	363	605
	Camowen	27558	1888825	556	926
	Drumragh	32497	2227344	655	1092
Faughan/Roe	Faughan	29850	2045919	602	1003
	Roe	38995	2672717	786	1310
	L. Foyle South margin	13383	917271	270	450
	L. Foyle East margin	6897	472720	139	232
Bann	Main	70927	4861337	1430	2383
	Sixmilewater	30148	2066344	608	1013
	Crumlin	5628	385743	113	189
	Glenavy	4683	320973	94	157
	Upper Bann	66063	4527958	1332	2220
	Blackwater	148037	10146456	2984	4974
	Ballinderry	43017	2948385	867	1445
	Moyola	31269	2143177	630	1051
	L. Bann tribs	89531	6136455	1805	3008
Bush and NE streams	Bush	33700	2309798	679	1132
	NE Streams	58872	4035087	1187	1978
Lagan/Co Down	Lagan	54631	3744409	1101	1835
	E. Antrim streams	24285	1664494	490	816
	Newry	28555	1957160	576	959
	SE Down streams	39591	2713567	798	1330
	Kilkeel/Mourne streams	32525	2229264	656	1093
Erne	Termon	6525	447224	132	219
	Bannagh	3745	256682	75	126
	Kesh	8840	605894	178	297
	Balinamallard	16024	1098285	323	538
	Colebrook	36102	2474431	728	1213
	Finn	32870	2252910	663	1104
	Annalee	77400	5304996	1560	2600
	Woodford	44570	3054828	898	1497
	Swanlinbar	11940	818368	241	401
	Arney	28866	1978476	582	970
	Silees	17534	1201780	353	589
N. Ireland total conservation limits		Catchment 1417523	Eggs 97157026	Females 28576	Fish 47626

Input parameters used :

Bush s/r derived MBAL (2.31 million eggs) referenced to catchment area (eggs/Ha)	68.54
eggs/spawner	3400
proportion female	0.6

Table 3.7.1.3 **Data used to set salmon stock conservation limits (at MSY) for rivers in UK (England and Wales)**

Map No.	River	Region	Catchm't area	GIS area (wetted area)	Av daily flow	Mean rod catch	Mean net catch	Total catch	Adjust' egg dep rate	MSY egg dep'	Fecundity	% female	% grilse	Total fish target	Grilse Target	MSW Target
			(km2)	(ha)	cumecs	(10yr mean)	(10yr mean)	(10yr mean)	eggs 100m-2	eggs (millions)	eggs/ fish	%	%			
2	** **Coquet**	North East	**584.48**	144	**8.976**	407	-	407	324	4.7	5732	54.3	72.8	1499	1091	408
3	Tyne	North East	2185.12	294	47.035	1069	-	1069	418	12.3	6966	61.4	27.2	2876	782	2094
4	* Wear	North East	1014.26	226	15.202	174	-	174	330	7.4	6210	55.6	57.2	2156	1233	923
5	Tees	North East	1269.95	319	24.77	24	-	24	302	9.6	6940	62.2	27.2	2231	607	1624
6	Esk-Yorks	North East	301.16	27	4.522	53	-	53	468	1.3	6087	59.0	61.2	357	218	138
9	** **Test**	Southern	**1245.5**	80	**13.146**	334	-	334	425	3.4	6346	56.1	52.6	955	502	453
10	* Itchen	Southern	519.5	70	5.995	215	151	366	234	1.6	5949	56.3	64.7	478	309	169
11	** **Avon-Hants**	South-west	**1722.8**	360	**19.212**	48		48	237	8.5	5966	51.5	67.3	2777	1869	908
13	Piddle	South-west	199.5	25	3.027	16		16	194	0.5	6616	63.9	36.5	116	43	74
14	* Frome	South-west	471.25	88	7.336	199		199	256	2.2	6174	58.3	56.3	623	351	272
16	Exe	South-west	1194.8	205	23.476	676	1659	2335	343	7.0	4812	45.0	100.0	3254	3254	0
17	* Teign	South-west	402.5	98	9.133	179	1244	1423	315	3.1	5566	55.2	77.1	1001	771	229
18	* Dart	South-west	289.25	132	10.733	205	1282	1486	297	3.9	5524	56.6	77.8	1251	973	278
19	Avon-Devon	South-west	110.5	18	3.654	45	-	45	294	0.5	5438	61.5	78.8	157	123	33
22	Plym	South-west	133.5	17	3.761	27	-	27	436	0.8	6542	64.7	38.4	178	68	109
23	Tavy	South-west	220.75	23	7.068	115	391	505	312	0.7	5396	57.4	81.5	228	185	42
24	** **Tamar**	South-west	**929.75**	197	**21.009**	512	1515	2027	293	5.8	5322	49.4	86.1	2195	1890	305
25	* Lynher	South-west	153.75	28	4.729	86	351	437	266	0.7	5049	58.1	92.4	254	235	19
27	Fowey	South-west	177.5	34	5.363	212	116	328	430	1.5	5445	58.9	79.5	458	364	94
28	Camel	South-west	219	37	5.635	289	178	468	338	1.2	6003	60.4	60.4	341	206	135
29	Taw	South-west	915.5	174	18.588	256		256	323	5.6	5630	51.6	76.8	1935	1486	449
30	** **Torridge**	South-west	**722.5**	150	**15.344**	96		96	291	4.4	5905	54.6	67.1	1354	908	445
31	Lyn	South-west	101.75	27	3.646	145		145	556	1.5	4812	60.1	100.0	518	518	0
32	** **Severn**	Midlands	**9990.5**	898	**111.88**	635	2826	3461	190	17.1	6760	54.8	41.2	4606	1898	2708
33	** **Wye**	Wales	**4077.8**	1653	**77.471**	2381	13	2393	281	46.4	6467	53.4	51.3	13450	6900	6550
34	Usk	Wales	1309.5	242	37.086	560	1872	2432	423	10.2	5575	49.5	79.2	3703	2933	770
35	Taff	Wales	520.25	72	22.294	48		48	436	3.1	5117	51.2	91.2	1199	1094	106
36	Ogmore	Wales	277.25	35	9.17	33		33	253	0.9	4994	54.3	94.5	322	304	18
37	Afan	Wales	91.75	17	4.42	6		6	450	0.8	4812	60.9	100.0	260	260	0
38	Neath	Wales	253	37	11.61	22		22	419	1.6	5069	55.2	92.2	555	512	43
39	Tawe	Wales	231.75	45	10.631	60		60	379	1.7	5413	57.2	81.1	552	447	104
40	Loughor	Wales	176.75	35	6.555	10		10	289	1.0	4812	56.3	100.0	375	375	0
42	Tywi	Wales	1107.8	278	38.837	623	165	787	377	10.5	5985	53.4	65.5	3278	2147	1131
43	Taf	Wales	249.25	88	6.936	74	9	83	276	2.4	5168	57.9	74.3	808	601	208
44	E&W Cleddau	Wales	423.25	122	10.893	50			402	4.9	5275	57.2	85.0	1624	1381	244
46	** **Teifi**	Wales	**948**	296	**25.826**	657	224	881	413	12.2	6076	54.8	61.9	3676	2276	1401
47	Aeron	Wales	163.25	35	4.02	12		12	417	1.4	5195	58.3	87.7	477	418	59
48	Ystwyth	Wales	196	46	6.036	19		19	397	1.8	5004	56.4	94.0	649	610	39
49	Rheidol	Wales	186.75	50	7.526	57		57	426	2.1	5155	57.4	89.2	724	646	78
50	* Dyfi	Wales	479.75	179	21.315	271	60	331	311	5.6	5414	53.4	82.3	1927	1586	341
51	Dysinni	Wales	106.5	45	4.734	13	12	25	287	1.3	4964	60.3	95.0	430	408	21
52	** **Mawddach**	Wales	**169.5**	57	**8.739**	222	11	233	312	1.8	5536	59.5	76.3	536	409	127
53	Artro	Wales	82	9	2.891	7		7	423	0.4	4812	61.7	100.0	126	126	0

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Table 3.7.1.3 (cont.)

Map No.	River	Region	Catchm't area	GIS area (wetted area)	Av daily flow	Mean rod catch	Mean net catch	Total catch	Adjust' egg dep rate	MSY egg dep'	Fecundity	% female	% grilse	Total fish target	Grilse Target	MSW Target
			(km2)	(ha)	cumecs	(10yr mean)	(10yr mean)	(10yr mean)	eggs 100m-2	eggs (millions)	eggs/ fish	%	%			
54	* Dwyryd	Wales	81	9	4.782	29		29	246	0.2	5209	62.7	86.3	70	60	10
55	* Glaslyn	Wales	129.5	25	8.703	53	17	70	242	0.6	5327	60.2	82.9	189	156	32
56	* Dwyfawr	Wales	107.75	33	4.528	28	43	71	322	1.1	5313	61.2	83.1	330	274	56
58	Gwyrfai	Wales	76.5	11	3.703	9		9	372	0.4	5071	66.7	30.1	117	35	81
59	* Seiont	Wales	82.5	21	5.041	74	160	234	288	0.6	5602	63.6	72.3	170	123	47
60	* Ogwen	Wales	87.25	24	5.467	110	130	240	449	1.1	5131	62.1	89.1	337	300	37
61	* Conwy	Wales	377.25	63	20.678	334	109	443	255	1.6	5549	55.4	77.5	523	405	118
62	* Clwyd	Wales	443	84	6.225	129	170	299	312	2.6	5165	52.4	89.8	967	869	99
63	** **Dee**	Wales	**1793.3**	620	**38.465**	531	1040	1572	248	15.4	5384	55.8	64.8	5118	3316	1802
64	Ribble	North-west	1154.35	158	30.675	498	445	943	413	6.5	5631	51.5	73.2	2248	1646	603
65	Wyre	North-west	280.63	46	6.404	20		20	264	1.2	4883	53.7	97.9	467	457	10
66	** **Lune**	North-west	**988.15**	423	**34.112**	1125	5248	6373	327	13.8	5596	51.6	75.4	4790	3612	1178
67	Kent	North-west	214.77	42	8.962	379	142	521	399	1.7	4541	57.7	80.9	643	520	123
68	** **Leven**	North-west	**254.81**	46	**14.317**	112	41	153	249	1.1	5181	55.6	88.7	396	351	45
69	Duddon	North-west	88.06	11	5.206	28		28	402	0.4	4946	61.5	95.5	147	140	7
70	Esk	North-west	71.53	14	4.327	52		52	401	0.6	6222	56.4	56.2	158	89	69
71	Irt	North-west	45.6	20	3.229	95		95	317	0.6	4961	66.3	94.5	191	180	10
72	Ehen	North-west	131.73	32	5.777	174		174	335	1.1	4946	58.8	95.7	372	356	16
73	Derwent	North-west	667.33	135	33.267	888		888	369	5.0	6063	56.1	61.4	1469	902	567
74	Ellen	North-west	103.18	17	2.395	20		20	322	0.5	4812	60.0	100.0	187	187	0
76	** **Eden**	North-west	**2294.46**	437	**59.41**	1472		1472	464	20.3	6601	48.0	76.3	6398	4882	1516
77	Esk-Border	North-west	851.51	144	27.807	406		406	440	6.3	5764	64.7	66.1	1693	1119	574
															63299	30148

* Refined target identified in Draft Salmon Action Plans

** Refined target identified in Final Salmon Action Plans

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Table 3.7.1.4 Salmon rivers in Russia by district.

a)

District	No.
Kola Peninsula	65
Karelia	14
Archangelsk	172
Total	**251**

The number of salmon rivers in Archangelsk region is uncertain.

b) Management targets for rivers in the Kola Peninsula

RIVER	CATCHMENT AREA (km2)	TOTAL SPAWNING AREA (ha)	MEAN ABUNDANCE (10 YR)	SMOLT OUTPUT	ADULTS	CONS. LIMIT	MANAGEMENT TARGET		APPROACH
							Min	Max	
B.Z. Litsa	1,660	124.7	880	54,300	4,900	1,230	1,480	1,600	4
Ura	1,080	83	1,800	36,140	3,250	810	970	1,050	4
Tuloma			6,120	132,000	13,200	3,300	3,960	4,290	4
Kola	3,846	217	10,010	161,400	16,200	4,050	4,860	5,270	4
Warsina	1,456	85	720	51,000	5,100	1,280	1,530	1,660	4
Iokanga	5,945	257.4	3,820	124,800	12,800	3,200	3,840	4,160	4
Kiza	1,646	81.7		203,000	10,150	2,540	3,050	3,300	4
Varsuga	9,836	1248	71,260	3,100,000	155,000	38,800	46,560	50,440	4
Umba	6,249	447.8	8,350	691,500	34,600	8,650	10,380	11,250	4
Drosdovka	468	17.5	280	9,800	1,000	250	300	325	4

Table 3.7.1.5 Spawning targets for French salmon rivers (1997).

River	Production area riffles and rapids 100m2 units	Spawning target (1) (M eggs)	Spawning 1SW	Target MSW	Possible harvest (2) (M eggs)	Comments
Bresle		n/a				sea trout river
Arques		n/a				sea trout river
Sienne	1372	0.65	211	46	0.24	low stock
See	1121	0.53	171	38	1.08	(3)
Selune	1113	0.53	171	38	0.39	
Couesnon	974	0.46	149	33	0.17	low stock
Leff	505	0.24	78	17	0.18	
Trieux	1559	0.74	239	52	0.54	
JAudy	1033	0.49	158	35	0.36	
Leguer	1924	0.91	294	65	0.67	
Yar	281	0.13	42	9	0.1	
Douron	452	0.21	68	15	0.26	(3)
Dourduff	322	0.15	49	11	0.11	
Jarlot	396	0.19	62	14	0.14	
Queffleuth	404	0.19	62	14	0.14	
Penze	581	0.28	91	20	0.3	(3)
Fleche	352	0.17	55	12	0.12	
Aber-Wrac'h	404	0.19	62	14	0.14	
Aber Ildut	430	0.2	65	14	0.15	
Aber Benoit	315	0.15	64	11	0.11	
Elorn	1139	0.54	175	39	0.81	(3)
Mignonne	385	0.18	58	13	0.13	
Camfrout	237	0.11	36	8	0.08	
Faou	177	0.08	26	6	0.06	
Aulne	7157	3.4	1108	244	2.5	
Goyen	489	0.23	74	16	0.17	
Jet	see Odet	see Odet	-	-		
Steir	see Odet	see Odet	-	-		
Odet-Steir-Jet	2490	1.74	562	124	1.38	(4)
Aven	749	0.36	116	25	0.44	(3)
Belon	255	0.12	38	9	0.09	
Isole	see Elle	see Elle	-	-		
Elle-Laïta-Isole	3420	1.62	524	115	1.2	
Laita	see Elle	see Elle	-	-		
Scorff	2000	0.95	307	67	0.86	
Blavet	3508	1.67	540	119	1.23	
Kergroix	262	0.12	38	9	0.09	
Loire	48500	23.04				fishery closed
Dordogne		n/a				fishery closed
Garonne		n/a				fishery closed
Adour	30600	14.54				
Nivelle	461	0.22			0.15	unofficially
Rhine	11300	5.37				fishery closed

Number of salmon rivers: 43
Number of target available: 37 86%

(1) Production area x 4.75
(2) Production area x 3.5, except on low stocks and most productive rivers (see (4))
(3) Possible harvest according to the 10 last year catches on most productive rivers
(4) Stock/recruitment relationship fitted to this river

Table 3.7.1.6 Estimates of areas of useable salmon rearing habitat in Swedish west-coast rivers.

River No.	Main river	Area of rearing habitat (ha)
1	R. Enningdalsälven	2.5
2	R. Orekilsälven	23.0
3	R. Göta älv, excl. R. Säveån	10.7
4	R. Säveån, tributary to R. Göta älv	6.9
5	R. Kungsbackaån	5.4
6	R. Rolfsån	3.2
7	R. Löftaån	0.8
8	R. Viskan	8.7
9	R. Himleån	3.2
10	R. Tvååkersån	1.4
11	R. Atran	52.5
12	R. Suseån	9.2
13	R. Nissan	10.0
14	R. Fylleån	12.3
15	R. Genevadsån	16.6
16	R Lagan	6.9
17	R. Stensån	11.0
18	R. Rönneån	27.0
	Total	**211.4**

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Table 3.7.1.7 **Preliminary estimate of adult spawning requirements for Irish rivers**

R. BUSH CRITERIA (Anon. 1995)

Female/Male Ratio 60:40
Transport target 68.54 eggs / ha
Average Fecundity 3400 per female

R. Shannon target based on current escapemer
R. Erne target based on current escapement

River / Lake	Region	District	Catchment Area (ha)	No. of eggs	No. Hens	SPAWNER TOTAL
Blackwater--Sth.Branch	East	Dundalk	150,738	10,331,583	3,039	5,065
Ballymasganlan R	East	Dundalk	9,713	665,695	196	326
Castletown River	East	Dundalk	25,253	1,730,806	509	848
Fane R (Muckno L)	East	Dundalk	34,965	2,396,501	705	1,175
Glyde R	East	Dundalk	34,836	2,387,625	702	1,170
Dee R	East	Dundalk	39,239	2,689,407	791	1,318
Boyne R	East	Drogheda	269,490	18,470,810	5,433	9,054
Nanny R	East	Drogheda	24,605	1,686,427	496	827
Liffey R	East	Dublin	136,946	9,386,296	2,761	4,601
Dargle R	East	Dublin	12,044	825,461	243	405
Vartry R	East	Dublin	15,540	1,065,112	313	522
Slaney R	East	Wexford	176,250	12,080,141	3,553	5,922
Owenavorragh R	East	Wexford	16,188	1,109,491	326	544
Stream	East	Wexford	15,670	1,073,988	316	526
Corock R	South	Waterford	14,439	989,666	291	485
Owenduff R	South	Waterford	10,231	701,198	206	344
Suir R	South	Waterford	361,046	24,746,093	7,278	12,130
Barrow R	South	Waterford	306,786	21,027,078	6,184	10,307
Nore R	South	Waterford	253,043	17,343,567	5,101	8,502
Mahon R	South	Waterford	11,202	767,768	226	376
Tay R	South	Waterford	6,346	434,921	128	213
Daligan R	South	Waterford	2,266	155,329	46	76
Colligan R	South	Waterford	10,231	701,198	206	344
Brickey R	South	Waterford	4,209	288,468	85	141
Blackwater Cork	South	Lismore	332,686	22,802,264	6,707	11,178
Womanagh R	South	Lismore	15,216	1,042,922	307	511
Owennacurra R	South West	Cork	16,835	1,153,871	339	566
Glashaboy R	South West	Cork	15,022	1,029,608	303	505
Glengarriff R	South West	Cork	4,144	284,030	84	139
Adrigole R	South West	Cork	2,979	204,146	60	100
Coomhola R	South West	Cork	6,540	448,234	132	220
Owvane R	South West	Cork	7,964	545,870	161	268
Mealagh R	South West	Cork	5,245	359,475	106	176
Lee R System	South West	Cork	125,291	8,587,462	2,526	4,210
Bandon R	South West	Cork	60,800	4,167,249	1,226	2,043
Owenboy R	South West	Cork	14,245	976,352	287	479
Stick R	South West	Cork	7,770	532,556	157	261
Argideen R	South West	Cork	14,634	1,002,980	295	492
Ilen R	South West	Cork	30,174	2,068,092	608	1,014
Roury R	South West	Cork	3,691	252,964	74	124
Leamawaddra R	South West	Cork	2,007	137,577	40	67
Bawnaknockane R	South West	Cork	4,209	288,468	85	141
Four Mile Water	South \west	Cork	3,756	257,402	76	126
Tyshe R	South West	Kerry	2,137	146,453	43	72
Maine R	South West	Kerry	39,886	2,733,786	804	1,340
Groin River	South West	Kerry	777	53,256	16	26
Owencashla R	South West	Kerry	1,360	93,197	27	46
Owenascaul R	South West	Kerry	4,015	275,154	81	135
Scorid R	South West	Kerry	3,302	226,336	67	111
Owenalongdrig R	South West	Kerry	2,979	204,146	60	100
Owenmore R	South West	Kerry	3,691	252,964	74	124
Owennafeanna R	South West	Kerry	1,554	106,511	31	52

River / Lake	Region	District	Catchment Area (ha)	No. of eggs	No. Hens	SPAWNER TOTAL
Stream R	South West	Kerry	2,914	199,708	59	98
Laune R Sys	South West	Kerry	82,880	5,680,595	1,671	2,785
Caragh R System	South West	Kerry	17,029	1,167,185	343	572
Behy R	South West	Kerry	5,180	355,037	104	174
Ferta R	South West	Kerry	5,504	377,227	111	185
Inny R	South West	Kerry	12,173	834,337	245	409
Waterville System	South West	Kerry	11,849	812,148	239	398
Sneem R	South West	Kerry	8,677	594,687	175	292
Blackwater (Kenmare)	South West	Kerry	8,806	603,563	178	296
Finnihy R	South West	Kerry	3,173	217,460	64	107
Roughty R	South West	Kerry	20,332	1,393,521	410	683
Sheen R	South West	Kerry	9,195	630,191	185	309
Cloonee System	South West	Kerry	2,784	190,832	56	94
Owenshagh R	South West	Kerry	3,108	213,022	63	104
Croansaght R	South West	Kerry	3,950	270,716	80	133
Kealincha R	South West	Kerry	2,202	150,891	44	74
Inagh R	Shannon	Shannon	26,030	1,784,062	525	875
Annagh R--Clare	Shannon	Shannon	4,792	328,409	97	161
Aughaveemagh R	Shannon	Shannon	1,813	124,263	37	61
Annagheeragh R (incl Doo L	Shannon	Shannon	6,346	434,921	128	213
Creegh R	Shannon	Shannon	7,123	488,176	144	239
Doonbeg R	Shannon	Shannon	13,403	918,659	270	450
Shannon R System	Shannon	Shannon	1,179,421	80,837,532	3,000	5,000
Suck System	Shannon	Shannon	159,933	10,961,774	4,000	6,667
Inny R System	Shannon	Shannon	126,004	8,636,280	300	500
Fergus Sys	Shannon	Shannon	104,183	7,140,686	2,100	3,500
Feale R System	Shannon	Shannon	115,385	7,908,454	2,326	3,877
Crumlin R	West	Galway	2,784	190,832	56	94
Owenriff R	West	Galway	1,813	124,263	37	61
Owenboliska R (Spiddal)	West	Galway	8,806	603,563	178	296
Knock R	West	Galway	2,590	177,519	52	87
Corrib R	West	Galway	313,843	21,510,816	6,327	10,545
Clarin R	West	Galway	12,562	860,965	253	422
Kilcolgan/Dunkellin R	West	Galway	38,462	2,636,151	775	1,292
Kinvara Catchment	West	Galway	43,642	2,991,188	880	1,466
Caher R	West	Galway	2,072	142,015	42	70
Aille R--Clare	West	Galway	8,547	585,811	172	287
Ballynahinch R	West	Connemara	17,547	1,202,689	354	590
Owengowla R	West	Connemara	5,051	346,161	102	170
Cashla /Costello R	West	Connemara	8,094	554,746	163	272
Carrowbeg R	West	Ballynakill	5,698	390,541	115	191
Owenee/Belclare R	West	Ballynakill	4,792	328,409	97	161
Bunowen R	West	Ballynakill	7,511	514,804	151	252
Carrownisky R	West	Ballynakill	5,828	399,417	117	196
Owennadornaun R	West	Ballynakill	1,230	84,321	25	41
Bundorragha R	West	Ballynakill	5,180	355,037	104	174
Erriff Fishery	West	Ballynakill	17,677	1,211,564	356	594
Culfin Sys incl. L.Fee	West	Ballynakill	2,266	155,329	46	76
Dawros System	West	Ballynakill	5,439	372,789	110	183
Traheen R	West	Ballynakill	971	66,569	20	33
Owenglin /Clifden R	West	Ballynakill	3,432	235,212	69	115
Muingnabo R	North West	Bangor	4,144	284,030	84	139
Glenamoy R	North West	Bangor	8,547	585,811	172	287
Owenmore R .	North West	Bangor	33,670	2,307,742	679	1,131
Owenduff R	North West	Bangor	13,339	914,221	269	448
Srahmore	North West	Bangor	10,878	745,578	219	365
Newport R	North West	Bangor	14,504	994,104	292	487
Rossow R	North West	Bangor	3,302	226,336	67	111

River / Lake	Region	District	Catchment Area (ha)	No. of eggs	No. Hens	SPAWNER TOTAL
Moyour R	North West	Bangor	4,727	323,971	95	159
Belderg R	North West	Ballina	2,072	142,015	42	70
Glencullen R	North West	Ballina	1,943	133,139	39	65
Ballinglen R	North West	Ballina	4,338	297,344	87	146
Cloonalaghan R	North West	Ballina	2,137	146,453	43	72
Palmerstown R	North West	Ballina	13,209	905,345	266	444
Moy R	North West	Ballina	208,625	14,299,123	4,206	7,009
Bellawady R	North West	Ballina	2,137	146,453	43	72
Leaffona R	North West	Ballina	3,561	244,088	72	120
Finned R	North West	Ballina	2,072	142,015	42	70
Easky R	North West	Ballina	10,554	723,388	213	355
Dunneill R	North West	Sligo	2,720	186,395	55	91
Ballysadare R	North West	Sligo	65,203	4,469,031	1,314	2,191
Garvoge R Sys	North West	Sligo	36,131	2,476,384	728	1,214
Stream	North West	Sligo	2,072	142,015	42	70
Drumcliff R	North West	Sligo	6,864	470,424	138	231
Glen R	North	Ballyshannon	12,044	825,461	243	405
Glenaddragh R	North	Ballyshannon	4,209	288,468	85	141
Bungosteen R	North	Ballyshannon	4,403	301,782	89	148
Oily R	North	Ballyshannon	4,209	288,468	85	141
Eany Water R	North	Ballyshannon	11,914	816,586	240	400
Eask R	North	Ballyshannon	10,619	727,826	214	357
Stream R	North	Ballyshannon	4,338	297,344	87	146
Ballintra R	North	Ballyshannon	8,547	585,811	172	287
Duff R	North	Ballyshannon	9,195	630,191	185	309
Drowes R	North	Ballyshannon	26,483	1,815,128	534	890
Bradoge R	North	Ballyshannon	3,108	213,022	63	104
Erne R	North	Ballyshannon	437,386	29,978,454	1,200	2,000
Keenagh R	North	Letterkenny	2,914	199,708	59	98
Carrownamaddy R	North	Letterkenny	2,007	137,577	40	67
Ray /Agher R	North	Letterkenny	5,439	372,789	110	183
Clonmany R	North	Letterkenny	5,245	359,475	106	176
Straid R	North	Letterkenny	2,266	155,329	46	76
Donagh R	North	Letterkenny	3,756	257,402	76	126
Loughinn	North	Letterkenny	3,497	239,650	70	117
Owenerk R	North	Letterkenny	2,072	142,015	42	70
Crana R	North	Letterkenny	10,101	692,323	204	339
Glenvar R	North	Letterkenny	1,230	84,321	25	41
Cabry R	North	Letterkenny	1,036	71,007	21	35
Culdaff R	North	Letterkenny	6,346	434,921	128	213
Bredagh R	North	Letterkenny	1,943	133,139	39	65
Drung R	North	Letterkenny	907	62,132	18	30
Roosky R	North	Letterkenny	971	66,569	20	33
Oencronahulla R	North	Letterkenny	1,878	128,701	38	63
Owenawillin R	North	Letterkenny	648	44,380	13	22
Glenna R	North	Letterkenny	2,590	177,519	52	87
Gweedore / Crolly R	North	Letterkenny	5,828	399,417	117	196
Clady R	North	Letterkenny	9,389	643,505	189	315
Tullaghobegley R	North	Letterkenny	3,302	226,336	67	111
Faymore R	North	Letterkenny	1,748	119,825	35	59
Duntally R	North	Letterkenny	971	66,569	20	33
Lackagh/Owencarrow R	North	Letterkenny	13,015	892,031	262	437
Big Burn R	North	Letterkenny	1,230	84,321	25	41
Bunlin R	North	Letterkenny	971	66,569	20	33
Loughkeel R	North	Letterkenny	518	35,504	10	17
Leannan R	North	Letterkenny	28,037	1,921,639	565	942
Drumhallagh R	North	Letterkenny	1,295	88,759	26	44
Glenalla	North	Letterkenny	1,813	124,263	37	61

River / Lake	Region	District	Catchment Area (ha)	No. of eggs	No. Hens	SPAWNER TOTAL
Mill R	North	Letterkenny	4,597	315,096	93	154
Burnfoot R	North	Letterkenny	2,266	155,329	46	76
Owennamarve R	North	Letterkenny	2,072	142,015	42	70
Gweebarra R	North	Letterkenny	15,540	1,065,112	313	522
Abberachrin R	North	Letterkenny	2,914	199,708	59	98
Owenea R	North	Letterkenny	11,526	789,958	232	387
Swilly R	North	Letterkenny	28,943	1,983,770	583	972
Owentocker R	North	Letterkenny	4,597	315,096	93	154
175 RIVERS		TOTALS	6,332,809	434,050,729	97,805	163,008

Table 3.7.2.1 Estimated lagged egg deposition by country and year.

year	Finland	France	Iceland	Ireland	Norway	Russia	Sweden	UK(EW)	UK(NI)	UK(Scot)	North Europe	South Europe	Total Europe
1971	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1972	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1973	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1974	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1975	n/a	170,958	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1976	n/a	206,849	n/a	1,783,871	n/a	n/a	3,843	354,462	147,791	n/a	n/a	n/a	n/a
1977	n/a	118,003	195,211	1,926,669	880,036	1,680,232	5,157	342,871	132,018	4,923,315	n/a	7,442,876	n/a
1978	79,872	101,006	200,947	2,097,259	997,365	2,452,405	5,865	357,283	130,158	4,857,492	n/a	7,543,198	n/a
1979	116,014	135,808	182,281	2,035,663	995,409	2,562,400	5,150	324,822	110,481	4,380,592	3,678,974	6,987,365	10,848,620
1980	115,615	106,859	173,757	1,562,506	942,739	2,831,746	3,767	261,166	81,789	3,792,473	3,893,866	5,804,793	9,872,417
1981	110,651	91,086	182,065	1,338,192	909,466	2,557,317	2,433	271,242	84,567	3,587,917	3,579,868	5,373,005	9,134,939
1982	98,299	97,982	190,511	1,197,379	848,311	1,982,328	2,330	251,373	98,942	3,855,783	2,931,269	5,501,459	8,623,240
1983	84,485	153,252	215,188	1,069,424	822,672	1,541,822	3,435	253,786	75,531	3,799,070	2,452,413	5,351,063	8,018,663
1984	56,344	196,020	213,667	929,046	909,256	1,616,588	4,676	320,393	85,002	3,718,854	2,586,864	5,249,316	8,049,846
1985	40,325	130,815	174,513	751,745	1,090,268	1,982,727	5,025	299,672	77,300	4,113,757	3,118,345	5,373,290	8,666,149
1986	51,556	98,329	142,842	835,861	1,036,355	1,626,003	6,041	257,693	102,635	4,354,917	2,719,955	5,649,435	8,512,232
1987	73,561	128,633	118,382	1,283,831	944,884	1,436,404	6,949	279,517	117,702	4,324,104	2,461,797	6,133,788	8,713,967
1988	83,986	140,812	122,649	888,859	898,839	1,922,965	8,426	292,892	60,649	4,090,040	2,914,217	5,473,252	8,510,118
1989	89,519	122,215	125,746	954,878	926,183	2,173,042	8,589	387,121	71,712	3,878,830	3,197,332	5,414,755	8,737,833
1990	76,972	159,175	130,905	1,004,616	943,688	2,423,616	8,986	456,431	70,928	4,452,173	3,453,261	6,143,323	9,727,489
1991	75,509	152,200	151,259	1,174,663	926,008	2,531,829	9,532	493,006	55,668	4,578,881	3,542,878	6,454,418	10,148,555
1992	59,171	108,928	177,015	1,574,000	864,212	1,850,129	9,449	493,389	97,195	4,113,167	2,782,961	6,386,680	9,346,656
1993	71,959	73,017	166,105	832,904	855,010	1,498,750	10,651	401,572	53,510	3,976,367	2,436,369	5,337,371	7,939,846
1994	60,093	80,384	154,971	647,036	1,069,047	1,252,778	11,213	329,944	74,726	3,452,470	2,393,130	4,584,561	7,132,662
1995	73,776	91,462	133,454	653,286	1,362,306	1,196,180	12,649	267,680	55,702	3,008,379	2,644,910	4,076,509	6,854,873
1996	81,637	109,320	143,206	751,900	1,388,137	1,773,642	15,452	298,720	134,502	3,273,043	3,258,869	4,567,485	7,969,560
1997	87,081	101,306	156,472	657,594	1,325,707	1,929,212	18,171	373,859	214,562	3,481,607	3,360,171	4,828,928	8,345,571

Table 3.7.2.2 Conservation limit options from lagged egg deposition analysis (and other sources)

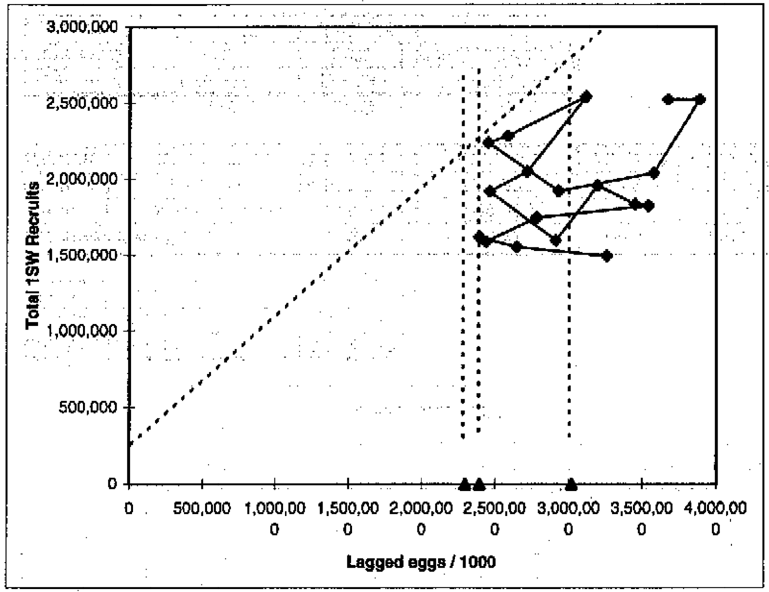
	Individual countries										Sum of countries			Stock complex analysis		
Option	Finland	France	Iceland	Ireland	Norway	Russia	Swed'n	UK(EW)	UK(NI)	UK(Sc)	South	North	Total	South	North	Total
1SW																
Opt. 1	6,683	20,531	20,217	256,109	133,720	198,389	705	46,176	11,547	469,362	803,725	339,496	1,163,438	799,368	408,197	1,252,630
Opt. 2	7,891	16,349	21,002	213,197	115,121	214,517	1,193	35,192	11,505	550,301	826,545	338,722	1,186,269	889,379	391,906	1,385,473
Opt. 3	11,051	25,699	27,924	347,485	148,934	251,654	1,735	48,943	15,224	609,365	1,046,716	413,374	1,488,014	1,087,449	515,074	1,552,171
other	0	0	0	0	0	0	0	63,000	0	0						
MSW																
Opt. 1	3,628	6,268	8,137	20,937	78,452	94,577	303	25,416	5,034	344,943	402,597	176,960	587,694	390,926	198,097	608,768
Opt. 2	4,284	4,991	8,453	17,429	67,541	102,265	513	19,370	5,016	404,426	451,232	174,603	634,288	434,945	190,191	673,328
Opt. 3	5,999	7,846	11,239	28,407	87,379	119,969	746	26,938	6,637	447,834	517,662	214,093	742,993	531,810	249,964	754,342
other	0	0	0	0	0	0	0	30,000	0	0						

Spawner escapement reserve:

		Sum of countries South	Sum of countries North	Sum of countries Total	Stock complex South	Stock complex North	Stock complex Total
1SW	Opt. 1	870,665	364,112	1,254,052	865,945	437,795	1,350,190
	Opt. 2	895,385	363,282	1,278,660	963,453	420,323	1,493,379
	Opt. 3	1,133,894	443,347	1,603,907	1,178,020	552,421	1,673,061
MSW	Opt. 1	477,201	209,751	696,597	463,366	234,806	721,575
	Opt. 2	534,848	206,957	751,824	515,543	225,435	798,099
	Opt. 3	613,587	253,765	880,674	630,357	296,284	894,125

Table 3.7.2.3 Lagged egg deposition analysis and estimation of conservation limit options - NORTHERN EUROPEAN STOCKS

Year	Lagged eggs	maturing recruits	Non-mat recruits	Total recruits	
	L			Rec.	Rec./L
1971	n/a	787,824	1,034,317	1,822,141	n/a
1972	n/a	995,069	1,316,592	2,311,661	n/a
1973	n/a	1,209,841	1,177,473	2,387,313	n/a
1974	n/a	1,153,700	1,283,790	2,437,490	n/a
1975	n/a	1,115,052	1,148,631	2,263,683	n/a
1976	n/a	1,023,532	966,452	1,989,984	n/a
1977	n/a	947,827	681,631	1,629,458	n/a
1978	n/a	757,928	1,013,453	1,771,381	n/a
1979	3,678,974	1,172,750	1,349,691	2,522,441	0.69
1980	3,893,866	1,088,130	1,435,682	2,523,812	0.65
1981	3,579,868	783,031	1,257,110	2,040,141	0.57
1982	2,931,269	657,005	1,263,745	1,920,750	0.66
1983	2,452,413	1,055,451	1,184,292	2,239,743	0.91
1984	2,586,864	1,095,207	1,188,538	2,283,745	0.88
1985	3,118,345	1,188,132	1,353,825	2,541,956	0.82
1986	2,719,955	1,065,575	983,572	2,049,147	0.75
1987	2,461,797	1,149,313	769,084	1,918,397	0.78
1988	2,914,217	879,114	716,182	1,595,296	0.55
1989	3,197,332	1,189,142	767,831	1,956,972	0.61
1990	3,453,261	1,065,017	768,869	1,833,885	0.53
1991	3,542,878	1,137,149	686,827	1,823,976	0.51
1992	2,782,961	1,053,950	692,470	1,746,421	0.63
1993	2,436,369	925,861	662,653	1,588,514	0.65
1994	2,393,130	1,020,966	595,696	1,616,662	0.68
1995	2,644,910	921,600	633,164	1,554,764	0.59
1996	3,258,869	977,514	515,385	1,492,900	0.46
1997	3,360,171	1,087,949	0	n/a	n/a



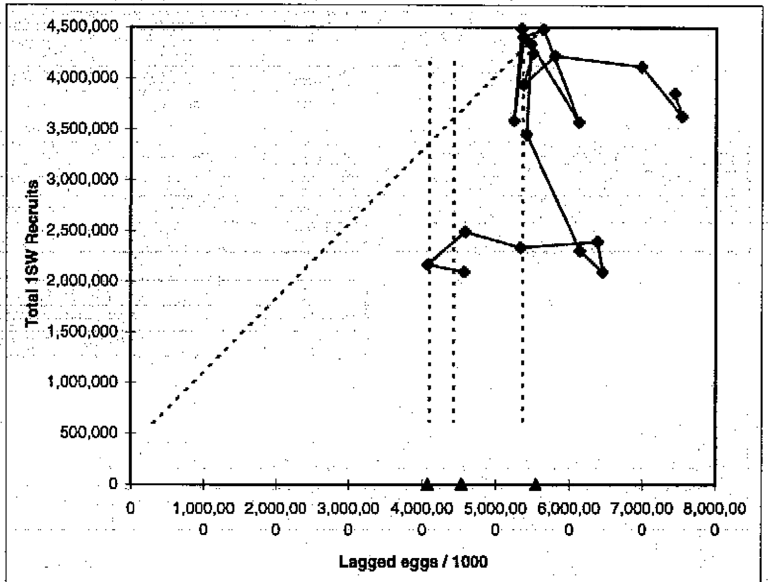
Median recruits	1,919,573
90%ile recruits	2,522,852
90%ile Rec./L	0.84

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lagged eggs)	2,393,130	408,197	198,097	606,294
Option 2	(MedRec./90%L)	2,297,623	391,906	190,191	582,098
Option 3	(90%Rec/90%L)	3,019,715	515,074	249,964	765,038

	1SW	MSW	Tot.
10yr av. #	546,233	265,086	811,319
10yr av.%	67%	33%	
eggsx10^3	990,079	2,212,311	3,202,391

Table 3.7.2.4 Lagged egg deposition analysis and estimation of conservation limit options - SOUTHERN EUROPEAN STOCKS

Year	Lagged eggs	maturing recruits	Non-mat recruits	Total recruits	
	L			Rec.	Rec./L
1971	n/a	3,105,081	2,209,779	5,314,860	n/a
1972	n/a	3,242,422	2,224,781	5,467,203	n/a
1973	n/a	3,513,025	1,936,321	5,449,346	n/a
1974	n/a	3,693,139	2,010,251	5,703,390	n/a
1975	n/a	3,381,157	1,539,409	4,920,566	n/a
1976	n/a	2,561,398	1,331,623	3,893,022	n/a
1977	7,442,876	2,419,921	1,438,005	3,857,926	0.52
1978	7,543,198	2,379,548	1,251,629	3,631,177	0.48
1979	6,987,365	2,137,434	1,977,592	4,115,026	0.59
1980	5,804,793	1,727,508	2,493,894	4,221,402	0.73
1981	5,373,005	1,746,872	2,195,294	3,942,166	0.73
1982	5,501,459	2,256,172	1,989,148	4,245,320	0.77
1983	5,351,063	3,077,066	1,409,628	4,486,693	0.84
1984	5,249,316	2,150,808	1,437,558	3,588,366	0.68
1985	5,373,290	2,392,915	2,013,347	4,406,262	0.82
1986	5,649,435	2,811,916	1,668,614	4,480,530	0.79
1987	6,133,788	2,160,619	1,410,601	3,571,220	0.58
1988	5,473,252	2,891,601	1,449,802	4,341,403	0.79
1989	5,414,755	2,214,097	1,235,778	3,449,875	0.64
1990	6,143,323	1,371,928	935,848	2,307,776	0.38
1991	6,454,418	1,142,548	951,964	2,094,512	0.32
1992	6,386,680	1,599,450	797,376	2,396,826	0.38
1993	5,337,371	1,461,954	875,483	2,337,437	0.44
1994	4,584,561	1,665,717	828,274	2,493,991	0.54
1995	4,076,509	1,437,584	731,874	2,169,459	0.53
1996	4,567,485	1,645,040	452,410	2,097,450	0.46
1997	4,828,928	1,192,986	0	n/a	n/a



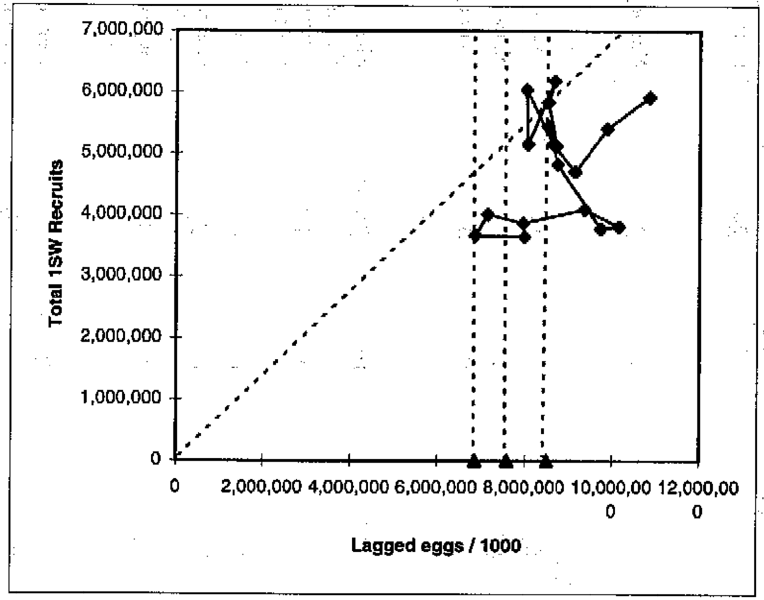
Median recruits	3,609,772
90%ile recruits	4,413,689
90%ile Rec./L	0.80

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lagged eggs)	4,076,509	799,368	390,926	1,190,294
Option 2	(MedRec./90%L)	4,535,537	889,379	434,945	1,324,325
Option 3	(90%Rec/90%L)	5,545,627	1,087,449	531,810	1,619,259

	1SW	MSW	Tot.
10yr av. #	979,339	478,939	1,458,279
10yr av.%	67%	33%	
eggsx10^{-3}	2,111,038	2,883,265	4,994,302

Table 3.7.2.5 Lagged egg deposition analysis and estimation of conservation limit options - ALL EUROPEAN STOCKS

Year	Lagged eggs	maturing recruits	Non-mat recruits	Total recruits	
	L			Rec.	Rec./L
1971	n/a	3,928,912	2,775,594	6,704,506	n/a
1972	n/a	4,269,270	2,999,237	7,268,507	n/a
1973	n/a	4,753,976	2,718,858	7,472,834	n/a
1974	n/a	4,869,343	2,816,362	7,685,706	n/a
1975	n/a	4,529,405	2,359,357	6,888,762	n/a
1976	n/a	3,615,504	2,086,807	5,702,311	n/a
1977	n/a	3,405,041	1,985,361	5,390,402	n/a
1978	n/a	3,185,978	1,986,389	5,172,367	n/a
1979	10,848,620	3,355,307	2,562,755	5,918,062	0.55
1980	9,872,417	2,814,718	2,586,881	5,401,599	0.55
1981	9,134,939	2,534,791	2,166,734	4,701,525	0.51
1982	8,623,240	2,912,140	2,245,491	5,157,631	0.60
1983	8,018,663	4,136,713	1,904,020	6,040,733	0.75
1984	8,049,846	3,252,496	1,900,349	5,152,845	0.64
1985	8,666,149	3,612,440	2,569,708	6,182,148	0.71
1986	8,512,232	3,928,959	1,905,276	5,834,235	0.69
1987	8,713,967	3,342,171	1,777,358	5,119,529	0.59
1988	8,510,118	3,838,168	1,605,802	5,443,970	0.64
1989	8,737,833	3,436,773	1,382,773	4,819,546	0.55
1990	9,727,489	2,465,546	1,309,957	3,775,502	0.39
1991	10,148,555	2,322,519	1,484,719	3,807,238	0.38
1992	9,346,656	2,717,226	1,373,163	4,090,389	0.44
1993	7,939,846	2,449,595	1,417,747	3,867,341	0.49
1994	7,132,662	2,722,604	1,286,134	4,008,737	0.56
1995	6,854,873	2,412,425	1,251,278	3,663,703	0.53
1996	7,969,560	2,667,376	976,218	3,643,594	0.46
1997	8,345,571	2,327,742	0	n/a	n/a



Median recruits	5,281,385
90%ile recruits	5,916,834
90%ile Rec/L	0.70

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lagged eggs)	6,854,873	1,252,630	608,768	1,861,398
Option 2	(MedRec./90%L)	7,581,840	1,385,473	673,328	2,058,801
Option 3	(90%Rec/90%L)	8,494,077	1,552,171	754,342	2,306,513

	1SW	MSW	Tot.
10yr av. #	1,550,835	753,693	2,304,528
10yr av.%	67%	33%	
eggsx10^{-3}	3,193,236	5,293,529	8,486,765

Table 3.9.1.1 Post-smolts and 1SW salmon caught in surface trawls in Norwegian and Scottish cruises in the northern North Sea and the Norwegian Sea with adjacent areas. Cruises marked with * were carried out by FRS, Scotland, all others by IMR, Bergen, Norway.

Year and cruise	Time of sampling (date to date)	Total no. of hauls	No. of post-smolts caught	No. of 1SW salmon	% hauls containing salmon	Area
1991	23 July / 27August	75	34	2	24	Norwegian Sea, N-East
1993	25 July / 15August	61	13	1	3	Norwegian Sea, S-E
1995 a	30 May / 1 July	47	46	2	19	SW Ireland, NW Hebrides
1995 b	7 July / 1 August	60	62	4	32	Norwegian Sea , E
1995 c	30 July / 14 August	50	2	0	4	Norwegian Sea , N
1996 a*	3 June / 13 June*	13*	167*	0*	38.5*	Shelf edge, Shetland-Faroes*
1996 b	5–15 June and 3–7 July	73	66	1	19	Norwegian Sea,S - NW Scotland -Faroes
1996 c	23 June / 2 July	8	0	0	0	North Sea
1996 d	9 July / 4 August	31	2	6	9	Greenland Sea- Norwegian Sea, N
1996 e	19 July / 15 August	89	12	1	8	Norwegian Sea E -Neast
1997 a	1 May / 1 June	75	0	3	4	Norwegian Sea, E - N-East
1997 b	28 May / 17 June	75	201[2]	3	29	Norwegian Sea,S - NW Scotland; Shetland -Faroes
1997 b[1]	28 May / 17 June	3[1]	0	1[1]	33[1]	Norwegian Sea,S - NW Scotland; Shetland -Faroes
1997 c*	23 May / 10 June*	23*	243*	0	39*	Shelf edge Shetland Faroes, Norwegian trench west
1997 d	19 June–12 July	34	1	1	6	Norwegian Sea, SE - NW
1997 e	25 July–15 August	82	2	0	2	Norwegian Sea, SE - NE
Total number 1991–97		799	851	25		

[1] A smaller «Harstad» trawl was used.
[2] One single 30 min. haul comprised 70,6% of the total

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, 1991 to 1997. The commercial fishery in SFA 14B of Labrador was closed in 1997. The commercial fishery in Québec Zone Q7 was closed in 1993 and in Zone Q8 in 1994.

	1991	1992	1993	1994	1995	1996	1997
Labrador (SFA 1, 2 and 14B)							
Licensed effort	570	495	288	218	218	218	205
Quota (t)	295	273	178	92	73.5	55	50
Harvest (t)	120	204	112	93	55	48	47
Harvest (number)	40,233	56,590	34,170	24,017	19,156	15,116	16,696
% Large (by number)	33%	57%	50%	64%	59%	48%	38%
Québec (Q7 to Q9)							
Licensed effort	152	147	94	90	90	87	87
Quota (number)	28,359	23,400	15,325	15,175	15,175	12,068	12,068
Harvest (number)	19,265	19,363	14,657	13,800	13,653	11,718	10,437
Harvest (t)	63	63	46	43	42	32	30
% Large (by number)	83%	80%	75%	72%	71%	61%	66%
Québec (Q11)							
Harvest (number)	389	337	212	485	300	268	296
Harvest (t)	2	2	1	3	2	1	2

Table 4.1.2.1 Percentages by user group and province of small and large salmon harvested in the Atlantic salmon fisheries of eastern Canada during 1997.

	% of Provincial Harvest			% of eastern	Number
	Native peoples	Recreational	Commercial	Canada	of fish
Small salmon					
Newfoundland / Labrador	1.7	64.4	34.0	53.6	30,651
Québec	1.5	58.9	39.7	15.6	8,902
New Brunswick	10.8	89.2	0.0	28.0	15,997
P.E.I.	0.3	99.7	0.0	0.7	375
Nova Scotia	13.3	86.7	0.0	2.1	1,218
Large salmon					
Newfoundland / Labrador	0.0	3.1	96.9	24.5	6,488
Québec	26.9	34.8	38.3	70.9	18.798
New Brunswick	100.0	0.0	0.0	3.9	1,028
P.E.I.	0.0	0.0	0.0	0.0	0
Nova Scotia	100.0	0.0	0.0	0.8	216
Eastern Canada		**% by User Group**			
Small salmon	4.4	71.2	24.4		57,143
Large salmon	23.7	25.4	50.9		26,530

Table 4.1.2.2 Hook-and-Released Atlantic Salmon by Anglers in Canada, 1984-97.
In New Brunswick, where spring fisheries for kelt are permitted, bright salmon are those returning in the year indicated.

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	19,173	2,324	21,497	3,526	5,661	9,187						472	238	710		1,718	1,718	**23,171**	**9,941**	**33,112**
1997	17,005	3,672	20,677	729	3,528	4,257	3,537	6,124	3,848	9,240	22,749	210	118	328	182	1,643	1,825	**27,787**	**22,049**	**49,836**

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

Table 4.1.2.3 Preliminary unreported catch estimates for Canada for 1997

ZONE	SMALL (KG)	SMALL (#)	LARGE (KG)	LARGE (#)	TOTAL (KG)	TOTAL (#)	COMMENTS
1							
2							
14B							
Labrador total					**2,500**		estimated by enforcement staff; no information on size or numbers of fish
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14A							
Newfoundland total					**24,500**		estimated by enforcement staff; no information on size or numbers of fish
15 (freshwater)	2,533	1,688	11,075	1,730	**13,608**	**3,418**	mean of 1990-94 estimate, based on value used for poaching and disease (% of inriver pop'n. estimate) for Restigouche assessment divided by 0.76 to account for whole area
15 (marine)	613	409	2,876	450	**3,489**	**859**	mean of 1990-94 estimated by enforcement staff (illegally retained); no estimates available since 1994
16 (freshwater)	7,110	4,444	5,844	1,111	**12,954**	**5,555**	mean of 1990-94 estimate, based on value used for poaching and disease for Miramichi assessment (4000 small and 1000 large) divided by 0.90 to account for whole area
16 (marine)	2,372	1,457	6,356	1,229	**8,728**	**2,686**	mean of 1990-94 estimated by enforcement staff (illegally retained); no estimates available since 1994
23	118	59	465	83	**583**	**142**	estimated by local biologist; no estimate availble from enforcement staff
New Brunswick total	12,746	8,057	26,616	4,603	**39,362**	**12,660**	
Prince Edward Island total 17	24	15	23	5	**47**	**20**	numbers estimated by local biologist; weights calculated as small = 1.59 kg and large = 4.5 kg
18	17	10	3,097	632	**3,114**	**642**	estimated by enforcement staff
19	38	20	509	93	**547**	**113**	estimated by enforcement staff
20	55	29	20	5	**75**	**34**	estimated by enforcement staff
21							no estimate available from enforcement staff
22	0	0	0	0	**0**	**0**	estimated by sceince staff
Nova Scotia total	110	59	3,626	730	**3,736**	**789**	
Q1	613	326	11,090	1,582	**11,703**	**1,908**	estimated by local biologist
Q2	274	160	3,341	621	**3,615**	**781**	estimated by local biologist
Q3	438	238	1,579	294	**2,017**	**532**	estimated by local biologist
Q5	8	4	228	48	**236**	**52**	estimated by local biologist
Q6	128	56	249	42	**377**	**98**	estimated by local biologist
Q7	165	78	285	55	**450**	**133**	estimated by local biologist
Q8	256	142	1,998	351	**2,254**	**493**	estimated by local biologist
Q9	460	219	165	37	**625**	**256**	estimated by local biologist
Q10	69	43	170	40	**239**	**83**	estimated by local biologist
Q11	159	56	154	27	**313**	**83**	estimated by local biologist based on mean 1992-96)
Quebec total	2,570	1,322	19,259	3,097	**21,829**	**4,419**	
TOTAL	15,450	9,453	49,524	8,435	**89,474**	**17,888**	

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 three rivers of eastern Maine, USA.

Magaguadavic River (SFA 23, Canada)						
Year	1SW	Prop. Aqua'	MSW	Prop. Aqua'	Total	Prop. 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%

Three rivers of eastern Maine						
	St. Croix		Dennys		Narraguagus	
Year	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%

[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 1997 relative to returns in 1996 and to returns in 1987 to 1996.

	Number of rivers in each category			
		Returns in 1997 relative to returns in 1996		
Size group	Total	<50%	50% to 90%	>= 90%
	Bay of Fundy and Atlantic Coast of Nova Scotia (SFA 19 to 23)			
Small	9	6	3	0
Large	9	3	4	2
Small & Large	10	4	4	2
	Southern Gulf of St. Lawrence (SFA 15 to 18)			
Small	10	3	5	2
Large	10	1	7	2
Small & Large	10	3	4	3
	Quebec (Zones Q1 to Q11)			
Small	13	3	6	4
Large	13	2	6	5
Small & Large	39	8	22	9
	Newfoundland and Labrador (SFA 1 to 14)			
Small	22	5	10	7
Large	22	2	4	16
Small & Large	22	4	10	8

		Rank of 1997 within the 1987 to 1997 period		
Size group	Number of rivers	Lowest	Median	Highest
	Bay of Fundy and Atlantic coast of Nova Scotia (SFA 19 to 23)			
Small	3	11	11	11
Large	4	11	11	6
Small & Large	4	11	11	5
	Southern Gulf of St. Lawrence (SFA 15 to 18)			
Small	6	11	10	7
Large	6	10	6.5	2
Small & Large	6	11	7.5	3
	Quebec (Zones Q1 to Q11)			
Small	11	11	9	3
Large	11	11	11	8
Small & Large	27	11	9	4
	Newfoundland and Labrador (SFA 1 to 14)			
Small	10	10	5.5	1
Large	10	10	1.5	1
Small & Large	10	10	5	1

Table 4.2.2.1 Estimated numbers of 1SW returns in North America by geographic regions, 1971-97.

	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	57918	11515	19525	32	204866	440305	322586
1972	24675	86362	108509	217092	12470	18704	42202	73600	9522	16915	18	197395	412692	305043
1973	5399	18897	143729	287832	16585	24877	43681	76665	14766	24823	23	224183	433117	328650
1974	27034	94619	84667	169103	16791	25186	65673	113925	26723	44336	55	220943	447223	334083
1975	53660	187809	111847	223890	18071	27106	58613	101792	25940	36316	84	268214	576997	422606
1976	37540	131391	114787	229853	19959	29938	90308	155440	36931	55937	186	299711	602745	451228
1977	33409	116931	109649	219106	18190	27285	31322	55906	30860	48387	75	223506	467691	345599
1978	16155	56542	97070	194133	16971	25456	26008	45347	12457	16587	155	168816	338221	253518
1979	21943	76800	106791	213327	21683	32524	50872	91768	30875	49052	250	232414	463721	348068
1980	49670	173845	120355	240449	29791	44686	45716	81297	49925	73560	818	296274	614655	455465
1981	55046	192662	156541	312697	41667	62501	70238	126290	37371	62083	1130	361994	757363	559679
1982	38136	133474	139951	279115	23699	35549	79874	141723	23839	38208	334	305833	628404	467118
1983	23732	83061	109378	218548	17987	26981	25337	43743	15553	23775	295	192282	396404	294343
1984	12283	42991	129235	257256	21566	30894	37696	63554	27954	47493	598	229331	442786	336058
1985	22732	79563	120816	240985	22771	33262	61255	109919	29410	51983	392	257376	516104	386740
1986	34270	119945	124547	248688	33758	46937	114718	203651	30935	54678	758	338986	674658	506822
1987	42938	150283	125116	249856	37816	54034	86564	155030	31746	55564	1128	325307	665893	495600
1988	39892	139623	132059	263363	43943	62193	123578	221720	32992	56935	992	373457	744826	559142
1989	27113	94896	59793	119261	34568	48407	72944	128962	34957	59662	1258	230634	452446	341540
1990	15853	55485	98830	197276	39962	54792	83670	156580	33939	60828	687	272941	525649	399295
1991	12849	44970	64016	127698	31488	42755	59721	111518	19759	31555	310	188143	358806	273474
1992	17993	62094	116116	231954	35257	48742	146539	229922	22832	37340	1194	339931	611246	475588
1993	25186	80938	131045	261721	30645	42156	89934	144797	15699	27747	466	292975	557825	425400
1994	18159	56888	95487	190655	29667	40170	55632	116913	7584	11785	436	206965	416847	311906
1995	25022	76453	111889	223758	23851	32368	26010	96242	12556	20539	213	199541	449573	324557
1996	51867	153553	141096	287328	32041	42618	50290	97888	17532	29428	651	293476	611466	452471
1997	66812	155963	85386	145148	24352	33091	27601	54122	6215	9350	365	210731	398039	304385

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, 1971-97.

Year	Labrador		Newfoundland		Quebec		Gulf of St. Lawrence		Scotia-Fundy		USA	North America		
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Mid-points
1971	4312	29279	2385	9104	34568	51852	29482	46780	11187	16410	653	82587	154078	118333
1972	3706	25168	2494	9129	45094	67642	35640	59880	14028	19731	1383	102346	182933	142640
1973	5183	35196	2995	11808	49765	74647	34911	59487	10359	14793	1427	104639	197358	150999
1974	5003	34148	1968	6702	66762	100143	49081	83344	21902	29071	1394	146109	254802	200455
1975	4772	32392	2382	8002	56695	85042	31174	51829	23944	31496	2331	121298	211093	166195
1976	5519	37401	2327	7663	56365	84547	29265	51382	21768	29837	1317	116561	212148	164355
1977	4867	33051	1880	6309	66442	99663	58821	100690	28606	39215	1998	162615	280928	221771
1978	3864	26147	2005	6419	59826	89739	30464	51395	16946	22561	4208	117314	200469	158891
1979	2231	15058	1103	3691	32994	49491	8670	14280	8962	12968	1942	55903	97430	76667
1980	5190	35259	2447	7794	78447	117670	43406	73765	31897	44823	5796	167183	285107	226145
1981	4734	32051	2317	7475	61633	92449	17742	29518	19030	28169	5601	111057	195263	153160
1982	3491	23662	2975	9228	54655	81982	31651	51031	17516	24182	6056	116343	196140	156242
1983	2538	17181	2511	7915	44886	67329	29037	46793	14310	20753	2155	95437	162125	128781
1984	1806	12252	2273	7117	44661	59160	20478	34063	17938	27899	3222	90378	143712	117045
1985	1448	9779	961	3319	45916	61460	23104	43274	22841	38784	5529	99799	162144	130972
1986	2470	16720	1592	5402	55159	72560	36208	70258	18102	33101	6176	119708	204217	161963
1987	3289	22341	1338	4629	52699	68365	22661	47156	11529	20679	3081	94597	166251	130424
1988	2068	14037	1553	5346	56870	75387	26137	49665	10370	19830	3286	100284	167550	133917
1989	2018	13653	704	2452	51656	67066	17307	34907	11939	21818	3197	86822	143092	114957
1990	1148	7790	1341	4562	50261	66352	25046	52970	10248	18871	5051	93095	155596	124346
1991	548	3740	1057	3577	46841	60724	20979	43771	10613	17884	2647	82686	132343	107515
1992	2515	15548	3024	10354	46917	61285	29090	60028	9777	16456	2459	93783	166130	129956
1993	3858	18234	1487	5217	37023	46484	25747	51074	7279	12622	2231	77626	135863	106745
1994	5653	24396	1889	6255	37703	47180	22086	56519	4600	7720	1346	73277	143415	108346
1995	12368	44205	2296	7462	43755	54186	24272	62503	4959	8722	1748	89398	178827	134112
1996	9113	32759	2603	8992	39433	49884	20372	42484	7045	12465	2407	80973	148991	114982
1997	9384	23833	2680	7044	32591	41348	17745	37778	3650	6161	1611	67662	117775	92719

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 4.2.4.1 Estimated numbers of 2SW spawners in North America by geographic regions, 1971-97.

	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	4302	8185	4496	9032	490	26932	72551	49742
1972	3435	24812	1985	8358	23160	34741	17802	32941	7459	12699	1038	54879	114588	84733
1973	4565	34376	2275	10720	23564	35346	20504	38068	3949	7844	1100	55956	127453	91705
1974	4490	33475	1534	6043	28657	42985	31701	57859	9526	15979	1147	77055	157487	117271
1975	4564	32119	1959	7355	23818	35726	18477	33167	11861	18830	1942	62620	129139	95879
1976	4984	36701	2003	7160	22653	33980	14821	29640	11045	18337	1126	56632	126944	91788
1977	4042	31969	1134	5131	32602	48902	32534	60108	13578	23119	643	84532	169872	127202
1978	3361	25490	1564	5728	29889	44834	11510	22725	6517	11428	3314	56156	113520	84838
1979	1823	14528	992	3506	12807	19210	3574	6770	4683	8234	1509	25388	53756	39572
1980	4633	34525	1894	6928	35594	53390	19946	37544	14270	25628	4263	80601	162278	121439
1981	4403	31615	1935	6874	26132	39199	4656	9937	5870	13353	4334	47330	105312	76321
1982	3081	23127	2635	8691	26492	39738	11035	20218	5656	11335	4643	53541	107752	80647
1983	2267	16824	2167	7364	17308	25963	7435	14191	1505	6529	1769	32451	72639	52545
1984	1478	11822	2082	6829	22345	32659	15332	27133	14245	23650	2547	58029	104640	81334
1985	1258	9530	949	3300	20668	31742	21165	39733	18185	33580	4884	67109	122768	94939
1986	2177	16334	1560	5354	24088	35939	32985	64335	15435	30120	5570	81816	157652	119734
1987	2895	21821	1322	4605	21723	31727	19871	42370	10235	19233	2781	58827	122536	90681
1988	1625	13452	1529	5310	25390	38343	23390	44584	9074	18381	3038	64046	123108	93577
1989	1727	13270	697	2441	25016	35905	14754	30450	11689	21539	2800	56683	106403	81543
1990	923	7493	1321	4532	24422	36219	22676	49533	9688	18245	4356	63385	120378	91881
1991	491	3665	1044	3557	19959	29052	19586	41299	9356	16479	2416	52853	96468	74661
1992	2012	14889	2968	10270	19337	28833	27438	53092	8725	15280	2292	62772	124655	93714
1993	3624	17922	1437	5139	15774	21428	25213	45605	6599	11862	2065	54712	104021	79366
1994	5339	23981	1825	6156	15631	21147	20308	53585	4321	7408	1344	48769	113621	81195
1995	12006	43726	2223	7350	22575	28703	22632	60074	4837	8586	1748	66021	150187	108104
1996	8838	32395	2535	8887	19030	25460	18413	39306	6662	12037	2407	57886	120491	89188
1997	9221	23646	2653	6999	15811	21243	16049	35216	3341	5816	1611	48686	94531	71609

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, 1971-97.

	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	35490	4800	12810	29	148673	372112	260393
1972	21728	83415	84107	192690	8213	12320	24319	43231	2992	10385	17	141376	342058	241717
1973	0	11405	108247	252350	10987	16480	28105	50913	8658	18715	13	156009	349876	252943
1974	24533	92118	58182	142618	10067	15100	48343	84561	16209	33822	40	157374	368259	262817
1975	49688	183837	78457	190500	11606	17409	42668	74845	18232	28608	67	200718	495266	347992
1976	31814	125665	80324	195390	12979	19469	56021	99611	24589	43595	151	205878	483881	344880
1977	28815	112337	75297	184754	12004	18006	14045	27443	16704	34231	54	146920	376826	261873
1978	13464	53851	68451	165514	11447	17170	13768	25423	5678	9808	127	112935	271892	192414
1979	17825	72682	75622	182158	15863	23795	29764	56148	18577	36754	247	157897	371783	264840
1980	45870	170045	84506	204600	20817	31226	26450	49952	28878	52513	722	207243	509057	358150
1981	49855	187471	109871	266027	30952	46428	39421	75643	18236	42948	1009	249345	619526	434436
1982	34032	129370	98080	237244	16877	25316	52020	95642	12179	26548	290	213478	514411	363944
1983	19360	78689	76958	186128	12030	18045	13611	24542	7747	15969	255	129961	323628	226794
1984	9348	40056	89904	217925	16316	24957	17990	33405	17964	37503	540	152062	354386	253224
1985	19631	76462	84264	204433	15608	25140	39514	73534	18158	40731	363	177539	420663	299101
1986	30806	116481	87051	211192	22230	33855	82122	149226	21204	44947	660	244072	556361	400216
1987	37572	144917	100634	225374	25789	40481	59330	109832	21589	45407	1087	246000	567096	406548
1988	34369	134100	92218	223522	28582	44815	85644	158765	23288	47231	923	265025	609356	437191
1989	22429	90212	41331	100799	24710	37319	44715	81484	23873	48578	1080	158138	359473	258806
1990	12544	52176	68863	167309	26594	39826	56161	110934	22753	49642	617	187531	420506	304018
1991	10526	42647	43487	107169	20582	30433	44350	86098	13814	25610	235	132994	292192	212593
1992	15229	59331	92434	208272	21754	33583	118723	188206	15125	29633	1124	264389	520149	392269
1993	22499	78251	104712	235387	17493	27444	70969	116268	11957	24005	444	228074	481799	354937
1994	15228	53958	65691	160859	16758	25642	32647	89883	6699	10900	427	137450	341670	239560
1995	22144	73575	81877	193746	14409	21548	15403	60744	10519	18502	213	144564	368328	256446
1996	48362	150048	102834	249067	18956	27864	24396	68735	14287	26183	651	209487	522549	366018
1997	64049	153200	67874	127637	14795	22304	12764	36484	5244	8379	365	165091	348368	256730

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	49742		652826		16447		5020		14777		6243		6764		490	
72	84733		645486		14124		5171		28951		25371		10079		1038	
73	91705		770199		19470		6497		29455		29286		5896		1100	
74	117271		712402		18982		3788		35821		44780		12752		1147	
75	95879		807390		18341		4657		29772		25822		15345		1942	
76	91788		718804		20842		4582		28316		22230		14691		1126	
77	127202		587325		18006		3132		40752		46321		18348		643	
78	84838	95491	330077	3.46	14425	14759	3646	5901	37362	28016	17118	35340	8973	10034	3314	1442
79	39572	107083	730725	6.82	8175	17486	2249	4752	16008	32232	5172	36790	6459	14270	1509	1553
80	121439	96196	639191	6.64	19579	18903	4411	4441	44492	31940	28745	24947	19949	14937	4263	1029
81	76321	104088	605934	5.82	18009	18795	4404	4517	32666	30266	7296	31923	9612	16888	4334	1699
82	80647	107257	503480	4.69	13104	19695	5663	3679	33115	34821	15626	34004	8496	12699	4643	2358
83	52545	82157	286897	3.49	9546	18710	4765	3457	21636	36526	10813	13216	4017	7514	1769	2733
84	81334	79783	296449	3.72	6650	15422	4456	2822	27502	28065	21232	14900	18947	14569	2547	4006
85	94939	85256	468772	5.50	5394	11576	2124	3682	26205	32359	30449	19527	25882	13668	4884	4443
86	119734	79228	505063	6.37	9255	15361	3457	4377	30013	35728	48660	11236	22777	8998	5570	3528
87	90681	77704	462952	5.96	12358	17772	2963	5171	26725	33119	31120	13470	14734	5813	2781	2359
88	93577	78778	370524	4.70	7538	14762	3420	5029	31866	27538	33987	15100	13728	13002	3038	3347
89	81543	93668	293735	3.14	7498	10875	1569	4506	30461	25762	22602	24599	16614	23026	2800	4901
90	91881	103267	256967	2.49	4208	7799	2926	3032	30320	26580	36105	37430	13966	23978	4356	4449
91	74661	99686	299080	3.00	2078	6285	2300	3043	24506	28072	30443	41156	12917	17965	2416	3166
92	93714	89278	180896	2.03	8451	8072	6619	3110	24085	28227	40265	32774	12002	14173	2292	2922
93	79366	91714	137699	1.50	10773	10649	3288	3197	18601	29616	35409	29377	9231	15464	2065	3410
94	81195	88949	161422	1.81	14660	9247	3990	2275	18389	30646	36947	28308	5865	15007	1344	3464
95	108104	89454	157197	1.76	27866	7453	4786	2480	25639	30138	41353	33463	6712	13350	1748	2570
96	89188	84350	127251	1.51	20617	5299	5711	2652	22245	27289	28860	34519	9350	12373	2407	2219
97	71609	83217			16434	3511	4826	4946	18527	24550	25632	38051	4579	10342	1611	1817
98		76916				6285		4358		21312		36166		7225		1571
99		80287				9930		3894		19459		38659		6391		1954
00		87251				14098		4510		22057		36258		8290		2039

Spawners lagged by:

Labrador = 0.0768 x i-5 spawners + 0.542 x i-6 + 0.341 x i-7 + 0.0401 x i-8
Newfoundland = 0.0408 x i-4 spawners + 0.5979 x i-5 + 0.3237 x i-6 + 0.0375 x i-7
Quebec = 0.0577 x i-4 spawners + 0.4644 x i-5 + 0.3783 x i-6 + 0.0892 x i-7 + 0.0104 x i-8
Gulf = 0.3979 x i-4 spawners + 0.5731 x i-5 + 0.0291 x i-6
Scotia-Fundy = 0.6002 x i-4 spawners + 0.3942 x i-5 + 0.0055 x i-6
USA = 0.3767 x i-3 spawners + 0.520 x i-4 + 0.1033 x i-5.

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		5,002
		Q2		3,116
		Q3		3,596
		Q5		1,326
		Q6		1,966
		Q7		6,461
		Q8		20,026
		Q9		7,794
		Q10		3,963
		Q11		7,500
	Subtotal		60,750	
	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			154,653	
USA	Connecticut			9,727
	Merrimack			2,599
	Penobscot			6,838
	Other Maine rivers			9,668
	Paucatuck			367
Total			29,199	
North American Total			183,852	

Table 4.5.1 Fishing mortalities of 2SW salmon equivalents by North American fisheries, 1972-97.
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)	% 1SW of total 2SW equivalents	NF-LAB Comm 2SW (Yr i)	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	242316	346	242662	24
1973	24016	8	223603	247619	719	904	32751	17913	6680	306586	327	306913	19
1974	32828	9	240676	273504	593	547	47631	21432	12734	356442	247	356689	23
1975	32316	9	242398	274714	241	535	41097	15680	12375	344640	389	345030	20
1976	47846	13	261770	309616	618	414	42139	18093	11111	381991	191	382182	19
1977	36777	10	246090	282867	954	962	42301	33435	15562	376081	1355	377436	25
1978	37200	14	160477	197677	580	566	37421	23812	10781	270837	894	271730	27
1979	18825	13	93917	112742	469	148	25234	6303	4506	149403	433	149836	25
1980	27923	8	221597	249520	646	709	53567	29841	18411	352693	1533	354225	30
1981	46088	14	205403	251492	384	491	44375	16334	13988	327064	1267	328331	23
1982	45894	18	137132	183026	473	438	35204	25715	12353	257208	1413	258621	29
1983	34348	15	113815	148163	313	448	34472	27102	13515	224013	386	224399	34
1984	25969	18	84480	110448	379	239	24408	6038	3971	145484	675	146159	24
1985	19578	14	80351	99929	219	16	27483	2740	4930	135318	645	135963	27
1986	26504	15	107009	133514	340	40	33846	4573	2824	175137	606	175742	24
1987	33629	16	134879	168508	457	21	33807	3788	1370	207950	300	208250	19
1988	42874	26	82769	125642	514	30	34262	3914	1373	165735	248	165983	24
1989	29664	20	82998	112662	337	9	28901	3505	265	145679	397	146076	23
1990	26164	22	58518	84682	261	25	27986	2903	593	116451	696	117146	28
1991	16101	18	41250	57352	66	17	29277	1932	1331	89975	231	90206	36
1992	13336	18	25615	38952	581	70	30016	4294	1114	75027	167	75194	48
1993	4315	10	13541	17856	273	64	23153	3002	720	45068	166	45235	61
1994	2859	7	12179	15038	365	82	24052	2356	295	42188	1	42189	64
1995	1660	5	8852	10511	420	93	23331	2034	129	36519	0	36519	71
1996	1437	4	5760	7197	320	87	22413	2569	406	32990	0	32990	78
1997	1295	5	5499	6795	175	36	18442	2129	327	27905	0	27905	76
1998	1544	-	-	-	-	-	-	-	-	-	-	-	-

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

Table 4.5.2 History of fishing-related mortalities of North American salmon as 2SW equivalents, 1972-97.

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	242316	346	242662	0.14	260296	502958	48
1973	306586	327	306913	0.11	181677	488590	63
1974	356442	247	356689	0.07	218512	575200	62
1975	344640	389	345030	0.11	199593	544622	63
1976	381991	191	382182	0.05	252304	634486	60
1977	376081	1355	377436	0.36	141060	518497	73
1978	270837	894	271730	0.33	171656	443386	61
1979	149403	433	149836	0.29	107543	257379	58
1980	352693	1533	354225	0.43	181023	535248	66
1981	327064	1267	328331	0.39	170108	498439	66
1982	257208	1413	258621	0.55	206056	464677	56
1983	224013	386	224399	0.17	176185	400585	56
1984	145484	675	146159	0.46	30077	176236	83
1985	135318	645	135963	0.47	35213	171175	79
1986	175137	606	175742	0.34	125983	301726	58
1987	207950	300	208250	0.14	155401	363652	57
1988	165735	248	165983	0.15	157158	323141	51
1989	145679	397	146076	0.27	105655	251731	58
1990	116451	696	117146	0.59	54917	172064	68
1991	89975	231	90206	0.26	66152	156357	58
1992	75027	167	75194	0.22	100147	175342	43
1993	45068	166	45235	0.37	37872	83106	54
1994	42188	1	42189	0.00	0	42189	100
1995	36519	0	36519	0.00	0	36519	100
1996	32990	0	32990	0.00	18846	51836	64
1997	27905	0	27905	0.00	14641	42546	66

Greenland harvest of 2SW equivalents = NG1 * 0.904837

Table 5.1.1.1 Nominal catches of salmon, West Greenland 1960-97 (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	-
1993	-	-	-	-	0[5]	0[5]	-
1994	-	-	-	-	0[5]	0[5]	-
1995	-	-	-	-	83	83	77
1996	-	-	-	-	92	92	174[8]
1997[9]	-	-	-	-	58	58	57

[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] Preliminary.

Factor used for converting landed catch to round fresh weight in fishery by Greenland vessels = 1.11.
Factor for Norwegian, Danish, and Faroese drift net vessels = 1.10.

Table 5.1.1.2 Distribution of nominal catches (metric tons), Greenland vessels.

	NAFO Division							Total	East	Total
Year	1A	1B	1C	1D	1E	1F	NK	Westgrl.	Greenland	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

[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) and from commercial samples (1978-92 and 1995-97).

		Sample size		Continent of origin (%)			
Source	Year	Length	Scales	NA	(95%CI)[1]	E	(95%CI)
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[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	65	(69,61)	35	(39,31)
	1996	3341	1297	55	(67,42)	45	(58,33)
	1997	794	282	60	(66,55)	40	(45,34)

[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 1982-97.

	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	65	35	20700	11200
1996	53	47	16800	15200
1997	61	39	13000	8300

Table 5.1.3.1 Annual mean fork lengths and whole weights of Atlantic salmon caught at West Greenland, 1969-92 and 1995-97. 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	3.1	3.8	5.5	5.8	-	5.1	3.3	3.9	3.6	65.0	68.7	77.0	80.3	-	75.3
1970	2.9	3.5	5.7	5.5	4.9	3.8	3.1	3.5	3.3	64.7	68.6	81.5	82.0	78.0	75.0
1971	2.7	3.4	4.3	-	-	-	2.7	3.4	3.1	62.8	67.7	72.0	-	-	-
1972	3.0	3.5	5.9	6.1	2.7	4.0	3.3	3.6	3.4	64.2	67.9	80.7	82.4	61.5	69.0
1973	3.3	4.5	9.5	10.0	-	-	3.8	4.7	4.2	64.5	70.4	88.0	96.0	61.5	-
1974	3.1	3.8	7.1	8.1	3.4	-	3.2	3.9	3.6	64.1	68.1	82.8	87.4	66.0	-
1975	2.6	3.4	6.1	6.2	2.6	4.8	2.7	3.5	3.1	61.7	67.5	80.6	82.2	66.0	75.0
1976	2.6	3.2	6.2	7.2	3.6	3.6	2.8	3.2	3.0	61.3	65.9	80.7	87.5	72.0	70.7
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	3.0	3.5	7.0	7.9	2.5	6.6	3.0	3.5	3.4	63.7	67.3	83.6	-	60.8	85.0
1979	3.0	3.5	7.1	7.6	3.9	6.3	3.1	3.6	3.3	63.4	66.7	81.6	85.3	61.9	82.0
1980	3.0	3.3	6.8	6.7	3.6	3.9	3.1	3.4	3.2	64.0	66.3	82.9	83.0	67.0	70.9
1981	2.8	3.5	6.9	7.4	4.1	3.7	2.9	3.6	3.2	62.3	66.7	82.8	84.5	72.5	-
1982	2.8	3.2	5.6	5.6	4.0	5.7	2.9	3.4	3.1	62.7	66.2	78.4	77.8	71.4	80.9
1983	2.5	3.0	5.8	5.9	3.4	3.6	3.0	3.1	3.1	61.5	65.4	81.1	81.5	68.2	70.5
1984	2.6	2.8	5.8	5.8	3.6	5.8	3.2	3.0	3.1	62.3	63.9	80.7	80.0	69.8	79.5
1985	2.5	2.9	5.4	5.5	5.2	5.0	2.7	3.0	2.9	61.2	64.3	78.9	78.6	79.1	77.0
1986	2.8	3.1	6.4	6.1	3.3	4.4	2.9	3.2	3.0	62.8	65.1	80.7	79.8	66.5	73.4
1987	3.0	3.2	6.4	6.0	4.7	4.7	3.1	3.3	3.2	64.2	65.6	81.2	79.6	74.8	74.8
1988	2.8	3.4	6.8	6.8	4.8	4.6	2.9	3.4	3.2	63.0	66.6	82.1	82.4	74.7	73.8
1989	2.6	2.9	5.9	5.8	4.2	5.8	2.8	3.0	2.9	62.3	64.5	80.8	81.0	73.8	82.2
1990	2.5	2.6	6.5	5.8	3.9	5.1	2.7	2.7	2.7	62.3	62.7	83.4	81.1	72.6	78.6
1991	2.4	2.5	5.8	6.2	5.2	5.1	2.6	2.8	2.7	61.6	62.7	80.6	82.2	81.7	80.0
1992	2.5	2.7	6.5	6.0	4.1	5.3	2.9	2.7	2.8	62.3	63.2	83.4	81.1	77.4	82.7
1995	2.4	2.6	6.5	5.3	3.8	4.0	2.7	2.6	2.5	61.2	62.6	82.1	78.5	71.5	72.8
1996	2.7	2.8	6.6	6.2	5.2	4.9	2.9	2.8	2.9	63.0	63.4	81.3	81.6	78.2	77.0
1997	2.6	2.7	7.5	-	5.6	3.6	2.7	2.7	2.7	62.6	63.1	85.3	-	84.2	69.0

Table 5.1.3.2 River age distribution (%) for all North American and European origin salmon caught at West Greenland, 1968-92 and 1995-97.

	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	5.3	29.1	35.2	20.2	8.4	1.9	0.0	0.0
1996	7.4	23.8	35.2	21.9	10.7	0.9	0.2	0.0
1997	2.0	18.7	45.3	16.7	16.0	1.3	0.0	0.0
Mean	4.4	36.7	36.0	16.3	6.2	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	14.7	54.9	27.5	3.0	0.0	0.0	0.0	0.0
1996	7.6	49.2	31.5	10.2	1.3	0.2	0.0	0.0
1997	3.6	55.0	37.8	2.7	0.9	0.0	0.0	0.0
Mean	19.7	60.1	17.5	2.9	0.4	0.0	0.0	0.0

Table 5.1.3.3 Sea-age composition (%) of samples from commercial catches at West Greenland, 1985-97.

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	97.3	1.3	1.4	96.0	2.5	1.6
1996	92.1	5.4	2.5	97.1	1.7	1.2
1997	98.0	0.9	1.1	99.7	0.5	0.8

Table 5.1.3.4 Distribution (percent of landings) by sizes of salmon captured at West Greenland, NAFO SA1 for the years 1987-92 and 1995-97.

Size category	Year								
kg	1987	1988	1989	1990	1991	1992	1995	1996	1997
1.1 - 3.3	63.8	56.1	77.5	72.9	82.9	55.3	84.5	66.7	71.5
3.3 - 5.6	32.1	41.3	18.4	23.5	14.4	41.7	12.4	28.8	25.1
> 5.6	4.0	2.6	4.1	3.6	2.7	3.0	3.1	4.5	3.4

Table 5.5.3.1 Descriptions of various steps followed in the procedure to provide catch advice for West Greenland. For each step a list of references, sections, figures and tables are provided as a guide to find more detailed explanation of the various assumptions and methods employed.

		References to present WG Report	
Step 1:	**Provide estimated returns (1SW & MSW) to North American (NA) regions**		
Method:	Run-reconstruction models for regions in NA (various river models)	**Sec.:**	**4.2.2**
		App.:	5
Input:	Abundance estimates, catches	Eq.:	4.2.3.1-3
Output:	Estimated number of maturing and non-maturing 1SW salmon returning to NA	Tab.:	4.2.2.1-2
Step 2:	**Run-reconstruction model**		
Method:	Adds NA returning estimate and catches to calculate pre-fishery abundance (PFA)	**Sec.:**	**4.2.3**
Input:	No. returns and spawners from step 1, Natural mortality estimates, Catches	Tab.:	4.2.2.2, 4.2.3.1-2
Output:	Back-calculated PFA	Tab.:	4.2.3.3
		Fig.:	4.2.3.1
Step 3:	**Predictions (forecast model) of currents year's PFA**		
Method:	Multiple linear regression, Jacknife prediction, Stochastic analysis	**Sec.:**	**5.6.2**
		App.:	**4**
Input:	Pre-fishery abundance estimates from step 2, Thermal habitat index (for a specific period of the year), Lagged spawner estimates	Tab.:	4.2.4.1, 4.2.4.3-4, 5.6.1.1
Output:	Predicted PFA's and a projection of current year's PFA (uncertainity estimated with cumulative probability distribution function in 5% percentile steps)	Tab.:	5.6.2.1-2
		Fig.:	5.6.1.1
Validation:	Compares predicted PFA's from step 3 and PFA's estimated from the run-reconstruction model in step 2	Fig.:	5.6.2.2-3
Step 4:	**Catch advice model -quota projections for Greenland**		
Method:	Quota calculations accounting for mortality and the spawner requirement set aside for NA, proportion of NA fish at Greenland, Mean weight of 1 SW salmon, Adjust for age composition of MSW (ACF) at Greenland, Exponential smoothing model	**Sec.:**	**5.6.3, 4.4**
		App.:	**6**
Input:	Estimated cumulative pdf of PFA values for the current year from step 3, Estimated no. 2SW spawning escapement, Proportion of NA fish at Greenland	Tab.:	5.6.2.2 (4.2.3.3-4), 4.4.1
Output:	Allowable harvest, Quota scenario's with associated levels of risk (of not meeting the NA spawning requirements/conservation targets)	Tab.:	5.6.3.1
Step 5:	**Risk associated of applying the Greenland quota to NA conservation requirements**		
Method:	Incorporate the uncertainities in all factors used to develop catch options (quota, Step 4)	**Sec.:**	**5.6.4, 4.4**
Input:	Uncertanity measures (pdf's and min-max bounds) of spawning requirement, PFA forecast, biological parameters to translate catches (weights) into numbers of NA origin salmon	Fig.:	5.6.4.2-3
Output:	Risk associated of not meeting the 100% NA spawner requirement for catch opions at W Greenland	Fig.:	5.6.4.4

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	578954	726699	652826	2011					
1972	557788	733183	645486	1990					
1973	672661	867737	770199	1708					
1974	623992	800812	712402	1862					
1975	710243	904537	807390	1827					
1976	610836	826772	718804	1676					
1977	506933	667717	587325	1915					
1978	288808	371345	330077	1951	35441	81978	58,710	508861.1	-178784
1979	630107	831343	730725	2058	42640	94840	68,740	601469.7	129255
1980	549069	729314	639191	1823	43222	97219	70,221	569398	69793
1981	527384	684484	605934	1912	43287	97645	70,466	613915.7	-7981
1982	439898	567062	503480	1703	43393	98396	70,895	557790.6	-54310
1983	236420	337375	286897	1416	40425	91991	66,208	403477.9	-116581
1984	245426	347472	296449	1257	37658	84098	60,878	238563.9	57885
1985	399007	538538	468772	1410	39305	83265	61,285	269111.1	199661
1986	435085	575040	505063	1688	39891	89038	64,465	443104.7	61958
1987	398154	527749	462952	1627	36298	87453	61,876	382448.2	80503
1988	317613	423435	370524	1698	37061	83602	60,332	387608.5	-17085
1989	241518	345953	293735	1642	41944	86394	64,169	442798	-149063
1990	218190	295743	256967	1503	40952	81826	61,389	342165.8	-85199
1991	249690	348471	299080	1357	37575	73152	55,364	182780.2	116300
1992	144482	217310	180896	1381	35591	71572	53,582	177352.6	3544
1993	95572	179827	137699	1252	38381	79473	58,927	229393.5	-91694
1994	109457	213387	161422	1329	38395	75957	57,176	219947.4	-58525
1995	117752	196643	157197	1310	36738	70104	53,421	151163.5	6034
1996	97940	156563	127251	1470	33488	61737	47,613	111649.6	15602
1997				1594	30356	56343	43,350	*93,326* 1	
1998				1849	26327	52031	39,179	*113,899* 1	

Table 5.6.2.1 Results of analysis of prefishery abundance (NN1) on February thermal habitat(H2)and North American spawners (SLNQ), 1978-96.

General Linear Models Procedure

Dependent Variable: NN1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	465212757379	232606378690	31.01	0.0001
Error	16	120018103905	7501131494		
Corrected Total	18	585230861284			

R-Square	C.V.	Root MSE	NN1 Mean
0.794922	24.14877	86609.073	358647.99

Source	DF	Type I SS	Mean Square	F Value	Pr > F
H2	1	358071389964	358071389964	47.74	0.0001
SLNQ	1	107141367416	107141367416	14.28	0.0016

Source	DF	Type III SS	Mean Square	F Value	Pr > F
H2	1	77336919941	77336919941	10.31	0.0055
SLNQ	1	107141367416	107141367416	14.28	0.0016

Regression statistics

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	-1101048.913	-5.55	0.0001	198365.4457
H2	334.707	3.21	0.0055	104.2400
SLNQ	15.239	3.78	0.0016	4.0321

Summary of Stepwise Procedure for Dependent Variable NN1

Step	Variable Entered	Variable Removed	Number In	Partial R**2	Model R**2	C(p)	F	Prob>F
1	SLNQ		1	0.6628	0.6628	11.3100	33.4113	0.0001
2	H2		2	0.1321	0.7949	3.0000	10.3100	0.0055

Table 5.6.2.2 Estimate of pre-fishery abundance in 1998 forecasted by H2-SNLQ regression model of probability levels between 25 and 75%.

Cumulative Density Function %	Forecast
25	14,235
30	36,326
35	56,943
40	76,459
45	95,362
50	113,899
55	132,581
60	151,512
65	171,000
70	191,607
75	213,945

Table 5.6.3.1 Quota options (mt) for 1998 at West Greenland based on H2-SNLQ 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										
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	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
75	0	4	9	13	18	22	27	31	36	40	45

Sp. res =	205,230
Prop NA =	0.5844
WT1SWNA =	2.623
WT1SWE =	2.740
ACF =	1.118

Figure 2.1.1.1 Nominal catches of salmon in four North Atlantic regions 1960-97

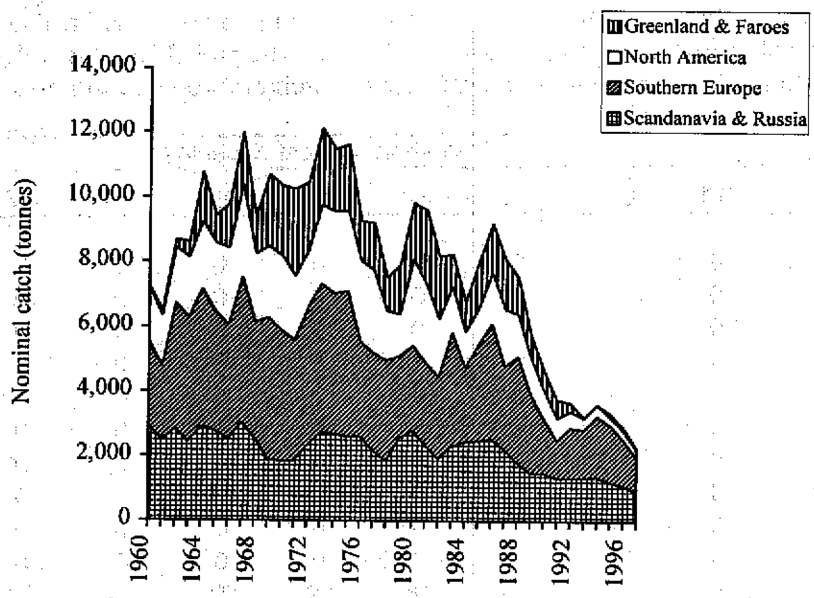


Figure 2.1.4.1. Total reported catch, unreported catch (in NASCO Areas) and % unreported catch of combined catch 1987-1996

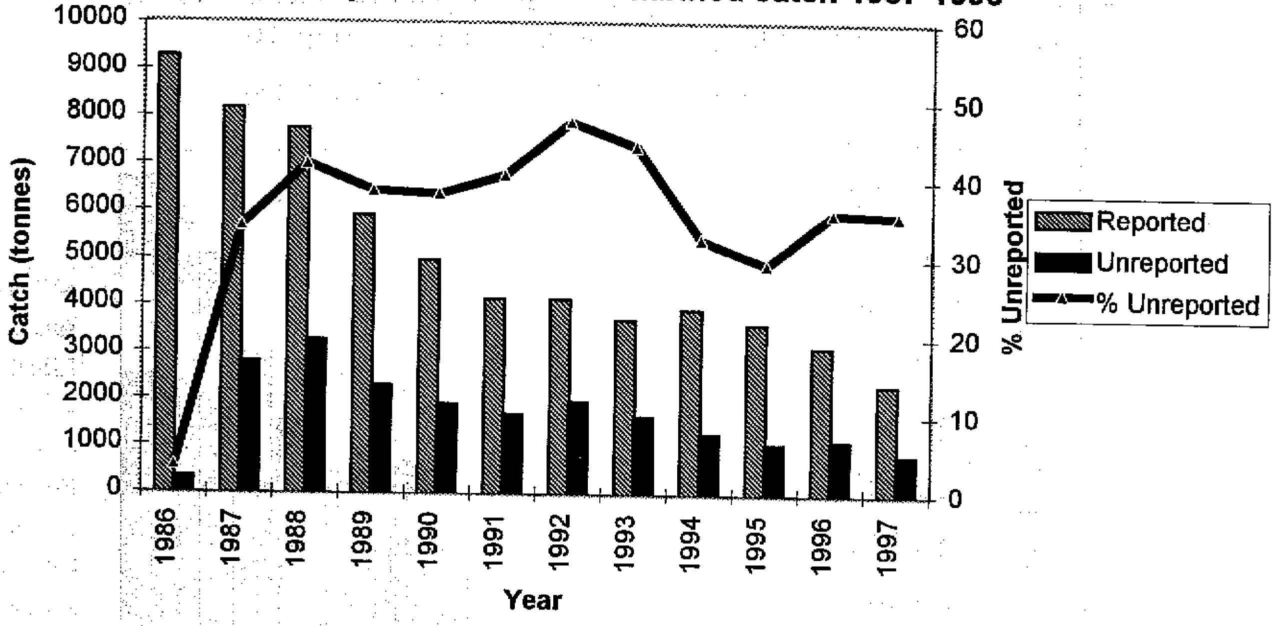


Figure 2.2.1.1 Production of farmed salmon (tonnes round fresh weight) in the North Atlantic, 1980-1997 (legend stacked relative to 1997 tonnages)

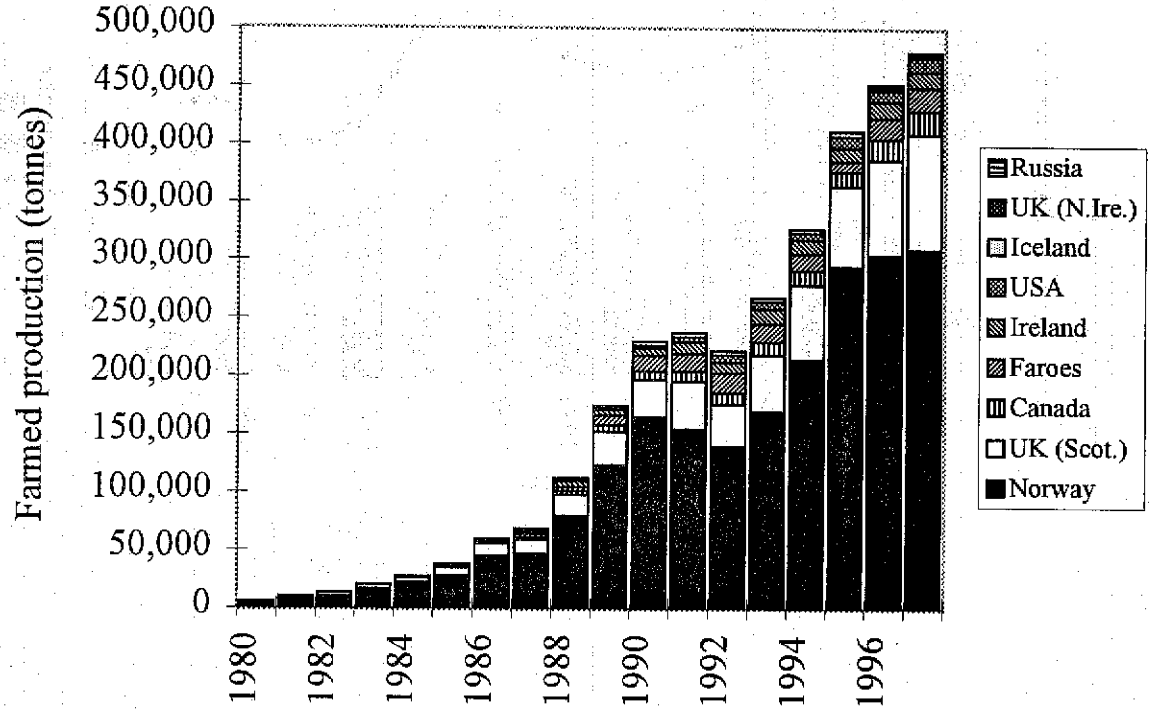


Figure 2.2.1.2 Production of farmed salmon (tonnes round fresh weight) in areas other than the North Atlantic, 1987-1997 (legend stacked relative to 1997 tonnages)

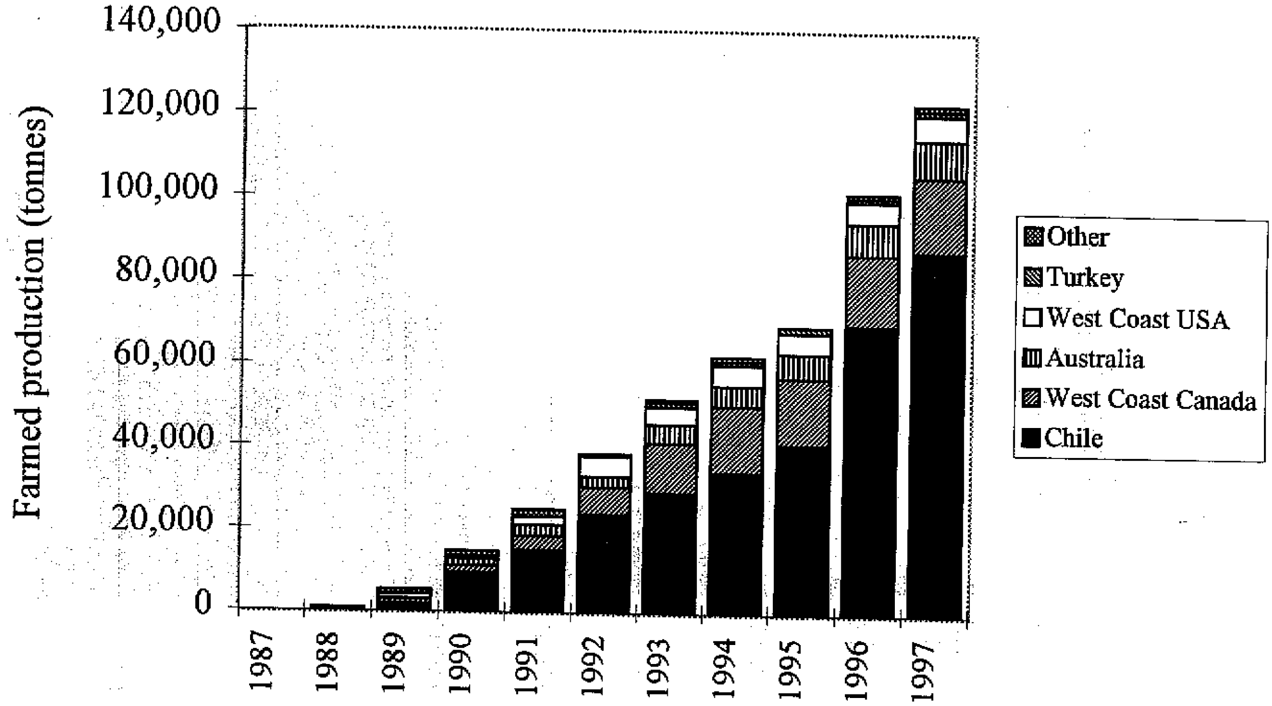


Figure 2.2.2.1. Production of ranched salmon (tonnes round fresh weight) as harvested at ranching facilities in the North Atlantic, 1980-1997 (legend stacked relative to 1997 tonnages).

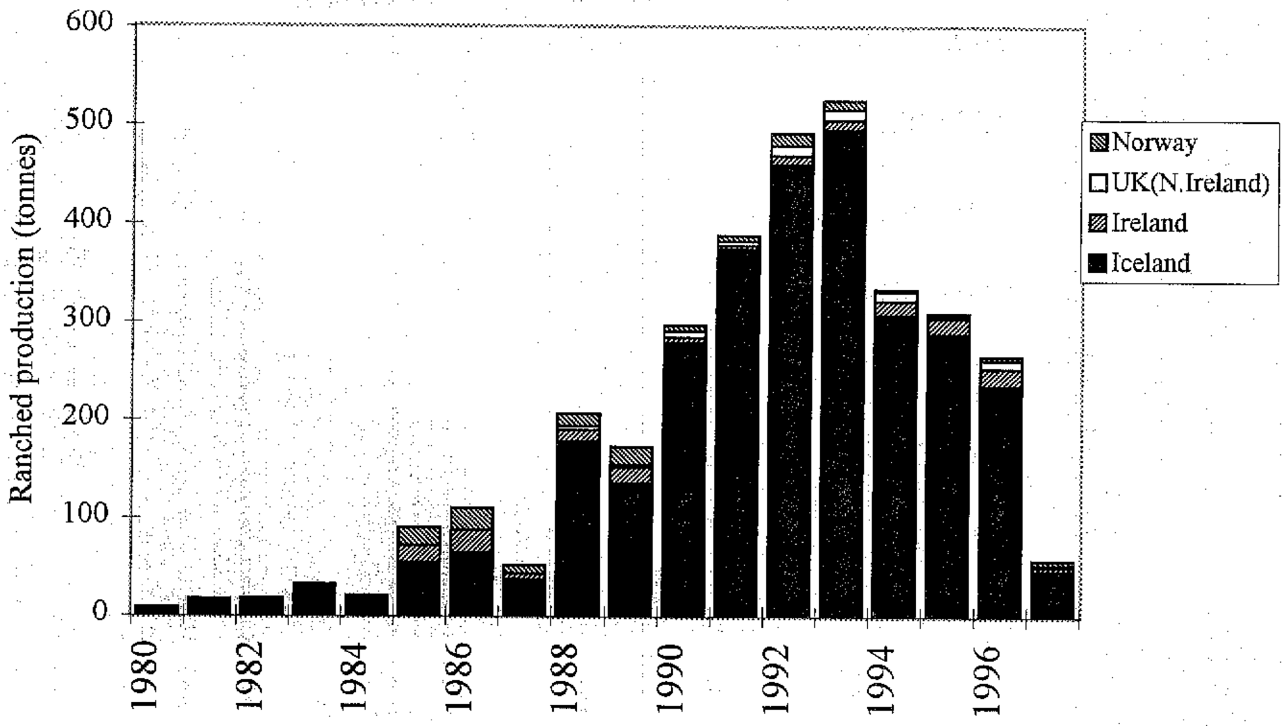


Figure 2.3.1.1. Map of Northwest Atlantic area showing post-smolt habitat for stocks in the Gulf of St. Lawrence and south (horizontal hatching) and sampling area for Gulf of St. Lawrence post-smolts (vertical hatching).

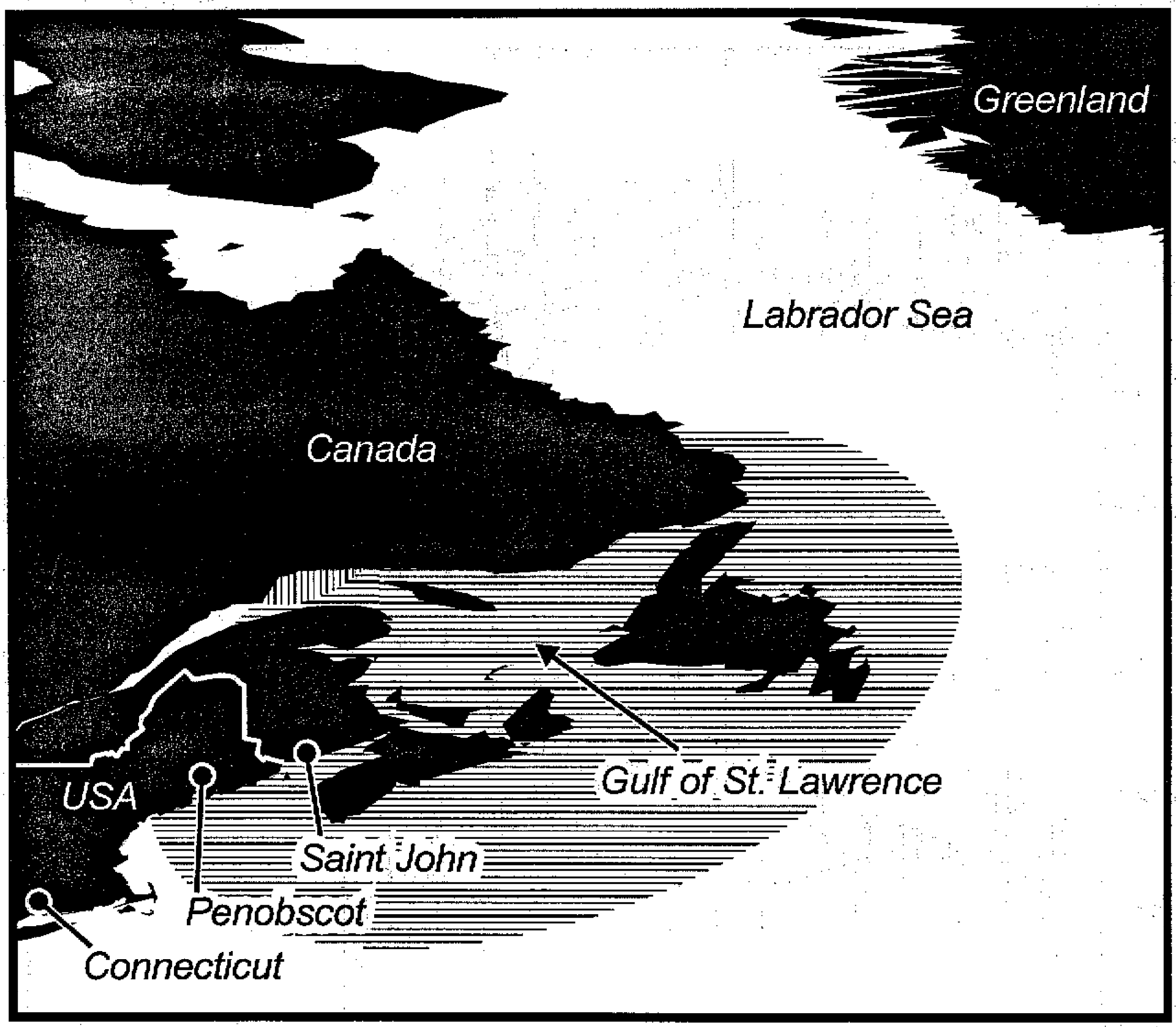


Figure 2.3.1.2. Circuli spacing versus circuli pair for Connecticut 2SW (Conn), Penobscot 1SW and 2SW (Pen), Saint John 1SW annd 2SW (SJ), and Gulf of St. Lawrence post-smolts (Gulf) for three smolt year classes, 1982 (A), 1983 (B), and 1984 (C). Error bars mark 95% confidence intervals.

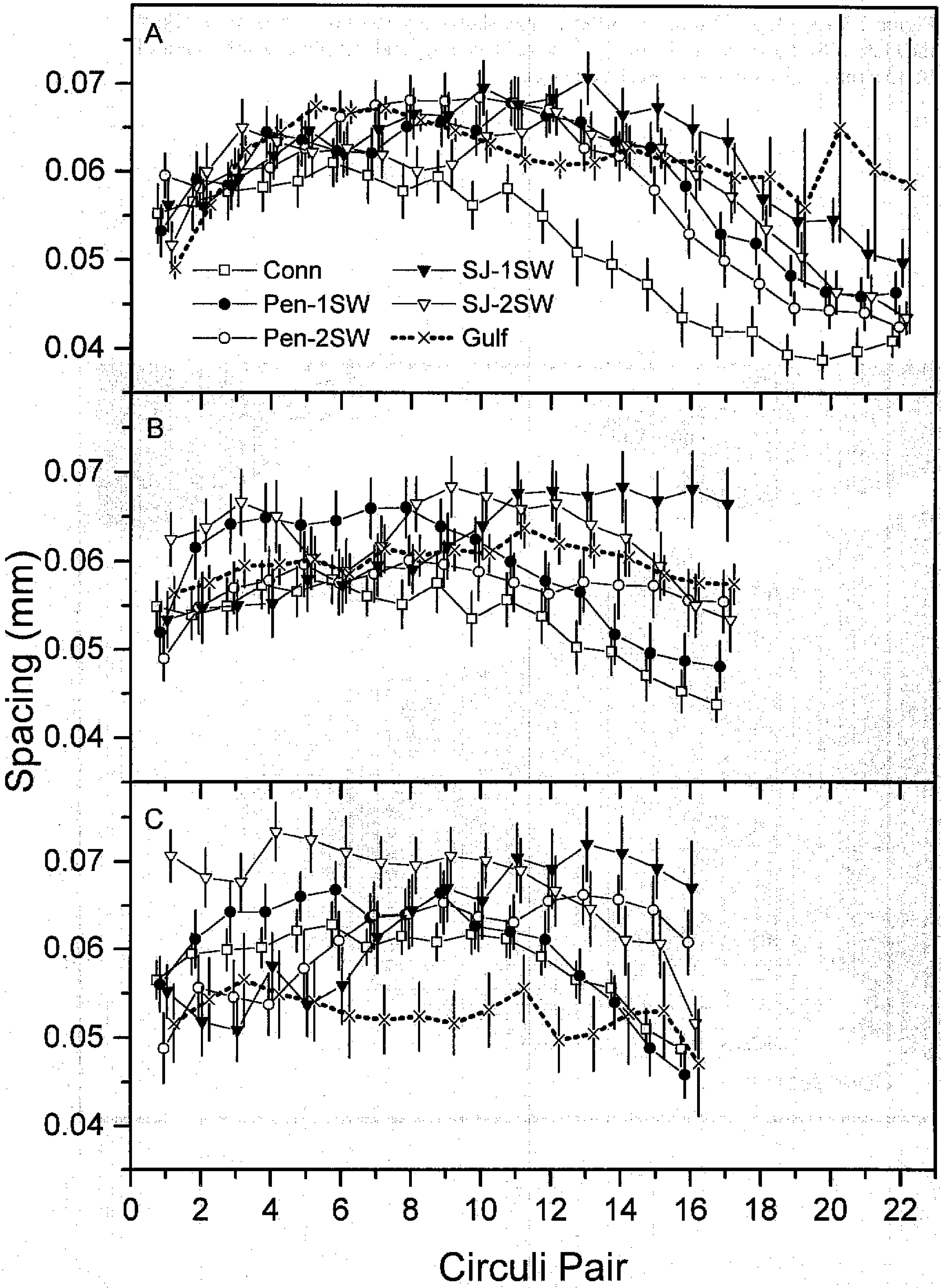


Figure 2.3.2.1. Map of the Northwest Atlantic area showing the location of research fishing for post-smolts and sub-area showing where post-smolts were encountered; and, location of stock used in post-smolt growth comparisons.

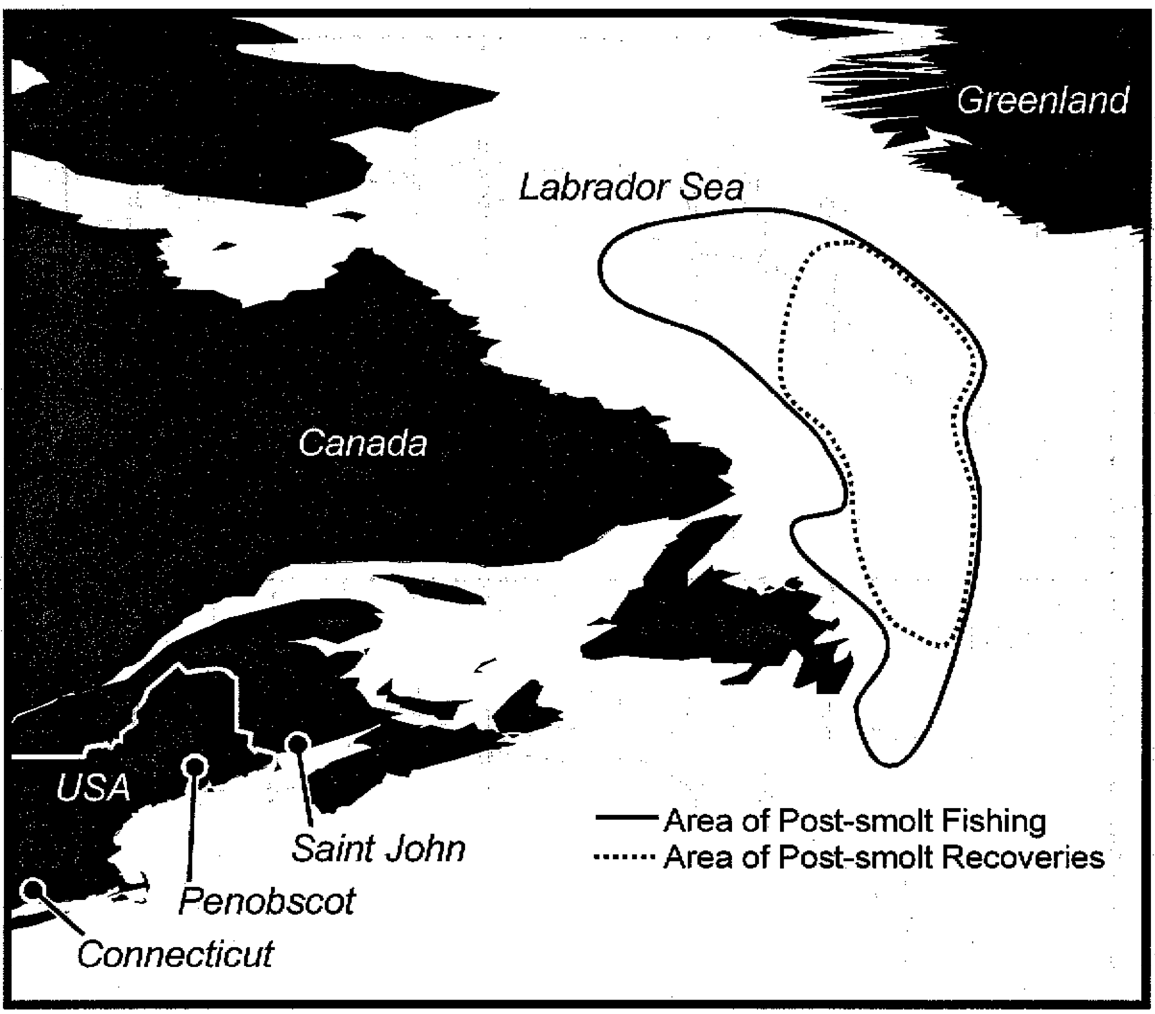


Figure 2.3.2.2. Circuli spacing versus circuli pair for Connecticut River 2SW returns and Labrador Sea post-smolts from three smolt years, 1988 (A), 1989 (B), and 1991 (C). Error bars show 95% confidence intervals.

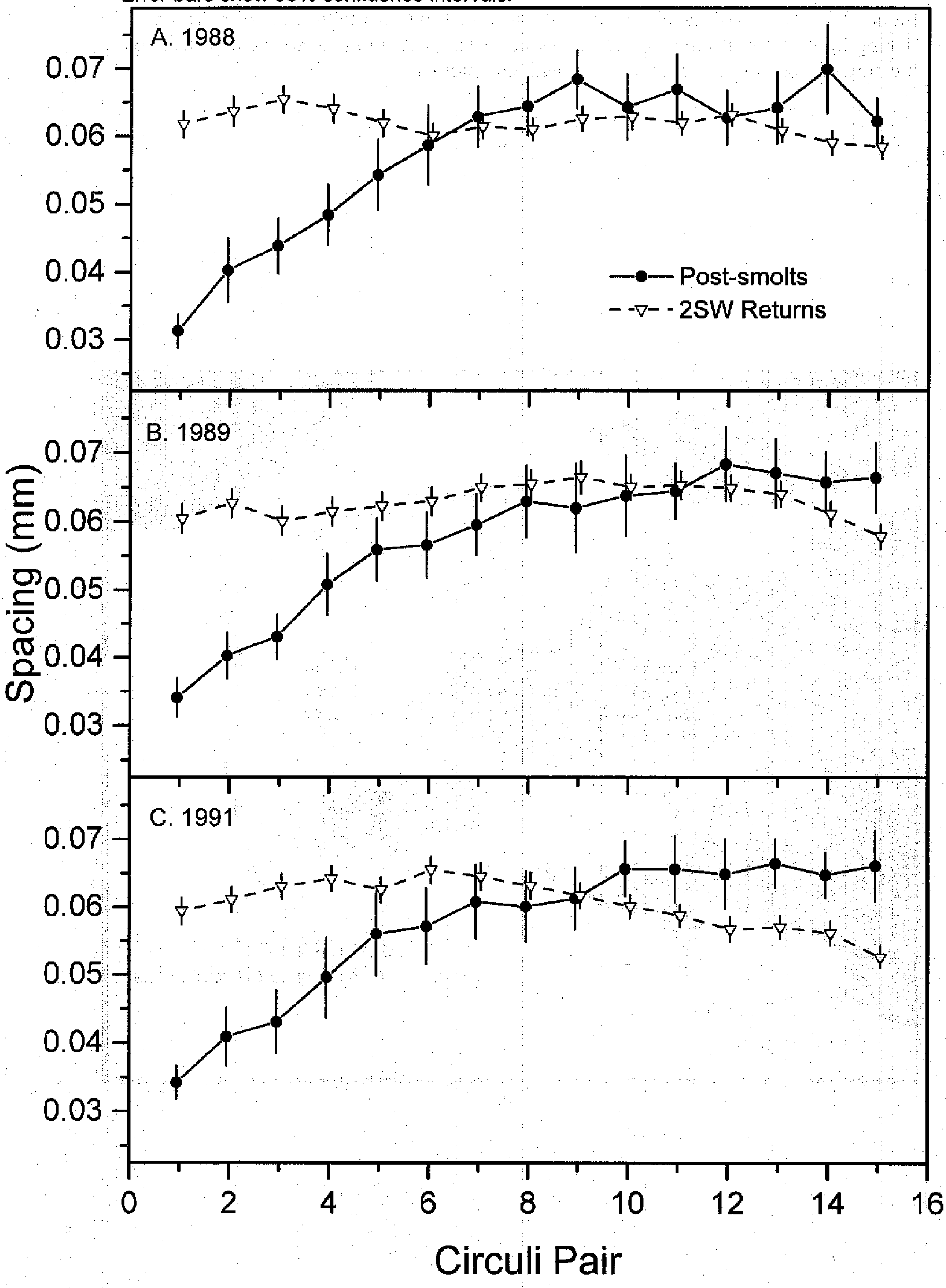


Figure 2.3.2.3. Circuli spacing versus circuli pair for Penobscot River 1SW and 2SW returns and Labrador Sea post-smolts from three smolt years, 1988 (A), 1989 (B), and 1991 (C). Error bars show 95% confidence intervals.

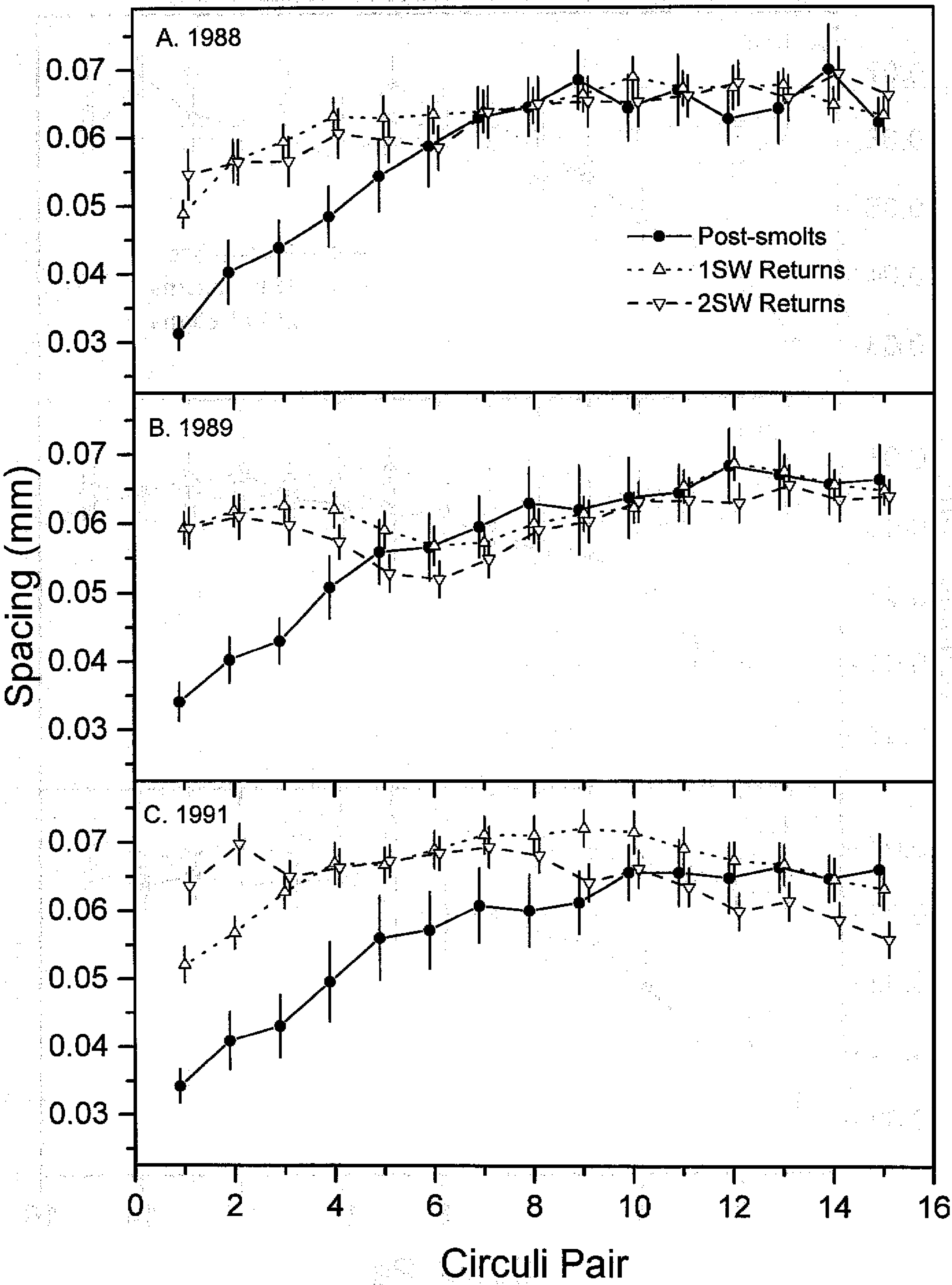


Figure 2.3.2.4. Circuli spacing versus circuli pair for Saint John River 1SW and 2SW returns and Labrador Sea post-smolts from three smolt years, 1988 (A), 1989 (B), and 1991 (C). Error bars show 95% confidence intervals.

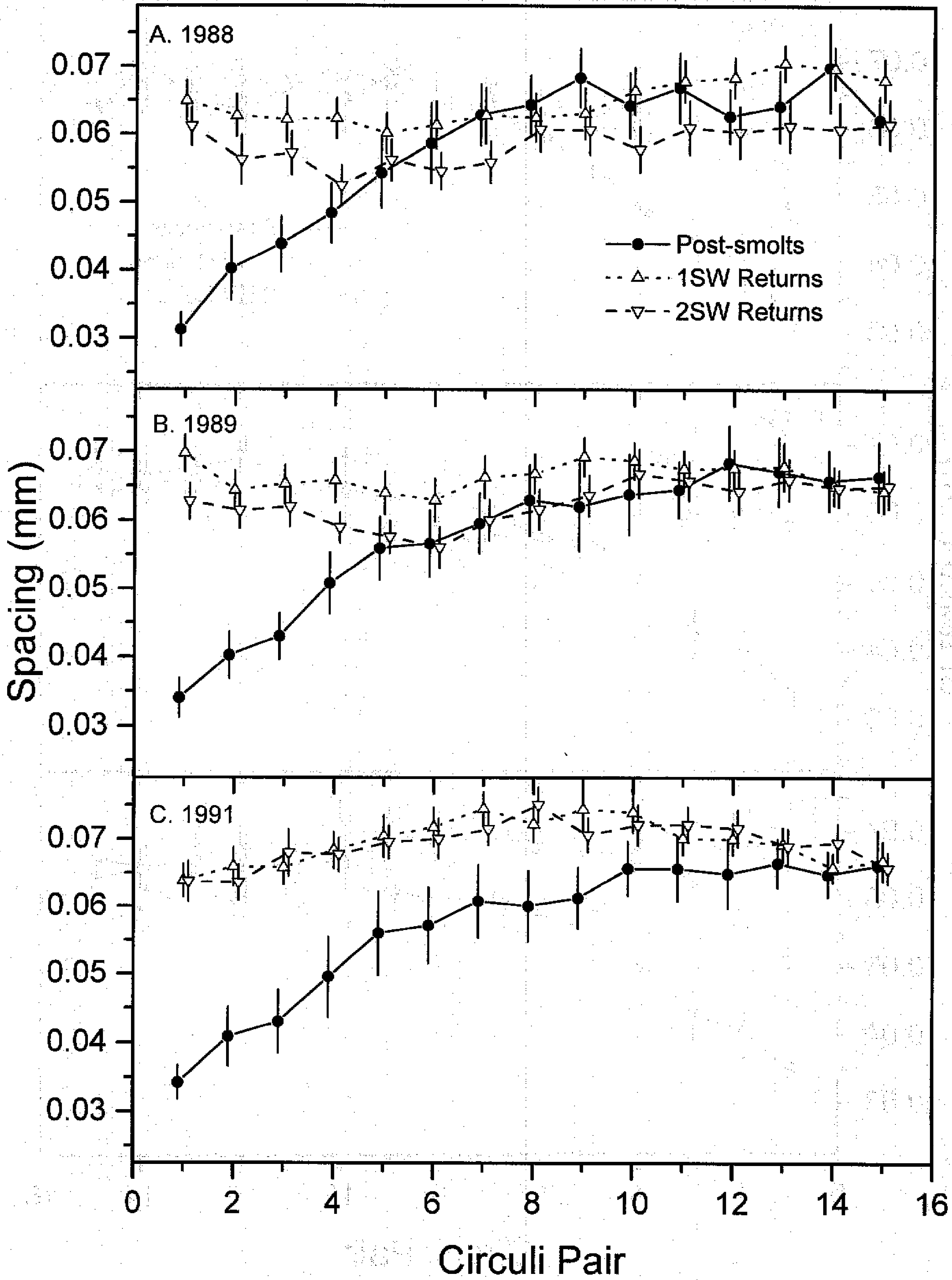


Figure 2.4.1.1 Post-smolt growth increment versus smolt year for 1SW and 2SW returns to the North Esk.

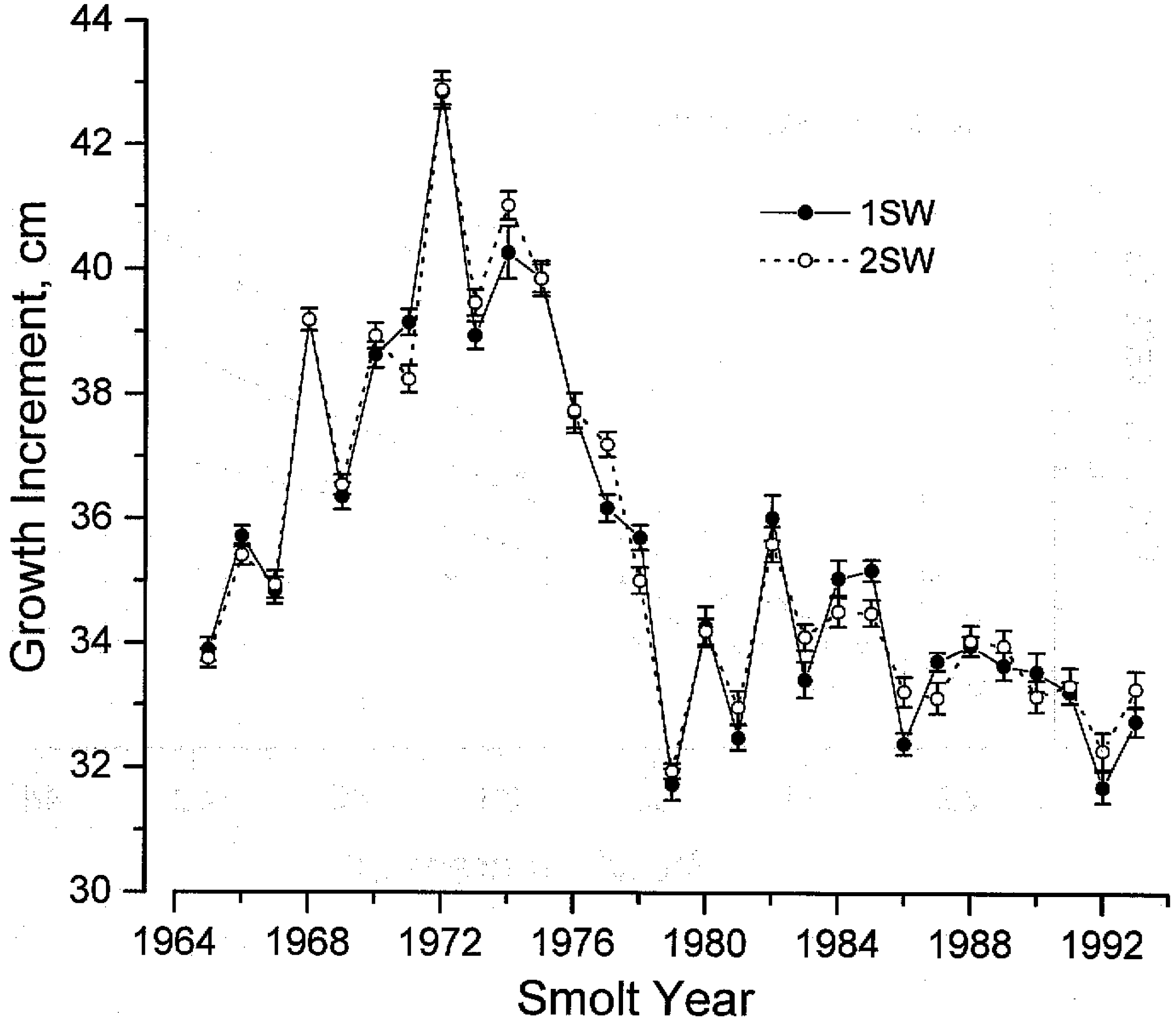


Figure 2.4.1.2 Scattergram and regression between 1SW return rate and post-smolt growth increment match by smolt years. Dashed line represent 95% confidence interval.

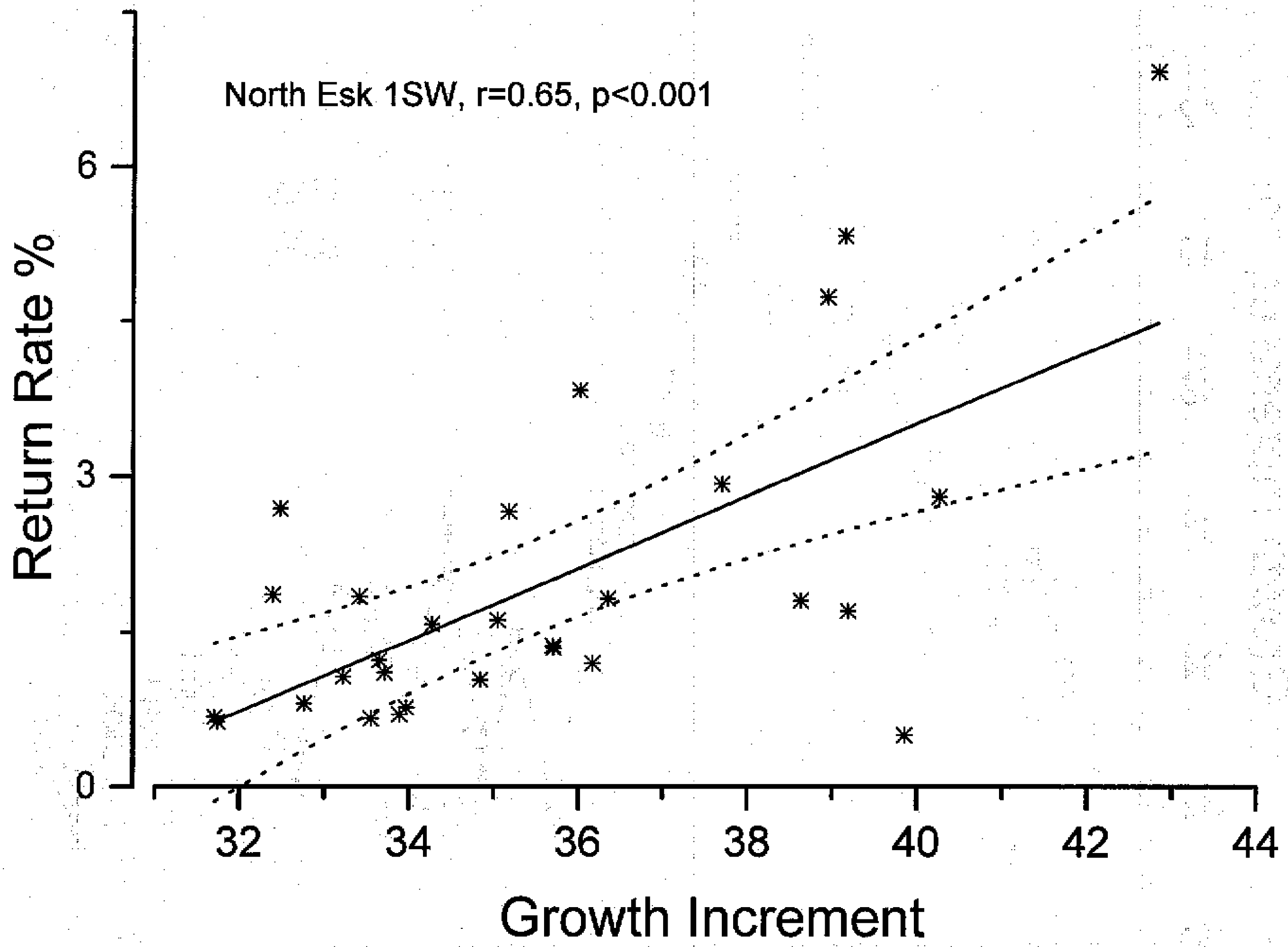


Figure 2.4.2.1 Depth-integrated temperature anomalies (annual and 5-year moving average) at Station 27 (near St. John's Newfoundland), 1945 to 1997.

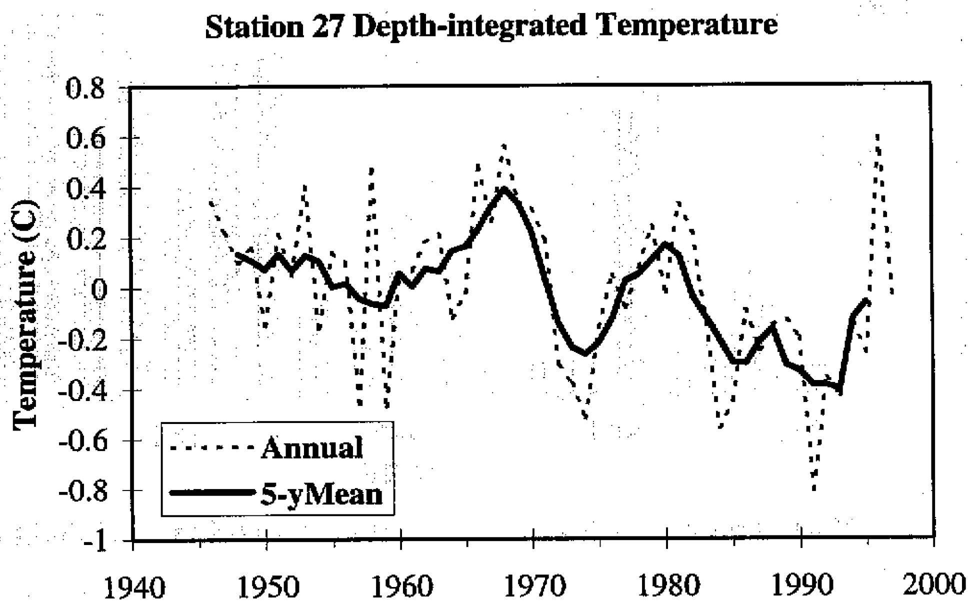


Figure 2.4.2.2 Diet composition of gannets from Funk Island, northern Newfoundland, during the month of August, 1977 to 1997.

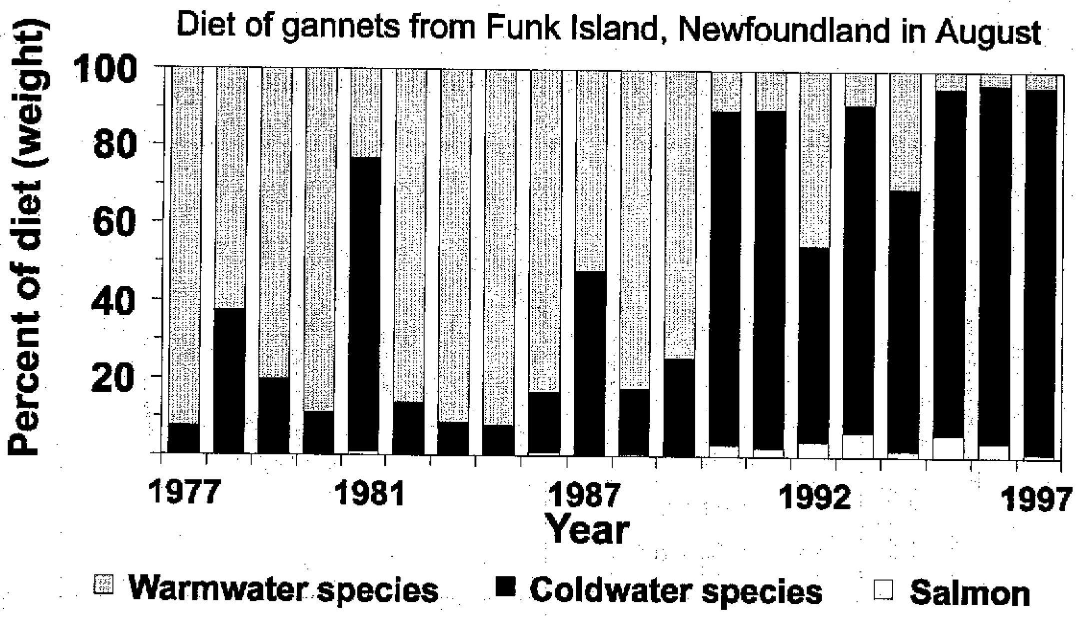


Figure 2.4.2.3 Harp seal abundance in the Northwest Atlantic, 1955 to 1997.

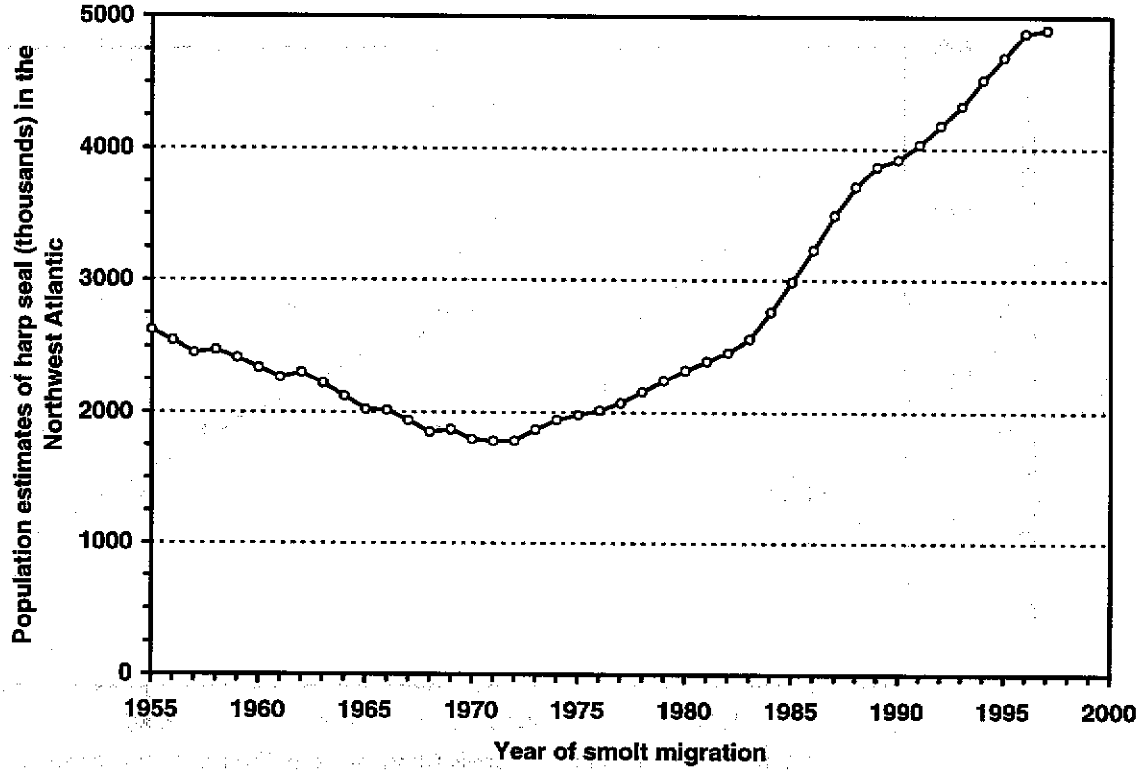


Figure 2.4.2.4 Association between harp seal abundance in the Northwest Atlantic and prefishery abundance of North American salmon (lagged to the smolt year).

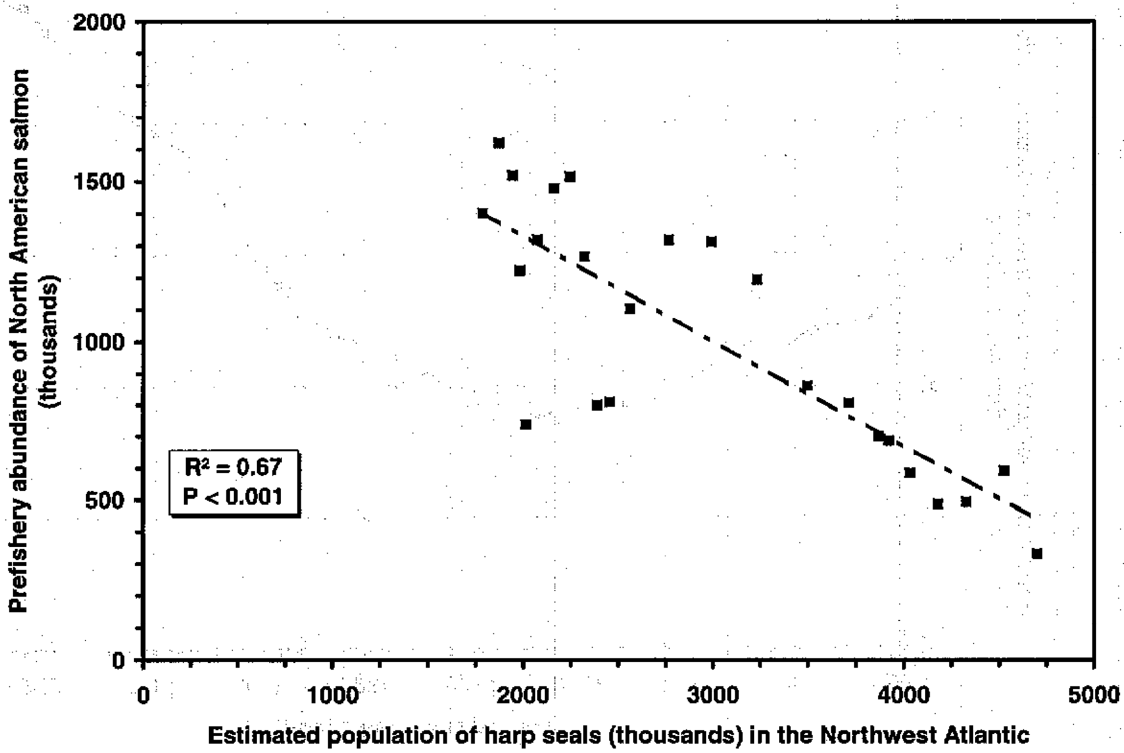


Figure 3.3.4.1. Nominal catches of salmon in the NEAC area in 1997 relative to previous indices

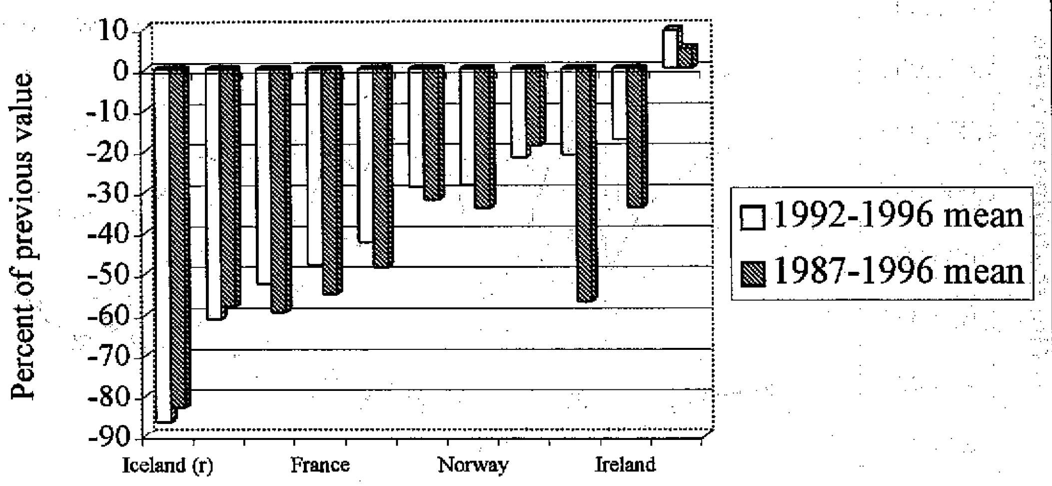


Figure 3.3.6.1. The proportions of 1SW salmon in NEAC catches in 1997 relative to previous indices

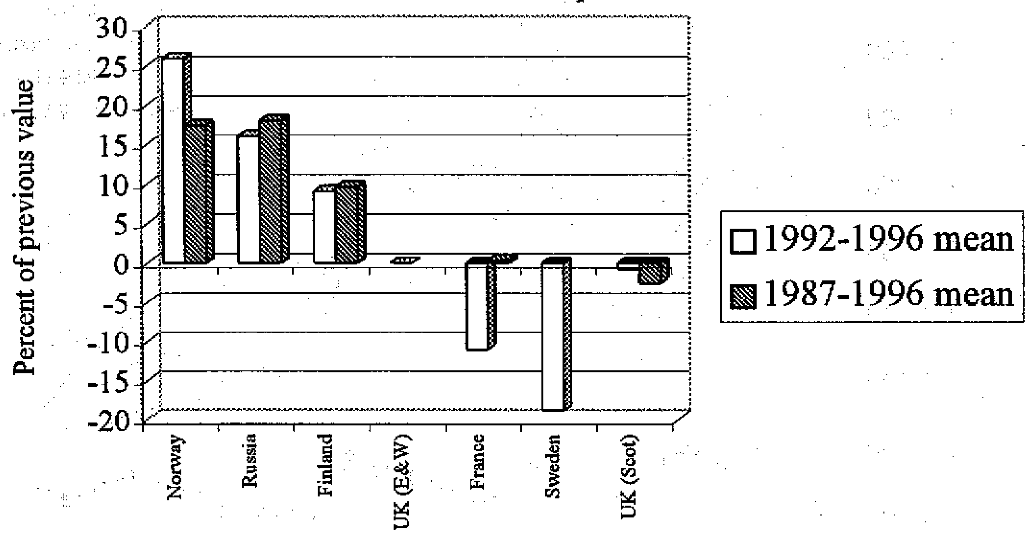


Figure 3.6.1 Estimates of pre-fishery abundance and numbers of spawners in Northern Europe, 1971-97

a) 1SW salmon (Northern)

b) MSW salmon (Northern)

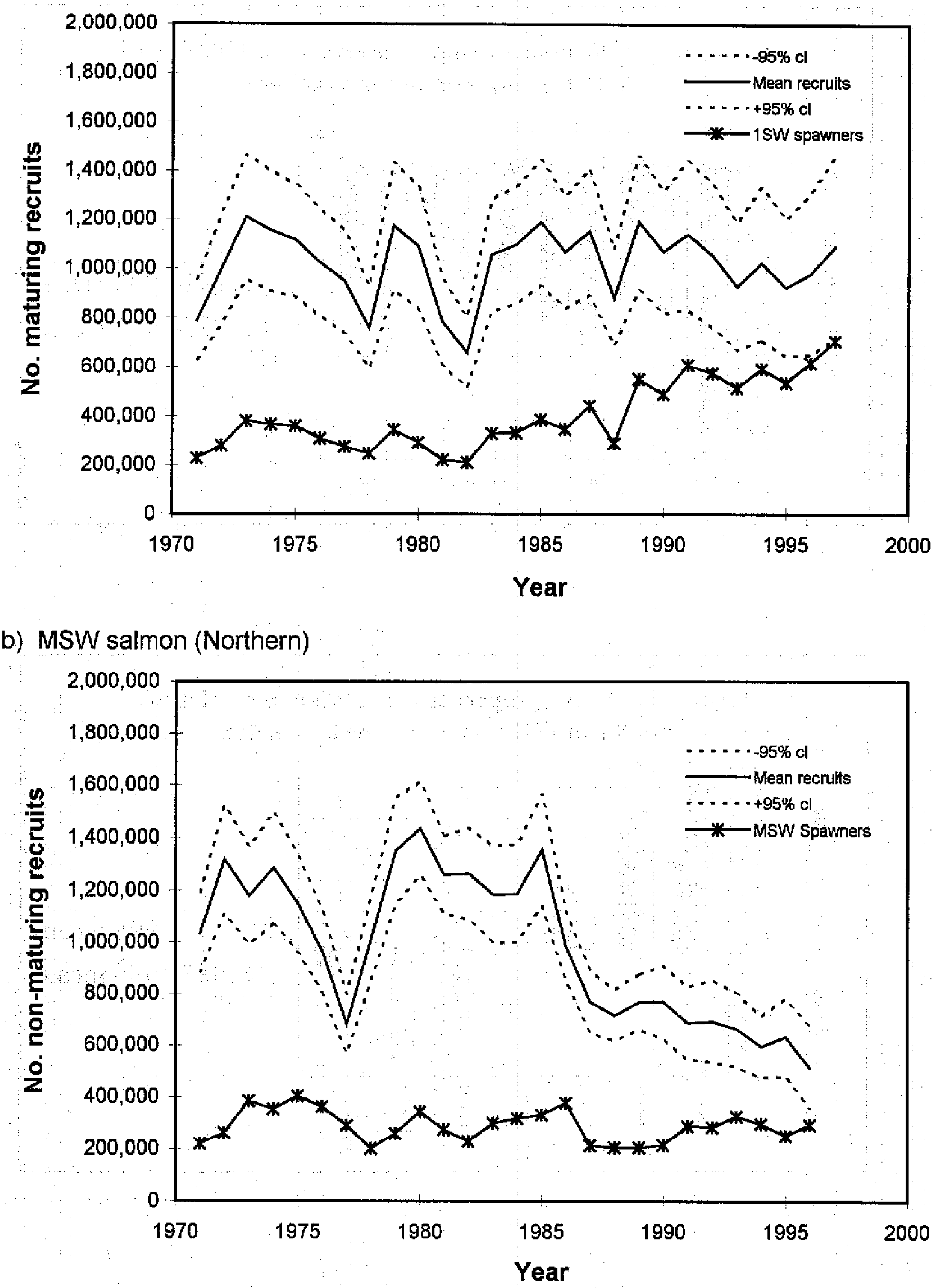
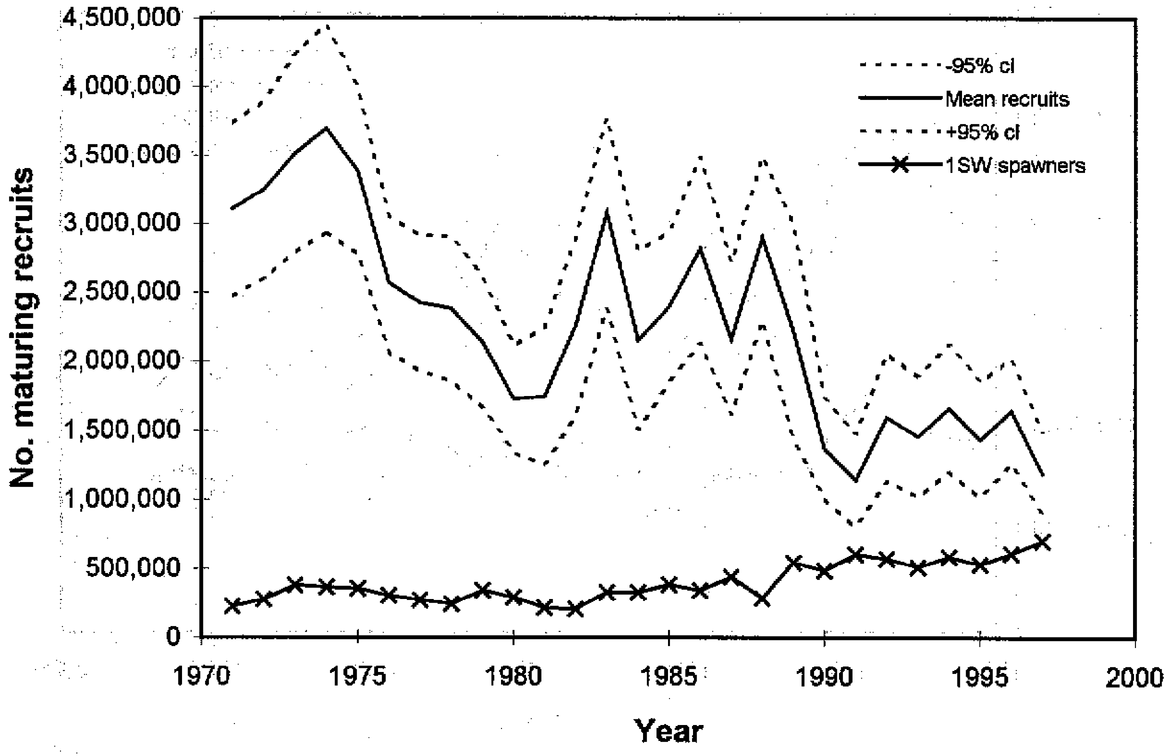


Figure 3.6.2 Estimates of pre-fishery abundance and numbers of spawners in Southern Europe, 1971-97

a) 1SW salmon (Southern)



b) MSW salmon (Southern)

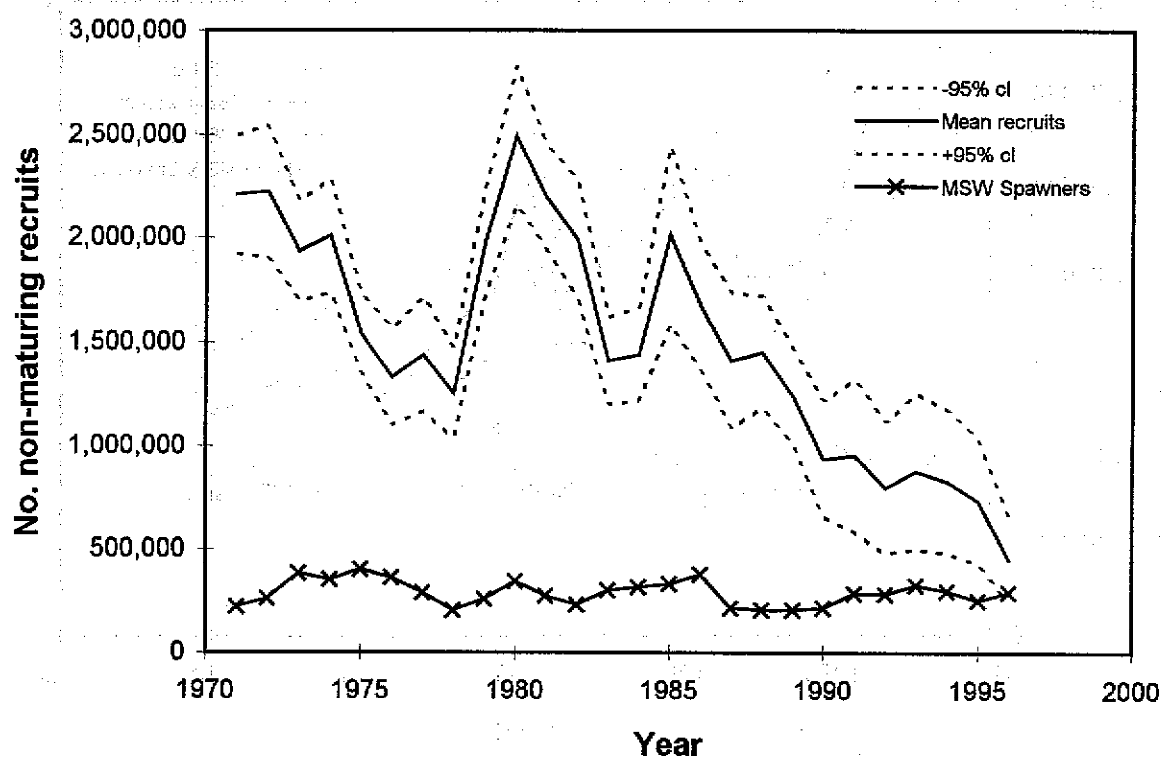
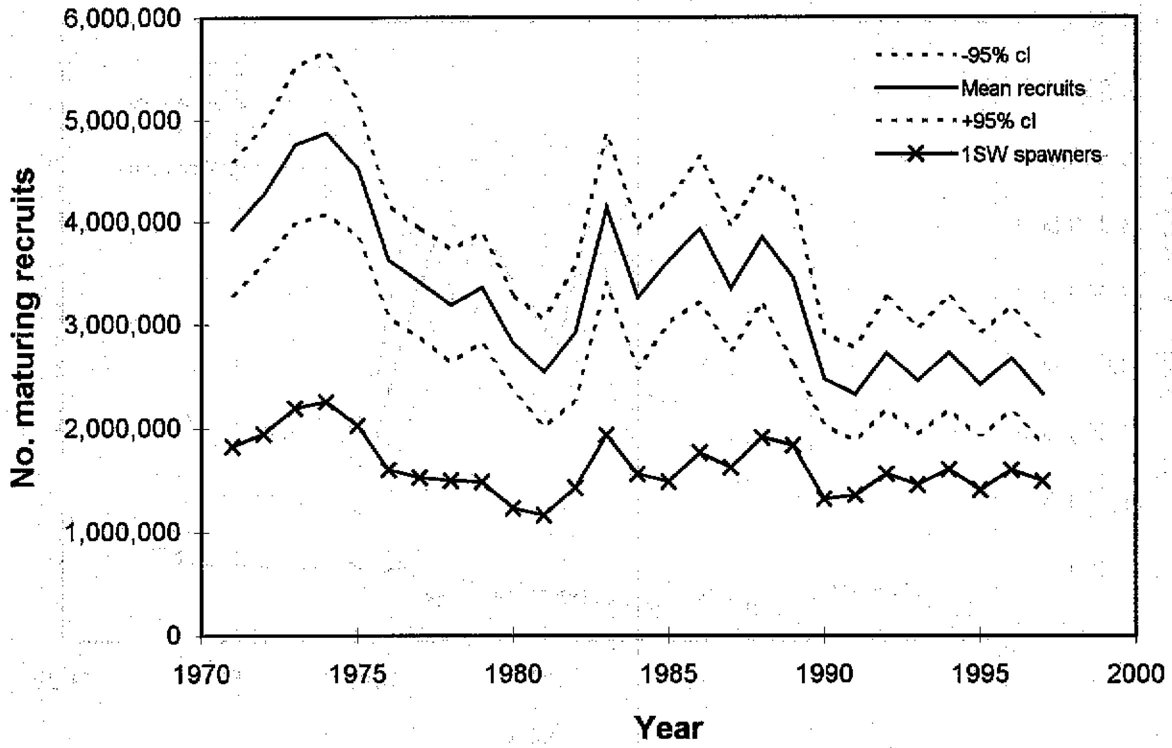


Figure 3.6.3 Estimates of pre-fishery abundance and numbers of spawners in NEAC Area, 1971-97

a) 1SW salmon (NEAC total)



b) MSW salmon (NEAC total)

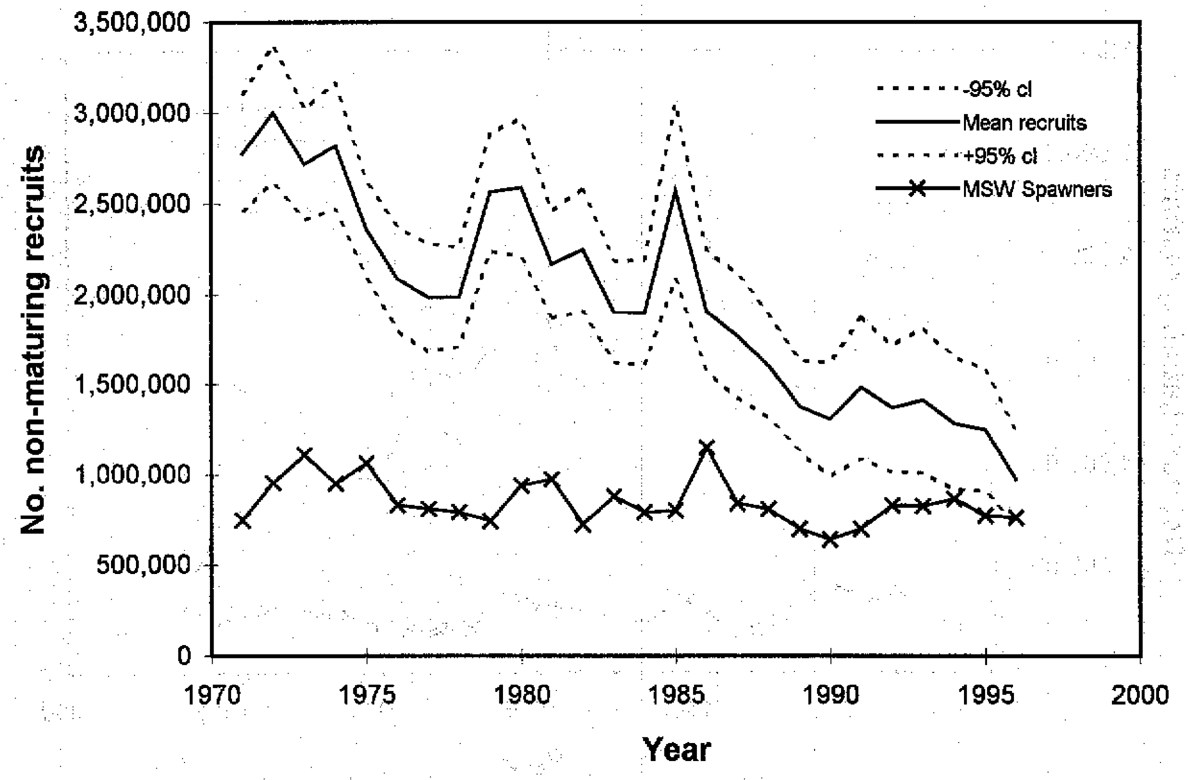


Figure 3.6.4 Joining cluster analysis of maturing stock component abundances.

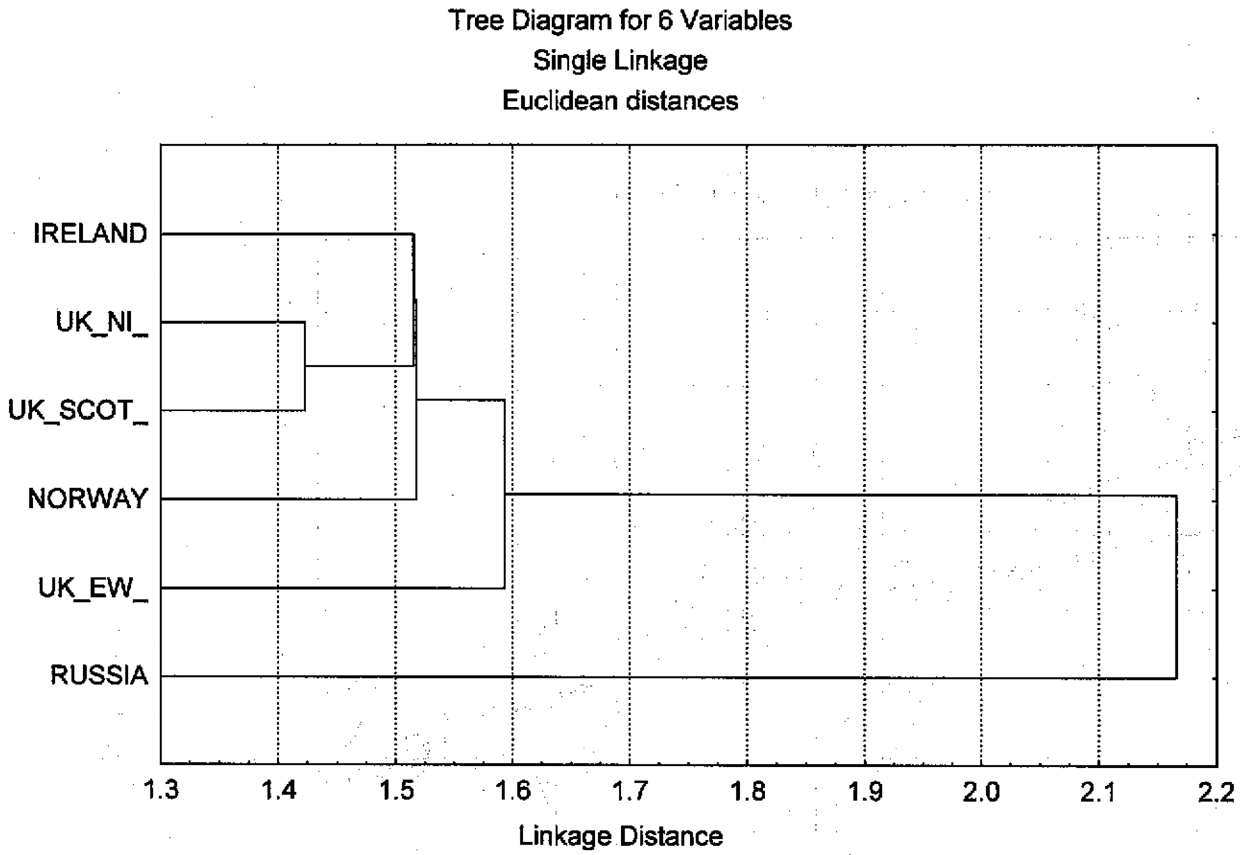


Figure 3.6.5 Normalized abundance of maturing stock components, Cases 1-27 for years 1971-1997.

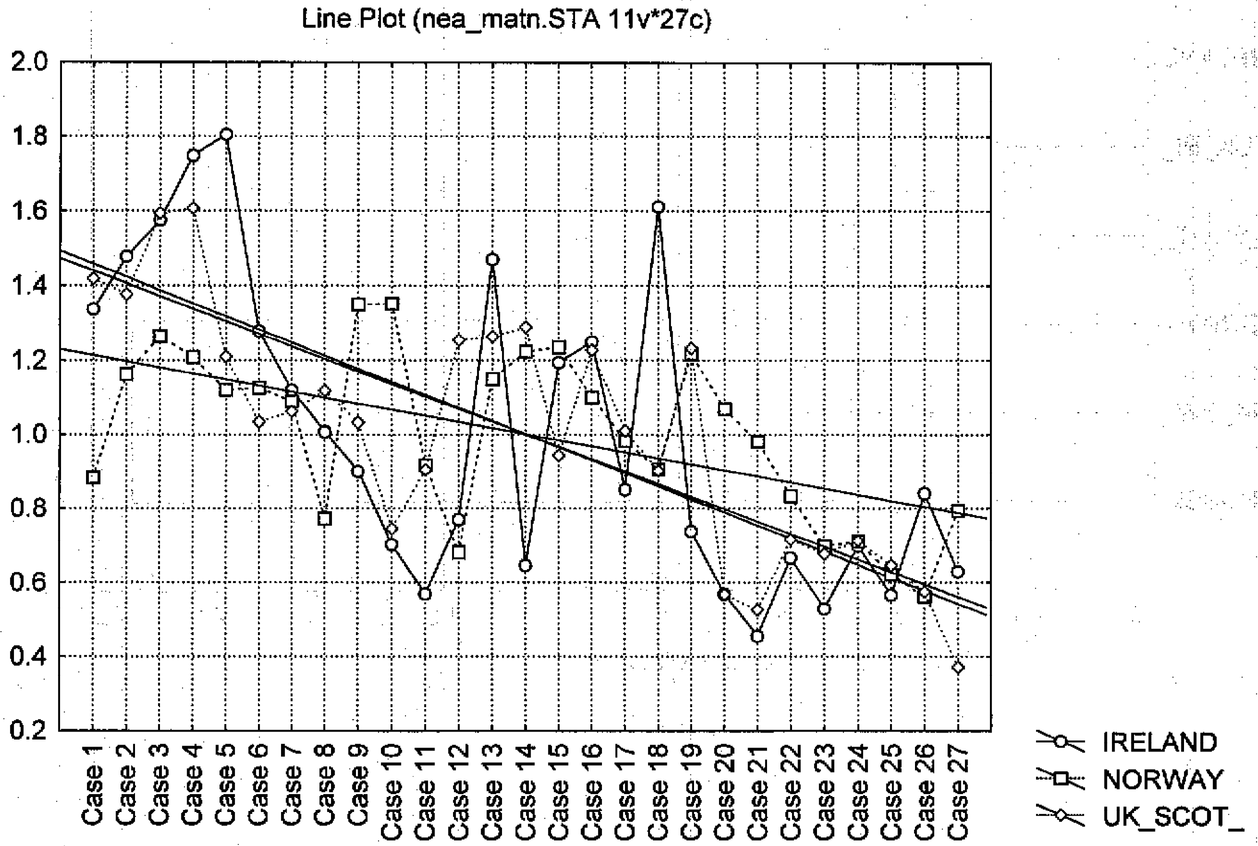


Figure 3.6.6 Joining cluster analysis of non-maturing stock component abundances.

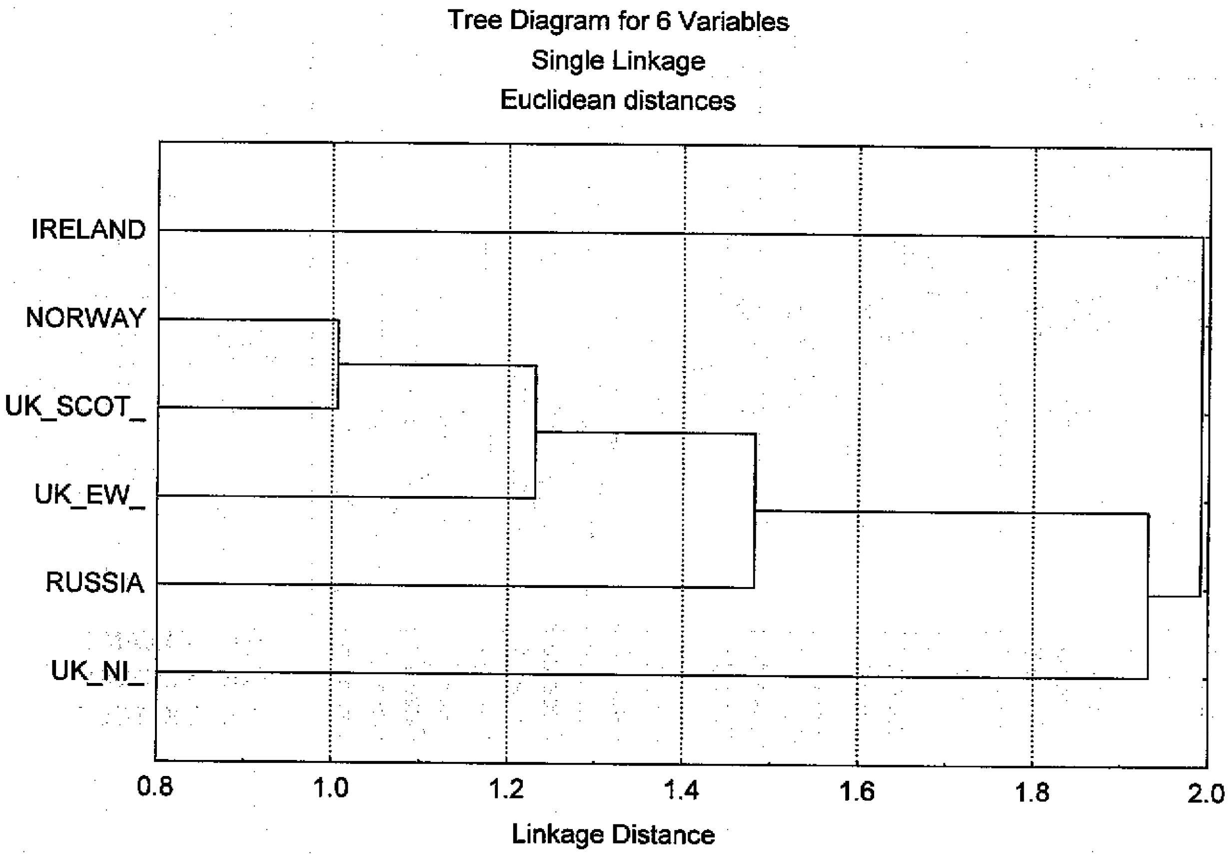


Figure 3.6.7 Normalized abundance of non-maturing stock components, Cases 1-26 for years 1971-1996.

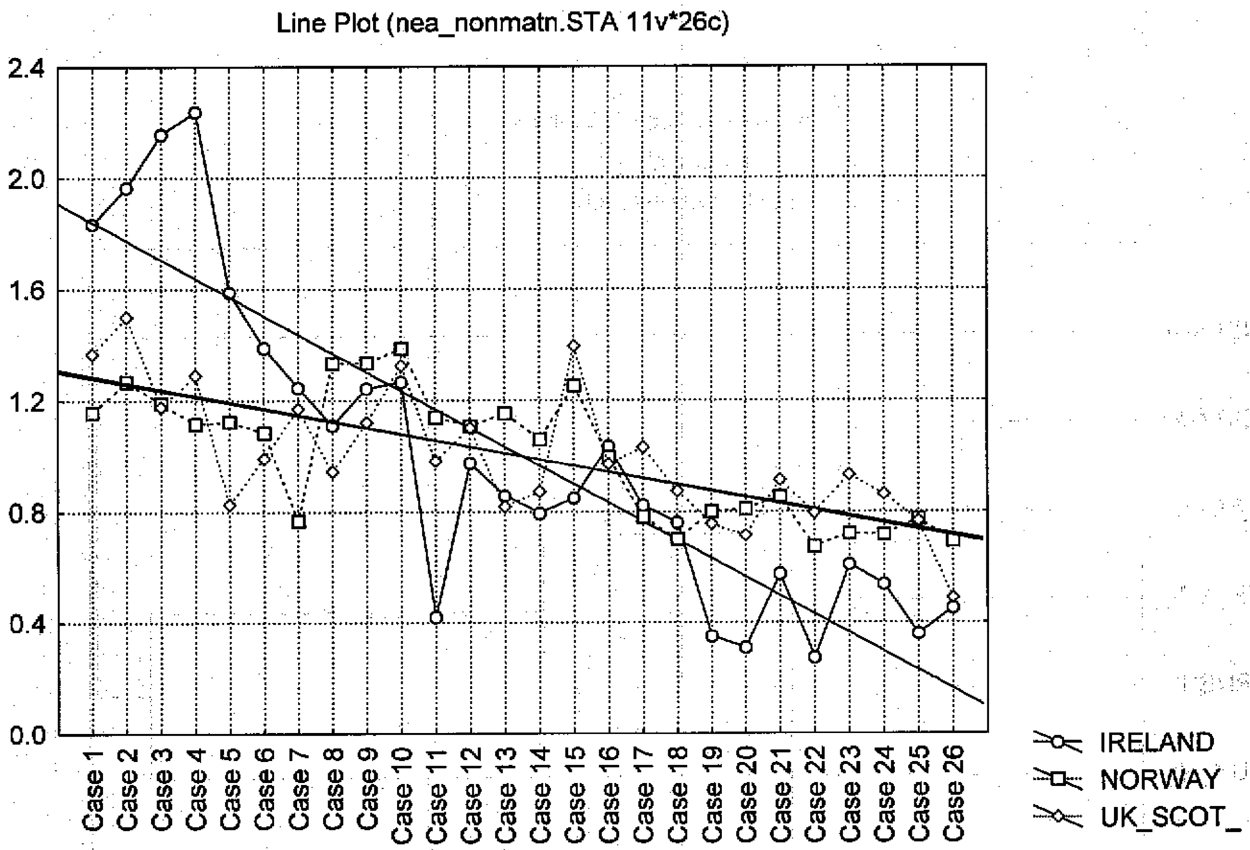


Figure 3.7.2.1 Example to show how Conservation Options Limit Options for NEAC area have been estimated.

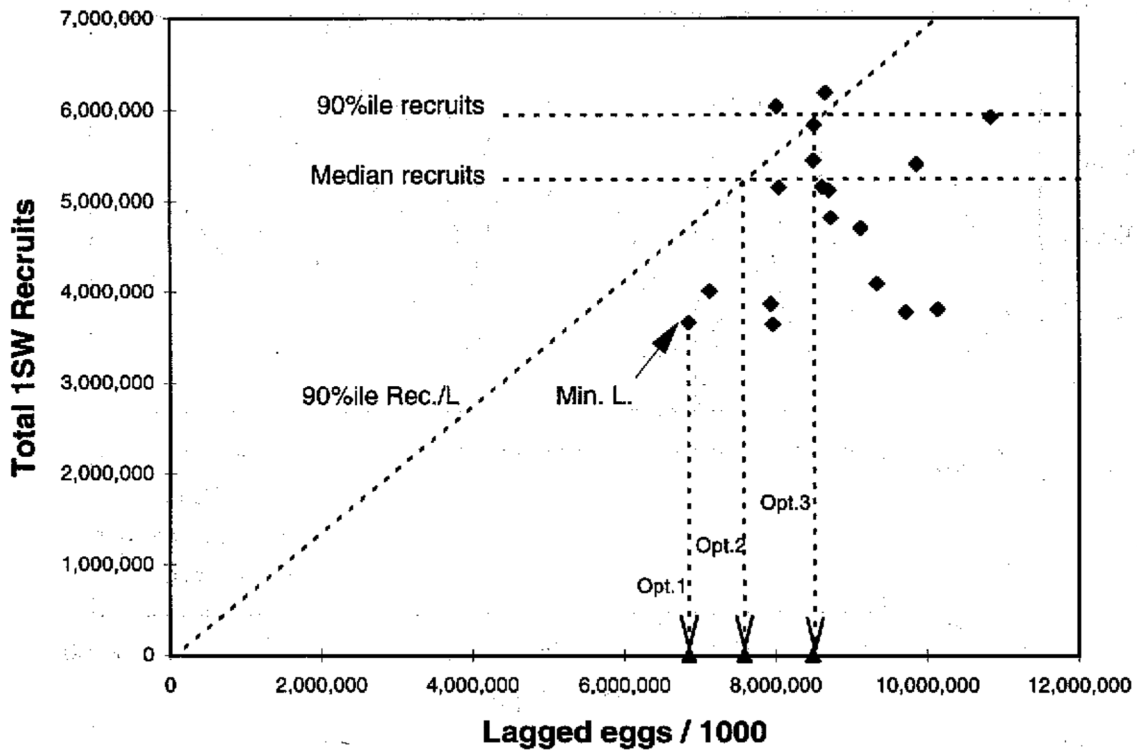
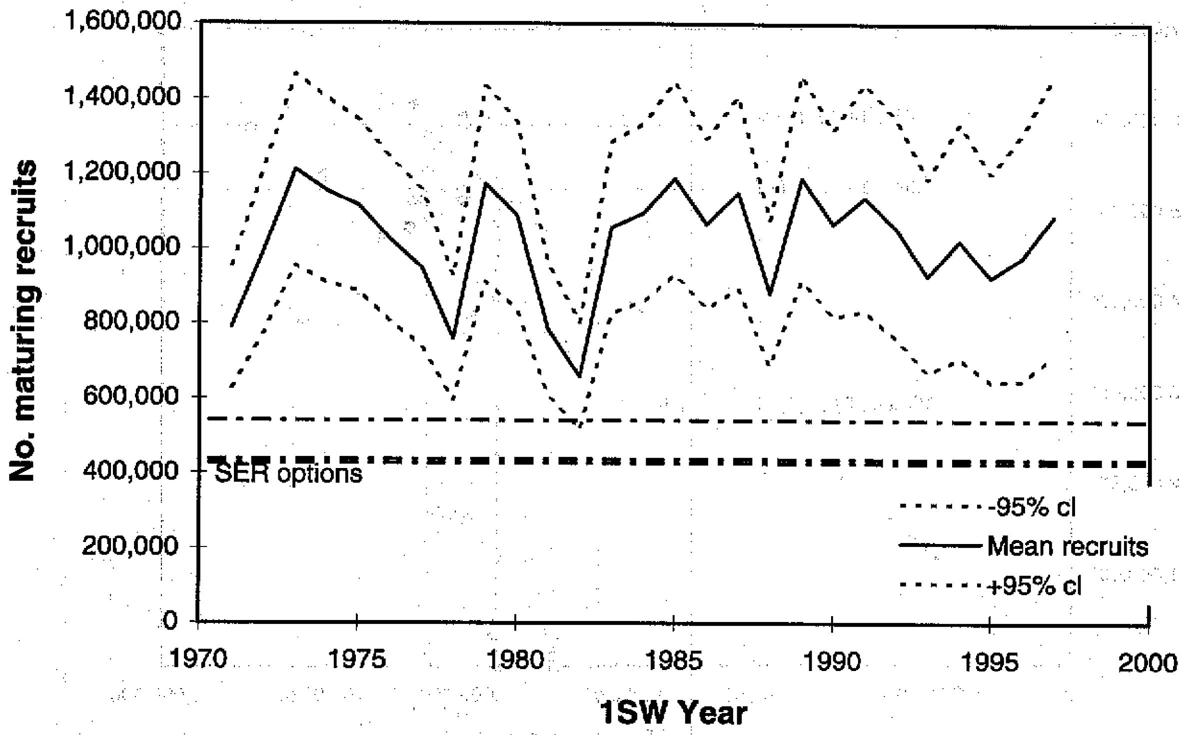


Figure 3.8.1 Estimated pre-fishery abundance of Northern European salmon stocks

a) maturing 1SW recruits (Northern)



b) non-maturing 1SW recruits (Northern)

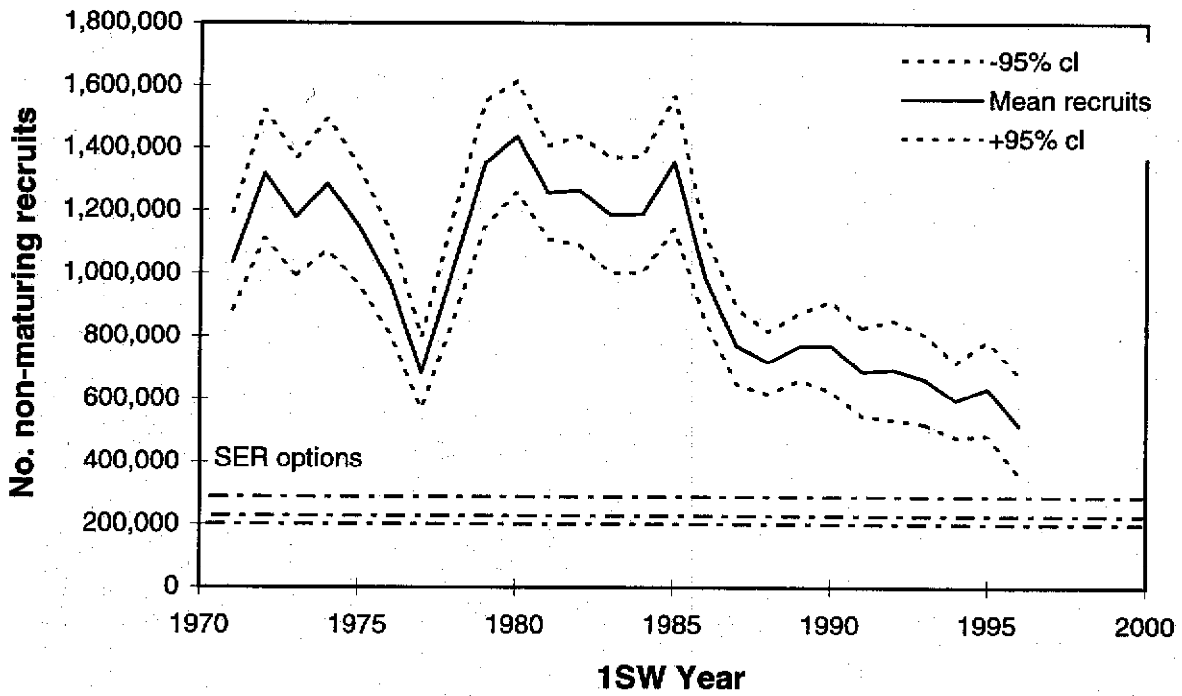
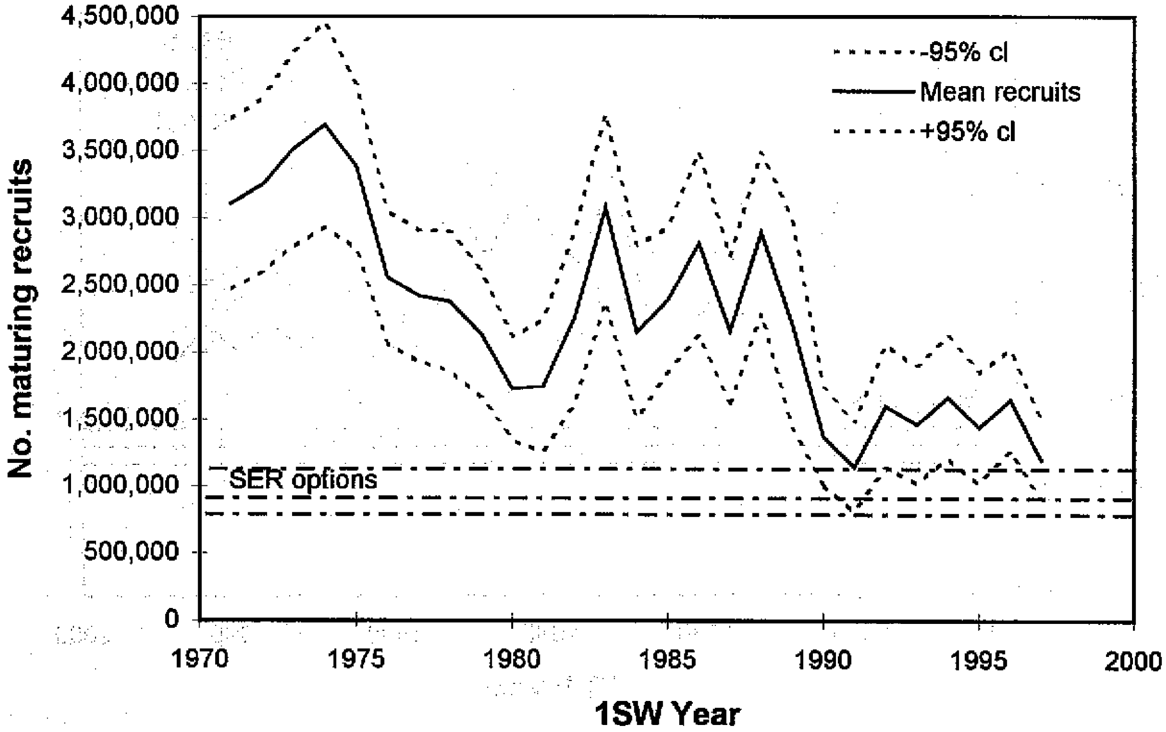


Figure 3.8.2 Estimated pre-fishery abundance of Southern European salmon stocks

a) maturing 1SW recruits (Southern)



b) non-maturing 1SW recruits (Southern)

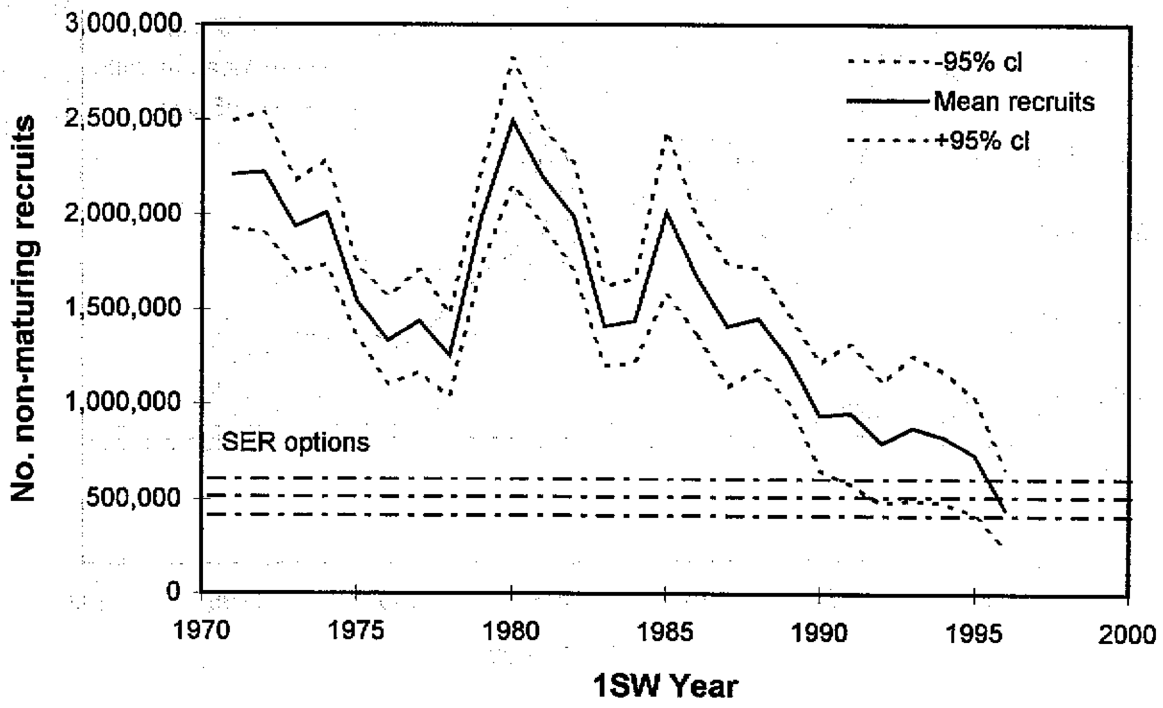
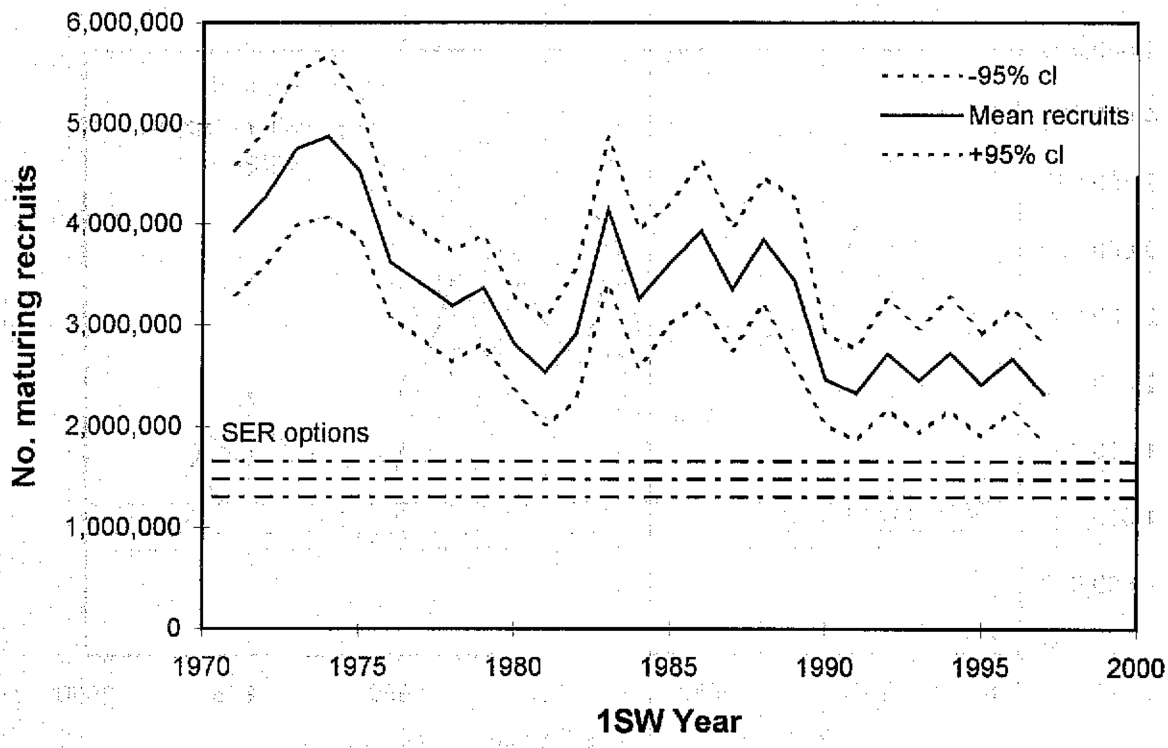
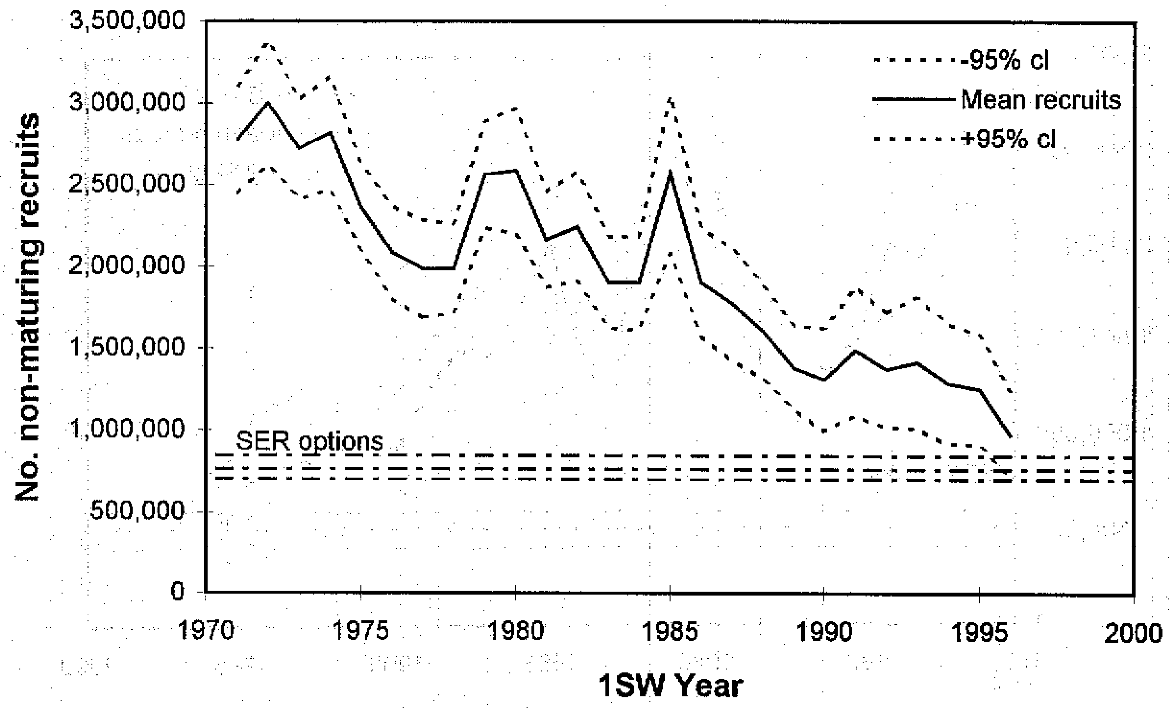


Figure 3.8.3 Estimated prefishery abundance of salmon stocks in the NEAC Area

a) maturing 1SW recruits (NEAC total)



b) non-maturing 1SW recruits (NEAC total)



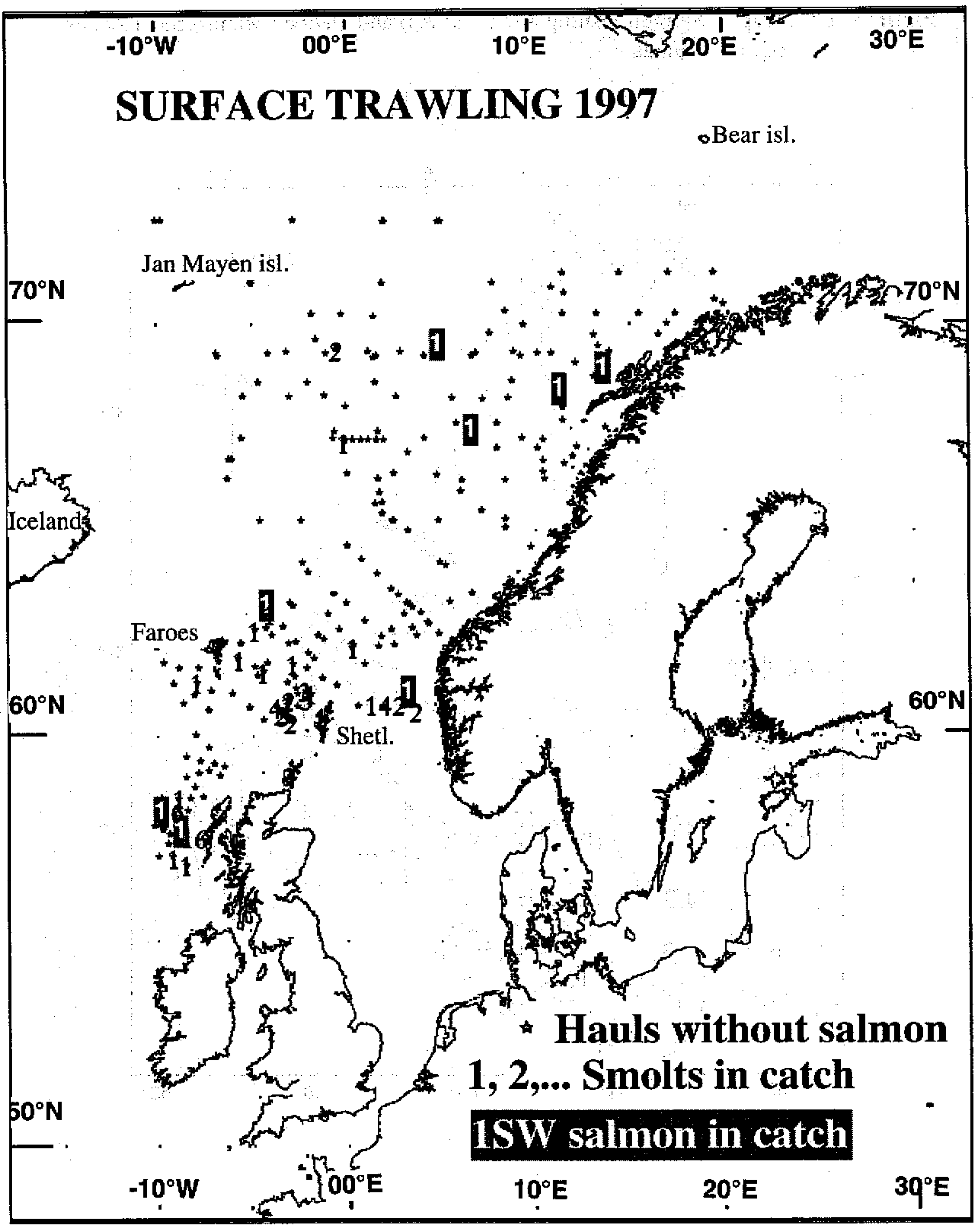


Figure 3.9.1.1 Surface trawl hauls in the 1997 cruises with the R/V Johan Hjort and the G.O.Sars. Legends: Stars = no salmon in the catch; black numbers = number of post- smolts caught; White number on black = number of 1SW salmon.

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

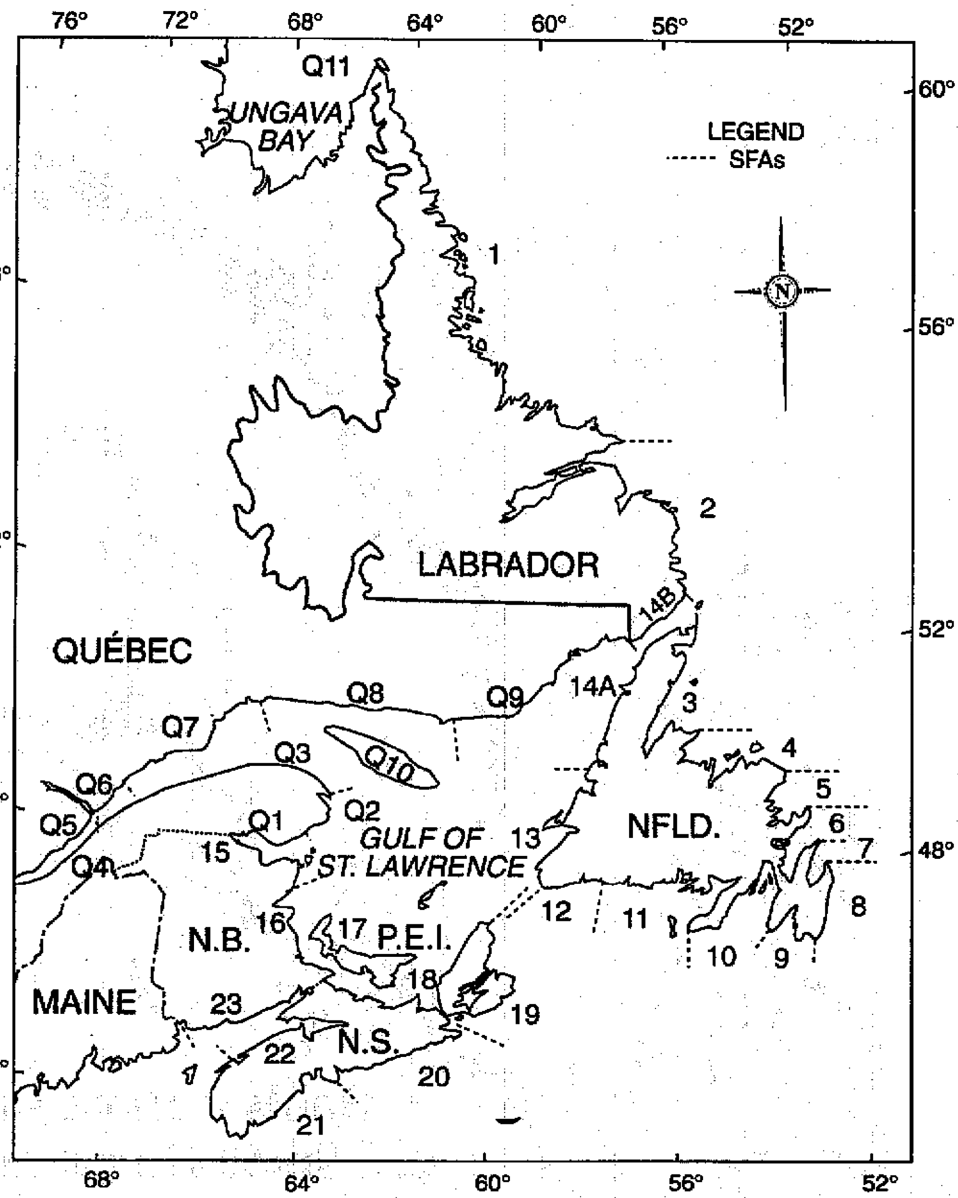
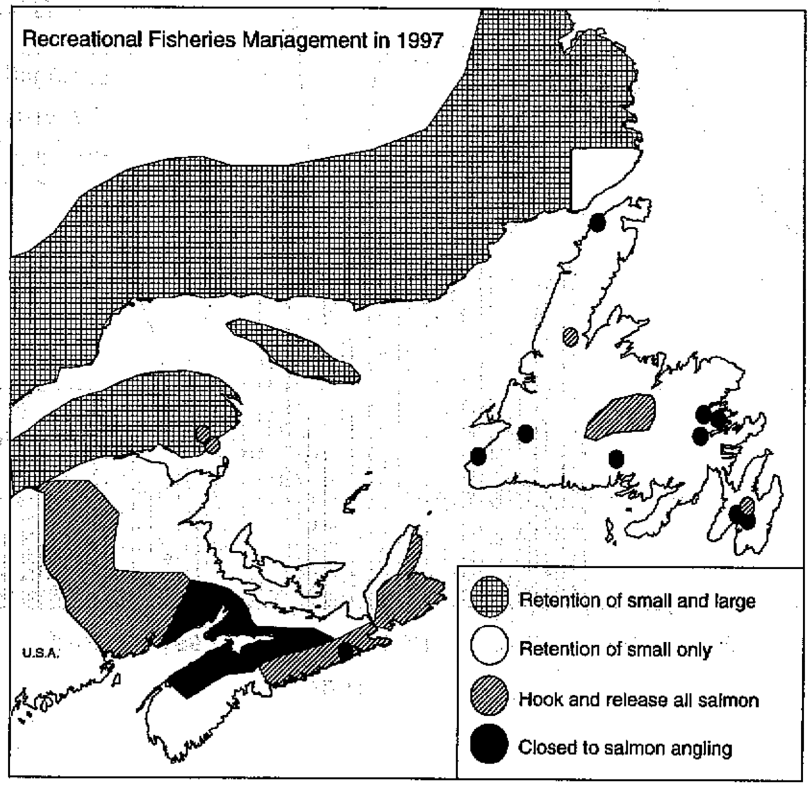


Figure 4.1.1.2 Summary of recreational fisheries management in eastern Canada at the start of the angling season (upper map) and after adjustments stemming from river/area specific inseason assessments during 1997.



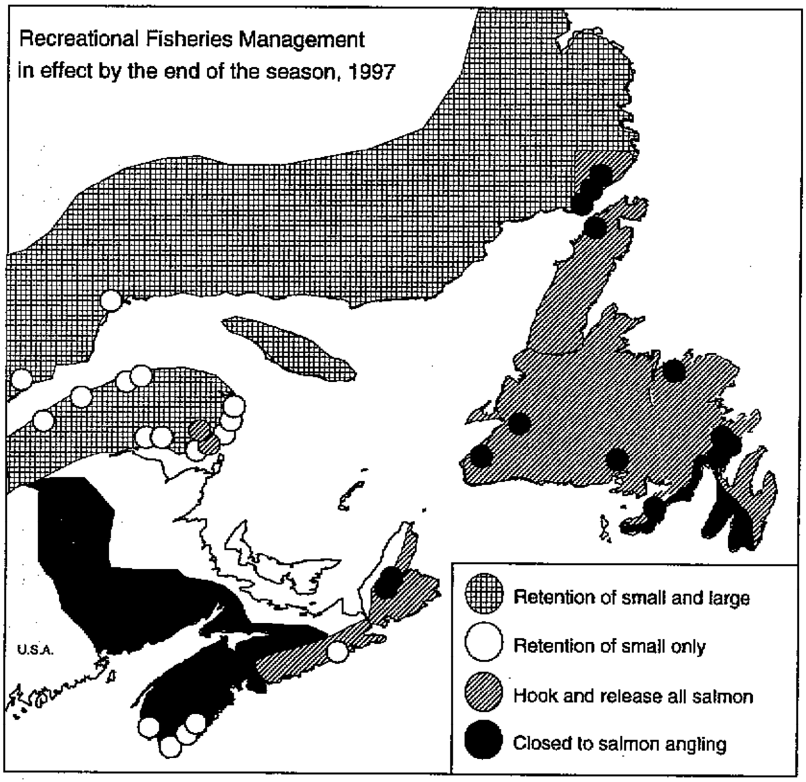


Figure 4.1.2.1 Harvest (t) of small salmon, large salmon, and combined in Canada, 1960 to 1997.

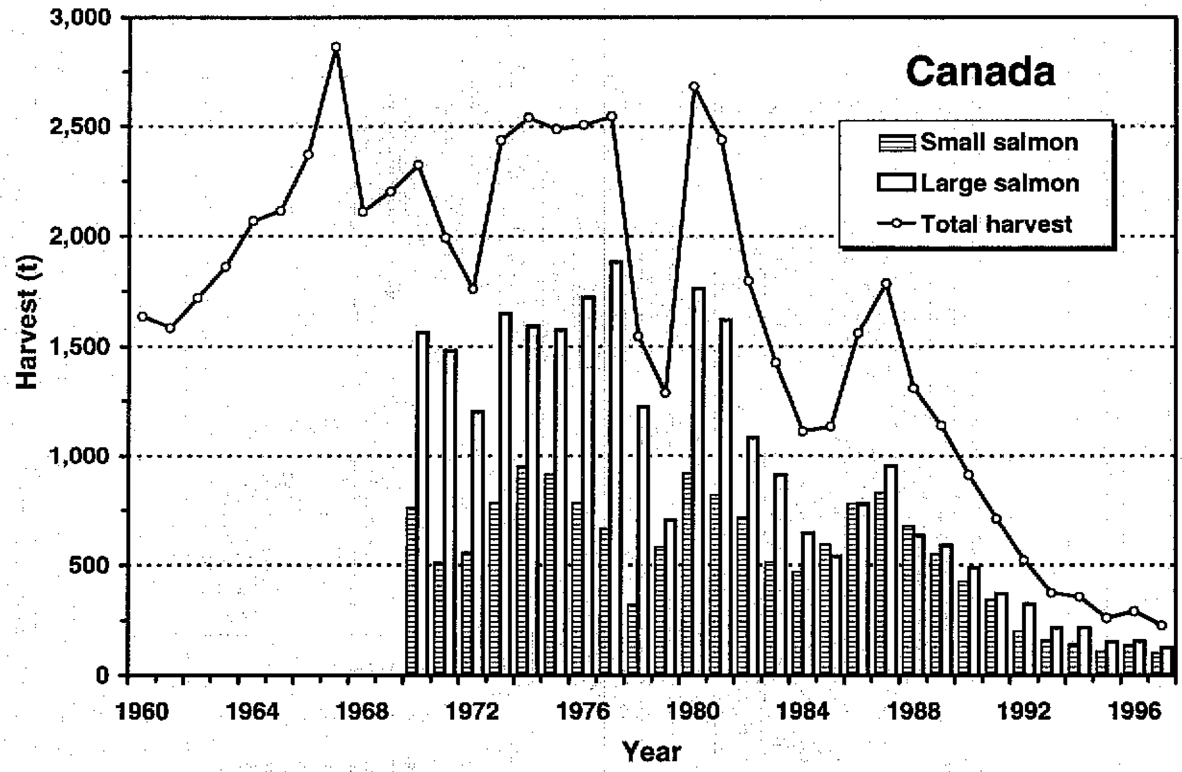


Figure 4.1.2.2 Harvest (number) of small salmon and large salmon and both sizes combined in the recreational fisheries in Canada, 1974 to 1997.

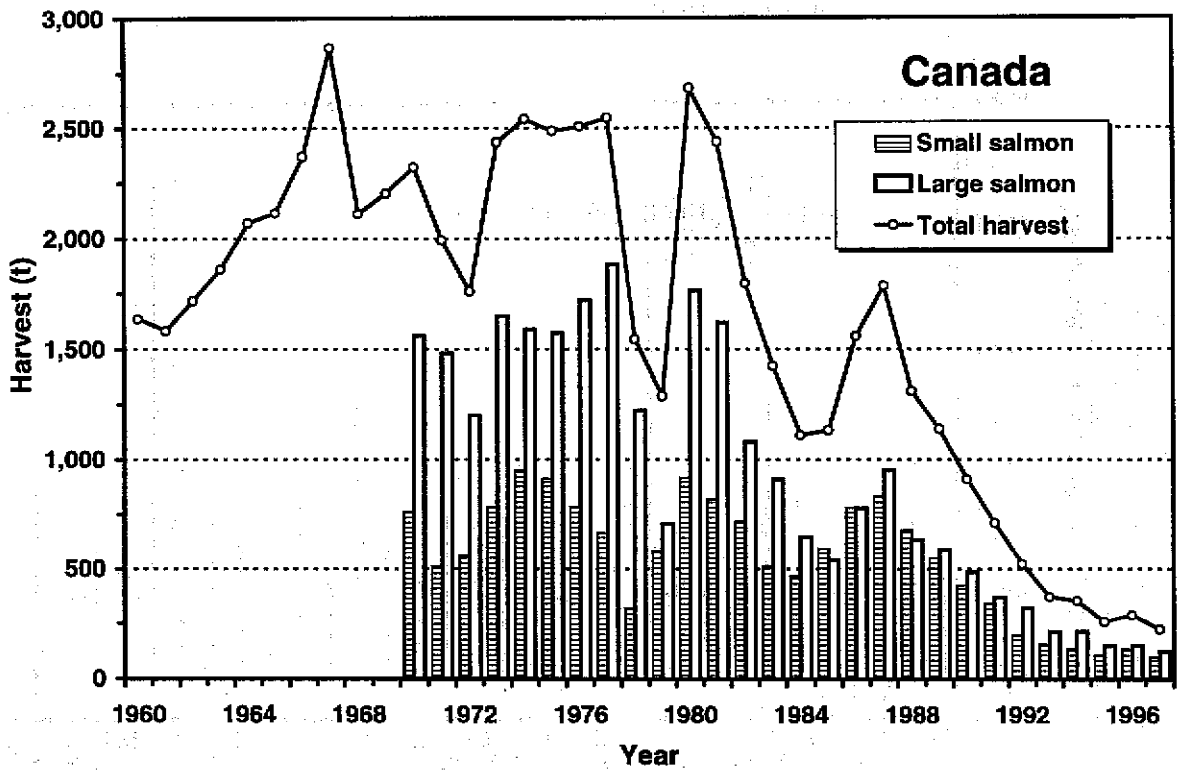
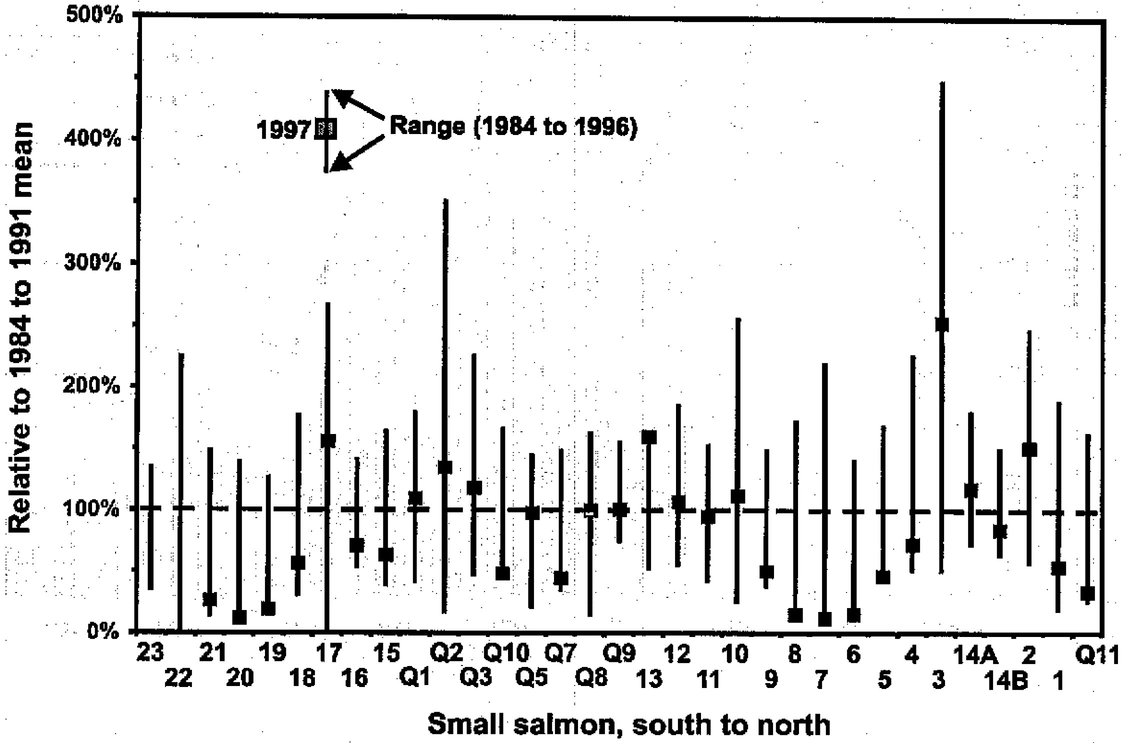


Figure 4.1.2.3 Angling catches (including kept and released fish) of small and large salmon by management area in 1997 (black square) expressed as a percentage of the average catches for the period 1984 to 1991. The vertical lines represent the minimum to maximum range. The 1984 to 1991 standard period 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.



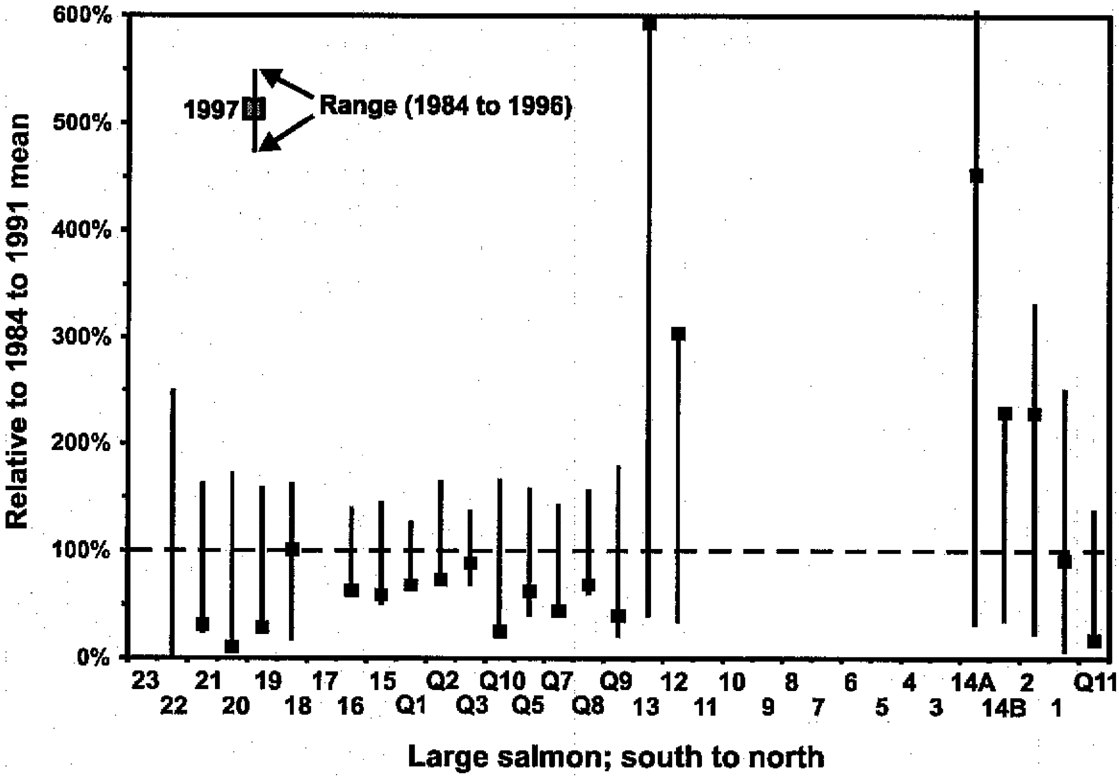


Figure 4.1.2.4 Harvest (t) of small salmon and large salmon and both size groups combined in the commercial fisheries of Canada, 1974 to 1997.

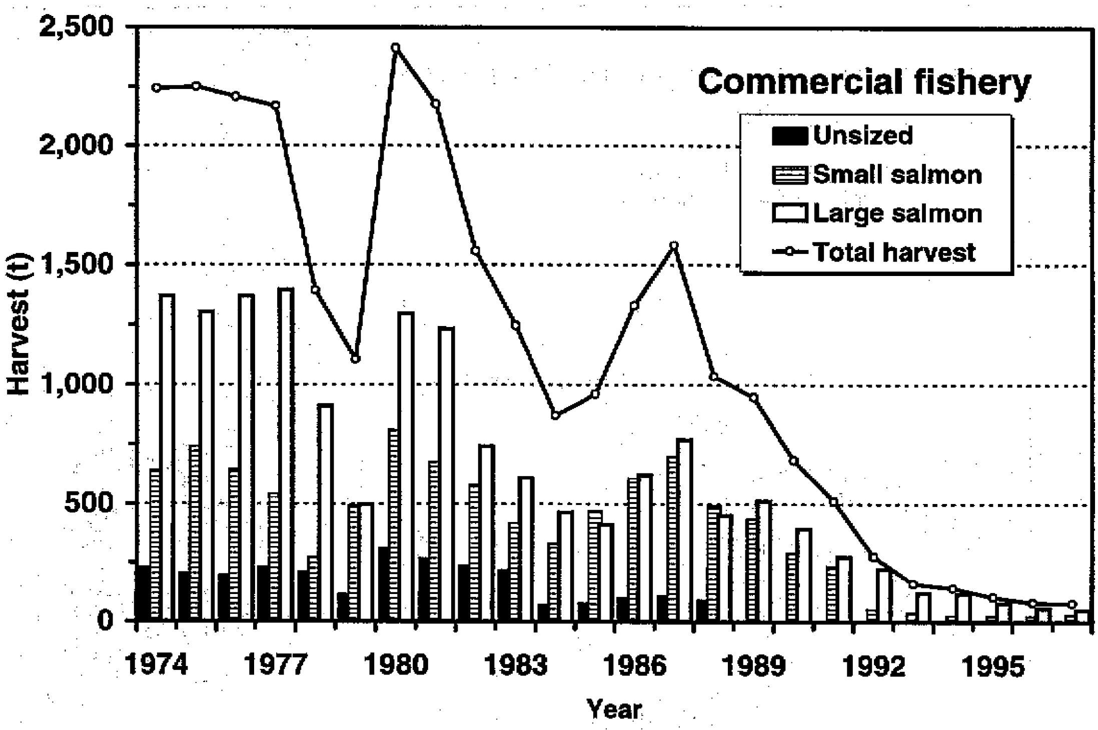


Figure 4.1.3.1 Origin (wild, hatchery, aquaculture) of Atlantic salmon returning to monitored rivers of eastern Canada in 1997. Only rivers in which more than one origin type were observed are indicated.

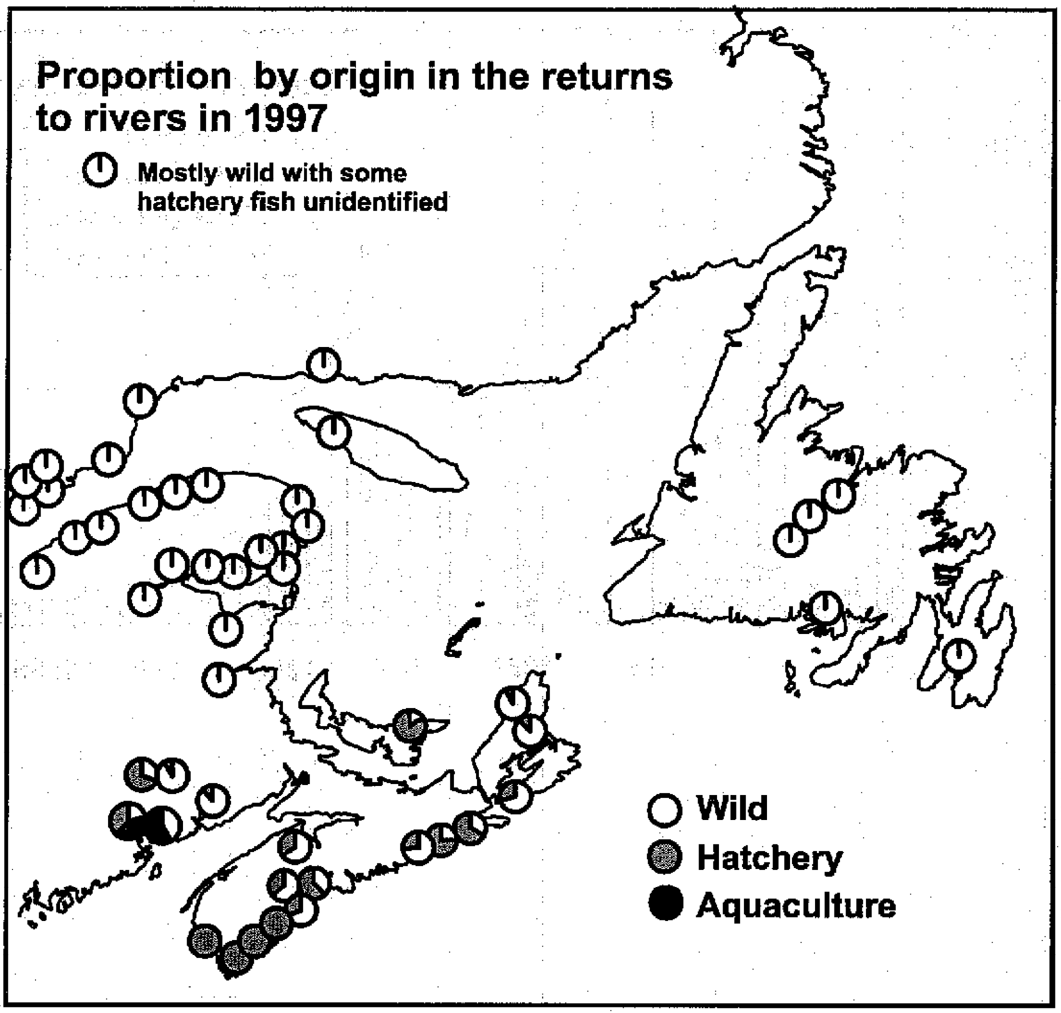


Figure 4.2.1.1 In-river returns of small salmon and large salmon for 54 monitored rivers of eastern Canada in 1997 relative to 1996.

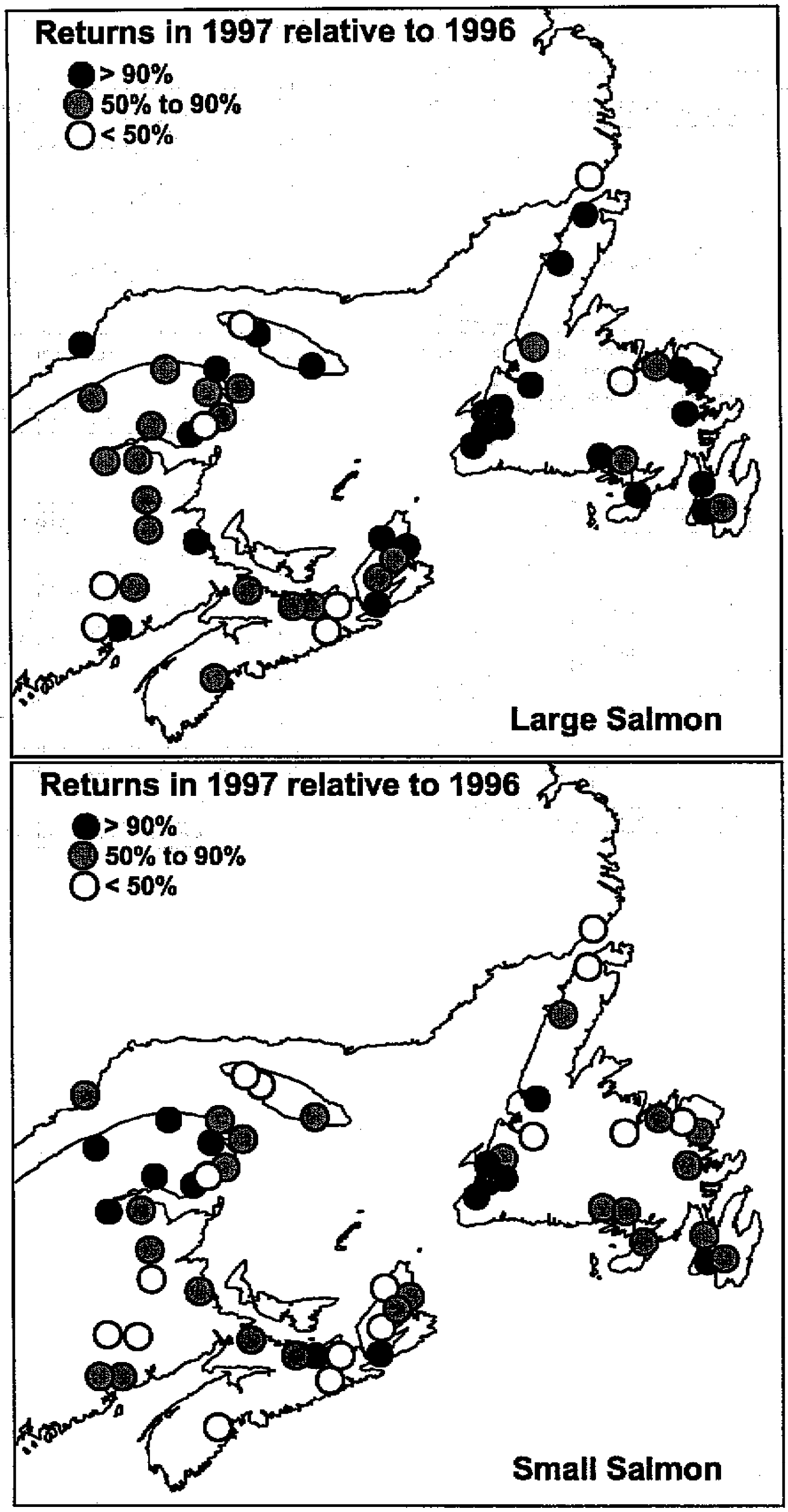


Figure 4.2.1.2 In-river returns of small salmon and large salmon for 24 monitored rivers in four geographic areas of eastern Canada from 1985 to 1997. The in-river returns do not account for removals in marine fisheries.

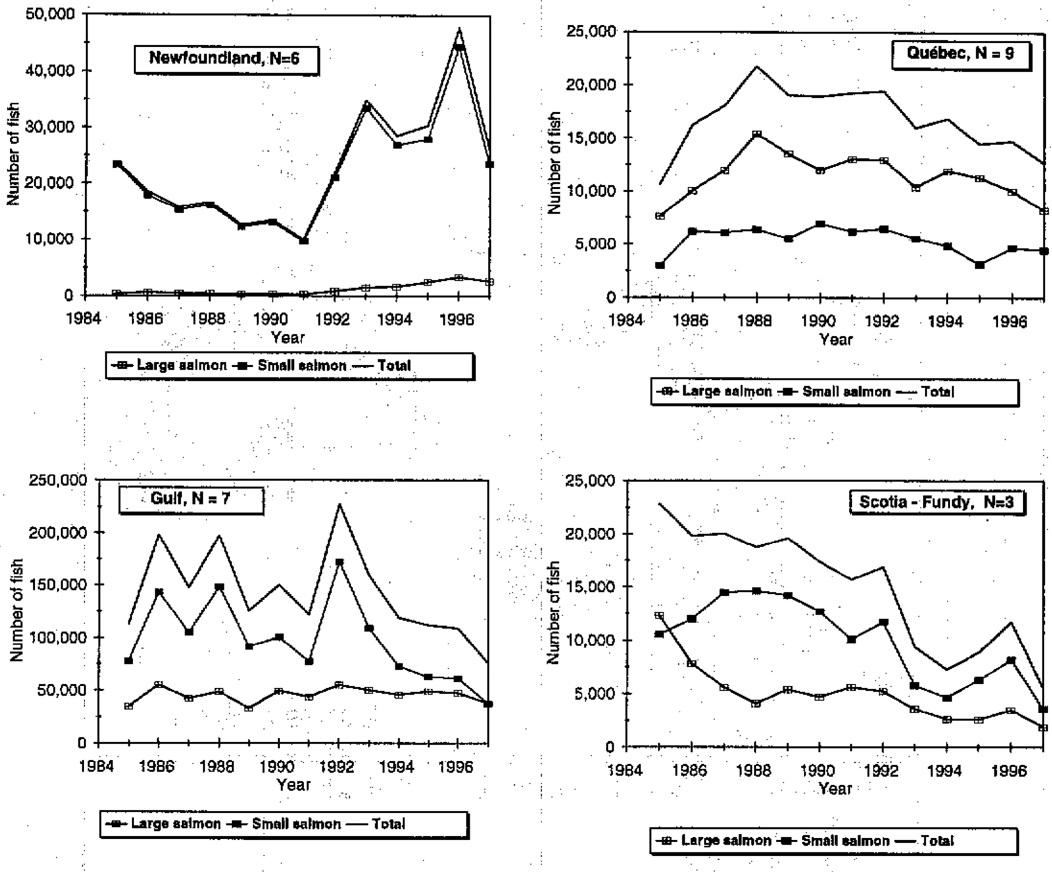


Figure 4.2.1.3 Mean juvenile Atlantic salmon densities in the Miramichi River (SFA 16), Restigouche River (SFA 15) and the Stewiacke River (SFA 22), Canada based on sampling at standard index sites in each river.

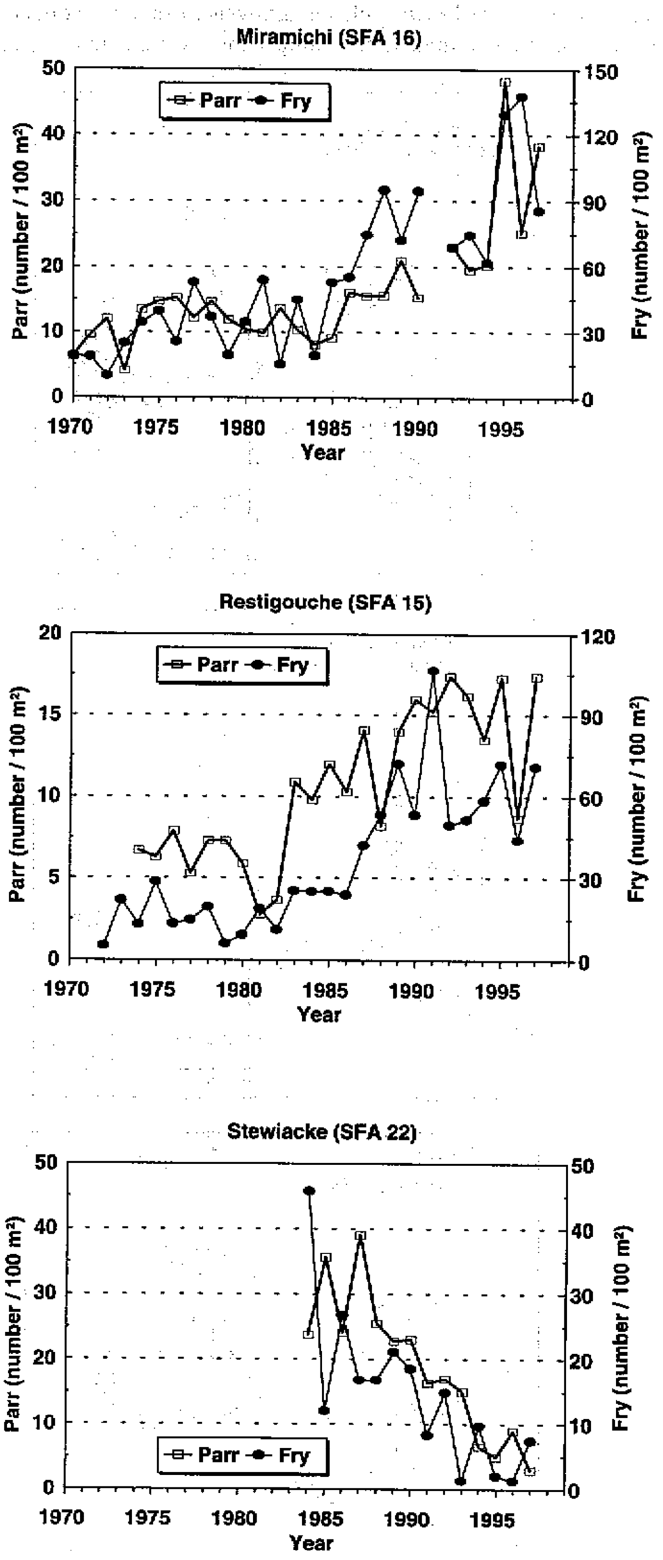


Figure 4.2.1.4 Trends in small salmon returns to rivers of eastern Canada, 1987 to 1997. Groups of rivers were obtained from a cluster analysis of returns (adjusted to the individual river means) conditioned upon a preliminary multivariate analysis (correpsondence analysis).

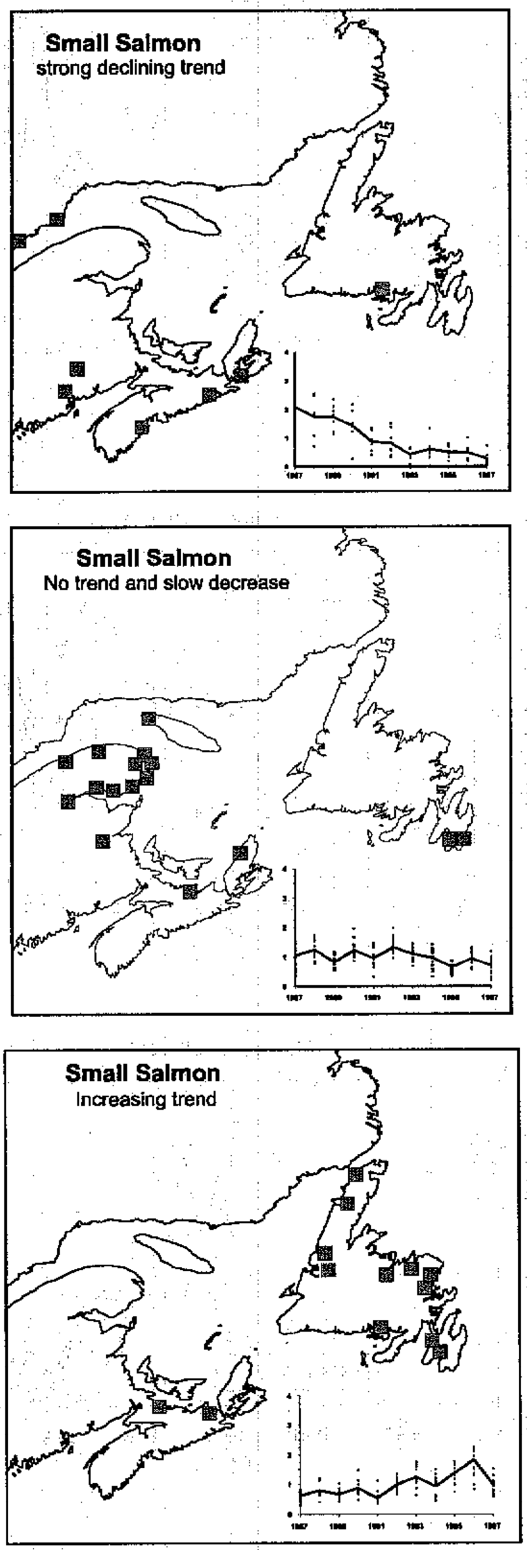


Figure 4.2.1.5 Trends in large salmon returns to rivers of eastern Canada, 1987 to 1997. Groups of rivers were obtained from a cluster analysis of returns (adjusted to the individual river means) conditioned upon a preliminary multivariate analysis (correpsondence analysis).

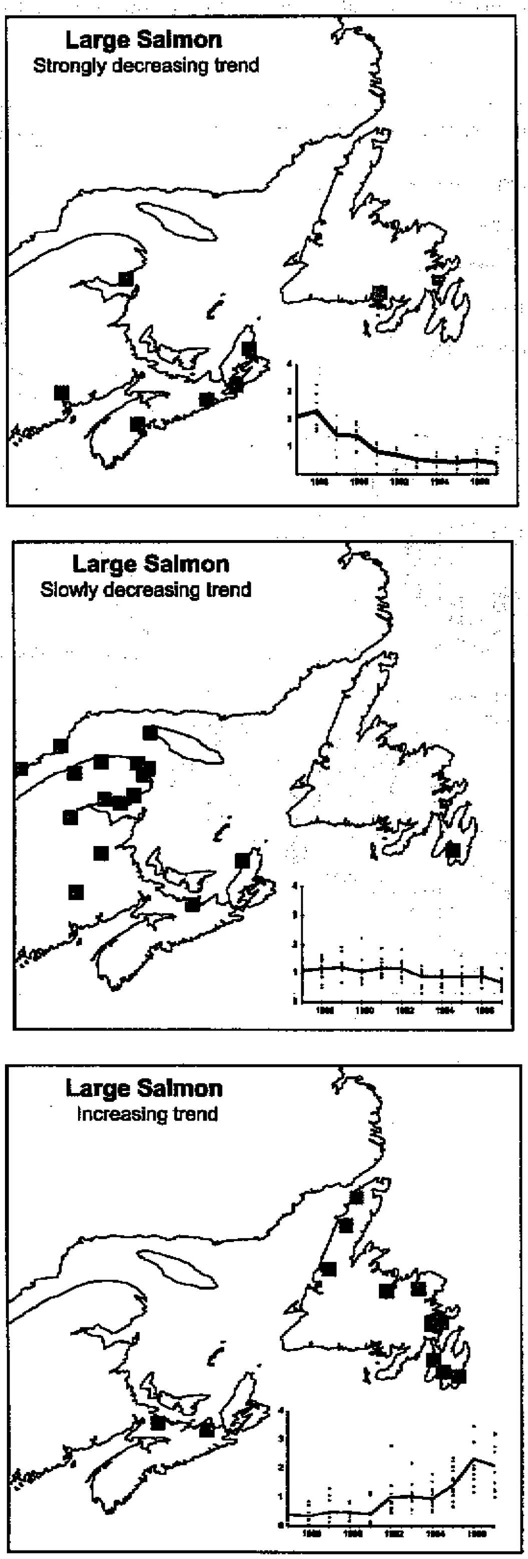


Figure 4.2.1.6 Overall geographic pattern of trends in abundance of small salmon and large salmon returning to rivers of eastern Canada, 1987 to 1997. Groups of rivers by size group were obtained from a cluster analysis of returns (adjusted to the individual river means) conditioned upon a preliminary multivariate analysis (correpsondence analysis). This summary plot is a qualitative integration of the trend patterns from the two size groups.

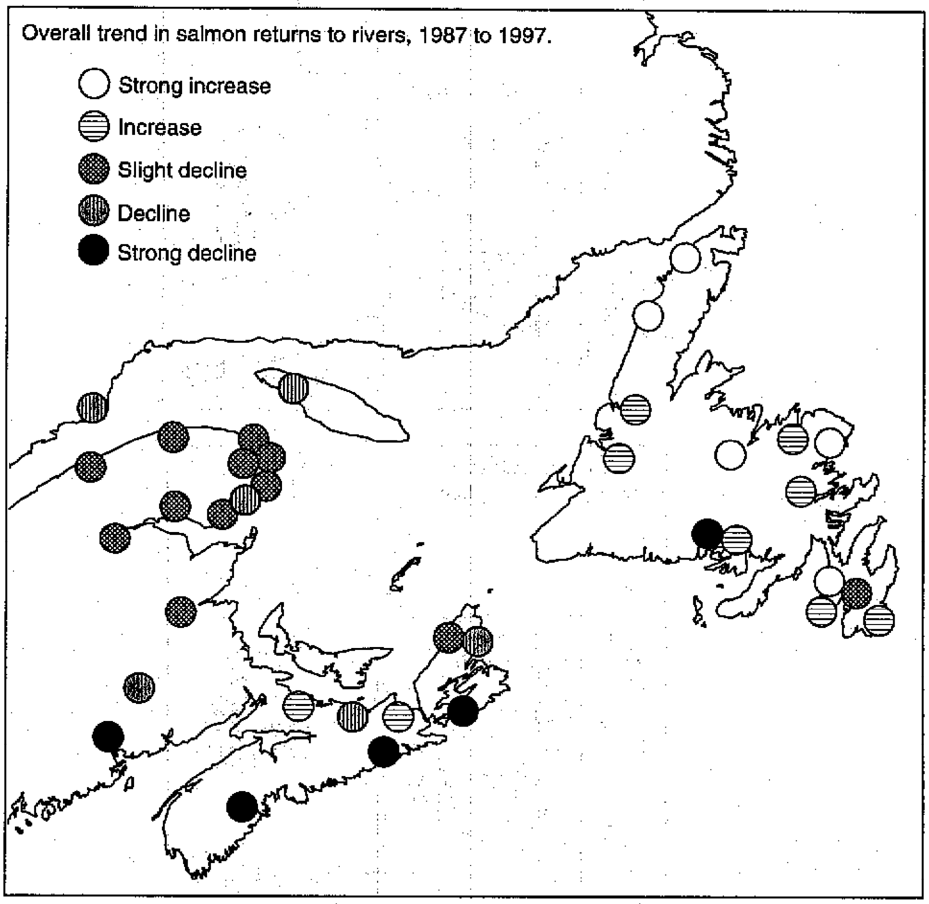


Figure 4.2.1.7 Documented Atlantic salmon returns to USA rivers.

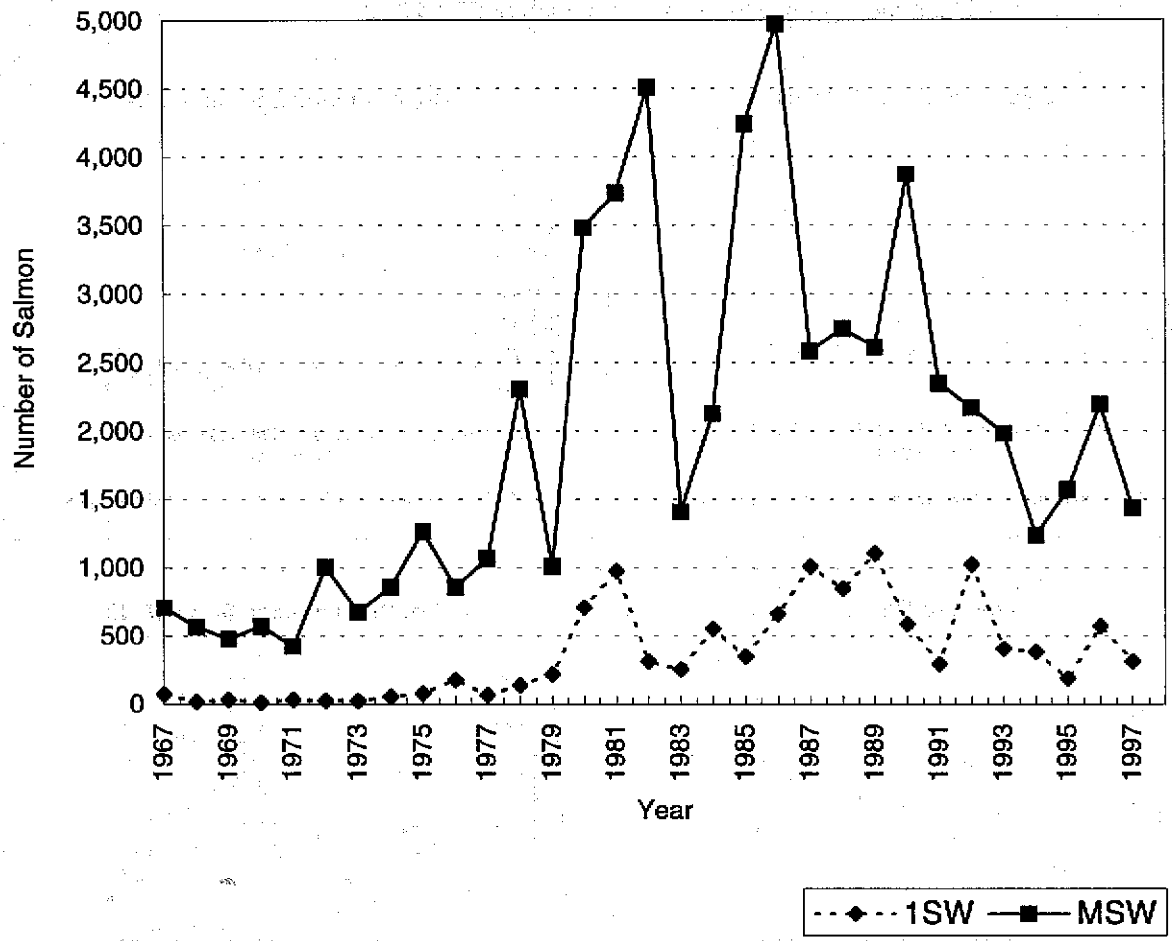


Figure 4.2.2.1 Comparison of estimated mid-points of 1SW returns (circles) to rivers of Nfld & Labrador and to SFAs of the other geographic areas, 1SW recruits of Nfld & Labrador origin before commercial fisheries in Nfld & Labrador (dashed lines), 1SW spawners (squares). Returns and spawners for Scotia-Fundy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

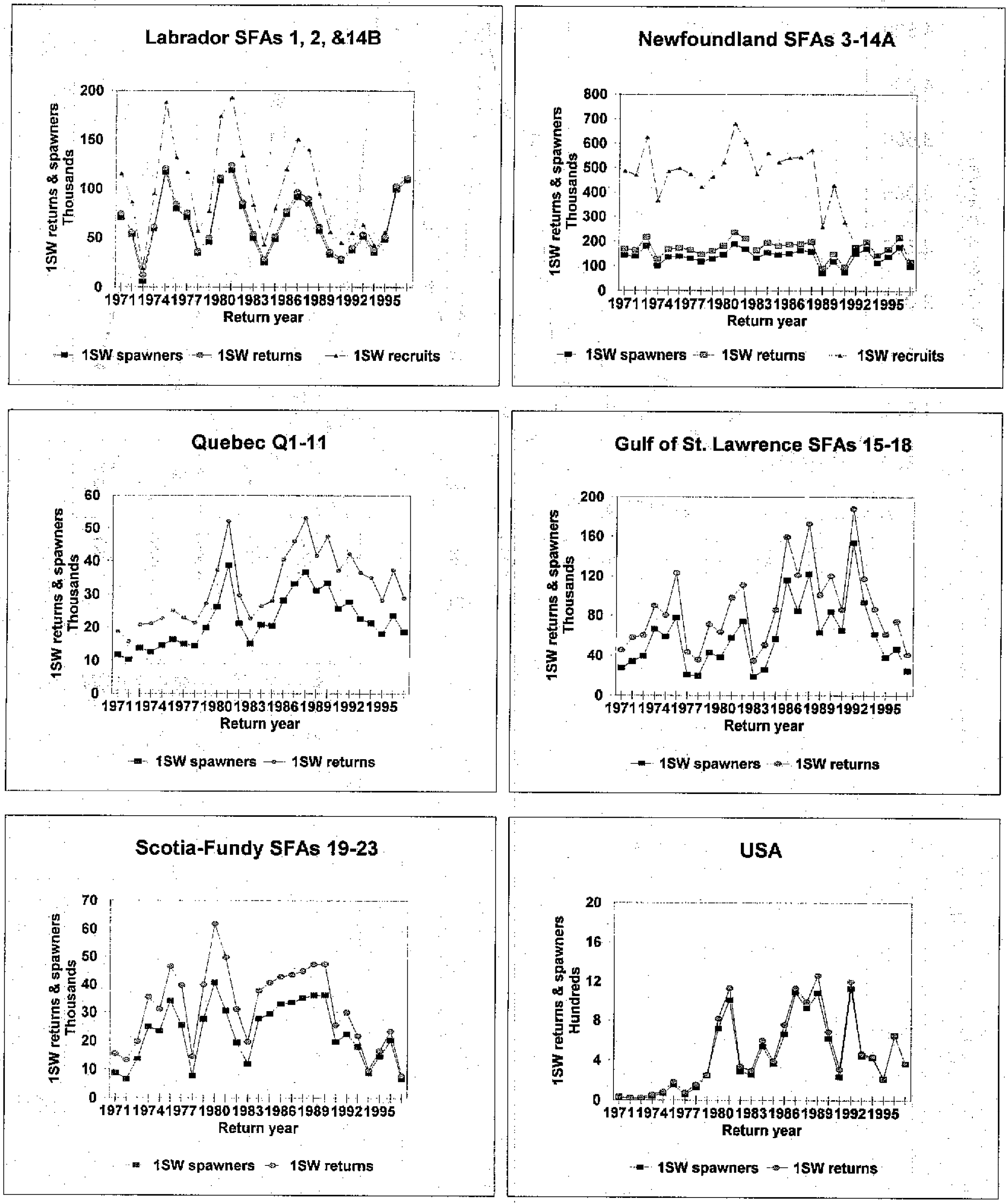


Figure 4.2.2.2 Comparison of estimated mid-points of 2SW returns (circles) to rivers of Nfld & Labrador and to SFAs of the other geographic areas, 2SW recruits of Nfld & Labrador origin before commercial fisheries in Nfld & Labrador (dashed lines), 2SW spawners (squares) and 2SW conservation requirements (triangles) for 1971-97 return years. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

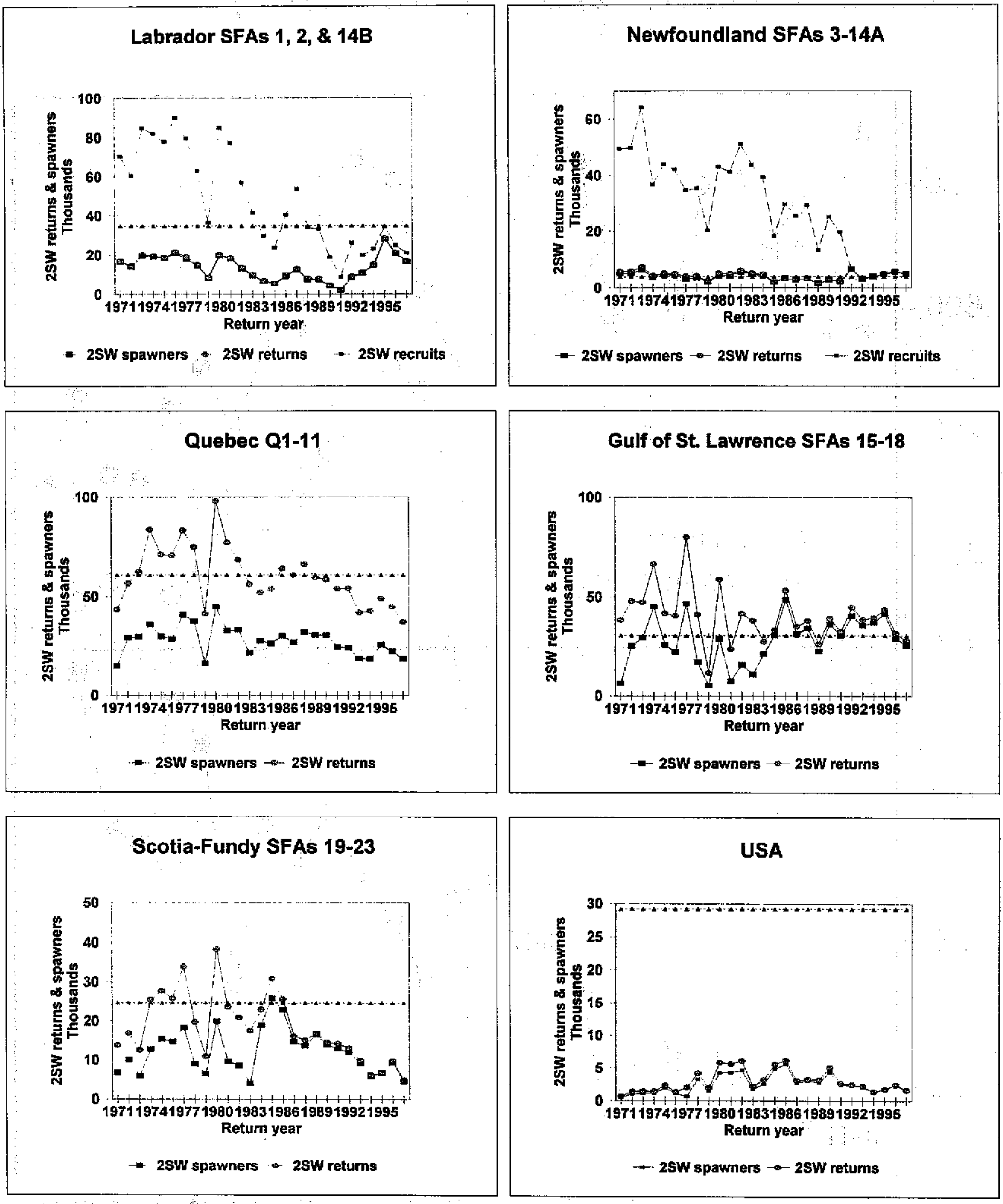


Figure 4.2.3.1. Pre-fishery abundance estimate of maturing and non-maturing salmon in North America (A), and proportion of smolt class maturing after 1SW (B).

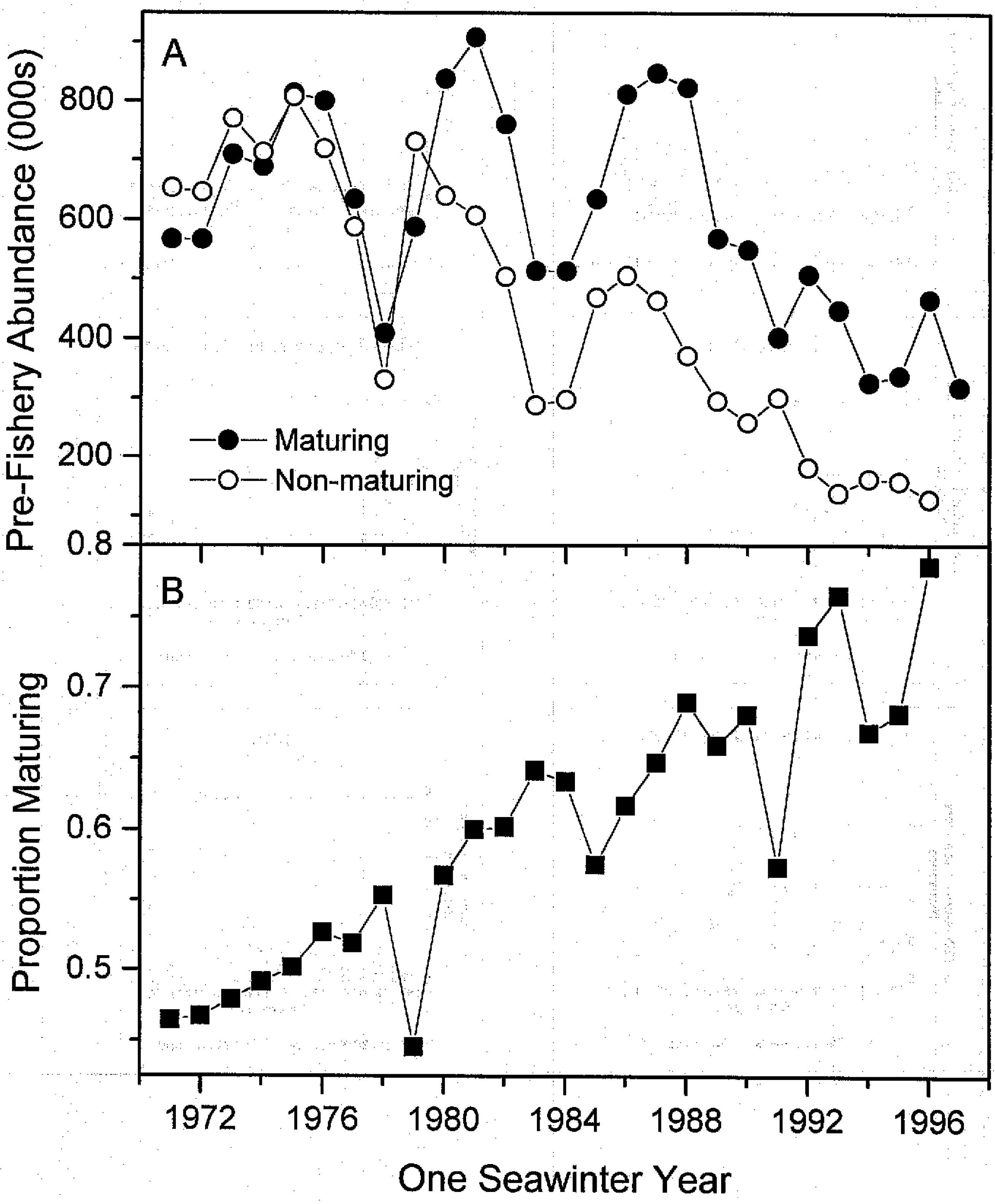


Figure 4.2.3.2. Total 1SW recruits (non-maturing and maturing) originating in North America.

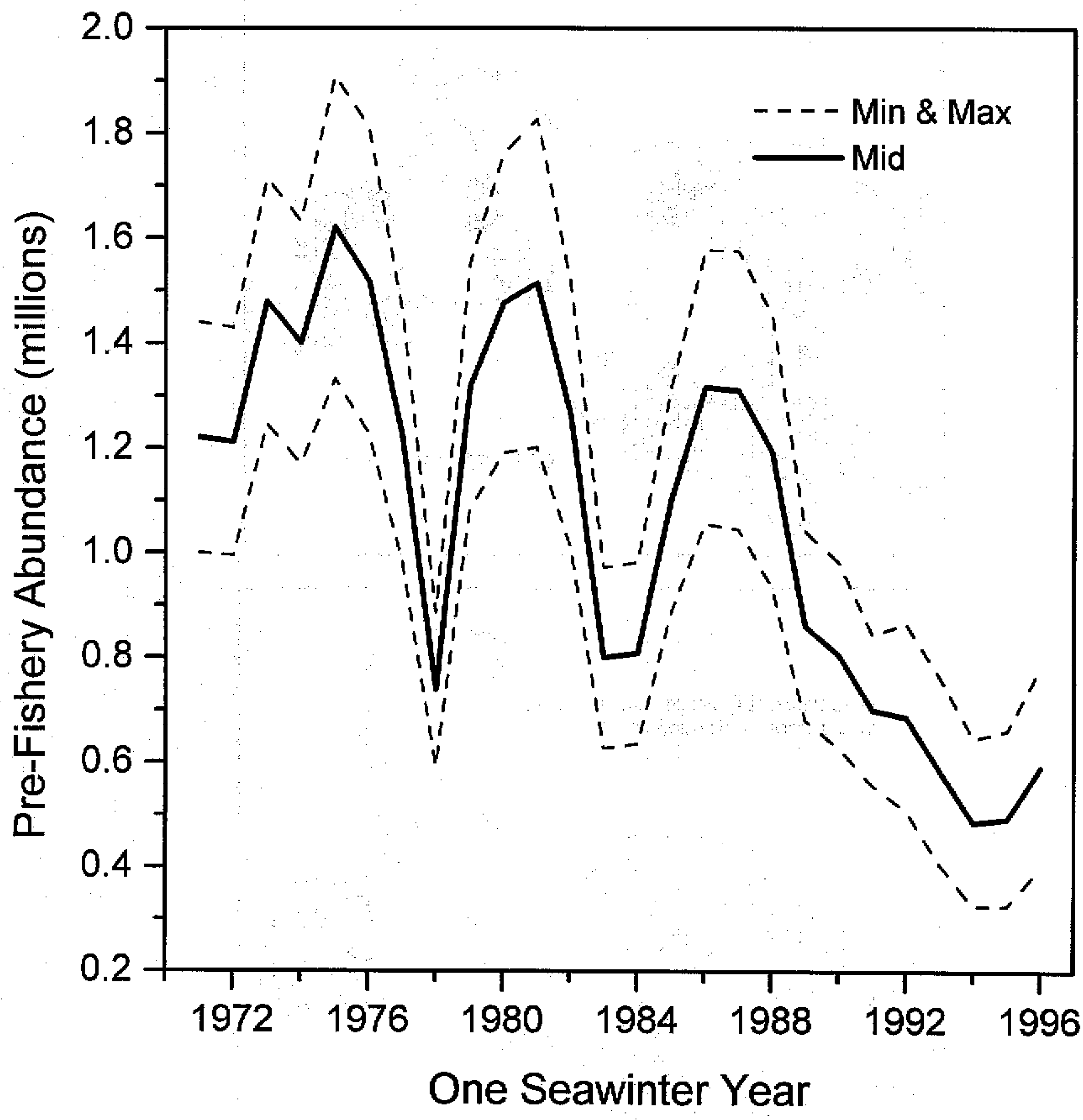
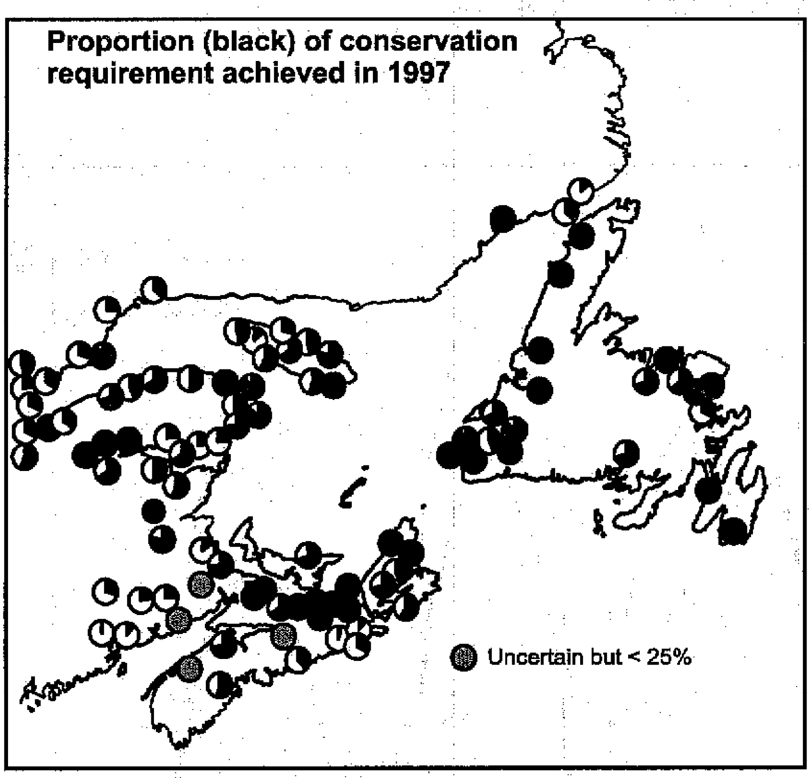


Figure 4.2.4.1 Egg depositions in 1997 relative to conservation requirements in 89 rivers (upper map) and for 19 rivers of eastern Canada under colonization or rehabilitation (lower map). The black slice represents the proportion of the conservation requirement achieved in 1997. A solid black circle indicates the egg deposition requirement was attained or exceeded.



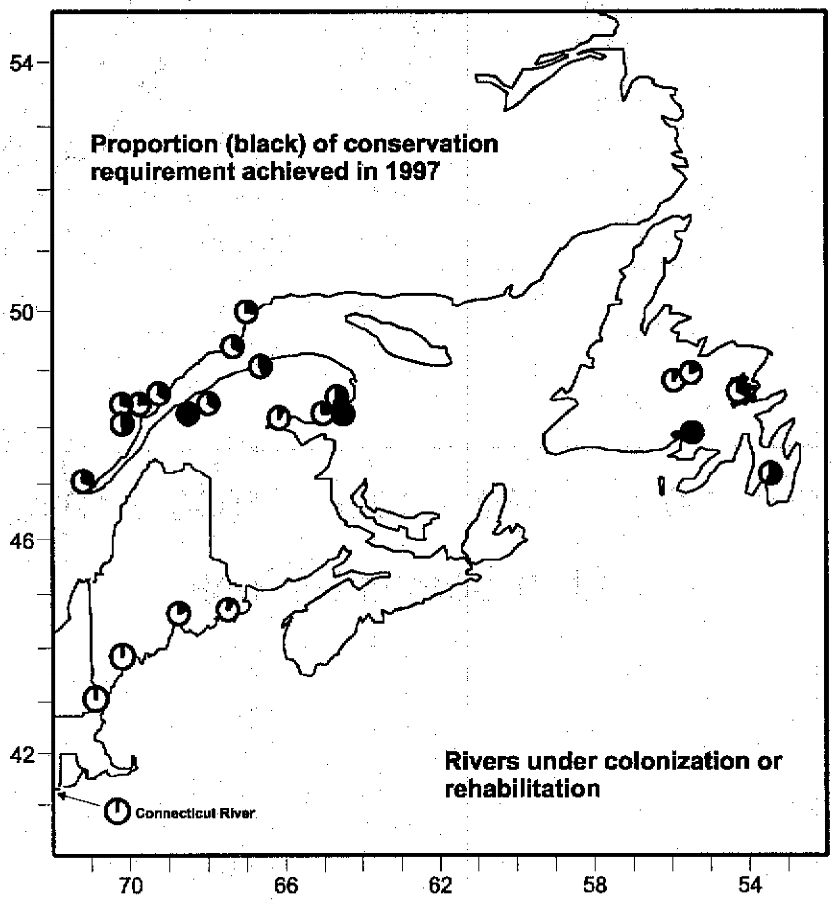


Figure 4.2.4.2 Proportion of the conservation requirements met in monitored rivers in four geographic area of eastern Canada, 1984 to 1997. The vertical line represents the minimum and maximum proportion achieved in individual rives, the black square is the median proportion and the number above the vertical line is the number of rivers included in the annual summary. The horizontal line defines the location of 100% of conservation requirements.

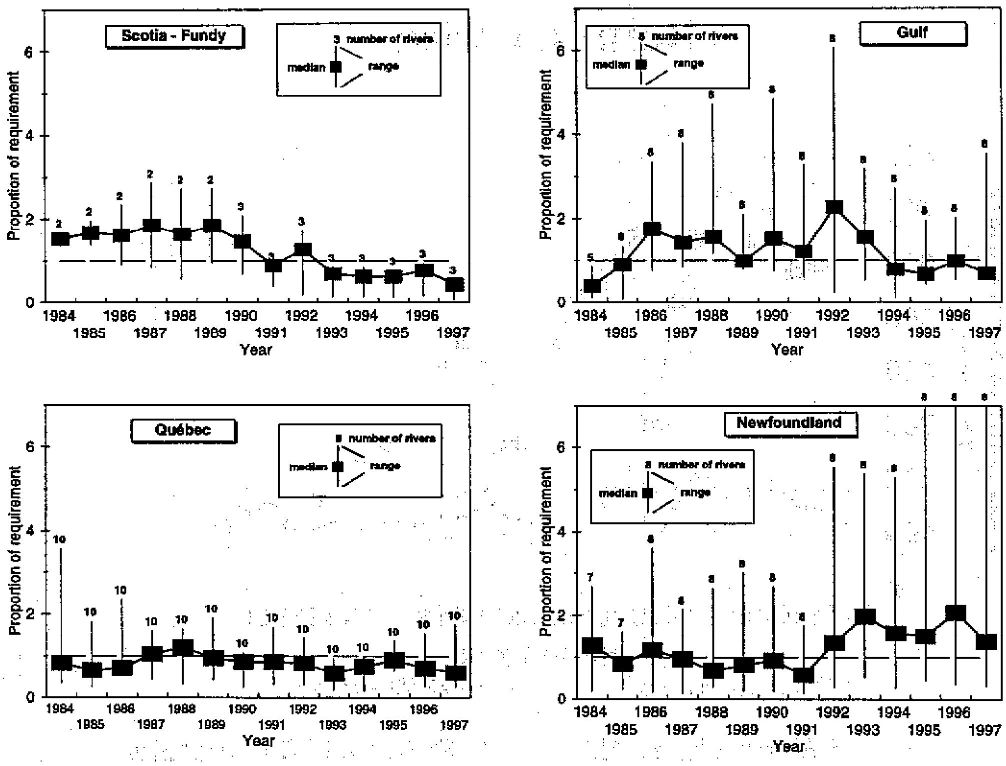
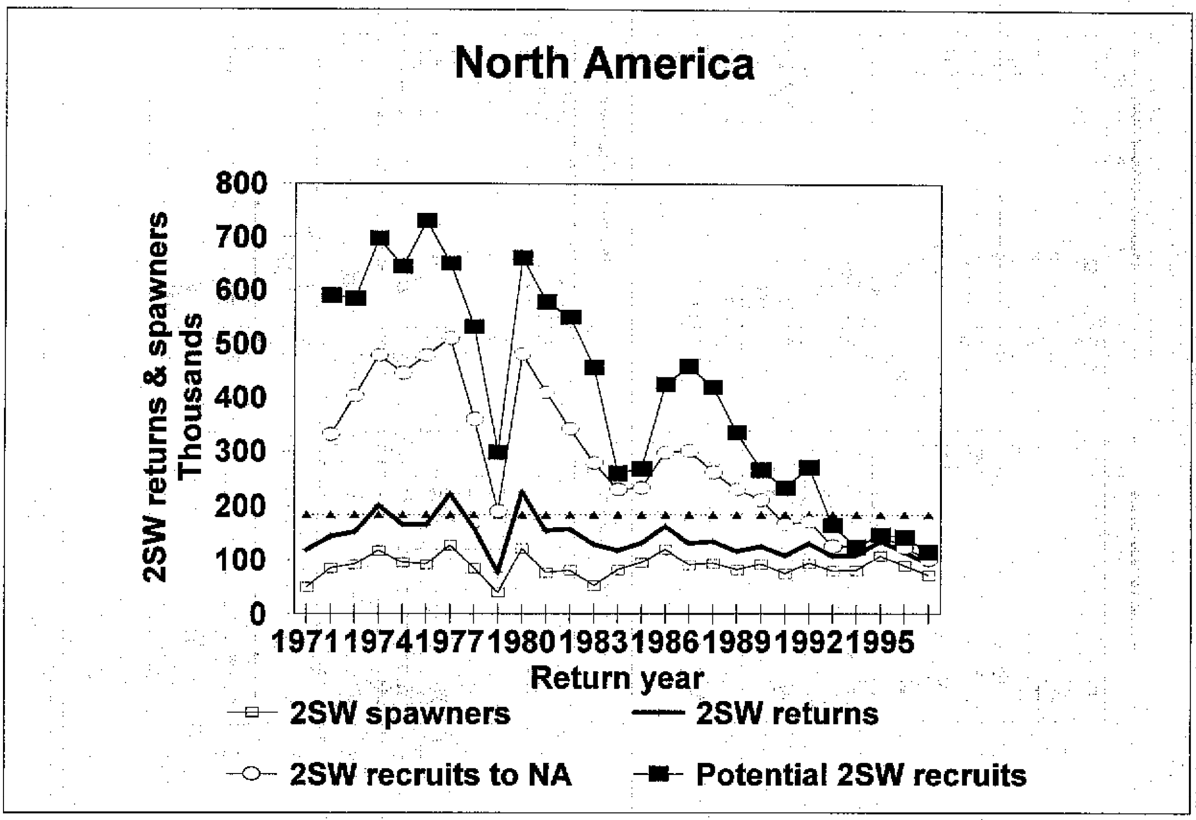


Figure 4.2.4.3 Top panel: comparison of estimated of potential 2SW production prior to all fisheries, 2SW recruits available to North America and 2SW returns and spawners for 1971-97. Triangles indicate the 2SW spawner threshold.
Bottom panel: comparison of potential maturing 1SW recruits and returns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



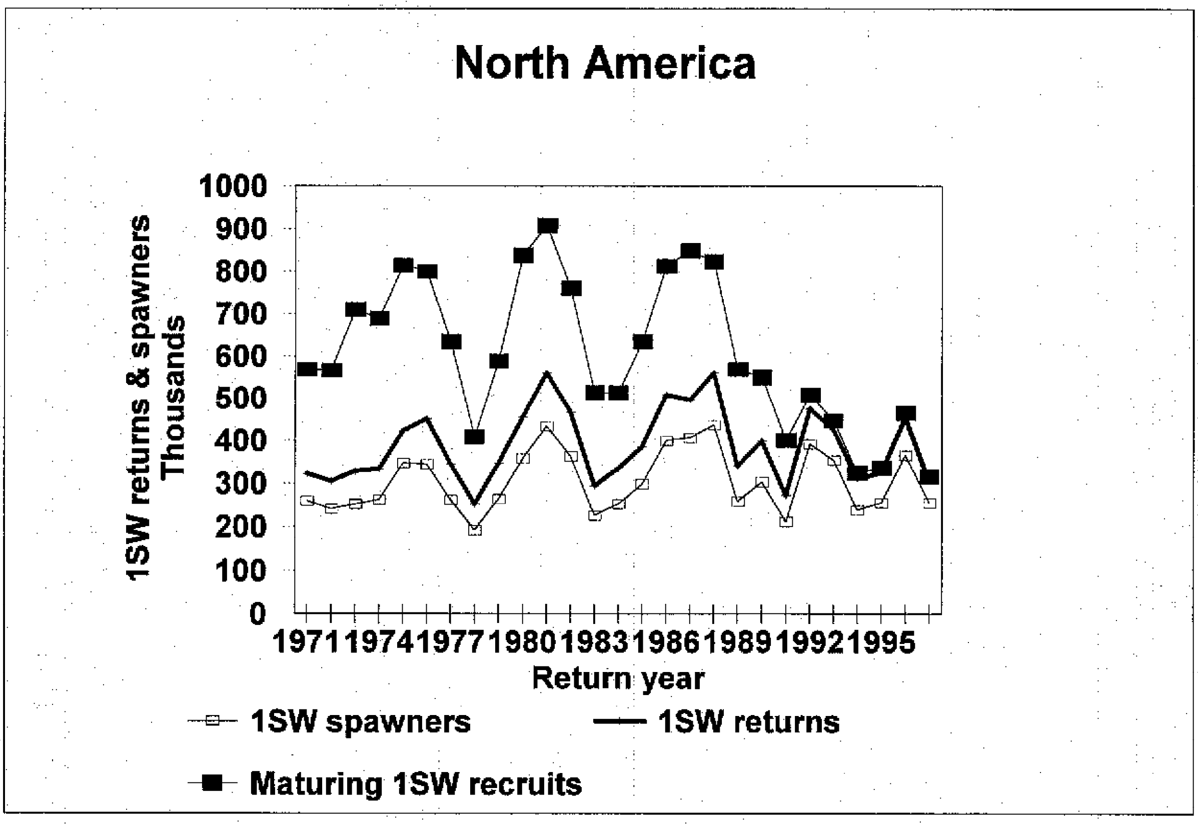


Figure 4.2.4.4 Lagged spawner contributions to potential recruitment in the given year for six geographic areas of North America. The horizontal line represents the spawning requirement (in terms of 2SW fish) in each geographic area.

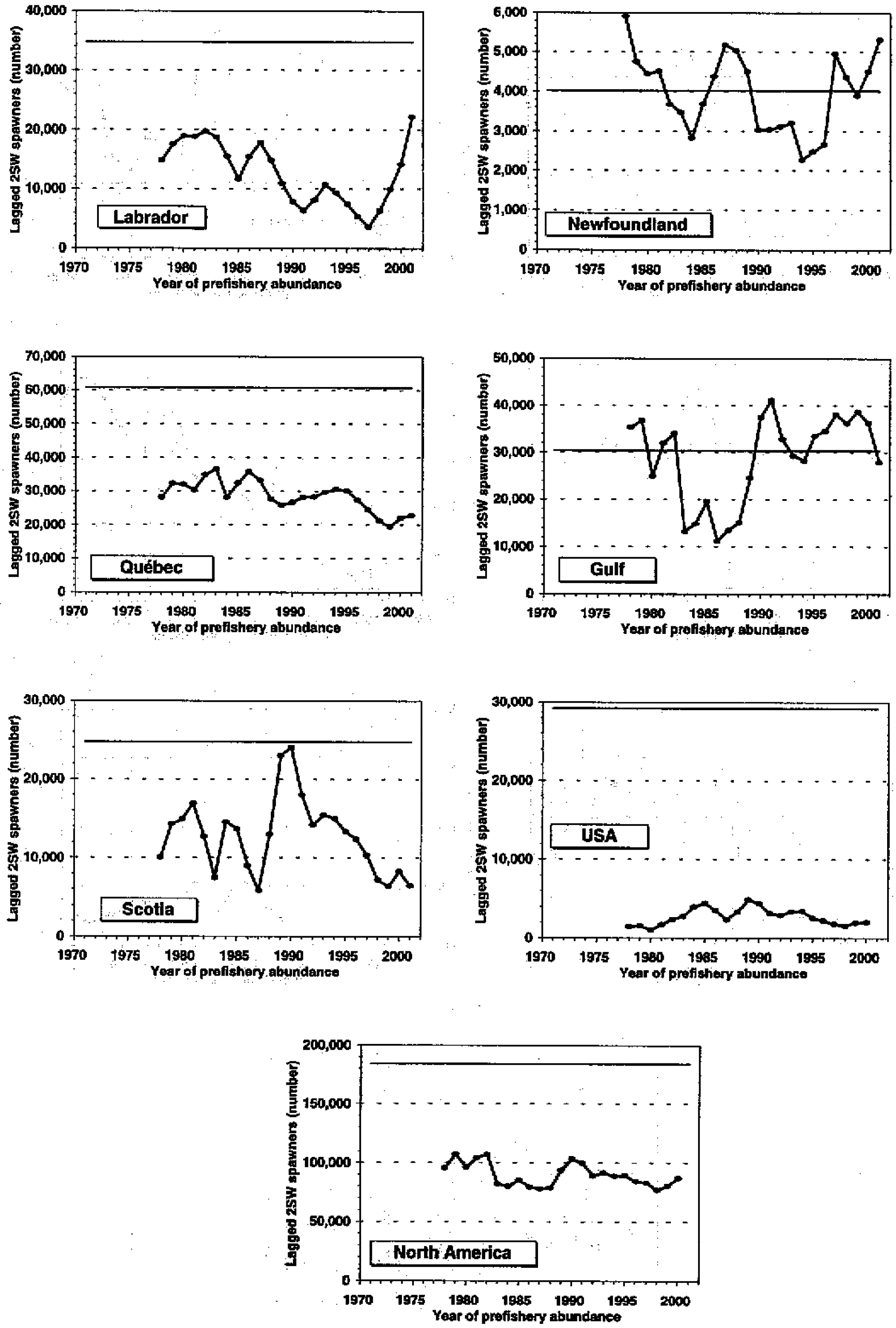


Figure 4.2.4.5 Proportion of lagged spawners in the six geographic areas of North America relative to the total lagged spawner escapement contributing to the year of prefishery abundance. The horizontal line represents the theoretical spawner proportions for each area based on the 2SW spawner requirement for North America.

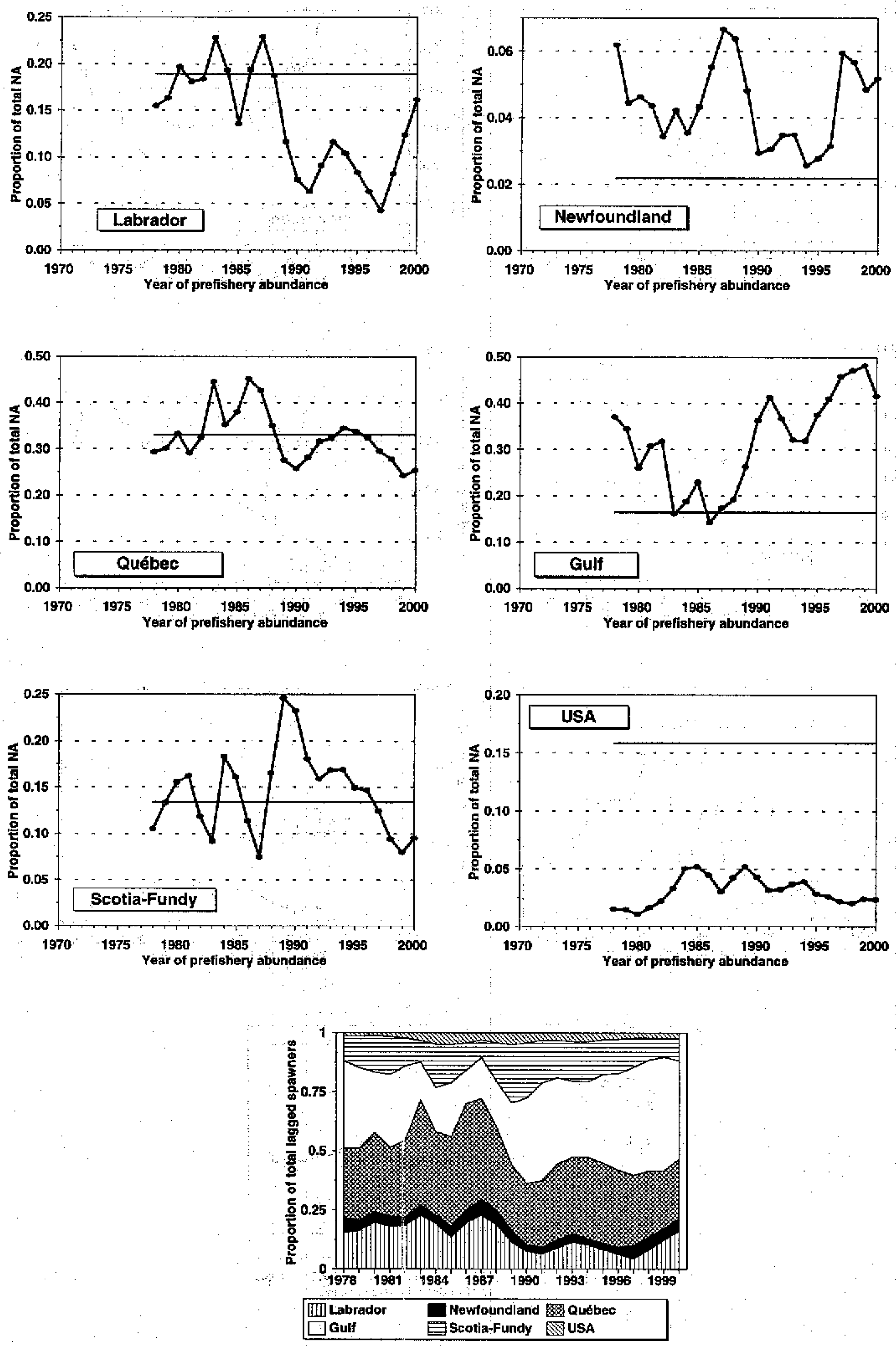


Figure 4.2.5.1 Variability in the wild smolt output from eight rivers of eastern Canada in 1984 to 1997 relative to the average smolt output (by individual river) for the 1990 to 1995 period.

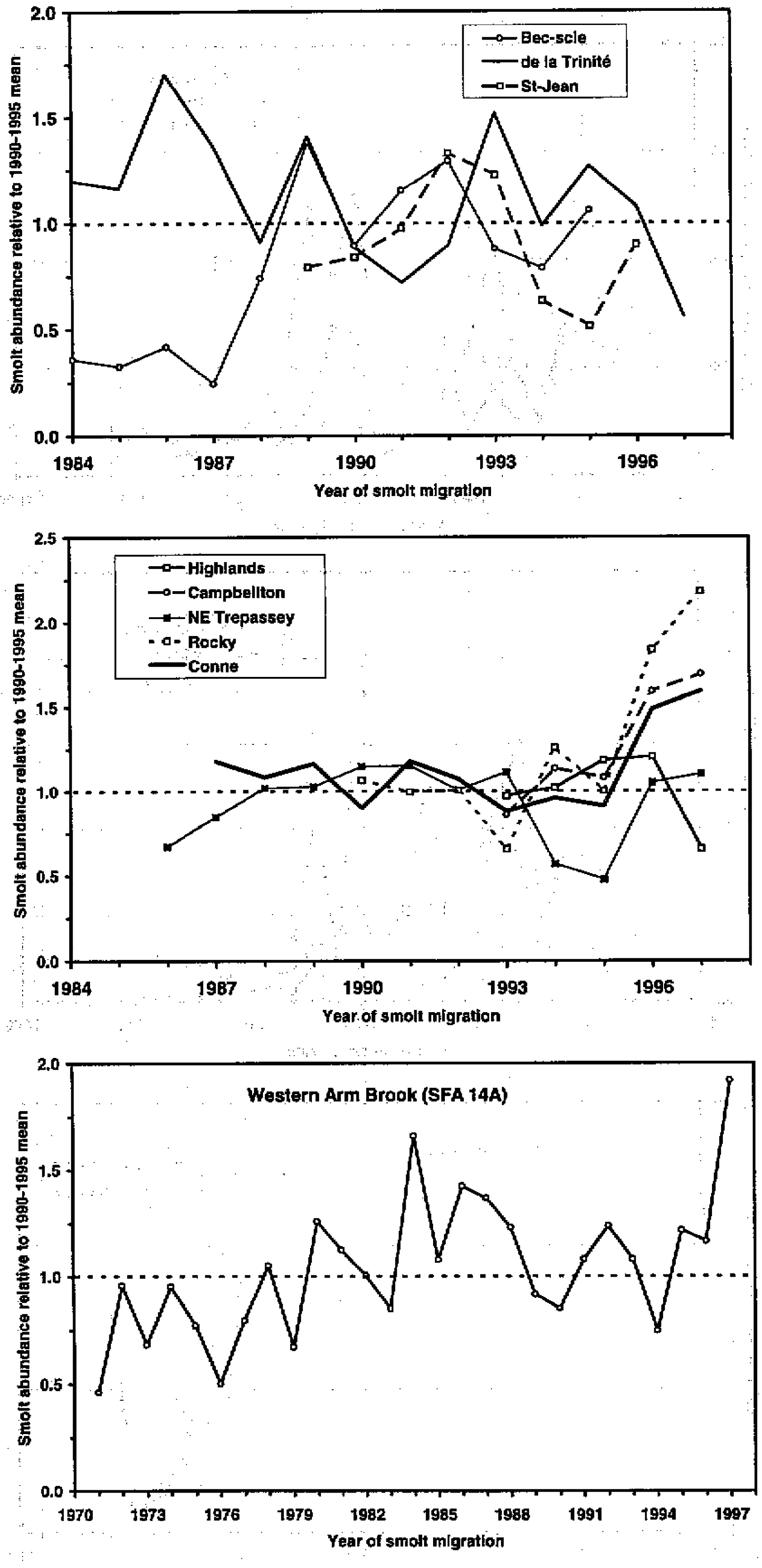


Figure 4.2.5.2 Trends in survival rates (%) of hatchery released smolts from the Saint John River (SFA 23), LaHave River (SFA 21), Liscomb River (SFA 20), and aux Rocher River (Q7) as 1SW, 2SW returns to the river.

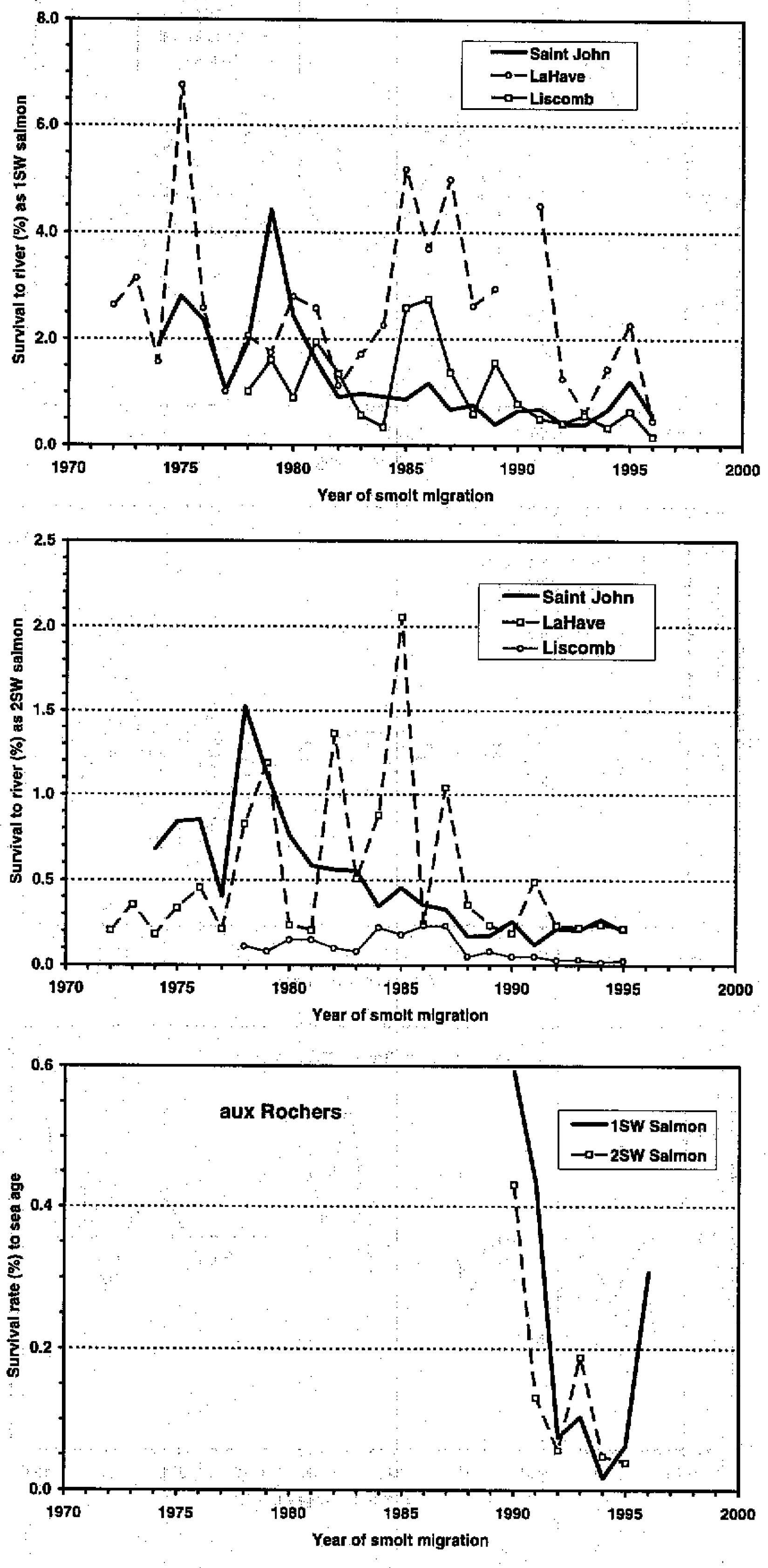


Figure 4.2.5.3 Trends in survival rates (%) of wild smolts as 1SW and 2SW salmon from the rivers in Quebec (Saint-Jean, Q2; de la Trinité, Q7; Bec-scie, Q10).

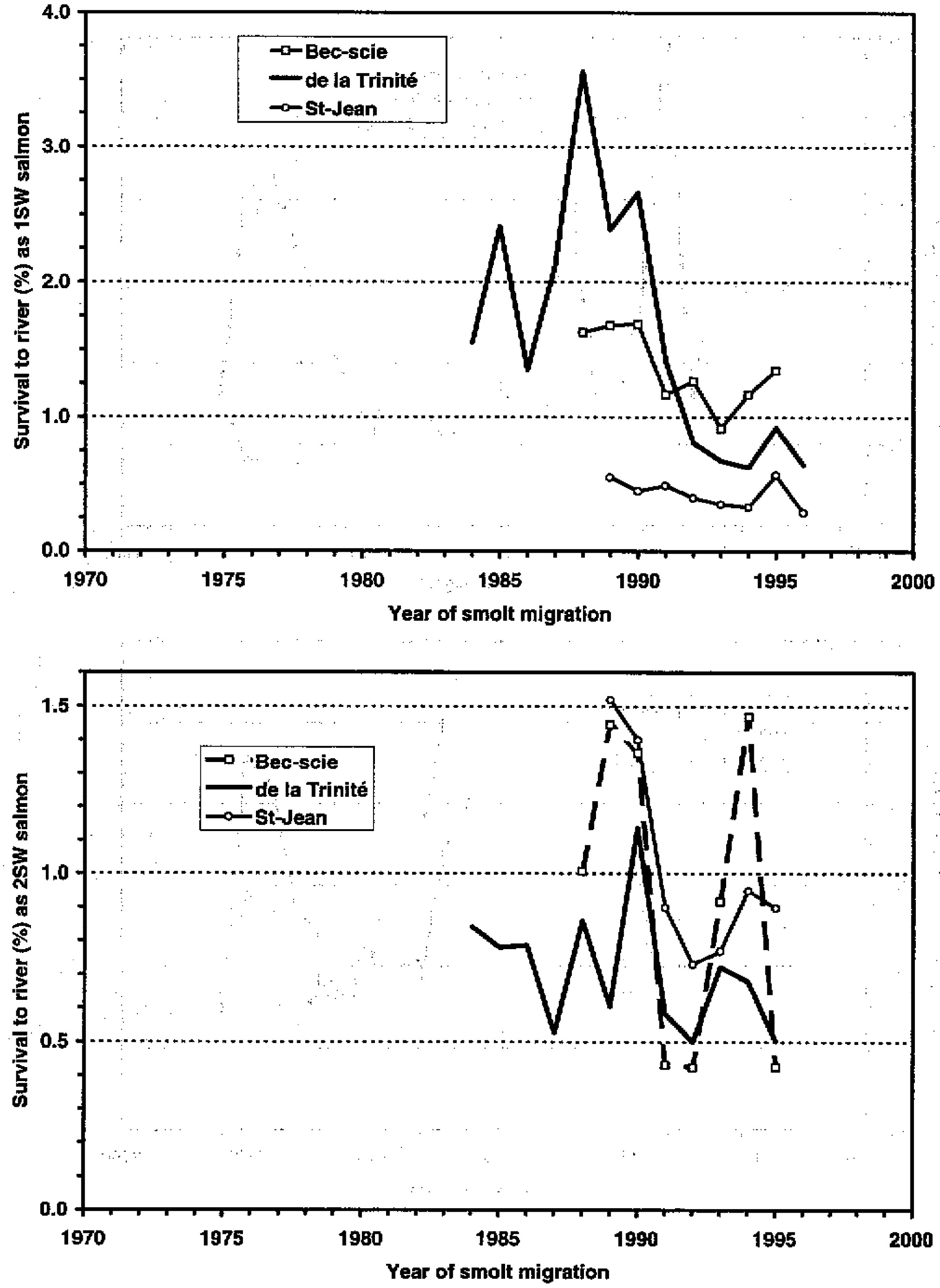
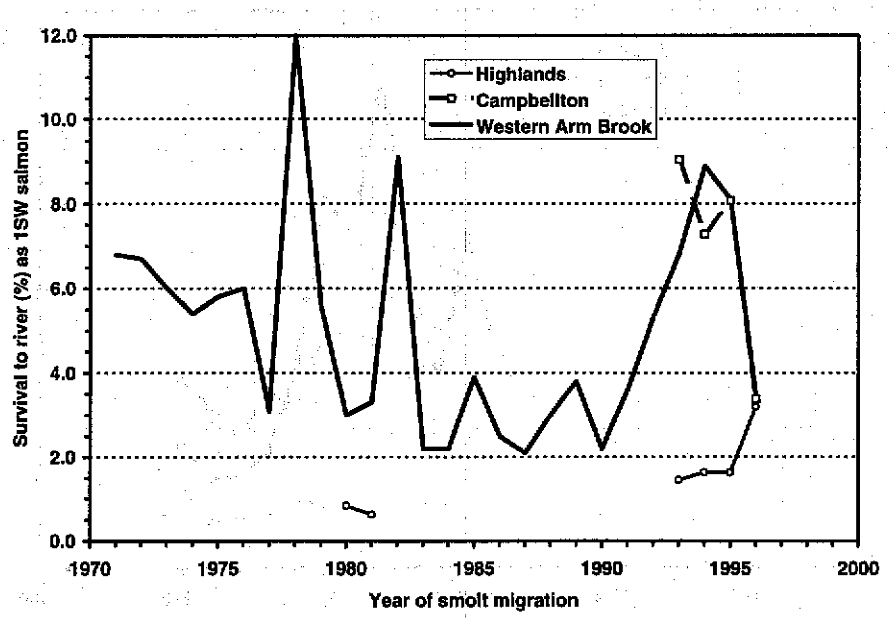


Figure 4.2.5.4 Trends in survival rates (%) of wild smolts as 1SW salmon from the rivers in Newfoundland (Campbellton, SFA 4; NE Trepassey, SFA 9; Rocky, SFA 9; Conne, SFA 10; and Highlands, SFA 13).



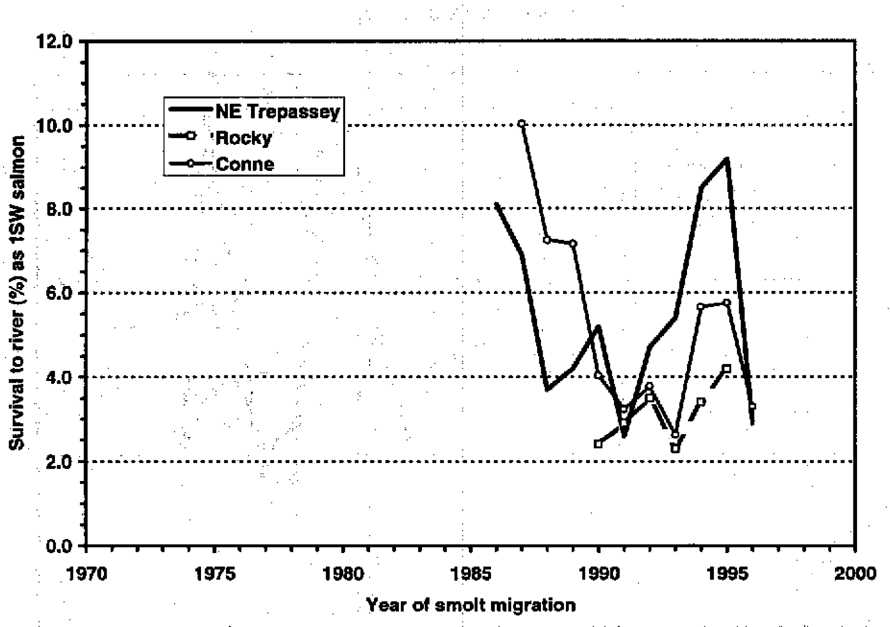


Figure 4.2.5.5 Marine survival of hatchery-reared Atlantic salmon smolts released into the Penobscot River, Maine, USA.

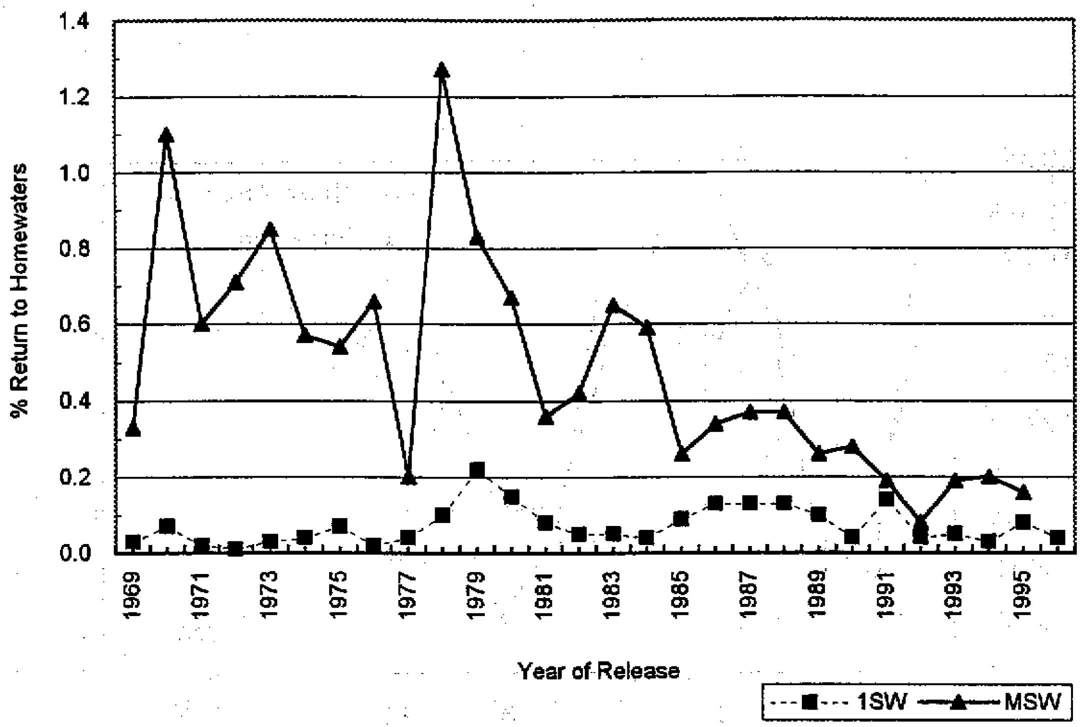


Figure 5.1.2.1 Numbers of North American and European Atlantic salmon caught at West Greenland 1982-92 and 1995-97.

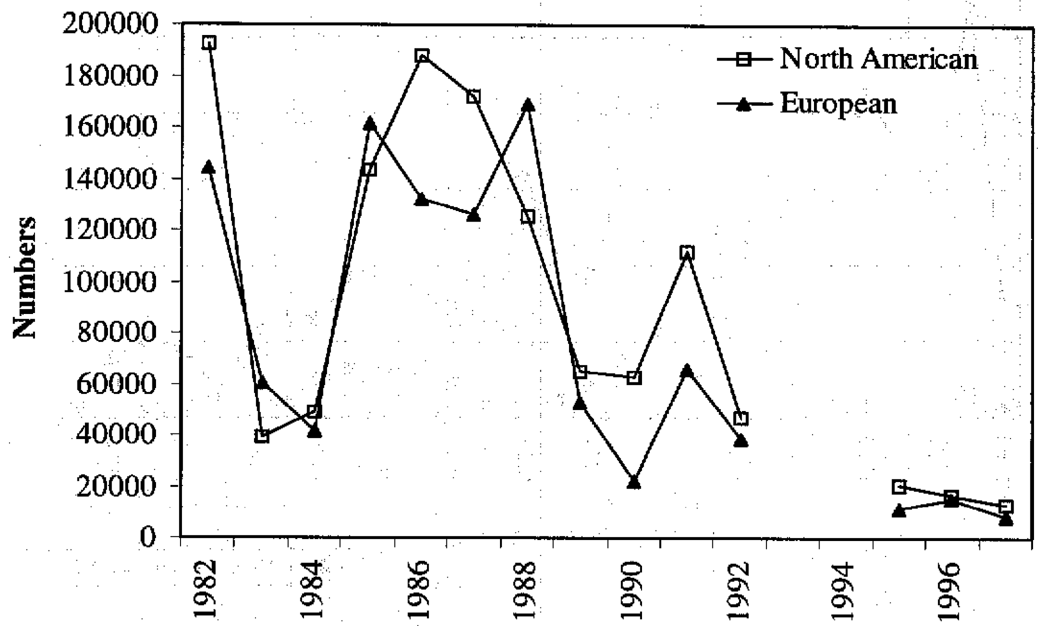


Figure 5.1.2.1 Numbers of North American and European Atlantic salmon caught at West Greenland 1982-92 and 1995-97.

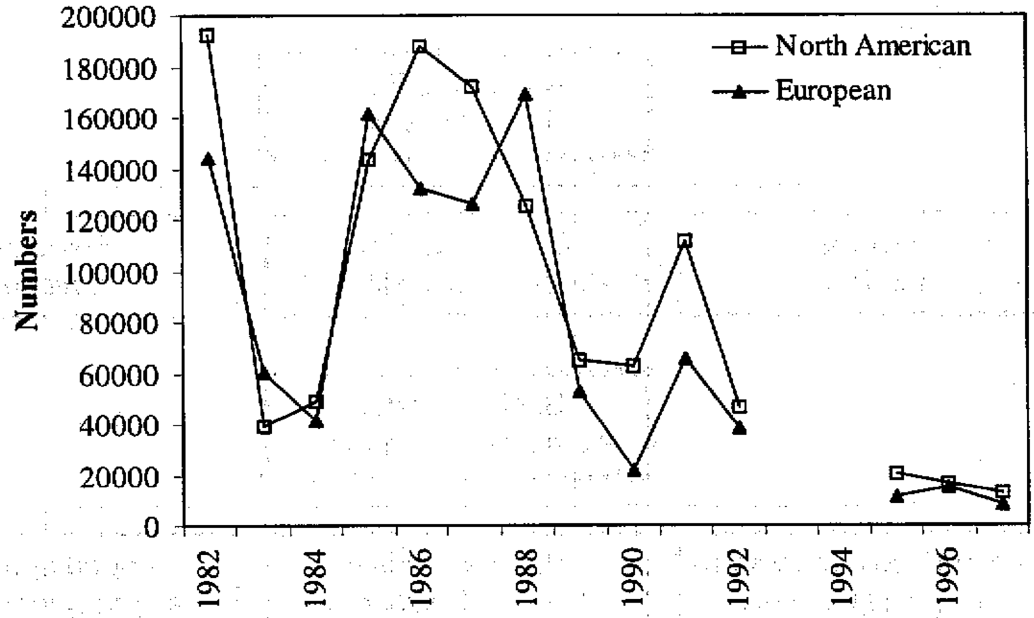


Figure 5.5.3.1. Flowchart showing overall procedure to provide catch advice.

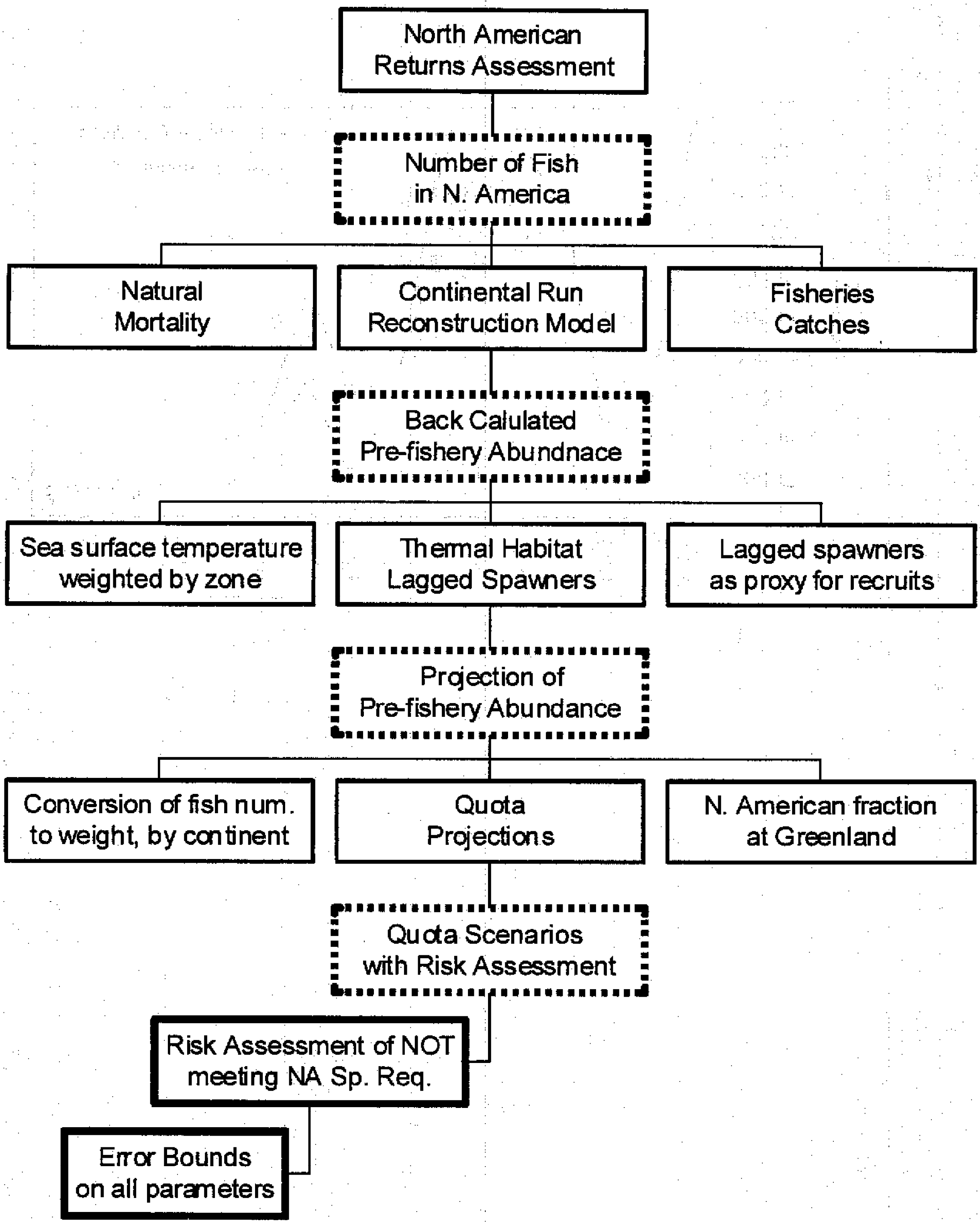


Figure 5.6.1.1 Thermal habitat index for February and lagged spawners (SNLQ).

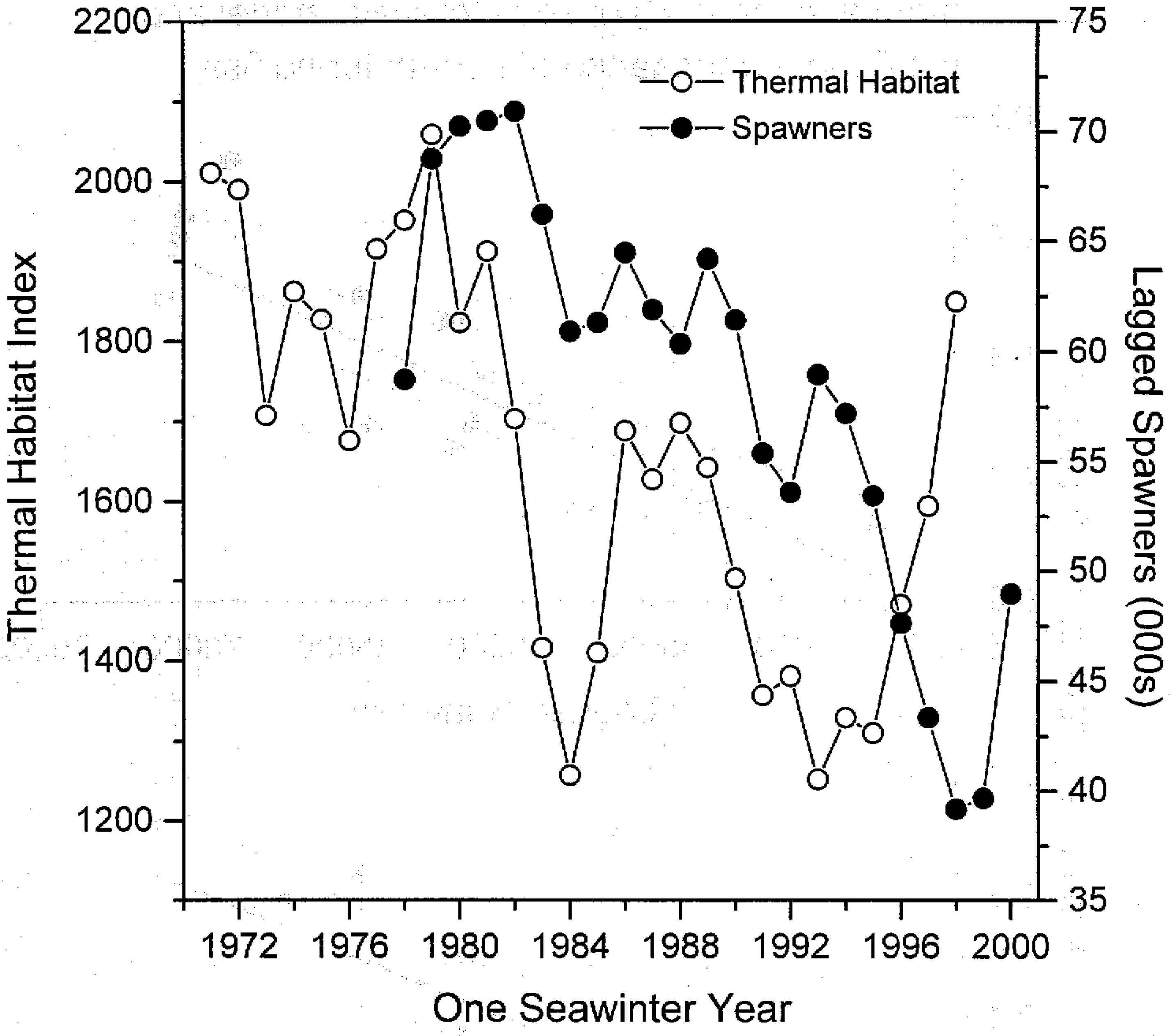


Figure 5.6.2.1. Bivariate relationships between independant variables lagged spawners (A) and thermal habitat (B) used in forecast model and pre-fishery abundance of non-maturing fish.

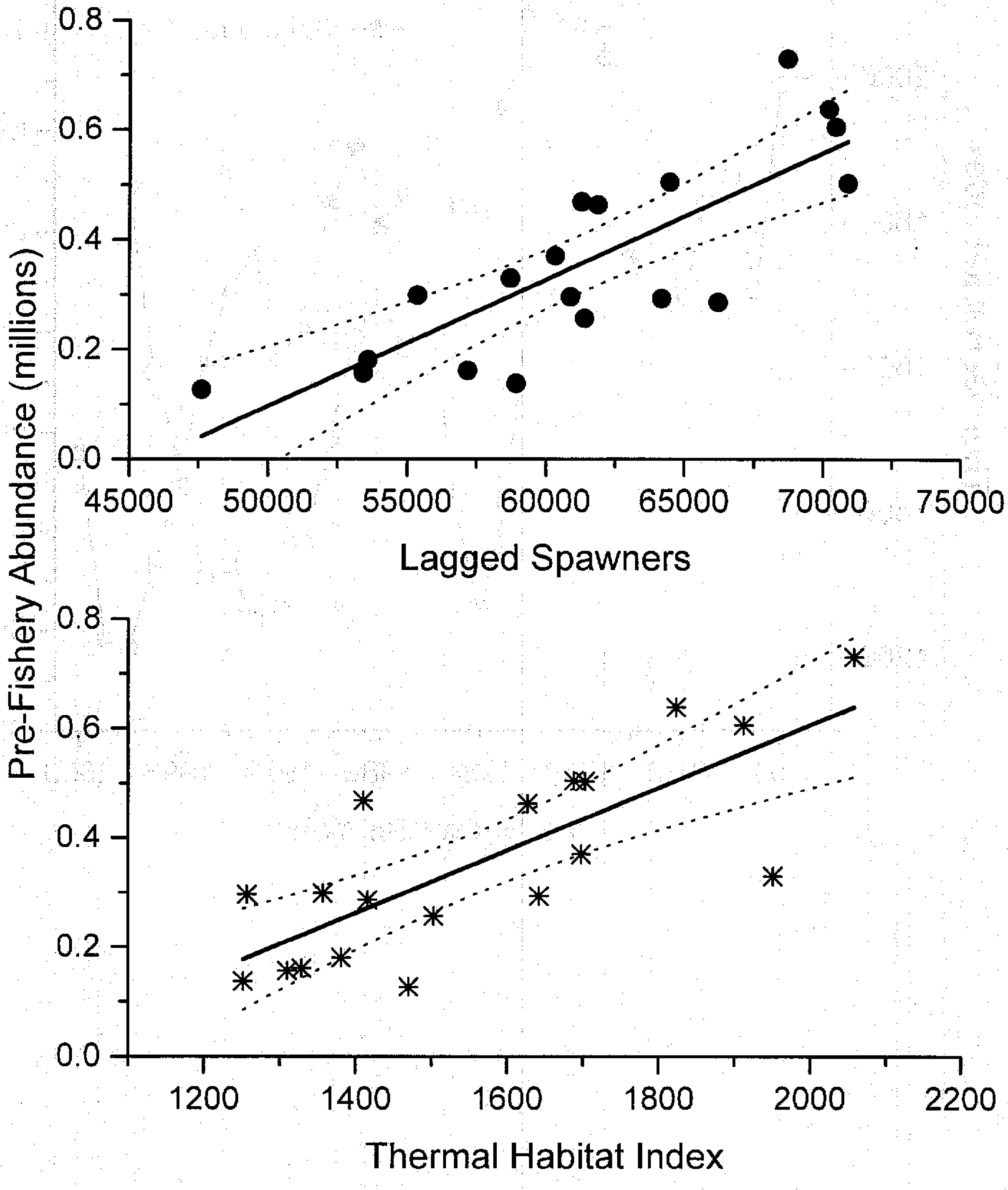


Figure 5.6.2.2. Observed estimates, jackknifed historical predictions, and deterministic forecasts (A) of pre-fishery abundance. Residual pattern from jackknifed predictions (B).

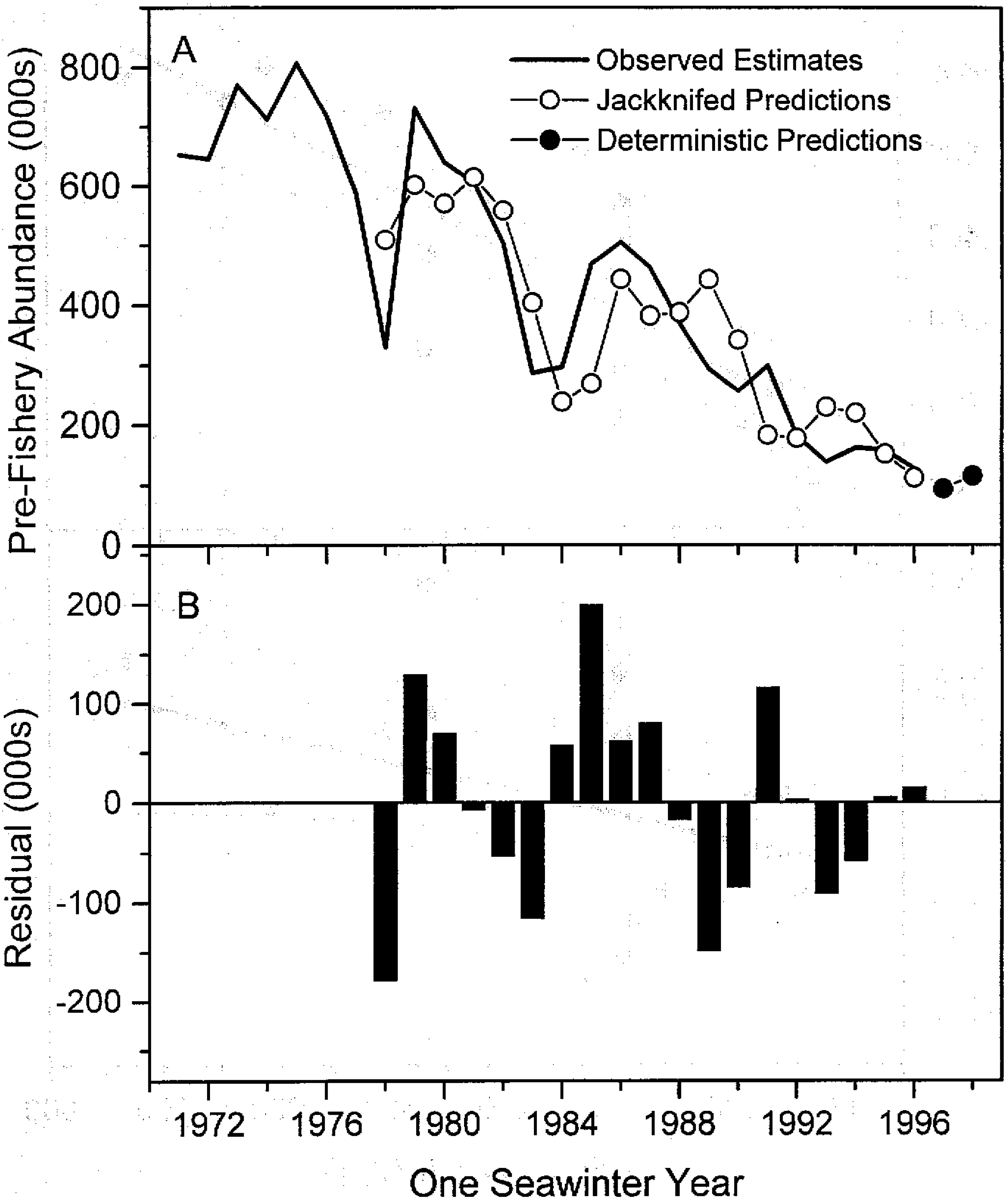


Figure 5.6.2.3. Jackknifed predictions versus observed (A) and residuals versus observed (B) pre-fishery abundance.

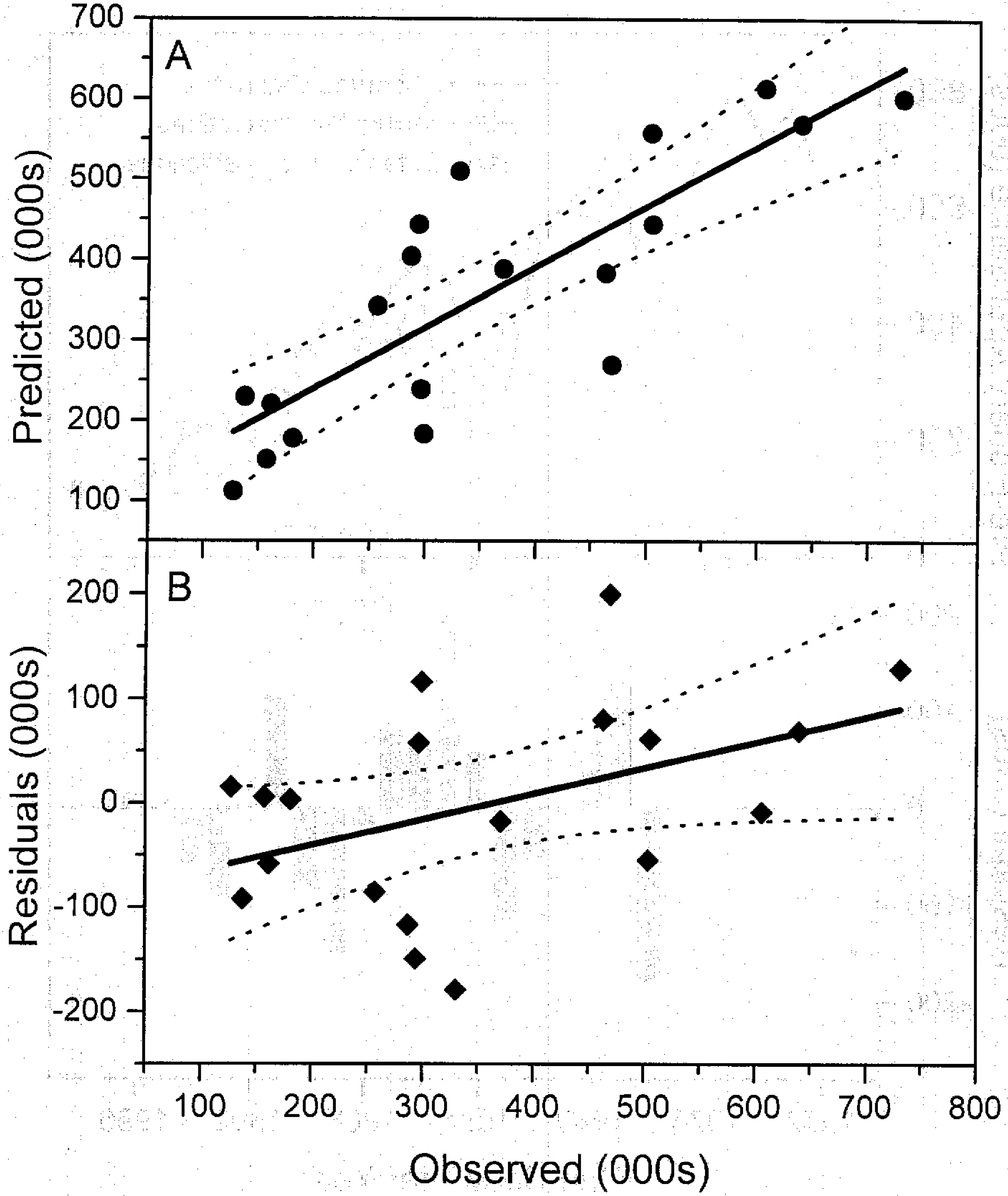


Figure 5.6.4.1 Theoretical risk analysis plots showing the risk-prone and risk-averse zones relative to the uncertainty of the stock assessment.

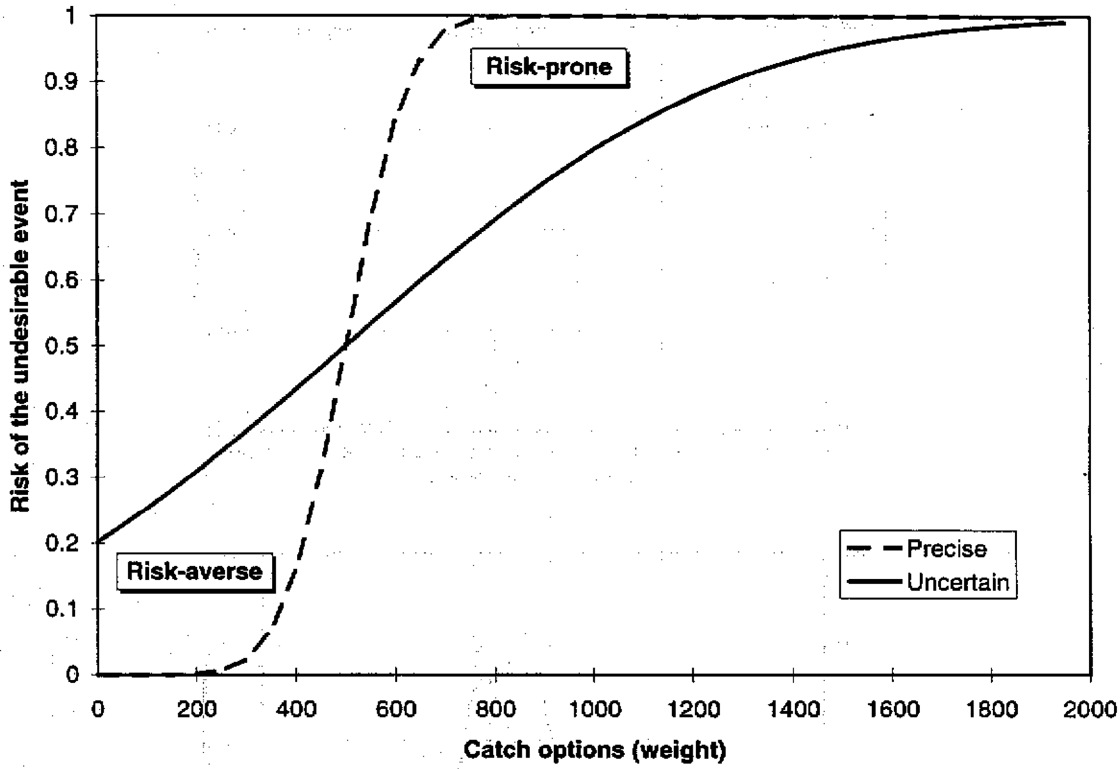


Figure 5.6.4.2 Distributions and probabilities of prefishery abundance forecasts for 1998 (upper panel), number of North American origin salmon captured in a 100 t fishery at West Greenland in 1998 (middle panel) and the post-fishery returns to North America in 1999 (bottom panel).

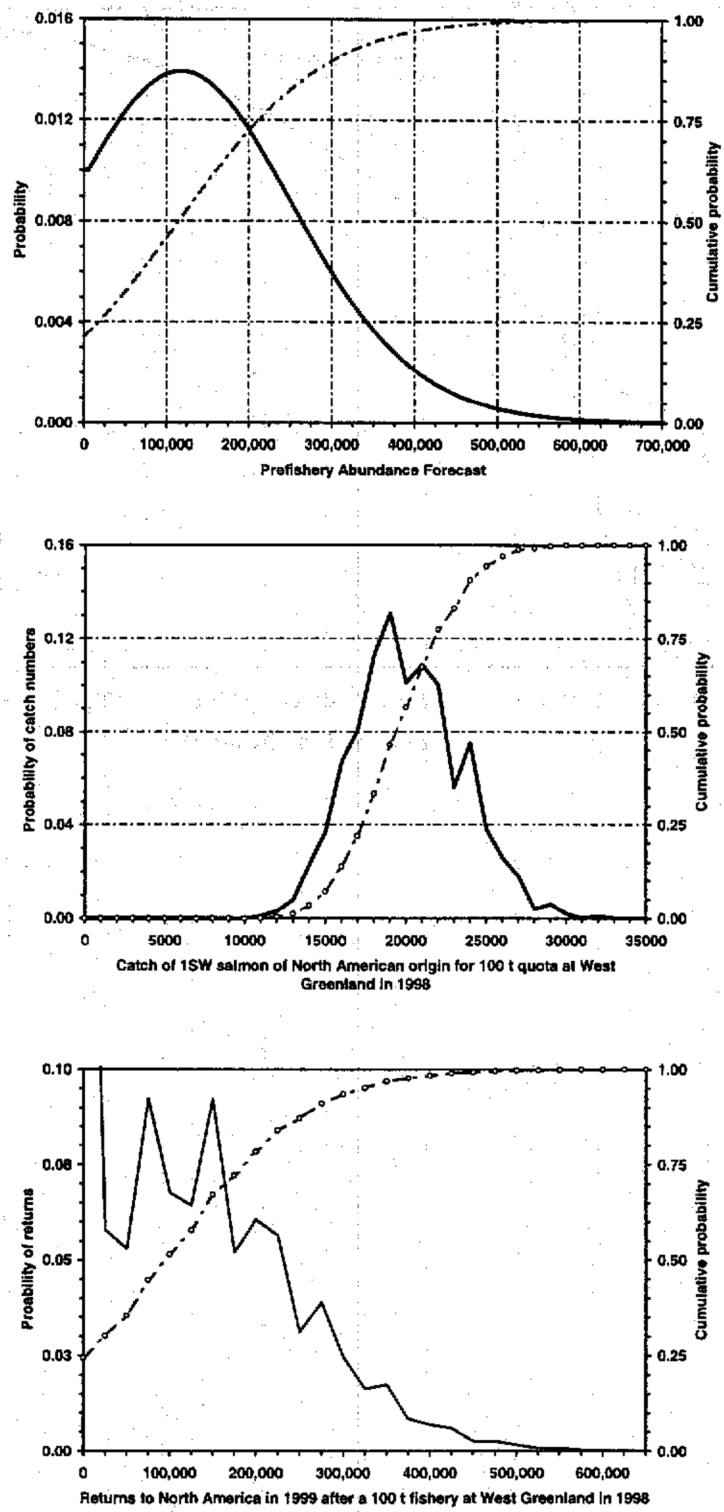


Figure 5.6.4.3 Summary of the distributions of the predicted biological characteristics of Atlantic salmon at West Greenland in 1998 generated from 1000 resampling events. The distribution of the weight of 1SW salmon of European origin is similar to the middle panel.

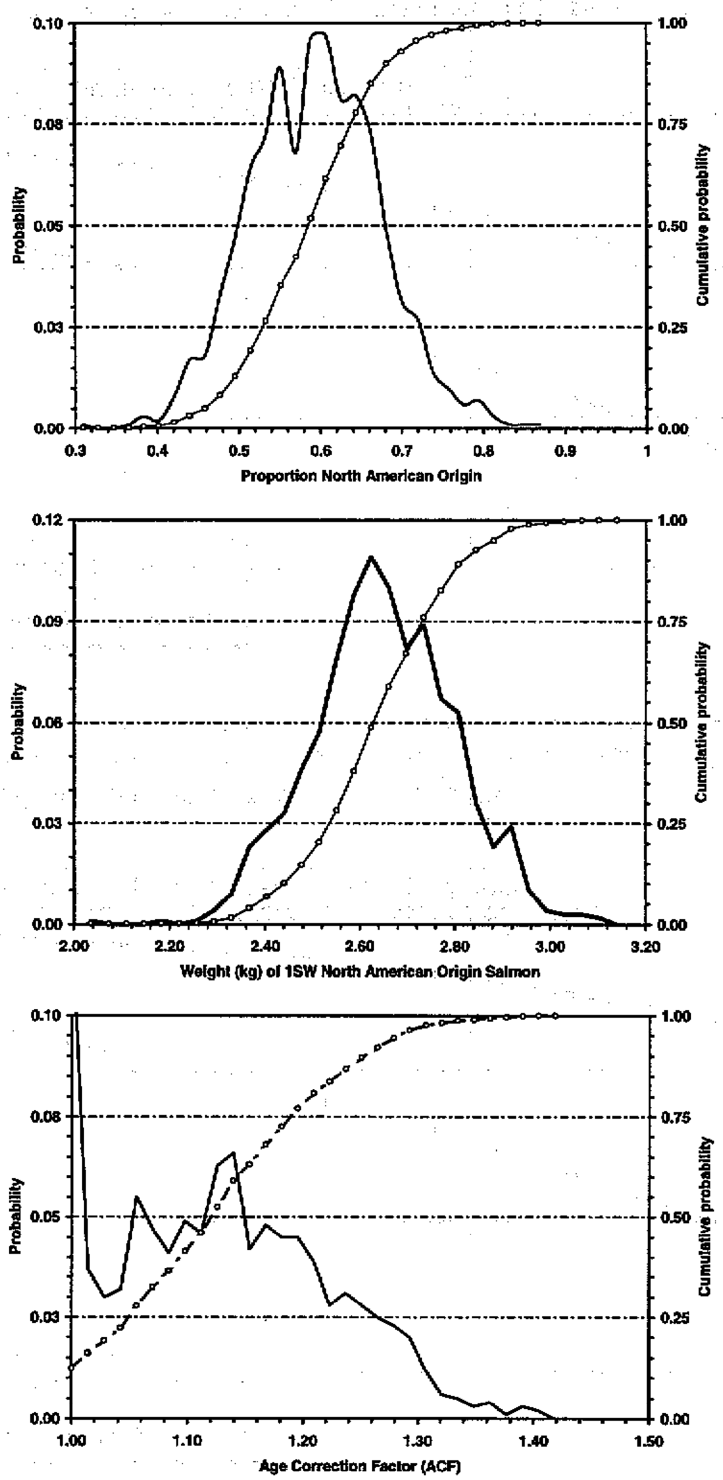


Figure 5.6.4.4 Risk analysis (probability of not meeting the conservation requirement in at least one of the six stock areas in North America) of catch options on the prefishery 1SW non-maturing salmon component in 1998. Risk is expressed relative to catch options at West Greenland in 1998 without fisheries in North America in 1999 (upper panel) and for combined fisheries at West Greenland in 1998 and North America in 1999 (lower panel). Exploitation rates in North America are based on the 1997 levels varying between 0.15 and 0.25 on the returning large salmon (Section 4.1.4).

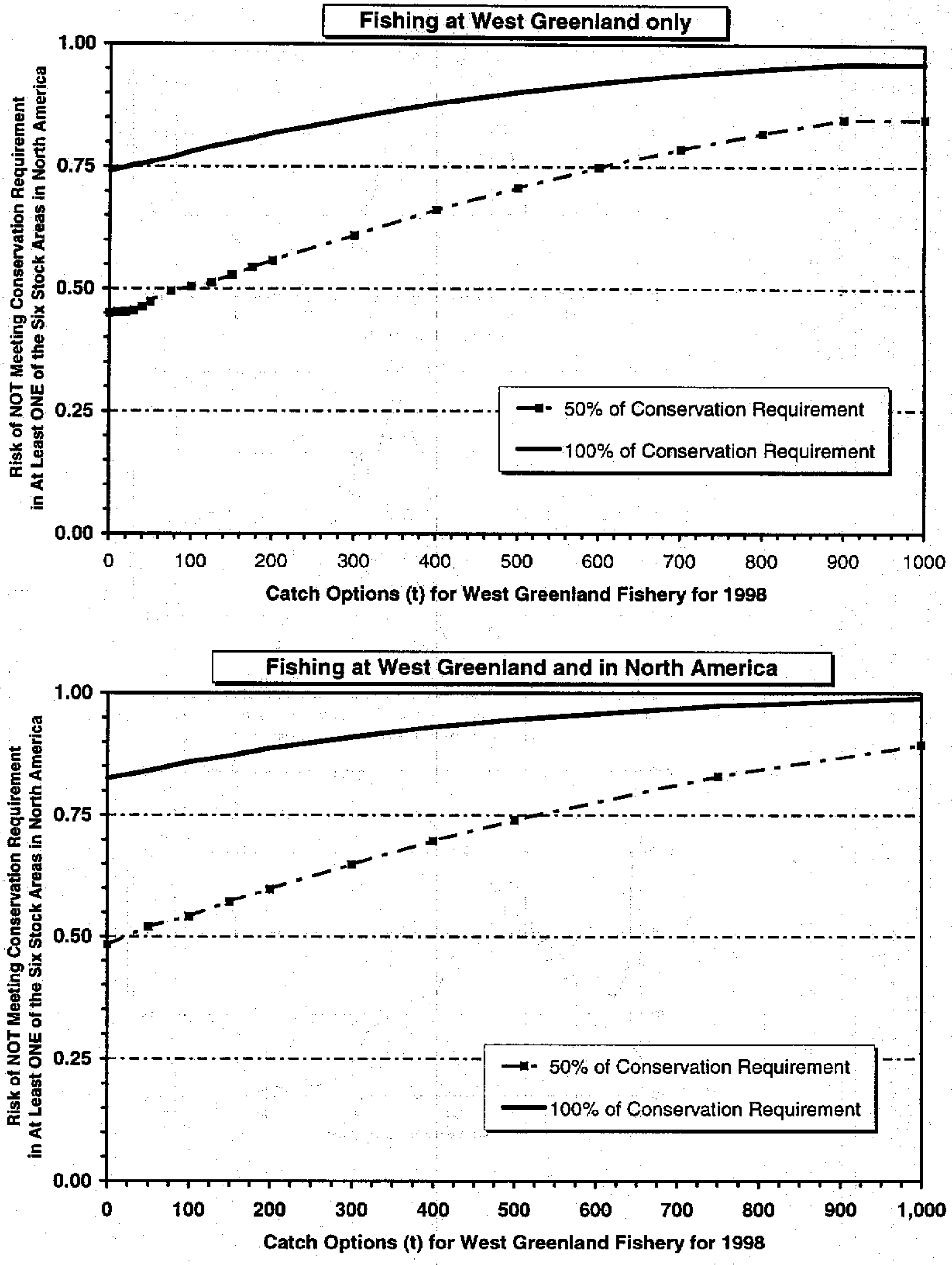
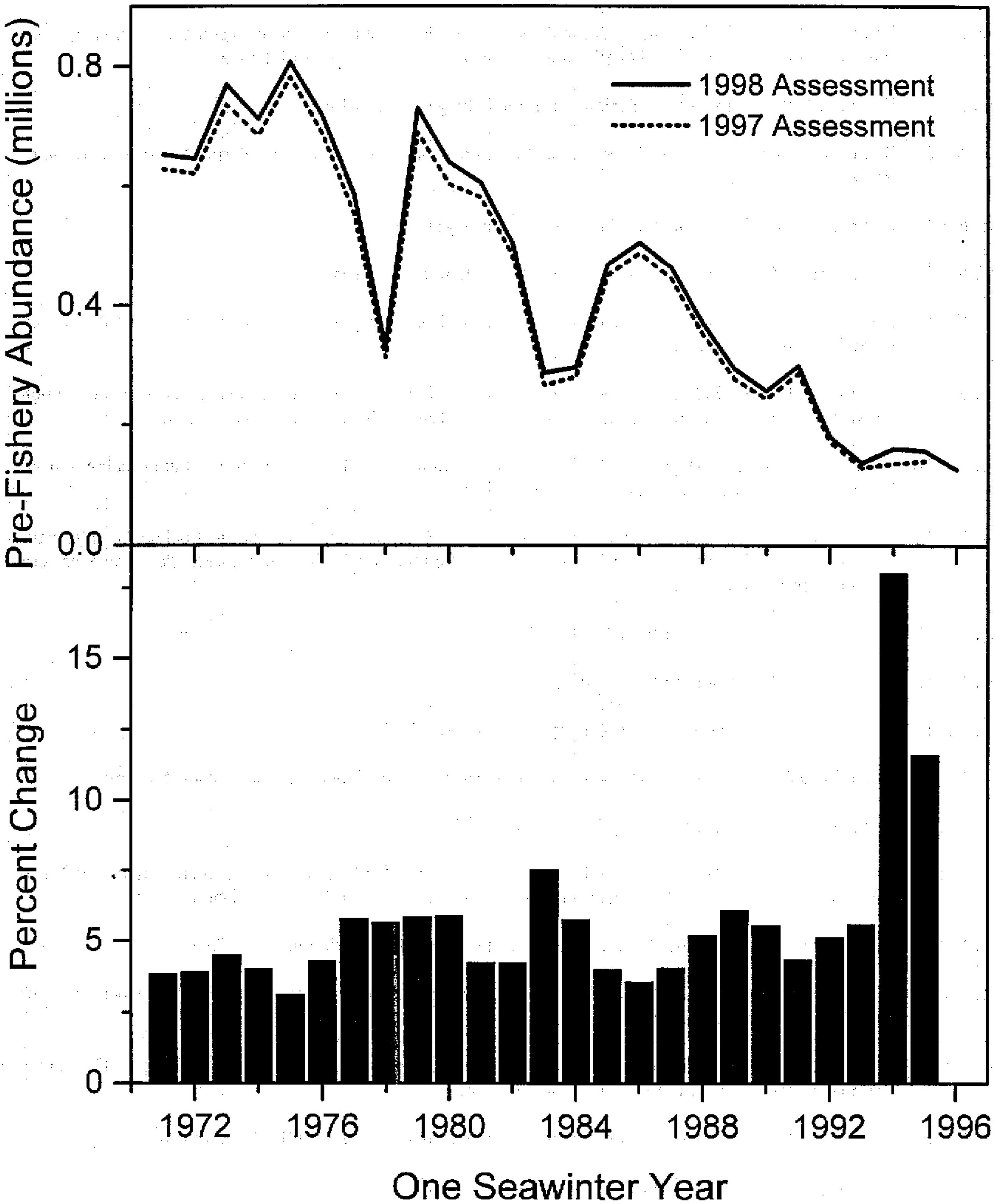


Figure 5.7.1.1. Comparison of 1997 and 1998 assessments of pre-fishery abundance for non-maturing 1SW recruits originating in North America.



APPENDIX 1

WORKING DOCUMENTS SUBMITTED TO THE WORKING GROUP ON NORTH ATLANTIC SALMON, 1998.

Doc. No. 1	Friedland, K.D. US origin tags reported from Greenland, 1997.
Doc. No. 2	Friedland, K.D., J.-D. Dutil and T. Sadusky. Growth patterns in Atlantic salmon post-smolts and the nature of the marine juvenile nursery.
Doc. No. 3	Friedland, K.D., L.P. Hansen, D.A. Dunkley and J.C. MacLean. Linkage between ocean climate, post-smolt growth, and survival of Atlantic salmon (*Salmo salar* L.) in the North Sea area.
Doc. No. 4	Erkinaro, J. National report for Finland - salmon fishing season in 1997.
Doc. No. 5	Baum, E.T. Production of farmed Atlantic salmon in Chile, Western North America, and other miscellaneous areas.
Doc. No. 6	Baum, E.T. 1997 USA Atlantic salmon stock status report.
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Doc. No. 10	Prusov, S.V., M. Ju. Alexeev, N.G. Popov, V.P. Antonova and V.A. Valetov. Atlantic salmon from Russian rivers. Fisheries and status of stocks in 1997.
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APPENDIX 3

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APPENDIX 4

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 | YR78_97 ! R3C1:R23C19';

OPTIONS NOCENTER LINESIZE = 120;

*... DATA FOR CATCH ADVICE FOR 1997 FROM RISKVAR.XLS ;

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 H123 GNF_L GNF_H GNF_M;

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;

DATA UNIV;
  SET PREDIC;
  IF YEAR=1997;
  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 5

Appendix 5(i). Estimated numbers of 1SW salmon recruits, returns and spawners for Labrador.

Year	Commercial catches of small salmon			Labrador origin small recruits before commercial fishery in Labrador						Labrador grilse recruits prior to commercial fishery						Grilse Recruits		Grilse to rivers		Labrador grilse spawners Angling catch subtracted	
	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		SFA 1		SFA 2		SFA 14B		SFA 1,2&14B+Nfld		SFA 1,2&14B		SFA 1,2&14B	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
*1969	10774	21627	6321	12929	28730	25952	57672	7585	16856	10343	25857	20762	51905	6068	15171	48912	122280	18587	65053	15476	61942
*1970	14666	29441	8605	17600	39110	35329	78509	10326	22947	14080	35199	28263	70658	8261	20652	66584	166459	25302	88556	21289	84543
*1971	19109	38359	11212	22931	50958	46031	102291	13454	29898	18345	45862	36825	92062	10763	26908	86754	216884	32966	115382	29032	111448
*1972	14303	28711	8392	17164	38141	34454	76563	10070	22378	13731	34327	27563	68907	8056	20140	64934	162335	24675	86362	21728	83415
*1973	3130	6282	1836	3756	8346	7539	16753	2203	4896	3004	7511	6031	15077	1763	4407	14208	35520	5399	18897	0	11405
1974	9848	37145	9328	11818	26261	44574	99053	11194	24875	9454	23635	35659	89148	8955	22387	71142	177856	27034	94619	24533	92118
1975	34937	57560	19294	41924	93165	69072	153493	23153	51451	33540	83849	55258	138144	18522	46306	141210	353024	53660	187809	49688	183837
1976	17589	47468	13152	21107	46904	56962	126581	15782	35072	16885	42214	45569	113923	12626	31565	98790	246976	37540	131391	31814	125665
1977	17796	40539	11267	21355	47456	48647	108104	13520	30045	17084	42710	38917	97294	10816	27041	87918	219796	33409	116931	28815	112337
1978	17095	12535	4026	20514	45587	15042	33427	4831	10736	16411	41028	12034	30084	3865	9662	42513	106282	16155	56542	13464	53851
1979	9712	28808	7194	11654	25899	34570	76821	8633	19184	9324	23309	27656	69139	6906	17266	57744	144360	21943	76800	17825	72682
1980	22501	72485	8493	27001	60003	86982	193293	10192	22648	21601	54002	69586	173964	8153	20383	130710	326776	49670	173845	45870	170045
1981	21596	86426	6658	25915	57589	103711	230469	7990	17755	20732	51830	82969	207422	6392	15979	144859	362147	55046	192662	49855	187471
1982	18478	53592	7379	22174	49275	64310	142912	8855	19677	17739	44347	51448	128621	7084	17710	100357	250892	38136	133474	34032	129370
1983	15964	30185	3292	19157	42571	36222	80493	3950	8779	15325	38314	28978	72444	3160	7901	62452	156129	23732	83061	19360	78689
1984	11474	11695	2421	13769	30597	14034	31187	2905	6456	11015	27538	11227	28068	2324	5810	32324	80811	12283	42991	9348	40056
1985	15400	24499	7460	18480	41067	29399	65331	8952	19893	14784	36960	23519	58798	7162	17904	59822	149555	22732	79563	19631	76462
1986	17779	45321	8296	21335	47411	54385	120856	9955	22123	17068	42670	43508	108770	7964	19910	90184	225461	34270	119945	30806	116481
1987	13714	64351	11389	16457	36571	77221	171603	13667	30371	13165	32914	61777	154442	10933	27334	112995	282486	42938	150283	37572	144917
1988	19641	56381	7087	23569	52376	67657	150349	8504	18899	18855	47138	54126	135314	6804	17009	104980	262449	39892	139623	34369	134100
1989	13233	34200	9053	15880	35288	41040	91200	10864	24141	12704	31759	32832	82080	8691	21727	71351	178377	27113	94896	22429	90212
1990	8736	20699	3592	10483	23296	24839	55197	4310	9579	8387	20966	19871	49678	3448	8621	41718	104296	15853	55485	12544	52176
1991	1410	20055	5303	1692	3760	24066	53480	6364	14141	1354	3384	19253	48132	5091	12727	33812	84531	12849	44970	10526	42647
1992	9588	13336	1325	14646	34850	20371	48613	2024	4830	11716	31455	16296	43751	1619	4347	29632	79554	17993	62094	15229	59331
1993	3893	12037	1144	9514	23619	29417	73030	2796	6941	7611	21257	23534	65727	2237	6247	33382	93231	25186	80938	22499	78251
1994	3303	4535	802	10659	26807	14635	36805	2588	6509	8527	24126	11708	33125	2071	5858	22306	63109	18159	56888	15228	53958
1995	3202	4561	217	14471	36647	20613	52201	981	2484	11577	32982	16491	46981	785	2235	28852	82199	25022	76453	22144	73575
1996	1676	5308	865	14849	37772	47029	119627	7664	19495	11880	33995	37623	107664	6131	17545	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-.1!
- SFA 1:0.07-0.14&SFA 2:0.22-0.40 (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).

**Preliminary values adjusted for change in size category

Appendix 5(ii). Estimated numbers of 2SW salmon recruits, returns and spawners for Labrador salmon stocks including west Greenland.

Year	Commercial catches of large salmon			Labrador Origin Large returns before commercial fishery						Labrador 2SW Recruits prior to commercial fishery						Labrador 2SW Recruits,NF & Greenland					Labrador 2SW to rivers		Labrador 2SW spawners	
	SFA 1	SFA 2	SFA 14B	SFA 1		SFA 2		SFA 14B		SFA 1		SFA 2		SFA 14B		SFAs 1,2 &14B		Labrador at Greenland	Total+NF+WG		SFAs 1,2 &14B		SFAs 1,2 &14B Angling catch subtracted	
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max	Min	Max
*1969	18929	48822	10300	12620	16826	32548	55797	6867	11772	8834	15144	19529	44637	4120	9418	32483	69198	34280	80636	133032	3248	20760	2890	20287
*1970	17633	45479	9595	11755	20152	30319	51976	6397	10966	8229	18137	18191	41581	3838	8773	30258	68490	56379	99561	154121	3026	20547	2676	20085
*1971	25127	64806	13673	16751	28716	43204	74064	9115	15626	11726	25845	25922	59251	5469	12501	43117	97596	24299	85831	163577	4312	29279	4012	28882
*1972	21599	55708	11753	14399	24685	37138	63666	7835	13432	10080	22216	22283	50933	4701	10746	37064	83895	59202	112096	178927	3706	25168	3435	24812
*1973	30204	77902	16436	20136	34519	51935	89031	10957	18784	14095	31067	31161	71225	6574	15027	51830	117319	22348	96314	189771	5183	35196	4565	34376
1974	13866	93036	15863	9244	15847	62024	106327	10575	18129	6471	14262	37214	85061	6345	14503	50030	113827	38035	109433	200476	5003	34148	4490	33475
1975	28601	71168	14752	19067	32687	47445	81335	9835	16859	13347	29418	28467	65068	5901	13488	47715	107974	40919	109012	195006	4772	32392	4564	32119
1976	38555	77796	15189	25703	44063	51864	88910	10126	17359	17992	39657	31118	71128	6076	13887	55186	124671	67730	146485	245646	5519	37401	4984	36701
1977	28158	70158	18664	18772	32181	46772	80181	12443	21330	13140	28963	28063	64144	7466	17064	48669	110171	28482	97937	185706	4867	33051	4042	31959
1978	30824	48934	11715	20549	35227	32623	55925	7810	13389	14385	31705	19574	44740	4686	10711	38644	87155	32668	87816	157045	3864	26147	3361	25490
1979	21291	27073	3874	14194	24333	18049	30941	2583	4427	9936	21899	10829	24752	1550	3542	22315	50194	18636	50481	90267	2231	15058	1823	14528
1980	28750	87067	9138	19167	32857	58045	99505	6092	10443	13417	29571	34827	79604	3655	8355	51899	117530	21426	95490	189152	5190	35259	4633	34525
1981	36147	68581	7606	24098	41311	45721	78378	5071	8693	16869	37180	27432	62703	3042	6954	47343	106836	32768	100331	185233	4734	32051	4403	31615
1982	24192	53085	5966	16128	27648	35390	60669	3977	6818	11290	24883	21234	48535	2386	5455	34910	78873	43678	93497	156236	3491	23662	3080	23127
1983	19403	33320	7489	12935	22175	22213	38080	4993	8559	9055	19957	13328	30464	2996	6847	25378	57268	30804	67021	112531	2538	17181	2267	16824
1984	11726	25258	6218	7817	13401	16839	28866	4145	7106	5472	12061	10103	23093	2487	5685	18063	40839	4026	29802	62306	1806	12252	1478	11822
1985	13252	16789	3954	8835	15145	11193	19187	2636	4519	6184	13631	6716	15350	1582	3615	14481	32596	3977	24644	50494	1448	9779	1258	9530
1986	19152	34071	5342	12768	21888	22714	38938	3561	6105	8938	19699	13628	31151	2137	4884	24703	55734	17738	52991	97275	2470	16720	2177	16334
1987	18257	49799	11114	12171	20865	33199	56913	7409	12702	8520	18779	19920	45531	4446	10161	32885	74471	29695	76625	135970	3289	22341	2895	21821
1988	12621	32386	4591	8414	14424	21591	37013	3061	5247	5890	12982	12954	29610	1836	4197	20681	46789	27842	57355	94614	2068	14037	1625	13452
1989	16261	26836	4646	10841	18584	17891	30670	3097	5310	7588	16726	10734	24536	1858	4248	20181	45509	26728	55528	91673	2018	13653	1727	13270
1990	7313	17316	2858	4875	8358	11544	19790	1905	3266	3413	7522	6926	15832	1143	2613	11482	25967	9771	26158	46828	1148	7790	923	7493
1991	1369	7679	4417	913	1565	5119	8776	2945	5048	639	1408	3072	7021	1767	4038	5477	12467	7779	15596	25571	548	3740	491	3665
1992	9981	19608	2752	7219	13760	14182	27032	1990	3794	5053	12384	8509	21626	1194	3035	14756	37045	13713	28469	50758	2515	15548	2012	14889
1993	3825	9651	3620	3682	8021	9290	20238	3485	7591	2577	7219	5574	16190	2091	6073	10242	29482	6592	16834	36074	3858	18234	3624	17922
1994	3464	11056	857	4124	9453	13162	30170	1020	2339	2887	8507	7897	24136	612	1871	11396	34514	0	11396	34514	5653	24396	5339	23981
1995	2150	8714	312	5132	12100	20801	49043	745	1756	3593	10890	12481	39235	447	1405	16520	51530	0	16520	51530	12368	44205	12006	43726
1996	1375	5479	418	3609	8664	14382	34523	1097	2634	2526	7798	8629	27619	658	2107	11814	37523	4432	16246	41956	9113	32759	8838	32395
**1997	1393	5550														13167	28647	2906	16073	31553	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.

**Preliminary values adjusted for change in size category

Appendix 5(iii). Atlantic salmon returns to freshwater, total recruits prior to the commercial fishery and spawners summed for Salmon Fishing Area 3-14A, insular Newfoundland, 1969-1997.
Ret. = retained fish; Rel. = released fish.

	Small catch	Small returns to river		Small recruits		Small spawners		Large returns to river		Large recruits		Large catch	Large spawners		2SW returns to river		2SW spawners		2SW recruits	
Year	Retained	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Retained	Min	Max	Min	Max	Min	Max	Min	Max
1969	34944	108807	217349	217613	724497	73863	182405	10484	26767	34946	267666	2310	8174	24457	2245	9324	1408	8054	7483	93240
1970	30437	139570	279594	279139	931980	109133	249157	12627	30508	42091	305081	2138	10490	28371	3184	11851	2384	10642	10613	118509
1971	26666	112266	224994	224532	749980	85600	198328	9857	24146	32856	241462	1602	8255	22544	2385	9104	1810	8230	7951	91039
1972	24402	108509	217092	217018	723640	84107	192690	10046	23996	33485	239955	1380	8666	22616	2494	9129	1985	8358	8314	91288
1973	35482	143729	287832	287457	959438	108247	252350	13292	33061	44308	330613	1923	11369	31138	2995	11808	2275	10720	9982	118082
1974	26485	84667	169103	169335	563676	58182	142618	10821	21662	36069	216616	1213	9608	20449	1968	6702	1534	6043	6559	67021
1975	33390	111847	223890	223694	746300	78457	190500	12222	24478	40741	244782	1241	10981	23237	2382	8002	1959	7355	7940	80018
1976	34463	114787	229853	229573	766175	80324	195390	10756	21550	35855	215501	1051	9705	20499	2327	7663	2003	7160	7758	76630
1977	34352	109649	219106	219299	730354	75297	184754	9750	19493	32499	194933	2755	6995	16738	1880	6309	1134	5131	6267	63094
1978	28619	97070	194133	194141	647109	68451	165514	7873	15786	26243	157860	1563	6310	14223	2005	6419	1564	5728	6682	64194
1979	31169	106791	213327	213582	711091	75622	182158	5549	11113	18496	111128	561	4988	10552	1103	3691	992	3506	3677	36906
1980	35849	120355	240449	240709	801497	84506	204600	9325	18691	31084	186909	1922	7403	16769	2447	7794	1894	6928	8157	77936
1981	46670	156541	312697	313083	1042325	109871	266027	9553	19144	31845	191442	1369	8184	17775	2317	7475	1935	6874	7723	74746
1982	41871	139951	279115	279902	930383	98080	237244	9528	19097	31758	190971	1248	8280	17849	2975	9228	2635	8691	9915	92276
1983	32420	109378	218548	218756	728495	76958	186128	8911	17871	29703	178711	1382	7529	16489	2511	7915	2167	7364	8372	79148
1984	39331	129235	257256	258469	857521	89904	217925	8007	15995	26691	159955	511	7496	15484	2273	7117	2082	6829	7576	71166
1985	36552	120816	240985	241633	803283	84264	204433	3612	7680	12041	76800	0	3581	7649	961	3319	949	3300	3205	33186
1986	37496	124547	248688	249094	828981	87051	211192	6850	14103	22832	141030	0	6770	14023	1592	5402	1560	5354	5308	54020
1987	24482	125116	249856	250232	832852	100634	225374	6357	13068	21190	130684	0	6316	13027	1338	4629	1322	4605	4461	46293
1988	39841	132059	263363	264119	877877	92218	223522	6369	13330	21231	133299	0	6309	13270	1553	5346	1529	5310	5177	53459
1989	18462	59793	119261	119587	397537	41331	100799	3260	6752	10865	67518	0	3241	6733	704	2452	697	2441	2347	24517
1990	29967	98830	197276	197659	657588	68863	167309	5751	11868	19170	118675	0	5701	11817	1341	4562	1321	4532	4470	45620
1991	20529	64016	127698	128032	425661	43487	107169	4449	9173	14831	91734	0	4416	9140	1057	3577	1044	3557	3524	35771
1992	23118	116116	231954	116116	231954	92434	208272	15797	31897	15797	31897	0	15656	31756	3024	10354	2968	10270	3024	10354
1993	24693	131045	261721	131045	261721	104712	235387	7955	16227	7955	16227	0	7791	16063	1487	5217	1437	5139	1487	5217
1994	28959	95487	190655	95487	190655	65691	160859	7915	16099	7915	16099	0	7709	15894	1889	6255	1825	6156	1889	6255
1995	29055	111889	223758	111889	223758	81877	193746	8972	18182	8972	18182	0	8753	17963	2296	7462	2223	7350	2296	7462
1996	36677	141096	287328	141096	287328	102834	249067	11838	24462	11838	24462	0	11619	24244	2603	8992	2535	8887	2603	8992
1997	13433	85386	145148	85386	145148	67874	127637	11686	20601	11686	20601	0	11562	20477	2680	7044	2653	6999	2680	7044

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, 1992-97.
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, 1992-95.
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 5(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

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 5(v a). Returns and escapements of large salmon to SFA 16

	2SW returns to SFA		Returns to the Miramichi River						Returns of large salmon to SFA 16	
			Large	0.8	1.33	Prop. 2SW	2SW Returns to Miramichi			
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

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 1997, 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

Same procedure for escapements as used to calculate returns.

	Escapement of 2SW		Escapements to the Miramichi River						Escapement of	
				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

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Appendix 5(v b) . Returns and escapements of small salmon to SFA 16

	1SW returns to SFA		Returns to the Miramichi River			Prop.	1SW Returns to Miramichi	
				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

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 1997, 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

Same procedure for escapements as used to calculate returns.

	Escapement of 1SW		Escapements to the Miramichi River					
							Escapement of 1S	
				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

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Appendix 5 (vi). Estimated Atlantic salmon returning recruits and spawners to the Morell River, SFA 17, 1955-1997. Ret. = retained fish; Rel. = released fish.

Year	Small (<63 cm)			Large (>= 63 cm)			Total (Small + Large)			Percent	Small recruits		Small spawners		Large recruits		Large spawners		2SW recruits		2SW spawners	
	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	small	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1970	0	.	.	13	.	.	13	.	.	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	.	.	0	.	.	0	.	.		0	0	0	0	0	0	0	0	0	0	0	0
1972	0	.	.	7	.	.	7	.	.	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	2	.	.	0	.	.	2	.	.	100	5	9	3	7	0	0	0	0	0	0	0	0
1974	0	.	.	2	.	.	2	.	.	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	.	.	0	.	.	0	.	.		0	0	0	0	0	0	0	0	0	0	0	0
1976	6	.	.	1	.	.	7	.	.	86	14	28	8	22	2	5	1	4	2	5	1	4
1977	0	.	.	0	.	.	0	.	.		0	0	0	0	0	0	0	0	0	0	0	0
1978	0	.	.	0	.	.	0	.	.		0	0	0	0	0	0	0	0	0	0	0	0
1979	1	.	.	2	.	.	3	.	.	33	2	5	1	4	5	9	3	7	5	9	3	7
1980	5	.	.	1	.	.	6	.	.	83	12	23	7	18	2	5	1	4	2	5	1	4
1981	108	.	.	4	.	.	112	.	.	87	259	498	151	390	40	77	36	73	40	77	36	73
1982	73	.	.	8	.	.	81	.	.	92	175	336	102	263	16	31	8	23	16	31	8	23
1983	7	.	.	2	.	.	9	.	.	50	17	32	10	25	17	32	15	30	17	32	15	30
1984	7	.	.	0	.	.	7	.	.	56	17	32	10	25	13	26	13	26	13	26	13	26
1985	47	.	.	0	.	.	47	.	.	93	113	217	66	170	8	15	8	15	8	15	8	15
1986	236	.	.	0	.	.	236	.	.	99	566	1088	330	852	5	11	5	11	5	11	5	11
1987	476	.	.	0	.	.	476	.	.	94	1141	2194	665	1718	66	128	66	128	66	128	66	128
1988	643	.	.	0	.	.	643	.	.	94	1542	2963	899	2320	96	185	96	185	96	185	96	185
1989	167	.	.	0	.	.	167	.	.	73	400	770	233	603	149	287	149	287	149	287	149	287
1990	768	.	.	0	.	.	768	.	.	87	1842	3539	1074	2771	284	545	284	545	284	545	284	545
1991	657	1033	1690	0	164	164	657	1197	1854	89	1576	3028	919	2371	188	361	188	361	188	361	188	361
1992	781	.	.	0	.	.	781	.	.	95	1873	3599	1092	2818	95	183	95	183	95	183	95	183
1993	533	.	.	0	.	.	533	.	.	98	1277	2454	745	1922	22	43	22	43	22	43	22	43
1994	89	111	200	0	99	99	89	210	299	55	202	371	113	282	163	299	163	299	163	299	163	299
1995	469	146	595	1	95	96	470	241	711	93	1049	1899	580	1430	85	153	84	152	85	153	84	152
1996	414	270	684	0	150	150	414	420	834	88	1137	2524	723	2110	155	344	155	344	155	344	155	344
1997	231	92	323	0	46	46	231	138	369	94	554	1065	323	834	35	68	35	68	35	68	35	68
55-87 $\bar{X}$	32		0	6	0	0 0	38			48 0	76	146 0	44	115	16	31	11	26	16	31	11	26
88-97 X	475		698 0	0	111	111 0	475	441	813	87 0	1145	2221 0	670	1746	127	247	127	247	127	247	127	247

Notes

CPUE is retained catch per rod-day.

In the above table a period indicates no data.

Size of angled salmon was not recorded in 1955-1969. Numbers of small and large salmon for these years are estimated from the overall small:large ratio for 1970-1980.

Number of small retained salmon in 1993 was not recorded. The number given is the mean for 1986-1992

For 1959-1969, percent small is the percent measured in 1970-1980. 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 numbers of small recruits are calculated using 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 5(vii a). *Total 2SW returns and spawners to SFA 18, 1970-1997.*

	LARGE RETURNS						Commercial catches			TOTAL 2SW		SPAWNERS				TOTAL	
	Margaree		SFA 18		2SW RETURNS			2SW ctch		RETURNS		Margaree		SFA 18		SPAWNERS	
	Large salmon		1.241	2.151	0.77	0.87	Zone 6	0.77	0.87	(inc comm.)				1.241	2.151	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	721	2,151	555	1,871	30,440	4,262	4,815	4,817	6,686	657	1,145	815	2,462	628	2,142
1971	254	437	315	940	243	818	12,001	1,680	1,898	1,923	2,716	256	446	318	959	245	834
1972	284	488	352	1,050	271	914	31,840	4,458	5,037	4,729	5,950	272	474	338	1,019	260	887
1973	316	544	392	1,170	302	1,018	27,694	3,877	4,381	4,179	5,399	287	499	356	1,074	274	934
1974	289	498	359	1,070	276	931	37,437	5,241	5,922	5,517	6,853	318	554	395	1,191	304	1,036
1975	173	298	215	641	165	558	23,631	3,308	3,738	3,474	4,296	214	372	265	800	204	696
1976	222	381	275	819	212	713	18,361	2,571	2,904	2,783	3,617	267	465	332	1,000	255	870
1977	378	651	469	1,400	361	1,218	26,221	3,671	4,148	4,032	5,366	393	683	487	1,469	375	1,278
1978	427	735	530	1,581	408	1,375	30,216	4,230	4,780	4,638	6,155	510	888	633	1,909	488	1,661
1979	219	377	272	811	209	705	7,917	1,108	1,252	1,318	1,958	265	461	329	991	253	863
1980	378	651	469	1,400	361	1,218	24,412	3,418	3,862	3,779	5,080	497	865	617	1,860	475	1,618
1981	375	647	465	1,391	358	1,211	15,562	2,179	2,462	2,537	3,672	451	785	560	1,688	431	1,469
1982	484	833	601	1,791	462	1,559	26,664	3,733	4,218	4,195	5,776	555	965	688	2,076	530	1,806
1983	402	693	499	1,490	384	1,297	24,280	3,399	3,841	3,783	5,137	480	834	595	1,794	458	1,561
1984	327	583	406	1,254	312	1,091	15,140	2,120	2,395	2,432	3,486	296	532	367	1,144	283	995
1985	1,109	2,217	1,376	4,768	1,060	4,148		0	0	1,060	4,148	1,025	2,133	1,272	4,587	979	3,991
1986	2,738	5,680	3,397	12,216	2,616	10,628		0	0	2,616	10,628	2,583	5,525	3,205	11,882	2,468	10,338
1987	2,976	6,540	3,693	14,065	2,843	12,237		0	0	2,843	12,237	2,860	6,424	3,549	13,816	2,732	12,020
1988	1,286	2,494	1,596	5,364	1,229	4,666		0	0	1,229	4,666	1,143	2,351	1,418	5,056	1,092	4,399
1989	1,708	3,693	2,119	7,942	1,632	6,910		0	0	1,632	6,910	1,583	3,568	1,964	7,673	1,512	6,676
1990	3,939	8,353	4,887	17,964	3,763	15,629		0	0	3,763	15,629	3,483	8,315	4,321	17,883	3,328	15,558
1991	1,853	5,785	2,299	12,441	1,770	10,824		0	0	1,770	10,824	1,692	5,624	2,099	12,095	1,617	10,523
1992	4,875	9,375	6,049	20,162	4,658	17,541		0	0	4,658	17,541	4,722	9,222	5,859	19,833	4,511	17,255
1993	2,408	6,158	2,988	13,244	2,301	11,522		0	0	2,301	11,522	2,274	6,024	2,822	12,955	2,173	11,271
1994	2,350	4,500	2,916	9,678	2,245	8,420		0	0	2,245	8,420	2,209	4,359	2,741	9,375	2,110	8,156
1995	1,750	3,815	2,171	8,205	1,672	7,138		0	0	1,672	7,138	1,693	3,758	2,101	8,082	1,617	7,031
1996	2,214	4,050	2,747	8,710	2,115	7,578		0	0	2,115	7,578	2,001	3,837	2,483	8,252	1,912	7,179
1997	3,461	5,756	4,294	12,379	3,307	10,770		0	0	3,307	10,770	3,234	5,529	4,013	11,891	3,090	10,345

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 1984-1996 based on various Margaree CAFSAC Research Documents.
Margaree catch to SFA 18 catch; MIN _MAX 2SW based on the ratio 0.77-0.87 2SW fish among MSW fish.
Margaree escapements 1970-1983 = returns minus removals; 1984-1996 from various Margaree CAFSAC Research Documents by Claytor and Chaput; 2SW equal 0.77-0.87 of MSW fish; Margaree raised to SFA by respective ratios in sport catch.

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Appendix 5(vii b). Total 1SW returns and spawners to SFA 18, 1970-1997.

	RETURNS				*SPAWNERS*			
	Margaree		*SFA 18*		*Margaree*		*SFA 18*	
	0.37	0.21	1.214	2.202			1.214	2.202
Year	Min	Max	Min	Max	Min	Max	Min	Max
1970	230	395	279	870	145	310	176	683
1971	57	98	69	215	36	77	43	169
1972	114	195	138	430	72	153	87	338
1973	449	772	545	1,700	283	606	343	1,334
1974	162	279	197	614	102	219	124	482
1975	97	167	118	369	61	131	74	289
1976	259	447	315	983	163	351	198	772
1977	186	321	226	707	117	252	143	555
1978	68	116	82	256	43	91	52	201
1979	1,614	2,777	1,959	6,113	1,017	2,180	1,234	4,799
1980	451	777	548	1,710	284	610	345	1,342
1981	2,430	4,181	2,950	9,205	1,531	3,282	1,859	7,226
1982	1,868	3,214	2,267	7,076	1,177	2,523	1,429	5,554
1983	184	316	223	696	116	248	141	547
1984	400	688	486	1,515	158	446	192	982
1985	634	1,167	770	2,569	125	658	152	1,449
1986	838	1,420	1,017	3,126	56	638	68	1,405
1987	1,143	1,865	1,388	4,106	166	888	202	1,955
1988	1,674	2,911	2,032	6,409	795	2,032	965	4,473
1989	591	977	718	2,151	30	416	36	916
1990	940	5,077	1,141	11,177	291	4,428	353	9,748
1991	794	3,891	964	8,566	42	3,139	51	6,911
1992	1,258	2,419	1,527	5,325	701	1,862	851	4,099
1993	1,489	3,851	1,808	8,478	906	3,268	1,100	7,195
1994	573	1,101	696	2,424	259	787	314	1,733
1995	538	1,083	653	2,384	329	874	399	1,924
1996	1,277	2,960	1,550	6,517	935	2,618	1,135	5,764
1997	330	1,670	401	3,677	88	1,428	107	3,144

Recreational ctch:

Year	SFA 18	Marg-aree	Ratio
1984	298	242	1.23
1985	618	509	1.21
1986	1180	782	1.51
1987	1289	977	1.32
1988	1349	879	1.53
1989	928	561	1.65
1990	1206	649	1.86
1991	1262	752	1.68
1992	1242	678	1.83
1993	1218	777	1.57
1994	659	429	1.54
1995	710	333	2.13
1996	2021	918	2.20
1997	576	330	1.75
		Min	1.214
		Max	2.202

Margaree returns, 1970-83, equal catch divided by MIN (0.215) and MAX (0.37) 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, 1984-1996, based on annual assessments in CAFSAC and DFO Atl. Fish. Res. Docs, eg., Claytor et al. MS 1995.
Spawners for 1970-1983 equal returns minus removals; 1984-1996 from various Margaree CAFSAC and Atl. Res. Doc. series, eg., Claytor et al. MS 1995.

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Appendix 5(viii). *Total 1SW returns and spawners, SFAs 19, 20, 21 and 23, 1970-1997.*

	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	
Year	MIN	MAX	19-21	Wild MIN	Wild MAX	Hatch	MIN	MAX	19-21	MIN	MAX	MIN	MAX		MIN	MAX
1970	8,236	16,868	3,189	5,206	7,421	100	16,731	27,578	3,609	4,627	13,259	5,306	7,521	1,420	8,513	19,360
1971	6,345	13,062	1,922	2,883	4,176	365	11,515	19,525	2,761	3,584	10,301	3,248	4,541	2,032	4,800	12,810
1972	6,636	13,354	1,055	1,546	2,221	285	9,522	16,915	2,917	3,719	10,437	1,831	2,506	2,558	2,992	10,385
1973	8,225	16,744	1,067	3,509	5,047	1,965	14,766	24,823	3,604	4,621	13,140	5,474	7,012	1,437	8,658	18,715
1974	14,478	29,385	2,050	6,204	8,910	3,991	26,723	44,336	6,340	8,138	23,045	10,195	12,901	2,124	16,209	33,822
1975	5,096	10,393	2,822	11,648	16,727	6,374	25,940	36,316	2,227	2,869	8,166	18,022	23,101	2,659	18,232	28,608
1976	12,421	25,398	1,675	13,761	19,790	9,074	36,931	55,937	5,404	7,017	19,994	22,835	28,864	5,263	24,589	43,595
1977	13,349	27,943	3,773	6,746	9,679	6,992	30,860	48,387	5,841	7,508	22,102	13,738	16,671	4,542	16,704	34,231
1978	2,535	5,241	3,651	3,227	4,651	3,044	12,457	16,587	1,113	1,422	4,128	6,271	7,695	2,015	5,678	9,808
1979	12,365	25,381	3,154	11,529	16,690	3,827	30,875	49,052	5,428	6,937	19,953	15,356	20,517	3,716	18,577	36,754
1980	16,534	33,825	8,252	14,346	20,690	10,793	49,925	73,560	7,253	9,281	26,572	25,139	31,483	5,542	28,878	52,513
1981	18,594	38,329	1,951	11,199	16,176	5,627	37,371	62,083	8,163	10,431	30,166	16,826	21,803	9,021	18,236	42,948
1982	10,008	20,552	2,020	8,773	12,598	3,038	23,839	38,208	4,361	5,647	16,191	11,811	15,636	5,279	12,179	26,548
1983	4,662	9,562	1,621	7,706	11,028	1,564	15,553	23,775	2,047	2,615	7,515	9,270	12,592	4,138	7,747	15,969
1984	12,398	25,815	0	14,105	20,227	1,451	27,954	47,493	4,724	7,674	21,091	15,556	21,678	5,266	17,964	37,503
1985	16,354	34,055	0	11,038	15,910	2,018	29,410	51,983	6,360	9,994	27,695	13,056	17,928	4,892	18,158	40,731
1986	16,661	34,495	0	13,412	19,321	862	30,935	54,678	6,182	10,479	28,313	14,274	20,183	3,549	21,204	44,947
1987	18,388	37,902	0	10,030	14,334	3,328	31,746	55,564	7,056	11,332	30,846	13,358	17,662	3,101	21,589	45,407
1988	16,611	33,851	0	15,131	21,834	1,250	32,992	56,935	6,384	10,227	27,467	16,381	23,084	3,320	23,288	47,231
1989	17,378	35,141	0	16,240	23,182	1,339	34,957	59,662	6,629	10,749	28,512	17,579	24,521	4,455	23,873	48,578
1990	20,119	41,652	0	12,287	17,643	1,533	33,939	60,828	7,391	12,728	34,261	13,820	19,176	3,795	22,753	49,642
1991	6,718	13,870	0	10,602	15,246	2,439	19,759	31,555	2,399	4,319	11,471	13,041	17,685	3,546	13,814	25,610
1992	9,269	18,936	0	11,340	16,181	2,223	22,832	37,340	3,629	5,640	15,307	13,563	18,404	4,078	15,125	29,633
1993	9,104	18,711	0	5,439	7,880	1,156	15,699	27,747	3,327	5,777	15,384	6,595	9,036	415	11,957	24,005
1994	2,446	4,973	0	3,880	5,554	1,258	7,584	11,785	493	1,953	4,480	5,138	6,812	392	6,699	10,900
1995	5,974	12,364	0	3,675	5,268	2,907	12,556	20,539	1,885	4,089	10,479	6,582	8,175	152	10,519	18,502
1996	9,888	20,791	0	2,250	3,243	5,394	17,532	29,428	2,211	7,677	18,580	7,644	8,637	1,034	14,287	26,183
1997	2,724	5,602	0	579	836	2,912	6,215	9,350	496	2,228	5,106	3,491	3,748	475	5,244	8,379

SFAs 19,20,21: Returns estimated as run size (1SW recreational catch / expl. rate [0.2 t0 0.45];
where MIN and MAX selected as 5th and 95th percentile values from 1,000 monte carlo estimates) + estimated 1SW fish in commercial landings 1970-1983 (Cutting et al. MS 1985).

SFA 22: Inner Fundy stocks and inner-Fundy SFA 23 (primarily 1SW fish) do not go to the North Atlantic.

SFA 23: Similar approach as for 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 exploitation rates, Marshall MS 1992 (commercial harvest, bi-catch etc., incl. in estimated returns); hatchery returns attributed to above Mactaquac only; 1SW production in remainder of SFA (outer Fundy) omitted.

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Appendix 5(ixa). Total 2SW returns to SFAs 19, 20, 21 and 23, 1970-1997.

Year	***SFA 19*** MIN 2SW=0.7-0.9 Exp. rate=0.2-0.45	***SFA 19*** MAX	***SFA 20*** MIN 2SW=0.6-0.9 Exp. rate=0.2-0.45	***SFA 20*** MAX	***SFA 21*** MIN 2SW=0.5-0.9 Exp. rate=0.2-0.45	***SFA 21*** MAX	Total Commercial 19-21	***SFA 23*** Wild MIN 2SW= 0.85-0.95 p. abv= 0.4-0.6	***SFA 23*** Wild MAX	***SFA 23*** Htch MIN 2SW= 0.85-0.95	***SFA 23*** Htch MAX	***TOTAL SFAs 19,20,21,23*** MIN	***TOTAL SFAs 19,20,21,23*** MAX
1970	1,170	2,537	658	1,535	597	1,525	2,644	8,540	12,674	0	0	13,609	20,915
1971	600	1,266	344	802	481	1,199	2,607	7,089	10,463	66	73	11,187	16,410
1972	735	1,614	421	1,002	454	1,198	4,549	7,362	10,809	507	559	14,028	19,731
1973	726	1,571	665	1,532	546	1,437	4,217	3,773	5,559	432	477	10,359	14,793
1974	1,035	2,225	691	1,588	548	1,397	8,873	8,766	12,790	1,989	2,198	21,902	29,071
1975	376	824	149	343	882	2,321	9,430	11,217	16,490	1,890	2,088	23,944	31,496
1976	791	1,672	346	822	441	1,146	5,916	12,304	18,106	1,970	2,175	21,768	29,837
1977	999	2,152	660	1,509	873	2,354	9,205	14,539	21,420	2,330	2,575	28,606	39,215
1978	810	1,739	429	995	655	1,706	6,827	6,059	8,903	2,166	2,391	16,946	22,561
1979	532	1,169	431	978	508	1,288	2,326	4,149	6,084	1,016	1,123	8,962	12,968
1980	1,408	3,051	746	1,714	1,483	3,989	9,204	16,500	24,041	2,556	2,824	31,897	44,823
1981	886	1,856	926	2,133	1,754	4,475	4,438	8,696	12,690	2,330	2,577	19,030	28,169
1982	917	1,990	316	746	682	1,756	5,819	8,266	12,198	1,516	1,673	17,516	24,182
1983	477	1,030	641	1,475	552	1,434	2,978	8,718	12,793	944	1,043	14,310	20,753
1984	828	1,768	638	1,500	766	2,004	0	14,753	21,573	953	1,054	17,938	27,899
1985	1,495	3,132	2,703	6,355	2,102	5,469	0	15,793	23,002	748	826	22,841	38,784
1986	3,500	7,541	2,561	5,987	2,150	5,312	0	9,210	13,507	681	754	18,102	33,101
1987	2,427	5,237	1,066	2,527	1,114	2,872	0	6,512	9,590	410	453	11,529	20,679
1988	2,635	5,724	1,914	4,464	1,105	2,945	0	3,936	5,836	780	861	10,370	19,830
1989	2,236	4,810	1,512	3,485	1,631	4,086	0	6,159	8,994	401	443	11,939	21,818
1990	2,406	5,178	1,085	2,515	1,271	3,260	0	4,994	7,375	492	543	10,248	18,871
1991	1,890	4,050	965	2,200	421	1,071	0	6,739	9,902	598	661	10,613	17,884
1992	1,788	3,923	631	1,488	480	1,236	0	6,213	9,074	665	735	9,777	16,456
1993	876	1,897	1,006	2,321	564	1,498	0	4,470	6,504	363	402	7,279	12,622
1994	833	1,845	242	561	305	773	0	2,790	4,066	430	475	4,600	7,720
1995	759	1,582	666	1,565	518	1,339	0	2,504	3,670	512	566	4,959	8,722
1996	1,231	2,692	604	1,404	894	2,293	0	3,460	5,129	856	947	7,045	12,465
1997	629	1,367	169	398	415	1,102	0	1,717	2,497	720	797	3,650	6,161

SFAs 19,20,21: Returns 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 et al. MS 1985).

SFA 22: Inner Fundy stocks do not go to north Atlantic.

SFA 23: 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, Marshall MS 1992 (commercial harvest, bi-catch etc., incl. in estimated returns) + est. 0.85-0.95 * MSW hatchery returns to Mactaquac; 2SW production in remainder of SFA ignored.

Appendix 5(ix b). Total 2SW spawners in SFAs 19, 20, 21 and 23, 1970-1997.

	RETURNS SFA 19		RETURNS SFA 20		RETURNS SFA 21		REMOVALS angled (19-21)		SPAWNERS SFAs (19-21)		SFA 23 RETURNS		SFA 23 REMOVALS		TOTAL SPAWNERS	
Year	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1970	1,170	2,537	658	1,535	597	1,525	941	1,375	1,485	4,222	8,540	12,674	7,004	7,828	3,021	9,068
1971	600	1,266	344	802	481	1,199	541	812	884	2,455	7,155	10,536	3,543	3,960	4,496	9,032
1972	735	1,614	421	1,002	454	1,198	623	922	987	2,892	7,869	11,368	1,397	1,562	7,459	12,699
1973	726	1,571	665	1,532	546	1,437	740	1,108	1,197	3,432	4,205	6,036	1,454	1,625	3,949	7,844
1974	1,035	2,225	691	1,588	548	1,397	871	1,277	1,404	3,933	10,755	14,988	2,632	2,942	9,526	15,979
1975	376	824	149	343	882	2,321	534	867	874	2,621	13,107	18,578	2,120	2,369	11,861	18,830
1976	791	1,672	346	822	441	1,146	603	887	975	2,754	14,274	20,281	4,203	4,698	11,045	18,337
1977	999	2,152	660	1,509	873	2,354	967	1,463	1,565	4,552	16,869	23,995	4,856	5,427	13,578	23,119
1978	810	1,739	429	995	655	1,706	723	1,088	1,171	3,352	8,225	11,294	2,879	3,218	6,517	11,428
1979	532	1,169	431	978	508	1,288	560	851	911	2,585	5,165	7,207	1,393	1,557	4,683	8,234
1980	1,408	3,051	746	1,714	1,483	3,989	1,390	2,131	2,247	6,623	19,056	26,865	7,033	7,860	14,270	25,628
1981	886	1,856	926	2,133	1,754	4,475	1,338	2,125	2,228	6,339	11,026	15,267	7,384	8,253	5,870	13,353
1982	917	1,990	316	746	682	1,756	734	1,096	1,181	3,396	9,782	13,871	5,307	5,932	5,656	11,335
1983	477	1,030	641	1,475	552	1,434	633	971	1,037	2,968	9,662	13,836	9,194	10,275	1,505	6,529
1984	828	1,768	638	1,500	766	2,004	267	419	1,965	4,853	15,706	22,627	3,426	3,829	14,245	23,650
1985	1,495	3,132	2,703	6,355	2,102	5,469			6,300	14,956	16,541	23,828	4,656	5,204	18,185	33,580
1986	3,500	7,541	2,561	5,987	2,150	5,312			8,211	18,840	9,891	14,261	2,667	2,981	15,435	30,120
1987	2,427	5,237	1,066	2,527	1,114	2,872			4,607	10,636	6,922	10,043	1,294	1,446	10,235	19,233
1988	2,635	5,724	1,914	4,464	1,105	2,945			5,654	13,133	4,716	6,697	1,296	1,449	9,074	18,381
1989	2,236	4,810	1,512	3,485	1,631	4,086			5,379	12,381	6,560	9,437	250	279	11,689	21,539
1990	2,406	5,178	1,085	2,515	1,271	3,260			4,762	10,953	5,486	7,918	560	626	9,688	18,245
1991	1,890	4,050	965	2,200	421	1,071			3,276	7,321	7,337	10,563	1,257	1,405	9,356	16,479
1992	1,788	3,923	631	1,488	480	1,236			2,899	6,647	6,878	9,809	1,052	1,176	8,725	15,280
1993	876	1,897	1,006	2,321	564	1,498			2,446	5,716	4,833	6,906	680	760	6,599	11,862
1994	833	1,845	242	561	305	773			1,380	3,179	3,220	4,541	279	312	4,321	7,408
1995	759	1,582	666	1,565	518	1,339			1,943	4,486	3,016	4,236	122	136	4,837	8,586
1996	1,231	2,692	604	1,404	894	2,293			2,729	6,389	4,316	6,076	383	428	6,662	12,037
1997	629	1,367	169	398	415	1,102			1,213	2,867	2,437	3,294	309	345	3,341	5,816

Returns from App.5(xa), returns minus removals equal spawners.

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APPENDIX 6

COMPUTATION OF CATCH ADVICE FOR WEST GREENLAND

The North American Spawning Target (SpT) for 2SW salmon has been revised to 183,852 fish in 1998.

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 1996 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 1998.

Appendix 7a 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	30	70	30	70
1972	4,865	4,932	20	30	20	30	30	70	30	70
1973	7,395	7,496	20	30	20	30	30	70	30	70
1974	6,803	7,253	20	30	20	30	30	70	30	70
1975	6,732	7,178	20	30	20	30	30	70	30	70
1976	5,817	6,202	20	30	20	30	30	70	30	70
1977	5,238	5,584	20	30	20	30	30	70	30	70
1978	3,832	3,481	20	30	20	30	30	70	30	70
1979	3,982	2,298	20	30	20	30	30	70	30	70
1980	3,920	3,093	20	30	20	30	30	70	30	70
1981	3,617	4,874	20	30	20	30	30	70	30	70
1982	2,598	5,408	20	30	20	30	30	70	30	70
1983	3,916	6,050	20	30	20	30	30	70	30	70
1984	4,899	4,726	20	30	20	30	30	70	30	70
1985	6,201	4,912	20	30	20	30	30	70	30	70
1986	6,131	3,244	20	30	20	30	30	70	30	70
1987	8,696	4,520	20	30	20	30	30	70	30	70
1988	5,926	3,495	20	30	20	30	30	70	30	70
1989	10,395	5,332	20	30	20	30	30	80	30	80
1990	10,084	5,600	20	30	20	30	30	80	30	80
1991	9,213	6,298	20	30	20	30	30	80	30	80
1992	15,017	6,284	20	30	20	30	30	80	30	80
1993	11,157	8,180	20	30	20	30	30	80	30	80
1994	7,493	6,230	20	30	20	30	30	80	30	80
1995	7,786	5,344	20	30	20	30	30	80	30	80
1996	10,726	2,717	20	30	20	30	30	70	30	70
1997	9,469	4,272	20	30	20	30	30	70	30	70

M(min)= 0.005
M(max)= 0.015

Return time (m)= 1SW(min) 7 MSW(min) 5
1SW(max) 9 MSW(max) 6

Appendix 7b 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
1971	1,740	4,060	30	40	30	40	8	15	22	37
1972	3,480	8,120	30	40	30	40	8	15	22	37
1973	2,130	4,970	30	40	30	40	8	15	22	37
1974	990	2,310	30	40	30	40	8	15	22	37
1975	1,980	4,620	30	40	30	40	8	15	20	35
1976	1,820	3,380	30	40	30	40	8	15	20	35
1977	1,400	2,600	30	40	30	40	8	15	20	35
1978	1,435	2,665	30	40	30	40	8	15	20	35
1979	1,645	3,055	30	40	30	40	8	15	20	35
1980	3,430	6,370	30	40	30	40	8	15	20	35
1981	2,720	4,080	30	40	30	40	8	15	20	35
1982	1,680	2,520	30	40	30	40	8	15	20	35
1983	1,800	2,700	30	40	30	40	8	15	20	35
1984	2,960	4,440	30	40	30	40	8	15	20	35
1985	1,100	3,330	30	40	30	40	8	15	20	35
1986	3,400	3,400	30	40	30	40	8	15	20	35
1987	6,000	1,800	20	30	20	30	8	15	20	35
1988	2,100	5,000	20	30	20	30	8	15	20	35
1989	1,100	2,300	20	30	20	30	8	15	20	35
1990	1,900	2,300	20	30	20	30	8	15	20	35
1991	1,400	2,100	20	30	20	30	7	12	20	35
1992	2,500	2,700	20	30	20	30	7	12	20	35
1993	3,600	1,300	20	30	20	30	8	15	20	35
1994	2,800	2,300	20	30	20	30	8	15	20	35
1995	1,669	1,095	20	30	20	30	8	15	20	35
1996	2,063	1,942	20	30	20	30	8	15	20	35
1997	1,060	1,000	20	30	20	30	8	15	20	35

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 4
M(max)= 0.015 1SW(max) 9 MSW(max) 5

Appendix 7c 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	0	0	0	0	40	60	40	60
1972	19,588	21,134	0	0	0	0	40	60	40	60
1973	20,052	18,021	0	0	0	0	40	60	40	60
1974	14,204	14,325	0	0	0	0	40	60	40	60
1975	20,328	18,032	0	0	0	0	40	60	40	60
1976	17,349	13,874	0	0	0	0	40	60	40	60
1977	19,454	17,419	0	0	0	0	40	60	40	60
1978	24,120	22,884	0	0	0	0	40	60	40	60
1979	23,759	15,981	0	0	0	0	40	60	40	60
1980	7,649	20,158	0	0	0	0	40	60	40	60
1981	15,543	9,516	0	0	0	0	40	60	40	60
1982	11,872	9,478	0	0	0	0	40	60	40	60
1983	16,031	11,483	0	0	0	0	40	60	40	60
1984	9,988	11,929	0	0	0	0	40	60	40	60
1985	20,064	6,882	0	0	0	0	40	60	40	60
1986	30,769	12,521	0	0	0	0	40	60	40	60
1987	20,392	12,898	0	0	0	0	40	60	40	60
1988	37,561	10,516	0	0	0	0	40	60	40	60
1989	20,366	9,399	0	0	0	0	40	60	40	60
1990	18,956	10,327	0	0	0	0	40	60	40	60
1991	22,878	8,614	0	0	0	0	40	60	40	60
1992	30,676	11,633	0	0	0	0	40	60	40	60
1993	29,360	9,665	0	0	0	0	40	60	40	60
1994	17,562	10,480	0	0	0	0	40	60	40	60
1995	25,552	8,689	0	0	0	0	40	60	40	60
1996	21,624	7,812	0	0	0	0	40	60	40	60
1997	21,476	7,164	0	0	0	0	40	60	40	60

M(min)= 0.005 Return time (m)= 1SW(min) 6 MSW(min) 5
M(max)= 0.015 1SW(max) 8 MSW(max) 6

Appendix 7d 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	40	65	40	60	62	72	47	55
1982	310,000	12,353	30	45	30	45	61	72	43	51
1983	502,000	29,411	30	50	30	50	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	40	60	70	35	41
1988	559,297	30,599	15	40	15	25	45	54	43	50
1989	305,667	24,891	30	40	30	45	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	45	40	47	49	57
1992	217,446	17,707	30	40	30	45	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	305,667	18,742	25	30	20	25	50	52	60	75
1997	193,460	15,754	10	20	20	25	30	45	40	50

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 5
M(max)= 0.015 1SW(max) 9 MSW(max) 6

Appendix 7e 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	40	70	40	70
1997	124,387	69,290	30	50	30	50	30	60	30	60

M(min)= 0.005 Return time (m)= 1SW(min) 5 MSW(min) 4
M(max)= 0.015 1SW(max) 7 MSW(max) 5

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Appendix 7f 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	60,841	11	25	11	25	25	45	25	45
1972	53,525	67,407	11	25	11	25	25	45	25	45
1973	89,440	112,636	11	25	11	25	25	45	25	45
1974	82,141	103,444	11	25	11	25	25	45	25	45
1975	87,944	129,896	11	25	11	25	25	45	25	45
1976	66,447	110,756	11	25	11	25	25	45	25	45
1977	55,463	83,195	11	25	11	25	25	45	25	45
1978	60,737	57,564	11	25	11	25	25	45	25	45
1979	69,423	63,844	11	25	11	25	25	45	25	45
1980	45,673	96,795	11	25	11	25	25	45	25	45
1981	32,611	52,528	11	25	11	25	20	40	20	40
1982	39,702	42,471	11	25	11	25	20	40	20	40
1983	57,870	68,396	11	25	11	25	20	40	20	40
1984	54,991	72,228	11	25	11	25	20	40	20	40
1985	72,803	80,292	11	25	11	25	20	40	20	40
1986	63,926	89,465	11	25	11	25	20	40	20	40
1987	97,242	41,769	11	25	11	25	20	40	20	40
1988	53,158	46,848	11	25	11	25	20	40	20	40
1989	78,023	29,454	11	25	11	25	20	40	20	40
1990	70,595	25,663	11	25	11	25	20	40	20	40
1991	40,603	17,543	33	47	33	47	10	25	10	25
1992	34,021	13,431	45	55	45	55	10	25	10	25
1993	28,100	17,907	50	60	50	60	10	25	10	25
1994	30,877	13,668	55	65	55	65	10	25	10	25
1995	27,775	10,023	55	65	55	65	10	25	10	25
1996	33,878	8,708	55	65	65	75	10	25	10	25
1997	31,857	7,107	55	65	65	75	10	25	10	25

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 4
M(max)= 0.015 1SW(max) 9 MSW(max) 5

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Appendix 7g 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	2,566	2,152	20	50	20	50	50	75	55	90

M(min)= 0.005
M(max)= 0.015

Return time (m)= 1SW(min) 6 MSW(min) 5
1SW(max) 8 MSW(max) 6

Appendix 7h 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
1971	34,534	18,595	15	35	15	35	30	60	30	60
1972	38,671	20,823	15	35	15	35	30	60	30	60
1973	36,214	19,500	15	35	15	35	30	60	30	60
1974	35,577	19,157	15	35	15	35	30	60	30	60
1975	41,046	22,102	15	35	15	35	30	60	30	60
1976	25,698	13,837	15	35	15	35	30	60	30	60
1977	28,969	15,599	15	35	15	35	30	60	30	60
1978	29,321	15,788	15	35	15	35	30	60	30	60
1979	23,009	12,390	15	35	15	35	30	60	30	60
1980	31,563	16,995	15	35	15	35	30	60	30	60
1981	38,244	20,593	15	35	15	35	30	60	30	60
1982	23,166	12,474	15	35	15	35	30	60	30	60
1983	31,842	17,146	15	35	15	35	30	60	30	60
1984	27,744	14,939	15	35	15	35	30	60	30	60
1985	30,034	16,172	15	35	15	35	30	50	30	50
1986	36,974	19,909	15	35	15	35	25	50	25	50
1987	34,495	18,574	15	35	15	35	25	50	25	50
1988	44,208	23,804	15	35	15	35	25	50	25	50
1989	32,285	17,384	15	35	15	35	25	50	25	50
1990	29,209	15,728	15	35	15	35	25	50	25	50
1991	20,349	10,957	15	35	15	35	25	50	25	50
1992	20,834	11,218	15	35	15	35	25	50	25	50
1993	27,214	14,654	15	35	15	35	25	50	25	50
1994	32,983	17,760	15	35	15	35	25	50	25	50
1995	26,675	14,363	15	35	15	35	20	45	20	40
1996	22,554	12,144	15	35	15	35	20	45	20	40
1997	18,000	10,000	15	35	15	35	20	45	20	40

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 4
M(max)= 0.015 1SW(max) 9 MSW(max) 5

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Appendix 7i 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

M(min)= 0.005 Return time (m)= 1SW(min) 7 MSW(min) 4
M(max)= 0.015 1SW(max) 9 MSW(max) 6

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Appendix 7j Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - UK(SCOTLAND)

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	262,160	161,601	20	40	20	40	20	40	30	50
1972	251,465	218,023	20	40	20	40	20	40	30	50
1973	293,090	237,920	20	40	20	40	20	40	30	50
1974	289,416	188,357	20	40	20	40	20	40	30	50
1975	222,345	207,978	20	40	20	40	20	40	30	50
1976	188,492	114,582	20	40	20	40	20	40	25	45
1977	194,264	138,987	20	40	20	40	20	40	25	45
1978	204,470	162,954	20	40	20	40	20	40	25	45
1979	187,236	132,509	20	40	20	40	20	40	25	45
1980	121,441	172,588	15	30	15	30	15	35	25	45
1981	150,738	174,721	15	30	15	30	15	35	20	40
1982	208,061	128,242	15	30	15	30	15	35	20	40
1983	209,617	145,961	15	30	15	30	15	35	20	40
1984	213,079	107,213	15	30	15	30	15	35	20	40
1985	158,012	114,648	15	30	15	30	15	35	20	40
1986	202,855	148,397	15	30	15	30	15	35	15	35
1987	164,785	103,994	15	30	15	30	15	35	15	35
1988	149,098	112,162	15	30	15	30	15	35	15	35
1989	174,941	103,886	10	20	10	20	10	30	15	35
1990	81,094	87,924	10	20	10	20	10	30	15	35
1991	73,608	65,193	10	20	10	20	10	30	10	30
1992	101,676	82,841	10	20	10	20	10	30	10	30
1993	94,517	71,726	10	20	10	20	10	30	10	30
1994	99,459	85,404	10	20	10	20	10	30	10	30
1995	89,921	78,452	10	20	10	20	10	30	10	30
1996	66,413	57,920	10	20	10	20	8	25	8	25
1997	42,403	36,140	10	20	10	20	8	25	8	25

M(min)=	0.005	Return time (m)=	1SW(min)	7	MSW(min)	5
M(max)=	0.015		1SW(max)	8	MSW(max)	6

Appendix 7k Input data for NEAC Area Pre Fishery Abundance analysis using Monte Carlo simulation - FAROES

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	2620	105796	5	15	0	0	100	100	100	100
1972	2754	111187	5	15	0	0	100	100	100	100
1973	3121	126012	5	15	0	0	100	100	100	100
1974	2186	88276	5	15	0	0	100	100	100	100
1975	2798	112984	5	15	0	0	100	100	100	100
1976	1830	73900	5	15	0	0	100	100	100	100
1977	1291	52112	5	15	0	0	100	100	100	100
1978	974	39309	5	15	0	0	100	100	100	100
1979	1736	70082	5	15	0	0	100	100	100	100
1980	4523	182616	5	15	0	0	100	100	100	100
1981	7443	300542	5	15	0	0	100	100	100	100
1982	6859	276957	5	15	0	0	100	100	100	100
1983	15861	215349	5	15	0	0	100	100	100	100
1984	5534	138227	5	15	0	0	100	100	100	100
1985	378	158103	5	15	0	0	100	100	100	100
1986	1979	180934	5	15	0	0	100	100	100	100
1987	90	166244	5	15	0	0	100	100	100	100
1988	8637	87629	5	15	0	0	100	100	100	100
1989	1788	121965	5	15	0	0	100	100	100	100
1990	1989	140054	5	15	0	0	100	100	100	100
1991	943	84935	5	15	0	0	100	100	100	100
1992	68	35700	5	15	0	0	100	100	100	100
1993	6	30023	5	15	0	0	100	100	100	100
1994	15	31672	5	15	0	0	100	100	100	100
1995	18	34662	5	15	0	0	100	100	100	100
1996	101	28381	5	15	0	0	100	100	100	100
1997	0	0	5	15	0	0	100	100	100	100

M(min)= 0.005
M(max)= 0.015

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

Prop'n 1SW returning as grilse = 0.170
0.270

Appendix 7I 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	439111	0	0	5	15	100	100	100	100
1972	0	345051	0	0	5	15	100	100	100	100
1973	0	382283	0	0	5	15	100	100	100	100
1974	0	292402	0	0	5	15	100	100	100	100
1975	0	354886	0	0	5	15	100	100	100	100
1976	0	198413	0	0	5	15	100	100	100	100
1977	0	251475	0	0	5	15	100	100	100	100
1978	0	145265	0	0	5	15	100	100	100	100
1979	0	244519	0	0	5	15	100	100	100	100
1980	0	166716	0	0	5	15	100	100	100	100
1981	0	246704	0	0	5	15	100	100	100	100
1982	0	143800	0	0	5	15	100	100	100	100
1983	0	60500	0	0	5	15	100	100	100	100
1984	0	41200	0	0	5	15	100	100	100	100
1985	0	161500	0	0	5	15	100	100	100	100
1986	0	131900	0	0	5	15	100	100	100	100
1987	0	126400	0	0	5	15	100	100	100	100
1988	0	168800	0	0	5	15	100	100	100	100
1989	0	52700	0	0	5	15	100	100	100	100
1990	0	21700	0	0	5	15	100	100	100	100
1991	0	65400	0	0	5	15	100	100	100	100
1992	0	39500	0	0	5	15	100	100	100	100
1993	0	0	0	0	5	15	100	100	100	100
1994	0	0	0	0	5	15	100	100	100	100
1995	0	11200	0	0	5	15	100	100	100	100
1996	0	15200	0	0	5	15	100	100	100	100
1997	0	8300	0	0	5	15	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

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APPENDIX 8

Appendix 8a Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis FINLAND

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	4,160	4,218	8,657	8,952	9,386	16,689	5,614,143	13,528,214	4,497	4,735	26,075
1972	6,504	6,589	13,695	13,998	14,857	25,564	14,000,833	33,199,555	7,191	7,409	40,421
1973	9,873	10,021	20,680	21,439	22,431	24,544	30,852,893	30,016,442	10,808	11,418	46,974
1974	9,094	9,677	19,493	20,589	21,140	23,993	28,969,420	29,068,828	10,399	10,912	45,133
1975	8,972	9,573	18,912	20,128	20,513	20,954	27,516,992	20,413,832	9,940	10,555	41,468
1976	7,772	8,295	16,418	17,579	17,814	18,638	20,421,502	16,880,131	8,647	9,283	36,452
1977	6,983	7,459	14,753	15,632	16,001	11,689	15,765,784	6,643,279	7,770	8,173	27,690
1978	5,119	4,650	10,762	9,803	11,674	7,668	8,762,764	2,822,903	5,642	5,153	19,342
1979	5,321	3,069	11,292	6,431	12,250	10,488	9,228,142	5,681,813	5,971	3,362	22,738
1980	5,234	4,125	11,266	8,798	12,218	16,312	9,275,423	12,763,816	6,032	4,673	28,530
1981	4,826	6,498	10,159	13,685	11,022	18,353	7,853,795	16,903,116	5,333	7,187	29,375
1982	3,477	7,224	7,325	15,394	7,947	20,155	4,153,368	20,228,167	3,848	8,170	28,103
1983	5,220	8,061	11,060	16,904	11,998	15,925	8,797,841	12,331,835	5,839	8,843	27,922
1984	6,542	6,310	13,878	13,356	15,058	16,489	14,367,157	13,212,285	7,336	7,047	31,547
1985	8,271	6,564	17,356	13,830	18,828	11,021	22,193,549	5,923,949	9,085	7,266	29,849
1986	8,188	4,331	17,367	9,244	18,838	15,288	23,608,559	11,511,181	9,178	4,912	34,126
1987	11,609	6,025	24,988	12,824	27,104	11,626	47,770,642	6,730,646	13,380	6,799	38,730
1988	7,916	4,664	16,782	9,751	18,200	16,467	20,879,161	17,925,207	8,866	5,086	34,667
1989	13,872	7,106	26,947	13,811	29,226	17,749	71,678,956	20,733,436	13,074	6,706	46,975
1990	13,473	7,466	26,027	14,884	28,227	19,566	66,874,335	24,607,793	12,555	7,418	47,792
1991	12,283	8,424	24,186	16,409	26,222	19,665	55,971,068	26,336,026	11,904	7,985	45,887
1992	20,034	8,393	38,930	16,495	42,217	25,681	150,587,420	43,748,958	18,895	8,102	67,898
1993	14,878	10,920	29,355	21,542	31,845	19,307	85,199,480	25,245,149	14,477	10,622	51,151
1994	10,012	8,326	19,722	16,192	21,391	16,679	39,473,803	18,687,134	9,711	7,866	38,069
1995	10,398	7,147	20,574	13,987	22,318	9,075	42,185,192	3,731,922	10,175	6,840	31,393
1996	14,313	3,631	30,242	7,612	32,799	14,452	65,954,684	11,144,593	15,928	3,981	47,252
1997	12,668	5,709	26,922	12,122	29,206	0	55,343,835	0	14,254	6,413	29,206

Appendix 8b Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis FRANCE

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	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits
			MCS mean	MCS mean	MCS mean	MCS mean					Sum means
1971	2,684	6,264	23,776	21,734	25,781	51,339	23,391,911	50,182,873	21,092	15,470	77,120
1972	5,372	12,524	48,026	43,502	52,098	31,565	97,798,572	19,963,131	42,654	30,977	83,664
1973	3,283	7,671	29,242	26,744	31,718	14,584	35,015,928	4,082,719	25,959	19,073	46,302
1974	1,528	3,558	13,841	12,359	15,011	31,148	8,288,850	22,107,669	12,313	8,801	46,158
1975	3,045	7,112	27,232	26,394	29,539	22,997	31,889,734	11,088,102	24,187	19,283	52,536
1976	2,807	5,220	25,154	19,488	27,291	17,537	27,215,066	6,799,097	22,346	14,268	44,827
1977	2,154	4,010	19,313	14,859	20,947	18,046	15,355,807	7,238,995	17,159	10,849	38,993
1978	2,213	4,110	19,768	15,290	21,444	20,597	16,856,626	9,214,504	17,555	11,180	42,041
1979	2,538	4,710	22,833	17,451	24,769	43,362	21,630,553	44,507,098	20,295	12,741	68,131
1980	5,287	9,806	48,054	36,745	52,118	27,539	96,014,078	16,522,395	42,767	26,939	79,658
1981	4,190	6,278	37,441	23,337	40,618	17,176	60,446,037	6,740,485	33,251	17,059	57,793
1982	2,597	3,886	23,216	14,554	25,187	18,157	23,646,492	7,431,323	20,619	10,667	43,344
1983	2,769	4,151	24,879	15,384	26,989	30,132	25,232,901	20,205,328	22,110	11,233	57,121
1984	4,563	6,843	41,018	25,532	44,502	22,546	70,492,576	11,231,684	36,455	18,688	67,048
1985	1,693	5,138	15,102	19,103	16,382	23,195	9,519,305	11,842,532	13,409	13,965	39,577
1986	5,242	5,241	47,088	19,654	51,079	10,599	97,107,345	2,469,568	41,846	14,413	61,677
1987	8,010	2,399	72,764	8,981	78,926	29,129	225,756,790	18,788,164	64,754	6,581	108,055
1988	2,805	6,673	25,209	24,681	27,342	13,426	26,428,910	3,919,936	22,404	18,008	40,768
1989	1,468	3,065	13,102	11,376	14,211	13,628	7,022,100	4,050,390	11,634	8,311	27,839
1990	2,538	3,066	22,576	11,547	24,486	12,327	20,932,799	3,292,488	20,038	8,481	36,813
1991	1,866	2,809	20,171	10,444	21,875	15,886	12,080,695	5,633,267	18,305	7,636	37,761
1992	3,335	3,606	35,765	13,461	38,791	7,666	39,487,884	1,286,509	32,430	9,855	46,457
1993	4,801	1,735	43,278	6,496	46,949	13,461	78,427,259	4,002,878	38,478	4,761	60,409
1994	3,741	3,074	33,680	11,405	36,532	6,439	47,610,041	921,784	29,939	8,331	42,972
1995	2,229	1,464	20,123	5,456	21,829	11,360	17,073,598	2,619,805	17,894	3,991	33,188
1996	2,753	2,595	24,681	9,625	26,770	5,888	24,368,427	828,120	21,928	7,030	32,658
1997	1,418	1,336	12,762	4,989	13,844	0	6,956,715	0	11,344	3,653	13,844

Appendix 8c Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis ICELAND

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	21,403	13,083	43,012	26,549	46,173	51,176	30,243,273	27,805,358	21,609	13,466	97,349
1972	19,588	21,134	39,601	42,924	42,522	43,757	26,006,857	21,479,210	20,012	21,790	86,279
1973	20,052	18,021	40,450	36,698	43,431	34,692	26,416,333	13,353,915	20,398	18,677	78,123
1974	14,204	14,325	28,949	29,100	31,081	43,413	13,781,069	20,931,958	14,744	14,775	74,494
1975	20,328	18,032	41,100	36,415	44,128	33,564	28,700,222	11,982,018	20,772	18,383	77,692
1976	17,349	13,874	35,121	28,154	37,714	41,901	21,013,193	18,898,184	17,771	14,280	79,615
1977	19,454	17,419	39,406	35,144	42,309	55,205	24,529,705	33,248,746	19,952	17,725	97,514
1978	24,120	22,884	48,724	46,300	52,317	38,450	38,051,716	16,137,050	24,603	23,416	90,767
1979	23,759	15,981	48,232	32,248	51,788	48,851	36,850,012	26,450,642	24,473	16,267	100,639
1980	7,649	20,158	15,629	40,976	16,780	22,942	3,924,414	5,635,628	7,980	20,817	39,722
1981	15,543	9,516	31,410	19,245	33,727	22,969	16,494,118	5,940,426	15,867	9,729	56,697
1982	11,872	9,478	23,994	19,265	25,764	27,624	9,803,461	8,522,076	12,122	9,787	53,388
1983	16,031	11,483	32,521	23,168	34,919	28,835	16,940,905	8,860,573	16,490	11,685	63,754
1984	9,988	11,929	20,267	24,185	21,763	16,596	6,820,692	3,010,328	10,279	12,256	38,359
1985	20,064	6,882	40,506	13,920	43,494	30,383	27,068,400	9,930,748	20,442	7,038	73,878
1986	30,769	12,521	62,381	25,484	66,978	31,250	66,449,168	10,663,610	31,612	12,963	98,228
1987	20,392	12,898	41,642	26,211	44,711	25,260	29,188,454	6,981,000	21,250	13,313	69,972
1988	37,561	10,516	76,177	21,186	81,786	22,637	92,469,575	5,635,597	38,616	10,670	104,423
1989	20,366	9,399	41,132	18,986	44,161	25,136	27,134,358	7,027,346	20,766	9,587	69,296
1990	18,956	10,327	38,194	21,081	41,006	20,774	23,345,939	4,661,294	19,238	10,754	61,780
1991	22,878	8,614	46,477	17,423	49,896	28,128	33,864,025	8,871,833	23,599	8,809	78,023
1992	30,676	11,633	61,948	23,592	66,510	23,418	62,082,280	5,957,685	31,272	11,959	89,927
1993	29,360	9,665	59,672	19,642	64,071	25,235	58,603,690	7,221,594	30,311	9,977	89,306
1994	17,562	10,480	35,663	21,165	38,289	20,981	20,628,471	4,892,504	18,100	10,685	59,271
1995	25,552	8,689	51,976	17,597	55,810	18,811	45,605,614	3,645,841	26,423	8,908	74,621
1996	21,624	7,812	43,807	15,777	47,035	17,317	30,380,559	3,516,012	22,183	7,965	64,352
1997	21,476	7,164	43,592	14,525	46,807	0	32,130,248	0	22,116	7,361	46,807

Appendix 8d 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 MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	765,906	85,119	1,312,140	167,735	1,423,192	220,124	13,807,766,797	271,214,359	546,234	82,617	1,643,317
1972	843,968	93,643	1,449,691	184,623	1,572,496	235,967	19,182,194,853	315,334,275	605,723	90,980	1,808,463
1973	900,702	100,277	1,545,820	197,901	1,676,727	258,964	21,196,836,389	356,870,643	645,118	97,624	1,935,691
1974	995,239	110,199	1,715,317	217,212	1,860,443	268,905	26,433,549,001	423,086,186	720,078	107,014	2,129,348
1975	1,030,707	114,677	1,770,056	225,543	1,920,071	190,766	26,833,982,043	198,337,489	739,349	110,866	2,110,837
1976	729,301	81,208	1,253,255	160,008	1,359,602	166,939	13,850,967,975	160,239,697	523,954	78,800	1,526,542
1977	638,562	71,206	1,097,928	140,015	1,190,973	149,844	10,931,716,234	133,453,013	459,366	68,809	1,340,817
1978	574,638	63,844	987,077	125,675	1,070,734	133,378	9,347,432,324	97,500,266	412,439	61,831	1,204,112
1979	512,682	56,894	882,352	111,862	957,220	149,424	7,250,216,974	135,864,878	369,669	54,968	1,106,644
1980	399,237	63,539	688,785	125,331	747,104	152,217	4,245,689,380	288,928,693	289,548	61,792	899,321
1981	373,544	64,877	558,268	127,667	605,607	50,383	10,317,751,406	14,386,028	184,724	62,791	655,990
1982	500,471	19,873	755,274	42,260	819,351	117,249	5,189,180,624	128,509,049	254,803	22,388	936,600
1983	841,062	49,203	1,442,144	98,339	1,564,427	102,956	29,893,231,517	103,077,811	601,082	49,136	1,667,383
1984	408,281	33,303	634,778	86,347	688,594	95,430	5,652,213,568	85,717,704	226,496	53,044	784,025
1985	836,250	33,052	1,171,374	80,033	1,270,542	101,925	19,898,314,805	96,520,526	335,124	46,981	1,372,467
1986	838,145	47,658	1,225,067	85,485	1,328,997	124,464	20,447,196,229	115,264,593	386,923	37,827	1,453,461
1987	537,465	39,561	834,202	104,395	904,870	98,653	11,995,073,426	29,383,200	296,737	64,834	1,003,523
1988	780,035	38,277	1,580,369	82,741	1,714,548	91,342	40,652,947,684	45,887,768	800,335	44,464	1,805,890
1989	470,852	39,870	723,539	76,612	784,871	41,881	2,809,043,049	6,024,778	252,687	36,742	826,751
1990	277,831	22,568	558,145	35,126	605,442	37,027	1,748,853,810	8,110,854	280,315	12,558	642,469
1991	192,931	16,465	447,028	31,054	484,868	68,897	1,024,719,234	26,858,689	254,097	14,589	553,764
1992	334,856	28,480	653,828	57,786	709,216	32,729	2,400,598,631	5,033,759	318,972	29,306	741,945
1993	258,183	21,059	518,537	27,451	562,538	72,916	2,120,814,757	11,625,270	260,354	6,392	635,453
1994	347,103	28,269	684,216	61,156	742,203	64,593	1,704,651,548	9,350,610	337,113	32,886	806,796
1995	306,931	25,011	554,922	54,175	601,960	42,934	1,148,911,297	6,253,547	247,991	29,164	644,893
1996	421,634	24,201	824,407	36,009	894,261	54,111	854,321,235	11,853,392	402,773	11,809	948,372
1997	228,247	20,341	617,682	45,385	670,080	0	7,130,386,041	0	389,434	25,043	670,080

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Appendix 8e Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis NORWAY

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	433,775	274,856	541,737	345,540	575,704	532,959	5,837,786,948	4,182,395,666	107,962	70,684	1,108,664
1972	568,498	358,942	712,988	451,580	757,760	584,723	11,436,594,119	5,026,634,099	144,491	92,638	1,342,483
1973	619,198	393,104	775,507	495,408	824,173	549,043	13,177,758,985	4,241,592,973	156,309	102,304	1,373,216
1974	587,813	369,969	741,229	465,247	787,683	514,676	12,324,636,309	4,075,575,230	153,416	95,278	1,302,359
1975	548,126	347,912	687,148	436,105	730,332	518,212	9,904,495,202	3,882,783,972	139,022	88,193	1,248,544
1976	549,654	349,428	689,793	439,112	733,235	500,438	10,068,293,714	3,793,972,209	140,139	89,684	1,233,673
1977	531,330	338,394	667,388	424,023	709,325	353,895	9,921,381,805	1,961,464,862	136,058	85,628	1,063,220
1978	377,359	238,897	473,379	299,850	503,123	614,805	5,300,450,813	5,417,322,351	96,019	60,953	1,117,928
1979	658,281	415,821	828,157	520,895	880,293	615,540	15,471,735,421	6,098,320,089	169,876	105,074	1,495,833
1980	656,553	414,105	829,086	521,584	881,101	639,009	15,256,533,974	6,002,675,695	172,533	107,479	1,520,111
1981	448,337	431,602	562,225	541,452	597,576	525,095	7,125,803,535	4,137,582,305	113,888	109,850	1,122,671
1982	332,943	353,526	417,552	444,960	443,838	510,136	3,815,019,712	3,945,140,880	84,610	91,433	953,975
1983	560,954	345,061	705,022	432,239	749,355	531,293	10,756,107,925	4,445,118,374	144,069	87,178	1,280,647
1984	596,823	358,074	750,111	450,147	797,275	488,690	11,940,468,686	3,604,683,384	153,288	92,073	1,285,965
1985	604,495	330,020	757,289	414,038	804,808	577,053	12,617,741,695	5,001,822,592	152,794	84,017	1,381,861
1986	536,957	388,148	674,373	488,934	716,801	459,837	9,432,135,685	3,238,440,399	137,416	100,786	1,176,637
1987	477,510	309,584	602,637	389,640	640,490	359,896	8,054,129,444	2,007,057,860	125,127	80,057	1,000,386
1988	441,720	243,559	555,440	304,927	590,412	322,436	7,225,373,181	1,849,483,963	113,719	61,368	912,847
1989	445,249	162,926	746,604	273,210	793,558	368,304	14,166,953,127	2,456,240,380	301,355	110,284	1,161,862
1990	391,085	184,490	654,554	312,070	695,671	372,461	11,649,553,243	2,606,161,696	263,469	127,581	1,068,132
1991	357,047	187,893	601,607	315,576	639,305	393,069	9,085,984,070	2,805,145,960	244,560	127,683	1,032,373
1992	304,695	197,954	510,841	333,057	542,910	310,088	7,201,596,479	1,437,009,280	206,146	135,102	852,998
1993	253,693	155,854	427,709	262,744	454,641	331,934	4,133,834,535	1,604,995,705	174,016	106,890	786,575
1994	258,563	167,801	435,557	281,243	462,956	330,497	4,298,737,102	1,634,826,524	176,994	113,442	793,453
1995	226,089	166,582	381,329	280,012	405,289	356,434	3,163,275,350	3,327,595,613	155,240	113,430	761,723
1996	184,900	162,876	344,336	302,008	365,932	319,143	4,639,325,907	4,445,133,668	159,435	139,131	685,075
1997	210,205	116,810	486,749	270,410	517,407	0	13,648,101,024	0	276,544	153,601	517,407

Appendix 8f 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 MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	59,111	74,447	171,477	219,081	185,941	286,671	1,078,931,393	2,001,740,297	112,367	144,634	472,612
1972	65,536	82,458	191,801	242,908	208,061	481,535	1,395,825,642	5,931,067,597	126,265	160,450	689,596
1973	109,321	137,885	318,853	407,979	345,850	439,285	3,723,879,749	4,738,453,542	209,532	270,094	785,135
1974	100,557	126,329	297,927	372,257	323,113	546,889	3,441,647,959	7,588,296,588	197,370	245,929	870,002
1975	107,242	158,547	313,891	463,433	340,481	470,841	3,769,601,968	5,164,495,790	206,649	304,887	811,321
1976	81,288	135,690	238,379	399,002	258,633	350,447	2,183,350,760	3,023,661,256	157,092	263,312	609,081
1977	67,663	101,757	198,568	296,941	215,377	243,488	1,455,244,786	1,466,679,615	130,905	195,184	458,865
1978	74,294	70,411	217,268	206,303	235,687	268,799	1,831,536,070	1,744,095,289	142,974	135,893	504,486
1979	84,944	78,053	250,110	227,739	271,321	411,698	2,332,899,670	4,477,151,598	165,166	149,686	683,020
1980	55,832	118,148	165,949	348,871	179,986	260,878	1,026,012,874	2,249,132,528	110,117	230,723	440,863
1981	39,832	64,085	137,316	221,082	148,969	213,480	989,614,869	1,577,880,703	97,485	156,998	362,449
1982	48,680	51,944	167,911	180,891	182,168	338,227	1,504,184,766	3,916,719,301	119,231	128,947	520,395
1983	70,593	83,376	244,735	286,568	265,490	361,034	2,968,043,768	4,395,400,619	174,142	203,193	626,523
1984	67,229	88,280	233,246	305,908	253,063	400,159	2,772,926,561	5,363,410,516	166,017	217,627	653,222
1985	88,870	98,253	305,640	339,057	331,558	450,117	4,743,084,983	6,791,519,237	216,770	240,804	781,675
1986	78,164	109,360	271,022	381,397	293,993	209,212	3,925,394,108	1,487,874,441	192,858	272,037	503,205
1987	118,837	50,945	417,176	177,278	452,503	231,595	9,153,302,777	1,840,936,787	298,339	126,334	684,097
1988	65,016	57,227	225,521	196,228	244,603	145,944	2,622,779,389	716,973,360	160,505	139,001	390,547
1989	95,305	35,914	328,056	123,661	355,827	129,544	5,438,156,066	563,964,527	232,751	87,747	485,371
1990	86,364	31,309	296,123	109,758	321,173	211,056	4,455,516,875	2,618,498,987	209,759	78,449	532,229
1991	67,786	29,457	415,559	178,817	450,554	194,649	15,044,845,620	2,294,713,029	347,774	149,360	645,203
1992	68,185	26,961	412,804	164,939	447,669	289,446	15,180,157,059	5,041,927,888	344,619	137,978	737,116
1993	62,564	39,939	384,284	245,275	416,897	245,891	13,284,880,280	3,693,703,430	321,720	205,336	662,788
1994	77,696	34,407	476,466	208,336	516,808	181,728	21,351,346,125	2,033,642,030	398,770	173,929	698,536
1995	69,821	25,260	429,854	153,966	466,294	209,080	16,910,692,561	2,554,105,240	360,033	128,706	675,373
1996	85,036	29,348	517,835	177,160	561,610	173,374	23,758,261,426	2,116,741,738	432,799	147,812	734,985
1997	80,338	23,962	492,474	146,901	534,285	0	22,634,434,079	0	412,136	122,939	534,285

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Appendix 8g 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	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits
			MCS mean	MCS mean	MCS mean	MCS mean					Sum means
1971	9,936	660	12,046	878	12,932	652	4,078,924	20,587	2,110	218	13,584
1972	7,881	463	9,604	616	10,311	2,279	2,925,287	258,254	1,723	154	12,590
1973	9,730	1,610	11,837	2,155	12,708	1,451	4,328,371	97,418	2,107	545	14,159
1974	14,052	1,031	17,240	1,372	18,507	349	9,427,642	6,066	3,188	341	18,856
1975	14,967	250	18,230	330	19,574	1,062	9,867,062	51,543	3,263	80	20,636
1976	8,504	757	10,371	1,005	11,138	788	3,212,152	30,595	1,867	248	11,926
1977	3,981	565	4,861	745	5,219	605	743,095	18,255	879	180	5,824
1978	4,580	432	5,583	572	5,995	1,747	1,043,996	143,434	1,003	140	7,741
1979	4,837	1,253	5,917	1,651	6,354	3,086	1,114,493	511,126	1,080	399	9,440
1980	6,142	2,183	7,548	2,919	8,103	887	1,786,407	37,404	1,406	735	8,990
1981	11,092	634	13,516	839	14,513	3,230	5,823,484	518,828	2,424	205	17,743
1982	9,836	2,290	11,987	3,055	12,873	2,179	4,437,513	237,331	2,151	765	15,052
1983	12,915	1,562	15,778	2,060	16,942	3,104	7,592,317	493,494	2,863	498	20,046
1984	18,301	2,208	22,359	2,935	24,009	1,297	14,998,888	82,056	4,058	727	25,306
1985	21,692	927	26,398	1,227	28,342	1,261	21,643,375	78,523	4,706	300	29,603
1986	22,926	893	27,987	1,192	30,053	3,732	23,013,345	693,956	5,061	300	33,785
1987	18,566	2,647	22,800	3,529	24,480	3,592	16,275,613	655,452	4,234	883	28,072
1988	15,580	2,579	19,048	3,397	20,456	10,012	12,021,745	4,810,117	3,469	817	30,467
1989	4,967	7,169	6,049	9,468	6,495	6,928	1,073,470	2,309,205	1,082	2,299	13,423
1990	11,670	4,885	14,189	6,551	15,235	7,988	6,392,441	3,154,787	2,518	1,667	23,223
1991	13,998	5,705	17,122	7,554	18,381	10,255	8,510,069	5,127,004	3,124	1,849	28,636
1992	15,401	7,298	18,754	9,698	20,135	14,053	11,362,489	9,767,627	3,352	2,401	34,188
1993	16,440	9,966	20,121	13,289	21,608	10,220	13,072,748	4,993,717	3,681	3,323	31,829
1994	12,624	7,324	17,611	9,664	18,912	6,482	11,018,190	1,647,471	4,987	2,341	25,394
1995	15,300	4,361	24,889	6,128	26,724	8,232	23,375,402	2,489,602	9,590	1,768	34,956
1996	9,391	5,561	15,213	7,784	16,332	5,038	8,405,434	1,104,820	5,822	2,223	21,370
1997	4,044	3,382	6,565	4,764	7,051	0	1,601,522	0	2,521	1,382	7,051

Appendix 8h Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - UK(E&W)

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	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits
			MCS mean	MCS mean	MCS mean	MCS mean					Sum means
1971	46,379	24,980	105,512	57,803	114,404	67,789	599,252,185	211,982,525	59,133	32,823	182,193
1972	52,004	27,957	119,551	64,764	129,686	63,908	798,148,827	196,585,460	67,547	36,807	193,594
1973	48,567	26,207	111,182	61,048	120,592	62,215	665,232,903	177,204,568	62,615	34,841	182,807
1974	47,826	25,652	111,593	59,446	121,019	71,068	718,268,813	241,188,144	63,768	33,793	192,087
1975	54,840	29,574	126,090	67,902	136,772	45,039	891,956,073	88,213,642	71,250	38,328	181,811
1976	34,504	18,624	79,512	43,034	86,272	50,214	353,922,456	117,198,767	45,008	24,410	136,486
1977	38,733	20,939	89,325	47,972	96,886	51,078	436,660,911	121,626,411	50,592	27,033	147,964
1978	39,369	21,197	90,454	48,795	98,123	39,841	476,874,233	71,624,780	51,085	27,598	137,964
1979	30,906	16,618	71,561	38,058	77,631	55,330	283,169,873	154,074,963	40,655	21,440	132,961
1980	42,334	22,740	99,118	52,865	107,499	66,268	541,768,381	199,749,918	56,784	30,125	173,767
1981	51,230	27,533	117,739	63,318	127,730	40,687	789,014,084	78,983,685	66,509	35,785	168,418
1982	31,216	16,743	71,784	38,873	77,881	54,913	296,341,355	142,564,544	40,568	22,130	132,794
1983	42,568	22,895	98,366	52,458	106,709	48,451	517,518,255	110,868,430	55,798	29,563	155,159
1984	37,216	20,032	86,056	46,286	93,367	57,903	403,951,284	93,077,414	48,840	26,254	151,271
1985	40,200	21,726	102,077	55,315	110,726	77,974	344,294,851	282,635,388	61,877	33,589	188,700
1986	49,603	26,700	137,564	74,493	149,228	72,340	1,085,156,683	246,473,601	87,961	47,793	221,568
1987	46,246	24,825	129,870	69,114	140,866	91,583	957,457,166	400,218,536	83,624	44,289	232,449
1988	59,343	31,890	164,716	87,490	178,662	66,948	1,540,312,177	207,072,364	105,373	55,600	245,611
1989	43,243	23,222	119,073	63,959	129,157	61,727	774,346,568	175,439,048	75,829	40,738	190,884
1990	39,227	21,029	107,598	58,967	116,702	42,617	640,818,061	84,037,257	68,371	37,938	159,318
1991	27,203	14,746	75,647	40,711	82,028	43,719	304,489,832	90,439,734	48,444	25,966	125,747
1992	27,903	15,054	76,833	41,769	83,328	57,240	328,810,215	153,998,748	48,930	26,715	140,568
1993	36,406	19,643	101,375	54,687	109,980	68,773	577,749,726	219,789,865	64,969	35,044	178,753
1994	44,301	23,864	123,172	65,699	133,608	69,986	865,254,789	231,804,029	78,871	41,835	203,594
1995	35,789	19,323	116,886	66,855	126,795	58,707	1,009,411,207	148,023,053	81,097	47,531	185,502
1996	30,212	16,312	97,741	56,085	106,005	48,823	678,242,429	122,385,626	67,528	39,773	154,827
1997	24,232	13,434	78,830	46,642	85,524	0	465,993,810	0	54,598	33,208	85,524

Appendix 8i Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - UK(N IRELAND)

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	90,916	12,049	131,577	26,309	142,709	24,839	206,758,520	6,887,520	40,661	14,260	167,548
1972	81,716	10,806	118,657	23,610	128,707	21,582	190,986,447	5,272,987	36,941	12,804	150,289
1973	70,606	9,375	102,413	20,513	111,085	21,692	138,317,385	5,022,468	31,807	11,138	132,777
1974	71,566	9,441	104,365	20,620	113,192	19,264	146,329,332	4,344,976	32,799	11,180	132,456
1975	63,358	8,408	91,972	18,312	99,767	13,390	107,543,098	1,945,099	28,615	9,904	113,158
1976	43,892	5,831	63,769	12,729	69,181	12,963	52,910,201	1,932,689	19,876	6,898	82,144
1977	42,532	5,659	61,834	12,321	67,074	17,470	51,464,929	3,621,388	19,302	6,662	84,544
1978	57,491	7,616	83,487	16,605	90,563	11,654	99,561,816	1,484,433	25,996	8,989	102,216
1979	38,472	5,089	56,000	11,077	60,753	14,388	43,159,620	2,541,614	17,529	5,988	75,141
1980	47,335	6,255	69,113	13,676	74,964	11,861	63,684,502	1,569,449	21,778	7,422	86,825
1981	39,132	5,173	56,815	11,275	61,633	15,614	44,093,943	2,783,758	17,683	6,102	77,247
1982	51,475	6,791	74,738	14,843	81,080	21,906	75,070,004	5,514,529	23,263	8,051	102,986
1983	72,293	9,566	105,161	20,822	114,078	9,207	145,248,888	1,012,786	32,868	11,256	123,285
1984	30,266	4,008	44,026	8,751	47,759	11,572	24,989,885	1,544,679	13,760	4,743	59,331
1985	37,936	5,046	55,040	10,999	59,700	12,891	40,077,218	1,884,017	17,103	5,953	72,591
1986	42,300	5,602	61,493	12,253	66,709	6,591	47,944,531	504,631	19,193	6,651	73,300
1987	21,716	2,867	31,693	6,265	34,377	17,117	13,448,395	3,501,896	9,976	3,399	51,494
1988	44,271	5,852	68,904	16,269	74,751	13,122	67,277,353	2,349,468	24,632	10,417	87,873
1989	56,607	7,473	63,696	12,474	69,100	12,136	66,421,821	658,797	7,090	5,000	81,236
1990	32,890	4,352	53,059	11,536	57,554	6,253	13,801,269	145,310	20,169	7,184	63,807
1991	19,219	2,551	29,930	5,943	32,463	13,992	4,408,848	977,138	10,711	3,393	46,455
1992	32,989	4,376	59,010	13,300	64,008	33,826	26,375,950	3,478,287	26,021	8,923	97,834
1993	29,007	3,845	71,059	32,153	77,084	11,919	26,339,682	1,065,984	42,052	28,308	89,003
1994	34,152	4,527	48,990	11,329	53,146	10,365	23,687,599	414,406	14,838	6,803	63,511
1995	31,123	4,128	46,696	9,853	50,654	11,548	12,488,431	3,975,913	15,574	5,725	62,202
1996	27,478	3,645	48,677	10,977	52,798	13,816	32,316,702	6,650,253	21,199	7,331	66,615
1997	32,708	4,329	55,076	13,133	59,748	0	40,477,128	0	22,368	8,804	59,748

Appendix 8j Estimated numbers of fish killed, returning, spawning and recruits from Monto Carlo simulation analysis - UK(SCOTLAND)

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	377,594	232,832	1,288,430	595,312	1,389,988	849,676	89,862,499,985	20,580,761,889	910,836	362,480	2,239,663
1972	362,721	313,927	1,250,750	803,520	1,349,916	931,849	87,998,257,073	25,808,963,319	888,030	489,594	2,281,764
1973	421,518	342,937	1,447,391	881,121	1,561,986	731,780	113,725,266,080	14,895,559,904	1,025,873	538,184	2,293,766
1974	417,282	270,441	1,460,551	692,112	1,575,875	801,976	124,076,055,836	19,016,294,139	1,043,269	421,670	2,377,852
1975	318,476	298,385	1,098,300	758,474	1,185,322	514,119	67,979,266,062	8,880,300,323	779,824	460,088	1,699,441
1976	271,419	165,429	938,157	486,257	1,012,725	617,469	49,396,110,473	13,766,753,900	666,738	320,828	1,630,194
1977	278,481	200,084	963,352	583,917	1,039,597	727,045	51,197,053,801	19,221,149,865	684,871	383,833	1,766,642
1978	294,442	234,634	1,014,829	687,503	1,095,305	588,023	60,721,599,927	12,075,842,961	720,388	452,869	1,683,328
1979	269,725	190,592	936,830	556,008	1,011,154	696,307	48,983,874,524	16,743,996,039	667,105	365,415	1,707,461
1980	157,181	223,000	676,641	658,548	730,140	822,946	34,061,055,249	28,924,569,005	519,459	435,548	1,553,086
1981	194,918	225,633	820,570	778,384	885,731	611,563	52,039,776,347	16,757,969,012	625,651	552,751	1,497,294
1982	270,216	166,077	1,138,496	578,361	1,228,925	684,491	101,582,287,754	20,786,471,466	868,280	412,284	1,913,416
1983	270,662	188,319	1,146,686	647,254	1,237,640	508,423	95,649,566,266	11,334,395,710	876,024	458,936	1,746,063
1984	275,819	138,742	1,169,975	480,792	1,263,044	542,121	102,880,573,494	12,741,465,740	894,156	342,050	1,805,164
1985	204,192	148,564	856,838	512,659	924,842	866,840	54,827,770,420	48,009,076,852	652,646	364,095	1,791,682
1986	262,624	192,060	1,113,839	819,762	1,202,161	604,346	98,295,484,318	23,555,571,683	851,214	627,702	1,806,507
1987	213,212	134,257	917,854	571,559	990,528	641,411	65,266,378,801	26,884,167,783	704,642	437,302	1,631,939
1988	193,095	145,051	818,861	606,529	883,597	542,891	50,831,617,671	18,345,997,947	625,766	461,478	1,426,488
1989	205,944	122,143	1,118,800	513,388	1,207,343	469,899	153,701,751,168	13,719,443,596	912,857	391,245	1,677,242
1990	95,560	103,414	515,968	444,314	556,752	443,017	32,673,745,978	20,043,644,396	420,408	340,899	999,769
1991	86,576	76,896	477,476	418,900	515,047	568,203	27,093,269,240	35,215,568,096	390,900	342,003	1,083,250
1992	119,661	97,593	650,391	537,377	701,729	493,619	52,215,272,946	25,805,869,667	530,730	439,784	1,195,348
1993	111,191	84,462	614,638	466,862	663,373	579,380	46,069,902,740	36,452,601,685	503,446	382,401	1,242,754
1994	117,207	100,669	646,977	547,856	698,129	536,166	52,813,170,639	30,810,703,344	529,770	447,187	1,234,295
1995	105,925	92,530	587,494	506,977	634,069	476,189	42,468,375,064	23,571,226,650	481,569	414,447	1,110,258
1996	78,178	68,266	521,977	450,349	563,246	303,351	35,573,307,207	11,249,788,179	443,799	382,083	866,597
1997	50,028	42,593	337,049	286,878	363,789	0	15,533,549,723	0	287,022	244,285	363,789

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Appendix 8k Estimated numbers of fish killed and recruits from Monto Carlo simulation analysis - FAROES

Year	Estimated total catch 1SW	Estimated total catch MSW	Estimated number 1SW returns MCS mean	Estimated number MSW returns MCS mean	Estimated maturing 1SW recruits MCS mean	Est. non-mat. 1SW recruits MCS mean	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits Sum means
1971	12,252	105,797	0	0	2,702	138,142	609,918	6,138,382	0	0	140,844
1972	12,959	111,188	0	0	2,856	155,744	665,464	7,077,222	0	0	158,599
1973	14,847	126,013	0	0	3,275	114,205	847,191	8,469,233	0	0	117,480
1974	10,347	88,276	0	0	2,280	138,518	414,131	4,523,475	0	0	140,798
1975	13,200	112,985	0	0	2,906	96,293	674,055	7,184,736	0	0	99,200
1976	8,623	73,901	0	0	1,898	67,298	278,971	2,997,330	0	0	69,196
1977	6,058	52,112	0	0	1,333	50,368	139,501	1,496,453	0	0	51,701
1978	4,594	39,309	0	0	1,014	84,304	89,280	948,024	0	0	85,318
1979	8,050	70,082	0	0	1,772	216,215	255,525	3,722,804	0	0	217,987
1980	21,365	182,617	0	0	4,705	363,017	1,761,702	21,499,169	0	0	367,723
1981	34,773	300,544	0	0	7,666	347,866	4,738,869	49,515,526	0	0	355,532
1982	32,298	276,958	0	0	7,124	275,133	4,104,620	40,767,763	0	0	282,258
1983	37,064	215,351	0	0	8,167	191,056	3,394,660	30,171,477	0	0	199,223
1984	18,435	138,228	0	0	4,062	197,332	1,148,020	11,832,213	0	0	201,394
1985	14,583	158,104	0	0	3,217	220,061	1,203,831	13,546,178	0	0	223,277
1986	18,671	180,935	0	0	4,123	206,853	1,735,481	17,828,840	0	0	210,975
1987	15,063	166,245	0	0	3,315	113,663	1,279,600	14,553,070	0	0	116,978
1988	17,276	87,629	0	0	3,810	154,926	665,179	5,417,883	0	0	158,737
1989	12,833	121,966	0	0	2,825	171,714	755,682	8,697,316	0	0	174,539
1990	14,940	140,055	0	0	3,298	110,458	1,080,596	11,031,600	0	0	113,756
1991	8,541	84,936	0	0	1,880	48,433	359,250	3,966,599	0	0	50,313
1992	3,240	35,700	0	0	714	37,242	61,246	720,033	0	0	37,956
1993	2,765	30,023	0	0	609	38,710	43,748	499,657	0	0	39,319
1994	2,860	31,672	0	0	630	42,217	46,348	565,965	0	0	42,847
1995	3,102	34,662	0	0	683	35,240	54,842	630,479	0	0	35,923
1996	2,672	28,381	0	0	588	2,364	37,672	414,411	0	0	2,953
1997	0	0	0	0	0	0	0	0	0	0	0

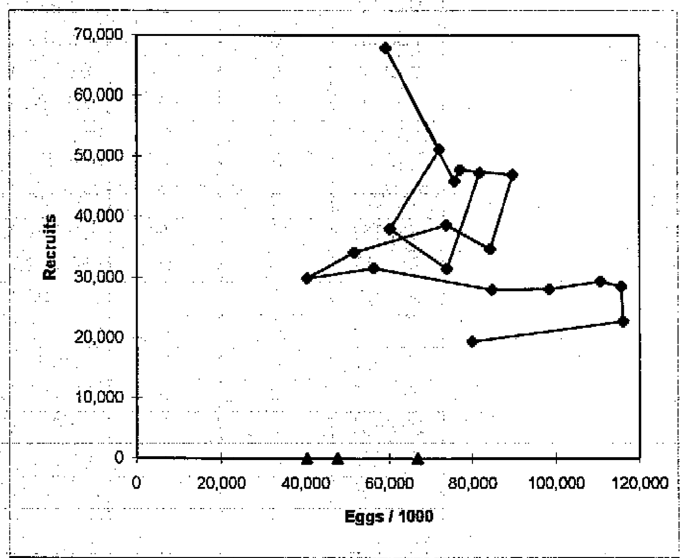
Appendix 8I Estimated numbers of fish killed and recruits from Monto Carlo simulation analysis - WEST GREENLAND

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	Variance on maturing 1SW recruits	Variance on non-mat. 1SW recruits	Est. 1SW spawners	Est MSW spawners	Total 1SW recruits
			MCS mean	MCS mean	MCS mean	MCS mean					Sum means
1971	0	488,694	0	0	0	535,538	0	505,056,325	0	0	535,538
1972	1	383,953	0	0	0	420,765	1	308,736,058	0	0	420,765
1973	2	425,594	0	0	0	466,403	2	372,198,718	0	0	466,403
1974	3	325,013	0	0	0	356,163	3	213,009,583	0	0	356,163
1975	4	394,316	0	0	0	432,119	4	332,331,900	0	0	432,119
1976	5	220,991	0	0	0	242,175	5	104,013,836	0	0	242,175
1977	6	279,801	0	0	0	306,627	6	164,387,791	0	0	306,627
1978	7	161,628	0	0	0	177,123	7	56,091,130	0	0	177,123
1979	8	271,987	0	0	0	298,066	8	153,972,415	0	0	298,066
1980	9	185,248	0	0	0	203,004	9	70,041,247	0	0	203,004
1981	10	274,039	0	0	0	300,317	10	160,465,961	0	0	300,317
1982	11	159,992	0	0	0	175,321	11	49,477,242	0	0	175,321
1983	12	67,167	0	0	0	73,606	12	9,296,426	0	0	73,606
1984	13	45,819	0	0	0	50,213	13	4,554,993	0	0	50,213
1985	14	179,745	0	0	0	196,987	14	72,100,002	0	0	196,987
1986	15	146,699	0	0	0	160,765	15	45,472,987	0	0	160,765
1987	16	140,379	0	0	0	153,833	16	40,676,595	0	0	153,833
1988	17	187,655	0	0	0	205,650	17	75,941,746	0	0	205,650
1989	18	58,518	0	0	0	64,127	18	6,949,530	0	0	64,127
1990	19	24,104	0	0	0	26,414	19	1,183,569	0	0	26,414
1991	20	72,840	0	0	0	79,824	20	11,441,931	0	0	79,824
1992	21	43,943	0	0	0	48,155	21	4,030,221	0	0	48,155
1993	22	0	0	0	0	0	22	0	0	0	0
1994	23	0	0	0	0	0	23	0	0	0	0
1995	24	12,473	0	0	0	13,670	24	332,727	0	0	13,670
1996	25	16,917	0	0	0	18,539	25	599,535	0	0	18,539
1997	26	9,237	0	0	0	10,123	26	188,011	0	0	10,123

APPENDIX 9

Appendix 9a   Lagged egg deposition analysis and estimation of conservation limit options - FINLAND

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	5000	13000	egg x 10-3	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	S	R	R/S
Fem	12%	77%		0%	0%	10%	80%	10%	0%	egg x 10^{-3}		
1971	4,497	4,735	50,092							n/a	26,075	
1972	7,191	7,409	78,482							n/a	40,421	
1973	10,808	11,418	120,774							n/a	46,974	
1974	10,399	10,912	115,470	0						n/a	45,133	
1975	9,940	10,555	111,616	0	0					n/a	41,468	
1976	8,647	9,283	98,113	0	0	5009				n/a	36,452	
1977	7,770	8,173	86,471	0	0	7848	40074			n/a	27,690	
1978	5,642	5,153	54,967	0	0	12077	62786	5009		79,872	19,342	0.24
1979	5,971	3,362	37,236	0	0	11547	96619	7848	0	116,014	22,738	0.20
1980	6,032	4,673	50,398	0	0	11162	92376	12077	0	115,615	28,530	0.25
1981	5,333	7,187	75,140	0	0	9811	89293	11547	0	110,651	29,375	0.27
1982	3,848	8,170	84,088	0	0	8647	78491	11162	0	98,299	28,103	0.29
1983	5,839	8,843	92,020	0	0	5497	69177	9811	0	84,485	27,922	0.33
1984	7,336	7,047	74,939	0	0	3724	43974	8647	0	56,344	31,547	0.56
1985	9,085	7,266	78,184	0	0	5040	29789	5497	0	40,325	29,849	0.74
1986	9,178	4,912	54,680	0	0	7514	40319	3724	0	51,556	34,126	0.66
1987	13,380	6,799	76,084	0	0	8409	60112	5040	0	73,561	38,730	0.53
1988	8,866	5,086	56,235	0	0	9202	67270	7514	0	83,986	34,667	0.41
1989	13,074	6,706	74,967	0	0	7494	73616	8409	0	89,519	46,975	0.52
1990	12,555	7,418	81,792	0	0	7818	59951	9202	0	76,972	47,792	0.62
1991	11,904	7,985	87,074	0	0	5468	62547	7494	0	75,509	45,887	0.61
1992	18,895	8,102	92,433	0	0	7608	43744	7818	0	59,171	67,898	1.15
1993	14,477	10,622	115,014	0	0	5623	60867	5468	0	71,959	51,151	0.71
1994	9,711	7,866	84,562	0	0	7497	44988	7608	0	60,093	38,069	0.63
1995	10,175	6,840	74,577	0	0	8179	59973	5623	0	73,776	31,393	0.43
1996	15,928	3,981	49,409	0	0	8707	65433	7497	0	81,637	47,252	0.58
1997	14,254	6,413	72,749	0	0	9243	69659	8179	0	87,081	n/a	n/a



Median recruits	34,126
90%ile recruits	47,792
90%ile Rec./L	0.72

Conservation limits		**Eggs**	**1SW**	**MSW**	**Total.**
Option 1	(Min Lag. eggs)	40,325	6,683	3,628	10,311
Option 2	(Med R./90%L)	47,615	7,891	4,284	12,175
Option 3	(90%Rec/90%L	66,682	11,051	5,999	17,050

	1SW	**MSW**	**Tot.**
10yr av. #	12,700	6,894	19,594
10yr av.%	65%	35%	
eggsx10^{-3}	7,620	69,011	76,631

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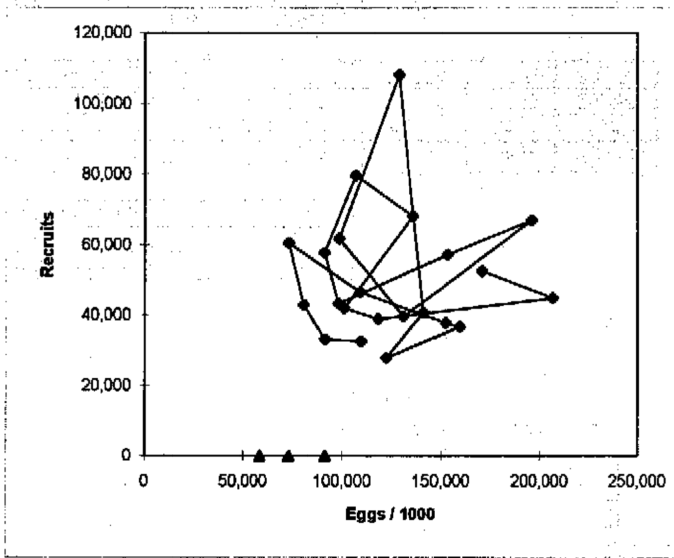
Appendix 9b Lagged egg deposition analysis and estimation of conservation limit options - FRANCE

	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	3950	7400										
Fem	50%	70%		40%	60%	0%	0%	0%	0%			
1971	21,092	15,470	121,793							n/a	77,120	
1972	42,654	30,977	244,704							n/a	83,664	
1973	25,959	19,073	150,067							n/a	46,302	
1974	12,313	8,801	69,907	48717						n/a	46,158	
1975	24,187	19,283	147,653	97882	73076					170,958	52,536	0.31
1976	22,346	14,268	118,040	60027	146823	0				206,849	44,827	0.22
1977	17,159	10,849	90,088	27963	90040	0	0			118,003	38,993	0.33
1978	17,555	11,180	92,583	59061	41944	0	0	0		101,006	42,041	0.42
1979	20,295	12,741	106,082	47216	88592	0	0	0	0	135,808	68,131	0.50
1980	42,767	26,939	224,007	36035	70824	0	0	0	0	106,859	79,658	0.75
1981	33,251	17,059	154,039	37033	54053	0	0	0	0	91,086	57,793	0.63
1982	20,619	10,667	95,980	42433	55550	0	0	0	0	97,982	43,344	0.44
1983	22,110	11,233	101,852	89603	63649	0	0	0	0	153,252	57,121	0.37
1984	36,455	18,688	168,805	61616	134404	0	0	0	0	196,020	67,048	0.34
1985	13,409	13,965	98,822	38392	92423	0	0	0	0	130,815	39,577	0.30
1986	41,846	14,413	157,304	40741	57588	0	0	0	0	98,329	61,677	0.63
1987	64,754	6,581	161,981	67522	61111	0	0	0	0	128,633	108,055	0.84
1988	22,404	18,008	137,529	39529	101283	0	0	0	0	140,812	40,768	0.29
1989	11,634	8,311	66,027	62922	59293	0	0	0	0	122,215	27,839	0.23
1990	20,038	8,481	83,503	64792	94382	0	0	0	0	159,175	36,813	0.23
1991	18,305	7,636	75,704	55012	97189	0	0	0	0	152,200	37,761	0.25
1992	32,430	9,855	115,098	26411	82518	0	0	0	0	108,928	46,457	0.43
1993	38,478	4,761	100,653	33401	39616	0	0	0	0	73,017	60,409	0.83
1994	29,939	8,331	102,285	30282	50102	0	0	0	0	80,384	42,972	0.53
1995	17,894	3,991	56,015	46039	45423	0	0	0	0	91,462	33,188	0.36
1996	21,928	7,030	79,724	40261	69059	0	0	0	0	109,320	32,658	0.30
1997	11,344	3,653	41,326	40914	60392	0	0	0	0	101,306	n/a	n/a



Median recruits	43,344
90%ile recruits	68,131
90%ile Rec./L	0.75

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	73,017	20,531	6,268	26,799
Option 2	(Med R./90%L)	58,145	16,349	4,991	21,341
Option 3	(90%Rec/90%L	91,396	25,699	7,846	33,545

	1SW	MSW	Tot.
10yr av. #	27,583	8,421	36,004
10yr av.%	77%	23%	[redacted]
eggsx10^{-3}	54,476	43,620	98,096

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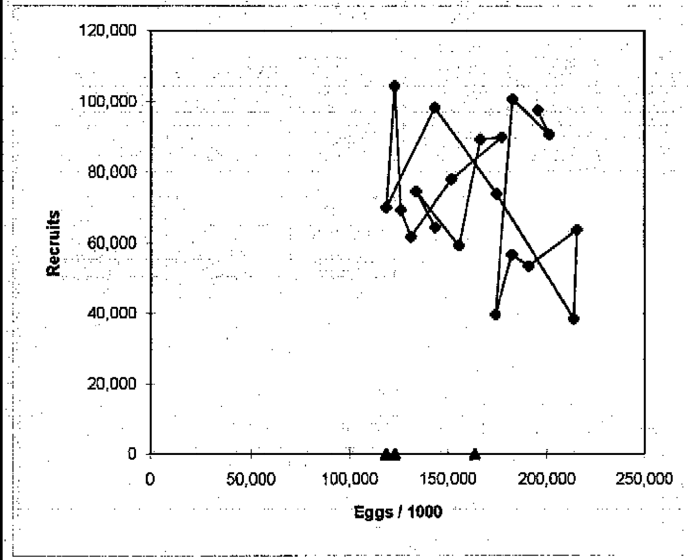
Appendix 9c Lagged egg deposition analysis and estimation of conservation limit options - ICELAND

	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	5800	10800										
Fem	47%	72%		0%	20%	40%	40%	0%	0%			
1971	21,609	13,466	163,619							n/a	97,349	
1972	20,012	21,790	223,991							n/a	86,279	
1973	20,398	18,677	200,836							n/a	78,123	
1974	14,744	14,775	155,081	0						n/a	74,494	
1975	20,772	18,383	199,570	0	32724					n/a	77,692	
1976	17,771	14,280	159,485	0	44798	65448				n/a	79,615	
1977	19,952	17,725	192,218	0	40167	89596	65448			195,211	97,514	0.50
1978	24,603	23,416	249,151	0	31016	80335	89596	0		200,947	90,767	0.45
1979	24,473	16,267	193,201	0	39914	62032	80335	0	0	182,281	100,639	0.55
1980	7,980	20,817	183,630	0	31897	79828	62032	0	0	173,757	39,722	0.23
1981	15,867	9,729	118,902	0	38444	63794	79828	0	0	182,065	56,697	0.31
1982	12,122	9,787	109,147	0	49830	76887	63794	0	0	190,511	53,388	0.28
1983	16,490	11,685	135,813	0	38640	99660	76887	0	0	215,188	63,754	0.30
1984	10,279	12,256	123,324	0	36726	77280	99660	0	0	213,667	38,359	0.18
1985	20,442	7,038	110,453	0	23780	73452	77280	0	0	174,513	73,878	0.42
1986	31,612	12,963	186,971	0	21829	47561	73452	0	0	142,842	98,228	0.69
1987	21,250	13,313	161,446	0	27163	43659	47561	0	0	118,382	69,972	0.59
1988	38,616	10,670	188,239	0	24665	54325	43659	0	0	122,649	104,423	0.85
1989	20,766	9,587	131,156	0	22091	49330	54325	0	0	125,746	69,296	0.55
1990	19,238	10,754	136,063	0	37394	44181	49330	0	0	130,905	61,780	0.47
1991	23,599	8,809	132,832	0	32289	74788	44181	0	0	151,259	78,023	0.52
1992	31,272	11,959	178,242	0	37648	64578	74788	0	0	177,015	89,927	0.51
1993	30,311	9,977	160,211	0	26231	75296	64578	0	0	166,105	89,306	0.54
1994	18,100	10,685	132,425	0	27213	52463	75296	0	0	154,971	59,271	0.38
1995	26,423	8,908	141,301	0	26566	54425	52463	0	0	133,454	74,621	0.56
1996	22,183	7,965	122,408	0	35648	53133	54425	0	0	143,206	64,352	0.45
1997	22,116	7,361	117,524	0	32042	71297	53133	0	0	156,472	n/a	n/a



Median recruits	73,878
90%ile recruits	98,228
90%ile Rec./L	0.60

Conservation limits		**Eggs**	**1SW**	**MSW**	**Total.**
Option 1	(Min Lag. eggs)	118,382	20,217	8,137	28,354
Option 2	(Med R./90%L)	122,981	21,002	8,453	29,455
Option 3	(90%Rec/90%L	163,515	27,924	11,239	39,163

	1SW	**MSW**	**Tot.**
10yr av. #	25,457	10,246	35,703
10yr av.%	71%	29%	
eggsx10^3	69,396	79,672	149,068

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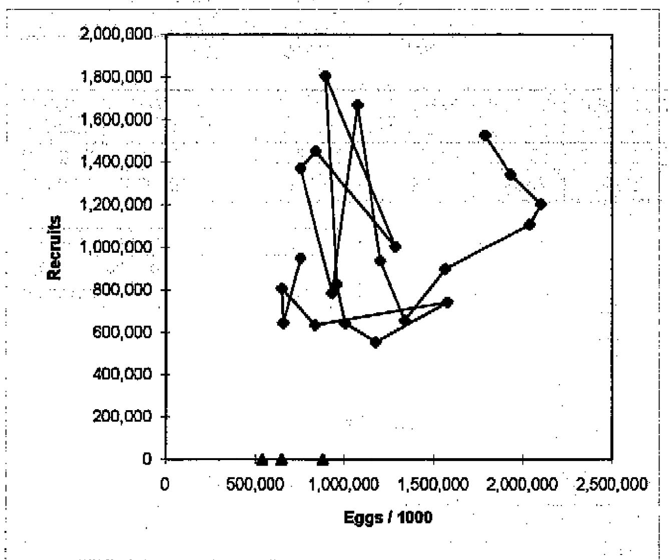
Appendix 9d Lagged egg deposition analysis and estimation of conservation limit options - IRELAND

	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%		0.20	0.70	0.10	0.00	0.00	0.00			
1971	546,234	82,617	1,605,886							n/a	1,643,317	
1972	605,723	90,980	1,777,003							n/a	1,808,463	
1973	645,118	97,624	1,896,900							n/a	1,935,691	
1974	720,078	107,014	2,105,691	321177						n/a	2,129,348	
1975	739,349	110,866	2,167,926	355401	1124120					n/a	2,110,837	
1976	523,954	78,800	1,537,727	379380	1243902	160589				1,783,871	1,526,542	0.86
1977	459,366	68,809	1,346,522	421138	1327830	177700	0			1,926,669	1,340,817	0.70
1978	412,439	61,831	1,209,272	433585	1473984	189690	0	0		2,097,259	1,204,112	0.57
1979	369,669	54,968	1,081,183	307545	1517548	210569	0	0	0	2,035,663	1,106,644	0.54
1980	289,548	61,792	958,342	269304	1076409	216793	0	0	0	1,562,506	899,321	0.58
1981	184,724	62,791	750,443	241854	942565	153773	0	0	0	1,338,192	655,990	0.49
1982	254,803	22,388	653,005	216237	846490	134652	0	0	0	1,197,379	936,600	0.78
1983	601,082	49,136	1,518,568	191668	756828	120927	0	0	0	1,069,424	1,667,383	1.56
1984	226,496	53,044	777,663	150089	670839	108118	0	0	0	929,046	784,025	0.84
1985	335,124	46,981	963,190	130601	525310	95834	0	0	0	751,745	1,372,467	1.83
1986	386,923	37,827	1,014,394	303714	457103	75044	0	0	0	835,861	1,453,461	1.74
1987	296,737	64,834	991,107	155533	1062998	65300	0	0	0	1,283,831	1,003,523	0.78
1988	800,335	44,464	1,897,243	192638	544364	151857	0	0	0	888,859	1,805,890	2.03
1989	252,687	36,742	734,096	202879	674233	77766	0	0	0	954,878	826,751	0.87
1990	280,315	12,558	646,563	198221	710076	96319	0	0	0	1,004,616	642,469	0.64
1991	254,097	14,589	605,164	379449	693775	101439	0	0	0	1,174,663	553,764	0.47
1992	318,972	29,306	825,075	146819	1328070	99111	0	0	0	1,574,000	741,945	0.47
1993	260,354	6,392	569,156	129313	513867	189724	0	0	0	832,904	635,453	0.76
1994	337,113	32,886	883,384	121033	452594	73410	0	0	0	647,036	806,796	1.25
1995	247,991	29,164	679,426	165015	423615	64656	0	0	0	653,286	644,893	0.99
1996	402,773	11,809	891,917	113831	577553	60516	0	0	0	751,900	948,372	1.26
1997	389,434	25,043	943,453	176677	398409	82508	0	0	0	657,594	n/a	n/a



Median recruits	936,600
90%ile recruits	1,526,542
90%ile Rec./L	1.74

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	647,036	256,109	20,937	277,046
Option 2	(Med R./90%L)	538,623	213,197	17,429	230,626
Option 3	(90%Rec/90%L)	877,889	347,485	28,407	375,892

	1SW	MSW	Tot.
10yr av. #	352,311	28,801	381,112
10yr av.%	92%	8%	
eggsx10^{-3}	718,714	171,367	890,081

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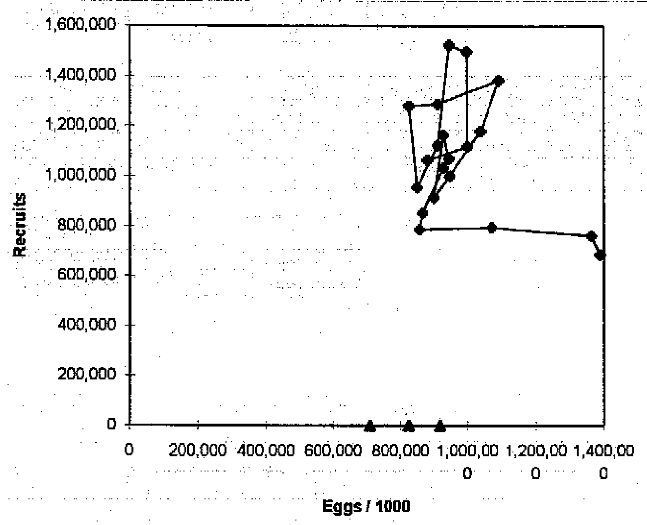
Appendix 9e Lagged egg deposition analysis and estimation of conservation limit options - NORWAY

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition 1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	Lagged egg dep. S	Total 1SW recruits R	R/S
Egg	3500	9000										
Fem	40%	90%		0.00	0.20	0.40	0.40	0.00	0%	egg x 10^{-3}		
1971	107,962	70,684	723,691							n/a	1,108,664	
1972	144,491	92,638	952,654							n/a	1,342,483	
1973	156,309	102,304	1,047,491							n/a	1,373,216	
1974	153,416	95,278	986,533	0						n/a	1,302,359	
1975	139,022	88,193	908,996	0	144738					n/a	1,248,544	
1976	140,139	89,684	922,636	0	190531	289476				n/a	1,233,673	
1977	136,058	85,628	884,069	0	209498	381061	289476			880,036	1,063,220	1.21
1978	96,019	60,953	628,146	0	197307	418996	381061	0		997,365	1,117,928	1.12
1979	169,876	105,074	1,088,929	0	181799	394613	418996	0	0	995,409	1,495,833	1.50
1980	172,533	107,479	1,112,129	0	184527	363598	394613	0	0	942,739	1,520,111	1.61
1981	113,888	109,850	1,049,227	0	176814	369054	363598	0	0	909,466	1,122,671	1.23
1982	84,610	91,433	859,064	0	125629	353628	369054	0	0	848,311	953,975	1.12
1983	144,069	87,178	907,838	0	217786	251259	353628	0	0	822,672	1,280,647	1.56
1984	153,288	92,073	960,392	0	222426	435571	251259	0	0	909,256	1,285,965	1.41
1985	152,794	84,017	894,452	0	209845	444851	435571	0	0	1,090,268	1,381,861	1.27
1986	137,416	100,786	1,008,748	0	171813	419691	444851	0	0	1,036,355	1,176,637	1.14
1987	125,127	80,057	823,637	0	181568	343626	419691	0	0	944,884	1,000,386	1.06
1988	113,719	61,368	656,291	0	192078	363135	343626	0	0	898,839	912,847	1.02
1989	301,355	110,284	1,315,196	0	178890	384157	363135	0	0	926,183	1,161,862	1.25
1990	263,469	127,581	1,402,260	0	201750	357781	384157	0	0	943,688	1,068,132	1.13
1991	244,560	127,683	1,376,616	0	164727	403499	357781	0	0	926,008	1,032,373	1.11
1992	206,146	135,102	1,382,934	0	131258	329455	403499	0	0	864,212	852,998	0.99
1993	174,016	106,890	1,109,434	0	263039	262516	329455	0	0	855,010	786,575	0.92
1994	176,994	113,442	1,166,672	0	280452	526078	262516	0	0	1,069,047	793,453	0.74
1995	155,240	113,430	1,136,119	0	275323	560904	526078	0	0	1,362,306	761,723	0.56
1996	159,435	139,131	1,350,174	0	276587	550646	560904	0	0	1,388,137	685,075	0.49
1997	276,544	153,601	1,631,326	0	221887	553174	550646	0	0	1,325,707	n/a	n/a



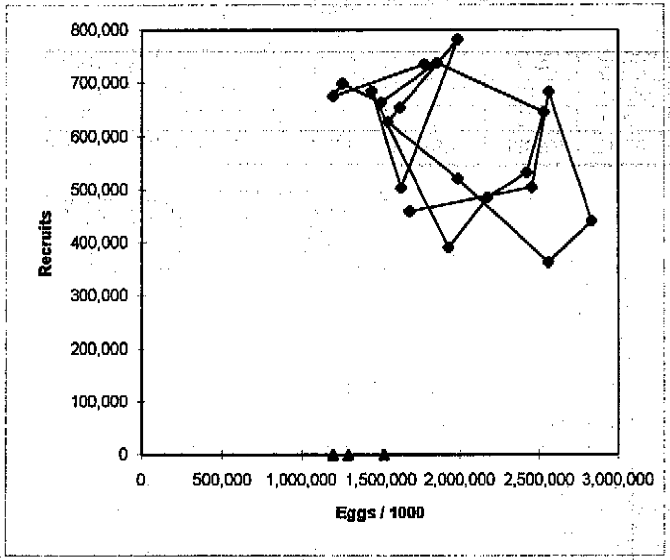
Median recruits	1,068,132
90%ile recruits	1,381,861
90%ile Rec./L	1.51

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	822,672	133,720	78,452	212,172
Option 2	(Med R./90%L)	708,250	115,121	67,541	182,662
Option 3	(90%Rec/90%L	916,275	148,934	87,379	236,313

	1SW	MSW	Tot.
10yr av. #	194,502	114,113	308,615
10yr av.%	63%	37%	
eggsx10^{-3}	272,303	924,315	1,196,617

Appendix 9f Lagged egg deposition analysis and estimation of conservation limit options - RUSSIA

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	4500	10500	egg x 10^{-3}	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	112,367	144,634	1,442,468							n/a	472,612	
1972	126,265	160,450	1,603,471							n/a	689,596	
1973	209,532	270,094	2,693,091							n/a	785,135	
1974	197,370	245,929	2,465,473	0						n/a	870,002	
1975	206,649	304,887	2,979,511	0	144247					n/a	811,321	
1976	157,092	263,312	2,529,931	0	160347	1009728				n/a	609,081	
1977	130,905	195,184	1,904,628	0	269309	1122430	288494			1,680,232	458,865	0.27
1978	142,974	135,893	1,431,019	0	246547	1885164	320694	0		2,452,405	504,486	0.21
1979	165,166	149,686	1,591,825	0	297951	1725831	538618	0	0	2,562,400	683,020	0.27
1980	110,117	230,723	2,161,062	0	252993	2085658	493095	0	0	2,831,746	440,863	0.16
1981	97,485	156,998	1,516,186	0	190463	1770952	595902	0	0	2,557,317	362,449	0.14
1982	119,231	128,947	1,324,601	0	143102	1333240	505986	0	0	1,982,328	520,395	0.26
1983	174,142	203,193	2,059,456	0	159183	1001714	380926	0	0	1,541,822	626,523	0.41
1984	166,017	217,627	2,164,255	0	216106	1114278	286204	0	0	1,616,588	653,222	0.40
1985	216,770	240,804	2,461,715	0	151619	1512743	318365	0	0	1,982,727	781,675	0.39
1986	192,858	272,037	2,675,646	0	132460	1061330	432212	0	0	1,626,003	503,205	0.31
1987	298,339	126,334	1,665,338	0	205946	927221	303237	0	0	1,436,404	684,097	0.48
1988	160,505	139,001	1,492,632	0	216426	1441619	264920	0	0	1,922,965	390,547	0.20
1989	232,751	87,747	1,208,398	0	246171	1514979	411891	0	0	2,173,042	485,371	0.22
1990	209,759	78,449	1,083,733	0	267565	1723200	432851	0	0	2,423,616	532,229	0.22
1991	347,774	149,360	1,958,870	0	166534	1872952	492343	0	0	2,531,829	645,203	0.25
1992	344,619	137,978	1,856,867	0	149263	1165737	535129	0	0	1,850,129	737,116	0.40
1993	321,720	205,336	2,376,308	0	120840	1044842	333068	0	0	1,498,750	662,788	0.44
1994	398,770	173,929	2,268,514	0	108373	845878	298526	0	0	1,252,778	698,536	0.56
1995	360,033	128,706	1,810,193	0	195887	758613	241680	0	0	1,196,180	675,373	0.56
1996	432,799	147,812	2,118,036	0	185687	1371209	216747	0	0	1,773,642	734,985	0.41
1997	412,136	122,939	1,867,264	0	237631	1299807	391774	0	0	1,929,212	n/a	n/a



Median recruits	626,523
90%ile recruits	734,985
90%ile Rec./L	0.48

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	1,196,180	198,389	94,577	292,965
Option 2	(Med R./90%L)	1,293,427	214,517	102,265	316,783
Option 3	(90%Rec/90%L	1,517,340	251,654	119,969	371,623

	1SW	MSW	Tot.
10yr av. #	309,339	147,469	456,808
10yr av.%	68%	32%	
eggsx10^{-3}	626,411	1,238,739	1,865,150

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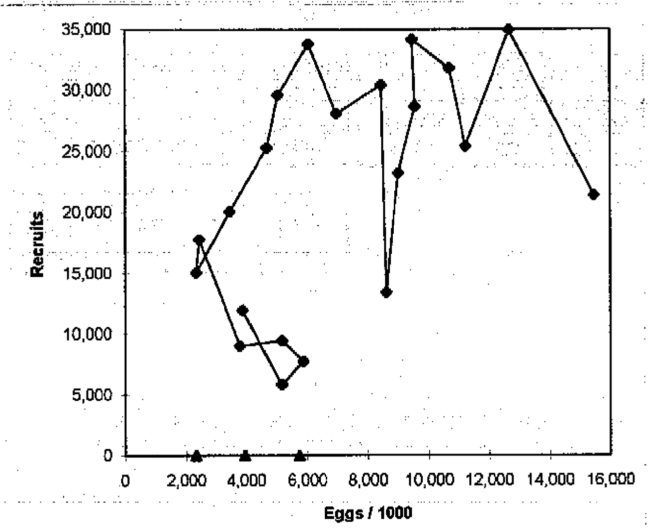
Appendix 9g Lagged egg deposition analysis and estimation of conservation limit options - SWEDEN

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition 1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	Lagged egg dep. S	Total 1SW recruits R	R/S
Egg	3000	6000										
Fem	50%	70%		0.20	0.60	0.20	0.00	0.00	0.00	egg x 10^{-3}		
1971	2,110	218	4,080							n/a	13,584	
1972	1,723	154	3,229							n/a	12,590	
1973	2,107	545	5,448							n/a	14,159	
1974	3,188	341	6,215	816						n/a	18,856	
1975	3,263	80	5,231	646	2448					n/a	20,636	
1976	1,867	248	3,843	1090	1938	816				3,843	11,926	3.10
1977	879	180	2,076	1243	3269	646	0			5,157	5,824	1.13
1978	1,003	140	2,094	1046	3729	1090	0	0		5,865	7,741	1.32
1979	1,080	399	3,295	769	3139	1243	0	0	0	5,150	9,440	1.83
1980	1,406	735	5,197	415	2306	1046	0	0	0	3,767	8,990	2.39
1981	2,424	205	4,496	419	1246	769	0	0	0	2,433	17,743	7.29
1982	2,151	765	6,440	659	1256	415	0	0	0	2,330	15,052	6.46
1983	2,863	498	6,387	1039	1977	419	0	0	0	3,435	20,046	5.84
1984	4,058	727	9,142	899	3118	659	0	0	0	4,676	25,306	5.41
1985	4,706	300	8,318	1288	2698	1039	0	0	0	5,025	29,603	5.89
1986	5,061	300	8,851	1277	3864	899	0	0	0	6,041	33,785	5.59
1987	4,234	883	10,058	1828	3832	1288	0	0	0	6,949	28,072	4.04
1988	3,469	817	8,636	1664	5485	1277	0	0	0	8,426	30,467	3.62
1989	1,082	2,299	11,280	1770	4991	1828	0	0	0	8,589	13,423	1.56
1990	2,518	1,667	10,778	2012	5310	1664	0	0	0	8,986	23,223	2.58
1991	3,124	1,849	12,452	1727	6035	1770	0	0	0	9,532	28,636	3.00
1992	3,352	2,401	15,111	2256	5182	2012	0	0	0	9,449	34,188	3.62
1993	3,681	3,323	19,477	2156	6768	1727	0	0	0	10,651	31,829	2.99
1994	4,987	2,341	17,312	2490	6467	2256	0	0	0	11,213	25,394	2.26
1995	9,590	1,768	21,809	3022	7471	2156	0	0	0	12,649	34,956	2.76
1996	5,822	2,223	18,071	3895	9066	2490	0	0	0	15,452	21,370	1.38
1997	2,521	1,382	9,586	3462	11686	3022	0	0	0	18,171	n/a	n/a



Median recruits	23,223
90%ile recruits	33,785
90%ile Rec./L	5.89

Conservation limits		**Eggs**	**1SW**	**MSW**	**Total.**
Option 1	(Min Lag. eggs)	2,330	705	303	1,008
Option 2	(Med R./90%L)	3,942	1,193	513	1,705
Option 3	(90%Rec/90%L)	5,735	1,735	746	2,481

	1SW	**MSW**	**Tot.**
10yr av. #	4,120	1,771	5,891
10yr av.%	70%	30%	
eggsx10^{-3}	6,180	7,438	13,618

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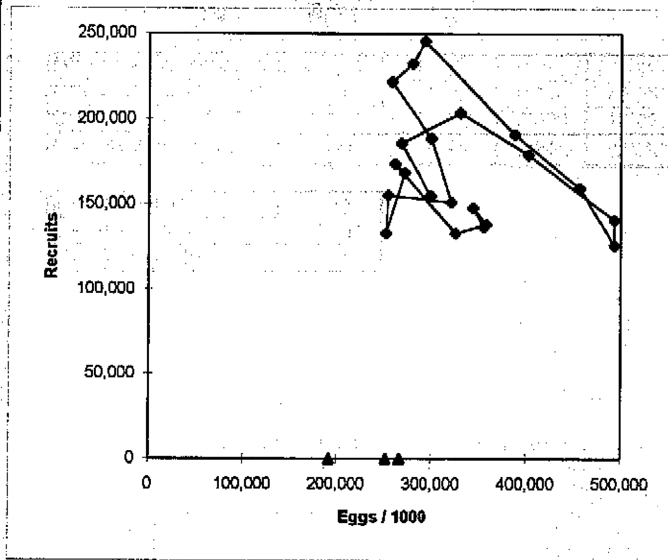
Appendix 9h Lagged egg deposition analysis and estimation of conservation limit options - UK(ENGLAND & WALES)

	Est. 1SW spawners	Est MSW spawners	Egg deposition egg x 10^{-3}	Smolt age composition 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	4800	7900										
Fem	50%	70%		0.40	0.55	0.05	0.00	0.00	0.00			
1971	59,133	32,823	323,429							n/a	182,193	
1972	67,547	36,807	365,658							n/a	193,594	
1973	62,615	34,841	342,947							n/a	182,807	
1974	63,768	33,793	339,918	129372						n/a	192,087	
1975	71,250	38,328	382,952	146263	177886					n/a	181,811	
1976	45,008	24,410	243,006	137179	201112	16171				354,462	136,486	0.39
1977	50,592	27,033	270,914	135967	188621	18283	0			342,871	147,964	0.43
1978	51,085	27,598	275,223	153181	186955	17147	0	0		357,283	137,964	0.39
1979	40,655	21,440	216,136	97202	210624	16996	0	0	0	324,822	132,961	0.41
1980	56,784	30,125	302,875	108366	133653	19148	0	0	0	261,166	173,767	0.67
1981	66,509	35,785	357,513	110089	149003	12150	0	0	0	271,242	168,418	0.62
1982	40,568	22,130	219,742	86454	151373	13546	0	0	0	251,373	132,794	0.53
1983	55,798	29,563	297,398	121150	118875	13761	0	0	0	253,786	155,159	0.61
1984	48,840	26,254	262,402	143005	166581	10807	0	0	0	320,393	151,271	0.47
1985	61,877	33,589	334,253	87897	196632	15144	0	0	0	299,672	188,700	0.63
1986	87,961	47,793	475,403	118959	120858	17876	0	0	0	257,693	221,568	0.86
1987	83,624	44,289	445,617	104961	163569	10987	0	0	0	279,517	232,449	0.83
1988	105,373	55,600	560,365	133701	144321	14870	0	0	0	292,892	245,611	0.84
1989	75,829	40,738	407,270	190161	183839	13120	0	0	0	387,121	190,884	0.49
1990	68,371	37,938	373,889	178247	261472	16713	0	0	0	456,431	159,318	0.35
1991	48,444	25,966	259,855	224146	245090	23770	0	0	0	493,006	125,747	0.26
1992	48,930	26,715	265,163	162908	308201	22281	0	0	0	493,389	140,568	0.28
1993	64,969	35,044	349,718	149556	223999	28018	0	0	0	401,572	178,753	0.45
1994	78,871	41,835	420,639	103942	205639	20364	0	0	0	329,944	203,594	0.62
1995	81,097	47,531	457,481	106065	142920	18694	0	0	0	267,680	185,502	0.69
1996	67,528	39,773	382,014	139887	145840	12993	0	0	0	298,720	154,827	0.52
1997	54,598	33,208	314,674	168255	192345	13258	0	0	0	373,859	n/a	n/a



Median recruits	159,318
90%ile recruits	221,568
90%ile Rec./L	0.83

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	251,373	46,176	25,416	71,592
Option 2	(Med R./90%L)	191,577	35,192	19,370	54,562
Option 3	(90%Rec/90%L)	266,432	48,943	26,938	75,881

	1SW	MSW	Tot.
10yr av. #	72,133	39,703	111,835
10yr av.%	64%	36%	[redacted]
eggsx10^{-3}	173,119	219,555	392,674

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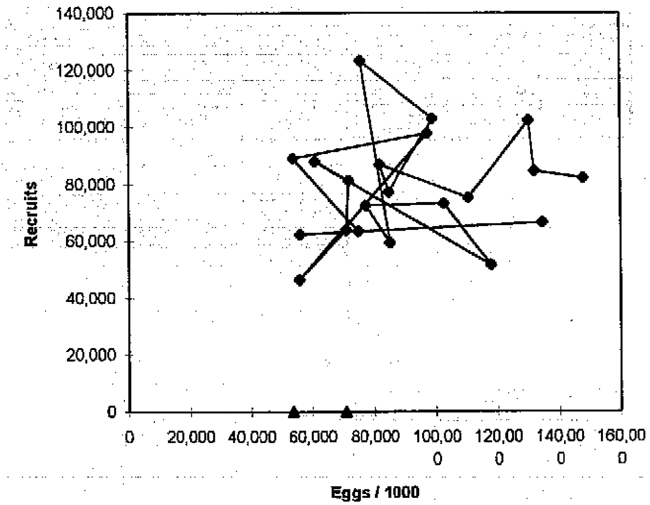
Appendix 9i Lagged egg deposition analysis and estimation of conservation limit options - UK(N IRELAND)

	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	40,661	14,260	167,796							n/a	167,548	
1972	36,941	12,804	151,543							n/a	150,289	
1973	31,807	11,138	131,156							n/a	132,777	
1974	32,799	11,180	133,430	33559						n/a	132,456	
1975	28,615	9,904	117,301	30309	130881					n/a	113,158	
1976	19,876	6,898	81,590	26231	118204	3356				147,791	82,144	0.56
1977	19,302	6,662	79,015	26686	102302	3031	0			132,018	84,544	0.64
1978	25,996	8,989	106,518	23460	104075	2623	0	0		130,158	102,216	0.79
1979	17,529	5,988	71,389	16318	91495	2669	0	0	0	110,481	75,141	0.68
1980	21,778	7,422	88,587	15803	63640	2346	0	0	0	81,789	86,825	1.06
1981	17,683	6,102	72,379	21304	61632	1632	0	0	0	84,567	77,247	0.91
1982	23,263	8,051	95,363	14278	83084	1580	0	0	0	98,942	102,986	1.04
1983	32,868	11,256	134,022	17717	55683	2130	0	0	0	75,531	123,285	1.63
1984	13,760	4,743	56,290	14476	69098	1428	0	0	0	85,002	59,331	0.70
1985	17,103	5,953	70,308	19073	56456	1772	0	0	0	77,300	72,591	0.94
1986	19,193	6,651	78,727	26804	74383	1448	0	0	0	102,635	73,300	0.71
1987	9,976	3,399	40,573	11258	104537	1907	0	0	0	117,702	51,494	0.44
1988	24,632	10,417	112,232	14062	43907	2680	0	0	0	60,649	87,873	1.45
1989	7,090	5,000	44,214	15745	54840	1126	0	0	0	71,712	81,236	1.13
1990	20,169	7,184	83,890	8115	61407	1406	0	0	0	70,928	63,807	0.90
1991	10,711	3,393	42,037	22446	31647	1575	0	0	0	55,668	46,455	0.83
1992	26,021	8,923	106,177	8843	87541	811	0	0	0	97,195	97,834	1.01
1993	42,052	28,308	254,217	16778	34487	2245	0	0	0	53,510	89,003	1.66
1994	14,838	6,803	70,748	8407	65434	884	0	0	0	74,726	63,511	0.85
1995	15,574	5,725	65,834	21235	32789	1678	0	0	0	55,702	62,202	1.12
1996	21,199	7,331	86,866	50843	82818	841	0	0	0	134,502	66,615	0.50
1997	22,368	8,804	98,013	14150	198289	2124	0	0	0	214,562	n/a	n/a



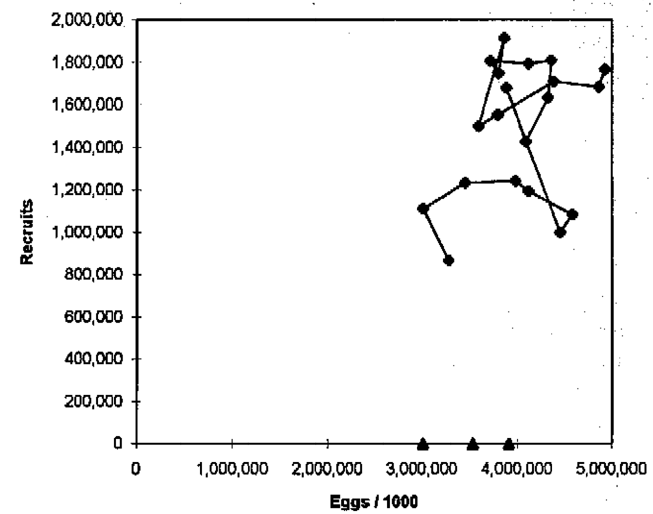
Median recruits	77,247
90%ile recruits	102,216
90%ile Rec./L	1.45

Conservation limits		Eggs	1SW	MSW	Total.
Option 1	(Min Lag. eggs)	53,510	11,547	5,034	16,581
Option 2	(Med R./90%L)	53,314	11,505	5,016	16,521
Option 3	(90%Rec/90%L	70,548	15,224	6,637	21,861

	1SW	MSW	Tot.
10yr av. #	19,485	8,495	27,980
10yr av.%	70%	30%	
eggsx10^{-3}	39,750	50,544	90,294

Appendix 9j Lagged egg deposition analysis and estimation of conservation limit options - UK(SCOTLAND)

	Est. 1SW spawners	Est MSW spawners	Egg deposition	Smolt age composition						Lagged egg dep.	Total 1SW recruits	
Egg	5000	10000	egg x 10^{-3}	1 yr	2 yr	3 yr	4 yr	5 yr	6 yr	L	R	R/L
Fem	40%	60%		10%	45%	40%	5%	0%	0%	egg x 10^{-3}		
1971	910,836	362,480	3,996,553							n/a	2,239,663	
1972	888,030	489,594	4,713,621							n/a	2,281,764	
1973	1,025,873	538,184	5,280,851							n/a	2,293,766	
1974	1,043,269	421,670	4,616,562	399655						n/a	2,377,852	
1975	779,824	460,088	4,320,178	471362	1798449					n/a	1,699,441	
1976	666,738	320,828	3,258,444	528085	2121130	1598621				n/a	1,630,194	
1977	684,871	383,833	3,672,738	461656	2376383	1885448	199828			4,923,315	1,766,642	0.36
1978	720,388	452,869	4,157,989	432018	2077453	2112340	235681	0		4,857,492	1,683,328	0.35
1979	667,105	365,415	3,526,703	325844	1944080	1846625	264043	0	0	4,380,592	1,707,461	0.39
1980	519,459	435,548	3,652,207	367274	1466300	1728071	230828	0	0	3,792,473	1,553,086	0.41
1981	625,651	552,751	4,567,807	415799	1652732	1303378	216009	0	0	3,587,917	1,497,294	0.42
1982	868,280	412,284	4,210,261	352670	1871095	1469095	162922	0	0	3,855,783	1,913,416	0.50
1983	876,024	458,936	4,505,663	365221	1587016	1663196	183637	0	0	3,799,070	1,746,063	0.46
1984	894,156	342,050	3,840,612	456781	1643493	1410681	207899	0	0	3,718,854	1,805,164	0.49
1985	652,646	364,095	3,489,863	421026	2055513	1460883	176335	0	0	4,113,757	1,791,682	0.44
1986	851,214	627,702	5,468,640	450566	1894617	1827123	182610	0	0	4,354,917	1,806,507	0.41
1987	704,642	437,302	4,033,094	384061	2027548	1684104	228390	0	0	4,324,104	1,631,939	0.38
1988	625,766	461,478	4,020,398	348986	1728276	1802265	210513	0	0	4,090,040	1,426,488	0.35
1989	912,857	391,245	4,173,183	546864	1570436	1536245	225283	0	0	3,878,830	1,677,242	0.43
1990	420,408	340,899	2,886,212	403309	2460888	1395945	192031	0	0	4,452,173	999,769	0.22
1991	390,900	342,003	2,833,818	402040	1814892	2187456	174493	0	0	4,578,881	1,083,250	0.24
1992	530,730	439,784	3,700,166	417318	1809179	1613238	273432	0	0	4,113,167	1,195,348	0.29
1993	503,446	382,401	3,301,296	288621	1877932	1608159	201655	0	0	3,976,367	1,242,754	0.31
1994	529,770	447,187	3,742,662	283382	1298796	1669273	201020	0	0	3,452,470	1,234,295	0.36
1995	481,569	414,447	3,449,819	370017	1275218	1154485	208659	0	0	3,008,379	1,110,258	0.37
1996	443,799	382,083	3,180,097	330130	1665075	1133527	144311	0	0	3,273,043	866,597	0.26
1997	287,022	244,285	2,039,751	374266	1485583	1480067	141691	0	0	3,481,607	n/a	n/a



Median recruits	1,630,194
90%ile recruits	1,805,164
90%ile Rec./L	0.46

Conservation limits		**Eggs**	**1SW**	**MSW**	**Total.**
Option 1	(Min Lag. eggs)	3,008,379	469,362	344,943	814,304
Option 2	(Med R./90%L)	3,527,159	550,301	404,426	954,727
Option 3	(90%Rec/90%L	3,905,732	609,365	447,834	1,057,199

	1SW	**MSW**	**Tot.**
10yr av. #	556,844	409,235	966,078
10yr av.%	58%	42%	
eggsx10^{-3}	1,113,687	2,455,408	3,569,095

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